| | | | | |
|---|---|---|---|---|
| **Prüfbericht-Nr.:** *Test Report No.:* | **50053865 001** | **Auftrags-Nr.:** *Order No.:* | **1140029035** | Seite 1 von 43 *Page 1 of 43* |
| **Kunden-Referenz-Nr.:** *Client Reference No.:* | **N/A** | **Auftragsdatum:** *Order date:* | **2016-08-22** | |
| **Auftraggeber:** *Client:* | **Beijing Siemens Cerberus Electronics Ltd.** *No. 1 Fengzhi Donglu, Xibeiwang Haidian District Beijing 100094 P.R.China* | | | |
| **Prüfgegenstand:** *Test item:* | **Smart Thermostat** | | | |
| **Bezeichnung / Typ-Nr.:** *Identification / Type No.:* | **RDS120** | | | |
| **Auftrags-Inhalt:** *Order content:* | **FCC report** | | | |
| **Prüfgrundlage:** *Test specification:* | **FCC Part 15 Subpart C Section 15.207**<br>**FCC Part 15 Subpart C Section 15.209**<br>**FCC Part 15 Subpart C Section 15.247** | | | |
| **Wareneingangsdatum:** *Date of receipt:* | **2016-12-10** | | | |
| **Prüfmuster-Nr.:** *Test sample No.:* | **Engineering sample** | | | |
| **Prüfzeitraum:** *Testing period:* | **2016-12-10 to 2017-01-10** | | | |
| **Ort der Prüfung:** *Place of testing:* | **TÜV Rheinland (China) Ltd.** | | | |
| **Prüflaboratorium:** *Testing laboratory:* | **TÜV Rheinland (China) Ltd.** | | | |
| **Prüfergebnis*:** *Test result*:* | **Passed** | | | |


| **geprüft von** / *tested by*: | | | **kontrolliert von** / *reviewed by*: | | |
|---|---|---|---|---|---|
| 2017-01-13 | Tao, Yu/PE | Tao Yu. | 2017-01-13 | Sun, Lixun/Reviewer | Sun Lixun |
| **Datum** *Date* | **Name / Stellung** *Name / Position* | **Unterschrift** *Signature* | **Datum** *Date* | **Name / Stellung** *Name / Position* | **Unterschrift** *Signature* |

**Sonstiges** / *Other*:

**Zustand des Prüfgegenstandes bei Anlieferung:** Prüfmuster vollständig und unbeschädigt
*Condition of the test item at delivery:* *Test item complete and undamaged*

| | | | | | |
|---|---|---|---|---|---|
| * Legende: | 1 = sehr gut | 2 = gut | 3 = befriedigend | 4 = ausreichend | 5 = mangelhaft |
| | P(ass) = entspricht o.g. Prüfgrundlage(n) | | F(ail) = entspricht nicht o.g. Prüfgrundlage(n) | N/A = nicht anwendbar | N/T = nicht getestet |
| *Legend:* | *1 = very good* | *2 = good* | *3 = satisfactory* | *4 = sufficient* | *5 = poor* |
| | *P(ass) = passed a.m. test specification(s)* | | *F(ail) = failed a.m. test specification(s)* | *N/A = not applicable* | *N/T = not tested* |



V04

# TEST SUMMARY

**4.1.1 ANTENNA REQUIREMENT**
*RESULT: Passed*

**4.1.2 MINIMUM 6DB BANDWIDTH**
*RESULT: Passed*

**4.1.3 PEAK CONDUCTED OUTPUT POWER**
*RESULT: Passed*

**4.1.4 BAND EDGE COMPLIANCE**
*RESULT: Passed*

**4.1.5 POWER SPECTRAL DENSITY**
*RESULT: Passed*

**4.1.6 RADIATED SPURIOUS EMISSION**
*RESULT: Passed*

**4.1.7 CONDUCTED EMISSIONS**
*RESULT: Passed*

**4.2.1 ELECTROMAGNETIC FIELDS**
*RESULT: Passed*

# Contents

# 1. Test Sites

## 1.1 Test Facilities

**Laboratory 1: TA Beijing Limited (FCC Registration No.: 413514)**
**Address: Building B-4, No.1, JingHai 3rd Road, BDA East Park, Beijing, 100176 China**
**Laboratory 2: TÜV Rheinland (China) Ltd.**
**Address: Room 303, 1st Area, Building B, Chuangxin Building, No.12, Hongda North Road, Economic - Technological Development Area, Beijing, China**

The used test equipment is in accordance with CISPR 16-1 for measurement of radio interference.

## 1.2 List of Test and Measurement Instruments

**Table 1: List of Test and Measurement Equipment**

Lab 1: (Radiated Emission, Conducted Emissions)

| Kind of Equipment | Type | S/N | Manufacturer | Calibrated until |
|---|---|---|---|---|
| Bi-log Antenna | HL562 | 100488 | Rohde & Schwarz | 2018-02-15 |
| Double Ridge Guide Horn Antenna | EMCO 3117 | 00056662 | ETS-Lindgren | 2018-02-15 |
| Horn Antenna | 3160-09 | 00165118 | ETS-Lindgren | 2017-03-21 |
| EMI Test Receiver | ESIB26 | 100301 | Rohde & Schwarz | 2017-03-26 |
| Signal Analyzer | FSQ26 | 200454 | Rohde & Schwarz | 2017-04-02 |
| Low Frequency Amplifier | SCU03 | / | Rohde & Schwarz | 2017-03-17 |
| High Frequency Amplifier | SCU18 | / | Rohde & Schwarz | 2017-03-17 |
| RF Cable | NA | NA | NA | 2017-03-17 |
| RF Cable | NA | NA | NA | 2017-03-17 |
| Antenna Tower | 2075 | 49402 | ETS-Lindgren | / |

| Kind of Equipment | Type | S/N | Manufacturer | Calibrated until |
|---|---|---|---|---|
| Antenna Tower | 7-TR/POL-3106 | 46587 | ETS-Lindgren | / |
| EMI Test Receiver | ESIB26 | 100301 | R&S | 2017-02-11 |
| LISN | ENV 216 | 101094 | R&S | 2017-03-17 |

Lab 2: (Peak Conducted Output Power, Minimum 6dB Bandwidth, Band Edge Compliance, Power Spectral Density)

| Kind of Equipment | Type | S/N | Manufacturer | Calibrated until |
|---|---|---|---|---|
| Signal analyzer | FSV30 | 101402 | R&S | 2017-11-14 |
| Wideband Power Sensor | NRP-Z81 | 103551 | R&S | 2017-01-11 |

## 1.3 Traceability

All measurement equipment calibrations are traceable to NIM (National Institude of Metrology P.R. China) or where calibration is performed outside the United States, to equivalent nationally recognized standards organizations.

## 1.4 Calibration

Equipment requiring calibration is calibrated periodically by the lab or according to lab's specifications. Additionally all equipment is verified for proper performance on a regular basics using in house standards or comparisons.

## 1.5 Measurement Uncertainty

For a 95% confidence level, the measurement expanded uncertainties for defined systems, in accordance with the recommendations of ISO/IEC 17025 are:

**Table 2: Measurement Uncertainty**

| Items | | Extended Uncertainty |
|---|---|---|
| RE (30-1000MHz) | Field strength (dBuV/m) | U=±4.94dB, k=2, σ=95% |
| RE (1-18GHz) | Field strength (dBuV/m) | U=±4.34dB, k=2, σ=95% |

# 2. General Product Information

## 2.1 Product Function and Intended Use

The EUT (equipment under test) is a Room Thermostat. For more information, please refer to the user manual.

## 2.2 Ratings and System Details

**Table 3: Rating of EUT**

| | |
|---|---|
| Kind of Equipment: | Smart Thermostat |
| Type Designation: | RDS120 |
| Rated Input Voltage | 24V AC |
| Rated comsuption power | 9VA |
| Hardware version | MS1 |
| Software version | V01.02.xx_Bxx |

**Table 4: Technical Specification**

| **Item** | **Description** |
|---|---|
| Operating Frequency band | 2.4GHz—2.4835GHz |
| Channel Number | 11 |
| Operating mode | 802.11b/g/n (HT 20) |
| Channel Center Frequency | 2412MHz, 2417MHz, 2422MHz, 2427MHz, 2432MHz, 2437MHz, 2442MHz, 2447MHz, 2452MHz, 2457MHz, 2462MHz |
| Modulation | CCK;DSSS;OFDM;BPSK;QPSK;16QAM;64QAM |
| Antenna | Integrated Antenna |
| Antenna Gain (dBi) | -3.5 |

## 2.3 Independent Operation Modes

The basic operation modes are:

A. On, transmitting (802.11b/g/n (HT 20))
B. On, receiving (802.11b/g/n (HT 20))
C. Off

## 2.4 Noise Generating and Noise Suppressing Parts

Refer to the Circuit Diagram.

## 2.5 Submitted Documents

None.

# 3. Test Set-up and Operation Modes

## 3.1 Principle of Configuration Selection

The equipment under test (EUT) was configured to measure its maximum power level. The test modes were adapted accordingly in reference to the instructions for use.

## 3.2 Test Operation and Test Software

Test operation refers to test setup in chapter 5. All testing were performed according to the procedures in ANSI C63.10: 2013.

## 3.3 Special Accessories and Auxiliary Equipment

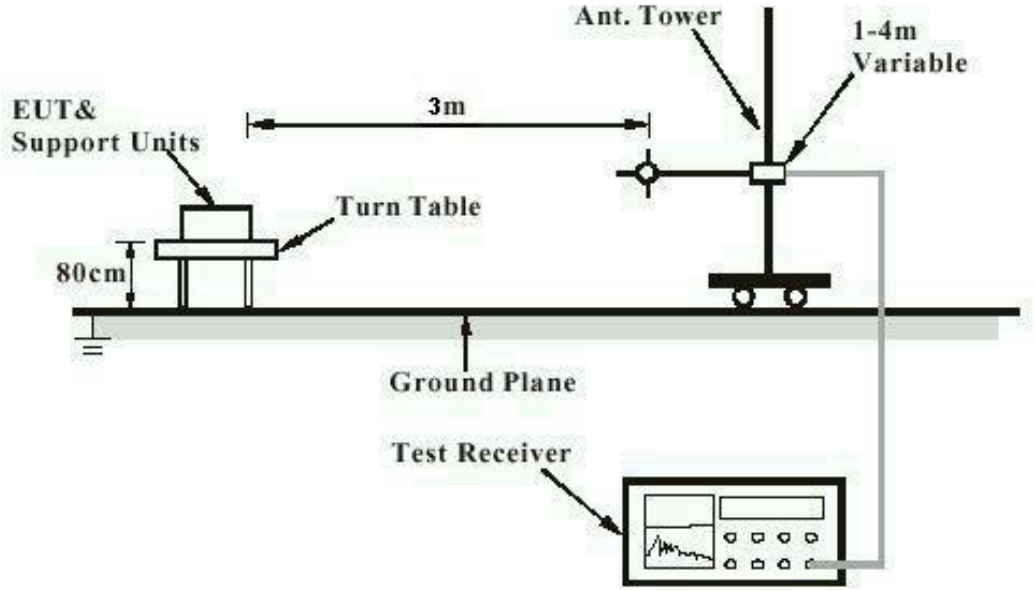
| Kind of accessories | Model | Manufacture |
|---|---|---|
| Computer | X201 | Lenovo |

## 3.4 Countermeasures to achieve intentional transmitter Compliance

None.

