

TEST REPORT

Report No. : 6080F

Date : 15th May 2006

Applicant : Xanavi Informatics Corporation
1410, Inada, Hitachinaka-shi, Ibaraki-ken, 312-8505 Japan.

EUT : Bluetooth Module

FCC ID : SJ2HJZ0095

Model No. : HJZ0095

Serial No. : 00000004 (Radiated Emission, DC Power line Conducted Emission)
00000005 (Conducted Emission)

Receipt date of tested sample : 18th April 2006

Date of measurement : 20th, 21st April 2006 (Radiated Emission)
19th April 2006 (Conducted Emission)
26th April 2006 (DC Power line Conducted Emission)

Test location : TAIYO YUDEN CO.,LTD., EMC Center
5607-2, Nakamuroda, Haruna-machi,
Gunma-Gun, Gunma, 370-3347, Japan.

Applied standard : FCC 47 CFR Part 15 Subpart C, Section 15.247, (10-1-05 Edition)
PUBLIC NOTICE DA 00-1407

Procedure : ANSI C63.4-2003 PUBLIC NOTICE DA 00-705

Test results: PASS



Approved by : 
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: 
Assistant / Yasuko Hirata

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Revised Record

| Revised Record | | | | |
|------------------------|---------------------------|------------------|--------------------|-------------|
| Number of Revised time | Date | Person in Charge | Detail of Revision | Approved by |
| Initial | 15 th May 2006 | | - | - |

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.
- (4) We hereby certify that no party to the applications authorized hereunder is subject to a denial of benefits, including FCC benefits, pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C 853(a).

2 General Information

2.1 Product Description

| | |
|---|---|
| EUT | : Bluetooth Module |
| Model No. | : HJZ0095 |
| Serial No. | : 00000004, 00000005 |
| FCC ID | : SJ2HJZ0095 |
| Production stage | : Production |
| Summary of EUT | : 2.4GHz Bluetooth module |
| Modulation | : GFSK |
| Power supply | : DC 3.3V |
| Weight | : 1.08g |
| Dimensions of EUT | : W25mm x D12mm x H2.6mm |
| Max antenna gain | : 0.8dBi |
| 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) |

EUT is attached to the digital devices and it is a wireless applications to communicate with other Bluetooth devices.

This is operated within the bands 2400 – 2483.5MHz frequency hopping intentional radiators that comply with FCC15.247. It provides 79 channels. And it adopts an AFH function to prevent interference with other wireless applications. Refer to APPENDIX 1.

EUT operates in the unlicensed 2.4 GHz ISM (Industrial Scientific Medical) band. A frequency hop transceiver is applied to combat interference and fading.

2.2 Summary of Test and Inspection Result

| No. | Item | Test Procedure | Specification | Remarks | Deviation | Worst Margin | Results | |
|-----|----------------------------------|---|-----------------------|-----------|-------------------------|--|---|------|
| 1 | DC Power line Conducted Emission | ANSI C63.4:2003 | FCC 15.207 | - | *1 | 11.5dB Transmitting mode:2441MHz 0.377MHz DC3.3V,GND | Pass | |
| 2 | Carrier Frequency Separation | ANSI C63.4:2003 Public Notice DA00-705 | FCC 15.247(a)(1) | Conducted | N/A | - | Pass | |
| 3 | Number of Hoping Frequency | | FCC 15.247(a)(1)(iii) | | N/A | - | Pass | |
| 4 | Dwell time | | FCC 15.247(a)(1)(iii) | | N/A | - | Pass | |
| 5 | Maximum peak Output Power | | FCC 15.247(b)(1) | | N/A | - | Pass | |
| 6 | Band Edge Compliance | | FCC 15.247(c) | | N/A | - | Pass | |
| 7 | Spurious RF Conducted Emission | | FCC 15.247(c) | | N/A | - | Pass | |
| 8 | Radiated Emission | | FCC 15.247(c) | | Radiated | N/A | 1.2dB Transmitting mode:2441MHz 1627.983MHz Direction:XY Horizontal, Vertical | Pass |
| 9 | E.I.R.P. | | FCC 15.247(b) (5) | | Conducted Calculated | N/A | - | Pass |

*1: The apparatus that equip EUT is unknown. Therefore, DC line conducted emission test was substituted for AC power line conducted emission test.

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). Refer the certificate of the accreditation to Appendix 2.

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 2441MHz
 - c. Highest frequency channel : CH78 2480MHz

3.2 Operating modes

(1) Transmitting mode

Modulation : GFSK
Signal pattern : PRBS9
Signal packet type : DH1, DH3, DH5 for Dwell time test
DH5 for other test
Representative channel : CH0 2402MHz (Lowest frequency channel)
CH39 2441MHz (Middle frequency channel)
CH78 2480MHz (Highest frequency channel)

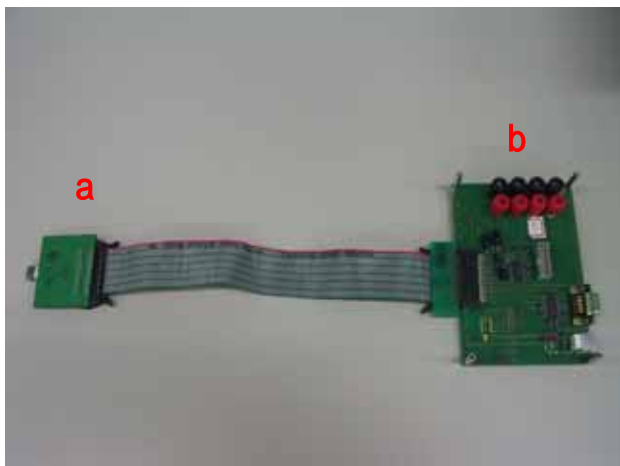
Remarks : -

Signal pattern PRBS9 : Periodic Pseudo Random Bit Sequence. $2^9 - 1$
Signal packet type : Data High rate, ACL type packet
Data payload with CRC, without FEC
Fully transmission within one consecutive 625 microsecond transmission slots.
Number of slot = 1(DH1), 3(DH3), 5(DH5)
Data size of payload = 27bytes(DH1), 183bytes(DH3), 339bytes(DH5)
Software (controller) : Bluesuite v1.20 software supplied by CSR Company was used to set up
the Bluetooth operating mode.

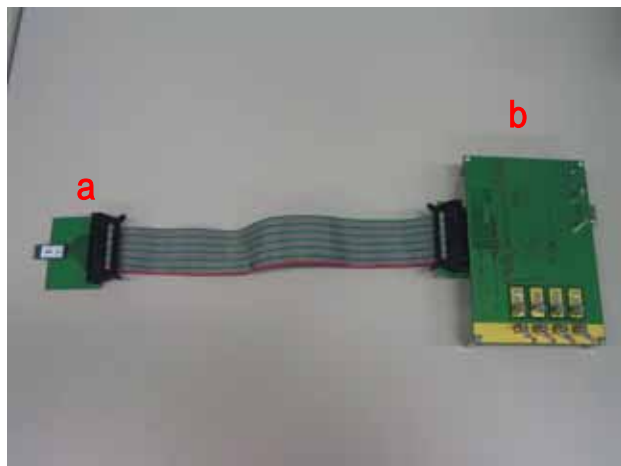
3.3 List of accessories

| | Product name | M/N | S/N | Manufacturer | Notes | FCC ID / DoC |
|---|---------------------------|-------------|--------------------------|--------------------------------|-------|----------------------|
| a | Supporting equipment 1 | - | - | Xanavi Informatics Corporation | - | N/A |
| b | Supporting equipment 2 | - | - | Xanavi Informatics Corporation | - | N/A |
| c | Personal Computer | PP04S | CN-0Y0119-36521-467-2020 | DELL | - | FCC ID: QDS-BRCM1007 |
| d | AC Adapter for PC | PA-1650-05D | - | DELL | - | N/A |
| e | Personal Computer | 08N1180 | 11812P43677 FX08729J4BG | IBM | - | |
| f | AC Adapter for PC | 02K6810 | 11S02K6810Z1 Z3BJ24T51J | IBM | - | N/A |
| g | Regulated DC power supply | PA18-1.2 | 2110071 | KENWOOD | - | N/A |
| h | Regulated DC power supply | PA18-3A | | KENWOOD | - | N/A |

Supporting equipments
Obverse side



Reverse side



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 | - | a EUT (Radiated, Conducted, AC Powerline Conducted Emission) | No | Yes | Plastic | 0.35m | - |
| 2 | RS232C cable | - | b 3 (Radiated) | No | Yes | Metal | 2.12m | - |
| 3 | RS232C – PC Conversion Cable | - | 3 c (Radiated) | No | Yes | Metal | 0.52m | - |
| 4 | USB cable | - | b c (Radiated) | No | Yes | Metal | 2.20m | - |
| 5 | DC cable | - | c d (Radiated) | Yes | Yes | Metal | 0.90m | - |
| 6 | AC cable | - | d AC (Radiated) | No | No | Plastic | 1.75m | - |
| 7 | RS232C cable | - | b 8 (Conducted, DC Powerline Conducted Emission) | No | Yes | Metal | 0.95m | - |
| 8 | RS232C – PC Conversion Cable | - | 7 e (Conducted, DC Powerline Conducted Emission) | No | Yes | Metal | 0.39m | - |
| 9 | USB cable | - | b e (Conducted, DC Powerline Conducted Emission) | No | Yes | Metal | 2.02m | Fold back and forth in the center (AC Powerline Conducted Emission only) |
| 10 | DC cable | - | e f (Conducted, DC Powerline Conducted Emission) | No | Yes | Metal | 1.84m | Fold back and forth in the center (AC Powerline Conducted Emission only) |
| 11 | AC cable | - | f AC (Conducted, DC Powerline Conducted Emission) | Yes | No | Metal | 1.00m | - |
| 12 | DC cable | - | b LISN (DC Powerline Conducted Emission) | No | No | Metal | 1.62m | - |
| 13 | DC cable | - | b g, h LISN (DC Powerline Conducted Emission) | No | No | Metal | 0.56m | - |
| 14 | AC cable | | h AC (DC Powerline Conducted Emission) | No | No | Metal | 1.97m | - |
| 15 | AC cable | | g AC (DC Powerline Conducted Emission) | No | No | Metal | 2.04m | - |

3.5 Special Test Condition

Nothing

3.6 Equipment Modifications

No modification has been carried out by the test laboratory.

