# FCC RF Test Report

| | | |
|---|---|---|
| **APPLICANT** | **:** | **Acer Incorporated** |
| **EQUIPMENT** | **:** | **Notebook computer** |
| **BRAND NAME** | **:** | **acer** |
| **MODEL NAME** | **:** | **N17H2** |
| **FCC ID** | **:** | **Contains FCC ID : HLZ9560D2W** |
| **STANDARD** | **:** | **FCC Part 15 Subpart C §15.247** |
| **CLASSIFICATION** | **:** | **(DSS) Spread Spectrum Transmitter** |

**The product was installed a module during the test: WLAN and BT, 2*2 PCIe M.2 1216 SD adapter card (Brand Name: acer, Model Name: 9560D2W, FCC ID: HLZ9560D2W) during test.**

**The product was received on Aug. 03, 2018 and testing was completed on Sep. 17, 2018. We, Sporton International (Shenzhen) Inc., would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.**

**The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International (Shenzhen) Inc., the test report shall not be reproduced except in full.**

Eric Shih

NVLAP TESTING
NVLAP LAB CODE 600156-0

**Approved by: Eric Shih / Manager**

***Sporton International (Shenzhen) Inc.***
***1/F, 2/F, Bldg 5, Shiling Industrial Zone, Xinwei Village, Xili, Nanshan, Shenzhen City, Guangdong Province 518055, China***

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# REVISION HISTORY

| REPORT NO. | VERSION | DESCRIPTION | ISSUED DATE |
|---|---|---|---|
| FR880301A | Rev. 01 | Initial issue of report | Sep. 26, 2018 |
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# SUMMARY OF TEST RESULT

| Report Section | FCC Rule | Description | Limit | Result | Remark |
|---|---|---|---|---|---|
| - | 15.247(a)(1) | Number of Channels | ≥ 15Chs | Pass | 1 |
| - | 15.247(a)(1) | Hopping Channel Separation | ≥ 2/3 of 20dB BW | Pass | 1 |
| - | 15.247(a)(1) | Dwell Time of Each Channel | ≤ 0.4sec in 31.6sec period | Pass | 1 |
| - | 15.247(a)(1) | 20dB Bandwidth | NA | Pass | 1 |
| - | - | 99% Bandwidth | - | Pass | 1 |
| 3.1 | 15.247(b)(1) | Peak Output Power | ≤ 125 mW | Pass | - |
| - | 15.247(d) | Conducted Band Edges | ≤ 20dBc | Pass | 1 |
| - | 15.247(d) | Conducted Spurious Emission | ≤ 20dBc | Pass | 1 |
| 3.2 | 15.247(d) | Radiated Band Edges and Radiated Spurious Emission | 15.209(a) & 15.247(d) | Pass | Under limit 8.14 dB at 30.00 MHz |
| 3.3 | 15.207 | AC Conducted Emission | 15.207(a) | Pass | Under limit 6.70 dB at 0.50 MHz |
| 3.4 | 15.203 & 15.247(b) | Antenna Requirement | N/A | Pass | - |
| **Remark 1**: Test items are leveraged from module RF report “170919-03.TR05”. | | | | | |

# 1 General Description

## 1.1 Applicant

**Acer Incorporated**

8F ,88, Sec.1 Xintai 5th Rd. Xizhi, New Taipei City 221, Taiwan, R.O.C

## 1.2 Manufacturer

**Acer Incorporated**

8F , 88, Sec.1 Xintai 5th Rd. Xizhi, New Taipei City 221, Taiwan, R.O.C

## 1.3 Product Feature of Equipment Under Test

| Product Feature | |
|---|---|
| **Equipment** | Notebook computer |
| **Brand Name** | acer |
| **Model Name** | N17H2 |
| **FCC ID** | Contains FCC ID : HLZ9560D2W |
| **EUT supports Radios application** | WLAN 2.4GHz 802.11b/g/n HT20/HT40<br>WLAN 5GHz 802.11a/n HT20/HT40<br>WLAN 5GHz 802.11ac VHT20/VHT40/VHT80/VHT160<br>Bluetooth BR/EDR/LE |
| **EUT Stage** | Identical Prototype |

| Module Feature & Specification | |
|---|---|
| **Equipment** | WLAN and BT, 2*2 PCIe M.2 1216 SD adapter card |
| **Brand Name** | acer |
| **Model Name** | 9560D2W |
| **FCC ID** | HLZ9560D2W |

**Remark:**

1. The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.
2. There are three samples under test, the detailed differences are shown in the Component List. The differences have no influence on RF features, only Sample 1 perform full test.

## 1.4 Product Specification of Equipment Under Test

| Standards-related Product Specification | |
|---|---|
| **Tx/Rx Frequency Range** | 2402 MHz ~ 2480 MHz |
| **Number of Channels** | 79 |
| **Carrier Frequency of Each Channel** | 2402+n*1 MHz; n=0~78 |
| **Maximum Output Power to Antenna** | Bluetooth BR(1Mbps) : 9.99 dBm (0.0100 W)<br>Bluetooth EDR (2Mbps) : 8.06 dBm (0.0064 W)<br>Bluetooth EDR (3Mbps) : 8.17 dBm (0.0066 W) |
| **Antenna Type / Gain** | PIFA Antenna with gain 1.07 dBi |
| **Type of Modulation** | Bluetooth BR (1Mbps) : GFSK<br>Bluetooth EDR (2Mbps) : $\pi$ /4-DQPSK<br>Bluetooth EDR (3Mbps) : 8-DPSK |

## 1.5 Component List

| Component | Sample 1 SKUC | Sample 2 SKUA | Sample 3 SKUB |
|---|---|---|---|
| CPU | N5000 | N5000 | N4000 |
| BT/WIFI Module | 9560D2W | 9560D2W | 9560D2W |
| RAM | HYNIX LPD4_2GB(200b_D4x32) H9HCNNNBPUMLHR-NME | HYNIX LPD4_2GB(200b_D4x32) H9HCNNNBPUMLHR-NME | MICRON LPD4_2GB(200b_D2x32) MT53E512M32D2NP-046 WT:E |
| EMMC | SANDISK NAND 128GB SDINADF4-128G-1220 | SANDISK NAND 64GB SDINBDA4-64-1220V | SANDISK NAND 64GB SDINBDA4-64-1220V |
| Camera front | 6SF009N2 | 6SF009N2 | 6SF009N2 |
| LCD | ZC-116A-1227BT | ZC-116A-1227BT | ZC-116A-1227BT |
| Battery | AP16L5J | AP16L5J | AP16L5J |

## 1.6 Modification of EUT

No modifications are made to the EUT during all test items.

## 1.7 Testing Location

Sporton Lab is accredited to ISO 17025 by National Voluntary Laboratory Accreditation Program (NVLAP code: 600156-0).

| | | | |
|---|---|---|---|
| **Test Site** | Sporton International (Shenzhen) Inc. | | |
| **Test Site Location** | 1/F, 2/F, Bldg 5, Shiling Industrial Zone, Xinwei Village, Xili, Nanshan, Shenzhen City, Guangdong Province 518055, China<br>TEL: +86-755-8637-9589<br>FAX: +86-755-8637-9595 | | |
| **Test Site No.** | **Sporton Site No.** | **FCC designation No.** | **FCC Test Firm Registration No.** |
| | TH01-SZ<br>CO01-SZ | CN5018 | 337463 |

| | | | |
|---|---|---|---|
| **Test Site** | Sporton International (Shenzhen) Inc. | | |
| **Test Site Location** | No. 3 Bldg the third floor of south, Shahe River west, Fengzeyuan Warehouse, Nanshan District, Shenzhen City, Guangdong Province 518055, China<br>TEL: +86-755- 3320-2398 | | |
| **Test Site No.** | **Sporton Site No.** | **FCC designation No.** | **FCC Test Firm Registration No.** |
| | 03CH03-SZ | CN5019 | 577730 |

## 1.8 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- FCC Part 15 Subpart C §15.247
- ANSI C63.10-2013

**Remark:**

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.

