



FCC 47 CFR PART 15 SUBPART C

TEST REPORT

For

Leadtek Research Inc.

Wireless GPS Receiver

Model: LR9537

Trade Name: Leadtek; DELORME

Prepared for

**Leadtek Research Inc.
18F, No. 166, Chien-Yi Rd., Chung-Ho,
Taipei Hsien, Taiwan, (235) R.O.C.**

Prepared by

**Compliance Certification Services Inc.
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1. TEST RESULT CERTIFICATION

Applicant: Leadtek Research Inc.
18F, No. 166, Chien-Yi Rd., Chung-Ho,
Taipei Hsien, Taiwan, (235) R.O.C.

Equipment Under Test: Wireless GPS Receiver

Trade Name: Leadtek; DELORME

Model: LR9537

Report Number: B31016206-RP

Date of Test: October 21 ~ November 1, 2003

| APPLICABLE STANDARDS | |
|-----------------------|-------------------------|
| STANDARD | TEST RESULT |
| FCC Part 15 Subpart C | No non-compliance noted |

We hereby certify that:

The above equipment was tested by Compliance Certification Services Inc. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.4 and the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits of FCC Rules Part 15.247.

The test results of this report relate only to the tested sample identified in this report.

Approved by:

Jonson Lee
Director of Linkou Laboratory
Compliance Certification Services Inc.

Reviewed by:

Eric Wong
Section Manager
Compliance Certification Services Inc.



2. EUT DESCRIPTION

| | |
|-----------------------------|---|
| Product | Wireless GPS Receiver |
| Trade Name | Leadtek; DELORME |
| Model Number | LR9537 |
| Model Discrepancy | N/A |
| Power Supply | Brand / Model: AK II / A05F1-05MP Input: AC 100-240V, 47-63 Hz; 0.2A Output: DC +5V, 1.0A |
| Frequency Range | 2402 – 2480MHz |
| Transmit Power | -2.8 dBm |
| Modulation Technique | GFSK |
| Number of Channels | 79 Channels |
| Antenna Designation | Chip Antenna (Max: 2 dBi) |

Note: This submittal(s) (test report) is intended for FCC ID: I2ILR9537C filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules. The composite system (digital device), if any, is compliance with Subpart B is authorized under a DoC procedure.



3. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4. Radiated testing was performed at an antenna to EUT distance 3 meters.

3.1 EUT CONFIGURATION

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

3.2 EUT EXERCISE

The EUT (Wireless GPS Receiver) was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements.

According to its specifications, the EUT must comply with the requirements of the Section 15.247 under the FCC Rules Part 15 Subpart C. The composite system (Digital device) is compliance with the Subpart B is authorized under the DoC procedure.

3.3 GENERAL TEST PROCEDURES

Conducted Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 13.1.4.1 of ANSI C63.4. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-peak and average detector modes.

Radiated Emissions

The EUT is placed on a turn table, which is 0.8 m above ground plane. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna, which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes according to the requirements in Section 13.1.4.1 of ANSI C63.4.



3.4 FCC PART 15.205 RESTRICTED BANDS OF OPERATIONS

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

| MHz | MHz | MHz | GHz |
|----------------------------|---------------------|-----------------|------------------|
| 0.090 - 0.110 | 16.42 - 16.423 | 399.9 - 410 | 4.5 - 5.15 |
| ¹ 0.495 - 0.505 | 16.69475 - 16.69525 | 608 - 614 | 5.35 - 5.46 |
| 2.1735 - 2.1905 | 16.80425 - 16.80475 | 960 - 1240 | 7.25 - 7.75 |
| 4.125 - 4.128 | 25.5 - 25.67 | 1300 - 1427 | 8.025 - 8.5 |
| 4.17725 - 4.17775 | 37.5 - 38.25 | 1435 - 1626.5 | 9.0 - 9.2 |
| 4.20725 - 4.20775 | 73 - 74.6 | 1645.5 - 1646.5 | 9.3 - 9.5 |
| 6.215 - 6.218 | 74.8 - 75.2 | 1660 - 1710 | 10.6 - 12.7 |
| 6.26775 - 6.26825 | 108 - 121.94 | 1718.8 - 1722.2 | 13.25 - 13.4 |
| 6.31175 - 6.31225 | 123 - 138 | 2200 - 2300 | 14.47 - 14.5 |
| 8.291 - 8.294 | 149.9 - 150.05 | 2310 - 2390 | 15.35 - 16.2 |
| 8.362 - 8.366 | 156.52475 - | 2483.5 - 2500 | 17.7 - 21.4 |
| 8.37625 - 8.38675 | 156.52525 | 2655 - 2900 | 22.01 - 23.12 |
| 8.41425 - 8.41475 | 156.7 - 156.9 | 3260 - 3267 | 23.6 - 24.0 |
| 12.29 - 12.293 | 162.0125 - 167.17 | 3332 - 3339 | 31.2 - 31.8 |
| 12.51975 - 12.52025 | 167.72 - 173.2 | 3345.8 - 3358 | 36.43 - 36.5 |
| 12.57675 - 12.57725 | 240 - 285 | 3600 - 4400 | (²) |
| 13.36 - 13.41 | 322 - 335.4 | | |

¹ Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

² Above 38.6

(b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

3.5 DESCRIPTION OF TEST MODES

The EUT (Wireless GPS Receiver) has been tested under operating condition.

Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.

Channel Low (2402MHz) 、 Mid (2441MHz) and High (2480MHz) with highest data rate (worst case) are chosen for full testing.



4. INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards.



5. FACILITIES AND ACCREDITATIONS

5.1 FACILITIES

All measurement facilities used to collect the measurement data are located at

- No. 81-1, Lane 210, Bade Rd. 2, Luchu Hsiang, Taoyuan Hsien, Taiwan, R.O.C.
- No. 199, Chunghsen Road, Hsintien City, Taipei Hsien, Taiwan, R.O.C.

The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.4 and CISPR Publication 22.

5.2 EQUIPMENT

Radiated emissions are measured with one or more of the following types of linearly polarized antennas: tuned dipole, biconical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.

Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers.

Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

5.3 LABORATORY ACCREDITATIONS AND LISTING

The test facilities used to perform radiated and conducted emissions tests are accredited by National Voluntary Laboratory Accreditation Program for the specific scope of accreditation under Lab Code: 200600-0 to perform Electromagnetic Interference tests according to FCC PART 15 AND CISPR 22 requirements. No part of this report may be used to claim or imply product endorsement by NVLAP or any agency of the US Government. In addition, the test facilities are listed with Federal Communications Commission (registration no: 93105 and 90471).

5.4 TABLE OF ACCREDITATIONS AND LISTINGS

| Country | Agency | Scope of Accreditation | Logo |
|---------|-----------------|---|---|
| USA | NVLAP* | EN 55011, EN 55014-1, AS/NZS 1044, CNS 13783-1, EN 55022, CNS 13438, EN 61000-3-2, EN 61000-3-3, ANSI C63.4, FCC OST/MP-5, AS/NZS 3548IEC 61000-4-2, IEC 61000-4-3, IEC 61000-4-4, IEC 61000-4-5, IEC 61000-4-6, IEC 61000-4-8, IEC 61000-4-11 |  200600-0 |
| USA | FCC | 3/10 meter Open Area Test Sites to perform FCC Part 15/18 measurements |  93105, 90471 |
| Japan | VCCI | 4 3/10 meter Open Area Test Sites to perform conducted/radiated measurements |  R-393/1066/725/879 C-402/747/912 |
| Norway | NEMKO | EN 50081-1/2, EN 50082-1/2, IEC 61000-6-1/2, EN 50091-2, EN 50130-4, EN 55011, EN 55013, EN 55014-1/2, EN 55015, EN 55022, EN 55024, EN 61000-3-2/3, EN 61326-1, IEC 61000-4-2/3/4/5/6/8/11, EN 60601-1-2, EN 300 328-2, EN 300 422-2, EN 301 419-1, EN 301 489-01/03/07/08/09/17, EN 301 419-2/3, EN 300 454-2, EN 301 357-2 |  ELA 124a ELA 124b ELA 124c |
| Taiwan | CNLA | EN 300 328-1, EN 300 328-2, EN 300 220-1, EN 300 220-2, EN 300 220-3, 47 CFR FCC Part 15 Subpart C, EN 61000-3-2, EN 61000-3-3, CNS 13439, CNS 13783-1, CNS 14115, CNS 13438, AS/NZS 3548, CNS 13022-1, IEC 1000-4-3/4/5/6/8/11, CNS 13022-2/3 |  0 3 6 3 ILAC MRA |
| Taiwan | BSMI | CNS 13438, CNS 13783-1, CNS 13439, CNS 14115 |  SL2-IS-E-0014 SL2-IN-E-0014 SL2-A1-E-0014 SL2-R1-E-0014 SL2-R2-E-0014 SL2-L1-E-0014 |
| Canada | Industry Canada | RSS212, Issue 1 |  IC 3991-3 IC 3991-4 |

* No part of this report may be used to claim or imply product endorsement by NVLAP or any agency of the US Government.



6. SETUP OF EQUIPMENT UNDER TEST

6.1 SUPPORT EQUIPMENT

Wireless GPS Receiver
(EUT)

| Device Type | Brand | Model | FCC ID | Series No. | Data Cable | Power Cord |
|-------------|-------|-------|--------|------------|------------|------------|
| N/A | N/A | N/A | N/A | N/A | N/A | N/A |

Notes:

1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

7. FCC PART 15.247 REQUIREMENTS

7.1 PEAK POWER

LIMIT

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

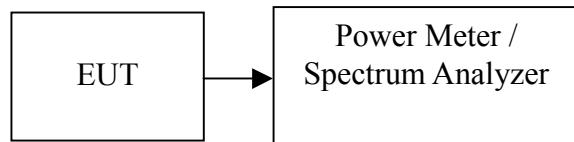
1. For systems using digital modulation in the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz: 1 watt.
2. Except as shown in paragraphs (b)(3) (i), (ii) and (iii) of this section, if transmitting antennas of directional gain greater than 6 dBi are used the peak output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1) or (b)(2) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

MEASUREMENT EQUIPMENT USED

| Name of Equipment | Manufacturer | Model | Serial Number | Calibration Due |
|-------------------|--------------|--------|---------------|-----------------|
| RF Power Meter | BOONTON | 4531 | 130601 | 01/09/2004 |
| RF Power Sensor | BOONTON | 56218 | 2240 | 01/09/2004 |
| Spectrum Analyzer | Agilent | E4446A | US42510252 | 04/27/2004 |
| Spectrum Analyzer | R&S | FSP30 | 1093.4495.30 | 07/22/2004 |

Remark: Each piece of equipment is scheduled for calibration once a year.

Test Configuration



TEST PROCEDURE

The transmitter output is connected to the RF Power Meter. The RF Power Meter is set to the peak power detection.

TEST RESULTS

No non-compliance noted

Test Data

| Channel | Frequency (MHz) | Reading Power (dBm) | Factor (dB) | Output Power (dBm) | Output Power (W) | Limit (W) | Result |
|---------|-----------------|---------------------|-------------|--------------------|------------------|-----------|--------|
| Low | 2402 | -3.73 | 0.00 | -3.73 | 0.000424 | 1.00 | PASS |
| Mid | 2441 | -3.05 | 0.00 | -3.05 | 0.000495 | | PASS |
| High | 2480 | -2.80 | 0.00 | -2.80 | 0.000525 | | PASS |



7.2 PEAK POWER SPECTRAL DENSITY

LIMIT

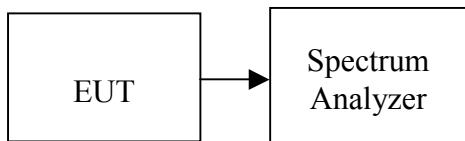
1. For direct sequence systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3kHz band during any time interval of continuous transmission.
2. The direct sequence operating of the hybrid system, with the frequency hopping operation turned off, shall comply with the power density requirements of paragraph (d) of this section.

MEASUREMENT EQUIPMENT USED

| Name of Equipment | Manufacturer | Model | Serial Number | Calibration Due |
|-------------------|--------------|--------|---------------|-----------------|
| Spectrum Analyzer | Agilent | E4446A | US42510252 | 04/28/2004 |
| Spectrum Analyzer | R&S | FSP30 | 1093.4495.30 | 07/22/2004 |

Remark: Each piece of equipment is scheduled for calibration once a year.

