



FCC TEST REPORT

**Test report
On Behalf of
Shenzhen SEI Robotics Co., Ltd.
For
4K ATV Stick
Model No.: SN8B6BX(X=A TO Z)

FCC ID: 2AOVU-SN8B6BB**

Prepared for : Shenzhen SEI Robotics Co., Ltd.
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Date of Test: June 07, 2018~ June 30, 2018
Date of Report: June 30, 2018
Report Number: HUAK180609519E1



TEST RESULT CERTIFICATION


Applicant's name : **Shenzhen SEI Robotics Co., Ltd.**
 Address..... : 3F(East), Block D, SDG Infoport, No.2 Kefeng Road, Nanshan
 District, Shenzhen, P.R. China
Manufacture's Name : **Shenzhen SEI Robotics Co., Ltd.**
 Address..... : 3F(East), Block D, SDG Infoport, No.2 Kefeng Road, Nanshan
 District, Shenzhen, P.R. China


Product description

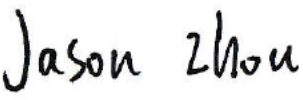
Trade Mark: N/A
 Product name..... : 4K ATV Stick
 Model and/or type reference : SN8B6BX(X=A TO Z)
Standards..... : FCC Rules and Regulations Part 15 Subpart C Section 15.247
 ANSI C63.10: 2013

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Date of Test :
 Date (s) of performance of tests..... : June 07, 2018~ June 30, 2018
 Date of Issue : June 30, 2018
 Test Result..... : **Pass**

Testing Engineer : 
 (Gary Qian)

Technical Manager : 
 (Eden Hu)

Authorized Signatory : 
 (Jason Zhou)



Revision History

| Revision | Issue Date | Revisions | Revised By |
|----------|---------------|---------------|------------|
| 00 | June 30, 2018 | Initial Issue | Jason Zhou |
| | | | |
| | | | |



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1. GENERAL INFORMATION

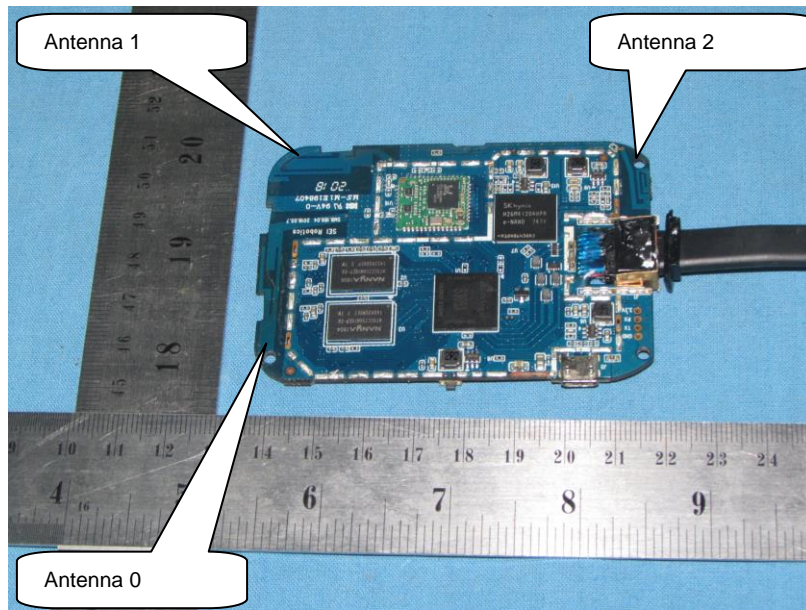
1.1. Description of Device (EUT)

| | |
|------------------------------|--|
| EUT | : 4K ATV Stick |
| Model Number | : SN8B6BX(X=A TO Z) |
| Model Declaration | : PCB board, structure and internal of these model(s) are the same, : Only models name is different for these models. |
| Test Model | : SN8B6BB |
| Power Supply | : DC 5V by adapter |
| Hardware version | : SMB.189.04 |
| Software version | : 8.0.0 |
| Bluetooth Version | : V4.1 |
| Channel Number | : 79 Channels for Bluetooth V3.0(DSS) : 40 Channels for Bluetooth V4.1(DTS) |
| Modulation Technology | : GFSK, $\pi/4$ -DQPSK, 8-DPSK for Bluetooth V3.0(DSS) : GFSK for Bluetooth V4.1(DTS) |
| Data Rates | : Bluetooth V3.0(DSS): 1~3Mbps : Bluetooth V4.1(DTS): 1Mbps |
| WLAN | : Supported IEEE 802.11a/b/g/n/ac IEEE 802.11b:2412-2462MHz IEEE 802.11g:2412-2462MHz IEEE 802.11n HT20:2412-2462MHz / 5180-5240MHz / 5745-5825MHz |
| WLAN FCC Operation Frequency | : IEEE 802.11n HT40:2422-2452MHz / 5190-5230MHz / 5755-5795MHz IEEE 802.11a: 5180-5240MHz / 5745-5825MHz IEEE 802.11ac VHT20: 5180-5240MHz / 5745-5825MHz IEEE 802.11ac VHT40: 5190-5230MHz / 5755-5795MHz IEEE 802.11ac VHT80: 5210MHz / 5775MHz |
| WLAN Channel Number | : 11 Channels for 2412-2462MHz(IEEE 802.11b/g/n HT20) 7 Channels for 2422-2452MHz(IEEE 802.11n HT40) 4 Channels for 5180-5240MHz (IEEE 802.11a/ac VHT20/n HT20) 2 Channels for 5190-5230MHz (IEEE 802.11ac VHT40/n HT40) 1 Channels for 5210MHz (IEEE 802.11ac VHT80) 5 Channels for 5745-5825MHz(IEEE 802.11a/ac VHT20/n HT20) 2 Channels for 5755-5795MHz(IEEE 802.11ac VHT40/n HT40) 1 Channels for 5775MHz(IEEE 802.11ac VHT80) |
| WLAN Modulation Technology | : IEEE 802.11b: DSSS(CCK,DQPSK,DBPSK) IEEE 802.11g: OFDM (64QAM, 16QAM, QPSK, BPSK) IEEE 802.11n: OFDM (64QAM, 16QAM, QPSK, BPSK) IEEE 802.11a: OFDM (64QAM, 16QAM, QPSK, BPSK) IEEE 802.11ac: OFDM (256QAM, 64QAM, 16QAM, QPSK, BPSK) |
| Antenna Type And Gain | : Three Antennas: Internal Antenna 0: 1.4dBi(Max.), for TX/RX (WLAN 2.4G Band), 2.0 dBi(Max.), for TX/RX (WLAN 5G Band) Internal Antenna 1: 1.1dBi(Max.), for TX/RX (WLAN 2.4G Band), 2.58 dBi(Max.), for TX/RX (WLAN 5G Band) Internal Antenna 2: 1.76dBi(Max.), for TX/RX (Bluetooth), |

802.11n/ac support 2T2R.[Antenna 0 and Antenna 1]

Directional Gain

- 4.26 dBi for MIMO(2.4G Band)
- 5.31 dBi for MIMO(5G Band)



1.2. Host System Configuration List and Details

| Manufacturer | Description | Model | Serial Number | Certificate |
|--------------|-------------|--------------|---------------|-------------|
| SUNUN | Adapter | SA69-050200U | A69-84 | N/A |

1.3. External I/O Cable

| I/O Port Description | Quantity | Cable |
|----------------------|----------|----------------|
| USB Port | 1 | 1m, unshielded |
| HDMI Port | 1 | N/A |

1.4. Description of Test Facility

Designation Number: CN1229

Test Firm Registration Number: 616276

The 3m-Semi anechoic test site fulfils CISPR 16-1-4 according to ANSI C63.10 and CISPR 16-1-4:2010 SVSWR requirement for radiated emission above 1GHz.

1.5. Statement of the Measurement Uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. To CISPR 16 – 4 “Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements” and is documented in the HUAK quality system acc. To DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.



1.6. Measurement Uncertainty

| Test Item | Frequency Range | Uncertainty | Note |
|--------------------------|-----------------|---------------------|------|
| Radiation Uncertainty : | 9KHz~30MHz | $\pm 3.08\text{dB}$ | (1) |
| | 30MHz~1000MHz | $\pm 4.42\text{dB}$ | (1) |
| | 1GHz~40GHz | $\pm 4.06\text{dB}$ | (1) |
| Conduction Uncertainty : | 150kHz~30MHz | $\pm 2.23\text{dB}$ | (1) |

(1). This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=2$.



1.7. Description of Test Modes

The EUT has been tested under operating condition.

AC power line conducted emission pre-test at both at AC 120V/60Hz and AC 240V/50Hz modes, recorded worst case.

Worst-case mode and channel used for 150 KHz-30 MHz power line conducted emissions was the mode and channel with the highest output power, that was determined to be 802.11n HT40 mode(Low Channel, Chain 0+Chain 1).

Worst-case mode and channel used for 9 KHz-1000 MHz radiated emissions was the mode and channel with the highest output power, that was determined to be 802.11n HT40 mode(Low Channel, Chain 0+Chain 1).

Worst-Case data rates were utilized from preliminary testing of the Chipset, worst-case data rates used during the testing are as follows:

IEEE 802.11b Mode: 1 Mbps, DSSS.

IEEE 802.11g Mode: 6 Mbps, OFDM.

IEEE 802.11n Mode HT20: MCS0, OFDM.

IEEE 802.11n Mode HT40: MCS0, OFDM.

Antenna & Bandwidth

| Antenna | Antenna 0 | | Antenna 1 | | Simultaneously |
|----------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|
| Bandwidth Mode | 20MHz | 40MHz | 20MHz | 40MHz | / |
| IEEE 802.11b | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| IEEE 802.11g | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| IEEE 802.11n | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |

Channel List & Frequency

IEEE 802.11b/g/n HT20

| Frequency Band | Channel No. | Frequency(MHz) | Channel No. | Frequency(MHz) |
|----------------|-------------|----------------|-------------|----------------|
| 2412~2462MHz | 1 | 2412 | 7 | 2442 |
| | 2 | 2417 | 8 | 2447 |
| | 3 | 2422 | 9 | 2452 |
| | 4 | 2427 | 10 | 2457 |
| | 5 | 2432 | 11 | 2462 |
| | 6 | 2437 | -- | -- |

IEEE 802.11n HT40

| Frequency Band | Channel No. | Frequency(MHz) | Channel No. | Frequency(MHz) |
|----------------|-------------|----------------|-------------|----------------|
| 2422~2452MHz | 1 | -- | 7 | 2442 |
| | 2 | -- | 8 | 2447 |
| | 3 | 2422 | 9 | 2452 |
| | 4 | 2427 | 10 | -- |
| | 5 | 2432 | 11 | -- |
| | 6 | 2437 | -- | -- |



2. 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.

The radiated testing was performed at an antenna-to-EUT distance of 3 meters. All radiated and conducted emissions measurement was performed at Shenzhen HUAK Testing Technology Co., Ltd.

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 that intends to maximize its emission characteristics in a continuous normal application.

2.2. EUT Exercise

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

According to FCC's request, Test Procedure KDB 558074 D01 DTS Meas Guidance v04 and KDB 662911 D01 Multiple Transmitter Output v02r01 are required to be used for this kind of FCC 15.247 digital modulation device.

According to its specifications, the EUT must comply with the requirements of the Section 15.203, 15.205, 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C.

2.3. General Test Procedures

2.3.1 Conducted Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 6.2.1 of ANSI C63.10-2013 Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using Quasi-peak and average detector modes.

2.3.2 Radiated Emissions

The EUT is placed on a turn table, which is 0.8 m above ground plane. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna, which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the maximum emissions, exploratory radiated emission measurements were made according to the requirements in Section 6.3 of ANSI C63.10-2013



3. SYSTEM TEST CONFIGURATION

3.1. Justification

The system was configured for testing in a continuous transmits condition.

3.2. EUT Exercise Software

The system was configured for testing in a continuous transmits condition and change test channels by software (MPTool) provided by application.

3.3. Special Accessories

| No. | Equipment | Manufacturer | Model No. | Serial No. | Length | shielded/ unshielded | Notes |
|-----|-----------|--------------|----------------|--------------|--------|-------------------------|-------|
| 1 | TV | AOC | 280LM000 03 | JVVGJA000307 | / | / | / |

3.4. Block Diagram/Schematics

Please refer to the related document

3.5. Equipment Modifications

Shenzhen HUAK Testing Technology Co., Ltd. has not done any modification on the EUT.

3.6. Test Setup

Please refer to the test setup photo.



4. SUMMARY OF TEST RESULTS

| Applied Standard: FCC Part 15 Subpart C | | |
|---|---|-----------|
| FCC Rules | Description of Test | Result |
| / | Duty Cycle | Compliant |
| §15.247(b) | Maximum Conducted Output Power | Compliant |
| §15.247(e) | Power Spectral Density | Compliant |
| §15.247(a)(2) | 6dB Bandwidth | Compliant |
| §15.247(a) | Occupied Bandwidth | Compliant |
| §15.209, §15.247(d) | Radiated and Conducted Spurious Emissions | Compliant |
| §15.205 | Emissions at Restricted Band | Compliant |
| §15.207(a) | Conducted Emissions | Compliant |
| §15.203 | Antenna Requirements | Compliant |
| §15.247(i)§2.1093 | RF Exposure | Compliant |

5. TEST RESULT

5.1. On Time and Duty Cycle

5.1.1. Standard Applicable

None; for reporting purpose only.

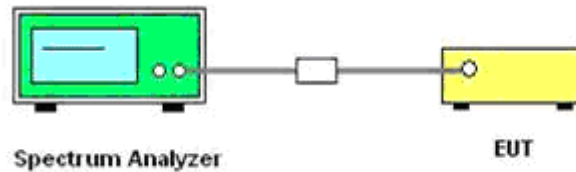
5.1.2. Measuring Instruments and Setting

Please refer to equipment's list in this report. The following table is the setting of the spectrum analyzer.

5.1.3. Test Procedures

1. Set the centre frequency of the spectrum analyzer to the transmitting frequency;
2. Set the span=0MHz, RBW=10MHz, VBW=10MHz, Sweep time=5ms;
3. Detector = peak;
4. Trace mode = Single hold.