## 3.5 Test Setup Diagram

**Diagram of Measurement Configuration for Radiation Test**




Note: Measurements above 1GHz are done with a table height of 0.8m. In addition, there is RF absorbing material on the floor of the test site for above 1GHz measurement.

**Diagram of Measurement Equipment Configuration for Conduction Measurement**

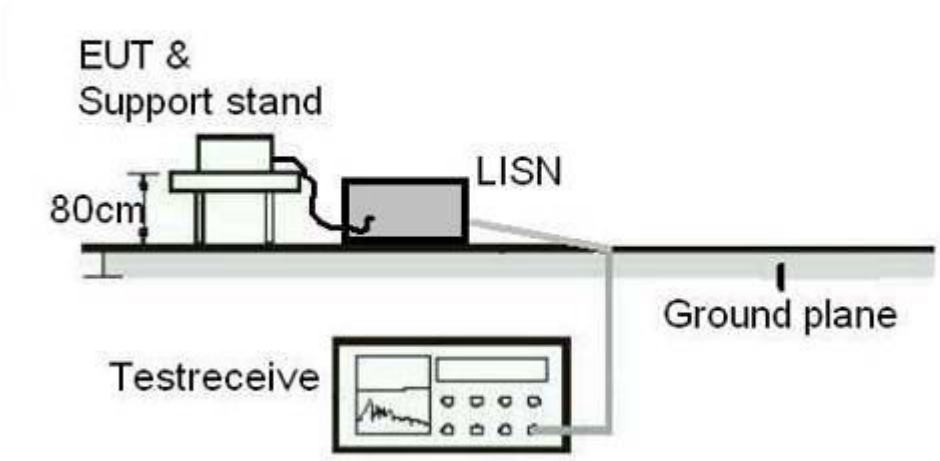
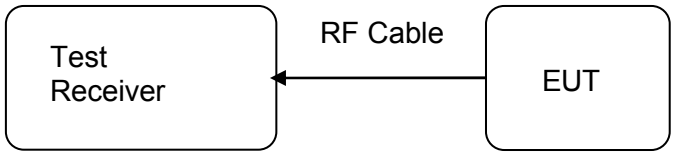



**Diagram of Measurement Equipment Configuration for Transmitter Measurement**



# 4. Test Results

## 4.1 Transmitter Requirement & Test Suites

### 4.1.1 Antenna Requirement

**RESULT:** **Passed**

| | | |
|---|---|---|
| Test date | : | 2016-12-20 |
| Test standard | : | FCC Part 15.247(b)(4) and Part 15.203 |
| Limit | : | the use of antennas with directional gains that do not exceed 6 dBi |

According to the manufacturer declared, the EUT has an Integrated Antenna, the directional gain of antenna is -3.5dBi. Therefore the EUT is considered sufficient to comply with the provision.

## 4.1.2 Minimum 6dB Bandwidth

**RESULT:** **Passed**

| | | |
|---|---|---|
| Date of testing | : | 2016-12-20 |
| Test standard | : | FCC Part 15.247(a)(2) |
| Basic standard | : | ANSI C63.10: 2013, 558074 D01 DTS Meas Guidance v03r05 |
| Kind of test site | : | Shielded room |

**Test setup**

| | | |
|---|---|---|
| Test Channel | : | Low/ Middle/ High |
| Operation Mode | : | A |
| Ambient temperature | : | 21℃ |
| Relative humidity | : | 30% |
| Atmospheric pressure | : | 101 kPa |

**Table 5: Test result of 6dB Bandwidth**

802.11b:

| Channel | Channel Frequency (MHz) | 6dB Bandwidth (MHz) | Limit(kHz) |
|---|---|---|---|
| Low Channel | 2412 | 9.076 | >500 |
| Mid Channel | 2437 | 9.076 | >500 |
| High Channel | 2462 | 9.076 | >500 |

802.11g:

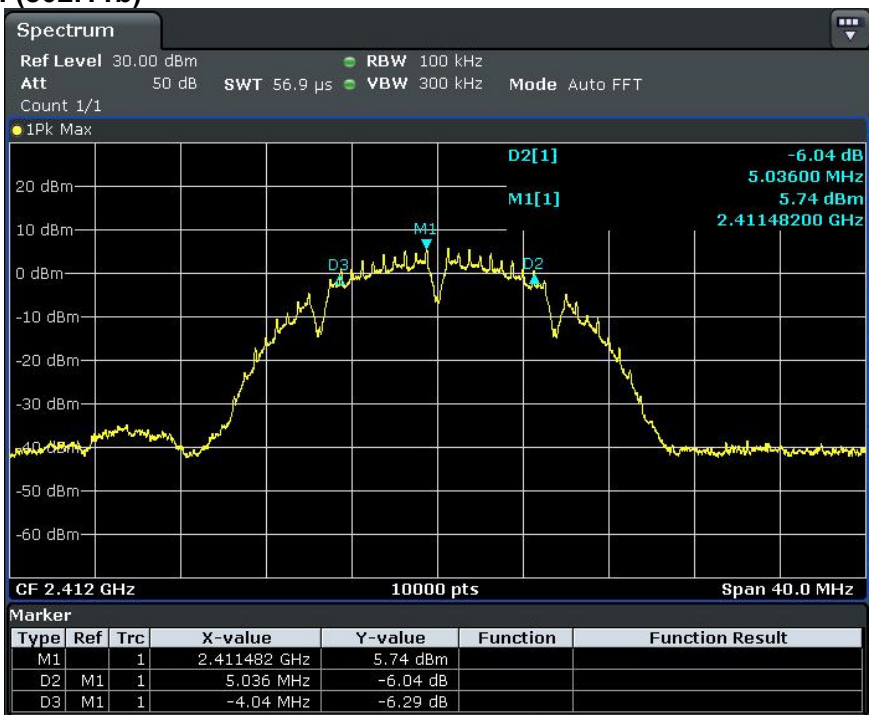
| Channel | Channel Frequency (MHz) | 6dB Bandwidth (MHz) | Limit(kHz) |
|---|---|---|---|
| Low Channel | 2412 | 15.108 | >500 |
| Mid Channel | 2437 | 15.104 | >500 |
| High Channel | 2462 | 15.108 | >500 |

802.11n (HT20):

| Channel | Channel Frequency (MHz) | 6dB Bandwidth (MHz) | Limit(kHz) |
|---|---|---|---|
| Low Channel | 2412 | 15.096 | >500 |
| Mid Channel | 2437 | 15.100 | >500 |
| High Channel | 2462 | 15.108 | >500 |

# Test Graph of 6dB Bandwidth

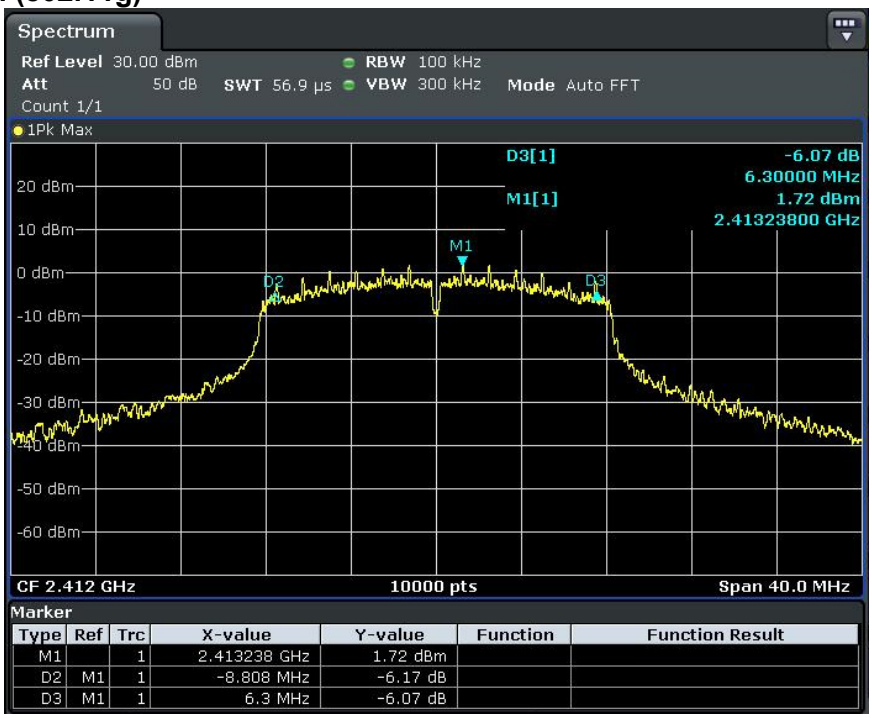
## Low Channel (802.11b)




