

FCC Test Report

Report No.: FC190716E01

FCC ID: J9C-QCNFA524

Test Model: QCNFA524

Received Date: July 16, 2019

Test Date: Oct. 16 to 30, 2019

Issued Date: Nov. 15, 2019

Applicant: Qualcomm Technologies, Inc.

Address: 5775 Morehouse Drive, San Diego, CA 92121-1714

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

Lab Address: E-2, No.1, Li Hsin 1st Road, Hsinchu Science Park, Hsinchu City 300,
Taiwan.

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

Test Location (2): No. 49, Ln. 206, Wende Rd., Shangshan Tsuen, Chiung Lin Hsiang, Hsin
Chu Hsien 307, Taiwan.

FCC Registration / 810758 / TW1085 for Test Location (1)
Designation Number: 960022 / TW1058 for Test Location (2)



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Release Control Record

| Issue No. | Description | Date Issued |
|-------------|-------------------|---------------|
| FC190716E01 | Original release. | Nov. 15, 2019 |

1 Certificate of Conformity

Product: Wi-Fi 6 + BT 5.1 M.2 1216 Module

Brand: Qualcomm

Test Model: QCNFA524

Sample Status: ENGINEERING SAMPLE

Applicant: Qualcomm Technologies, Inc.

Test Date: Oct. 16 to 30, 2019

Standards: 47 CFR FCC Part 15, Subpart B, Class B
ICES-003:2016 Issue 6, updated Apr. 2019, Class B
ANSI C63.4:2014

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 :

Phoenix Huang
Phoenix Huang / Specialist

Date:

Nov. 15, 2019

Approved by :

Ken Lu
Ken Lu / Manager

Date:

Nov. 15, 2019

2 Summary of Test Results

47 CFR FCC Part 15, Subpart B / ICES-003:2016 Issue 6, updated Apr. 2019, Class B

ANSI C63.4:2014

| FCC Clause | ICES-003 Clause | Test Item | Result/Remarks | Verdict |
|------------|-----------------|-----------------------------------|--|---------|
| 15.107 | 6.1 | AC Power Line Conducted Emissions | Minimum passing Class B margin is -11.46 dB at 0.15781 MHz | Pass |
| 15.109 | 6.2.1 | Radiated Emissions up to 1 GHz | Minimum passing Class B margin is -0.97 dB at 199.54 MHz | Pass |
| | 6.2.2 | Radiated Emissions above 1 GHz | Minimum passing Class B margin is -9.20 dB at 11469.60 MHz | Pass |

Note: Determining compliance based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

2.1 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT:

| Measurement | Frequency | Expanded Uncertainty (k=2) (\pm) |
|------------------------------------|----------------|--------------------------------------|
| Conducted Emissions at mains ports | 150kHz ~ 30MHz | 1.8 dB |
| Radiated Emissions up to 1 GHz | 30MHz ~ 1GHz | 4.0 dB |
| Radiated Emissions above 1 GHz | 1GHz ~ 6GHz | 4.7 dB |
| | 6GHz ~ 18GHz | 5.2 dB |
| | 18GHz ~ 40GHz | 5.3 dB |

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 Description of EUT

| | |
|---------------------|----------------------------------|
| Product | Wi-Fi 6 + BT 5.1 M.2 1216 Module |
| Brand | Qualcomm |
| Test Model | QCNFA524 |
| Sample Status | ENGINEERING SAMPLE |
| Operating Software | NA |
| Power Supply Rating | 3.3Vdc from host equipment |
| Accessory Device | NA |
| Data Cable Supplied | NA |

Note:

1. This device of WLAN (2.4GHz & 5GHz U-NII-1 Band) can support hotspot mode.
2. The EUT incorporates a MIMO function:

| 2.4GHz Band | | |
|---------------------------------------|-----------------------|-----|
| MODULATION MODE | TX & RX CONFIGURATION | |
| 802.11b | 2TX | 2RX |
| 802.11g | 2TX | 2RX |
| 802.11n (HT20) | 2TX | 2RX |
| 802.11n (HT40) | 2TX | 2RX |
| VHT20 | 2TX | 2RX |
| VHT40 | 2TX | 2RX |
| 802.11ax (HE20) | 2TX | 2RX |
| 802.11ax (HE40) | 2TX | 2RX |
| 802.11ax (RU26/52/106/242/484) | 2TX | 2RX |
| 5GHz Band | | |
| MODULATION MODE | TX & RX CONFIGURATION | |
| 802.11a | 2TX | 2RX |
| 802.11n (HT20) | 2TX | 2RX |
| 802.11n (HT40) | 2TX | 2RX |
| 802.11ac (VHT20) | 2TX | 2RX |
| 802.11ac (VHT40) | 2TX | 2RX |
| 802.11ac (VHT80) | 2TX | 2RX |
| 802.11ax (HE20) | 2TX | 2RX |
| 802.11ax (HE40) | 2TX | 2RX |
| 802.11ax (HE80) | 2TX | 2RX |
| 802.11ax (RU26/52/106/242/484/996) | 2TX | 2RX |

3. Simultaneously transmission condition.

| Condition | Technology | |
|-----------|---------------|-------------|
| 1 | WLAN (2.4GHz) | WLAN (5GHz) |
| 2 | WLAN (5GHz) | Bluetooth |

4. The device of WLAN (2.4GHz) and Bluetooth technology can't transmit simultaneously, it was used timely shared coexistence technology.

3.2 Features of EUT

The tests reported herein were performed according to the method specified by Qualcomm Technologies, Inc., for detailed feature description, please refer to the manufacturer's specifications or user's manual.

