



RF REPORT

Report Reference No......: **TRE1708000801** **R/C.....:** 31689

FCC ID.....: 2AMHN1001055

IC.....: 21797-1001055

Applicant's name.....: Cellnovo Limited

Address.....: Pencoed Technology Park, Pencoed, CF35 5HZ. United Kingdom

Manufacturer.....: CK Telecom Limited

Address.....: Room 802/901/902 Building 4C, Software Industry Base, Keyuan Road, Nanshan Dist, Shenzhen, Guangdong, China

Test item description.....: Cellnovo OTS Handset

Trade Mark: Cellnovo

Model/Type reference.....: 1001055

Standard.....: FCC CFR Title 47 Part 15 Subpart C Section 15.247
RSS-247: Issue 2, February 2017 / RSS-GEN: Issue 4, November 2014

Date of receipt of test sample.....: Jun. 16, 2017

Date of testing.....: Jun. 21, 2017 - Jul. 05, 2017

Date of issue.....: Jul. 06, 2017

Result.....: **Pass**

| | | | |
|---|--|--|--|
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TABLE OF CONTENTS

| | |
|---|-----------|
| 1. GENERAL INFORMATION | 3 |
| 1.1. EUT Description | 3 |
| 1.2. Test Standards and Results..... | 4 |
| 1.3. Description of test environment test modes..... | 5 |
| 1.4. Facilities and Accreditations | 7 |
| 2. 47 CFR PART 15C REQUIREMENTS..... | 8 |
| 2.1. Antenna requirement..... | 8 |
| 2.2. Peak Output Power..... | 9 |
| 2.3. 6dB & 99% Bandwidth | 10 |
| 2.4. Conducted Band Edges and Spurious Emissions..... | 11 |
| 2.5. Power spectral density (PSD) | 13 |
| 2.6. Radiated Band Edge and Spurious Emission..... | 15 |
| 2.7. Conducted Emission | 24 |
| 3. LIST OF MEASURING EQUIPMENT | 28 |

APPENDIX A: TEST RESULT OF CONDUCTED TEST

| Change History | | |
|----------------|------------|-------------------|
| Issue | Date | Reason for change |
| 1.0 | 2017.07.06 | First edition |
| | | |
| | | |

1. General Information

1.1. EUT Description

| | |
|---------------------------------|---------------------------------------|
| EUT Type | Cellnovo OTS Handset |
| Hardware Version | MIRAGE03A-V1.0 |
| Software Version | MIRAGE03A-S00B_CKT_L142EN_V101_150724 |
| EUT supports Radios application | Bluetooth V4.0 BLE |
| Frequency Range | 2402MHz~2480MHz |
| Channel Number | 40 |
| Bit Rate of Transmitter | 1Mbps |
| Modulation Type | GFSK |
| Antenna Type | PIFA Antenna |
| Antenna Gain | 1dBi |

Note 1: The EUT is a BLUETOOTH SPEAKER, it contain Bluetooth 4.0 BLE chipset operating at 2.4GHz ISM band; the frequencies allocated for the Bluetooth 4.0 BLE is $F(\text{MHz})=2402+2*n$ ($0 \leq n \leq 39$). The lowest, middle, highest channel numbers of the Bluetooth Module used and tested in this report are separately 0 (2402MHz), 19(2440MHz) and 39 (2480MHz).

Note 2: For a more detailed description, please refer to Specification or User's Manual supplied by the applicant and/or manufacturer.

1.2. Test Standards and Results

The objective of the report is to perform testing according to 47 CFR Part 15 Subpart C (Bluetooth, 2.4GHz ISM band radiators) for the EUT FCC / IC Certification:

| No. | Identity | Document Title |
|-----|---------------------------------|--|
| 1 | 47 CFR Part 15 Subpart C 2017 | Radio Frequency Devices |
| 2 | ANSI C63.10 2013 | American National Standard for Testing Unlicensed Wireless Devices |
| 3 | RSS-GEN: Issue 4, November 2014 | General Requirements and Information for the Certification of Radio Apparatus |
| 4 | RSS-247: Issue 2, February 2017 | Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices |

Test detailed items/section required by FCC/IC rules and results are as below:

| No. | Standard(s) Section | | Description | Result |
|-----|------------------------|-----------------------------------|---|--------|
| | FCC | IC | | |
| 1 | 15.203 | 8.3 | Antenna Requirement | PASS |
| 2 | 15.247(b)(3) | RSS-247 Issue2 - 5.4(4) | Peak Output Power | PASS |
| 3 | 15.247(a)(2) | RSS-247 Issue2 - 5.2(1) | Bandwidth – 6dB bandwidth | PASS |
| 4 | / | RSS Gen clause - 4.6.1 | 99% Occupied Bandwidth | PASS |
| 5 | 15.247(d) | RSS-247 Issue2 - 5.5 | Conducted Spurious Emission | PASS |
| 6 | 15.247(e) | RSS-247 Issue2 - 5.2(2) | Power spectral density (PSD) | PASS |
| 7 | 15.205 15.247(d) | RSS-247 Issue2 - 5.5 RSS - Gen | Band Edge | PASS |
| 8 | 15.209(a) | RSS-GEN | Spurious emissions radiated below 30MHz | PASS |
| 9 | 15.247(d) 15.109 | RSS-247 Issue2 - 5.5 RSS-Gen | Spurious emissions radiated 30 MHz to 1GHz and above 1GHz | PASS |
| 10 | 15.107(a), 15.20(c) | RSS-GEN | Conducted Emission | PASS |

The tests of Conducted Emission and Radiated Emission were performed according to the method of measurements prescribed in ANSI C63.10 2013.

These RF tests were performed according to the method of measurements prescribed in KDB558074 D01 V03r05.

1.3. Description of test environment test modes

40 channels are provided for Bluetooth LE 4.0

| Channel | Frequency(MHz) | Channel | Frequency(MHz) |
|---------|----------------|---------|----------------|
| 0 | 2402 | 20 | 2442 |
| 1 | 2404 | 21 | 2444 |
| 2 | 2406 | 22 | 2446 |
| 3 | 2408 | 23 | 2448 |
| 4 | 2410 | 24 | 2450 |
| 5 | 2412 | 25 | 2452 |
| 6 | 2414 | 26 | 2454 |
| 7 | 2416 | 27 | 2456 |
| 8 | 2418 | 28 | 2458 |
| 9 | 2420 | 29 | 2460 |
| 10 | 2422 | 30 | 2462 |
| 11 | 2424 | 31 | 2464 |
| 12 | 2426 | 32 | 2466 |
| 13 | 2428 | 33 | 2468 |
| 14 | 2430 | 34 | 2470 |
| 15 | 2432 | 35 | 2472 |
| 16 | 2434 | 36 | 2474 |
| 17 | 2436 | 37 | 2476 |
| 18 | 2438 | 38 | 2478 |
| 19 | 2440 | 39 | 2480 |

To investigate the maximum EMI emission characteristics generates from EUT, the test system was pre-scanning tested base on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of this EUT operation mode(s) or test configuration mode(s) mentioned above was evaluated respectively.

| Pretest Mode | Description |
|--------------|-----------------------|
| Mode 1 | TX CH 0 |
| Mode 2 | TX CH 19 |
| Mode 3 | TX CH 39 |
| Mode 4 | Normal operating mode |

| For Conducted Emission | |
|------------------------|-----------------------|
| Final Test Mode | Description |
| Mode 4 | Normal operating mode |

| For Radiated Emission | |
|-----------------------|-------------|
| Final Test Mode | Description |
| Mode 1 | TX CH 0 |
| Mode 2 | TX CH 19 |
| Mode 3 | TX CH 39 |

Note1: The EUT was programmed to be in continuously transmitting mode and the transmit duty cycle is not less than 98%.

Note2: Fully-charged battery was used during test.



1.4. Facilities and Accreditations

1.4.1. Facilities

CNAS-Lab Code: L1225

Shenzhen Huatongwei International Inspection Co., Ltd. has been assessed and proved to be in compliance with CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories (identical to ISO/IEC17025: 2005 General Requirements) for the Competence of Testing and Calibration Laboratories, Date of Registration: February 28, 2015. Valid time is until February 27, 2018.

FCC-Registration No.: 317478

Shenzhen Huatongwei International Inspection Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the FCC (Federal Communications Commission). The acceptance letter from the FCC is maintained in our files. Registration 317478, Renewal date Jul. 18, 2014, valid time is until Jul. 18, 2017.

IC-Registration No.: 5377B

Two 3m Alternate Test Site of Shenzhen Huatongwei International Inspection Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for the performance of radiated measurements with Registration No. 5377B on Dec.03, 2014, valid time is until Dec.03, 2017.

1.4.2. Test Environment Conditions

During the measurement, the environmental conditions were within the listed ranges:

| | |
|-----------------------------|--------------|
| Temperature (°C): | 15°C - 35°C |
| Relative Humidity (%): | 30% -60% |
| Atmospheric Pressure (kPa): | 86KPa-106KPa |



2. 47 CFR Part 15C Requirements

2.1. Antenna requirement

2.1.1. Applicable Standard

According to FCC 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

And according to FCC 47 CFR Section 15.247(c), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

2.1.2. Antenna Information

Antenna Category: PIFA antenna, can't be removed.

Antenna General Information:

| No. | EUT | Ant. Type | Gain(dBi) |
|-----|----------------------|-----------|-----------|
| 1 | Cellnovo OTS Handset | PIFA | 1 |

2.1.3. Result: comply

The EUT has a permanently and irreplaceable attached antenna. Please refer to the EUT internal photos.

2.2. Peak Output Power

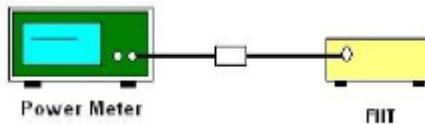
2.2.1. Limit of Peak Output Power

For systems using digital modulation in the 2400-2483.5MHz, the limit for peak output power is 30dBm. If transmitting antenna of directional gain greater than 6dBi is used, the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the antenna exceeds 6 dBi. 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.

2.2.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.2.3. Test Setup



2.2.4. Test Procedures

1. The testing follows the Measurement Procedure of FCC KDB 558074D01 v03r05.
2. 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.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Measure the conducted output power and record the results in the test report.

2.2.5. Test Result

| Channel | Frequency (MHz) | RF Power(dBm) | Limit (dBm) | Verdict |
|---------|--------------------|---------------|----------------|---------|
| | | GFSK/1Mbps | | |
| 0 | 2402 | 0.33 | 30 | PASS |
| 19 | 2440 | -0.13 | | PASS |
| 39 | 2480 | 0.98 | | PASS |

2.3. 6dB & 99% Bandwidth

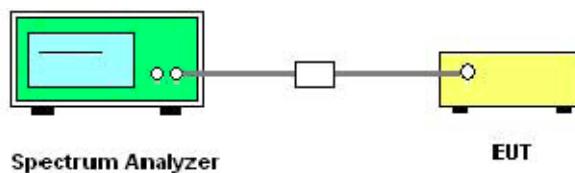
2.3.1. Limit of 6dB & 99% Bandwidth

The minimum 6 dB bandwidth shall be at least 500 kHz.

