



FCC TEST REPORT (15.247)

REPORT NO.: RF140421E04 R1

MODEL NO.: CS-600

FCC ID: HV4CS600

RECEIVED: Apr. 21, 2014

TESTED: Apr. 23 to 29, 2014

ISSUED: May 14, 2014

APPLICANT: Wacom Co., Ltd.

ADDRESS: 2-510-1 Toyonodai, Kazo-shi, Saitama
349-1148 Japan

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

LAB ADDRESS : No. 81-1, Lu Liao Keng, 9th Ling, Wu Lung Tsuen,
Chiung Lin Hsiang, Hsin Chu Hsien 307, Taiwan,
R.O.C.

TEST LOCATION (1): No. 81-1, Lu Liao Keng, 9th Ling, Wu Lung Tsuen,
Chiung Lin Hsiang, Hsin Chu Hsien 307, Taiwan,
R.O.C.

TEST LOCATION (2): No. 49, Ln. 206, Wende Rd., Shangshan Tsuen,
Chiung Lin Hsiang, Hsin Chu Hsien 307, Taiwan,
R.O.C.

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RELEASE CONTROL RECORD

| ISSUE NO. | REASON FOR CHANGE | DATE ISSUED |
|----------------|---------------------|--------------|
| RF140421E04 | Original release | May 13, 2014 |
| RF140421E04 R1 | Revised model name. | May 14, 2014 |



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1. CERTIFICATION

PRODUCT: Active stylus for tablets
BRAND NAME: Wacom
MODEL NO.: CS-600
TEST SAMPLE: ENGINEERING SAMPLE
APPLICANT: Wacom Co., Ltd.
TESTED: Apr. 23 to 29, 2014
STANDARDS: **FCC Part 15, Subpart C (Section 15.247)**
ANSI C63.10-2009

The above equipment (Model: CS-600) 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 :  , **DATE:** May 14, 2014
(Midoli Peng, Specialist)

APPROVED BY :  , **DATE:** May 14, 2014
(May Chen, Manager)



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2. SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specifications:

| APPLIED STANDARD: FCC PART 15, SUBPART C (SECTION 15.247) | | | |
|---|-----------------------------|--------|---|
| STANDARD SECTION | TEST TYPE | RESULT | REMARK |
| 15.207 | AC Power Conducted Emission | PASS | Meet the requirement of limit. Minimum passing margin is -15.40dB at 0.16444MHz |
| 15.247(d) 15.209 | Radiated Emissions | PASS | Meet the requirement of limit. Minimum passing margin is -8.2dB at 122.64MHz |
| 15.247(d) | Band Edge Measurement | PASS | Meet the requirement of limit. |
| 15.247(a)(2) | 6dB bandwidth | PASS | Meet the requirement of limit. |
| 15.247(b) | Conducted Output 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. |



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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:

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=2$.

| Measurement | Value |
|-----------------------------------|---------|
| Conducted emissions | 2.86 dB |
| Radiated emissions (30MHz-1GHz) | 5.43 dB |
| Radiated emissions (1GHz -6GHz) | 3.72 dB |
| Radiated emissions (6GHz -18GHz) | 4.00 dB |
| Radiated emissions (18GHz -40GHz) | 4.11 dB |



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3. GENERAL INFORMATION

3.1 GENERAL DESCRIPTION OF EUT

| | |
|------------------------------|---|
| PRODUCT | Active stylus for tablets |
| MODEL NO. | CS-600 |
| POWER SUPPLY | DC 3.7V from battery or DC 5V from USB interface |
| MODULATION TYPE | BT-LE (GFSK) |
| MODULATION TECHNOLOGY | DTS |
| TRANSFER RATE | 1Mbps |
| OPERATING FREQUENCY | 2.402 ~ 2.480GHz |
| NUMBER OF CHANNEL | 40 |
| MAXIMUM OUTPUT POWER | 2.612mW |
| ANTENNA TYPE | Please see NOTE |
| DATA CABLE | USB to mini USB cable (Unshielded, 0.25m) <for charge only> |
| I/O PORTS | Refer to user's manual |
| ASSOCIATED DEVICES | NA |

Note:

1. The EUT could be supplied with Li-ion 3.7V, please refer to the following table:

| Brand Name | P/N | Rating |
|------------|----------|--------------|
| EVE | P0466-LF | 3.7V ,180mAh |

2. The antenna provided to the EUT, please refer to the following table:

| Brand | Model | Antenna Gain(dBi) <Including cable loss> | Frequency range (MHz to MHz) | Antenna Type | Connector Type |
|------------------------|--------------|---|---------------------------------|-----------------|-------------------|
| JOHANSON TECHNOLOGY | 2450AT18A100 | 0.5 | 2400~2500 | Chip | NA |



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3. The EUT was pre-tested under following test modes:

| Pre-test Mode | Power supply function | Polarity |
|---------------|-----------------------|-------------------|
| Mode A | Battery mode | Laying-flat plane |
| Mode B | USB mode | Laying-flat plane |
| Mode C | USB mode | Stand-flat plane |

From the above pre-test modes, the worse radiated emission was found in **Mode B** (below 1GHz) and **Mode C** (above 1GHz). Therefore only the test data of the mode was recorded in this report.

4. The above EUT information was declared by the manufacturer and for more detailed features description, please refer to the manufacturer's specifications or User's Manual.



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3.2 DESCRIPTION OF TEST MODES

40 channels are provided for Bluetooth LE mode:

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



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3.2.1 TEST MODE APPLICABILITY AND TESTED CHANNEL DETAIL

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

Where **PLC**: Power Line Conducted Emission **RE < 1G**: Radiated Emission below 1GHz
RE ≥ 1G: Radiated Emission above 1GHz **APCM**: Antenna Port Conducted Measurement
OB: Conducted Out-Band Emission Measurement

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.

| MODE | AVAILABLE CHANNEL | TESTED CHANNEL | MODULATION TECHNOLOGY | MODULATION TYPE | DATA RATE (Mbps) |
|-------|-------------------|----------------|-----------------------|-----------------|------------------|
| BT-LE | 0 to 39 | 39 | DSS | GFSK | 1 |

RADIATED EMISSION TEST (BELOW 1 GHz):

- 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.

| MODE | AVAILABLE CHANNEL | TESTED CHANNEL | MODULATION TECHNOLOGY | MODULATION TYPE | DATA RATE (Mbps) |
|-------|-------------------|----------------|-----------------------|-----------------|------------------|
| BT-LE | 0 to 39 | 39 | DSS | GFSK | 1 |



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RADIATED EMISSION TEST (ABOVE 1 GHz):

- 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.

| MODE | AVAILABLE CHANNEL | TESTED CHANNEL | MODULATION TECHNOLOGY | MODULATION TYPE | DATA RATE (Mbps) |
|-------|-------------------|----------------|-----------------------|-----------------|------------------|
| BT-LE | 0 to 39 | 0, 19, 39 | DTS | GFSK | 1 |