3.3 Description of Antenna

The antenna gain was declared by client; please refer to the following table:

| Ant. No. | Brand | Model | Antenna Net gain | Frequency range (GHz) | Cable Loss (dBi) | Ant. Type | Connector Type | Cable Length (mm) |
|----------|-------|--------------|------------------|-----------------------|------------------|-----------|----------------|-------------------|
| 1 | WNC | 81.EBJ15.005 | 3.00 | 2.4~2.4835 | 1.15 | PIFA | i-pex(MHF2) | 300 |
| | | | 2.56 | 5.15~5.35 | 1.70 | | | |
| | | | 4.76 | 5.47~5.725 | 1.74 | | | |
| | | | 4.76 | 5.725~5.850 | 1.79 | | | |
| 2 | WNC | 81.EBJ15.005 | 3.62 | 2.4~2.4835 | 1.15 | PIFA | i-pex(MHF2) | 300 |
| | | | 3.08 | 5.15~5.35 | 1.70 | | | |
| | | | 3.31 | 5.47~5.725 | 1.74 | | | |
| | | | 2.42 | 5.725~5.850 | 1.79 | | | |

Note: 1. Above antenna gains of antenna are Total (H+V).

2. The Antenna No. 1 was selected for the final test.

3.4 Operating Modes of EUT and Determination of Worst Case Operating Mode

Test mode is presented in the report as below.

| Mode | Test Condition |
|------|---|
| 1 | Client MODE AX 2.4G / 5G + Hotspot MODE 2.4G / 5G + Bluetooth |

NOTE: The test configurations are defined by the applicant requirement.

3.5 Test Program Used and Operation Descriptions

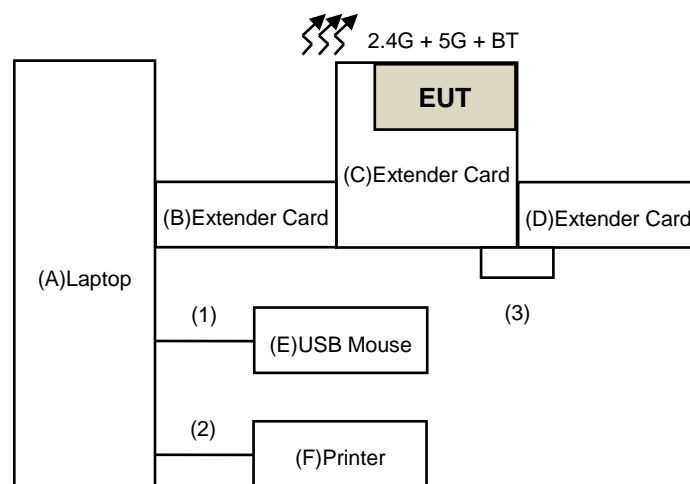
1. Turn on the power of all equipment.
2. Support unit G & H (AP Router) links EUT via wireless 2.4G / 5G of Client MODE.
3. Support unit K & L (Laptop) links EUT via wireless 2.4G / 5G of Hotspot MODE.
4. Support unit K (Laptop) runs "Ping.exe" program to communicate with support unit I (Laptop) via wireless 2.4G.
5. Support unit L (Laptop) runs "Ping.exe" program to communicate with support unit J (Laptop) via wireless 5G.
6. Support unit M (BT Speaker) play audio by support unit A (Laptop) runs "media player.exe" via BT of EUT.
7. Support unit A (Laptop) runs "EMC test.exe" then sends "H" messages to itself.

3.6 Primary Clock Frequencies of Internal Source

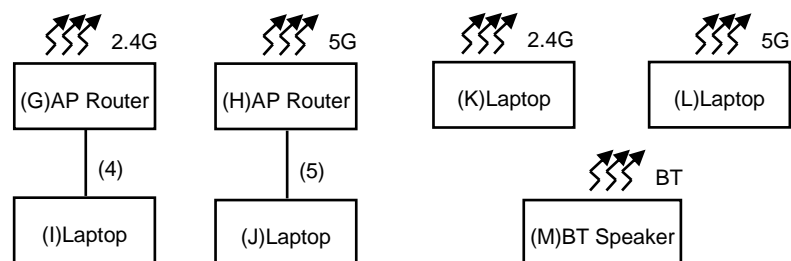
The EUT is provided by Qualcomm Technologies, Inc., for detailed internal source, please refer to the manufacturer's specifications.

4 Configuration and Connections with EUT

4.1 Connection Diagram of EUT and Peripheral Devices



Remote Site



4.2 Configuration of Peripheral Devices and Cable Connections

| ID | Product | Brand | Model No. | Serial No. | FCC ID | Remarks |
|----|---------------|----------|-----------|------------|---------|--------------------|
| A. | Laptop | Dell | E6230 | 4BGVYW1 | NA | Provided by Lab |
| B. | Extender Card | Qualcomm | Y6570 | NA | NA | Supplied by client |
| C. | Extender Card | Qualcomm | YB222 | NA | NA | Supplied by client |
| D. | Extender Card | Qualcomm | Y5984 | NA | NA | Supplied by client |
| E. | USB Mouse | DELL | MO56UO | 516045397 | NA | Provided by Lab |
| F. | Printer | EPSON | LQ-300+II | G88Y074083 | FCC DoC | Provided by Lab |
| G. | AP Router | ASUS | AX6000 | NA | NA | Provided by Lab |
| H. | AP Router | ASUS | AX6000 | NA | NA | Provided by Lab |
| I. | Laptop | DELL | PP27L | 6YLB32S | FCC DoC | Provided by Lab |
| J. | Laptop | DELL | PP27L | 7YLB32S | FCC DoC | Provided by Lab |
| K. | Laptop | DELL | P70F | JJY07L2 | FCC DoC | Provided by Lab |
| L. | Laptop | DELL | P70F | 1KY07L2 | FCC DoC | Provided by Lab |
| M. | BT Speaker | NA | NA | NA | 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. | USB Cable | 1 | 1.8 | Yes | 0 | Provided by Lab |
| 2. | USB Cable | 1 | 1.8 | Yes | 0 | Provided by Lab |
| 3. | USB to Micro USB Cable | 1 | 1 | Yes | 0 | Supplied by client |

5 Conducted Emissions at Mains Ports

5.1 Limits

| Frequency (MHz) | Class A (dBuV) | | Class B (dBuV) | |
|-----------------|----------------|---------|----------------|---------|
| | Quasi-peak | Average | Quasi-peak | Average |
| 0.15 - 0.5 | 79 | 66 | 66 - 56 | 56 - 46 |
| 0.50 - 5.0 | 73 | 60 | 56 | 46 |
| 5.0 - 30.0 | 73 | 60 | 60 | 50 |