5.1.4. Test Setup Layout



5.1.5. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

5.1.6. Test result

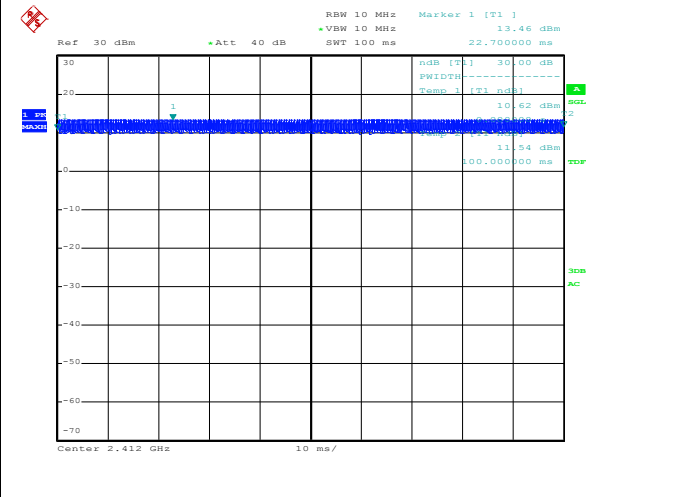
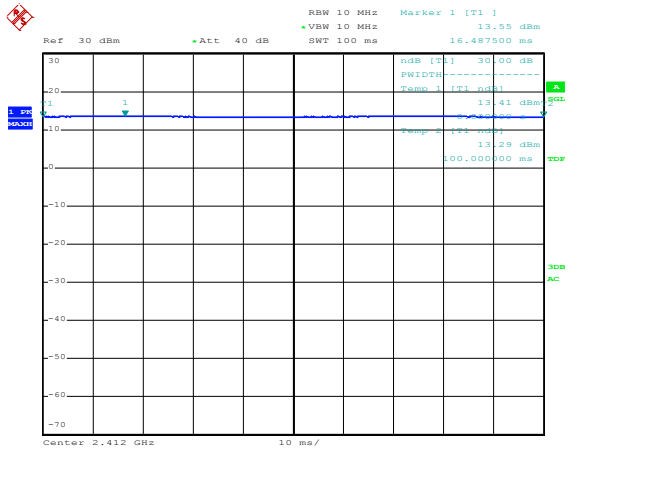
| Mode | On Time B (ms) | Period (ms) | Duty Cycle x (Linear) | Duty Cycle (%) | Duty Cycle Correction Factor (dB) | 1/B Minimum VBW(KHz) |
|-------------------|----------------|-------------|-----------------------|----------------|-----------------------------------|----------------------|
| IEEE 802.11b | 5 | 5 | 1 | 100 | 0 | 0.010 |
| IEEE 802.11g | 5 | 5 | 1 | 100 | 0 | 0.010 |
| IEEE 802.11n HT20 | 5 | 5 | 1 | 100 | 0 | 0.010 |
| IEEE 802.11n HT40 | 5 | 5 | 1 | 100 | 0 | 0.010 |

Remark:

1. Measured duty cycle for WLAN at antenna 0 and antenna 1 port, the two antenna ports results were same, just recorded results at antenna 0;

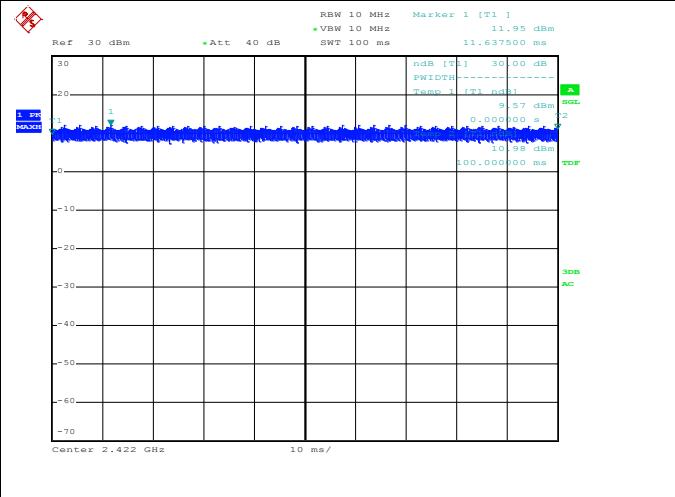
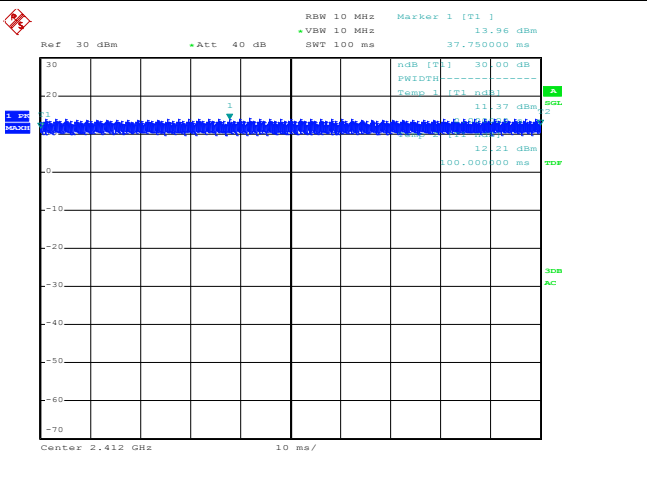


On Time and Duty Cycle



IEEE 802.11b

IEEE 802.11g



IEEE 802.11n HT20

IEEE 802.11n HT40

5.2. Maximum Conducted Output Power Measurement

5.2.1. Standard Applicable

According to §15.247(b): For systems using digital modulation in the 2400-2483.5 MHz and 5725-5850 MHz band, the limit for maximum peak conducted output power is 30dBm. The limit has to be reduced by the amount in dB that the gain of the antenna exceeds 6dBi. In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

Systems operating in the 5725-5850 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi without any corresponding reduction in transmitter peak output power.

5.2.2. Measuring Instruments and Setting

Please refer to equipment list in this report. The following table is the setting of the power meter.

5.2.3. Test Procedures

According to KDB558074 D01 DTS Measurement Guidance Section 9.1 Maximum peak conducted output power, 9.1.2 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.

According to KDB558074 D01 DTS Measurement Guidance Section 9.2 Maximum average conducted output power, 9.2.3.1 Method AVGPM (Measurement using an RF average power meter)

(a) As an alternative to spectrum analyzer or EMI receiver measurements, measurements may be performed using a wideband RF power meter with a thermocouple detector or equivalent if all of the conditions listed below are satisfied.

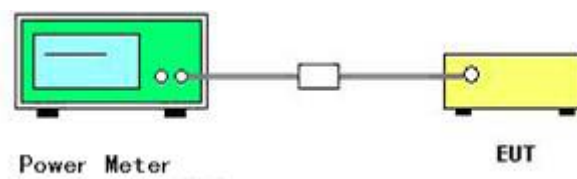
- 1) The EUT is configured to transmit continuously, or to transmit with a constant duty factor.
- 2) At all times when the EUT is transmitting, it shall be transmitting at its maximum power control level.
- 3) The integration period of the power meter exceeds the repetition period of the transmitted signal by at least a factor of five.

(b) If the transmitter does not transmit continuously, measure the duty cycle (x) of the transmitter output signal as described in Section 6.0.

(c) Measure the average power of the transmitter. This measurement is an average over both the on and off periods of the transmitter.

(d) Adjust the measurement in dBm by adding $10\log(1/x)$, where x is the duty cycle to the measurement result.

5.2.4. Test Setup Layout



5.2.5. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.



5.2.6. Test Result of Maximum Conducted Output Power

| | | | |
|---------------|-------------|----------------|------------------|
| Temperature | 25.1 °C | Humidity | 52.4% |
| Test Engineer | Jayden Zhuo | Configurations | IEEE 802.11b/g/n |

| Test Mode | Channel | Frequency (MHz) | Measured Peak Output Power (dBm) | | | Limits (dBm) | Verdict |
|-------------------|---------|-----------------|----------------------------------|-----------|-------|--------------|---------|
| | | | Antenna 0 | Antenna 1 | Sum | | |
| IEEE 802.11b | 1 | 2412 | 13.66 | 15.29 | -/- | 30 | PASS |
| | 6 | 2437 | 13.5 | 14.66 | -/- | | |
| | 11 | 2462 | 13.8 | 14.76 | -/- | | |
| IEEE 802.11g | 1 | 2412 | 15.59 | 16.74 | -/- | 30 | PASS |
| | 6 | 2437 | 14.96 | 16.29 | -/- | | |
| | 11 | 2462 | 15.6 | 16.00 | -/- | | |
| IEEE 802.11n HT20 | 1 | 2412 | 16.49 | 17.20 | 19.87 | 30 | PASS |
| | 6 | 2437 | 15.92 | 16.75 | 19.37 | | |
| | 11 | 2462 | 16.38 | 16.44 | 19.42 | | |
| IEEE 802.11n HT40 | 3 | 2422 | 14.94 | 15.50 | 18.24 | 30 | PASS |
| | 6 | 2437 | 14.65 | 16.14 | 18.47 | | |
| | 9 | 2452 | 14.85 | 16.46 | 18.74 | | |

| Test Mode | Channel | Frequency (MHz) | Measured Average Output Power (dBm) | | | Limits (dBm) | Verdict |
|-------------------|---------|-----------------|-------------------------------------|-----------|-------|--------------|---------|
| | | | Antenna 0 | Antenna 1 | Sum | | |
| IEEE 802.11b | 1 | 2412 | 10.61 | 12.26 | -/- | 30 | PASS |
| | 6 | 2437 | 10.45 | 11.63 | -/- | | |
| | 11 | 2462 | 10.76 | 11.76 | -/- | | |
| IEEE 802.11g | 1 | 2412 | 9.85 | 10.88 | -/- | 30 | PASS |
| | 6 | 2437 | 9.24 | 10.45 | -/- | | |
| | 11 | 2462 | 9.85 | 10.27 | -/- | | |
| IEEE 802.11n HT20 | 1 | 2412 | 10.39 | 11.00 | 13.72 | 30 | PASS |
| | 6 | 2437 | 9.66 | 10.55 | 13.14 | | |
| | 11 | 2462 | 10.23 | 10.42 | 13.34 | | |
| IEEE 802.11n HT40 | 3 | 2422 | 9.15 | 9.72 | 12.45 | 30 | PASS |
| | 6 | 2437 | 8.83 | 10.38 | 12.68 | | |
| | 9 | 2452 | 9.03 | 10.62 | 12.91 | | |

Remark:

1. Measured output power at difference data rate for each mode and recorded worst case for each mode.
2. Test results including cable loss;
3. Worst case data at 1Mbps at IEEE 802.11b; 6Mbps at IEEE 802.11g; 6.5Mbps at IEEE 802.11n HT20; 13.5Mbps at IEEE 802.11n HT40;
4. “-/-” means no need measured or sum as cannot work at MIMO mode;
5. Average power is for report only;

5.3. Power Spectral Density Measurement

5.3.1. Standard Applicable

According to §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.

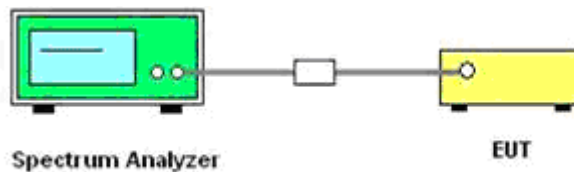
5.3.2. Measuring Instruments and Setting

Please refer to equipment’s list in this report. The following table is the setting of Spectrum Analyzer.

5.3.3. Test Procedures

1. The transmitter was connected directly to a Spectrum Analyzer.
2. The power was monitored at the coupler port with a Spectrum Analyzer. The power level was set to the maximum level.
3. Set the RBW = 3 KHz~100 KHz.
4. Set the VBW $\geq 3 \times$ RBW
5. Set the span to 1.5 times the DTS channel bandwidth.
6. Detector = peak.
7. Sweep time = auto couple.
8. Trace mode = max hold.
9. Allow trace to fully stabilize.
10. Use the peak marker function to determine the maximum power level in any 3 kHz band segment within the fundamental EBW.
11. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

5.3.4. Test Setup Layout



5.3.5. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

5.3.6. Test Result of Power Spectral Density

| | | | |
|---------------|-----------|----------------|------------------|
| Temperature | 25.1℃ | Humidity | 52.4% |
| Test Engineer | Gary Qian | Configurations | IEEE 802.11b/g/n |



| Test Mode | Channel | Frequency (MHz) | Measured Peak Power Spectral Density (dBm/100KHz) | | | Convert Factor | Report Peak Power Spectral Density | Directional Gain | Limits (dBm/3KHz) | Verdict |
|-------------------|---------|-----------------|---|-----------|-------|----------------|------------------------------------|------------------|-------------------|---------|
| | | | Antenna 0 | Antenna 1 | Sum | | | | | |
| IEEE 802.11b | 1 | 2412 | -0.11 | 1.59 | -/- | -15.23 | -13.64 | -/- | 8.00 | PASS |
| | 6 | 2437 | -0.16 | 1.00 | -/- | -15.23 | -14.23 | -/- | | |
| | 11 | 2462 | -0.01 | 1.10 | -/- | -15.23 | -14.13 | -/- | | |
| IEEE 802.11g | 1 | 2412 | -5.70 | -4.80 | -/- | -15.23 | -20.03 | -/- | 8.00 | PASS |
| | 6 | 2437 | -6.22 | -4.76 | -/- | -15.23 | -19.99 | -/- | | |
| | 11 | 2462 | -5.54 | -5.29 | -/- | -15.23 | -20.52 | -/- | | |
| IEEE 802.11n HT20 | 1 | 2412 | -4.98 | -4.69 | -1.82 | -15.23 | -19.92 | 4.26 | 8.00 | PASS |
| | 6 | 2437 | -4.98 | -4.64 | -1.80 | -15.23 | -19.87 | 4.26 | | |
| | 11 | 2462 | -4.77 | -4.51 | -1.63 | -15.23 | -19.74 | 4.26 | | |
| IEEE 802.11n HT40 | 3 | 2422 | -8.72 | -8.91 | -5.80 | -15.23 | -24.14 | 4.26 | 8.00 | PASS |
| | 6 | 2437 | -9.49 | -7.26 | -5.22 | -15.23 | -22.49 | 4.26 | | |
| | 9 | 2452 | -9.30 | -7.27 | -5.16 | -15.23 | -22.50 | 4.26 | | |

Remark:

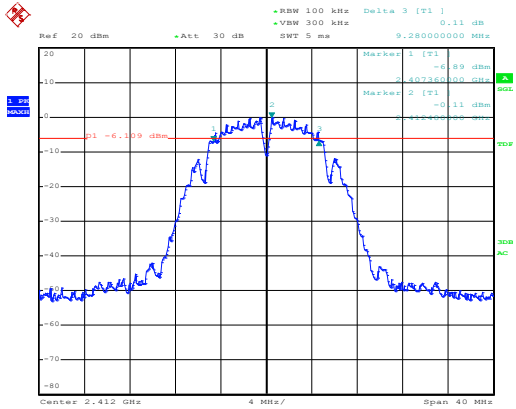
1. Measured peak power spectrum density at difference data rate for each mode and recorded worst case for each mode.
2. Test results including cable loss;
3. Worst case data at 1Mbps at IEEE 802.11b; 6Mbps at IEEE 802.11g; 6.5Mbps at IEEE 802.11n HT20; 13.5Mbps at IEEE 802.11n HT40;
4. Please refer to following plots;
5. For MIMO with CCD technology device, The Directional Gain= Gain of individual transmit antennas (dBi) + Array gain;

$$\text{Directional gain} = 10 \log[(10^{G1/10} + 10^{G2/10} + \dots + 10^{GN/10})/N_{ANT}] \text{ dBi, where antenna gains given by } G1, G2, \dots, GN \text{ dBi, } N_{ANT} \text{ is the antennas total Number.}$$
6. “-/-“ means no need measured or sum as cannot work at MIMO mode;
7. Convert Factor= $10 \cdot \log_{10}(3/100) = -15.23 \text{ (dB)}$,
 $\text{PSD[dBm/100KHz]} + \text{Convert Factor} = \text{PSD[dBm/3KHz]}$