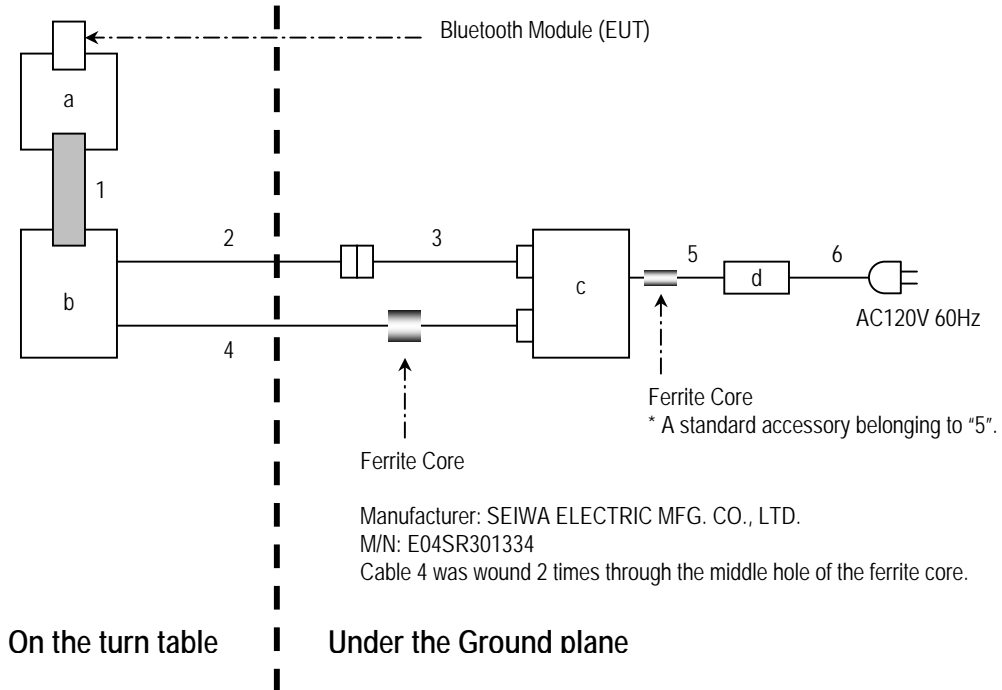
3.7 Configuration of Tested System

(1) Radiated Emission Test

These numbers and the marks in the picture are corresponding to the numbers and the marks in Tables shown at the Section 3.3 and 3.4.

Power supply of EUT: DC3.3V from Supporting equipment "b"

(DC5V is supplied to Supporting equipment "b" from PC via USB, and converted to DC3.3V by Supporting equipment "b".)

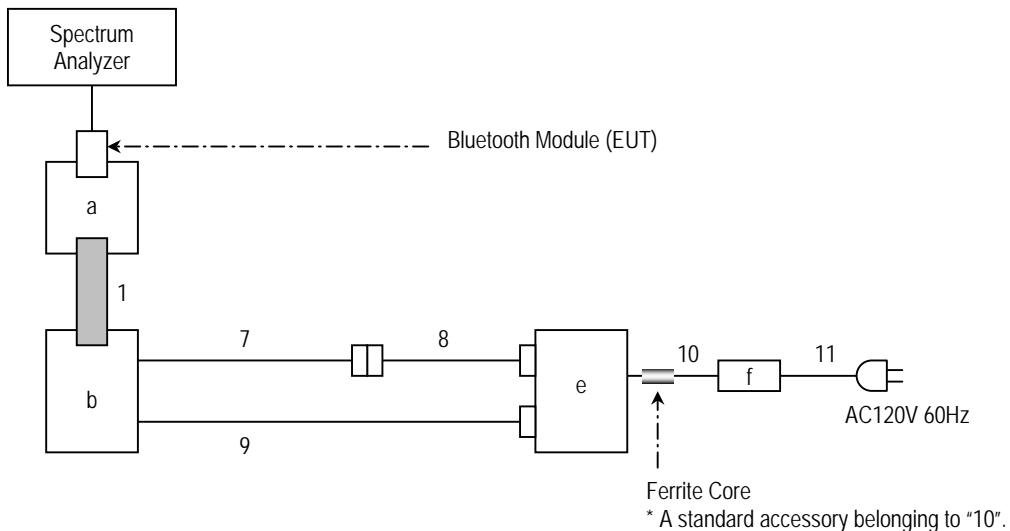


(2) Conducted Emission Test

These numbers and the marks in the picture are corresponding to the numbers and the marks in Tables shown at the Section 3.3 and 3.4.

Power supply of EUT: DC3.3V from Supporting equipment "b"

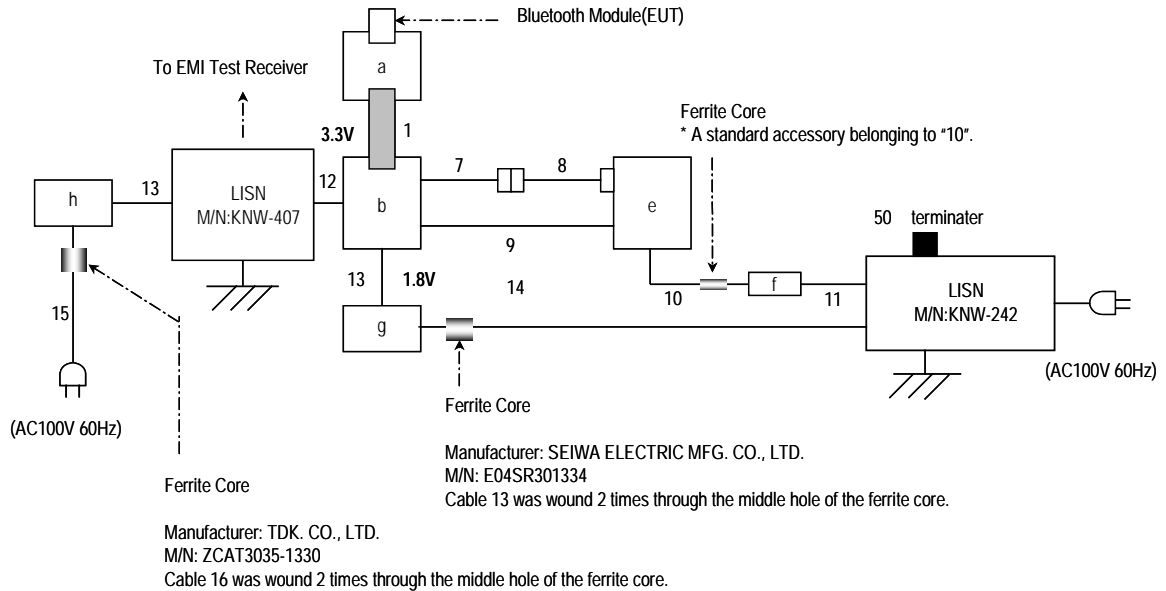
(DC5V is supplied to Supporting equipment "b" from PC via USB, and converted to DC3.3V by Supporting equipment "b".)



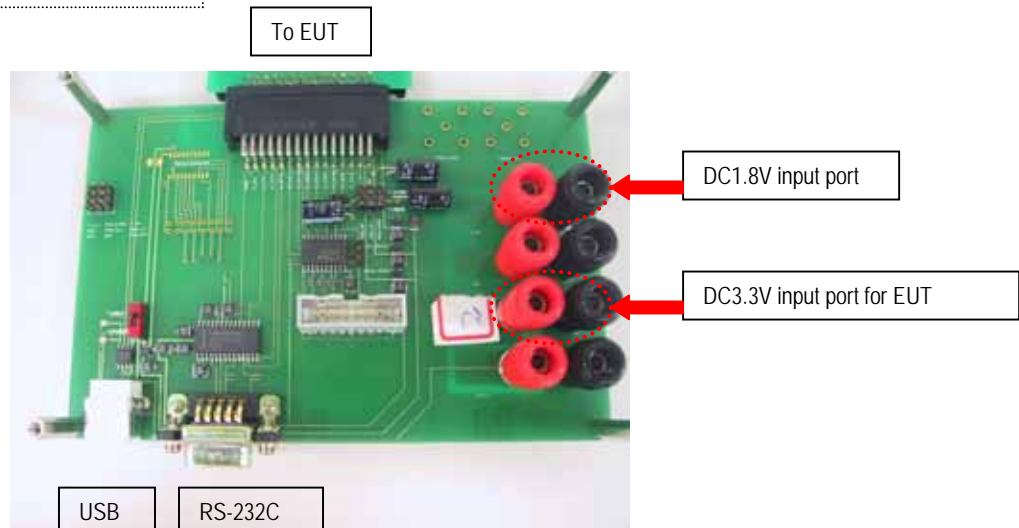
(3)DC Power line Conducted Emission Test

These numbers and the marks in the picture are corresponding to the numbers and the marks in Tables shown at the Section 3.3 and 3.4.

Power supply of EUT: DC3.3V from Supporting equipment "b"
 (DC3.3V is supplied to Supporting equipment "b" from Regulated DC power supply)



Supporting equipment "b"



4 Antenna Requirement

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

Antenna type: Monopole antenna
Antenna gain: 0.8dBi

Refer to Section 15 of this REPORT.

5 DC 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 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.

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 3.3V(VA) and GND(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. | Calibration Date | Next Calibration Due | Note |
|------------------------|-----------------------------|----------------|------------|---------------------------|----------------------------|----------------------------------|
| Shielded room | TDK Co.,Ltd | DA-06912 | - | - | - | - |
| EMI Test Receiver | R&S | ESHS 10 | 100005 | 10 th .8.2005. | 9 th .8.2006. | - |
| LISN | KYORITSU ELECTRICAL WORK | KNW-407 | 8-680-1 | 13 th .3.2006. | 12 th .3.2008. | for PC to connect EUT |
| | | KNW-242 | 8-818-8 | 13 th .3.2006. | 12 th .3.2008. | for peripherals other than PC |
| Cable | SUHNER | RG223 | CE-1 | 27 th .4.2005 | 26 th .4.2006. | - |
| | | RG223 | CE-2 | 27 th .4.2005 | 26 th .4.2006. | - |
| | | RG2214 | CE-3 | 27 th .4.2005 | 26 th .4.2006. | - |
| Attenuator | KYORITSU | KPD-602 | 5K325 | 27 th .4.2005 | 26 th .4.2006. | - |
| Pulse Limiter | Agilent Technologies | 11867A | 1387 | 27 th .4.2005 | 26 th .4.2006. | - |
| RF Selector | TDK Co.,Ltd | NS4900 | 0302-009 | 27 th .4.2005 | 26 th .4.2006. | - |
| 50Ω terminator | Agilent Technologies | HP11593A | No.1 | 13 th .3.2006. | 12 th .3.2007. | - |
| Software | TOYO Corporation | EP5/CE Ver.2.0 | 0208085 | - | - | - |

5.3 Conducted Emission Calculation

The basic equation with a sample calculation is as follows:

$$\begin{aligned} \text{c.f.} &= \text{CF} + \text{AL} \\ \text{CE} &= \text{RA} + \text{c.f.} \end{aligned}$$

Where

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

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

$$\text{CE} = 37.5 + 3.5 = 41.0 \text{ dB } \mu \text{ V}$$

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

5.4 Test Results

DC Power line Conducted Emission 2402MHz

Serial No. : 00000004
 Power : DC 3.3V
 Mode : Transmitting mode
 Temperature : 21
 Humidity : 42%

DC3.3V (PLUS)

| Frequency [MHz] | Meter Reading [dB(uV)] | | Factor [dB] | Conducted Emission [dB(uV)] | | Limits [dB(uV)] | | Margin [dB] | |
|-----------------|------------------------|------|-------------|-----------------------------|------|-----------------|------|---------------|------|
| | QP | AV | | QP | AV | QP | AV | QP | AV |
| 0.173 | 35.0 | 27.5 | 3.4 | 38.4 | 30.9 | 64.8 | 54.8 | 26.4 | 23.9 |
| 0.274 | 29.9 | 22.4 | 3.3 | 33.2 | 25.7 | 61.0 | 51.0 | 27.8 | 25.3 |
| 0.340 | 34.2 | 20.7 | 3.3 | 37.5 | 24.0 | 59.2 | 49.2 | 21.7 | 25.2 |
| 0.561 | 29.7 | 19.4 | 3.3 | 33.0 | 22.7 | 56.0 | 46.0 | 23.0 | 23.3 |
| 0.672 | 27.6 | 17.3 | 3.3 | 30.9 | 20.6 | 56.0 | 46.0 | 25.1 | 25.4 |
| 1.020 | 28.7 | 19.6 | 3.3 | 32.0 | 22.9 | 56.0 | 46.0 | 24.0 | 23.1 |