# 2 Test Configuration of Equipment Under Test

## 2.1 Carrier Frequency Channel

| Frequency Band | Channel | Freq. (MHz) | Channel | Freq. (MHz) | Channel | Freq. (MHz) |
|---|---|---|---|---|---|---|
| 2400-2483.5 MHz | 0 | 2402 | 27 | 2429 | 54 | 2456 |
| | 1 | 2403 | 28 | 2430 | 55 | 2457 |
| | 2 | 2404 | 29 | 2431 | 56 | 2458 |
| | 3 | 2405 | 30 | 2432 | 57 | 2459 |
| | 4 | 2406 | 31 | 2433 | 58 | 2460 |
| | 5 | 2407 | 32 | 2434 | 59 | 2461 |
| | 6 | 2408 | 33 | 2435 | 60 | 2462 |
| | 7 | 2409 | 34 | 2436 | 61 | 2463 |
| | 8 | 2410 | 35 | 2437 | 62 | 2464 |
| | 9 | 2411 | 36 | 2438 | 63 | 2465 |
| | 10 | 2412 | 37 | 2439 | 64 | 2466 |
| | 11 | 2413 | 38 | 2440 | 65 | 2467 |
| | 12 | 2414 | 39 | 2441 | 66 | 2468 |
| | 13 | 2415 | 40 | 2442 | 67 | 2469 |
| | 14 | 2416 | 41 | 2443 | 68 | 2470 |
| | 15 | 2417 | 42 | 2444 | 69 | 2471 |
| | 16 | 2418 | 43 | 2445 | 70 | 2472 |
| | 17 | 2419 | 44 | 2446 | 71 | 2473 |
| | 18 | 2420 | 45 | 2447 | 72 | 2474 |
| | 19 | 2421 | 46 | 2448 | 73 | 2475 |
| | 20 | 2422 | 47 | 2449 | 74 | 2476 |
| | 21 | 2423 | 48 | 2450 | 75 | 2477 |
| | 22 | 2424 | 49 | 2451 | 76 | 2478 |
| | 23 | 2425 | 50 | 2452 | 77 | 2479 |
| | 24 | 2426 | 51 | 2453 | 78 | 2480 |
| | 25 | 2427 | 52 | 2454 | - | - |
| | 26 | 2428 | 53 | 2455 | - | - |

## 2.2 Test Mode

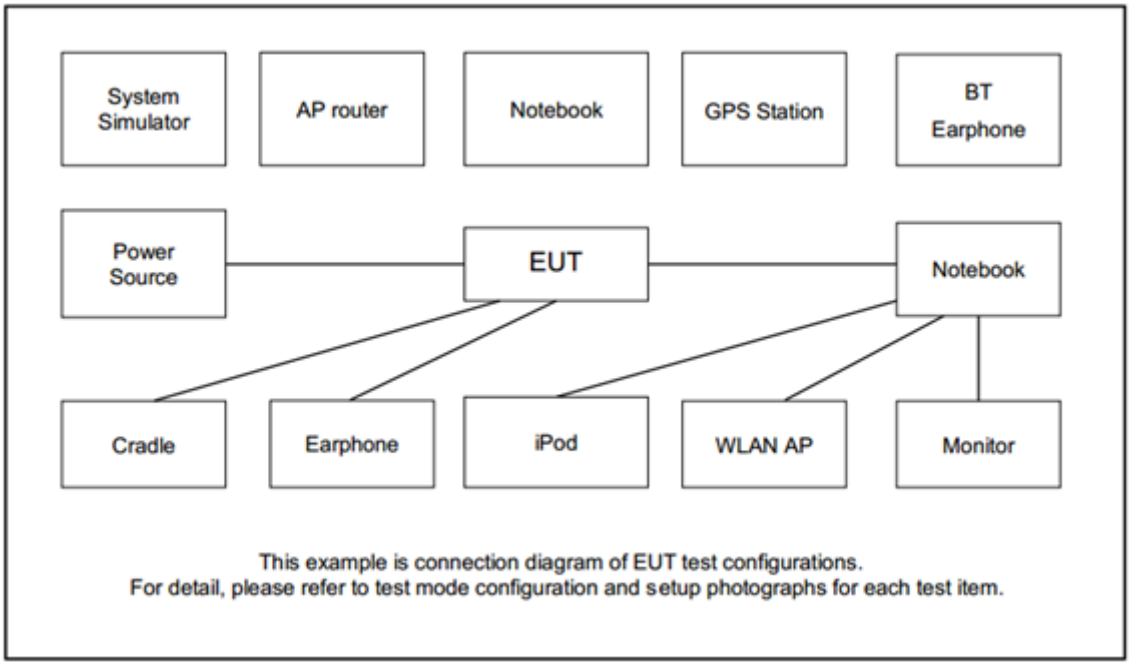
a. The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: conduction emission (150 kHz to 30 MHz), radiation emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). The worst mode of radiated spurious emissions is Bluetooth 1Mbps mode, and recorded in this report.

b. AC power line Conducted Emission was tested under maximum output power.

The following summary table is showing all test modes to demonstrate in compliance with the standard.

| Summary table of Test Cases | | | |
|---|---|---|---|
| **Test Item** | **Data Rate / Modulation** | | |
| | **Bluetooth BR 1Mbps GFSK** | **Bluetooth EDR 2Mbps π/4-DQPSK** | **Bluetooth EDR 3Mbps 8-DPSK** |
| **Conducted Test Cases** | Mode 1: CH00_2402 MHz<br>Mode 2: CH39_2441 MHz<br>Mode 3: CH78_2480 MHz | Mode 4: CH00_2402 MHz<br>Mode 5: CH39_2441 MHz<br>Mode 6: CH78_2480 MHz | Mode 7: CH00_2402 MHz<br>Mode 8: CH39_2441 MHz<br>Mode 9: CH78_2480 MHz |
| **Radiated Test Cases** | **Bluetooth BR 1Mbps GFSK** | | |
| | Mode 1: CH00_2402 MHz<br>Mode 2: CH39_2441 MHz<br>Mode 3: CH78_2480 MHz | | |
| **AC Conducted Emission** | Mode 1 : Bluetooth Link + WLAN Link (2.4G) + Adapter 1 + Earphone<br>Mode 2 : Bluetooth Link + WLAN Link (2.4G) + Adapter 2 + Earphone<br>Mode 3 : **Bluetooth Link + WLAN Link (2.4G) + Adapter 3 + Earphone**<br>Mode 4 : Bluetooth Link + WLAN Link (2.4G) + Adapter 4 + Earphone<br>Mode 5 : Bluetooth Link + WLAN Link (2.4G) + Adapter 5 + Earphone | | |
| **Remark:**<br>1. For radiated test cases, the worst mode data rate 1Mbps was reported only, because this data rate has the highest RF output power at preliminary tests, and no other significantly frequencies found in conducted spurious emission.<br>2. The worst case of AC is mode 3; only the test data of this mode is reported.<br>3. For Radiated Test Cases, The tests were performed with Adapter 1 and Earphone. | | | |

