

EMC TEST REPORT

Report No. : EME-060124

Model No. : AWBC1E

Issued Date : May 4, 2006

Applicant : Asia Pacific Microsystems, Inc.
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Hsinchu, Taiwan

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Project Engineer



Marx Yan

Reviewed By



Jerry Liu

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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 °C
Relative Humidity: 55 %
Atmospheric Pressure: 1023 hPa

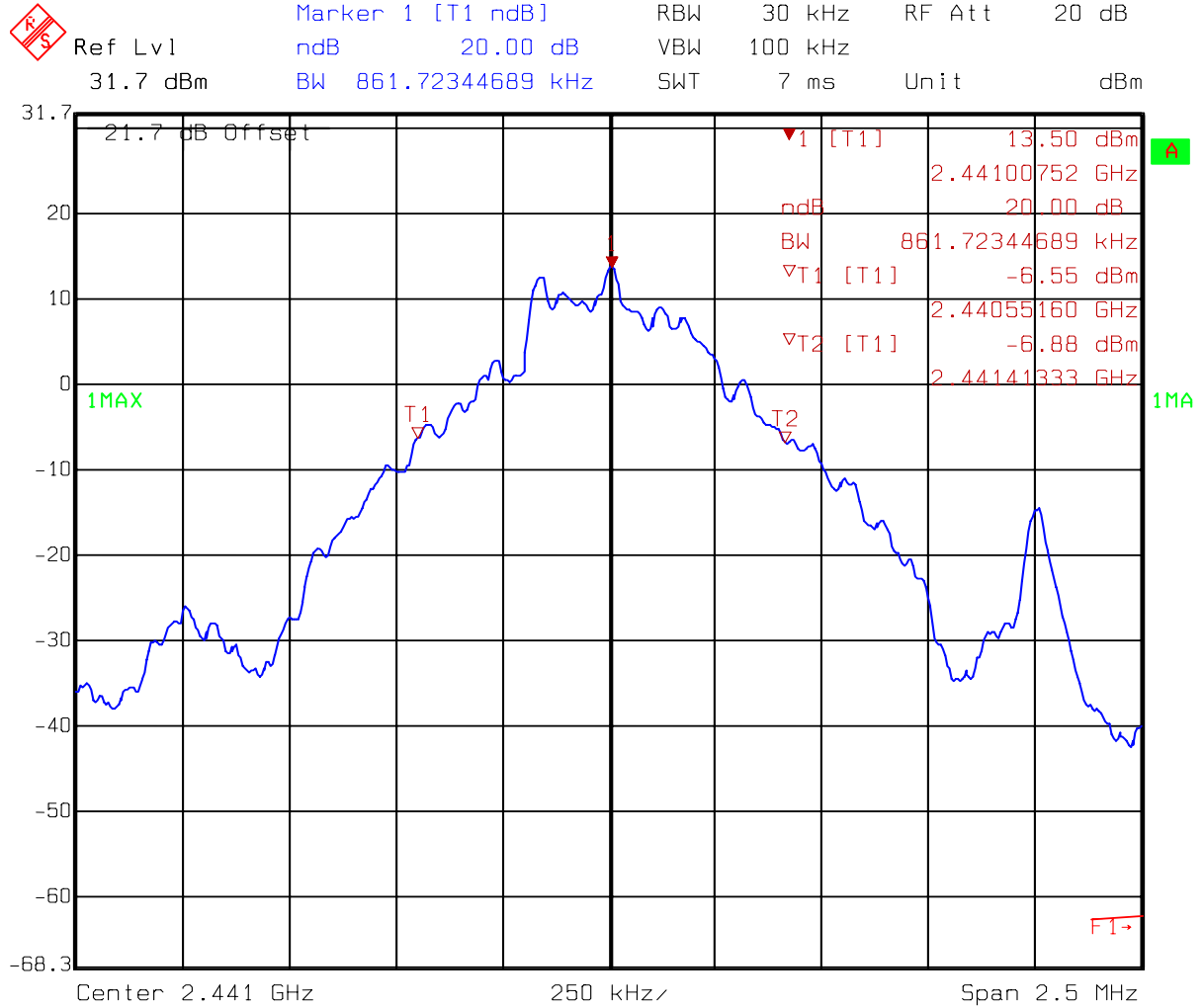
3.2 Test setup & procedure

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 $\geq$ 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.



