

# COLLAGE INVESTMENTS LLC

## Mobile phone

**Main Model: L1-Forst**

**Serial Model: N/A**

**December 05, 2012**

**Report No.: 12050085-FCC-R2**

**(This report supersedes NONE)**



Modifications made to the product : None

This Test Report is Issued Under the Authority of:

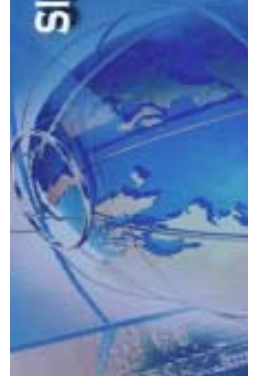
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|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
|  |  |  |
| Eaton Wang<br>Compliance Engineer                                                   | Alex Liu<br>Technical Manager                                                       |                                                                                       |

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Test result presented in this test report is applicable to the representative sample only.

# RF Test Report

To: FCC Part 15.247: 2012, ANSI C63.4: 2009

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| Country/Region | Accreditation Body     | Scope                              |
|----------------|------------------------|------------------------------------|
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| Canada         | IC, A2LA, NIST         | EMC, RF/Wireless , Telecom         |
| Taiwan         | BSMI , NCC , NIST      | EMC, RF, Telecom , Safety          |
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| Mexico         | NOM, COFETEL, Caniety  | Safety, EMC , RF/Wireless, Telecom |
| Europe         | A2LA, NIST             | EMC, RF, Telecom , Safety          |

### Accreditations for Product Certifications

| Country/Region | Accreditation Body | Scope                 |
|----------------|--------------------|-----------------------|
| USA            | FCC TCB, NIST      | EMC , RF , Telecom    |
| Canada         | IC FCB , NIST      | EMC , RF , Telecom    |
| Singapore      | iDA, NIST          | EMC , RF , Telecom    |
| EU             | NB                 | EMC & R&TTE Directive |
| Japan          | MIC, (RCB 208)     | RF , Telecom          |
| Hong Kong      | OFTA (US002)       | RF , Telecom          |

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# 1 EXECUTIVE SUMMARY & EUT INFORMATION

The purpose of this test programme was to demonstrate compliance of the COLLAGE INVESTMENTS LLC, Mobile phone and model: L1-Forst against the current Stipulated Standards. The Mobile phone has demonstrated compliance with the FCC 15.247: 2012, ANSI C63.4: 2009.

## EUT Information

|                                                    |                                                                                                                                                                                                                           |
|----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>EUT</b>                                         |                                                                                                                                                                                                                           |
| <b>Description</b>                                 | : Mobile phone                                                                                                                                                                                                            |
| <b>Main Model</b>                                  | : L1-Forst                                                                                                                                                                                                                |
| <b>Serial Model</b>                                | : N/A                                                                                                                                                                                                                     |
| <b>Antenna Gain</b>                                | : GSM850: -1 dBi<br>PCS1900: 2 dBi<br>Bluetooth: 1 dBi<br>WIFI: 1 dBi                                                                                                                                                     |
| <b>Input Power</b>                                 | : Li-ion Rechargeable Battery<br>Model: SP01<br>Capacity: 1200mAh<br>Nominal Voltage: 3.7V<br>Charging Voltage Limit: 4.2V<br>Adapter<br>Model: A1502-500550<br>Input: AC 100-240V 50/60Hz 0.15A<br>Output: DC 5.0V 550mA |
| <b>Classification Per Stipulated Test Standard</b> | : FCC 15.247: 2012, ANSI C63.4: 2009                                                                                                                                                                                      |

## **2 TECHNICAL DETAILS**

|                                        |                                                                                                                                                                                                               |
|----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>                         | <b>Compliance testing of Mobile phone with stipulated standard</b>                                                                                                                                            |
| <b>Applicant / Client</b>              | <b>COLLAGE INVESTMENTS LLC<br/>11437 NW 34 STREET, DORAL, FLORIDA 33178 U.S.A.</b>                                                                                                                            |
| <b>Manufacturer</b>                    | <b>NINGBO BIRD CO., LTD<br/>No.999 Dacheng East Road,Fenghua City,Zhejiang</b>                                                                                                                                |
| <b>Laboratory performing the tests</b> | <b>SIEMIC Nanjing (China) Laboratories<br/>NO.2-1, Longcang Dadao, Yuhua Economic Development Zone,<br/>Nanjing, China<br/>Tel:+86(25)86730128/86730129<br/>Fax:+86(25)86730127<br/>Email:info@siemic.com</b> |
| <b>Test report reference number</b>    | <b>12050085-FCC-R2</b>                                                                                                                                                                                        |
| <b>Date EUT received</b>               | <b>November 26, 2012</b>                                                                                                                                                                                      |
| <b>Standard applied</b>                | <b>FCC 15.247: 2012, ANSI C63.4: 2009</b>                                                                                                                                                                     |
| <b>Dates of test (from – to)</b>       | <b>November 27, 2012</b>                                                                                                                                                                                      |
| <b>No of Units</b>                     | <b>#1</b>                                                                                                                                                                                                     |
| <b>Equipment Category</b>              | <b>DSS</b>                                                                                                                                                                                                    |
| <b>Trade Name</b>                      | <b>LIKUID</b>                                                                                                                                                                                                 |
| <b>RF OPERATING FREQUENCY (IES)</b>    | <b>GSM850 TX : 824.2 ~ 848.8 MHz; RX :869.2 ~ 893.8 MHz<br/>PCS1900 TX : 1850.2 ~ 1909.8 MHz; RX :1930.2 ~ 1989.8 MHz<br/>Bluetooth: 2402-2480MHz<br/>802.11b/g/n(20M): 2412-2462 MHz</b>                     |
| <b>NUMBER OF CHANNELS</b>              | <b>299CH (PCS1900) and 124CH (GSM850)<br/>Bluetooth: 79 CH<br/>802.11b/g/n(20M): 11 CH</b>                                                                                                                    |
| <b>MODULATION</b>                      | <b>GSM / GPRS: GMSK<br/>Bluetooth: GFSK<br/>802.11b/g/n: DSSS</b>                                                                                                                                             |
| <b>GPRS MULTI-SLOT CLASS</b>           | <b>8/10/12</b>                                                                                                                                                                                                |
| <b>FCC ID</b>                          | <b>GAO-L1F</b>                                                                                                                                                                                                |

### 3 MODIFICATION

**NONE**

## **4 TEST SUMMARY**

The product was tested in accordance with the following specifications.  
 All testing has been performed according to below product classification:

### **Spread Spectrum System/Device**

#### **Test Results Summary**

| Test Standard                   | Description                    | Product Class | Pass / Fail |
|---------------------------------|--------------------------------|---------------|-------------|
| §15.247(i), §2.1093             | RF Exposure                    | See Above     | Pass        |
| §15.203                         | Antenna Requirement            | See Above     | Pass        |
| §15.207(a)                      | AC Line Conducted Emissions    | See Above     | Pass        |
| §15.205, §15.209,<br>§15.247(d) | Radiated Emissions             | See Above     | Pass        |
| §15.247(a)(1)                   | 20 dB Bandwidth                | See Above     | Pass        |
| §15.247(a)(1)                   | Channel Separation             | See Above     | Pass        |
| §15.247(a)(1)(iii)              | Time of Occupancy (Dwell Time) | See Above     | Pass        |
| §15.247(a)(1)(iii)              | Quantity of Hopping Channel    | See Above     | Pass        |
| §15.247(b)(1)                   | Peak Output Power              | See Above     | Pass        |
| §15.247(d)                      | Band Edge                      | See Above     | Pass        |

## **5 MEASUREMENTS, EXAMINATION AND DERIVED RESULTS**

### **5.1 §15.247 (i) and §2.1093 – RF Exposure**

#### **Standard Requirement:**

According to §15.247 (i) and §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

**Table 2 – Summary of SAR Evaluation Requirements for a Cell Phone with Multiple Transmitters**

|                                | Individual Transmitter                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Simultaneous Transmission                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|--------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Licensed Transmitters</b>   | <u>Routine evaluation required</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>SAR not required:</b><br><u>Unlicensed only</u><br><ul style="list-style-type: none"> <li>when stand-alone 1-g SAR is not required and antenna is <math>\geq 5</math> cm from other antennas</li> </ul> <u>Licensed &amp; Unlicensed</u><br><ul style="list-style-type: none"> <li>when the sum of the 1-g SAR is <math>&lt; 1.6</math> W/kg for all simultaneous transmitting antennas</li> <li>when SAR to peak location separation ratio of simultaneous transmitting antenna pair is <math>&lt; 0.3</math></li> </ul> <b>SAR required:</b><br><u>Licensed &amp; Unlicensed</u><br>antenna pairs with SAR to peak location separation ratio $\geq 0.3$ ; test is only required for the configuration that results in the highest SAR in stand-alone configuration for each wireless mode and exposure condition<br><b>Note: simultaneous transmission exposure conditions for head and body can be different for different style phones; therefore, different test requirements may apply</b> |
| <b>Unlicensed Transmitters</b> | <p><u>When there is no simultaneous transmission –</u></p> <ul style="list-style-type: none"> <li>output <math>\leq 60</math> f: SAR not required</li> <li>output <math>&gt; 60</math> f: stand-alone SAR required</li> </ul> <p><u>When there is simultaneous transmission –</u></p> <p><u>Stand-alone SAR not required when</u></p> <ul style="list-style-type: none"> <li>output <math>\leq 2 \cdot P_{Ref}</math> and antenna is <math>\geq 5.0</math> cm from other antennas</li> <li>output <math>\leq P_{Ref}</math> and antenna is <math>\geq 2.5</math> cm from other antennas</li> <li>output <math>\leq P_{Ref}</math> and antenna is <math>&lt; 2.5</math> cm from other antennas, each with either output power <math>\leq P_{Ref}</math> or 1-g SAR <math>&lt; 1.2</math> W/kg</li> </ul> <p><u>Otherwise stand-alone SAR is required</u></p> <p><u>When stand-alone SAR is required</u></p> <ul style="list-style-type: none"> <li>test SAR on highest output channel for each wireless mode and exposure condition</li> <li>if SAR for highest output channel is <math>&gt; 50\%</math> of SAR limit, evaluate all channels according to normal procedures</li> </ul> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Jaw, Mouth and Nose</b>     | <p><u>Flat phantom SAR required</u></p> <ul style="list-style-type: none"> <li>when measurement is required in tight regions of SAM and it is not feasible or the results can be questionable due to probe tilt, calibration, positioning and orientation issues</li> <li>position rectangular and clam-shell phones according to flat phantom procedures and conduct SAR measurements for these specific locations</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | When simultaneous transmission SAR testing is required, contact the FCC Laboratory for interim guidance.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

Routine SAR evaluation refers to that specifically required by § 2.1093, using measurements or computer simulation. When routine SAR evaluation is not required, portable transmitters with output power greater than the applicable low threshold require SAR evaluation to qualify for TCB approval.

Three antennas are available for the EUT, (GSM antenna, Bluetooth antenna WIFI antenna).

Bluetooth and GSM Antenna separation is  $7.8\text{ cm} > 5\text{ cm}$ , Bluetooth and WIFI Antenna separation is  $0\text{ cm} < 5\text{ cm}$ , GSM and WIFI Antenna separation is  $7.8 > 5\text{ cm}$  and the maximum output power of Bluetooth is  $7.18\text{ mW} < 2\text{ Pref}(24\text{ mW})$ , maximum average output power for WiFi is  $13.43\text{ mW} < 2 * \text{Pref}(24\text{ mW})$  and maximum 1-g SAR value is  $1.142\text{ W/kg} < 1.2\text{ W/kg}$

According to KDB 648474, no stand-alone required for Bluetooth & WiFi antenna, so no simultaneous SAR measurement is required too

**Test Result: Pass**

The SAR measurement is exempt.

## **5.2 §15.203 – Antenna Requirement**

### **Standard Requirement:**

According to § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the user of a standard antenna jack or electrical connector is prohibited. The structure and application of the EUT were analyzed to determine compliance with section §15.203 of the rules. §15.203 state that the subject device must meet the following criteria:

- a. Antenna must be permanently attached to the unit.
- b. Antenna must use a unique type of connector to attach to the EUT.
- c. Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.

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

### **Antenna Connector Construction**

The EUT has 2 antennas: . a monopole antenna for Bluetooth, the gain is 1 dBi;  
a monopole antenna for WIFI, the gain is 1 dBi  
.a PIFA antenna for GSM, the gain are -1 dBi for GSM, 2 dBi for PCS  
which in accordance to section 15.203, please refer to the internal photos.

**Test Result: Pass**

### **5.3 §15.207 (a) – AC Line Conducted Emissions**

#### **Standard Requirement:**

| Frequency of emission (MHz) | Conducted limit (dBμV) |           |
|-----------------------------|------------------------|-----------|
|                             | Quasi-peak             | Average   |
| 0.15–0.5                    | 66 to 56*              | 56 to 46* |
| 0.5–5                       | 56                     | 46        |
| 5–30                        | 60                     | 50        |

\*Decreases with the logarithm of the frequency.

