

EMC TEST REPORT

Report No. : EME-060124

Model No. : AWBC1E

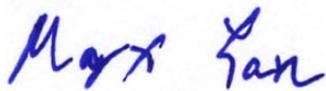
Issued Date : May 4, 2006

Applicant : Asia Pacific Microsystems, Inc.
No. 2, R&D Road 6, Science-Based Industrial Park,
Hsinchu, Taiwan

Test By : Intertek Testing Services Taiwan Ltd.
No. 11, Lane 275, Ko-Nan 1 Street, Chia-Tung Li,
Shiang-Shan District, Hsinchu City, Taiwan

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Project Engineer



Marx Yan

Reviewed By



Jerry Liu

Table of Contents

| | |
|---|----|
| Summary of Tests | 4 |
| 1. General information | 5 |
| 1.1 Identification of the EUT | 5 |
| 1.2 Additional information about the EUT | 5 |
| 1.3 Antenna description | 6 |
| 1.4 Peripherals equipment | 6 |
| 2. Test specifications | 7 |
| 2.1 Test standard | 7 |
| 2.2 Operation mode | 7 |
| 2.3 Test equipment..... | 8 |
| 3. 20dB Bandwidth test | 9 |
| 3.1 Operating environment..... | 9 |
| 3.2 Test setup & procedure | 9 |
| 3.3 Measured data of modulated bandwidth test results..... | 9 |
| 4. Carrier Frequency Separation test | 11 |
| 4.1 Operating environment..... | 11 |
| 4.2 Test setup & procedure | 11 |
| 4.3 Measured data of Carrier Frequency Separation test result..... | 11 |
| 5. Number of hopping frequencies test | 13 |
| 5.1 Operating environment..... | 13 |
| 5.2 Test setup & procedure | 13 |
| 5.3 Measured data of number of hopping frequencies test result..... | 13 |
| 6. Time of Occupancy (dwell time) test | 15 |
| 6.1 Operating environment..... | 15 |
| 6.2 Test setup & procedure | 15 |
| 7. Maximum Output Power test | 19 |
| 7.1 Operating environment..... | 19 |
| 7.2 Test setup & procedure | 19 |
| 7.3 Measured data of Maximum Output Power test results | 19 |
| 8. Radiated Emission test | 20 |
| 8.1 Operating environment..... | 20 |
| 8.2 Test setup & procedure | 20 |
| 8.3 Emission limits | 21 |
| 8.4 Radiated spurious emission test data..... | 22 |
| 8.4.1 Measurement results: frequencies equal to or less than 1 GHz..... | 22 |
| 8.4.2 Measurement results: frequency above 1GHz..... | 23 |
| 9. Emission on the band edge §FCC 15.247(C)..... | 24 |
| 9.1 Band-edge (Conducted method)..... | 25 |
| 9.2 Band-edge (Radiated method)..... | 27 |

10. Power Line Conducted Emission test §FCC 15.20731

 10.1 Operating environment31

 10.2 Test setup & procedure31

 10.3 Emission limit.....32

 10.4 Uncertainty of Conducted Emission.....32

 10.5 Power Line Conducted Emission test data33

Summary of Tests**Bluetooth V.1.2 Class1 USB Dongle-Model: AWBC1E
FCC ID: RU5AWBC1E**

| Test | Reference | Results |
|---------------------------------------|----------------|----------|
| Maximum Output Power test | 15.247(b) | Complies |
| Carrier Frequency Separation test | 15.247(a)(1) | Complies |
| Number of hopping frequencies test | 15.247(a)(1) | Complies |
| Time of Occupancy (dwell time) test | 15.247(a)(1) | Complies |
| 20dB Bandwidth test | 15.247(a)(1) | Complies |
| Radiated Spurious Emission test | 15.205, 15.209 | Complies |
| Emission on the Band Edge test | 15.247(d) | Complies |
| AC Power Line Conducted Emission test | 15.207 | Complies |

1. General information

1.1 Identification of the EUT

| | |
|---------------------------|-------------------------------------|
| Applicant | : Asia Pacific Microsystems, Inc. |
| Product | : Bluetooth V.1.2 Class1 USB Dongle |
| Model No. | : AWBC1E |
| FCC ID. | : RU5AWBC1E |
| Frequency Range | : 2400MHz ~ 2483.5MHz |
| Channel Number | : 79 channels |
| Frequency of Each Channel | : 2402 + k MHz; k = 0-78 |
| Type of Modulation | : GFSK |
| Rated Power | : DC 5V from Notebook PC |
| Power Cord | : N/A |
| Sample Received | : July 22, 2005 |
| Test Date(s) | : July 22, 2005 ~ Oct. 14, 2005 |

A FCC DoC report has been generated for the client.

1.2 Additional information about the EUT

The EUT is a Bluetooth USB Dongle, and was defined as radio and telecommunications terminal equipment.

For more detail features, please refer to User's manual as file name "Installation guide.pdf"

1.3 Antenna description

The EUT uses a permanently connected antenna.

Antenna Gain : 2.22dBi max
Antenna Type : PCB Printed antenna
Connector Type : N/A

1.4 Peripherals equipment

| Peripherals | Manufacturer | Product No. | Serial No. | FCC ID |
|-------------|--------------|-------------|--------------------------|------------------|
| Notebook PC | DELL | PP05L | CN-5G5152-48643-498-6810 | FCC DoC Approved |

2. Test specifications

2.1 Test standard

The EUT was performed according to the procedures in FCC Part 15 Subpart C Section § 15.205, §15.207, §15.209, §15.247 and ANSI C63.4/2003.

The test of radiated measurements according to FCC Part15 Section 15.33(a) had been conducted and the field strength of this frequency band were all meet limit requirement, thus we evaluate the EUT pass the specified test.

2.2 Operation mode

The EUT was transmitted continuously during the test.

2.3 Test equipment

| Equipment | Brand | Frequency range | Model No. | Intertek ID No. | Next Cal. Date |
|-----------------------------------|-----------------|-----------------|---------------------|-----------------|----------------|
| EMI Test Receiver | Rohde & Schwarz | 9kHz~2.75GHz | ESCS 30 | EC303 | 04/17/2007 |
| EMI Test Receiver | Rohde & Schwarz | 20Hz~26.5GHz | ESMI | EC317 | 08/07/2006 |
| Spectrum Analyzer | Rohde & Schwarz | 9kHz~30GHz | FSP 30 | EC353 | 07/24/2006 |
| Spectrum Analyzer | Rohde & Schwarz | 20Hz~40GHz | FSEK 30 | EC365 | 11/01/2006 |
| Horn Antenna | SCHWARZBECK | 1GHz~18GHz | BBHA 9120 D | EC371 | 12/22/2007 |
| Horn Antenna | SCHWARZBECK | 14GHz~40GHz | BBHA 9170 | EC351 | 07/08/2007 |
| Bilog Antenna | SCHWARZBECK | 25MHz~2GHz | VULB 9168 | EC347 | 12/23/2007 |
| Pre-Amplifier | MITEQ | 100MHz~26.5GHz | 919981 | EC373 | 12/29/2006 |
| Pre-Amplifier | MITEQ | 26GHz~40GHz | 828825 | EC374 | 01/28/2007 |
| Wideband Peak Power Meter/ Sensor | Anritsu | 100MHz~18GHz | ML2497A/ MA2491A | EC396 | 11/10/2006 |
| Controller | HDGmbH | N/A | CM 100 | EP346 | N/A |
| Antenna Tower | HDGmbH | N/A | MA 240 | EP347 | N/A |
| LISN | Rohde & Schwarz | 9KHz~30MHz | ESH3-Z5 | EC344 | 01/13/2007 |

- Note: 1. The above equipments are within the valid calibration period.
 2. The test antennas (receiving antenna) are calibration per 3 years.