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

4. Carrier Frequency Separation test

4.1 Operating environment

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

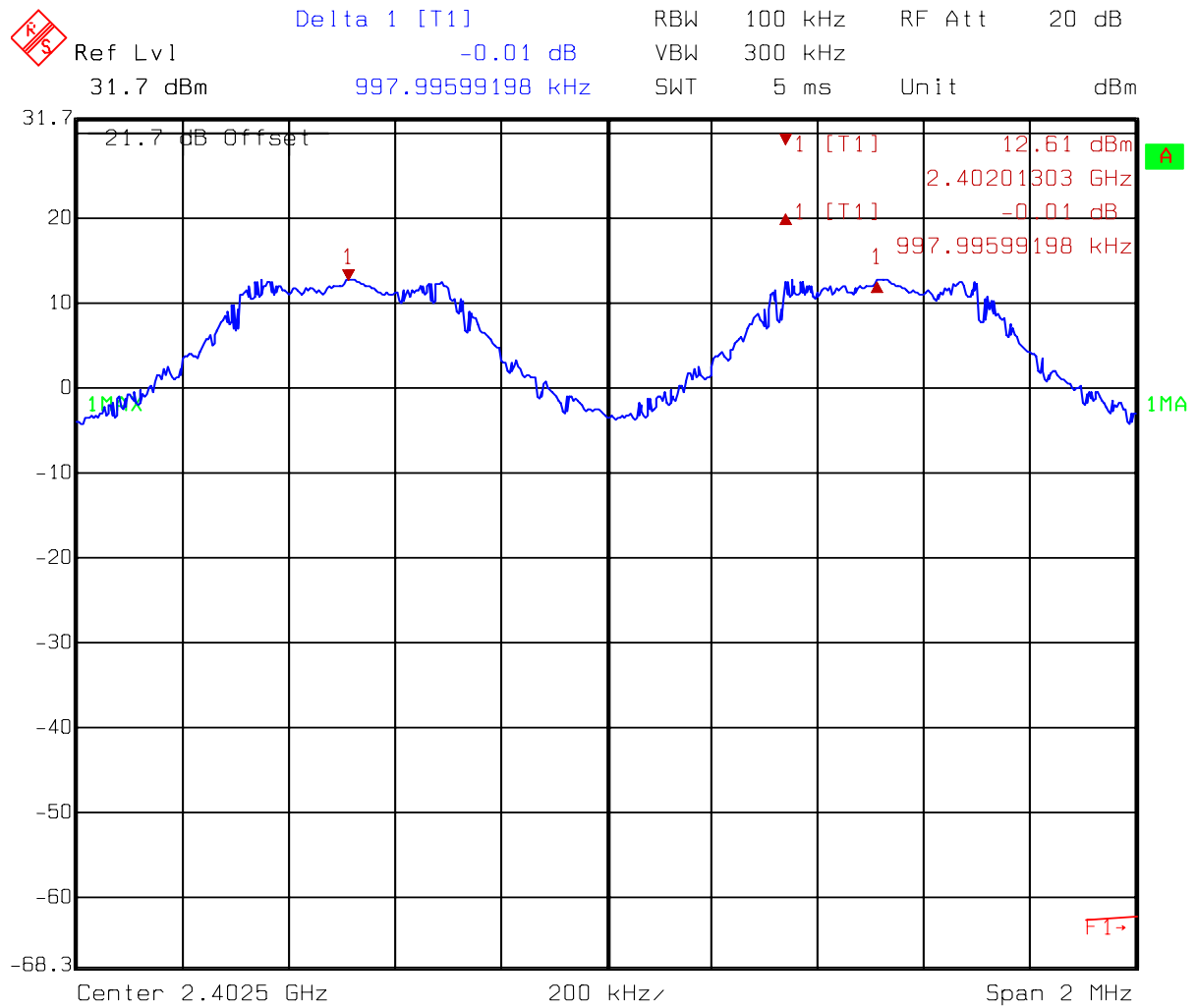
4.2 Test setup & procedure

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 $\geq$ 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 °C
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 $\geq$ 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

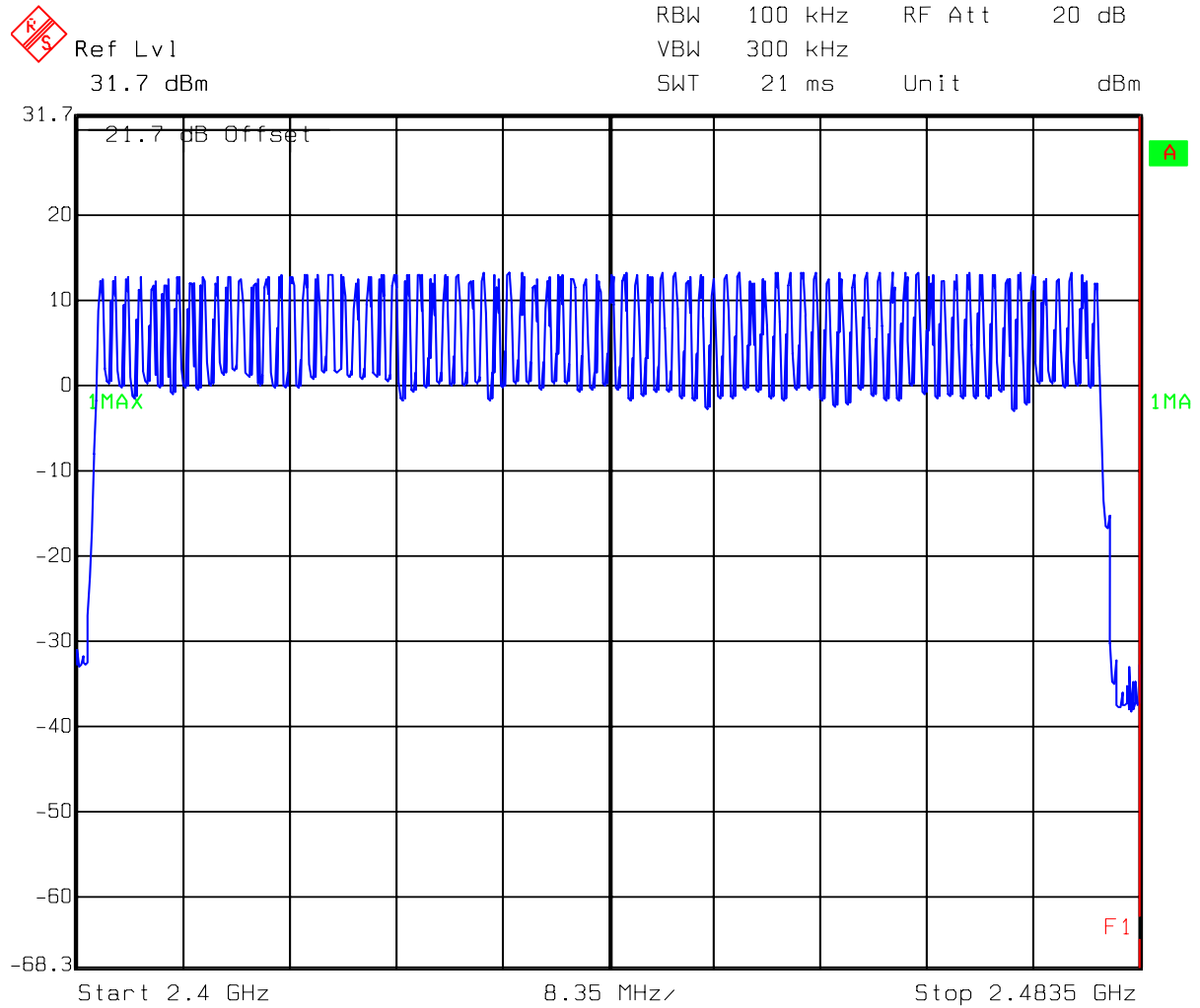
Frequency Range (MHz)	Total hopping channels
2400 ~ 2483.5	79

Please see the plot below.

FCC ID.: RU5AWBC1E

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Title:

Comment A: No of hopping frequencies

Date: 21.FEB.2006 09:04:42

6. Time of Occupancy (dwell time) test

6.1 Operating environment

Temperature: 25 °C
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 $\geq$ 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