## Mid Channel (802.11b)

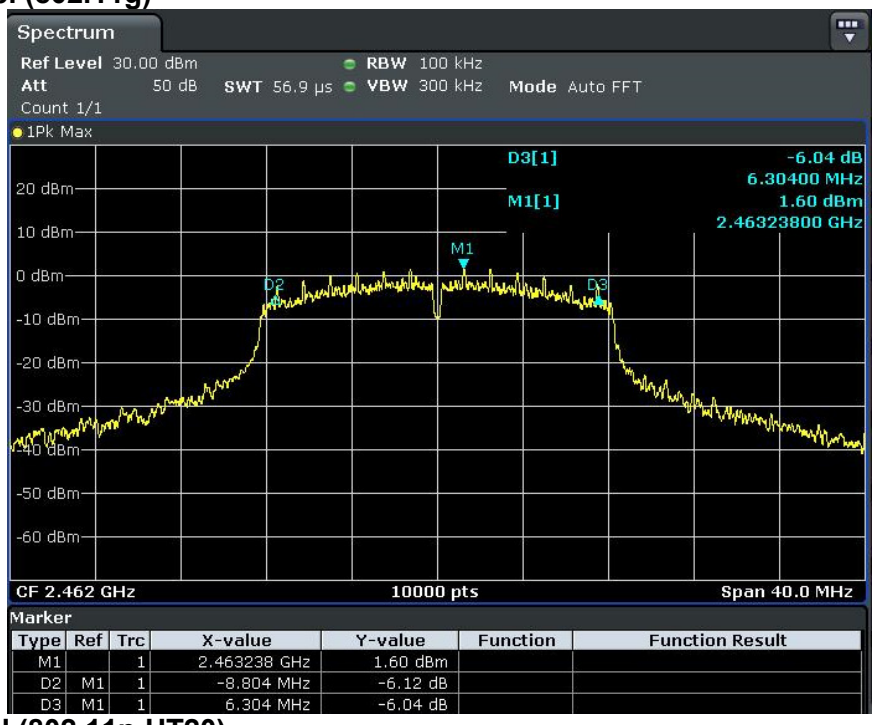

## High Channel (802.11b)


**Low Channel (802.11g)**

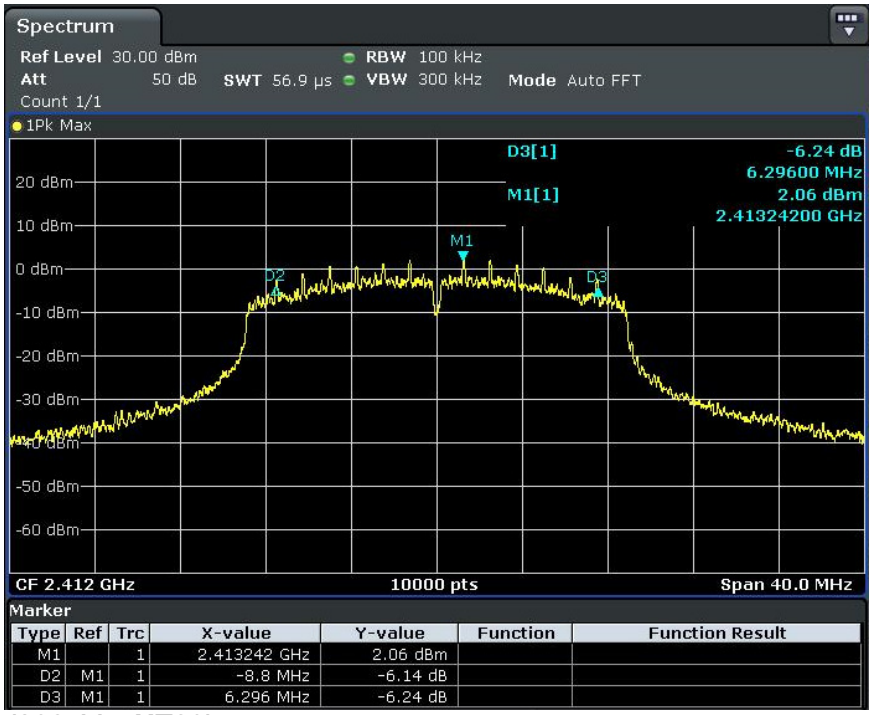



**Mid Channel (802.11g)**

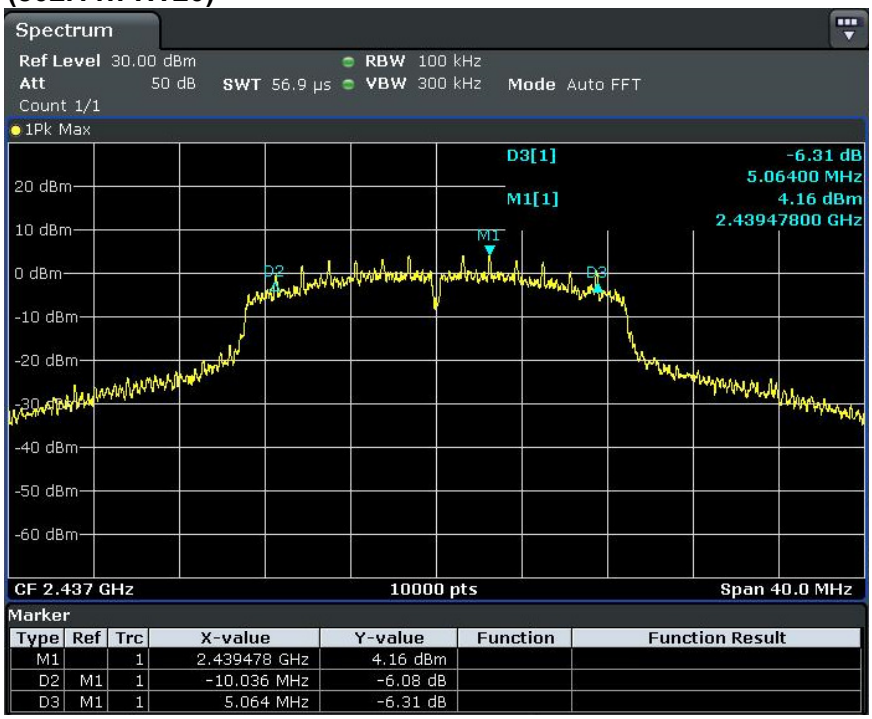

**High Channel (802.11g)**



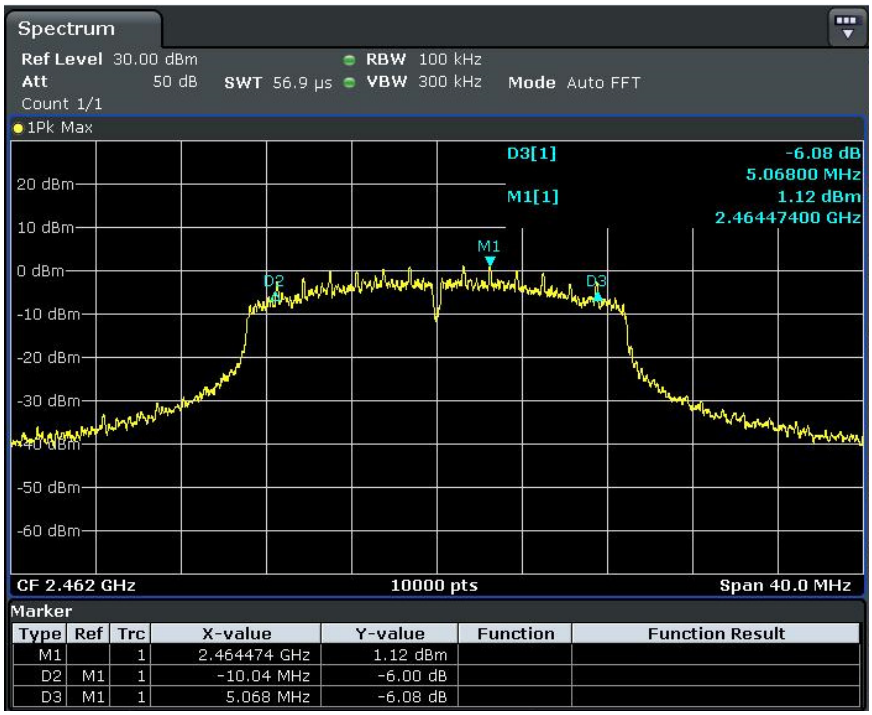

**Low Channel (802.11n-HT20)**




**Mid Channel (802.11n-HT20)**




**High Channel (802.11n-HT20)**


Spectrum
Ref Level 30.00 dBm
RBW 100 kHz
Att 50 dB
SWT 56.9 µs
VBW 300 kHz
Mode Auto FFT
Count 1/1
1Pk Max
D3[1]
-6.08 dB
5.06800 MHz
M1[1]
1.12 dBm
2.46447400 GHz
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
M1
D2
D3
CF 2.462 GHz
10000 pts
Span 40.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.464474 GHz 1.12 dBm
D2 M1 1 -10.04 MHz -6.00 dB
D3 M1 1 5.068 MHz -6.08 dB

## 4.1.3 Peak Conducted Output Power

**RESULT:** **Passed**

| | | |
|---|---|---|
| Test date | : | 2016-12-20 |
| Test standard | : | FCC Part 15.247(b)(1) |
| Basic standard | : | ANSI C63.10: 2013, 558074 D01 DTS Meas Guidance v03r05 |
| Limit | : | 1 Watt (30dBm) |
| Kind of test site | : | Shielded room |

**Test setup**

| | | |
|---|---|---|
| Test Channel | : | Low/ Middle/ High |
| Operation Mode | : | A |
| Ambient temperature | : | 21℃ |
| Relative humidity | : | 30% |
| Atmospheric pressure | : | 101 kPa |

**Table 6: Test result of Peak Output Power**

| | Channel Frequency (MHz) | Peak Output Power (dBm) | Limit (dBm) |
|---|---|---|---|
| 802.11b | 2412 | 16.71 | 30 |
| | 2437 | 17.82 | 30 |
| | 2462 | 16.85 | 30 |
| 802.11g | 2412 | 19.48 | 30 |
| | 2437 | 19.84 | 30 |
| | 2462 | 19.12 | 30 |
| 802.11n-HT20 | 2412 | 19.43 | 30 |
| | 2437 | 19.47 | 30 |
| | 2462 | 19.15 | 30 |

## 4.1.4 Band Edge Compliance

**RESULT:** **Passed**

| | | |
|---|---|---|
| Date of testing | : | 2016-12-20 |
| Test standard | : | FCC part 15.247(d) |
| Basic standard | : | ANSI C63.10: 2013, 558074 D01 DTS Meas Guidance v03r05 |
| Limit | : | 20dB (below that in the 100kHz bandwidth within the band that contains the highest level of the desired power) |
| Kind of test site | : | Shield room |

**Test setup**

| | | |
|---|---|---|
| Test Channel | : | Low/ Mid/High |
| Operation mode | : | A |
| Ambient temperature | : | 21℃ |
| Relative humidity | : | 30% |
| Atmospheric pressure | : | 101 kPa |

**Table 7: Test result of Band Edge compliance**

802.11b:

| Channel | Difference (dB) | Limit(dB) |
|---|---|---|
| Low Channel | 36.68 | >20 |
| High Channel | 36.15 | >20 |

802.11g:

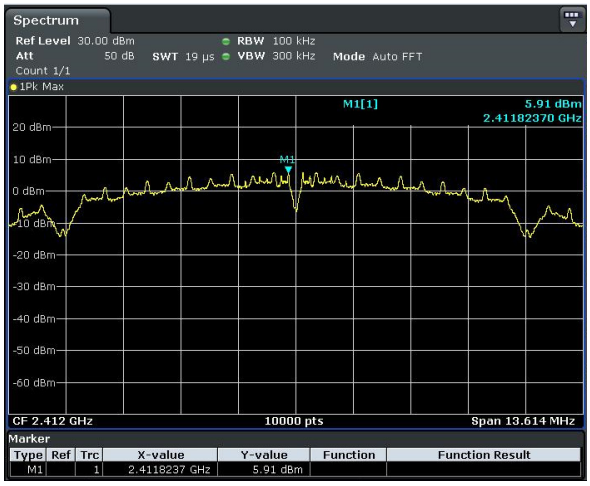
| Channel | Difference (dB) | Limit(dB) |
|---|---|---|
| Low Channel | 30.13 | >20 |
| High Channel | 34.10 | >20 |

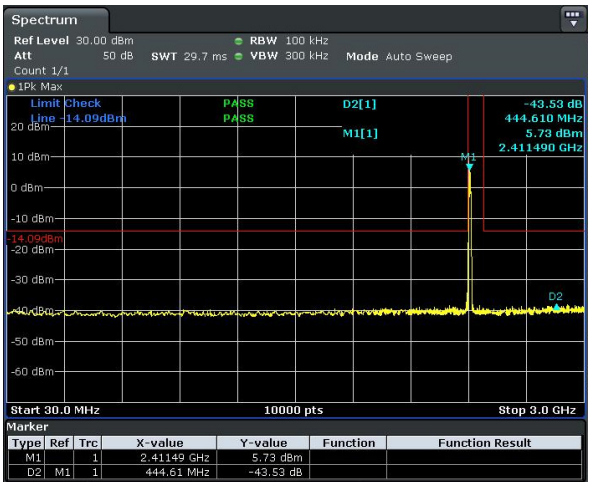
802.11n-HT20:

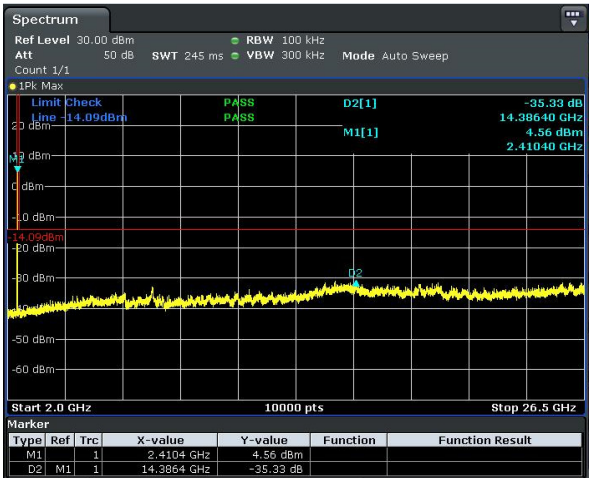
| Channel | Difference (dB) | Limit(dB) |
|---|---|---|
| Low Channel | 33.56 | >20 |
| High Channel | 33.39 | >20 |