GND

| Frequency [MHz] | Meter Reading [dB(uV)] | | Factor [dB] | Conducted Emission [dB(uV)] | | Limits [dB(uV)] | | Margin [dB] | |
|-----------------|------------------------|------|-------------|-----------------------------|------|-----------------|------|---------------|------|
| | QP | AV | | QP | AV | QP | AV | QP | AV |
| 0.156 | 35.0 | 27.0 | 3.4 | 38.4 | 30.4 | 65.7 | 55.7 | 27.3 | 25.3 |
| 0.290 | 34.7 | 22.9 | 3.3 | 38.0 | 26.2 | 60.5 | 50.5 | 22.5 | 24.3 |
| 0.338 | 34.4 | 21.8 | 3.3 | 37.7 | 25.1 | 59.2 | 49.2 | 21.5 | 24.1 |
| 0.559 | 29.7 | 19.5 | 3.3 | 33.0 | 22.8 | 56.0 | 46.0 | 23.0 | 23.2 |
| 0.681 | 28.3 | 15.9 | 3.3 | 31.6 | 19.2 | 56.0 | 46.0 | 24.4 | 26.8 |
| 0.861 | 33.6 | 29.1 | 3.3 | 36.9 | 32.4 | 56.0 | 46.0 | 19.1 | 13.6 |

Conducted Emission 2441MHz

Serial No. : 00000004
 Power : DC 3.3V
 Mode : Transmitting mode
 Temperature : 21
 Humidity : 42%

DC3.3V (PLUS)

| Frequency [MHz] | Meter Reading [dB(uV)] | | Factor [dB] | Conducted Emission [dB(uV)] | | Limits [dB(uV)] | | Margin [dB] | |
|-----------------|------------------------|------|-------------|-----------------------------|------|-----------------|------|---------------|------|
| | QP | AV | | QP | AV | QP | AV | QP | AV |
| 0.202 | 34.4 | 24.4 | 3.3 | 37.7 | 27.7 | 63.5 | 53.5 | 25.8 | 25.8 |
| 0.377 | 37.4 | 33.5 | 3.3 | 40.7 | 36.8 | 58.3 | 48.3 | 17.6 | 11.5 |
| 0.588 | 31.8 | 28.9 | 3.3 | 35.1 | 32.2 | 56.0 | 46.0 | 20.9 | 13.8 |
| 0.786 | 29.3 | 16.3 | 3.3 | 32.6 | 19.6 | 56.0 | 46.0 | 23.4 | 26.4 |
| 0.858 | 33.4 | 28.4 | 3.3 | 36.7 | 31.7 | 56.0 | 46.0 | 19.3 | 14.3 |
| 1.240 | 32.0 | 27.3 | 3.3 | 35.3 | 30.6 | 56.0 | 46.0 | 20.7 | 15.4 |

GND

| Frequency [MHz] | Meter Reading [dB(uV)] | | Factor [dB] | Conducted Emission [dB(uV)] | | Limits [dB(uV)] | | Margin [dB] | |
|-----------------|------------------------|------|-------------|-----------------------------|------|-----------------|------|---------------|------|
| | QP | AV | | QP | AV | QP | AV | QP | AV |
| 0.159 | 37.2 | 28.4 | 3.4 | 40.6 | 31.8 | 65.5 | 55.5 | 24.9 | 23.7 |
| 0.202 | 35.0 | 24.4 | 3.3 | 38.3 | 27.7 | 63.5 | 53.5 | 25.2 | 25.8 |
| 0.376 | 37.3 | 33.5 | 3.3 | 40.6 | 36.8 | 58.3 | 48.3 | 17.7 | 11.5 |
| 0.589 | 31.9 | 28.5 | 3.3 | 35.2 | 31.8 | 56.0 | 46.0 | 20.8 | 14.2 |
| 0.860 | 33.5 | 29.3 | 3.3 | 36.8 | 32.6 | 56.0 | 46.0 | 19.2 | 13.4 |
| 1.240 | 32.1 | 27.5 | 3.3 | 35.4 | 30.8 | 56.0 | 46.0 | 20.6 | 15.2 |

Conducted Emission 2480MHz

Serial No. : 00000004
 Power : DC 3.3V
 Mode : Transmitting mode
 Temperature : 21
 Humidity : 42%

DC3.3V (PLUS)

| Frequency [MHz] | Meter Reading [dB(uV)] | | Factor [dB] | Conducted Emission [dB(uV)] | | Limits [dB(uV)] | | Margin [dB] | |
|-----------------|------------------------|------|-------------|-----------------------------|------|-----------------|------|---------------|------|
| | QP | AV | | QP | AV | QP | AV | QP | AV |
| 0.159 | 37.3 | 28.1 | 3.4 | 40.7 | 31.5 | 65.5 | 55.5 | 24.8 | 24.0 |
| 0.383 | 35.3 | 25.8 | 3.3 | 38.6 | 29.1 | 58.2 | 48.2 | 19.6 | 19.1 |
| 0.589 | 31.9 | 28.4 | 3.3 | 35.2 | 31.7 | 56.0 | 46.0 | 20.8 | 14.3 |
| 0.777 | 29.0 | 16.6 | 3.3 | 32.3 | 19.9 | 56.0 | 46.0 | 23.7 | 26.1 |
| 0.862 | 33.5 | 29.4 | 3.3 | 36.8 | 32.7 | 56.0 | 46.0 | 19.2 | 13.3 |
| 1.003 | 29.2 | 18.3 | 3.3 | 32.5 | 21.6 | 56.0 | 46.0 | 23.5 | 24.4 |

GND

| Frequency [MHz] | Meter Reading [dB(uV)] | | Factor [dB] | Conducted Emission [dB(uV)] | | Limits [dB(uV)] | | Margin [dB] | |
|-----------------|------------------------|------|-------------|-----------------------------|------|-----------------|------|---------------|------|
| | QP | AV | | QP | AV | QP | AV | QP | AV |
| 0.158 | 37.0 | 28.0 | 3.4 | 40.4 | 31.4 | 65.5 | 55.5 | 25.1 | 24.1 |
| 0.382 | 36.2 | 29.8 | 3.3 | 39.5 | 33.1 | 58.2 | 48.2 | 18.7 | 15.1 |
| 0.549 | 29.2 | 19.4 | 3.3 | 32.5 | 22.7 | 56.0 | 46.0 | 23.5 | 23.3 |
| 0.749 | 29.7 | 17.5 | 3.3 | 33.0 | 20.8 | 56.0 | 46.0 | 23.0 | 25.2 |
| 0.865 | 32.7 | 26.6 | 3.3 | 36.0 | 29.9 | 56.0 | 46.0 | 20.0 | 16.1 |
| 1.002 | 28.9 | 17.8 | 3.3 | 32.2 | 21.1 | 56.0 | 46.0 | 23.8 | 24.9 |

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.

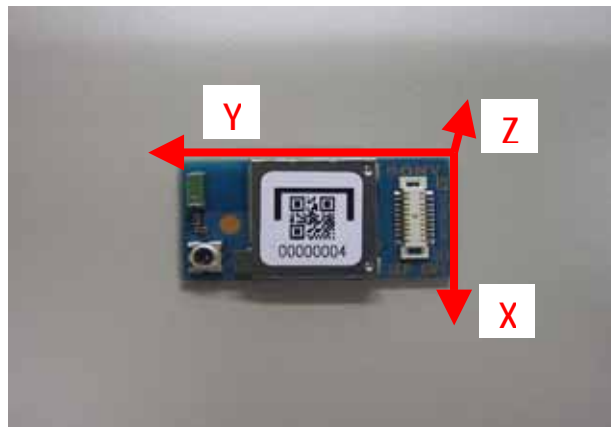
For further description of the configuration refer to the pictures of this report.

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

Spectrum Analyzer Setting

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

Axial Direction



6.2 Test Instrumentation

| Facility/ Equipment | Manufacturer | Model No. | Serial No. | Frequency Range | Calibration Date | Next Calibration Due |
|------------------------|----------------------|----------------|------------|---------------------------|---|----------------------------|
| 10m anechoic chamber | TDK Co.,Ltd | DA-06912 | - | - | 13 th .17 th .3.2006. | 12 th .3.2007. |
| EMI Test Receiver | R&S | ESCS 30 | 100148 | 30-1000MHz | 11 th .8.2005. | 10 th .8.2006. |
| Spectrum Analyzer | Agilent Technologies | 8563E | 3416A02230 | 30-1000MHz | 12 th .4.2006. | 11 th .4.2007. |
| | | E4446A | US42070181 | 1-40GHz | 14 th .11.2005. | 13 th .11.2006. |
| Amplifier | | 8449B | 3008A00571 | 1-26.5GHz | 6 st .3.2006. | 5 th .3.2007. |
| 8447D | | 2944A06812 | 30-1000MHz | 13 th .2.2006. | 12 th .2.2007. | |
| RF Selector | TDK Co.,Ltd | NS4900 | 0302-010 | - | 13 th .2.2006. | 12 th .2.2007. |
| RF Cable | SUHNER | RG214 | RG 1 | 30-1000MHz | 13 th .2.2006. | 12 th .2.2007. |
| | | RG214 | RG 3 | 30-1000MHz | 13 th .2.2006. | 12 th .2.2007. |
| | | RG214 | RG 8 | 30-1000MHz | 13 th .2.2006. | 12 th .2.2007. |
| | | RG214 | RG 5 | 30-1000MHz | 13 th .2.2006. | 12 th .2.2007. |
| | | RG214 | RG 6 | 30-1000MHz | 13 th .2.2006. | 12 th .2.2007. |
| | | SUCOFLEX 106 | SU1 | 1-18GHz | 6 th .3.2006. | 5 th .3.2007. |
| | SUCOFLEX 104 | SU4 | 1-18GHz | 6 th .3.2006. | 5 th .3.2007. | |
| | HP | 85381C | No.3 | 18-25GHz | 25 th .4.2006. | 24 th .4.2007. |
| 85381C | | No.5 | 18-25GHz | 25 th .4.2006. | 24 th .4.2007. | |
| Attenuator | KYORITSU | KPD-602 | 220142 | 30-1000MHz | 13 th .2.2006. | 12 th .2.2007. |
| Antenna | Schwarzbeck | BBA9106 | No.4 | 30-300MHz | 25 nd .2.2006. | 24 th .2.2007. |
| | | UHALP9108-A | 160 | 300-1000MHz | 25 nd .2.2006. | 24 th .2.2007. |
| | EMCO | 3115 | 9403-4232 | 1-18GHz | 1 st .4.2005. | 31 st .3.2007. |
| | | 3116 | 9311-2227 | 18-40GHz | 1 st .4.2005. | 31 st .3.2007. |
| Software | TOYO Corporation | EP5/RE Ver.2.0 | 0208086 | - | - | - |

6.3 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:

$$\begin{aligned} \text{c.f.} &= \text{AF} + \text{CF} + \text{AL} - \text{AG} - \text{DF} \\ \text{RE} &= \text{RA} + \text{c.f.} \end{aligned}$$

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 μ V is obtained. The Correction Factor of -1.1 dB/m is added, giving a Radiated Emission of 40.2 dB μ V/m. The 40.2 dB μ V/m value was mathematically converted to its corresponding level in μ V/m.

