

Supplemental “Transmit Simultaneously” Test Report

Report No.: RF180731E05-2

FCC ID: NKR-LRV5-100

Test Model: LRV5-100

Received Date: Aug. 02, 2018

Test Date: Aug. 04 to 13, 2018

Issued Date: Sep. 03, 2018

Applicant: Wistron NeWeb Corp.

Address: 20 Park Avenue II, Hsinchu Science Park, Hsinchu 308, Taiwan, R.O.C.

Issued By: Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch
Hsin Chu Laboratory

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Taiwan R.O.C.

Test Location: E-2, No.1, Li Hsin 1st Road, Hsinchu Science Park, Hsinchu City 300,
Taiwan R.O.C.

**FCC Registration /
Designation Number:** 723255 / TW2022



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Release Control Record

| Issue No. | Description | Date Issued |
|---------------|-------------------|---------------|
| RF180731E05-2 | Original release. | Sep. 03, 2018 |

1 Certificate of Conformity

Product: Router

Brand: Verizon Wireless

Test Model: LRV5-100

Sample Status: ENGINEERING SAMPLE

Applicant: Wistron NeWeb Corp.

Test Date: Aug. 04 to 13, 2018

Standards: 47 CFR FCC Part 15, Subpart C (Section 15.247)

47 CFR FCC Part 15, Subpart E (Section 15.407)

FCC Part 22, Subpart H

ANSI C63.10: 2013

The above equipment has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

Prepared by : Wendy Wu , **Date:** Sep. 03, 2018
Wendy Wu / Specialist

Approved by : May Chen , **Date:** Sep. 03, 2018
May Chen / Manager

2 Summary of Test Results

| 47 CFR FCC Part 15, Subpart C, E (SECTION 15.247, 15.407) | | | |
|--|--|--------|--|
| FCC Clause | Test Item | Result | Remarks |
| 15.207 15.407(b)(6) | AC Power Conducted Emission | PASS | Meet the requirement of limit. Minimum passing margin is -5.24dB at 0.35416MHz. |
| 15.205 / 15.209 / 15.247(d) 15.407(b) (1/2/3/4(i/ii)/6) | Radiated Emissions and Band Edge Measurement | PASS | Meet the requirement of limit. Minimum passing margin is -0.1dB at 10460.00MHz. |
| 2.1053 22.917 | Radiated Spurious Emissions | PASS | Meet the requirement of limit. Minimum passing margin is -31.84dB at 2487MHz. |

2.1 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

| Measurement | Frequency | Expanded Uncertainty (k=2) (±) |
|------------------------------------|----------------|--------------------------------|
| Conducted Emissions at mains ports | 150kHz ~ 30MHz | 1.84 dB |
| Radiated Emissions up to 1 GHz | 30MHz ~ 1GHz | 5.33 dB |
| Radiated Emissions above 1 GHz | 1GHz ~ 6GHz | 5.10 dB |
| | 6GHz ~ 18GHz | 4.85 dB |
| | 18GHz ~ 40GHz | 5.24 dB |

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

| | |
|-----------------------|---|
| Product | Router |
| Brand | Verizon Wireless |
| Test Model | LRV5-100 |
| Status of EUT | ENGINEERING SAMPLE |
| Power Supply Rating | DC 54V from power adapter (WLAN function) or DC 3.6V from battery (LTE function) |
| Modulation Type | CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM 256QAM for OFDM in 11ac mode |
| Modulation Technology | DSSS, OFDM |
| Transfer Rate | 802.11b: up to 11Mbps 802.11a/g: up to 54Mbps 802.11n: up to 600Mbps 802.11ac: up to 1733.3Mbps |
| Operating Frequency | 2.4GHz: 2.412 ~ 2.462GHz 5GHz: 5.18 ~ 5.24GHz, 5.745 ~ 5.825GHz |
| Number of Channel | 2.4GHz: 802.11b, 802.11g, 802.11n (HT20): 11 802.11n (HT40): 7 5GHz: 802.11a, 802.11n (HT20), 802.11ac (VHT20): 9 802.11n (HT40), 802.11ac (VHT40): 4 802.11ac (VHT80): 2 |
| Antenna Type | Refer to Note |
| Antenna Connector | Refer to Note |
| Accessory Device | Adapter x1 |
| Data Cable Supplied | NA |

Note:

1. The EUT contains certified LTE modular which FCC ID: NKR-IMG2.

2. The EUT has below radios as following table:

| Radio 1 | Radio 2 | Radio 3 | Radio 4 | Radio 5 |
|---------------|----------------------|-----------------------|---------|---------|
| WLAN - 2.4GHz | WLAN - 5GHz Low Band | WLAN - 5GHz High Band | LTE | GPS |

3. Simultaneously transmission condition.

| Condition | Technology | | | | |
|-----------|-------------|-------------------------|--------------------------|-----|-----|
| 1 | WLAN 2.4GHz | WLAN 5GHz (Low Band) | WLAN 5GHz (High Band) | LTE | GPS |

4. The antennas provided to the EUT, please refer to the following table:

| Frequency Range (GHz) | Directional Antenna Gain (dBi) | Antenna Type | Antenna Connector |
|--------------------------|-----------------------------------|--------------|-------------------|
| 2.4~2.4835 | 3.05 | Dipole | i-pex(MHF) |
| 5.15~5.25 | 6.43 | | |
| 5.25~5.35 | 6.43 | | |
| 5.47~5.725 | 6.47 | | |
| 5.725~5.85 | 6.47 | | |

Note: More detailed information, please refer to operating description.

5. The EUT could be supplied from a power adapter or battery as following table:

| Adapter | | |
|---------|----------------|--|
| Brand | Model No. | Spec. |
| FSP | FSP120-AWAN3-W | Input: 100-240Vac, 1.8A, 50-60Hz Output: 54V, 2.22A DC cable: Unshielded, 1.5m with one core |
| Battery | | |
| Brand | Model No. | Spec. |
| WNC | BTY-LRV5000 | 3.6 V, 2280mAh |