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

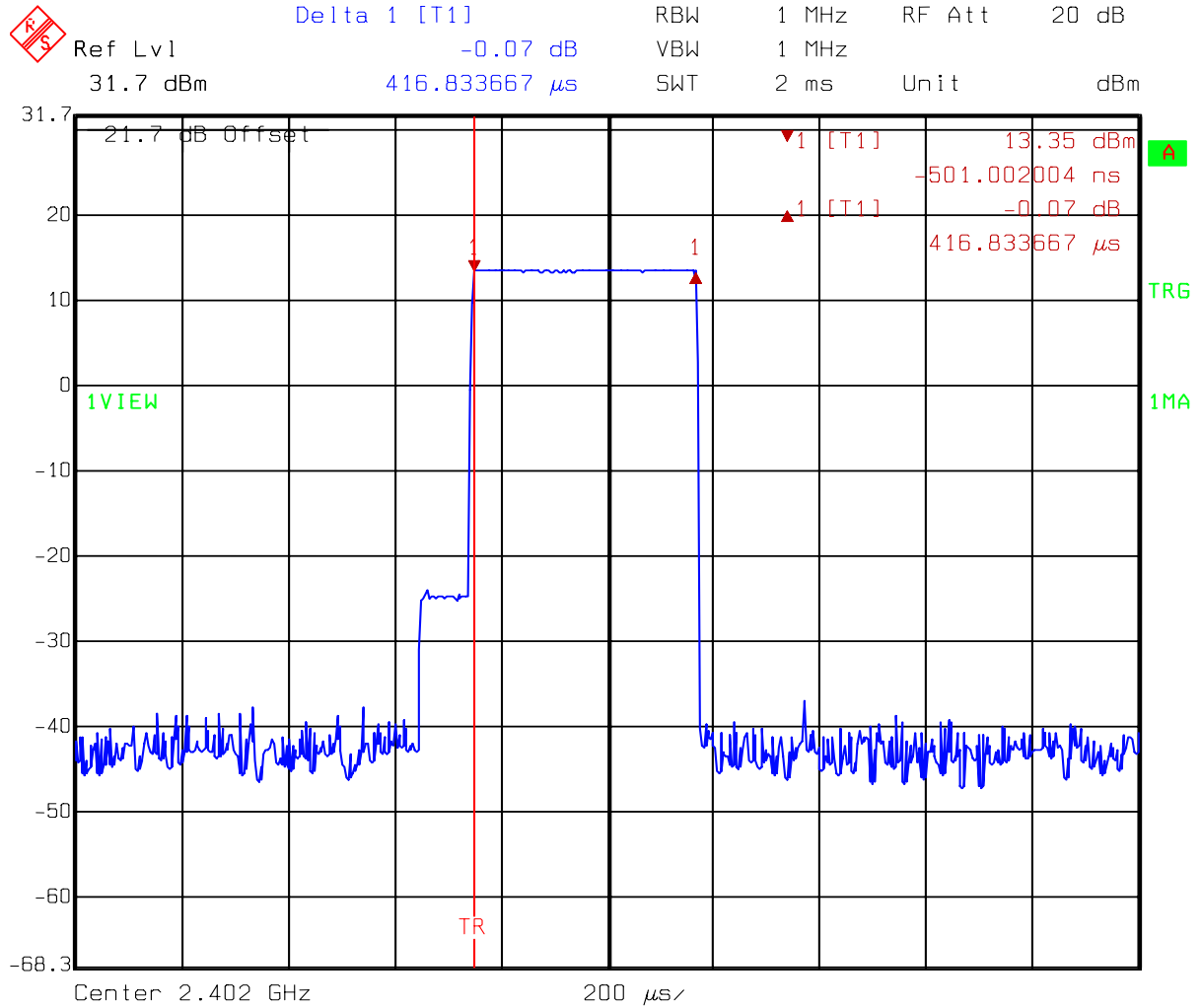
Time of occupancy (dwell time) for DH3

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

Time of occupancy (dwell time) for DH5

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

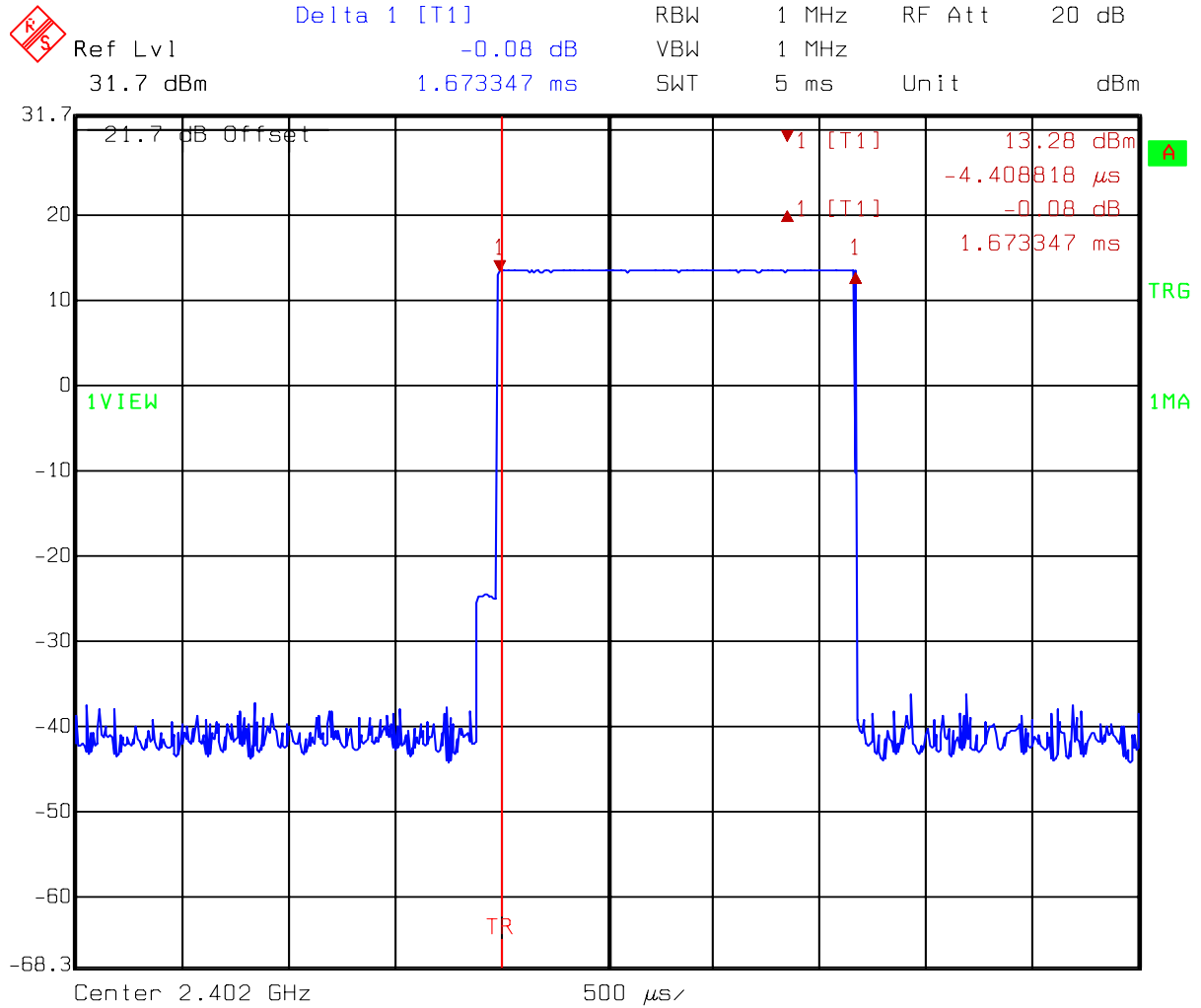
Please see the plot below.