$$\begin{aligned} \text{RE} &= 41.3 + (-1.1) = 40.2 \text{ dB } \mu \text{ V/m} \\ \text{Level in } \mu \text{ V/m} &= \text{Common Antilogarithm : } 10^{(40.2/20)} = 102.3 \mu \text{ V/m} \end{aligned}$$

6.4 Test Results

Spurious Emission (Radiated) 2402MHz

Serial No. : 00000004
 Power : DC 3.3V
 Mode : Transmitting mode
 Temperature : 20
 Humidity : 49 %

Axial Direction : XY-Plane

| Frequency [MHz] | Antenna Polarization | Meter Reading [dB(uV)] | | Factor [dB/m] | Emission Level [dB(uV/m)] | | Limits [dB(uV/m)] | | Margin [dB] | |
|-----------------|----------------------|------------------------|-------|---------------|---------------------------|-------|-------------------|------|-------------|-------|
| | | Average | Peak | | Average | Peak | Average | Peak | Average | Peak |
| 1601.975 | Horizontal | 62.2 | 63.8 | -12.3 | 49.9 | 51.5 | 54.0 | 74.0 | 4.1 | 22.5 |
| 1601.925 | Vertical | 61.4 | 63.0 | -12.3 | 49.1 | 50.7 | 54.0 | 74.0 | 4.9 | 23.3 |
| 4804.275 | Horizontal | 37.6 | 47.0 | -0.5 | 37.1 | 46.5 | 54.0 | 74.0 | 16.9 | 27.5 |
| 4804.317 | Vertical | 34.0 | 46.0 | -0.5 | 33.5 | 45.5 | 54.0 | 74.0 | 20.5 | 28.5 |
| 7206.183 | Horizontal | <33.2 | <41.8 | 3.5 | <36.7 | <45.3 | 54.0 | 74.0 | >17.3 | >28.7 |
| 9608.183 | Horizontal | <33.1 | <45.2 | 5.7 | <38.8 | <50.9 | 54.0 | 74.0 | >15.2 | >23.1 |
| 12010.000 | Horizontal | <32.8 | <44.2 | 9.0 | <41.8 | <53.2 | 54.0 | 74.0 | >12.2 | >20.8 |
| 14412.183 | Horizontal | <33.2 | <43.6 | 13.2 | <46.4 | <56.8 | 54.0 | 74.0 | >7.6 | >17.2 |

Axial Direction : YZ-Plane

| Frequency [MHz] | Antenna Polarization | Meter Reading [dB(uV)] | | Factor [dB/m] | Emission Level [dB(uV/m)] | | Limits [dB(uV/m)] | | Margin [dB] | |
|-----------------|----------------------|------------------------|-------|---------------|---------------------------|-------|-------------------|------|-------------|-------|
| | | Average | Peak | | Average | Peak | Average | Peak | Average | Peak |
| 1602.050 | Horizontal | 60.2 | 62.0 | -12.3 | 47.9 | 49.7 | 54.0 | 74.0 | 6.1 | 24.3 |
| 1601.983 | Vertical | 63.5 | 64.8 | -12.3 | 51.2 | 52.5 | 54.0 | 74.0 | 2.8 | 21.5 |
| 4804.233 | Horizontal | 36.1 | 46.5 | -0.5 | 35.6 | 46.0 | 54.0 | 74.0 | 18.4 | 28.0 |
| 4803.283 | Vertical | 35.2 | 45.7 | -0.5 | 34.7 | 45.2 | 54.0 | 74.0 | 19.3 | 28.8 |
| 7206.183 | Horizontal | <33.2 | <41.8 | 3.5 | <36.7 | <45.3 | 54.0 | 74.0 | >17.3 | >28.7 |
| 9608.183 | Horizontal | <33.1 | <45.2 | 5.7 | <38.8 | <50.9 | 54.0 | 74.0 | >15.2 | >23.1 |
| 12010.000 | Horizontal | <32.8 | <44.2 | 9.0 | <41.8 | <53.2 | 54.0 | 74.0 | >12.2 | >20.8 |
| 14412.183 | Horizontal | <33.2 | <43.6 | 13.2 | <46.4 | <56.8 | 54.0 | 74.0 | >7.6 | >17.2 |

Axial Direction : ZX-Plane

| Frequency [MHz] | Antenna Polarization | Meter Reading [dB(uV)] | | Factor [dB/m] | Emission Level [dB(uV/m)] | | Limits [dB(uV/m)] | | Margin [dB] | |
|-----------------|----------------------|------------------------|-------|---------------|---------------------------|-------|-------------------|------|-------------|-------|
| | | Average | Peak | | Average | Peak | Average | Peak | Average | Peak |
| 1601.950 | Horizontal | 63.8 | 65.1 | -12.3 | 51.5 | 52.8 | 54.0 | 74.0 | 2.5 | 21.2 |
| 1602.050 | Vertical | 63.2 | 64.6 | -12.3 | 50.9 | 52.3 | 54.0 | 74.0 | 3.1 | 21.7 |
| 4804.450 | Horizontal | 36.2 | 47.2 | -0.5 | 35.7 | 46.7 | 54.0 | 74.0 | 18.3 | 27.3 |
| 4804.183 | Vertical | <32.8 | <42.1 | -0.5 | <32.3 | <41.6 | 54.0 | 74.0 | >21.7 | >32.4 |
| 7206.183 | Horizontal | <33.2 | <41.8 | 3.5 | <36.7 | <45.3 | 54.0 | 74.0 | >17.3 | >28.7 |
| 9608.183 | Horizontal | <33.1 | <45.2 | 5.7 | <38.8 | <50.9 | 54.0 | 74.0 | >15.2 | >23.1 |
| 12010.000 | Horizontal | <32.8 | <44.2 | 9.0 | <41.8 | <53.2 | 54.0 | 74.0 | >12.2 | >20.8 |
| 14412.183 | Horizontal | <33.2 | <43.6 | 13.2 | <46.4 | <56.8 | 54.0 | 74.0 | >7.6 | >17.2 |

The Mark "<", ">" in the table each means floor noise data and the data is below or over the shown value.

Spurious Emission (Radiated) 2441MHz

Serial No. : 00000004
 Power : DC 3.3V
 Mode : Transmitting mode
 Temperature : 20
 Humidity : 49 %

Axial Direction : XY-Plane

| Frequency [MHz] | Antenna Polarization | Meter Reading [dB(uV)] | | Factor [dB/m] | Emission Level [dB(uV/m)] | | Limits [dB(uV/m)] | | Margin [dB] | |
|-----------------|----------------------|------------------------|-------|---------------|---------------------------|-------|-------------------|------|-------------|-------|
| | | Average | Peak | | Average | Peak | Average | Peak | Average | Peak |
| 1627.983 | Horizontal | 65.0 | 66.1 | -12.2 | 52.8 | 53.9 | 54.0 | 74.0 | 1.2 | 20.1 |
| 1627.983 | Vertical | 65.0 | 66.0 | -12.2 | 52.8 | 53.8 | 54.0 | 74.0 | 1.2 | 20.2 |
| 4881.758 | Horizontal | <32.3 | <42.6 | -0.4 | <31.9 | <42.2 | 54.0 | 74.0 | >22.1 | >31.8 |
| 7323.117 | Horizontal | 37.1 | 47.8 | 3.6 | 40.7 | 51.4 | 54.0 | 74.0 | 13.3 | 22.6 |
| 7322.975 | Vertical | 33.5 | 44.6 | 3.6 | 37.1 | 48.2 | 54.0 | 74.0 | 16.9 | 25.8 |
| 9763.950 | Horizontal | <32.7 | <44.9 | 5.8 | <38.5 | <50.7 | 54.0 | 74.0 | >15.5 | >23.3 |
| 12204.950 | Horizontal | <32.1 | <43.7 | 8.8 | <40.9 | <52.5 | 54.0 | 74.0 | >13.3 | >21.5 |
| 14645.950 | Horizontal | <33.0 | <43.1 | 12.9 | <45.9 | <56.0 | 54.0 | 74.0 | >8.1 | >18.1 |

Axial Direction : YZ-Plane

| Frequency [MHz] | Antenna Polarization | Meter Reading [dB(uV)] | | Factor [dB/m] | Emission Level [dB(uV/m)] | | Limits [dB(uV/m)] | | Margin [dB] | |
|-----------------|----------------------|------------------------|-------|---------------|---------------------------|-------|-------------------|------|-------------|-------|
| | | Average | Peak | | Average | Peak | Average | Peak | Average | Peak |
| 1627.850 | Horizontal | 64.6 | 65.7 | -12.2 | 52.4 | 53.5 | 54.0 | 74.0 | 1.6 | 20.5 |
| 1628.000 | Vertical | 64.9 | 65.8 | -12.2 | 52.7 | 53.6 | 54.0 | 74.0 | 1.3 | 20.4 |
| 4881.758 | Horizontal | <32.3 | <42.6 | -0.4 | <31.9 | <42.2 | 54.0 | 74.0 | >22.1 | >31.8 |
| 7323.117 | Horizontal | 37.1 | 47.8 | 3.6 | 40.7 | 51.4 | 54.0 | 74.0 | 13.3 | 22.6 |
| 7322.975 | Vertical | 33.5 | 44.6 | 3.6 | 37.1 | 48.2 | 54.0 | 74.0 | 16.9 | 25.8 |
| 9763.950 | Horizontal | <32.7 | <44.9 | 5.8 | <38.5 | <50.7 | 54.0 | 74.0 | >15.5 | >23.3 |
| 12204.950 | Horizontal | <32.1 | <43.7 | 8.8 | <40.9 | <52.5 | 54.0 | 74.0 | >13.3 | >21.5 |
| 14645.950 | Horizontal | <33.0 | <43.1 | 12.9 | <45.9 | <56.0 | 54.0 | 74.0 | >8.1 | >18.1 |

Axial Direction : ZX-Plane

| Frequency [MHz] | Antenna Polarization | Meter Reading [dB(uV)] | | Factor [dB/m] | Emission Level [dB(uV/m)] | | Limits [dB(uV/m)] | | Margin [dB] | |
|-----------------|----------------------|------------------------|-------|---------------|---------------------------|-------|-------------------|------|-------------|-------|
| | | Average | Peak | | Average | Peak | Average | Peak | Average | Peak |
| 1628.033 | Horizontal | 62.6 | 63.9 | -12.2 | 50.4 | 51.7 | 54.0 | 74.0 | 3.6 | 22.3 |
| 1628.050 | Vertical | 63.1 | 64.5 | -12.2 | 50.9 | 52.3 | 54.0 | 74.0 | 3.1 | 21.7 |
| 4881.758 | Horizontal | <32.3 | <42.6 | -0.4 | <31.9 | <42.2 | 54.0 | 74.0 | >22.1 | >31.8 |
| 7323.667 | Horizontal | 34.0 | 45.8 | 3.6 | 37.6 | 49.4 | 54.0 | 74.0 | 16.4 | 24.6 |
| 7323.433 | Vertical | 36.0 | 47.2 | 3.6 | 39.6 | 50.8 | 54.0 | 74.0 | 14.4 | 23.2 |
| 9763.950 | Horizontal | <32.7 | <44.9 | 5.8 | <38.5 | <50.7 | 54.0 | 74.0 | >15.5 | >23.3 |
| 12204.950 | Horizontal | <32.1 | <43.7 | 8.8 | <40.9 | <52.5 | 54.0 | 74.0 | >13.3 | >21.5 |
| 14645.950 | Horizontal | <33.0 | <43.1 | 12.9 | <45.9 | <56.0 | 54.0 | 74.0 | >8.1 | >18.1 |

The Mark "<", ">" in the table each means floor noise data and the data is below or over the shown value.