6. Power supplied from batteries condition only support WWAN function.

7. The EUT incorporates a MIMO function:

| 2.4GHz Band | | | |
|-------------------------|------------------------|----------------------------------|-----|
| MODULATION MODE | DATA RATE (MCS) | TX & RX CONFIGURATION | |
| 802.11b | 1 ~ 11Mbps | 1TX Fixed Chain 2 | 1RX |
| 802.11g | 6 ~ 54Mbps | 2TX | 2RX |
| 802.11n (HT20) | MCS 0~7 | 2TX | 2RX |
| | MCS 8~15 | 2TX | 2RX |
| 802.11n (HT40) | MCS 0~7 | 2TX | 2RX |
| | MCS 8~15 | 2TX | 2RX |
| 5GHz Band | | | |
| MODULATION MODE | DATA RATE (MCS) | TX & RX CONFIGURATION | |
| 802.11a | 6 ~ 54Mbps | 4TX | 4RX |
| 802.11n (HT20) | MCS 0~7 | 4TX | 4RX |
| | MCS 8~15 | 4TX | 4RX |
| | MCS 16~23 | 4TX | 4RX |
| | MCS 24~31 | 4TX | 4RX |
| 802.11n (HT40) | MCS 0~7 | 4TX | 4RX |
| | MCS 8~15 | 4TX | 4RX |
| | MCS 16~23 | 4TX | 4RX |
| | MCS 24~31 | 4TX | 4RX |
| 802.11ac (VHT20) | MCS0~8 Nss=1 | 4TX | 4RX |
| | MCS0~8 Nss=2 | 4TX | 4RX |
| | MCS0~9 Nss=3 | 4TX | 4RX |
| | MCS0~8 Nss=4 | 4TX | 4RX |
| 802.11ac (VHT40) | MCS0~9 Nss=1 | 4TX | 4RX |
| | MCS0~9 Nss=2 | 4TX | 4RX |
| | MCS0~9 Nss=3 | 4TX | 4RX |
| | MCS0~9 Nss=4 | 4TX | 4RX |
| 802.11ac (VHT80) | MCS0~9 Nss=1 | 4TX | 4RX |
| | MCS0~9 Nss=2 | 4TX | 4RX |
| | MCS0~9 Nss=3 | 4TX | 4RX |
| | MCS0~9 Nss=4 | 4TX | 4RX |

Note: All of modulation mode support beamforming function except 802.11b modulation mode.

8. The above EUT information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications or user's manual.

3.1.1 Test Mode Applicability and Tested Channel Detail

| EUT CONFIGURE MODE | APPLICABLE TO | | | | DESCRIPTION |
|--------------------|---------------|-----------|-----|----|-------------|
| | RE \geq 1G | RE $<$ 1G | PLC | OB | |
| - | √ | √ | √ | √ | - |

Where **RE \geq 1G**: Radiated Emission above 1GHz & Bandedge Measurement

RE $<$ 1G: Radiated Emission below 1GHz

PLC: Power Line Conducted Emission

OB: Conducted Out-Band Emission Measurement

Radiated Emission Test (Above 1GHz):

Following channel(s) was (were) selected for the final test as listed below.

| MODE | AVAILABLE CHANNEL | TESTED CHANNEL | MODULATION TECHNOLOGY | MODULATION TYPE |
|-----------------------|-------------------|----------------|-----------------------|-----------------|
| 802.11n (HT20) + | 1 to 11 | 1 | OFDM | BPSK |
| 802.11ac (VHT40) + | 38 to 46 | 46 | OFDM | BPSK |
| 802.11ac (VHT40) + | 151 to 159 | 151 | OFDM | BPSK |
| LTE Band 5 | 20450 to 26000 | 20450 | QPSK | - |

Radiated Emission Test (Below 1GHz):

Following channel(s) was (were) selected for the final test as listed below.

| MODE | AVAILABLE CHANNEL | TESTED CHANNEL | MODULATION TECHNOLOGY | MODULATION TYPE |
|-----------------------|-------------------|----------------|-----------------------|-----------------|
| 802.11n (HT20) + | 1 to 11 | 1 | OFDM | BPSK |
| 802.11ac (VHT40) + | 38 to 46 | 46 | OFDM | BPSK |
| 802.11ac (VHT40) + | 151 to 159 | 151 | OFDM | BPSK |
| LTE Band 5 | 20450 to 26000 | 20450 | QPSK | - |

Power Line Conducted Emission Test:

Following channel(s) was (were) selected for the final test as listed below.

| MODE | AVAILABLE CHANNEL | TESTED CHANNEL | MODULATION TECHNOLOGY | MODULATION TYPE |
|-----------------------|-------------------|----------------|-----------------------|-----------------|
| 802.11n (HT20) + | 1 to 11 | 1 | OFDM | BPSK |
| 802.11ac (VHT40) + | 38 to 46 | 46 | OFDM | BPSK |
| 802.11ac (VHT40) + | 151 to 159 | 151 | OFDM | BPSK |
| LTE Band 5 | 20450 to 26000 | 20450 | QPSK | - |

Conducted Out-Band Emission Measurement:

Following channel(s) was (were) selected for the final test as listed below.

| MODE | AVAILABLE CHANNEL | TESTED CHANNEL | MODULATION TECHNOLOGY | MODULATION TYPE |
|---------------------|-------------------|----------------|-----------------------|-----------------|
| 802.11n (HT20) + | 1 to 11 | 1 | OFDM | BPSK |
| 802.11ac (VHT40) | 38 to 46 | 46 | OFDM | BPSK |

Test Condition:

| APPLICABLE TO | ENVIRONMENTAL CONDITIONS | INPUT POWER | TESTED BY |
|------------------------------|--------------------------|--------------|---------------|
| RE\geq1G | 22deg. C, 66%RH | 120Vac, 60Hz | Frank Chuang |
| RE$<$1G | 24deg. C, 67%RH | 120Vac, 60Hz | Frank Chuang |
| PLC | 24deg. C, 72%RH | 120Vac, 60Hz | Andy Ho |
| OB | 25deg. C, 60%RH | 120Vac, 60Hz | Anderson Chen |

3.2 Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

| ID | Product | Brand | Model No. | Serial No. | FCC ID | Remarks |
|----|-----------|----------|-----------|--------------|---------|--------------------|
| A. | Test Tool | NA | NA | NA | NA | Supplied by client |
| B. | Laptop | DELL | E5430 | HYV4VY1 | FCC DoC | Provided by Lab |
| C. | Telephone | WONDER | WD-303 | 7C17KA 04011 | NA | Provided by Lab |
| D. | SIM Card | NA | NA | NA | NA | Provided by Lab |
| E. | Simulator | Keysight | E7515A | MY56030229 | NA | Provided by Lab |

