# TEST REPORT

| | |
|---|---|
| Report No. : | ICM05008-FCC |
| Date : | 22nd June 2005 |
| Applicant : | SEIKO EPSON CORPORATION MATSUMO MINAMI PLANT<br>2070 Kotobuki Koaka , Matsumoto-shi , Nagano-Ken ,<br>399-8702 Japan |
| EUT : | Bluetooth Interface board for printer |
| FCC ID : | BKMFBM224A |
| Model No. : | M224A |
| Serial No. : | 7,10 |
| Receipt date of tested sample : | 10th June 2005 |
| Date of measurement : | 14th , 17th June 2005 (Radiated Emission)<br>15th June 2005 (Conducted Emission)<br>16th June 2005 (AC Powerline Conducted Emission) |
| Test location : | Taiyo Yuden Co.,Ltd. EMC Center<br>5607-2, Nakamuroda,Haruna-machi,<br>Gunma-Gun, Gunma , 370-3347,Japan. |
| Applied standard : | FCC 47 CFR Part 15 Subpart C Section15.207 , (10-1-04 Edition) |
| Procedure : | ANSI C63.4-2003 |
| Test results: | PASS |

**Approved by** : Manager / Kenzo Furuta

**Reviewed by** : Chief Engineer / Takeshi Matsumura

NVLAP LAB CODE 200607-0

# Table of Contents


**1 TEST REPORT ..... 4**

**2 GENERAL INFORMATION ..... 4**

2.1 PRODUCT DESCRIPTION ..... 4
2.2 SUMMARY OF TEST AND INSPECTION RESULT ..... 5
2.3 TEST METHODOLOGY ..... 5
2.4 TEST FACILITY ..... 5

**3 SYSTEM TEST CONFIGURATION ..... 6**

3.1 JUSTIFICATION ..... 6
3.2 OPERATING MODES ..... 6
3.3 LIST OF ACCESSORIES ..... 7
3.4 INTERFACE CABLES ..... 7
3.5 SPECIAL TEST CONDITION ..... 7
3.6 EQUIPMENT MODIFICATIONS ..... 7
3.7 CONFIGURATION OF TESTED SYSTEM ..... 8

**4 ANTENNA REQUIREMENT ..... 9**

**5 AC POWERLINE CONDUCTED EMISSION TEST ..... 10**

5.1 TEST SETUP ..... 10
5.2 TEST INSTRUMENTATION ..... 10
5.3 CONDUCTED EMISSION CALCULATION ..... 11
5.4 TEST RESULTS ..... 12
5.4.1 Transmitting mode ..... 12

**6 RADIATED EMISSION TEST ..... 15**

6.1 TEST SETUP ..... 15
6.2 RADIATED EMISSION CALCULATION ..... 16
6.3 TEST RESULTS ..... 17
6.3.1 Transmitting mode ..... 17

**7 20DB BANDWIDTH ..... 23**

7.1 TEST SETUP ..... 23
7.2 TEST INSTRUMENT ..... 23
7.3 TEST RESULTS ..... 23

**8 CARRIER FREQUENCY SEPARATION ..... 24**

8.1 TEST SETUP ..... 24
8.2 TEST INSTRUMENT ..... 24
8.3 TEST RESULTS ..... 24

**9 NUMBER OF HOPPING FREQUENCY ..... 25**

9.1 TEST SETUP ..... 25
9.2 TEST INSTRUMENT ..... 25
9.3 TEST RESULTS ..... 25

**10 DWELL TIME ..... 26**

10.1 TEST SETUP ..... 26
10.2 TEST INSTRUMENT ..... 26
10.3 TEST RESULTS ..... 26

**11 MAXIMUM PEAK OUTPUT POWER ..... 28**
11.1 TEST SETUP ..... 28
11.2 TEST INSTRUMENT ..... 28
11.3 TEST RESULTS ..... 28
**12 BAND EDGE COMPLIANCE ..... 29**
12.1 TEST SETUP ..... 29
12.2 TEST INSTRUMENT ..... 29
12.3 TEST RESULTS ..... 29
**13 SPURIOUS RF CONDUCTED EMISSION ..... 31**
13.1 TEST SETUP ..... 31
13.2 TEST INSTRUMENT ..... 31
13.3 TEST RESULTS ..... 31
**14 EIRP CALCULATION FROM PEAK POWER ..... 35**
**15 PHOTOS OF TESTED EUT ..... 36**
**16 PHOTOS OF TEST SETUP ..... 37**
16.1 PHOTOS OF RADIATED MEASUREMENT ..... 37
16.2 PHOTOS OF CONDUCTED MEASUREMENT ..... 38

# 1 Test report

(1) This report summarizes the result of a single investigation and test result relate only to tested sample.
(2) The report shall not be reproduced except in full without the written approval of the Taiyo Yuden Co.,Ltd.
(3) This test report must not be used by the client to claim product endorsement by any government agency.

# 2 General Information

## 2.1 Product Description

EUT : Bluetooth Interface board for printer
Model No. : M224A
Serial No. : 7,10
FCC ID : BKMFBM224A
Description of EUT : Pre-Production
Summary of EUT : The Epson Bluetooth Interface board for printer is frequency hopping intentional radiators that operates on the 2400 – 2483.5MHz band.
It is designed to be install in the host printer.
The EUT uses integral antenna.
Modulation : GFSK
Power supply : DC 3.3V
Waight : 12.58g
Dimensions of EUT : W50mm × D70mm × H6.7mm
Antenna gain : 2.044dBi.(at 2441MHz)
The clock frequencies used in this EUT:
1.MHz (IF-TX mode)
1.5MHz (IF-RX mode)
Fvco (1200.25 to 1239.25MHz[RX],1201 to 1240MHz[TX])
X' tal (16 MHz)

## 2.2 Summary of Test and Inspection Result

| No. | Item | Test Procedure | Specification | Remarks | Deviation | Worst Margin | Results |
|---|---|---|---|---|---|---|---|
| 1 | AC Powerline Conducted Emission | ANSI C63.4:2003 | FCC 15.207 | - | N/A | 4.6dB Transmittingmode:2402MHz 0.558MHz VA (AV) | Pass |
| 2 | 20dB Bandwideth | ANSI C63.4:2003 Public Notice DA00-705 | FCC 15.247(a)(1) (i) | Conducted | N/A | - | Pass |
| 3 | Carrier Frequency Separation | | FCC 15.247(a)(1) FCC 04-165 | | N/A | - | Pass |
| 4 | Number of Hoping Frequency | | FCC 15.247(a)(1)(iii) | | N/A | - | Pass |
| 5 | Dwell time | | FCC 15.247(a)(1)(iii) | | N/A | - | Pass |
| 6 | Maximum peak Output Power | | FCC 15.247(b)(1) | | N/A | - | Pass |
| 7 | Band Edge Compliance | | FCC 15.247(c) | | N/A | - | Pass |
| 8 | Spurious RF Conducted Emission | | FCC 15.247(c) | | N/A | - | Pass |
| 9 | Radiated Emission | | FCC 15.247(c) | Radiated | N/A | 9.8dB Tansmitting mode:2480MHz Direction:XY Horizontal (AV)14880.0MHz | Pass |

## 2.3 Test Methodology

Interference measurements were made in accordance with ANSI C63.4-2003 Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

## 2.4 Test Facility

1. FCC 47CFR, Part 15, Section 15.247 regulation test were performed on the shielded room, and radiated interference field strength test was performed on the 10 meter semi-anechoic chamber located at Taiyo Yuden Co.,Ltd. EMC Center, 5607-2 Nakamuroda Haruna-Machi Gunma-Gun Gunma, 370-3347 Japan.
2. This Laboratory is accredited under the National Voluntary Laboratory Accreditation Program (NVLAP) by United States Department of Commerce, National Institute of Standard and Technology (NIST) for satisfactory compliance with criteria established in Title 15, Part 285 Code of Federal Regulations.
3. These criteria encompass the requirements of ISO/IEC 17025:1999 and the relevant requirements of ISO 9002:1994 as suppliers of calibration or test results. Accreditation awarded for specific services, listed on the Scope of Accreditation for: ELECTROMAGNETIC COMPATIBILITY AND TELECOMMUNICATIONS FCC. (NVLAP LAB CODE: 200607-0).

# 3 System Test Configuration

## 3.1 Justification

1. Emission tests were performed with no deviation from the ANSI C63.4-2003 and FCC 47CFR, Part 15, Section 15.247 regulation tests were performed with no deviation from the FCC Public Notice DA00-705 released March 30, 2000.
2. The system was configured for testing a typical fashion. (as a customer would normally use it.)
3. Radiate testing in the range of 1 GHz to 25 GHz was investigated with the spectrum (peak detector function) under the FCC regulation section 15.209 (e) and 15.35 (b). The test performed at an antenna to EUT distance of 1 meter. The level of any unwanted emissions from EUT did not exceed the level of the fundamental emission (Compliance with 15.209 (c)). And test result found to be compliance with FCC regulation section 15.209 (a) Radiated emission limits (500 micro-volts/meter). Data is presented for the "worst case" measurements, that E.U.T was normal operated.
4. Radiate testing in the range of 30 MHz to 1000 MHz was performed at an antenna to EUT distance of 3 meters under the 15.209 (e) and 15.31(f)(1).
5. All tests were performed with the representative channel operation as follows.

   a. Lowest frequency channel : CH0 2402MHz
   b. Middle frequency channel : CH39 2442MHz
   c. Highest frequency channel : CH78 2480MHz

## 3.2 Operating modes

| Mode | Explanation of the mode |
|---|---|
| Transmitting mode | Signal pattern : PRBS9<br>Signal packet type : DH5 (Dwell time : DH1,DH3,DH5) |
| Receiving mode | RX continuous |

| | |
|---|---|
| DH1 | Description : A 5 slot, Data High rate, ACL type packet. Supports a data payload of 0 to 27 bytes with CRC, no FEC, and fully transmits within five consecutive 625 microsecond transmission slots. Makes up the front half of a 5/1 multi-slot Frame. |
| DH3 | Description : A 5 slot, Data High rate, ACL type packet. Supports a data payload of 0 to 183 bytes with CRC, no FEC, and fully transmits within five consecutive 625 microsecond transmission slots. Makes up the front half of a 5/1 multi-slot Frame. |
| DH5 | Description : A 5 slot, Data High rate, ACL type packet. Supports a data payload of 0 to 339 bytes with CRC, no FEC, and fully transmits within five consecutive 625 microsecond transmission slots. Makes up the front half of a 5/1 multi-slot Frame. |
| PRBS9 | A periodic Pseudo Random Bit Sequence. $2^9$ -1 |

## 3.3 List of accessories

| | Product name | M/N | S/N | Manufacturer | Notes |
|---|---|---|---|---|---|
| a | Board for test | - | - | TAIYO YUDEN Co.,Ltd | - |
| b | Conversion Board | - | - | TAIYO YUDEN Co.,Ltd | - |
| c | Personal Computer | PP04S | CN-0Y0119-36521-467-2020 | DELL | - |
| d | AC Adapter for PC | PA-1650-05D | - | DELL | - |
| e | Regulated DC power supply | PA18-1.2 | 2110071 | KENWOOD | - |
| f | Handy printer | M196B | GL6G00003 | SEIKO EPSON CORP. | - |
| g | AC Adapter for Handy Printer | PA-42Y12 | FYYZ000122 | SEIKO EPSON CORP. | - |