3. 20dB Bandwidth test

3.1 Operating environment

Temperature: 25
Relative Humidity: 55 %
Atmospheric Pressure: 1023 hPa

3.2 Test setup & procedure

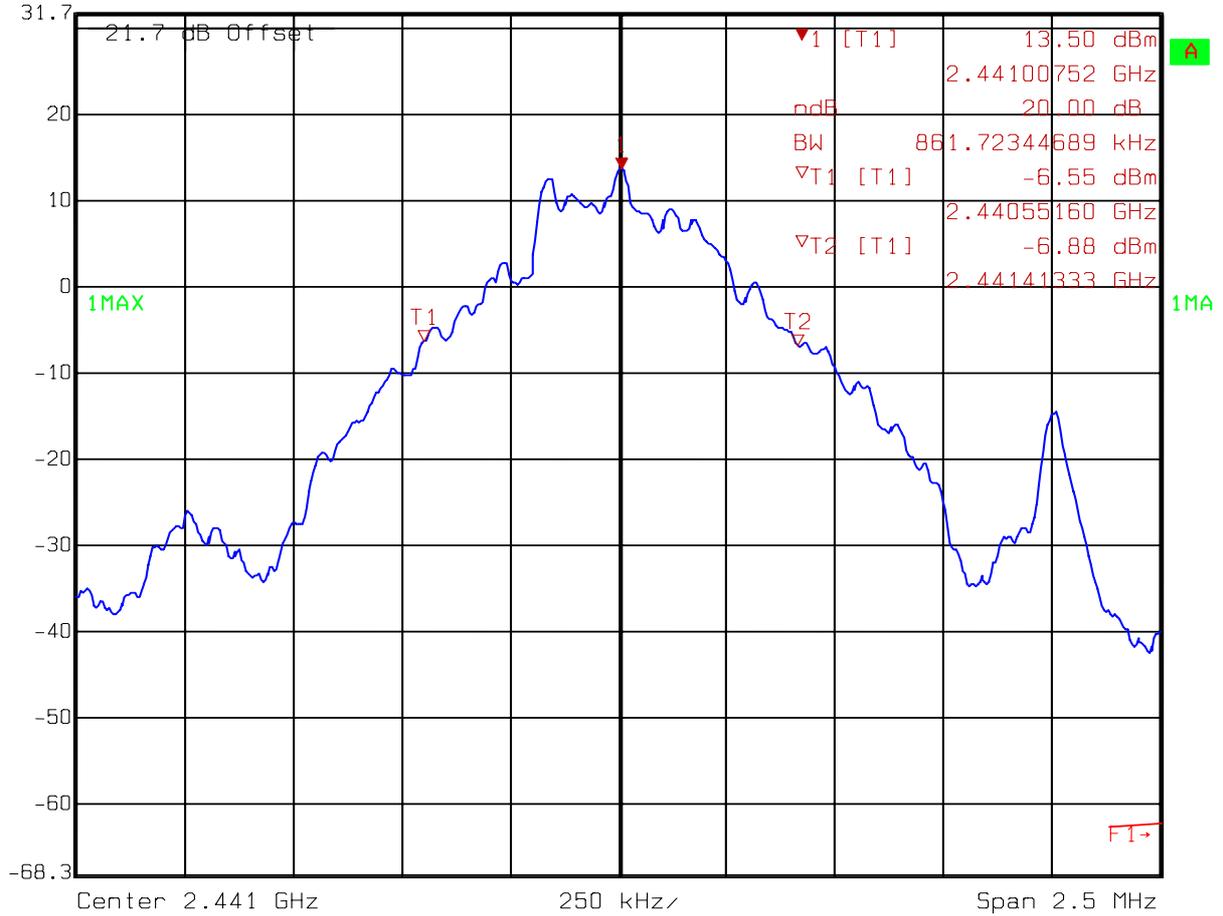
The 20dB bandwidth per FCC §15.247(a)(1)(i) was measured using a 50 ohm spectrum analyzer with the resolutions bandwidth set at 100 kHz, the video bandwidth RBW, and the SPAN may equal to approximately 2 to 3 times the 20dB bandwidth. The maximum 20dB modulation bandwidth is in the following Table.

3.3 Measured data of modulated bandwidth test results

| Channel | Frequency (MHz) | Bandwidth (kHz) |
|------------|-----------------|-----------------|
| Channel 40 | 2441.000 | 861.72 |

Please see the plot below.

| | | | | | | |
|--|----------|---------------------|-----|---------|--------|-------|
| | Ref Lvl | Marker 1 [T1 ndB] | RBW | 30 kHz | RF Att | 20 dB |
| | 31.7 dBm | ndB 20.00 dB | VBW | 100 kHz | | |
| | | BW 861.72344689 kHz | SWT | 7 ms | Unit | dBm |



Title:
 Comment A: 20dB Bandwidth
 Date: 21.FEB.2006 09:08:27

4. Carrier Frequency Separation test

4.1 Operating environment

Temperature: 25
Relative Humidity: 55 %
Atmospheric Pressure: 1023 hPa

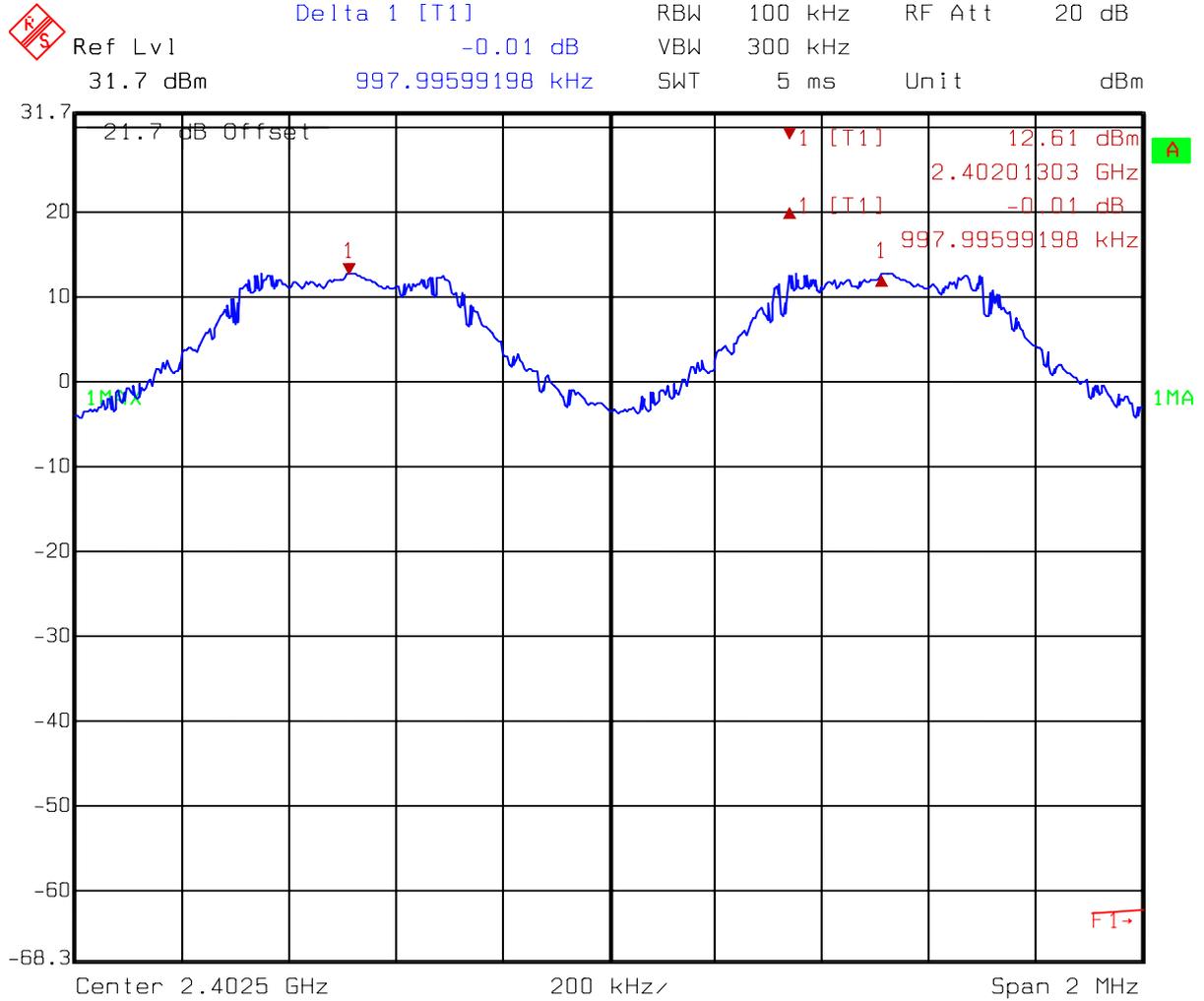
4.2 Test setup & procedure

The carrier frequency separation per FCC §15.247(a)(1) was measured using a 50 ohm spectrum analyzer with the resolutions bandwidth set at 1 % of the span, the video bandwidth RBW, and the SPAN was wide enough to capture the peaks of two adjacent channels. The carrier frequency separation result is in the following Table.

4.3 Measured data of Carrier Frequency Separation test result

| Channel | Frequency (MHz) | Measurement Frequency separation (kHz) |
|---------|-----------------|--|
| 1 | 2402 | 997.996 |
| 2 | 2403 | |

Please see the plot below.