## Test Graph of Band Edge Compliance

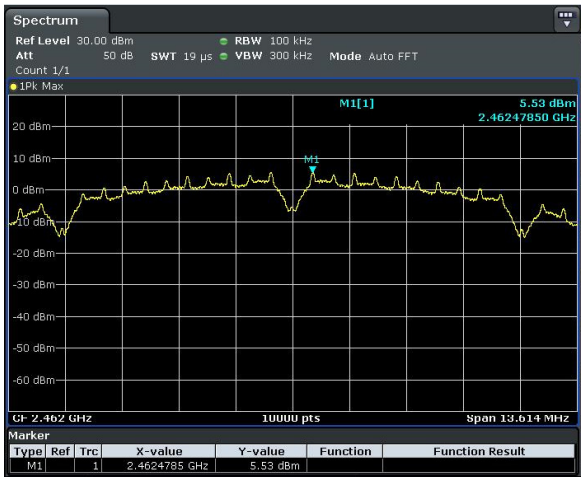
802.11b: Low Channel

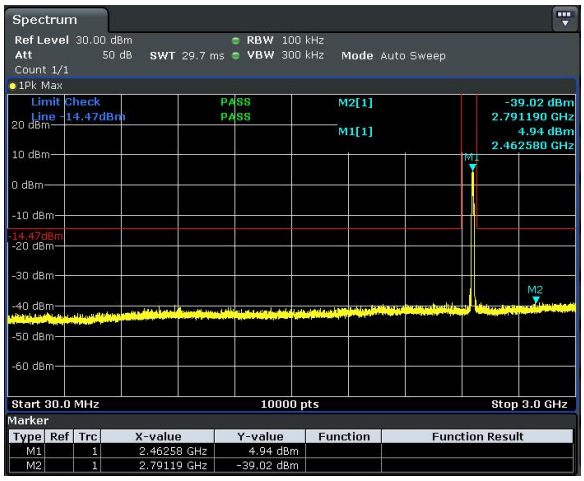


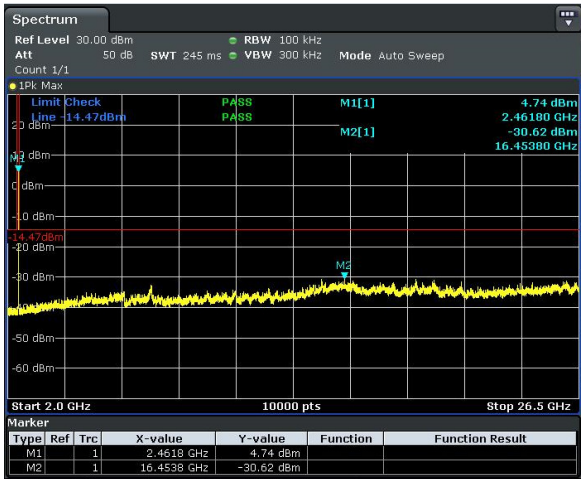



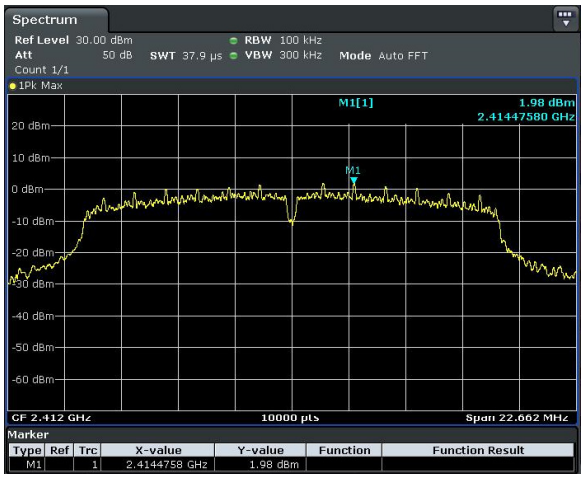
802.11b: High Channel

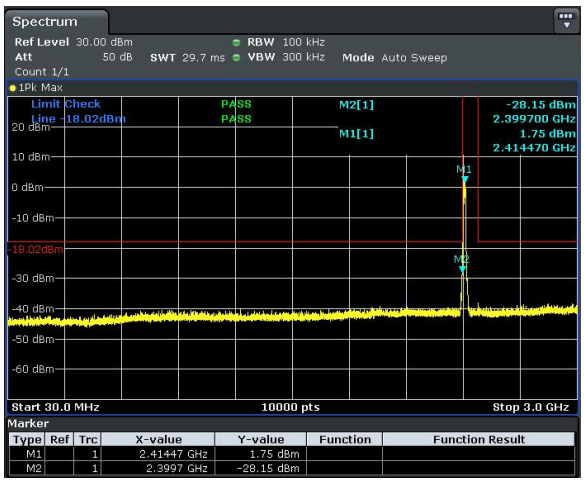


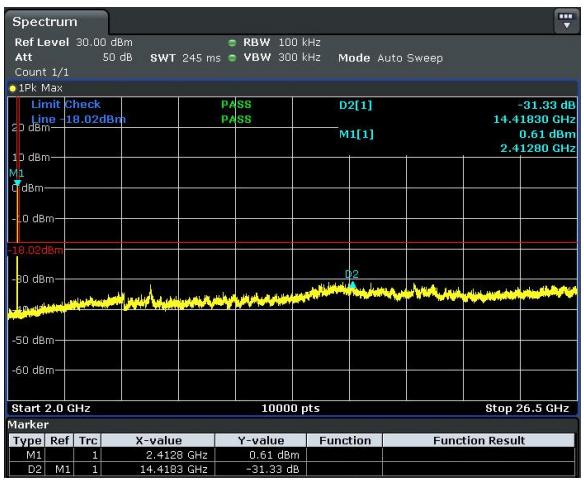



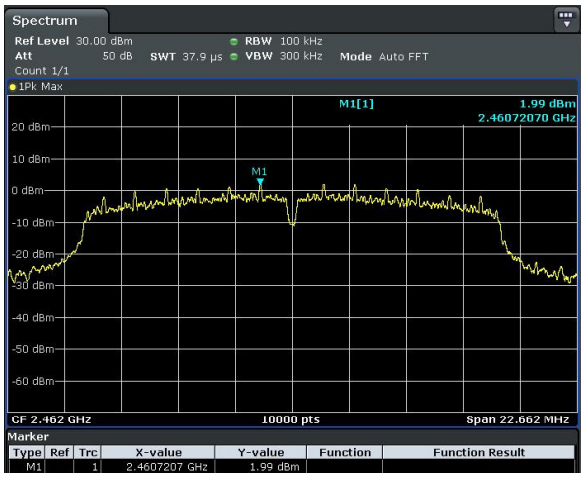
802.11g: Low Channel

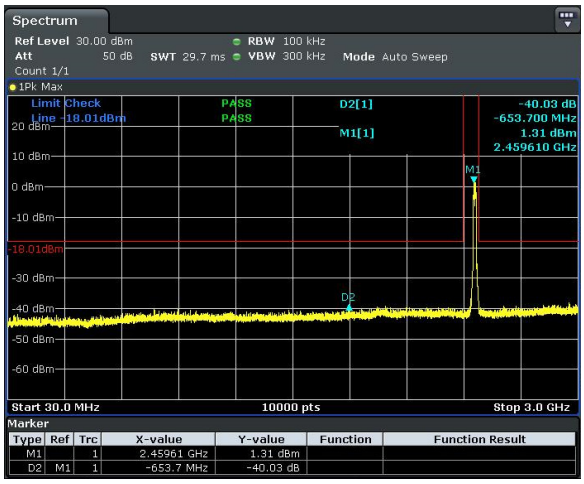


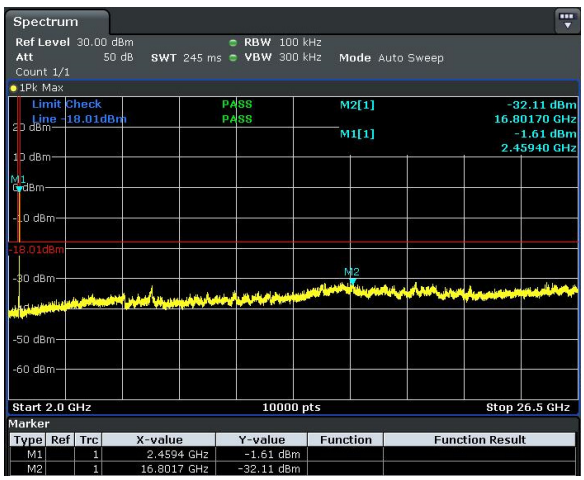



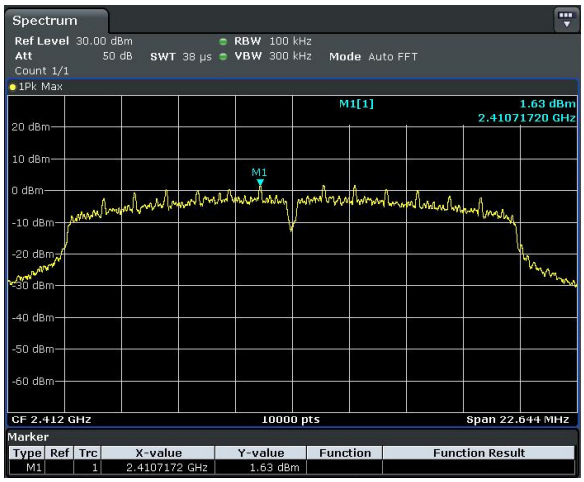
802.11g: High Channel

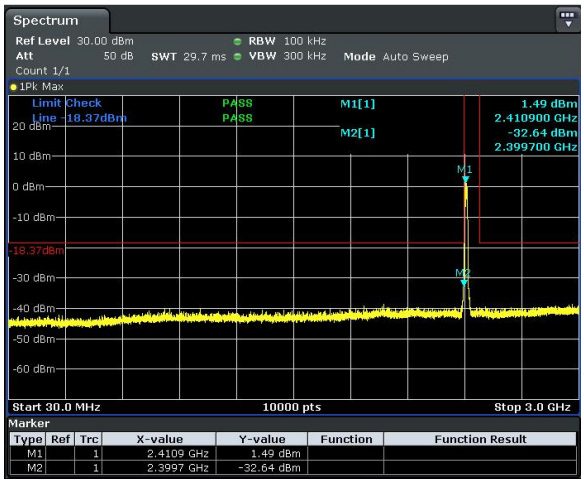


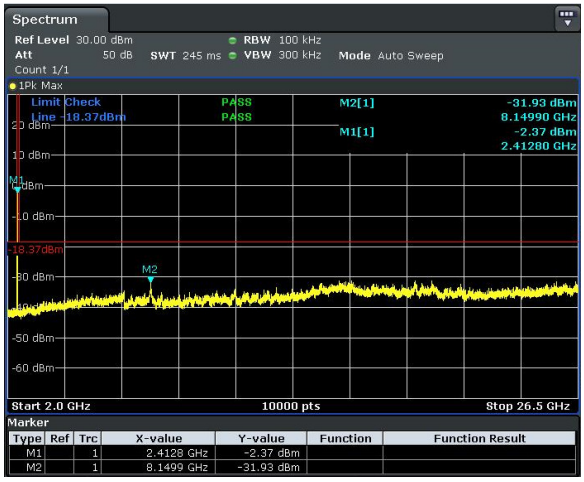



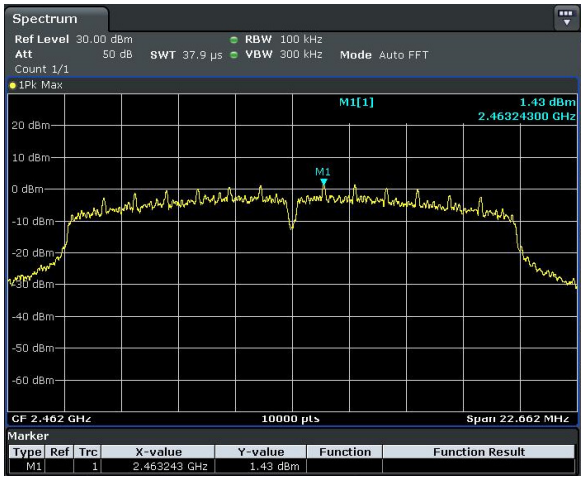
802.11n-HT20: Low Channel

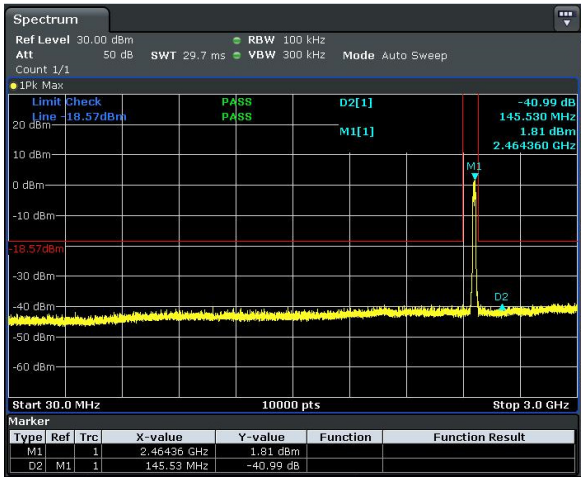


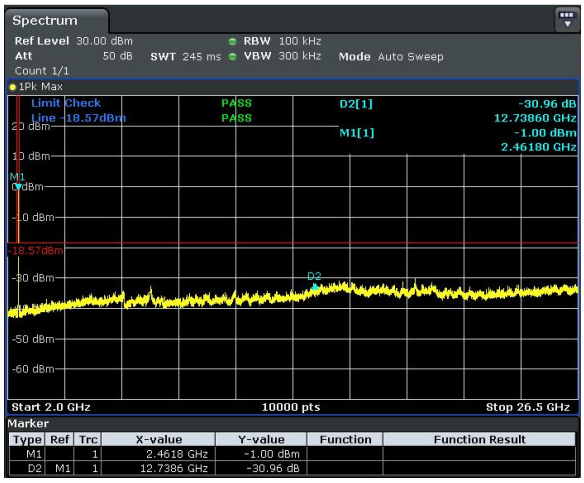



802.11n-HT20: High Channel



## 4.1.5 Power Spectral Density

**RESULT:** **Passed**

| | | |
|---|---|---|
| Date of testing | : | 2016-12-20 |
| Test standard | : | FCC part 15.247(e) |
| Basic standard | : | ANSI C63.10: 2013, 558074 D01 DTS Meas Guidance v03r05 |
| Limits | : | 8.0 dBm (in any 3kHz band) |
| Kind of test site | | Shield room |

**Test Setup**

| | | |
|---|---|---|
| Test Channel | : | Low/ Middle/ High |
| Operation mode | : | A |
| Ambient temperature | : | 21℃ |
| Relative humidity | : | 30% |
| Atmospheric pressure | : | 101 kPa |

**Table 8: Test result of power spectral density (PSD)**

802.11b:

| Channel | Maximum power spectral density (dBm/3kHz) | Limit (dBm/3kHz) |
|---|---|---|
| Low Channel | -9.88 | <8 |
| Mid Channel | -9.32 | <8 |
| High Channel | -9.78 | <8 |

802.11g:

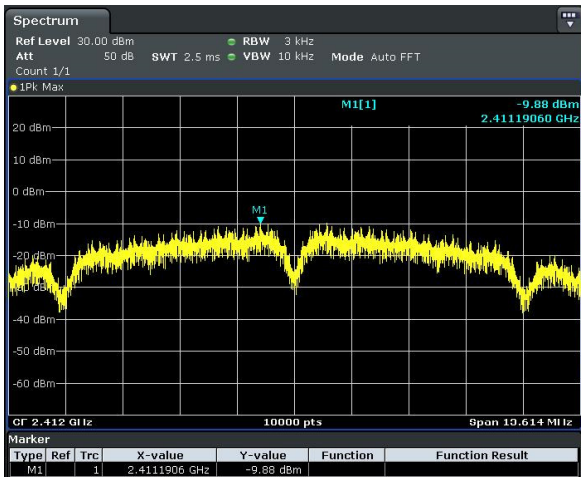
| Channel | Maximum power spectral density (dBm/3kHz) | Limit (dBm/3kHz) |
|---|---|---|
| Low Channel | -13.04 | <8 |
| Mid Channel | -10.54 | <8 |
| High Channel | -13.29 | <8 |

802.11n-HT20:

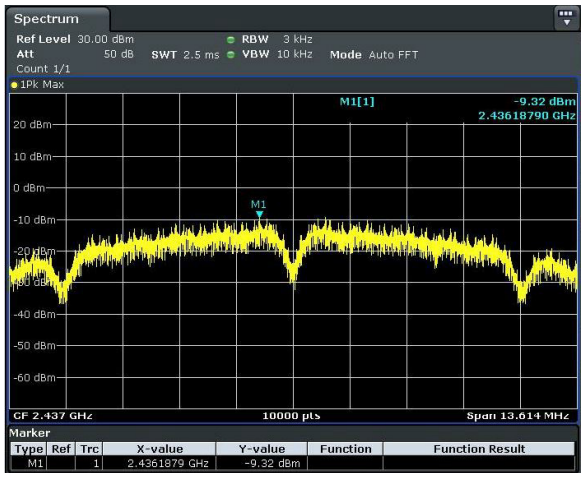
| Channel | Maximum power spectral density (dBm/3kHz) | Limit (dBm/3kHz) |
|---|---|---|
| Low Channel | -11.80 | <8 |
| Mid Channel | -9.08 | <8 |
| High Channel | -11.58 | <8 |