## 3.4 Interface cables

| | Cable Type | M/N | Connection | Ferrite core | Shielded | Material of connector | Length | Treatment for the extra length |
|---|---|---|---|---|---|---|---|---|
| 1 | Flexible Flat cable | - | b⇔EUT | - | Yes | Metal | 0.05m | - |
| 2 | Conversion cable | UC-SGT | a⇔3 | Yes | Yes | Metal | 0.40m | - |
| 3 | RS232C cable | - | c⇔2 | Yes | Yes | Metal | 1.72m | Fold back and forth in the center |
| 4 | DC cable | - | c⇔d | No | Yes | Metal | 1.80m | - |
| 5 | AC cable | - | d⇔AC | No | No | Plastic | 0.90m | - |
| 6 | DC cable | - | f⇔g | Yes | Yes | Metal | 0.40m | Fold back and forth in the center |
| 7 | AC cable | - | g⇔AC | No | No | Plastic | 1.70m | Fold back and forth in the center |

## 3.5 Special Test Condition

Nothing

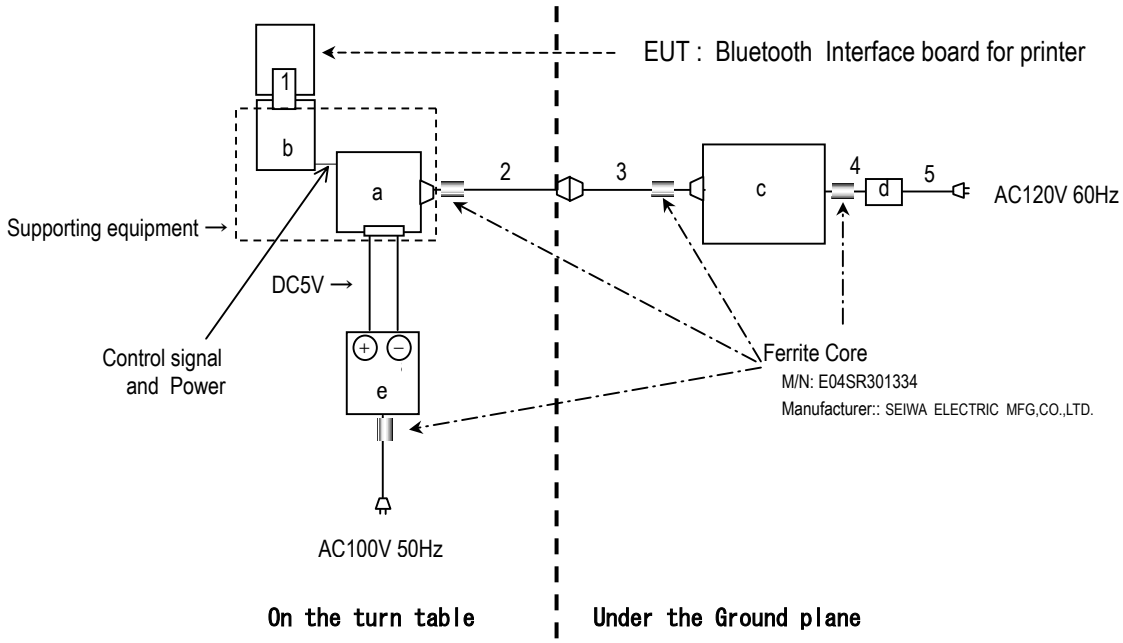
## 3.6 Equipment Modifications

No modification has been carried out by the test laboratory.

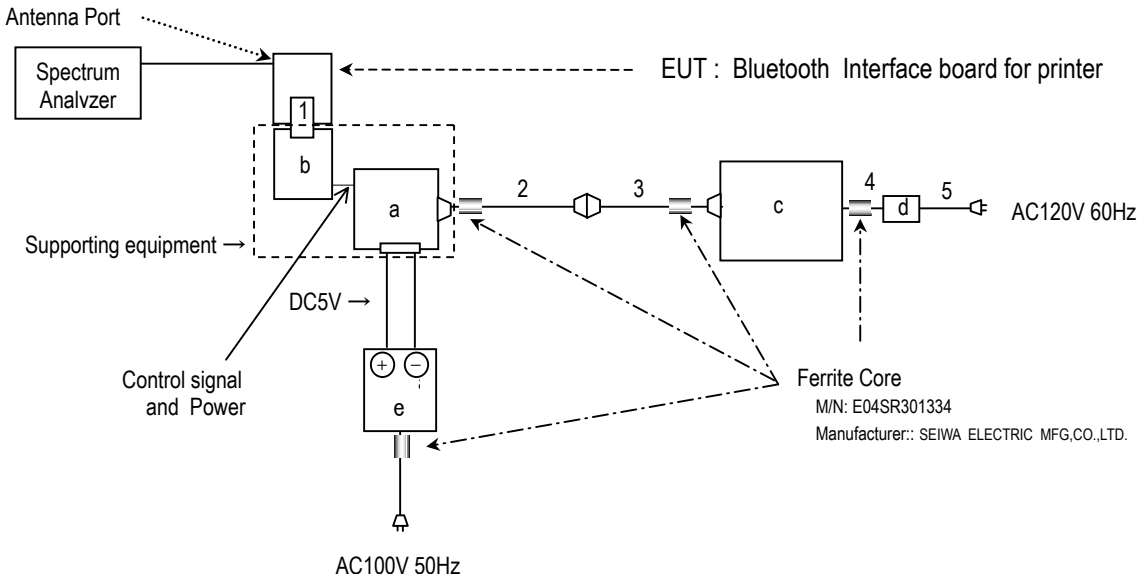
## 3.7 Configuration of Tested System

Operation within the bands 2400-2483.5MHz

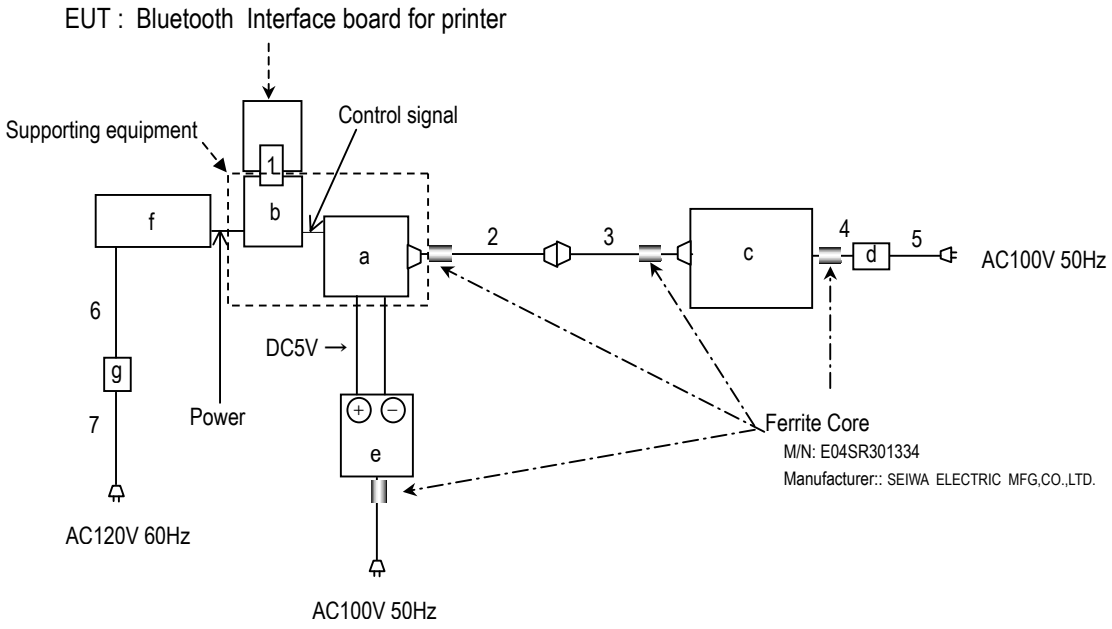
Radiated Emission Test




Conducted Emission Test



AC Power line Conducted Emission Test




These numbers and the marks in the picture above are corresponding to the numbers and the mark in Figure 3.3 and 3.4 on page 7.

# 4 Antenna Requirement

The EUT provide a permanently attached antenna and it found to be compliance with FCC regulation section 15.203 .

Antenna Data
Manufacturer: Taiyo Yuden Co.,Ltd.
Model No.: AH104F

Refer to Section 15 of this REPORT and APPENDIX1.

# 5 AC Powerline Conducted Emission Test

## 5.1 Test Setup

Conducted emission measurements were performed from 150kHz to 30 MHz.
The test setup was made according to RSS-210 and ANSI STD C63.4-2003 clause 7 in the Shielded room.
The rear of non-conductive wooden table top was placed 0.4 m from a vertical metal reference plane that one of the wall.
Rears of the peripherals were all aligned and flush with rear of non-conductive wooden tabletop.
The height of this table was 0.8 m and 1.5 m wide x 1.0 m deep size.
The spacing between the each equipment was 10 cm.
Connection of the Handy printer connected EUT to the artificial mains network (LISN) was required.
The distance between the closet surface of the EUT and the closet surface of the artificial mains network (LISN) was 0.8 m.
Connection of the all other equipment to the second artificial mains network (LISN) was required. The distance between the peripherals and the closet surface of the second artificial mains network (LISN) was minimum 0.8 m.
The second artificial mains network is terminated with 50 ohm terminator. Where a mains flexible cord is provided by the manufacture this is 2.0 m long and excess cable was folded back and forth as far as possible to 0.8 m so as to from a bundle not exceeding 0.4 m in length. Interconnecting cables of table top equipment that hang closer than 0.4 m to the floor ground plane were folded back and forth forming a bundle 30 to 40 cm long, hanging approximately in the middle between ground plane and table.
The measurement has been conducted with both neutral (VA) and line (VB) power supply polarization.
The highest voltage emission has been recorded.
For further description of the configuration refer to the photographs of this report.

Detector Mode: Quasi-Peak and Average Bandwidth: 10kHz

## 5.2 Test Instrumentation

| Facility/ Equipment | Manufacturer | Model No. | Serial No. | Next Calibration Due | Note |
|---|---|---|---|---|---|
| Shielded room | TDK Co.,Ltd | DA-06912 | - | - | - |
| EMI Test Receiver | R&S | ESHS 10 | 100005 | 4th.8.2005. | - |
| LISN | KYORITSU ELECTRICAL WORK | KNW-407 | 8-680-1 | 18th.3.2006. | for EUT |
| Cable | SUHNER | RG223 | CE-1 | 27th.4.2006. | - |
| | | RG223 | CE-2 | 27th.4.2006. | - |
| | | RG2214 | CE-3 | 27th.4.2006. | - |
| Attenuator | KYORITSU | KPD-602 | 5K325 | 27th.4.2006. | - |
| Pulse Limiter | Agilent Technologies | 11867A | 1387 | 27th.4.2006. | - |
| RF Selector | TDK Co.,Ltd | NS4900 | 0302-009 | 27th.4.2006. | - |
| Software | TOYO Corporation | EP5/CE Ver.2.0 | 0208085 | - | - |

## 5.3 Conducted Emission Calculation

The basic equation with a sample calculation is as follows:

c.f.= CF + AL
CE = RA + c.f.

Where c.f. = Correction Factor (dB)
CE = Conducted Emission (Emission Level - Result) (dBuV)
RA = Receiver Amplitude (Reading Level) (dBuV)
CF = Cable Attenuation Loss (dB)
AL = Attenuator Loss (dB)

Assume a receiver reading of 37.5 dB $\mu$ V is obtained. The Factor of 3.5dB is added, giving a terminal voltage of 41.0 dB $\mu$ V. The 41.0 dB $\mu$ V value was mathematically converted to its corresponding level in $\mu$ V.