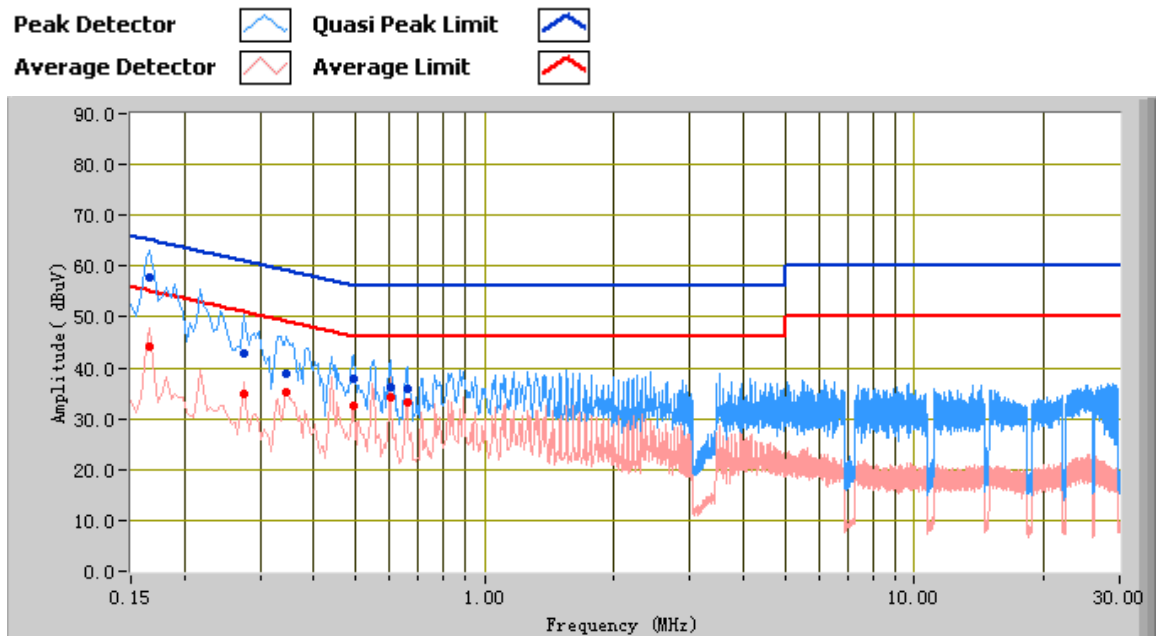
#### **Procedures:**

1. All possible modes of operation were investigated. Only the 6 worst case emissions measured, using the correct CISPR and Average detectors, are reported. All other emissions were relatively insignificant.
2. A "-ve" margin indicates a PASS as it refers to the margin present below the limit line at the particular frequency.
3. Conducted Emissions Measurement Uncertainty  
All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95% (in the case where distributions are normal), with a coverage factor of 2, in the range 9kHz – 30MHz (Average & Quasi-peak) is ±3.5dB.
4. Environmental Conditions
 

|                      |          |
|----------------------|----------|
| Temperature          | 22°C     |
| Relative Humidity    | 50%      |
| Atmospheric Pressure | 1019mbar |
5. Test date : November 27, 2012  
Tested By : Eaton Wang

**Test Result: Pass**

|                   |                                         |
|-------------------|-----------------------------------------|
| <b>Test Mode:</b> | <b>Charging &amp; GFSK Transmitting</b> |
|-------------------|-----------------------------------------|

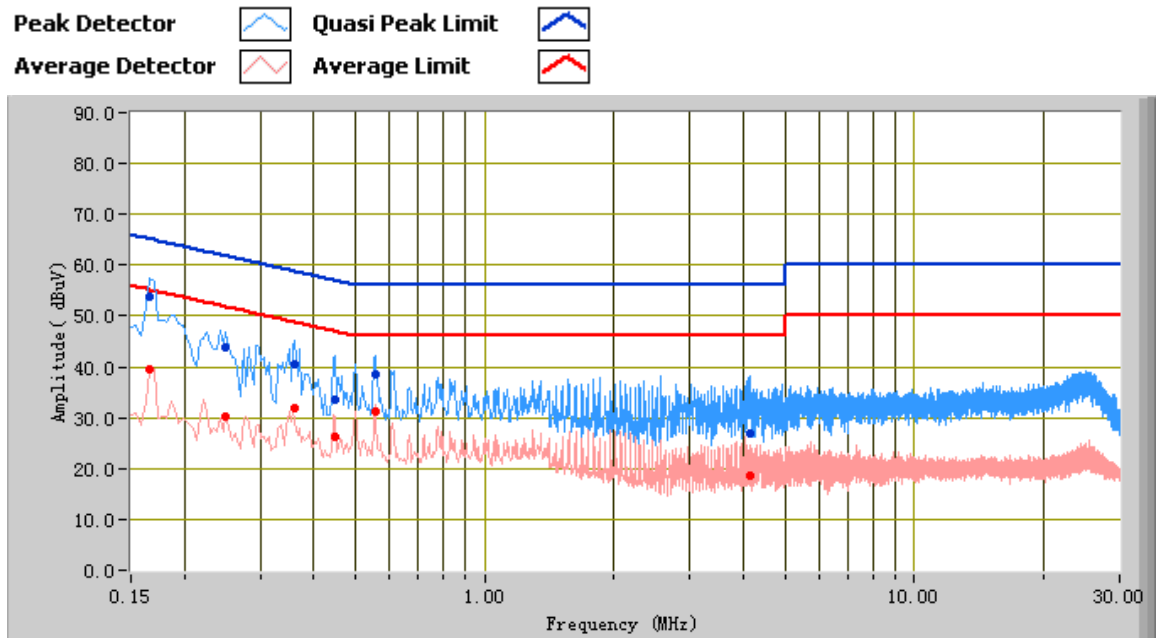


### Test Data

**Phase Line Plot at 120Vac, 60Hz**

| Frequency<br>(MHz) | Quasi<br>Peak<br>(dBμV) | Limit<br>(dBμV) | Margin<br>(dB) | Average<br>(dBμV) | Limit<br>(dBμV) | Margin<br>(dB) | Factors<br>(dB) |
|--------------------|-------------------------|-----------------|----------------|-------------------|-----------------|----------------|-----------------|
| 0.17               | 57.83                   | 65.16           | -7.33          | 44.02             | 55.16           | -11.14         | 11.99           |
| 0.27               | 42.76                   | 61.00           | -18.24         | 34.88             | 51.00           | -16.12         | 11.42           |
| 0.35               | 39.00                   | 59.06           | -20.05         | 35.31             | 49.06           | -13.75         | 11.31           |
| 0.49               | 37.73                   | 56.10           | -18.37         | 32.69             | 46.10           | -13.41         | 11.10           |
| 0.60               | 36.16                   | 56.00           | -19.84         | 34.26             | 46.00           | -11.74         | 11.01           |
| 0.66               | 35.98                   | 56.00           | -20.02         | 33.16             | 46.00           | -12.84         | 10.96           |

|            |                              |
|------------|------------------------------|
| Test Mode: | Charging & GFSK Transmitting |
|------------|------------------------------|



### Test Data

Phase Neutral Plot at 120Vac, 60Hz

| Frequency (MHz) | Quasi Peak (dBμV) | Limit (dBμV) | Margin (dB) | Average (dBμV) | Limit (dBμV) | Margin (dB) | Factors (dB) |
|-----------------|-------------------|--------------|-------------|----------------|--------------|-------------|--------------|
| 0.17            | 53.86             | 65.16        | -11.29      | 39.42          | 55.16        | -15.74      | 11.99        |
| 0.36            | 40.40             | 58.68        | -18.28      | 31.85          | 48.68        | -16.83      | 11.28        |
| 0.55            | 38.63             | 56.00        | -17.37      | 31.22          | 46.00        | -14.78      | 11.02        |
| 0.45            | 33.47             | 56.95        | -23.48      | 26.07          | 46.95        | -20.88      | 11.14        |
| 0.25            | 43.70             | 61.76        | -18.06      | 30.22          | 51.76        | -21.53      | 11.46        |
| 4.14            | 26.75             | 56.00        | -29.25      | 18.55          | 46.00        | -27.45      | 10.94        |

## **5.4 §15.209, §15.205 & §15.247(d) - Spurious Emissions**

1. All possible modes of operation were investigated. Only the 6 worst case emissions measured, using the correct CISPR detectors, are reported. All other emissions were relatively insignificant.
2. A "-ve" margin indicates a PASS as it refers to the margin present below the limit line at the particular frequency.
3. Radiated Emissions Measurement Uncertainty  
All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95% (in the case where distributions are normal), with a coverage factor of 2, in the range 30MHz – 1GHz ( 3m & 10m ) & 1GHz above ( 3m ) is +5.6/-4.5dB.
4. Environmental Conditions

|                      |          |
|----------------------|----------|
| Temperature          | 22°C     |
| Relative Humidity    | 50%      |
| Atmospheric Pressure | 1019mbar |
5. Test date : November 27, 2012  
Tested By : Eaton Wang

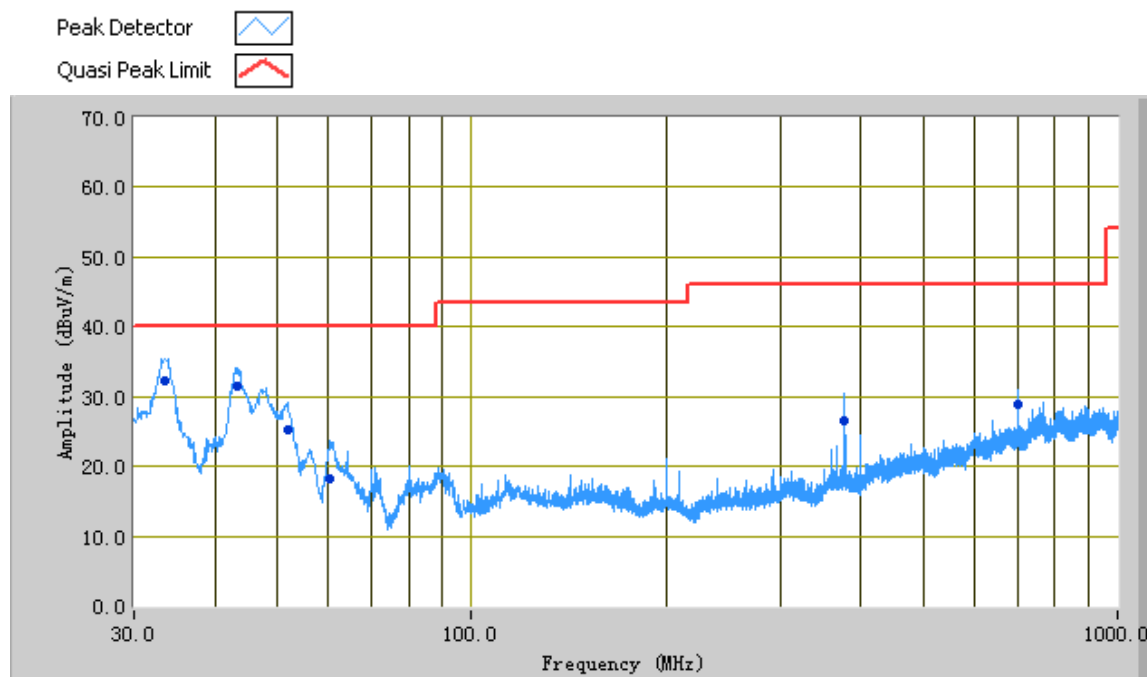
### **Standard Requirement:**

The emissions from the Low-power radio-frequency devices shall not exceed the field strength levels specified in the following table and the level of any unwanted emissions shall not exceed the level of the fundamental emission. The tighter limit applies at the band edges.

### **Test Result: Pass**

|                   |                                         |
|-------------------|-----------------------------------------|
| <b>Test Mode:</b> | <b>Charging &amp; GFSK Transmitting</b> |
|-------------------|-----------------------------------------|

***Below 1GHz***



***Test Data***

**Horizontal & Vertical Polarity Plot @3m**

| Frequency (MHz) | Peak (dBμV/m) | Azimuth | Polarity (H/V) | Height (cm) | Factors (dB) | Limit (dBμV/m) | Margin (dB) |
|-----------------|---------------|---------|----------------|-------------|--------------|----------------|-------------|
| 33.39           | 32.35         | 237.00  | V              | 125.00      | -22.66       | 40.00          | -7.65       |
| 43.15           | 31.56         | 360.00  | V              | 131.00      | -30.25       | 40.00          | -8.44       |
| 51.94           | 25.20         | 360.00  | V              | 117.00      | -35.78       | 40.00          | -14.80      |
| 700.03          | 28.82         | 338.00  | H              | 180.00      | -21.21       | 46.00          | -17.18      |
| 378.07          | 26.56         | 6.00    | V              | 124.00      | -30.74       | 46.00          | -19.44      |
| 60.60           | 18.26         | 206.00  | V              | 129.00      | -38.06       | 40.00          | -21.74      |

|                   |                                         |
|-------------------|-----------------------------------------|
| <b>Test Mode:</b> | <b>Charging &amp; GFSK Transmitting</b> |
|-------------------|-----------------------------------------|

### Above 1 GHz

**Note: Other Bluetooth modes were verified; only the result of worst case DH5 mode was presented.**

#### Low Channel (2402 MHz)

| Frequency (MHz) | S.A. Reading (dBμV) | Detector (PK/AV) | Direction (degree) | Height (cm) | Polarity (H/V) | Ant. Factor (dB/m) | Cable Loss (dB) | Pre-Amp. Gain (dB) | Cord. Amp. (dBμV/m) | Limit (dBμV/m) | Margin (dB) |
|-----------------|---------------------|------------------|--------------------|-------------|----------------|--------------------|-----------------|--------------------|---------------------|----------------|-------------|
| 4804            | 48.15               | AV               | 123                | 212         | V              | 32.7               | 8.17            | 55                 | 34.02               | 54             | -19.98      |
| 4804            | 47.42               | AV               | 251                | 151         | H              | 32.7               | 8.17            | 55                 | 33.29               | 54             | -20.71      |
| 4804            | 70.77               | PK               | 123                | 212         | V              | 32.7               | 8.17            | 55                 | 56.64               | 74             | -17.36      |
| 4804            | 71.44               | PK               | 251                | 151         | H              | 32.7               | 8.17            | 55                 | 57.31               | 74             | -16.69      |
| 7206            | 46.03               | AV               | 232                | 115         | V              | 35.5               | 9.84            | 55                 | 36.37               | 54             | -17.63      |
| 7206            | 46.12               | AV               | 121                | 154         | H              | 35.5               | 9.84            | 55                 | 36.46               | 54             | -17.54      |
| 7206            | 69.13               | PK               | 232                | 115         | V              | 35.5               | 9.84            | 55                 | 59.47               | 74             | -14.53      |
| 7206            | 68.13               | PK               | 121                | 154         | H              | 35.5               | 9.84            | 55                 | 58.47               | 74             | -15.53      |