ANTENNA PORT CONDUCTED MEASUREMENT:

- 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.

| MODE | AVAILABLE CHANNEL | TESTED CHANNEL | MODULATION TECHNOLOGY | MODULATION TYPE | DATA RATE (Mbps) |
|-------|-------------------|----------------|-----------------------|-----------------|------------------|
| BT-LE | 0 to 39 | 0, 19, 39 | DTS | GFSK | 1 |

CONDUCTED OUT-BAND EMISSION MEASUREMENT:

- 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.

| MODE | AVAILABLE CHANNEL | TESTED CHANNEL | MODULATION TECHNOLOGY | MODULATION TYPE | DATA RATE (Mbps) |
|-------|-------------------|----------------|-----------------------|-----------------|------------------|
| BT-LE | 0 to 39 | 0, 19, 39 | DTS | GFSK | 1 |

TEST CONDITION:

| APPLICABLE TO | ENVIRONMENTAL CONDITIONS | INPUT POWER | TESTED BY |
|--------------------|--------------------------|--------------|------------|
| PLC | 25deg. 62C,%RH | 120Vac, 60Hz | Scott Chen |
| RE<1G | 25deg. C, 67%RH | 120Vac, 60Hz | Andy Ho |
| RE ³ 1G | 22deg. C, 68%RH | 120Vac, 60Hz | Andy Ho |
| APCM | 25deg. C, 60%RH | 120Vac, 60Hz | Chilin Lee |
| OB | 25deg. C, 60%RH | 120Vac, 60Hz | Chilin Lee |

3.3 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)

558074 D01 DTS Meas Guidance v03r01

ANSI C63.10-2009

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

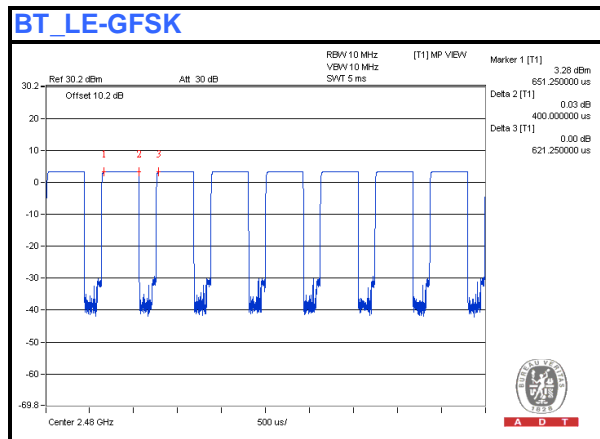
Note: The EUT has been verified to comply with the requirements of FCC Part 15, Subpart B, Class B (DoC). The test report has been issued separately.

3.4 DUTY CYCLE OF TEST SIGNAL

Duty cycle of test signal is < 98%.

For **BT_LE-GFSK**:

Duty cycle = 0.4 ms/0.62125 ms = 0.644





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3.5 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.

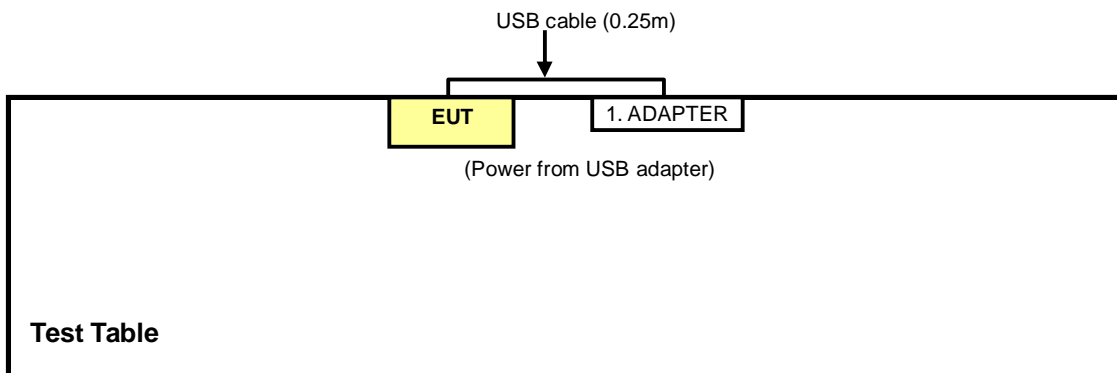
| For conducted emission test | | | | | |
|-----------------------------|---------|--------|-----------|------------|--------|
| NO. | PRODUCT | BRAND | MODEL NO. | SERIAL NO. | FCC ID |
| 1 | ADAPTER | Apple | A1357 | NA | NA |
| For other test items | | | | | |
| NO. | PRODUCT | BRAND | MODEL NO. | SERIAL NO. | FCC ID |
| 1 | ADAPTER | Kamera | DB110 | DB110_01 | NA |

| For conducted emission test | |
|-----------------------------|---|
| NO. | SIGNAL CABLE DESCRIPTION OF THE ABOVE SUPPORT UNITS |
| 1 | USB cable(0.25m) |
| For other test items | |
| NO. | SIGNAL CABLE DESCRIPTION OF THE ABOVE SUPPORT UNITS |
| 1 | USB cable(0.27m) |

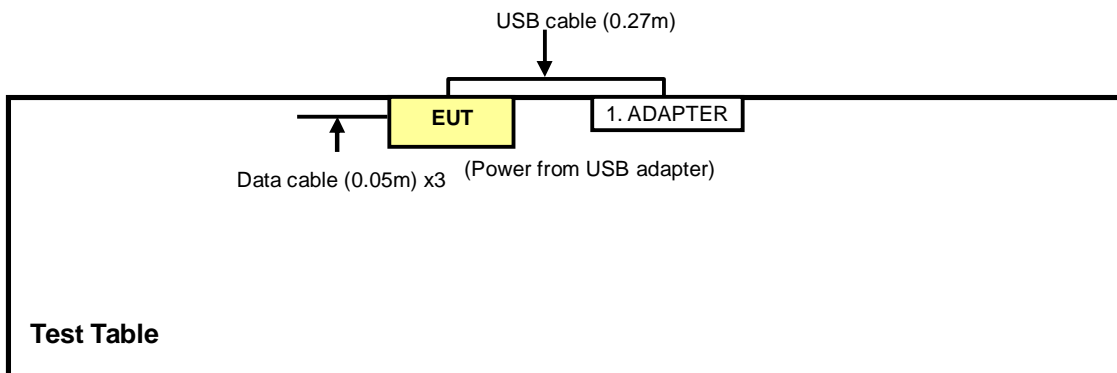
NOTE: All power cords of the above support units are non shielded (1.8m).

