# FCC Test Report

| | |
|---|---|
| **Report No.:** | RF181025E03 |
| **FCC ID:** | JNZGR0005 |
| **Test Model:** | GR0005 |
| **Received Date:** | Oct. 25, 2018 |
| **Test Date:** | Oct. 30, 2018 |
| **Issued Date:** | Nov. 22, 2018 |
| **Applicant:** | LOGITECH FAR EAST LTD. |
| **Address:** | #2 Creation Rd. 4, Science-Based Ind. Park Hsinchu Taiwan, R.O.C. |
| **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 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 |

## Table of Contents

## Release Control Record

| Issue No. | Description | Date Issued |
|---|---|---|
| RF181025E03 | Original release. | Nov. 22, 2018 |

## 1 Certificate of Conformity

| | |
|---|---|
| **Product:** | Wireless Dongle |
| **Brand:** | Astro |
| **Test Model:** | GR0005 |
| **Sample Status:** | ENGINEERING SAMPLE |
| **Applicant:** | LOGITECH FAR EAST LTD. |
| **Test Date:** | Oct. 30, 2018 |
| **Standards:** | 47 CFR FCC Part 15, Subpart C (Section 15.247)<br>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:** Nov. 22, 2018

Wendy Wu / Specialist

**Approved by :** , **Date:** Nov. 22, 2018

May Chen / Manager

## 2 Summary of Test Results

| 47 CFR FCC Part 15, Subpart C (Section 15.247) | | | |
|---|---|---|---|
| FCC Clause | Test Item | Result | Remarks |
| 15.207 | AC Power Conducted Emission | PASS | Meet the requirement of limit. Minimum passing margin is -10.82dB at 0.20469MHz. |
| 15.205 / 15.209 / 15.247(d) | Radiated Emissions and Band Edge Measurement | PASS | Meet the requirement of limit. Minimum passing margin is -5.4dB at 2390.00MHz. |
| 15.247(d) | Antenna Port Emission | PASS | Meet the requirement of limit. |
| 15.247(a)(2) | 6dB bandwidth | PASS | Meet the requirement of limit. |
| 15.247(b) | Conducted power | PASS | Meet the requirement of limit. |
| 15.247(e) | Power Spectral Density | PASS | Meet the requirement of limit. |
| 15.203 | Antenna Requirement | PASS | No antenna connector is used. |

### 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 | 5.08 dB |
| | 6GHz ~ 18GHz | 4.98 dB |
| | 18GHz ~ 40GHz | 5.19 dB |

### 2.2 Modification Record

There were no modifications required for compliance.

## 3 General Information

### 3.1 General Description of EUT

| | |
|---|---|
| Product | Wireless Dongle |
| PMN | NA |
| Brand | Astro |
| Test Model | GR0005 |
| Status of EUT | ENGINEERING SAMPLE |
| Power Supply Rating | 5Vdc from USB interface |
| Modulation Type | GFSK |
| Modulation Technology | DTS |
| Transfer Rate | Up to 2Mbps |
| Operating Frequency | 2.402 ~ 2.480GHz |
| Number of Channel | 79 |
| Output Power | 2.168mW |
| Antenna Type | Refer to Note |
| Antenna Connector | Refer to Note |
| Accessory Device | NA |
| Data Cable Supplied | NA |

Note:

1. The EUT may have a lot of colors for marketing requirement.
2. The antennas provided to the EUT, please refer to the following table:

| PCB Chain No. | Antenna Gain(dBi) | Frequency range (GHz) | Antenna Type | Connector Type |
|---|---|---|---|---|
| 1 | 4.47 | 2.4~2.4835 | Printed Antenna | NA |
| 2 | 4.78 | 2.4~2.4835 | Printed Antenna | NA |

Note:
1. The EUT incorporates a SISO function. (1TX / 1RX Diversity)
2. Max. gain was selected for the final test.

3. 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.

### 3.2 Description of Test Modes

79 channels are provided to this EUT:

| Channel | Freq. (MHz) | Channel | Freq. (MHz) | Channel | Freq. (MHz) | Channel | Freq. (MHz) |
|---|---|---|---|---|---|---|---|
| 1 | 2402 | 21 | 2422 | 41 | 2442 | 61 | 2462 |
| 2 | 2403 | 22 | 2423 | 42 | 2443 | 62 | 2463 |
| 3 | 2404 | 23 | 2424 | 43 | 2444 | 63 | 2464 |
| 4 | 2405 | 24 | 2425 | 44 | 2445 | 64 | 2465 |
| 5 | 2406 | 25 | 2426 | 45 | 2446 | 65 | 2466 |
| 6 | 2407 | 26 | 2427 | 46 | 2447 | 66 | 2467 |
| 7 | 2408 | 27 | 2428 | 47 | 2448 | 67 | 2468 |
| 8 | 2409 | 28 | 2429 | 48 | 2449 | 68 | 2469 |
| 9 | 2410 | 29 | 2430 | 49 | 2450 | 69 | 2470 |
| 10 | 2411 | 30 | 2431 | 50 | 2451 | 70 | 2471 |
| 11 | 2412 | 31 | 2432 | 51 | 2452 | 71 | 2472 |
| 12 | 2413 | 32 | 2433 | 52 | 2453 | 72 | 2473 |
| 13 | 2414 | 33 | 2434 | 53 | 2454 | 73 | 2474 |
| 14 | 2415 | 34 | 2435 | 54 | 2455 | 74 | 2475 |
| 15 | 2416 | 35 | 2436 | 55 | 2456 | 75 | 2476 |
| 16 | 2417 | 36 | 2437 | 56 | 2457 | 76 | 2477 |
| 17 | 2418 | 37 | 2438 | 57 | 2458 | 77 | 2478 |
| 18 | 2419 | 38 | 2439 | 58 | 2459 | 78 | 2479 |
| 19 | 2420 | 39 | 2440 | 59 | 2460 | 79 | 2480 |
| 20 | 2421 | 40 | 2441 | 60 | 2461 | | |

### 3.2.1 Test Mode Applicability and Tested Channel Detail

| EUT CONFIGURE MODE | APPLICABLE TO | | | | DESCRIPTION |
|---|---|---|---|---|---|
| | RE≥1G | RE<1G | PLC | APCM | |
| - | √ | √ | √ | √ | - |

Where **RE≥1G:** Radiated Emission above 1GHz & Bandedge Measurement **RE<1G:** Radiated Emission below 1GHz

**PLC:** Power Line Conducted Emission **APCM:** Antenna Port Conducted Measurement

Note:

1. The EUT had been pre-tested on the positioned of each 3 axis. The worst case was found when positioned on **X-plane.**

**Radiated Emission Test (Above 1GHz):**

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

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

| AVAILABLE CHANNEL | TESTED CHANNEL | MODULATION TYPE | DATA RATE (Mbps) |
|---|---|---|---|
| 1 to 79 | 1, 39, 79 | GFSK | 2 |

**Radiated Emission Test (Below 1GHz):**

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

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

| AVAILABLE CHANNEL | TESTED CHANNEL | MODULATION TYPE | DATA RATE (Mbps) |
|---|---|---|---|
| 1 to 79 | 79 | GFSK | 2 |

**Power Line Conducted Emission Test:**

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

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

| AVAILABLE CHANNEL | TESTED CHANNEL | MODULATION TYPE | DATA RATE (Mbps) |
|---|---|---|---|
| 1 to 79 | 79 | GFSK | 2 |

**Antenna Port Conducted Measurement:**

☒ This item includes all test value of each mode, but only includes spectrum plot of worst value of each mode.