Title:
 Comment A: Carrier frequencies separation between CH1 and CH2
 Date: 21.FEB.2006 09:01:17

5. Number of hopping frequencies test

5.1 Operating environment

Temperature: 25
Relative Humidity: 55 %
Atmospheric Pressure: 1023 hPa

5.2 Test setup & procedure

The number of hopping frequencies per FCC §15.247(a)(1) was measured using a 50 ohm spectrum analyzer with the resolutions bandwidth set at 1 % of the span, the video bandwidth RBW, and the SPAN was the frequency band of operation. The carrier frequency separation result is in the following Table.

5.3 Measured data of number of hopping frequencies test result

| Frequency Range (MHz) | Total hopping channels |
|-----------------------|------------------------|
| 2400 ~ 2483.5 | 79 |

Please see the plot below.

6. Time of Occupancy (dwell time) test

6.1 Operating environment

Temperature: 25
Relative Humidity: 55 %
Atmospheric Pressure: 1023 hPa

6.2 Test setup & procedure

The time of occupancy (dwell time) per FCC §15.247(a)(1) was measured using a 50 ohm spectrum analyzer with the resolutions bandwidth set at 1MHz, the video bandwidth RBW, and the zero span function of spectrum analyzer was enable. The EUT has its hopping function enable.

The system makes worst case 1600 hops per second or 1 time slot has a length of 625µs with 79 channels.

Time of occupancy (dwell time) for DH1

$$\begin{aligned} \text{Dwell time} &= 416.8337 \mu\text{s} * 1600 * 1/2 * 1/\text{s} / 79 * 31.6\text{s} \\ &= 133.386 \text{ ms (in a 31.6s period)} \end{aligned}$$

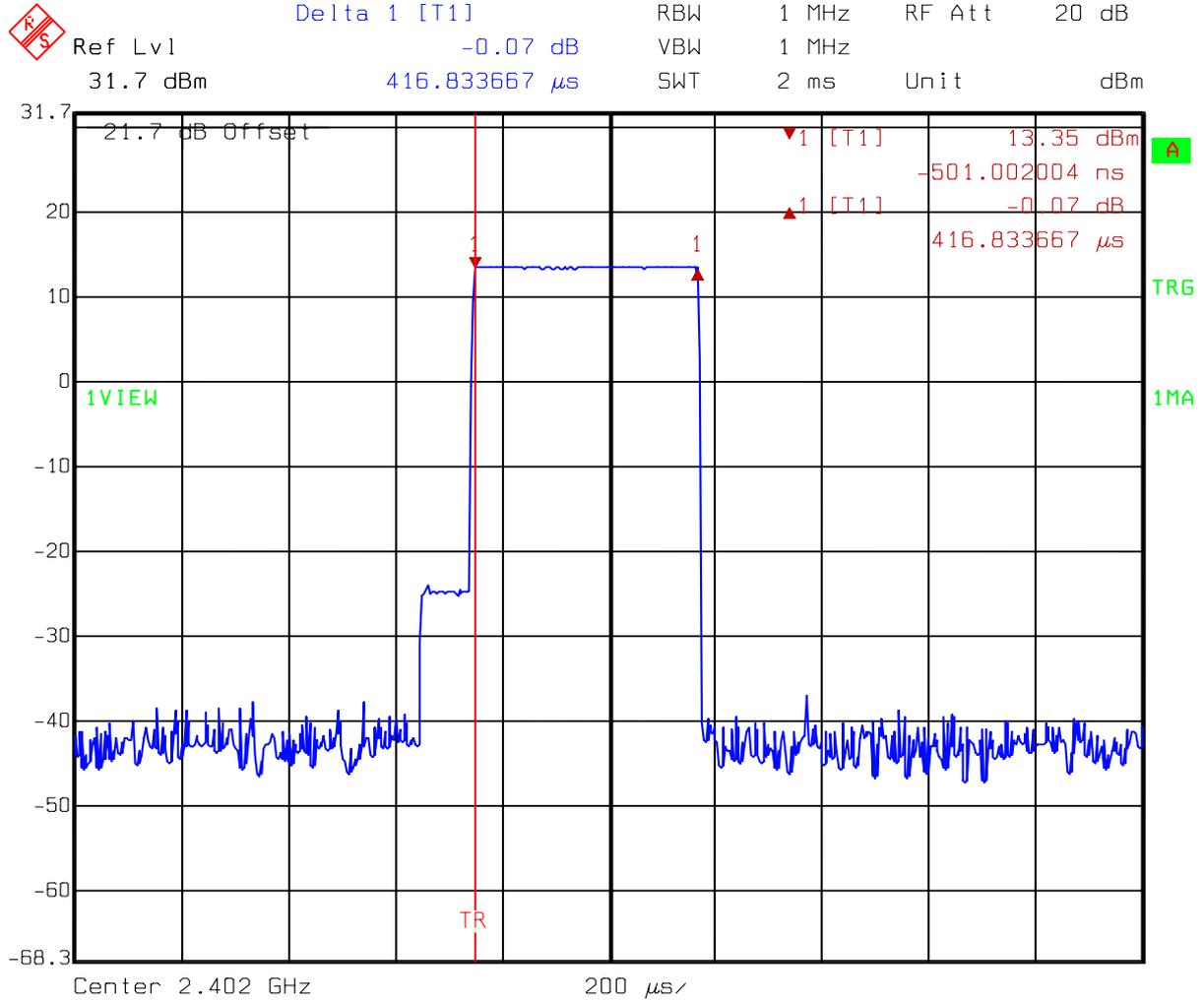
Time of occupancy (dwell time) for DH3

$$\begin{aligned} \text{Dwell time} &= 1.6733 \text{ ms} * 1600 * 1/4 * 1/\text{s} / 79 * 31.6\text{s} \\ &= 267.728 \text{ ms (in a 31.6s period)} \end{aligned}$$

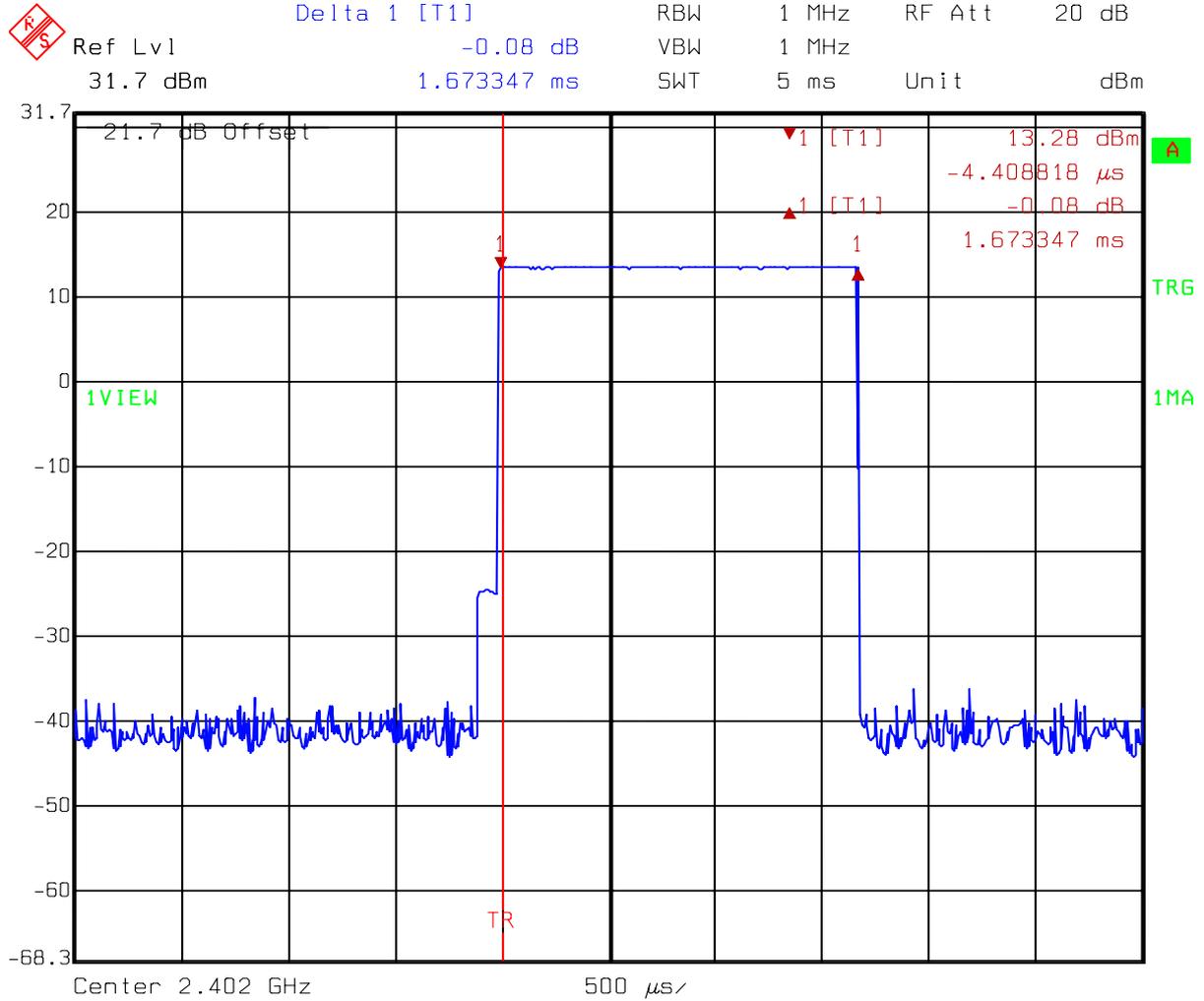
Time of occupancy (dwell time) for DH5

$$\begin{aligned} \text{Dwell time} &= 2.9078 \text{ ms} * 1600 * 1/6 * 1/\text{s} / 79 * 31.6\text{s} \\ &= 310.165 \text{ ms (in a 31.6s period)} \end{aligned}$$