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

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

5.2 Test Instruments

| DESCRIPTION & MANUFACTURER | MODEL NO. | SERIAL NO. | CALIBRATED DATE | CALIBRATED UNTIL |
|---|-------------------------|------------|-----------------|------------------|
| Test Receiver R&S | ESCS 30 | 100375 | May 15, 2019 | May 14, 2020 |
| Line-Impedance Stabilization Network (for EUT) SCHWARZBECK | NSLK-8127 | 8127-522 | Sep. 04, 2019 | Sep. 03, 2020 |
| Line-Impedance Stabilization Network (for Peripheral) R&S | ENV 216 | 100072 | June 12, 2019 | June 11, 2020 |
| RF Cable | 5D-FB | COACAB-001 | Mar. 14, 2019 | Mar. 13, 2020 |
| 10 dB PAD EMEC | STI02-2200-10 | 004 | Mar. 14, 2019 | Mar. 13, 2020 |
| 50 ohms Terminator | N/A | EMC-03 | Sep. 25, 2019 | Sep. 24, 2020 |
| 50 ohms Terminator | N/A | EMC-02 | Sep. 25, 2019 | Sep. 24, 2020 |
| Software BVADT | BVADT_Cond_ V7.3.7.4 | NA | NA | NA |

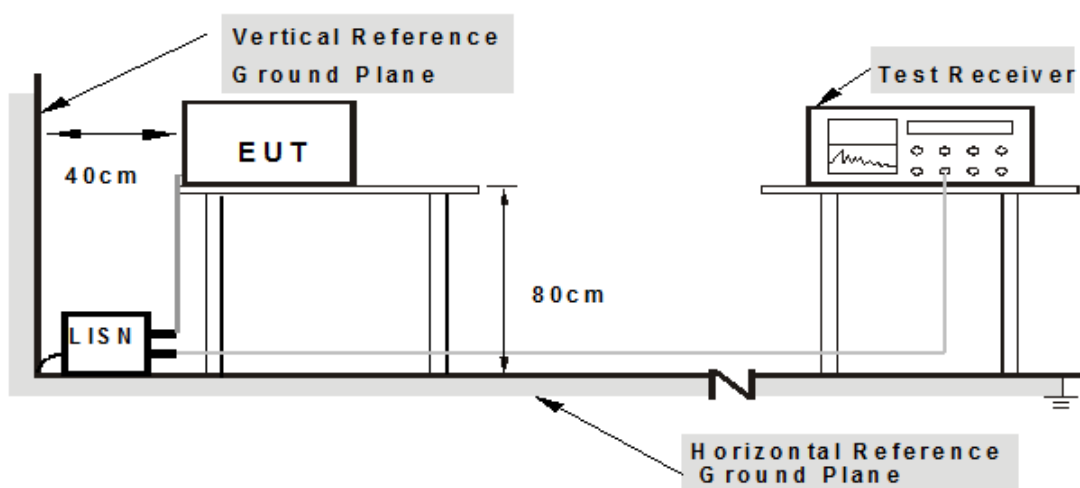
Note:

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 Conducted Room C
3. The VCCI Con C Registration No. is C-13611.
4. Tested Date: Oct. 16, 2019

5.3 Test Arrangement

- 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 test results of conducted emissions at mains ports are recorded of six worst margins for quasi-peak (mandatory) [and average (if necessary)] values against the limits at frequencies of interest unless the margin is 20 dB or greater.

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.



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

For the actual test configuration, please refer to the related Item – Photographs of the Test Configuration.

5.4 Supplementary Information

There is not any deviation from the test standards for the test method.

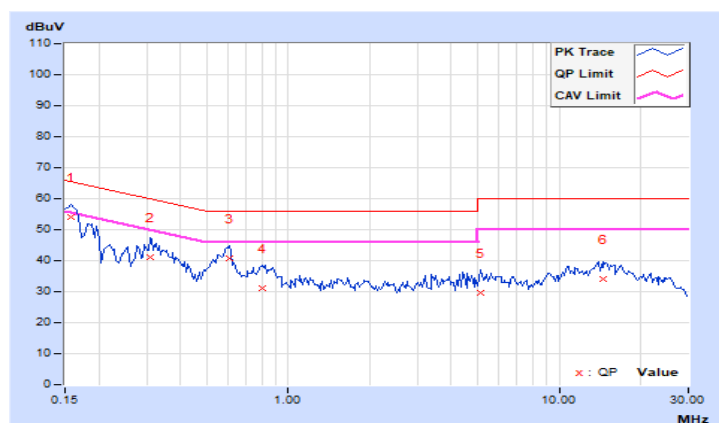
5.5 Test Results

| | | | |
|-----------------|----------------|--|--------------------------------------|
| Frequency Range | 150kHz ~ 30MHz | Detector Function & Resolution Bandwidth | Quasi-Peak (QP) / Average (AV), 9kHz |
| Input Power | 120Vac, 60Hz | Environmental Conditions | 25°C, 75%RH |
| Tested by | Nick Lo | | |
| Test Mode | Mode 1 | | |

| Phase Of Power : Line (L) | | | | | | | | | | |
|---------------------------|-----------------|------------------------|----------------------|-------|-----------------------|-------|--------------|-------|-------------|--------|
| No | Frequency (MHz) | Correction Factor (dB) | Reading Value (dBuV) | | Emission Level (dBuV) | | Limit (dBuV) | | Margin (dB) | |
| | | | Q.P. | AV. | Q.P. | AV. | Q.P. | AV. | Q.P. | AV. |
| 1 | 0.15781 | 10.02 | 43.98 | 34.08 | 54.00 | 44.10 | 65.58 | 55.58 | -11.58 | -11.48 |
| 2 | 0.31016 | 10.02 | 31.22 | 19.66 | 41.24 | 29.68 | 59.97 | 49.97 | -18.73 | -20.29 |
| 3 | 0.60703 | 10.04 | 30.74 | 23.86 | 40.78 | 33.90 | 56.00 | 46.00 | -15.22 | -12.10 |
| 4 | 0.80234 | 10.05 | 21.08 | 14.38 | 31.13 | 24.43 | 56.00 | 46.00 | -24.87 | -21.57 |
| 5 | 5.14063 | 10.22 | 19.30 | 11.84 | 29.52 | 22.06 | 60.00 | 50.00 | -30.48 | -27.94 |
| 6 | 14.45703 | 10.47 | 23.60 | 16.38 | 34.07 | 26.85 | 60.00 | 50.00 | -25.93 | -23.15 |

