

# Certification of Compliance

## CFR 47 Part 15 Subpart C

Test Report File No. : 09-IST-0383 Date of Issue : June 05, 2009

Model(s) : O2USZM01  
Kind of Product : Wireless Laundry Payment Device  
FCC ID : XERO2USZM01  
Applicant : Otwo CashKorea.Ltd  
Address : 103-1519 hyundai the loft, 536-2, Bupyeong-dong, Bupyeong-gu, Incheon-si, Korea  
Manufacturer : Otwo CashKorea.Ltd  
Address : 103-1519 hyundai the loft, 536-2, Bupyeong-dong, Bupyeong-gu, Incheon-si, Korea

### Test Result

Positive

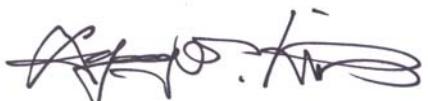
Negative

Reviewed By



S.J.CHO / EMC Group Manager

Approved By



B.S.KIM / Chief

### Comment(s)

- Investigations requested : Measurement to the relevant clauses of FCC rules and regulations Part 15 Subpart C.
- The test report with appendix consists of 40 pages.
- The test result only responds to the tested sample.
- It is not allowed to copy this report even partly without the allowance of IST EMC Laboratory.
- This equipment as for has been shown to be capable of continued compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.4

I assume full responsibility for accuracy and completeness of these data.



## TABLE OF CONTENTS

|  |    |
|--|----|
| <b>Table of contents</b>   | 2  |
| <b>Information of test laboratory, Environmental conditions, Power used, Product information</b> | 3  |
| <b>Descriptions of Test</b>  | 4  |
| - <b>Conducted Emission</b>  | 4  |
| - <b>Radiated Emission</b>   | 5  |
| - <b>Radiated Emission, 9KHz to 30MHz(Magnetic Field Test)</b>                                   | 6  |
| <b>Measurement Uncertainty Calculations</b>  | 7  |
| <b>Equipment Under Test</b>  | 8  |
| <b>Summary</b>   | 9  |
| - <b>Conducted Emission</b>  | 11 |
| - <b>Zigbee Mode (2405 MHz~2480 MHz)</b>   | 14 |
| <b>Radiated Emission</b>   | 14 |
| <b>Peak power output</b>   | 21 |
| <b>Band edge</b>   | 23 |
| <b>6dB Band</b>  | 30 |
| <b>Power Density</b>   | 32 |
| - <b>RFID Mode(13.56 MHz)</b>  | 34 |
| <b>Radiated Emission-15.225(a)</b>   | 34 |
| <b>Radiated Field Emission-15.225(b)(c)</b>  | 35 |
| <b>Radiated Field Emission-15.109, 15.209&amp;15.225(d)</b>                                      | 36 |
| <b>Frequency Stability -15.225(e)</b>  | 37 |
| - <b>Test Photo of Test Setup</b>  | 38 |
| - <b>The Photos of Equipment Under Test</b>  | 40 |

Note:

## INFORMATIONS OF TEST LABORATORY

EMC LABORATORY of IST Co., Ltd. (*FCC Filing Lab-400603.*)

Singal-dong, Giheung-gu, Yongin-City

Kyonggi-Do, 400-19, Korea

TEL : +82 31 326 6700

FAX : +82 31 326 6797

## ENVIRONMENTAL CONDITIONS

Temperature 19.53 °C Humidity 454 %

Atmospheric pressure 1018 mbar

## POWER SUPPLY SYSTEM USED

Power supply system DC 12V(Refer to the product information)

## PRODUCT INFORMATION

| Item                        |                                | Specification  |
|-----------------------------|--------------------------------|--|
| Wireless Communication part | <b>Frequency</b>               | 2400 ~ 2483.5MHz                                     |
|                             | <b>Output Power</b>            | 7dBm(±1dB)   |
|                             | <b>Rx Sensitivity</b>          | -94dBm   |
|                             | <b>RF Data Rate</b>            | 250 Kbps   |
|                             | <b>Networking Topology</b>     | point-to- point                                      |
|                             | <b>Hardware interface</b>      | UART   |
|                             | <b>Spread Spectrum Type</b>    | DSSS<br>(Direct Sequence Spread Spectrum)            |
|                             | <b>Channel Capacity</b>        | 16 Direct Sequence Channels<br>(software selectable) |
|                             | <b>CPU</b>                     | 8 Bit Micro Processor                                |
|                             | <b>Antenna/Gain</b>            | Chip Antenna / 1dBi                                  |
| RF Card                     | <b>Operating Temperature</b>   | -20~ 50°C (Relative humidity 90%)                    |
|                             | <b>Operating Voltage Range</b> | DC 12V / 200mA                                       |
|                             | <b>Frequency</b>               | 13.56MHz   |
|                             | <b>Output Power</b>            | MAX 500mW  |
|                             | <b>Antenna</b>                 | PCB Loop Antenna                                     |
|                             | <b>Operating Voltage Range</b> | 5VDC ± 5%  |
|                             | <b>Operating Temperature</b>   | -20~50°C (Relative humidity 90%)                     |

- Regards to the frequency band operation; the highest that was included the lowest, middle and highest frequency of channel were selected to perform the test, and then shown on this report.

- Please refer to user's manual.

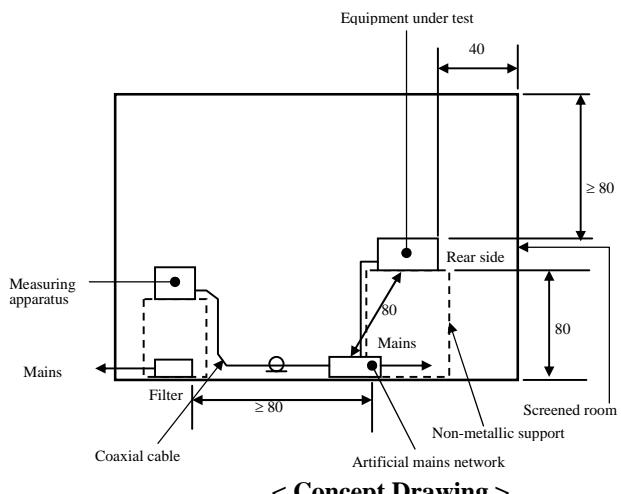
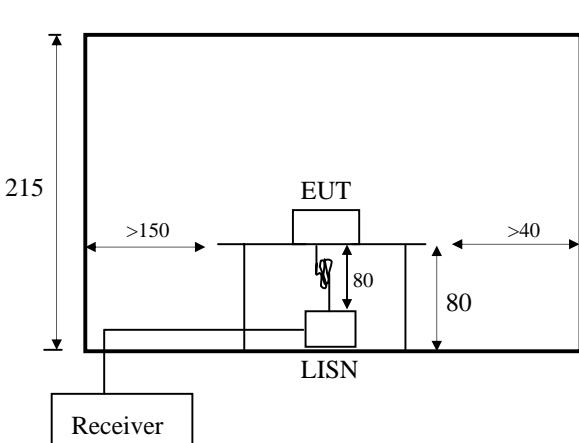
## DESCRIPTION OF TEST

### Conducted Emissions:

The measurement were performed over the frequency range of 0.15 MHz to 30 MHz using a 50 Ω/50 uH LISN as the input transducer to a Spectrum Analyzer or a Field Intensity Meter. The measurements were made with the detector set for "Peak" amplitude within a bandwidth of 10KHz or for "quasi-peak" & "Average" within a bandwidth of 9 KHz.

#### -Procedure of Test

The line-conducted facility is located inside a shielded room No.1. A 1 m X 1.5 m wooden table 80 cm height is placed 40 cm away from the vertical wall and 1.5 m away from the other wall of the shielded room. The R/S ESCI and Hyup-Rip KNW-407 LISN are bonded to bottom of the shielded room. The EUT is located on the wooden table with distance more than 80 cm from the LISN and powered from the EMC LISN. The peripheral equipment is powered from the other LISN. Power to the LISNs are filtered by a noise cut power line filters. All electrical cables are shielded by braided tinned steel tubing with inner  $\phi$  1.2 cm. If the EUT is a DC-powered device, power will be derived from the source power supply it normally will be powered from and this supply lines will be connected to the EMC LISN. All interconnecting cables more than 1m were shortened by non-inductive bundling to a 1m length. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating conditions. The RF output of the LISN was connected to the R/S receiver to determine the frequency producing the maximum emission from the EUT. The frequency producing the maximum level was reexamined using Quasi-Peak mode by manual measurement, after scanned by automatic Peak mode for frequency range from 0.15 to 30 MHz. The bandwidth of the receiver was set to 10 kHz. The EUT, peripheral equipment, and interconnecting cables were arranged and manipulated to maximize each EME emission.

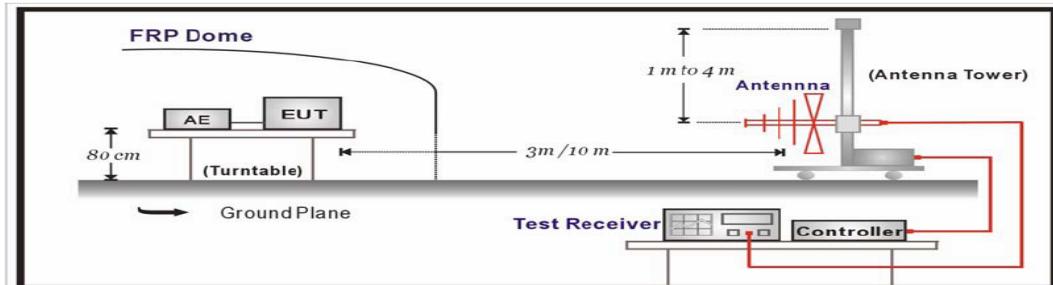


## Radiated Emissions:

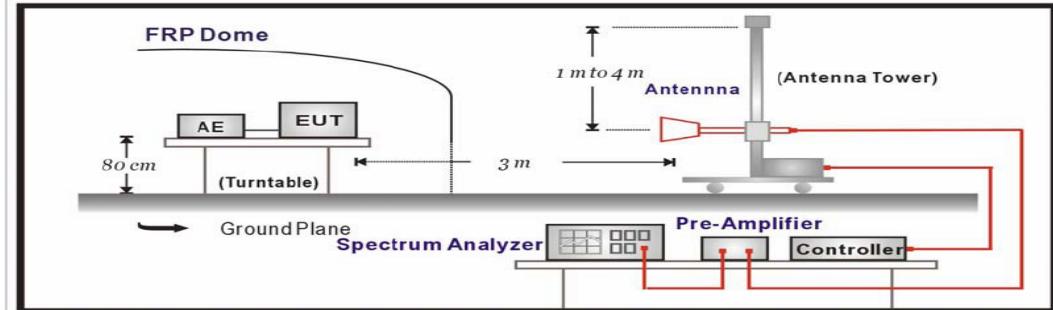
The measurement was performed over the frequency range of 30MHz to 1GHz using antenna as the input transducer to a Spectrum analyzer or a Field Intensity Meter. The measurement was made with the detector set for "quasi-peak" within a bandwidth of 120kHz. Procedure of Test

Preliminary measurements were made at 3 meter using bi-log antennas, and spectrum analyzer to determine the frequency producing the max. emission in anechoic chamber. Appropriate precaution was taken to ensure that all emission from the EUT were maximized and investigated. The system configuration, mode of operation, turn-table azimuth and height with respect to the antenna were noted for each frequency found. The spectrum was scanned from 30MHz to 1000MHz using bi-log antenna. Above 1GHz, linearly polarized double ridge horn antennas were used. Final measurements were made at open site with 3-meters test distance using bi-log antenna or horn antenna. The OATS have been verified in regular for its normalized site attenuation. The test equipment was placed on a wooden table. Sufficient time for the EUT, peripheral equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. Each frequency found during pre-scan measurements was re-examined by manual. The detector function was set to CISPR quasi-peak mode and the bandwidth of the receiver was set to 120kHz or 1MHz depending on the frequency of type of signal. The EUT, peripheral equipment and interconnecting cables were re-configured to the set-up producing the max. emission for the frequency and were placed on top of a 0.8-meter high nonmetallic 1 x 1.5 meter table. The EUT, peripheral equipment, and interconnecting cables were re-arranged and manipulated to maximize each emission. The turntable containing the system was rotated; the antenna height was varied 1 to 4 meters and stopped at the azimuth or height producing the maximum emission. Each emission was maximized by: varying the mode of operation to the EUT and/or peripheral equipment and changing the polarity of the antenna, whichever determined the worst-case emission. (The bandwidth below 1GHz setting on the field strength meter is 120KHz and above 1GHz is 1MHz.)

### Under 1GHz Test Setup:



### Above 1GHz Test Setup:



### **Radiated Emissions Test, 9 kHz to 30 MHz(Magnetic Field Test)**

1. The preliminary radiated measurements were performed to determine the frequency producing the maximum emissions at a distance of 3 meters according to Section 15.31(f)(2).
2. The EUT was placed on the top of the 0.8-meter height, 1 x 1.5 meter non-metallic table.
3. Emissions from the EUT are maximized by adjusting the orientation of the Loop antenna and rotating the EUT on the turntable. Manipulating the system cables also maximizes EUT emissions if applicable.
4. To obtain the final measurement data, each frequency found during preliminary measurements was re-examined and investigated. The test-receiver system was set up to average, peak, and quasi-peak detector with specified bandwidth.