2.3.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.3.3. Test Setup



2.3.4. Test Procedures

1. The testing follows FCC KDB 558074D01 v03r05.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. Set the Video bandwidth (VBW) = 300 kHz. In order to make an accurate measurement. The 6dB bandwidth must be greater than 500 kHz.
5. For 99% Bandwidth Measurement, the spectrum analyzer's resolution bandwidth (RBW) is set 30 kHz and set the Video bandwidth (VBW) = 100 kHz.
6. Measure and record the results in the test report.

2.3.5. Test Results of 6dB and 99% Bandwidth

Please refer to Appendix A for detail

2.4. Conducted Band Edges and Spurious Emissions

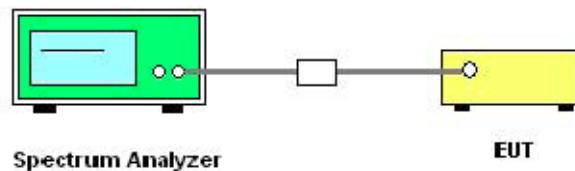
2.4.1. Limit of Conducted Band Edges and Spurious Emissions

All harmonics/spurious must be at least 20 dB down from the highest emission level within the authorized band.

2.4.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.4.3. Test Setup



2.4.4. Test Procedure

1. The testing follows FCC KDB 558074D01 v03r05.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Set RBW = 100 kHz, VBW=300 kHz, Peak Detector. Unwanted Emissions measured in any 100kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when maximum peak conducted output power procedure is used. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB per 15.247(d).
5. Measure and record the results in the test report.
6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.



2.4.5. Test Results of Conducted Band Edges and Spurious Emissions

Please refer to Appendix A for detail

2.5. Power spectral density (PSD)

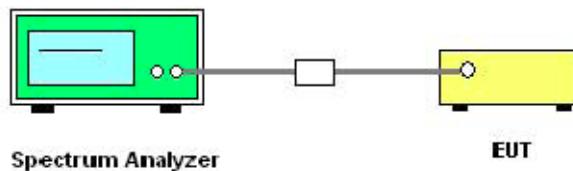
2.5.1. Limit of Power Spectral Density

The peak power spectral density shall not be greater than 8dBm in any 3kHz band at any time interval of continuous transmission.

2.5.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.5.3. Test Setup



2.5.4. Test Procedures

1. The testing follows Measurement Procedure 10.2 Method PKPSD of FCC KDB 558074D01 v03r05.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 3 kHz. Video bandwidth VBW = 10 kHz In order to make an accurate measurement, set the span to 1.5 times DTS Channel Bandwidth. (6dB BW)
5. Detector = peak, Sweep time = auto couple, Trace mode = max hold, Allow trace to fully stabilize. Use the peak marker function to determine the maximum power level.
6. Measure and record the results in the test report.
7. The Measured power density (dBm)/ 100kHz is a reference level and used as 20dBc down limit line for Conducted Band Edges and Conducted Spurious Emission.



2.5.5. Test Results of Power spectral density

Please refer to Appendix A for detail

2.6. Radiated Band Edge and Spurious Emission

2.6.1. 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. If the output power of this device was measured by spectrum analyzer, the attenuation under this paragraph shall be 30 dB instead of 20 dB. In addition, radiated emissions which fall in the restricted bands must also comply with the FCC section 15.209 limits as below.

Note: Wireless charger configuration was evaluated.

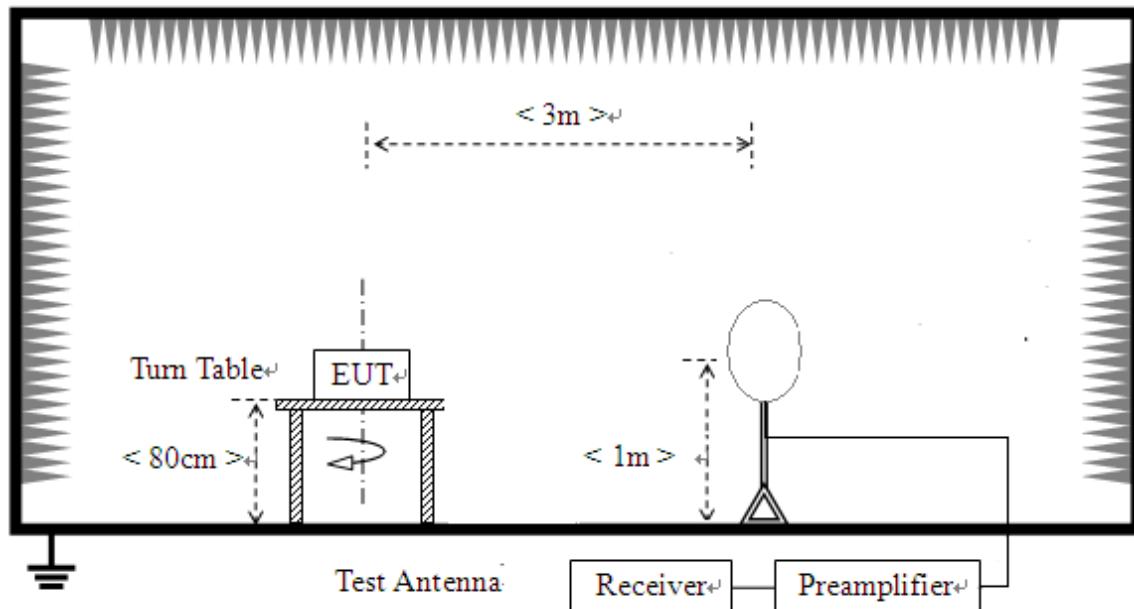
| Frequency (MHz) | Field Strength (μ V/m) | Measurement Distance (m) |
|-----------------|-----------------------------|--------------------------|
| 0.009 - 0.490 | 2400/F(kHz) | 300 |
| 0.490 - 1.705 | 24000/F(kHz) | 30 |
| 1.705 - 30.0 | 30 | 30 |
| 30 - 88 | 100 | 3 |
| 88 - 216 | 150 | 3 |
| 216 - 960 | 200 | 3 |
| Above 960 | 500 | 3 |

2.6.2. Measuring Instruments

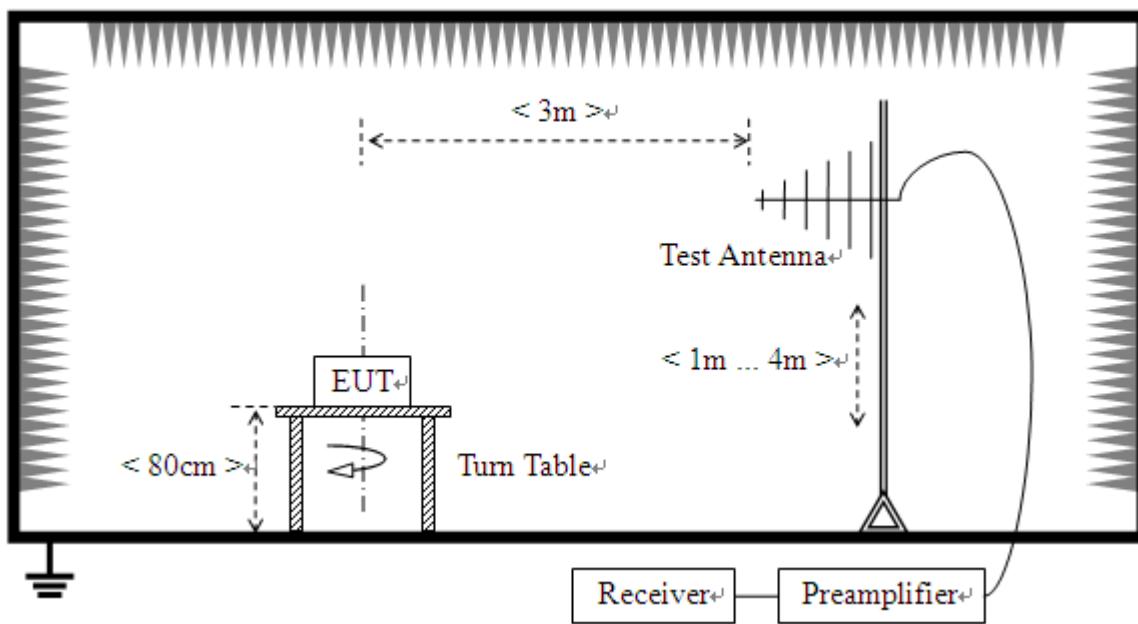
The measuring equipment is listed in the section 3 of this test report.

2.6.3. Test Setup

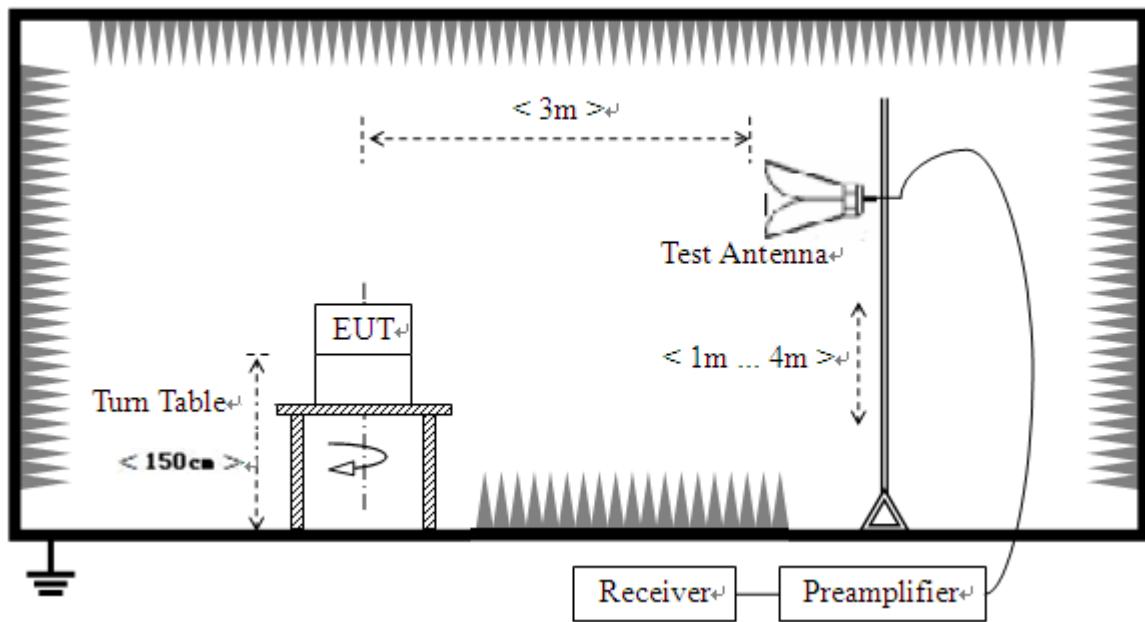
For radiated emissions from 9kHz to 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



2.6.4. Test Procedures

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meters semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
3. Height of receiving antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
6. If the emission level of the EUT in peak mode was lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported.
Otherwise the emissions would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
7. For the radiated emission test above 1GHz:
Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.