Test Configuration



TEST PROCEDURE

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set the spectrum analyzer as RBW = 3kHz, VBW = 10kHz, Span = 300kHz, Sweep=100s
4. Record the max. reading.
5. Repeat the above procedure until the measurements for all frequencies are completed.

TEST RESULTS

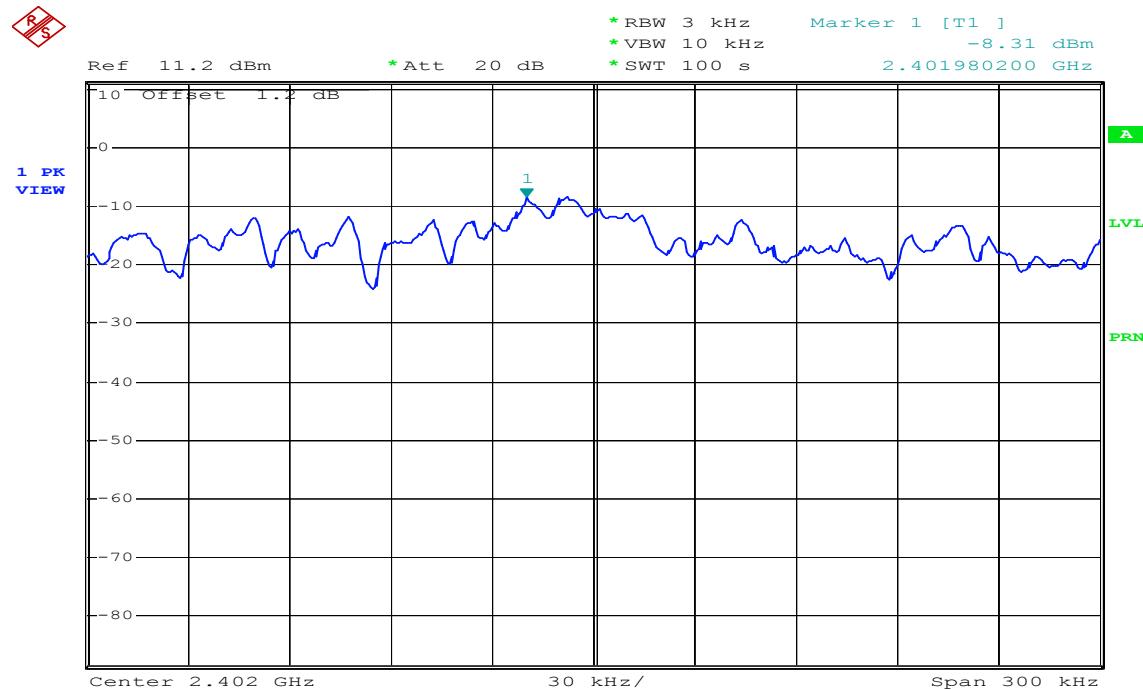
No non-compliance noted

Test Data

| Channel | Frequency (MHz) | Reading (dBm) | Factor (dB) | PPSD (dBm) | Limit (dBm) | Result |
|---------|-----------------|---------------|-------------|------------|-------------|--------|
| Low | 2402 | -9.51 | 1.20 | -8.31 | 8.00 | PASS |
| Mid | 2441 | -10.18 | 1.20 | -8.98 | | PASS |
| High | 2480 | -11.99 | 1.20 | -10.79 | | PASS |

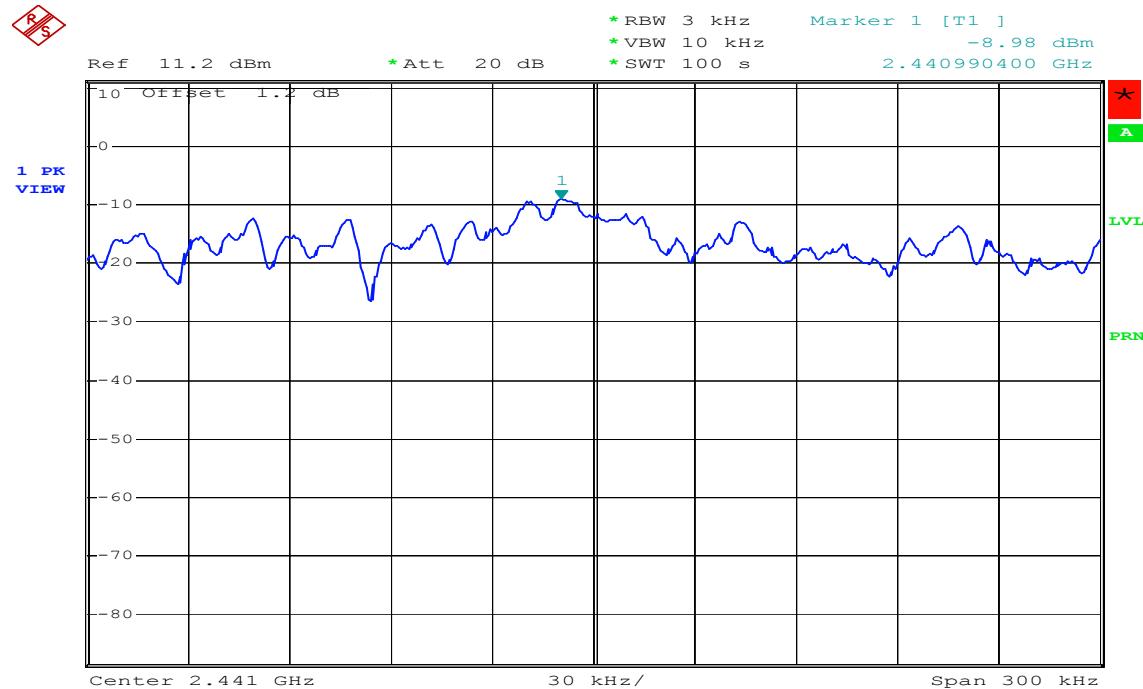
Test Plot

PPSD (CH Low)

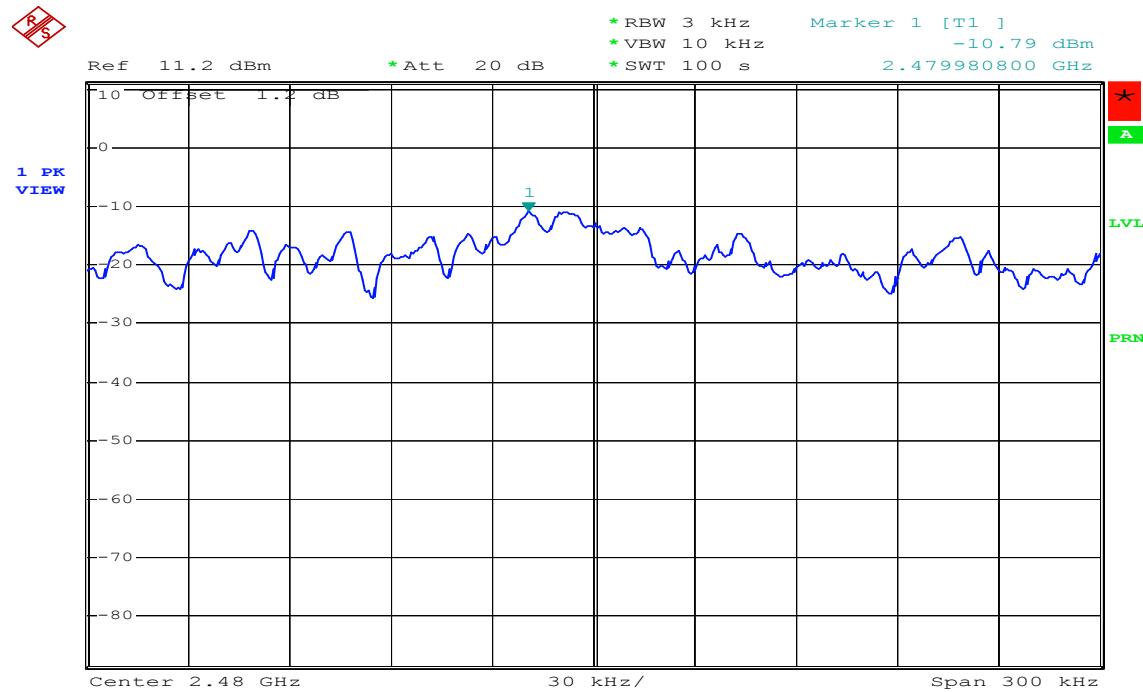


Date: 5.DEC.2003 10:55:29

PPSD (CH Mid)



Date: 5.DEC.2003 10:57:58

PPSD (CH High)

Date: 5.DEC.2003 11:00:42

7.3 BAND EDGES MEASUREMENT

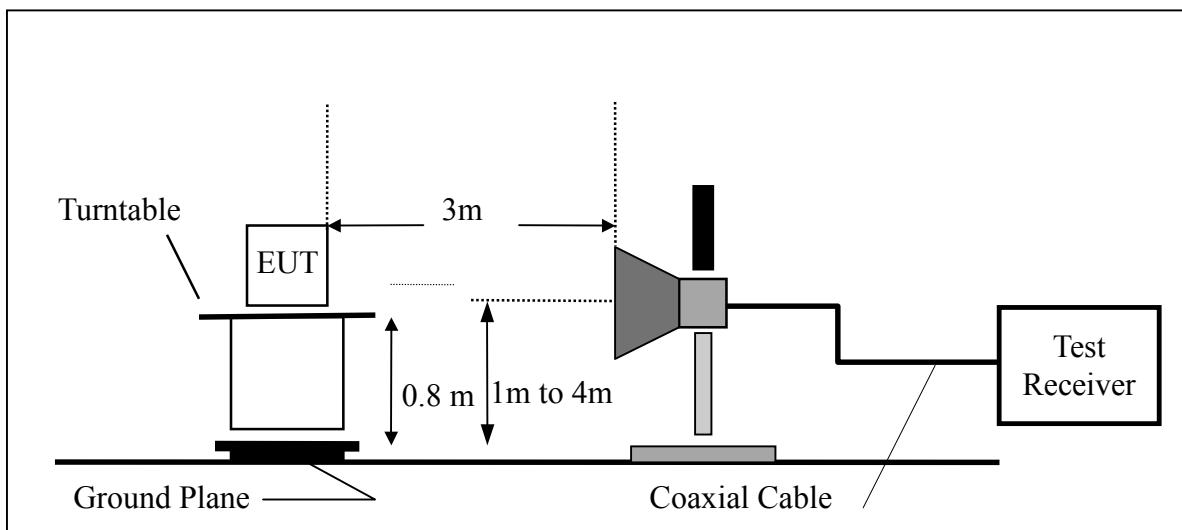
LIMIT

According to §15.247(c), in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in 15.209(a).