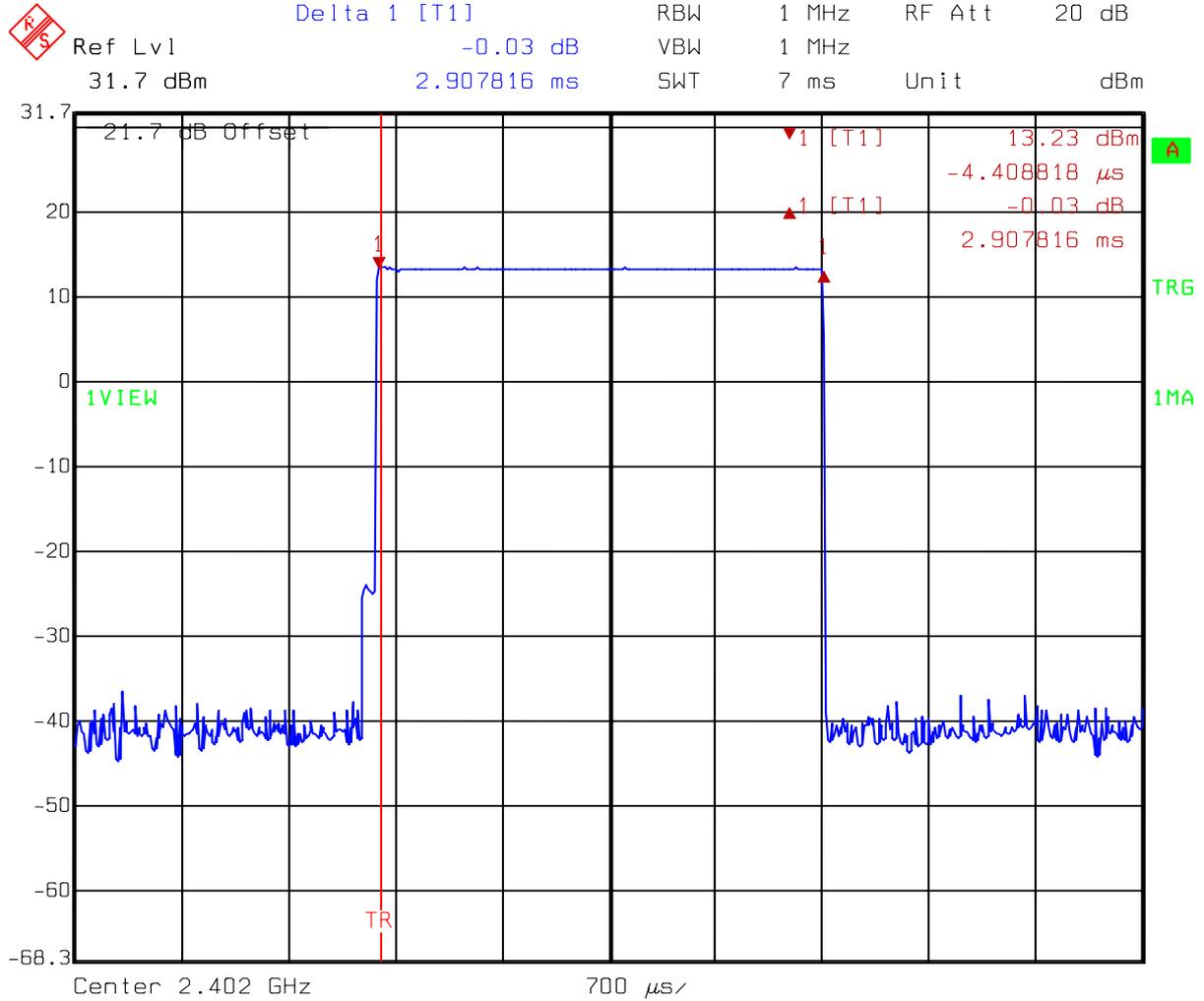
Please see the plot below.



Title:
 Comment A: Dwell time of DH1 mode
 Date: 21.FEB.2006 09:14:43



Title:
 Comment A: Dwell time of DH3 mode
 Date: 21.FEB.2006 09:18:27



Title:
 Comment A: Dwell time of DH5 mode
 Date: 21.FEB.2006 09:20:24

7. Maximum Output Power test

7.1 Operating environment

Temperature: 25
 Relative Humidity: 50 %
 Atmospheric Pressure: 1022 hPa

7.2 Test setup & procedure

The power output per FCC §15.247(b) was measured on the EUT using a 50 ohm SMA cable connected to peak power meter via power sensor. Power was read directly and cable loss correction (0.5dB) was added to the reading to obtain power at the EUT antenna terminals. The test was performed at 3 channels (lowest, middle and highest channel).

7.3 Measured data of Maximum Output Power test results

| Channel | Freq. (MHz) | C.L. (dB) | Reading (dBm) | Conducted Peak Output Power | | Limit (dBm) |
|--------------|-------------|-----------|---------------|-----------------------------|------|-------------|
| | | | | (dBm) | (mW) | |
| 1 (lowest) | 2402 | 0.5 | 12.5 | 13.0 | 19.9 | 30 |
| 40 (middle) | 2442 | 0.5 | 12.6 | 13.1 | 20.4 | 30 |
| 79 (highest) | 2480 | 0.5 | 12.8 | 13.3 | 21.3 | 30 |

Remark:

Conducted Peak Output Power = Reading + C.L.

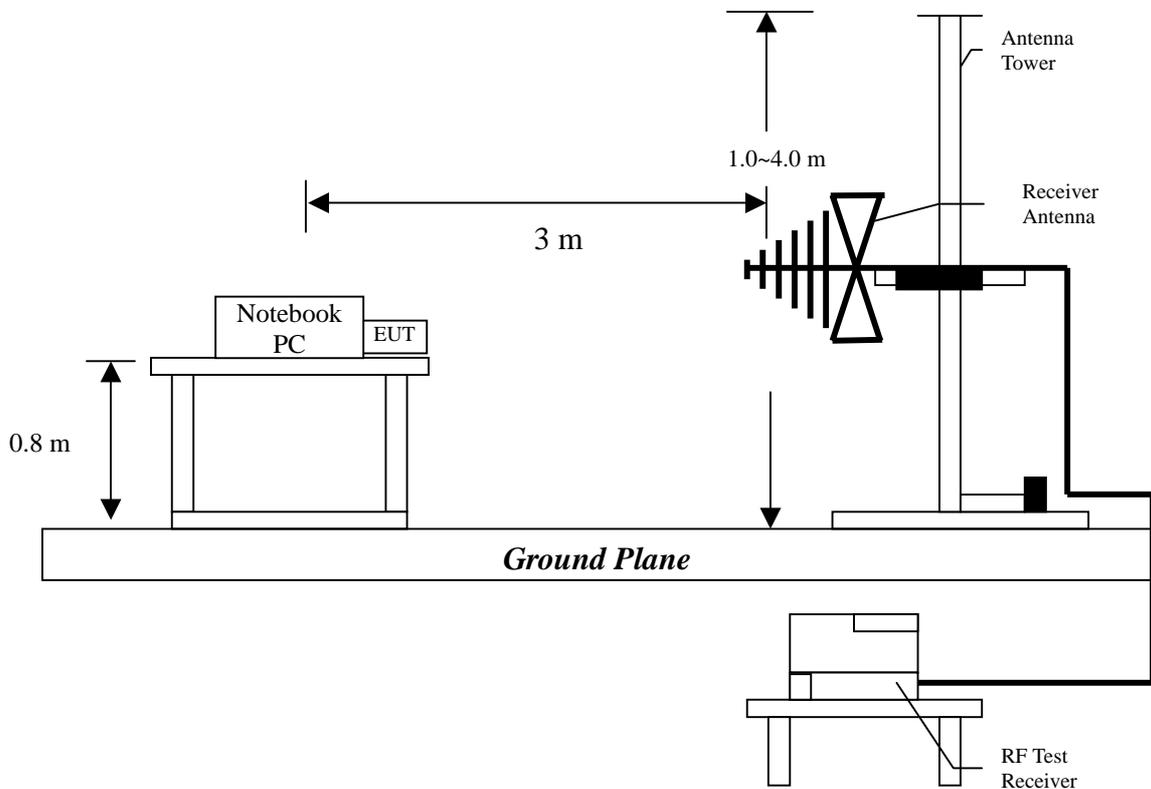
8. Radiated Emission test

8.1 Operating environment

Temperature: 23
Relative Humidity: 53 %
Atmospheric Pressure: 1023 hPa

8.2 Test setup & procedure

The Diagram below shows the test setup, which is utilized to make these measurements.