NOTE:

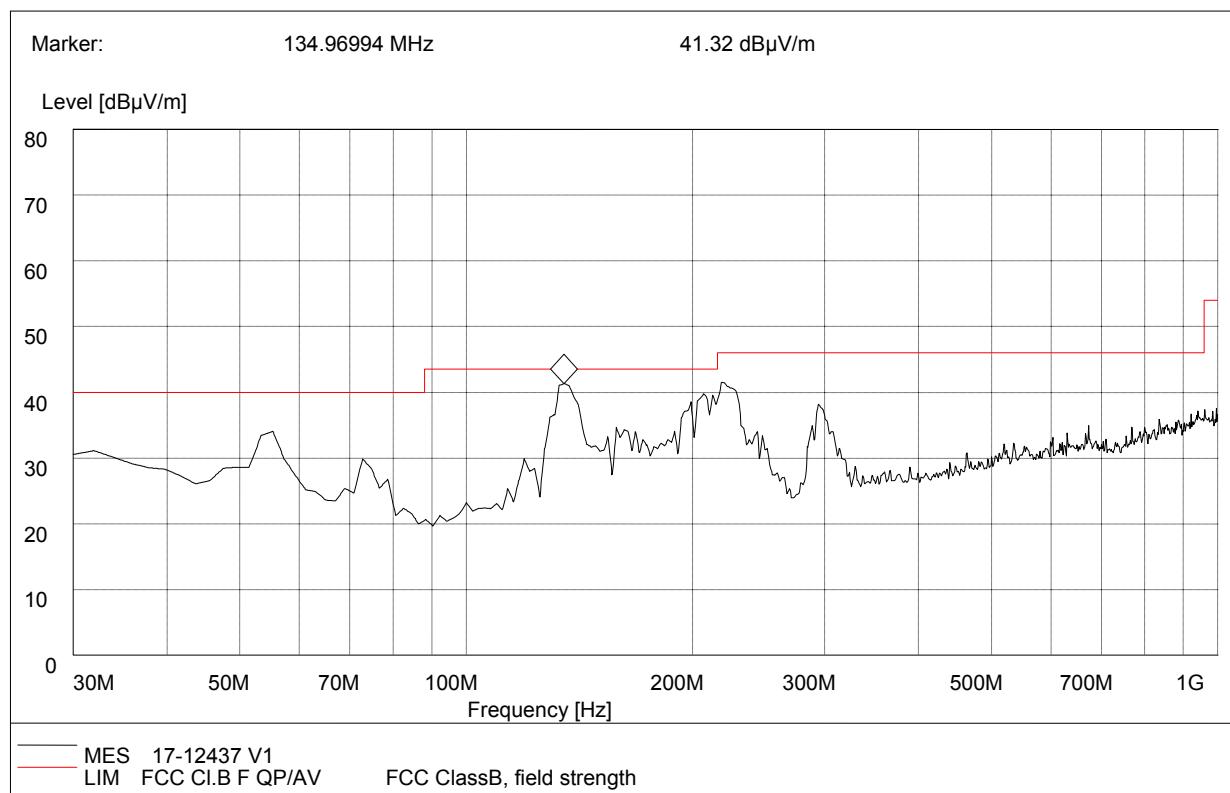
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz for Peak detection at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is $\geq 1/T$ (Duty cycle $< 98\%$) or 10Hz(Duty cycle $> 98\%$) for Average detection (AV) at frequency above 1GHz.
4. All radiated emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

2.6.5. Test Results of Radiated Band Edge and Spurious Emission

For 9KHz to 30MHz

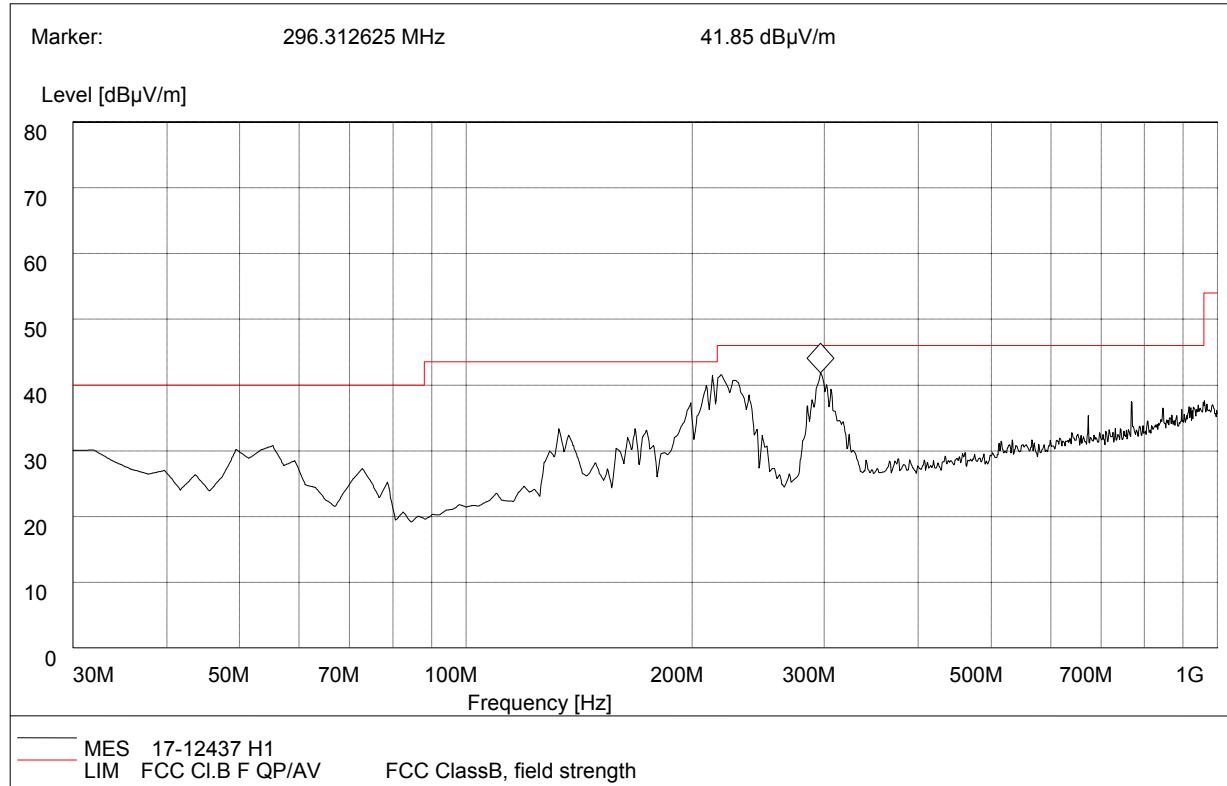
The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

For 30MHz to 1000 MHz



Plot A: 30MHz to 1GHz, Antenna Vertical

| Frequency (MHz) | QuasiPeak (dB μ V/m) | Bandwidth (kHz) | Antenna height (cm) | Limit (dB μ V/m) | Antenna | Verdict |
|-----------------|--------------------------|-----------------|---------------------|----------------------|----------|---------|
| 33.190000 | 29.18 | 120.000 | 100.0 | 40.0 | Vertical | Pass |
| 56.180000 | 32.05 | 120.000 | 100.0 | 40.0 | Vertical | Pass |
| 73.370000 | 27.40 | 120.000 | 100.0 | 40.0 | Vertical | Pass |
| 135.810000 | 39.39 | 120.000 | 100.0 | 43.5 | Vertical | Pass |
| 219.050000 | 40.58 | 120.000 | 100.0 | 46.0 | Vertical | Pass |
| 295.180000 | 37.18 | 120.000 | 100.0 | 46.0 | Vertical | Pass |



Plot B: 30MHz to 1GHz, Antenna Horizontal

| Frequency (MHz) | QuasiPeak (dB μ V/m) | Bandwidth (kHz) | Antenna height (cm) | Limit (dB μ V/m) | Antenna | Verdict |
|-----------------|--------------------------|-----------------|---------------------|----------------------|------------|---------|
| 30.850000 | 27.55 | 120.000 | 100.0 | 40.0 | Horizontal | Pass |
| 56.180000 | 28.48 | 120.000 | 100.0 | 40.0 | Horizontal | Pass |
| 133.870000 | 31.92 | 120.000 | 100.0 | 43.5 | Horizontal | Pass |
| 168.690000 | 31.27 | 120.000 | 100.0 | 43.5 | Horizontal | Pass |
| 213.230000 | 39.38 | 120.000 | 100.0 | 43.5 | Horizontal | Pass |
| 298.510000 | 39.48 | 120.000 | 100.0 | 46.0 | Horizontal | Pass |

For 1GHz to 25GHz

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M (0CH_2402MHz)

| No. | Fre. (MHz) | Emssion Level (dBuV/m) | | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV/m) | Cab. Loss (dB) | Ant. Factor (dB) | Pre. Amp. (dB) | Cor. Factor (dB/m) |
|-----|---------------|------------------------------|----|-------------------|----------------|--------------------------|----------------------------|--------------------------|----------------------|------------------------|----------------------|--------------------------|
| 1 | 1001.94 | 44.86 | PK | 74.00 | -29.14 | 1.50 H | 36 | 45.66 | 1.5 | 29.6 | 31.9 | -0.8 |
| 2 | 1001.94 | 34.14 | AV | 54.00 | -19.86 | 1.50 H | 36 | 34.94 | 1.5 | 29.6 | 31.9 | -0.8 |
| 3 | 2390.18 | 48.21 | PK | 74.00 | -25.79 | 1.50 H | 52 | 46.91 | 5.2 | 28.6 | 32.5 | 1.3 |
| 4 | 2390.18 | 36.56 | AV | 54.00 | -17.44 | 1.50 H | 52 | 35.26 | 5.2 | 28.6 | 32.5 | 1.3 |
| 5 | 4799.60 | 47.75 | PK | 74.00 | -26.25 | 1.50 H | 60 | 41.35 | 7.4 | 30.4 | 31.4 | 6.4 |
| 6 | 4799.60 | 36.35 | AV | 54.00 | -17.65 | 1.50 H | 60 | 29.95 | 7.4 | 30.4 | 31.4 | 6.4 |

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M (0CH_2402MHz)

| No. | Frequency (MHz) | Emssion Level (dBuV/m) | | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV/m) | Cab. Loss (dB) | Ant. Factor (dB) | Pre. Amp. (dB) | Cor. Factor (dB/m) |
|-----|--------------------|------------------------------|----|-------------------|----------------|--------------------------|----------------------------|--------------------------|----------------------|------------------------|----------------------|--------------------------|
| 1 | 1001.94 | 45.12 | PK | 74.00 | -28.88 | 1.50 V | 45 | 45.92 | 1.5 | 29.6 | 31.9 | -0.8 |
| 2 | 1001.94 | 34.37 | AV | 54.00 | -19.63 | 1.50 V | 45 | 35.17 | 1.5 | 29.6 | 31.9 | -0.8 |
| 3 | 2390.18 | 48.85 | PK | 74.00 | -25.15 | 1.50 V | 33 | 47.55 | 5.2 | 28.6 | 32.5 | 1.3 |
| 4 | 2390.18 | 38.56 | AV | 54.00 | -15.44 | 1.50 V | 33 | 37.26 | 5.2 | 28.6 | 32.5 | 1.3 |
| 5 | 4799.60 | 48.29 | PK | 74.00 | -25.71 | 1.50 V | 50 | 41.89 | 7.4 | 30.4 | 31.4 | 6.4 |
| 6 | 4799.60 | 36.35 | AV | 54.00 | -17.65 | 1.50 V | 50 | 29.95 | 7.4 | 30.4 | 31.4 | 6.4 |