MEASUREMENT EQUIPMENT USED

| Name of Equipment | Manufacturer | Model | Serial Number | Calibration Due |
|-------------------|--------------|--------|---------------|-----------------|
| Spectrum Analyzer | Agilent | E4446A | US42510252 | 04/27/2004 |
| Spectrum Analyzer | R&S | FSP30 | 1093.4495.30 | 07/22/2004 |
| Horn Antenna | EMCO | 3115 | N/A | 02/24/2004 |

TEST CONFIGURATION

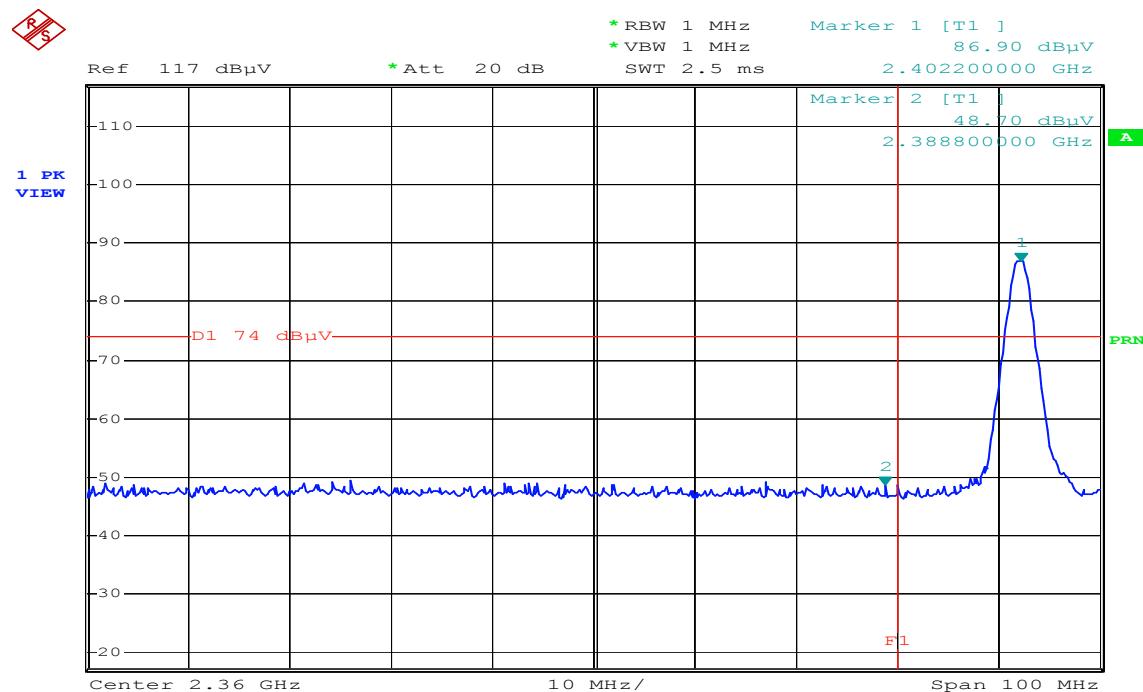


TEST PROCEDURE

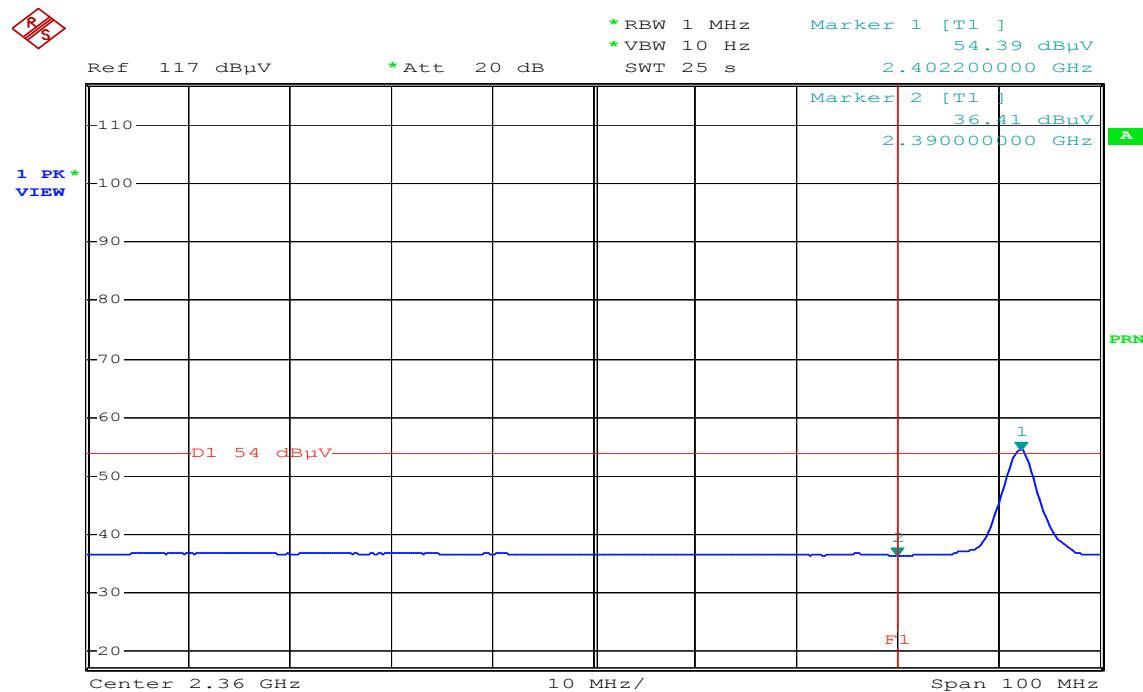
1. The EUT is placed on a turntable, which is 0.8m above the ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emission.
4. Set the spectrum analyzer in the following setting in order to capture the lower and upper band-edges of the emission:
 - (a) PEAK: RBW=VBW=1MHz / Sweep=AUTO
 - (b) AVERAGE: RBW=1MHz / VBW=10Hz / Sweep=AUTO
5. Repeat the procedures until all the PEAK and AVERAGE versus POLARIZATION are measured.

TEST RESULTS

Refer to attach spectrum analyzer data chart.

Band Edges Test Data (CH-Low)**Detector mode: Peak****Polarity: Vertical**

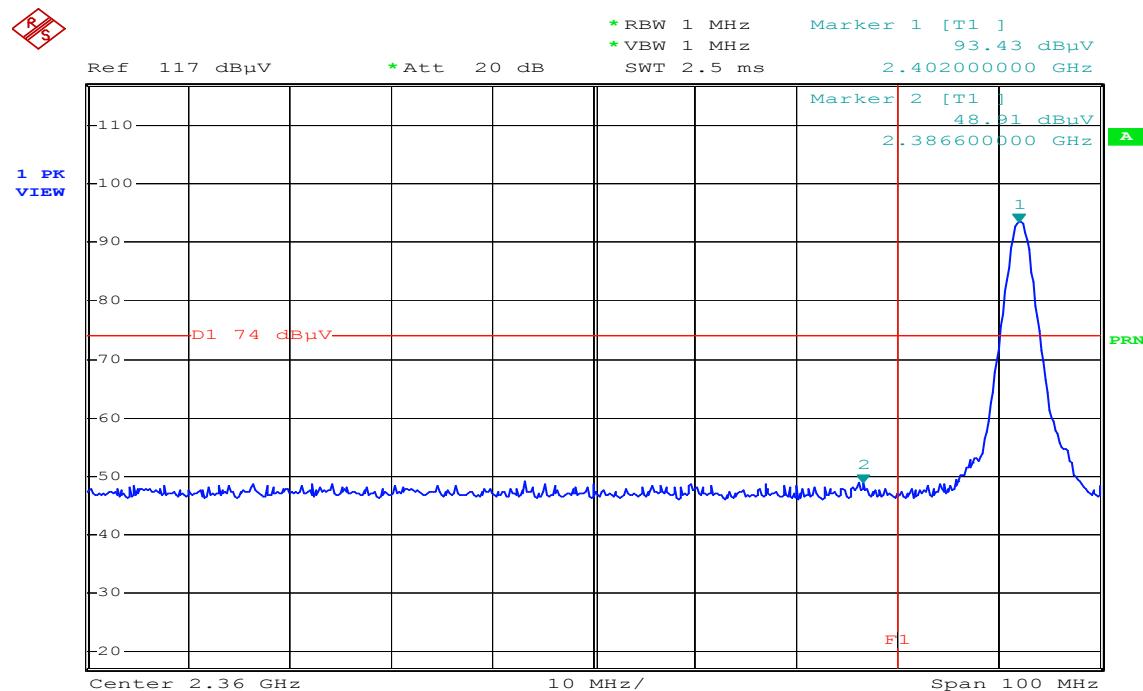
Date: 21.OCT.2003 13:29:47

Detector mode: Average**Polarity: Vertical**

Date: 21.OCT.2003 13:28:35

Detector mode: Peak

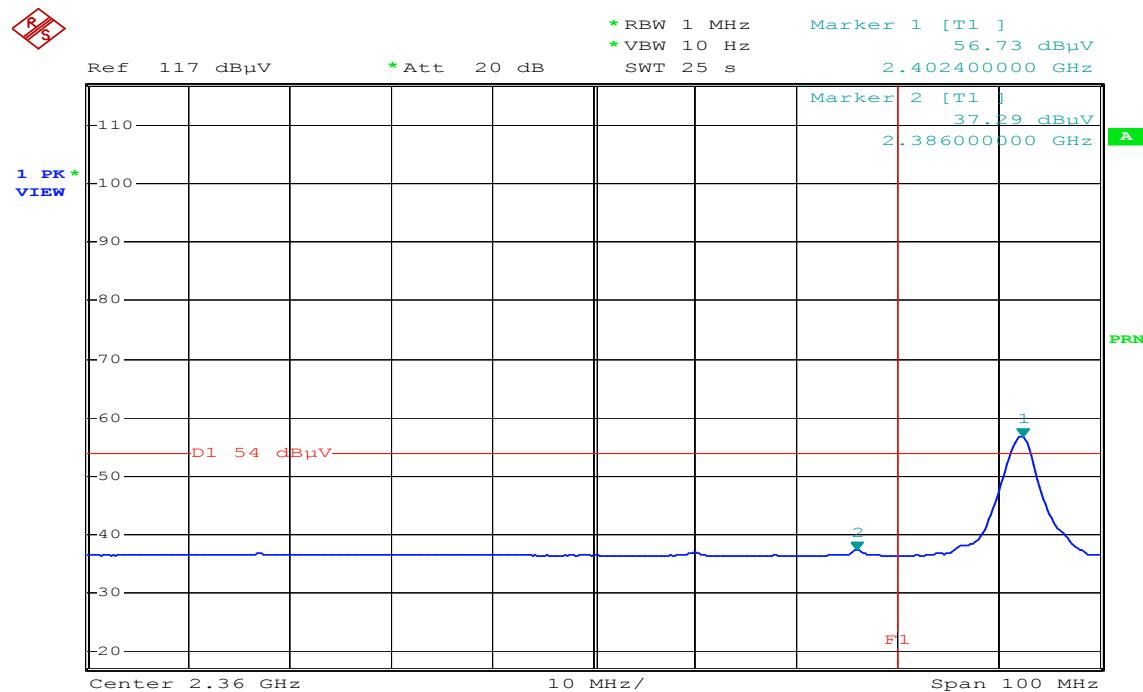
Polarity: Horizontal



Date: 21.OCT.2003 13:31:43

Detector mode: Average

Polarity: Horizontal

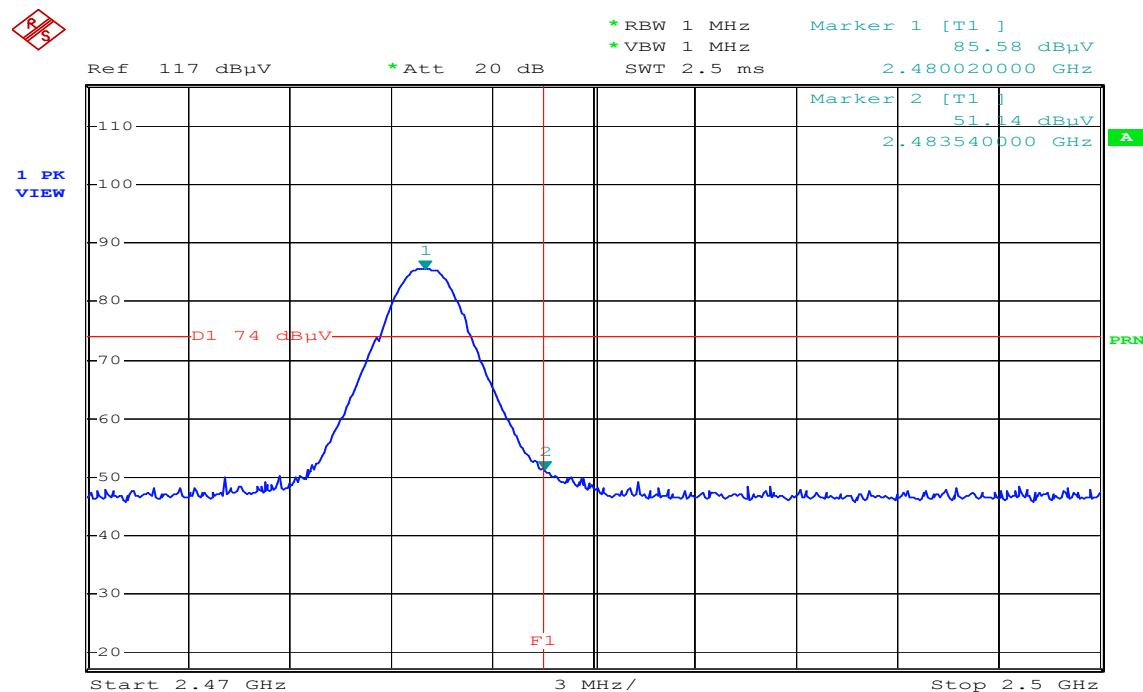


Date: 21.OCT.2003 13:32:51

Band Edges Test Data (CH-High)