3.6 CONFIGURATION OF SYSTEM UNDER TEST

For conducted emission test



For other test items





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4. TEST TYPES AND RESULTS

4.1 CONDUCTED EMISSION MEASUREMENT

4.1.1 LIMITS OF CONDUCTED EMISSION MEASUREMENT

| FREQUENCY OF EMISSION (MHz) | CONDUCTED LIMIT (dB μ V) | |
|-----------------------------|------------------------------|----------|
| | Quasi-peak | Average |
| 0.15-0.5 | 66 to 56 | 56 to 46 |
| 0.5-5 | 56 | 46 |
| 5-30 | 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 0.50 MHz.

4.1.2 TEST INSTRUMENTS

| DESCRIPTION & MANUFACTURER | MODEL NO. | SERIAL NO. | CALIBRATED DATE | CALIBRATED UNTIL |
|--|-----------------------------|------------|-----------------|------------------|
| Test Receiver ROHDE & SCHWARZ | ESCS 30 | 847124/029 | Oct. 21, 2013 | Oct. 20, 2014 |
| Line-Impedance Stabilization Network (for EUT) ROHDE & SCHWARZ | NSLK-8127 | 5127-523 | Oct. 02, 2013 | Oct. 01, 2014 |
| Line-Impedance Stabilization Network (for Peripheral) ROHDE & SCHWARZ | ENV216 | 100071 | Nov. 13, 2013 | Nov. 12, 2014 |
| RF Cable (JYEBAO) | 5DFB | COACAB-001 | May 27, 2013 | May 26, 2014 |
| 50 ohms Terminator | 50 | 3 | Oct. 17, 2013 | Oct. 16, 2014 |
| 50 ohms Terminator | N/A | EMC-04 | Oct. 17, 2013 | Oct. 16, 2014 |
| Software ADT | BV ADT_Cond_V7.3.7. 3 | NA | NA | NA |

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 test was performed in Shielded Room No. C.
3. The VCCI Con C Registration No. is C-3611.
4. Tested Date: Apr. 29, 2014

4.1.3 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.
- b. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument.
- c. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
- d. The frequency range from 150kHz to 30MHz was searched. Emission levels under (Limit - 20dB) were not recorded.

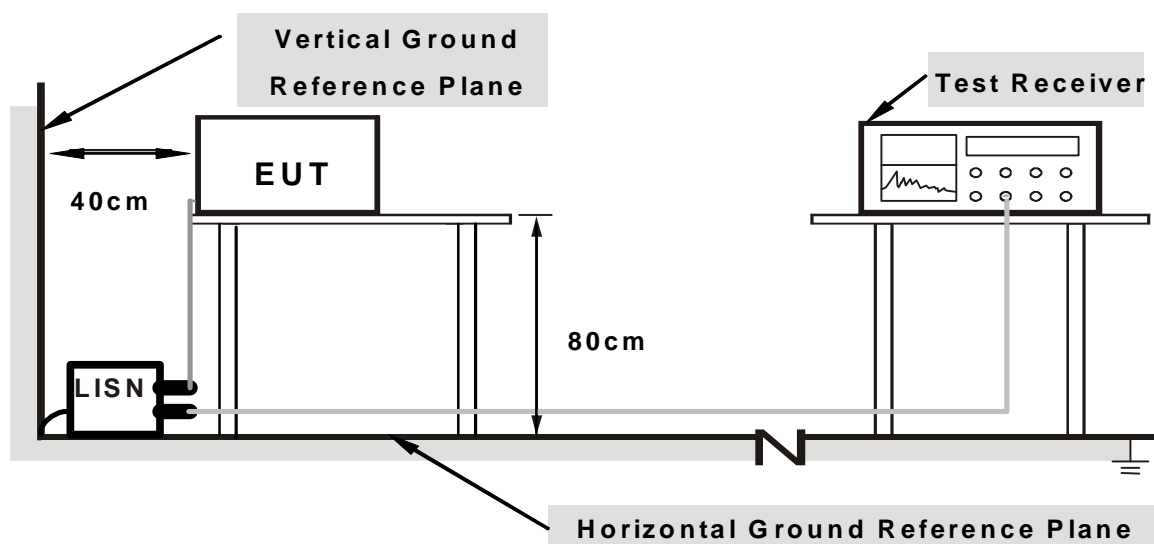
NOTE:

1. The resolution bandwidth of test receiver is 9kHz for Quasi-peak detection (QP) & Average detection (AV).

4.1.4 DEVIATION FROM TEST STANDARD

No deviation

4.1.5 TEST SETUP



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.

4.1.6 EUT OPERATING CONDITIONS

1. Turn on the power of EUT.
2. The communication partner run test program “nrfgostudio.exe” to enable EUT under transmission/receiving condition continuously at specific channel frequency.



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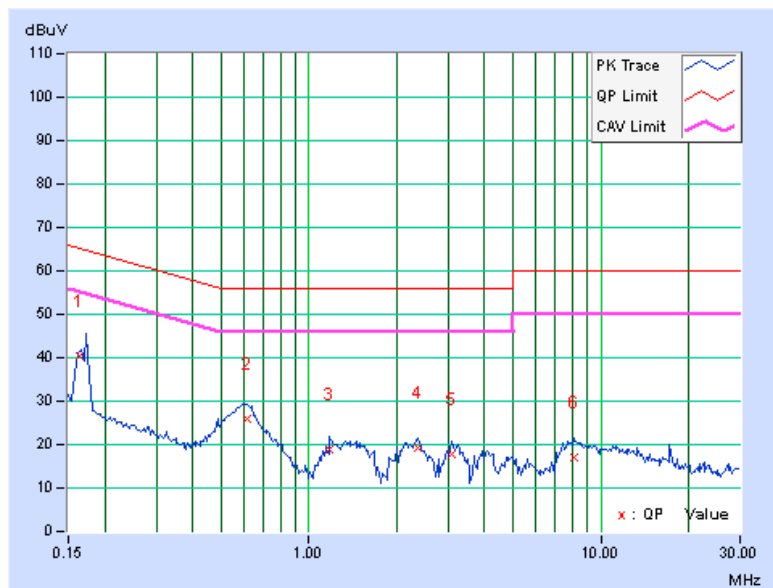
4.1.7 TEST RESULTS

| | | | |
|--------------|----------|--------------------------|--------------------------------|
| PHASE | Line (L) | DETECTOR FUNCTION | Quasi-Peak (QP) / Average (AV) |
|--------------|----------|--------------------------|--------------------------------|

| No | Freq. [MHz] | Corr. Factor (dB) | Reading Value [dB (uV)] | | Emission Level [dB (uV)] | | Limit [dB (uV)] | | Margin (dB) | |
|----|-------------|-------------------|-------------------------|-------|--------------------------|-------|-----------------|-------|-------------|--------|
| | | | Q.P. | AV. | Q.P. | AV. | Q.P. | AV. | Q.P. | AV. |
| 1 | 0.16444 | 0.07 | 40.39 | 39.76 | 40.46 | 39.83 | 65.24 | 55.24 | -24.77 | -15.40 |
| 2 | 0.61094 | 0.15 | 25.66 | 18.96 | 25.81 | 19.11 | 56.00 | 46.00 | -30.19 | -26.89 |
| 3 | 1.17969 | 0.19 | 18.71 | 12.44 | 18.90 | 12.63 | 56.00 | 46.00 | -37.10 | -33.37 |
| 4 | 2.36719 | 0.28 | 18.81 | 12.70 | 19.09 | 12.98 | 56.00 | 46.00 | -36.91 | -33.02 |
| 5 | 3.08594 | 0.36 | 17.45 | 11.82 | 17.81 | 12.18 | 56.00 | 46.00 | -38.19 | -33.82 |
| 6 | 8.07031 | 0.62 | 16.38 | 10.69 | 17.00 | 11.31 | 60.00 | 50.00 | -43.00 | -38.69 |