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

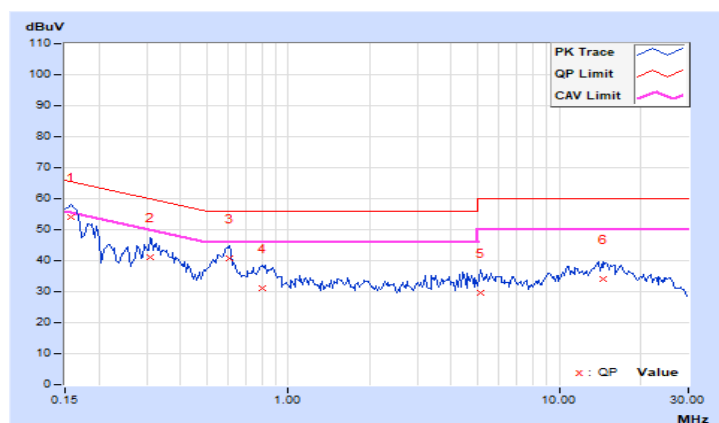


| | | | |
|-----------------|----------------|--|--------------------------------------|
| Frequency Range | 150kHz ~ 30MHz | Detector Function & Resolution Bandwidth | Quasi-Peak (QP) / Average (AV), 9kHz |
| Input Power | 120Vac, 60Hz | Environmental Conditions | 25°C, 75%RH |
| Tested by | Nick Lo | | |
| Test Mode | Mode 1 | | |

| Phase Of Power : Neutral (N) | | | | | | | | | | |
|------------------------------|-----------------|------------------------|----------------------|-------|-----------------------|-------|--------------|-------|-------------|--------|
| No | Frequency (MHz) | Correction Factor (dB) | Reading Value (dBuV) | | Emission Level (dBuV) | | Limit (dBuV) | | Margin (dB) | |
| | | | Q.P. | AV. | Q.P. | AV. | Q.P. | AV. | Q.P. | AV. |
| 1 | 0.15781 | 10.04 | 43.98 | 34.08 | 54.02 | 44.12 | 65.58 | 55.58 | -11.56 | -11.46 |
| 2 | 0.31016 | 10.04 | 31.22 | 19.66 | 41.26 | 29.70 | 59.97 | 49.97 | -18.71 | -20.27 |
| 3 | 0.60703 | 10.05 | 30.74 | 23.86 | 40.79 | 33.91 | 56.00 | 46.00 | -15.21 | -12.09 |
| 4 | 0.80234 | 10.05 | 21.08 | 14.38 | 31.13 | 24.43 | 56.00 | 46.00 | -24.87 | -21.57 |
| 5 | 5.14063 | 10.21 | 19.30 | 11.84 | 29.51 | 22.05 | 60.00 | 50.00 | -30.49 | -27.95 |
| 6 | 14.45703 | 10.46 | 23.60 | 16.38 | 34.06 | 26.84 | 60.00 | 50.00 | -25.94 | -23.16 |

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



6 Radiated Emissions up to 1 GHz

6.1 Limits

Emissions radiated outside of the specified bands, shall be according to the general radiated limits as following:

| Radiated Emissions Limits at 10 meters (dBμV/m) | | | | |
|---|-----------------------------|-----------------------------|-------------------|-------------------|
| Frequencies (MHz) | FCC 15B / ICES-003, Class A | FCC 15B / ICES-003, Class B | CISPR 22, Class A | CISPR 22, Class B |
| 30-88 | 39 | 29.5 | 40 | 30 |
| 88-216 | 43.5 | 33.1 | | |
| 216-230 | 46.4 | 35.6 | | |
| 230-960 | | | 47 | 37 |
| 960-1000 | 49.5 | 43.5 | | |

| Radiated Emissions Limits at 3 meters (dBμV/m) | | | | |
|--|-----------------------------|-----------------------------|-------------------|-------------------|
| Frequencies (MHz) | FCC 15B / ICES-003, Class A | FCC 15B / ICES-003, Class B | CISPR 22, Class A | CISPR 22, Class B |
| 30-88 | 49.5 | 40 | 50.5 | 40.5 |
| 88-216 | 54 | 43.5 | | |
| 216-230 | 56.9 | 46 | | |
| 230-960 | | | | |
| 960-1000 | 60 | 54 | 57.5 | 47.5 |

- Notes:
1. The lower limit shall apply at the transition frequencies.
 2. Emission level (dB μ V/m) = 20 log Emission level (μ V/m).
 3. QP detector shall be applied if not specified.