## Measurement Uncertainty Calculations

The measurement uncertainties stated were calculated in accordance with the requirements of NIST Technical Note 1297 and NIS 81 (1994).

| TYPE | Contribution  | Probability Distribution                  | Uncertainty                   | Remark |
|------|---|---|-------------------------------|--------|
| B    | <b>AMN</b><br>Impedance<br>Voltage Division Factor<br>Attenuation : AMN to Receiver   | Triangular<br>normal(k=2)<br>normal(k=2)  | +2.6/-2.7 dB<br>±0.2<br>±0.1  | CISPR  |
|      | <b>Receiver(ESCI(S/N:100374))</b><br>Sine-Wave Voltage Accuracy<br>Pulse Amplitude Response<br>Pulse Repetition Rate Response | normal(k=2)<br>Rectangular<br>Rectangular | ±1.0 dB<br>±1.5 dB<br>±1.5 dB | CISPR  |
|      | Mismatch<br>AMN to Receiver   | U-Shaped                                  | +0.7/-0.8 dB                  | CISPR  |
|      | Reading   | normal(k=1)                               | ±0.1                          |        |
|      | Combined Standard Uncertainty   | normal                                    | ± 1.8 dB                      |        |
|      | Expanded Uncertainty U  | normal(k=2)                               | ± 3.6 dB                      | 95 %   |
|      |   |   |                               |        |

$$U = -3.70 / +3.42 \text{ (k=2, 95.45% confidence level)}$$

| TYPE | Contribution   | Probability Distribution  | Uncertainty  | Remark                                   |
|------|--|---|--|--|
| B    | <b>Antenna</b><br>AF factor<br>AF frequency interpolation<br>AF height deviations<br>directivity difference<br>phase center location(3 m)<br>phase center location(10 m) | Normal(k=2)<br>Rectangular<br>Rectangular<br>Rectangular<br>Rectangular | ±0.56<br>±0.30 dB<br>±0.50 dB<br>±0.30 dB<br>+1.0/-0.0 dB<br>±1.0 dB<br>±0.30 dB | CAL.<br>CISPR<br>CISPR<br>CISPR<br>CISPR |
|      | <b>Receiver</b><br>Sine Wave Voltage Accuracy<br>Pulse Amplitude Sensibility<br>Pulse Frequency Response<br>Random Noise   | Normal(k=2)<br>Normal(k=2)<br>Normal(k=2)<br>Normal(k=2)                | ±0.20 dB<br>±0.40 dB<br>±0.57 dB<br>±0.35 dB                                     | CAL.<br>CAL.<br>CAL.<br>CAL.             |
|      | Mismatch : Antenna - receiver  | U-Shaped  | +0.9/-1.0 dB   | CISPR                                    |
|      | Table height   | Normal(k=2)   | ±0.01 dB   | CISPR                                    |
|      | Separation distance(3 m)<br>Separation distance(10 m)  | Rectangular   | ±0.30 dB<br>±0.10 dB   | CISPR                                    |
|      | Combined standard Uncertainty  | Normal  | ± 1.13   |  |
|      | Expanded Uncertainty U   | Normal(k=2)   | ± 2.26 dB  | 95 %                                     |

$$U = ±2.26 \text{ (k=2, 95% confidence level)}$$

## Equipment Under Test

### EUT Type :

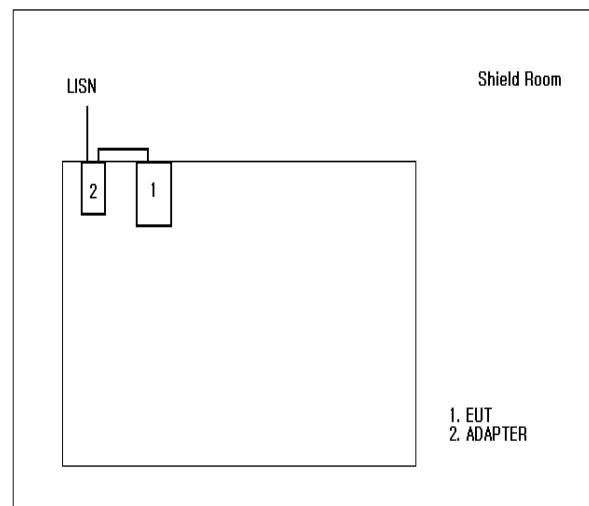
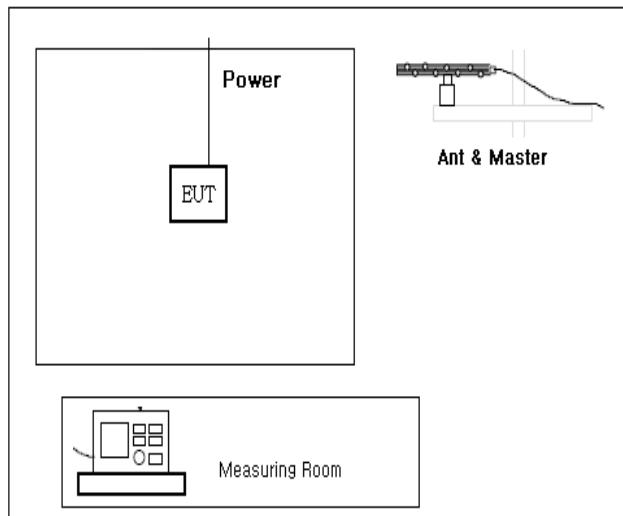
- Table-Top.
- Floor-Standing.
- Table-Top and Floor-Standing(Combination).
- Built-in

### Operation – mode of the E.U.T. :

The equipment under test was operated during the measurement under following conditions :

- Standby Mode
- Operational Condition : Continue Transmitting

## Test Set-Up Configuration



## Radiated/Conducted Emissions

## SUMMARY

### Zigbee Mode ( 2405 MHz ~ 2480 MHz)

#### Test Descriptions

|                                |      |
|--------------------------------|------|
| ■ Conducted Emission           | PASS |
| -Conducted Emission result     |      |
| ■ Radiated Emission            | PASS |
| - Radiated Emission Result     |      |
| ■ Peak power output            | PASS |
| - Test result                  |      |
| ■ Band edge                    | PASS |
| - Test result                  |      |
| ■ 6dB Band(Occupied Bandwidth) | PASS |
| - Test Result                  |      |
| ■ Power Density                | PASS |
| - Test Result                  |      |

### RFID Mode ( 13.56 MHz)

#### Test Descriptions

|  |      |
|--|------|
| ■ Conducted Emission                                 | PASS |
| -Conducted Emission result                           |      |
| ■ Radiated Emission-15.225(a)                        | PASS |
| - Radiated Emission Result                           |      |
| ■ Radiated Electric Field Emission-15.225(b)(c)      | PASS |
| - Test result  |      |
| ■ Radiated Electric Field Emission-15.109, 15.225(d) | PASS |
| - Test result  |      |
| ■ Frequency Stability -15.225(e)                     | PASS |

#### Test Result

The frequency tolerance of the carrier signal shall be maintained within  $\pm 0.01\%$  of the operating frequency over a temperature variation of -20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

#### Note :

- ■ means that the test is applicable,
- □ means that the test is not applicable.

**Test Date**

Begin of Testing : May 07, 2009 - End of Testing : June 05, 2009

Prepared By



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U.H. Ryu / Senior Engineer

**Conducted Emissions**

[Applicable]

◆ Test Equipment Used

| Model Name | Description   | Manufacturer    | Calibration Date | Serial No.  |
|------------|---------------|-----------------|------------------|-------------|
| ESCI       | Test Receiver | Rohde & Schwarz | Jun. 26, 2008    | 100373      |
| KNW-407    | LISN          | HyupRip         | Oct. 11, 2008    | 8-833-10    |
| ESH3-Z2    | Pulse Limiter | Rohde & Schwarz | May. 21, 2008    | 357.8810.52 |