Spurious Emission (Radiated) 2480MHz

Serial No. : 00000004
 Power : DC 3.3V
 Mode : Transmitting mode
 Temperature : 20
 Humidity : 49 %

Axial Direction : XY-Plane

| Frequency [MHz] | Antenna Polarization | Meter Reading [dB(uV)] | | Factor [dB/m] | Emission Level [dB(uV/m)] | | Limits [dB(uV/m)] | | Margin [dB] | |
|-----------------|----------------------|------------------------|-------|---------------|---------------------------|-------|-------------------|------|-------------|-------|
| | | Average | Peak | | Average | Peak | Average | Peak | Average | Peak |
| 1653.992 | Horizontal | 60.8 | 62.6 | -12.2 | 48.7 | 50.5 | 54.0 | 74.0 | 5.3 | 23.5 |
| 1653.992 | Vertical | 61.1 | 62.6 | -12.1 | 49.0 | 50.5 | 54.0 | 74.0 | 5.0 | 23.5 |
| 4960.033 | Horizontal | <32.7 | <43.3 | -0.4 | <32.3 | <42.9 | 54.0 | 74.0 | >21.7 | >31.1 |
| 7440.033 | Horizontal | <33.9 | <43.9 | 3.6 | <37.5 | <47.5 | 54.0 | 74.0 | >16.5 | >26.5 |
| 9920.033 | Horizontal | <33.2 | <42.3 | 6.1 | <39.3 | <48.4 | 54.0 | 74.0 | >14.7 | >25.6 |
| 12400.033 | Horizontal | <32.3 | <42.5 | 8.7 | <40.9 | <51.2 | 54.0 | 74.0 | >13.1 | >22.8 |
| 14880.033 | Horizontal | <32.7 | <43.2 | 11.9 | <44.6 | <55.1 | 54.0 | 74.0 | >0.4 | >18.9 |

Axial Direction : YZ-Plane

| Frequency [MHz] | Antenna Polarization | Meter Reading [dB(uV)] | | Factor [dB/m] | Emission Level [dB(uV/m)] | | Limits [dB(uV/m)] | | Margin [dB] | |
|-----------------|----------------------|------------------------|-------|---------------|---------------------------|-------|-------------------|------|-------------|-------|
| | | Average | Peak | | Average | Peak | Average | Peak | Average | Peak |
| 1653.967 | Horizontal | 62.2 | 63.6 | -12.1 | 50.1 | 51.5 | 54.0 | 74.0 | 3.9 | 22.5 |
| 1654.067 | Vertical | 61.1 | 62.5 | -12.1 | 49.0 | 50.4 | 54.0 | 74.0 | 5.0 | 23.6 |
| 4960.033 | Horizontal | <32.7 | <43.3 | -0.4 | <32.3 | <42.9 | 54.0 | 74.0 | >21.7 | >31.1 |
| 7440.033 | Horizontal | <33.9 | <43.9 | 3.6 | <37.5 | <47.5 | 54.0 | 74.0 | >16.5 | >26.5 |
| 9920.033 | Horizontal | <33.2 | <42.3 | 6.1 | <39.3 | <48.4 | 54.0 | 74.0 | >14.7 | >25.6 |
| 12400.033 | Horizontal | <32.3 | <42.5 | 8.7 | <40.9 | <51.2 | 54.0 | 74.0 | >13.1 | >22.8 |
| 14880.033 | Horizontal | <32.7 | <43.2 | 11.9 | <44.6 | <55.1 | 54.0 | 74.0 | >0.4 | >18.9 |

Axial Direction : ZX-Plane

| Frequency [MHz] | Antenna Polarization | Meter Reading [dB(uV)] | | Factor [dB/m] | Emission Level [dB(uV/m)] | | Limits [dB(uV/m)] | | Margin [dB] | |
|-----------------|----------------------|------------------------|-------|---------------|---------------------------|-------|-------------------|------|-------------|-------|
| | | Average | Peak | | Average | Peak | Average | Peak | Average | Peak |
| 1653.975 | Horizontal | 63.9 | 65.2 | -12.1 | 51.8 | 53.1 | 54.0 | 74.0 | 2.2 | 20.9 |
| 1653.958 | Vertical | 63.5 | 64.8 | -12.1 | 51.4 | 52.7 | 54.0 | 74.0 | 2.6 | 21.3 |
| 4960.033 | Horizontal | <32.7 | <43.3 | -0.4 | <32.3 | <42.9 | 54.0 | 74.0 | >21.7 | >31.1 |
| 7440.033 | Horizontal | <33.9 | <43.9 | 3.6 | <37.5 | <47.5 | 54.0 | 74.0 | >16.5 | >26.5 |
| 9920.033 | Horizontal | <33.2 | <42.3 | 6.1 | <39.3 | <48.4 | 54.0 | 74.0 | >14.7 | >25.6 |
| 12400.033 | Horizontal | <32.3 | <42.5 | 8.7 | <40.9 | <51.2 | 54.0 | 74.0 | >13.1 | >22.8 |
| 14880.033 | Horizontal | <32.7 | <43.2 | 11.9 | <44.6 | <55.1 | 54.0 | 74.0 | >0.4 | >18.9 |

The Mark "<", ">" in the table each means floor noise data and the data is below or over the shown value.

7 20dB Bandwidth

7.1 Test Setup

The spectrum analyzer was connected to the transmitter output port through the RF cable.

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. | Calibration Date | Next Calibration Due |
|-------------------|-----------------|---------------|-------------|---------------------------|--------------------------|
| Spectrum Analyzer | Rohde & Schwarz | FSIQ26 | 840061/0004 | 10 th .2.2006. | 9 th .2.2007. |
| RF cable | SUHNER | SUCOFLEX 104E | RF2 | 5 th .7.2005. | 4 th .7.2006. |

7.3 Test Results

Serial No. : 00000005
 Power : DC 3.3V
 Mode : Transmitting mode , Non Frequency Hopping
 Temperature : 22.1
 Humidity : 52.4 %

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

8 Carrier Frequency Separation

8.1 Test Setup

The spectrum analyzer was connected to the transmitter output port through the RF cable.

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. | Calibration Date | Next Calibration Due |
|-------------------|-----------------|---------------|-------------|---------------------------|--------------------------|
| Spectrum Analyzer | Rohde & Schwarz | FSIQ26 | 840061/0004 | 10 th .2.2006. | 9 th .2.2007. |
| RF cable | SUHNER | SUCOFLEX 104E | RF2 | 5 th .7.2005. | 4 th .7.2006. |

8.3 Test Results

Serial No. : 00000005
 Power : DC 3.3V
 Mode : Transmitting mode , Frequency Hopping
 Transmitting mode , Adoptive Frequency Hopping
 Temperature : 22.1
 Humidity : 52.4 %
 Regulation : FCC Part15 C §15.247 (a)(1)

Transmitting mode , Frequency Hopping (79ch)

| Channel | Channel Separation [MHz] | Limit *1 [MHz] |
|------------------------------|--------------------------|----------------|
| Low frequency (0ch-1ch) | 0.992 | > 0.628 |
| Middle frequency (38ch-39ch) | 0.992 | > 0.628 |
| High frequency (77ch-78ch) | 0.998 | > 0.628 |

Transmitting mode , Adoptive Frequency Hopping (20ch)

| Channel | Channel Separation [MHz] | Limit *1 [MHz] |
|------------------------------|--------------------------|----------------|
| Low frequency (0ch-1ch) | 0.986 | > 0.628 |
| Middle frequency (38ch-39ch) | 1.004 | > 0.628 |
| High frequency (77ch-78ch) | 0.998 | > 0.628 |

*1 Limit value of Carrier Frequency Separation is 2/3 of 20dB Bandwidth. Refer the result of 20dB Bandwidth to Section 7.

9 Number of Hopping Frequency

9.1 Test Setup

The spectrum analyzer was connected to the transmitter output port through the RF cable.

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

9.2 Test Instrument

| Equipment | Manufacture | Model No. | Serial No. | Calibration Date | Next Calibration Due |
|-------------------|-----------------|---------------|-------------|---------------------------|--------------------------|
| Spectrum Analyzer | Rohde & Schwarz | FSIQ26 | 840061/0004 | 10 th .2.2006. | 9 th .2.2007. |
| RF cable | SUHNER | SUCOFLEX 104E | RF2 | 5 th .7.2005. | 4 th .7.2006. |

9.3 Test Results

Serial No. : 00000005
 Power : DC 3.3V
 Mode : Transmitting mode , Frequency Hopping
 Transmitting mode , Adoptive Frequency Hopping
 Temperature : 22.1
 Humidity : 52.4 %
 Regulation : FCC Part15 C §15.247 (a)(1)(iii)

| Mode | Number of channel [time] | Limit [time] |
|--|--------------------------|--------------|
| Transmitting mode Frequency Hopping (79ch) | 79 | ≥ 15 |
| Transmitting mode Adoptive Frequency Hopping (20ch) | 20 *A | ≥ 15 |

AFH: Intelligent hopping techniques to avoid interference to other transmission.

*A: None of them is overlapped each other.

10 Dwell Time

10.1 Test Setup

The spectrum analyzer was connected to the transmitter output port through the RF cable.

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. | Calibration Date | Next Calibration Due |
|-------------------|-----------------|---------------|-------------|---------------------------|--------------------------|
| Spectrum Analyzer | Rohde & Schwarz | FSIQ26 | 840061/0004 | 10 th .2.2006. | 9 th .2.2007. |
| RF cable | SUHNER | SUCOFLEX 104E | RF2 | 5 th .7.2005. | 4 th .7.2006. |

10.3 Test Results

Serial No. : 00000005
 Power : DC 3.3V
 Mode : Transmitting mode (DH1,DH3,DH5), Frequency Hopping
 Temperature : 22.1
 Humidity : 52.4 %
 Regulation : FCC Part15 C §15.247 (a)(1)(iii)

| Packet | Dwell time [ms] | Limit [ms] |
|--------|-----------------|------------|
| DH1 | 135.41 | 400 |
| DH3 | 269.62 | 400 |
| DH5 | 311.59 | 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.

$$800/79=10.13 \text{ (times)}$$

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 $0.4 \times 79 = 31.6$ seconds

The number of times that appears in 1 channel per 31.6 seconds is as follows.

$$10.13 \times 31.6 = 320.11 \text{ (times)}$$

Transmitting time is 0.423ms.

Then, dwell time is $320.11 \times 0.423\text{ms} = 135.41\text{ms}$ 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.

$$400/79=5.1 \text{ (times)}$$

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 $0.4 \times 79 = 31.6$ seconds

The number of times that appears in 1 channel per 31.6 seconds is as follows.

$$5.1 \times 31.6 = 161.16 \text{ (times)}$$

Transmitting time is 1.673ms.

Then, dwell time is $161.16 \times 1.673\text{ms} = 269.62\text{ms}$ 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.

$$266.67/79=3.37 \text{ (times)}$$

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 $0.4 \times 79 = 31.6$ seconds

The number of times that appears in 1 channel per 31.6 seconds is as follows.

$$3.37 \times 31.6 = 106.49 \text{ (times)}$$

Transmitting time is 2.926ms.