CE = 37.5 + 3.5 = 41.0 dB $\mu$ V

Level in $\mu$ V = Common Antilogarithm : 10^(41.0/20) = 112.2 $\mu$ V

## 5.4 Test Results

### 5.4.1 Transmitting mode

AC Powerline Conducted Emission 2402MHz

Serial No. : 7
Power : AC 120V 60Hz
Mode : Transmitting mode
Temperature : 23℃
Humidity : 66%

VA

| Frequency [MHz] | Meter Reading [dB(μV)] | | Factor [dB] | Conducted Emission [dB(μV)] | | Limits [dB(μV)] | | Margin [dB] | |
|---|---|---|---|---|---|---|---|---|---|
| | QP | AV | | QP | AV | QP | AV | QP | AV |
| 0.150 | 37.5 | 31.9 | 3.5 | 41.0 | 35.4 | 66.0 | 56.0 | 25.0 | 20.6 |
| 0.184 | 35.9 | 31.1 | 3.4 | 39.3 | 34.5 | 64.3 | 54.3 | 25.0 | 19.8 |
| 0.371 | 31.2 | 28.7 | 3.3 | 34.5 | 32.0 | 58.5 | 48.5 | 24.0 | 16.5 |
| 0.404 | 31.0 | 28.1 | 3.3 | 34.3 | 31.4 | 57.8 | 47.8 | 23.5 | 16.4 |
| 0.558 | 40.5 | 38.1 | 3.3 | 43.8 | 41.4 | 56.0 | 46.0 | 12.2 | 4.6 |
| 1.008 | 30.6 | 27.1 | 3.3 | 33.9 | 30.4 | 56.0 | 46.0 | 22.1 | 15.6 |
| 15.521 | 28.5 | 21.2 | 4.0 | 32.5 | 25.2 | 60.0 | 50.0 | 27.5 | 24.8 |
| 21.389 | 36.6 | 29.1 | 4.3 | 40.9 | 33.4 | 60.0 | 50.0 | 19.1 | 16.6 |
| 26.066 | 31.4 | 26.1 | 4.5 | 35.9 | 30.6 | 60.0 | 50.0 | 24.1 | 19.4 |

VB

| Frequency [MHz] | Meter Reading [dB(μV)] | | Factor [dB] | Conducted Emission [dB(μV)] | | Limits [dB(μV)] | | Margin [dB] | |
|---|---|---|---|---|---|---|---|---|---|
| | QP | AV | | QP | AV | QP | AV | QP | AV |
| 0.150 | 40.4 | 35.5 | 3.5 | 43.9 | 39.0 | 66.0 | 56.0 | 22.1 | 17.0 |
| 0.186 | 38.4 | 34.4 | 3.4 | 41.8 | 37.8 | 64.2 | 54.2 | 22.4 | 16.4 |
| 0.372 | 32.7 | 29.8 | 3.3 | 36.0 | 33.1 | 58.5 | 48.5 | 22.5 | 15.4 |
| 0.405 | 32.1 | 28.6 | 3.3 | 35.4 | 31.9 | 57.8 | 47.8 | 22.4 | 15.9 |
| 0.558 | 40.6 | 38.1 | 3.3 | 43.9 | 41.4 | 56.0 | 46.0 | 12.1 | 4.6 |
| 1.008 | 30.2 | 26.5 | 3.3 | 33.5 | 29.8 | 56.0 | 46.0 | 22.5 | 16.2 |
| 20.477 | 35.4 | 27.7 | 3.9 | 39.3 | 31.6 | 60.0 | 50.0 | 20.7 | 18.4 |
| 25.550 | 33.1 | 27.4 | 4.1 | 37.2 | 31.5 | 60.0 | 50.0 | 22.8 | 18.5 |

## Conducted Emission 2441MHz

Serial No. : 7
Power : AC 120V 60Hz
Mode : Transmitting mode
Temperature : 23℃
Humidity : 66%

## VA

| Frequency [MHz] | Meter Reading [dB(μV)] | | Factor [dB] | Conducted Emission [dB(μV)] | | Limits [dB(μV)] | | Margin [dB] | |
|---|---|---|---|---|---|---|---|---|---|
| | QP | AV | | QP | AV | QP | AV | QP | AV |
| 0.150 | 37.4 | 31.9 | 3.5 | 40.9 | 35.4 | 66.0 | 56.0 | 25.1 | 20.6 |
| 0.187 | 35.8 | 31.0 | 3.4 | 39.2 | 34.4 | 64.2 | 54.2 | 25.0 | 19.8 |
| 0.373 | 31.3 | 28.7 | 3.3 | 34.6 | 32.0 | 58.4 | 48.4 | 23.8 | 16.4 |
| 0.407 | 30.4 | 28.3 | 3.3 | 33.7 | 31.6 | 57.7 | 47.7 | 24.0 | 16.1 |
| 0.559 | 40.7 | 38.1 | 3.3 | 44.0 | 41.4 | 56.0 | 46.0 | 12.0 | 4.6 |
| 1.007 | 30.6 | 27.1 | 3.3 | 33.9 | 30.4 | 56.0 | 46.0 | 22.1 | 15.6 |
| 15.520 | 28.6 | 21.2 | 4.0 | 32.6 | 25.2 | 60.0 | 50.0 | 27.4 | 24.8 |
| 21.360 | 35.9 | 28.2 | 4.2 | 40.1 | 32.4 | 60.0 | 50.0 | 19.9 | 17.6 |
| 26.068 | 31.3 | 26.2 | 4.5 | 35.8 | 30.7 | 60.0 | 50.0 | 24.2 | 19.3 |

## VB

| Frequency [MHz] | Meter Reading [dB(μV)] | | Factor [dB] | Conducted Emission [dB(μV)] | | Limits [dB(μV)] | | Margin [dB] | |
|---|---|---|---|---|---|---|---|---|---|
| | QP | AV | | QP | AV | QP | AV | QP | AV |
| 0.150 | 40.3 | 35.4 | 3.5 | 43.8 | 38.9 | 66.0 | 56.0 | 22.2 | 17.1 |
| 0.184 | 38.3 | 34.4 | 3.4 | 41.7 | 37.8 | 64.3 | 54.3 | 22.6 | 16.5 |
| 0.372 | 32.7 | 29.8 | 3.3 | 36.0 | 33.1 | 58.5 | 48.5 | 22.5 | 15.4 |
| 0.405 | 32.1 | 29.1 | 3.3 | 35.4 | 32.4 | 57.8 | 47.8 | 22.4 | 15.4 |
| 0.559 | 40.6 | 38.1 | 3.3 | 43.9 | 41.4 | 56.0 | 46.0 | 12.1 | 4.6 |
| 1.008 | 30.2 | 26.5 | 3.3 | 33.5 | 29.8 | 56.0 | 46.0 | 22.5 | 16.2 |
| 20.350 | 36.6 | 28.7 | 3.9 | 40.5 | 32.6 | 60.0 | 50.0 | 19.5 | 17.4 |
| 26.065 | 31.4 | 26.2 | 4.1 | 35.5 | 30.3 | 60.0 | 50.0 | 24.5 | 19.7 |

## Conducted Emission 2480MHz

Serial No. : 7
Power : AC 120V 60Hz
Mode : Transmitting mode
Temperature : 23℃
Humidity : 66%

## VA

| Frequency [MHz] | Meter Reading [dB(μV)] | | Factor [dB] | Conducted Emission [dB(μV)] | | Limits [dB(μV)] | | Margin [dB] | |
|---|---|---|---|---|---|---|---|---|---|
| | QP | AV | | QP | AV | QP | AV | QP | AV |
| 0.150 | 37.4 | 31.8 | 3.5 | 40.9 | 35.3 | 66.0 | 56.0 | 25.1 | 20.7 |
| 0.185 | 35.9 | 31.1 | 3.4 | 39.3 | 34.5 | 64.3 | 54.3 | 25.0 | 19.8 |
| 0.373 | 31.2 | 28.8 | 3.3 | 34.5 | 32.1 | 58.4 | 48.4 | 23.9 | 16.3 |
| 0.409 | 30.9 | 28.3 | 3.3 | 34.2 | 31.6 | 57.7 | 47.7 | 23.5 | 16.1 |
| 0.559 | 40.8 | 38.1 | 3.3 | 44.1 | 41.4 | 56.0 | 46.0 | 11.9 | 4.6 |
| 1.006 | 30.5 | 27.1 | 3.3 | 33.8 | 30.4 | 56.0 | 46.0 | 22.2 | 15.6 |
| 15.520 | 28.6 | 21.2 | 4.0 | 32.6 | 25.2 | 60.0 | 50.0 | 27.4 | 24.8 |
| 20.998 | 38.0 | 30.6 | 4.2 | 42.2 | 34.8 | 60.0 | 50.0 | 17.8 | 15.2 |
| 26.200 | 27.4 | 22.0 | 4.5 | 31.9 | 26.5 | 60.0 | 50.0 | 28.1 | 23.5 |

## VB

| Frequency [MHz] | Meter Reading [dB(μV)] | | Factor [dB] | Conducted Emission [dB(μV)] | | Limits [dB(μV)] | | Margin [dB] | |
|---|---|---|---|---|---|---|---|---|---|
| | QP | AV | | QP | AV | QP | AV | QP | AV |
| 0.150 | 40.3 | 35.4 | 3.5 | 43.8 | 38.9 | 66.0 | 56.0 | 22.2 | 17.1 |
| 0.186 | 38.3 | 34.3 | 3.4 | 41.7 | 37.7 | 64.2 | 54.2 | 22.5 | 16.5 |
| 0.370 | 32.3 | 29.8 | 3.3 | 35.6 | 33.1 | 58.5 | 48.5 | 22.9 | 15.4 |
| 0.404 | 32.0 | 29.0 | 3.3 | 35.3 | 32.3 | 57.8 | 47.8 | 22.5 | 15.5 |
| 0.557 | 40.6 | 38.1 | 3.3 | 43.9 | 41.4 | 56.0 | 46.0 | 12.1 | 4.6 |
| 1.007 | 30.2 | 26.5 | 3.3 | 33.5 | 29.8 | 56.0 | 46.0 | 22.5 | 16.2 |
| 15.500 | 27.6 | 21.5 | 3.8 | 31.4 | 25.3 | 60.0 | 50.0 | 28.6 | 24.7 |
| 20.999 | 37.9 | 29.6 | 3.9 | 41.8 | 33.5 | 60.0 | 50.0 | 18.2 | 16.5 |
| 26.069 | 31.4 | 26.2 | 4.1 | 35.5 | 30.3 | 60.0 | 50.0 | 24.5 | 19.7 |

# 6 Radiated Emission Test

## 6.1 Test Setup

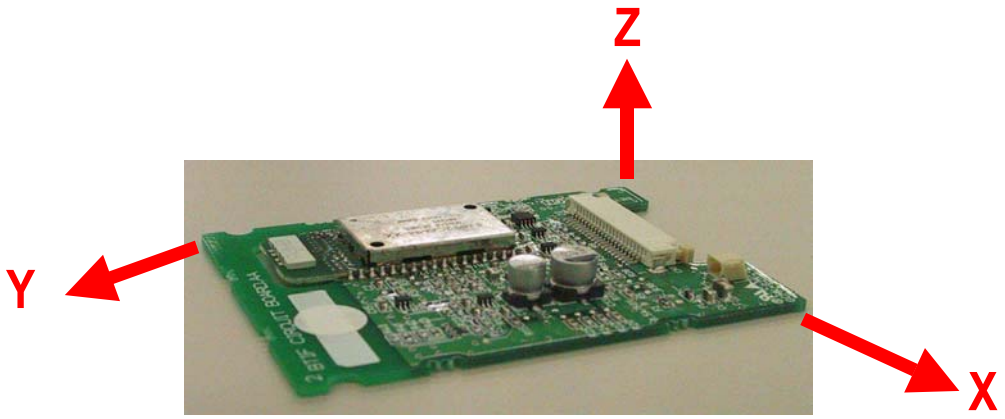
The test setup was made according to ANSI STD C63.4-2003 clause 8 on the 10 meter semi-anechoic chamber, which allows a 3 or 1 m distance measurement.
EUT was placed on non-conductive table (foam polystyrene). The height of this table was 0.8 m.
The measurement has been conducted with both horizontal and vertical antenna polarization.
The turntable has been fully rotated. The highest radiation of the equipment has been recorded.
For further description of the configuration refer to the pictures of this report.