Detector mode: Peak

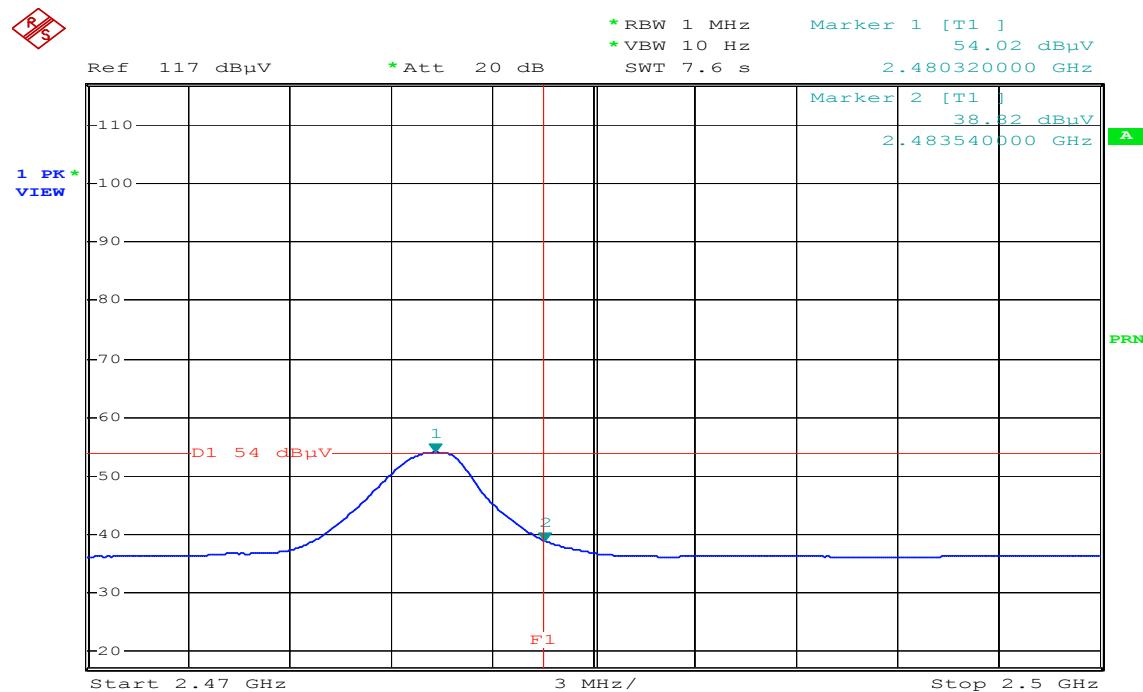
Polarity: Vertical



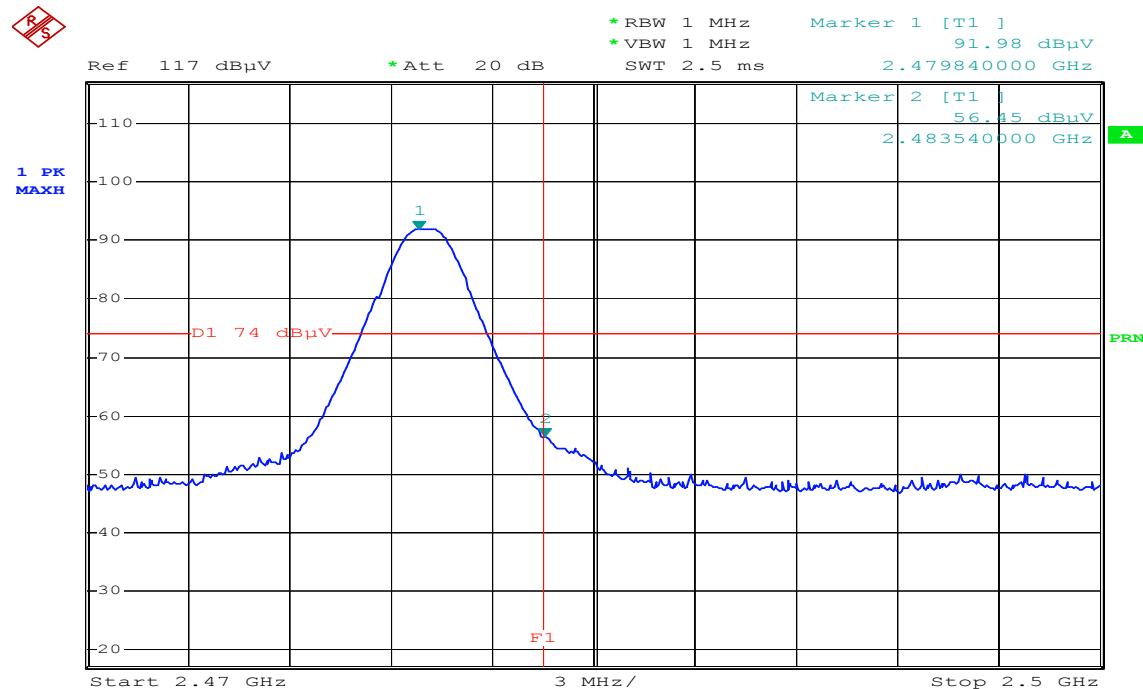
Date: 21.OCT.2003 13:39:54

Detector mode: Average

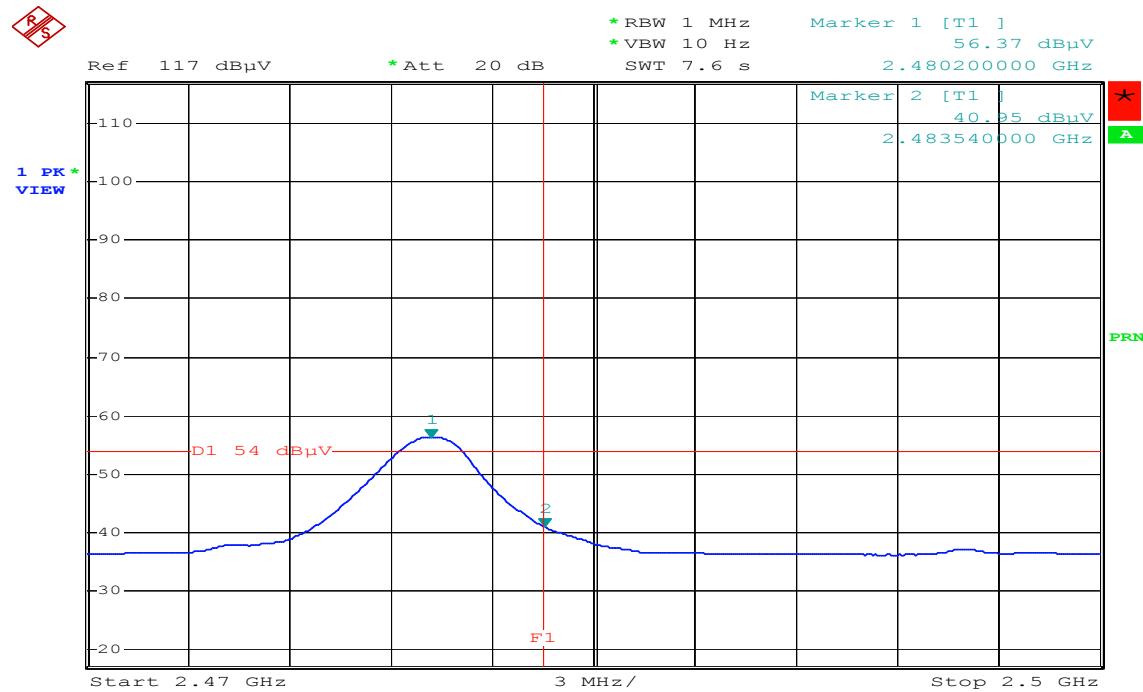
Polarity: Vertical



Date: 21.OCT.2003 13:40:34

Detector mode: Peak
Polarity: Horizontal


Date: 21.OCT.2003 13:37:15

Detector mode: Average
Polarity: Horizontal


Date: 21.OCT.2003 13:38:29

7.4 FREQUENCY SEPARATION

LIMIT

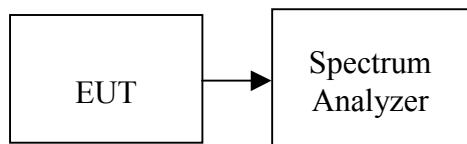
According to §15.247(a)(1), Frequency hopping systems shall have hopping channel carrier frequencies separated by minimum of 25kHz or the 20dB bandwidth of the hopping channel, whichever is greater.

MEASUREMENT EQUIPMENT USED

| Name of Equipment | Manufacturer | Model | Serial Number | Calibration Due |
|-------------------|--------------|--------|---------------|-----------------|
| Spectrum Analyzer | Agilent | E4446A | US42510252 | 04/28/2004 |
| Spectrum Analyzer | R&S | FSP30 | 1093.4495.30 | 07/22/2004 |

Remark: Each piece of equipment is scheduled for calibration once a year.

Test Configuration



TEST PROCEDURE

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set center frequency of spectrum analyzer = middle of hopping channel.
4. Set the spectrum analyzer as RBW, VBW=100kHz, Adjust Span to 5 MHz, Sweep = auto.
5. Max hold. Mark 3 Peaks of hopping channel and record the 3 peaks frequency.