## 2.3 Connection Diagram of Test System




## 2.4 Support Unit used in test configuration and system

| Item | Equipment | Trade Name | Model Name | FCC ID | Data Cable | Power Cord |
|---|---|---|---|---|---|---|
| 1. | BT Base Station | R&S | CBT | N/A | N/A | Unshielded, 1.8 m |
| 2. | WLAN AP | Dlink | DIR-820L | KA2IR820LA1 | N/A | Unshielded,1.8m |
| 3. | Notebook | Lenovo | E540 | FCC DoC | N/A | AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m |
| 4. | Bluetooth Earphone | Samsung | EO-MG900 | PYAHS-107W | N/A | N/A |
| 5. | Earphone | apple | DCAY1V-A9007ZJW3-000 | N/A | N/A | Unshielded,1.8m |
| 6. | SD Card | N/A | MicroSD HC | FCC DoC | N/A | N/A |
| 7. | Monitor | DELL | P2715QT | FCC DoC | N/A | N/A |
| 8. | ipod | apple | MC69029/A | N/A | N/A | Unshielded,1.8m |

## 2.5 EUT Operation Test Setup

For Bluetooth function, the engineering test program was provided and enabled to make EUT connect with Bluetooth base station to continuous transmit/receive.

For AC power line conducted emissions, the EUT was set to connect with the WLAN AP under large package sizes transmission.

# 3 Test Result

## 3.1 Output Power Measurement

### 3.1.1 Limit of Output Power

The maximum peak conducted output power of the intentional radiator shall not exceed the following: (1) For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band 0.125 watts. The power limit for 1Mbps, 2Mbps, 3Mbps and AFH modes are 0.125 watts.

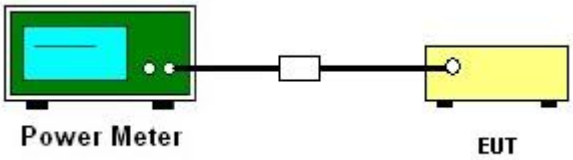
### 3.1.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

### 3.1.3 Test Procedures

1. The testing follows ANSI C63.10-2013 clause 7.8.5.
1. The RF output of EUT was connected to the power meter by RF cable and attenuator. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit continuously.
3. Measure the conducted output power with cable loss and record the results in the test report.
4. Measure and record the results in the test report.

### 3.1.4 Test Setup



### 3.1.5 Test Result of Peak Output Power

| Test Mode : | 1Mbps | Temperature : | 24~26℃ |
|---|---|---|---|
| Test Engineer : | Hayden Chen | Relative Humidity : | 50~53% |

| Channel | Frequency (MHz) | RF Power (dBm) | | |
|---|---|---|---|---|
| | | GFSK | Max. Limits (dBm) | Pass/Fail |
| | | 1 Mbps | | |
| 00 | 2402 | 8.13 | 20.97 | Pass |
| 39 | 2441 | 9.27 | 20.97 | Pass |
| 78 | 2480 | 9.99 | 20.97 | Pass |

| Test Mode : | 2Mbps | Temperature : | 24~26℃ |
|---|---|---|---|
| Test Engineer : | Hayden Chen | Relative Humidity : | 50~53% |

| Channel | Frequency (MHz) | RF Power (dBm) | | |
|---|---|---|---|---|
| | | $\pi$ /4-DQPSK | Max. Limits (dBm) | Pass/Fail |
| | | 2 Mbps | | |
| 00 | 2402 | 7.16 | 20.97 | Pass |
| 39 | 2441 | 7.89 | 20.97 | Pass |
| 78 | 2480 | 8.06 | 20.97 | Pass |

| Test Mode : | 3Mbps | Temperature : | 24~26℃ |
|---|---|---|---|
| Test Engineer : | Hayden Chen | Relative Humidity : | 50~53% |

| Channel | Frequency (MHz) | RF Power (dBm) | | |
|---|---|---|---|---|
| | | 8-DPSK | Max. Limits (dBm) | Pass/Fail |
| | | 3 Mbps | | |
| 00 | 2402 | 7.24 | 20.97 | Pass |
| 39 | 2441 | 8.01 | 20.97 | Pass |
| 78 | 2480 | 8.17 | 20.97 | Pass |

## 3.2 Radiated Band Edges and Spurious Emission Measurement

### 3.2.1 Limit of Radiated Band Edges and Spurious Emission

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. In addition, radiated emissions which fall in the restricted bands must also comply with the limits as below.

| Frequency (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 |

### 3.2.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

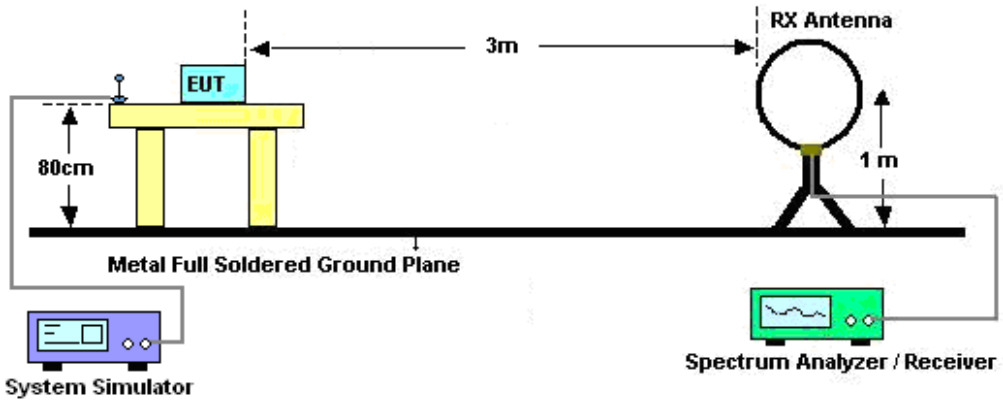
### 3.2.3 Test Procedures

1. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
2. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
3. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.
4. Set to the maximum power setting and enable the EUT transmit continuously.
5. Use the following spectrum analyzer settings:
   (1) Span shall wide enough to fully capture the emission being measured;
   (2) Set RBW=100 kHz for f < 1 GHz, RBW=1MHz for f>1GHz ; VBW ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold for peak
   (3) For average measurement: use duty cycle correction factor method per 15.35(c).
   Duty cycle = On time/100 milliseconds
   On time = $N_1*L_1+N_2*L_2+...+N_{n-1}*LN_{n-1}+N_n*L_n$
   Where $N_1$ is number of type 1 pulses, $L_1$ is length of type 1 pulses, etc.
   Average Emission Level = Peak Emission Level + 20*log(Duty cycle)
6. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
7. For testing below 1GHz, if the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then peak values of EUT will be reported, otherwise, the emissions will be repeated one by one using the CISPR quasi-peak method and reported.
8. For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than average limit (that means the emission level in average mode also complies with the limit in average mode), then peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.