Distance between equipment and antenna : 3m (30MHz to 18GHz)
: 1m (18GHz to 25GHz)

Spectrum Analyzer Setting

| | |
|---|---|
| 30～1000MHz | Detector : Quasi-Peak<br>Bandwidth : 120kHz |
| 1～25GHz | Detector : Peak and Average<br>Bandwidth : 1MHz |

Axial Direction



Test Instrumentation

| Facility/ Equipment | Manufacturer | Model No. | Serial No. | Frequency Range | Next Calibration Due |
|---|---|---|---|---|---|
| 10m anechoic chamber | TDK Co.,Ltd | DA-06912 | - | - | 13st.3.2006. |
| EMI Test Receiver | R&S | ESCS 30 | 100148 | 30-1000MHz | 29nd.8.2005. |
| Spectrum Analyzer | Agilent Technologies | 8563E | 3416A02230 | 30-1000MHz | 4th.4.2006. |
| | | E4446A | US42070181 | 1-40GHz | 31th.3.2006. |
| Amplifier | | 8449B | 3008A00571 | 1-26.5GHz | 26th.2.2006. |
| | | 8447D | 2944A06812 | 30-1000MHz | 5th.4.2006. |
| RF Selector | TDK Co.,Ltd | NS4900 | 0302-010 | - | 5th.4.2006. |
| RF Cable | SUHNER | RG214 | RG 1 | 30-1000MHz | 5th.4.2006. |
| | | RG214 | RG 3 | 30-1000MHz | 5th.4.2006. |
| | | RG214 | RG 8 | 30-1000MHz | 5th.4.2006. |
| | | RG214 | RG 5 | 30-1000MHz | 5th.4.2006. |
| | | RG214 | RG 6 | 30-1000MHz | 5th.4.2006. |
| | | SUCOFLEX 106 | SU1 | 1-18GHz | 28th.2.2006. |
| | | SUCOFLEX 104 | SU4 | 1-18GHz | 28th.2.2006. |
| | HP | 85381C | No.3 | 18-25GHz | 15th.7.2005. |
| | | 85381C | No.5 | 18-25GHz | 15th.7.2005. |
| Attenuator | KYORITSU | KPD-602 | 220142 | 30-1000MHz | 5th.4.2006. |
| Antenna | Schwarzbeck | BBA9106 | No.4 | 30-300MHz | 28rd.2.2006. |
| | | UHALP9108-A | 160 | 300-1000MHz | 28rd.2.2006 |
| | EMCO | 3115 | 9403-4232 | 1-18GHz | 31th.3.2006. |
| | | 3116 | 9311-2227 | 18-40GHz | 31th.3.2006. |
| Software | TOYO Corporation | EP5/RE Ver.2.0 | 0208086 | - | - |

## 6.2 Radiated Emission Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

c.f.= AF + CF +AL – AG - DF
RE = RA + c.f.

Where c.f. = Correction Factor (dB/m)
RE = Radiated Emission (Emission Level - Result) (dBuV/m)
RA = Receiver Amplitude (Reading Level) (dBuV)
AF = Antenna Factor (dB/m)
CF = Cable Attenuation Loss (dB)
AG = Amplifier Gain (dB)
AL = Attenuator Loss (dB)
DF = Distance Factor
Distance between equipment and antenna:3m = 0(dB)
Distance between equipment and antenna:1m = 9.5(dB)

Assume a receiver reading of 41.3 dB $\mu$ V is obtained. The Correction Factor of –1.1 dB/m is added, giving a Radiated Emission of 40.2 dB $\mu$ V/m. The 40.2 dB $\mu$ V/m value was mathematically converted to its corresponding level in $\mu$ V/m.

RE = 41.3 + (-1.1) = 40.2 dB $\mu$ V/m

Level in $\mu$ V/m = Common Antilogarithm : 10^(40.2/20)= 102.3 $\mu$ V/m

## 6.3 Test Results

Radiated emission was measured in all test modes; GFSK Modulation.
The results show the worst case.

### 6.3.1 Transmitting mode

Spurious Emission (Radiated) 2402MHz

Serial No. : 7
Power : DC 3.3V
Mode : Transmitting mode
Temperature : 23℃
Humidity : 66 %

Axial Direction : XY-Plane

| Frequency [MHz] | Antenna Polarization | Meter Reading [dB(μV)] QP | Factor [dB/m] | Emission Level [dB(μV/m)] QP | Limits [dB(μV/m)] | Margin [dB] |
|---|---|---|---|---|---|---|
| 48.01 | Vertical | 33.8 | -10.3 | 23.5 | 40.0 | 16.5 |
| 60.01 | Vertical | 38.7 | -13.8 | 24.9 | 40.0 | 15.1 |
| 72.01 | Vertical | 41.3 | -15.4 | 25.9 | 40.0 | 14.1 |
| 239.99 | Horizontal | 31.4 | -2.5 | 28.9 | 46.0 | 17.1 |

| Frequency [MHz] | Antenna Polarization | Meter Reading [dB(μV)] | | Factor [dB/m] | Emission Level [dB(μV/m)] | | Limits [dB(μV/m)] | Margin [dB] | |
|---|---|---|---|---|---|---|---|---|---|
| | | Average | Peak | | Average | Peak | | Average | Peak |
| 1065.0 | Verticall | ----- | 57.3 | -13.9 | ----- | 43.4 | 74.0 | ----- | 30.6 |
| | | 41.5 | ----- | -13.9 | 27.6 | ----- | 54.0 | 26.4 | ----- |
| 1201.0 | Vertical | ----- | 54.3 | -12.8 | ----- | 41.5 | 74.0 | ----- | 32.5 |
| | | 48.4 | ----- | -12.8 | 35.6 | ----- | 54.0 | 18.4 | ----- |
| 4804.0 | Horizontal | ----- | 50.3 | -1.1 | ----- | 49.2 | 74.0 | ----- | 24.8 |
| | | 41.3 | ----- | -1.1 | 40.2 | ----- | 54.0 | 13.8 | ----- |

Axial Direction : YZ-Plane

| Frequency [MHz] | Antenna Polarization | Meter Reading [dB(μV)] QP | Factor [dB/m] | Emission Level [dB(μV/m)] QP | Limits [dB(μV/m)] | Margin [dB] |
|---|---|---|---|---|---|---|
| 48.01 | Vertical | 33.9 | -10.3 | 23.6 | 40.0 | 16.4 |
| 60.00 | Vertical | 38.7 | -13.8 | 24.9 | 40.0 | 15.1 |
| 72.01 | Vertical | 41.3 | -15.4 | 25.9 | 40.0 | 14.1 |
| 240.00 | Horizontal | 31.4 | -2.5 | 28.9 | 46.0 | 17.1 |

| Frequency [MHz] | Antenna Polarization | Meter Reading [dB(μV)] | | Factor [dB/m] | Emission Level [dB(μV/m)] | | Limits [dB(μV/m)] | Margin [dB] | |
|---|---|---|---|---|---|---|---|---|---|
| | | Average | Peak | | Average | Peak | | Average | Peak |
| 1202.0 | Vertical | ----- | 54.2 | -12.8 | ----- | 41.4 | 74.0 | ----- | 32.6 |
| | | 48.8 | ----- | -12.8 | 36.0 | ----- | 54.0 | 18.0 | ----- |
| 3000.0 | Horizontal | ----- | 47.9 | -6.0 | ----- | 41.9 | 74.0 | ----- | 32.1 |
| | | 34.2 | ----- | -6.0 | 28.2 | ----- | 54.0 | 25.8 | ----- |

Axial Direction : ZX-Plane

| Frequency [MHz] | Antenna Polarization | Meter Reading [dB(μV)] QP | Factor [dB/m] | Emission Level [dB(μV/m)] QP | Limits [dB(μV/m)] | Margin [dB] |
|---|---|---|---|---|---|---|
| 48.01 | Vertical | 33.8 | -10.3 | 23.6 | 40.0 | 16.5 |
| 60.00 | Vertical | 38.7 | -13.8 | 24.9 | 40.0 | 15.1 |
| 72.00 | Vertical | 41.4 | -15.4 | 26.0 | 40.0 | 14.0 |
| 240.00 | Horizontal | 31.6 | -2.5 | 29.1 | 46.0 | 16.9 |

| Frequency [MHz] | Antenna Polarization | Meter Reading [dB(μV)] | | Factor [dB/m] | Emission Level [dB(μV/m)] | | Limits [dB(μV/m)] | Margin [dB] | |
|---|---|---|---|---|---|---|---|---|---|
| | | Average | Peak | | Average | Peak | | Average | Peak |
| 1202.0 | Vertical | ----- | 55.9 | -12.8 | ----- | 43.1 | 74.0 | ----- | 30.9 |
| | | 50.8 | ----- | -12.8 | 38.0 | ----- | 54.0 | 16.0 | ----- |
| 4804.0 | Vertical | ----- | 47.9 | -1.1 | ----- | 46.8 | 74.0 | ----- | 27.2 |
| | | 38.1 | ----- | -1.1 | 37.0 | ----- | 54.0 | 17.0 | ----- |

## Spurious Emission (Radiated) 2441MHz

Serial No. : 7
Power : DC 3.3V
Mode : Transmitting mode
Temperature : 23℃
Humidity : 66 %

Axial Direction : XY-Plane

| Frequency [MHz] | Antenna Polarization | Meter Reading [dB(μV)] | Factor [dB/m] | Emission Level [dB(μV/m)] | Limits [dB(μV/m)] | Margin [dB] |
|---|---|---|---|---|---|---|
| | | QP | | QP | | |
| 48.00 | Vertical | 33.8 | -10.3 | 23.5 | 40.0 | 16.5 |
| 60.01 | Vertical | 38.9 | -13.8 | 25.1 | 40.0 | 14.9 |
| 72.01 | Vertical | 41.3 | -15.4 | 25.9 | 40.0 | 14.1 |
| 199.89 | Vertical | 30.2 | -3.0 | 27.2 | 43.5 | 16.3 |

| Frequency [MHz] | Antenna Polarization | Meter Reading [dB(μV)] | | Factor [dB/m] | Emission Level [dB(μV/m)] | | Limits [dB(μV/m)] | Margin [dB] | |
|---|---|---|---|---|---|---|---|---|---|
| | | Average | Peak | | Average | Peak | | Average | Peak |
| 1065.0 | Vertical | ----- | 58.5 | -13.9 | ----- | 44.6 | 74.0 | ----- | 29.4 |
| | | 41.6 | ----- | -13.9 | 27.7 | ----- | 54.0 | 26.3 | ----- |
| 3000.0 | Horizontal | ----- | 47.9 | -6.0 | ----- | 41.9 | 74.0 | ----- | 32.1 |
| | | 34.2 | ----- | -6.0 | 28.2 | ----- | 54.0 | 25.8 | ----- |