◆ Test Accessories Used

◆ Test Program Continue Transmit

◆ Test Date June 05, 2009

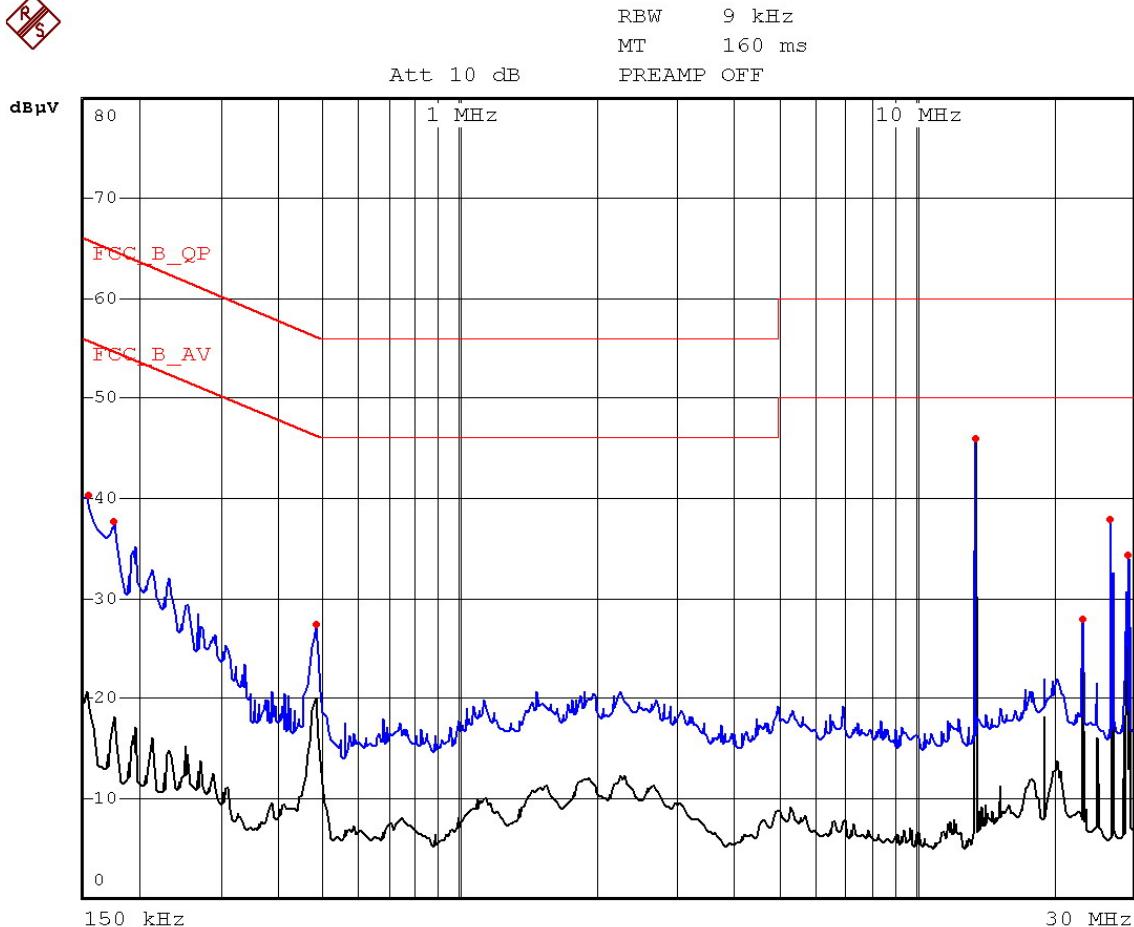
◆ Test Area Conducted Room No.1

*Note :-*

Conducted Emissions Result

Phase : Live

RS



Model Name : O2USZM01 Op : 120Vac 60Hz Phase : Live

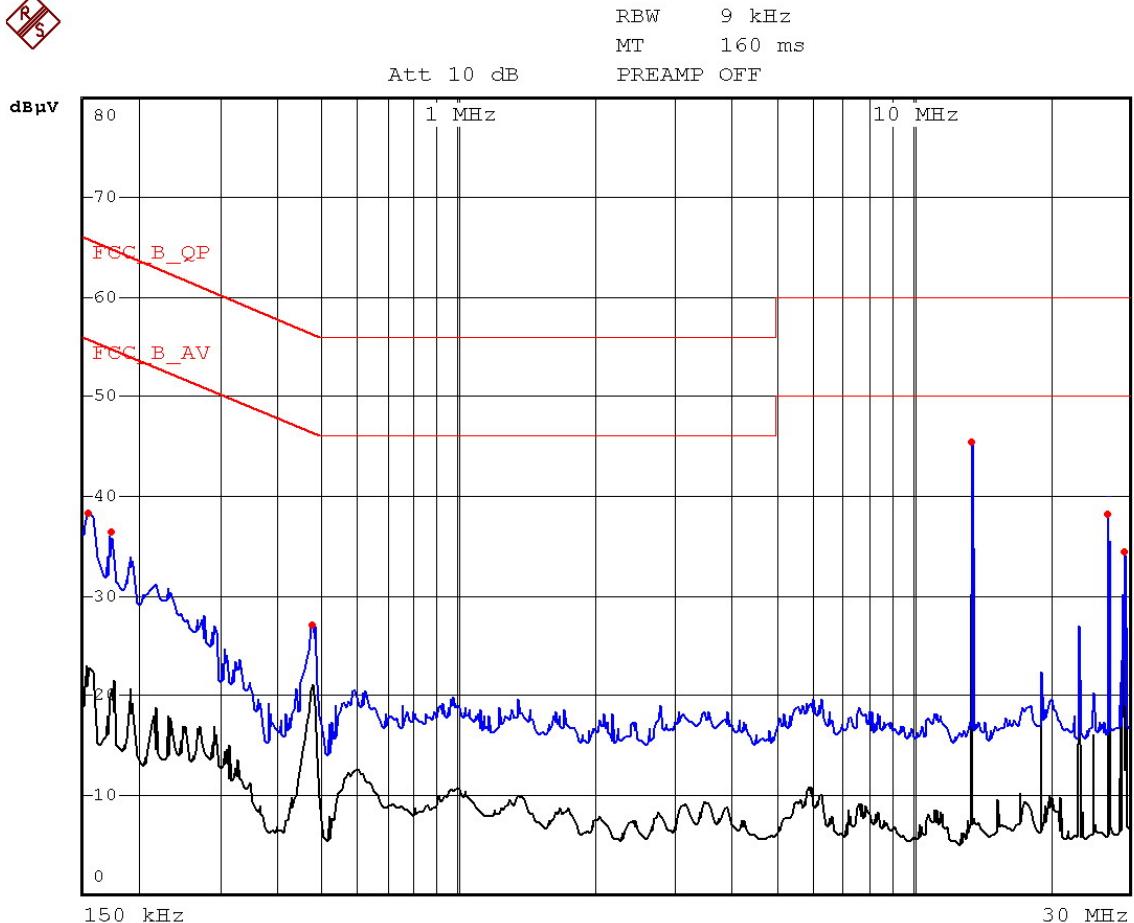
| Freq.<br>[MHz] | Measurement<br>[dB $\mu$ V] |         | Limit<br>[dB $\mu$ V] |         | Insertion<br>Loss<br>[dB] | Cable<br>Loss<br>[dB $\mu$ V] | Result<br>[dB $\mu$ V] |         | Margin<br>[dB] |         |
|----------------|-----------------------------|---------|-----------------------|---------|---------------------------|-------------------------------|------------------------|---------|----------------|---------|
|                | Q-peak                      | Average | Q-peak                | Average |                           |                               | Q-peak                 | Average | Q-peak         | Average |
| 0.150          | 35.02                       | 19.16   | 66.00                 | 56.00   | 0.38                      | 0.60                          | 36.00                  | 20.14   | 30.00          | 35.86   |
| 0.174          | 34.07                       | 18.62   | 64.77                 | 54.77   | 0.41                      | 0.60                          | 35.08                  | 19.63   | 29.68          | 35.13   |
| 0.482          | 23.85                       | 20.21   | 56.30                 | 46.30   | 0.22                      | 0.77                          | 24.84                  | 21.20   | 31.46          | 25.10   |
| 13.560         | 46.97                       | 44.93   | 60.00                 | 50.00   | 0.38                      | 0.70                          | 48.05                  | 46.01   | 11.96          | 4.00    |
| 23.165         | 26.15                       | 25.61   | 60.00                 | 50.00   | 0.59                      | 0.70                          | 27.44                  | 26.90   | 32.56          | 23.10   |
| 27.120         | 38.57                       | 38.10   | 60.00                 | 50.00   | 0.67                      | 1.00                          | 40.24                  | 39.77   | 19.76          | 10.23   |
| 29.490         | 36.62                       | 36.81   | 60.00                 | 50.00   | 0.70                      | 0.80                          | 38.12                  | 38.31   | 21.88          | 11.69   |

Note : Continue Transmit Mode

Conducted Emissions Result

Phase : Neutral

RS



Model Name : O2USZM01 Op : 120Vac 60Hz Phase : Neutral

| Freq.<br>[MHz] | Measurement<br>[dB $\mu$ V] |         | Limit<br>[dB $\mu$ V] |         | Insertion<br>Loss | Cable<br>Loss | Result<br>[dB $\mu$ V] |         | Margin<br>[dB] |         |
|----------------|-----------------------------|---------|-----------------------|---------|-------------------|---------------|------------------------|---------|----------------|---------|
|                | Q-peak                      | Average | Q-peak                | Average |                   |               | Q-peak                 | Average | Q-peak         | Average |
| 0.150          | 33.58                       | 20.84   | 66.00                 | 56.00   | 0.38              | 0.60          | 34.56                  | 21.82   | 31.44          | 34.18   |
| 0.174          | 32.92                       | 31.59   | 64.77                 | 54.77   | 0.41              | 0.60          | 33.93                  | 32.60   | 30.83          | 22.16   |
| 0.482          | 24.08                       | 20.54   | 56.30                 | 46.30   | 0.22              | 0.77          | 25.07                  | 21.53   | 31.23          | 24.77   |
| 13.560         | 47.15                       | 45.87   | 60.00                 | 50.00   | 0.38              | 0.70          | 48.23                  | 46.95   | 11.78          | 3.06    |
| 27.120         | 38.77                       | 37.65   | 60.00                 | 50.00   | 0.67              | 1.00          | 40.44                  | 39.32   | 19.56          | 10.68   |
| 29.490         | 37.08                       | 37.10   | 60.00                 | 50.00   | 0.70              | 0.80          | 38.58                  | 38.60   | 21.42          | 11.40   |

Note : Continue Transmit Mode

### Radiated Emission

[Applicable]

#### ◆ Test Equipment Used

| Name                 | Type          | Manufacturer    | Calibration. Date | Serial Number |
|----------------------|---------------|-----------------|-------------------|---------------|
| ESCS30               | EMI Receiver  | Rohde & Schwarz | Sep. 10, 2008     | 100171        |
| SPECTRUM<br>ANALYZER | R3273         | ADVANTEST       | Sep. 12, 2008     | 110600587     |
| Loop Antenna         | HFH2-Z2       | Rohde & Schwarz | Oct. 23, 2008     | 8620771017    |
| Log-bicon<br>Antenna | VULB9161SE    | Schwarz beck    | Aug. 28, 2007     | 4089          |
| HORN-Antenna         | 3115          | EMCO            | Dec. 26, 2007     | 9012-3602     |
| HORN-Antenna         | SAS-571       | A.H. SYSTEMS    | Dec. 26, 2007     | 500           |
| PRE AMPLIFIER        | 8449B OPT H02 | Rohde & Schwarz | Oct. 11, 2008     | 3008A0530     |

*Note : 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to RRL, KRISS, KTL and HCT.*

*2. The calibration interval of horn ant. and loop ant. is 24 months*

#### Field Strength Calculation

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

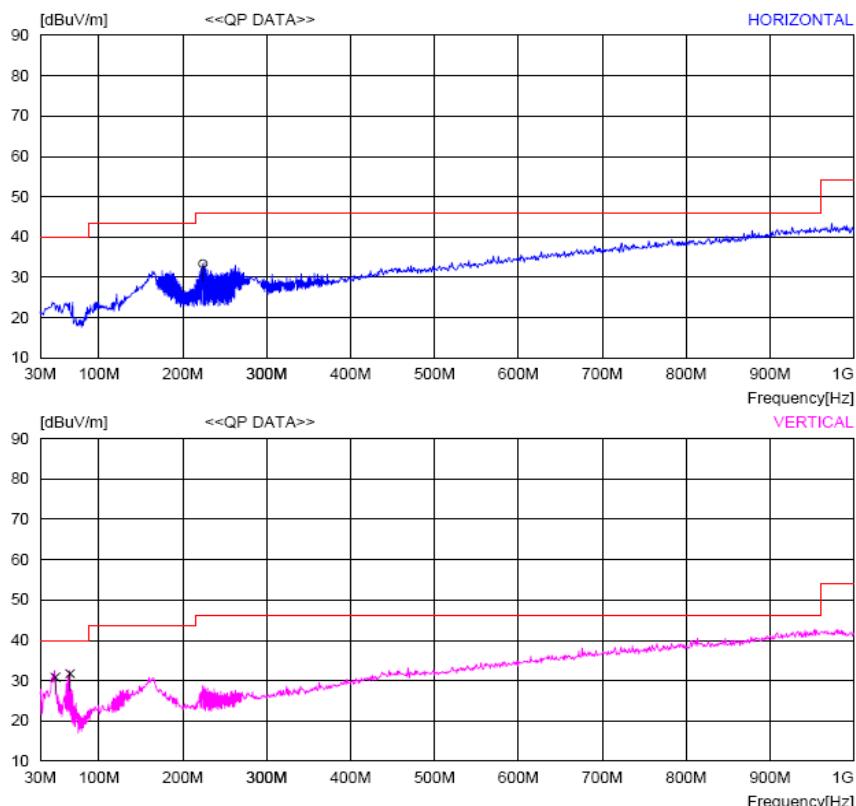
Corr. Factor = Antenna Factor + Cable Factor - Amplifier Gain (if any)

**Zigbee Mode ( 2405 MHz ~ 2480 MHz)**

**Radiated Emission Result**

**[Applicable]**

|       |          |       |                     |
|-------|----------|-------|---------------------|
| EUT   | O2USZM01 | PROBE | 0 . 3GHz~1GHz       |
| POWER | DC 12 V  | NOTE  | TX-CH1 ( 2405 MHz ) |



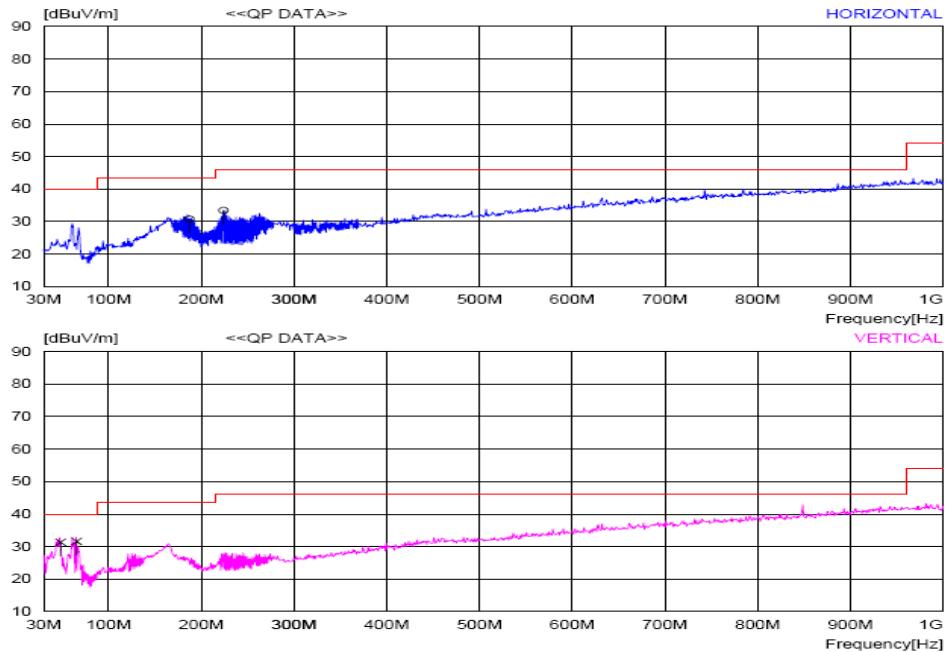
| Frequency<br>MHz | Reading<br>dBuV | P<br>(H, V) | Ant. Factor<br>dB | Cable Loss<br>dB | AMP GAIN<br>dB | Limit<br>dBuV | Total<br>dBuV | Margin<br>dB |
|------------------|-----------------|-------------|-------------------|------------------|----------------|---------------|---------------|--------------|
| 48.31            | 18.4            | V           | 11.4              | 1.1              | 0.0            | 40.00         | 30.9          | 9.2          |
| *65.69           | 20.4            | V           | 10.2              | 1.1              | 0.0            | 40.00         | 31.7          | 8.3          |
| 224.13           | 20.1            | H           | 10.7              | 2.6              | 0.0            | 46.0          | 33.4          | 12.6         |

*Note :*

1. Remark "\*" means that the data is the worst emission level.
2. All reading levels are Quasi-peak value.
3. Measurement level = reading level + correct factor

[Applicable]

|       |          |       |                     |
|-------|----------|-------|---------------------|
| EUT   | O2USZM01 | PROBE | 0 . 3GHz~1GHz       |
| POWER | DC 12 V  | NOTE  | TX-CH8 ( 2445 MHz ) |