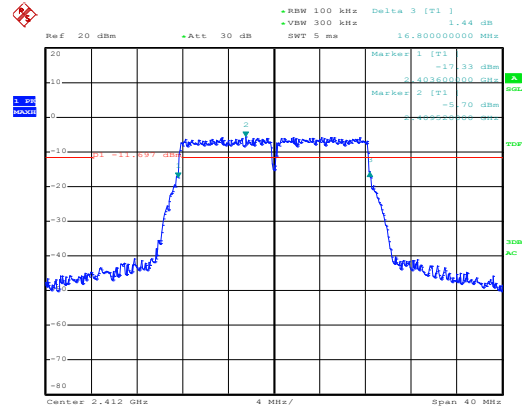
Power Spectral Density

Antenna 0 IEEE 802.11b



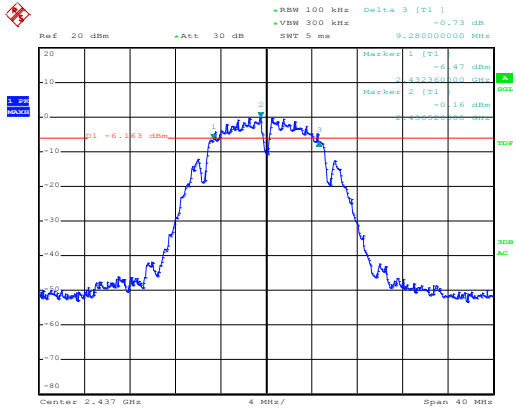
Date: 20.JUN.2018 16:23:07

Antenna 0 IEEE 802.11g



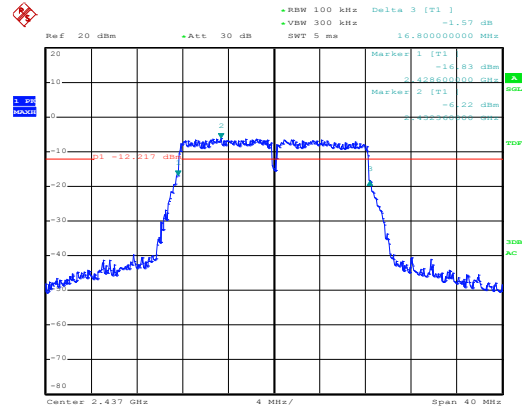
Date: 20.JUN.2018 16:27:31

Channel 1 / 2412 MHz



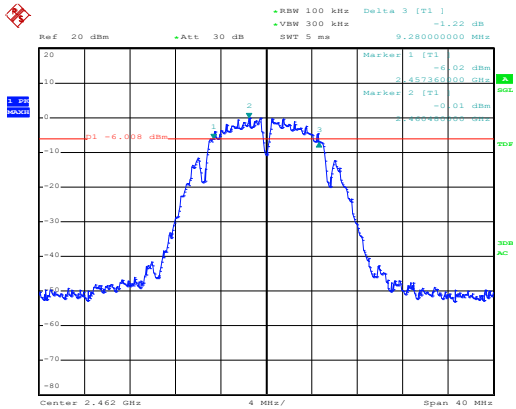
Date: 20.JUN.2018 16:24:57

Channel 1 / 2412 MHz



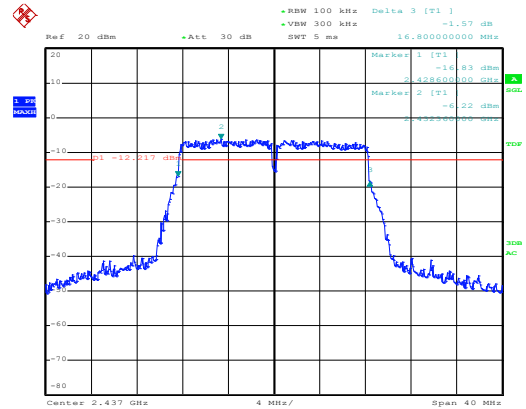
Date: 20.JUN.2018 16:28:57

Channel 6 / 2437 MHz



Date: 20.JUN.2018 16:25:45

Channel 6 / 2437 MHz



Date: 20.JUN.2018 16:28:57

Channel 11 / 2462 MHz

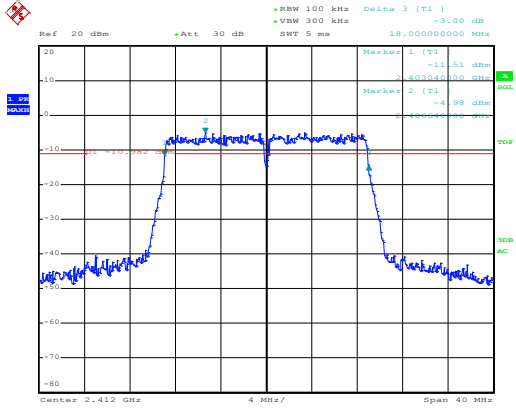
Channel 11 / 2462 MHz



Power Spectral Density

Antenna 0

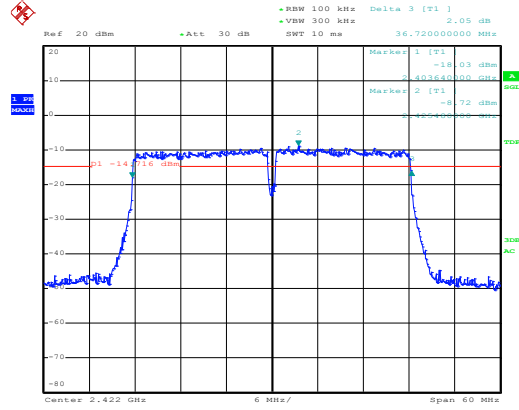
IEEE 802.11n HT20



Date: 20.JUN.2018 16:31:22

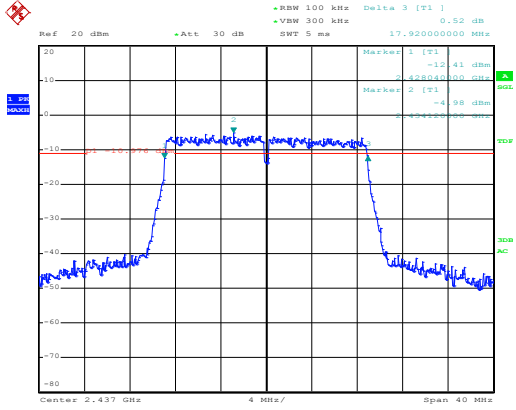
Antenna 0

IEEE 802.11n HT40



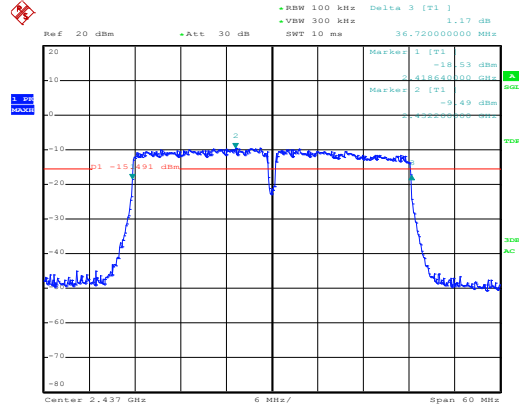
Date: 20.JUN.2018 16:35:50

Channel 1 / 2412 MHz



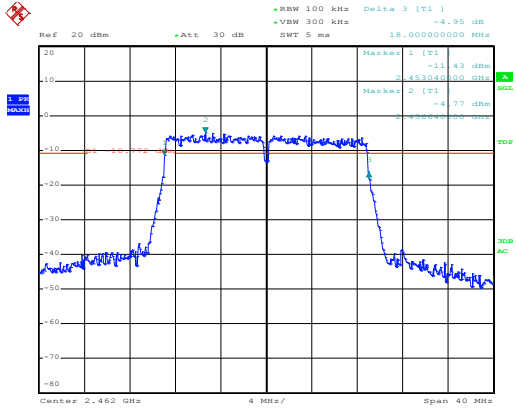
Date: 20.JUN.2018 16:32:49

Channel 3 / 2422 MHz



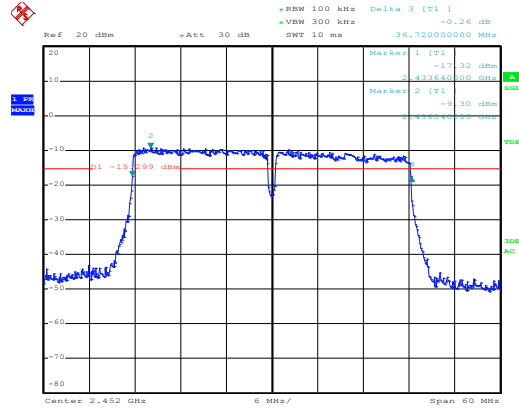
Date: 20.JUN.2018 16:37:13

Channel 6 / 2437 MHz



Date: 20.JUN.2018 16:33:24

Channel 6 / 2437 MHz



Date: 20.JUN.2018 16:37:45

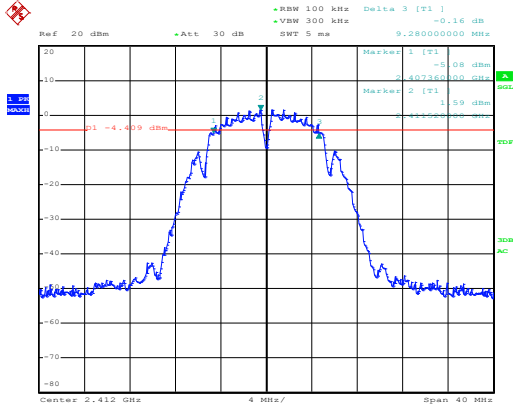
Channel 11 / 2462 MHz

Channel 9 / 2452 MHz



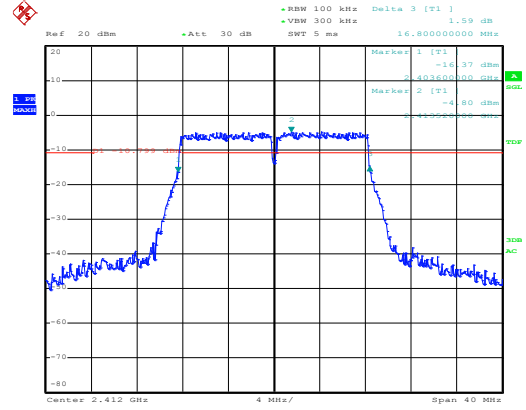
Power Spectral Density

Antenna 1 IEEE 802.11b



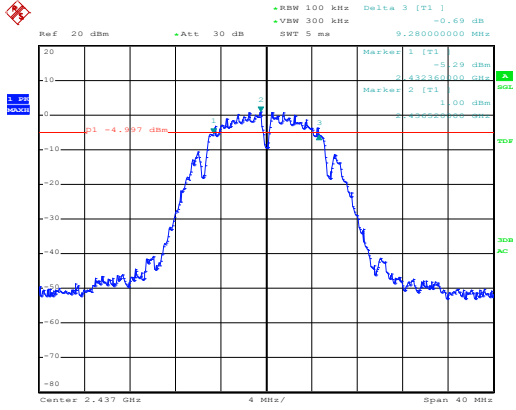
Date: 20.JUN.2018 16:52:05

Antenna 1 IEEE 802.11g



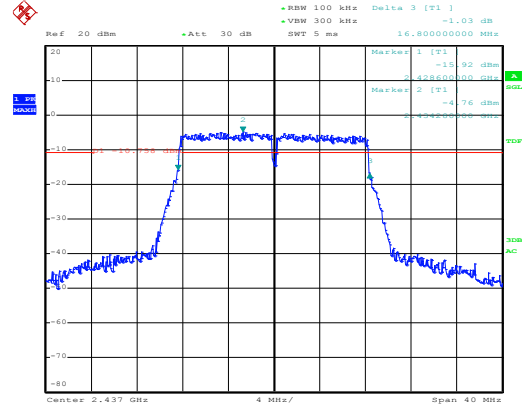
Date: 20.JUN.2018 16:55:32

Channel 1 / 2412 MHz



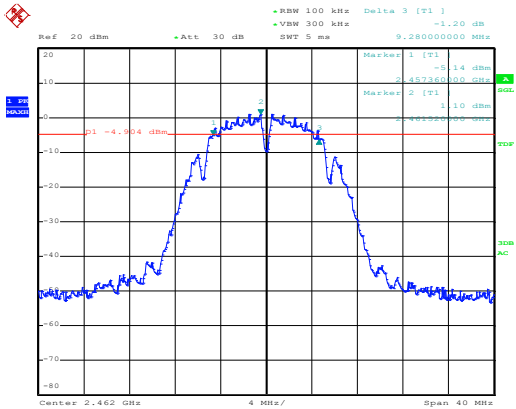
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Channel 1 / 2412 MHz



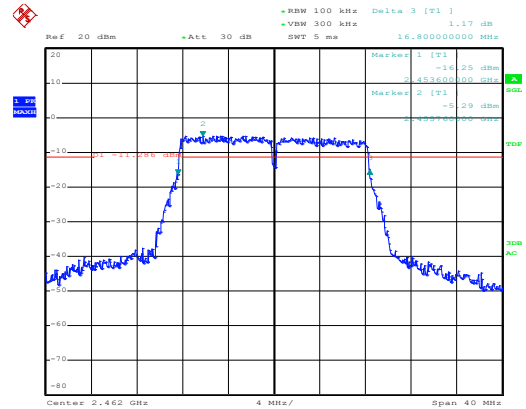
Date: 20.JUN.2018 16:57:00

Channel 6 / 2437 MHz



Date: 20.JUN.2018 16:54:13

Channel 6 / 2437 MHz



Date: 20.JUN.2018 16:57:36

Channel 11 / 2462 MHz

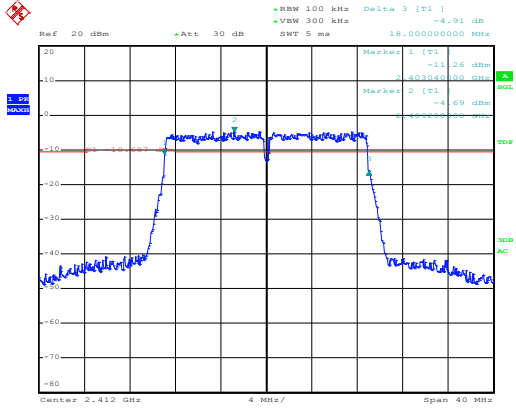
Channel 11 / 2462 MHz



Power Spectral Density

Antenna 1

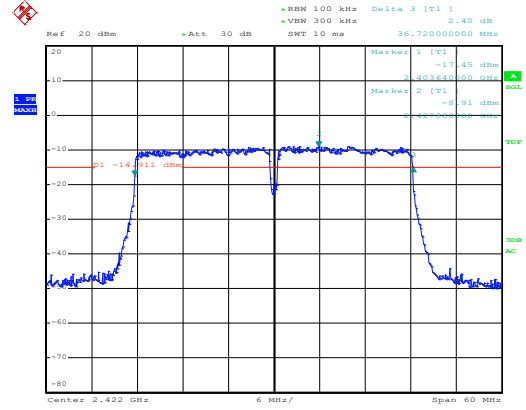
IEEE 802.11n HT20



Date: 20.JUN.2018 16:59:05

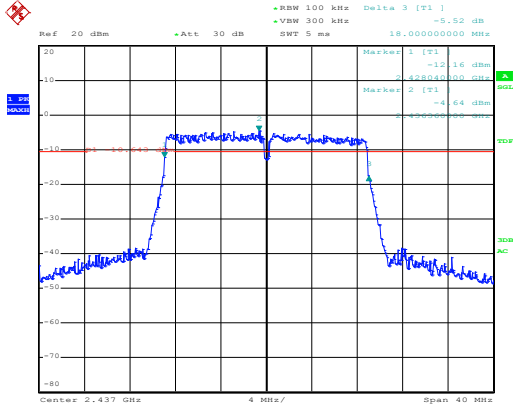
Antenna 1

IEEE 802.11n HT40



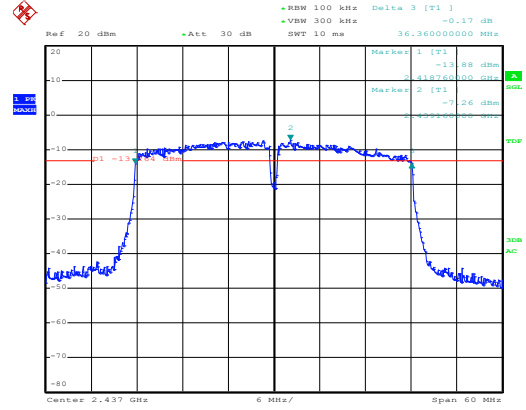
Date: 20.JUN.2018 17:02:25

Channel 1 / 2412 MHz



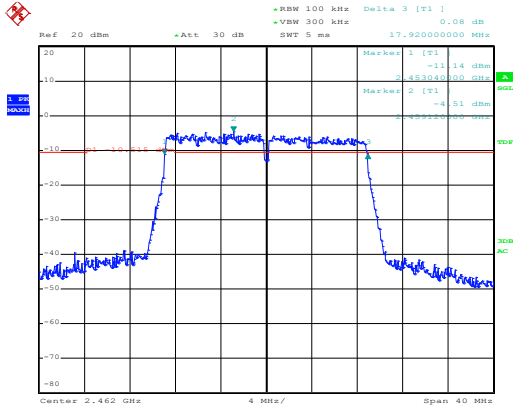
Date: 20.JUN.2018 17:00:32

Channel 3 / 2422 MHz



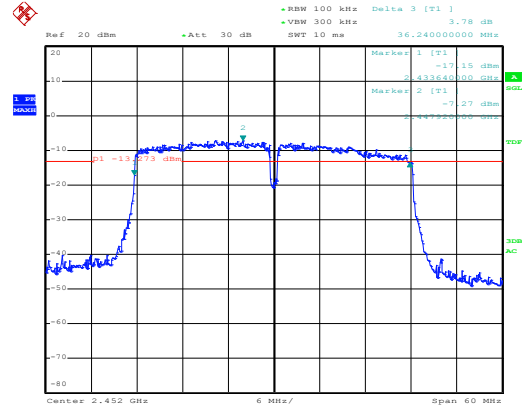
Date: 20.JUN.2018 17:03:49

Channel 6 / 2437 MHz



Date: 20.JUN.2018 17:01:07

Channel 6 / 2437 MHz



Date: 20.JUN.2018 17:04:33

Channel 11 / 2462 MHz

Channel 9 / 2452 MHz



5.4. 6 dB Spectrum Bandwidth Measurement

5.4.1. Standard Applicable

According to §15.247(a) (2): For digital modulation systems, the minimum 6 dB bandwidth shall be at least 500 kHz.