6.2 Test Instruments

| DESCRIPTION & MANUFACTURER | MODEL NO. | SERIAL NO. | CALIBRATED DATE | CALIBRATED UNTIL |
|--|--------------------------|--|-----------------|------------------|
| Test Receiver Agilent | N9038A | MY50010125 | Apr. 11, 2019 | Apr. 10, 2020 |
| Test Receiver Agilent | N9038A | MY50010132 | July 12, 2019 | July 11, 2020 |
| Pre-Amplifier Sonoma | 310N | 352925 | Aug. 26, 2019 | Aug. 25, 2020 |
| | 310N | 352926 | Aug. 26, 2019 | Aug. 25, 2020 |
| Trilog Broadband Antenna SCHWARZBECK | VULB 9168 | 9168-359 | Nov. 22, 2018 | Nov. 21, 2019 |
| | VULB 9168 | 9168-358 | Nov. 21, 2018 | Nov. 20, 2019 |
| Fixed attenuator Mini-Circuits | UNAT-5+ | CHF-001 | Sep. 04, 2019 | Sep. 03, 2020 |
| | UNAT-5+ | CHF-002 | Sep. 04, 2019 | Sep. 03, 2020 |
| RF Cable | 8D-FB | CHFCAB-001-1 CHFCAB-001-3 CHFCAB-001-4 | Sep. 16, 2019 | Sep. 15, 2020 |
| | | CHFCAB-002-1 CHFCAB-002-3 CHFCAB-002-4 | Sep. 16, 2019 | Sep. 15, 2020 |
| Software BVADT | ADT_Radiated_V 8.7.08 | NA | NA | NA |
| Antenna Tower & Turn Table CT | NA | NA | NA | NA |

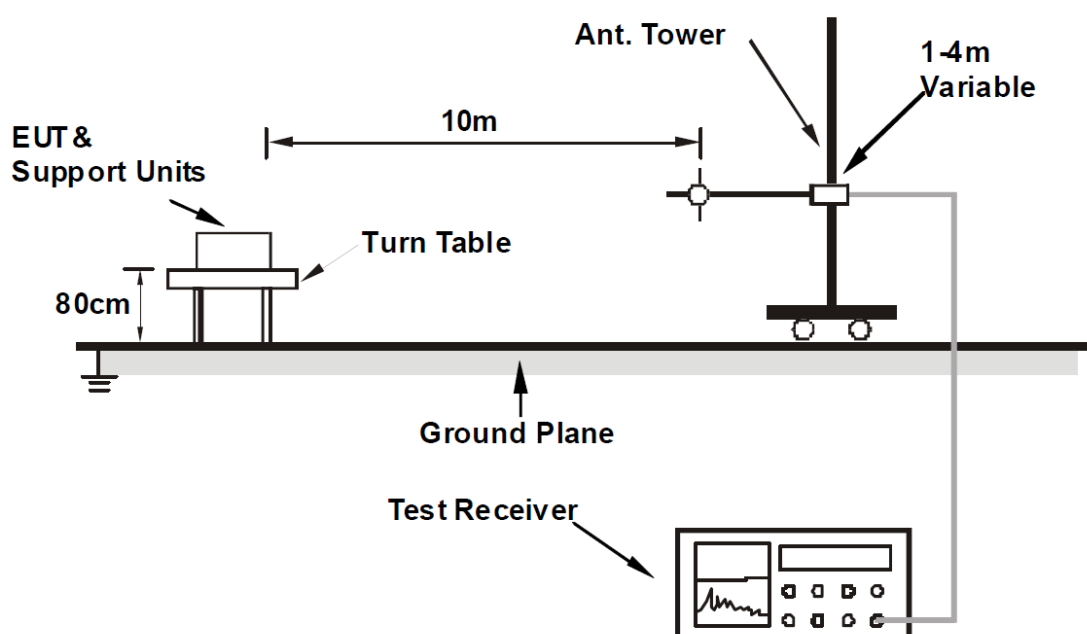
Note:

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 Chamber F room
3. The VCCI Site Registration No. is R-13252.
4. Tested Date: Oct. 30, 2019

6.3 Test Arrangement

- The EUT was placed on the top of a rotating table 0.8 meters above the ground at an accredited test facility. The table was rotated 360 degrees to determine the position of the highest radiation.
- The EUT was set 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- The antenna is a broadband antenna, and its height 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.
- 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.
- The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is up to 1 GHz.

Note: The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for quasi-peak detection (QP) at frequency up to 1GHz.



For the actual test configuration, please refer to the related Item – Photographs of the Test Configuration.

6.4 Supplementary Information

There is not any deviation from the test standards for the test method.

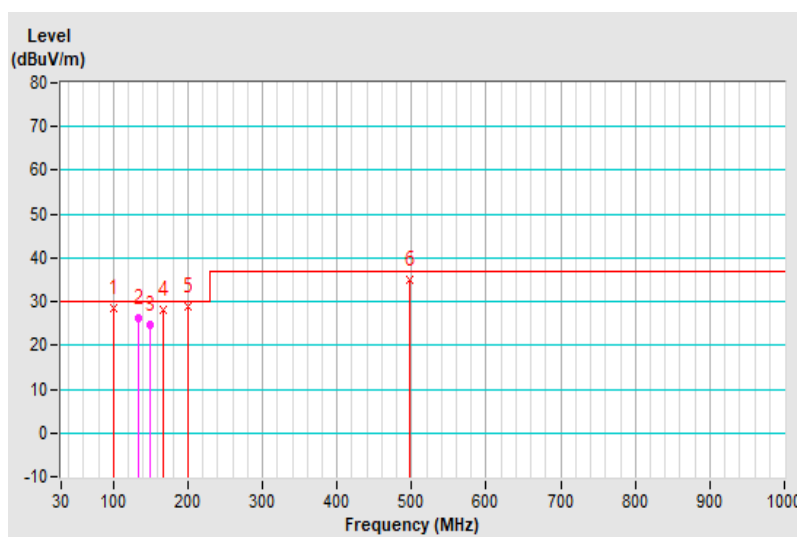
6.5 Test Results

| | | | |
|-----------------|----------------------------|--|-------------------------|
| Frequency Range | 30MHz ~ 1GHz | Detector Function & Resolution Bandwidth | Quasi-Peak (QP), 120kHz |
| Input Power | 3.3Vdc from host equipment | Environmental Conditions | 25°C, 62%RH |
| Tested by | Pon Tsai | | |
| Test Mode | Mode 1 | | |

| Antenna Polarity & Test Distance : Horizontal at 10 m | | | | | | | | |
|---|-----------------|-------------------------|----------------|--------------|--------------------|----------------------|------------------|--------------------------|
| No | Frequency (MHz) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV) | Correction Factor (dB/m) |
| 1 | 99.62 | 28.53 QP | 30.00 | -1.47 | 4.00 H | 73 | 45.30 | -16.77 |
| 2 | 133.04 | 26.34 QP | 30.00 | -3.66 | 4.00 H | 145 | 39.60 | -13.26 |
| 3 | 148.63 | 24.59 QP | 30.00 | -5.41 | 4.00 H | 2 | 36.91 | -12.32 |
| 4 | 165.99 | 28.01 QP | 30.00 | -1.99 | 4.00 H | 78 | 40.37 | -12.36 |
| 5 | 199.54 | 29.03 QP | 30.00 | -0.97 | 3.98 H | 83 | 43.58 | -14.55 |
| 6 | 497.88 | 35.02 QP | 37.00 | -1.98 | 2.00 H | 225 | 40.88 | -5.86 |