Axial Direction : YZ-Plane

| Frequency [MHz] | Antenna Polarization | Meter Reading [dB(μV)] QP | Factor [dB/m] | Emission Level [dB(μV/m)] QP | Limits [dB(μV/m)] | Margin [dB] |
|---|---|---|---|---|---|---|
| 48.02 | Vertical | 33.8 | -10.3 | 23.5 | 40.0 | 16.5 |
| 60.02 | Vertical | 38.9 | -13.8 | 25.1 | 40.0 | 14.9 |
| 72.01 | Vertical | 41.3 | -15.4 | 25.9 | 40.0 | 14.1 |
| 199.89 | Vertical | 30.1 | -3.0 | 27.1 | 43.5 | 16.4 |

| Frequency [MHz] | Antenna Polarization | Meter Reading [dB(μV)] | | Factor [dB/m] | Emission Level [dB(μV/m)] | | Limits [dB(μV/m)] | Margin [dB] | |
|---|---|---|---|---|---|---|---|---|---|
| | | Average | Peak | | Average | Peak | | Average | Peak |
| 1220.0 | Vertical | ----- | 54.7 | -12.7 | ----- | 42.0 | 74.0 | ----- | 32.0 |
| | | 49.3 | ----- | -12.7 | 36.6 | ----- | 54.0 | 17.4 | ----- |
| 4882.0 | Horizontal | ----- | 45.7 | -0.9 | ----- | 44.8 | 74.0 | ----- | 29.2 |
| | | 33.8 | ----- | -0.9 | 32.9 | ----- | 54.0 | 21.1 | ----- |

Axial Direction : ZX-Plane

| Frequency [MHz] | Antenna Polarization | Meter Reading [dB(μV)] QP | Factor [dB/m] | Emission Level [dB(μV/m)] QP | Limits [dB(μV/m)] | Margin [dB] |
|---|---|---|---|---|---|---|
| 48.00 | Vertical | 33.8 | -10.3 | 23.5 | 40.0 | 16.5 |
| 60.01 | Vertical | 38.7 | -13.8 | 24.9 | 40.0 | 15.1 |
| 72.01 | Vertical | 41.3 | -15.4 | 25.9 | 40.0 | 14.1 |
| 199.89 | Vertical | 30.0 | -3.0 | 27.0 | 43.5 | 16.5 |

| Frequency [MHz] | Antenna Polarization | Meter Reading [dB(μV)] | | Factor [dB/m] | Emission Level [dB(μV/m)] | | Limits [dB(μV/m)] | Margin [dB] | |
|---|---|---|---|---|---|---|---|---|---|
| | | Average | Peak | | Average | Peak | | Average | Peak |
| 1220.0 | Horizontal | ----- | 53.1 | -12.7 | ----- | 40.4 | 74.0 | ----- | 33.6 |
| | | 46.4 | ----- | -12.7 | 33.7 | ----- | 54.0 | 20.3 | ----- |
| 4882.0 | Vertical | ----- | 46.0 | -0.9 | ----- | 45.1 | 74.0 | ----- | 28.9 |
| | | 35.3 | ----- | -0.9 | 34.4 | ----- | 54.0 | 19.6 | ----- |

## Spurious Emission (Radiated) 2480MHz

Serial No. : 7
Power : DC 3.3V
Mode : Transmitting mode
Temperature : 23℃
Humidity : 66 %

Axial Direction : XY-Plane

| Frequency [MHz] | Antenna Polarization | Meter Reading [dB(μV)] | Factor [dB/m] | Emission Level [dB(μV/m)] | Limits [dB(μV/m)] | Margin [dB] |
|---|---|---|---|---|---|---|
| | | QP | | QP | | |
| 48.01 | Vertical | 33.8 | -10.3 | 23.5 | 40.0 | 16.5 |
| 60.01 | Vertical | 38.7 | -13.8 | 24.9 | 40.0 | 15.1 |
| 72.01 | Vertical | 41.0 | -15.4 | 25.6 | 40.0 | 14.4 |
| 240.08 | Horizontal | 31.6 | -2.5 | 29.1 | 46.0 | 16.9 |

| Frequency [MHz] | Antenna Polarization | Meter Reading [dB(μV)] | | Factor [dB/m] | Emission Level [dB(μV/m)] | | Limits [dB(μV/m)] | Margin [dB] | |
|---|---|---|---|---|---|---|---|---|---|
| | | Average | Peak | | Average | Peak | | Average | Peak |
| 1065.0 | Vertical | ----- | 51.0 | -13.9 | ----- | 37.1 | 74.0 | ----- | 36.9 |
| | | 37.9 | ----- | -13.9 | 24.0 | ----- | 54.0 | 30.0 | ----- |
| 4960.0 | Vertical | ----- | 45.6 | -0.7 | ----- | 44.9 | 74.0 | ----- | 29.1 |
| | | 32.2 | ----- | -0.7 | 31.5 | ----- | 54.0 | 22.5 | ----- |
| 9920.0 | Horizontal | ----- | 45.7 | 5.5 | ----- | 51.2 | 74.0 | ----- | 22.8 |
| | | 33.0 | ----- | 5.5 | 38.5 | ----- | 54.0 | 15.5 | ----- |
| 14880.0 | Horizontal | ----- | 49.6 | 11.0 | ----- | 60.6 | 74.0 | ----- | 13.4 |
| | | 33.2 | ----- | 11.0 | 44.2 | ----- | 54.0 | 9.8 | ----- |

Axial Direction : YZ-Plane

| Frequency [MHz] | Antenna Polarization | Meter Reading [dB(μV)] | Factor [dB/m] | Emission Level [dB(μV/m)] | Limits [dB(μV/m)] | Margin [dB] |
|---|---|---|---|---|---|---|
| | | QP | | QP | | |
| 48.01 | Vertical | 33.9 | -10.3 | 23.6 | 40.0 | 16.4 |
| 60.00 | Vertical | 38.7 | -13.8 | 24.9 | 40.0 | 15.1 |
| 72.03 | Vertical | 41.3 | -15.4 | 25.9 | 40.0 | 14.1 |
| 240.09 | Horizontal | 31.4 | -2.5 | 28.9 | 46.0 | 17.1 |

| Frequency [MHz] | Antenna Polarization | Meter Reading [dB(μV)] | | Factor [dB/m] | Emission Level [dB(μV/m)] | | Limits [dB(μV/m)] | Margin [dB] | |
|---|---|---|---|---|---|---|---|---|---|
| | | Average | Peak | | Average | Peak | | Average | Peak |
| 1069.0 | Vertical | ----- | 51.1 | -13.8 | ----- | 37.3 | 74.0 | ----- | 36.7 |
| | | 37.9 | ----- | -13.8 | 24.1 | ----- | 54.0 | 29.9 | ----- |
| 1240.0 | Vertical | ----- | 54.8 | -12.7 | ----- | 42.1 | 74.0 | ----- | 31.9 |
| | | 49.8 | ----- | -12.7 | 37.1 | ----- | 54.0 | 16.9 | ----- |

Axial Direction : ZX-Plane

| Frequency [MHz] | Antenna Polarization | Meter Reading [dB(μV)] | Factor [dB/m] | Emission Level [dB(μV/m)] | Limits [dB(μV/m)] | Margin [dB] |
|---|---|---|---|---|---|---|
| | | QP | | QP | | |
| 48.01 | Vertical | 33.8 | -10.3 | 23.6 | 40.0 | 16.5 |
| 60.00 | Vertical | 38.7 | -13.8 | 24.9 | 40.0 | 15.1 |
| 72.00 | Vertical | 41.4 | -15.4 | 26.0 | 40.0 | 14.0 |
| 240.09 | Horizontal | 31.5 | -2.5 | 29.0 | 46.0 | 17.0 |

| Frequency [MHz] | Antenna Polarization | Meter Reading [dB(μV)] | | Factor [dB/m] | Emission Level [dB(μV/m)] | | Limits [dB(μV/m)] | Margin [dB] | |
|---|---|---|---|---|---|---|---|---|---|
| | | Average | Peak | | Average | Peak | | Average | Peak |
| 1240.0 | Vertical | ----- | 53.6 | -12.7 | ----- | 40.9 | 74.0 | ----- | 33.1 |
| | | 47.6 | ----- | -12.7 | 34.9 | ----- | 54.0 | 19.1 | ----- |
| 4960.0 | Vertical | ----- | 45.4 | -0.7 | ----- | 44.7 | 74.0 | ----- | 29.3 |
| | | 34.3 | ----- | -0.7 | 33.6 | ----- | 54.0 | 20.4 | ----- |

# 7 20dB Bandwidth

## 7.1 Test Setup

The spectrum analyzer was connected directly to the transmitter output.

Spectrum analyzer setting : -
DETECTOR MODE : PEAK
RBW : 30kHz
VBW : 30kHz
SPAN : 2MHz
SWEEP TIME : AUTO

## 7.2 Test Instrument

| Equipment | Manufacture | Model No. | Serial No. | Next Calibration Due |
|---|---|---|---|---|
| Spectrum Analyzer | Rohode&Schwarz | FSIQ26 | 840061/0004 | 7th.2.2006. |

## 7.3 Test Results

Serial No. : 10
Power : DC 3.3V
Mode : Transmitting mode , Non Frequency Hopping
Temperature : 22.7 ℃
Humidity : 51.4%
Regulation : FCC Part15 C §15.247 (a)(1)(i)

(1) Operation mode: Transmitting mode

| CH | Freqency [MHz] | 20dB Bandwidth [MHz] | Limit [MHz] |
|---|---|---|---|
| 0ch(Lowest) | 2402.0 | 0.942 | 1.0 |
| 39ch(Middle) | 2441.0 | 0.934 | 1.0 |
| 78ch(Highest) | 2480.0 | 0.934 | 1.0 |

# 8 Carrier Frequency Separation

## 8.1 Test Setup

The spectrum analyzer was connected directly to the transmitter output.

Spectrum Analyzer setting : -
DETECTOR MODE :PEAK
RBW : 100kHz
VBW : 300kHz
SPAN : 3MHz
SWEEP TIME : AUTO

## 8.2 Test Instrument

| Equipment | Manufacture | Model No. | Serial No. | Next Calibration Due |
|---|---|---|---|---|
| Spectrum Analyzer | Rohode&Schwarz | FSIQ26 | 840061/0004 | 7th.2.2006. |

## 8.3 Test Results

Serial No. : 10
Power : DC 3.3V
Mode : Transmitting mode , Frequency Hopping
Temperature : 22.7 ℃
Humidity : 51.4%
Regulation : FCC Part15 C §15.247 (a)(1)
FCC 04-165

(1) Operation mode: Transmitting mode
Transmitting mode , Frequency Hopping (79ch)

| Channel | Channel Separation [MHz] | Limit |
|---|---|---|
| Low frequency (0ch-1ch) | 1.016 | > two-thirds of the 20dB Bandwidth |
| Middle frequency (38ch-39ch) | 1.028 | > two-thirds of the 20dB Bandwidth |
| High frequency (77ch-78ch) | 0.980 | > two-thirds of the 20dB Bandwidth |

Remarks: two-thirds of the 20dB Bandwidth is 0.628MHz. Refer to Clause 7.3

# 9 Number of Hopping Frequency

## 9.1 Test Setup

The spectrum analyzer was connected directly to the transmitter output.

spectrum analyzer setting : -
DETECTOR MODE : PEAK
RBW : 300kHz
VBW : 300kHz
SWEEP TIME : AUTO

## 9.2 Test Instrument

| Equipment | Manufacture | Model No. | Serial No. | Next Calibration Due |
|---|---|---|---|---|
| Spectrum Analyzer | Rohode&Schwarz | FSIQ26 | 840061/0004 | 7th.2.2006. |

## 9.3 Test Results

Serial No. : 10
Power : DC 3.3V
Mode : Transmitting mode , Frequency Hopping
Temperature : 22.7 ℃
Humidity : 50%
Regulation : FCC Part15 C §15.247 (a)(1)(iii)

(1) Operation mode: Transmitting mode

| Mode | Number of channel [time] | Limit [time] |
|---|---|---|
| Transmitting mode Frequency Hopping (79ch) | 79 | ≧ 75 |

# 10 Dwell Time

## 10.1 Test Setup

The spectrum analyzer was connected directly to the transmitter output.