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

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

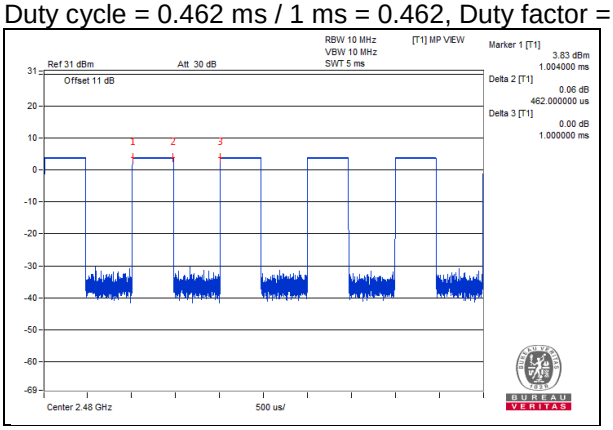
| AVAILABLE CHANNEL | TESTED CHANNEL | MODULATION TYPE | DATA RATE (Mbps) |
|---|---|---|---|
| 1 to 79 | 1, 39, 79 | GFSK | 2 |

## Test Condition:

| APPLICABLE TO | ENVIRONMENTAL CONDITIONS | INPUT POWER (SYSTEM) | TESTED BY |
|---|---|---|---|
| **RE≥1G** | 23deg. C, 67%RH | 120Vac, 60Hz | Frank Chuang |
| **RE<1G** | 23deg. C, 67%RH | 120Vac, 60Hz | Frank Chuang |
| **PLC** | 24deg. C, 76%RH | 120Vac, 60Hz | Andy Ho |
| **APCM** | 25deg. C, 60%RH | 120Vac, 60Hz | Jyunchun Lin |

### 3.3 Duty Cycle of Test Signal

Duty cycle = 0.462 ms / 1 ms = 0.462, Duty factor = 10 * log( 1/Duty cycle) = 3.35



## 3.4 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.

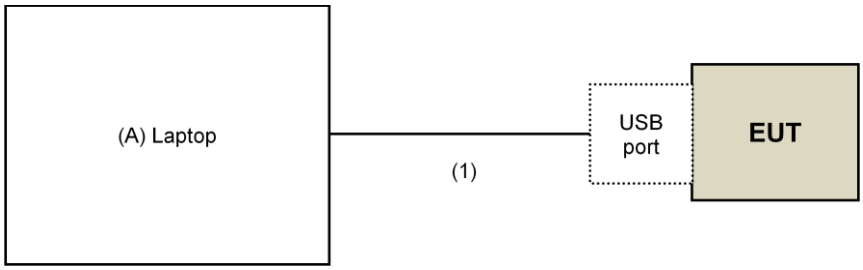
| ID | Product | Brand | Model No. | Serial No. | FCC ID | Remarks |
|---|---|---|---|---|---|---|
| A. | Laptop | DELL | E6420 | B92T3R1 | FCC DoC | Provided by Lab |

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 | 3 | Yes | 0 | Provided by Lab |

### 3.4.1 Configuration of System under Test



### 3.5 General Description of Applied Standards

The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

**FCC Part 15, Subpart C (15.247)**
**KDB 558074 D01 15.247 Meas Guidance v05**
**ANSI C63.10-2013**

All test items have been performed and recorded as per the above standards.

## 4 Test Types and Results

### 4.1 Radiated Emission and Bandedge Measurement

4.1.1 Limits of Radiated Emission and Bandedge Measurement

Radiated emissions which fall in the restricted bands must comply with the radiated emission limits specified as below table. Other emissions shall be at least 20dB below the highest level of the desired power:

| 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:**

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. 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.

4.1.2 Test Instruments

| DESCRIPTION & MANUFACTURER | MODEL NO. | SERIAL NO. | CALIBRATED DATE | CALIBRATED UNTIL |
|---|---|---|---|---|
| Test Receiver<br>Agilent | N9038A | MY50010156 | July 12, 2018 | July 11, 2019 |
| Pre-Amplifier<br>EMCI | EMC001340 | 980142 | Feb. 09, 2018 | Feb. 08, 2019 |
| Loop Antenna(*)<br>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<br>Mini-Circuits | ZFL-1000VH2B | AMP-ZFL-05 | May 05, 2018 | May 04, 2019 |
| Trilog Broadband Antenna<br>SCHWARZBECK | VULB 9168 | 9168-361 | Nov. 29, 2017 | Nov. 28, 2018 |
| RF Cable | 8D | 966-3-1 | Mar. 20, 2018 | Mar. 19, 2019 |
| RF Cable | 8D | 966-3-2 | Mar. 20, 2018 | Mar. 19, 2019 |
| RF Cable | 8D | 966-3-3 | Mar. 20, 2018 | Mar. 19, 2019 |
| Fixed attenuator<br>Mini-Circuits | UNAT-5+ | PAD-3m-3-01 | Sep. 27, 2018 | Sep. 26, 2019 |
| Horn_Antenna<br>SCHWARZBECK | BBHA9120-D | 9120D-406 | Dec. 12, 2017 | Dec. 11, 2018 |
| Pre-Amplifier<br>EMCI | EMC12630SE | 980384 | Jan. 29, 2018 | Jan. 28, 2019 |
| RF Cable | EMC104-SM-SM-1200 | 160922 | Jan. 29, 2018 | Jan. 28, 2019 |
| RF Cable | EMC104-SM-SM-2000 | 150317 | Jan. 29, 2018 | Jan. 28, 2019 |
| RF Cable | EMC104-SM-SM-5000 | 150322 | Jan. 29, 2018 | Jan. 28, 2019 |
| Spectrum Analyzer<br>Keysight | N9030A | MY54490679 | July 23, 2018 | July 22, 2019 |
| Pre-Amplifier<br>EMCI | EMC184045SE | 980386 | Jan. 29, 2018 | Jan. 28, 2019 |
| Horn_Antenna<br>SCHWARZBECK | BBHA 9170 | BBHA9170608 | Dec. 14, 2017 | Dec. 13, 2018 |
| RF Cable | EMC102-KM-KM-1200 | 160924 | Jan. 29, 2018 | Jan. 28, 2019 |
| Software | ADT_Radiated_V8.7.08 | NA | NA | NA |
| Antenna Tower & Turn Table<br>Max-Full | MF-7802 | MF780208406 | NA | NA |
| Boresight Antenna Fixture | FBA-01 | FBA-SIP01 | NA | NA |
| Spectrum Analyzer<br>R&S | FSV40 | 100964 | June 20, 2018 | June 19, 2019 |
| Power meter<br>Anritsu | ML2495A | 1014008 | May 09, 2018 | May 08, 2019 |
| Power sensor<br>Anritsu | MA2411B | 0917122 | May 09, 2018 | May 08, 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. 3.
4. The CANADA Site Registration No. is 20331-1
5. Loop antenna was used for all emissions below 30 MHz.
6. Tested Date: Oct. 30, 2018