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

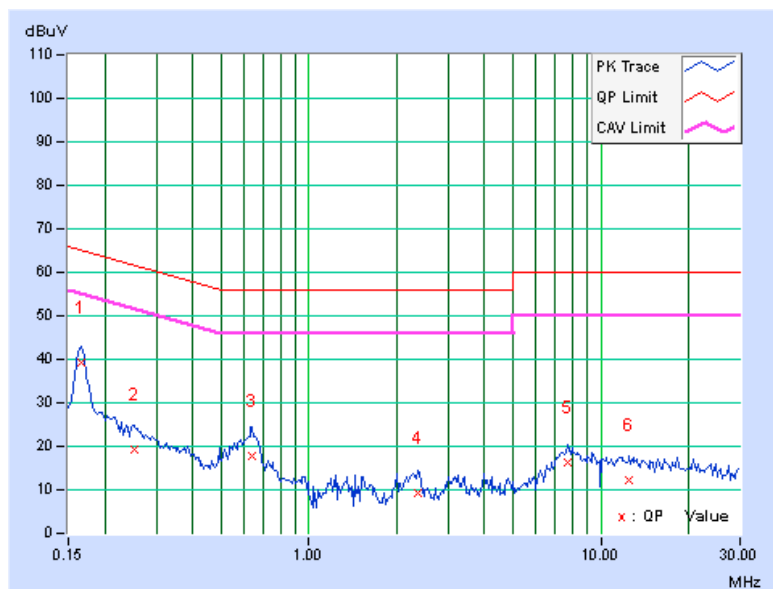


| | | | |
|-------|-------------|-------------------|--------------------------------|
| PHASE | Neutral (N) | DETECTOR FUNCTION | Quasi-Peak (QP) / Average (AV) |
|-------|-------------|-------------------|--------------------------------|

| No | Freq. [MHz] | Corr. Factor [dB] | Reading Value [dB (uV)] | | Emission Level [dB (uV)] | | Limit [dB (uV)] | | Margin (dB) | |
|----|-------------|-------------------|-------------------------|-------|--------------------------|-------|-----------------|-------|-------------|--------|
| | | | Q.P. | AV. | Q.P. | AV. | Q.P. | AV. | Q.P. | AV. |
| 1 | 0.16562 | 0.07 | 39.24 | 38.94 | 39.31 | 39.01 | 65.18 | 55.18 | -25.87 | -16.17 |
| 2 | 0.25156 | 0.09 | 19.34 | 9.93 | 19.43 | 10.02 | 61.71 | 51.71 | -42.28 | -41.69 |
| 3 | 0.63828 | 0.16 | 17.51 | 11.55 | 17.67 | 11.71 | 56.00 | 46.00 | -38.33 | -34.29 |
| 4 | 2.35938 | 0.25 | 8.96 | 0.57 | 9.21 | 0.82 | 56.00 | 46.00 | -46.79 | -45.18 |
| 5 | 7.68750 | 0.54 | 15.70 | 10.95 | 16.24 | 11.49 | 60.00 | 50.00 | -43.76 | -38.51 |
| 6 | 12.56250 | 0.79 | 11.53 | 4.11 | 12.32 | 4.90 | 60.00 | 50.00 | -47.68 | -45.10 |

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





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4.2 RADIATED EMISSION AND BANDEGE MEASUREMENT

4.2.1 LIMITS OF RADIATED EMISSION AND BANDEGE 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.



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4.2.2 TEST INSTRUMENTS

| DESCRIPTION & MANUFACTURER | MODEL NO. | SERIAL NO. | CALIBRATED DATE | CALIBRATED UNTIL |
|---|--------------------------|-------------------------------------|-----------------|------------------|
| MXE EMI Receiver Agilent | N9038A | MY50010156 | Jan. 15, 2014 | Jan. 14, 2015 |
| Pre-Amplifier Mini-Circuits | ZFL-1000VH2 B | AMP-ZFL-04 | Nov. 13, 2013 | Nov. 12, 2014 |
| Trilog Broadband Antenna SCHWARZBECK | VULB 9168 | 9168-361 | Feb. 27, 2014 | Feb. 26, 2015 |
| RF Cable | NA | CHHCAB_001 | Oct. 06, 2013 | Oct. 05, 2014 |
| Spectrum Analyzer R&S | FSV40 | 100964 | July 15, 2013 | July 14, 2014 |
| Horn_Antenna AISi | AIH.8018 | 0000220091110 | Dec. 06, 2013 | Dec. 05, 2014 |
| Pre-Amplifier Agilent | 8449B | 3008A01923 | Oct. 29, 2013 | Oct. 28, 2014 |
| RF Cable | NA | RF104-205 RF104-207 RF104-202 | Dec. 12, 2013 | Dec. 11, 2014 |
| Spectrum Analyzer Agilent | E4446A | MY48250253 | Aug. 28, 2013 | Aug. 27, 2014 |
| Pre-Amplifier SPACEK LABS | SLKKa-48-6 | 9K16 | Nov. 13, 2013 | Nov. 12, 2014 |
| Horn_Antenna SCHWARZBECK | BBHA 9170 | 9170-424 | Oct. 08, 2013 | Oct. 07, 2014 |
| Software | ADT_Radiated _V8.7.07 | NA | NA | NA |
| Antenna Tower & Turn Table CT | NA | NA | NA | NA |

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 horn antenna, preamplifier (model: 8449B) are used only for the measurement of emission frequency above 1GHz if tested.
- 3 The test was performed in 966 Chamber No. H.
4. The FCC Site Registration No. is 797305.
- 5 The CANADA Site Registration No. is IC 7450H-3.
- 6 Tested Date: Apr. 23, 2014

4.2.3 TEST PROCEDURES

- a. The EUT was placed on the top of a rotating table 0.8 meters 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:

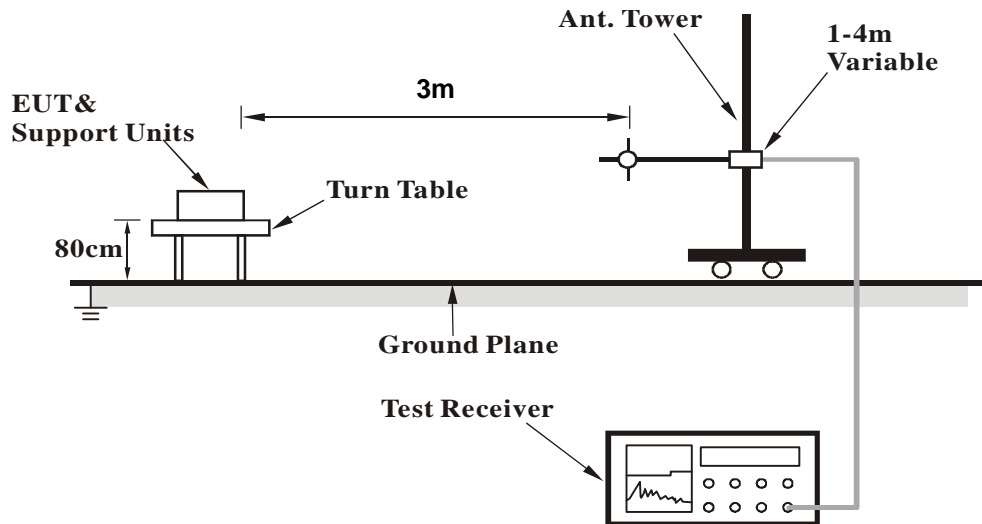
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
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.

4.2.4 DEVIATION FROM TEST STANDARD

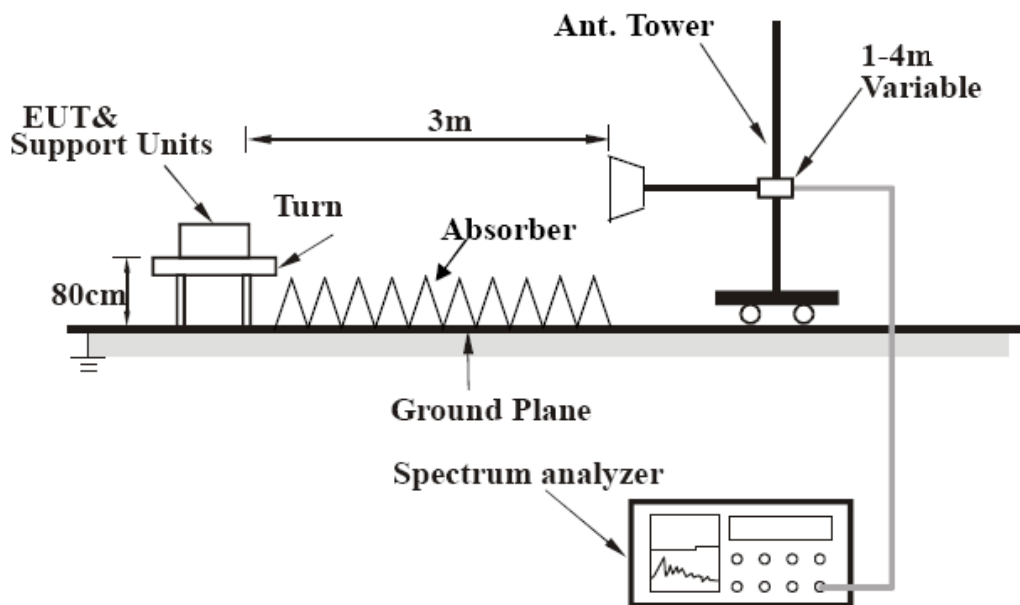
No deviation

4.2.5 TEST SETUP

<Frequency Range below 1GHz>



<Frequency Range above 1GHz>



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

4.2.6 EUT OPERATING CONDITIONS

Same as 4.1.6



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4.2.7 TEST RESULTS

BELOW 1GHz WORST-CASE DATA

BT_LE-GFSK

| | | | |
|------------------------|--------------|--------------------------|-----------------|
| CHANNEL | TX Channel 0 | DETECTOR FUNCTION | Quasi-Peak (QP) |
| FREQUENCY RANGE | Below 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 | 122.64 | 35.4 QP | 43.5 | -8.2 | 1.50 H | 323 | 49.74 | -14.39 |
| 2 | 134.76 | 29.3 QP | 43.5 | -14.3 | 2.00 H | 95 | 42.62 | -13.37 |
| 3 | 165.51 | 31.3 QP | 43.5 | -12.2 | 1.50 H | 77 | 44.18 | -12.84 |
| 4 | 177.97 | 28.8 QP | 43.5 | -14.7 | 1.50 H | 61 | 42.83 | -14.02 |
| 5 | 315.03 | 31.0 QP | 46.0 | -15.0 | 1.50 H | 340 | 42.06 | -11.04 |
| 6 | 940.54 | 36.7 QP | 46.0 | -9.3 | 1.50 H | 322 | 35.32 | 1.37 |

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 | 40.82 | 29.2 QP | 40.0 | -10.8 | 1.00 V | 171 | 42.57 | -13.38 |
| 2 | 123.56 | 35.1 QP | 43.5 | -8.4 | 1.00 V | 345 | 49.44 | -14.31 |
| 3 | 171.43 | 34.2 QP | 43.5 | -9.3 | 1.00 V | 339 | 47.46 | -13.27 |
| 4 | 330.02 | 32.7 QP | 46.0 | -13.3 | 1.00 V | 350 | 43.32 | -10.64 |
| 5 | 409.17 | 34.8 QP | 46.0 | -11.2 | 1.50 V | 181 | 43.89 | -9.09 |
| 6 | 940.68 | 34.3 QP | 46.0 | -11.7 | 1.00 V | 158 | 32.92 | 1.37 |

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



ABOVE 1GHz WORST-CASE DATA

BT_LE-GFSK

| | | | |
|------------------------|--------------|------------------------------|--------------|
| CHANNEL | TX Channel 0 | DETECTOR FUNCTION | Peak (PK) |
| FREQUENCY RANGE | 1GHz ~ 25GHz | | 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 | 2390.00 | 47.8 PK | 74.0 | -26.2 | 1.34 H | 125 | 14.27 | 33.53 |
| 2 | 2390.00 | 35.1 AV | 54.0 | -18.9 | 1.34 H | 125 | 1.57 | 33.53 |
| 3 | *2402.00 | 88.4 PK | | | 1.34 H | 125 | 54.84 | 33.56 |
| 4 | *2402.00 | 87.4 AV | | | 1.34 H | 125 | 53.84 | 33.56 |
| 5 | 4804.00 | 48.6 PK | 74.0 | -25.4 | 1.32 H | 84 | 5.44 | 43.16 |
| 6 | 4804.00 | 38.7 AV | 54.0 | -15.3 | 1.32 H | 84 | -4.46 | 43.16 |

| 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 | 48.0 PK | 74.0 | -26.0 | 1.00 V | 0 | 14.47 | 33.53 |
| 2 | 2390.00 | 35.3 AV | 54.0 | -18.7 | 1.00 V | 0 | 1.77 | 33.53 |
| 3 | *2402.00 | 89.7 PK | | | 1.00 V | 0 | 56.14 | 33.56 |
| 4 | *2402.00 | 88.9 AV | | | 1.00 V | 0 | 55.34 | 33.56 |
| 5 | 4804.00 | 47.0 PK | 74.0 | -27.0 | 1.16 V | 157 | 3.84 | 43.16 |
| 6 | 4804.00 | 35.4 AV | 54.0 | -18.6 | 1.16 V | 157 | -7.76 | 43.16 |

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.