Spectrum analyzer setting : -
DETECTOR MODE : PEAK
RBW : 1MHz
VBW : 1MHz
SPAN : 0Hz
SWEEP TIME : AUTO

## 10.2 Test Instrument

| Equipment | Manufacture | Model No. | Serial No. | Next Calibration Due |
|---|---|---|---|---|
| Spectrum Analyzer | Rohode&Schwarz | FSIQ26 | 840061/0004 | 7th.2.2006. |

## 10.3 Test Results

Serial No. : 10
Power : DC 3.3V
Mode : Transmitting mode (DH1,DH3,DH5), Frequency Hopping
Temperature : 22.7 ℃
Humidity : 51.4%
Regulation : FCC Part15 C §15.247 (a)(1)(iii)

| Packet | Dwell time [ms] | Limit [ms] |
|---|---|---|
| DH1 | 134.77 | 400 |
| DH3 | 269.62 | 400 |
| DH5 | 312.65 | 400 |

-

# Data of Dwell Time (Frequency Hopping (79ch))

## Time of occupancy (Dwell Time) for packet type DH1.

FH hop rate of Bluetooth system is 1600hops per 1 second.
A DH1 packet needs 1 time slot for transmitting and 1 time slot for receiving.

In a DH1 packet, it hops 800 times for transmitting per 1 second.
The number of hopping channel is 79.
The number of times that appears in 1 channel per 1 second is as follows.
800/79=10.13 (times)

The average time of occupancy on any channel shall not be greater than 0.4 seconds (400ms) within a period of 0.4 seconds multiplied by the number of hopping channels employed 0.4 x 79 = 31.6 seconds
The number of times that appears in 1 channel per 31.6 seconds is as follows.
10.13 x 31.6 = 320.11 (times)

Transmitting time is 420.8μs .
Then dwell time is 320.11 x 421us = 134.77ms per 31.6 seconds.

## Time of occupancy (Dwell Time) for packet type DH3.

FH hop rate of Bluetooth system is 1600hops per 1 second.
A DH3 packet needs 3 times slot for transmitting and 1 time slot for receiving.

In a DH3 packet, it hops 400 times for transmitting per 1 second.
The number of hopping channel is 79.
The number of times that appears in 1 channel per 1 second is as follows.
400/79=5.1 (times)

The average time of occupancy on any channel shall not be greater than 0.4 seconds (400ms) within a period of 0.4 seconds multiplied by the number of hopping channels employed 0.4 x 79 = 31.6 seconds
The number of times that appears in 1 channel per 31.6 seconds is as follows.
5.1 x 31.6 = 161.16 (times)

Transmitting time is 1.673ms .
Then dwell time is 161.16 x 1.673ms = 269.62ms per 31.6 seconds.

## Time of occupancy (Dwell Time) for packet type DH5.

FH hop rate of Bluetooth system is 1600hops per 1 second.
A DH5 packet needs 5 times slot for transmitting and 1 time slot for receiving.

In a DH5 packet, it hops 266.67 times for transmitting per 1 second.
The number of hopping channel is 79.
The number of times that appears in 1 channel per 1 second is as follows.
266.67/79=3.37 (times)

The average time of occupancy on any channel shall not be greater than 0.4 seconds (400ms) within a period of 0.4 seconds multiplied by the number of hopping channels employed 0.4 x 79 = 31.6 seconds
The number of times that appears in 1 channel per 31.6 seconds is as follows.
3.37 x 31.6 = 106.49 (times)

Transmitting time is 2.936ms .
Then dwell time is 106.49 x 2.936ms = 312.65ms per 31.6 seconds.

# 11 Maximum Peak Output Power

## 11.1 Test Setup

The spectrum analyzer was connected directly to the transmitter output.

spectrum analyzer setting : -
DETECTOR MODE : PEAK
RBW : 1MHz
VBW : 1MHz
SWEEP TIME : AUTO

## 11.2 Test Instrument

| Equipment | Manufacture | Model No. | Serial No. | Next Calibration Due |
|---|---|---|---|---|
| Spectrum Analyzer | Rohode&Schwarz | FSIQ26 | 840061/0004 | 7th.2.2006. |

## 11.3 Test Results

Serial No. : 10
Power : DC 3.3V
Mode : Transmitting mode , Non Frequency Hopping
Temperature : 22.7 ℃
Humidity : 51.4%
Regulation : FCC Part15 C §15.247 (b)(1)

(1) Operation mode: Transmitting mode

| CH | Freq. [MHz] | Reading [dBm] | Cable Loss [dB] | Result [dBm] | Limit [dBm] |
|---|---|---|---|---|---|
| 0ch(Lowest) | 2402.0 | -1.65 | 0.67 | -0.98 | 30.0 |
| 39ch(Middle) | 2441.0 | -1.52 | 0.67 | -0.85 | 30.0 |
| 78ch(Highest) | 2480.0 | -1.17 | 0.67 | -0.50 | 30.0 |

Result = Reading + Cable Loss

# 12 Band Edge Compliance

## 12.1 Test Setup

The spectrum analyzer was connected directly to the transmitter output.

Spectrum analyzer setting : -
DETECTOR MODE : PEAK
RBW : 100kHz
VBW : 100kHz
SWEEP TIME : AUTO

## 12.2 Test Instrument

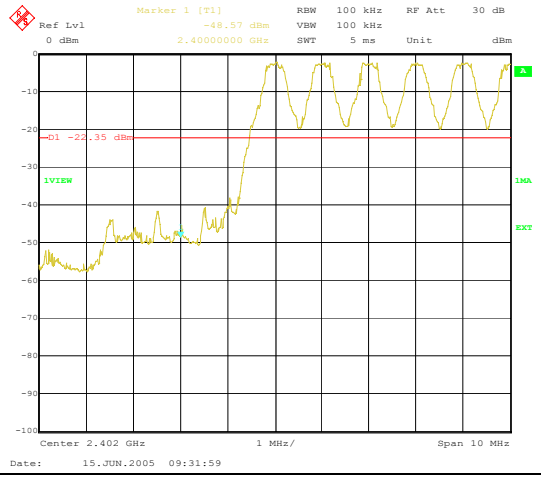
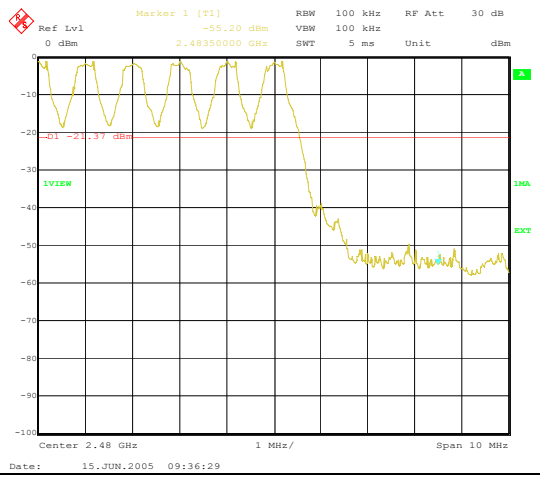
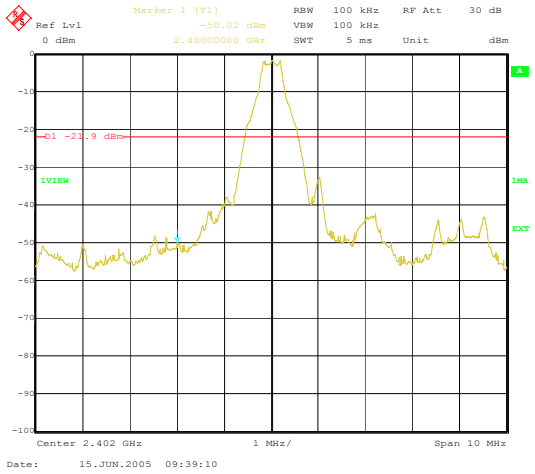
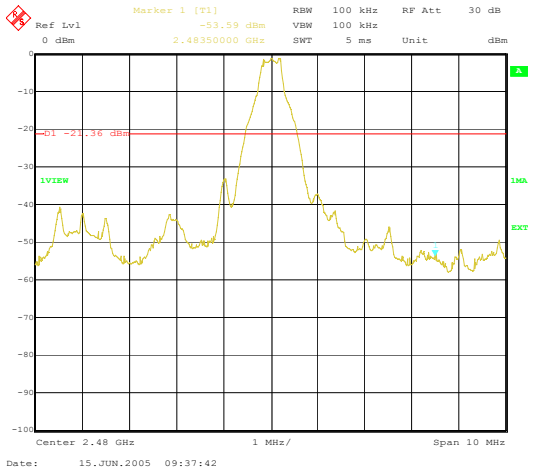
| Equipment | Manufacture | Model No. | Serial No. | Next Calibration Due |
|---|---|---|---|---|
| Spectrum Analyzer | Rohode&Schwarz | FSIQ26 | 840061/0004 | 7th.2.2006. |

## 12.3 Test Results

Serial No. : 10
Power : DC 3.3V
Mode : Transmitting mode , Frequency Hopping
Temperature : 22.7 ℃
Humidity : 51.4%
Regulation : FCC Part15 C §15.247 (c)

The spectrum data are attached below. Display line indicates the 20dB offset below highest level. It shows compliance with the requirement in part 15.247(c)

(1) Operation mode: Transmitting mode

| Frequency Hopping 79ch (2402MHz) | Frequency Hopping 79ch (2480MHz) |
|---|---|
|  |  |
| Non Frequency Hopping (0ch(Lowest) 2402MHz) | Non Frequency Hopping (0ch(Lowest) 2480MHz) |
|  |  |

# 13 Spurious RF Conducted Emission

## 13.1 Test Setup

The spectrum analyzer was connected directly to the transmitter output.

spectrum analyzer setting : -
DETECTOR : PEAK
RBW : 100kHz
VBW : 100kHz
SWEEP TIME : AUTO

## 13.2 Test Instrument

| Equipment | Manufacture | Model No. | Serial No. | Next Calibration Due |
|---|---|---|---|---|
| Spectrum Analyzer | Rohode&Schwarz | FSIQ26 | 840061/0004 | 7th.2.2006. |

## 13.3 Test Results

Serial No. : 10
Power : DC 3.3V
Mode : Transmitting mode , Non Frequency Hopping
Temperature : 22.7 ℃
Humidity : 51.4%
Regulation : FCC Part15 C §15.247 (c)

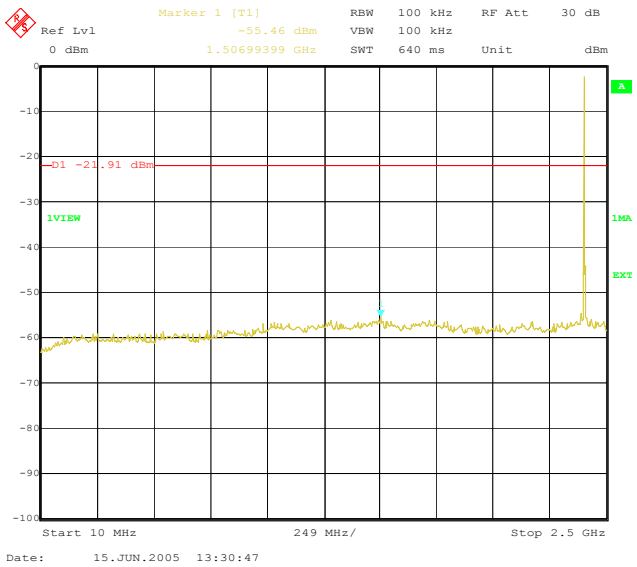
The spectrum data are attached below. Display line indicates the 20dB offset below highest level.
It shows compliance with the requirement in part 15.247(c)