4.1.3 Test Procedures

**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 detects 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:**

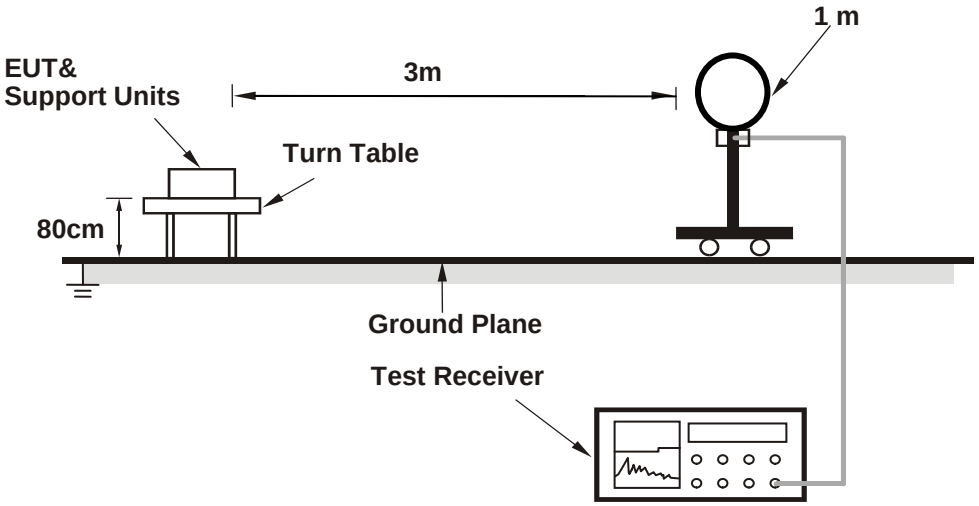
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is ≥ 1/T (Duty cycle < 98%) or 10Hz (Duty cycle ≥ 98%) for Average detection (AV) at frequency above 1GHz.
4. All modes of operation were investigated and the worst-case emissions are reported.

4.1.4 Deviation from Test Standard

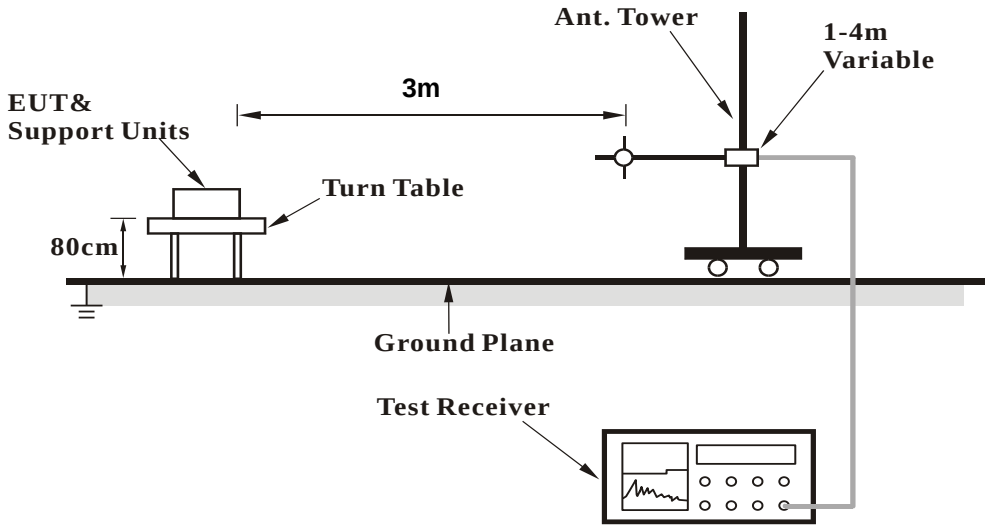
No deviation.

4.1.5 Test Setup

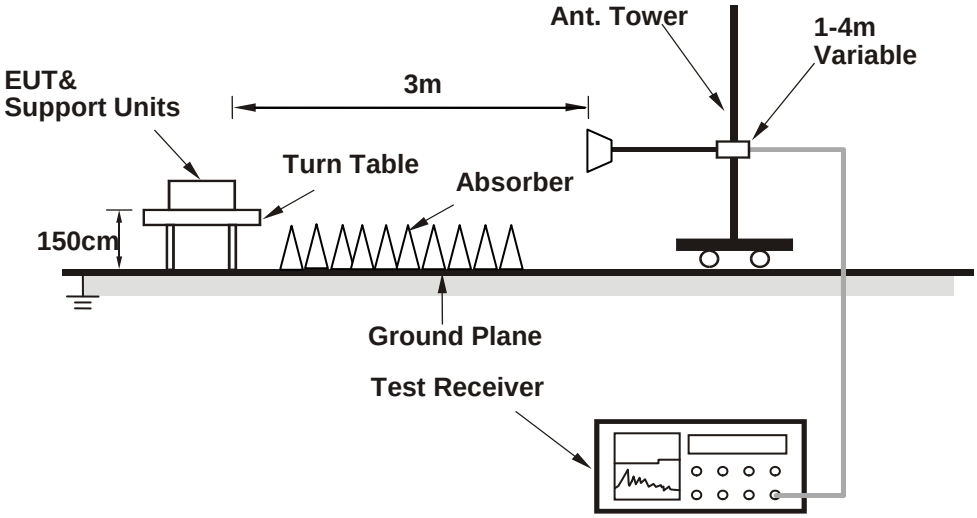
**For Radiated emission below 30MHz**




**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. Placed the EUT on the testing table.
b. Controlling software (Jigsaw Ariel (2.26)) has been activated to set the EUT under transmission/receiving condition continuously.

4.1.7 Test Results

**Above 1GHz Data:**

| CHANNEL | TX Channel 1 | DETECTOR FUNCTION | Peak (PK)<br>Average (AV) |
|---|---|---|---|
| FREQUENCY RANGE | 1GHz ~ 25GHz | | |

| 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 | 2390.00 | 64.1 PK | 74.0 | -9.9 | 1.52 H | 339 | 66.8 | -2.7 |
| **2** | **2390.00** | **48.6 AV** | **54.0** | **-5.4** | **1.52 H** | **339** | **51.3** | **-2.7** |
| 3 | *2402.00 | 101.5 PK | | | 1.52 H | 339 | 104.2 | -2.7 |
| 4 | *2402.00 | 99.2 AV | | | 1.52 H | 339 | 101.9 | -2.7 |
| 5 | 4804.00 | 52.5 PK | 74.0 | -21.5 | 1.50 H | 47 | 50.9 | 1.6 |
| 6 | 4804.00 | 44.8 AV | 54.0 | -9.2 | 1.50 H | 47 | 43.2 | 1.6 |
| **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 | 2390.00 | 57.9 PK | 74.0 | -16.1 | 1.32 V | 93 | 60.6 | -2.7 |
| 2 | 2390.00 | 43.3 AV | 54.0 | -10.7 | 1.32 V | 93 | 46.0 | -2.7 |
| 3 | *2402.00 | 95.1 PK | | | 1.32 V | 93 | 97.8 | -2.7 |
| 4 | *2402.00 | 93.1 AV | | | 1.32 V | 93 | 95.8 | -2.7 |
| 5 | 4804.00 | 47.7 PK | 74.0 | -26.3 | 1.47 V | 259 | 46.1 | 1.6 |
| 6 | 4804.00 | 39.6 AV | 54.0 | -14.4 | 1.47 V | 259 | 38.0 | 1.6 |