#### Middle Channel (2441 MHz)

| Frequency (MHz) | S.A. Reading (dBμV) | Detector (PK/AV) | Direction (degree) | Height (cm) | Polarity (H/V) | Ant. Factor (dB/m) | Cable Loss (dB) | Pre-Amp. Gain (dB) | Cord. Amp. (dBμV/m) | Limit (dBμV/m) | Margin (dB) |
|-----------------|---------------------|------------------|--------------------|-------------|----------------|--------------------|-----------------|--------------------|---------------------|----------------|-------------|
| 4882            | 53.11               | AV               | 175                | 150         | V              | 32.8               | 9               | 55                 | 39.91               | 54             | -14.09      |
| 4882            | 51.06               | AV               | 197                | 104         | H              | 32.8               | 9               | 55                 | 37.86               | 54             | -16.14      |
| 4882            | 73.94               | PK               | 175                | 150         | V              | 32.8               | 9               | 55                 | 60.74               | 74             | -13.26      |
| 4882            | 72.48               | PK               | 197                | 104         | H              | 32.8               | 9               | 55                 | 59.28               | 74             | -14.72      |
| 1593            | 58.24               | AV               | 89                 | 187         | V              | 27.4               | 1.82            | 55                 | 32.46               | 54             | -21.54      |
| 1593            | 59.81               | AV               | 255                | 116         | H              | 27.4               | 1.82            | 55                 | 34.03               | 54             | -19.97      |
| 1593            | 81.13               | PK               | 89                 | 187         | V              | 27.4               | 1.82            | 55                 | 55.35               | 74             | -18.65      |
| 1593            | 81.88               | PK               | 255                | 116         | H              | 27.4               | 1.82            | 55                 | 56.10               | 74             | -17.90      |

#### High Channel (2480 MHz)

| Frequency (MHz) | S.A. Reading (dBμV) | Detector (PK/AV) | Direction (degree) | Height (cm) | Polarity (H/V) | Ant. Factor (dB/m) | Cable Loss (dB) | Pre-Amp. Gain (dB) | Cord. Amp. (dBμV/m) | Limit (dBμV/m) | Margin (dB) |
|-----------------|---------------------|------------------|--------------------|-------------|----------------|--------------------|-----------------|--------------------|---------------------|----------------|-------------|
| 4960            | 42.20               | AV               | 233                | 136         | V              | 32.9               | 8.17            | 55                 | 28.27               | 54             | -25.73      |
| 4960            | 42.73               | AV               | 211                | 264         | H              | 32.9               | 8.17            | 55                 | 28.80               | 54             | -25.20      |
| 4960            | 69.38               | PK               | 233                | 136         | V              | 32.9               | 8.17            | 55                 | 55.45               | 74             | -18.55      |
| 4960            | 70.87               | PK               | 211                | 264         | H              | 32.9               | 8.17            | 55                 | 56.94               | 74             | -17.06      |
| 7440            | 41.26               | AV               | 232                | 115         | V              | 35.9               | 10.04           | 55                 | 32.20               | 54             | -21.80      |
| 7440            | 41.09               | AV               | 121                | 154         | H              | 35.9               | 10.04           | 55                 | 32.03               | 54             | -21.97      |
| 7440            | 67.47               | PK               | 232                | 115         | V              | 35.9               | 10.04           | 55                 | 58.41               | 74             | -15.59      |
| 7440            | 65.42               | PK               | 121                | 154         | H              | 35.9               | 10.04           | 55                 | 56.36               | 74             | -17.64      |

## **5.5 §15.247(a) (1)-Channel Separation**

1. Conducted Measurement  
EUT was set for low, mid, high channel with modulated mode and highest RF output power.  
The spectrum analyzer was connected to the antenna terminal.
2. Environmental Conditions

|                      |          |
|----------------------|----------|
| Temperature          | 22°C     |
| Relative Humidity    | 50%      |
| Atmospheric Pressure | 1019mbar |
3. Conducted Emissions Measurement Uncertainty  
All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95% (in the case where distributions are normal), with a coverage factor of 2, in the range 30MHz – 40GHz is ±1.5dB.
4. Test date : November 27, 2012  
Tested By : Eaton Wang

### **Standard Requirement:**

According to §15.247(a)(1), Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or two-thirds of the 20dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

### **Procedures:**

1. Place the EUT on the table and set it in hopping function transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set center frequency of spectrum analyzer = middle of hopping channel.
4. Set the spectrum analyzer as Resolution (or IF) Bandwidth (RBW) ≥ 1% of the span, Video (or Average) Bandwidth (VBW) ≥ RBW, Sweep = auto, Detector function = peak, Trace = max hold.
5. Max hold, mark 2 peaks of hopping channel and record the 2 peaks frequency.

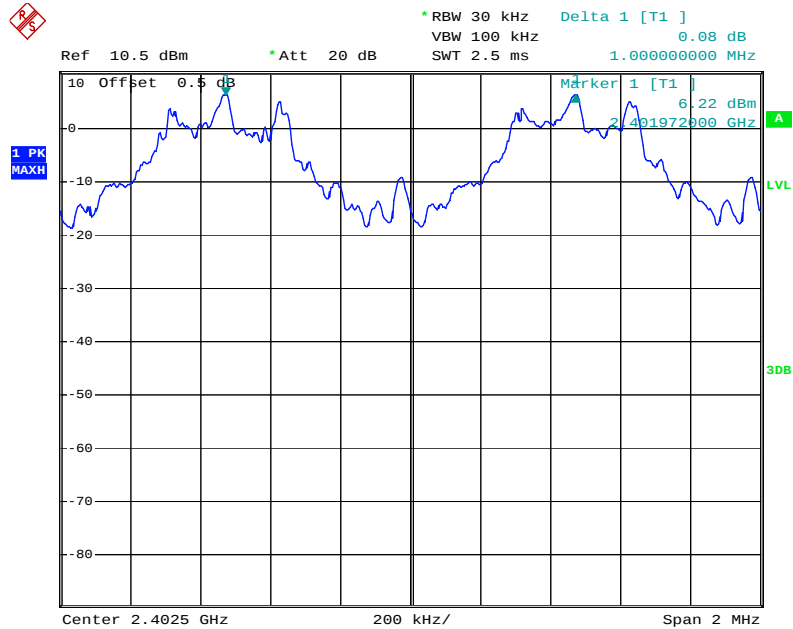
**Test Result: Pass**

|                   |                          |
|-------------------|--------------------------|
| <b>Test Mode:</b> | <b>GFSK Transmitting</b> |
|-------------------|--------------------------|

| Channel           | Channel Frequency (MHz) | Channel Separation (MHz) | Limit (MHz) | Result |
|-------------------|-------------------------|--------------------------|-------------|--------|
| Low Channel       | 2402                    | 1.000                    | 0.696       | Pass   |
| Adjacency Channel | 2403                    |                          |             |        |
| Mid Channel       | 2440                    | 1.004                    | 0.696       | Pass   |
| Adjacency Channel | 2441                    |                          |             |        |
| High Channel      | 2480                    | 1.004                    | 0.696       | Pass   |
| Adjacency Channel | 2479                    |                          |             |        |

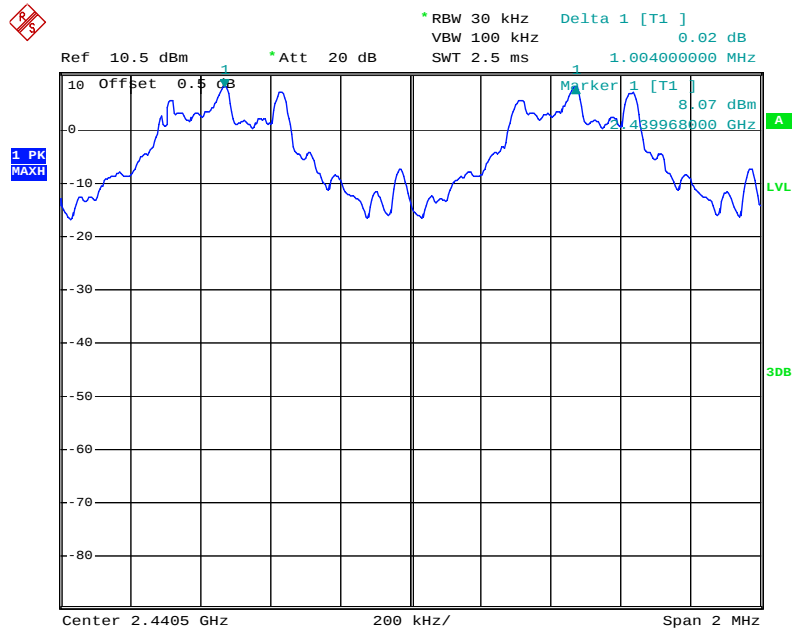
Please refer to the following plots.

### Low Channel

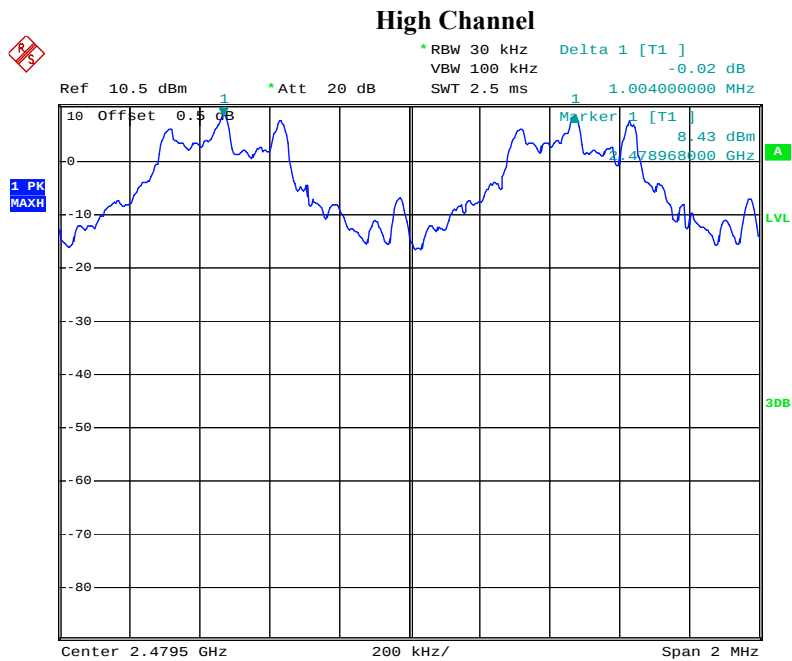


Date: 27.NOV.2012 23:08:31

### Middle Channel



Date: 27.NOV.2012 23:10:54



Date: 27.NOV.2012 23:12:42

## **§15.247(a) (1) – 20dB Bandwidth**

1. Conducted Measurement  
EUT was set for low, mid, high channel with modulated mode and highest RF output power.  
The spectrum analyzer was connected to the antenna terminal.
2. Environmental Conditions
 

|                      |          |
|----------------------|----------|
| Temperature          | 22°C     |
| Relative Humidity    | 50%      |
| Atmospheric Pressure | 1019mbar |
3. Conducted Emissions Measurement Uncertainty  
All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95% (in the case where distributions are normal), with a coverage factor of 2, in the range 30MHz – 40GHz is  $\pm 1.5\text{dB}$ .
4. Test date : November 27, 2012  
Tested By : Eaton Wang

### **Standard Requirement:**

According to §15.247(a)(1), Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

### **Procedures:**

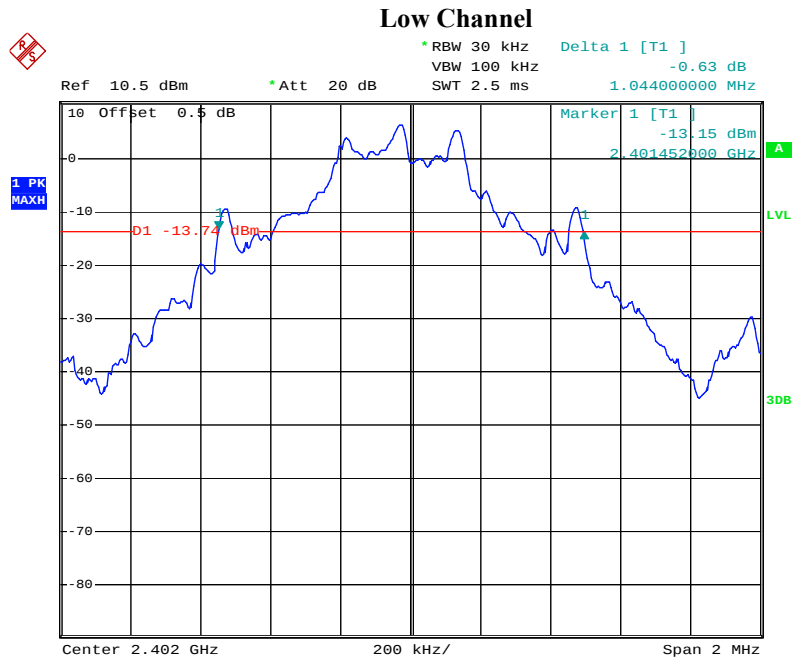
1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set the spectrum analyzer as Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel, RBW  $\geq 1\%$  of the 20 dB bandwidth, VBW  $\geq$  RBW, Sweep = auto, Detector function = peak, Trace = max hold.
4. Set the measured low, middle and high frequency and test 20dB bandwidth with spectrum analyzer.