Title:

Comment A: Dwell time of DH1 mode

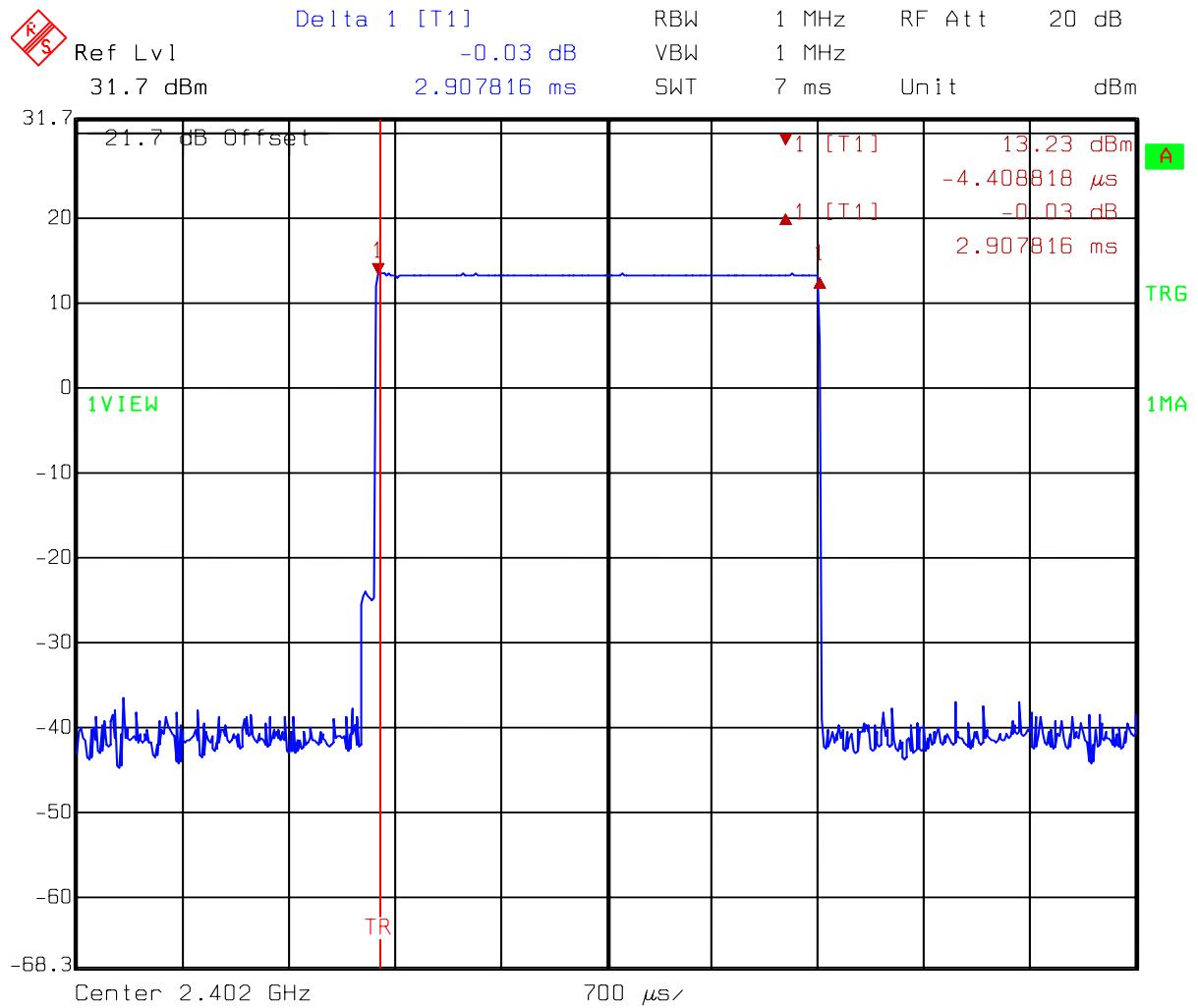
Date: 21.FEB.2006 09:14:43



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 °C
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.