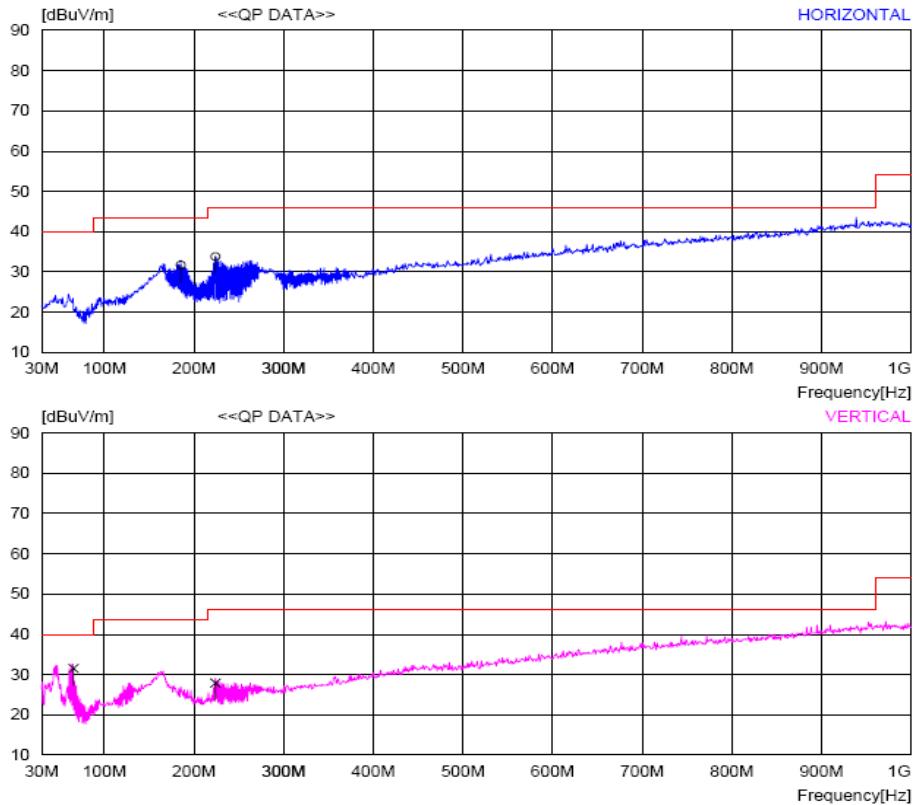
| Frequency<br>MHz | Reading<br>dBuV | P<br>(H, V) | Ant. Factor<br>dB | Cable Loss<br>dB | AMP GAIN<br>dB | Limit<br>dBuV | Total<br>dBuV | Margin<br>dB |
|------------------|-----------------|-------------|-------------------|------------------|----------------|---------------|---------------|--------------|
| 48.31            | 18.9            | V           | 11.4              | 1.1              | 0.0            | 40.00         | 31.4          | 8.6          |
| *65.69           | 20.3            | V           | 10.2              | 1.1              | 0.0            | 40.0          | 31.6          | 8.4          |
| 187.43           | 16.1            | H           | 12.4              | 2.3              | 0.0            | 43.5          | 30.8          | 12.8         |
| 224.14           | 20.1            | H           | 10.7              | 2.6              | 0.0            | 46.0          | 33.4          | 12.6         |

Note :

1. Remark "\*" means that the data is the worst emission level.
2. All reading levels are Quasi-peak value.
3. Measurement level = reading level + correct factor

**[Applicable]**

|       |          |       |                    |
|-------|----------|-------|--------------------|
| EUT   | O2USZM01 | PROBE | 0 . 3GHz~1GHz      |
| POWER | DC 12 V  | NOTE  | TX-CH15 (2480 MHz) |



| Frequency<br>MHz | Reading<br>dBuV | P<br>(H, V) | Ant. Factor<br>dB | Cable Loss<br>dB | AMP GAIN<br>dB | Limit<br>dBuV | Total<br>dBuV | Margin<br>dB |
|------------------|-----------------|-------------|-------------------|------------------|----------------|---------------|---------------|--------------|
| *65.69           | 20.2            | V           | 10.2              | 1.1              | 0.0            | 40.0          | 31.5          | 8.5          |
| 185.48           | 16.6            | H           | 12.8              | 2.3              | 0.0            | 43.5          | 31.7          | 11.8         |
| 224.12           | 20.5            | H           | 10.7              | 2.6              | 0.0            | 46.0          | 33.8          | 12.2         |
| 224.13           | 14.6            | V           | 10.7              | 2.6              | 0.0            | 46.0          | 27.9          | 18.1         |

*Note :*

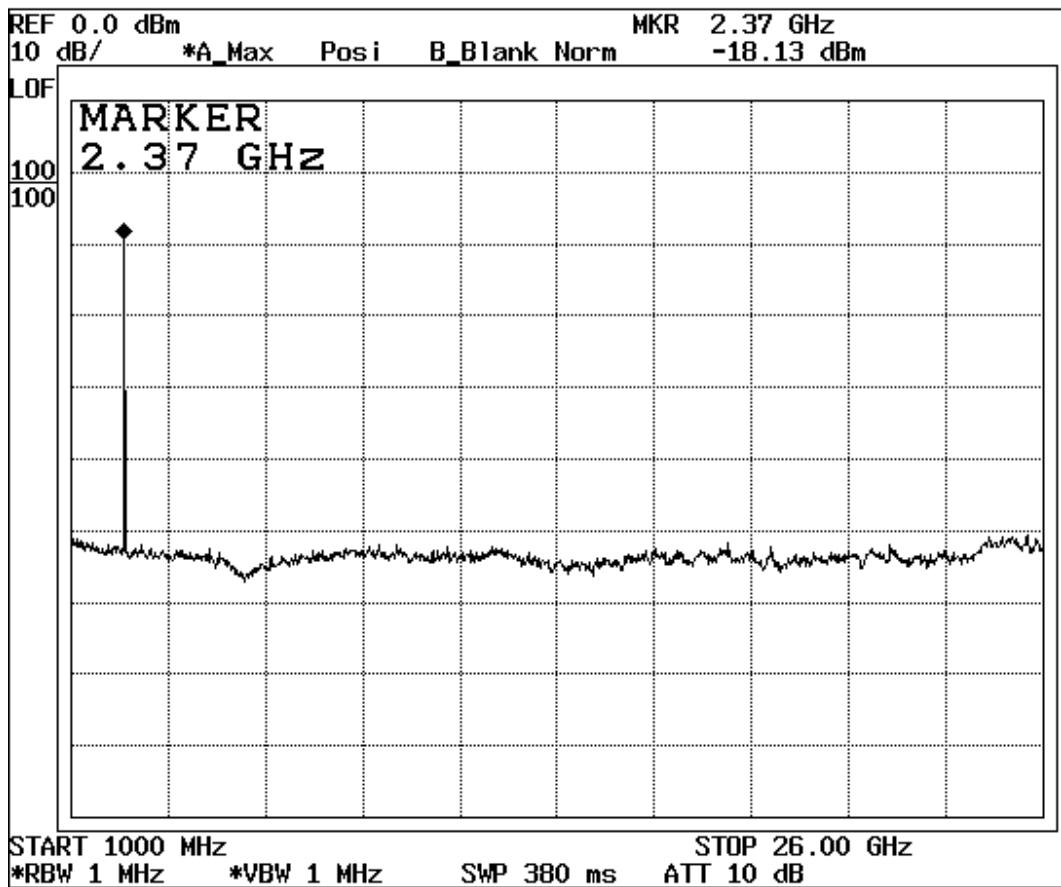
1. Remark "\*" means that the data is the worst emission level.
2. All reading levels are Quasi-peak value.
3. Measurement level = reading level + correct factor

**Radiated Emissions Result**

(Disturbance Radiation)

[Applicable]

|       |          |       |                   |
|-------|----------|-------|-------------------|
| EUT   | O2USZM01 | PROBE | RF 1GHZ~26GHz     |
| POWER | DC 12 V  | NOTE  | TX-CH1 (2405 MHz) |

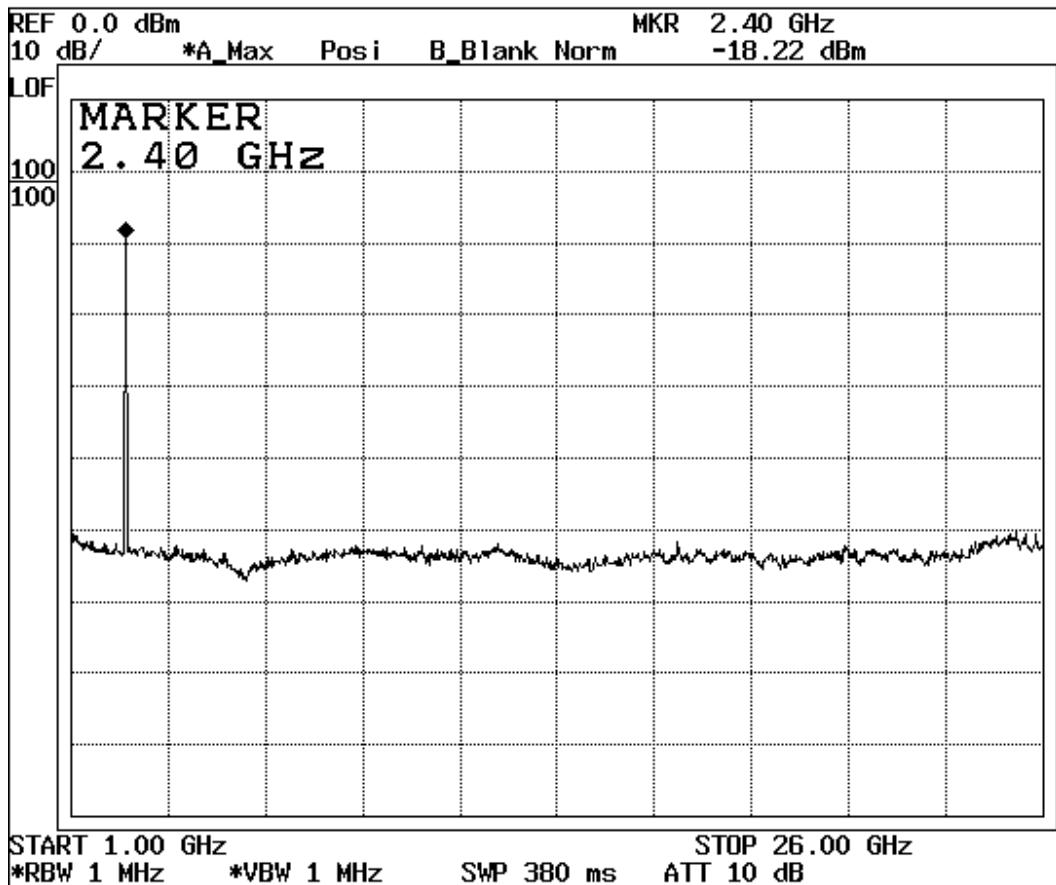


| Frequency<br>MHz | Reading<br>dBuV | P<br>(H, V) | Ant. Factor<br>dB | Cable Loss<br>dB | AMP GAIN<br>dB | Total<br>dBuV | Limit<br>dBuV | Margin<br>dB |
|------------------|-----------------|-------------|-------------------|------------------|----------------|---------------|---------------|--------------|
| -                | -               | -           | -                 | -                | -              | -             | -             | -            |

Note : Other emissions don't exceed the level of 20 dB below the applicable Limit.

[Applicable]

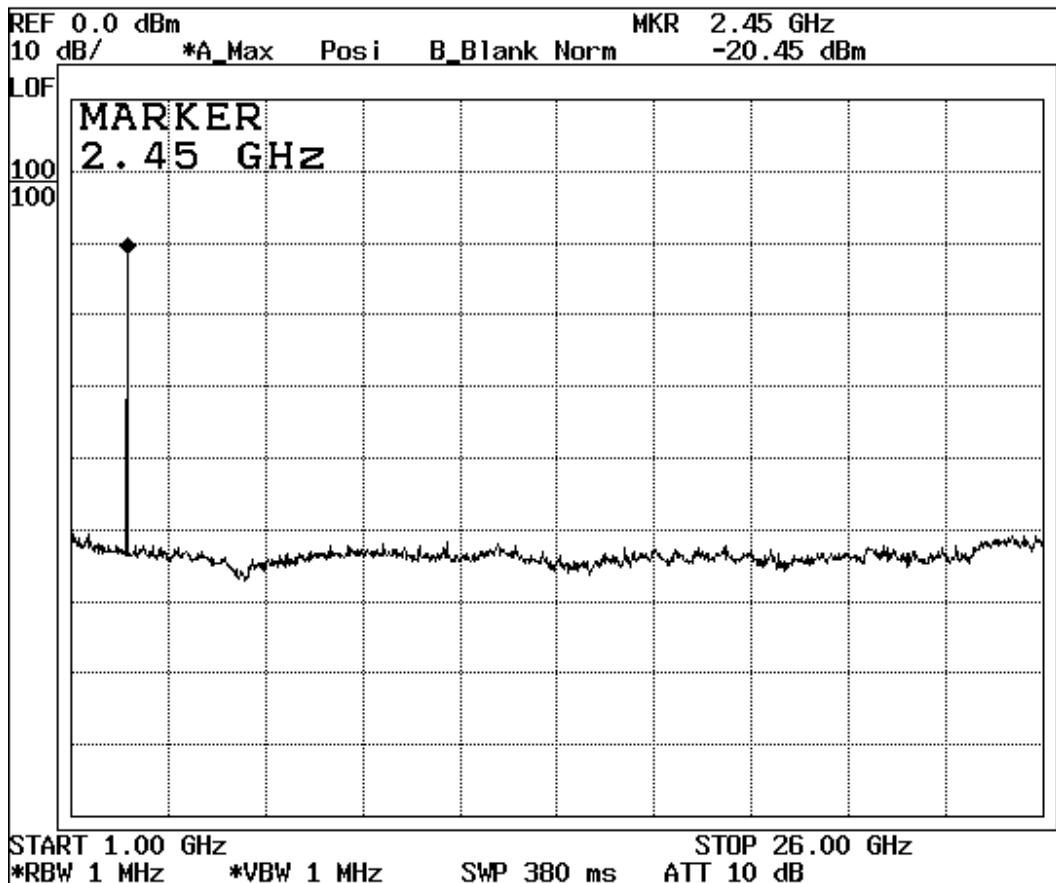
|       |          |       |                   |
|-------|----------|-------|-------------------|
| EUT   | O2USZM01 | PROBE | RF 1GHZ~26GHz     |
| POWER | DC 12 V  | NOTE  | TX-CH8 (2445 MHz) |



Note : Other emissions don't exceed the level of 20 dB below the applicable Limit.