### **Test Result: Pass**

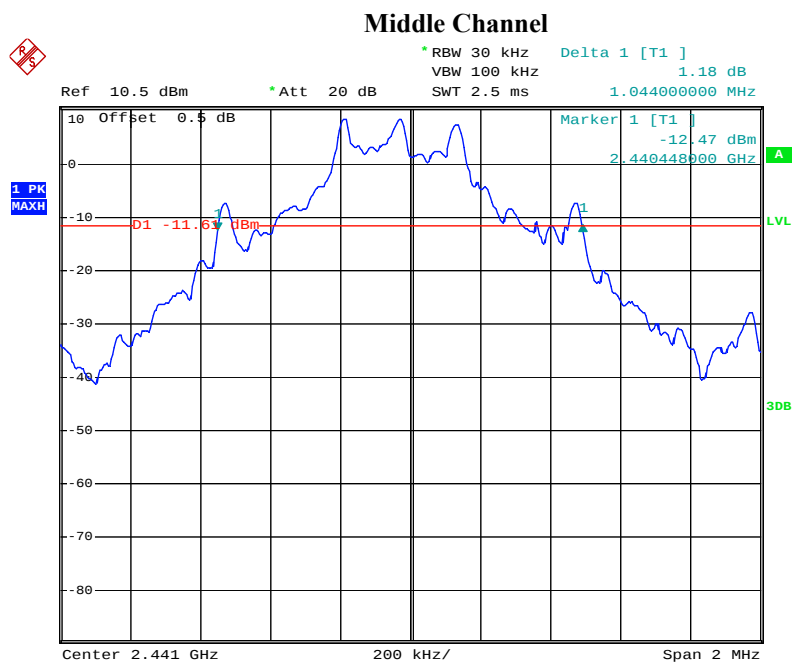
|                   |                          |
|-------------------|--------------------------|
| <b>Test Mode:</b> | <b>GFSK Transmitting</b> |
|-------------------|--------------------------|

| Channel | Frequency (MHz) | 20 dB Bandwidth (MHz) |
|---------|-----------------|-----------------------|
| Low     | 2402            | 1.044                 |
| Middle  | 2441            | 1.044                 |
| High    | 2480            | 1.044                 |

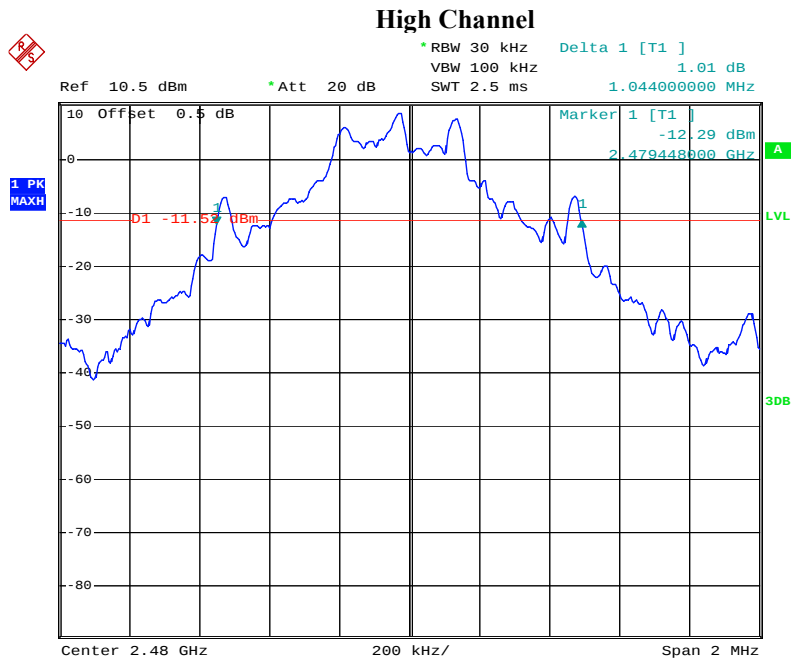
Please refer to the following plots.



Date: 27.NOV.2012 23:01:36



Date: 27.NOV.2012 22:59:26



Date: 27.NOV.2012 23:03:00

## **5.6 §15.247(a) (1) (iii)-Number of Hopping Channels**

1. Conducted Measurement  
EUT was set for low, mid, high channel with modulated mode and highest RF output power.  
The spectrum analyzer was connected to the antenna terminal.
2. Conducted Emissions Measurement Uncertainty  
All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95% (in the case where distributions are normal), with a coverage factor of 2, in the range 30MHz – 40GHz is  $\pm 1.5\text{dB}$ .
3. Environmental Conditions

|                      |          |
|----------------------|----------|
| Temperature          | 22°C     |
| Relative Humidity    | 50%      |
| Atmospheric Pressure | 1019mbar |
4. Test date : November 27, 2012  
Tested By : Eaton Wang

### **Standard Requirement:**

According to §15.247(a)(1)(iii), Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels.

### **Procedures:**

1. Place the EUT on the table and set it in hopping function transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set the spectrum analyzer as Start=2400MHz, Stop = 2483.5MHz, Span = the frequency band of operation, RBW  $\geq 1\%$  of the span, VBW  $\geq$  RBW, Sweep = auto, Detector function = peak, Trace = max hold.
4. Count the quantity of peaks to get the number of hopping channels.

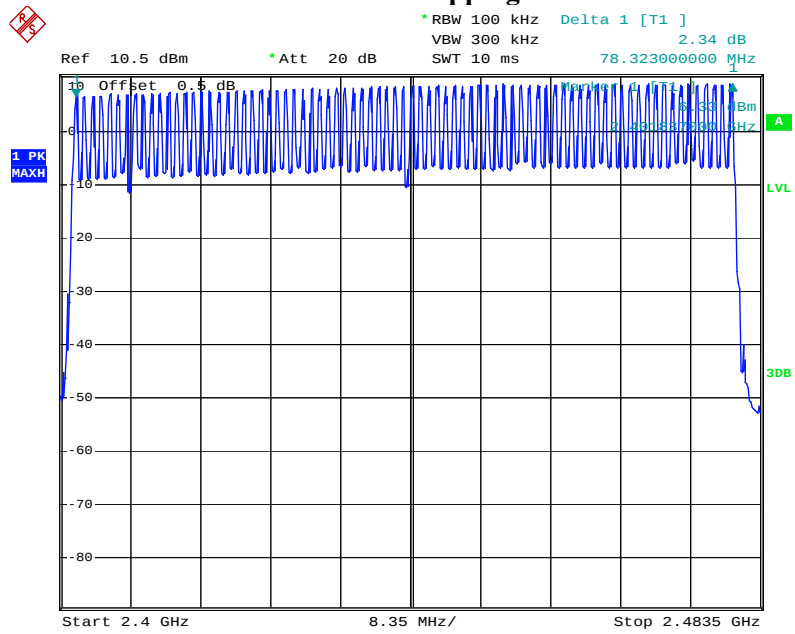
### **Test Result: Pass**

|                   |                                          |
|-------------------|------------------------------------------|
| <b>Test Mode:</b> | <b>Hopping Mode With GFSK Modulation</b> |
|-------------------|------------------------------------------|

| Frequency Range<br>(MHz) | Number of<br>Hopping Channels | Limit     |
|--------------------------|-------------------------------|-----------|
| 2400-2483.5              | 79                            | $\geq 15$ |

**Please refer to following tables and plots**

Number of Hopping Channels



Date: 27.NOV.2012    22:51:25

## **5.7 §15.247(a) (1) (iii) -Time of Occupancy (Dwell Time)**

1. Conducted Measurement  
EUT was set for low, mid, high channel with modulated mode and highest RF output power.  
The spectrum analyzer was connected to the antenna terminal.
2. Conducted Emissions Measurement Uncertainty  
All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95% (in the case where distributions are normal), with a coverage factor of 2, in the range 30MHz – 40GHz is  $\pm 1.5\text{dB}$ .
3. Environmental Conditions

|                      |          |
|----------------------|----------|
| Temperature          | 22°C     |
| Relative Humidity    | 50%      |
| Atmospheric Pressure | 1019mbar |
4. Test date : November 27, 2012  
Tested By : Eaton Wang

### **Standard Requirement:**

According to §15.247(a)(1)(iii), The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

### **Procedures:**

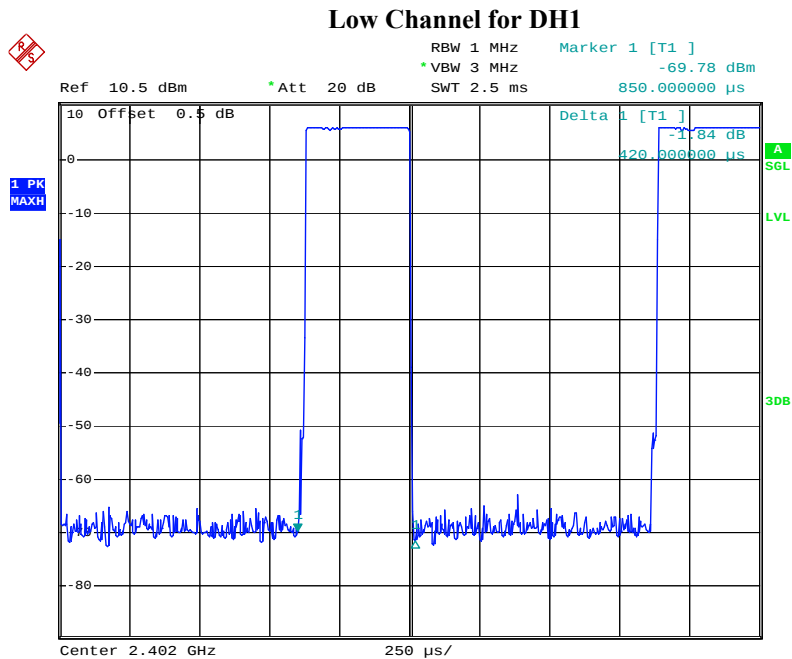
1. Place the EUT on the table and set it in transmitting mode and switch on frequency hopping function.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set the spectrum analyzer as Span = zero span, centered on a hopping channel,  
RBW=1MHz, VBW  $\geq$  RBW, Sweep = as necessary to capture the entire dwell time per hopping channel, Detector function = peak, Trace = max hold.
4. Calculate the time of occupancy in a period with time occupancy of a burst and quantity of bursts.

**Test Result: Pass**

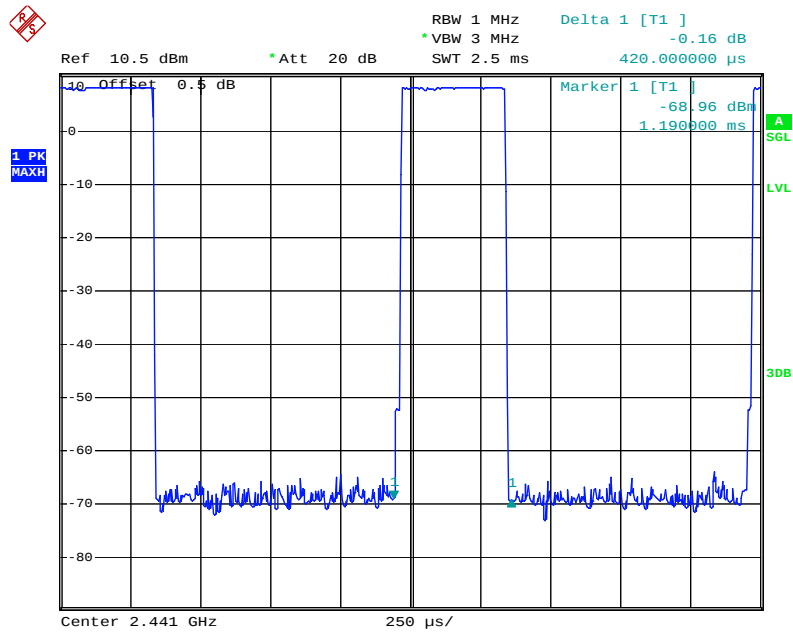
|            |                                   |
|------------|-----------------------------------|
| Test Mode: | Hopping Mode With GFSK Modulation |
|------------|-----------------------------------|

| Mode | Channel                                                                | Pulse Width (ms) | Dwell Time (s) | Limit (s) | Result |
|------|------------------------------------------------------------------------|------------------|----------------|-----------|--------|
| DH 1 | Low                                                                    | 0.420            | 0.13440        | 0.4       | Pass   |
|      | Middle                                                                 | 0.420            | 0.13440        | 0.4       | Pass   |
|      | High                                                                   | 0.420            | 0.13440        | 0.4       | Pass   |
|      | <i>Note:</i> Dwell time=Pulse time (ms) × (1600 ÷ 2 ÷ 79) ×31.6 Second |                  |                |           |        |
| DH 3 | Low                                                                    | 1.690            | 0.27040        | 0.4       | Pass   |
|      | Middle                                                                 | 1.690            | 0.27040        | 0.4       | Pass   |
|      | High                                                                   | 1.690            | 0.27040        | 0.4       | Pass   |
|      | <i>Note:</i> Dwell time=Pulse time (ms) × (1600 ÷ 4 ÷ 79) ×31.6 Second |                  |                |           |        |
| DH 5 | Low                                                                    | 2.960            | 0.31573        | 0.4       | Pass   |
|      | Middle                                                                 | 2.960            | 0.31573        | 0.4       | Pass   |
|      | High                                                                   | 2.960            | 0.31573        | 0.4       | Pass   |
|      | <i>Note:</i> Dwell time=Pulse Time (ms) × (1600 ÷ 6 ÷ 79) ×31.6 Second |                  |                |           |        |

Please refer to the following plots.