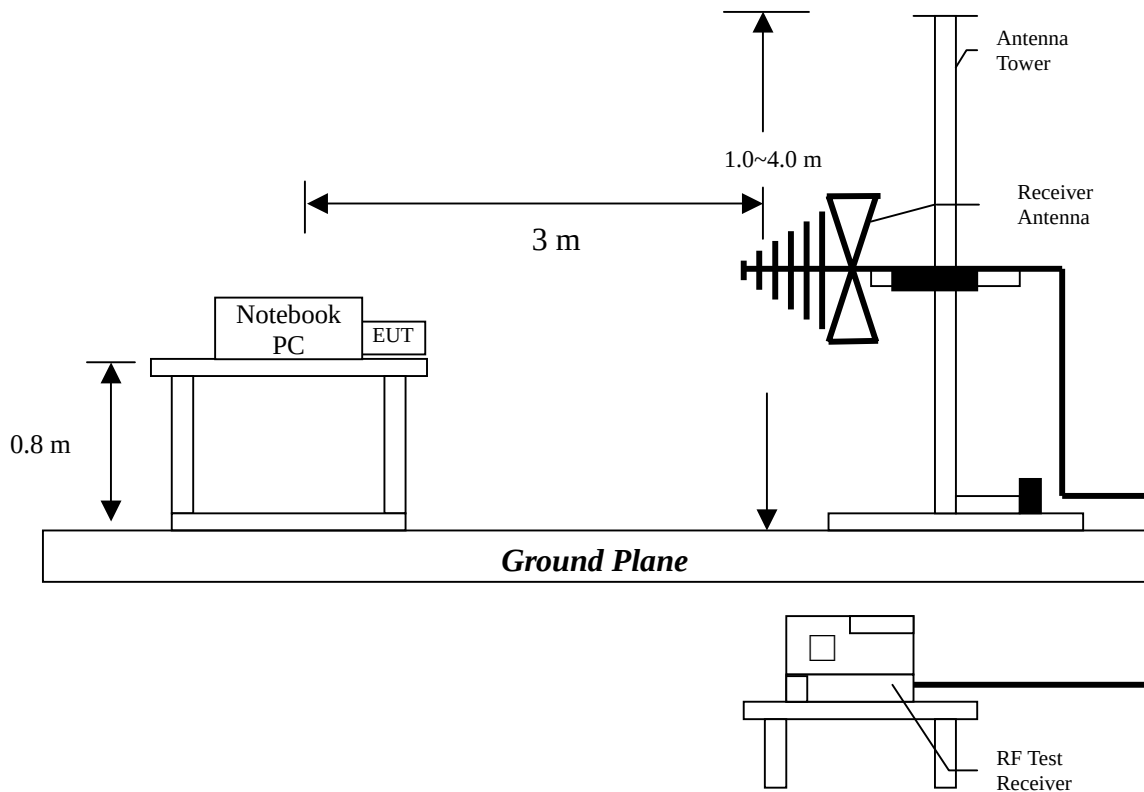
8. Radiated Emission test

8.1 Operating environment

Temperature: 23 °C
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

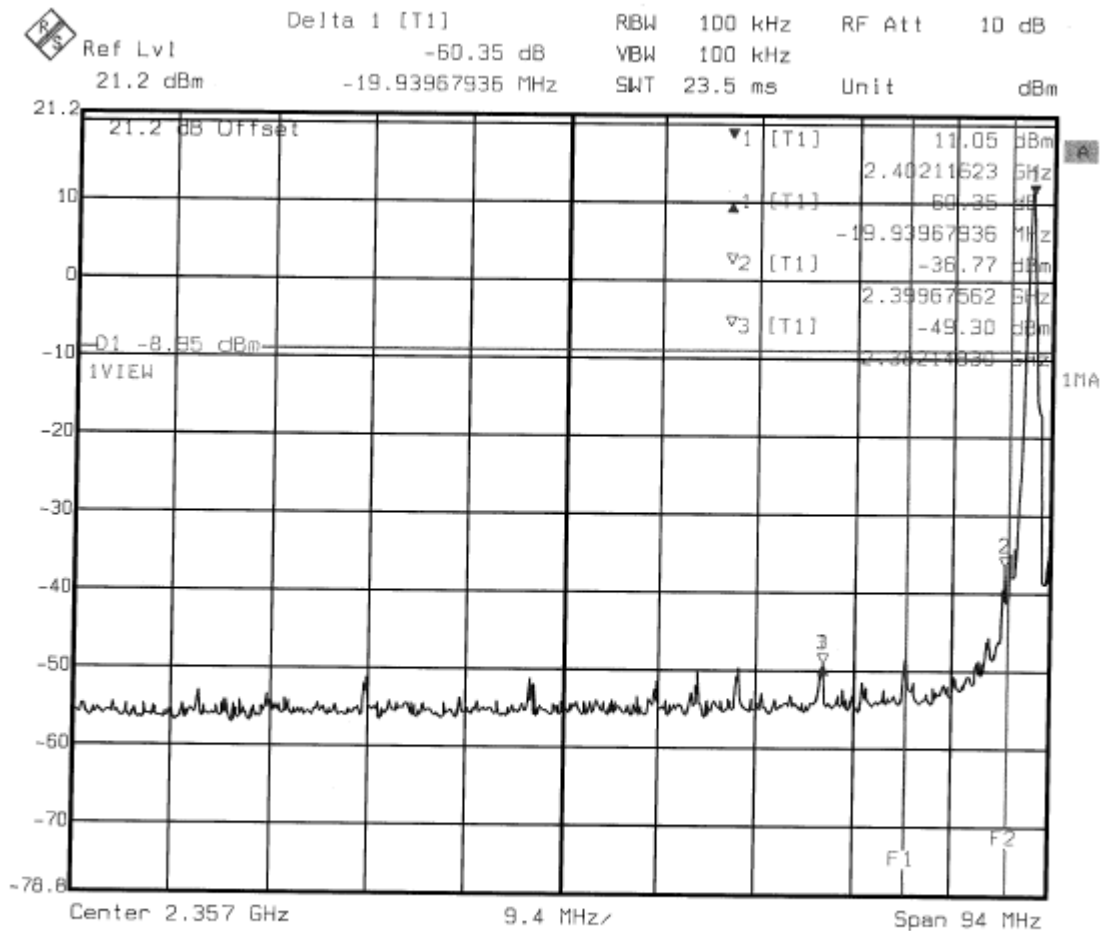
14GHz-26.5GHz: 28dBuV

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

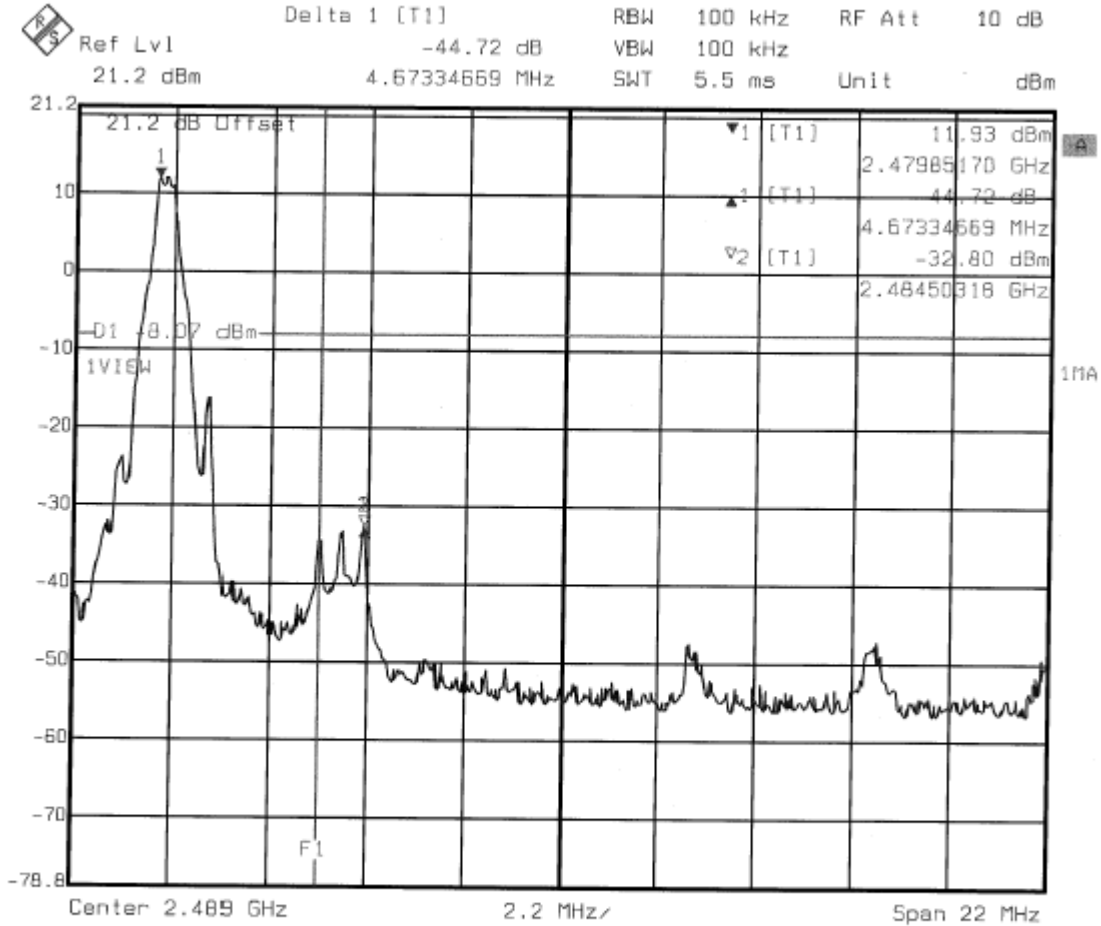
In any 100kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 KHz bandwidth within the band that contains the highest level of the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

Please see the plot below.