Non Frequency Hopping

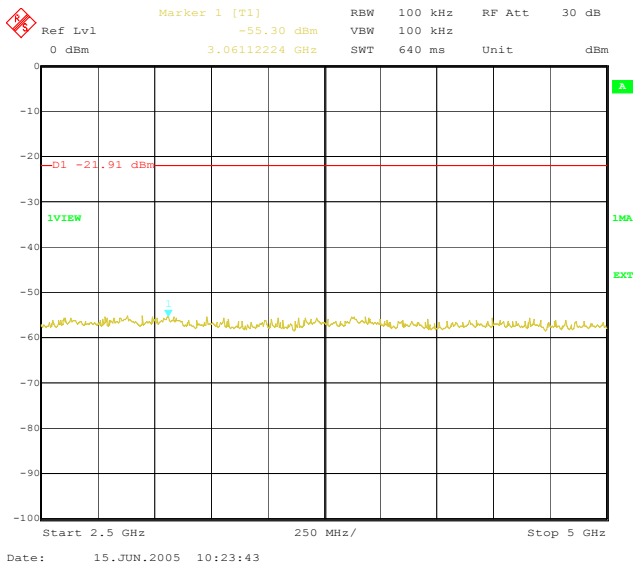
(1) Operation mode: Transmitting mode

0ch(Lowest) 2402MHz

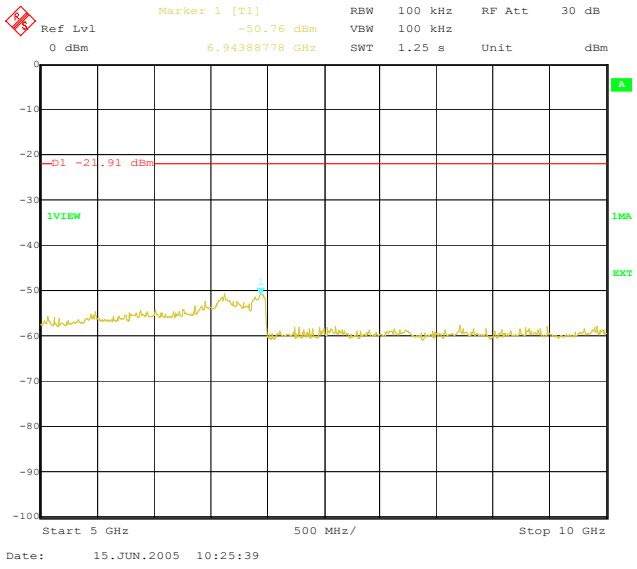
10MHz～2.5GHz



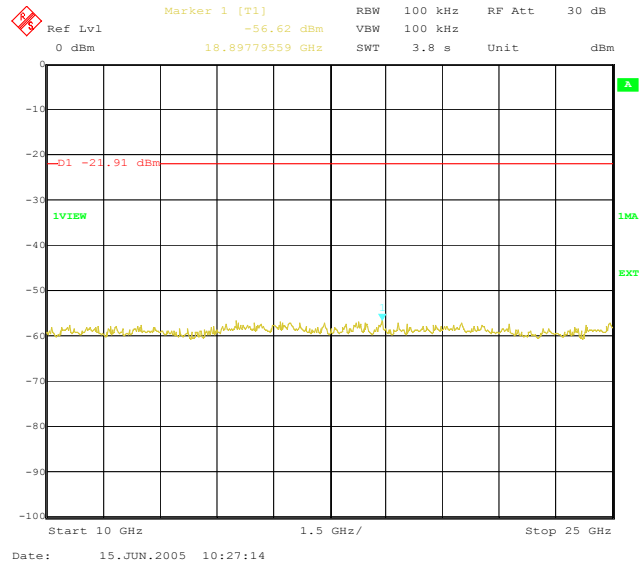

2.5GHz～10GHz




5GHz～10GHz

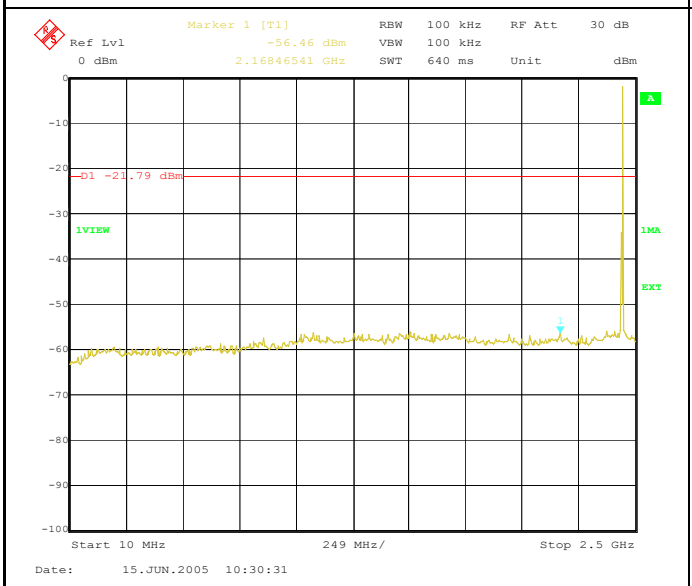



10GHz～25GHz

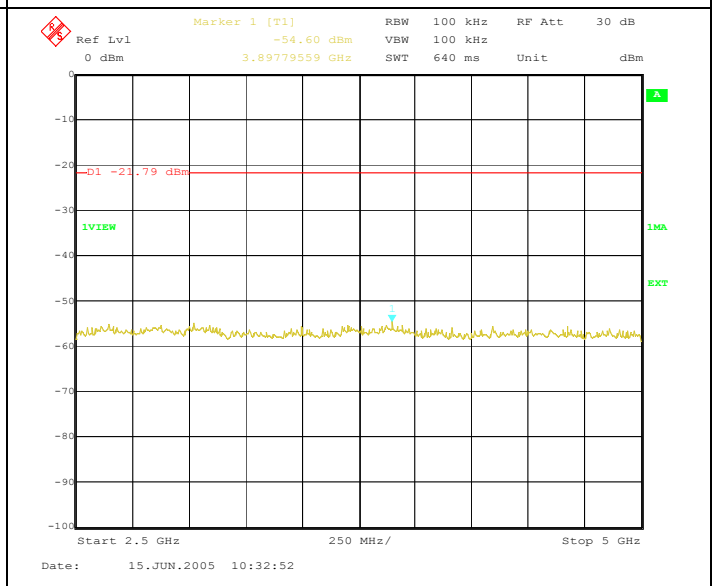


39ch(Middle) 2441MHz

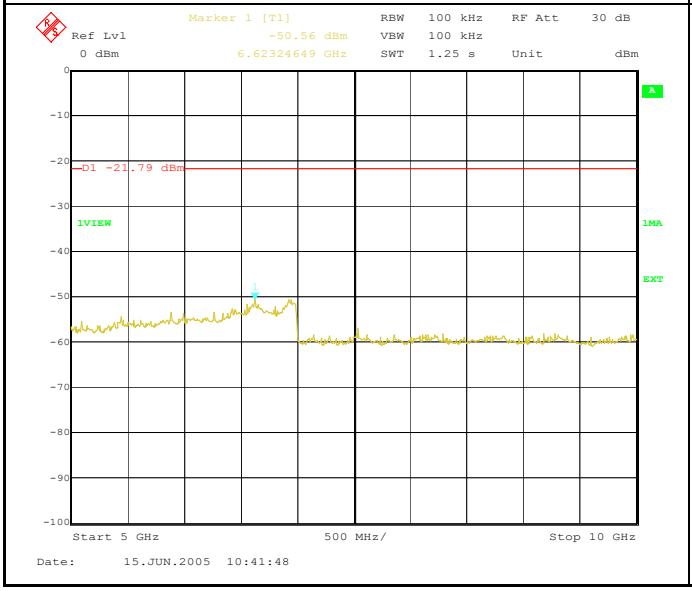
10MHz～2.5GHz



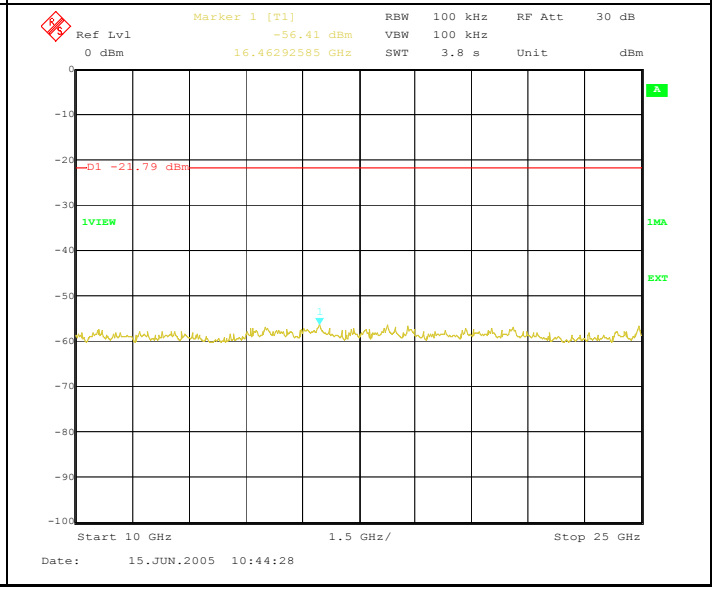

2.5GHz～10GHz




5GHz～10GHz

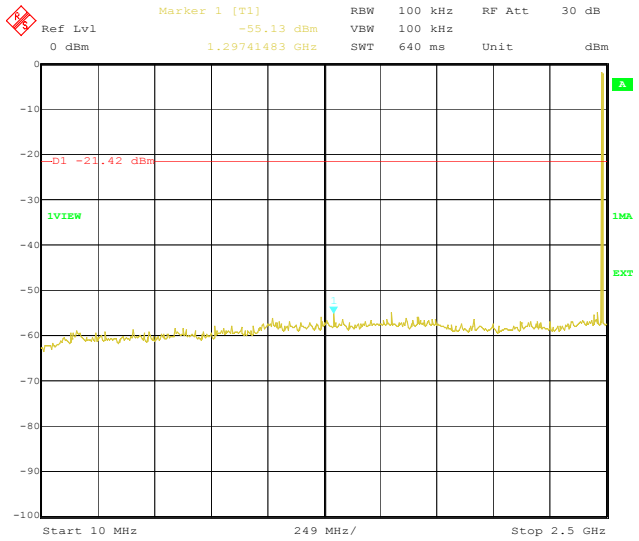



10GHz～25GHz

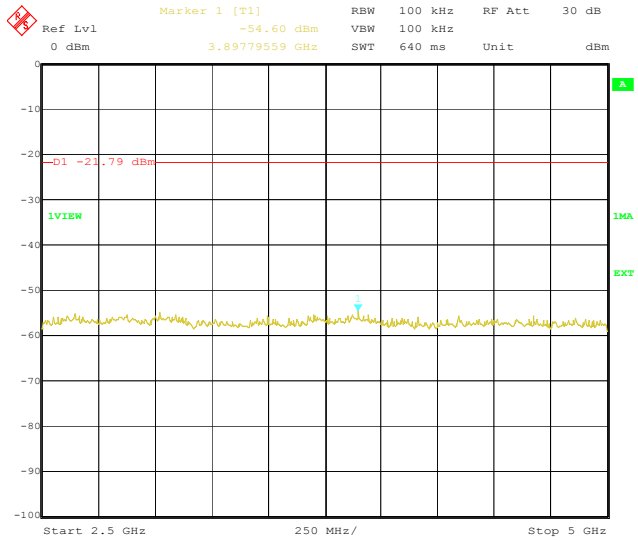


## 78ch(Highest) 2480MHz

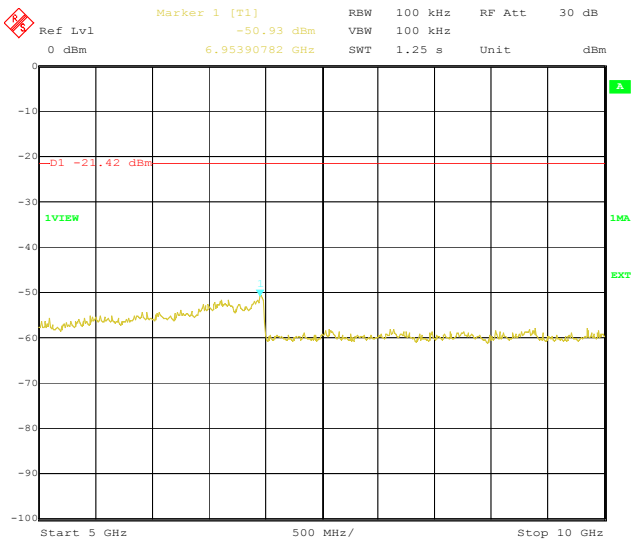
### 10MHz～2.5GHz



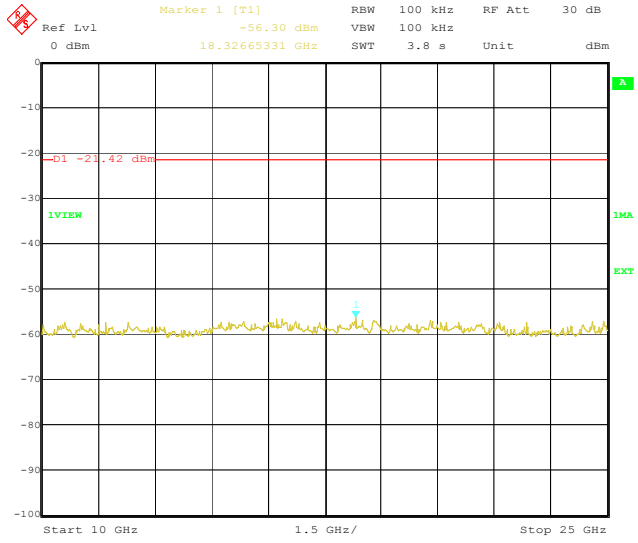

### 2.5GHz～10GHz




### 5GHz～10GHz




### 10GHz～25GHz



# 14 EIRP Calculation from Peak Power

15.247 (b)(5): 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 levels in excess of the Commission's guidelines.

EIRP Calculation :

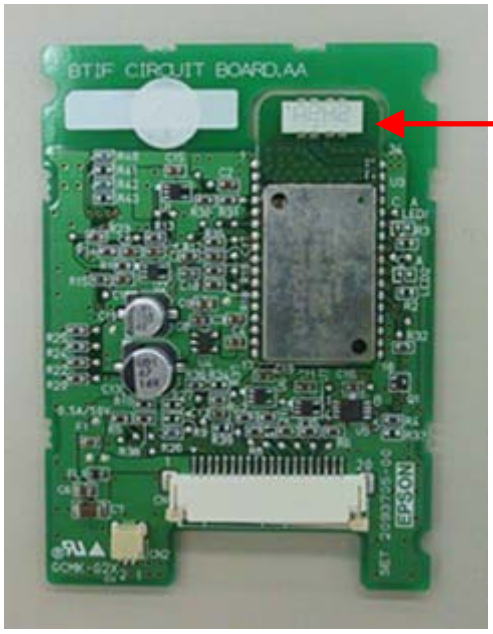