TEST RESULTS

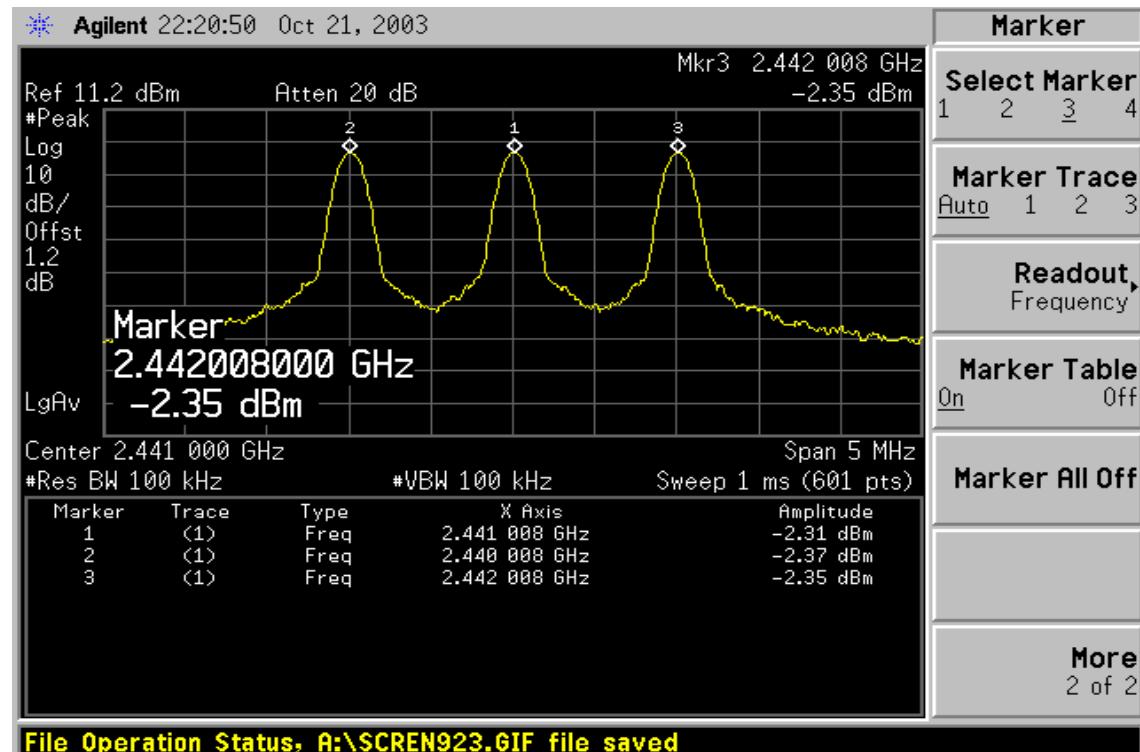
No non-compliance noted

Test Data

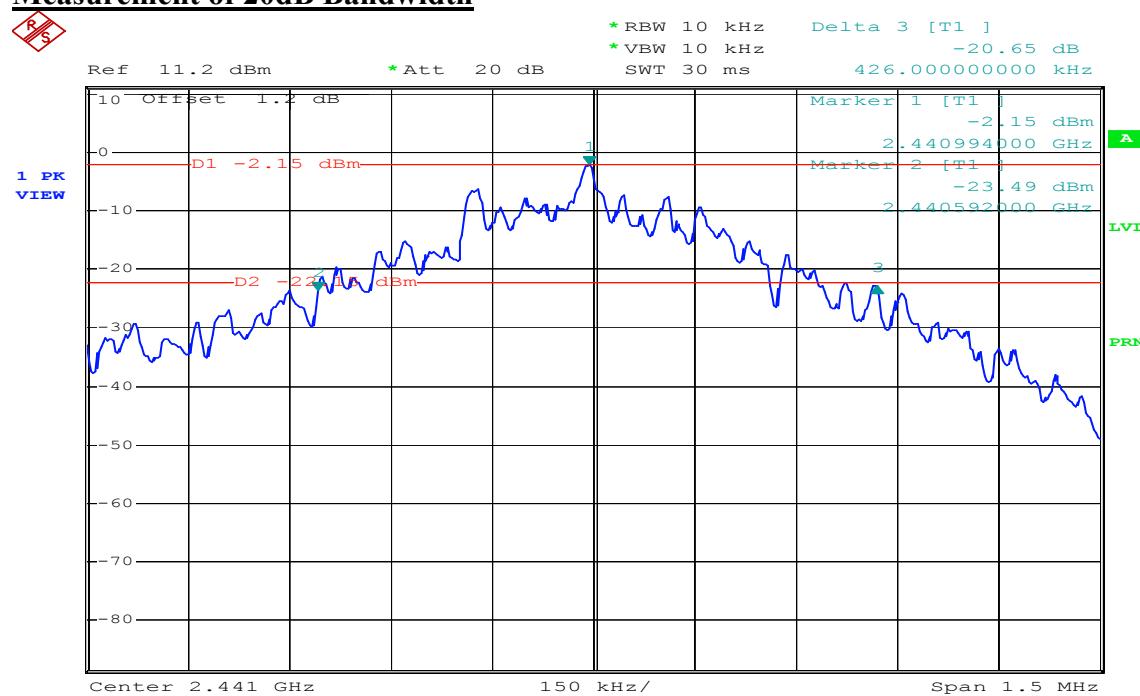
| Channel Separation (MHz) | 20dB Bandwith (kHz) | Limit (kHz) | Result |
|--------------------------|---------------------|-------------|--------|
| 1.00 | 426.00 | >25 | Pass |

Test Plot

Measurement of Channel Separation



Measurement of 20dB Bandwidth



Date: 5.DEC.2003 11:05:39



7.5 NUMBER OF HOPPING FREQUENCY

LIMIT

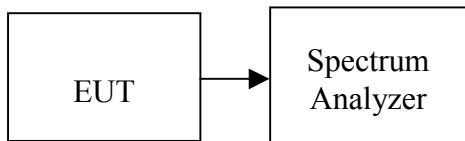
According to §15.247(a)(1)(ii), Frequency hopping systems operating in the 2400MHz-2483.5 MHz bands shall use at least 75 hopping frequencies.

MEASUREMENT EQUIPMENT USED

| Name of Equipment | Manufacturer | Model | Serial Number | Calibration Due |
|-------------------|--------------|--------|---------------|-----------------|
| Spectrum Analyzer | Agilent | E4446A | US42510252 | 04/28/2004 |
| Spectrum Analyzer | R&S | FSP30 | 1093.4495.30 | 07/22/2004 |

Remark: Each piece of equipment is scheduled for calibration once a year.

Test Configuration



TEST PROCEDURE

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set spectrum analyzer Start=2400MHz, Stop = 2441.5MHz, Sweep = 250s and Start=2441.5MHz, Stop = 2483.5MHz, Sweep = 250s.
4. Set the spectrum analyzer as RBW, VBW=100kHz,
5. Max hold, view and count how many channel in the band.

TEST RESULTS

No non-compliance noted

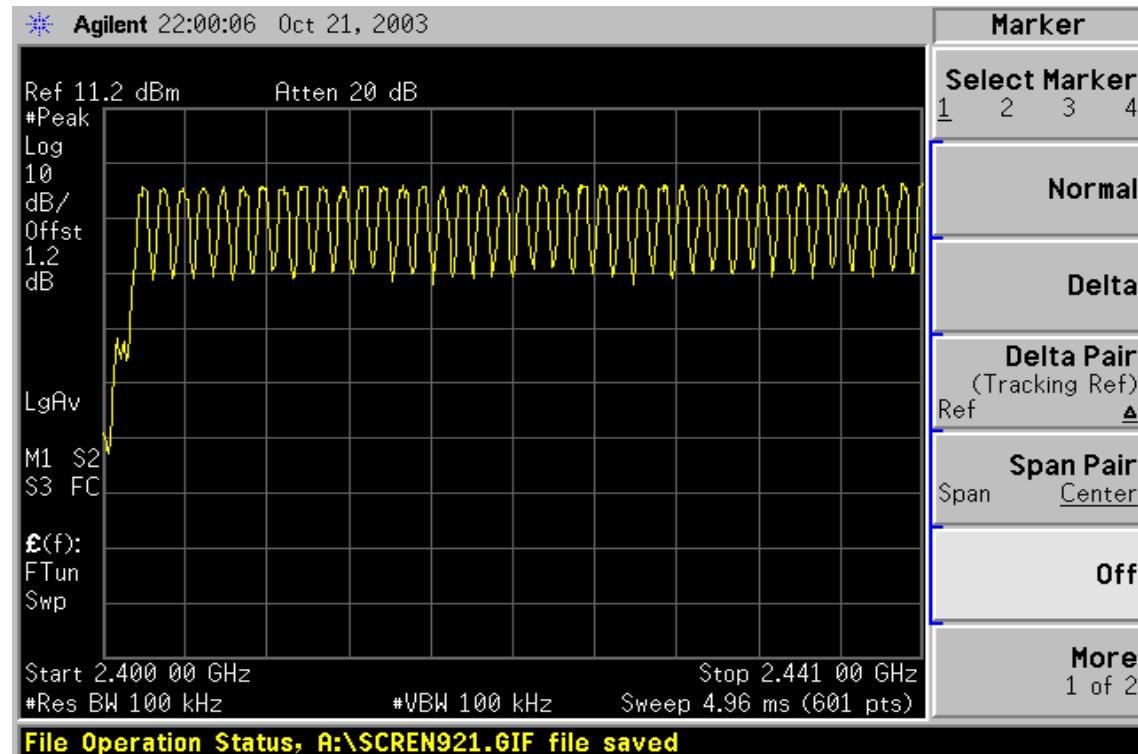
Test Data

| Result (No. of CH) | Limit (No. of CH) | Result |
|--------------------|-------------------|--------|
| 79 | > 75 | PASS |

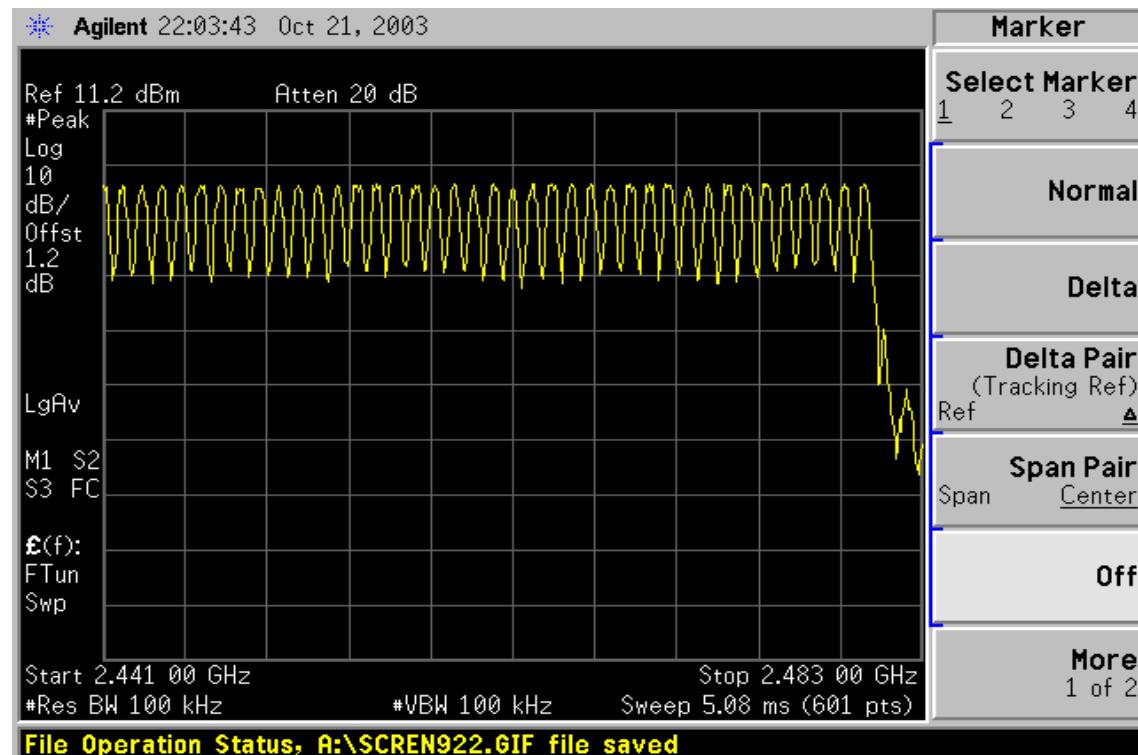
Test Plot

Channel Number

2.4 GHz – 2.441 GHz



2.441 GHz – 2.483 GHz





7.6 TIME OF OCCUPANCY (DWELL TIME)

LIMIT

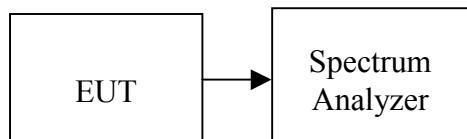
According to §15.247(a)(1)(iii), Frequency hopping systems operating in the 2400MHz-2483.5 MHz bands. The average time of occupancy on any channels shall not greater than 0.4 s within a period 0.4 s multiplied by the number of hopping channels employed.

MEASUREMENT EQUIPMENT USED

| Name of Equipment | Manufacturer | Model | Serial Number | Calibration Due |
|-------------------|--------------|--------|---------------|-----------------|
| Spectrum Analyzer | Agilent | E4446A | US42510252 | 04/28/2004 |
| Spectrum Analyzer | R&S | FSP30 | 1093.4495.30 | 07/22/2004 |

Remark: Each piece of equipment is scheduled for calibration once a year.

Test Configuration



TEST PROCEDURE

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set center frequency of spectrum analyzer = operating frequency.
4. Set the spectrum analyzer as RBW, VBW=10kHz, Span = 0Hz, Adjust Sweep = 100ms / RBW= 1MHz, VBW=3MHz, Span = 0Hz, Adjust Sweep = 2ms.
5. Repeat above procedures until all frequency measured were complete.