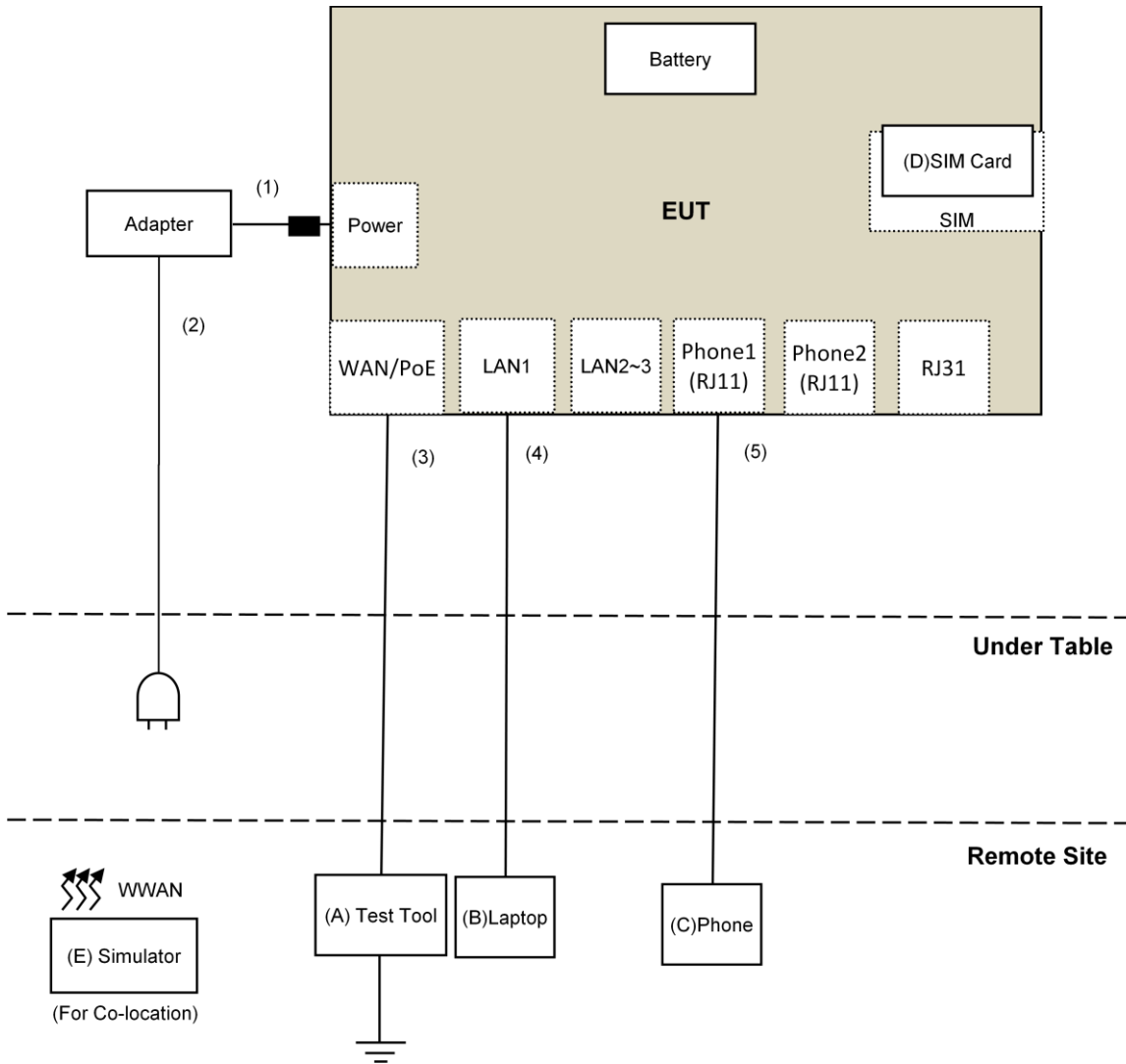
Note:

1. All power cords of the above support units are non-shielded (1.8m).

| ID | Descriptions | Qty. | Length (m) | Shielding (Yes/No) | Cores (Qty.) | Remarks |
|----|--------------|------|------------|--------------------|--------------|--------------------|
| 1. | DC Cable | 1 | 1.5 | No | 1 | Supplied by client |
| 2. | AC Cable | 1 | 1.8 | No | 0 | Provided by Lab |
| 3. | RJ-45 Cable | 1 | 10 | No | 0 | Provided by Lab |
| 4. | RJ-45 Cable | 1 | 10 | No | 0 | Provided by Lab |
| 5. | RJ-11 Cable | 1 | 10 | No | 0 | Provided by Lab |

Note: The core(s) is(are) originally attached to the cable(s).

3.2.1 Configuration of System under Test



4 Test Types and Results

4.1 Radiated Emission and Bandedge Measurement

4.1.1 Limits of Radiated Emission and Bandedge Measurement

For 47 CFR FCC Part 15:

Radiated emissions which fall in the restricted bands must comply with the radiated emission limits specified as below table.

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

Note:

- The lower limit shall apply at the transition frequencies.
- Emission level (dBuV/m) = 20 log Emission level (uV/m).
- For frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20dB under any condition of modulation.

Limits of unwanted emission out of the restricted bands

| Applicable To | | Limit | |
|---|---|--|---|
| 789033 D02 General UNII Test Procedure New Rules v02r01 | | Field Strength at 3m | |
| | | PK:74 (dBuV/m) | AV:54 (dBuV/m) |
| Frequency Band | Applicable To | EIRP Limit | Equivalent Field Strength at 3m |
| 5150~5250 MHz | 15.407(b)(1) | PK:-27 (dBm/MHz) | PK:68.2(dBuV/m) |
| 5250~5350 MHz | 15.407(b)(2) | | |
| 5470~5725 MHz | 15.407(b)(3) | | |
| 5725~5850 MHz | <input checked="" type="checkbox"/> 15.407(b)(4)(i) | PK:-27 (dBm/MHz) ^{*1} PK:10 (dBm/MHz) ^{*2} PK:15.6 (dBm/MHz) ^{*3} PK:27 (dBm/MHz) ^{*4} | PK: 68.2(dBuV/m) ^{*1} PK:105.2 (dBuV/m) ^{*2} PK: 110.8(dBuV/m) ^{*3} PK:122.2 (dBuV/m) ^{*4} |
| | <input type="checkbox"/> 15.407(b)(4)(ii) | Emission limits in section 15.247(d) | |
| ^{*1} beyond 75 MHz or more above of the band edge. ^{*3} below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above. | | ^{*2} below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above. ^{*4} from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge. | |

Note:

The following formula is used to convert the equipment isotropic radiated power (eirp) to field strength:

$$E = \frac{1000000\sqrt{30P}}{3} \mu\text{V/m, where P is the eirp (Watts).}$$

FCC Part 22:

The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB. The emission limit equal to -13dBm .