# Test Graph of Power Spectral Density

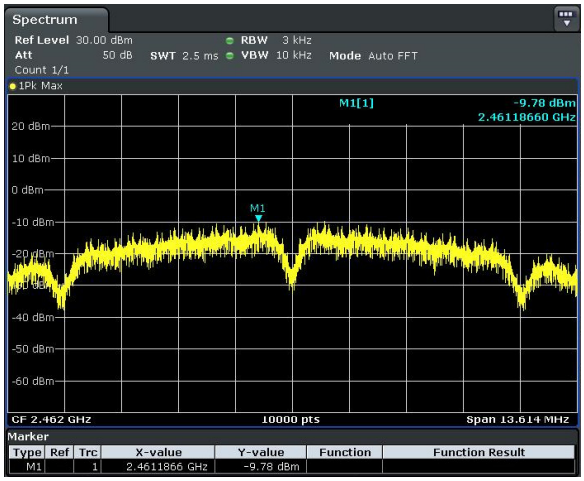
802.11b: Low Channel



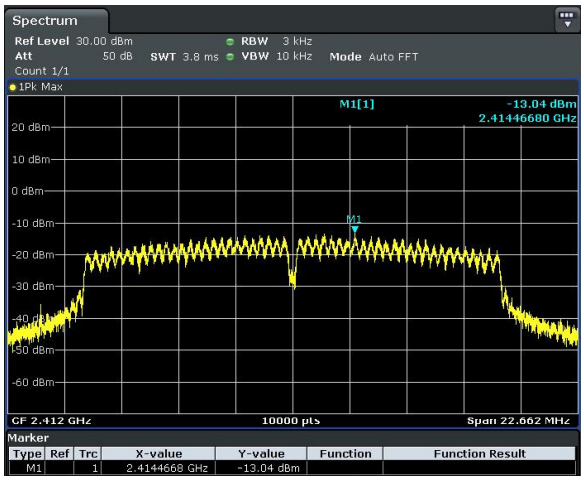

802.11b: Mid Channel



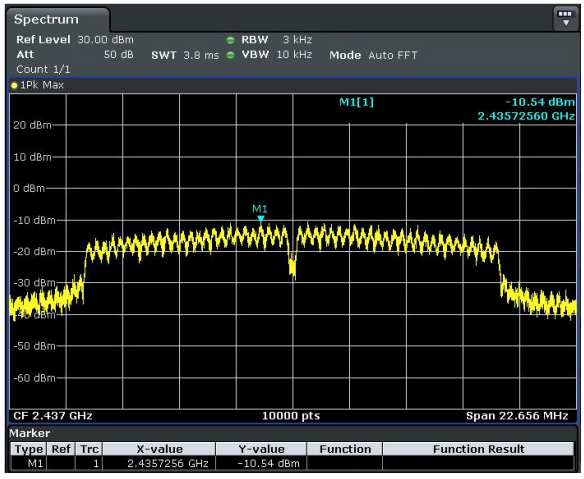

802.11b: High Channel



802.11g: Low Channel

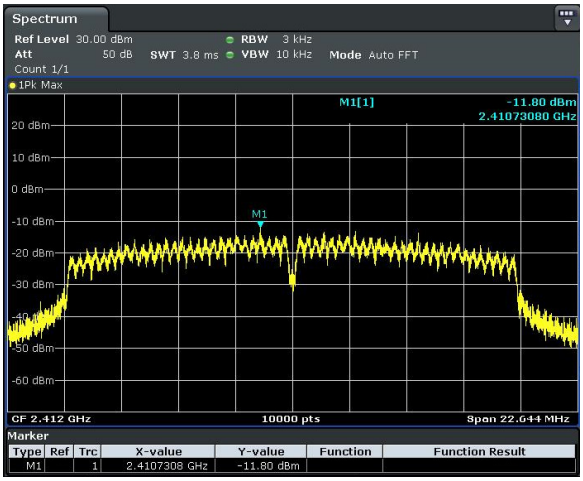



802.11g: Mid Channel

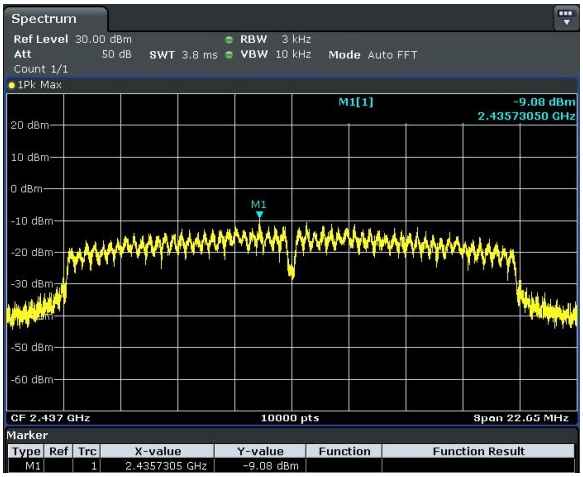



802.11g: High Channel

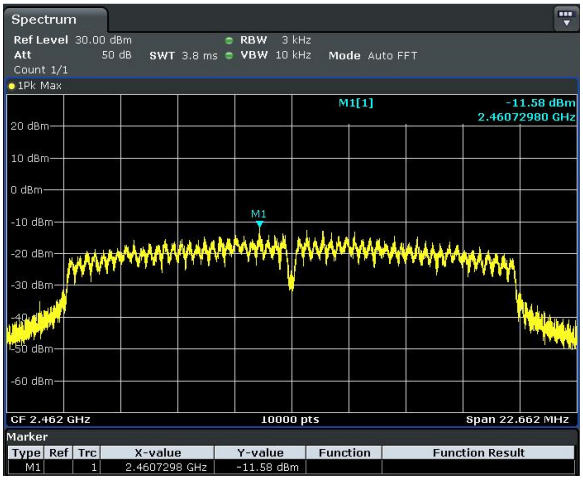
802.11n-HT20: Low Channel




802.11n-HT20: Mid Channel




802.11n-HT20: High Channel



## 4.1.6 Radiated Spurious Emission

**RESULT:** **Passed**

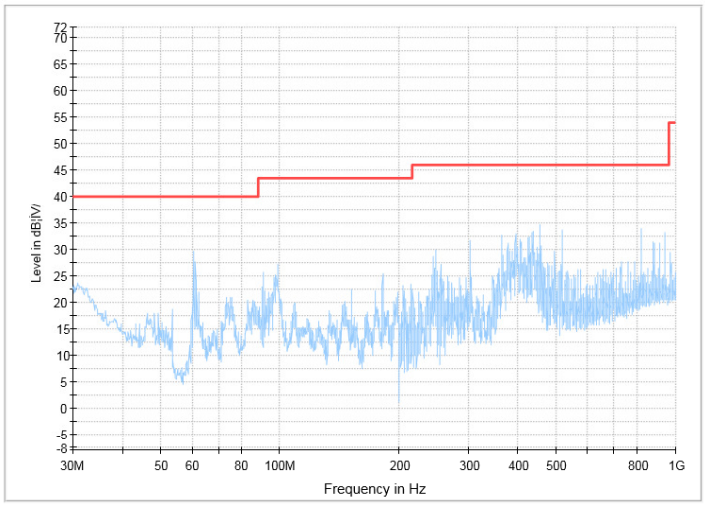
| | | |
|---|---|---|
| Date of testing | : | 2016-12-27 |
| Test standard | : | FCC part 15.247(d) |
| Basic standard | : | ANSI C63.10: 2013 |
| Limits | : | In addition, radiated emissions which fall in the restricted bands, must also comply with the radiated emission limits specified in 15.209(a) |
| Kind of test site | : | 3m Semi-Anechoic Chamber |

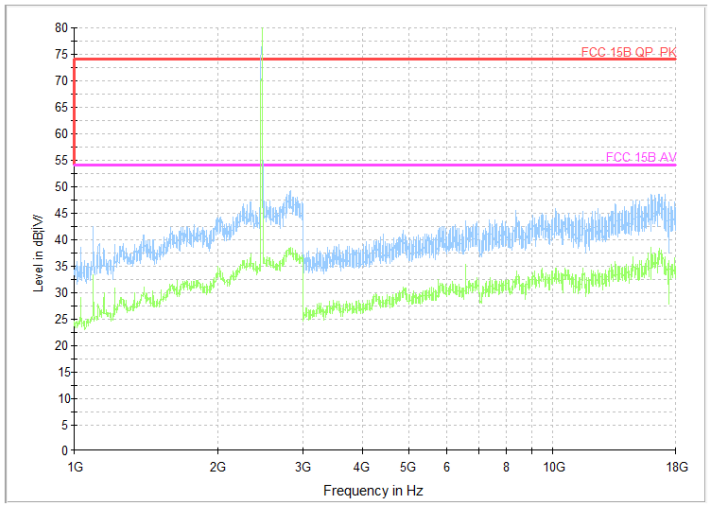
**Test setup**

| | | |
|---|---|---|
| Test Channel | : | Low/ Middle/ High |
| Operation mode | : | A |
| Ambient temperature | : | 21℃ |
| Relative humidity | : | 30% |
| Atmospheric pressure | : | 100 kPa |

During the test, the nonconducting table was rotated 360° around and the antenna was varied from 1m to 4m to find the maximum disturbance. The test was performed with the antenna both in its horizontal and vertical polarizations. The height and polarization of the EUT is varied to maximize the measured emissions.
The following figures and tables were those measured by an automatic measurement system. A pre-test was performed, no radiated harmonics or unintentional emission was found below 30MHz. The following plots are provided as reference. The Low, Middle and High channels were tested, only worst case showed. 9 kHz - 30 MHz emission result was far below limit, hence not presented in this test report.