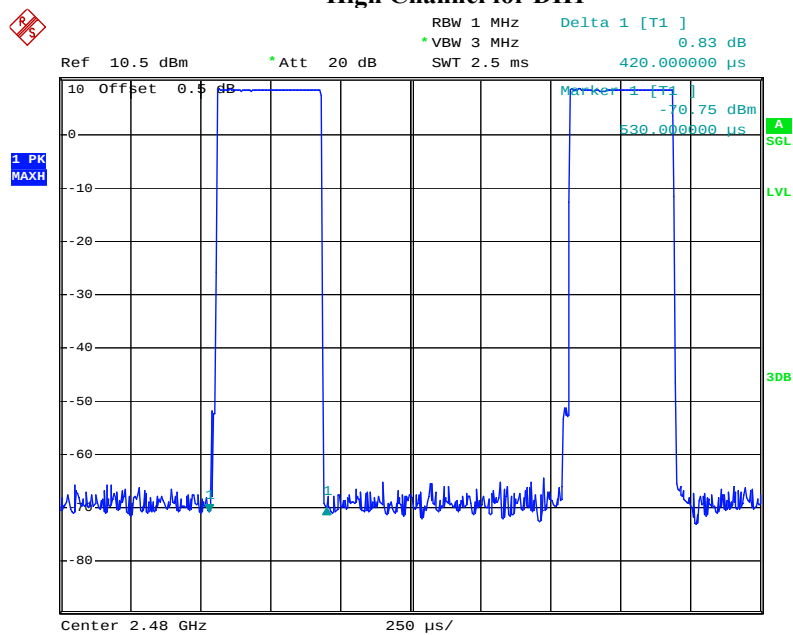


Middle Channel for DH1



Date: 27.NOV.2012 23:26:41

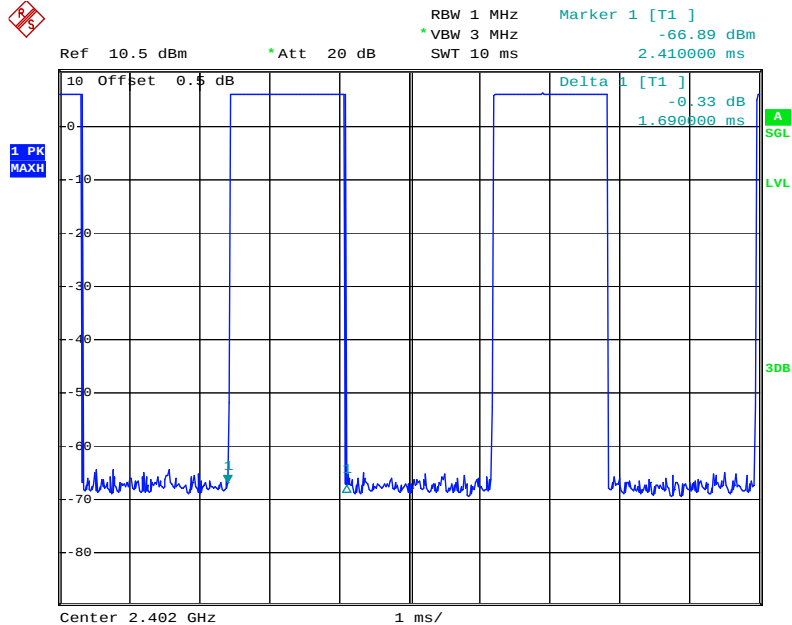
High Channel for DH1



Date: 27.NOV.2012 23:27:29



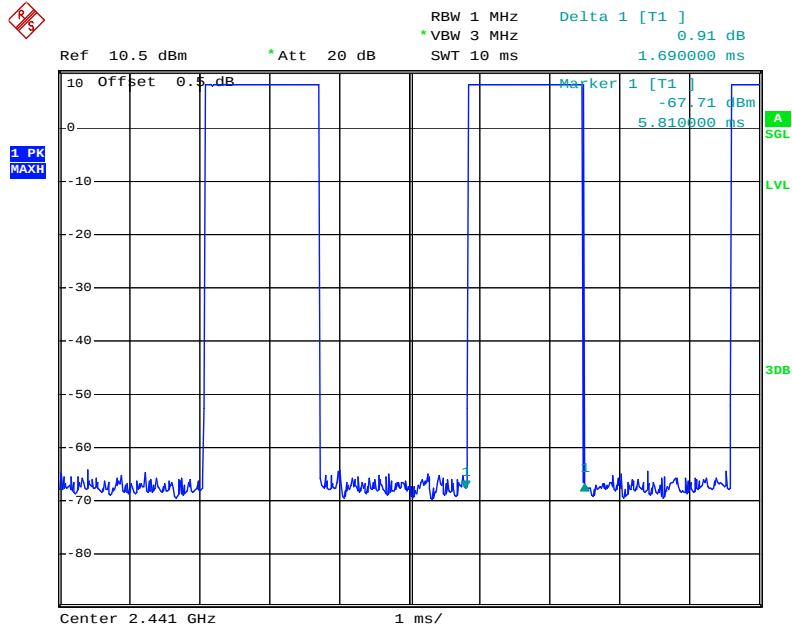
### Low Channel for DH3



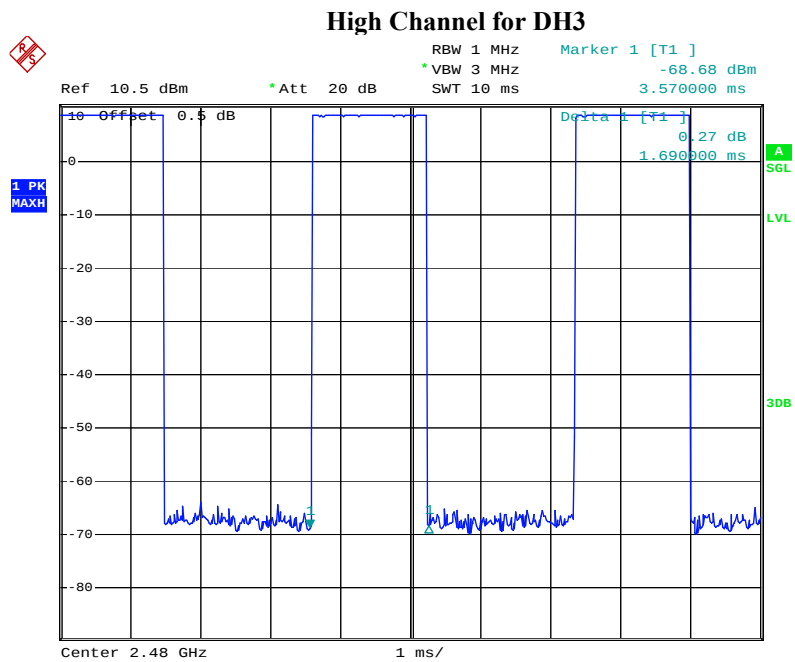
Date: 27.NOV.2012 23:22:00



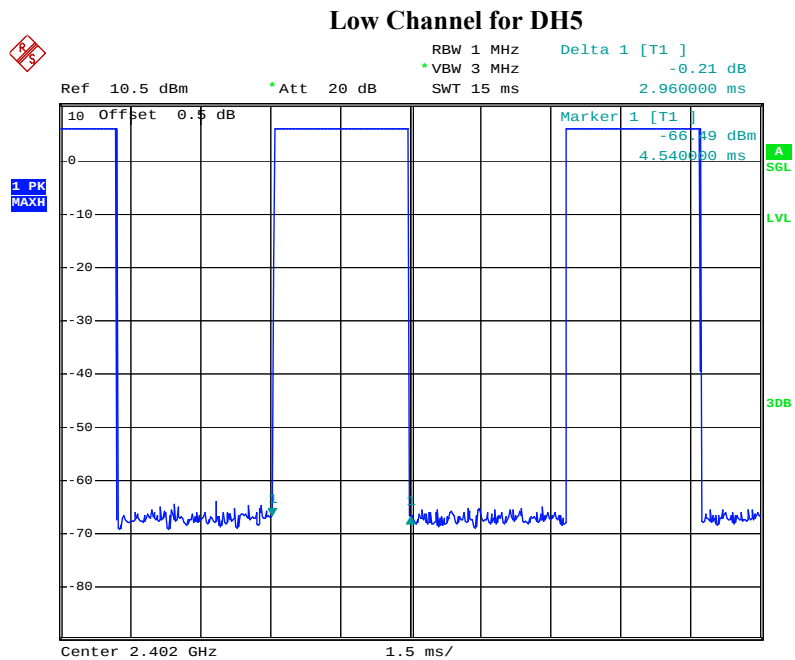
### Middle Channel for DH3



Date: 27.NOV.2012 23:21:18

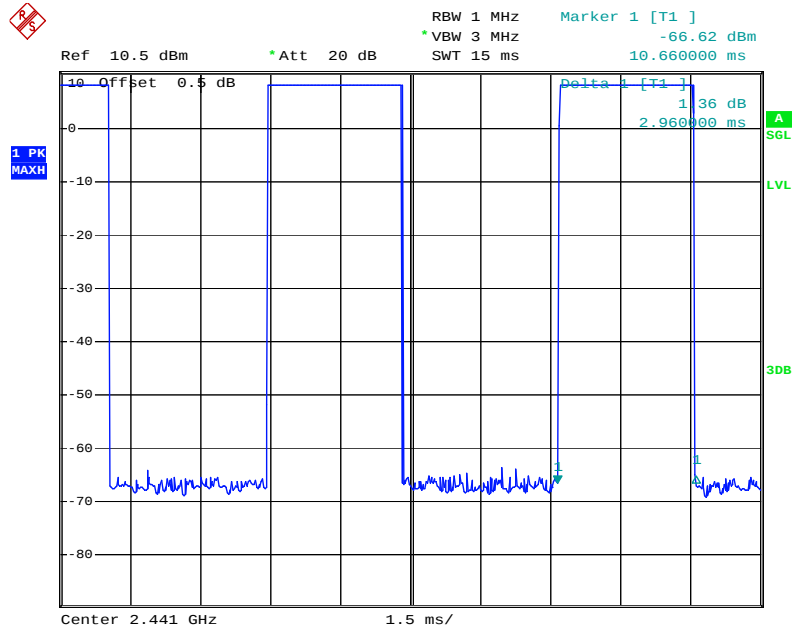


Date: 27.NOV.2012 23:20:38



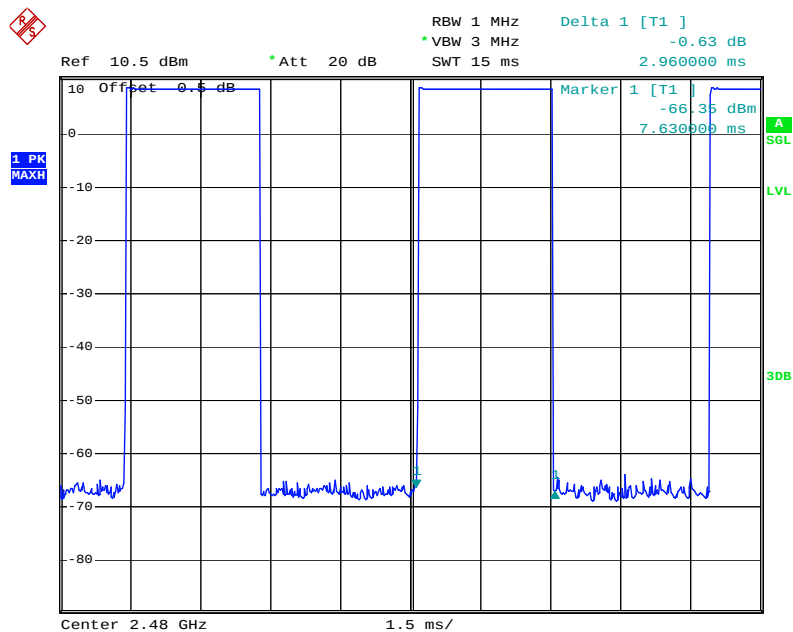
Date: 27.NOV.2012 23:18:00

### Middle Channel for DH5



Date: 27.NOV.2012 23:19:14

### High Channel for DH5



Date: 27.NOV.2012 23:19:53

## **5.8 §15.247(b) (1) - Peak Output Power**

1. Conducted Measurement  
EUT was set for low, mid, high channel with modulated mode and highest RF output power.  
The spectrum analyzer was connected to the antenna terminal.
2. Conducted Emissions Measurement Uncertainty  
All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95% (in the case where distributions are normal), with a coverage factor of 2, in the range 30MHz – 40GHz is  $\pm 1.5\text{dB}$ .
3. Environmental Conditions

|                      |          |
|----------------------|----------|
| Temperature          | 22°C     |
| Relative Humidity    | 50%      |
| Atmospheric Pressure | 1019mbar |
4. Test date : November 27, 2012  
Tested By : Eaton Wang

### **Standard Requirement:**

According to §15.247(b)(2), For frequency hopping systems in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5MHz band: 0.125watts.

### **Procedures:**

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set the spectrum analyzer as Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel, RBW > the 20 dB bandwidth of the emission being measured, VBW  $\geq$  RBW, Sweep=auto, Detector function=peak, Trace = max hold.
4. Then set the EUT to transmit at low, middle and high channel and measure the conducted output power separately.

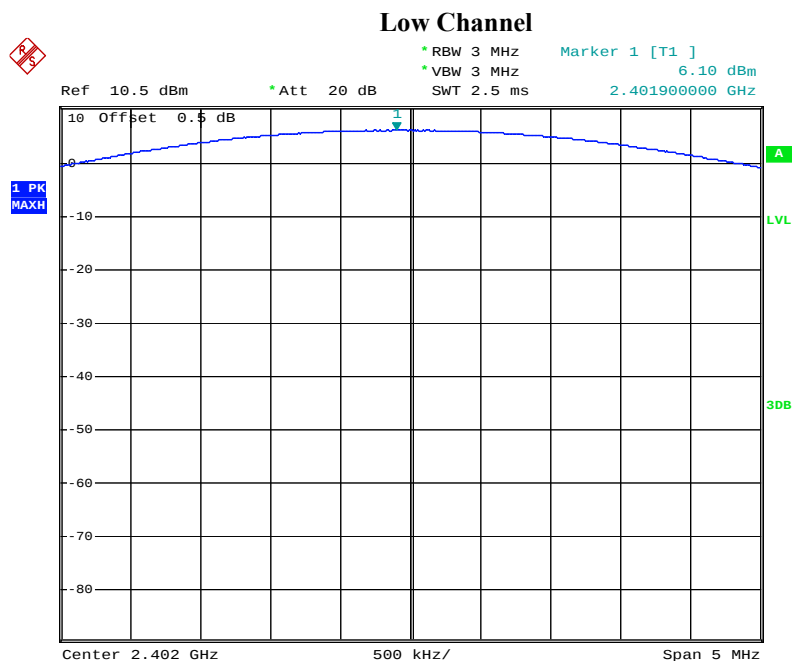
**Test Result: Pass**

|                   |                          |
|-------------------|--------------------------|
| <b>Test Mode:</b> | <b>GFSK Transmitting</b> |
|-------------------|--------------------------|

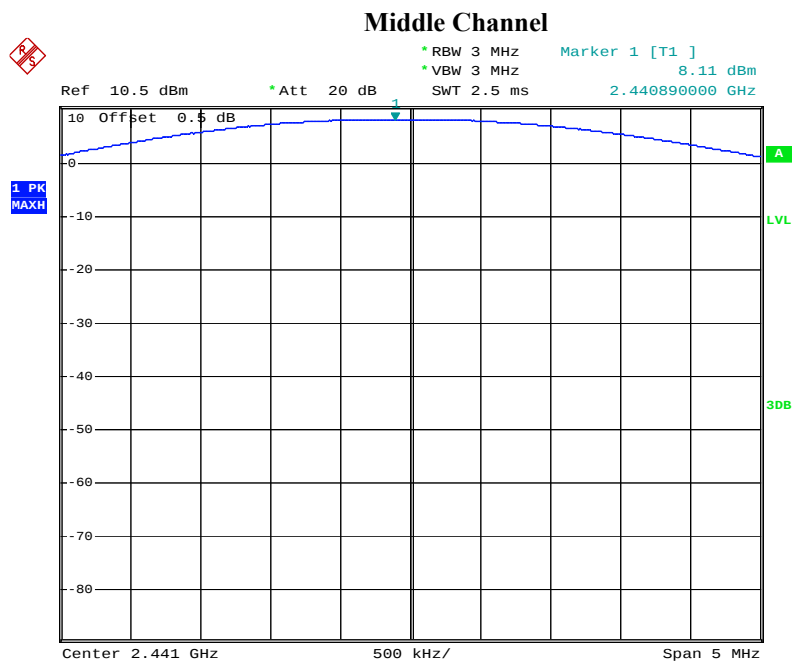
| Channel        | Channel frequency (MHz) | Peak output power (dBm) | Power output (mW) | Limit (mW) |
|----------------|-------------------------|-------------------------|-------------------|------------|
| Low channel    | 2402                    | 6.10                    | 4.07              | 125        |
| Middle channel | 2441                    | 8.11                    | 6.47              | 125        |
| High channel   | 2480                    | 8.56                    | <b>7.18</b>       | 125        |

Please refer to the following plots.