4.1.2 Test Instruments

| DESCRIPTION & MANUFACTURER | MODEL NO. | SERIAL NO. | CALIBRATED DATE | CALIBRATED UNTIL |
|---|----------------------|-------------|-----------------|------------------|
| Test Receiver Keysight | N9038A | MY54450088 | July 05, 2018 | July 04, 2019 |
| Pre-Amplifier EMC1 | EMC001340 | 980142 | Feb. 09, 2018 | Feb. 08, 2019 |
| Loop Antenna(*) Electro-Metrics | EM-6879 | 264 | Dec. 16, 2016 | Dec. 15, 2018 |
| RF Cable | NA | LOOPCAB-001 | Jan. 15, 2018 | Jan. 14, 2019 |
| RF Cable | NA | LOOPCAB-002 | Jan. 15, 2018 | Jan. 14, 2019 |
| Pre-Amplifier Mini-Circuits | ZFL-1000VH2B | AMP-ZFL-01 | Nov. 09, 2017 | Nov. 08, 2018 |
| Trilog Broadband Antenna SCHWARZBECK | VULB 9168 | 9168-406 | Nov. 29, 2017 | Nov. 28, 2018 |
| RF Cable | 8D | 966-4-1 | Mar. 21, 2018 | Mar. 20, 2019 |
| RF Cable | 8D | 966-4-2 | Mar. 21, 2018 | Mar. 20, 2019 |
| RF Cable | 8D | 966-4-3 | Mar. 21, 2018 | Mar. 20, 2019 |
| Fixed attenuator Mini-Circuits | UNAT-5+ | PAD-3m-4-01 | Oct. 03, 2017 | Oct. 02, 2018 |
| Horn_Antenna SCHWARZBECK | BBHA 9120D | 9120D-783 | Dec. 12, 2017 | Dec. 11, 2018 |
| Pre-Amplifier Mini-Circuits | ZVA-183-S+ | AMP-ZVA-03 | May 10, 2018 | May 09, 2019 |
| RF Cable | EMC104-SM-SM-1200 | 160923 | Jan. 29, 2018 | Jan. 28, 2019 |
| RF Cable | EMC104-SM-SM-2000 | 150318 | Jan. 29, 2018 | Jan. 28, 2019 |
| RF Cable | EMC104-SM-SM-5000 | 150321 | Jan. 29, 2018 | Jan. 28, 2019 |
| Pre-Amplifier EMC1 | EMC184045SE | 980387 | Jan. 29, 2018 | Jan. 28, 2019 |
| Horn_Antenna SCHWARZBECK | BBHA 9170 | BBHA9170608 | Dec. 14, 2017 | Dec. 13, 2018 |
| RF Cable | EMC102-KM-KM-1200 | 160925 | Jan. 29, 2018 | Jan. 28, 2019 |
| Software | ADT_Radiated_V8.7.08 | NA | NA | NA |
| Boresight Antenna Tower & Turn Table Max-Full | MF-7802BS | MF780208530 | NA | NA |
| Spectrum Analyzer R&S | FSV40 | 100964 | June 20, 2018 | June 19, 2019 |

Note:

1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. *The calibration interval of the above test instruments is 24 months and the calibrations are traceable to NML/ROC and NIST/USA.
3. The test was performed in 966 Chamber No. 4.
4. The CANADA Site Registration No. is 20331-2
5. Loop antenna was used for all emissions below 30 MHz.
6. Tested Date: Aug. 07 to 13, 2018

4.1.3 Test Procedures

For 47 CFR FCC Part 15:

For Radiated emission below 30MHz

- a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. Parallel, perpendicular, and ground-parallel orientations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

Note:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9kHz at frequency below 30MHz.

For Radiated emission above 30MHz

- a. The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d. 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.
- e. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
- f. The test-receiver system was set to peak and average detect function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Note:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) 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 $\geq 98\%$) for Average detection (AV) at frequency above 1GHz.
4. All modes of operation were investigated and the worst-case emissions are reported.

FCC Part 22:

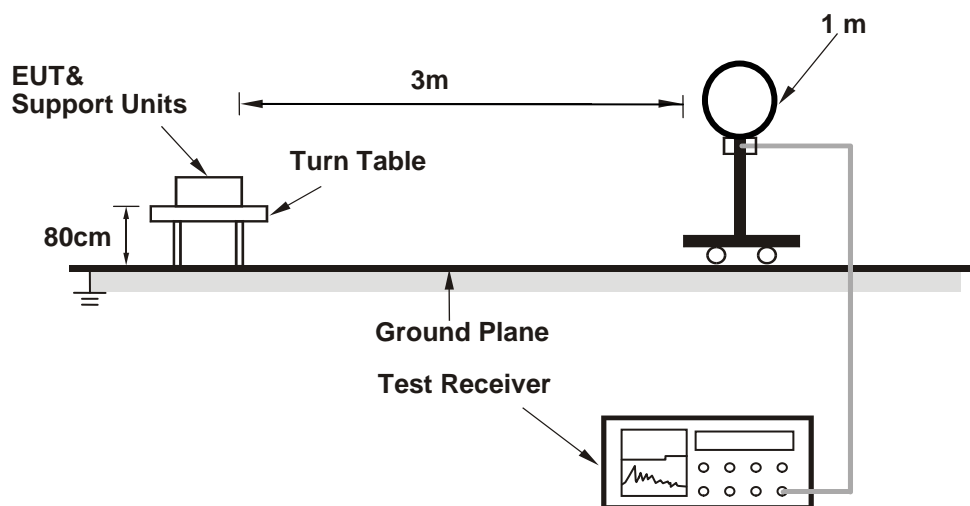
- a. The power was measured with Spectrum Analyzer.
- b. Substitution method is used for EIRP measurement. In the semi-anechoic chamber, EUT placed on the 0.8m/1.5m height of Turn Table, rotated the table around 360 degrees to search the maximum radiation power and receiver antenna shall be rotated vertical and horizontal polarization and moved height from 1m to 4m to find the maximum polar radiated power. The "Read Value" is the spectrum reading the maximum power value.
- c. The substitution antenna is substituted for EUT at the same position and signals generator export the CW signal to the substitution antenna via a TX cable. Rotated the Turn Table and moved receiving antenna to find the maximum radiation power. Adjust output power level of S.G to get a Value of spectrum reading equal to "Read Value " of step b. Record the power level of S.G
- d. $EIRP = \text{Output power level of S.G} - \text{TX cable loss} + \text{Antenna gain of substitution antenna}$.
- e. ERP power can be calculated form EIRP power by subtracting the gain of dipole, $ERP \text{ power} = EIRP \text{ power} - 2.15\text{dBi}$.