**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
5. " * ": Fundamental frequency.

| CHANNEL | TX Channel 39 | DETECTOR FUNCTION | Peak (PK)<br>Average (AV) |
|---|---|---|---|
| FREQUENCY RANGE | 1GHz ~ 25GHz | | |

| 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 | *2440.00 | 102.0 PK | | | 1.46 H | 355 | 105.0 | -3.0 |
| 2 | *2440.00 | 99.7 AV | | | 1.46 H | 355 | 102.7 | -3.0 |
| 3 | 4880.00 | 51.6 PK | 74.0 | -22.4 | 1.46 H | 21 | 49.9 | 1.7 |
| 4 | 4880.00 | 44.1 AV | 54.0 | -9.9 | 1.46 H | 21 | 42.4 | 1.7 |
| 5 | 7320.00 | 54.5 PK | 74.0 | -19.5 | 1.64 H | 360 | 46.7 | 7.8 |
| 6 | 7320.00 | 45.2 AV | 54.0 | -8.8 | 1.64 H | 360 | 37.4 | 7.8 |
| 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 | *2440.00 | 95.2 PK | | | 1.34 V | 98 | 98.2 | -3.0 |
| 2 | *2440.00 | 92.8 AV | | | 1.34 V | 98 | 95.8 | -3.0 |
| 3 | 4880.00 | 47.1 PK | 74.0 | -26.9 | 1.41 V | 241 | 45.4 | 1.7 |
| 4 | 4880.00 | 39.1 AV | 54.0 | -14.9 | 1.41 V | 241 | 37.4 | 1.7 |
| 5 | 7320.00 | 48.2 PK | 74.0 | -25.8 | 1.99 V | 163 | 40.4 | 7.8 |
| 6 | 7320.00 | 39.9 AV | 54.0 | -14.1 | 1.99 V | 163 | 32.1 | 7.8 |

**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
5. " * ": Fundamental frequency.

| CHANNEL | TX Channel 79 | DETECTOR FUNCTION | Peak (PK)<br>Average (AV) |
|---|---|---|---|
| FREQUENCY RANGE | 1GHz ~ 25GHz | | |

| 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 | *2480.00 | 101.6 PK | | | 1.50 H | 351 | 104.6 | -3.0 |
| 2 | *2480.00 | 99.5 AV | | | 1.50 H | 351 | 102.5 | -3.0 |
| 3 | 2483.50 | 63.6 PK | 74.0 | -10.4 | 1.50 H | 351 | 66.6 | -3.0 |
| 4 | 2483.50 | 48.3 AV | 54.0 | -5.7 | 1.50 H | 351 | 51.3 | -3.0 |
| 5 | 4960.00 | 52.2 PK | 74.0 | -21.8 | 1.46 H | 34 | 50.3 | 1.9 |
| 6 | 4960.00 | 44.6 AV | 54.0 | -9.4 | 1.46 H | 34 | 42.7 | 1.9 |
| 7 | 7440.00 | 54.8 PK | 74.0 | -19.2 | 1.62 H | 352 | 46.9 | 7.9 |
| 8 | 7440.00 | 45.5 AV | 54.0 | -8.5 | 1.62 H | 352 | 37.6 | 7.9 |
| 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 | *2480.00 | 95.2 PK | | | 1.37 V | 85 | 98.2 | -3.0 |
| 2 | *2480.00 | 93.1 AV | | | 1.37 V | 85 | 96.1 | -3.0 |
| 3 | 2483.50 | 57.6 PK | 74.0 | -16.4 | 1.37 V | 85 | 60.6 | -3.0 |
| 4 | 2483.50 | 43.2 AV | 54.0 | -10.8 | 1.37 V | 85 | 46.2 | -3.0 |
| 5 | 4960.00 | 47.8 PK | 74.0 | -26.2 | 1.47 V | 252 | 45.9 | 1.9 |
| 6 | 4960.00 | 39.5 AV | 54.0 | -14.5 | 1.47 V | 252 | 37.6 | 1.9 |
| 7 | 7440.00 | 48.5 PK | 74.0 | -25.5 | 2.01 V | 157 | 40.6 | 7.9 |
| 8 | 7440.00 | 40.1 AV | 54.0 | -13.9 | 2.01 V | 157 | 32.2 | 7.9 |

**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
5. " * ": Fundamental frequency.

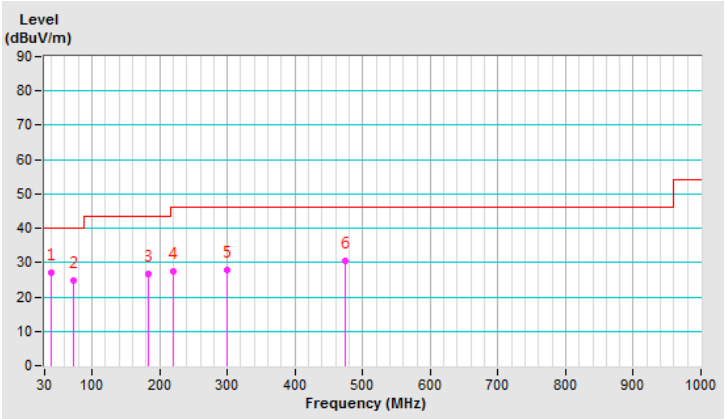
**Below 1GHz Data:**

| | | | |
|---|---|---|---|
| **CHANNEL** | TX Channel 79 | **DETECTOR FUNCTION** | Quasi-Peak (QP) |
| **FREQUENCY RANGE** | 9kHz ~ 1GHz | | |

| 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 | 39.99 | 27.0 QP | 40.0 | -13.0 | 2.00 H | 282 | 35.3 | -8.3 |
| 2 | 73.63 | 24.6 QP | 40.0 | -15.4 | 2.00 H | 113 | 35.5 | -10.9 |
| 3 | 182.68 | 26.6 QP | 43.5 | -16.9 | 2.00 H | 86 | 36.2 | -9.6 |
| 4 | 220.68 | 27.4 QP | 46.0 | -18.6 | 1.50 H | 0 | 38.2 | -10.8 |
| 5 | 298.79 | 27.9 QP | 46.0 | -18.1 | 1.50 H | 256 | 34.9 | -7.0 |
| 6 | 474.09 | 30.6 QP | 46.0 | -15.4 | 2.00 H | 123 | 33.2 | -2.6 |

**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. Margin value = Emission Level – Limit value
4. The emission levels were very low against the limit of frequency range 9kHz~30MHz: the amplitude of spurious emissions attenuated more than 20 dB below the permissible value to be report.