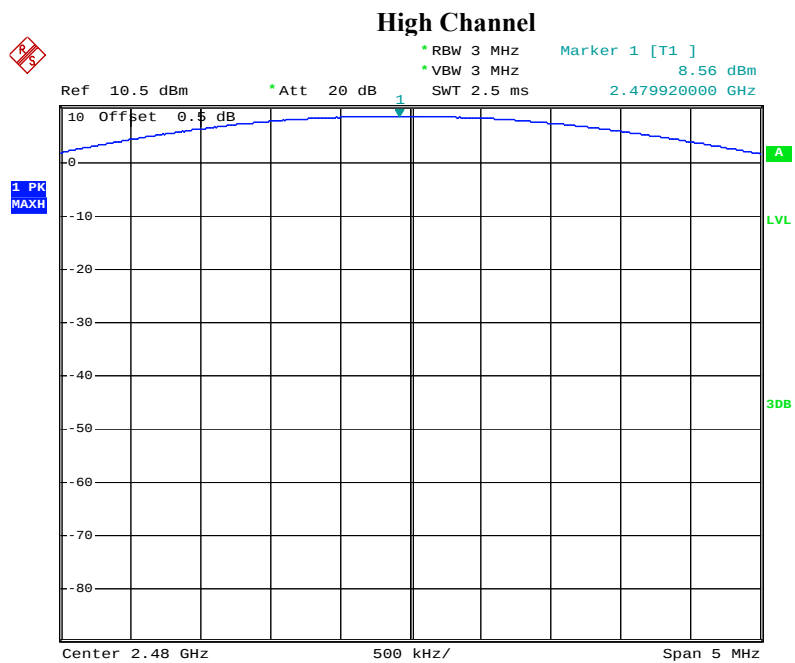
**Note:** The data above was tested in conducted mode.



Date: 27.NOV.2012 23:16:10



Date: 27.NOV.2012 23:15:45



Date: 27.NOV.2012 23:15:24

## **5.9 §15.247(d) - Band Edge**

### **Standard Requirement:**

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

### **Procedures:**

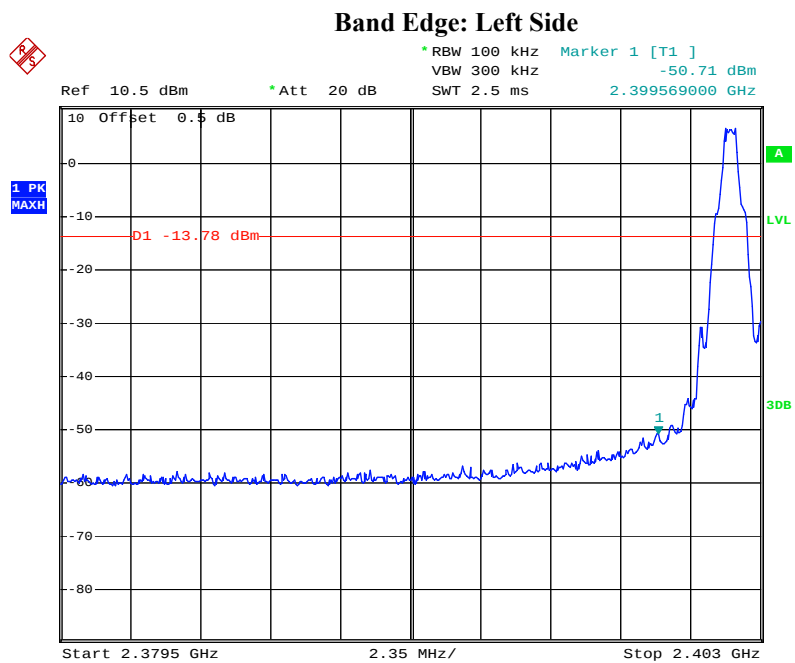
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Put it on the Rotated table and turn on the EUT and make it operate in transmitting mode. Then set it to Low Channel and High Channel within its operating range, and make sure the instrument is operated in its linear range.
3. Set both RBW and VBW of spectrum analyzer to 100 kHz with a convenient frequency span including 100kHz bandwidth from band edge, for Radiated emissions restricted band RBW=1MHz, VBW=3MHz.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

### **Test Result: Pass**

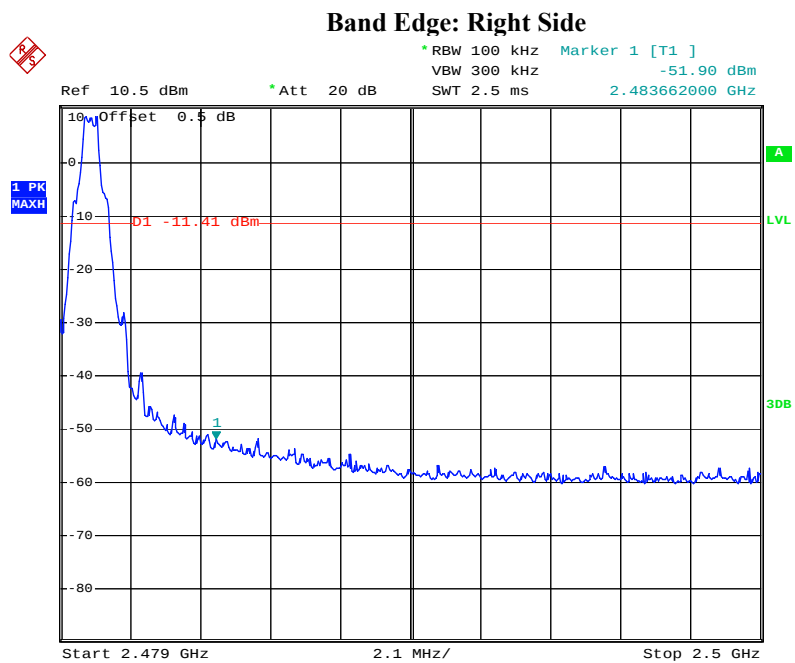
|                   |                          |
|-------------------|--------------------------|
| <b>Test Mode:</b> | <b>GFSK Transmitting</b> |
|-------------------|--------------------------|

| Frequency<br>(MHz) | Delta Peak to Band Emission<br>(dBc) | Limit<br>(dBc) |
|--------------------|--------------------------------------|----------------|
| 2399.569           | 50.71                                | 20             |
| 2483.662           | 51.90                                | 20             |

*Note: The point fall into the strict band was recorded in FCC 15.209, please refer to the restrict band testing.*



Date: 27.NOV.2012    23:06:17



Date: 27.NOV.2012    23:05:04

## Annex A. TEST INSTRUMENT & METHOD

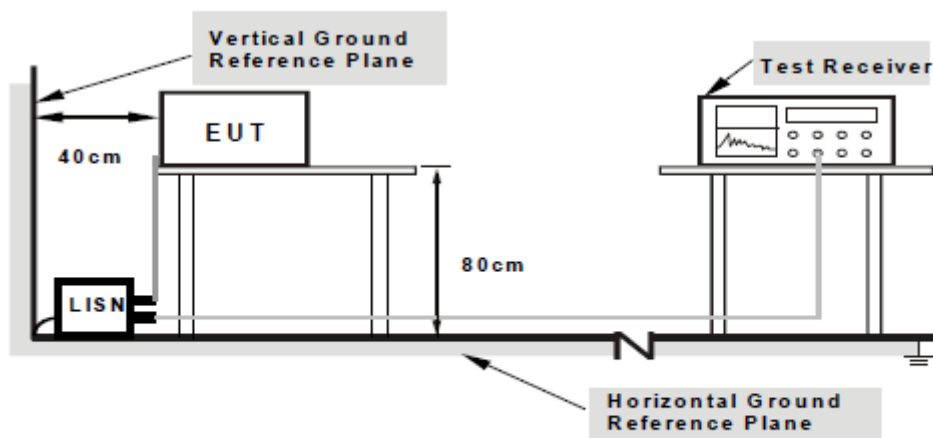
### Annex A.i. TEST INSTRUMENTATION & GENERAL PROCEDURES

| Instrument                                  | Model                  | Serial #       | Calibration Date | Calibration Due Date |
|---------------------------------------------|------------------------|----------------|------------------|----------------------|
| <b>AC Line Conducted Emissions</b>          |                        |                |                  |                      |
| R&S EMI Test Receiver                       | ESPI3                  | 101216         | 10/27/2012       | 10/26/2013           |
| V-LISN                                      | ESH3-Z5                | 838979/005     | 10/27/2012       | 10/26/2013           |
| Com-Power Transient Limiter                 | LIT-153                | 531021         | 11/03/2012       | 11/02/2013           |
| Universal Radio Communication Tester        | CMU200                 | 104031         | 10/27/2012       | 10/26/2013           |
| A- INFOMW Antenna (1 ~18GHz)                | JXTXLB-10180           | J2031081120092 | 06/25/2012       | 06/24/2013           |
| SIEMIC Labview Conducted Emissions software | V1.0                   | N/A            | N/A              | N/A                  |
| <b>Radiated Emissions</b>                   |                        |                |                  |                      |
| Hp Spectrum Analyzer                        | 8563E                  | 3821A09023     | 01/10/2012       | 01/09/2013           |
| R&S EMI Receiver                            | ESPI3                  | 101216         | 10/27/2012       | 10/26/2013           |
| Antenna (30MHz~6GHz)                        | JB6                    | A121411        | 12/28/2011       | 12/27/2012           |
| EMCO Horn Antenna (1 ~18GHz)                | 3115                   | N/A            | 10/29/2012       | 10/28/2013           |
| A- INFOMW Antenna (1 ~18GHz)                | JXTXLB-10180           | J2031081120092 | 06/25/2012       | 06/24/2013           |
| Horn Antenna (18~40GHz)                     | AH-840                 | 101013         | 04/22/2012       | 04/22/2013           |
| Microwave Pre-Amp (18~40GHz)                | PA-840                 | 181250         | 05/30/2012       | 05/29/2013           |
| Hp Agilent Pre-Amplifier                    | 8447F                  | 1937A01160     | 11/03/2012       | 11/02/2013           |
| MITEQ Pre-Amplifier (0.1 ~ 18GHz)           | AMF-7D-00101800-30-10P | 1451709        | 11/03/2012       | 11/02/2013           |
| Universal Radio Communication Tester        | CMU200                 | 104031         | 10/27/2012       | 10/26/2013           |
| Chamber                                     | 3m                     | N/A            | 04/13/2012       | 04/12/2013           |
| SIEMIC Labview Radiated Emissions software  | V1.0                   | N/A            | N/A              | N/A                  |

## Annex A.ii. CONDUCTED EMISSIONS TEST DESCRIPTION

### Test Set-up

1. The EUT and supporting equipment were set up in accordance with the requirements of the standard on top of a 1.5m x 1m x 0.8m high, non-metallic table, as shown in Annex B.
2. The power supply for the EUT was fed through a 50Ω/50μH EUT LISN, connected to filtered mains.
3. The RF OUT of the EUT LISN was connected to the EMI test receiver via a low-loss coaxial cable.
4. All other supporting equipments were powered separately from another main supply.



**Note: 1.Support units were connected to second LISN.  
2.Both of LISNs (AMN) are 80cm from EUT and at least 80cm from other units and other metal planes support units.**

For the actual test configuration, please refer to the related item – Photographs of the Test Configuration1.

### Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition.
2. A scan was made on the NEUTRAL line (for AC mains) or Earth line (for DC power) over the required frequency range using an EMI test receiver.
3. High peaks, relative to the limit line, were then selected.
4. The EMI test receiver was then tuned to the selected frequencies and the necessary measurements made with a receiver bandwidth setting of 10 kHz. For FCC tests, only Quasi-peak measurements were made; while for CISPR/EN tests, both Quasi-peak and Average measurements were made.
5. Steps 2 to 4 were then repeated for the LIVE line (for AC mains) or DC line (for DC power).

### Description of Conducted Emission Program

This EMC Measurement software run LabView automation software and offers a common user interface for electromagnetic interference (EMI) measurements. This software is a modern and powerful tool for controlling and monitoring EMI test receivers and EMC test systems. It guarantees reliable collection, evaluation, and documentation of measurement results. Basically, this program will run a pre-scan measurement before it proceeds with the final measurement. The pre-scan routine will run the common scan range from 150 kHz to 30 MHz; the program will first start a peak and average scan on selectable measurement time and step size. After the program complete the pre-scan, this program will perform the Quasi Peak and Average measurement, based on the pre-scan peak data reduction result.