4.1.4 Deviation from Test Standard

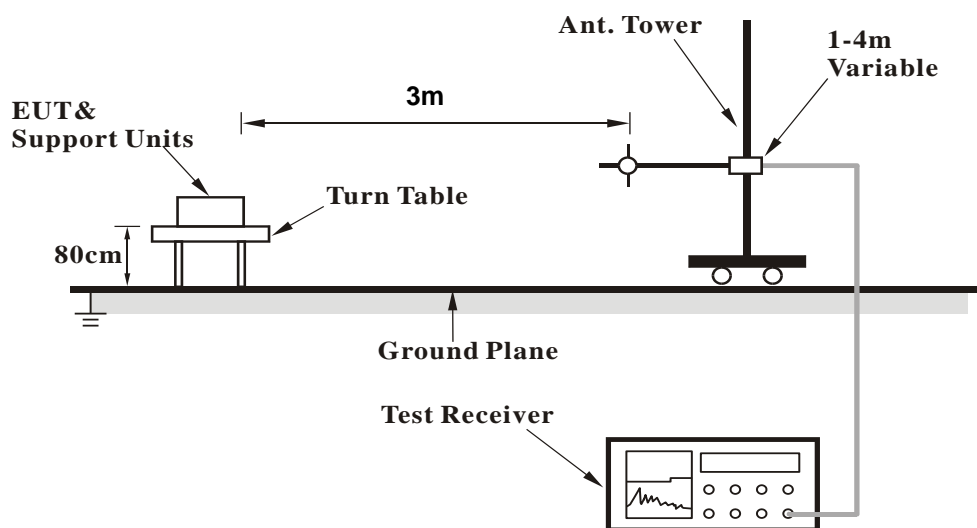
No deviation.

4.1.5 Test Setup

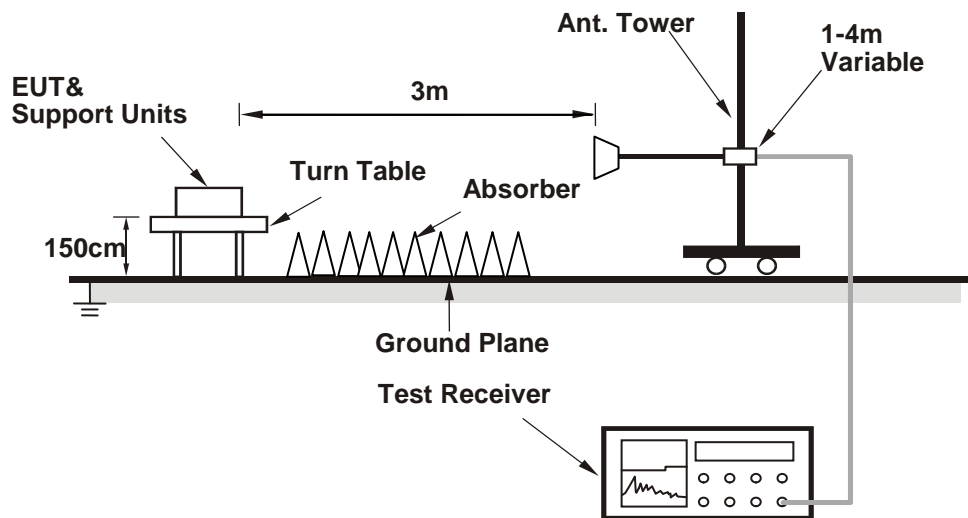
For Radiated emission below 30MHz



For Radiated emission 30MHz to 1GHz



For Radiated emission above 1GHz



For the actual test configuration, please refer to the attached file (Test Setup Photo).

4.1.6 EUT Operating Conditions

- a. Connected the EUT with the Laptop which is placed on remote site.
- b. Controlling software (Lantiq DUT Ver.541.41) has been activated to set the EUT on specific status.

4.1.7 Test Results

Above 1GHz Data

| | | | |
|------------------------|--------------|--------------------------|---------------------------|
| FREQUENCY RANGE | 1GHz ~ 40GHz | DETECTOR FUNCTION | Peak (PK) Average (AV) |
|------------------------|--------------|--------------------------|---------------------------|

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M

| NO. | FREQ. (MHz) | EMISSION LEVEL (dBuV/m) | LIMIT (dBuV/m) | MARGIN (dB) | ANTENNA HEIGHT (m) | TABLE ANGLE (Degree) | RAW VALUE (dBuV) | CORRECTION FACTOR (dB/m) |
|-----|-------------|-------------------------|----------------|-------------|--------------------|----------------------|------------------|--------------------------|
| 1 | 4824.00 | 48.3 PK | 74.0 | -25.7 | 1.69 H | 203 | 46.5 | 1.8 |
| 2 | 4824.00 | 35.4 AV | 54.0 | -18.6 | 1.69 H | 203 | 33.6 | 1.8 |
| 3 | 10460.00 | 65.2 PK | 68.2 | -3.0 | 2.06 H | 101 | 52.3 | 12.9 |
| 4 | 11510.00 | 56.9 PK | 74.0 | -17.1 | 2.28 H | 294 | 43.5 | 13.4 |
| 5 | 11510.00 | 45.9 AV | 54.0 | -8.1 | 2.28 H | 294 | 32.5 | 13.4 |
| 6 | 15690.00 | 65.2 PK | 74.0 | -8.8 | 2.17 H | 168 | 52.8 | 12.4 |
| 7 | 15690.00 | 50.4 AV | 54.0 | -3.6 | 2.17 H | 168 | 38.0 | 12.4 |
| 8 | 17265.00 | 60.3 PK | 68.2 | -7.9 | 1.37 H | 247 | 43.5 | 16.8 |