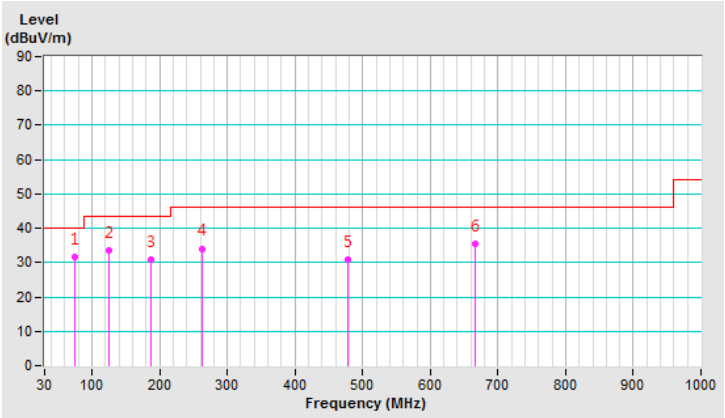


| CHANNEL | TX Channel 79 | DETECTOR FUNCTION | Quasi-Peak (QP) |
|---|---|---|---|
| FREQUENCY RANGE | 9kHz ~ 1GHz | | |

| 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 | 74.55 | 31.8 QP | 40.0 | -8.2 | 1.50 V | 360 | 43.0 | -11.2 |
| 2 | 125.50 | 33.5 QP | 43.5 | -10.0 | 1.00 V | 0 | 42.8 | -9.3 |
| 3 | 187.31 | 30.7 QP | 43.5 | -12.8 | 1.50 V | 118 | 40.8 | -10.1 |
| 4 | 262.24 | 34.1 QP | 46.0 | -11.9 | 1.50 V | 360 | 42.5 | -8.4 |
| 5 | 478.09 | 30.8 QP | 46.0 | -15.2 | 1.00 V | 307 | 33.3 | -2.5 |
| 6 | 666.49 | 35.6 QP | 46.0 | -10.4 | 1.00 V | 222 | 34.4 | 1.2 |

**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. Margin value = Emission Level – Limit value
4. The emission levels were very low against the limit of frequency range 9kHz~30MHz: the amplitude of spurious emissions attenuated more than 20 dB below the permissible value to be report.



## 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-04 | Nov. 01, 2017 | Oct. 31, 2018 |
| RF Cable | 5D-FB | COCCAB-001 | Sep. 28, 2018 | Sep. 27, 2019 |
| 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: Oct. 30, 2018

4.2.3 Test Procedures

a. 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.

b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

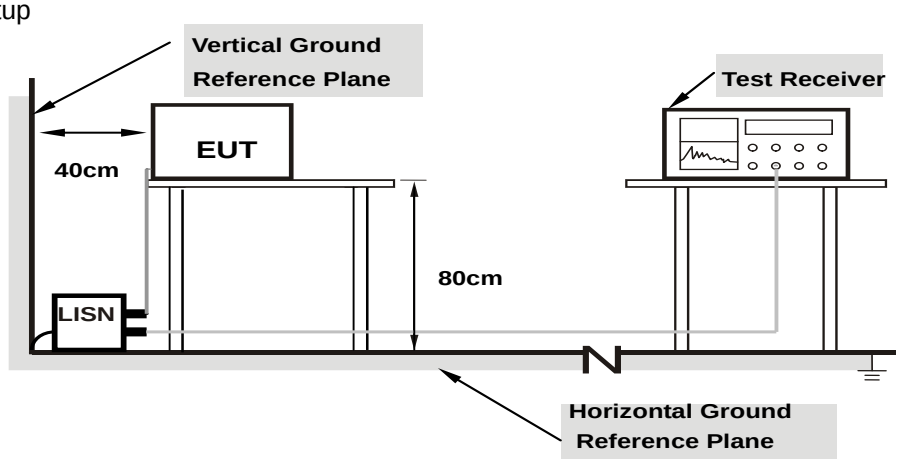
c. The frequency range from 150kHz to 30MHz was searched. Emission levels under (Limit - 20dB) was not recorded.

**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.

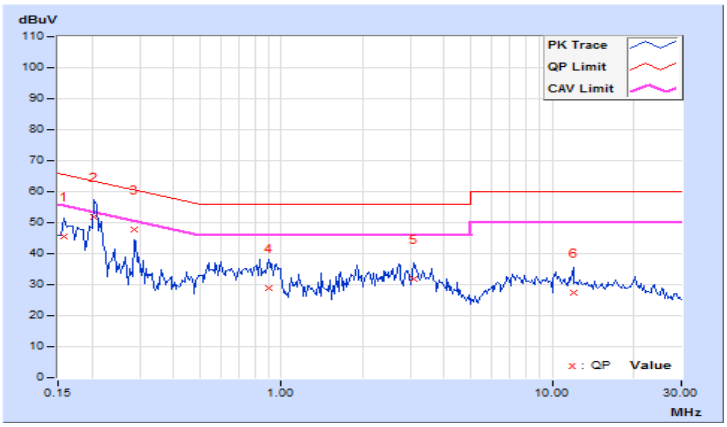
4.2.7 Test Results

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

| No | Freq. | Corr. Factor | Reading Value [dB (uV)] | | Emission Level [dB (uV)] | | Limit [dB (uV)] | | Margin (dB) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | [MHz] | (dB) | Q.P. | AV. | Q.P. | AV. | Q.P. | AV. | Q.P. | AV. |
| 1 | 0.15781 | 10.03 | 35.53 | 22.32 | 45.56 | 32.35 | 65.58 | 55.58 | -20.02 | -23.23 |
| 2 | 0.20469 | 10.05 | 41.83 | 21.41 | 51.88 | 31.46 | 63.42 | 53.42 | -11.54 | -21.96 |
| 3 | 0.28672 | 10.06 | 37.69 | 14.58 | 47.75 | 24.64 | 60.62 | 50.62 | -12.87 | -25.98 |
| 4 | 0.89609 | 10.12 | 18.84 | 8.59 | 28.96 | 18.71 | 56.00 | 46.00 | -27.04 | -27.29 |
| 5 | 3.07422 | 10.26 | 21.41 | 14.67 | 31.67 | 24.93 | 56.00 | 46.00 | -24.33 | -21.07 |
| 6 | 11.94531 | 10.83 | 16.65 | 10.05 | 27.48 | 20.88 | 60.00 | 50.00 | -32.52 | -29.12 |

**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

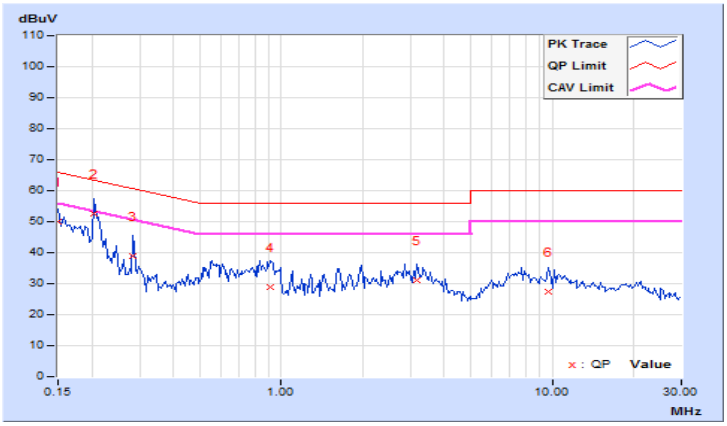


| Phase | Neutral (N) | Detector Function | Quasi-Peak (QP) / Average (AV) |
|---|---|---|---|

| No | Freq. | Corr. Factor | Reading Value [dB (uV)] | | Emission Level [dB (uV)] | | Limit [dB (uV)] | | Margin (dB) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | [MHz] | (dB) | Q.P. | AV. | Q.P. | AV. | Q.P. | AV. | Q.P. | AV. |
| 1 | 0.15000 | 9.94 | 39.88 | 21.72 | 49.82 | 31.66 | 66.00 | 56.00 | -16.18 | -24.34 |
| **2** | **0.20469** | **9.95** | **42.65** | **22.71** | **52.60** | **32.66** | **63.42** | **53.42** | **-10.82** | **-20.76** |
| 3 | 0.28281 | 9.96 | 28.98 | 14.45 | 38.94 | 24.41 | 60.73 | 50.73 | -21.79 | -26.32 |
| 4 | 0.91172 | 10.00 | 19.02 | 9.78 | 29.02 | 19.78 | 56.00 | 46.00 | -26.98 | -26.22 |
| 5 | 3.16797 | 10.13 | 21.10 | 14.36 | 31.23 | 24.49 | 56.00 | 46.00 | -24.77 | -21.51 |
| 6 | 9.73828 | 10.51 | 17.00 | 11.30 | 27.51 | 21.81 | 60.00 | 50.00 | -32.49 | -28.19 |