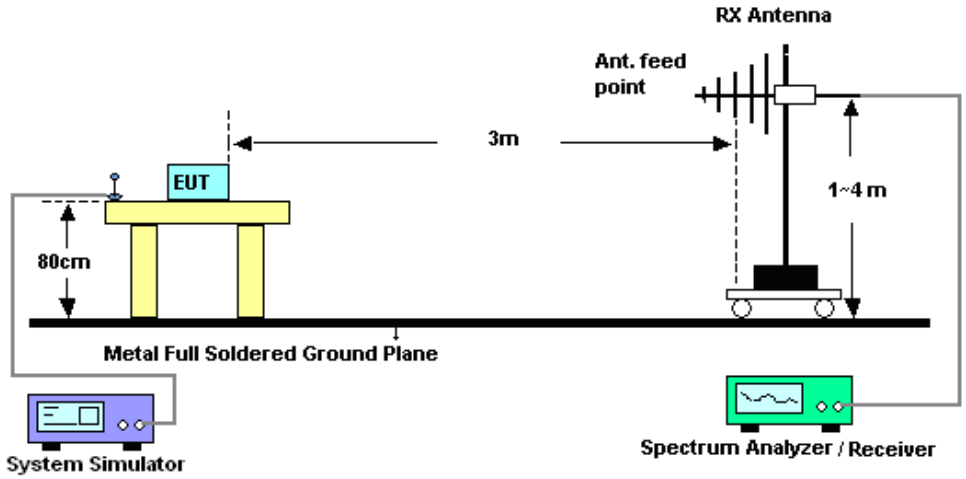
Note: The average levels were calculated from the peak level corrected with duty cycle correction factor (-24.79dB) derived from 20log (dwell time/100ms). This correction is only for signals that hop with the fundamental signal, such as band-edge and harmonic. Other spurious signals that are independent of the hopping signal would not use this correction.

## 3.2.4 Test Setup

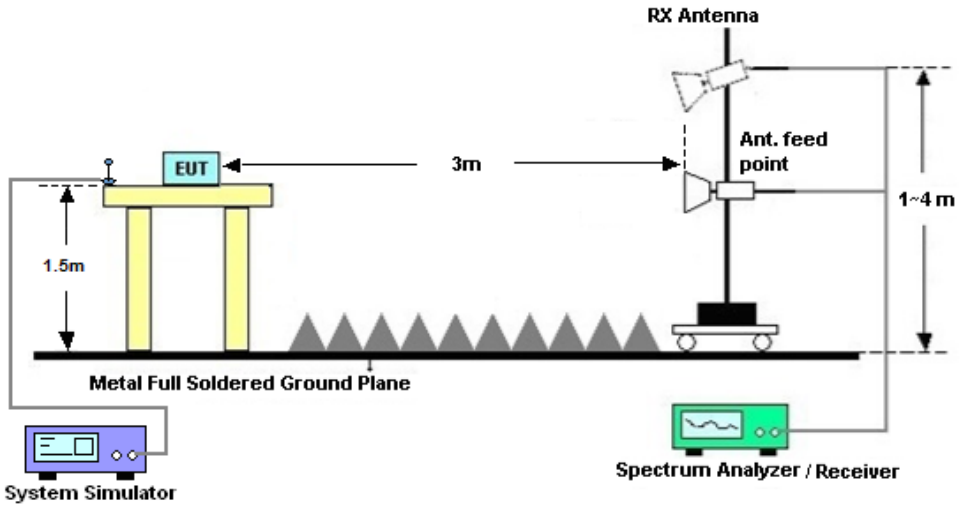
**For radiated emissions below 30MHz**




**For radiated emissions from 30MHz to 1GHz**




**For radiated emissions above 1GHz**



### 3.2.5 Test Results of Radiated Spurious Emissions (9 kHz ~ 30 MHz)

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line was not reported.

There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

### 3.2.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix B.

### 3.2.7 Test Result of Radiated Spurious Emission (30MHz ~ 10$^{th}$ Harmonic)

Please refer to Appendix B.

### 3.2.8 Duty cycle correction factor for average measurement

Please refer to Appendix C.

# 3.3 AC Conducted Emission Measurement

## 3.3.1 Limit of AC Conducted Emission

For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

| Frequency of emission (MHz) | Conducted limit (dBμV) | |
|---|---|---|
| | Quasi-peak | Average |
| 0.15-0.5 | 66 to 56* | 56 to 46* |
| 0.5-5 | 56 | 46 |
| 5-30 | 60 | 50 |

*Decreases with the logarithm of the frequency.

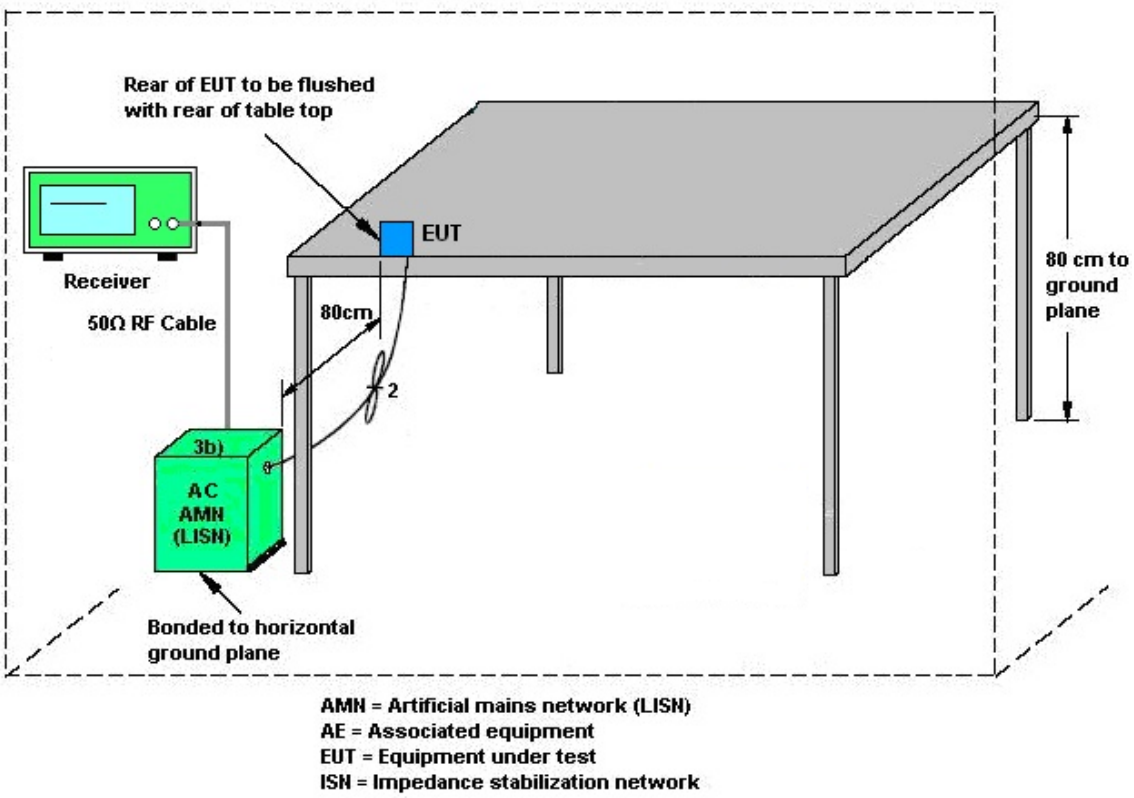
## 3.3.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

## 3.3.3 Test Procedures

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

### 3.3.4 Test Setup




AMN = Artificial mains network (LISN)
AE = Associated equipment
EUT = Equipment under test
ISN = Impedance stabilization network

### 3.3.5 Test Result of AC Conducted Emission

Please refer to Appendix A.

## 3.4 Antenna Requirements

### 3.4.1 Standard Applicable

If directional gain of transmitting antennas is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the rule.

### 3.4.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

### 3.4.3 Antenna Gain

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.