5.4.2. Measuring Instruments and Setting

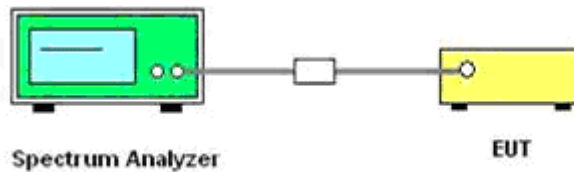
Please refer to equipments list in this report. The following table is the setting of the Spectrum Analyzer.

| | |
|--------------------|----------|
| Spectrum Parameter | Setting |
| Attenuation | Auto |
| Span Frequency | > RBW |
| Detector | Peak |
| Trace | Max Hold |
| Sweep Time | 100ms |

5.4.3. Test Procedures

1. The transmitter output (antenna port) was connected to the spectrum analyzer in peak hold mode.
2. The resolution bandwidth and the video bandwidth were set according to KDB558074.
3. Measured the spectrum width with power higher than 6dB below carrier.

5.4.4. Test Setup Layout



5.4.5. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

5.4.6. Test Result of 6dB Spectrum Bandwidth

| | | | |
|---------------|-----------|----------------|------------------|
| Temperature | 25.1°C | Humidity | 52.4% |
| Test Engineer | Gary Qian | Configurations | IEEE 802.11b/g/n |



| Test Mode | Channel | Frequency (MHz) | 6dB Bandwidth (MHz) | | Limits (MHz) | Verdict |
|-------------------|---------|-----------------|---------------------|-----------|--------------|---------|
| | | | Antenna 0 | Antenna 1 | | |
| IEEE 802.11b | 1 | 2412 | 9.280 | 9.280 | 0.500 | PASS |
| | 6 | 2437 | 9.280 | 9.280 | | |
| | 11 | 2462 | 9.280 | 9.280 | | |
| IEEE 802.11g | 1 | 2412 | 16.800 | 16.800 | 0.500 | PASS |
| | 6 | 2437 | 16.800 | 16.800 | | |
| | 11 | 2462 | 16.800 | 16.800 | | |
| IEEE 802.11n HT20 | 1 | 2412 | 18.000 | 18.000 | 0.500 | PASS |
| | 6 | 2437 | 17.920 | 18.000 | | |
| | 11 | 2462 | 18.000 | 17.920 | | |
| IEEE 802.11n HT40 | 3 | 2422 | 36.720 | 36.720 | 0.500 | PASS |
| | 6 | 2437 | 36.720 | 36.360 | | |
| | 9 | 2452 | 36.720 | 36.240 | | |

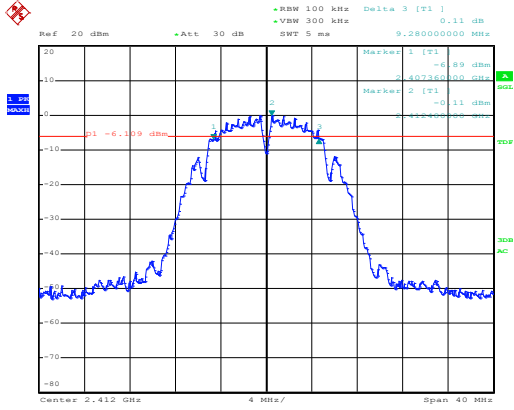
Remark:

- 1. Measured 6dB Bandwidth at difference data rate for each mode and recorded worst case for each mode.*
- 2. Test results including cable loss;*
- 3. Worst case data at 1Mbps at IEEE 802.11b; 6Mbps at IEEE 802.11g; 6.5Mbps at IEEE 802.11n HT20; 13.5Mbps at IEEE 802.11n HT40;*
- 4. Please refer to following plots;*