**Figure 1: Spurious emission measurement results, 802.11b, low channel, 30MHz-26.5GHz.**



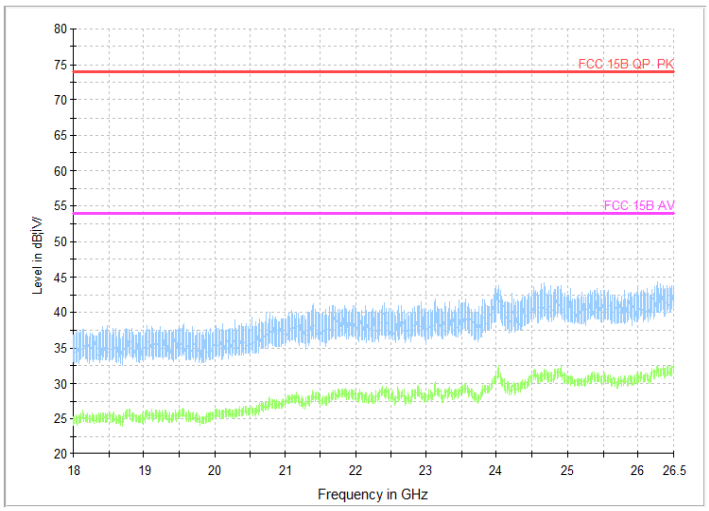
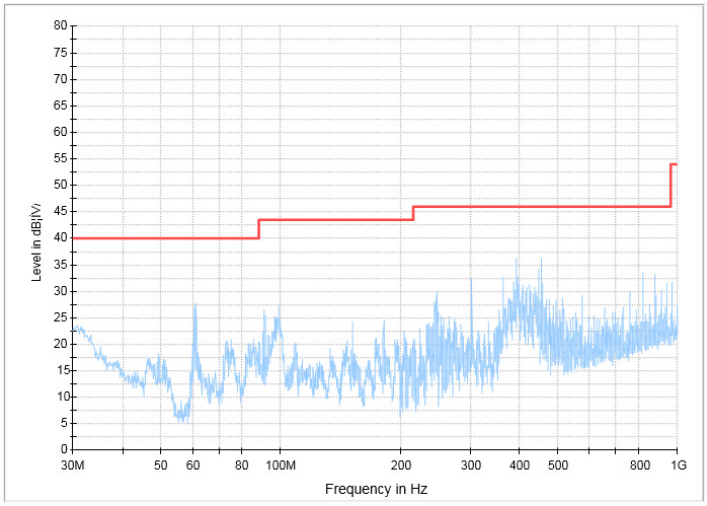
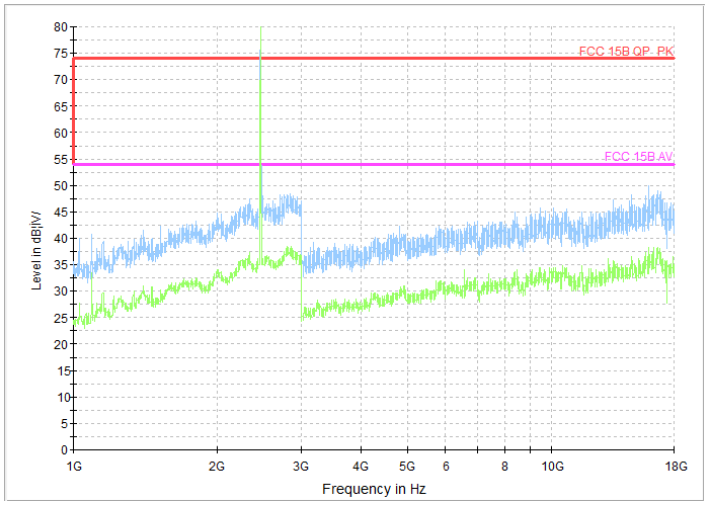



**Figure 2: Spurious emission measurement results, 802.11g, low channel, 30MHz-26.5GHz.**



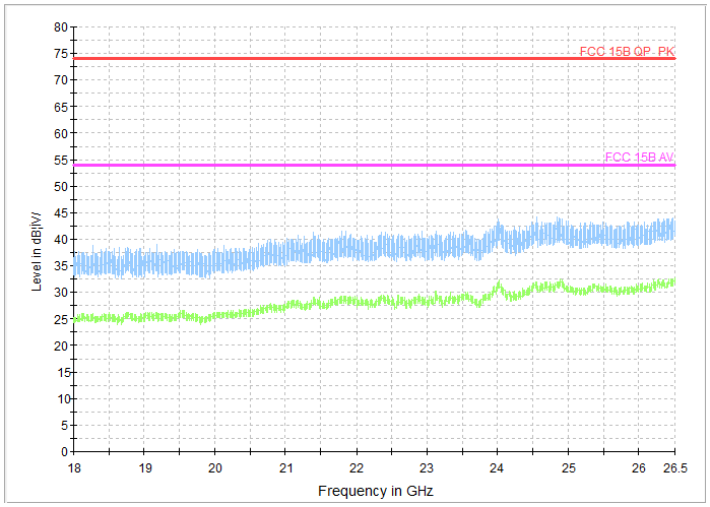
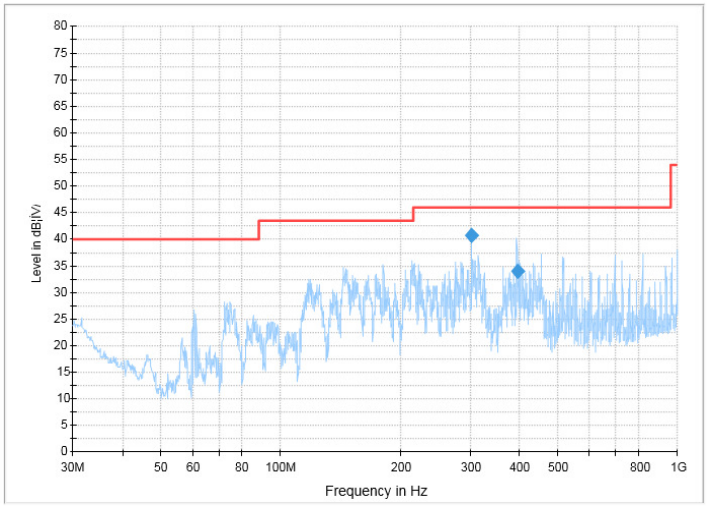
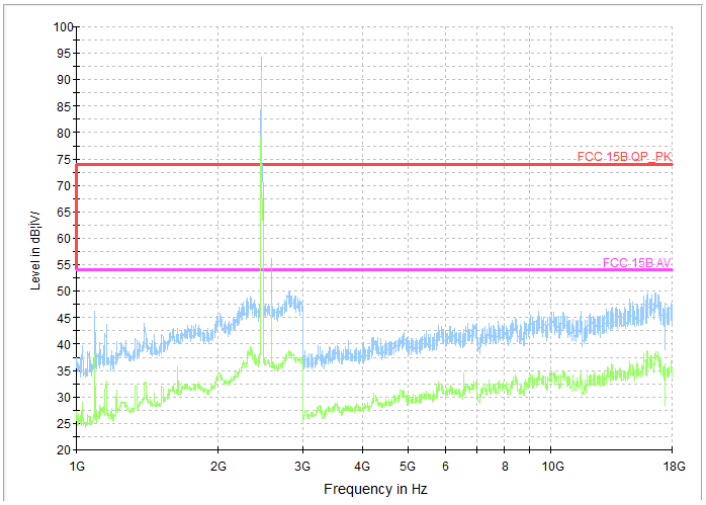
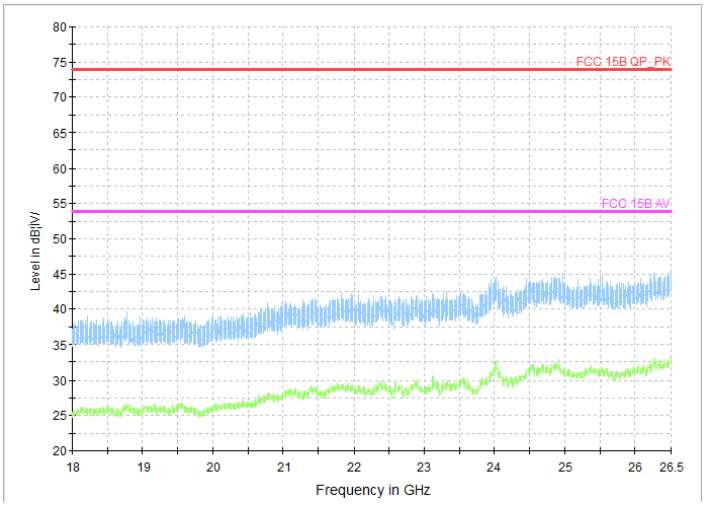



**Figure 3: Spurious emission measurement results, 802.11n-HT20, low channel, 30MHz-26.5GHz.**




| Frequency (MHz) | QuasiPeak (dBµV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBµV/m) |
|---|---|---|---|---|---|---|---|---|---|
| 303.46601 | 40.7 | 1000. | 120.000 | 200.0 | V | 292.0 | -31.8 | 5.30 | 46.00 |
| 394.78877 | 33.9 | 1000. | 120.000 | 100.0 | V | 0.0 | -29.5 | 12.10 | 46.00 |




FCC 15B QP_PK
FCC 15B AV
Level in dBµV
Frequency in GHz
80
75
70
65
60
55
50
45
40
35
30
25
20
18
19
20
21
22
23
24
25
26
26.5

## 4.1.7 Conducted Emissions

**RESULT:** **Passed**

| | | |
|---|---|---|
| Date of testing | : | 2017-01-08 |
| Test standard | : | FCC Part 15.207(a) |
| Basic standard | : | ANSI C63.10: 2013 |
| Frequency range | : | 0.15 – 30MHz |
| Limits | : | FCC Part 15.207(a) |
| Kind of test site | : | Shield room |

**Test setup**

| | | |
|---|---|---|
| Input Voltage | : | AC 24V |
| Operation Mode | : | A |
| Earthing | : | Not Connected |
| Ambient temperature | : | 21℃ |
| Relative humidity | : | 30% |
| Atmospheric pressure | : | 100 kPa |

The measurement setup was made in a shielded room.

The measurement equipment like test receivers, quasi-peak detector, average detector and LISN are in compliance with CISPR 16-1 series standards and ANSI C63.10-2013. The tested object was operated under its rated voltage and its rated frequency. Prior to the measurements the test object operated about 5 minutes (warm-up) in order to stabilize its operating conditions and to ensure reliable measurement values.

Furthermore an internal calibration with the test receiver was conducted prior to each measurement.

The EUT was set 0.8m away from the LISN. The cord longer than necessary to be connected to the LISN was folded forth and back parallel so as to form a bundle with a length between 0.3m and 0.4m.

The interference voltage was determined while measuring the line conductor by turns.

The following figures and tables were those measured by an automatic measuring system. A preview test was first made with peak detector. Final test with quasi-peak detector and average detector was only performed at these critical frequencies found via preview test.