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M

| NO. | FREQ. (MHz) | EMISSION LEVEL (dBuV/m) | LIMIT (dBuV/m) | MARGIN (dB) | ANTENNA HEIGHT (m) | TABLE ANGLE (Degree) | RAW VALUE (dBuV) | CORRECTION FACTOR (dB/m) |
|----------|-----------------|-------------------------|----------------|-------------|--------------------|----------------------|------------------|--------------------------|
| 1 | 4824.00 | 52.9 PK | 74.0 | -21.1 | 1.21 V | 26 | 51.1 | 1.8 |
| 2 | 4824.00 | 40.0 AV | 54.0 | -14.0 | 1.21 V | 26 | 38.2 | 1.8 |
| 3 | 10460.00 | 68.1 PK | 68.2 | -0.1 | 1.15 V | 325 | 55.2 | 12.9 |
| 4 | 11510.00 | 58.0 PK | 74.0 | -16.0 | 1.63 V | 223 | 44.6 | 13.4 |
| 5 | 11510.00 | 45.7 AV | 54.0 | -8.3 | 1.63 V | 223 | 32.3 | 13.4 |
| 6 | 15690.00 | 66.5 PK | 74.0 | -7.5 | 3.27 V | 344 | 54.1 | 12.4 |
| 7 | 15690.00 | 51.8 AV | 54.0 | -2.2 | 3.27 V | 344 | 39.4 | 12.4 |
| 8 | 17265.00 | 62.1 PK | 68.2 | -6.1 | 1.89 V | 246 | 45.3 | 16.8 |

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

| | | | |
|------|------------------|-----------------|---------------|
| Mode | TX channel 20450 | Frequency Range | Above 1000MHz |
|------|------------------|-----------------|---------------|

Antenna Polarity & Test Distance: Horizontal at 3 M

| No. | Freq. (MHz) | Reading (dBm) | S.G Power Value (dBm) | Correction Factor (dB) | Emission Value (dBm) | Limit (dBm) | Margin (dB) |
|----------|-------------|---------------|-----------------------|------------------------|----------------------|-------------|---------------|
| 1 | 1658 | 43.82 | -58.91 | 6.27 | -52.64 | -13 | -39.64 |
| 2 | 2487 | 46.86 | -51.47 | 6.64 | -44.84 | -13 | -31.84 |
| 3 | 3316 | 35.75 | -66.78 | 7.97 | -58.81 | -13 | -45.81 |
| 4 | 4145 | 42.03 | -62.85 | 7.46 | -55.39 | -13 | -42.39 |
| 5 | 4974 | 30.77 | -73.42 | 7.00 | -66.42 | -13 | -53.42 |
| 6 | 5803 | 46.36 | -58.11 | 6.91 | -51.20 | -13 | -38.20 |
| 7 | 6632 | 44.79 | -58.79 | 5.68 | -53.12 | -13 | -40.12 |
| 8 | 7461 | 49.77 | -52.85 | 4.58 | -48.27 | -13 | -35.27 |
| 9 | 8290 | 49.59 | -53.03 | 4.17 | -48.86 | -13 | -35.86 |

Antenna Polarity & Test Distance: Vertical at 3 M

| No. | Freq. (MHz) | Reading (dBm) | S.G Power Value (dBm) | Correction Factor (dB) | Emission Value (dBm) | Limit (dBm) | Margin (dB) |
|-----|-------------|---------------|-----------------------|------------------------|----------------------|-------------|-------------|
| 1 | 1658 | 36.21 | -66.52 | 6.27 | -60.25 | -13 | -47.25 |
| 2 | 2487 | 39.86 | -58.47 | 6.64 | -51.84 | -13 | -38.84 |
| 3 | 3316 | 45.80 | -56.73 | 7.97 | -48.76 | -13 | -35.76 |
| 4 | 4145 | 47.41 | -57.47 | 7.46 | -50.01 | -13 | -37.01 |
| 5 | 4974 | 48.64 | -55.55 | 7.00 | -48.55 | -13 | -35.55 |
| 6 | 5803 | 48.30 | -56.17 | 6.91 | -49.26 | -13 | -36.26 |
| 7 | 6632 | 48.65 | -54.93 | 5.68 | -49.26 | -13 | -36.26 |
| 8 | 7461 | 48.91 | -53.71 | 4.58 | -49.13 | -13 | -36.13 |
| 9 | 8290 | 47.57 | -55.05 | 4.17 | -50.88 | -13 | -37.88 |

Remarks:

1. Emission Value (dBm) = S.G Value (dBm) + Correction Factor (dB).
2. Correction Factor (dB) = Substitution Antenna Gain (dB) + Cable Loss (dB).

Below 1GHz Data:

| | | | |
|------------------------|-------------|--------------------------|-----------------|
| FREQUENCY RANGE | 9kHz ~ 1GHz | DETECTOR FUNCTION | Quasi-Peak (QP) |
|------------------------|-------------|--------------------------|-----------------|

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M

| NO. | FREQ. (MHz) | EMISSION LEVEL (dBuV/m) | LIMIT (dBuV/m) | MARGIN (dB) | ANTENNA HEIGHT (m) | TABLE ANGLE (Degree) | RAW VALUE (dBuV) | CORRECTION FACTOR (dB/m) |
|-----|-------------|-------------------------|----------------|-------------|--------------------|----------------------|------------------|--------------------------|
| 1 | 35.72 | 28.3 QP | 40.0 | -11.7 | 1.50 H | 157 | 37.1 | -8.8 |
| 2 | 94.36 | 26.9 QP | 43.5 | -16.6 | 2.00 H | 226 | 40.1 | -13.2 |
| 3 | 147.88 | 25.8 QP | 43.5 | -17.7 | 2.00 H | 84 | 33.5 | -7.7 |
| 4 | 204.70 | 25.5 QP | 43.5 | -18.0 | 2.00 H | 89 | 36.6 | -11.1 |
| 5 | 392.10 | 34.0 QP | 46.0 | -12.0 | 1.00 H | 74 | 38.4 | -4.4 |
| 6 | 422.17 | 37.6 QP | 46.0 | -8.4 | 1.00 H | 320 | 41.2 | -3.6 |

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M

| NO. | FREQ. (MHz) | EMISSION LEVEL (dBuV/m) | LIMIT (dBuV/m) | MARGIN (dB) | ANTENNA HEIGHT (m) | TABLE ANGLE (Degree) | RAW VALUE (dBuV) | CORRECTION FACTOR (dB/m) |
|-----|-------------|-------------------------|----------------|-------------|--------------------|----------------------|------------------|--------------------------|
| 1 | 82.55 | 32.1 QP | 40.0 | -7.9 | 1.50 V | 15 | 45.2 | -13.1 |
| 2 | 180.03 | 27.6 QP | 43.5 | -15.9 | 1.00 V | 360 | 37.0 | -9.4 |
| 3 | 288.17 | 25.3 QP | 46.0 | -20.7 | 2.00 V | 206 | 32.7 | -7.4 |
| 4 | 412.93 | 39.9 QP | 46.0 | -6.1 | 1.00 V | 6 | 43.8 | -3.9 |
| 5 | 459.95 | 34.1 QP | 46.0 | -11.9 | 1.00 V | 327 | 36.6 | -2.5 |
| 6 | 799.70 | 34.8 QP | 46.0 | -11.2 | 1.00 V | 11 | 31.1 | 3.7 |

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

4.2 Conducted Emission Measurement

4.2.1 Limits of Conducted Emission Measurement

| Frequency (MHz) | Conducted Limit (dBuV) | |
|-----------------|------------------------|---------|
| | Quasi-peak | Average |
| 0.15 - 0.5 | 66 - 56 | 56 - 46 |
| 0.50 - 5.0 | 56 | 46 |
| 5.0 - 30.0 | 60 | 50 |

Note: 1. The lower limit shall apply at the transition frequencies.