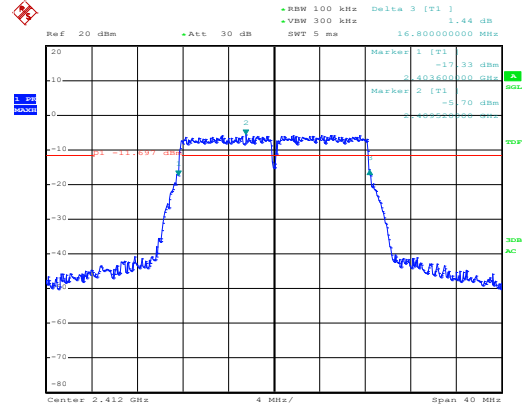
6 dB Bandwidth

Antenna 0
IEEE 802.11b



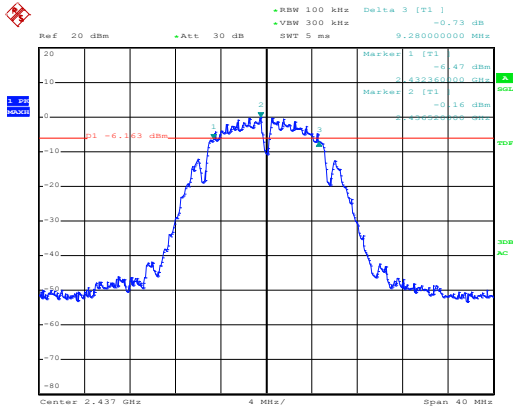
Date: 20 JUN.2018 16:23:07

Antenna 0
IEEE 802.11g



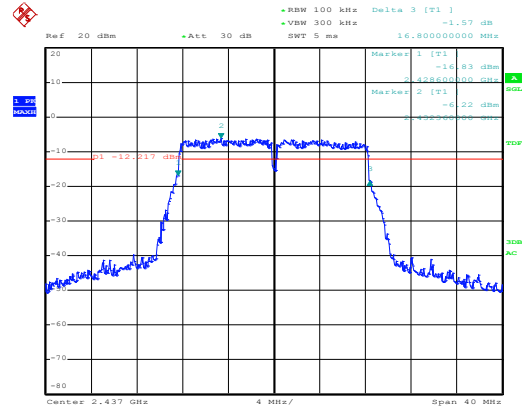
Date: 20 JUN.2018 16:27:31

Channel 1 / 2412 MHz



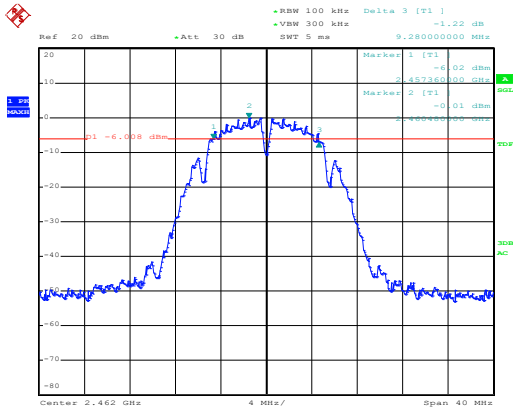
Date: 20 JUN.2018 16:24:57

Channel 1 / 2412 MHz



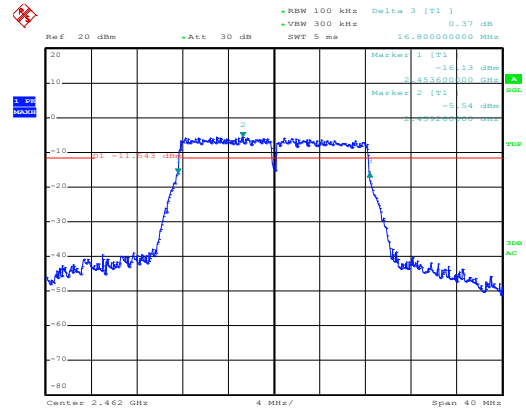
Date: 20 JUN.2018 16:28:57

Channel 6 / 2437 MHz



Date: 20 JUN.2018 16:25:45

Channel 6 / 2437 MHz



Date: 20 JUN.2018 16:29:56

Channel 11 / 2462 MHz

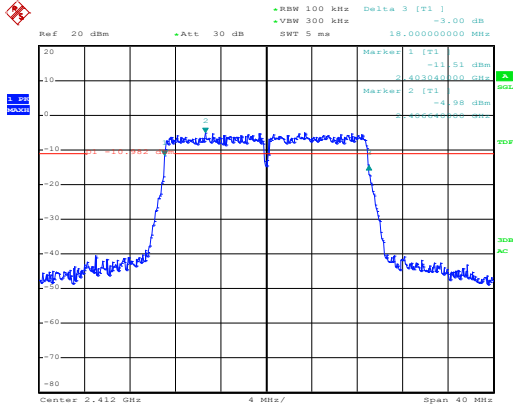
Channel 11 / 2462 MHz



6 dB Bandwidth

Antenna 0

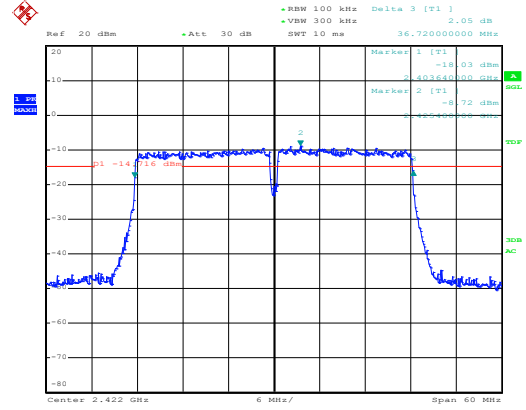
IEEE 802.11n HT20



Date: 20 JUN 2018 16:31:22

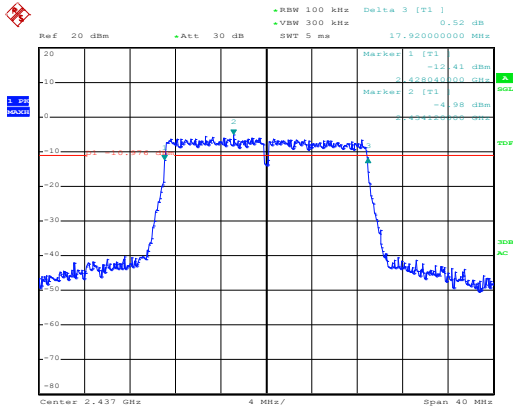
Antenna 0

IEEE 802.11n HT40



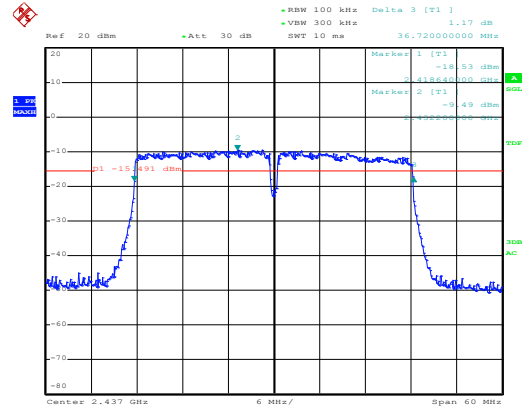
Date: 20 JUN 2018 16:35:50

Channel 1 / 2412 MHz



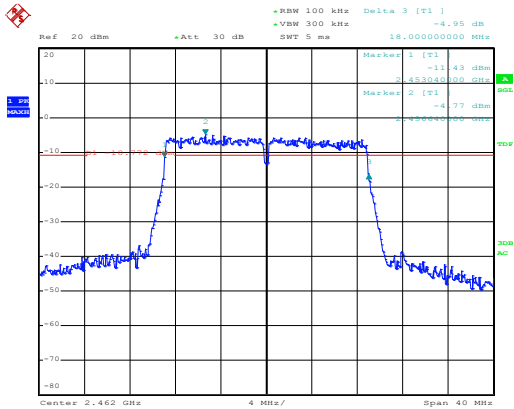
Date: 20 JUN 2018 16:32:49

Channel 3 / 2422 MHz



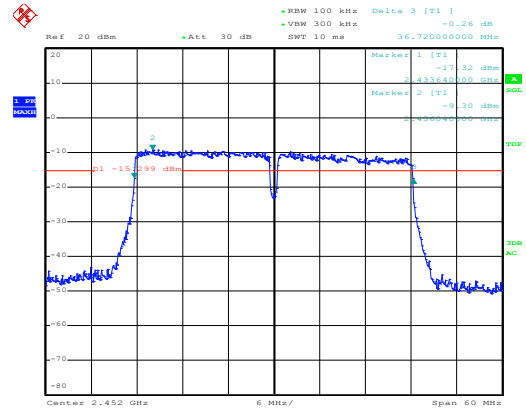
Date: 20 JUN 2018 16:37:13

Channel 6 / 2437 MHz



Date: 20 JUN 2018 16:33:24

Channel 6 / 2437 MHz



Date: 20 JUN 2018 16:37:45

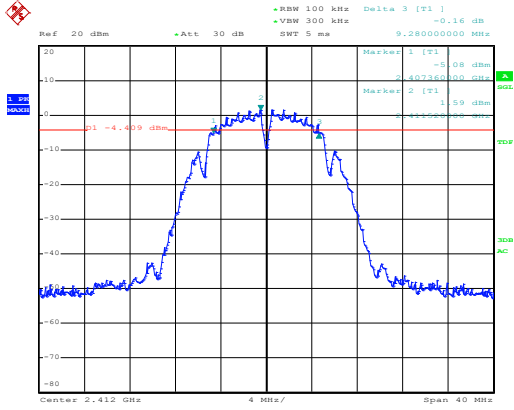
Channel 11 / 2462 MHz

Channel 9 / 2452 MHz

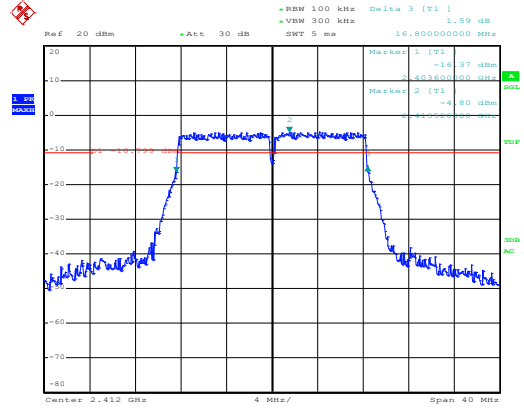


6 dB Bandwidth

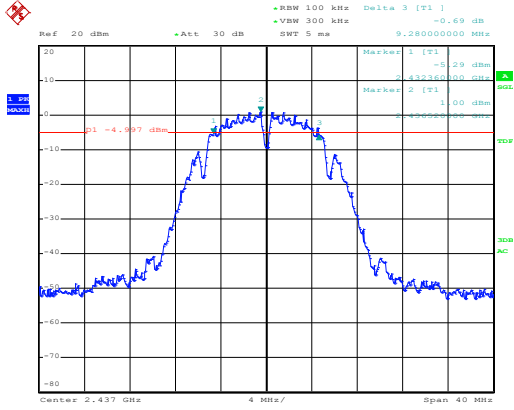
Antenna 1
IEEE 802.11b



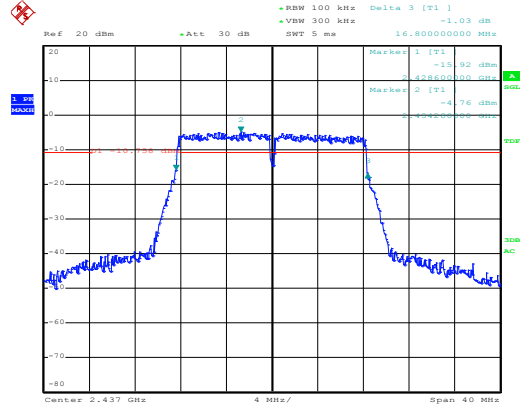
Antenna 1
IEEE 802.11g



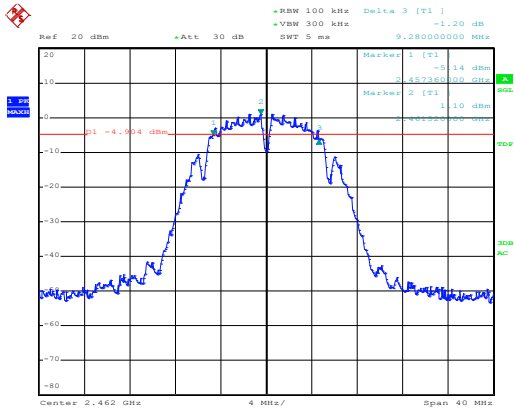
Channel 1 / 2412 MHz



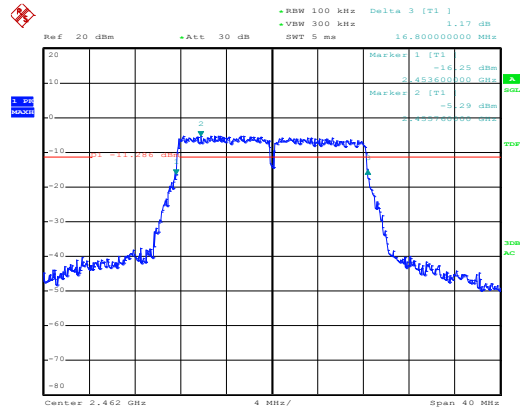
Channel 1 / 2412 MHz



Channel 6 / 2437 MHz



Channel 6 / 2437 MHz



Channel 11 / 2462 MHz

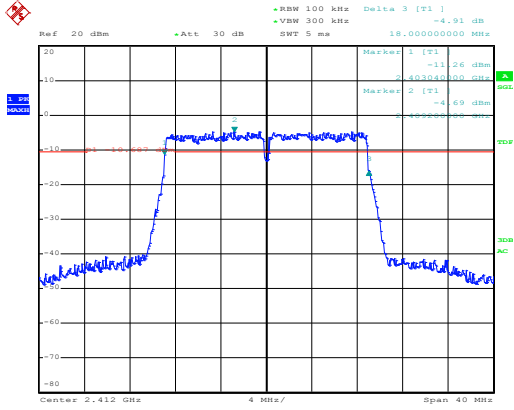
Channel 11 / 2462 MHz



6 dB Bandwidth

Antenna 1

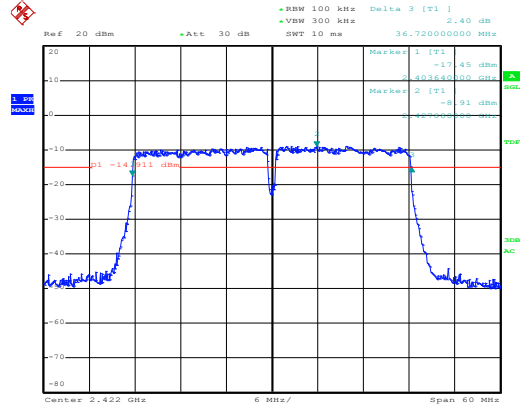
IEEE 802.11n HT20



Date: 20.JUN.2018 16:59:05

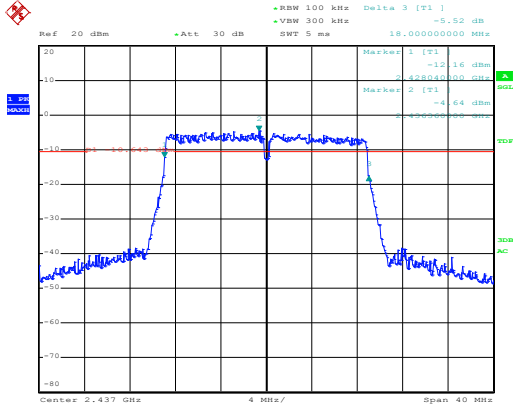
Antenna 1

IEEE 802.11n HT40



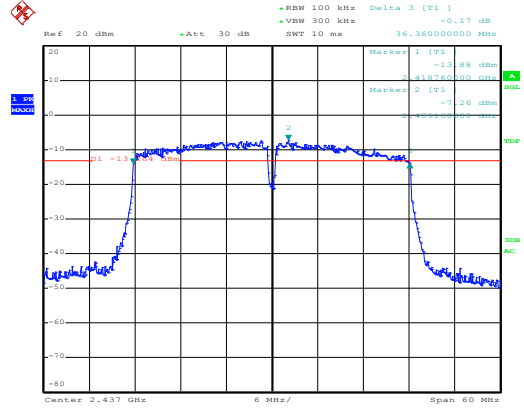
Date: 20.JUN.2018 17:02:25

Channel 1 / 2412 MHz



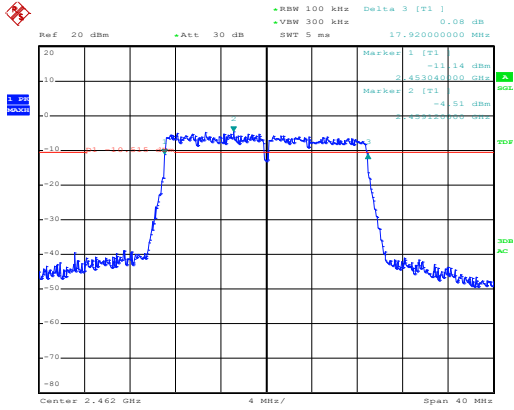
Date: 20.JUN.2018 17:00:32

Channel 3 / 2422 MHz



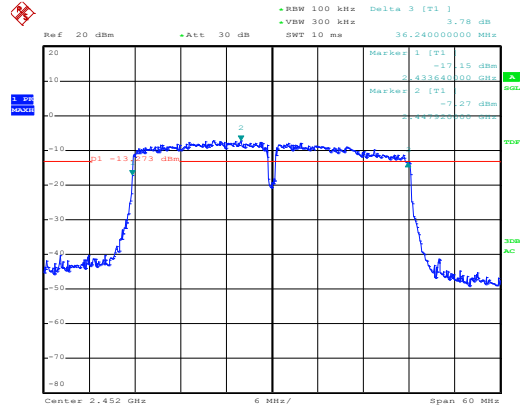
Date: 20.JUN.2018 17:03:49

Channel 6 / 2437 MHz



Date: 20.JUN.2018 17:01:07

Channel 6 / 2437 MHz



Date: 20.JUN.2018 17:04:33

Channel 11 / 2462 MHz

Channel 9 / 2452 MHz



5.5. Radiated Emissions Measurement

5.5.1. Standard Applicable

15.205 (a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

| MHz | MHz | MHz | GHz |
|-------------------|---------------------|---------------|-------------|
| 0.090-0.110 | 16.42-16.423 | 399.9-410 | 4.5-5.15 |
| \1\ 0.495-0.505 | 16.69475-16.69525 | 608-614 | 5.35-5.46 |
| 2.1735-2.1905 | 16.80425-16.80475 | 960-1240 | 7.25-7.75 |
| 4.125-4.128 | 25.5-25.67 | 1300-1427 | 8.025-8.5 |
| 4.17725-4.17775 | 37.5-38.25 | 1435-1626.5 | 9.0-9.2 |
| 4.20725-4.20775 | 73-74.6 | 1645.5-1646.5 | 9.3-9.5 |
| 6.215-6.218 | 74.8-75.2 | 1660-1710 | 10.6-12.7 |
| 6.26775-6.26825 | 108-121.94 | 1718.8-1722.2 | 13.25-13.4 |
| 6.31175-6.31225 | 123-138 | 2200-2300 | 14.47-14.5 |
| 8.291-8.294 | 149.9-150.05 | 2310-2390 | 15.35-16.2 |
| 8.362-8.366 | 156.52475-156.52525 | 2483.5-2500 | 17.7-21.4 |
| 8.37625-8.38675 | 156.7-156.9 | 2690-2900 | 22.01-23.12 |
| 8.41425-8.41475 | 162.0125-167.17 | 3260-3267 | 23.6-24.0 |
| 12.29-12.293 | 167.72-173.2 | 3332-3339 | 31.2-31.8 |
| 12.51975-12.52025 | 240-285 | 3345.8-3358 | 36.43-36.5 |
| 12.57675-12.57725 | 322-335.4 | 3600-4400 | (\2) |
| 13.36-13.41 | | | |

\1\ Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

\2\ Above 38.6

According to §15.247 (d): 20dBc in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

| Frequencies (MHz) | Field Strength (microvolts/meter) | Measurement Distance (meters) |
|-------------------|-----------------------------------|-------------------------------|
| 0.009~0.490 | 2400/F(KHz) | 300 |
| 0.490~1.705 | 24000/F(KHz) | 30 |
| 1.705~30.0 | 30 | 30 |
| 30~88 | 100 | 3 |
| 88~216 | 150 | 3 |
| 216~960 | 200 | 3 |
| Above 960 | 500 | 3 |

5.5.2. Measuring Instruments and Setting

Please refer to equipment list in this report. The following table is the setting of spectrum analyzer and receiver.

| Spectrum Parameter | Setting |
|---|---|
| Attenuation | Auto |
| Start Frequency | 1000 MHz |
| Stop Frequency | 10 ^m carrier harmonic |
| RB / VB (Emission in restricted band) | 1MHz / 1MHz for Peak, 1 MHz / 1/B kHz for Average |
| RB / VB (Emission in non-restricted band) | 1MHz / 1MHz for Peak, 1 MHz / 1/B kHz for Average |

| Receiver Parameter | Setting |
|------------------------|--|
| Attenuation | Auto |
| Start ~ Stop Frequency | 9kHz~150kHz / RB/VB 200Hz/1KHz for QP/AVG |
| Start ~ Stop Frequency | 150kHz~30MHz / RB/VB 9kHz/30KHz for QP/AVG |
| Start ~ Stop Frequency | 30MHz~1000MHz / RB/VB 120kHz/1MHz for QP |



5.5.3. Test Procedures

1) Sequence of testing 9 kHz to 30 MHz

Setup:

- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.
- If the EUT is a tabletop system, a rotatable table with 0.8 m height is used.
- If the EUT is a floor standing device, it is placed on the ground.
- Auxiliary equipment and cables were positioned to simulate normal operation conditions.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- The measurement distance is 3 meter.
- The EUT was set into operation.

Premeasurement:

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna height is 1.5 meter.
- At each turntable position the analyzer sweeps with peak detection to find the maximum of all emissions

Final measurement:

- Identified emissions during the premeasurement the software maximizes by rotating the turntable position (0° to 360°) and by rotating the elevation axes (0° to 360°).
- The final measurement will be done in the position (turntable and elevation) causing the highest emissions with QPK detector.
- The final levels, frequency, measuring time, bandwidth, turntable position, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement and the limit will be stored.



2) Sequence of testing 30 MHz to 1 GHz

Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a table with 0.8 m height is used, which is placed on the ground plane.

--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.

--- Auxiliary equipment and cables were positioned to simulate normal operation conditions

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

--- The measurement distance is 3 meter.

--- The EUT was set into operation.

Premeasurement:

--- The turntable rotates from 0° to 315° using 45° steps.

--- The antenna is polarized vertical and horizontal.

--- The antenna height changes from 1 to 3 meter.

--- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.

Final measurement:

--- The final measurement will be performed with minimum the six highest peaks.

--- According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position ($\pm 45^\circ$) and antenna movement between 1 and 4 meter.

--- The final measurement will be done with QP detector with an EMI receiver.

--- The final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.



3) Sequence of testing 1 GHz to 18 GHz

Setup:

- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.
- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables were positioned to simulate normal operation conditions
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- The measurement distance is 3 meter.
- The EUT was set into operation.

Premeasurement:

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height scan range is 1 meter to 2.5 meter.
- At each turntable position and antenna polarization the analyzer sweeps with peak detection to find the maximum of all emissions.

Final measurement:

- The final measurement will be performed with minimum the six highest peaks.
- According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position ($\pm 45^\circ$) and antenna movement between 1 and 4 meter. This procedure is repeated for both antenna polarizations.
- The final measurement will be done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and Average detector.
- The final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.

4) Sequence of testing above 18 GHz



Setup:

- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.
- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables were positioned to simulate normal operation conditions
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- The measurement distance is 1 meter.
- The EUT was set into operation.

Premeasurement:

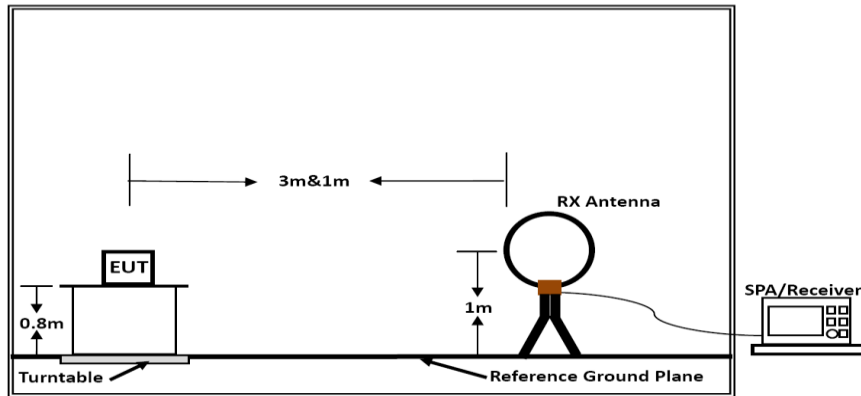
- The antenna is moved spherical over the EUT in different polarizations of the antenna.