9.1 Band-edge (Conducted method)

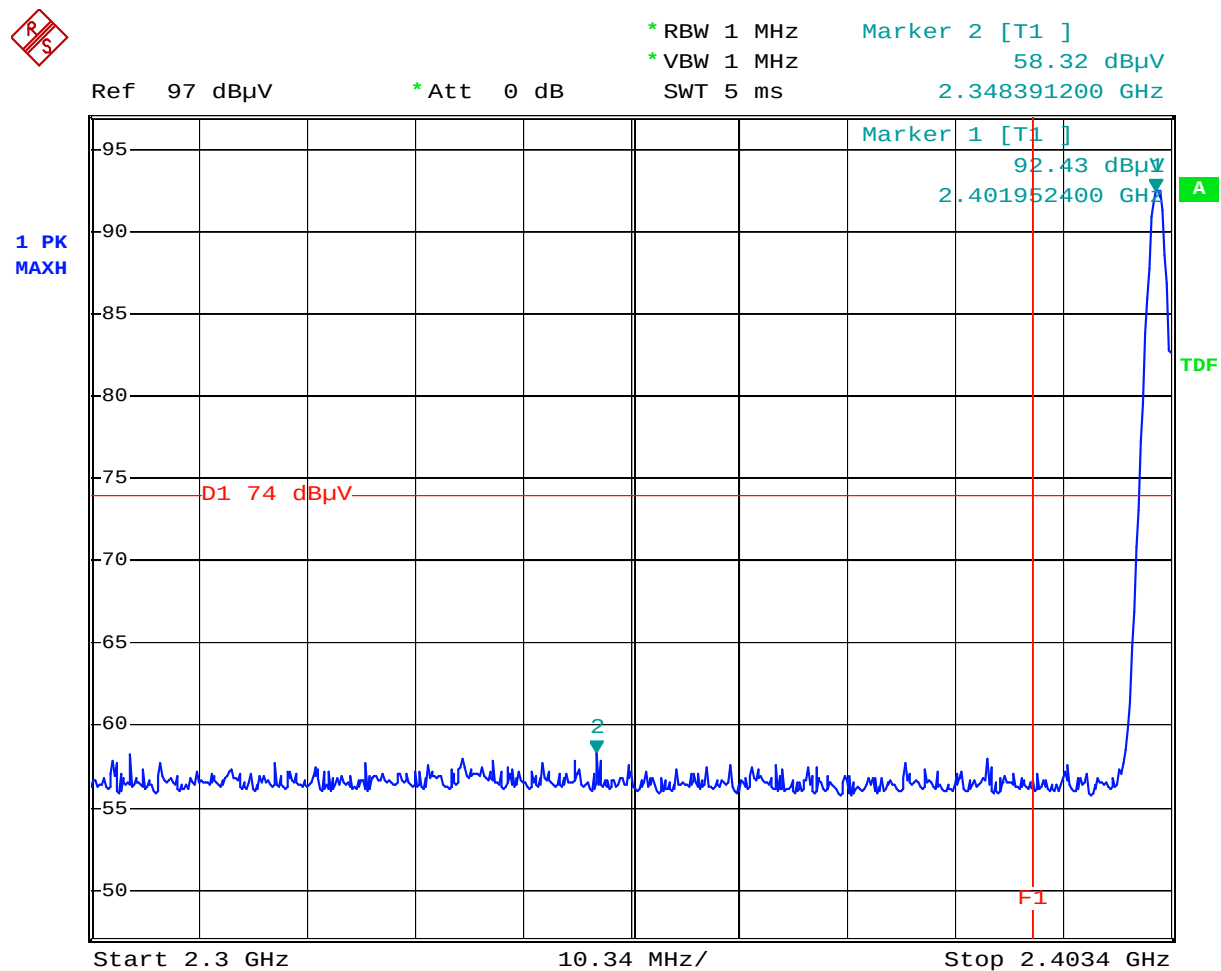


Title: Band Edge
 Comment A: Bluetooth mode at low channel
 F1=2390MHz F2=2400MHz (PK Detect)
 Date: 23.FEB.2006 19:17:12



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

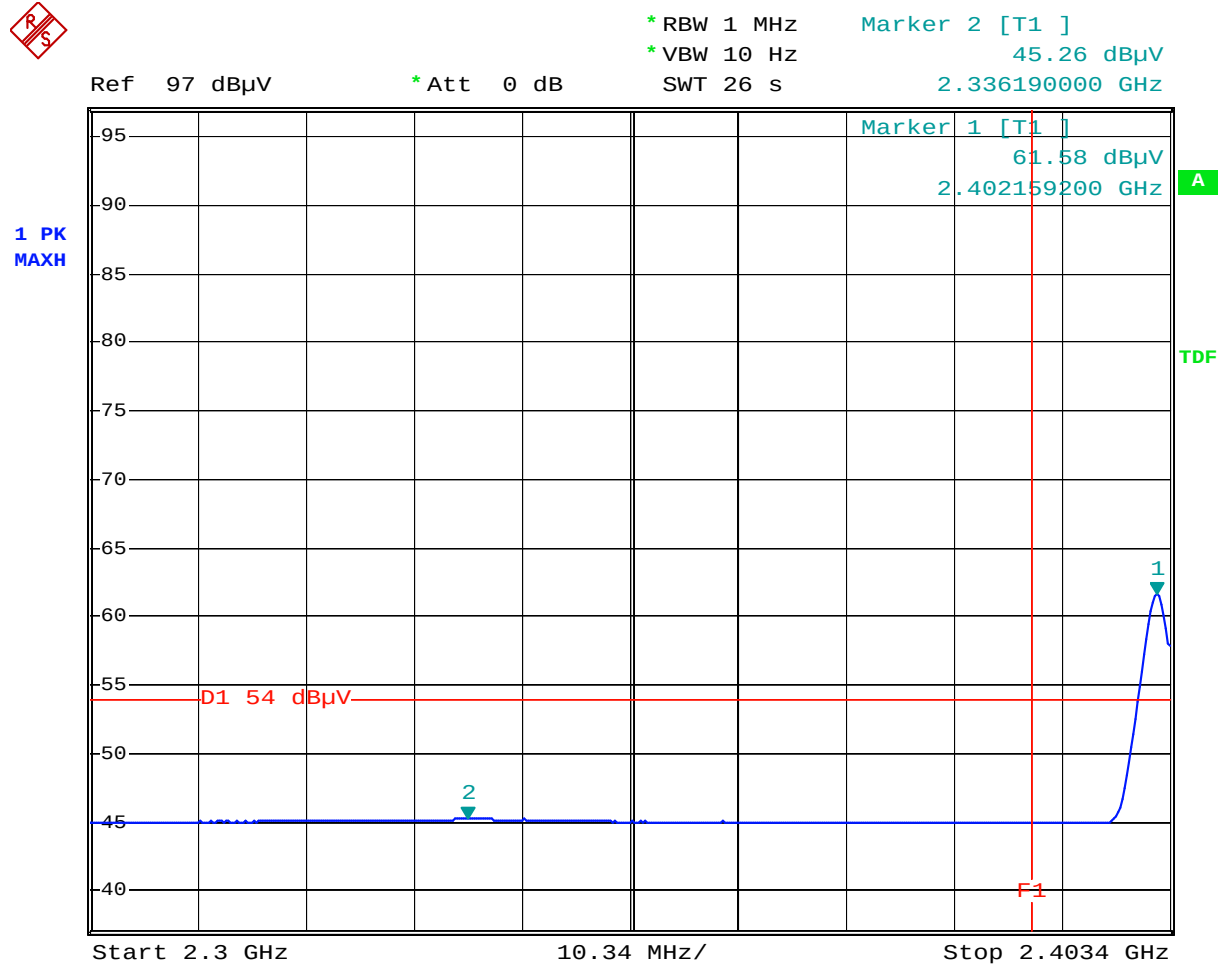
9.2 Band-edge (Radiated method)