Radiated emissions were investigated cover the frequency range from 30MHz to 1000MHz using a receiver RBW of 120kHz record QP reading, and the frequency over 1GHz using a spectrum analyzer RBW of 1MHz and 10Hz VBW record Average reading. (15.209 paragraph), the Peak reading (1MHz RBW/VBW) recorded also on the report.

The EUT for testing is arranged on a wooden turntable. If some peripherals apply to the EUT, the peripherals will be connected to EUT and the whole system. During the test, all cables were arranged to produce worst-case emissions. The signal is maximized through rotation. The height of antenna and polarization is changing constantly for exploring for maximum signal level. The height of antenna can be up to 4 meters and down to 1 meter.

The measurement for radiated emission will be done at the distance of three meters unless the signal level is too low to measure at that distance. In the case of the reading under noise floor, a pre-amplifier is used and/or the test is conducted at a closer distance. And then all readings are extrapolated back to the equivalent 3 meter reading using inverse scaling with distance.

The EUT configuration please refer to the “Spurious set-up photo.pdf”.

8.3 Emission limits

The spurious Emission shall test through the 10th harmonic. 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).

| Frequency (MHz) | Limits (dB μ V/m@3m) |
|-----------------|--------------------------|
| 30-88 | 40 |
| 88-216 | 43.5 |
| 216-960 | 46 |
| Above 960 | 54 |

Remark:

1. In the above table, the tighter limit applies at the band edges.
2. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system

Uncertainty was calculated in accordance with NAMAS NIS 81.

Expanded uncertainty (k=2) of radiated emission measurement is 4.98 dB.

8.4 Radiated spurious emission test data

8.4.1 Measurement results: frequencies equal to or less than 1 GHz

EUT : AWBC1E
 Test Condition : Normal operating mode

| Antenna Polariz. (V/H) | Freq. (MHz) | Receiver Detector | Corr. Factor (dB/m) | Reading (dBuV) | Corrected Level (dBuV/m) | Limit @ 3 m (dBuV/m) | Margin (dB) | Antenna high (cm) | Turn Table angle (degree) |
|------------------------|-------------|-------------------|---------------------|----------------|--------------------------|----------------------|-------------|-------------------|---------------------------|
| V | 125.060 | QP | 9.47 | 19.12 | 28.59 | 43.50 | -14.92 | 100 | 21 |
| V | 158.404 | QP | 15.83 | 13.64 | 29.47 | 43.50 | -14.03 | 100 | 86 |
| V | 433.520 | QP | 17.64 | 13.58 | 31.22 | 46.00 | -14.78 | 179 | 293 |
| V | 476.200 | QP | 18.43 | 14.59 | 33.02 | 46.00 | -12.99 | 176 | 348 |
| V | 674.080 | QP | 21.50 | 14.77 | 36.27 | 46.00 | -9.73 | 230 | 359 |
| V | 945.680 | QP | 25.13 | 12.05 | 37.18 | 46.00 | -8.83 | 207 | 104 |
| H | 158.040 | QP | 13.60 | 17.88 | 31.48 | 43.50 | -12.02 | 400 | 352 |
| H | 220.120 | QP | 11.63 | 19.10 | 30.73 | 46.00 | -15.28 | 400 | 152 |
| H | 367.560 | QP | 15.48 | 14.67 | 30.15 | 46.00 | -15.86 | 244 | 190 |
| H | 433.520 | QP | 18.12 | 14.02 | 32.14 | 46.00 | -13.86 | 213 | 248 |
| H | 476.200 | QP | 18.64 | 14.66 | 33.30 | 46.00 | -12.70 | 193 | 42 |
| H | 945.680 | QP | 25.33 | 14.18 | 39.51 | 46.00 | -6.49 | 100 | 44 |

Remark:

1. Corr. Factor = Antenna Factor + Cable Loss
2. Corrected Level = Reading + Corr. Factor

8.4.2 Measurement results: frequency above 1GHz

EUT : AWBC1E
Test Condition : Tx at channel 1, 40, 80

Test Result:

No spurious emission was found above the spectrum analyzer's noise floor.

Noise floor level is:

For PK:

1GHz-3GHz: 20dBuV

3GHz-14GHz: 27dBuV

14GHz-26.5GHz: 39dBuV

For AV:

1GHz-3GHz: 10dBuV

3GHz-14GHz: 16dBuV

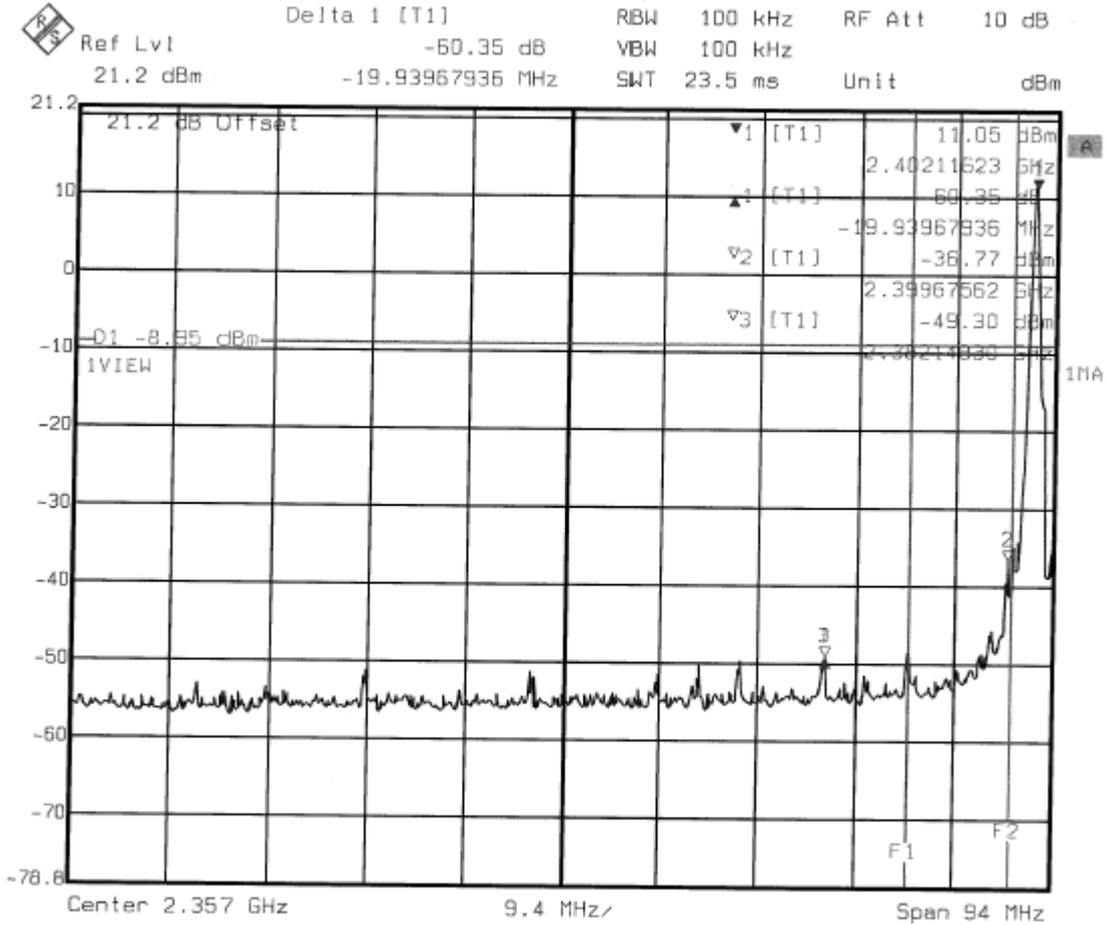
14GHz-26.5GHz: 28dBuV

9. Emission on the band edge §FCC 15.247(C)

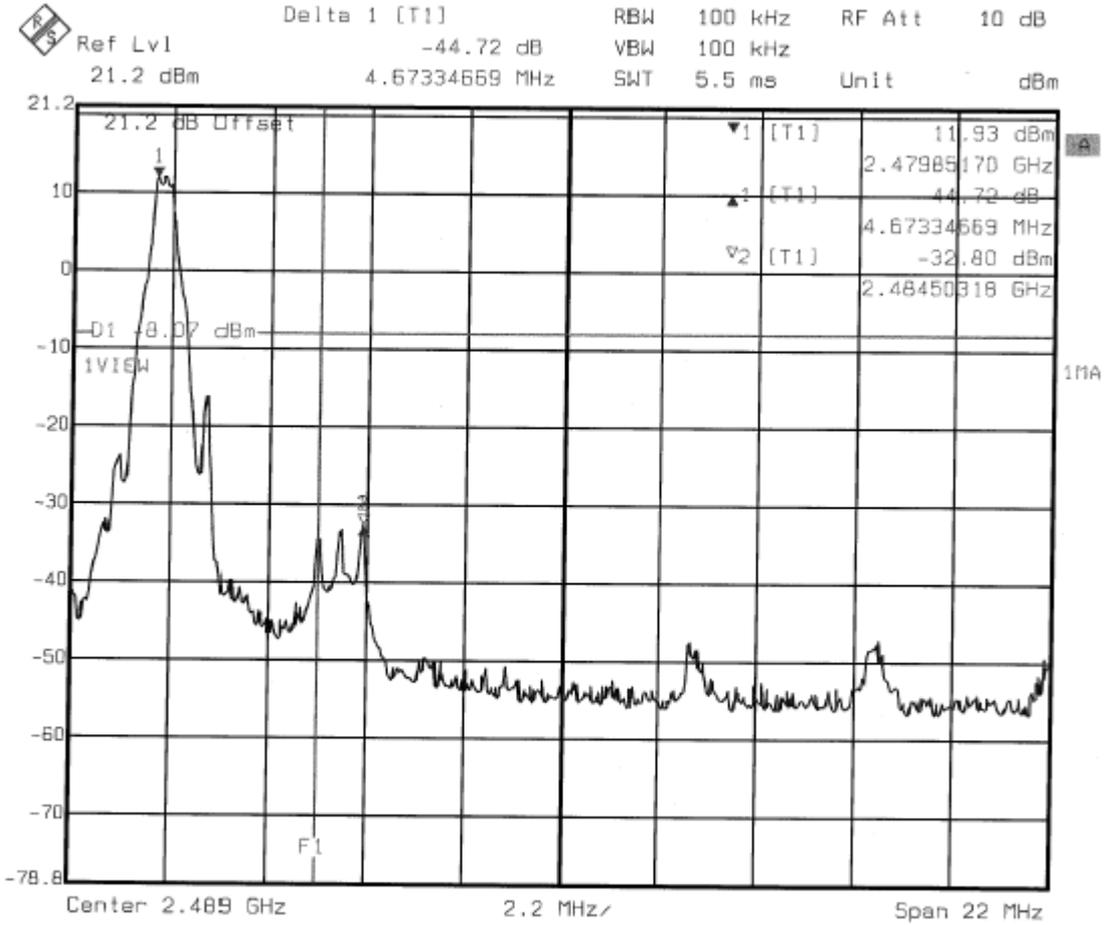
In any 100kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 KHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

Please see the plot below.

9.1 Band-edge (Conducted method)

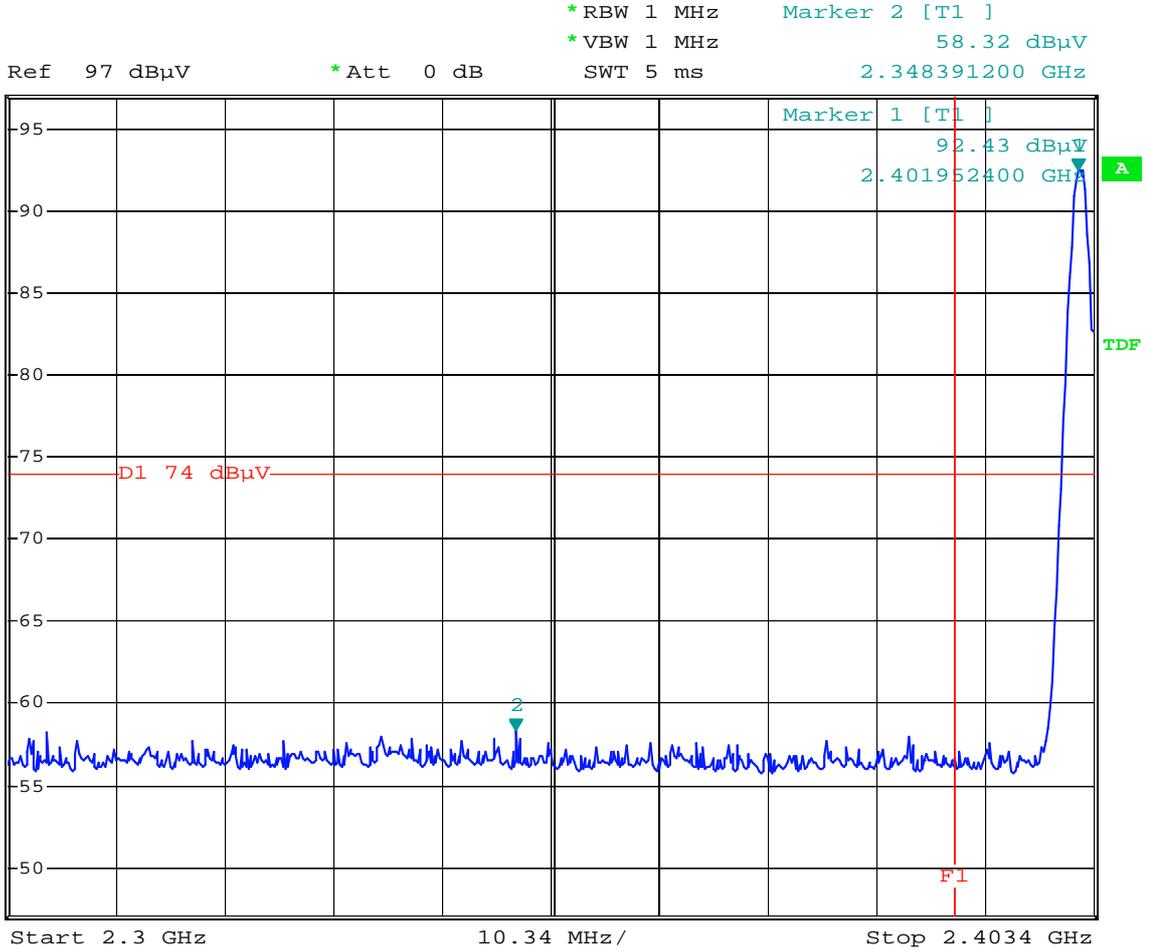


Title: Band Edge
 Comment A: Bluetooth mode at low channel
 F1=2390MHz F2=2400MHz (PK Detect)
 Date: 23.FEB.2006 19:17:12