TEST RESULTS

No non-compliance noted

Test Data

DH1

CH Low: $0.42 * (1600/2)/79 * 30 = 252.15$ (ms)

CH Mid: $0.41 * (1600/2)/79 * 30 = 249.11$ (ms)

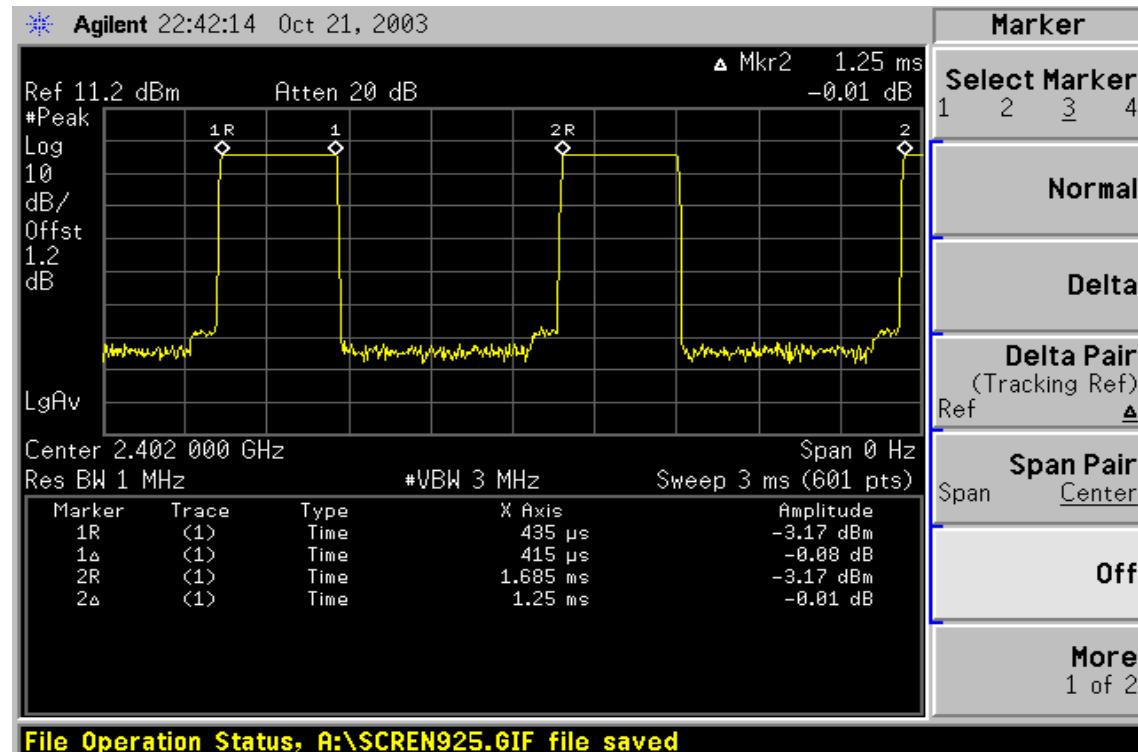
CH High: $0.42 * (1600/2)/79 * 30 = 252.15$ (ms)

| CH | Pulse Time (ms) | Total of Dwell (ms) | Period Time (s) | Limit (ms) | Result |
|------|-----------------|---------------------|-----------------|------------|--------|
| Low | 0.42 | 252.15 | 30.00 | 400.00 | PASS |
| Mid | 0.41 | 249.11 | 30.00 | | PASS |
| High | 0.42 | 252.15 | 30.00 | | PASS |

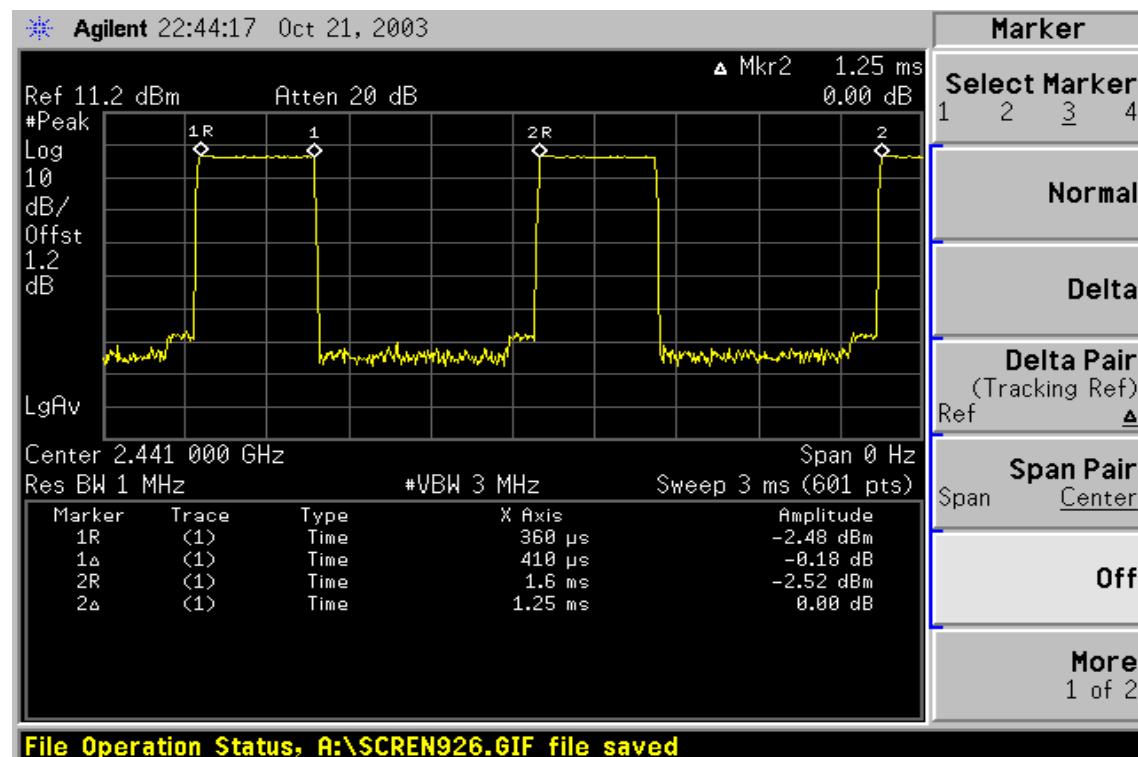
Test Plot

DH1

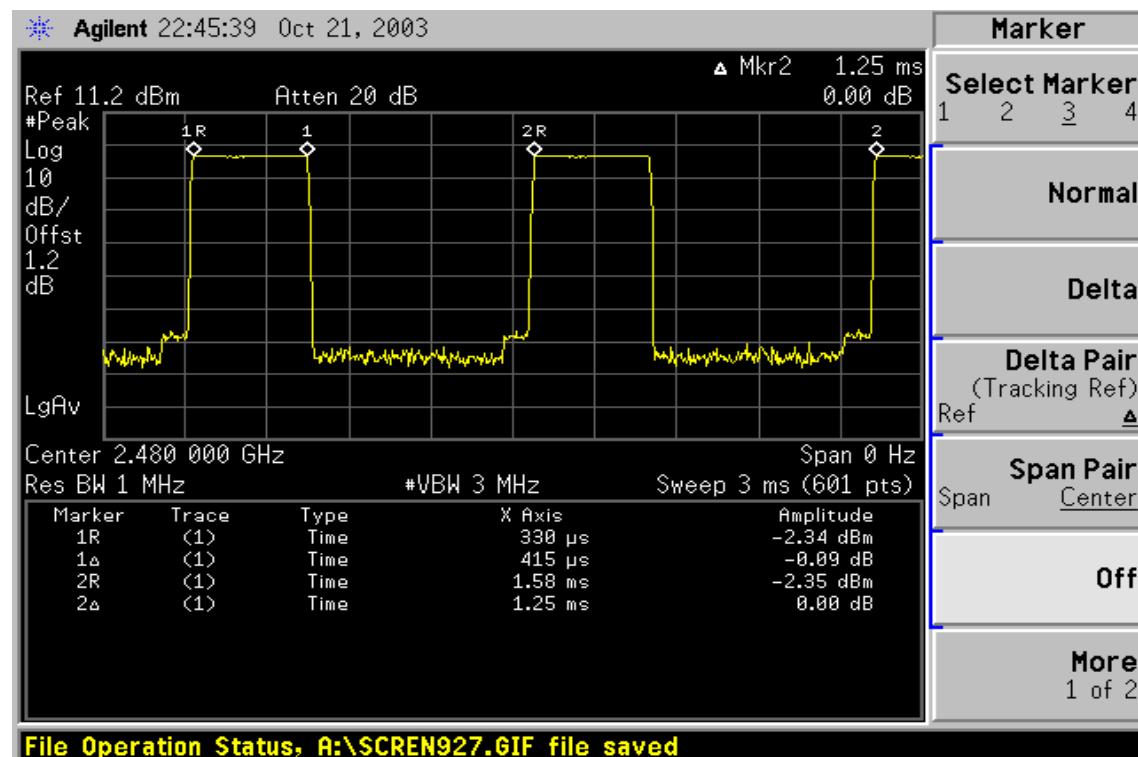
(CH Low)



(CH Mid)



(CH High)





7.7 RADIO FREQUENCY EXPOSURE

LIMIT

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. See §15.247(b)(4) and §1.1307(b)(1) of this chapter.

EUT Specification

| | |
|--|--|
| EUT | Wireless GPS Receiver |
| Frequency band (Operating) | <input type="checkbox"/> WLAN: 2.412GHz ~ 2.462GHz <input type="checkbox"/> WLAN: 5.18GHz ~ 5.32GHz / 5.50GHz ~ 5.70GHz <input type="checkbox"/> WLAN: 5.745GHz ~ 5825GHz <input checked="" type="checkbox"/> Others Bluetooth: 2402GHz ~ 2480GHz |
| Device category | <input type="checkbox"/> Portable (<20cm separation) <input checked="" type="checkbox"/> Mobile (>20cm separation) <input type="checkbox"/> Others |
| Exposure classification | <input type="checkbox"/> Occupational/Controlled exposure ($S = 5mW/cm^2$) <input checked="" type="checkbox"/> General Population/Uncontrolled exposure ($S=1mW/cm^2$) |
| Antenna diversity | <input checked="" type="checkbox"/> Single antenna <input type="checkbox"/> Multiple antennas <input type="checkbox"/> Tx diversity <input type="checkbox"/> Rx diversity <input type="checkbox"/> Tx/Rx diversity |
| Max. output power | -2.8 dBm (0.525mW) |
| Antenna gain (Max) | 2 dBi (Numeric gain: 1.585) |
| Evaluation applied | <input checked="" type="checkbox"/> MPE Evaluation <input type="checkbox"/> SAR Evaluation |
| Note: | |
| 1. The maximum output power is <u>-2.8dBm (0.525mW)</u> at <u>2480MHz</u> (with <u>1.585 numeric antenna gain</u>). | |
| 2. For mobile or fixed location transmitters, no SAR consideration applied. The minimum separation generally be used is at least 20 cm, even if the calculations indicate that the MPE distance would be lesser. | |

TEST RESULTS

No non-compliance noted

**Calculation**

$$\text{Given } E = \sqrt{\frac{30 \times P \times G}{d}} \quad \& \quad S = \frac{E^2}{3770}$$

Where E = Field Strength in Volts / meter

P = Power in Watts

G = Numeric antenna gain

d = Distance in meters

S = Power Density in milliwatts / square centimeter

Combining equations and re-arranging the terms to express the distance as a function of the remaining variables yields:

$$d = \sqrt{\frac{30 \times P \times G}{3770 \times S}}$$

Changing to units of mW and cm, using:

$$P \text{ (mW)} = P \text{ (W)} / 1000 \text{ and}$$

$$d \text{ (cm)} = 100 * d \text{ (m)}$$

Yields

$$d = 100 \times \sqrt{\frac{30 \times (P/1000) \times G}{3770 \times S}} = 0.282 \times \sqrt{\frac{P \times G}{S}}$$

Where d = distance in cm

P = Power in mW

G = Numeric antenna gain

S = Power Density in mW / cm²

Substituting the logarithmic form of power and gain using:

$$P \text{ (mW)} = 10^{(P \text{ (dBm)} / 10)} \text{ and}$$

$$G \text{ (numeric)} = 10^{(G \text{ (dBi)} / 10)}$$

Yields

$$d = 0.282 \times \frac{10^{(P+G)/20}}{\sqrt{20}} \quad \text{Equation 1}$$

Where d = MPE safe distance in cm

P = Power in dBm

G = Antenna Gain in dBi

S = Power Density Limit in mW / cm²



Maximum Permissible Exposure (Bluetooth Module)

EUT output power = 0.525 mW

Antenna Gain = 1.585

S = 1.0 mW / cm² from 1.1310 Table 1

Substituting these parameters into the above Equation 1:

→ MPE Safe Distance = 2.57 cm

(For mobile or fixed location transmitters, the minimum separation distance is 20 cm, even if calculations indicate that the MPE distance would be less.)