# 4 List of Measuring Equipment

| Instrument | Manufacturer | Model No. | Serial No. | Characteristics | Calibration Date | Test Date | Due Date | Remark |
|---|---|---|---|---|---|---|---|---|
| Pulse Power Senor | Anritsu | MA2411B | 1207253 | 30MHz~40GHz | Dec. 26, 2017 | Sep. 11, 2018 | Dec. 25, 2018 | Conducted (TH01-SZ) |
| Power Meter | Anritsu | ML2495A | 1218010 | 50MHz Bandwidth | Dec. 26, 2017 | Sep. 11, 2018 | Dec. 25, 2018 | Conducted (TH01-SZ) |
| EMI Test Receiver&SA | KEYSIGHT | N9038A | MY54450083 | 20Hz~8.4GHz | Apr. 19, 2018 | Sep. 17, 2018 | Apr. 18, 2019 | Radiation (03CH03-SZ) |
| EXA Spectrum Anaiyzer | KEYSIGHT | N9010A | MY55150246 | 10Hz~44GHz; | Apr. 19, 2018 | Sep. 17, 2018 | Apr. 18, 2019 | Radiation (03CH03-SZ) |
| Loop Antenna | R&S | HFH2-Z2 | 100354 | 9kHz~30MHz | May 14, 2018 | Sep. 17, 2018 | May 13, 2019 | Radiation (03CH03-SZ) |
| Bilog Antenna | TeseQ | CBL6112D | 35408 | 30MHz-2GHz | Apr. 19, 2018 | Sep. 17, 2018 | Apr. 18, 2019 | Radiation (03CH03-SZ) |
| Double Ridge Horn Antenna | SCHWARZBECK | BBHA9120D | 9120D-1355 | 1GHz~18GHz | Mar. 29 2018 | Sep. 17, 2018 | Mar. 28, 2019 | Radiation (03CH03-SZ) |
| SHF-EHF Horn | com-power | AH-840 | 101071 | 18Ghz-40GHz | Mar. 30 2018 | Sep. 17, 2018 | Mar. 29, 2019 | Radiation (03CH03-SZ) |
| Amplifier | Burgeon | BPA-530 | 102210 | 0.01Hz ~3000MHz | Oct. 19, 2017 | Sep. 17, 2018 | Oct. 18, 2018 | Radiation (03CH03-SZ) |
| HF Amplifier | MITEQ | AMF-7D-00101800-30-10P-R | 1943528 | 1GHz~18GHz | Oct. 19, 2017 | Sep. 17, 2018 | Oct. 18, 2018 | Radiation (03CH03-SZ) |
| Amplifier | Agilent Technologies | 83017A | MY39501302 | 500MHz~26.5GHz | Dec. 27, 2017 | Sep. 17, 2018 | Dec. 26, 2018 | Radiation (03CH03-SZ) |
| HF Amplifier | MITEQ | TTA1840-35-HG | 1871923 | 18GHz~40GHz | Jul. 30, 2018 | Sep. 17, 2018 | Jul. 30, 2019 | Radiation (03CH03-SZ) |
| AC Power Source | Chroma | 61601 | 616010001985 | N/A | NCR | Sep. 17, 2018 | NCR | Radiation (03CH03-SZ) |
| Turn Table | EM | EM1000 | N/A | 0~360 degree | NCR | Sep. 17, 2018 | NCR | Radiation (03CH03-SZ) |
| Antenna Mast | EM | EM1000 | N/A | 1 m~4 m | NCR | Sep. 17, 2018 | NCR | Radiation (03CH03-SZ) |
| EMI Receiver | R&S | ESR7 | 101630 | 9kHz~7GHz; | Dec. 26, 2017 | Aug. 22, 2018 | Dec. 25, 2018 | Conduction (CO01-SZ) |
| AC LISN | EMCO | 3816/2SH | 00103912 | 9kHz~30MHz | Dec. 26, 2017 | Aug. 22, 2018 | Dec. 25, 2018 | Conduction (CO01-SZ) |
| AC LISN (for auxiliary equipment) | MessTec | 3816/2SH | 00103892 | 9kHz~30MHz | Nov. 01, 2017 | Aug. 22, 2018 | Oct. 31, 2018 | Conduction (CO01-SZ) |
| AC Power Source | Chroma | 61602 | 616020000891 | 100Vac~250Vac | Jul. 18, 2018 | Aug. 22, 2018 | Jul. 17, 2019 | Conduction (CO01-SZ) |

NCR: No Calibration Required

# 5 Uncertainty of Evaluation

**Uncertainty of Conducted Emission Measurement (150 kHz ~ 30 MHz)**

| | |
|---|---|
| **Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))** | **2.6dB** |

**Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)**

| | |
|---|---|
| **Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))** | **5.0dB** |

**Uncertainty of Radiated Emission Measurement (1000 MHz ~ 18000 MHz)**

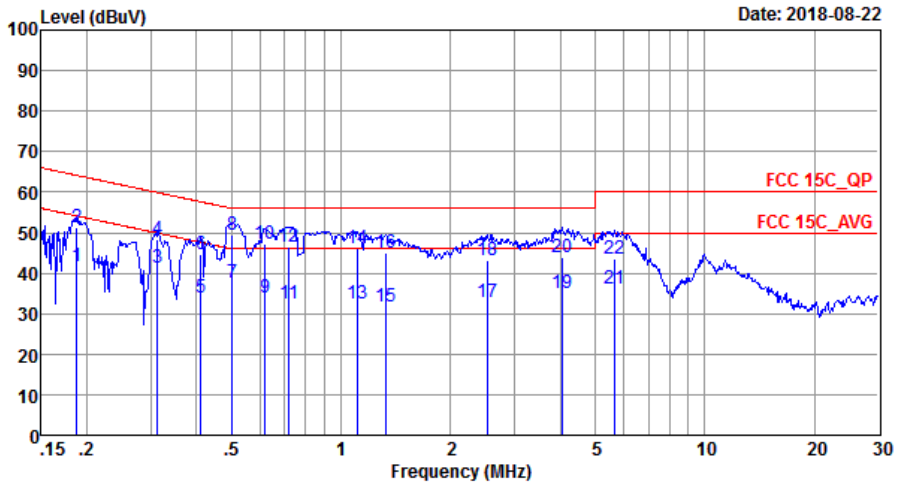
| | |
|---|---|
| **Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))** | **4.8dB** |

**Uncertainty of Radiated Emission Measurement (18000 MHz ~ 40000 MHz)**

| | |
|---|---|
| **Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))** | **4.6dB** |

# Appendix A. AC Conducted Emission Test Results

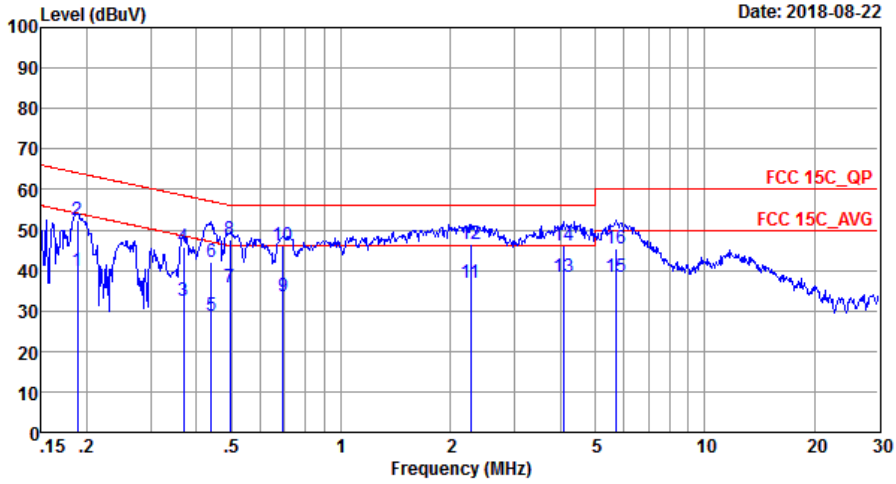
| Test Engineer : | Zhang Xu | Temperature : | 22~25℃ |
|---|---|---|---|
| | | Relative Humidity : | 50~55% |
| Test Voltage : | 120Vac / 60Hz | Phase : | Line |