Then, dwell time is $106.49 \times 2.926\text{ms} = 311.59\text{ms}$ per 31.6 seconds.

11 Maximum Peak Output Power

11.1 Test Setup

The spectrum analyzer was connected to the transmitter output port through the RF cable.

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

11.2 Test Instrument

| Equipment | Manufacture | Model No. | Serial No. | Calibration Date | Next Calibration Due |
|-------------------|-----------------|---------------|-------------|---------------------------|--------------------------|
| Spectrum Analyzer | Rohde & Schwarz | FSIQ26 | 840061/0004 | 10 th .2.2006. | 9 th .2.2007. |
| RF cable | SUHNER | SUCOFLEX 104E | RF2 | 5 th .7.2005. | 4 th .7.2006. |

11.3 Test Results

Serial No. : 00000005
 Power : DC 3.3V
 Mode : Transmitting mode , Non Frequency Hopping
 Temperature : 22.1
 Humidity : 52.4 %
 Regulation : FCC Part15 C §15.247 (b)(1)

| CH | Freq. [MHz] | Reading [dBm] | Cable Loss1 [dB] | Cable Loss2 [dB] | Result [dBm] | Limit [dBm] |
|---------------|-------------|---------------|------------------|------------------|--------------|-------------|
| 0ch(Lowest) | 2402.0 | 0.15 | 0.65 | 1.3 | 2.10 | 30.0 |
| 39ch(Middle) | 2441.0 | -0.47 | 0.63 | 1.3 | 1.46 | 30.0 |
| 78ch(Highest) | 2480.0 | -1.19 | 0.66 | 1.3 | 0.77 | 30.0 |

Result = Reading + Cable Loss1+Cable Loss2

Note:Cable Loss1:RF2

Cable Loss2: Conversion cable used for connecting to SMA type

12 Band Edge Compliance

12.1 Test Setup

The spectrum analyzer was connected to the transmitter output port through the RF cable.

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

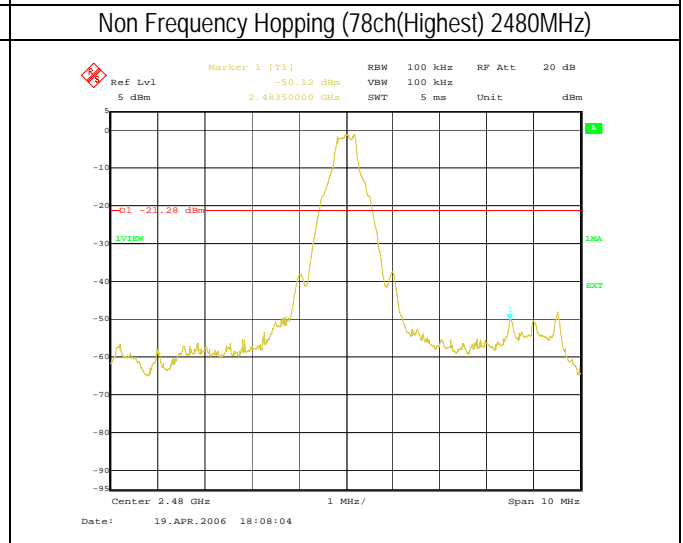
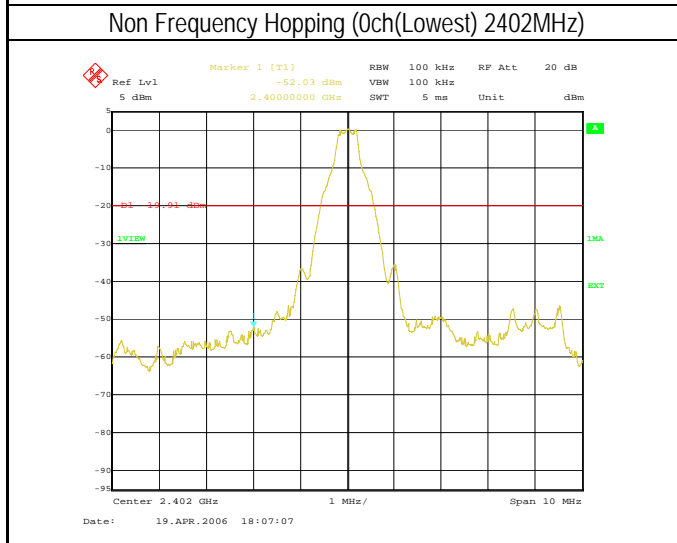
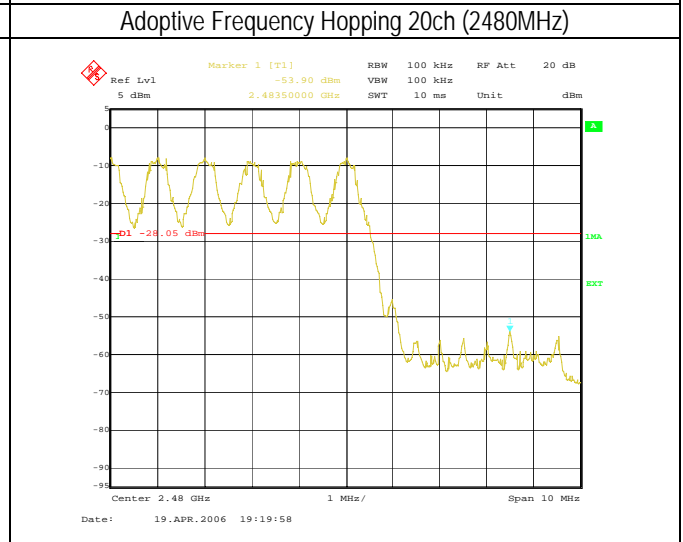
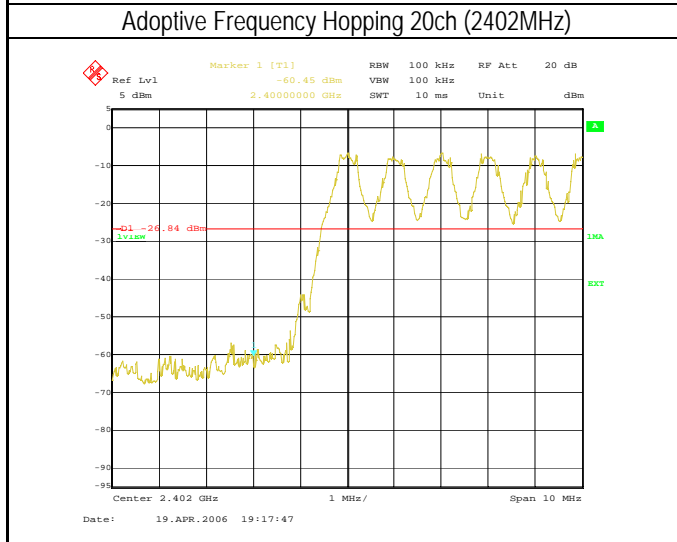
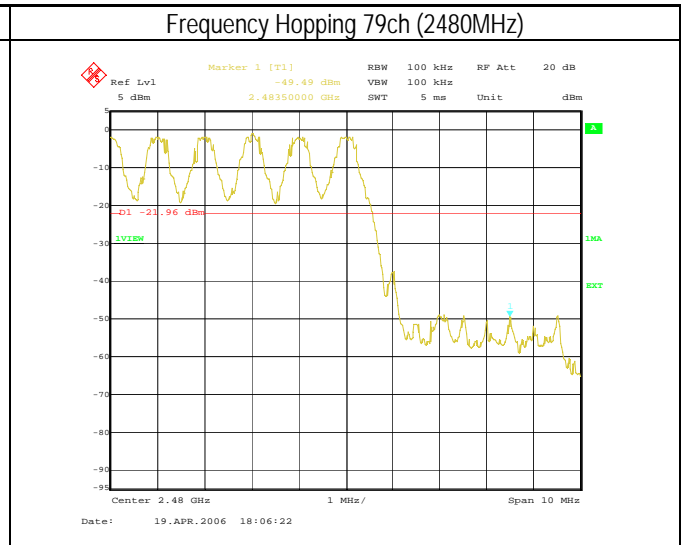
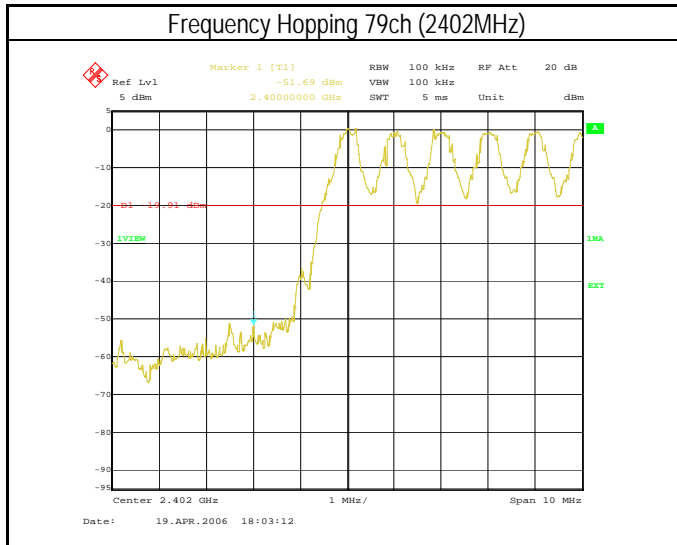
12.2 Test Instrument

| Equipment | Manufacture | Model No. | Serial No. | Calibration Date | Next Calibration Due |
|-------------------|----------------------|---------------|------------|----------------------------|----------------------------|
| Spectrum Analyzer | Agilent Technologies | E4446A | US42070181 | 14 th .11.2005. | 13 th .11.2006. |
| RF cable | SUHNER | SUCOFLEX 104E | RF2 | 5 th .7.2005. | 4 th .7.2006. |

12.3 Test Results

Serial No. : 00000005
 Power : DC 3.3V
 Mode : Transmitting mode , Frequency Hopping (79ch)
 Transmitting mode , Adoptive Frequency Hopping (20ch)
 Transmitting mode , Non Frequency Hopping
 Temperature : 22.1
 Humidity : 52.4 %
 Regulation : FCC Part15 C §15.247 (c)

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



13 Spurious RF Conducted Emission

13.1 Test Setup

The spectrum analyzer was connected to the transmitter output port through the RF cable.