[Applicable]

|       |          |       |                    |
|-------|----------|-------|--------------------|
| EUT   | O2USZM01 | PROBE | RF 1GHZ~26GHZ      |
| POWER | DC 12 V  | NOTE  | TX-CH15 (2480 MHz) |



Note : Other emissions don't exceed the level of 20 dB below the applicable Limit.

## Peak Power Output

### ◆Test Equipment

The following test equipment are used during the test:

| Item | Equipment         | Manufacturer | Model no/Serial No. | Last Cal.     |
|------|-------------------|--------------|---------------------|---------------|
| 1    | Spectrum Analyzer | ADVANTEST    | R3273 / 95090431    | Aug. 01, 2008 |
| 2    | RF ROOM           |              |                     |               |

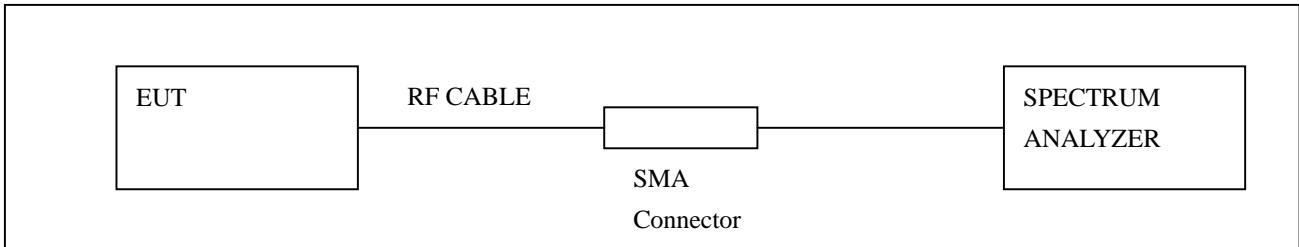
*Note : All equipment upon which need to calibrated are with calibration period of 1 year.*

### ◆Limits

The maximum peak output power of the intentional radiator shall not exceed the following :

1. According to § 15.247(b)(3), for systems using digital modulation in the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz : 1Watt.
2. According to § 15.247(b)(4), the conducted output power limit specified in paragraph(b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph(c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs(b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi

### ◆Test Setup



### ◆Test Procedure

The transmitter output is connected to the Spectrum analyzer. The Spectrum analyzer is set to the peak power detection.

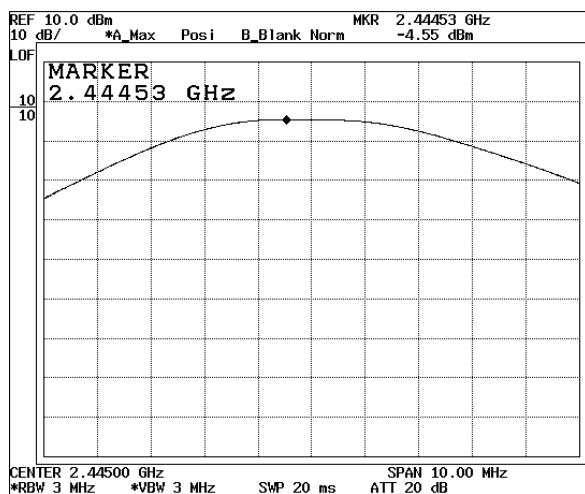
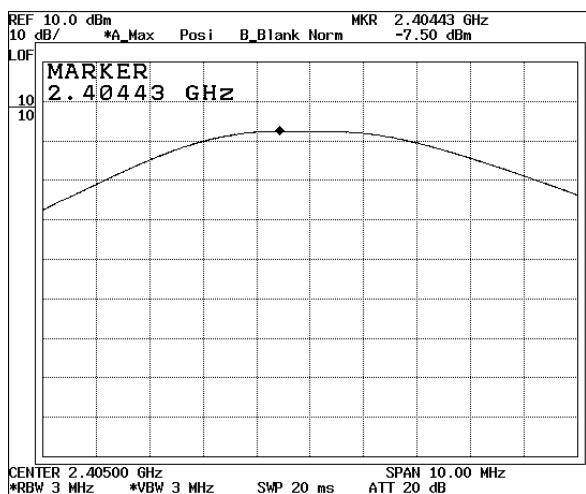
### Peak Power Test result

|                    |                   |  |  |  |
|--------------------|-------------------|--|--|--|
| Product            | O2USZM01          |  |  |  |
| Test Item          | Peak Power Output |  |  |  |
| Test Mode          | Transmit          |  |  |  |
| Test Site          | RF Room           |  |  |  |
| Measurement Method | Conducted         |  |  |  |

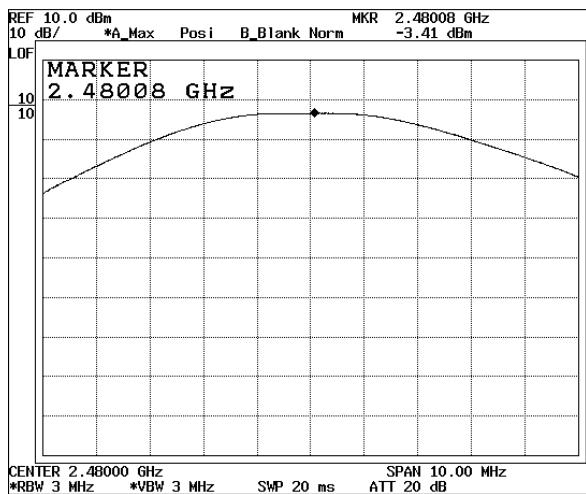
| Channel No. | Frequency (MHz) | Measure Level (dBm) | Limit (dBm) | Result |
|-------------|-----------------|---------------------|-------------|--------|
| 1           | 2405            | -7.50               | 1Watt=30dBm | Pass   |
| 8           | 2445            | -4.55               | 1Watt=30dBm | Pass   |
| 15          | 2480            | -3.41               | 1Watt=30dBm | Pass   |

Channel 1.

Channel 8.



Channel 15



Note : Measurement level = reading level + correct factor

### Band Edge

#### ◆TEST Equipment

The following test equipment are used during the test:

| Name                 | Type          | Manufacturer    | Calibration. Date | Serial Number |
|----------------------|---------------|-----------------|-------------------|---------------|
| ESCS30               | EMI Receiver  | Rohde & Schwarz | Sep. 10, 2008     | 100171        |
| SPECTRUM<br>ANALYZER | R3273         | ADVANTEST       | Sep. 12, 2008     | 95095431      |
| BICONILOG<br>Antenna | VULB 9160     | Schwarz beck    | Aug. 28, 2007     | 3047          |
| HORN-Antenna         | 3115          | EMCO            | Dec. 26, 2007     | 9012-3602     |
| HORN-Antenna         | SAS-571       | A.H. SYSTEMS    | Dec. 26, 2007     | 500           |
| PRE AMPLIFIER        | 8449B OPT H02 | Rohde & Schwarz | Oct. 11, 2008     | 3008A0530     |

*Note : 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to RRL, KRISS, KTL and HCT.  
 2. The calibration interval of horn ant. and loop ant. is 24 months*

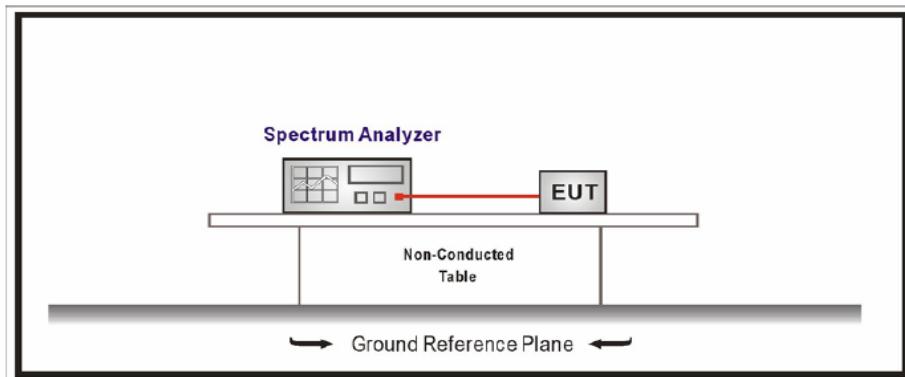
#### ◆Limits

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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.

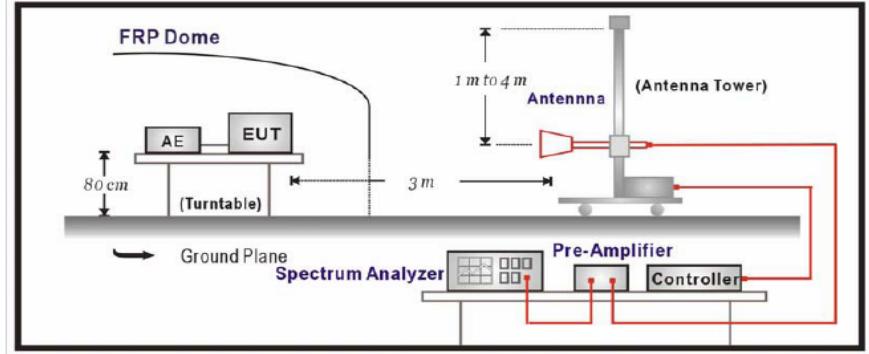
Attenuation below the general limits specified in section 15.209(a) is not required. In addition, radiated emission which fall in the restricted bands, as defined in section 15.205(a), must also comply with the radiated emission limits specified in section 15.209(a)(see Section 15.205(c)).

## ◆Test setup

### RF Conducted Measurement:



### RF Radiated Measurement:



## ◆Test procedure

The EUT and its simulators are placed on a turn table which is 0.8 meter above ground. The turn table can rotate 360 degrees to determine the position of the maximum emission level. The EUT was positioned such that the distance from antenna to the EUT was 3 meters. The antenna can move up and down between 1 meter and 4 meters to fine out the maximum emission level.

Both horizontal and vertical polarization of the antenna are set on measurement. In order to find the maximum emission, all of the interface cables must be manipulated according to ANSI C63.4:2003 on radiated measurement.

The bandwidth below 1 GHz setting on the field strength meter is 120 kHz, above 1GHz are 1MHz.

Test specification

According to FCC Part 15 Subpart C paragraph 15.247:2005

Band Edge Test result

|                    |           |
|--------------------|-----------|
| Product            | O2USZM01  |
| Test Item          | Band Edge |
| Test Mode          | Transmit  |
| Test Site          | RF Room   |
| Measurement Method | Conducted |

Detect mode : Peak

Channel : 1 CH(2405 MHz)



Detect mode : Peak

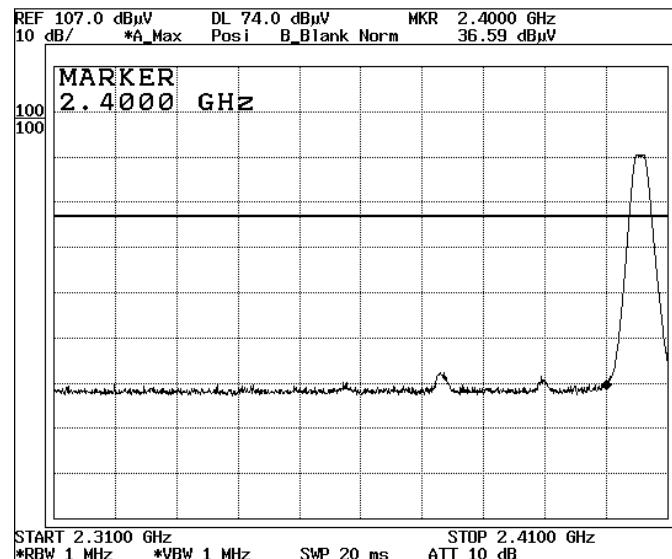
Channel : 15 CH(2480 MHz)



|                    |                          |
|--------------------|--------------------------|
| Product            | O2USZM01                 |
| Test Item          | Band Edge                |
| Test Mode          | Transmit                 |
| Test Site          | Radiated Measure Room #1 |
| Measurement Method | Radiated                 |

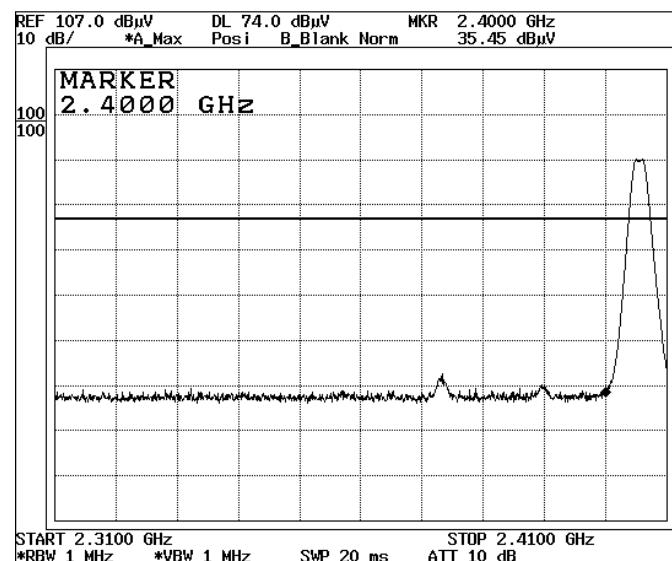
Detect mode : Peak

Channel : 1 CH(2405 MHz)-Ver.