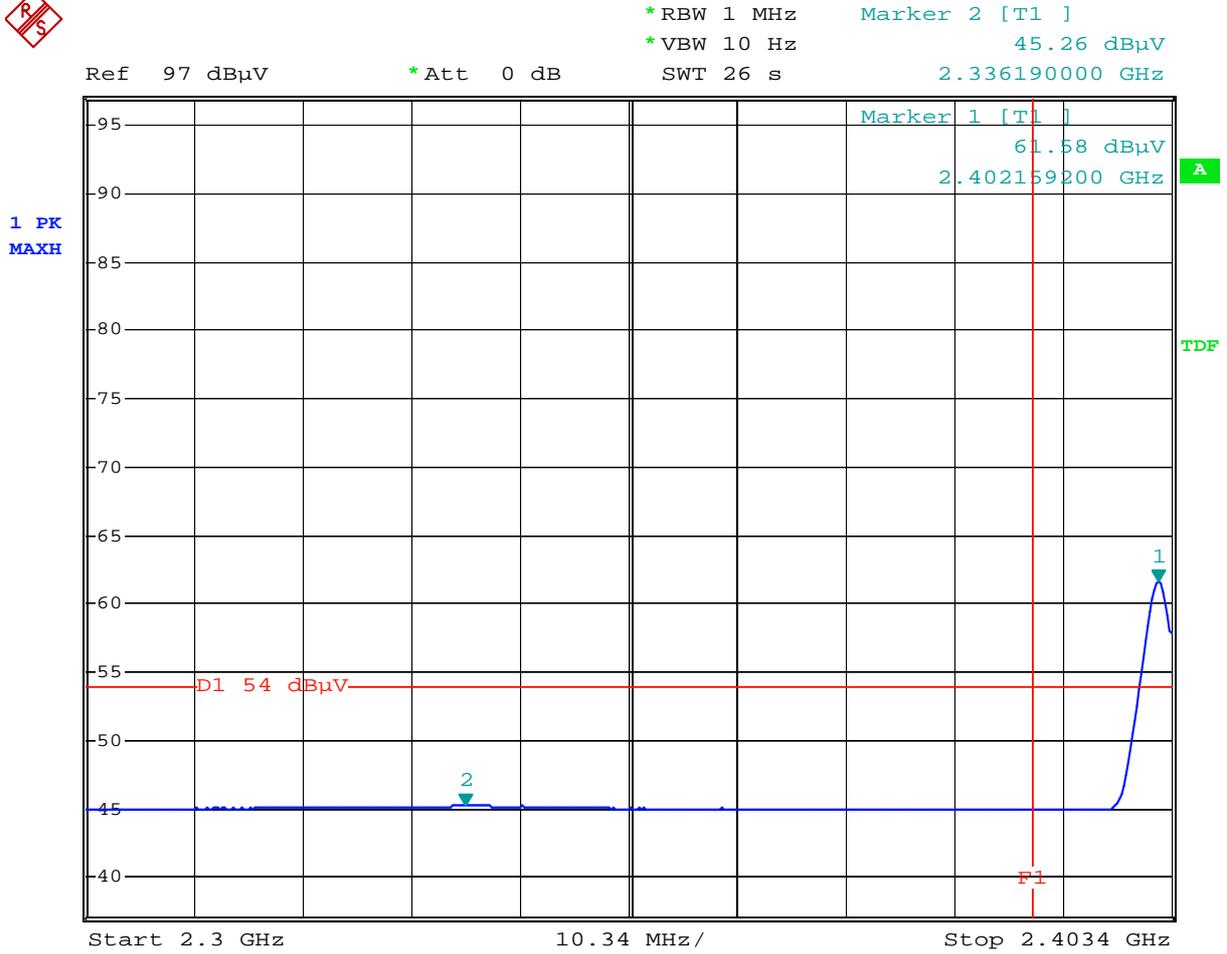


Title: Band Edge
 Comment A: Bluetooth mode at high channel
 F1=2483.5MHz (PK Detect)
 Date: 23.FEB.2006 19:24:00

9.2 Band-edge (Radiated method)



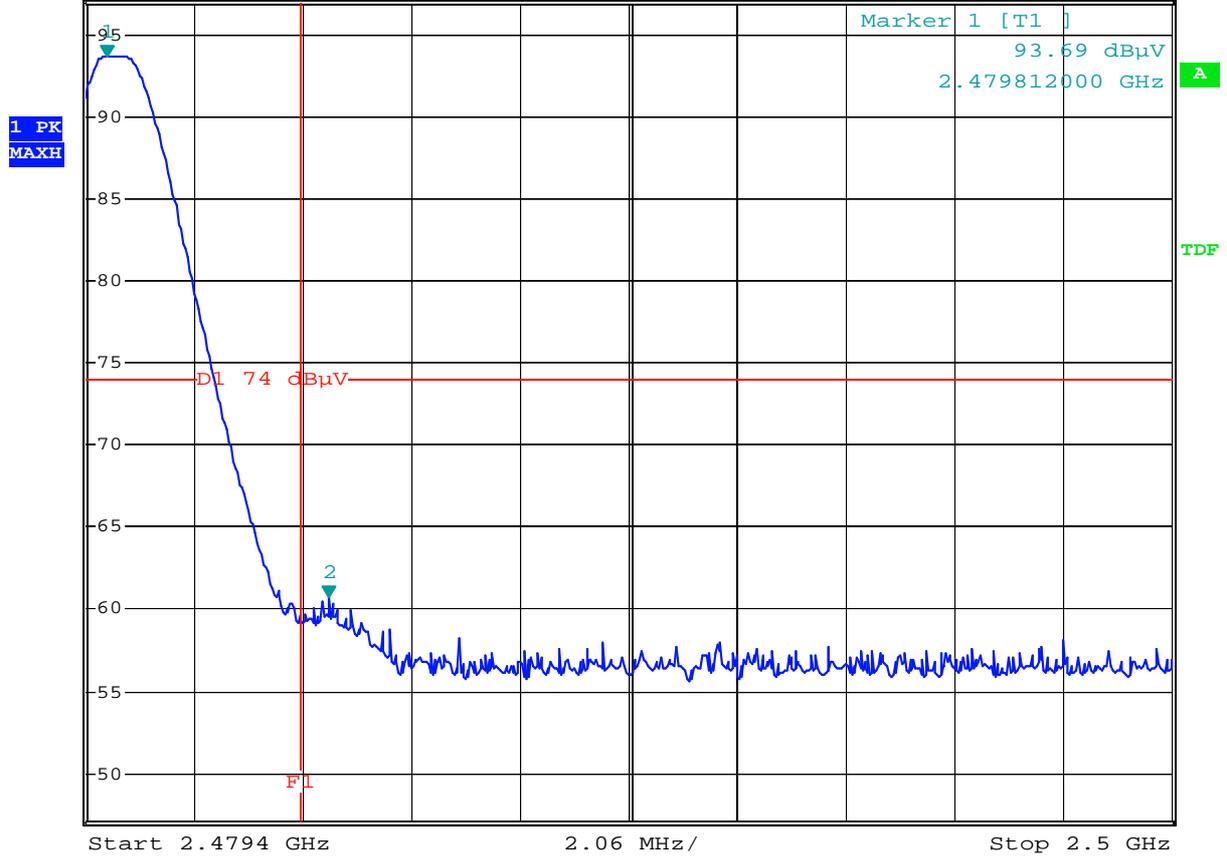
Comment: Band-edge at low channel
 Comment: PK detector F1=2390MHz
 Date: 21.FEB.2006 19:50:09



Comment: Band-edge at low channel
 Comment: AV detector F1=2390MHz
 Date: 21.FEB.2006 19:52:37



*RBW 1 MHz Marker 2 [T1]
 *VBW 1 MHz 60.74 dBμV
 Ref 97 dBμV *Att 0 dB SWT 2.5 ms 2.484014400 GHz



Comment: Band-edge at high channel
 Comment: PK detector F1=2483.5MHz
 Date: 21.FEB.2006 20:00:25