**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

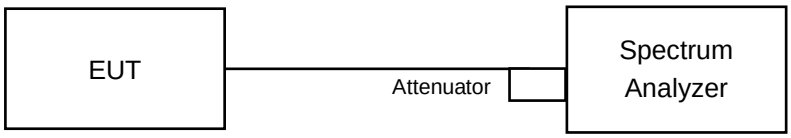


## 4.3 6dB Bandwidth Measurement

### 4.3.1 Limits of 6dB Bandwidth Measurement

The minimum of 6dB Bandwidth Measurement is 0.5 MHz.

### 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 Procedure

a. Set resolution bandwidth (RBW) = 100kHz
b. Set the video bandwidth (VBW) ≥ 3 x RBW, Detector = Peak.
c. Trace mode = max hold.
d. Sweep = auto couple.
e. Measure the maximum width of the emission that is constrained by the frequencies associated with the two amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

### 4.3.5 Deviation from Test Standard

No deviation.

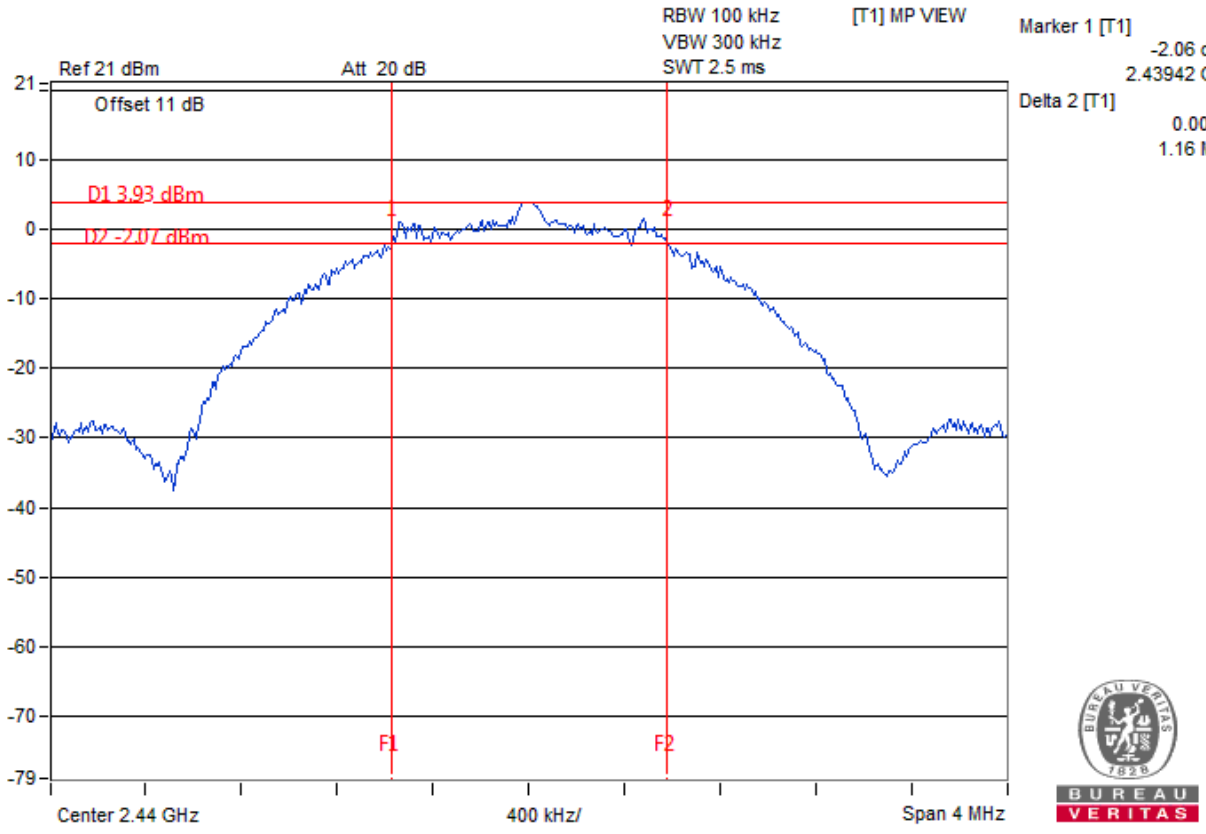
### 4.3.6 EUT Operating Conditions

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

| Channel | Frequency (MHz) | 6dB Bandwidth (MHz) | Minimum Limit (MHz) | Pass / Fail |
|---|---|---|---|---|
| 1 | 2402 | 1.19 | 0.5 | Pass |
| 39 | 2440 | 1.16 | 0.5 | Pass |
| 79 | 2480 | 1.17 | 0.5 | Pass |

| Spectrum Plot of Worst Value |
|---|
| **CH 39** |

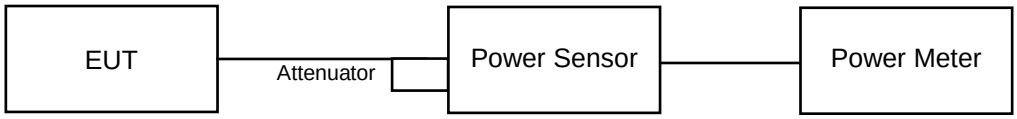


## 4.4 Conducted Output Power Measurement

### 4.4.1 Limits of Conducted Output Power Measurement

For systems using digital modulation in the 2400–2483.5 MHz bands: 1 Watt (30dBm)

### 4.4.2 Test Setup




### 4.4.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

### 4.4.4 Test Procedures

A peak power sensor was used on the output port of the EUT. A power meter was used to read the response of the peak power sensor. Record the power level.

Average power sensor was used to perform output power measurement, trigger and gating function of wide band power meter is enabled to measure max output power of TX on burst. Duty factor is not added to measured value.

### 4.4.5 Deviation from Test Standard

No deviation.

### 4.4.6 EUT Operating Conditions

Same as Item 4.3.6.