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M (19CH_2440MHz)

| No. | Fre. (MHz) | Emssion Level (dBuV/m) | | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV/m) | Cab. Loss (dB) | Ant. Factor (dB) | Pre. Amp. (dB) | Cor. Factor (dB/m) |
|-----|---------------|------------------------------|----|-------------------|----------------|--------------------------|----------------------------|--------------------------|----------------------|------------------------|----------------------|--------------------------|
| 1 | 1197.45 | 45.18 | PK | 74.00 | -28.82 | 1.50 H | 25 | 45.78 | 1.8 | 29.5 | 31.9 | -0.6 |
| 2 | 1197.45 | 34.31 | AV | 54.00 | -19.69 | 1.50 H | 25 | 34.91 | 1.8 | 29.5 | 31.9 | -0.6 |
| 3 | 2997.63 | 46.84 | PK | 74.00 | -27.16 | 1.50 H | 34 | 42.09 | 6.2 | 30.05 | 31.5 | 4.75 |
| 4 | 2997.63 | 35.72 | AV | 54.00 | -18.28 | 1.50 H | 34 | 30.97 | 6.2 | 30.05 | 31.5 | 4.75 |
| 5 | 4883.77 | 48.65 | PK | 74.00 | -25.35 | 1.50 H | 30 | 42.25 | 6.7 | 31.2 | 31.5 | 6.4 |
| 6 | 4883.77 | 36.61 | AV | 54.00 | -17.39 | 1.50 H | 30 | 30.21 | 6.7 | 31.2 | 31.5 | 6.4 |

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M (19CH_2440MHz)

| No. | Frequency (MHz) | Emssion Level (dBuV/m) | | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV/m) | Cab. Loss (dB) | Ant. Factor (dB) | Pre. Amp. (dB) | Cor. Factor (dB/m) |
|-----|--------------------|------------------------------|----|-------------------|----------------|--------------------------|----------------------------|--------------------------|----------------------|------------------------|----------------------|--------------------------|
| 1 | 1197.45 | 45.31 | PK | 74.00 | -28.69 | 1.50 V | 32 | 45.91 | 1.8 | 29.5 | 31.9 | -0.6 |
| 2 | 1197.45 | 34.52 | AV | 54.00 | -19.48 | 1.50 V | 32 | 35.12 | 1.8 | 29.5 | 31.9 | -0.6 |
| 3 | 2997.63 | 47.03 | PK | 74.00 | -26.97 | 1.50 V | 40 | 42.28 | 6.2 | 30.05 | 31.5 | 4.75 |
| 4 | 2997.63 | 35.96 | AV | 54.00 | -18.04 | 1.50 V | 40 | 31.21 | 6.2 | 30.05 | 31.5 | 4.75 |
| 5 | 4883.77 | 48.85 | PK | 74.00 | -25.15 | 1.50 V | 40 | 42.45 | 6.7 | 31.2 | 31.5 | 6.4 |
| 6 | 4883.77 | 37.01 | AV | 54.00 | -16.99 | 1.50 V | 40 | 30.61 | 6.7 | 31.2 | 31.5 | 6.4 |

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M (39CH_2480MHz)

| No. | Frequency (MHz) | Emssion Level (dBuV/m) | | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV/m) | Cab. Loss (dB) | Ant. Factor (dB) | Pre. Amp. (dB) | Cor. Factor (dB/m) |
|-----|-----------------|------------------------|----|----------------|-------------|--------------------|----------------------|--------------------|----------------|------------------|----------------|--------------------|
| 1 | 2483.37 | 50.46 | PK | 74.00 | -23.54 | 1.50 H | 30 | 47.86 | 5.7 | 28.7 | 31.8 | 2.6 |
| 2 | 2483.37 | 37.87 | AV | 54.00 | -16.13 | 1.50 H | 30 | 35.27 | 5.7 | 28.7 | 31.8 | 2.6 |
| 3 | 4955.91 | 47.60 | PK | 74.00 | -26.40 | 1.50 H | 45 | 40.90 | 7 | 31.2 | 31.5 | 6.7 |
| 4 | 4955.91 | 37.06 | AV | 54.00 | -16.94 | 1.50 H | 45 | 30.36 | 7 | 31.2 | 31.5 | 6.7 |
| 5 | 11152.50 | 53.16 | PK | 74.00 | -20.84 | 1.50 H | 50 | 38.26 | 16 | 30.9 | 32 | 14.9 |
| 6 | 11152.50 | 41.27 | AV | 54.00 | -12.73 | 1.50 H | 50 | 26.37 | 16 | 30.9 | 32 | 14.9 |

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M (39CH_2480MHz)

| No. | Frequency (MHz) | Emssion Level (dBuV/m) | | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV/m) | Cab. Loss (dB) | Ant. Factor (dB) | Pre. Amp. (dB) | Cor. Factor (dB/m) |
|-----|-----------------|------------------------|----|----------------|-------------|--------------------|----------------------|--------------------|----------------|------------------|----------------|--------------------|
| 1 | 2483.37 | 48.81 | PK | 74.00 | -25.19 | 1.50 V | 38 | 46.21 | 5.7 | 28.7 | 31.8 | 2.6 |
| 2 | 2483.37 | 37.39 | AV | 54.00 | -16.61 | 1.50 V | 38 | 34.79 | 5.7 | 28.7 | 31.8 | 2.6 |
| 3 | 4955.91 | 49.11 | PK | 74.00 | -24.89 | 1.50 V | 52 | 42.41 | 7 | 31.2 | 31.5 | 6.7 |
| 4 | 4955.91 | 37.07 | AV | 54.00 | -16.93 | 1.50 V | 52 | 30.37 | 7 | 31.2 | 31.5 | 6.7 |
| 5 | 11152.50 | 53.84 | PK | 74.00 | -20.16 | 1.50 V | 40 | 38.94 | 16 | 30.9 | 32 | 14.9 |
| 6 | 11152.50 | 41.06 | AV | 54.00 | -12.94 | 1.50 V | 40 | 26.16 | 16 | 30.9 | 32 | 14.9 |

REMARKS:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB)
 - Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level - Limit value

2.7. Conducted Emission

2.7.1. Limit of Conducted Emission

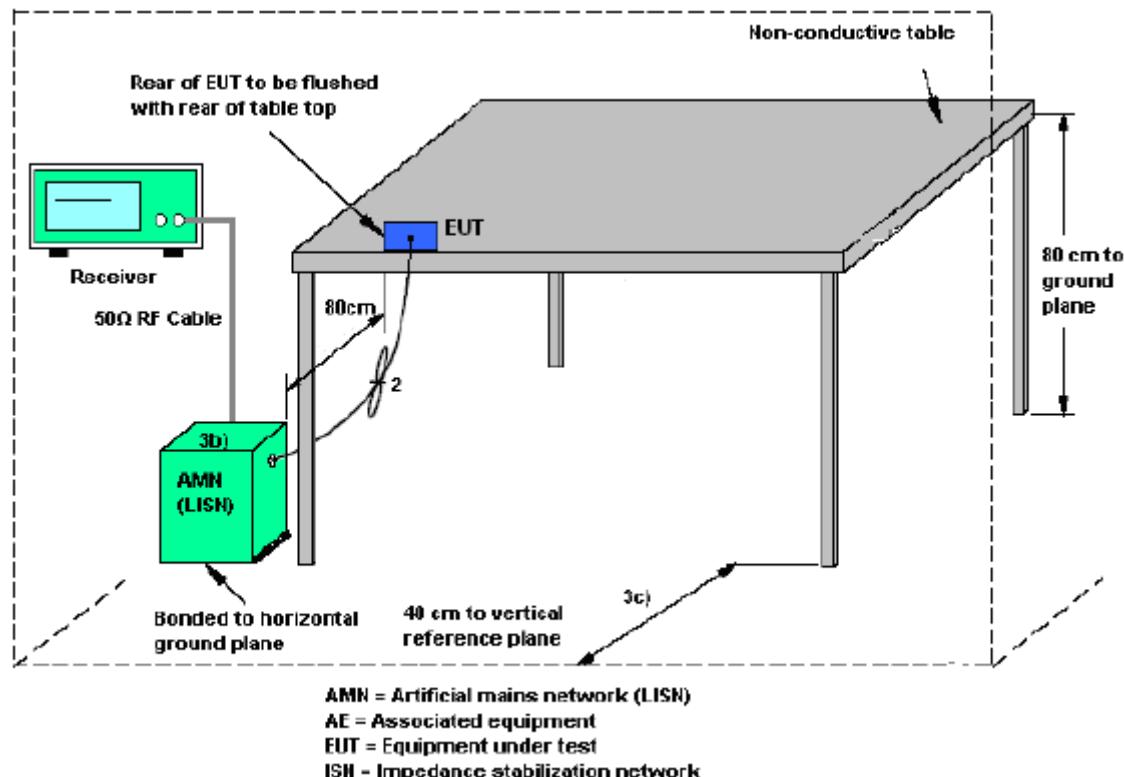
For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

| Frequency range (MHz) | Conducted Limit (dB μ V) | |
|-----------------------|------------------------------|----------|
| | Quasi-peak | Average |
| 0.15 - 0.50 | 66 to 56 | 56 to 46 |
| 0.50 - 5 | 56 | 46 |
| 5 - 30 | 60 | 50 |

2.7.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.7.3. Test Setup

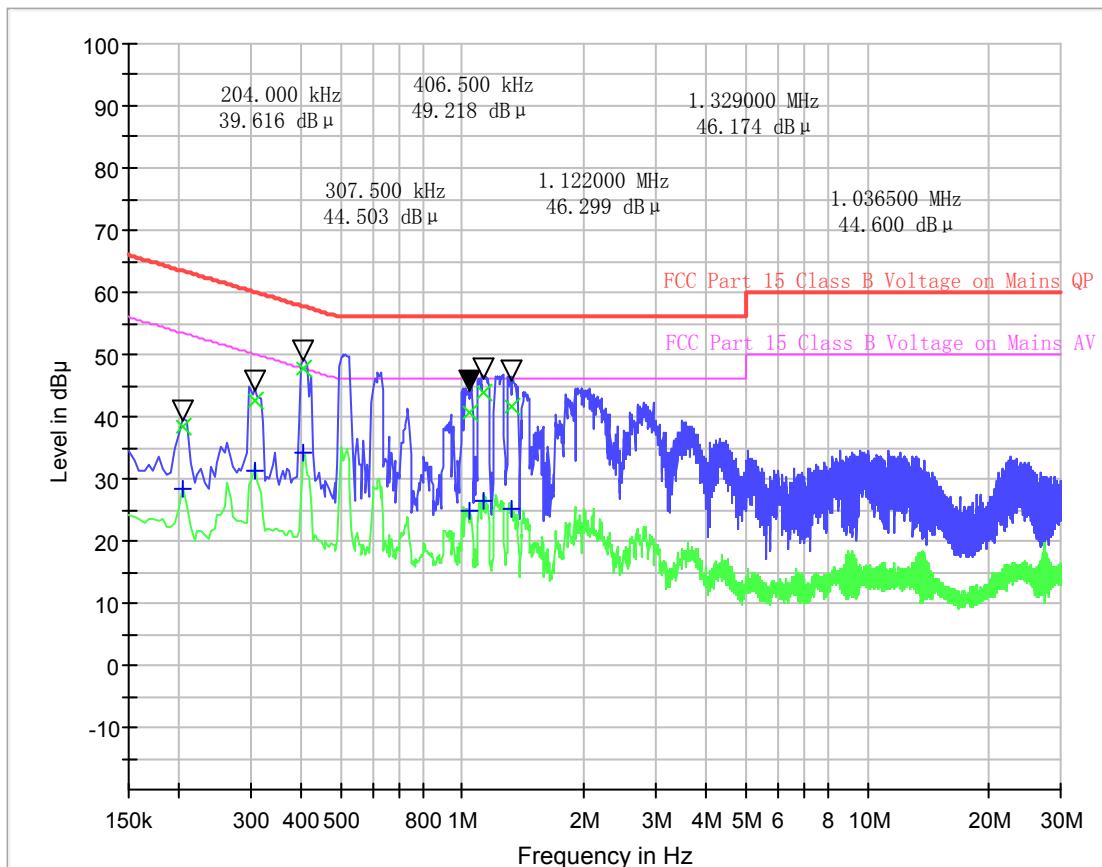


2.7.4. Test Procedures

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.