Site : CO01-SZ
Condition: FCC 15C_QP LISN_20170907_L LINE

| | | Freq | Level | Over Limit | Limit Line | Read Level | LISN Factor | Cable Loss | Remark |
|---|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dBuV | dBuV | dB | dB | |
| 1 | | 0.19 | 41.80 | -12.35 | 54.15 | 31.70 | 0.03 | 10.07 | Average |
| 2 | | 0.19 | 51.30 | -12.85 | 64.15 | 41.20 | 0.03 | 10.07 | QP |
| 3 | | 0.31 | 41.21 | -8.67 | 49.88 | 31.10 | 0.03 | 10.08 | Average |
| 4 | | 0.31 | 48.51 | -11.37 | 59.88 | 38.40 | 0.03 | 10.08 | QP |
| 5 | | 0.41 | 33.91 | -13.68 | 47.59 | 23.80 | 0.03 | 10.08 | Average |
| 6 | | 0.41 | 44.51 | -13.08 | 57.59 | 34.40 | 0.03 | 10.08 | QP |
| 7 | | 0.50 | 37.50 | -8.50 | 46.00 | 27.40 | 0.02 | 10.08 | Average |
| 8 | * | 0.50 | 49.30 | -6.70 | 56.00 | 39.20 | 0.02 | 10.08 | QP |
| 9 | | 0.62 | 34.10 | -11.90 | 46.00 | 24.00 | 0.02 | 10.08 | Average |
| 10 | | 0.62 | 47.40 | -8.60 | 56.00 | 37.30 | 0.02 | 10.08 | QP |
| 11 | | 0.72 | 32.40 | -13.60 | 46.00 | 22.30 | 0.02 | 10.08 | Average |
| 12 | | 0.72 | 46.60 | -9.40 | 56.00 | 36.50 | 0.02 | 10.08 | QP |
| 13 | | 1.11 | 32.37 | -13.63 | 46.00 | 22.20 | 0.08 | 10.09 | Average |
| 14 | | 1.11 | 46.27 | -9.73 | 56.00 | 36.10 | 0.08 | 10.09 | QP |
| 15 | | 1.33 | 31.78 | -14.22 | 46.00 | 21.59 | 0.09 | 10.10 | Average |
| 16 | | 1.33 | 45.08 | -10.92 | 56.00 | 34.89 | 0.09 | 10.10 | QP |
| 17 | | 2.53 | 32.97 | -13.03 | 46.00 | 22.70 | 0.14 | 10.13 | Average |
| 18 | | 2.53 | 43.27 | -12.73 | 56.00 | 33.00 | 0.14 | 10.13 | QP |
| 19 | | 4.05 | 35.14 | -10.86 | 46.00 | 24.79 | 0.18 | 10.17 | Average |
| 20 | | 4.05 | 43.84 | -12.16 | 56.00 | 33.49 | 0.18 | 10.17 | QP |
| 21 | | 5.62 | 36.11 | -13.89 | 50.00 | 25.70 | 0.20 | 10.21 | Average |
| 22 | | 5.62 | 43.71 | -16.29 | 60.00 | 33.30 | 0.20 | 10.21 | QP |

| Test Engineer : | Zhang Xu | Temperature : | 22~25℃ |
|---|---|---|---|
| | | Relative Humidity : | 50~55% |
| Test Voltage : | 120Vac / 60Hz | Phase : | Neutral |




Site : CO01-SZ
Condition: FCC 15C_QP LISN_20170907_N NEUTRAL

| | | Freq | Level | Over Limit | Limit Line | Read Level | LISN Factor | Cable Loss | Remark |
|---|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dBuV | dBuV | dB | dB | |
| 1 | | 0.19 | 39.90 | -14.21 | 54.11 | 29.80 | 0.03 | 10.07 | Average |
| 2 | | 0.19 | 52.40 | -11.71 | 64.11 | 42.30 | 0.03 | 10.07 | QP |
| 3 | | 0.37 | 32.50 | -16.02 | 48.52 | 22.40 | 0.02 | 10.08 | Average |
| 4 | | 0.37 | 45.70 | -12.82 | 58.52 | 35.60 | 0.02 | 10.08 | QP |
| 5 | | 0.44 | 28.90 | -18.17 | 47.07 | 18.80 | 0.02 | 10.08 | Average |
| 6 | | 0.44 | 41.90 | -15.17 | 57.07 | 31.80 | 0.02 | 10.08 | QP |
| 7 | | 0.49 | 35.80 | -10.30 | 46.10 | 25.70 | 0.02 | 10.08 | Average |
| 8 | | 0.49 | 47.70 | -8.40 | 56.10 | 37.60 | 0.02 | 10.08 | QP |
| 9 | | 0.69 | 33.40 | -12.60 | 46.00 | 23.30 | 0.02 | 10.08 | Average |
| 10 | | 0.69 | 46.00 | -10.00 | 56.00 | 35.90 | 0.02 | 10.08 | QP |
| 11 | | 2.27 | 36.96 | -9.04 | 46.00 | 26.80 | 0.04 | 10.12 | Average |
| 12 | | 2.27 | 46.46 | -9.54 | 56.00 | 36.30 | 0.04 | 10.12 | QP |
| 13 | * | 4.09 | 38.52 | -7.48 | 46.00 | 28.30 | 0.05 | 10.17 | Average |
| 14 | | 4.09 | 46.22 | -9.78 | 56.00 | 36.00 | 0.05 | 10.17 | QP |
| 15 | | 5.71 | 38.38 | -11.62 | 50.00 | 28.10 | 0.07 | 10.21 | Average |
| 16 | | 5.71 | 45.38 | -14.62 | 60.00 | 35.10 | 0.07 | 10.21 | QP |