Comment: Band-edge at low channel

Comment: PK detector F1=2390MHz

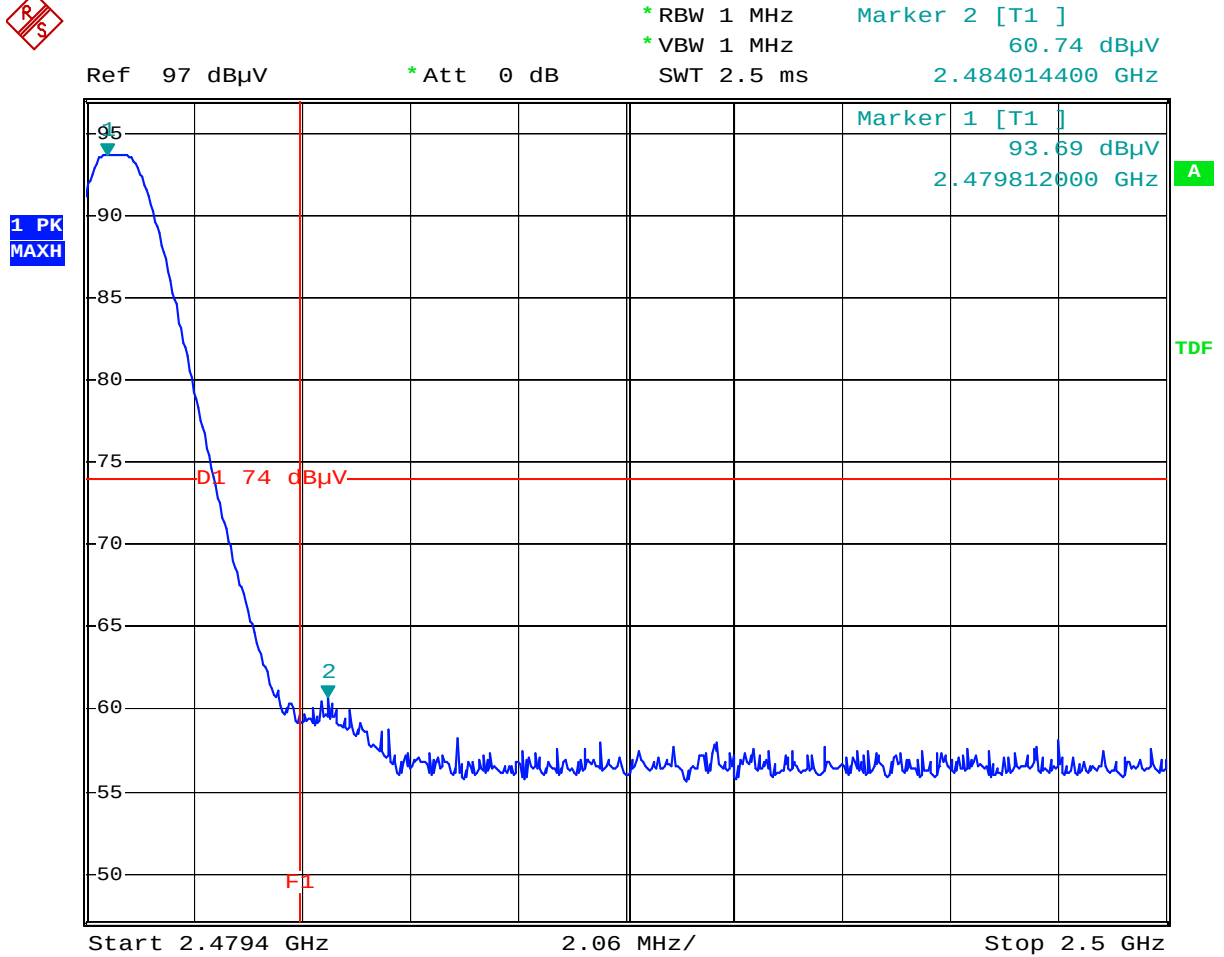
Date: 21.FEB.2006 19:50:09



Comment: Band-edge at low channel

Comment: AV detector F1=2390MHz

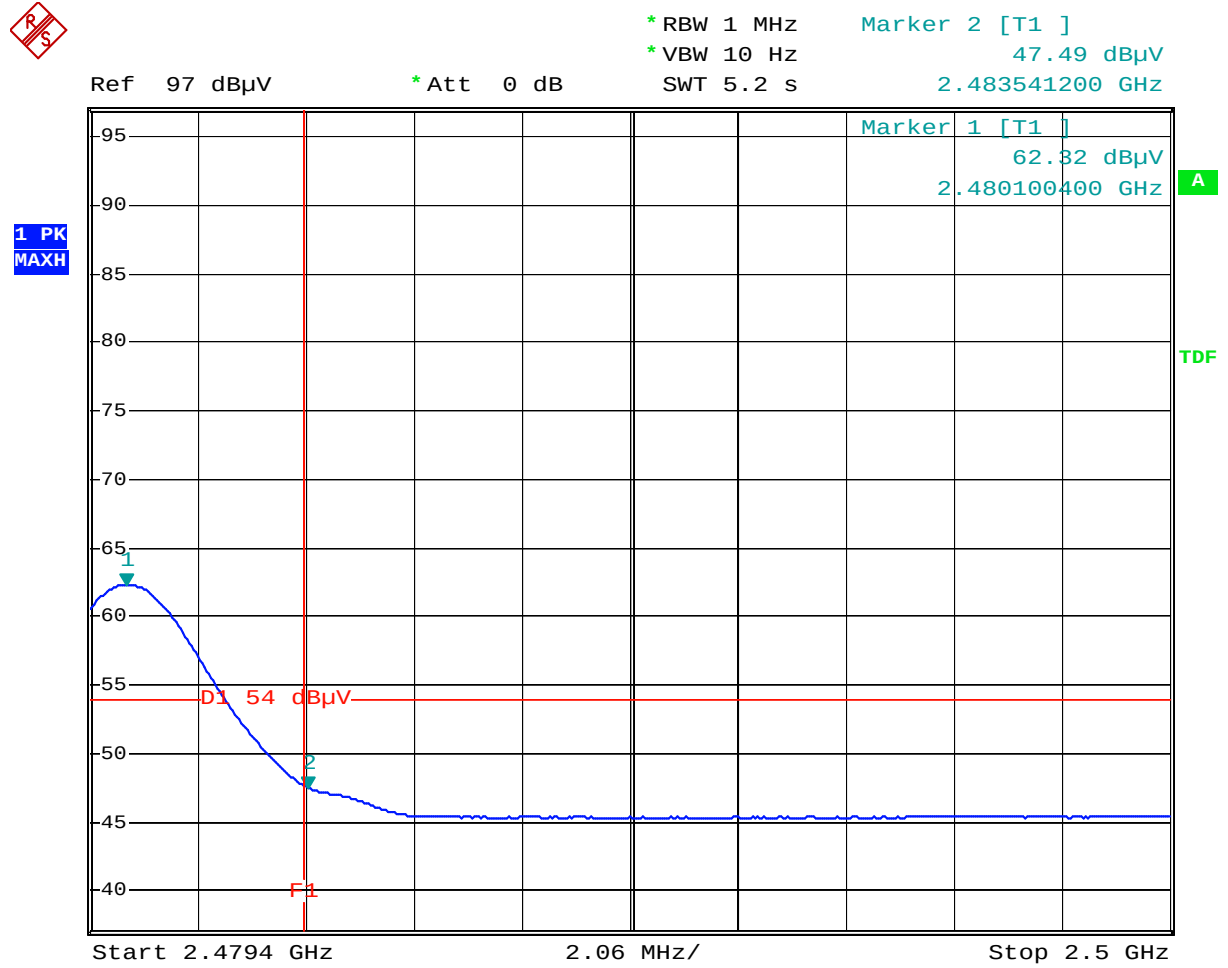
Date: 21.FEB.2006 19:52:37



Comment: Band-edge at high channel

Comment: PK detector F1=2483.5MHz

Date: 21.FEB.2006 20:00:25



Comment: Band-edge at high channel

Comment: AV detector F1=2483.5MHz

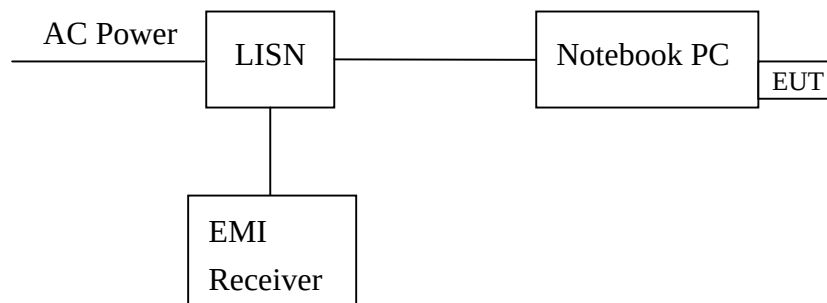
Date: 21.FEB.2006 20:01:44

10. Power Line Conducted Emission test §FCC 15.207