7.8 RADIATED EMISSIONS

LIMIT

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

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

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

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

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

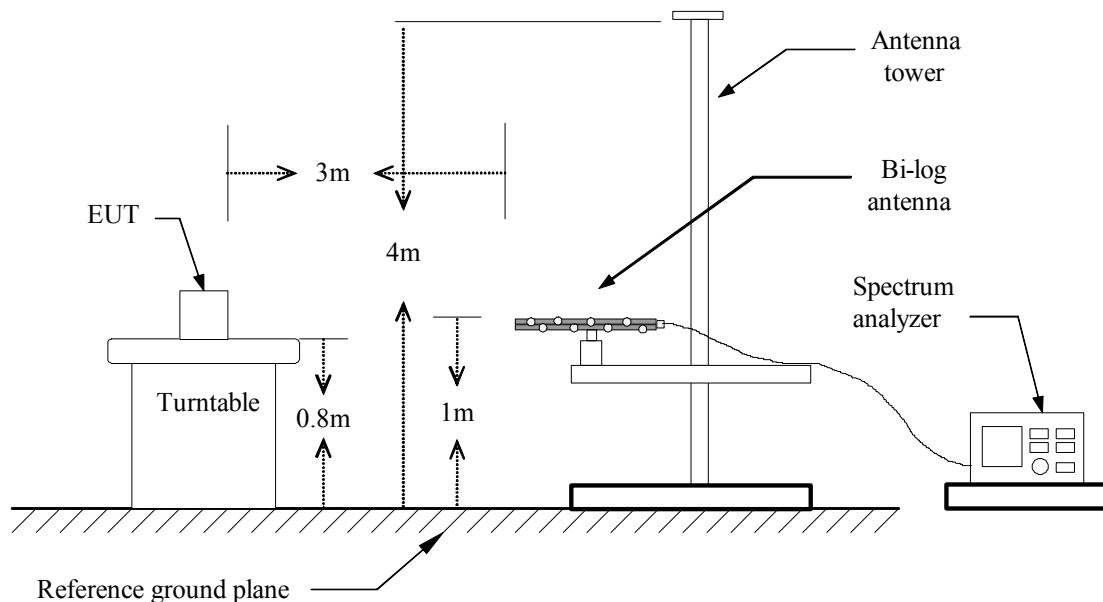
MEASUREMENT EQUIPMENT USED

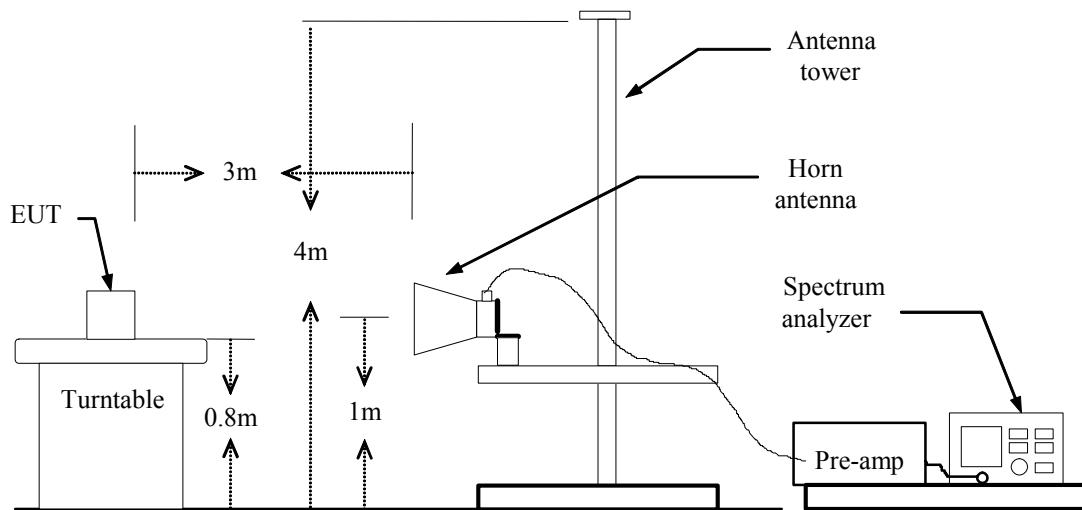
| Open Area Test Site #3 | | | | |
|------------------------|--------------|-----------|---------------|-----------------|
| Name of Equipment | Manufacturer | Model | Serial Number | Calibration Due |
| Spectrum Analyzer | Agilent | E4446A | US42510252 | 04/27/2004 |
| EMI Test Receiver | R&S | ESVS20 | 838804/004 | 01/08/2004 |
| Pre-Amplifier | HP | 8447D | 2944A09173 | 03/02/2004 |
| Bilog Antenna | SCHWAZBECK | VULB9163 | 145 | 07/05/2004 |
| Turn Table | EMCO | 2081-1.21 | 9709-1885 | N.C.R |
| Antenna Tower | EMCO | 2075-2 | 9707-2060 | N.C.R |
| Controller | EMCO | 2090 | 9709-1256 | N.C.R |
| RF Switch | ANRITSU | MP59B | M53867 | N.C.R |
| Site NSA | C&C | N/A | N/A | 09/06/2004 |
| Horn Antenna | EMCO | 3115 | 00022250 | 03/15/2004 |

Remark: Each piece of equipment is scheduled for calibration once a year.

Test Configuration

Below 1 GHz



Above 1 GHz**TEST PROCEDURE**

1. The EUT is placed on a turntable, which is 0.8m above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.



TEST RESULTS

Below 1 GHz

Operation Mode: TX CH Low Mode **Test Date:** November 1, 2003

Temperature: 20°C **Tested by:** Jacky

Humidity: 70 % RH **Polarity:** Ver. / Hor.

| Freq. (MHz) | Ant.Pol. H/V | Detector Mode (PK/QP) | Reading (dBuV) | Factor (dB) | Actual FS (dBuV/m) | Limit 3m (dBuV/m) | Safe Margin (dB) |
|----------------|-----------------|-----------------------------|-------------------|----------------|-----------------------|----------------------|------------------------|
| 72.30 | V | Peak | 21.26 | 9.99 | 31.25 | 40.00 | -8.75 |
| 192.00 | V | Peak | 13.54 | 14.12 | 27.66 | 43.50 | -15.84 |
| 283.80 | V | Peak | 13.27 | 16.05 | 29.32 | 46.00 | -16.68 |
| 384.00 | V | Peak | 13.20 | 19.86 | 33.06 | 46.00 | -12.94 |
| 454.00 | V | Peak | 19.64 | 20.36 | 40.00 | 46.00 | -6.00 |
| 872.83 | V | Peak | 3.96 | 27.68 | 31.64 | 46.00 | -14.36 |
| 144.30 | H | Peak | 20.28 | 10.98 | 31.26 | 43.50 | -12.24 |
| 192.00 | H | Peak | 16.21 | 14.12 | 30.33 | 43.50 | -13.17 |
| 283.80 | H | Peak | 19.77 | 16.05 | 35.82 | 46.00 | -10.18 |
| 384.00 | H | Peak | 16.87 | 19.86 | 36.73 | 46.00 | -9.27 |
| 455.16 | H | Peak | 17.12 | 20.41 | 37.53 | 46.00 | -8.47 |
| 480.83 | H | Peak | 11.58 | 21.61 | 33.19 | 46.00 | -12.81 |

Notes:

1. Measuring frequencies from 30 MHz to the 1GHz.
2. Radiated emissions measured in frequency range from 30 MHz to 1000MHz were made with an instrument using Peak detector mode.
3. Data of measurement within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
4. The IF bandwidth of SPA between 30MHz to 1GHz was 100kHz.



Operation Mode: TX CH Mid Mode **Test Date:** November 1, 2003
Temperature: 20°C **Tested by:** Jacky
Humidity: 70 % RH **Polarity:** Ver. / Hor.

| Freq. (MHz) | Ant.Pol. H/V | Detector Mode (PK/QP) | Reading (dBuV) | Factor (dB) | Actual FS (dBuV/m) | Limit 3m (dBuV/m) | Safe Margin (dB) |
|----------------|-----------------|-----------------------------|-------------------|----------------|-----------------------|----------------------|------------------------|
| 72.30 | V | Peak | 20.26 | 9.99 | 30.25 | 40.00 | -9.75 |
| 192.00 | V | Peak | 13.21 | 14.12 | 27.33 | 43.50 | -16.17 |
| 283.35 | V | Peak | 14.61 | 16.03 | 30.64 | 46.00 | -15.36 |
| 384.00 | V | Peak | 12.54 | 19.86 | 32.40 | 46.00 | -13.60 |
| 455.16 | V | Peak | 19.12 | 20.41 | 39.53 | 46.00 | -6.47 |
| 872.83 | V | Peak | 3.46 | 27.68 | 31.14 | 46.00 | -14.86 |
| 144.30 | H | Peak | 21.78 | 10.98 | 32.76 | 43.50 | -10.74 |
| 192.00 | H | Peak | 15.54 | 14.12 | 29.66 | 43.50 | -13.84 |
| 283.80 | H | Peak | 19.11 | 16.05 | 35.16 | 46.00 | -10.84 |
| 384.00 | H | Peak | 17.04 | 19.86 | 36.90 | 46.00 | -9.10 |
| 455.16 | H | Peak | 17.62 | 20.41 | 38.03 | 46.00 | -7.97 |
| 480.83 | H | Peak | 11.58 | 21.61 | 33.19 | 46.00 | -12.81 |

Notes:

1. Measuring frequencies from 30 MHz to the 1GHz.
2. Radiated emissions measured in frequency range from 30 MHz to 1000MHz were made with an instrument using Peak detector mode.
3. Data of measurement within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
4. The IF bandwidth of SPA between 30MHz to 1GHz was 100kHz.



Operation Mode: TX CH High Mode **Test Date:** November 1, 2003
Temperature: 20°C **Tested by:** Jacky
Humidity: 70 % RH **Polarity:** Ver. / Hor.

| Freq. (MHz) | Ant.Pol. H/V | Detector Mode (PK/QP) | Reading (dBuV) | Factor (dB) | Actual FS (dBuV/m) | Limit 3m (dBuV/m) | Safe Margin (dB) |
|----------------|-----------------|-----------------------------|-------------------|----------------|-----------------------|----------------------|------------------------|
| 71.85 | V | Peak | 21.15 | 10.02 | 31.17 | 40.00 | -8.83 |
| 283.35 | V | Peak | 14.11 | 16.03 | 30.14 | 46.00 | -15.86 |
| 384.00 | V | Peak | 12.37 | 19.86 | 32.23 | 46.00 | -13.77 |
| 401.50 | V | Peak | 10.33 | 20.70 | 31.03 | 46.00 | -14.97 |
| 455.16 | V | Peak | 17.95 | 20.41 | 38.36 | 46.00 | -7.64 |
| 909.00 | V | Peak | 2.07 | 28.28 | 30.35 | 46.00 | -15.65 |
| 144.30 | H | Peak | 20.28 | 10.98 | 31.26 | 43.50 | -12.24 |
| 192.00 | H | Peak | 16.04 | 14.12 | 30.16 | 43.50 | -13.34 |
| 283.35 | H | Peak | 19.44 | 16.03 | 35.47 | 46.00 | -10.53 |
| 384.00 | H | Peak | 17.54 | 19.86 | 37.40 | 46.00 | -8.60 |
| 455.16 | H | Peak | 17.29 | 20.41 | 37.70 | 46.00 | -8.30 |
| 479.66 | H | Peak | 11.62 | 21.56 | 33.18 | 46.00 | -12.82 |

Notes:

1. Measuring frequencies from 30 MHz to the 1GHz.
2. Radiated emissions measured in frequency range from 30 MHz to 1000MHz were made with an instrument using Peak detector mode.
3. Data of measurement within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
4. The IF bandwidth of SPA between 30MHz to 1GHz was 100kHz.

**Above 1 GHz**

Operation Mode: TX CH Low Mode **Test Date:** November 1, 2003
Temperature: 20°C **Tested by:** Jacky
Humidity: 70 % RH **Polarity:** Ver. / Hor.

| Freq. (MHz) | Ant. Pol H/V | Peak Reading (dBuV) | AV Reading (dBuV) | Ant. / CL CF (dB) | Actual Fs | | Peak Limit (dBuV/m) | AV Limit (dBuV/m) | Margin (dB) | Remark |
|----------------|-----------------|---------------------------|-------------------------|-------------------------|------------------|----------------|---------------------------|-------------------------|----------------|--------|
| | | | | | Peak (dBuV/m) | AV (dBuV/m) | | | | |
| 1706.66 | V | 43.50 | --- | -6.22 | 37.28 | --- | 74.00 | 54.00 | -16.72 | Peak |
| --- | | | | | | | | | | |
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Notes:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
4. Spectrum Peak Setting 1GHz - 26GHz, RBW = 1MHz, VBW = 1MHz, Sweep time = 200 ms.
5. Spectrum AV Setting 1GHz - 26GHz, RBW = 1MHz, VBW = 10Hz, Sweep time = 200 ms



Operation Mode: TX CH Mid Mode **Test Date:** November 1, 2003
Temperature: 20°C **Tested by:** Jacky
Humidity: 70 % RH **Polarity:** Ver. / Hor.