# Appendix B. Radiated Spurious Emission

**2.4GHz 2400~2483.5MHz**

**BT (Band Edge @ 3m)**

| BT | Note | Frequency | Level | Over Limit | Limit Line | Read Level | Antenna Factor | Cable Loss | Preamp Factor | Ant Pos | Table Pos | Peak Avg. | Pol. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ( MHz ) | ( dBμV/m ) | ( dB ) | ( dBμV/m ) | ( dBμV ) | ( dB/m ) | ( dB ) | ( dB ) | ( cm ) | ( deg ) | (P/A) | (H/V) |
| BT CH00 2402MHz | | 2325.44 | 39.8 | -34.2 | 74 | 39.91 | 27.91 | 4.98 | 33 | 164 | 329 | P | H |
| | | 2325.44 | 15.01 | -38.99 | 54 | - | - | - | - | 164 | 329 | A | H |
| | * | 2402 | 100.59 | - | - | 100.73 | 27.8 | 5.06 | 33 | 164 | 329 | P | H |
| | * | 2402 | 75.8 | - | - | - | - | - | - | 164 | 329 | A | H |
| | | 2325.12 | 41.01 | -32.99 | 74 | 41.12 | 27.91 | 4.98 | 33 | 189 | 8 | P | V |
| | | 2325.12 | 16.22 | -37.78 | 54 | - | - | - | - | 189 | 8 | A | V |
| | * | 2402 | 101.24 | - | - | 101.38 | 27.8 | 5.06 | 33 | 189 | 8 | P | V |
| | * | 2402 | 76.45 | - | - | - | - | - | - | 189 | 8 | A | V |
| BT CH 39 2441MHz | | 2363.9 | 40.83 | -33.17 | 74 | 40.96 | 27.85 | 5.02 | 33 | 253 | 326 | P | H |
| | | 2363.9 | 16.04 | -37.96 | 54 | - | - | - | - | 253 | 326 | A | H |
| | * | 2441 | 101.39 | - | - | 101.56 | 27.71 | 5.12 | 33 | 253 | 326 | P | H |
| | * | 2441 | 76.6 | - | - | - | - | - | - | 253 | 326 | A | H |
| | | 2493.28 | 39.54 | -34.46 | 74 | 39.72 | 27.63 | 5.19 | 33 | 253 | 326 | P | H |
| | | 2493.28 | 14.75 | -39.25 | 54 | - | - | - | - | 253 | 326 | A | H |
| | | 2364.32 | 40.34 | -33.66 | 74 | 40.47 | 27.85 | 5.02 | 33 | 143 | 290 | P | V |
| | | 2364.32 | 15.55 | -38.45 | 54 | - | - | - | - | 143 | 290 | A | V |
| | * | 2441 | 101.49 | - | - | 101.66 | 27.71 | 5.12 | 33 | 143 | 290 | P | V |
| | * | 2441 | 76.7 | - | - | - | - | - | - | 143 | 290 | A | V |
| | | 2498.74 | 40.07 | -33.93 | 74 | 40.25 | 27.63 | 5.19 | 33 | 143 | 290 | P | V |
| | | 2498.74 | 15.28 | -38.72 | 54 | - | - | - | - | 143 | 290 | A | V |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BT CH 78 2480MHz | * | 2480 | 102.07 | - | - | 102.22 | 27.66 | 5.19 | 33 | 215 | 327 | P | H |
| | * | 2480 | 77.28 | - | - | - | - | - | - | 215 | 327 | A | H |
| | | 2488.8 | 45.85 | -28.15 | 74 | 46.03 | 27.63 | 5.19 | 33 | 215 | 327 | P | H |
| | | 2488.8 | 21.06 | -32.94 | 54 | - | - | - | - | 215 | 327 | A | H |
| | * | 2480 | 102.98 | - | - | 103.13 | 27.66 | 5.19 | 33 | 161 | 10 | P | V |
| | * | 2480 | 78.19 | - | - | - | - | - | - | 161 | 10 | A | V |
| | | 2483.68 | 49.94 | -24.06 | 74 | 50.09 | 27.66 | 5.19 | 33 | 161 | 10 | P | V |
| | | 2483.68 | 25.15 | -28.85 | 54 | - | - | - | - | 161 | 10 | A | V |
| **Remark** | 1. No other spurious found.<br>2. All results are PASS against Peak and Average limit line. | | | | | | | | | | | | |

**2.4GHz 2400~2483.5MHz**

**BT (Harmonic @ 3m)**

| BT | Note | Frequency ( MHz ) | Level ( dBμV/m ) | Over Limit ( dB ) | Limit Line ( dBμV/m ) | Read Level ( dBμV ) | Antenna Factor ( dB/m ) | Cable Loss ( dB ) | Preamp Factor ( dB ) | Ant Pos ( cm ) | Table Pos ( deg ) | Peak Avg. (P/A) | Pol. (H/V) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BT CH 00 2402MHz | | 4804 | 38.71 | -35.29 | 74 | 57.36 | 31.1 | 8.59 | 58.34 | 151 | 219 | P | H |
| | | 4804 | 13.92 | -40.08 | 54 | - | - | - | - | 151 | 219 | A | H |
| | | 4804 | 39.34 | -34.66 | 74 | 57.99 | 31.1 | 8.59 | 58.34 | 165 | 70 | P | V |
| | | 4804 | 14.55 | -39.45 | 54 | - | - | - | - | 165 | 70 | A | V |
| BT CH 39 2441MHz | | 4882 | 39.08 | -34.92 | 74 | 57.62 | 31.17 | 8.62 | 58.33 | 150 | 258 | P | H |
| | | 4882 | 14.29 | -39.71 | 54 | - | - | - | - | 150 | 258 | A | H |
| | | 7323 | 45.3 | -28.7 | 74 | 58.39 | 36.08 | 10.24 | 59.41 | 152 | 309 | P | H |
| | | 7323 | 20.51 | -33.49 | 54 | - | - | - | - | 152 | 309 | A | H |
| | | 4882 | 39.91 | -34.09 | 74 | 58.45 | 31.17 | 8.62 | 58.33 | 157 | 100 | P | V |
| | | 4882 | 15.12 | -38.88 | 54 | - | - | - | - | 157 | 100 | A | V |
| | | 7323 | 45.38 | -28.62 | 74 | 58.47 | 36.08 | 10.24 | 59.41 | 172 | 90 | P | V |
| | | 7323 | 20.59 | -33.41 | 54 | - | - | - | - | 172 | 90 | A | V |
| BT CH 78 2480MHz | | 4960 | 39.85 | -34.15 | 74 | 58.27 | 31.25 | 8.65 | 58.32 | 118 | 289 | P | H |
| | | 4960 | 15.06 | -38.94 | 54 | - | - | - | - | 118 | 289 | A | H |
| | | 7440 | 45.72 | -28.28 | 74 | 58.5 | 36.44 | 10.25 | 59.47 | 158 | 273 | P | H |
| | | 7440 | 20.93 | -33.07 | 54 | - | - | - | - | 158 | 273 | A | H |
| | | 4960 | 40.3 | -33.7 | 74 | 58.72 | 31.25 | 8.65 | 58.32 | 192 | 213 | P | V |
| | | 4960 | 15.51 | -38.49 | 54 | - | - | - | - | 192 | 213 | A | V |
| | | 7440 | 44.8 | -29.2 | 74 | 57.58 | 36.44 | 10.25 | 59.47 | 114 | 202 | P | V |
| | | 7440 | 20.01 | -33.99 | 54 | - | - | - | - | 114 | 202 | A | V |
| **Remark** | 1. No other spurious found.<br>2. All results are PASS against Peak and Average limit line. | | | | | | | | | | | | |