4.4.7 Test Results

**FOR PEAK POWER**

| Channel | Frequency (MHz) | Peak Power (mW) | Peak Power (dBm) | Limit (dBm) | Pass/Fail |
|---|---|---|---|---|---|
| 1 | 2402 | 2.168 | 3.36 | 30 | Pass |
| 39 | 2440 | 2.148 | 3.32 | 30 | Pass |
| 79 | 2480 | 2.158 | 3.34 | 30 | Pass |

**FOR AVERAGE POWER**

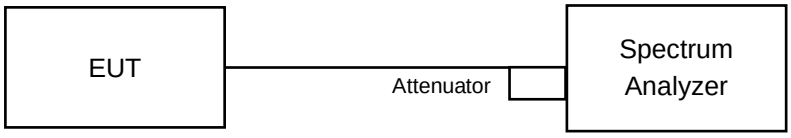
| Channel | Frequency (MHz) | Average Power (mW) | Average Power (dBm) |
|---|---|---|---|
| 1 | 2402 | 2.089 | 3.20 |
| 39 | 2440 | 2.08 | 3.18 |
| 79 | 2480 | 2.094 | 3.21 |

## 4.5 Power Spectral Density Measurement

### 4.5.1 Limits of Power Spectral Density Measurement

The Maximum of Power Spectral Density Measurement is 8dBm in any 3 kHz.

### 4.5.2 Test Setup




### 4.5.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

### 4.5.4 Test Procedure

a. Set analyzer center frequency to DTS channel center frequency.
b. Set the span to 1.5 times the DTS bandwidth.
c. Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
d. Set the VBW ≥ 3 × RBW.
e. Detector = peak.
f. Sweep time = auto couple.
g. Trace mode = max hold.
h. Allow trace to fully stabilize.
i. Use the peak marker function to determine the maximum amplitude level within the RBW.

### 4.5.5 Deviation from Test Standard

No deviation.

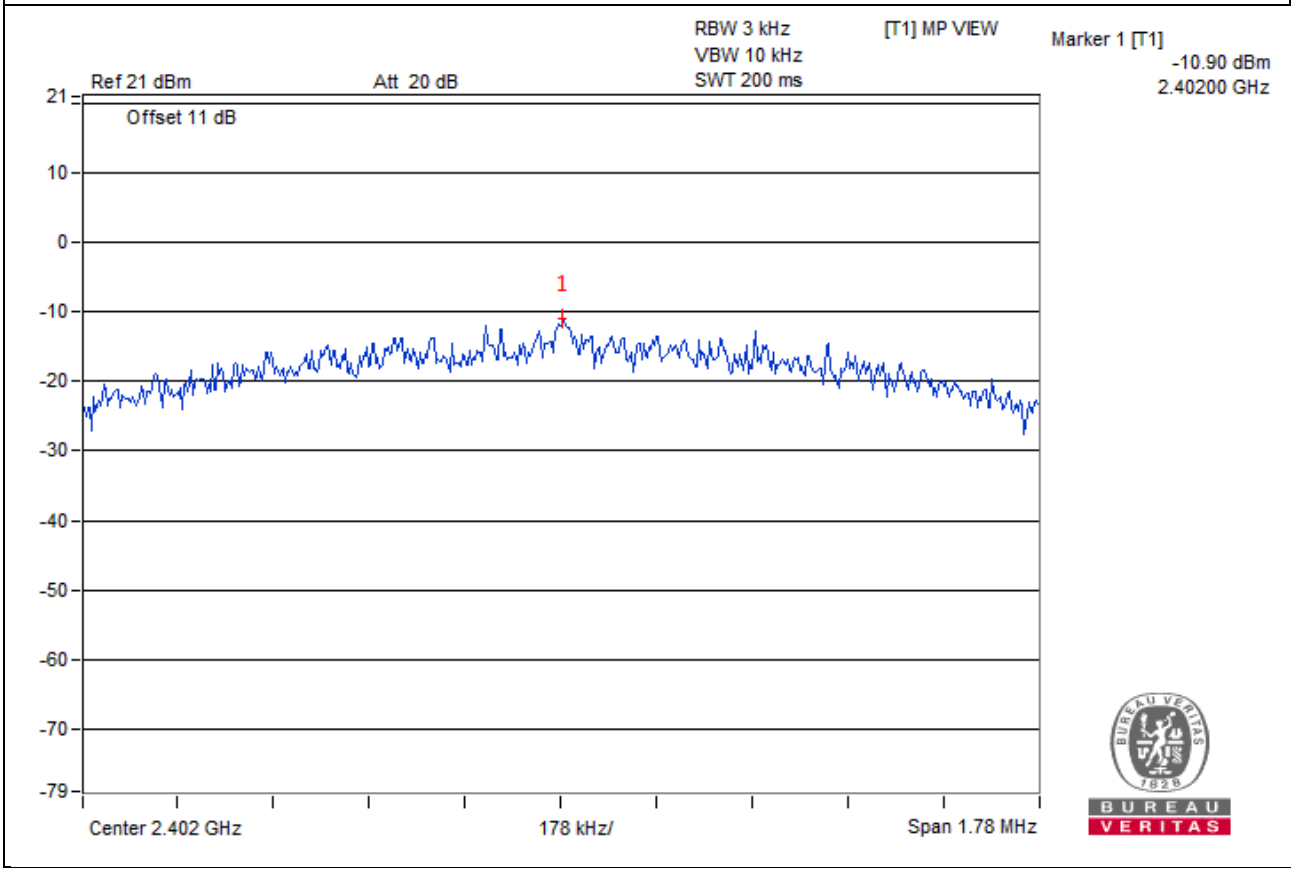
### 4.5.6 EUT Operating Condition

Same as Item 4.3.6.

4.5.7 Test Results

| Channel | Freq. (MHz) | PSD (dBm/3kHz) | Limit (dBm/3kHz) | Pass /Fail |
|---|---|---|---|---|
| 1 | 2402 | -10.90 | 8 | Pass |
| 39 | 2440 | -11.21 | 8 | Pass |
| 79 | 2480 | -11.30 | 8 | Pass |

| Spectrum Plot of Worst Value |
|---|
| **CH 1** |

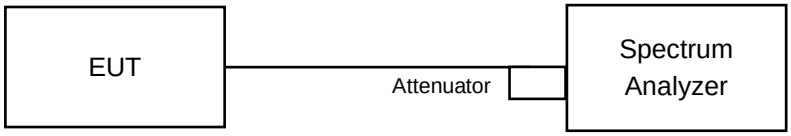


## 4.6 Conducted Out of Band Emission Measurement

### 4.6.1 Limits of Conducted Out of Band Emission Measurement

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

### 4.6.2 Test Setup




### 4.6.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

### 4.6.4 Test Procedure

**MEASUREMENT PROCEDURE REF**

1. Set the RBW = 100 kHz.
2. Set the VBW ≥ 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 OOBE**

1. Set RBW = 100 kHz.
2. Set VBW ≥ 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.

### 4.6.5 Deviation from Test Standard

No deviation.