### **Sample Calculation Example**

At 20 MHz

limit =  $250\ \mu\text{V} = 47.96\ \text{dB}\mu\text{V}$

Transducer factor of LISN, pulse limiter & cable loss at 20 MHz = 11.20 dB

Q-P reading obtained directly from EMI Receiver = 40.00 dB $\mu\text{V}$   
(Calibrated for system losses)

Therefore, Q-P margin =  $47.96 - 40.00 = 7.96$  i.e. **7.96 dB below limit**

## Annex A. iii. RADIATED EMISSIONS TEST DESCRIPTION

### Limit

- Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

| Frequency (MHz) | Field Strength (mV/m) | Measurement Distance (m) |
|-----------------|-----------------------|--------------------------|
| 30-88           | 100*                  | 3                        |
| 88-216          | 150*                  | 3                        |
| 216-960         | 200*                  | 3                        |
| Above 960       | 500                   | 3                        |

**Remark:** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

- In the above emission table, the tighter limit applies at the band edges.

| Frequency (Hz) | Field Strength ( $\mu\text{V/m}$ at 3-meter) | Field Strength (dB $\mu\text{V/m}$ at 3-meter) |
|----------------|----------------------------------------------|------------------------------------------------|
| 30-88          | 100                                          | 40                                             |
| 88-216         | 150                                          | 43.5                                           |
| 216-960        | 200                                          | 46                                             |
| Above 960      | 500                                          | 54                                             |

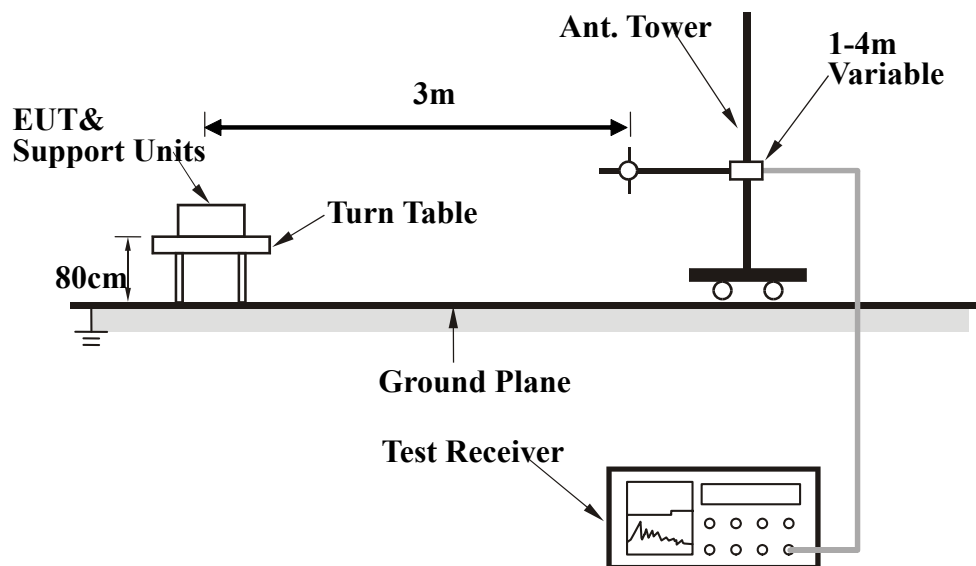
### EUT Characterisation

EUT characterisation, over the frequency range from 30MHz to 10<sup>th</sup> Harmonic, was done in order to minimise radiated emissions testing time while still maintaining high confidence in the test results.

The EUT was placed in the chamber, at a height of about 0.8m on a turntable. Its radiated emissions frequency profile was observed, using a spectrum analyzer /receiver with the appropriate broadband antenna placed 3m away from the EUT. Radiated emissions from the EUT were maximised by rotating the turntable manually, changing the antenna polarisation and manipulating the EUT cables while observing the frequency profile on the spectrum analyzer / receiver. Frequency points at which maximum emissions occurred, clock frequencies and operating frequencies were then noted for the formal radiated emissions test at the Open Area Test Site (OATS) or 3m EMC chamber.

### **Test Set-up**

1. The EUT and supporting equipment were set up in accordance with the requirements of the standard on top of a 1.5m X 1.0m X 0.8m high, non-conductive table.
2. The filtered power supply for the EUT and supporting equipment were tapped from the appropriate power sockets located on the turntable.
3. The relevant broadband antenna was set at the required test distance away from the EUT and supporting equipment boundary.



### **Test Method**

The following procedure was performed to determine the maximum emission axis of EUT:

1. With the receiving antenna is H polarization, rotate the EUT in turns with three orthogonal axes to determine the axis of maximum emission.
2. With the receiving antenna is V polarization, rotate the EUT in turns with three orthogonal axes to determine the axis of maximum emission.
3. Compare the results derived from above two steps. So, the axis of maximum emission from EUT was determined and the configuration was used to perform the final measurement.

#### **Final Radiated Emission Measurement**

1. Setup the configuration according to figure 1. Turn on EUT and make sure that it is in normal function.
2. For emission frequencies measured below 1 GHz, a pre-scan is performed in a shielded chamber to determine the accurate frequencies of higher emissions will be checked on an open test site. As the same purpose, for emission frequencies measured above 1 GHz, a pre-scan also be performed with a 1 meter measuring distance before final test.
3. For emission frequencies measured below and above 1 GHz, set the spectrum analyzer on a 100 kHz and 1 MHz resolution bandwidth respectively for each frequency measured in step 2.
4. The search antenna is to be raised and lowered over a range from 1 to 4 meters in horizontally polarized orientation. Position the highness when the highest value is indicated on spectrum analyzer, then change the orientation of EUT on test table over a range from 0 ° to 360 ° with a speed as slow as possible, and keep the azimuth that highest emission is indicated on the spectrum analyzer. Vary the antenna position again and record the highest value as a final reading.
5. Repeat step 4 until all frequencies need to be measured was complete.
6. Repeat step 5 with search antenna in vertical polarized orientations.

During the radiated emission test, the Spectrum Analyzer was set with the following configurations:

| Frequency Band (MHz) | Function | Resolution bandwidth | Video Bandwidth |
|----------------------|----------|----------------------|-----------------|
| 30 to 1000           | Peak     | 100 kHz              | 100 kHz         |
| Above 1000           | Peak     | 1 MHz                | 1 MHz           |
|                      | Average  | 1 MHz                | 10 Hz           |

### **Description of Radiated Emissions Program**

This EMC Measurement software run LabView automation software and offers a common user interface for electromagnetic interference (EMI) measurements. This software is a modern and powerful tool for controlling and monitoring EMI test receivers and EMC test systems. It guarantees reliable collection, evaluation, and documentation of measurement results. Basically, this program will run a pre-scan measurement before it proceeds with the final measurement. The pre-scan routine will run the scan on four different antenna heights, 2 antenna polarity, and 360 degrees table rotation. For example, the program was set to run 30 MHz to 1 GHz scan; the program will first start from a meter antenna height and divide the 30 MHz to 1 GHz into 10 separate parts of maximum hold sweeps. Each parts of maximum hold sweep, the program will collect the data from 0 degree to 360 degrees table rotation. After the program complete the 1m scan, the antenna continues to rise to 2m and continue the scan. The step will repeated for all specified antenna height and polarity. This program will perform the Quasi Peak measurement after the signal maximization process and pre-scan routine. The final measurement will be base on the pre-scan data reduction result.

### **Sample Calculation Example**

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. For the limit is employed average value, therefore the peak value can be transferred to average value by subtracting the duty factor. The basic equation with a sample calculation is as follows:

$$\text{Peak} = \text{Reading} + \text{Corrected Factor}$$

where

Corr. Factor = Antenna Factor + Cable Factor - Amplifier Gain (if any)

And the average value is

$$\begin{aligned} \text{Average} &= \text{Peak Value} + \text{Duty Factor or} \\ \text{Set RBW} &= 1\text{MHz, VBW} = 10\text{Hz.} \end{aligned}$$

Note:

If the measured frequencies are fall in the restricted frequency band, the limit employed must be quasi peak value when frequencies are below or equal to 1 GHz. And the measuring instrument is set to quasi peak detector function.

### **Radiated emission test facilities for frequencies above 1 GHz (ANSI C63.4-2009 Chapter 5.5)**

Currently, test site reference validation requirements above 1 GHz have not been established. However, facilities suitable for measurements in the frequency range 30 MHz to 1000 MHz are considered suitable for the frequency range 1 GHz to 40 GHz with RF absorbing material covering the ground plane such that the site validation criterion called out in CISPR 16-1-4:2007 is met, or alternatively covering a minimum area of 2.4 m by 2.4 m (for a 3 m test distance) between the antenna and the EUT using RF absorbing material with a minimum-rated attenuation of 20 dB (for normal incidence) up to 18 GHz. For separation distances greater than 3 m, a proportional increase in the area of suitable absorbing material is required.