Detect mode : Peak

Channel : 1 CH(2405 MHz)-Hor.



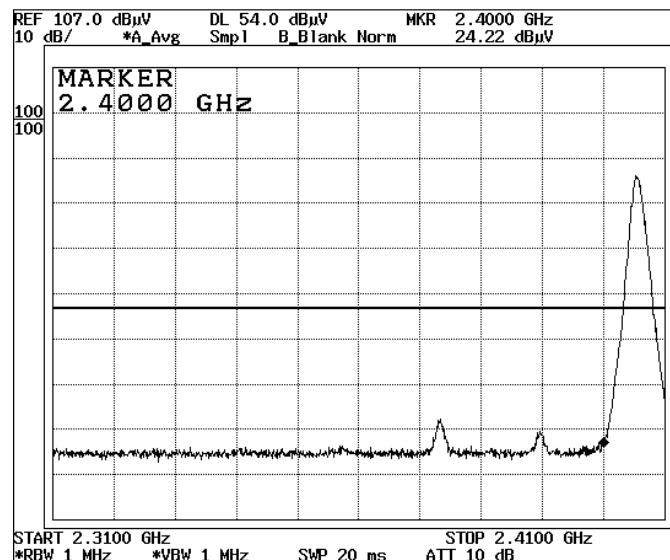
Detect mode : Average

Channel : 1 CH(2405 MHz)-Ver.



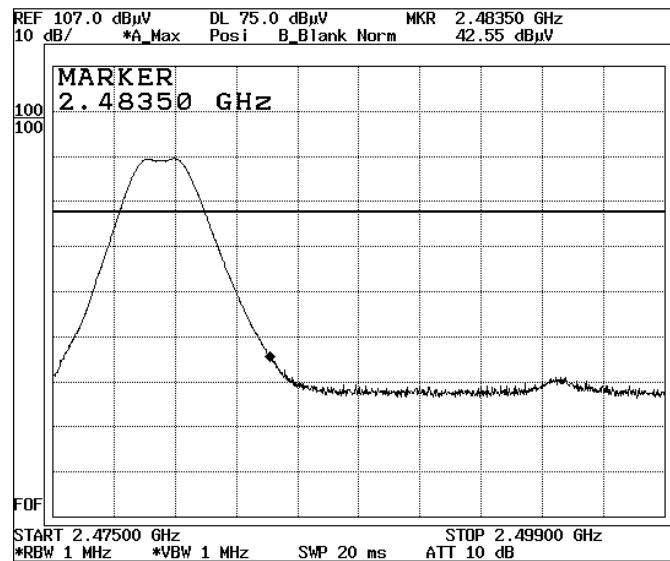
Detect mode : Average

Channel : 1 CH(2405MHz)-Hor.



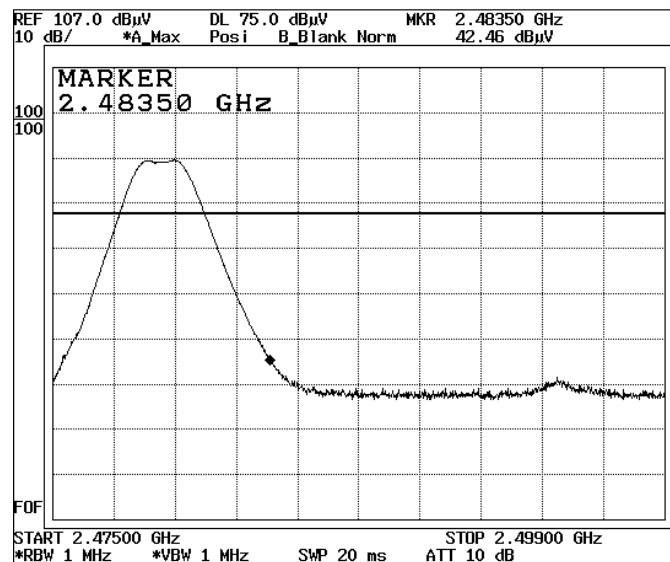
Detect mode : Peak

Channel : 15 CH(2480 MHz)-Ver.



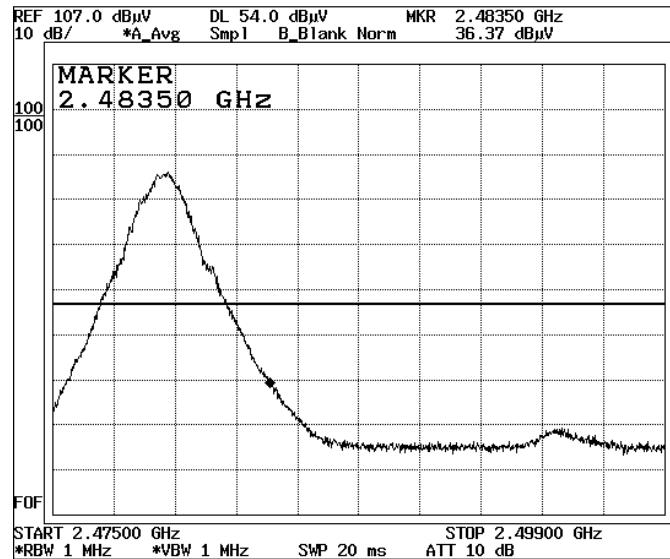
Detect mode : Peak

Channel : 15 CH(2408 MHz)-Hor.



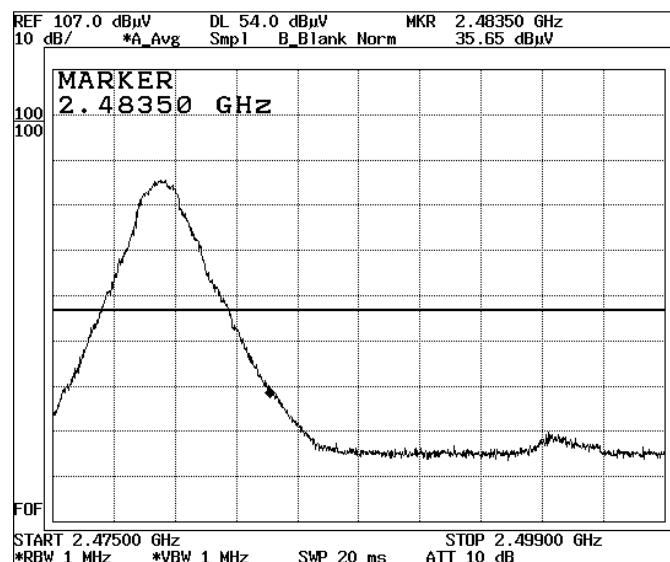
Detect mode : Average

Channel : 15 CH(2480 MHz)-Ver.



Detect mode : Average

Channel : 15 CH(2480 MHz)-Hor.



## 6dB Band

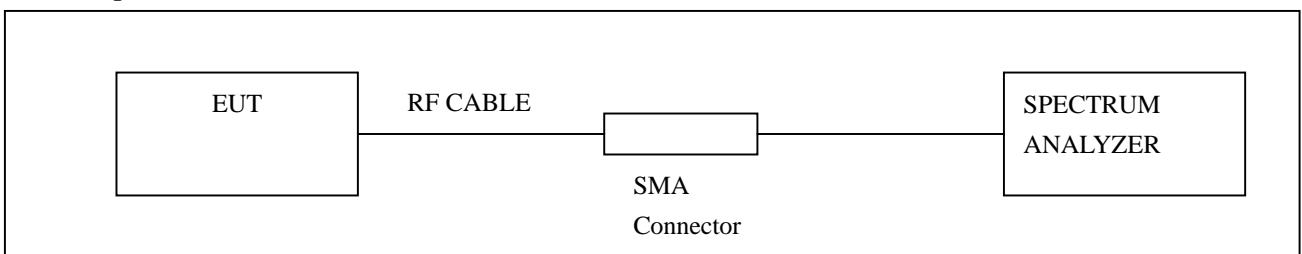
### ◆Test Equipment

The following test equipment are used during the test:

| Item | Equipment         | Manufacturer | Model no/Serial No. | Last Cal.    |
|------|-------------------|--------------|---------------------|--------------|
| 1    | Spectrum Analyzer | ADVANTEST    | R3273 / 95090431    | Sep.12, 2008 |
| 2    | RF ROOM           |              |                     |              |

*Note : All equipment upon which need to calibrated are with calibration period of 1 year.*

### ◆Test Setup



### ◆Limits

(a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions :

(2) systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

### ◆Test Procedure

The transmitter output is connected to the Spectrum analyzer. The Spectrum analyzer is set to the 6dB Band(Occupied Bandwidth). According to FCC CFR Title 47 Part 15 Subpart C Section 15.247:2005

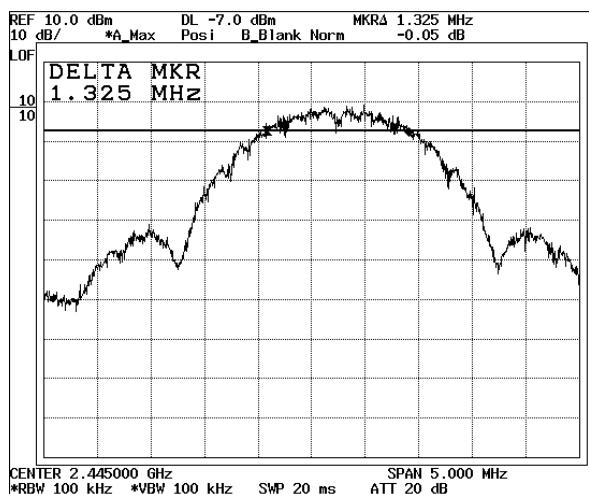
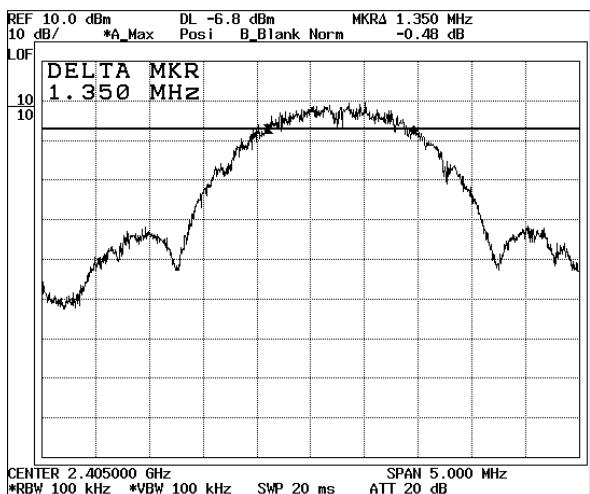
Test result

|                    |           |
|--------------------|-----------|
| Product            | O2USZM01  |
| Test Item          | 6dB Band  |
| Test Mode          | Transmit  |
| Test Site          | RF Room   |
| Measurement Method | Conducted |

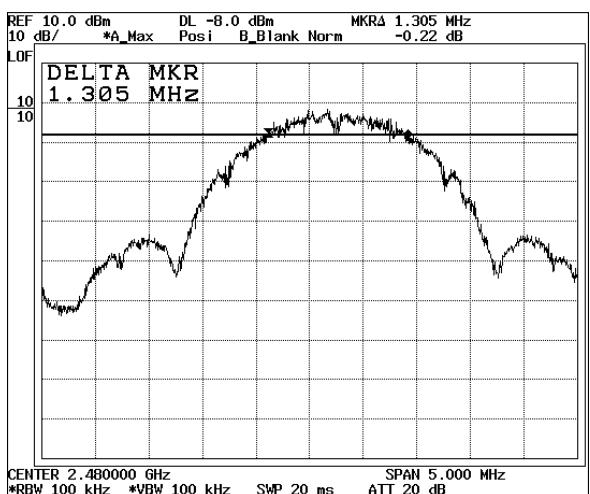
| Channel No. | Frequency (MHz) | Measure Level (KHz) | Limit (KHz) | Result |
|-------------|-----------------|---------------------|-------------|--------|
| 1           | 2405            | 1580                | >500        | Pass   |
| 8           | 2445            | 1560                | >500        | Pass   |
| 15          | 2480            | 1550                | >500        | Pass   |

Channel 1.

Channel 8.