Final measurement:

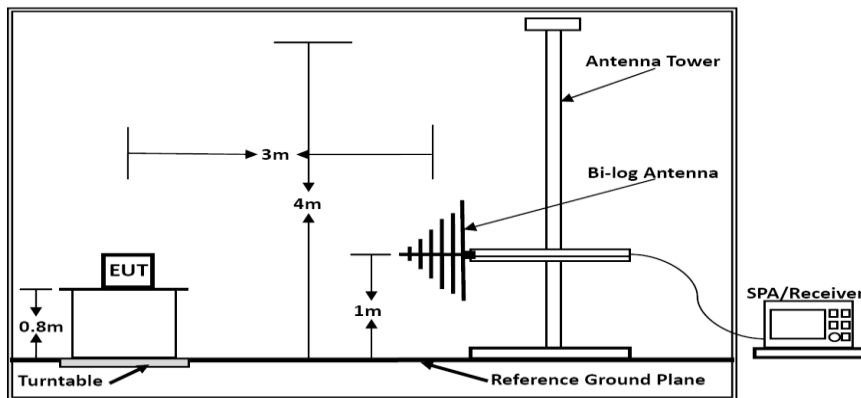
- The final measurement will be performed at the position and antenna orientation for all detected emissions that were found during the premeasurements with Peak and Average detector.
- The final levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement and the limit will be stored.

5.5.4. Test Setup Layout

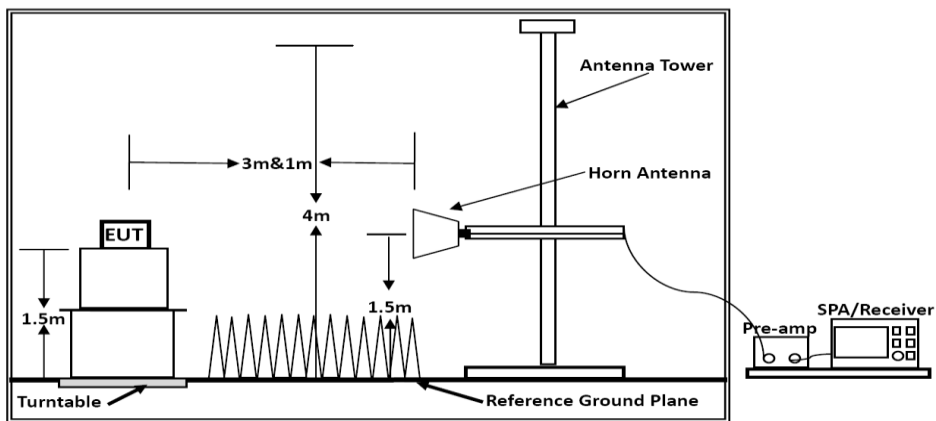
For radiated emissions below 30MHz



Below 30MHz



Below 1GHz



Above 1GHz

Above 18 GHz shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade from 3m to 1m.

Distance extrapolation factor = $20 \log(\text{specific distance [3m]} / \text{test distance [1m]})$ (dB);
 Limit line = specific limits (dBuV) + distance extrapolation factor [6 dB].

5.5.5. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.



5.5.6. Results of Radiated Emissions (9 KHz~30MHz)

| | | | |
|---------------|---------------|----------------|------------------|
| Temperature | 24.5°C | Humidity | 56.2% |
| Test Engineer | Gary Qian | Configurations | IEEE 802.11b/g/n |
| Test Date | June 26, 2018 | | |

| Freq. (MHz) | Level (dBuV) | Over Limit (dB) | Over Limit (dBuV) | Remark |
|-------------|--------------|-----------------|-------------------|----------|
| - | - | - | - | See Note |

Note:

The amplitude of spurious emissions which are attenuated by more than 20 dB below the permissible value has no need to be reported.

Distance extrapolation factor = $40 \log(\text{specific distance} / \text{test distance})$ (dB);

Limit line = specific limits (dBuV) + distance extrapolation factor.

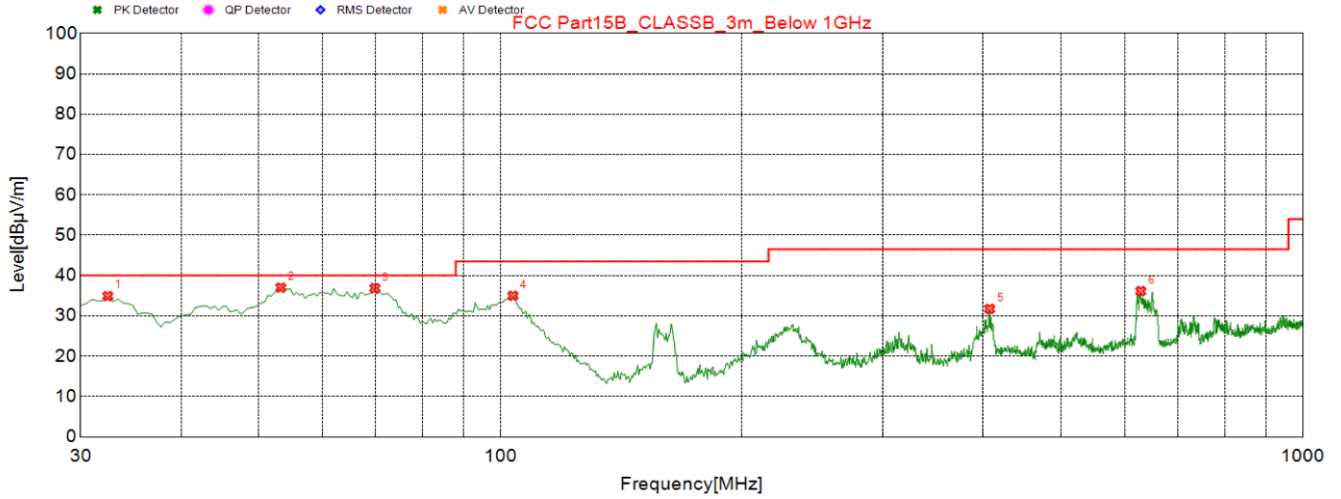
5.5.7. Results of Radiated Emissions (30MHz~1GHz)

| | | | |
|---------------|---------------|----------------|---|
| Temperature | 24.5°C | Humidity | 56.2% |
| Test Engineer | Gary Qian | Configurations | 802.11n HT40 Low Channel, Chain 0+Chain 1 |
| Test Date | June 26, 2018 | | |

The Worst Test result for 802.11n HT40 (Low Channel) @Chain 0+Chain 1



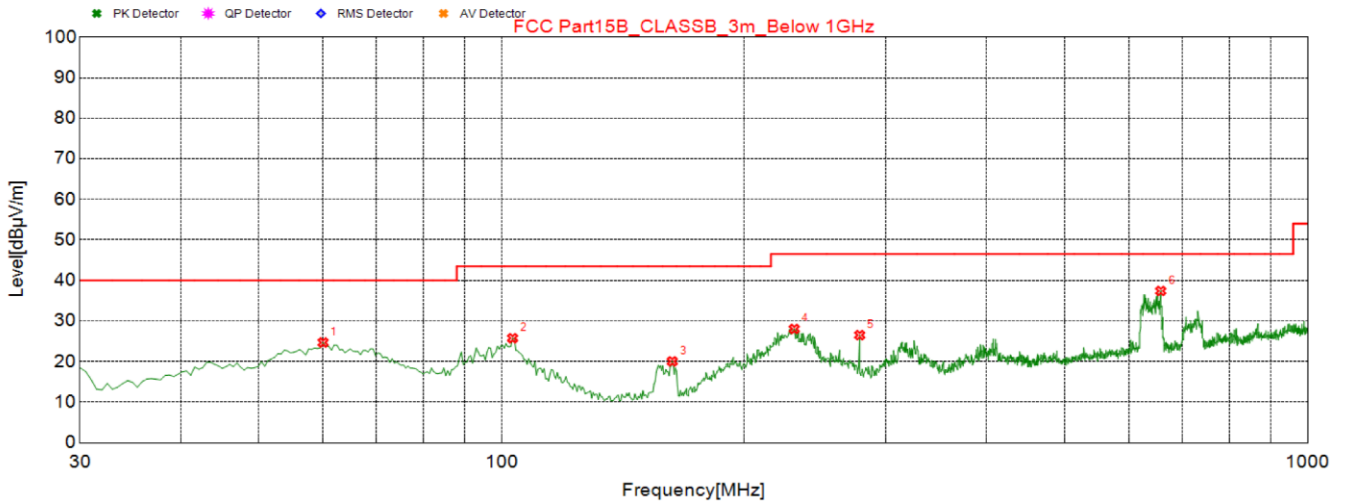
Vertical



| NO. | Freq. [MHz] | Result Level [dBµV/m] | Factor [dB/m] | Limit [dBµV/m] | Margin [dB] | Height [cm] | Angle [°] | Polarity |
|-----|-------------|-----------------------|---------------|----------------|-------------|-------------|-----------|----------|
| 1 | 32.425 | 34.89 | -16.15 | 40.00 | 5.11 | 100 | 160 | Vertical |
| 2 | 53.280 | 36.99 | -14.66 | 40.00 | 3.01 | 100 | 193 | Vertical |
| 3 | 69.770 | 36.87 | -18.15 | 40.00 | 3.13 | 100 | 152 | Vertical |
| 4 | 103.720 | 34.99 | -15.99 | 43.50 | 8.51 | 100 | 36 | Vertical |
| 5 | 407.330 | 31.73 | -9.89 | 46.50 | 14.77 | 100 | 301 | Vertical |
| 6 | 628.490 | 36.14 | -5.24 | 46.50 | 10.36 | 100 | 318 | Vertical |



Horizontal



| NO. | Freq. [MHz] | Result Level [dBuV/m] | Factor [dB/m] | Limit [dBuV/m] | Margin [dB] | Height [cm] | Angle [°] | Polarity |
|-----|-------------|-----------------------|---------------|----------------|-------------|-------------|-----------|------------|
| 1 | 60.070 | 24.7 | -15.67 | 40.00 | 15.30 | 100 | 243 | Horizontal |
| 2 | 103.235 | 25.76 | -15.99 | 43.50 | 17.74 | 100 | 235 | Horizontal |
| 3 | 162.890 | 20.05 | -18.21 | 43.50 | 23.45 | 100 | 354 | Horizontal |
| 4 | 230.790 | 28.05 | -15.10 | 46.50 | 18.45 | 100 | 163 | Horizontal |
| 5 | 278.320 | 26.52 | -13.70 | 46.50 | 19.98 | 100 | 177 | Horizontal |
| 6 | 657.590 | 37.42 | -4.88 | 46.50 | 9.08 | 100 | 309 | Horizontal |

Note:

- 1). Pre-scan all modes and recorded the worst case results in this report (IEEE 802.11n HT40 (Low Channel) @ Chain 0+Chain 1
- 2). Emission level (dBuV/m) = 20 log Emission level (uV/m).
- 3). Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.



5.5.8. Results for Radiated Emissions (Above 1GHz)

*IEEE 802.11b**Antenna 0**Channel 1 / 2412 MHz*

| Freq. MHz | Reading dBuV | Ant. Fac. dB/m | Pre. Fac. dB | Cab. Loss dB | Measured dBuV/m | Limit dBuV/m | Margin dB | Remark | Pol. |
|-----------|--------------|----------------|--------------|--------------|-----------------|--------------|-----------|---------|------------|
| 4824.00 | 57.67 | 33.06 | 35.04 | 3.94 | 59.63 | 74.00 | 14.37 | Peak | Horizontal |
| 4824.00 | 45.08 | 33.06 | 35.04 | 3.94 | 47.04 | 54.00 | 6.96 | Average | Horizontal |
| 4824.00 | 56.25 | 33.06 | 35.04 | 3.94 | 58.21 | 74.00 | 15.79 | Peak | Vertical |
| 4824.00 | 45.91 | 33.06 | 35.04 | 3.94 | 47.87 | 54.00 | 6.13 | Average | Vertical |

Channel 6 / 2437 MHz

| Freq. MHz | Reading dBuV | Ant. Fac. dB/m | Pre. Fac. dB | Cab. Loss dB | Measured dBuV/m | Limit dBuV/m | Margin dB | Remark | Pol. |
|-----------|--------------|----------------|--------------|--------------|-----------------|--------------|-----------|---------|------------|
| 4874.00 | 56.15 | 33.16 | 35.15 | 3.96 | 58.12 | 74.00 | 15.88 | Peak | Horizontal |
| 4874.00 | 41.29 | 33.16 | 35.15 | 3.96 | 43.26 | 54.00 | 10.74 | Average | Horizontal |
| 4874.00 | 58.25 | 33.16 | 35.15 | 3.96 | 60.22 | 74.00 | 13.78 | Peak | Vertical |
| 4874.00 | 44.37 | 33.16 | 35.15 | 3.96 | 46.34 | 54.00 | 7.66 | Average | Vertical |

Channel 11 / 2462 MHz

| Freq. MHz | Reading dBuV | Ant. Fac. dB/m | Pre. Fac. dB | Cab. Loss dB | Measured dBuV/m | Limit dBuV/m | Margin dB | Remark | Pol. |
|-----------|--------------|----------------|--------------|--------------|-----------------|--------------|-----------|---------|------------|
| 4924.00 | 57.63 | 33.26 | 35.14 | 3.98 | 59.73 | 74.00 | 14.27 | Peak | Horizontal |
| 4924.00 | 42.13 | 33.26 | 35.14 | 3.98 | 44.23 | 54.00 | 9.77 | Average | Horizontal |
| 4924.00 | 59.11 | 33.26 | 35.14 | 3.98 | 61.21 | 74.00 | 12.79 | Peak | Vertical |
| 4924.00 | 43.47 | 33.26 | 35.14 | 3.98 | 45.57 | 54.00 | 8.43 | Average | Vertical |

*IEEE 802.11g**Antenna 0**Channel 1 / 2412 MHz*

| Freq. MHz | Reading dBuV | Ant. Fac. dB/m | Pre. Fac. dB | Cab. Loss dB | Measured dBuV/m | Limit dBuV/m | Margin dB | Remark | Pol. |
|-----------|--------------|----------------|--------------|--------------|-----------------|--------------|-----------|---------|------------|
| 4824.00 | 58.23 | 33.06 | 35.04 | 3.94 | 60.19 | 74.00 | 13.81 | Peak | Horizontal |
| 4824.00 | 42.26 | 33.06 | 35.04 | 3.94 | 44.22 | 54.00 | 9.78 | Average | Horizontal |
| 4824.00 | 57.55 | 33.06 | 35.04 | 3.94 | 59.51 | 74.00 | 14.49 | Peak | Vertical |
| 4824.00 | 45.19 | 33.06 | 35.04 | 3.94 | 47.15 | 54.00 | 6.85 | Average | Vertical |

*Channel 6 / 2437 MHz*

| Freq. MHz | Reading dBuV | Ant. Fac. dB/m | Pre. Fac. dB | Cab. Loss dB | Measured dBuV/m | Limit dBuV/m | Margin dB | Remark | Pol. |
|-----------|--------------|----------------|--------------|--------------|-----------------|--------------|-----------|---------|------------|
| 4874.00 | 58.76 | 33.16 | 35.15 | 3.96 | 60.73 | 74.00 | 13.27 | Peak | Horizontal |
| 4874.00 | 42.71 | 33.16 | 35.15 | 3.96 | 44.68 | 54.00 | 9.32 | Average | Horizontal |
| 4874.00 | 56.69 | 33.16 | 35.15 | 3.96 | 58.66 | 74.00 | 15.34 | Peak | Vertical |
| 4874.00 | 43.82 | 33.16 | 35.15 | 3.96 | 45.79 | 54.00 | 8.21 | Average | Vertical |