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

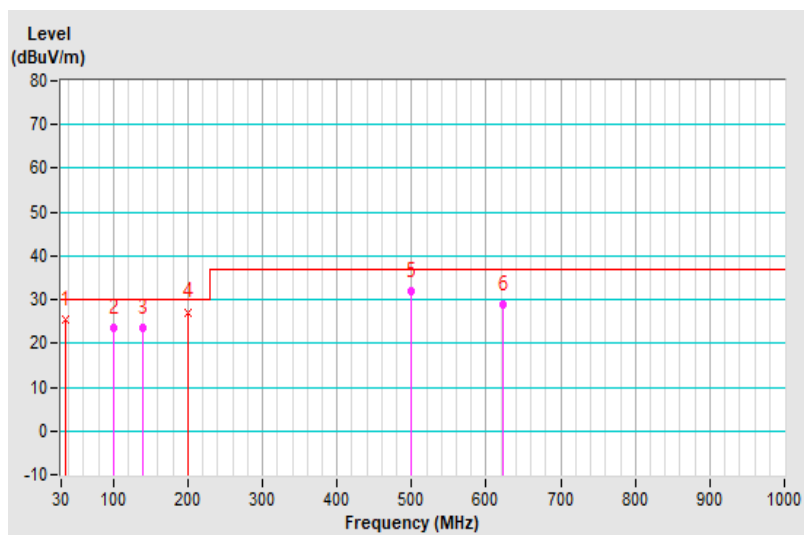


| | | | |
|-----------------|----------------------------|--|-------------------------|
| Frequency Range | 30MHz ~ 1GHz | Detector Function & Resolution Bandwidth | Quasi-Peak (QP), 120kHz |
| Input Power | 3.3Vdc from host equipment | Environmental Conditions | 25°C, 62%RH |
| Tested by | Pon Tsai | | |
| Test Mode | Mode 1 | | |

| Antenna Polarity & Test Distance : Vertical at 10 m | | | | | | | | |
|---|-----------------|-------------------------|----------------|-------------|--------------------|----------------------|------------------|--------------------------|
| No | Frequency (MHz) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV) | Correction Factor (dB/m) |
| 1 | 35.47 | 25.57 QP | 30.00 | -4.43 | 1.00 V | 203 | 39.59 | -14.02 |
| 2 | 99.72 | 23.54 QP | 30.00 | -6.46 | 1.00 V | 30 | 40.19 | -16.65 |
| 3 | 139.22 | 23.37 QP | 30.00 | -6.63 | 3.00 V | 230 | 35.97 | -12.60 |
| 4 | 199.17 | 27.16 QP | 30.00 | -2.84 | 1.01 V | 261 | 41.83 | -14.67 |
| 5 | 498.90 | 31.82 QP | 37.00 | -5.18 | 1.00 V | 262 | 37.31 | -5.49 |
| 6 | 623.42 | 28.88 QP | 37.00 | -8.12 | 3.00 V | 292 | 31.33 | -2.45 |

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



7 Radiated Emissions above 1 GHz

7.1 Limits

Emissions radiated outside of the specified bands, shall be according to the general radiated limits as following:

| Radiated Emissions Limits at 10 meters (dB μ V/m) | | | | |
|---|-----------------------------|-----------------------------|-------------------|-------------------|
| Frequencies (MHz) | FCC 15B / ICES-003, Class A | FCC 15B / ICES-003, Class B | CISPR 22, Class A | CISPR 22, Class B |
| 1000-3000 | Avg: 49.5 Peak: 69.5 | Avg: 43.5 Peak: 63.5 | Not defined | Not defined |
| Above 3000 | | | Not defined | Not defined |

| Radiated Emissions Limits at 3 meters (dB μ V/m) | | | | |
|--|-----------------------------|-----------------------------|---------------------|---------------------|
| Frequencies (MHz) | FCC 15B / ICES-003, Class A | FCC 15B / ICES-003, Class B | CISPR 22, Class A | CISPR 22, Class B |
| 1000-3000 | Avg: 60 Peak: 80 | Avg: 54 Peak: 74 | Avg: 56 Peak: 76 | Avg: 50 Peak: 70 |
| Above 3000 | | | Avg: 60 Peak: 80 | Avg: 54 Peak: 74 |

- Notes:
1. The lower limit shall apply at the transition frequencies.
 2. Emission level (dB μ V/m) = 20 log Emission level (uV/m).
 3. As shown in 15.35(b), 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.

Frequency Range (For unintentional radiators)

| Highest frequency generated or used in the device or on which the device operates or tunes (MHz) | Upper frequency of measurement range (MHz) |
|--|--|
| Below 1.705 | 30 |
| 1.705-108 | 1000 |
| 108-500 | 2000 |
| 500-1000 | 5000 |
| Above 1000 | 5th harmonic of the highest frequency or 40GHz, whichever is lower |