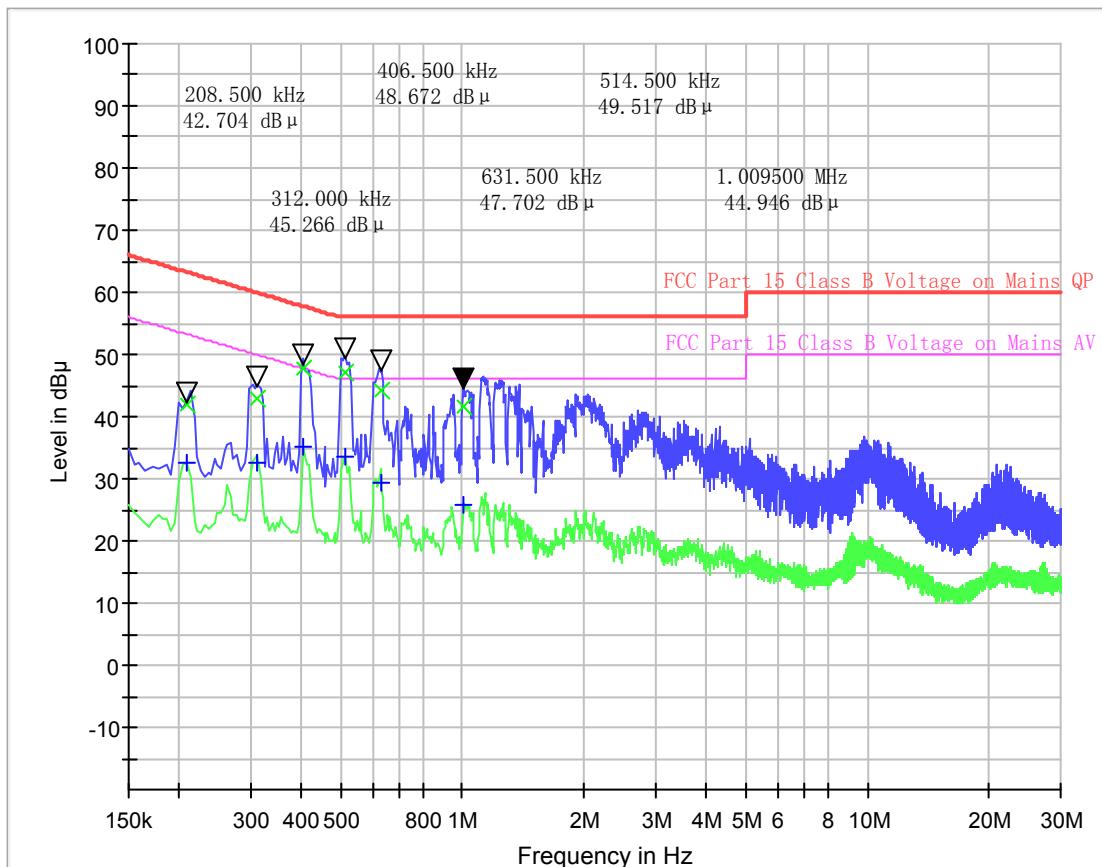
2.7.5. Test Result

1. The EUT configuration of the emission tests is Bluetooth Link.
2. The power adapter support (100~240V AC, 50/60Hz), the EUT was tested at the (120V/60Hz)



(Plot A: L Phase)

| Conducted Disturbance at Mains Terminals | | | | | |
|--|---------------|--------------------------|-----------------|---------------|--------------------------|
| QP | | | AV | | |
| Frequency (MHz) | Limits (dBμV) | Measurement Value (dBμV) | Frequency (MHz) | Limits (dBμV) | Measurement Value (dBμV) |
| 0.204000 | 63.4 | 38.51 | 0.204000 | 53.4 | 28.43 |
| 0.307500 | 60.0 | 42.67 | 0.307500 | 50.0 | 31.23 |
| 0.406500 | 57.7 | 47.59 | 0.406500 | 47.7 | 34.16 |
| 1.036500 | 56.0 | 40.74 | 1.036500 | 46.0 | 24.74 |
| 1.122000 | 56.0 | 43.94 | 1.122000 | 46.0 | 26.48 |
| 1.329000 | 56.0 | 41.68 | 1.329000 | 46.0 | 25.05 |



(Plot B: N Phase)

| Conducted Disturbance at Mains Terminals | | | | | |
|--|---------------|--------------------------|-----------------|---------------|--------------------------|
| QP | | | AV | | |
| Frequency (MHz) | Limits (dBμV) | Measurement Value (dBμV) | Frequency (MHz) | Limits (dBμV) | Measurement Value (dBμV) |
| 0.208500 | 63.3 | 41.87 | 0.208500 | 53.3 | 32.52 |
| 0.312000 | 59.9 | 42.86 | 0.312000 | 49.9 | 32.73 |
| 0.406500 | 57.7 | 47.89 | 0.406500 | 47.7 | 35.12 |
| 0.514500 | 56.0 | 47.00 | 0.514500 | 46.0 | 33.48 |
| 0.631500 | 56.0 | 44.31 | 0.631500 | 46.0 | 29.51 |
| 1.009500 | 56.0 | 41.50 | 1.009500 | 46.0 | 25.81 |

3. List of measuring equipment

| Radiated Emission | | | | | |
|-------------------|-------------------------|------------------------------|---------------------|------------|------------|
| Item | Test Equipment | Manufacturer | Model No. | Serial No. | Last Cal |
| 1 | Ultra-Broadband Antenna | ShwarzBeck | VULB9163 | 538 | 11/13/2016 |
| 2 | EMI TEST RECEIVER | Rohde&Schwarz | ESI 26 | 100009 | 11/13/2016 |
| 3 | EMI TEST Software | Audix | E3 | N/A | N/A |
| 4 | TURNTABLE | ETS | 2088 | 2149 | N/A |
| 5 | ANTENNA MAST | ETS | 2075 | 2346 | N/A |
| 6 | EMI TEST Software | Rohde&Schwarz | ESK1 | N/A | N/A |
| 7 | HORNANTENNA | ShwarzBeck | 9120D | 1011 | 11/13/2016 |
| 8 | Amplifier | Sonoma | 310N | E009-13 | 11/13/2016 |
| 9 | JS amplifier | Rohde&Schwarz | JS4-00101800-2 8-5A | F201504 | 11/13/2016 |
| 10 | High pass filter | Compliance Direction systems | BSU-6 | 34202 | 11/13/2016 |
| 11 | HORNANTENNA | ShwarzBeck | 9120D | 1012 | 11/13/2016 |
| 12 | Amplifier | Compliance Direction systems | PAP1-4060 | 120 | 11/13/2016 |
| 13 | Loop Antenna | Rohde&Schwarz | HFH2-Z2 | 100020 | 11/13/2016 |
| 14 | TURNTABLE | MATURO | TT2.0 | ---- | N/A |
| 15 | ANTENNA MAST | MATURO | TAM-4.0-P | ---- | N/A |
| 16 | Horn Antenna | SCHWARZBECK | BBHA9170 | 25841 | 11/13/2016 |
| 17 | ULTRA-BROADBAND ANTENNA | Rohde&Schwarz | HL562 | 100015 | 11/13/2016 |

| Maximum Peak Output Power / Power Spectral Density / 6dB Bandwidth / Band Edge Compliance of RF Emission / Spurious RF Conducted Emission | | | | | |
|---|---------------------------|-----------------|-----------|------------|------------|
| Item | Test Equipment | Manufacturer | Model No. | Serial No. | Last Cal |
| 1 | Spectrum Analyzer | Rohde&Schwarz | FSV-40 | 101008 | 05/04/2017 |
| 2 | Switch Unit with OSP-B157 | Rohde&Schwarz | OSP120 | 101130 | 05/04/2017 |
| 2 | Power Meter | Anritsu | ML2480B | 100798 | 11/13/2016 |
| 3 | Power Sensor | Anritsu | MA2411B | 100258 | 11/13/2016 |
| Conducted Emission | | | | | |
| Item | Test Equipment | Manufacturer | Model No. | Serial No. | Last Cal. |
| 1 | EMI TEST RECEIVER | Rohde & Schwarz | ESCI | 100106 | 11/13/2016 |
| 2 | ARTIFICIAL MAINS | Rohde & Schwarz | ESH2-Z5 | 100028 | 11/13/2016 |
| 3 | PULSE LIMITER | Rohde & Schwarz | ESHSZ2 | 100044 | 11/13/2016 |
| 4 | EMI TEST SOFTWARE | Rohde & Schwarz | ES-K1 | N/A | N/A |