Channel 11 / 2462 MHz

| Freq. MHz | Reading dBuV | Ant. Fac. dB/m | Pre. Fac. dB | Cab. Loss dB | Measured dBuV/m | Limit dBuV/m | Margin dB | Remark | Pol. |
|-----------|--------------|----------------|--------------|--------------|-----------------|--------------|-----------|---------|------------|
| 4924.00 | 59.44 | 33.26 | 35.14 | 3.98 | 61.54 | 74.00 | 12.46 | Peak | Horizontal |
| 4924.00 | 45.08 | 33.26 | 35.14 | 3.98 | 47.18 | 54.00 | 6.82 | Average | Horizontal |
| 4924.00 | 56.20 | 33.26 | 35.14 | 3.98 | 58.30 | 74.00 | 15.70 | Peak | Vertical |
| 4924.00 | 40.59 | 33.26 | 35.14 | 3.98 | 42.69 | 54.00 | 11.31 | Average | Vertical |

*IEEE 802.11n HT20**Combined Antenna 0, Antenna 1 and Antenna 2**Channel 1 / 2412 MHz*

| Freq. MHz | Reading dBuV | Ant. Fac. dB/m | Pre. Fac. dB | Cab. Loss dB | Measured dBuV/m | Limit dBuV/m | Margin dB | Remark | Pol. |
|-----------|--------------|----------------|--------------|--------------|-----------------|--------------|-----------|---------|------------|
| 4824.00 | 58.69 | 33.06 | 35.04 | 3.94 | 60.65 | 74.00 | 13.35 | Peak | Horizontal |
| 4824.00 | 43.31 | 33.06 | 35.04 | 3.94 | 45.27 | 54.00 | 8.73 | Average | Horizontal |
| 4824.00 | 56.09 | 33.06 | 35.04 | 3.94 | 58.05 | 74.00 | 15.95 | Peak | Vertical |
| 4824.00 | 43.82 | 33.06 | 35.04 | 3.94 | 45.78 | 54.00 | 8.22 | Average | Vertical |

Channel 6 / 2437 MHz

| Freq. MHz | Reading dBuV | Ant. Fac. dB/m | Pre. Fac. dB | Cab. Loss dB | Measured dBuV/m | Limit dBuV/m | Margin dB | Remark | Pol. |
|-----------|--------------|----------------|--------------|--------------|-----------------|--------------|-----------|---------|------------|
| 4874.00 | 58.07 | 33.16 | 35.15 | 3.96 | 60.04 | 74.00 | 13.96 | Peak | Horizontal |
| 4874.00 | 40.79 | 33.16 | 35.15 | 3.96 | 42.76 | 54.00 | 11.24 | Average | Horizontal |
| 4874.00 | 58.93 | 33.16 | 35.15 | 3.96 | 60.90 | 74.00 | 13.10 | Peak | Vertical |
| 4874.00 | 40.19 | 33.16 | 35.15 | 3.96 | 42.16 | 54.00 | 11.84 | Average | Vertical |



Channel 11 / 2462 MHz

| Freq. MHz | Reading dBuV | Ant. Fac. dB/m | Pre. Fac. dB | Cab. Loss dB | Measured dBuV/m | Limit dBuV/m | Margin dB | Remark | Pol. |
|-----------|--------------|----------------|--------------|--------------|-----------------|--------------|-----------|---------|------------|
| 4924.00 | 59.31 | 33.26 | 35.14 | 3.98 | 61.41 | 74.00 | 12.59 | Peak | Horizontal |
| 4924.00 | 41.51 | 33.26 | 35.14 | 3.98 | 43.61 | 54.00 | 10.39 | Average | Horizontal |
| 4924.00 | 57.97 | 33.26 | 35.14 | 3.98 | 60.07 | 74.00 | 13.93 | Peak | Vertical |
| 4924.00 | 41.70 | 33.26 | 35.14 | 3.98 | 43.80 | 54.00 | 10.20 | Average | Vertical |

IEEE 802.11n HT40

Combined Antenna 0, Antenna 1 and Antenna 2

Channel 3 / 2422 MHz

| Freq. MHz | Reading dBuV | Ant. Fac. dB/m | Pre. Fac. dB | Cab. Loss dB | Measured dBuV/m | Limit dBuV/m | Margin dB | Remark | Pol. |
|-----------|--------------|----------------|--------------|--------------|-----------------|--------------|-----------|---------|------------|
| 4844.00 | 59.56 | 33.06 | 35.04 | 3.94 | 61.52 | 74.00 | 12.48 | Peak | Horizontal |
| 4844.00 | 43.25 | 33.06 | 35.04 | 3.94 | 45.21 | 54.00 | 8.79 | Average | Horizontal |
| 4844.00 | 56.28 | 33.06 | 35.04 | 3.94 | 58.24 | 74.00 | 15.76 | Peak | Vertical |
| 4844.00 | 43.49 | 33.06 | 35.04 | 3.94 | 45.45 | 54.00 | 8.55 | Average | Vertical |

Channel 6 / 2437 MHz

| Freq. MHz | Reading dBuV | Ant. Fac. dB/m | Pre. Fac. dB | Cab. Loss dB | Measured dBuV/m | Limit dBuV/m | Margin dB | Remark | Pol. |
|-----------|--------------|----------------|--------------|--------------|-----------------|--------------|-----------|---------|------------|
| 4874.00 | 59.94 | 33.16 | 35.15 | 3.96 | 61.91 | 74.00 | 12.09 | Peak | Horizontal |
| 4874.00 | 43.65 | 33.16 | 35.15 | 3.96 | 45.62 | 54.00 | 8.38 | Average | Horizontal |
| 4874.00 | 56.14 | 33.16 | 35.15 | 3.96 | 58.11 | 74.00 | 15.89 | Peak | Vertical |
| 4874.00 | 40.98 | 33.16 | 35.15 | 3.96 | 42.95 | 54.00 | 11.05 | Average | Vertical |

Channel 9 / 2452 MHz

| Freq. MHz | Reading dBuV | Ant. Fac. dB/m | Pre. Fac. dB | Cab. Loss dB | Measured dBuV/m | Limit dBuV/m | Margin dB | Remark | Pol. |
|-----------|--------------|----------------|--------------|--------------|-----------------|--------------|-----------|---------|------------|
| 4904.00 | 56.88 | 33.26 | 35.14 | 3.98 | 58.98 | 74.00 | 15.02 | Peak | Horizontal |
| 4904.00 | 44.10 | 33.26 | 35.14 | 3.98 | 46.20 | 54.00 | 7.80 | Average | Horizontal |
| 4904.00 | 59.78 | 33.26 | 35.14 | 3.98 | 61.88 | 74.00 | 12.12 | Peak | Vertical |
| 4904.00 | 44.65 | 33.26 | 35.14 | 3.98 | 46.75 | 54.00 | 7.25 | Average | Vertical |

Notes:

1. Measuring frequencies from 9 KHz - 10th harmonic or 26.5GHz (which is less), No emission found between lowest internal used/generated frequency to 30MHz.
2. Radiated emissions measured in frequency range from 9 KHz ~10th harmonic or 26.5GHz (which is less) were made with an instrument using Peak detector mode.
3. Data of measurement within this frequency range shown "---" in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
4. Worst case data at 1Mbps at IEEE 802.11b; 6Mbps at IEEE 802.11g; 6.5Mbps at IEEE 802.11n HT20;



13.5Mbps at IEEE 802.11n HT40;

5. Pre-scan at Antenna 0 and Antenna 1 for IEEE 802.11b and IEEE 802.11g mode, pre-scan at Antenna 0, Antenna 1 and Combined Antenna 0 and Antenna 1 for IEEE 802.11n mode, recorded worst case;



5.6. Conducted Spurious Emissions and Band Edges Test

5.6.1. Standard Applicable

According to §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. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

5.6.2. Measuring Instruments and Setting

Please refer to section 6 of equipment list in this report. The following table is the setting of the spectrum analyzer.

| Spectrum Parameter | Setting |
|---|---------------|
| Detector | Peak |
| Attenuation | Auto |
| RB / VB (Emission in restricted band) | 100KHz/300KHz |
| RB / VB (Emission in non-restricted band) | 100KHz/300KHz |

5.6.3. Test Procedures

The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz

The spectrum from 9 KHz to 26.5GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

5.6.4. Test Setup Layout

This test setup layout is the same as that shown in section 5.4.4.

5.6.5. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

5.6.6. Test Results of Conducted Spurious Emissions

| | | | |
|---------------|-----------|----------------|------------------|
| Temperature | 24.5°C | Humidity | 56.2% |
| Test Engineer | Gary Qian | Configurations | IEEE 802.11b/g/n |



| Test Mode | Channel | Frequency (MHz) | Measured Frequency Range | Spurious RF Conducted Emission (dBc) | | | Limits (dBc) | Verdict |
|-------------------|---------|-----------------|--------------------------|--------------------------------------|-----------|-----------|--------------|---------|
| | | | | Antenna 0 | Antenna 1 | Antenna 2 | | |
| IEEE 802.11b | 1 | 2412 | 9 KHz – 26.5 GHz | <-20 | <-20 | <-20 | -20 | PASS |
| | 6 | 2437 | 9 KHz – 26.5 GHz | <-20 | <-20 | <-20 | | |
| | 11 | 2462 | 9 KHz – 26.5 GHz | <-20 | <-20 | <-20 | | |
| IEEE 802.11g | 1 | 2412 | 9 KHz – 26.5 GHz | <-20 | <-20 | <-20 | -20 | PASS |
| | 6 | 2437 | 9 KHz – 26.5 GHz | <-20 | <-20 | <-20 | | |
| | 11 | 2462 | 9 KHz – 26.5 GHz | <-20 | <-20 | <-20 | | |
| IEEE 802.11n HT20 | 1 | 2412 | 9 KHz – 26.5 GHz | <-20 | <-20 | <-20 | -20 | PASS |
| | 6 | 2437 | 9 KHz – 26.5 GHz | <-20 | <-20 | <-20 | | |
| | 11 | 2462 | 9 KHz – 26.5 GHz | <-20 | <-20 | <-20 | | |
| IEEE 802.11n HT40 | 3 | 2422 | 9 KHz – 26.5 GHz | <-20 | <-20 | <-20 | -20 | PASS |
| | 6 | 2437 | 9 KHz – 26.5 GHz | <-20 | <-20 | <-20 | | |
| | 9 | 2452 | 9 KHz – 26.5 GHz | <-20 | <-20 | <-20 | | |

Remark:

1. Measured RF conducted spurious emission at difference data rate for each mode and recorded worst case for each mode.
2. Test results including cable loss;
3. Worst case data at 1Mbps at IEEE 802.11b; 6Mbps at IEEE 802.11g; 6.5Mbps at IEEE 802.11n HT20; 13.5Mbps at IEEE 802.11n HT40;
4. “---“means that the fundamental frequency not for 15.209 limits requirement.
5. Not recorded emission values from 9 KHz to 30 MHz as emission level at least 20 dBc lower than limit;
6. Please refer to following plots;



RF Conducted Spurious Emissions

Antenna 0

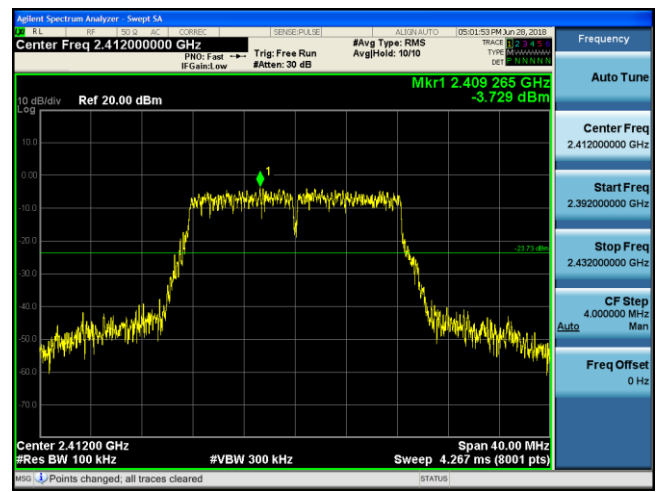
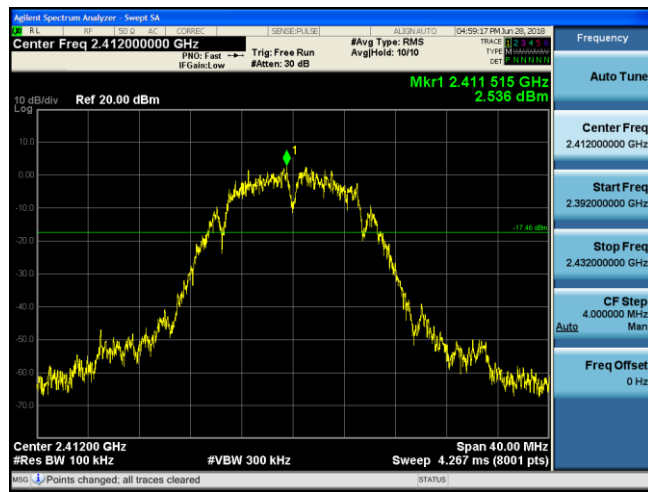
IEEE 802.11b

Channel 1 / 2412 MHz

Antenna 0

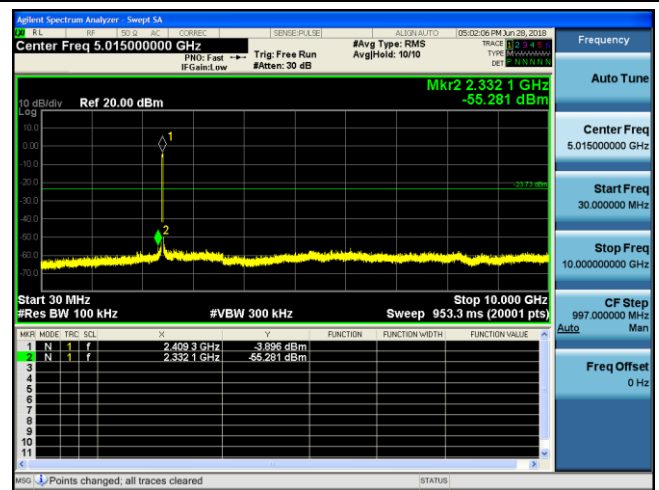
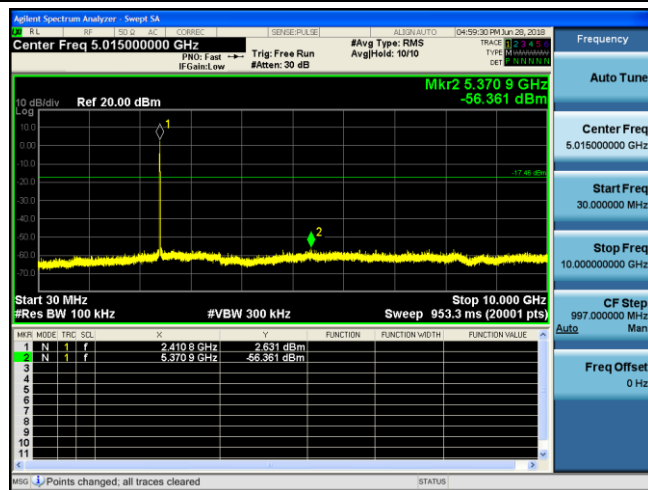
IEEE 802.11g