## **Annex B. EUT AND TEST SETUP PHOTOGRAPHS**

### **Annex B.i. Photograph 1: EUT External Photo**



Whole Package - Top View



EUT - Front View



EUT - Rear View



EUT - Top View



EUT - Bottom View



EUT - Left View



EUT - Right View

**Annex B.ii. Photograph 2: EUT Internal Photo**



Cover Off - Top View1



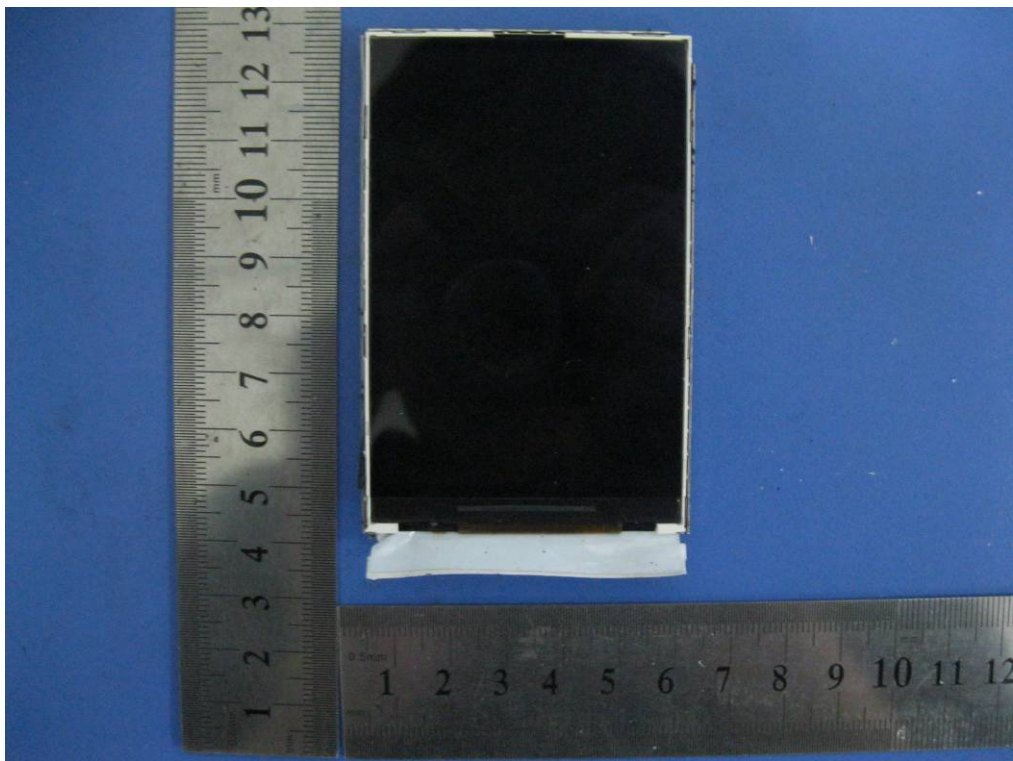
Cover Off - Bottom View



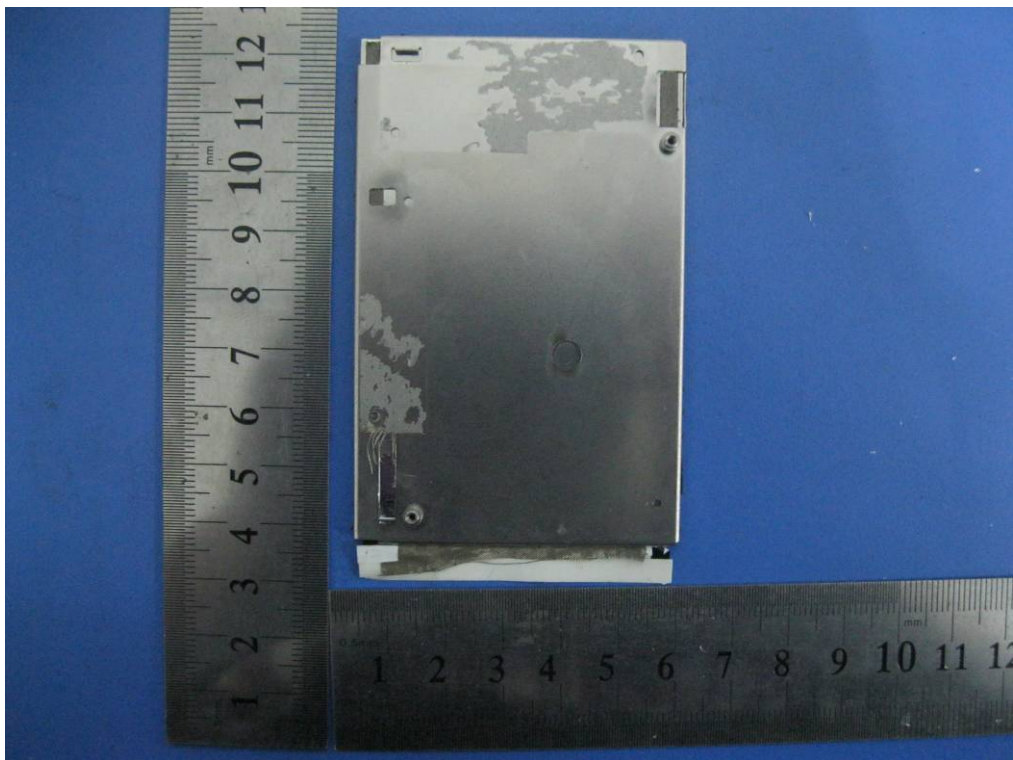
Battery - Top View



Battery - Bottom View



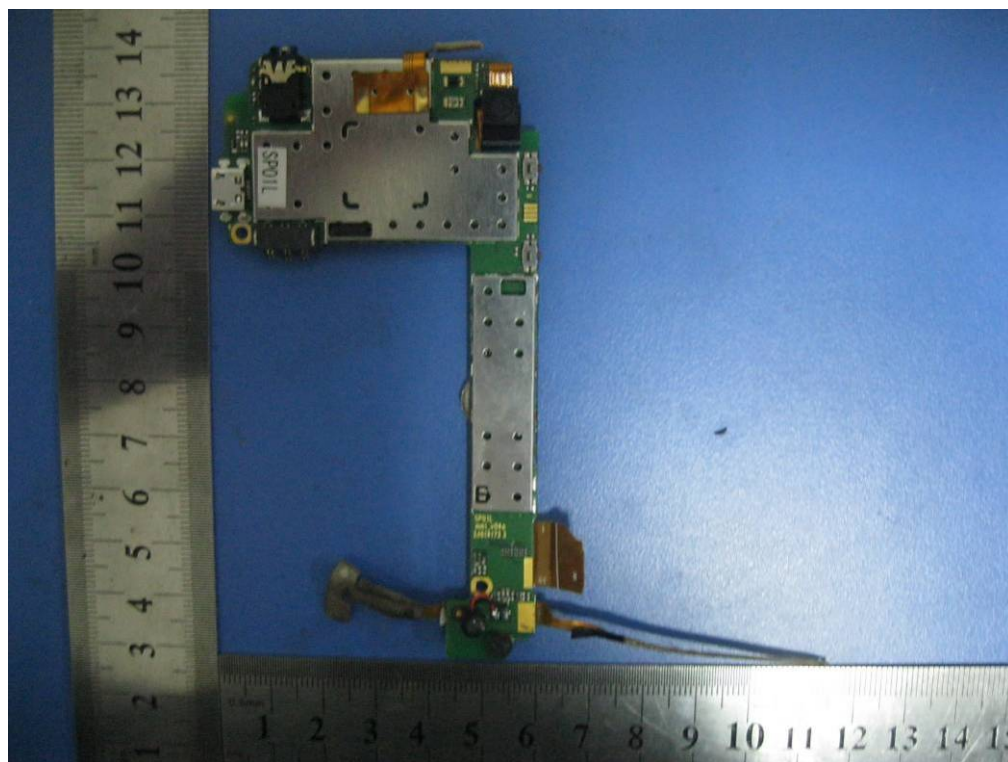
LCD - Top View



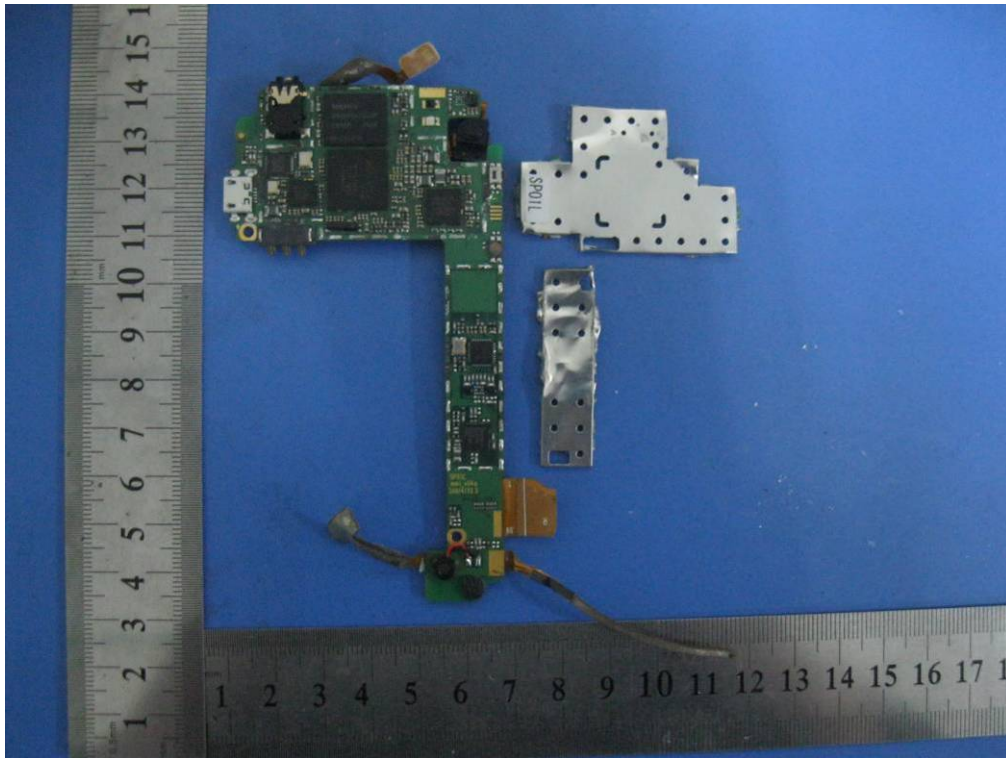
LCD - Bottom View



Uncover - Top View



Uncover without LCD - Top View



Uncover Without Shielding - Top View

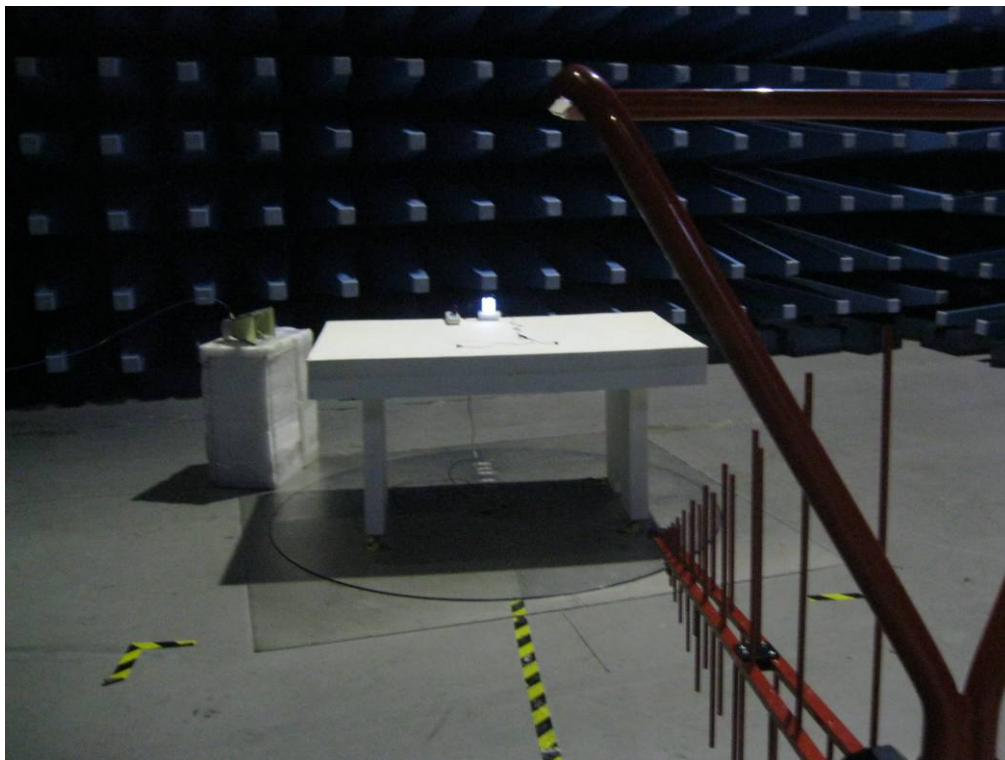
**Annex B.iii. Photograph 3: Test Setup Photo**



Conducted Emissions Test Setup Front View



Conducted Emissions Test Setup Side View



Radiated Spurious Emissions Test Setup Below 1GHz - Front View



Radiated Spurious Emissions Test Setup Above 1GHz -Front View

## **Annex C. TEST SETUP AND SUPPORTING EQUIPMENT**

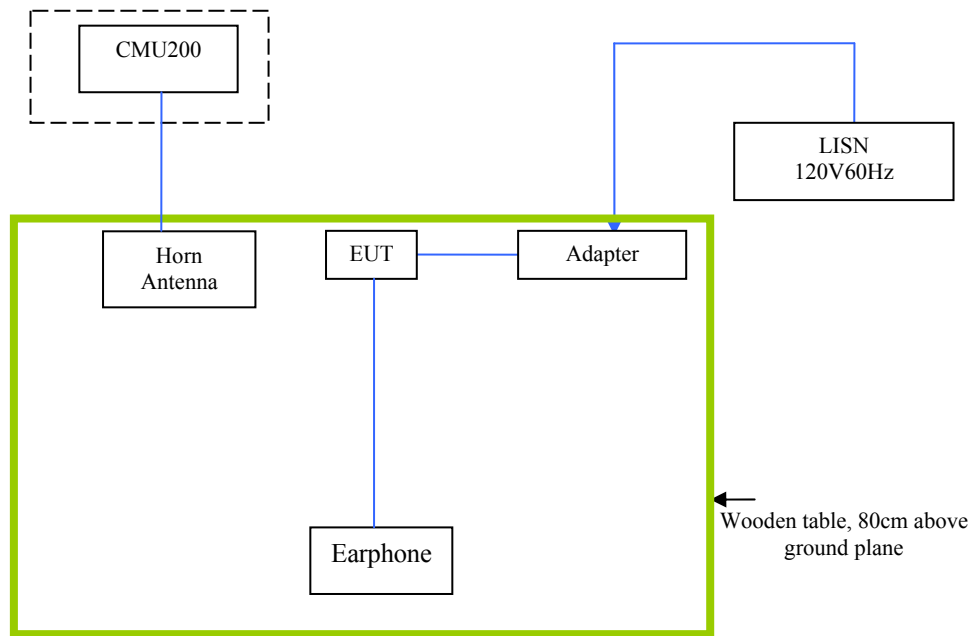
### **EUT TEST CONDITIONS**

#### **Annex C. i. SUPPORTING EQUIPMENT DESCRIPTION**

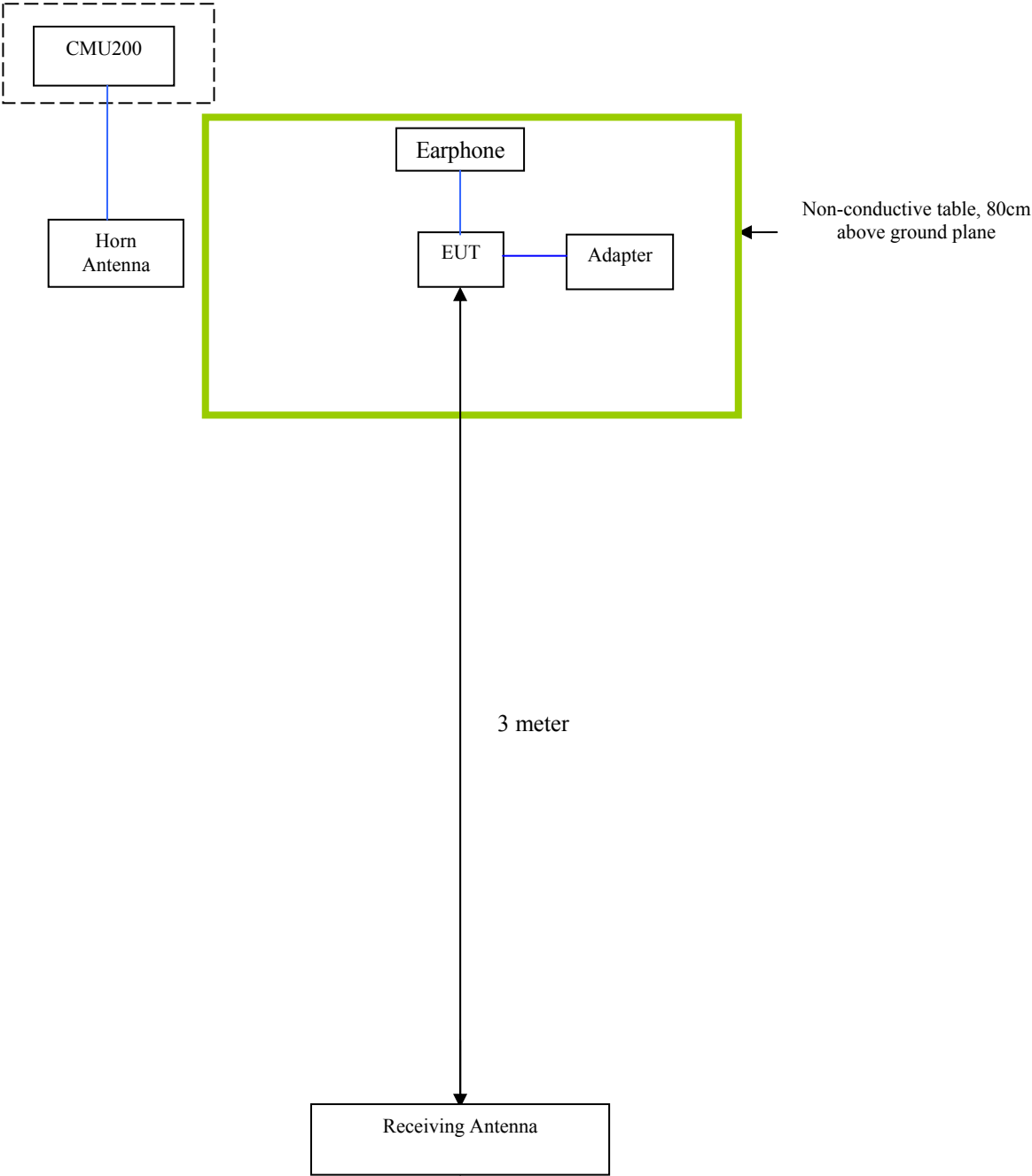
The following is a description of supporting equipment and details of cables used with the EUT.

| Manufacturer    | Equipment Description<br>(Including Brand Name) | Model        | Calibration Date | Calibration Due Date |
|-----------------|-------------------------------------------------|--------------|------------------|----------------------|
| A-INFOMW        | Horn Antenna                                    | JXTXLB-10180 | 06/25/2012       | 06/24/2013           |
| Rohde & Schwarz | Universal Radio Communication Tester            | CMU200       | 10/27/2012       | 10/26/2013           |

**Block Configuration Diagram for AC Line Conducted Emissions**



**Block Configuration Diagram for Radiated Emissions**



## **Annex C.ii. EUT OPERATING CONDITIONS**

The following is the description of how the EUT is exercised during testing.

| Test              | Description Of Operation                                           |
|-------------------|--------------------------------------------------------------------|
| Emissions Testing | The EUT was continuously transmitting to stimulate the worst case. |

## **Annex D. USER MANUAL / BLOCK DIAGRAM / SCHEMATICS / PART LIST**

**Please see attachment**

## **Annex E. DECLARATION OF SIMILARITY**

**N/A**