Notes:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
4. Spectrum Peak Setting 1GHz - 26GHz, RBW = 1MHz, VBW = 1MHz, Sweep time = 200 ms.
5. Spectrum AV Setting 1GHz - 26GHz, RBW = 1MHz, VBW = 10Hz, Sweep time = 200 ms



Operation Mode: TX CH High Mode **Test Date:** November 1, 2003

Temperature: 20°C Tested by: Jacky

Humidity: 70 % RH **Polarity:** Ver. / Hor.

Notes:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
4. Spectrum Peak Setting 1GHz - 26GHz, RBW = 1MHz, VBW = 1MHz, Sweep time = 200 ms.
5. Spectrum AV Setting 1GHz - 26GHz, RBW = 1MHz, VBW = 10Hz, Sweep time = 200 ms



7.9 POWERLINE CONDUCTED EMISSIONS

LIMIT

For an intentional radiator which is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed 250 microvolts (The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz). The limits at specific frequency range is listed as follows:

| Frequency Range (MHz) | Limits (dB μ V) | |
|-----------------------|---------------------|----------|
| | Quasi-peak | Average |
| 0.15 to 0.50 | 66 to 56 | 56 to 46 |
| 0.50 to 5 | 56 | 46 |
| 5 to 30 | 60 | 50 |

Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line (LINE and NEUTRAL) and ground at the power terminals.

MEASUREMENT EQUIPMENT USED

| Name of Equipment | Manufacturer | Model | Serial Number | Calibration Due |
|-------------------|--------------|---------|---------------|-----------------|
| EMI Test Receiver | R&S | ESCS30 | 847793/012 | 12/20/2003 |
| LISN | R&S | ESH2-Z5 | 843285/010 | 12/15/2003 |
| LISN | EMCO | 3825/2 | 9003-1628 | 07/25/2004 |

Remark: Each piece of equipment is scheduled for calibration once a year.



Test Configuration

1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI C63.4.
2. The EUT was plug-in the host PC via USB port. The host PC system was placed on the center of the back edge on the test table. The peripherals like modem, monitor printer, K/B, and mouse were placed on the side of the host PC system. The rear of the EUT and peripherals were placed flushed with the rear of the tabletop.
3. The keyboard was placed directly in the front of the monitor, flushed with the front tabletop. The mouse was placed next to the Keyboard, flushed with the back of keyboard.
4. The spacing between the peripherals was 10 centimeters.
5. External I/O cables were draped along the edge of the test table and bundle when necessary.
6. The host PC system was connected with 110Vac/60Hz power source.

The EUT is set to transmit in a continuous mode.

TEST PROCEDURE

1. The EUT was placed on a table, which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured were complete.



TEST RESULTS

The initial step in collecting conducted data is a spectrum analyzer peak scan of the measurement range. Significant peaks are then marked as shown on the following data page, and these signals are then quasi-peaked.

Operation Mode: TX + RX mode **Test Date:** October 21, 2003
Temperature: 25°C **Humidity:** 67% RH
Tested by: Jacky

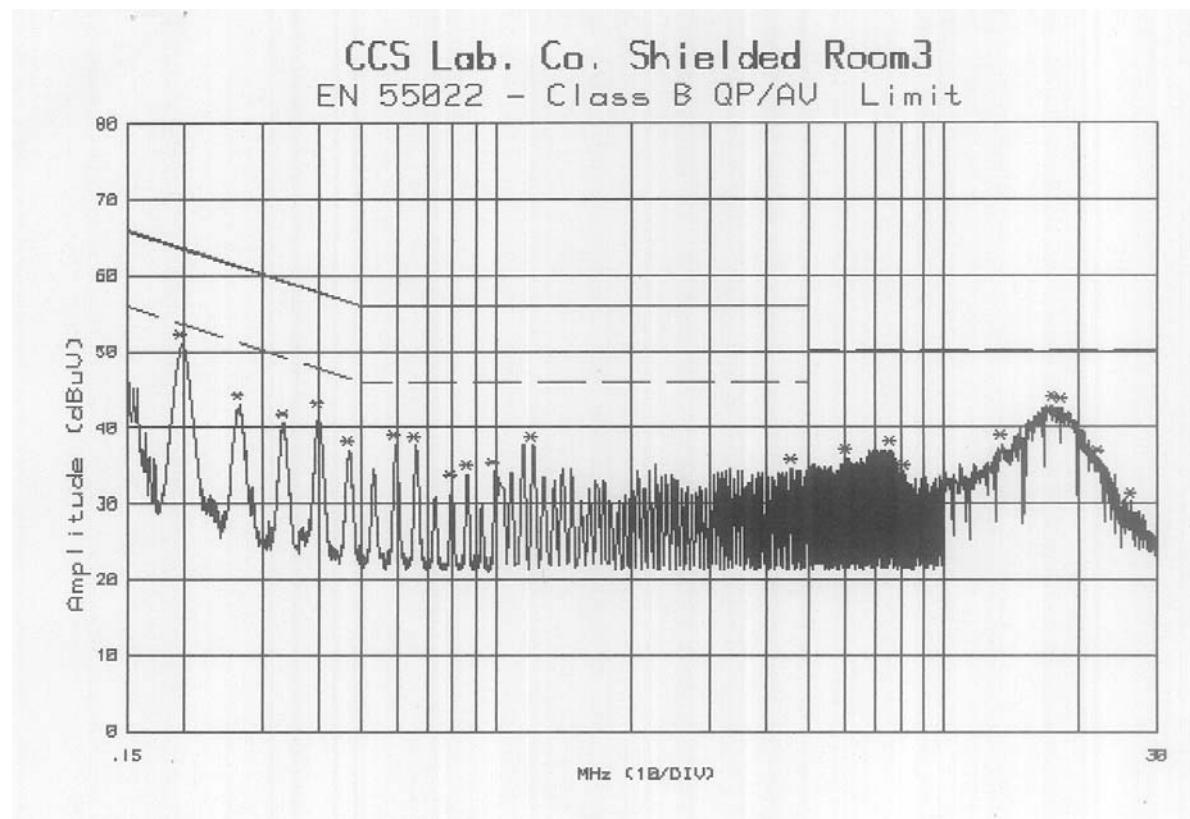
| Freq. (MHz) | Q.P. Raw (dBuV) | Avg Raw (dBuV) | Q.P. Limit (dBuV) | Avg Limit (dBuV) | Q.P. Margin (dB) | Avg Margin (dB) | Note |
|----------------|-----------------------|----------------------|-------------------------|------------------------|------------------------|-----------------------|------|
| 0.199 | 49.00 | --- | 63.65 | 53.65 | -14.65 | --- | L1 |
| 0.267 | 38.60 | --- | 61.21 | 51.21 | -22.61 | --- | L1 |
| 0.336 | 38.50 | --- | 59.30 | 49.30 | -20.80 | --- | L1 |
| 0.403 | 38.40 | --- | 57.79 | 47.79 | -19.39 | --- | L1 |
| 0.471 | 32.70 | --- | 56.50 | 46.50 | -23.80 | --- | L1 |
| 0.597 | 34.80 | --- | 56.00 | 46.00 | -21.20 | --- | L1 |
| <hr/> | | | | | | | |
| 0.200 | 48.90 | --- | 63.61 | 53.61 | -14.71 | --- | L2 |
| 0.267 | 38.80 | --- | 61.21 | 51.21 | -22.41 | --- | L2 |
| 0.335 | 36.20 | --- | 59.33 | 49.33 | -23.13 | --- | L2 |
| 0.402 | 36.00 | --- | 57.81 | 47.81 | -21.81 | --- | L2 |
| 0.471 | 34.10 | --- | 56.50 | 46.50 | -22.40 | --- | L2 |
| 0.596 | 30.10 | --- | 56.00 | 46.00 | -25.90 | --- | L2 |

Note:

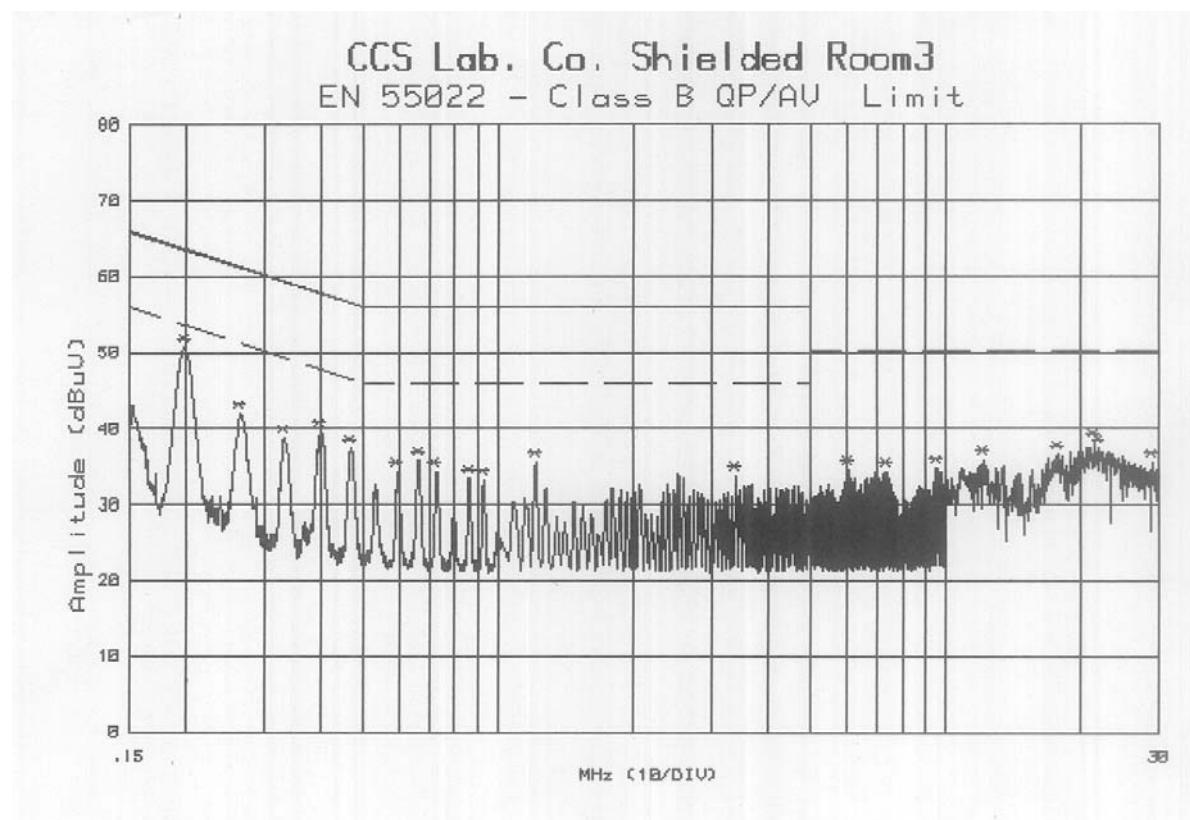
1. The measuring frequencies range between 0.15 MHz and 30 MHz.
2. The emissions measured in the frequency range between 0.15 MHz and 30MHz were made with an instrument using Quasi-peak detector and Average detector.
3. “---” denotes the emission level was or more than 2dB below the Average limit, and no re-check was made.
4. The IF bandwidth of SPA between 0.15MHz and 30MHz was 10KHz. The IF bandwidth of Test Receiver between 0.15MHz and 30MHz was 9KHz.
5. L1 = Line One (Live Line) / L2 = Line Two (Neutral Line)

Test Data Plots

Conducted emissions (Line 1)



Conducted emissions (Line 2)



APPENDIX 1

PHOTOGRPHS OF TEST SETUP

Radiated Emission Set up Photos



Conducted Emission Set Up Photos