Channel 1 / 2412 MHz



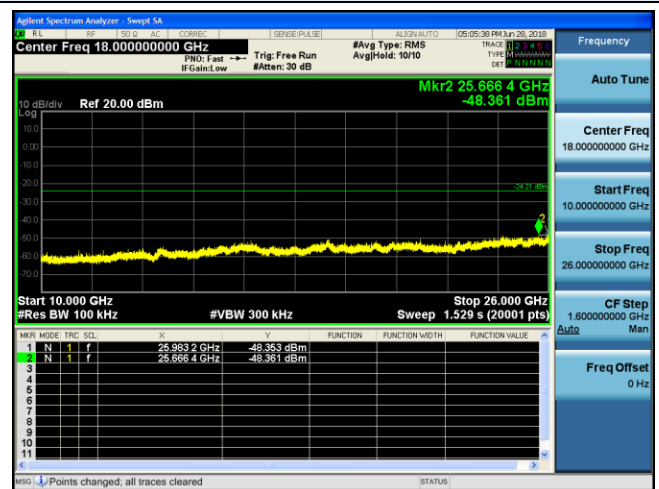
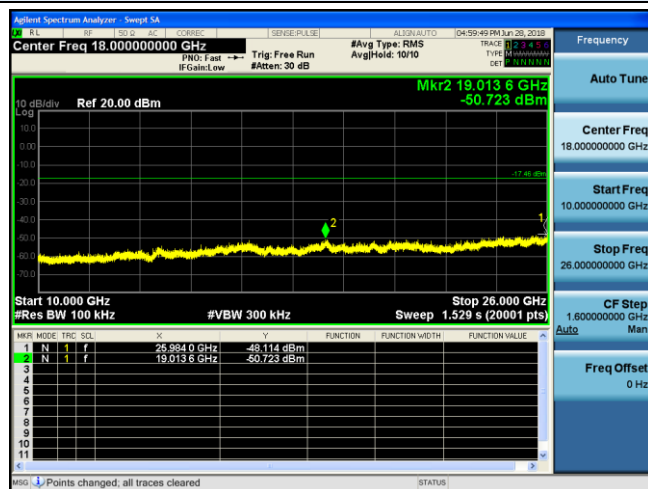
2392 MHz – 2432 MHz

2392 MHz – 2432 MHz



30 MHz – 10 GHz

30 MHz – 10 GHz



10 GHz – 26 GHz

10 GHz – 26 GHz



RF Conducted Spurious Emissions

Antenna 0

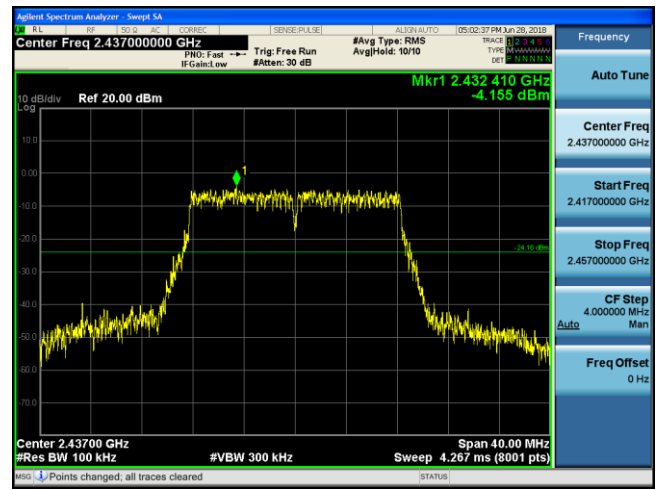
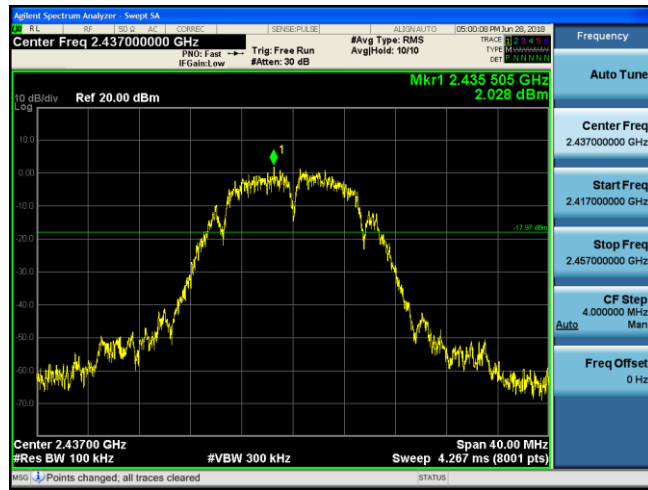
IEEE 802.11b

Channel 6 / 2437 MHz

Antenna 0

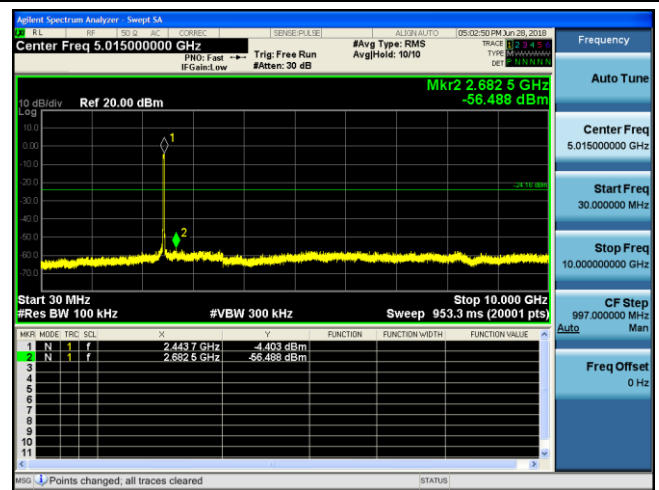
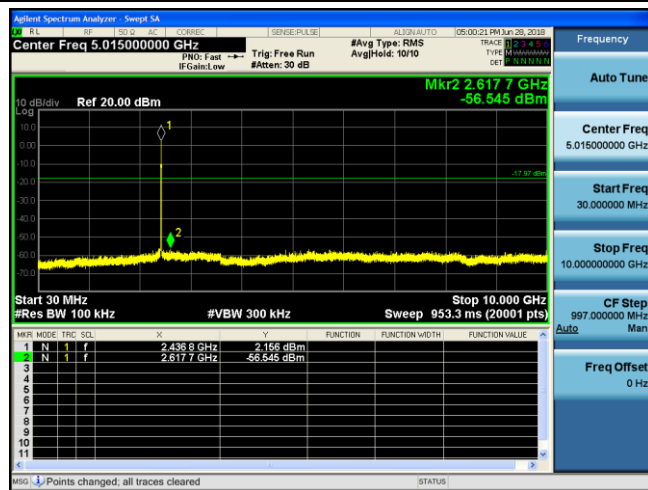
IEEE 802.11g

Channel 6 / 2437 MHz



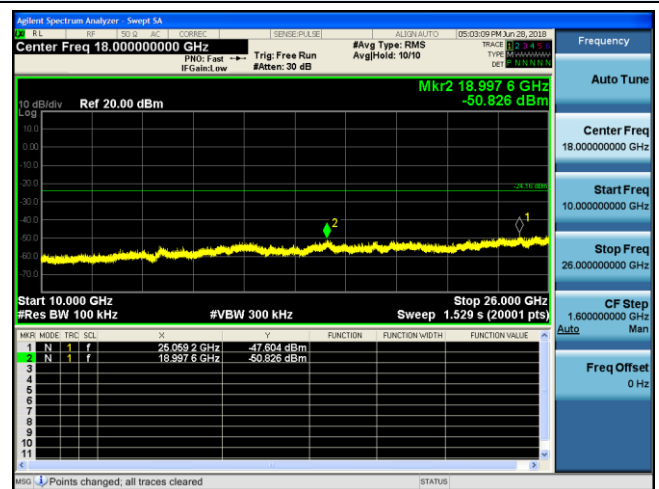
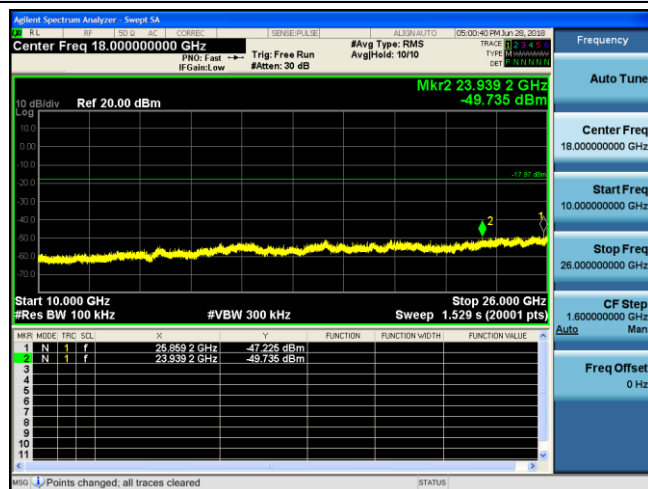
2417 MHz – 2457 MHz

2417 MHz – 2457 MHz



30 MHz – 10 GHz

30 MHz – 10 GHz



10 GHz – 26 GHz

10 GHz – 26 GHz



RF Conducted Spurious Emissions

Antenna 0

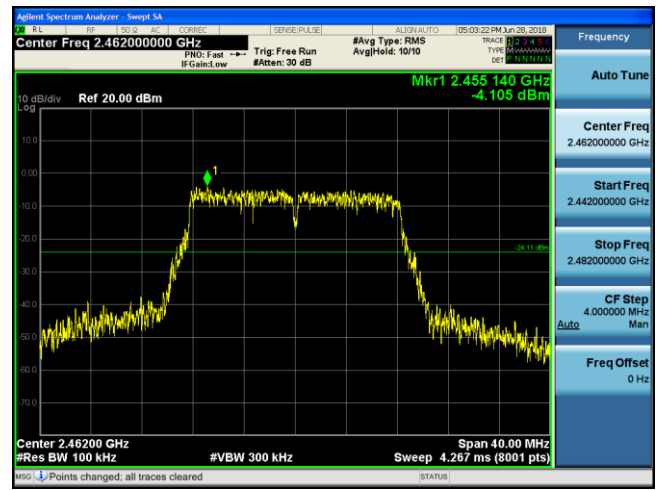
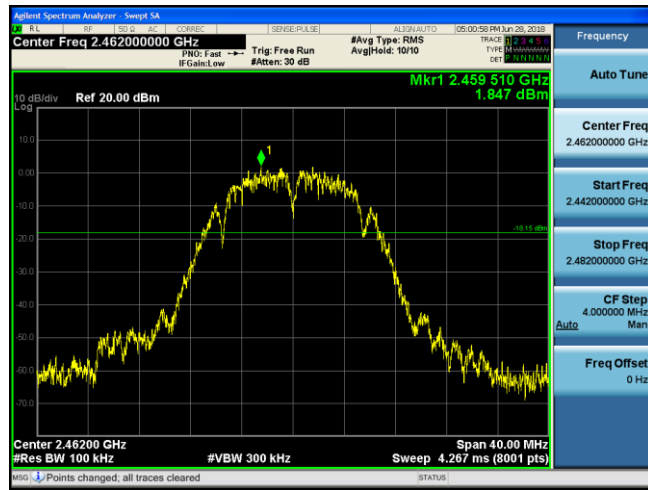
IEEE 802.11b

Channel 11 / 2462 MHz

Antenna 0

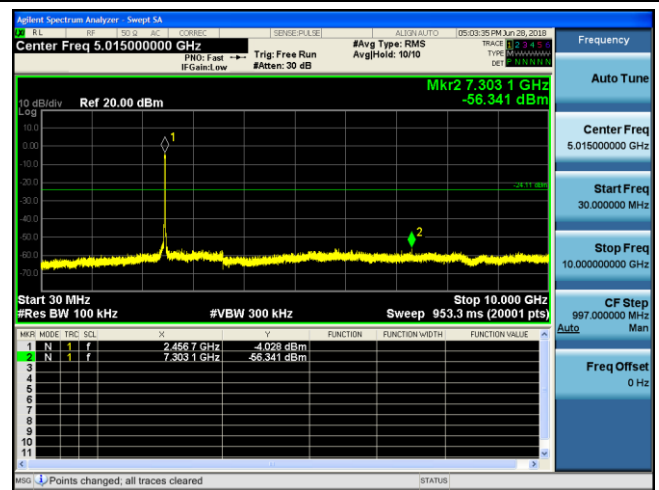
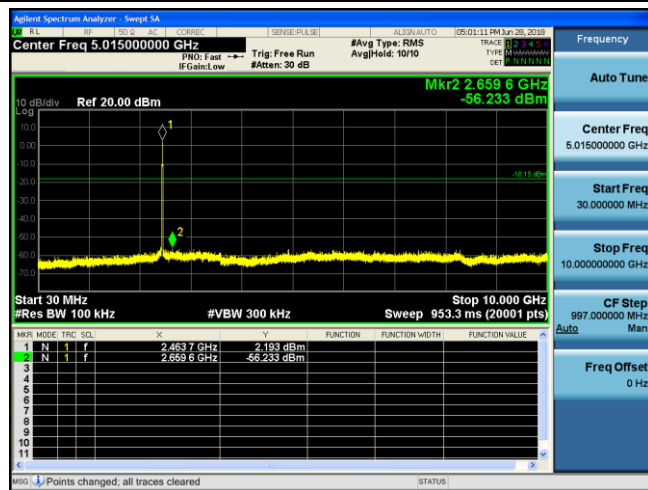
IEEE 802.11g

Channel 11 / 2462 MHz



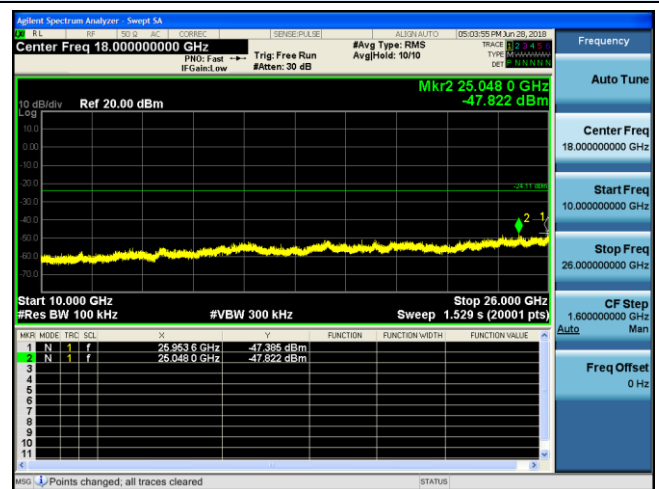
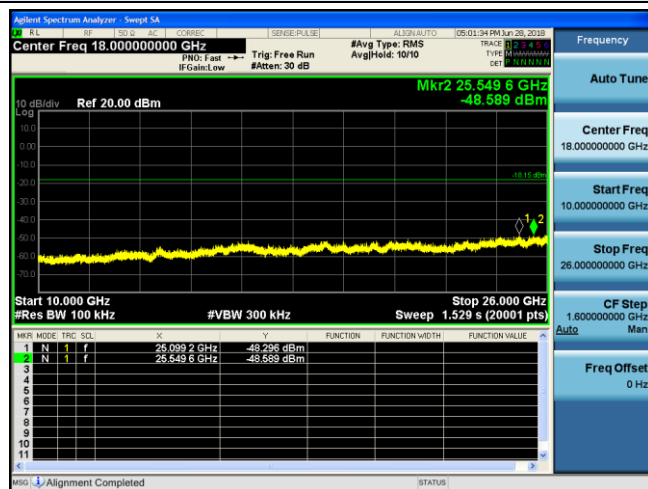
2442 MHz – 2482 MHz

2442 MHz – 2482 MHz



30 MHz – 10 GHz

30 MHz – 10 GHz



10 GHz – 26 GHz

10 GHz – 26 GHz