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

13.2 Test Instrument

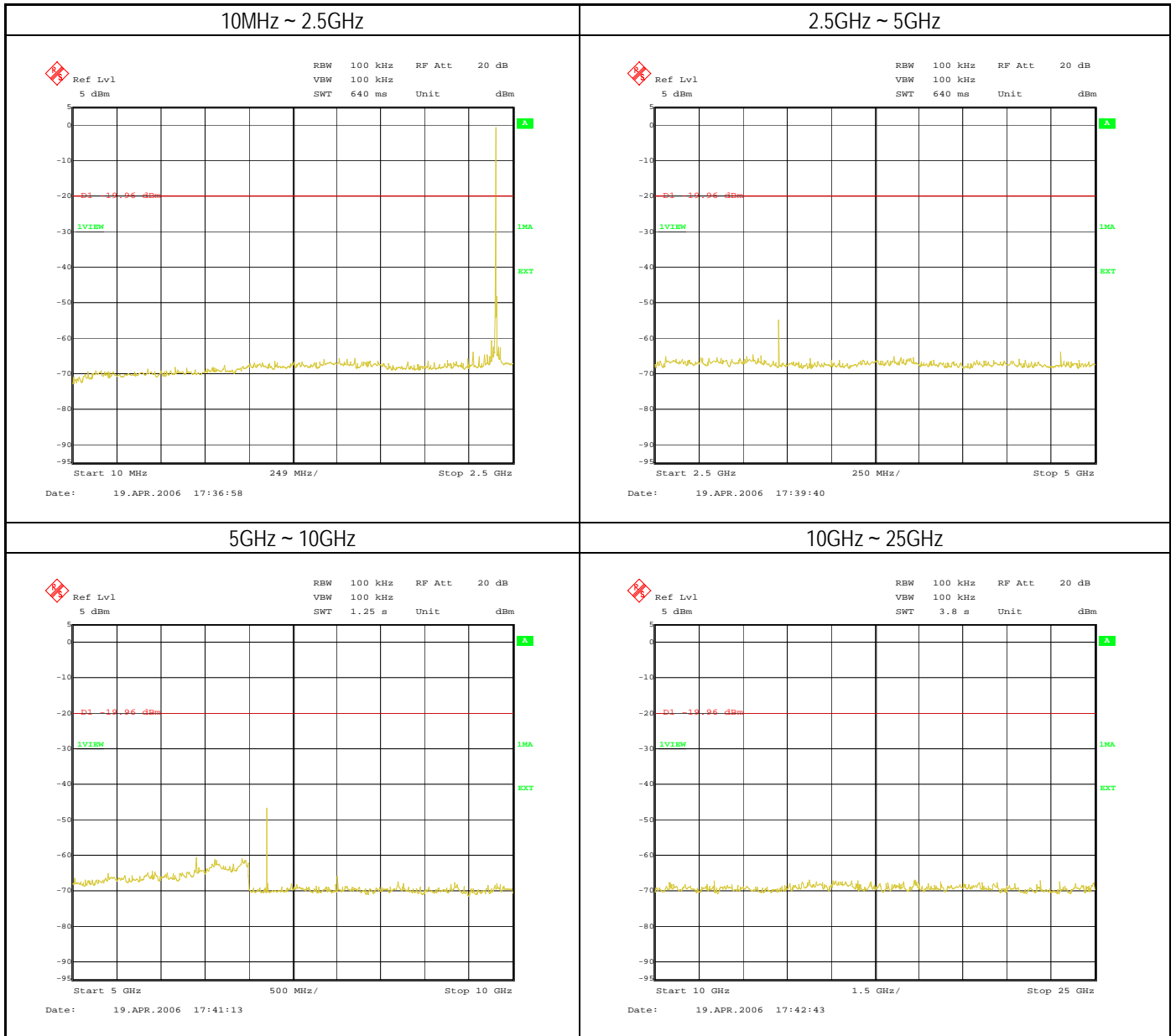
| Equipment | Manufacture | Model No. | Serial No. | Calibration Date | Next Calibration Due |
|-------------------|-----------------|---------------|-------------|---------------------------|--------------------------|
| Spectrum Analyzer | Rohde & Schwarz | FSIQ26 | 840061/0004 | 10 th .2.2006. | 9 th .2.2007. |
| RF cable | SUHNER | SUCOFLEX 104E | RF2 | 5 th .7.2005. | 4 th .7.2006. |

13.3 Test Results

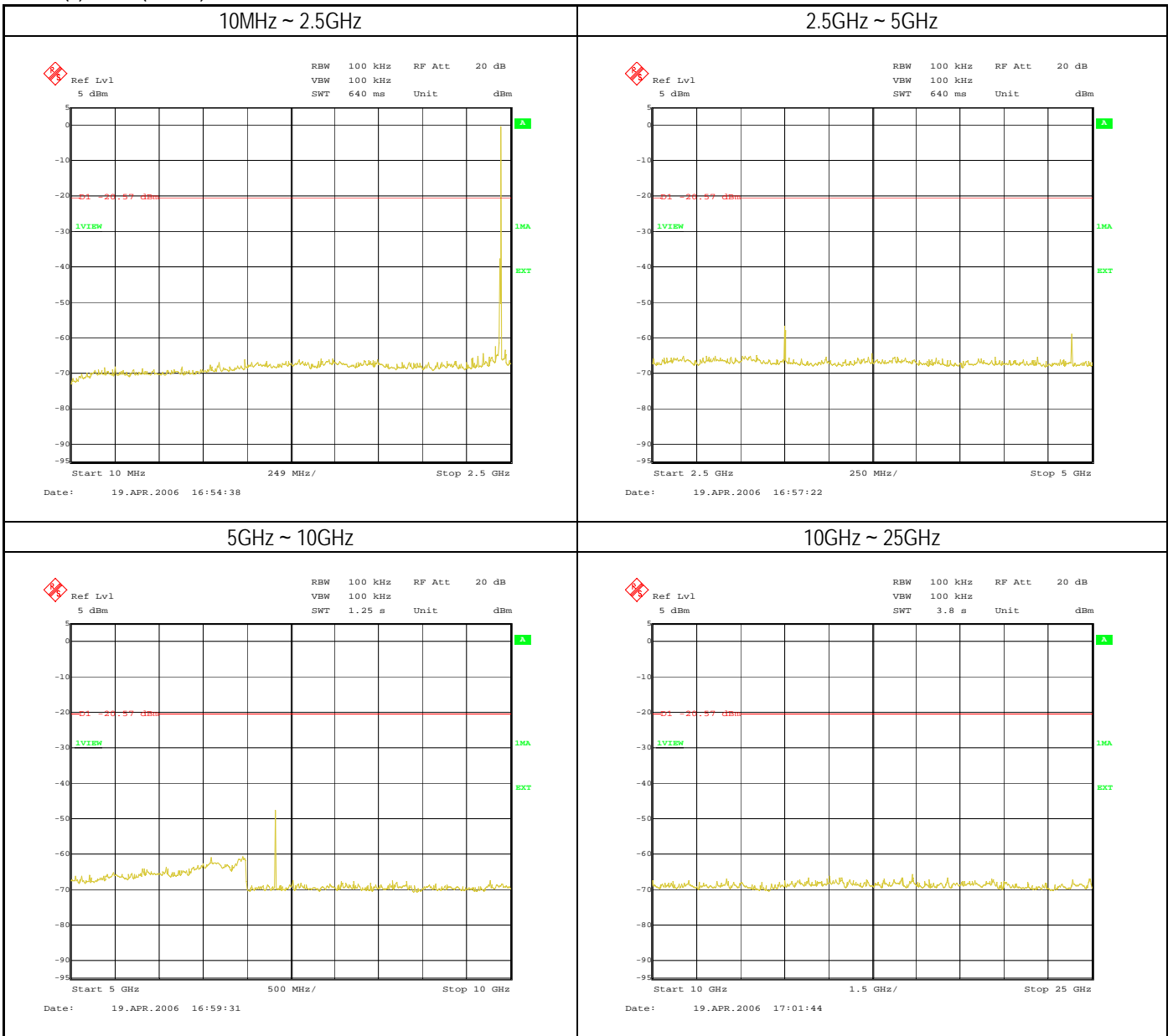
Serial No. : 00000005
 Power : DC 3.3V
 Mode : Transmitting mode , Non Frequency Hopping
 Temperature : 22.1
 Humidity : 52.4 %
 Regulation : FCC Part15 C §15.247 (c)

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

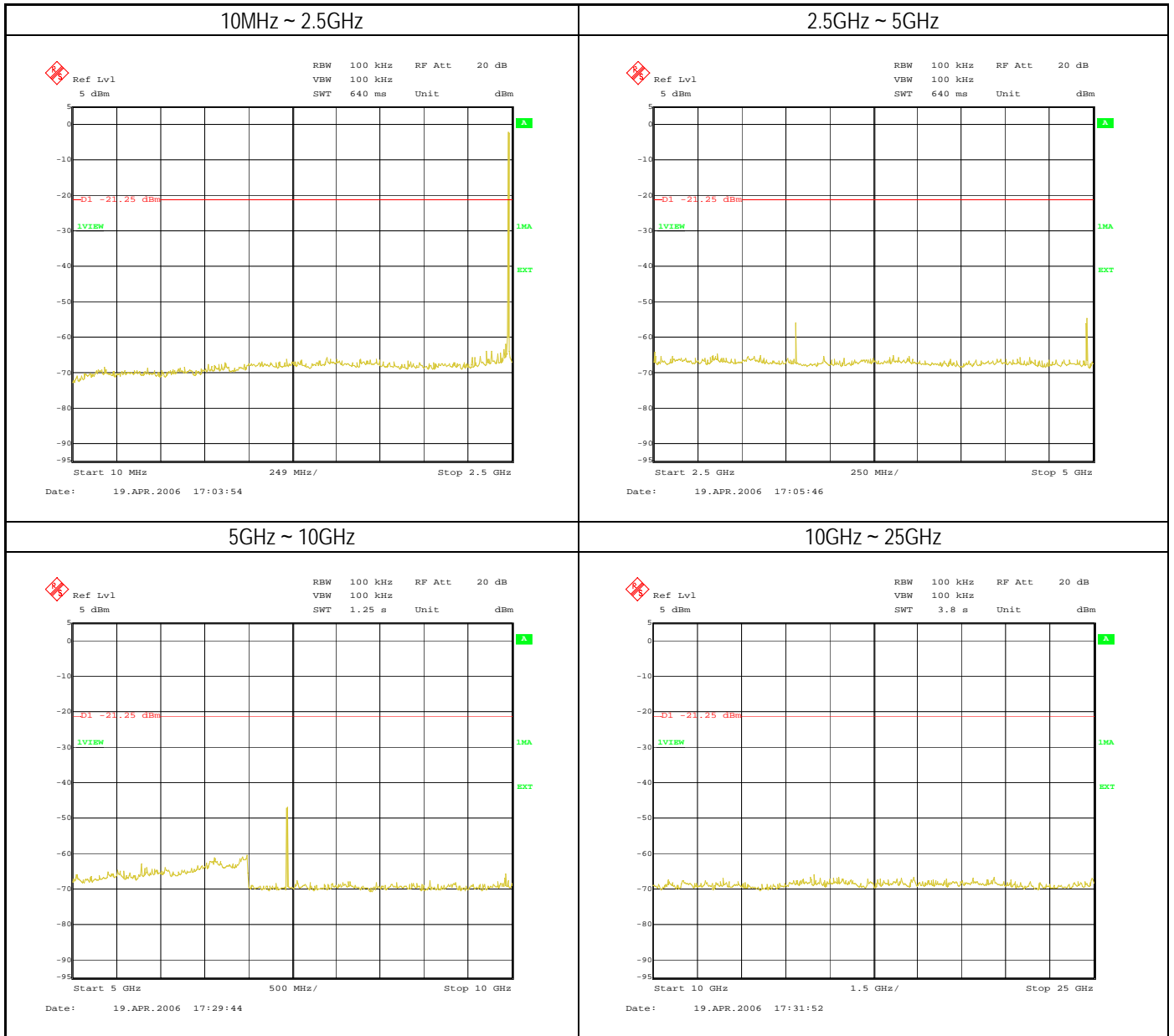
(1) Och(Lowest) 2402MHz



(2) 39ch(Middle) 2441MHz



(3) 78ch(Highest) 2480MHz



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.
(Limit (W) = $60 / f$ (MHz) , 24mW at 2.5GHz)