*RBW 1 MHz Marker 2 [T1]
 *VBW 10 Hz 47.49 dBμV
 SWT 5.2 s 2.483541200 GHz

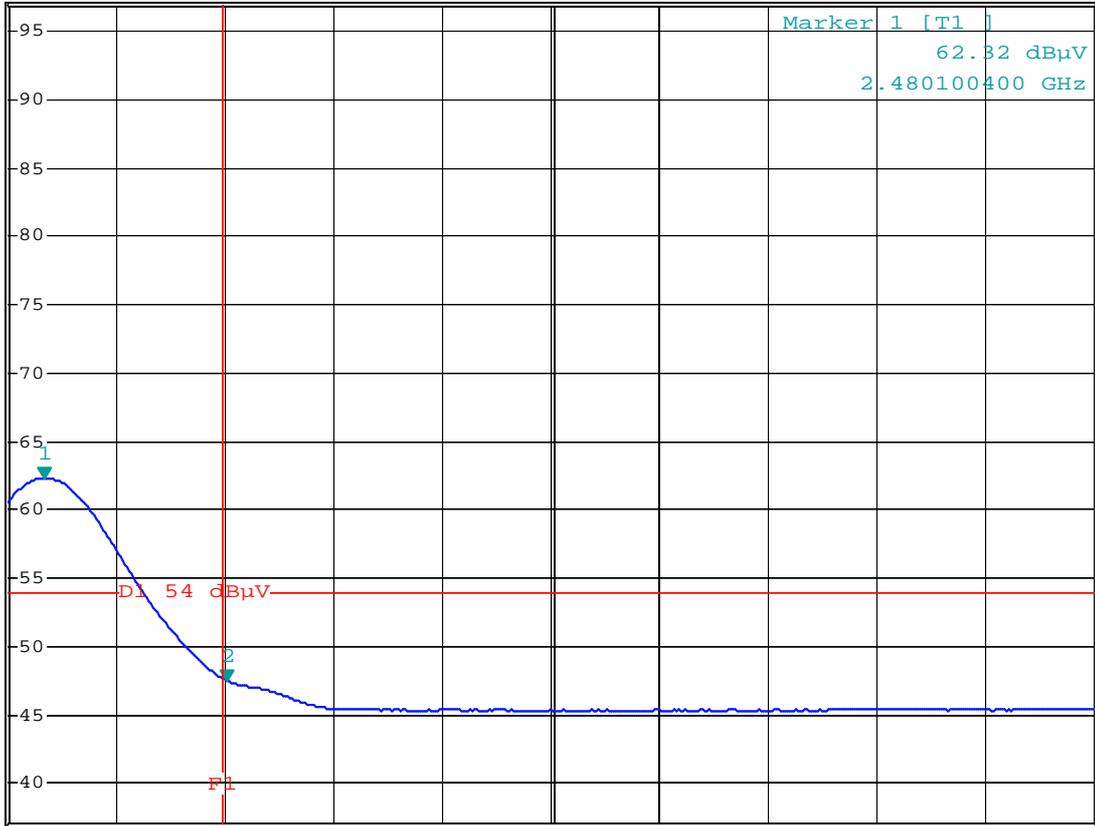
Ref 97 dBμV

*Att 0 dB

SWT 5.2 s

2.483541200 GHz

1 PK
MAXH



Start 2.4794 GHz 2.06 MHz/ Stop 2.5 GHz

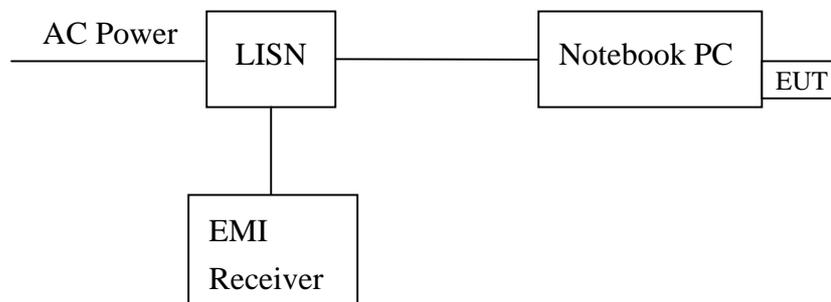
Comment: Band-edge at high channel
 Comment: AV detector F1=2483.5MHz
 Date: 21.FEB.2006 20:01:44

10. Power Line Conducted Emission test §FCC 15.207

10.1 Operating environment

Temperature: 25
Relative Humidity: 60 %
Atmospheric Pressure 1023 hPa

10.2 Test setup & procedure



The EUT are connected to the main power through a line impedance stabilization network (LISN). This provides a 50 ohm/50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm/50uH coupling impedance with 50ohm termination.

Both sides (Line and Neutral) of AC line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.4/2003 on conducted measurement. The bandwidth of the field strength meter (R & S Test Receiver ESCS 30) is set at 9kHz.

The EUT configuration please refer to the “Conducted set-up photo.pdf”.

10.3 Emission limit

| Freq. (MHz) | Conducted Limit (dBuV) | |
|----------------|------------------------|----------|
| | Q.P. | Ave. |
| 0.15~0.50 | 66 – 56* | 56 – 46* |
| 0.50~5.00 | 56 | 46 |
| 5.00~30.0 | 60 | 50 |

*Decreases with the logarithm of the frequency.

10.4 Uncertainty of Conducted Emission

Expanded uncertainty (k=2) of conducted emission measurement is ± 2.6 dB.

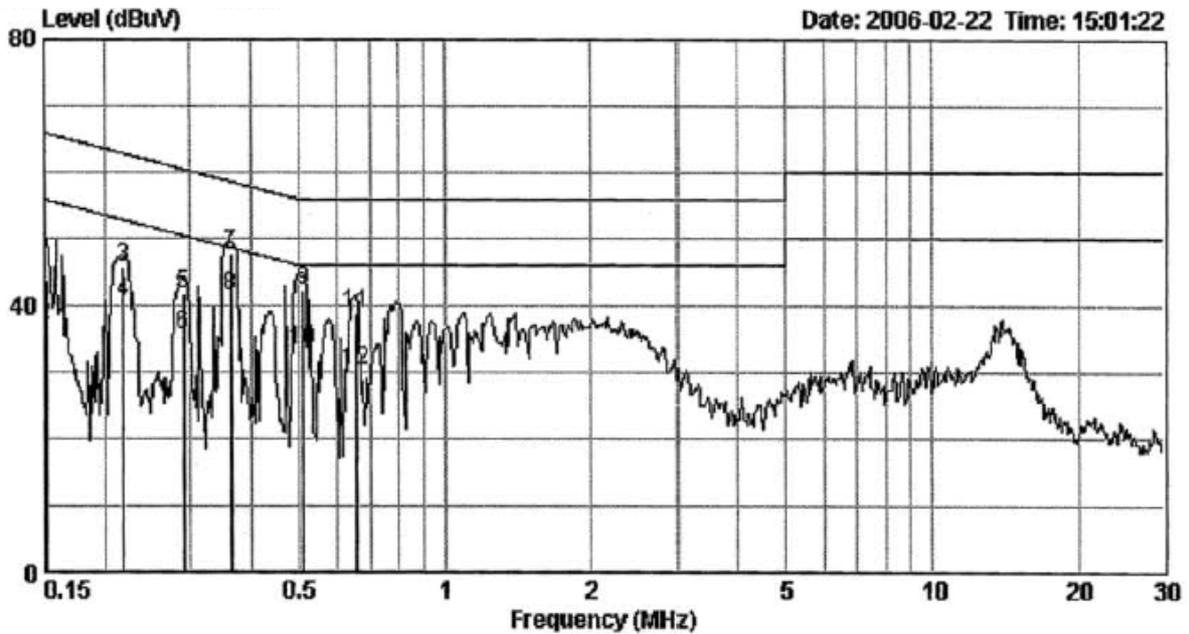
10.5 Power Line Conducted Emission test data

Phase : Line
 EUT : AWBC1E
 Test Condition : Hopping mode

| Frequency (MHz) | Corr. Factor (dB) | Level Qp (dBuV) | Limit Qp (dBuV) | Level AV (dBuV) | Limit Av (dBuV) | Margin (dB) | |
|-----------------|-------------------|-----------------|-----------------|-----------------|-----------------|-------------|--------|
| | | | | | | Qp | Av |
| 0.151 | 0.10 | 43.59 | 65.93 | 37.06 | 55.93 | -22.34 | -18.87 |
| 0.218 | 0.10 | 45.76 | 62.89 | 40.45 | 52.89 | -17.13 | -12.44 |
| 0.291 | 0.10 | 41.54 | 60.51 | 35.41 | 50.51 | -18.97 | -15.10 |
| 0.363 | 0.10 | 47.65 | 58.65 | 41.31 | 48.65 | -11.00 | -7.34 |
| 0.512 | 0.10 | 42.08 | 56.00 | 33.10 | 46.00 | -13.92 | -12.90 |
| 0.655 | 0.10 | 38.82 | 56.00 | 30.06 | 46.00 | -17.18 | -15.94 |

Remark:

1. Correction Factor (dB) = LISN Factor (dB) + Cable Loss (dB)
2. Margin (dB) = Level (dBuV) - Limit (dBuV)



Phase : Neutral
 EUT : AWBC1E
 Test Condition : Hopping mode

| Frequency (MHz) | Corr. Factor (dB) | Level Qp (dBuV) | Limit Qp (dBuV) | Level AV (dBuV) | Limit Av (dBuV) | Margin (dB) | |
|--------------------|-------------------------|-----------------------|-----------------------|-----------------------|-----------------------|----------------|--------|
| | | | | | | Qp | Av |
| 0.150 | 0.10 | 45.42 | 66.00 | 39.82 | 56.00 | -20.58 | -16.18 |
| 0.220 | 0.10 | 45.20 | 62.82 | 39.71 | 52.82 | -17.62 | -13.11 |
| 0.288 | 0.10 | 42.46 | 60.57 | 37.25 | 50.57 | -18.11 | -13.32 |
| 0.360 | 0.10 | 47.64 | 58.72 | 39.20 | 48.72 | -11.08 | -9.52 |
| 0.492 | 0.10 | 36.38 | 56.14 | 15.51 | 46.14 | -19.76 | -30.63 |
| 0.655 | 0.10 | 37.25 | 56.00 | 29.76 | 46.00 | -18.75 | -16.24 |

Remark:

1. Correction Factor (dB)= LISN Factor (dB) + Cable Loss (dB)
2. Margin (dB) = Level (dBuV) – Limit (dBuV)