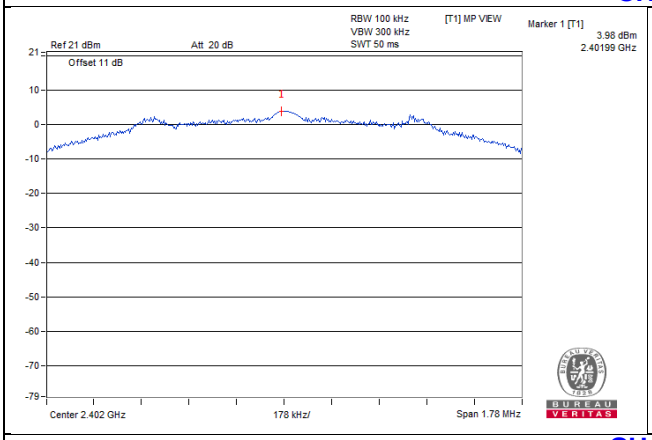
### 4.6.6 EUT Operating Condition

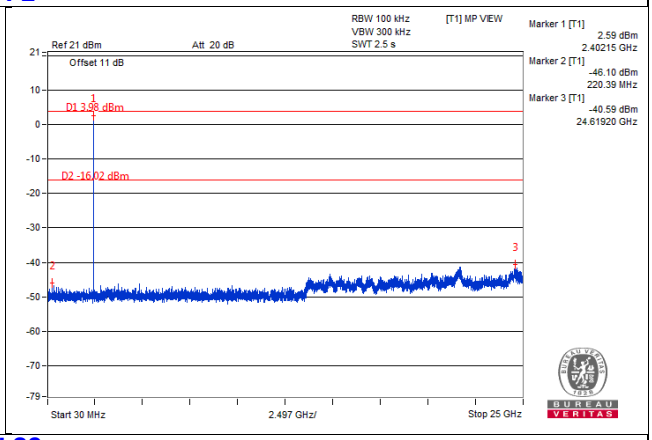
The software provided by client enabled the EUT to transmit and receive data at lowest and highest channel frequencies individually.

### 4.6.7 Test Results

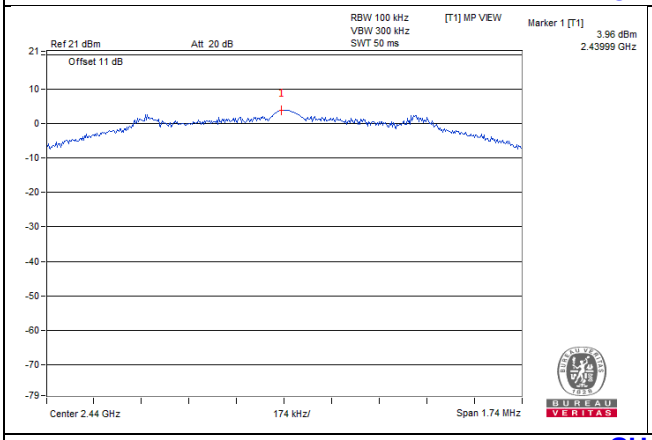
The spectrum plots are attached on the following pages. D1 line indicates the highest level, and D2 line indicates the 20dB offset below D1. It shows compliance with the requirement.

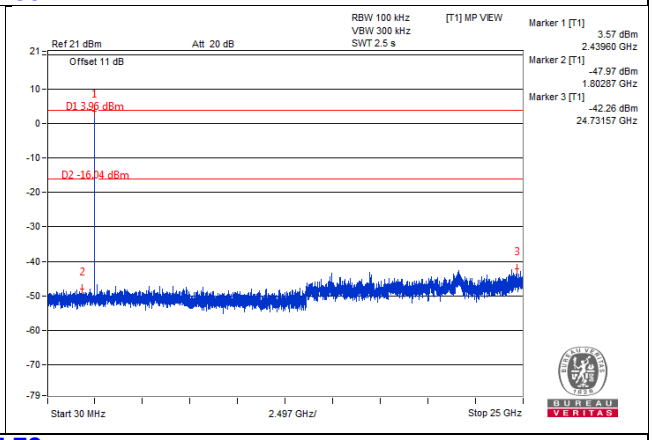
## CH 1



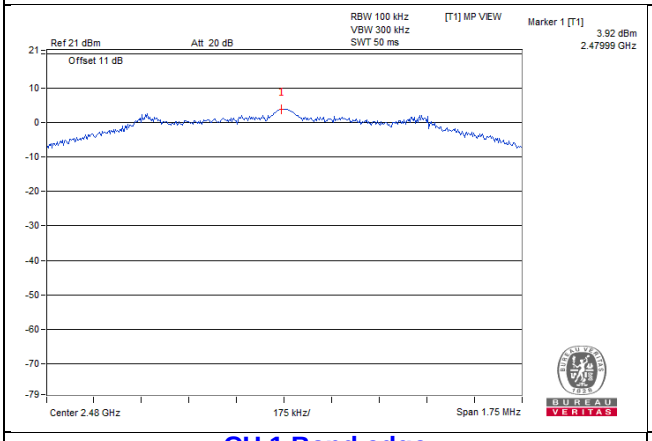



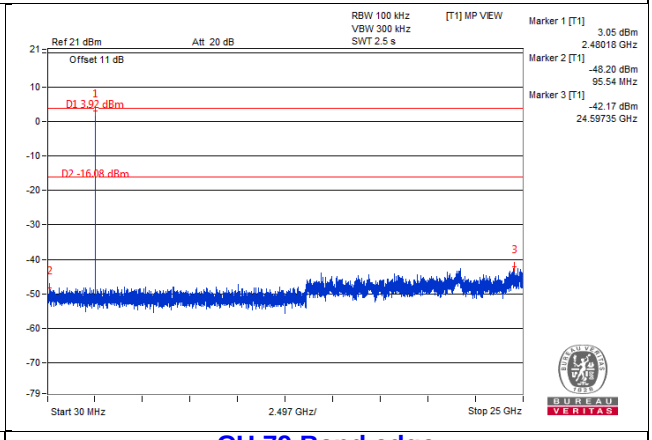

## CH 39



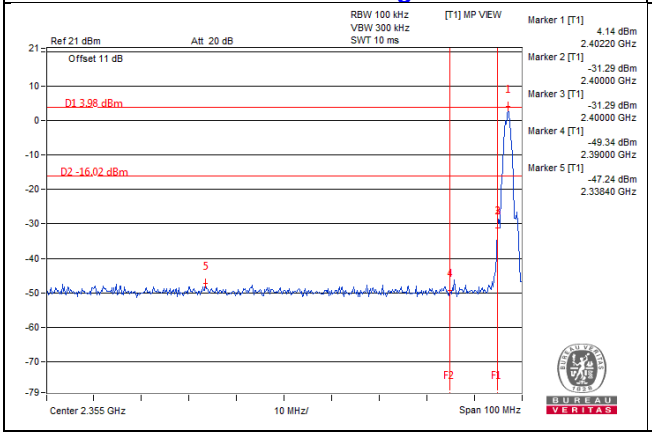




## CH 79

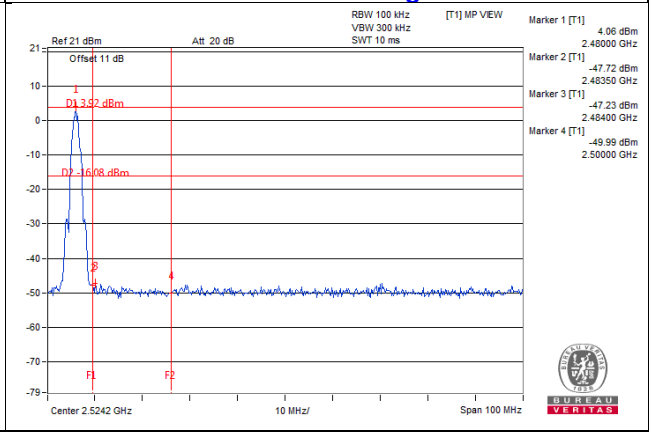



## CH 1 Band edge




## CH 79 Band edge



## 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:


**Linkou 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.

**--- END ---**