2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

4.2.2 Test Instruments

| DESCRIPTION & MANUFACTURER | MODEL NO. | SERIAL NO. | CALIBRATED DATE | CALIBRATED UNTIL |
|--|-------------------------|------------|-----------------|------------------|
| Test Receiver R&S | ESCS 30 | 847124/029 | Nov. 01, 2017 | Oct. 31, 2018 |
| Line-Impedance Stabilization Network (for EUT) R&S | ESH3-Z5 | 848773/004 | Nov. 15, 2017 | Nov. 14, 2018 |
| Line-Impedance Stabilization Network (for Peripheral) R&S | ENV216 | 100072 | June 04, 2018 | June 03, 2019 |
| 50 ohms Terminator | N/A | EMC-02 | Sep. 22, 2017 | Sep. 21, 2018 |
| RF Cable | 5D-FB | COCCAB-001 | Sep. 29, 2017 | Sep. 28, 2018 |
| Fixed attenuator EMCI | STI02-2200-10 | 003 | Mar. 16, 2018 | Mar. 15, 2019 |
| Software BVADT | BVADT_Cond_ V7.3.7.4 | NA | NA | NA |

Note:

1. The calibration interval of the above test instruments are 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. The test was performed in Conduction 1.
3. Tested Date: Aug. 04, 2018

4.2.3 Test Procedures

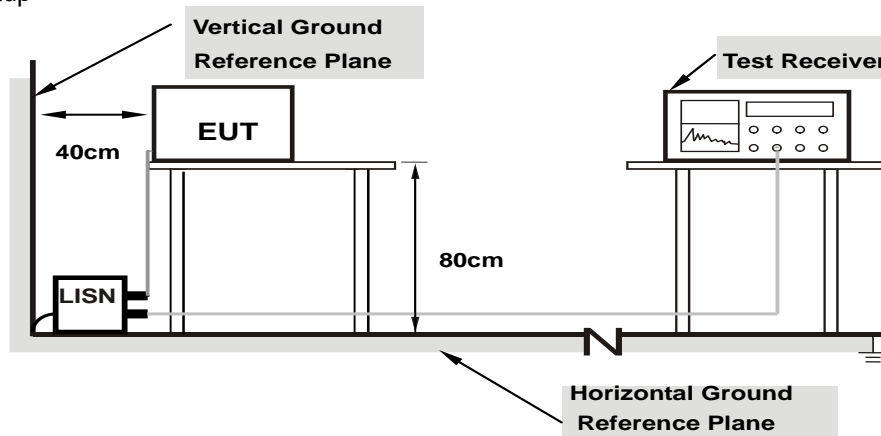
- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument.
- Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
- The frequency range from 150kHz to 30MHz was searched. Emission levels under (Limit - 20dB) was not recorded.

Note: The resolution bandwidth and video bandwidth of test receiver is 9kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15MHz-30MHz.

4.2.4 Deviation from Test Standard

No deviation.

4.2.5 Test Setup



Note: 1.Support units were connected to second LISN.

For the actual test configuration, please refer to the attached file (Test Setup Photo).

4.2.6 EUT Operating Conditions

Same as 4.1.6.

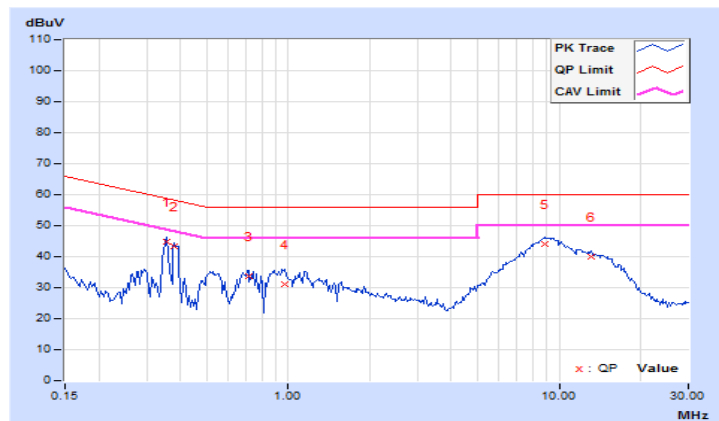
4.2.7 Test Results

| Phase | Line (L) | Detector Function | Quasi-Peak (QP) / Average (AV) |
|-------|----------|-------------------|--------------------------------|
|-------|----------|-------------------|--------------------------------|

| No | Freq. [MHz] | Corr. Factor | Reading Value [dB (uV)] | | Emission Level [dB (uV)] | | Limit [dB (uV)] | | Margin (dB) | |
|----|----------------|-----------------|----------------------------|-------|-----------------------------|-------|--------------------|-------|----------------|--------|
| | | (dB) | Q.P. | AV. | Q.P. | AV. | Q.P. | AV. | Q.P. | AV. |
| | 1 | 0.35703 | 10.10 | 34.70 | 32.69 | 44.80 | 42.79 | 58.80 | 48.80 | -14.00 |
| 2 | 0.38047 | 10.11 | 33.14 | 31.56 | 43.25 | 41.67 | 58.27 | 48.27 | -15.02 | -6.60 |
| 3 | 0.71250 | 10.13 | 23.75 | 18.91 | 33.88 | 29.04 | 56.00 | 46.00 | -22.12 | -16.96 |
| 4 | 0.97422 | 10.15 | 21.01 | 18.49 | 31.16 | 28.64 | 56.00 | 46.00 | -24.84 | -17.36 |
| 5 | 8.85547 | 10.49 | 33.74 | 27.15 | 44.23 | 37.64 | 60.00 | 50.00 | -15.77 | -12.36 |
| 6 | 13.06250 | 10.72 | 29.27 | 21.55 | 39.99 | 32.27 | 60.00 | 50.00 | -20.01 | -17.73 |