Channel 15



## Power Density

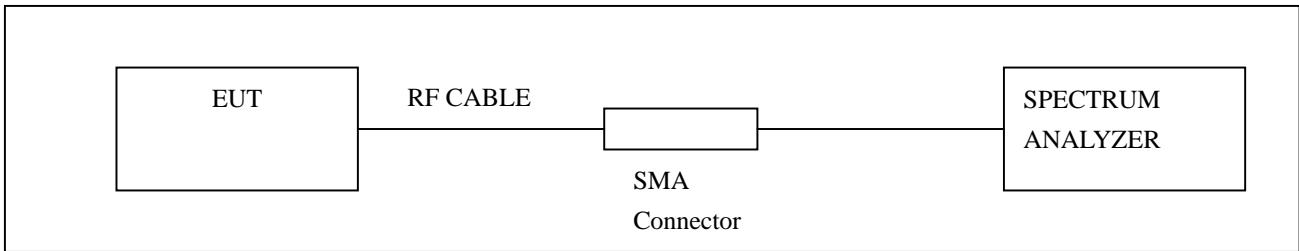
### ◆Test Equipment

The following test equipment are used during the test:

| Item | Equipment         | Manufacturer | Model no/Serial No. | Last Cal.     |
|------|-------------------|--------------|---------------------|---------------|
| 1    | Spectrum Analyzer | ADVANTEST    | R3273 / 95090431    | Sep. 12, 2008 |
| 2    | RF ROOM           |              |                     |               |

*Note : All equipment upon which need to calibrated are with calibration period of 1 year.*

### ◆Test Setup



### ◆Limits

Section 15.247 (e) For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (v) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

### ◆Test Procedure

The transmitter output is connected to the Spectrum analyzer. The Spectrum analyzer is set to the 6dB Band(Occupied Bandwidth). According to FCC CFR Title 47 Part 15 Subpart C Section 15.247:2005

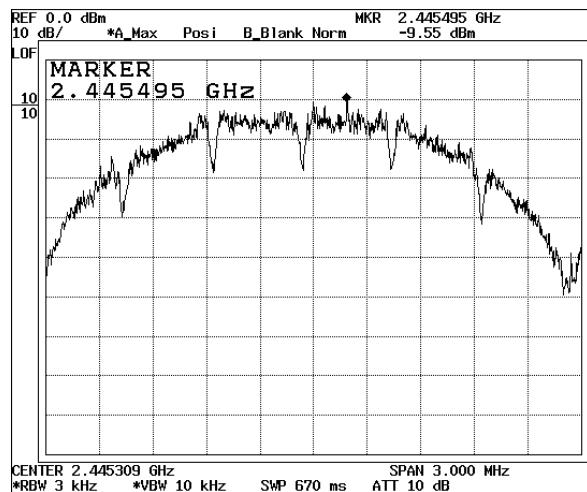
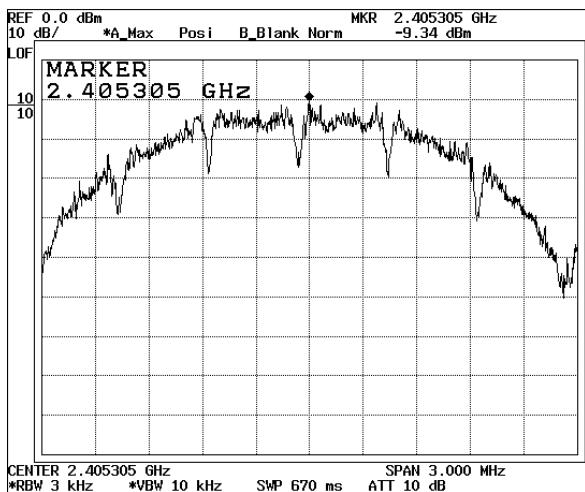
Test result

|                    |               |
|--------------------|---------------|
| Product            | O2USZM010     |
| Test Item          | Power Density |
| Test Mode          | Transmit      |
| Test Site          | RF Room       |
| Measurement Method | Conducted     |

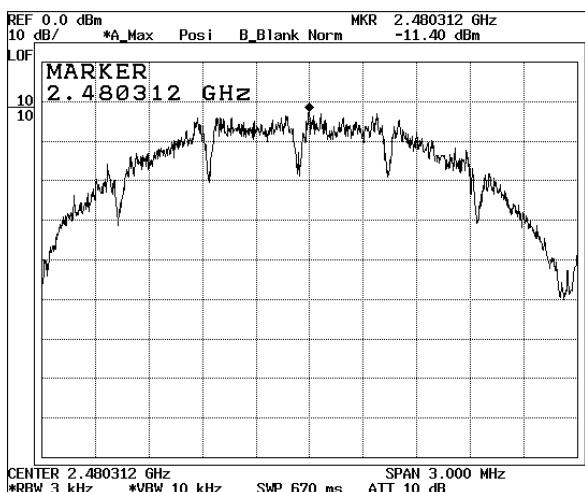
| Channel No. | Frequency (MHz) | Measure Level (dBm) | Limit (dBm) | Result |
|-------------|-----------------|---------------------|-------------|--------|
| 1           | 2405            | -22.11              | < 8         | Pass   |
| 8           | 2445            | -19.88              | < 8         | Pass   |
| 15          | 2480            | -18.52              | < 8         | Pass   |

Channel 1.

Channel 8.



Channel 15



Note : Measurement level = reading level + correct factor

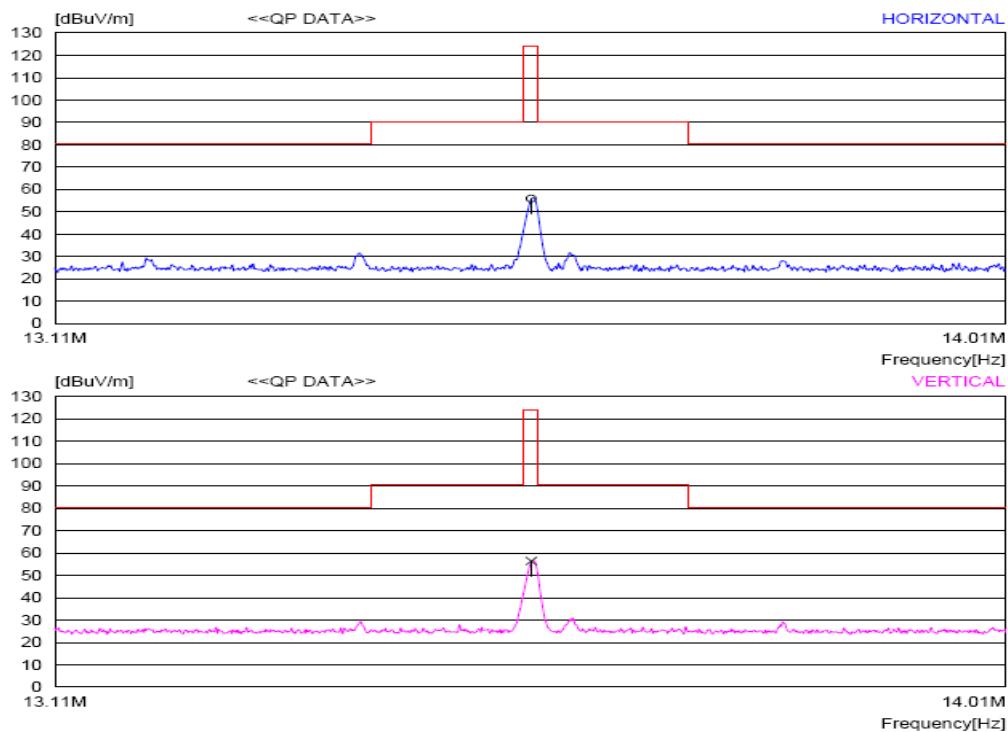
## RFID Mode ( 13.56 MHz )

### Radiated Field Emission-15.225(a)

| Frequency(MHz)  | Field Strength of Fundamental uV/m | Field Strength of Fundamental dBuV/m(30m) | Field Strength of Fundamental dBuV/m(3m) |
|-----------------|------------------------------------|---|--|
| 13.553 – 13.567 | 15,848                             | 83.9                                      | 123.9                                    |

#### [Applicable]

| Freq. [MHz] | Reading [dBuV] | Height [m] | Antenna Factor [dB/m] | Cable Loss [dB] | Polar. [H/V] | Result [dBuV/m] | Limit [dBuV/m] | Margin [dB] |
|-------------|----------------|------------|-----------------------|-----------------|--------------|-----------------|----------------|-------------|
| 13.5615     | 37.5           | 1          | 18.3                  | 0.1             | H            | 55.9            | 123.9          | 68.0        |
| 13.56215    | 38.0           | 1          | 18.3                  | 0.1             | V            | 56.4            | 123.9          | 67.5        |



Note :

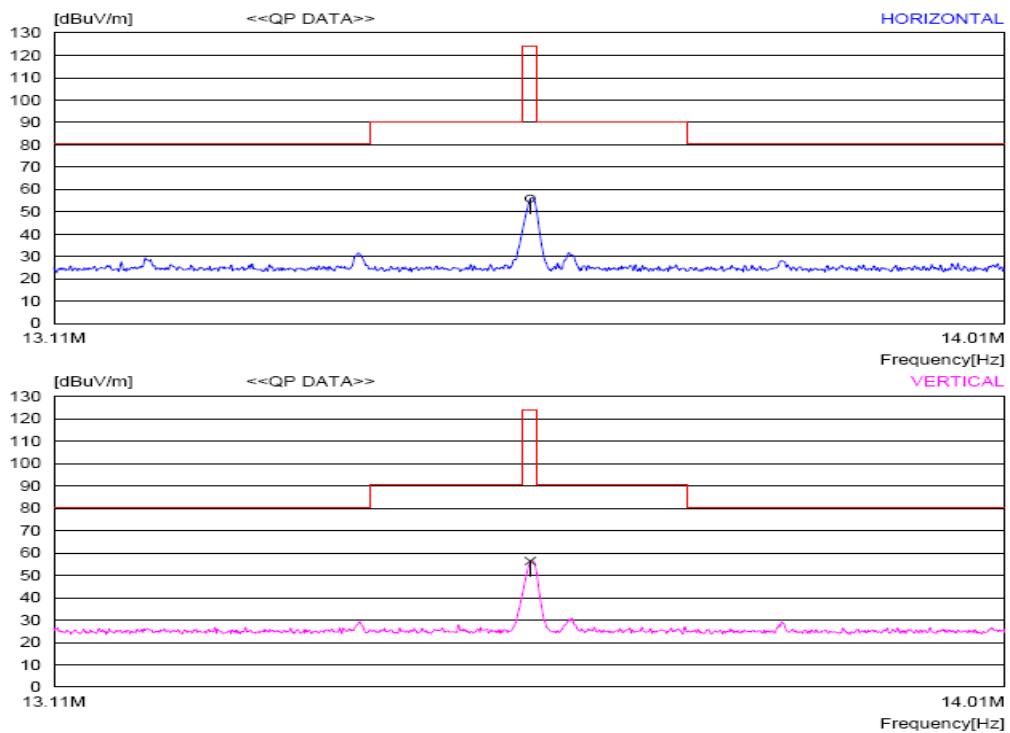
Radiated Electric Emission-15.225(b)(c)

| Frequency<br>(MHz) | Field Strength of<br>Fundamental uV/m | Field Strength of<br>Fundamental dBuV/m(30m) | Field Strength of<br>Fundamental dBuV/m(3m) |
|--------------------|---------------------------------------|--|---|
| 13.110 - 13.410    | 106                                   | 40.5   | 80.5  |
| 13.410 - 13.553    | 334                                   | 50.4   | 90.4  |
| 13.567 - 13.710    | 334                                   | 50.4   | 90.4  |
| 13.710 - 14.010    | 106                                   | 40.5   | 80.5  |

[Applicable]

| Freq.<br>[MHz] | Reading<br>[dBuV] | Height<br>[m] | Antenna<br>Factor<br>[dB/m] | Cable<br>Loss<br>[dB] | Polar.<br>[H/V] | Result<br>[dBuV/m] | Limit<br>[dBuV/m] | Margin<br>[dB] |
|----------------|-------------------|---------------|-----------------------------|-----------------------|-----------------|--------------------|-------------------|----------------|
| -              | -                 | -             | -                           | -                     | -               | -                  | -                 | -              |

Note : Other emission don't exceed the level 20dB below the applicable limit.