**Figure 4: Conducted emission measurement results, AC power line, Line L, 802.11b**

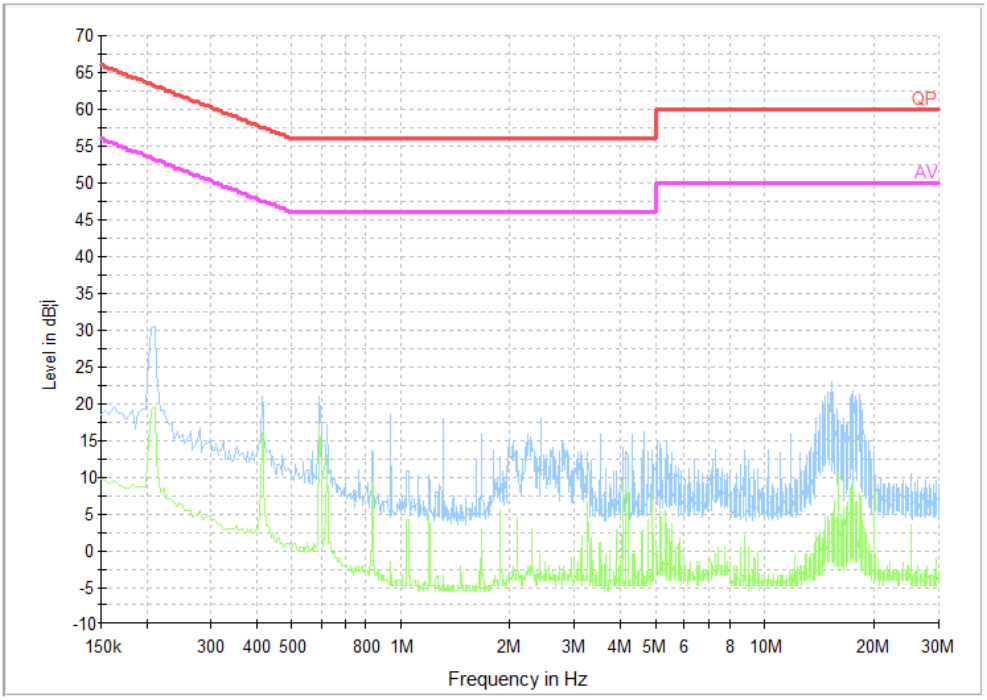



**Figure 5: Conducted emission measurement results, AC power line, Line N, 802.11b**

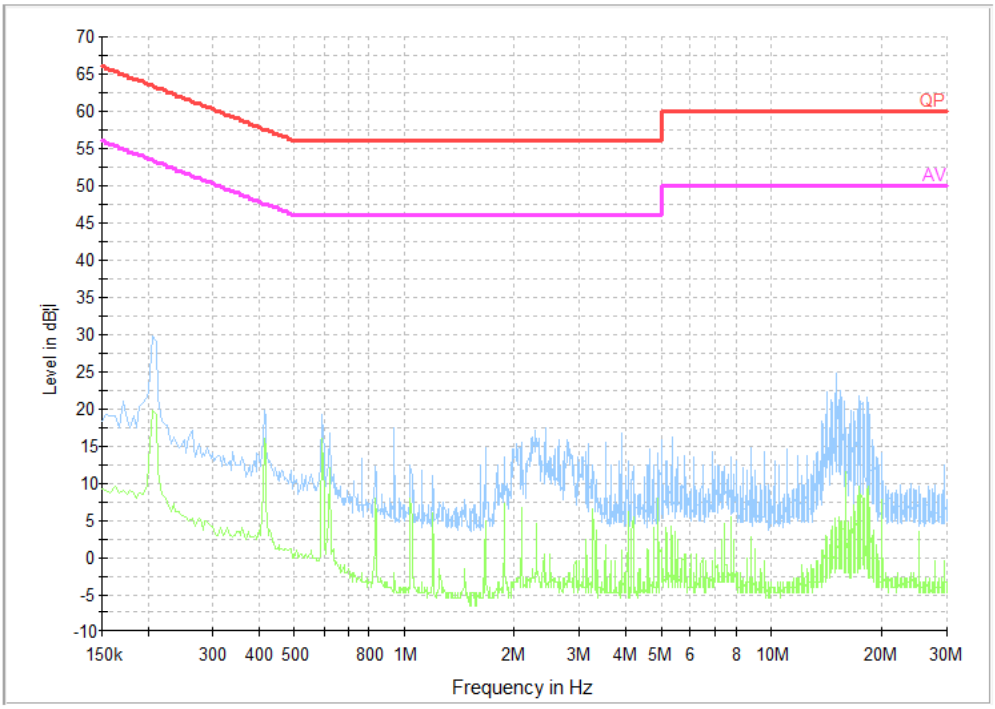


**Figure 6: Conducted emission measurement results, AC power line, Line L, 802.11g**

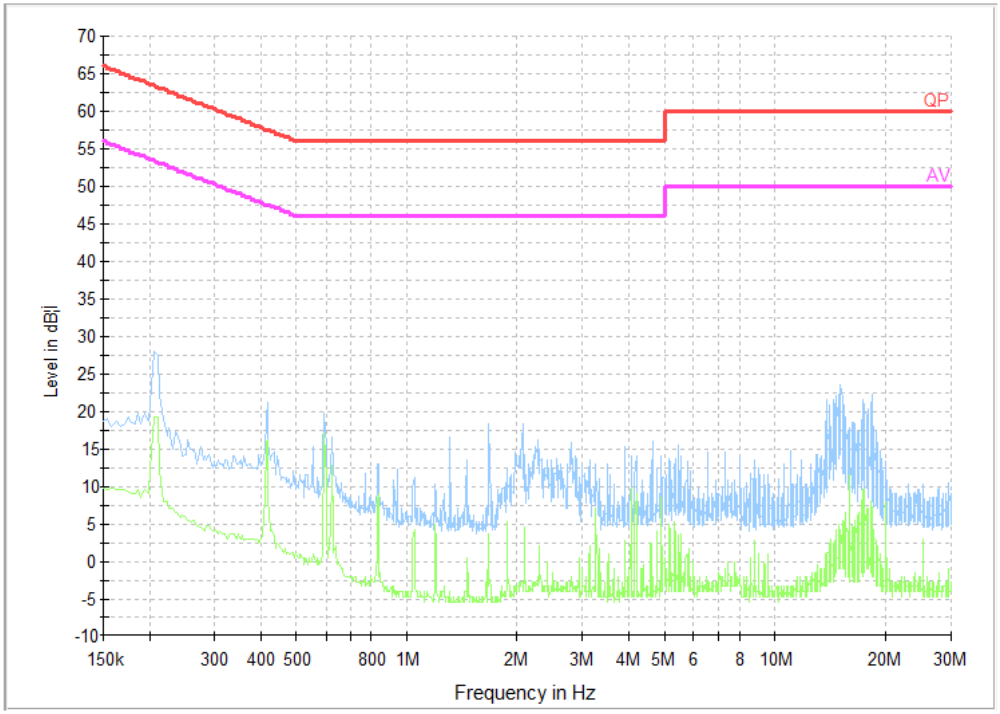



**Figure 7: Conducted emission measurement results, AC power line, Line N, 802.11g**

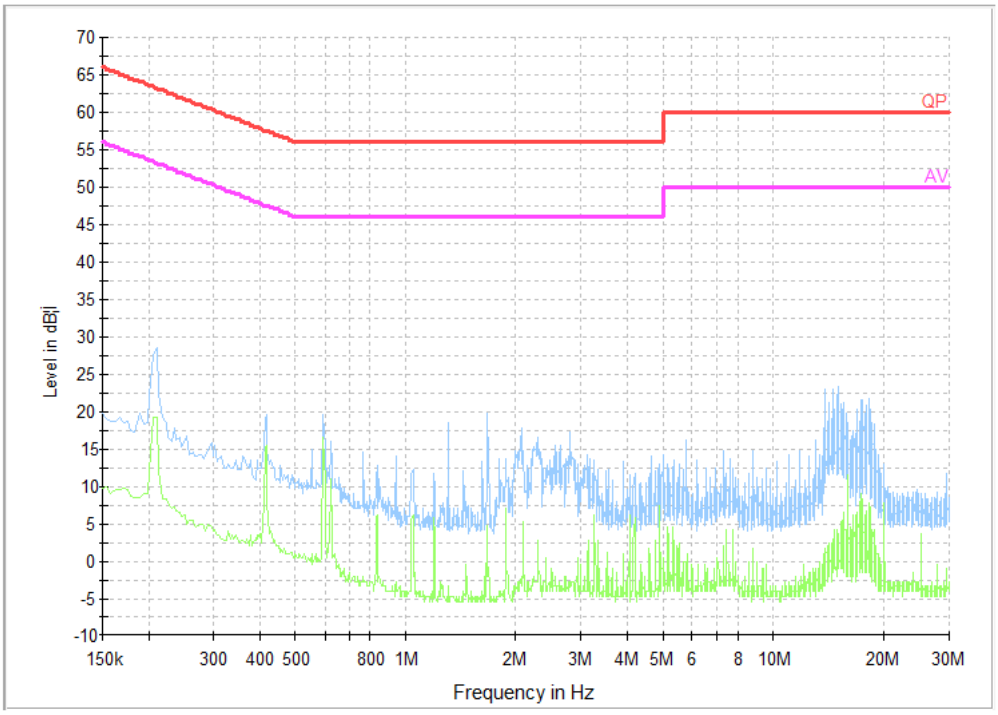


**Figure 8: Conducted emission measurement results, AC power line, Line L, 802.11n-HT20**

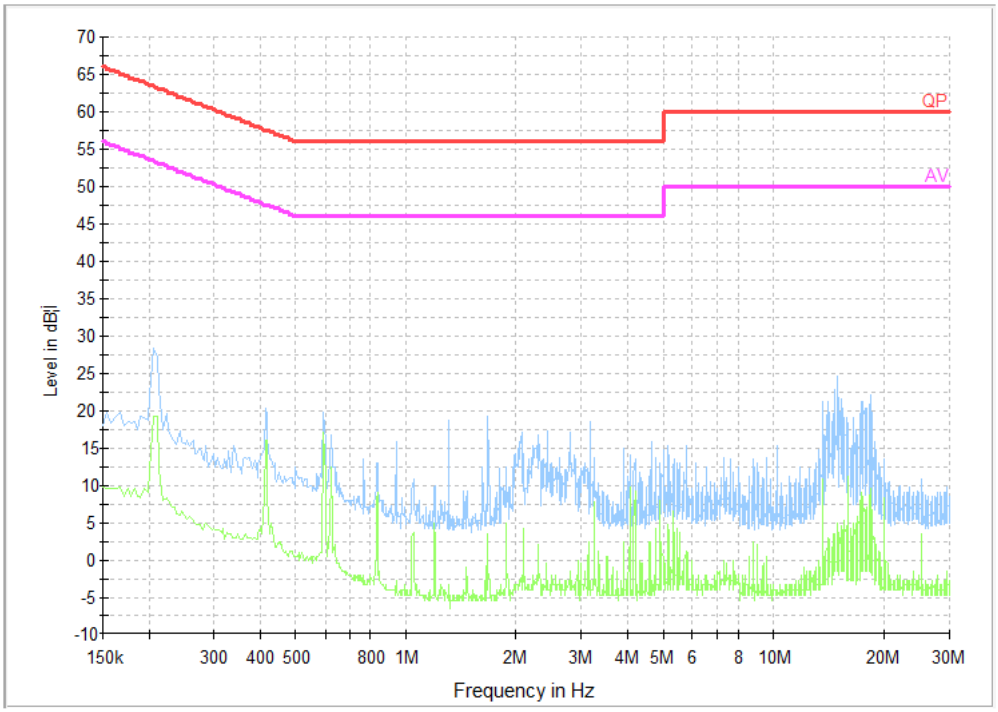



**Figure 9: Conducted emission measurement results, AC power line, Line N, 802.11n-HT20**