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| | | | |
|------------------------|---------------|--------------------------|--------------|
| CHANNEL | TX Channel 19 | DETECTOR FUNCTION | Peak (PK) |
| FREQUENCY RANGE | 1GHz ~ 25GHz | | 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 | *2440.00 | 88.3 PK | | | 1.31 H | 119 | 54.62 | 33.68 |
| 2 | *2440.00 | 85.0 AV | | | 1.31 H | 119 | 51.32 | 33.68 |
| 3 | 4880.00 | 48.8 PK | 74.0 | -25.2 | 1.34 H | 84 | 5.56 | 43.24 |
| 4 | 4880.00 | 38.8 AV | 54.0 | -15.2 | 1.34 H | 84 | -4.44 | 43.24 |
| 5 | 7320.00 | 50.8 PK | 74.0 | -23.2 | 1.00 H | 334 | 2.69 | 48.11 |
| 6 | 7320.00 | 39.3 AV | 54.0 | -14.7 | 1.00 H | 334 | -8.81 | 48.11 |

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 | 89.4 PK | | | 1.18 V | 20 | 55.72 | 33.68 |
| 2 | *2440.00 | 86.3 AV | | | 1.18 V | 20 | 52.62 | 33.68 |
| 3 | 4880.00 | 46.7 PK | 74.0 | -27.3 | 1.10 V | 167 | 3.46 | 43.24 |
| 4 | 4880.00 | 35.0 AV | 54.0 | -19.0 | 1.10 V | 167 | -8.24 | 43.24 |
| 5 | 7320.00 | 51.6 PK | 74.0 | -22.4 | 1.00 V | 123 | 3.49 | 48.11 |
| 6 | 7320.00 | 39.9 AV | 54.0 | -14.1 | 1.00 V | 123 | -8.21 | 48.11 |

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.



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|------------------------|---------------|--------------------------|--------------|
| CHANNEL | TX Channel 39 | DETECTOR FUNCTION | Peak (PK) |
| FREQUENCY RANGE | 1GHz ~ 25GHz | | 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 | *2480.00 | 85.4 PK | | | 1.28 H | 178 | 51.60 | 33.80 |
| 2 | *2480.00 | 84.0 AV | | | 1.28 H | 178 | 50.20 | 33.80 |
| 3 | 2483.50 | 48.9 PK | 74.0 | -25.1 | 1.28 H | 178 | 15.09 | 33.81 |
| 4 | 2483.50 | 35.6 AV | 54.0 | -18.4 | 1.28 H | 178 | 1.79 | 33.81 |
| 5 | 4960.00 | 48.7 PK | 74.0 | -25.3 | 1.29 H | 85 | 5.43 | 43.27 |
| 6 | 4960.00 | 38.8 AV | 54.0 | -15.2 | 1.29 H | 85 | -4.47 | 43.27 |
| 7 | 7440.00 | 51.3 PK | 74.0 | -22.7 | 1.00 H | 344 | 2.80 | 48.50 |
| 8 | 7440.00 | 39.6 AV | 54.0 | -14.4 | 1.00 H | 344 | -8.90 | 48.50 |

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 | 85.2 PK | | | 1.00 V | 0 | 51.40 | 33.80 |
| 2 | *2480.00 | 83.9 AV | | | 1.00 V | 0 | 50.10 | 33.80 |
| 3 | 2483.50 | 53.8 PK | 74.0 | -20.2 | 1.00 V | 0 | 19.99 | 33.81 |
| 4 | 2483.50 | 35.8 AV | 54.0 | -18.2 | 1.00 V | 0 | 1.99 | 33.81 |
| 5 | 4960.00 | 46.9 PK | 74.0 | -27.1 | 1.11 V | 166 | 3.63 | 43.27 |
| 6 | 4960.00 | 35.5 AV | 54.0 | -18.5 | 1.11 V | 166 | -7.77 | 43.27 |
| 7 | 7440.00 | 51.2 PK | 74.0 | -22.8 | 1.00 V | 124 | 2.70 | 48.50 |
| 8 | 7440.00 | 39.5 AV | 54.0 | -14.5 | 1.00 V | 124 | -9.00 | 48.50 |

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.



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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 INSTRUMENTS

| DESCRIPTION & MANUFACTURER | MODEL NO. | SERIAL NO. | CALIBRATED DATE | CALIBRATED UNTIL |
|----------------------------|-----------|------------|-----------------|------------------|
| SPECTRUM ANALYZER R&S | FSV 40 | 100964 | July 15, 2013 | July 14, 2014 |

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. Tested date : Apr. 24, 2014

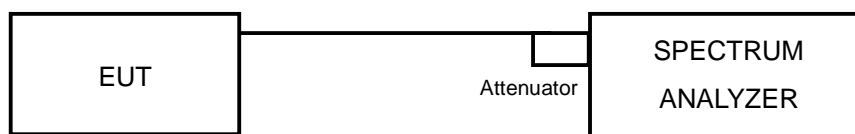
4.3.3 TEST PROCEDURE

1. Set resolution bandwidth (RBW) = 100kHz
2. Set the video bandwidth (VBW) $\geq 3 \times$ RBW, Detector = Peak.
3. Trace mode = max hold.
4. Sweep = auto couple.
5. 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

4.3.4 DEVIATION FROM TEST STANDARD

No deviation

4.3.5 TEST SETUP



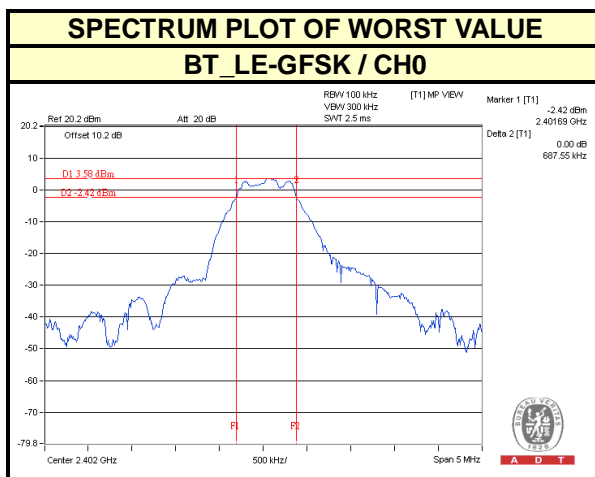
4.3.6 EUT OPERATING CONDITIONS

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

BT_LE-GFSK

| CHANNEL | FREQUENCY (MHz) | 6dB BANDWIDTH (MHz) | MINIMUM LIMIT (MHz) | PASS / FAIL |
|---------|-----------------|---------------------|---------------------|-------------|
| 0 | 2402 | 0.69 | 0.5 | PASS |
| 19 | 2440 | 0.69 | 0.5 | PASS |
| 39 | 2480 | 0.69 | 0.5 | PASS |