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level – Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value

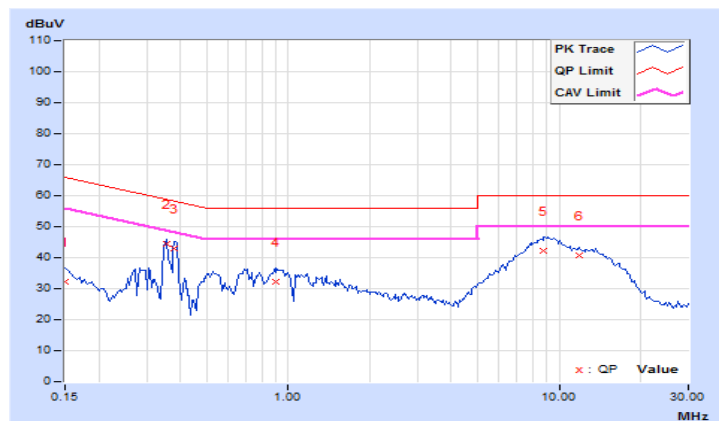


| | | | |
|-------|-------------|-------------------|--------------------------------|
| Phase | Neutral (N) | Detector Function | Quasi-Peak (QP) / Average (AV) |
|-------|-------------|-------------------|--------------------------------|

| No | Freq. [MHz] | Corr. | Reading Value | | Emission Level | | Limit | | Margin | |
|----------|----------------|-------------|---------------|--------------|----------------|--------------|--------------|--------------|---------------|--------------|
| | | Factor | [dB (uV)] | | [dB (uV)] | | [dB (uV)] | | (dB) | |
| | (dB) | Q.P. | AV. | Q.P. | AV. | Q.P. | AV. | Q.P. | AV. | |
| 1 | 0.15000 | 9.94 | 22.35 | 15.95 | 32.29 | 25.89 | 66.00 | 56.00 | -33.71 | -30.11 |
| 2 | 0.35416 | 9.99 | 34.33 | 33.63 | 44.32 | 43.62 | 58.86 | 48.86 | -14.54 | -5.24 |
| 3 | 0.38047 | 10.00 | 33.12 | 32.01 | 43.12 | 42.01 | 58.27 | 48.27 | -15.15 | -6.26 |
| 4 | 0.89609 | 10.02 | 22.05 | 7.09 | 32.07 | 17.11 | 56.00 | 46.00 | -23.93 | -28.89 |
| 5 | 8.80078 | 10.34 | 31.95 | 26.08 | 42.29 | 36.42 | 60.00 | 50.00 | -17.71 | -13.58 |
| 6 | 11.88672 | 10.49 | 30.13 | 22.72 | 40.62 | 33.21 | 60.00 | 50.00 | -19.38 | -16.79 |

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level – Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value

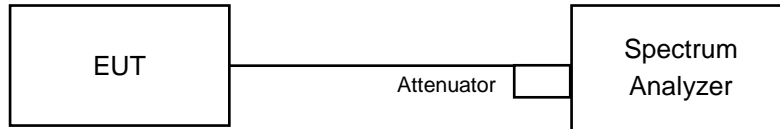


4.3 Conducted Out of Band Emission Measurement

4.3.1 Limits of Conducted Out of Band Emission Measurement

Below 20dB of the highest emission level of operating band (in 100kHz Resolution Bandwidth).

4.3.2 Test Setup



4.3.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.3.4 Test Procedures

MEASUREMENT PROCEDURE REF

1. Set the RBW = 100 kHz.
2. Set the VBW \geq 300 kHz.
3. Detector = peak.
4. Sweep time = auto couple.
5. Trace mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.

MEASUREMENT PROCEDURE OOB

1. Set RBW = 100 kHz.
2. Set VBW \geq 300 kHz.
3. Detector = peak.
4. Sweep = auto couple.
5. Trace Mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum amplitude level.

4.3.5 Deviation from Test Standard

No deviation.

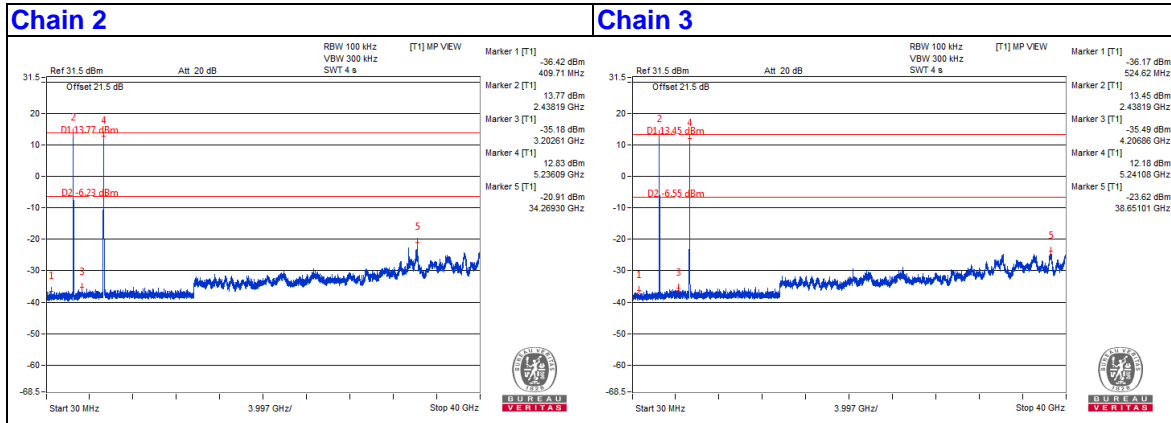
4.3.6 EUT Operating Conditions

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

4.3.7 Test Results

The spectrum plots are attached on the following pages. D1 line indicates the highest level, and D2 line indicates the 20dB offset below D1. It shows compliance with the requirement.

2.4GHz_802.11n (HT20) CH1 + 5GHz_802.11ac (VHT40) CH46



5 Pictures of Test Arrangements

Please refer to the attached file (Test Setup Photo).

Appendix – Information on the Testing Laboratories

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are FCC recognized accredited test firms and accredited according to ISO/IEC 17025.

If you have any comments, please feel free to contact us at the following:

Linko EMC/RF Lab

Tel: 886-2-26052180

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Web Site: www.bureauveritas-adt.com

The address and road map of all our labs can be found in our web site also.

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