| A | B | C | D | E |
|---|---|---|---|---|
| Specified Antenna Gain (dBi) | Minimum Cable Losses (dB) | Total Antenna Gain (dBi) | Max. RF Output Power at Antenna Terminal (dBm) | **Total EIRP (dBm)** |
| 2.044 | 0 | 2.044 | -0.5 | **1.544** |

Calculation : C = A + B, E = C + D

Note : Cable losses was very small and it can not measured due to the antenna and the transmitting circuit was connected by printed circuit.

EIRP = 1.544dBm = 1.427mW

# 15 PHOTOS OF TESTED EUT

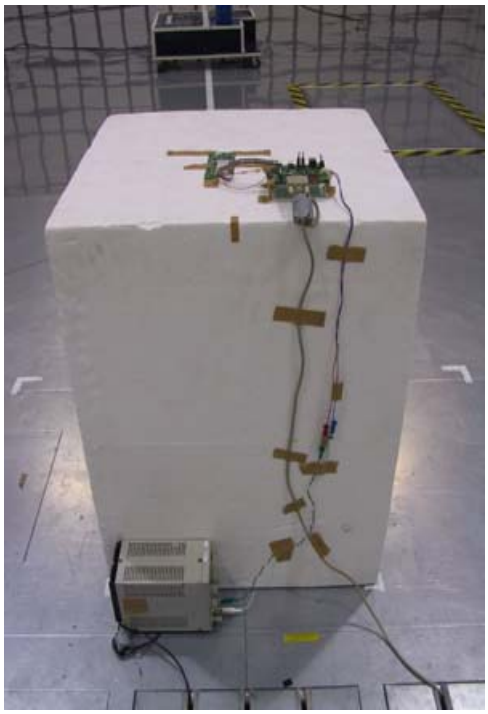


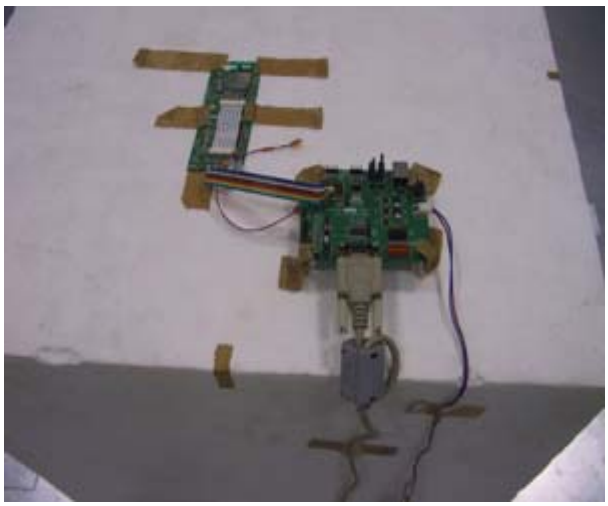

Antenna

# 16 PHOTOS OF TEST SETUP

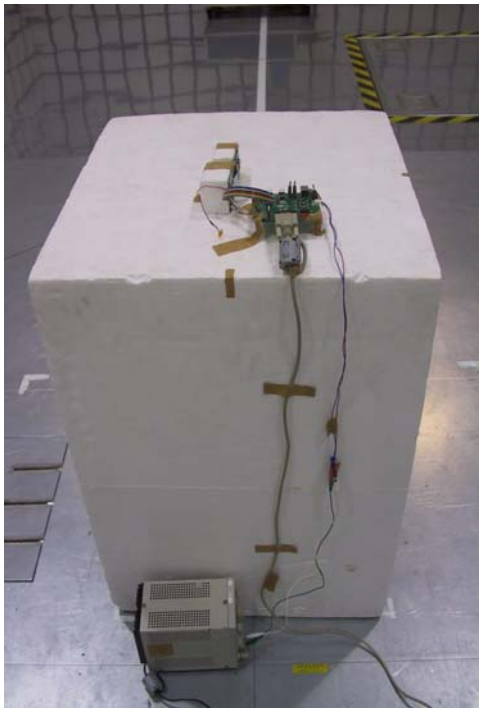
## 16.1 Photos of Radiated Measurement

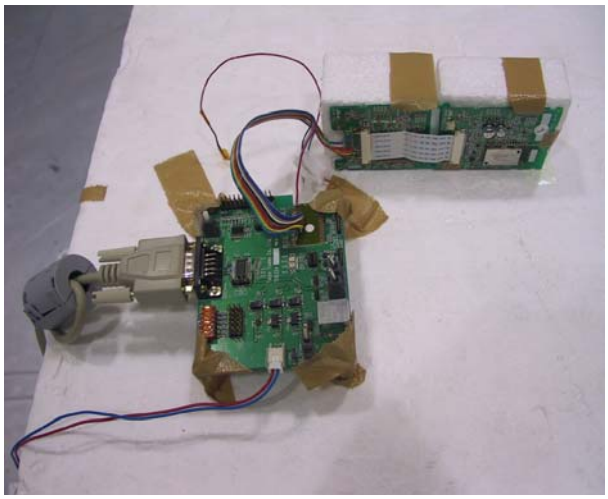
Axial Direction : XY-Plane



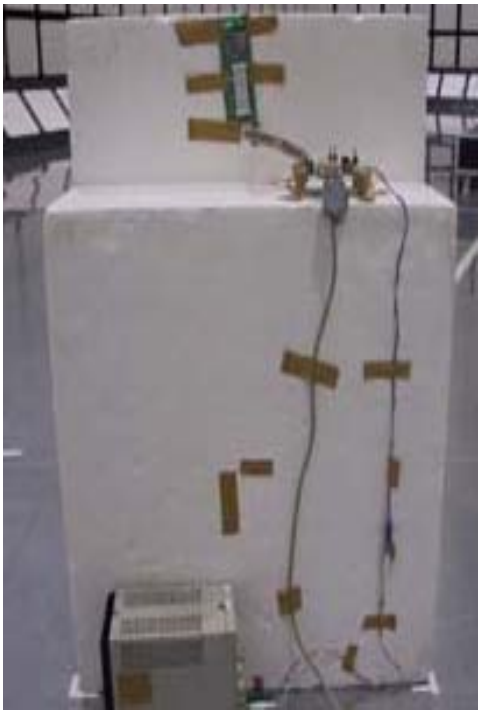


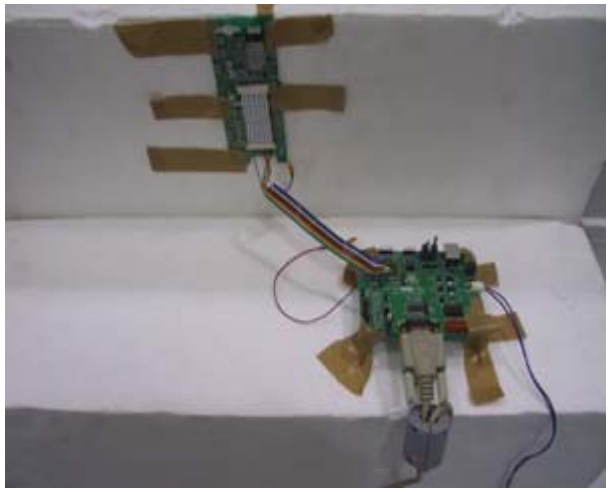
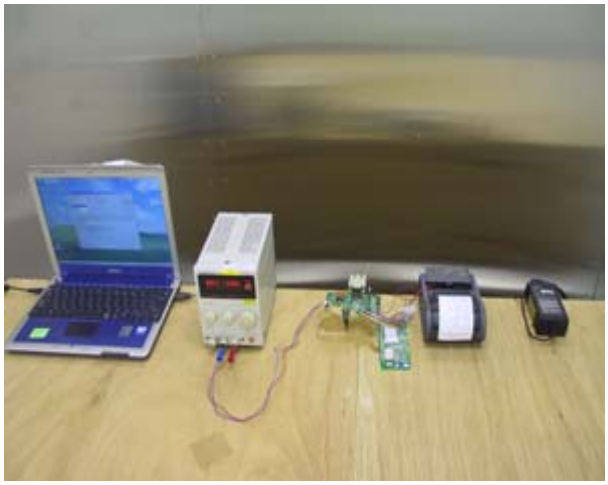
Axial Direction : YZ-Plane





Axial Direction : ZX-Plane





## 16.2 Photos of Conducted Measurement