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 INSTRUMENTS

| DESCRIPTION & MANUFACTURER | MODEL NO. | SERIAL NO. | CALIBRATED DATE | CALIBRATED UNTIL |
|----------------------------|-----------|------------|-----------------|------------------|
| Power meter | ML2495A | 0824006 | May 20, 2013 | May 19, 2014 |
| Power sensor | MA2411B | 0738172 | May 20, 2013 | May 19, 2014 |

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. Tested date : Apr. 24, 2014

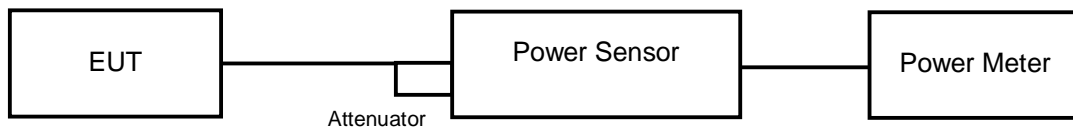
4.4.3 TEST PROCEDURES

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

4.4.4 DEVIATION FROM TEST STANDARD

No deviation.

4.4.5 TEST SETUP



4.4.6 EUT OPERATING CONDITIONS

Same as Item 4.3.6



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4.4.7 TEST RESULTS

BT_LE-GFSK

FOR PEAK POWER

| CHANNEL | FREQUENCY (MHz) | PEAK POWER (mW) | PEAK POWER (dBm) | LIMIT (dBm) | PASS/FAIL |
|---------|-----------------|-----------------|------------------|-------------|-----------|
| 0 | 2402 | 2.612 | 4.17 | 30 | PASS |
| 19 | 2440 | 2.529 | 4.03 | 30 | PASS |
| 39 | 2480 | 2.438 | 3.87 | 30 | PASS |

FOR AVERAGE POWER

| CHANNEL | FREQUENCY (MHz) | AVERAGE POWER (mW) | AVERAGE POWER (dBm) |
|---------|-----------------|--------------------|---------------------|
| 0 | 2402 | 2.333 | 3.68 |
| 19 | 2440 | 2.291 | 3.60 |
| 39 | 2480 | 2.178 | 3.38 |

4.5 POWER SPECTRAL DENSITY MEASUREMENT

4.5.1 LIMITS OF POWER SPECTRAL DENSITY MEASUREMENT

The Maximum of Power Spectral Density Measurement is 8dBm.

4.5.2 TEST INSTRUMENTS

| DESCRIPTION & MANUFACTURER | MODEL NO. | SERIAL NO. | CALIBRATED DATE | CALIBRATED UNTIL |
|----------------------------|-----------|------------|-----------------|------------------|
| SPECTRUM ANALYZER R&S | FSV 40 | 100964 | July 15, 2013 | July 14, 2014 |

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. Tested date : Apr. 21, 2014

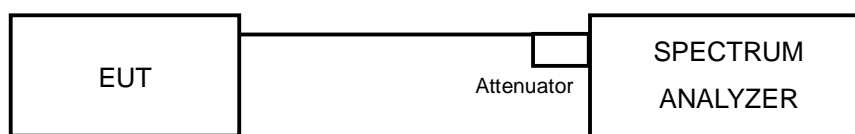
4.5.3 TEST PROCEDURE

1. Set the RBW = 3 kHz, VBW = 10 kHz, Detector = peak.
2. Sweep time = auto couple, Trace mode = max hold, allow trace to fully stabilize.
3. Use the peak marker function to determine the maximum amplitude level.

4.5.4 DEVIATION FROM TEST STANDARD

No deviation

4.5.5 TEST SETUP



4.5.6 EUT OPERATING CONDITION

Same as Item 4.3.6

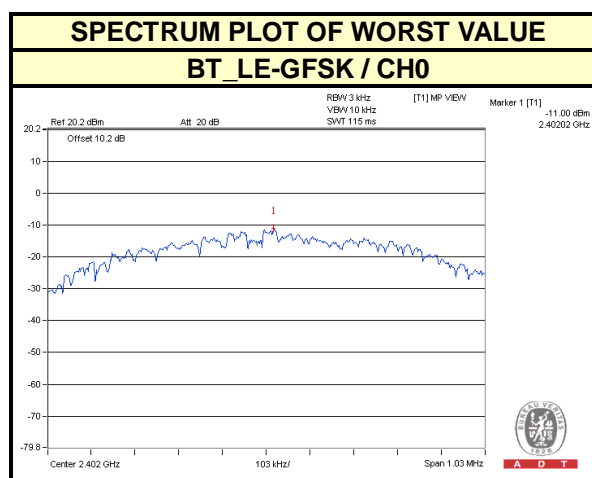


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4.5.7 TEST RESULTS

BT_LE-GFSK

| Channel | FREQUENCY (MHz) | PSD (dBm) | LIMIT (dBm) | PASS /FAIL |
|---------|-----------------|-----------|-------------|------------|
| 0 | 2402 | -11.00 | 8 | PASS |
| 19 | 2440 | -11.44 | 8 | PASS |
| 39 | 2480 | -11.44 | 8 | PASS |





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4.6 CONDUCTED OUT-BAND EMISSION MEASUREMENT

4.6.1 LIMITS OF CONDUCTED OUT-BAND EMISSION MEASUREMENT

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

4.6.2 TEST INSTRUMENTS

| DESCRIPTION & MANUFACTURER | MODEL NO. | SERIAL NO. | CALIBRATED DATE | CALIBRATED UNTIL |
|----------------------------|-----------|------------|-----------------|------------------|
| SPECTRUM ANALYZER R&S | FSV 40 | 100964 | July 15, 2013 | July 14, 2014 |

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. Tested date : Apr. 21, 2014

4.6.3 TEST PROCEDURE

Measurement Procedure - Reference Level

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.

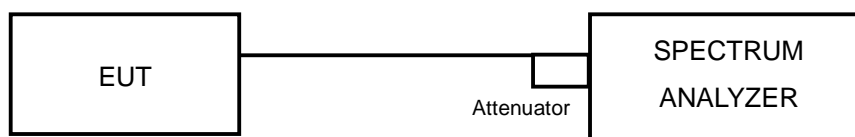
Measurement Procedure –Unwanted Emission Level

1. Set RBW = 100 kHz.
2. Set VBW \geq 300 kHz.
3. Set span to encompass the spectrum to be examined
4. Detector = peak.
5. Trace Mode = max hold.
6. Sweep = auto couple.