7.2 Test Instruments

| DESCRIPTION & MANUFACTURER | MODEL NO. | SERIAL NO. | CALIBRATED DATE | CALIBRATED UNTIL |
|---|--------------------------|------------|-----------------|------------------|
| Test Receiver Agilent | N9038A | MY50010125 | Apr. 11, 2019 | Apr. 10, 2020 |
| Pre-Amplifier Agilent | 8449B | 3008A01975 | Feb. 21, 2019 | Feb. 20, 2020 |
| Horn Antenna SCHWARZBECK | BBHA 9120D | D123 | Nov. 25, 2018 | Nov. 24, 2019 |
| RF Coaxial Cable | EMC104-SM-SM -2500 | 170209 | Mar. 05, 2019 | Mar. 04, 2020 |
| RF Coaxial Cable | EMC104-SM-SM -6000 | 170207 | Mar. 05, 2019 | Mar. 04, 2020 |
| RF Coaxial Cable | EMC104-SM-SM -11000 | 170206 | Mar. 05, 2019 | Mar. 04, 2020 |
| Spectrum Analyzer Agilent | E4446A | MY48250253 | July 24, 2019 | July 23, 2020 |
| Pre-Amplifier SPACEK LABS | SLKKa-48-6 | 9K16 | Dec. 04, 2018 | Dec. 03, 2019 |
| Horn Antenna SCHWARZBECK | BBHA 9170 | 9170-424 | Nov. 25, 2018 | Nov. 24, 2019 |
| RF Cable | SUCOFLEX 102 | 36432/2 | Jan. 10, 2019 | Jan. 09, 2020 |
| RF Cable | SUCOFLEX 102 | 36443/2 | Jan. 10, 2019 | Jan. 09, 2020 |
| Software BVADT | ADT_Radiated_ V8.7.08 | NA | NA | NA |
| Antenna Tower & Turn Table CT | NA | NA | NA | NA |
| Fix tool for Boresight antenna tower | BAF-01 | 5 | NA | NA |

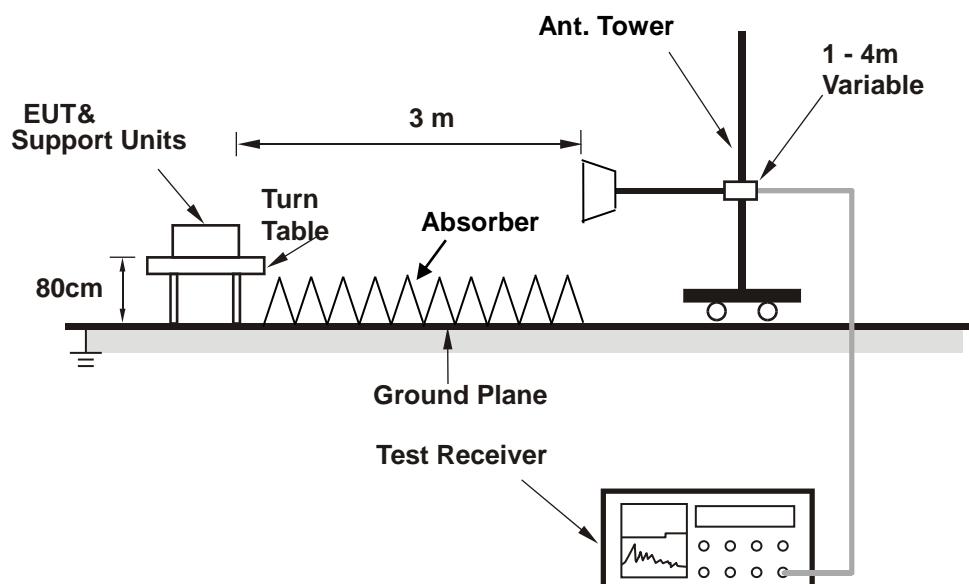
Note:

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 Chamber F room
3. Tested Date: Oct. 30, 2019

7.3 Test Arrangement

- The EUT was placed on the top of a rotating table 0.8 meters above the ground at an accredited chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.
- The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- The height of antenna can be varied from one meter to four meters, the height of adjustment depends on the EUT height and the antenna 3dB beamwidth both, to detect the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- The spectrum analyzer system was set to peak and average detect function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz.

Note: The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz for Peak detection (PK) at frequency above 1GHz. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz for Average detection (AV) at frequency above 1GHz.



The test arrangement is in accordance with ANSI 63.4:2014. For the actual test configuration, please refer to the related item – Photographs of the Test Configuration.

7.4 Supplementary Information

There is not any deviation from the test standards for the test method.

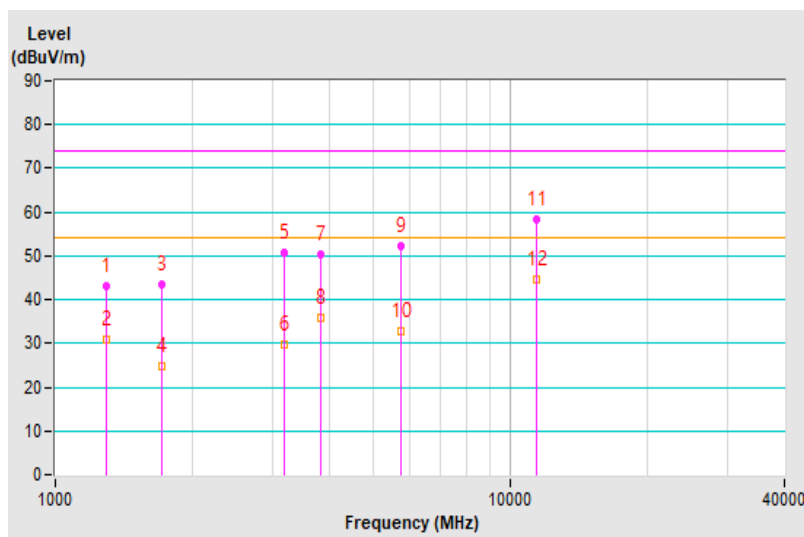
7.5 Test Results

| | | | |
|-----------------|----------------|--|--------------------------------|
| Frequency Range | 1GHz ~ 29.5GHz | Detector Function & Resolution Bandwidth | Peak (PK) / Average (AV), 1MHz |
| Input Power | 120Vac, 60Hz | Environmental Conditions | 25°C, 62%RH |
| Tested by | Pon Tsai | | |
| Test Mode | Mode 1 | | |