EIRP Calculation :

| A | B | C | | Limit (W) $60 / f$ (MHz) |
|------------------------------------|---|------------|------|-----------------------------|
| Specified Antenna Gain (dBi) | Max. RF Output Power at Antenna Terminal (dBm) | Total EIRP | | |
| | | (dBm) | (mW) | |
| 0.8 | 2.10 | 2.90 | 1.95 | 24mW |

Calculation : $C \text{ (dBm)} = A \text{ (dBi)} + B \text{ (dBm)}$

EIRP = 2.90dBm = 1.95mW

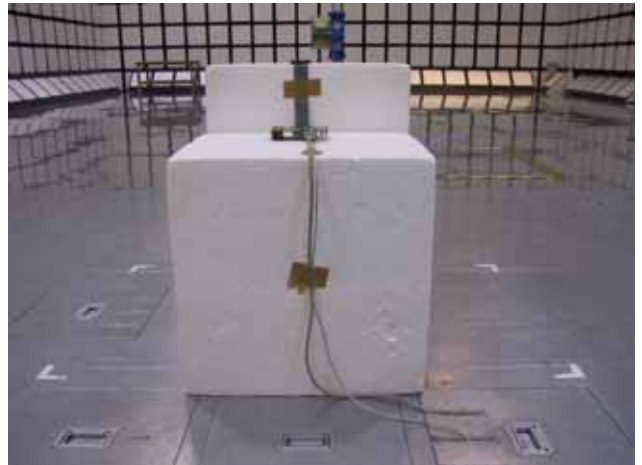
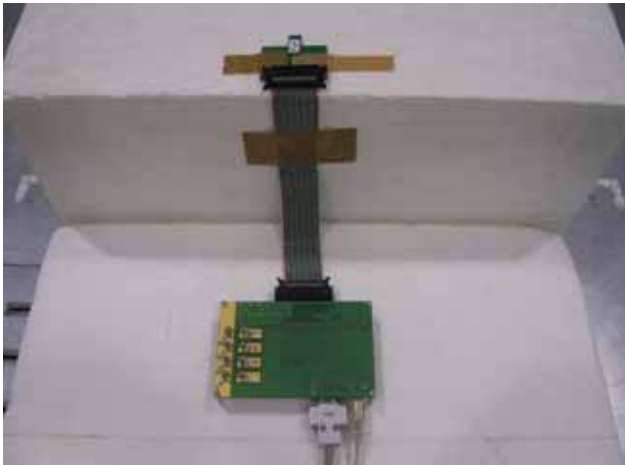
15 PHOTOS OF TESTED EUT



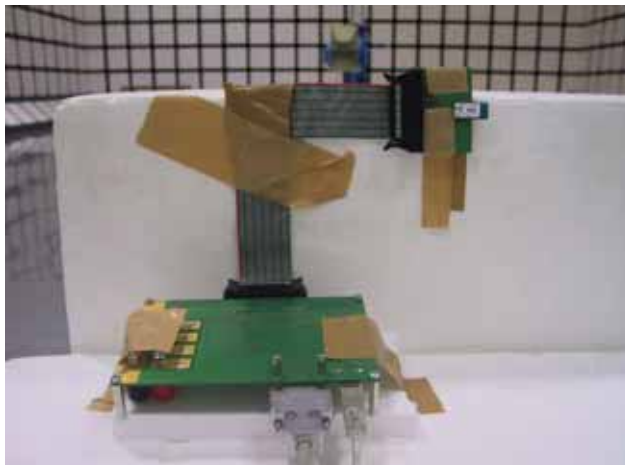
16 PHOTOS OF TEST SETUP

16.1 Photos of Radiated Measurement

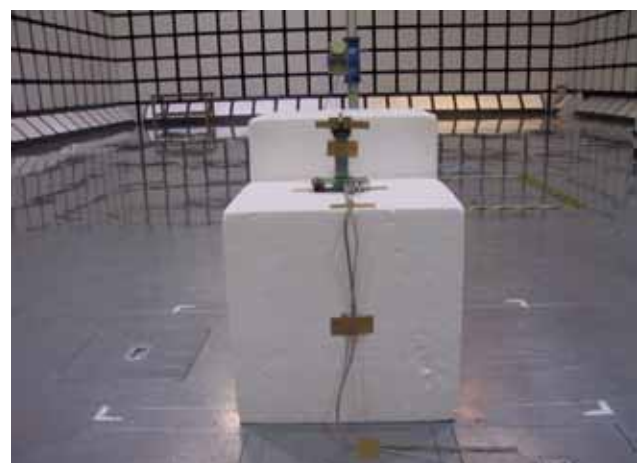
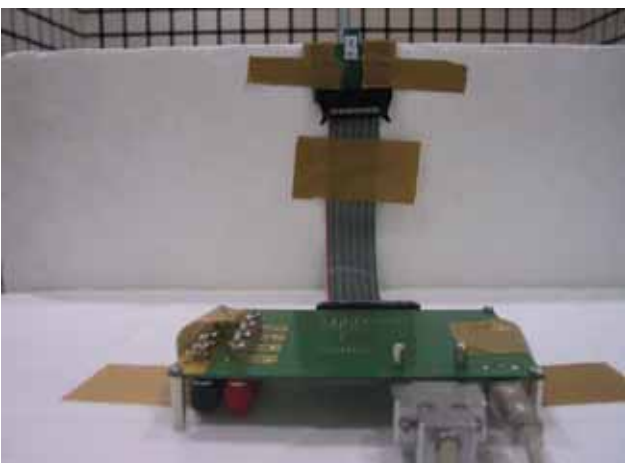
Axial Direction : XY-Plane



Axial Direction : YZ-Plane



Axial Direction : ZX-Plane



16.2 Photos of Conducted Measurement

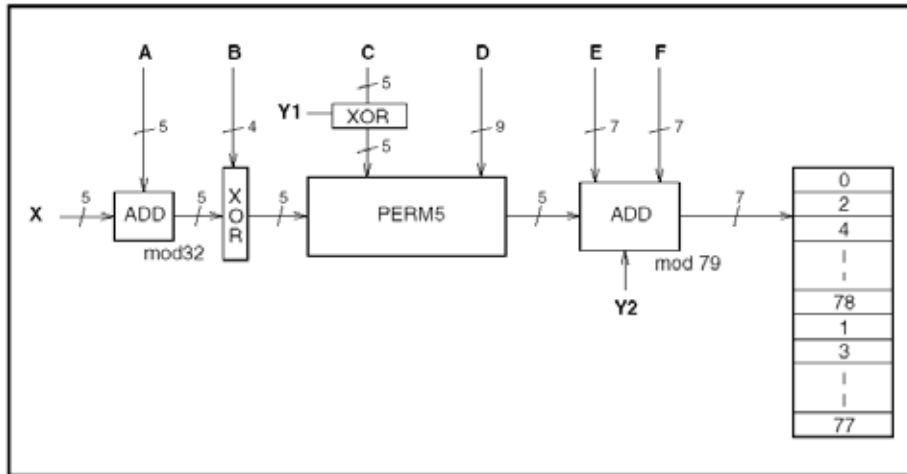


APPENDIX 1

About AFH-Hopping Sequence

AFH-Hopping Sequence is provided for in the Bluetooth Spec 1.2. Here is an outline below.

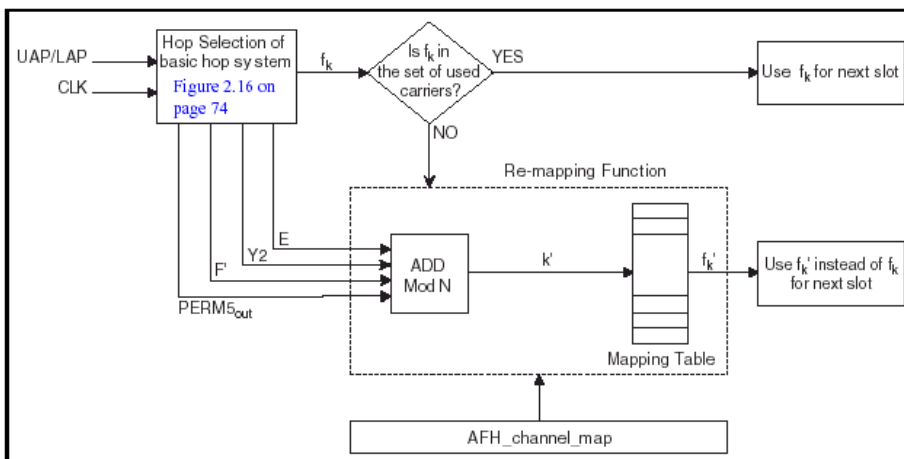
1. In the case of 79Hopping



Due to the above flow, 32 hops are made into 5 ways. Then, the sign of the sign head 160 is formed. The remainder that is worked out by dividing with 79 is assigned to Hopping Channel.

Each parameter of the above figure uses the value calculated from the Bluetooth clock and the Bluetooth address which are shown in the next page.

2. In the case of AFH-Hopping



Also in the case of AFH, the fundamental sign adopt the sign head 160 that is the same as the case of 79Hopping. Hopping Pattern uses the value that is worked out by dividing with the number of AFH-Channel's. Then, available Hopping becomes even as well as 79Hopping.

The selection of the communication Channel is done by the communication error rate and the receiving signal strength. Frequency is determined by pairing the channel and the value which is divided by the number of AFH-Channel one-to-one.

It is decided in the specifications that Communication Channel has to have "20Channels" at least. However, if the number of communication Channel is controlled to be under 20 back to 79Channel-Hopping, and select the communication Channel again.

3.The parameter list which decides Hopping-Pattern

| | Page scan / Interlaced Page Scan / Inquiry scan / Interlaced Inquiry Scan | Page/Inquiry | Master/Slave page response and Inquiry response | Connection state |
|----|--|---------------------------------------|---|------------------------------------|
| X | $CLKN_{16-12} / (CLKN_{16-12} + 16) \bmod 32 / Xir_{4-0} / Xir_{4-0} + 16) \bmod 32$ | Xp_{4-0} / Xi_{4-0} | $Xprm_{4-0} / Xprs_{4-0} / Xir_{4-0}$ | CLK_{6-2} |
| Y1 | 0 | $CLKE_1 / CLKN_1$ | $CLKE_1 / CLKN_1 / 1$ | CLK_1 |
| Y2 | 0 | $32 \times CLKE_1 / 32 \times CLKN_1$ | $32 \times CLKE_1 / 32 \times CLKN_1 / 32 \times 1$ | $32 \times CLK_1$ |
| A | A_{27-23} | A_{27-23} | A_{27-23} | $A_{27-23} \oplus CLK_{25-21}$ |
| B | A_{22-19} | A_{22-19} | A_{22-19} | A_{22-19} |
| C | $A_{8,6,4,2,0}$ | $A_{8,6,4,2,0}$ | $A_{8,6,4,2,0}$ | $A_{8,6,4,2,0} \oplus CLK_{20-16}$ |
| D | A_{18-10} | A_{18-10} | A_{18-10} | $A_{18-10} \oplus CLK_{15-7}$ |
| E | $A_{13,11,9,7,5,3,1}$ | $A_{13,11,9,7,5,3,1}$ | $A_{13,11,9,7,5,3,1}$ | $A_{13,11,9,7,5,3,1}$ |
| F | 0 | 0 | 0 | $16 \times CLK_{27-7} \bmod 79$ |
| F' | n/a | n/a | n/a | $16 \times CLK_{27-7} \bmod N$ |

APPENDIX 2

United States Department of Commerce
National Institute of Standards and Technology

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