**Radiated Field Emission-15.109, 15.225(d)**

| Frequency<br>(MHz) | Field Strength of<br>Fundamental uV/m | Field Strength of<br>Fundamental dBuV/m(3m) |
|--------------------|---------------------------------------|---|
| 1.705 - 30.0       | 30                                    | 49.5  |
| 30 - 88            | 100                                   | 40  |
| 88 - 216           | 150                                   | 43.5  |
| 216 - 960          | 200                                   | 46  |
| Above 960          | 500                                   | 54  |

**[Applicable]**

| Freq.<br>[MHz] | Reading<br>[dBuV] | Height<br>[m] | Antenna<br>Factor<br>[dB/m] | Cable<br>Loss<br>[dB] | Polar.<br>[H/V] | Result<br>[dBuV/m] | Limit<br>[dBuV/m] | Margin<br>[dB] |
|----------------|-------------------|---------------|-----------------------------|-----------------------|-----------------|--------------------|-------------------|----------------|
| 18.220         | 13.89             | 100           | 18.35                       | 0.66                  | V               | 32.90              | 49.50             | 16.60          |
| 19.995         | 5.84              | 100           | 18.40                       | 0.69                  | H               | 24.93              | 49.50             | 24.57          |
| 23.335         | 3.96              | 100           | 18.41                       | 0.70                  | V               | 23.07              | 49.50             | 26.43          |
| 24.395         | 5.18              | 100           | 18.41                       | 0.70                  | H               | 24.29              | 49.50             | 25.21          |
| 108.499        | 17.90             | 107           | 10.80                       | 2.30                  | V               | 31.0               | 43.50             | 12.50          |
| 135.624        | 15.90             | 120           | 13.60                       | 2.50                  | V               | 32.0               | 43.50             | 11.50          |
| 352.623        | 13.60             | 105           | 13.80                       | 3.90                  | H               | 31.3               | 46.00             | 14.70          |
| 448.253        | 18.60             | 105           | 16.70                       | 4.50                  | V               | 39.8               | 46.00             | 6.20           |
| 515.382        | 18.50             | 104           | 17.00                       | 4.60                  | V               | 40.1               | 46.00             | 5.90           |
| 596.753        | 15.10             | 116           | 18.70                       | 5.00                  | H               | 38.8               | 46.00             | 7.20           |
| 786.634        | 14.30             | 162           | 21.30                       | 5.50                  | H               | 41.1               | 46.00             | 4.90           |
| 800.194        | 12.10             | 101           | 21.50                       | 5.60                  | H               | 39.2               | 46.00             | 6.80           |

**Frequency Stability -15.225(e)**

◆ Test Equipment Used

| Name   | Type              | Manufacturer | Calibration. Date | Serial Number |
|--------|-------------------|--------------|-------------------|---------------|
| R3273  | SPECTRUM ANALYZER | ADVANTEST    | Sep. 12, 2008     | 95090431      |
| PL-4SP | Temp&Humi Chamber | TABAII       | Aug. 19, 2008     | 44VH0266      |

The frequency tolerance of the carrier signal shall be maintained within  $\pm 0.01\%$  of the operating frequency over a temperature variation of -20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery

**[Applicable]**

Table 1 : Frequency Tolerance

Reference Frequency : 13.5615 MHz, Limit : within  $\pm 1356$  Hz

| Environment Temperature [°C] | Power Supplied [Vdc] | Carrier Frequency Measured with Time Elapsed |         |           |         |           |         |            |         |
|------------------------------|----------------------|--|---------|-----------|---------|-----------|---------|------------|---------|
|                              |                      | STARTUP                                      |         | 2 minutes |         | 5 minutes |         | 10 minutes |         |
|                              |                      | [MHz]  | Err[Hz] | [MHz]     | Err[Hz] | [MHz]     | Err[Hz] | [MHz]      | Err[Hz] |
| +50                          | 12                   | 13.561471                                    | -29     | 13.561453 | -47     | 13.561449 | -51     | 13.561453  | -47     |
| +40                          | 12                   | 13.561522                                    | 22      | 13.561536 | 36      | 13.561567 | 67      | 13.561521  | 21      |
| +30                          | 12                   | 13.561568                                    | 68      | 13.561542 | 42      | 13.561569 | 69      | 13.561533  | 33      |
| +20                          | 12                   | 13.561604                                    | 104     | 13.561597 | 97      | 13.561583 | 83      | 13.561608  | 108     |
| +10                          | 12                   | 13.561627                                    | 127     | 13.561605 | 105     | 13.561611 | 111     | 13.561621  | 121     |
| 0                            | 12                   | 13.561624                                    | 124     | 13.561627 | 127     | 13.561625 | 125     | 13.561627  | 127     |
| -10                          | 12                   | 13.561629                                    | 129     | 13.561623 | 123     | 13.561636 | 136     | 13.561627  | 127     |
| -20                          | 12                   | 13.561637                                    | 137     | 13.561635 | 135     | 13.561638 | 138     | 13.561639  | 139     |

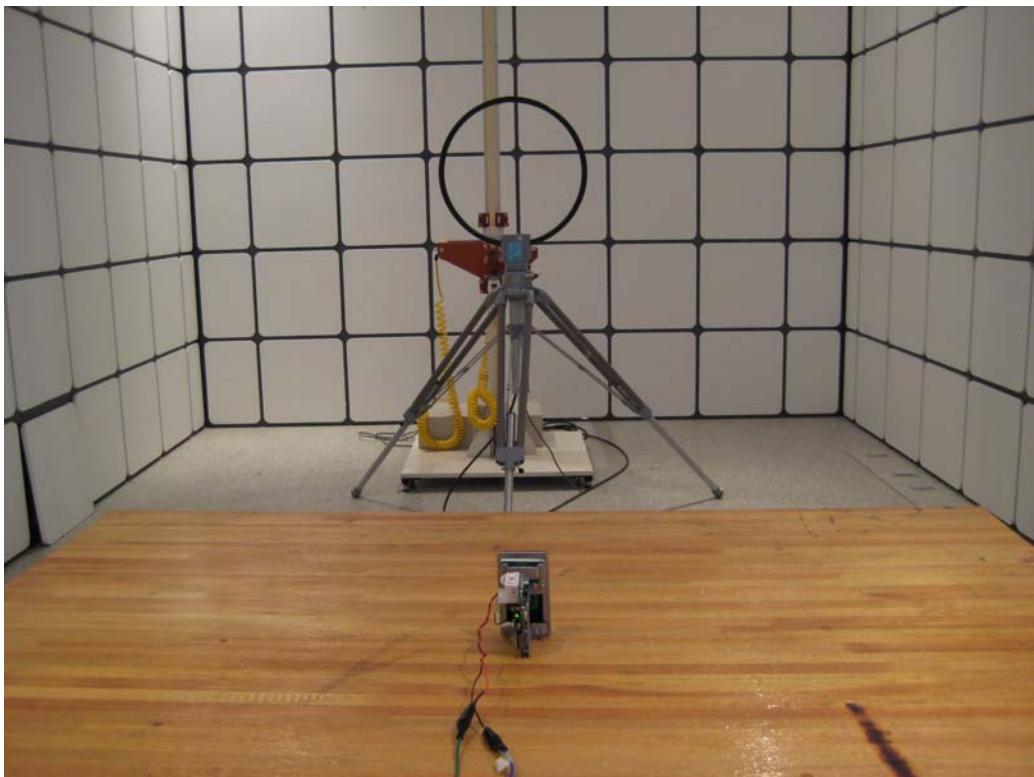
Table 2 : Frequency Tolerance

Reference Frequency : 13.5615 MHz, Limit : within  $\pm 1356$  Hz

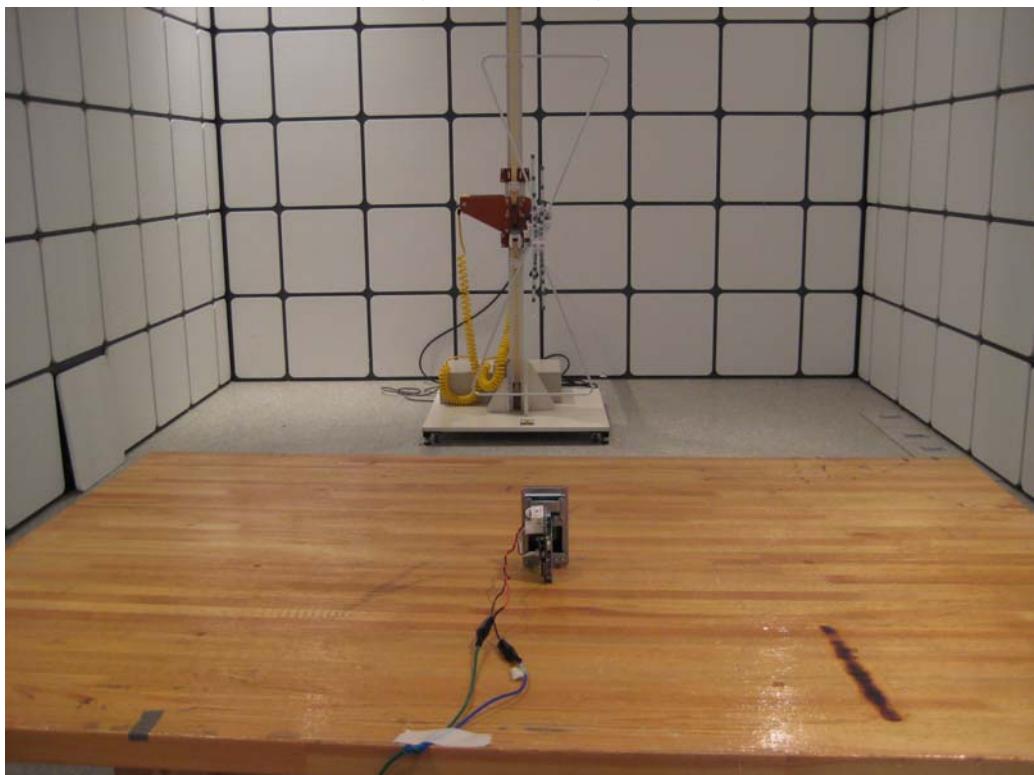
| Power Supplied [Vdc] | Carrier Frequency Measured with Time Elapsed |         |           |         |           |         |            |         |
|----------------------|--|---------|-----------|---------|-----------|---------|------------|---------|
|                      | STARTUP                                      |         | 2 minutes |         | 5 minutes |         | 10 minutes |         |
|                      | [MHz]  | Err[Hz] | [MHz]     | Err[Hz] | [MHz]     | Err[Hz] | [MHz]      | Err[Hz] |
| 85%                  | 13.561548                                    | 48      | 13.561551 | 51      | 13.561563 | 63      | 13.561569  | 69      |
| 100%                 | 13.561549                                    | 49      | 13.561553 | 53      | 13.561562 | 62      | 13.561569  | 69      |
| 115%                 | 13.561548                                    | 48      | 13.561553 | 53      | 13.561563 | 63      | 13.56157   | 70      |

**Err[Hz] = Measured carrier frequency (MHz) – Reference Frequency (13.5615 MHz)**

**Appendix A. The Photos of Test Setup**



**Radiated Emissions(9 KHz~30 MHz) - Continue Transmit**

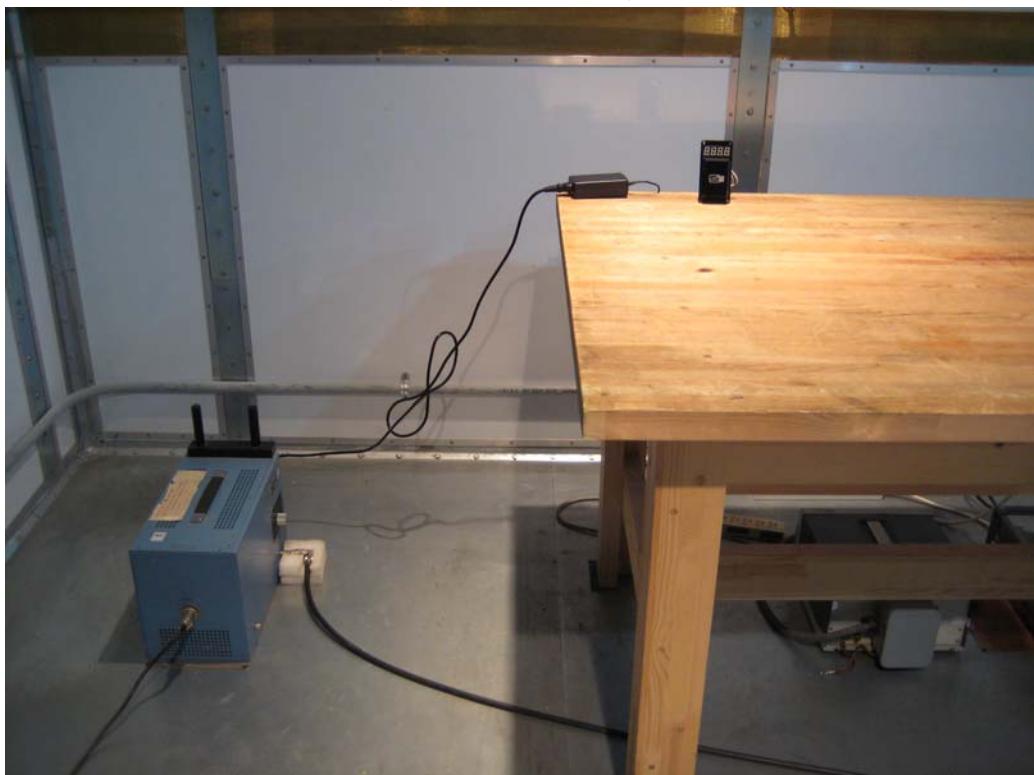


**Radiated Emissions(30 MHz~1000 MHz) - Continue Transmit**

**Appendix A. The Photos of Test Setup**



**Radiated Emissions(1000 MHz~1800MHz) - Continue Transmit**



**Conducted Emissions(150 KHz~30 MHz) - Continue Transmit**

Appendix B. The Photos of Equipment Under Test



Front view



rear view