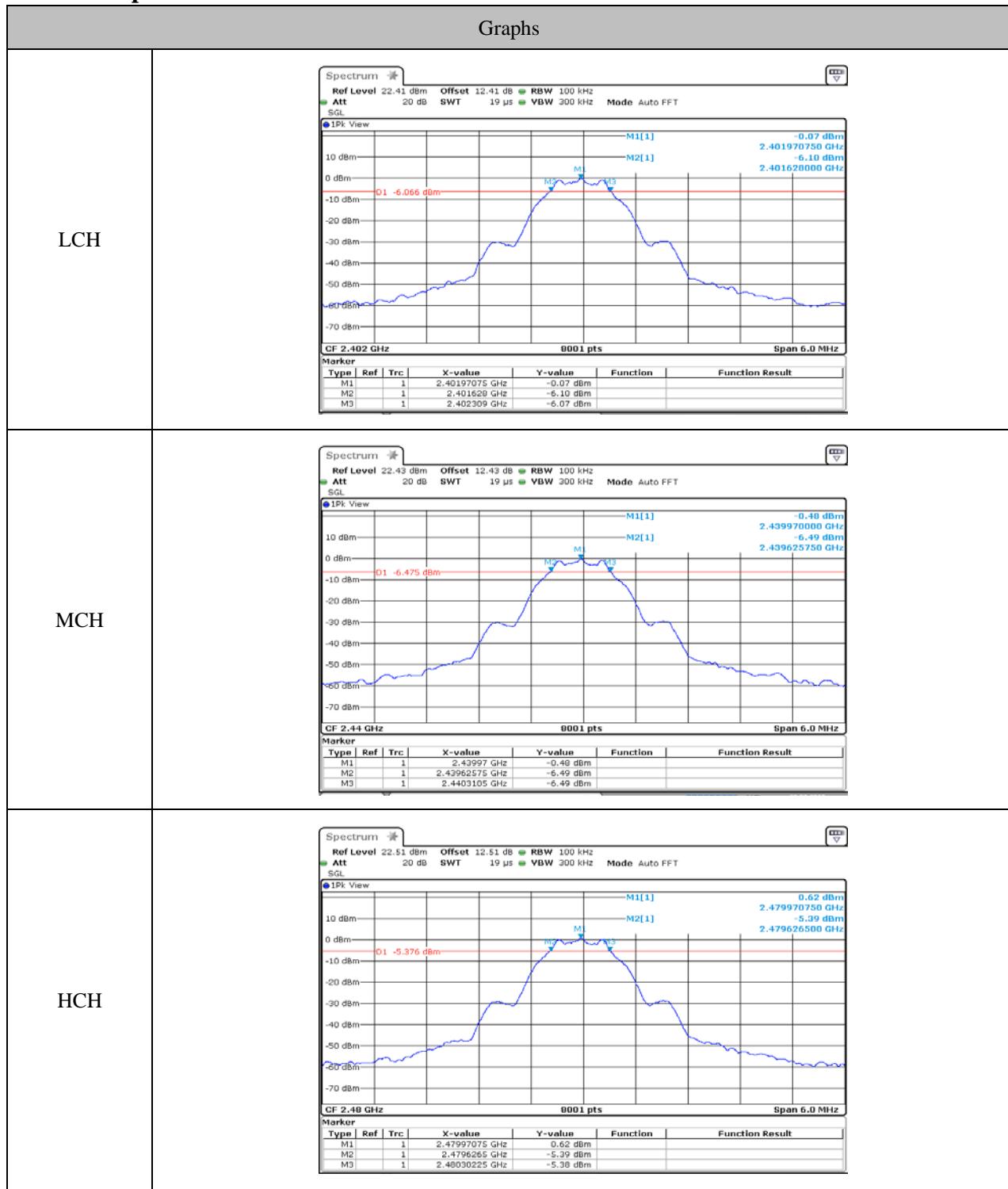
Appendix A: Test result of Conducted test

6dB Bandwidth

Test Result

| Mode | Channel | 6dB Bandwidth [MHz] | Verdict |
|------|---------|---------------------|---------|
| BLE | LCH | 0.681 | PASS |
| BLE | MCH | 0.685 | PASS |
| BLE | HCH | 0.676 | PASS |

Test Graphs

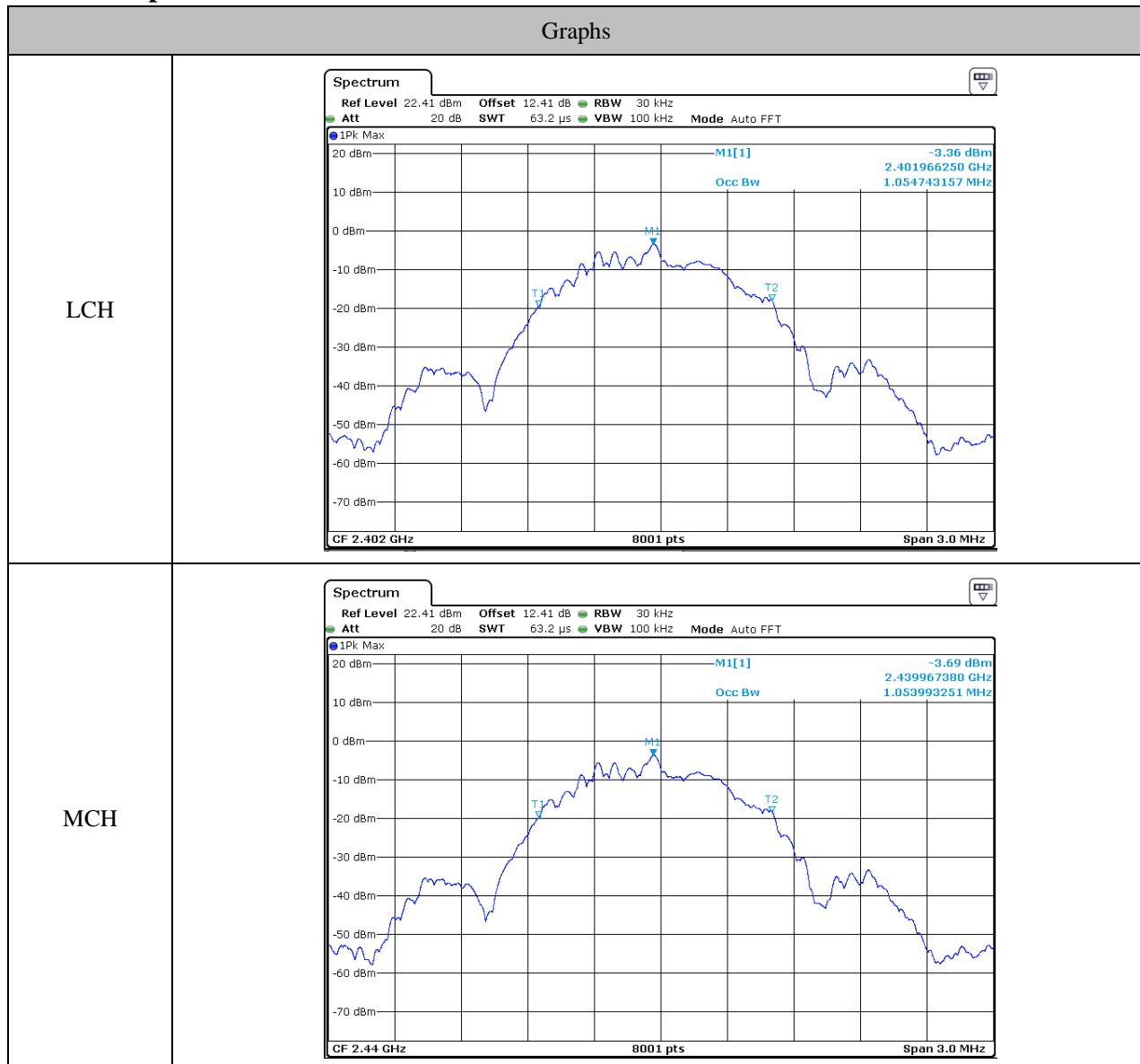


99% Occupied Bandwidth

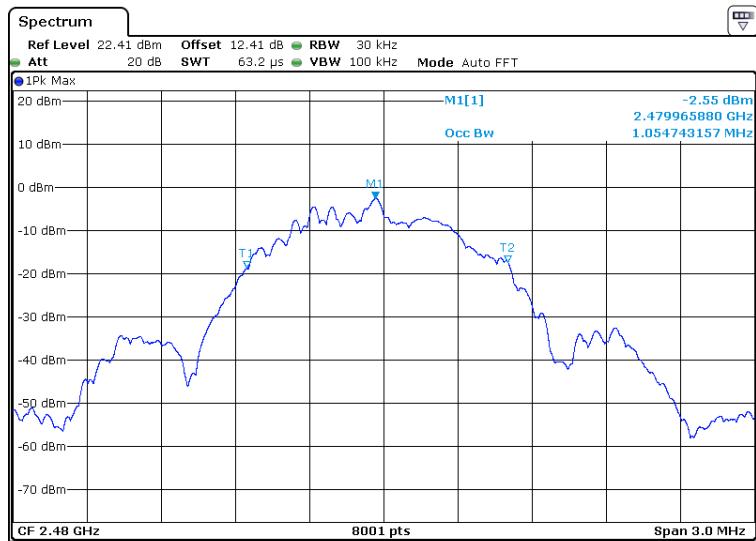
Test Result

| Mode | Channel | 99% OBW[MHz] | Verdict |
|------|---------|--------------|---------|
| BLE | LCH | 1.055 | PASS |
| BLE | MCH | 1.054 | PASS |
| BLE | HCH | 1.055 | PASS |

Test Graphs



HCH



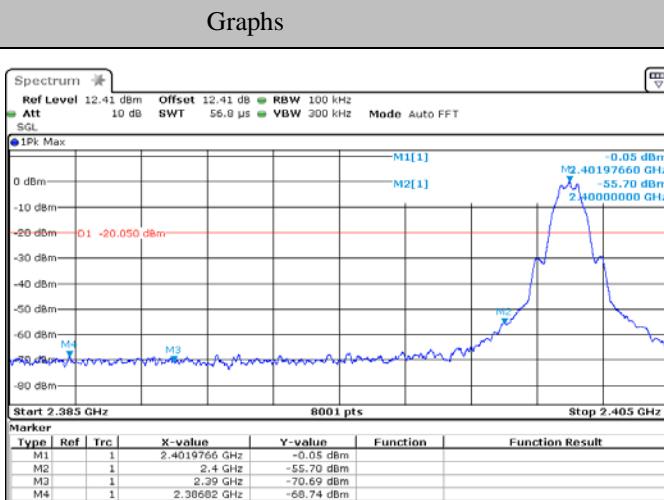
Band-edge for RF Conducted Emissions

Result Table

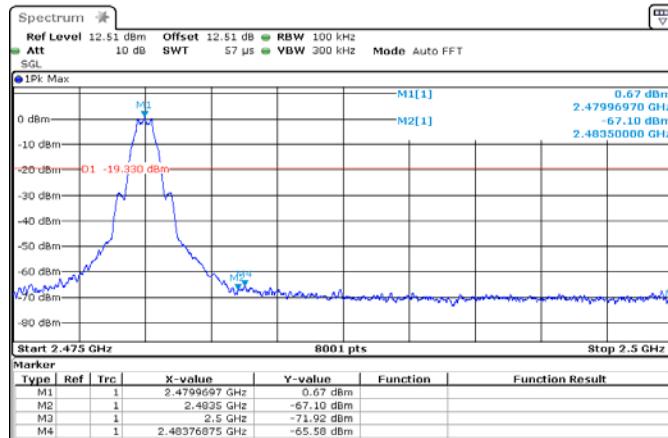
| Mode | Channel | Carrier Power[dBm] | Max.Spurious Level [dBm] | Limit [dBm] | Verdict |
|------|---------|--------------------|--------------------------|-------------|---------|
| BLE | LCH | -0.050 | -68.741 | -20.05 | PASS |
| BLE | HCH | 0.670 | -65.578 | -19.33 | PASS |