4.6.4 DEVIATION FROM TEST STANDARD

No deviation

4.6.5 TEST SETUP



4.6.6 EUT OPERATING CONDITION

Same as Item 4.3.6

4.6.7 TEST RESULTS

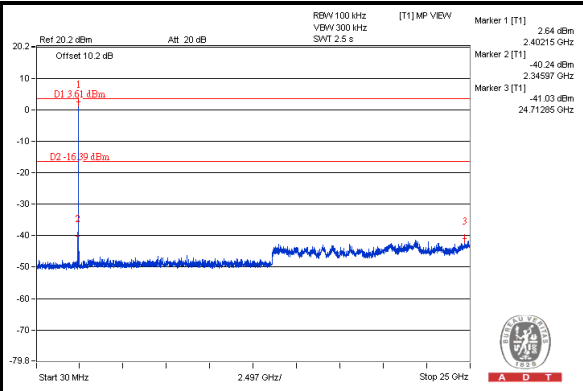
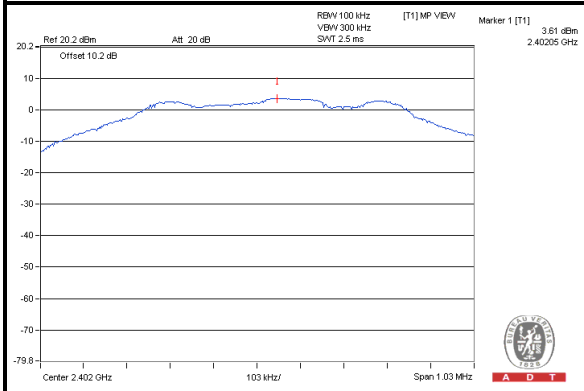
The spectrum plots are attached on the following pages. D1 line indicates the highest level, and D2 line indicates the 20dB offset below D1. It shows compliance with the requirement.



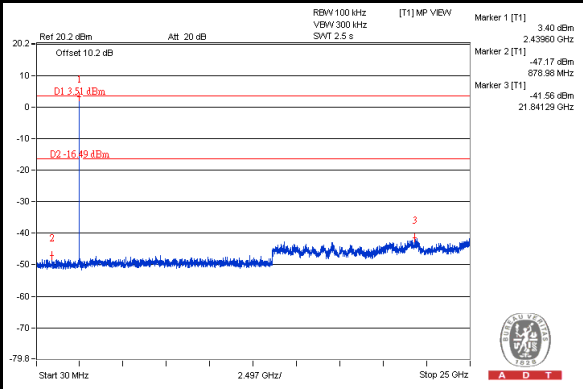
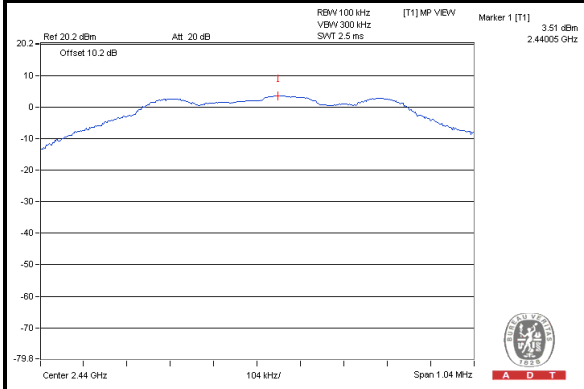
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BT_LE-GFSK

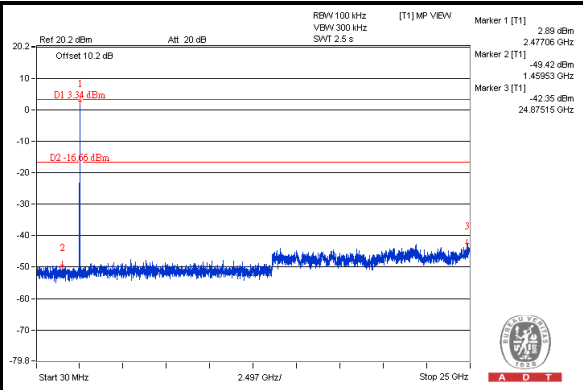
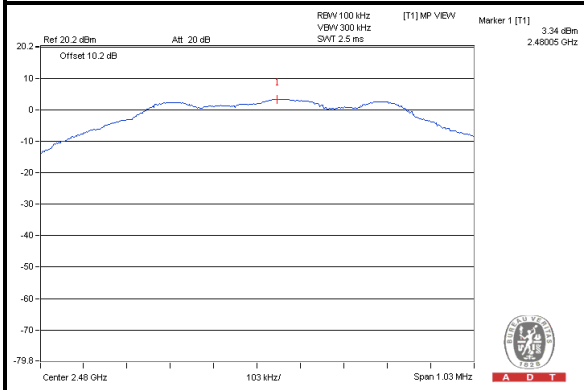
CH 0



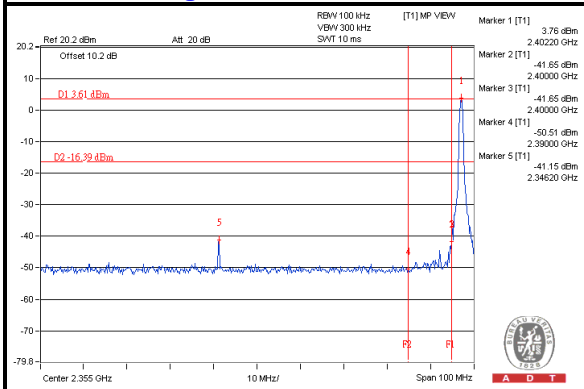
CH 19



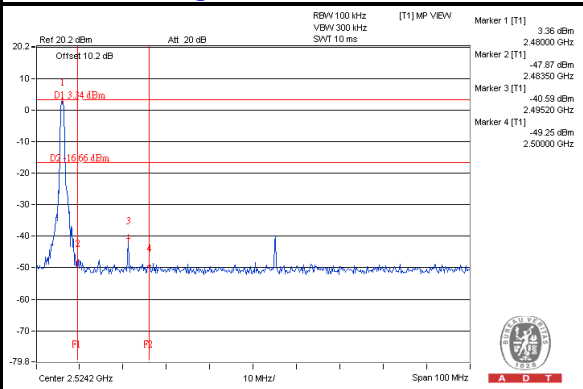
CH 39



CH 0 Band edge



CH 39 Band edge





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5. PHOTOGRAPHS OF THE TEST CONFIGURATION

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





6. 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 accredited and approved 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

Fax: 886-2-26052943

Hsin Chu EMC/RF Lab:

Tel: 886-3-5935343

Fax: 886-3-5935342

Hwa Ya EMC/RF/Safety/Telecom 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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7. APPENDIX A - MODIFICATIONS RECORDERS FOR ENGINEERING CHANGES TO THE EUT BY THE LAB

No modifications were made to the EUT by the lab during the test.

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