## Emission below 1GHz

### 2.4GHz BT (LF)

| BT | Note | Frequency | Level | Over | Limit | Read | Antenna | Cable | Preamp | Ant | Table | Peak | Pol. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Limit | Line | Level | Factor | Loss | Factor | Pos | Pos | Avg. | |
| | | ( MHz ) | ( dBμV/m ) | ( dB ) | ( dBμV/m ) | (dBμV) | ( dB/m ) | ( dB ) | ( dB ) | ( cm ) | ( deg ) | (P/A) | (H/V) |
| 2.4GHz BT LF | | 30.97 | 23.83 | -16.17 | 40 | 31.24 | 24.62 | 0.57 | 32.6 | - | - | P | H |
| | | 69.77 | 20.62 | -19.38 | 40 | 39.77 | 12.5 | 0.85 | 32.5 | - | - | P | H |
| | | 95.96 | 22.57 | -20.93 | 43.5 | 37.08 | 16.18 | 1.01 | 31.7 | - | - | P | H |
| | | 149.31 | 21.82 | -21.68 | 43.5 | 36.17 | 16.58 | 1.27 | 32.2 | - | - | P | H |
| | | 203.63 | 30.05 | -13.45 | 43.5 | 44.42 | 15.5 | 1.48 | 31.35 | 126 | 92 | P | H |
| | | 234.67 | 28.25 | -17.75 | 46 | 41.51 | 17 | 1.6 | 31.86 | - | - | P | H |
| | | 30 | 31.86 | -8.14 | 40 | 38.7 | 25.2 | 0.56 | 32.6 | 148 | 129 | P | V |
| | | 52.31 | 23.4 | -16.6 | 40 | 41.22 | 13.94 | 0.74 | 32.5 | - | - | P | V |
| | | 70.74 | 23.63 | -16.37 | 40 | 42.7 | 12.57 | 0.86 | 32.5 | - | - | P | V |
| | | 94.02 | 23.48 | -20.02 | 43.5 | 38.36 | 15.82 | 1 | 31.7 | - | - | P | V |
| | | 202.66 | 25.74 | -17.76 | 43.5 | 40.11 | 15.5 | 1.48 | 31.35 | - | - | P | V |
| | | 881.66 | 28.96 | -17.04 | 46 | 30.57 | 26.69 | 3.28 | 31.58 | - | - | P | V |
| **Remark** | 1. No other spurious found.<br>2. All results are PASS against limit line. | | | | | | | | | | | | |

**Note symbol**

| | |
|---|---|
| * | **Fundamental Frequency** which can be ignored. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency. |
| ! | Test result is **over limit** line. |
| P/A | **P**eak or **A**verage |
| H/V | **H**orizontal or **V**ertical |

## A calculation example for radiated spurious emission is shown as below:

| WIFI | Note | Frequency | Level | Over | Limit | Read | Antenna | Cable | Preamp | Ant | Table | Peak | Pol. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ant. | | | | Limit | Line | Level | Factor | Loss | Factor | Pos | Pos | Avg. | |
| 1+2 | | ( MHz ) | ( dBμV/m ) | ( dB ) | ( dBμV/m ) | ( dBμV ) | ( dB/m ) | ( dB ) | ( dB ) | ( cm ) | ( deg ) | (P/A) | (H/V) |
| 802.11b CH 01 2412MHz | | 2390 | 55.45 | -18.55 | 74 | 54.51 | 32.22 | 4.58 | 35.86 | 103 | 308 | P | H |
| | | 2390 | 43.54 | -10.46 | 54 | 42.6 | 32.22 | 4.58 | 35.86 | 103 | 308 | A | H |

1. Level(dBμV/m) =

Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)

2. Over Limit(dB) = Level(dBμV/m) – Limit Line(dBμV/m)

**For Peak Limit @ 2390MHz:**

1. Level(dBμV/m)

= Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)

= 32.22(dB/m) + 4.58(dB) + 54.51(dBμV) – 35.86 (dB)

= 55.45 (dBμV/m)

2. Over Limit(dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 55.45(dBμV/m) – 74(dBμV/m)

= -18.55(dB)

**For Average Limit @ 2390MHz:**

1. Level(dBμV/m)

= Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)

= 32.22(dB/m) + 4.58(dB) + 42.6(dBμV) – 35.86 (dB)

= 43.54 (dBμV/m)

2. Over Limit(dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

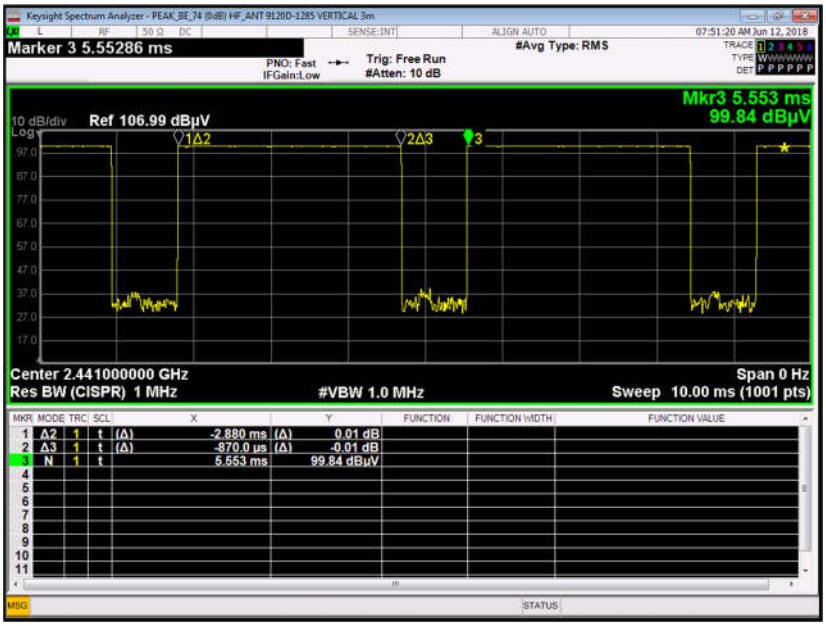
= 43.54(dBμV/m) – 54(dBμV/m)

= -10.46(dB)

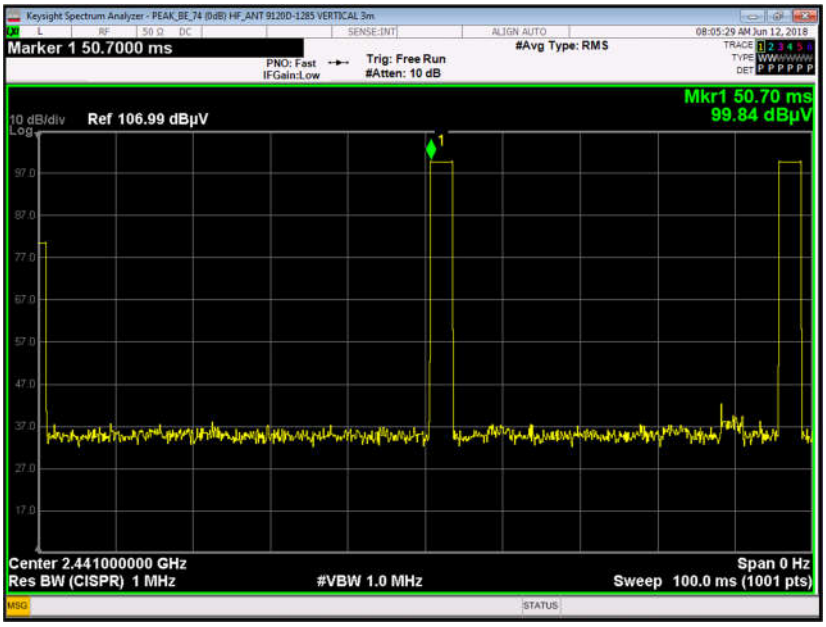
**Both peak and average measured complies with the limit line, so test result is "PASS".**

# Appendix C. Duty Cycle Plots

## DH5 on time (One Pulse) Plot on Channel 39




## DH5 on time (Count Pulses) Plot on Channel 39




**Note:**

1. Worst case Duty cycle = on time/100 milliseconds = 2 * 2.88 / 100 = 5.76 %
2. Worst case Duty cycle correction factor = 20*log(Duty cycle) = -24.79 dB
3. DH5 has the highest duty cycle worst case and is reported.