Test Graphs

LCH



HCH

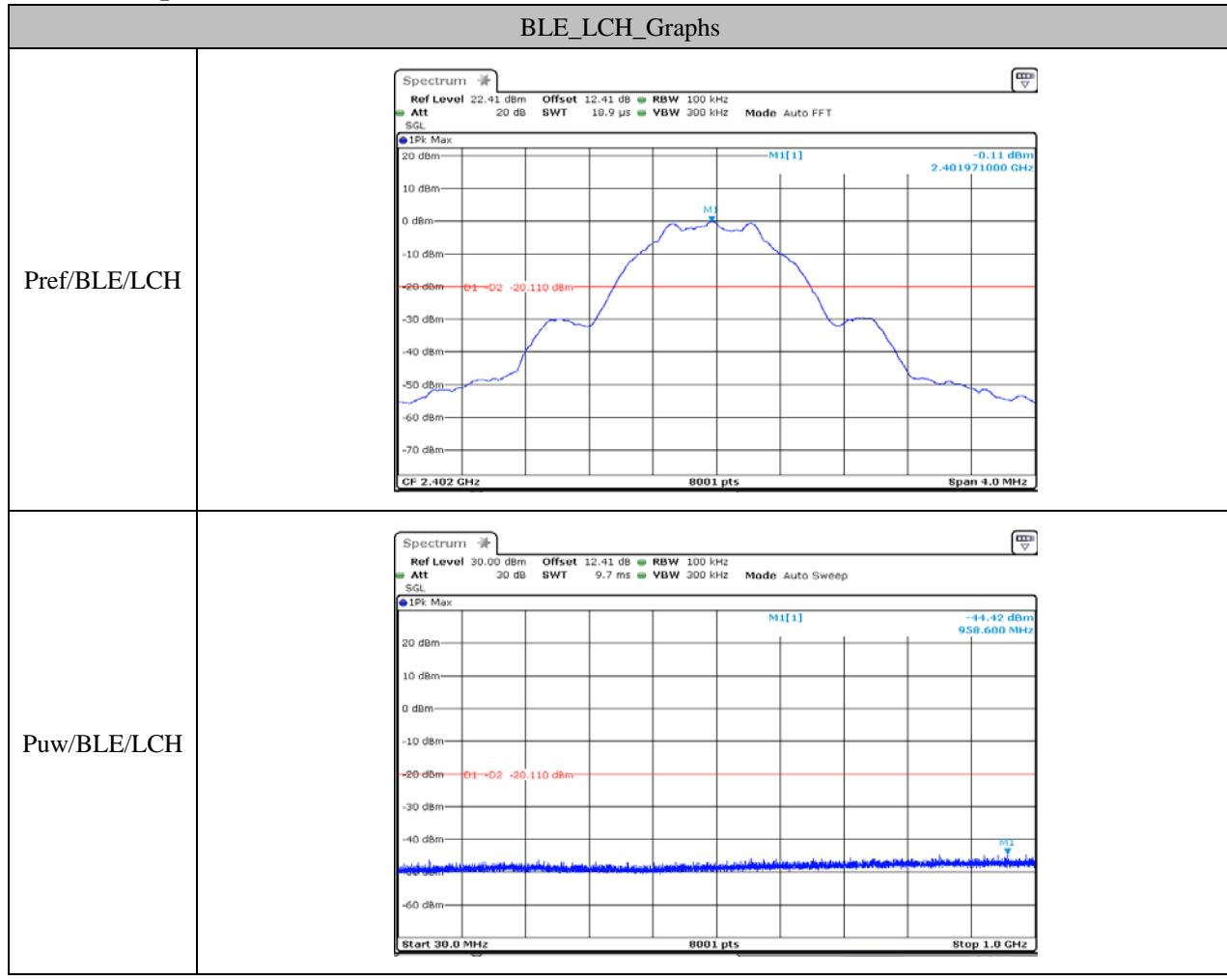


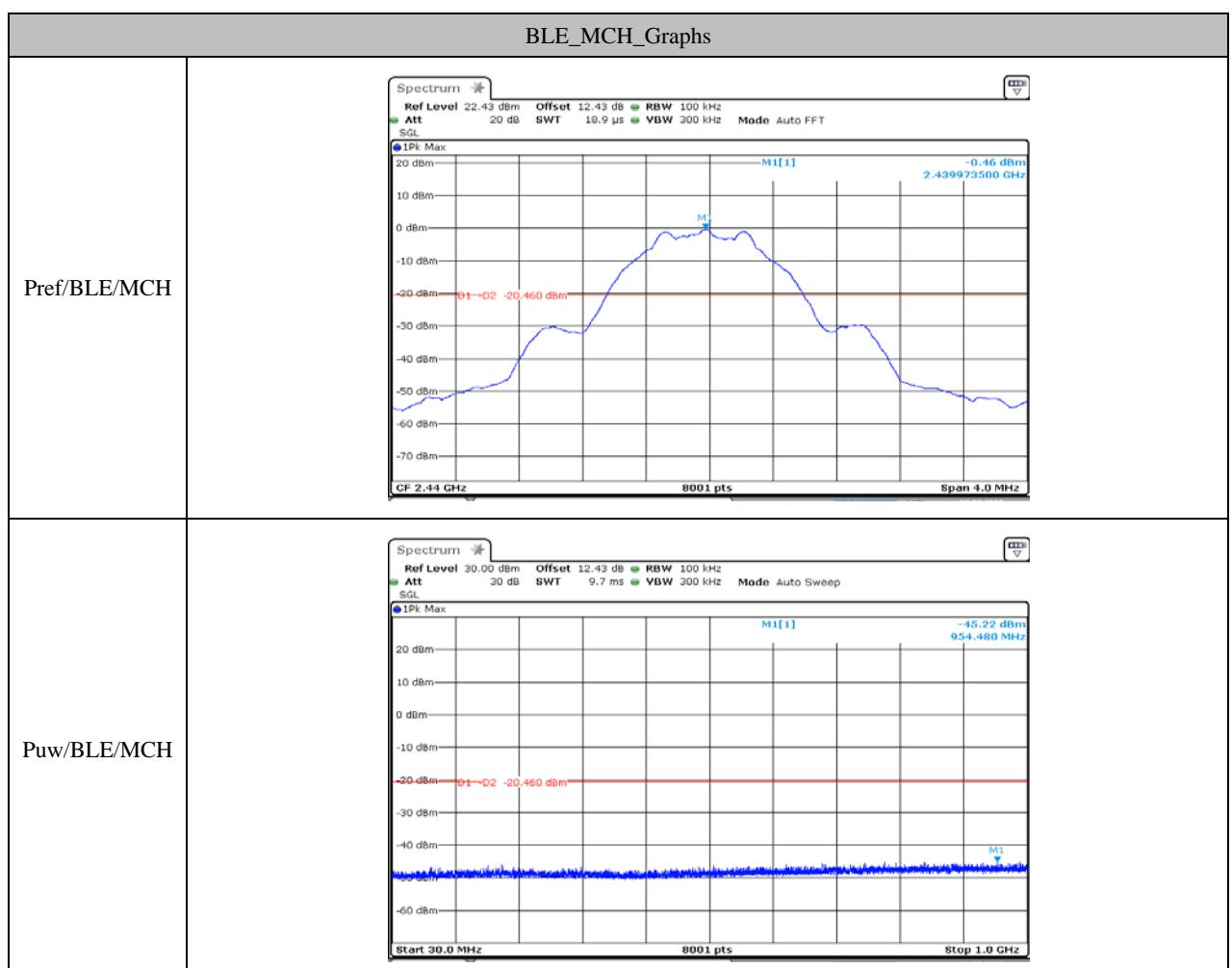
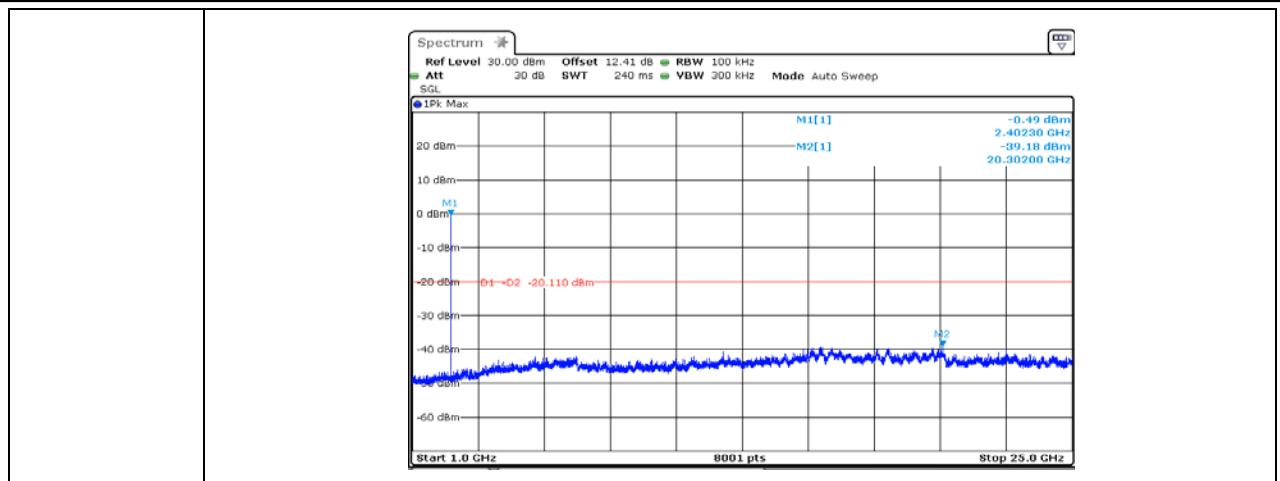
RF Conducted Spurious Emissions