10.1 Operating environment

Temperature:	25	°C
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.

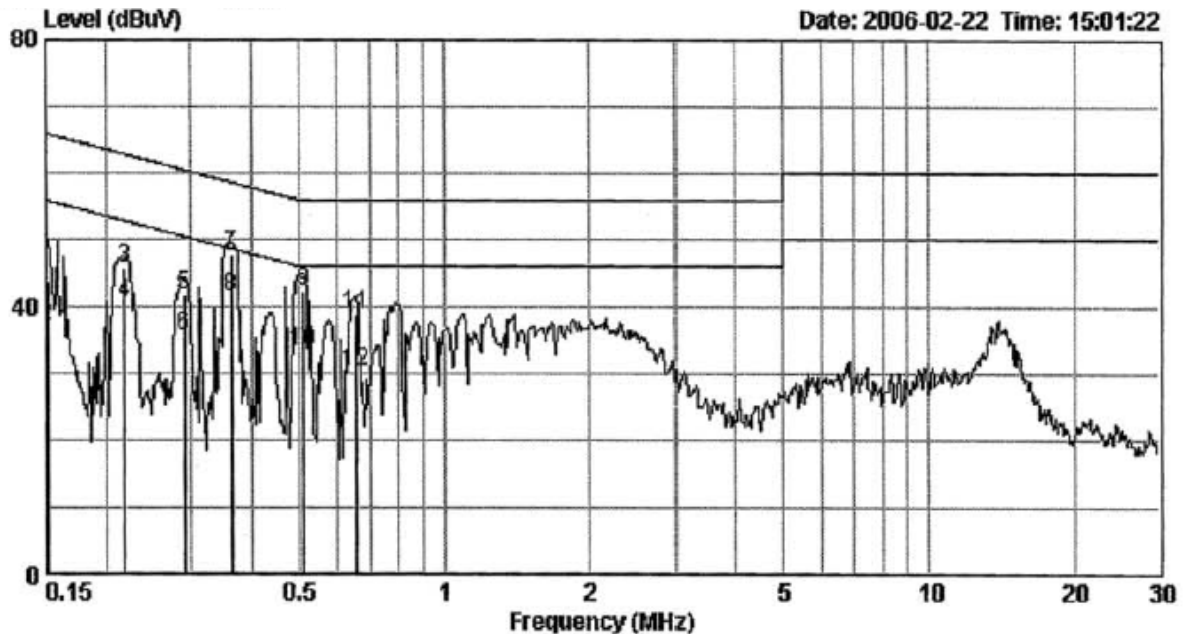
10.5 Power Line Conducted Emission test data

Phase : Line
EUT : AWBC1E
Test Condition : Hopping mode

Frequency (MHz)	Corr. Factor (dB)	Level Op (dBuV)	Limit Op (dBuV)	Level AV (dBuV)	Limit Av (dBuV)	Margin (dB)	
						Op	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	Limit	Level	Limit	Margin (dB)	
		Qp (dBuV)	Qp (dBuV)	AV (dBuV)	Av (dBuV)	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)