| Antenna Polarity & Test Distance : Horizontal at 3 m | | | | | | | | |
|--|-----------------|-------------------------|----------------|-------------|--------------------|----------------------|------------------|--------------------------|
| No | Frequency (MHz) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV) | Correction Factor (dB/m) |
| 1 | 1295.16 | 43.06 PK | 74.00 | -30.94 | 1.00 H | 122 | 46.23 | -3.17 |
| 2 | 1295.16 | 30.95 AV | 54.00 | -23.05 | 1.00 H | 116 | 34.12 | -3.17 |
| 3 | 1718.67 | 43.43 PK | 74.00 | -30.57 | 1.00 H | 38 | 45.46 | -2.03 |
| 4 | 1718.67 | 24.79 AV | 54.00 | -29.21 | 1.00 H | 17 | 26.82 | -2.03 |
| 5 | 3188.53 | 50.83 PK | 74.00 | -23.17 | 1.00 H | 102 | 46.79 | 4.04 |
| 6 | 3188.53 | 29.67 AV | 54.00 | -24.33 | 1.00 H | 99 | 25.63 | 4.04 |
| 7 | 3836.43 | 50.21 PK | 74.00 | -23.79 | 1.00 H | 125 | 44.33 | 5.88 |
| 8 | 3836.43 | 35.82 AV | 54.00 | -18.18 | 1.00 H | 116 | 29.94 | 5.88 |
| 9 | 5759.15 | 52.33 PK | 74.00 | -21.67 | 1.00 H | 135 | 42.08 | 10.25 |
| 10 | 5759.15 | 32.78 AV | 54.00 | -21.22 | 1.00 H | 116 | 22.53 | 10.25 |
| 11 | 11452.87 | 58.23 PK | 74.00 | -15.77 | 1.00 H | 99 | 33.74 | 24.49 |
| 12 | 11452.87 | 44.56 AV | 54.00 | -9.44 | 1.00 H | 79 | 20.07 | 24.49 |

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

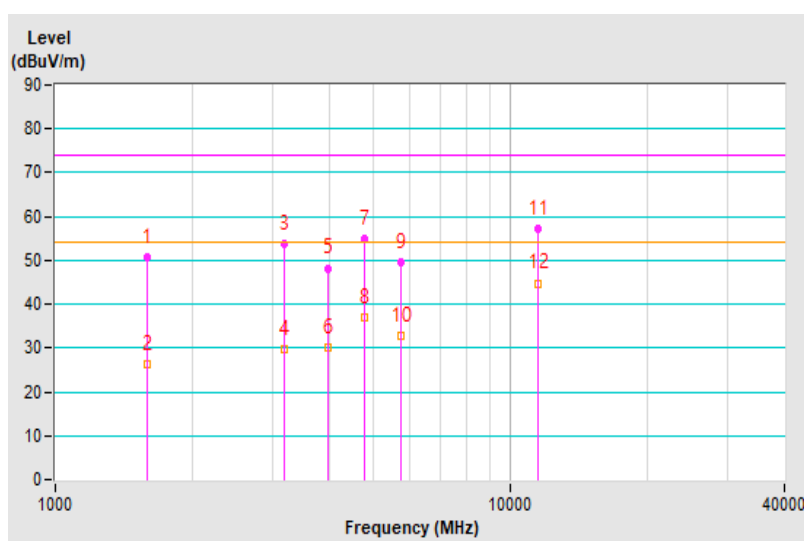


| | | | |
|-----------------|----------------|--|--------------------------------|
| Frequency Range | 1GHz ~ 29.5GHz | Detector Function & Resolution Bandwidth | Peak (PK) / Average (AV), 1MHz |
| Input Power | 120Vac, 60Hz | Environmental Conditions | 25°C, 62%RH |
| Tested by | Pon Tsai | | |
| Test Mode | Mode 1 | | |

| Antenna Polarity & Test Distance : Vertical at 3 m | | | | | | | | |
|--|-----------------|-------------------------|----------------|-------------|--------------------|----------------------|------------------|--------------------------|
| No | Frequency (MHz) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV) | Correction Factor (dB/m) |
| 1 | 1596.30 | 50.67 PK | 74.00 | -23.33 | 1.00 V | 112 | 53.02 | -2.35 |
| 2 | 1596.30 | 26.41 AV | 54.00 | -27.59 | 1.00 V | 128 | 28.76 | -2.35 |
| 3 | 3186.13 | 53.68 PK | 74.00 | -20.32 | 1.00 V | 177 | 49.64 | 4.04 |
| 4 | 3186.13 | 29.59 AV | 54.00 | -24.41 | 1.00 V | 166 | 25.55 | 4.04 |
| 5 | 3986.00 | 48.24 PK | 74.00 | -25.76 | 1.00 V | 352 | 41.64 | 6.60 |
| 6 | 3986.00 | 30.00 AV | 54.00 | -24.00 | 1.00 V | 360 | 23.40 | 6.60 |
| 7 | 4783.25 | 54.75 PK | 74.00 | -19.25 | 1.00 V | 312 | 41.03 | 13.72 |
| 8 | 4783.25 | 37.01 AV | 54.00 | -16.99 | 1.00 V | 360 | 23.29 | 13.72 |
| 9 | 5737.28 | 49.42 PK | 74.00 | -24.58 | 1.00 V | 142 | 39.30 | 10.12 |
| 10 | 5737.28 | 32.86 AV | 54.00 | -21.14 | 1.00 V | 135 | 22.74 | 10.12 |
| 11 | 11469.60 | 57.16 PK | 74.00 | -16.84 | 1.00 V | 236 | 32.62 | 24.54 |
| 12 | 11469.60 | 44.80 AV | 54.00 | -9.20 | 1.00 V | 242 | 20.26 | 24.54 |

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



8 Pictures of Test Arrangements

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

Appendix – Information of 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:

Lin Kou EMC/RF Lab

Tel: 886-2-26052180

Fax: 886-2-26051924

Hsin Chu EMC/RF/Telecom Lab

Tel: 886-3-6668565

Fax: 886-3-6668323

Hwa Ya EMC/RF/Safety Lab

Tel: 886-3-3183232

Fax: 886-3-3270892

Email: service.adt@tw.bureauveritas.com

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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