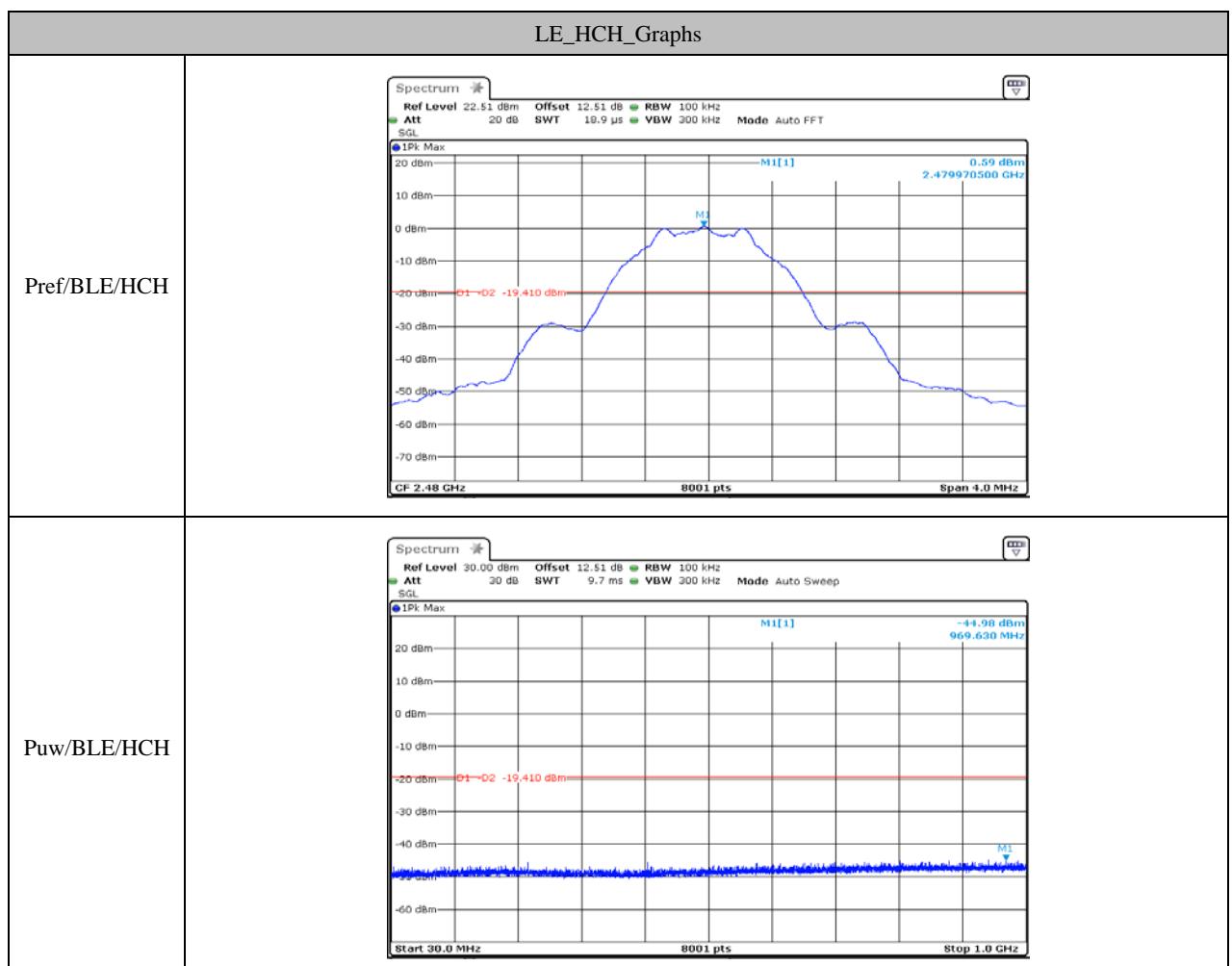
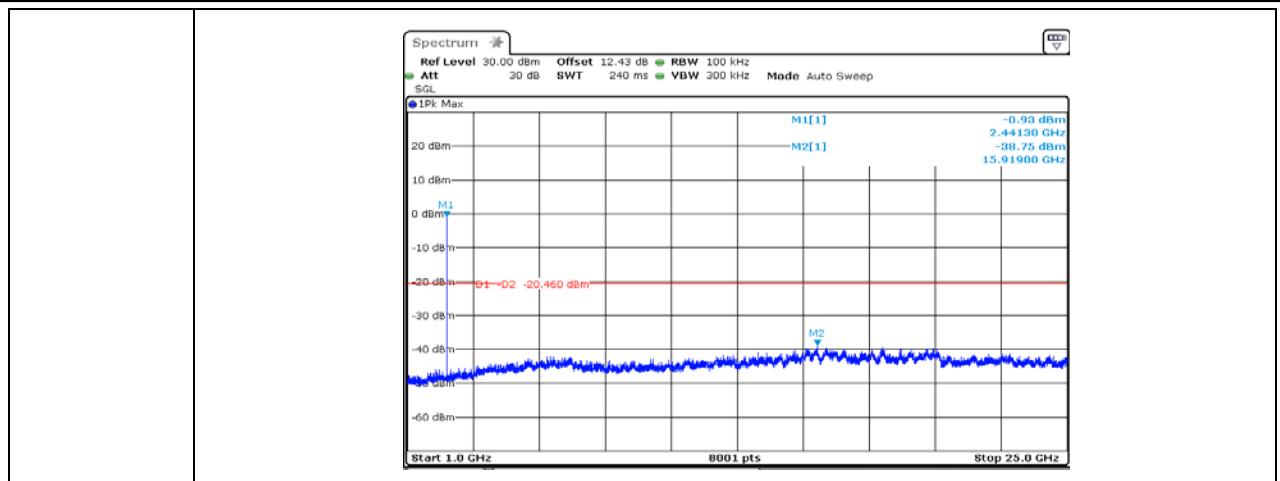
Result Table

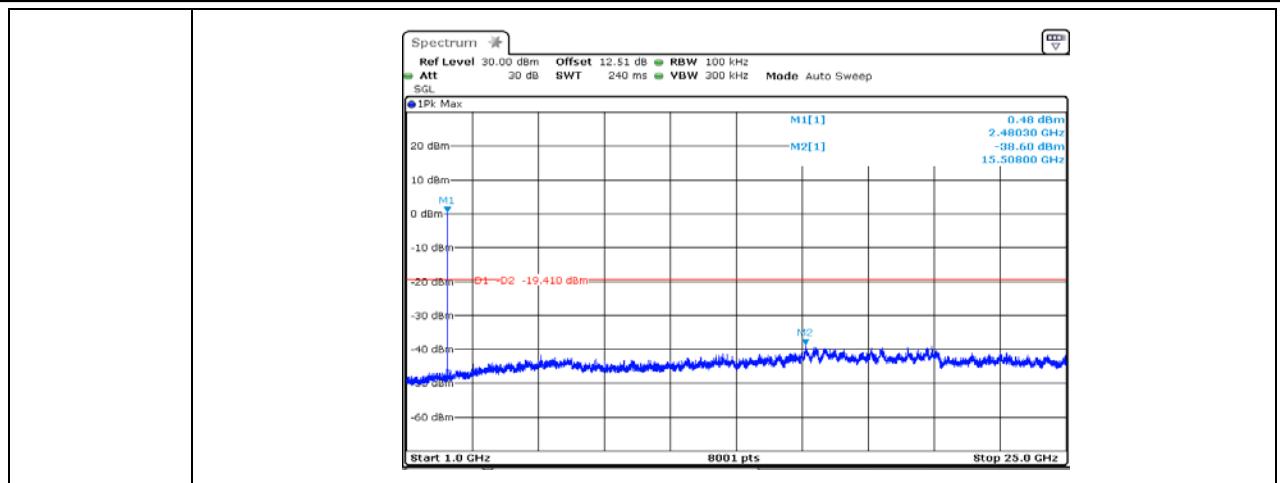
| Mode | Channel | Pref [dBm] | Puw[dBm] | Verdict |
|------|---------|------------|----------|---------|
| BLE | LCH | -0.11 | <Limit | PASS |
| BLE | MCH | -0.46 | <Limit | PASS |
| BLE | HCH | 0.59 | <Limit | PASS |

Test Graphs







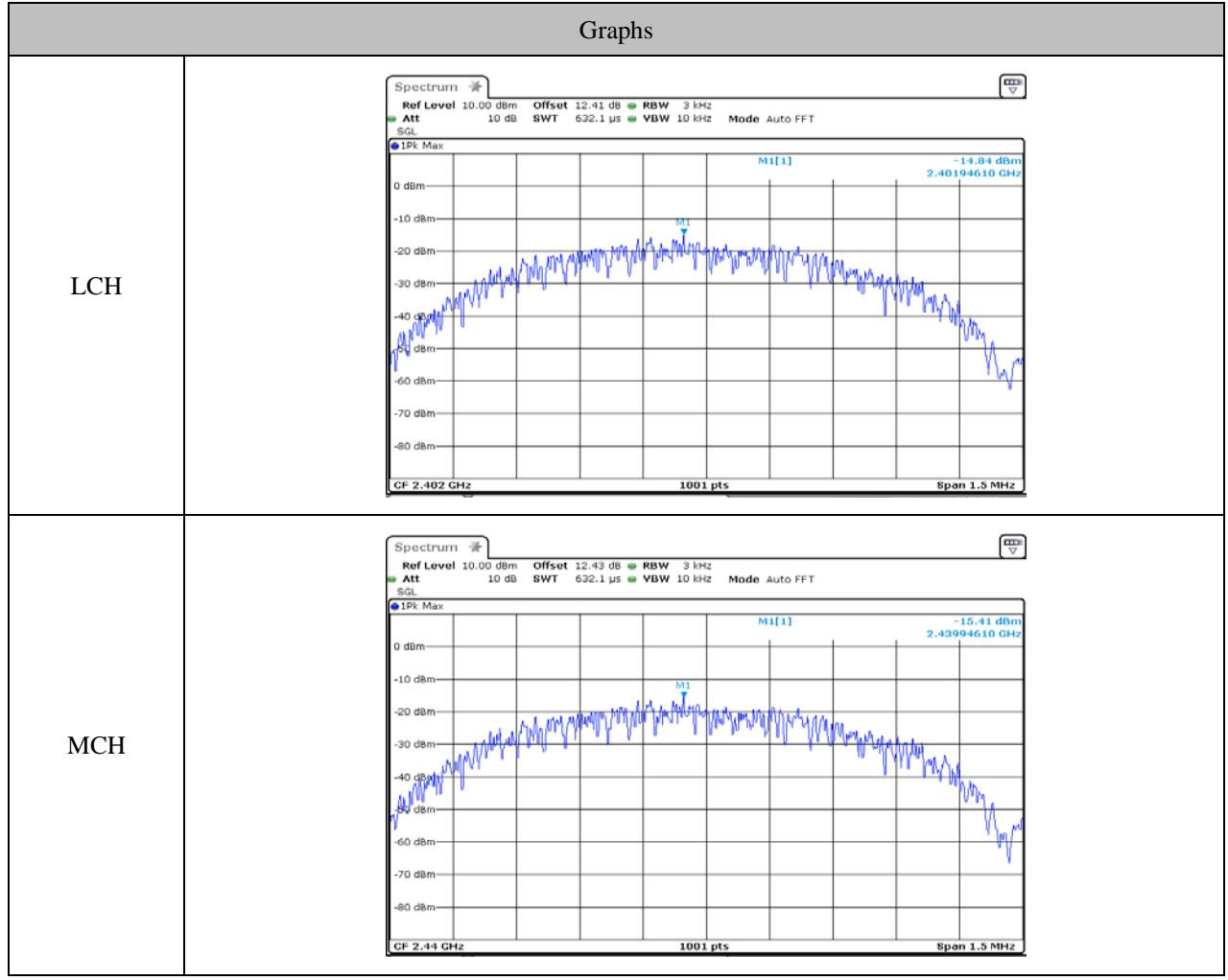


Power Spectral Density

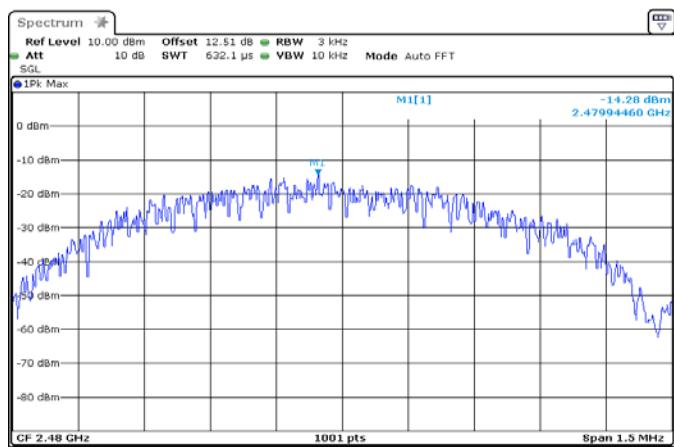
Result Table

| Mode | Channel | PSD [dBm] | Verdict |
|------|---------|-----------|---------|
| BLE | LCH | -14.840 | PASS |
| BLE | MCH | -15.410 | PASS |
| BLE | HCH | -14.280 | PASS |

Test Graphs



HCH



** END OF REPORT **