FCC TEST REPORT

CATEGORY:	Outdoor Mobile End Product
PRODUCT NAME:	**Bluetooth headset/handfree kit**
FCC ID.:	RS6BT-4A-CK-CKS
FILING TYPE:	Certification
BRAND NAME:	Halfa
MODEL NAME:	**BT-4A, BT-CKS, BT-CK**
APPLICANT:	**Halfa Enterprise Co., Ltd.** 5F, No. 102, Ming Chuan Road, Hsin Tien, Taipei, Taiwan 231, R.O.C.
MANUFACTURER:	The same as Applicant.
ISSUED BY:	**SPORTON INTERNATIONAL INC.** 6F, No. 106, Sec. 1, Hsin Tai Wu Rd., His Chih, Taipei Hsien, Taiwan, R.O.C.

Statements:

The test result in this report refers exclusively to the presented test model / sample.

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Certificate or Test Report could not be used by the applicant to claim the product endorsement by CNLA, NVLAP or any agency of U.S. government.

The test equipment used to perform the test are calibrated and traceable to NML/ROC or NIST/USA.

Dr. Alan Lane
Vice General Manager

Lab Code: 200079-0

Table of Contents

History of this test report

■ No additional attachment.

☐ Additional attachment were issued as following record:

Attachment No.	Issue Date	Description

1. General Description of Equipment under Test

1.1. General Description

Items	Description
Sample Type	Bluetooth headset/handfree kit
Date of Testing	Nov. 26, 2003

1.2. List of EUT Accessories

Items	Description
CHENTAI	Linear, 5V
TRANSPOWER	Switching, 12V
Car Audio System	From Adapter (AC-DC) : Wall-Mount, 2pin From Battery : 3.7 VDC
Car Charger	From battery 3.7V

1.3. Technical Features

Items	Description
Communication Technique	FHSS
Modulation	GFSK
Number of Channels	79
Operating Frequency Band	2402~2480 MHz
Bandwidth of each channel	1MHz
Maximum Conducted RF Power	3.5 dBm
Type of Antenna Connector (Ex: SMA, TNC, MCX, MMCX, UFC…….etc)	N/A
Type of Antenna (Gain)	PIFA Antenna (2dBi)
Function Type	Transceiver
Duty Cycle	100%

Note: The table below is the summary of the operating frequencies.

Channel	Frequency	Channel	Frequency	Channel	Frequency
00	2402 MHz	27	2429 MHz	54	2456 MHz
01	2403 MHz	28	2430 MHz	55	2457 MHz
02	2404 MHz	29	2431 MHz	56	2458 MHz
03	2405 MHz	30	2432 MHz	57	2459 MHz
04	2406 MHz	31	2433 MHz	58	2460 MHz
05	2407 MHz	32	2434 MHz	59	2461 MHz
06	2408 MHz	33	2435 MHz	60	2462 MHz
07	2409 MHz	34	2436 MHz	61	2463 MHz
08	2410 MHz	35	2437 MHz	62	2464 MHz
09	2411 MHz	36	2438 MHz	63	2465 MHz
10	2412 MHz	37	2439 MHz	64	2466 MHz
11	2413 MHz	38	2440 MHz	65	2467 MHz
12	2414 MHz	39	2441 MHz	66	2468 MHz
13	2415 MHz	40	2442 MHz	67	2469 MHz
14	2416 MHz	41	2443 MHz	68	2470 MHz
15	2417 MHz	42	2444 MHz	69	2471 MHz
16	2418 MHz	43	2445 MHz	70	2472 MHz
17	2419 MHz	44	2446 MHz	71	2473 MHz
18	2420 MHz	45	2447 MHz	72	2474 MHz
19	2421 MHz	46	2448 MHz	73	2475 MHz
20	2422 MHz	47	2449 MHz	74	2476 MHz
21	2423 MHz	48	2450 MHz	75	2477 MHz
22	2424 MHz	49	2451 MHz	76	2478 MHz
23	2425 MHz	50	2452 MHz	77	2479 MHz
24	2426 MHz	51	2453 MHz	78	2480 MHz
25	2427 MHz	52	2454 MHz		
26	2428 MHz	53	2455 MHz		

2. TEST CONFIGURATION OF THE EQUIPMENT UNDER TEST

2.1. Description of the Test

a) For 15.247(g), during data transmission, the carrier frequency is repeatly switched on 79 hopping frequencies, any 2 hopping frequencies will not be available on the spectrum simultaneously. So, this device can be taken as true frequeny hopping device.

b) For 15.247(h), the hopping sequence is determined by the address of piconet master. Each piconet master will have its unique address at any moment, so re-use of the hopping sequence is completely not possible. Within the piconet, one master can be communicated with many slaves via the same hopping sequency, but at any moment only one (master or slave) can be "talk". It is determined by the master that who should be "listen" or "talk". Any slave who want to "talk" has to sent "inquery" to master first. So, 2 slaves (or one slave one master) is not possible to be on "talk" mode simultaneously.

c) The used peripherals as well as the configuration fulfill the requirements of ANSI C63.4:2001. The configuration is operated in a manner which tends to maximize its emission characteristics in a typical application.

d) 3 meters measurement distance was used in this test.

e) The device can be powered by 4 suppliers, the following is the modes of the testing:

Mode 1: CH00 (2402MHz), Power Supply: CHENTAI (Linear, 5V)
Mode 2: CH39 (2441MHz), Power Supply: CHENTAI (Linear, 5V)
Mode 3: CH78 (2480MHz), Power Supply: CHENTAI (Linear, 5V)
Mode 4: CH00 (2402MHz), Power Supply: TRANSPOWER (Switching, 12V)
Mode 5: CH39 (2441MHz), Power Supply: TRANSPOWER (Switching, 12V)
Mode 6: CH78 (2480MHz), Power Supply: TRANSPOWER (Switching, 12V)
Mode 7: CH00 (2402MHz), Power Supply: Car Audio System
Mode 8: CH39 (2441MHz), Power Supply: Car Audio System
Mode 9: CH78 (2480MHz), Power Supply: Car Audio System
Mode 10: CH00 (2402MHz), Power Supply: Car Charger (for radiation test only)
Mode 11: CH39 (2441MHz), Power Supply: Car Charger (for radiation test only)
Mode 12: CH78 (2480MHz), Power Supply: Car Charger (for radiation test only)
For conduction test, cause “Mode 1, 6, 8” generated the worst test result, it was reported as final data.
For radiation test, cause “Mode 2, 5, 8, 10” generated the worst test result, it was reported as final data.

2.2. Frequency Range Investigated

a) Conducted power line test: from 150 kHz to 30 MHz

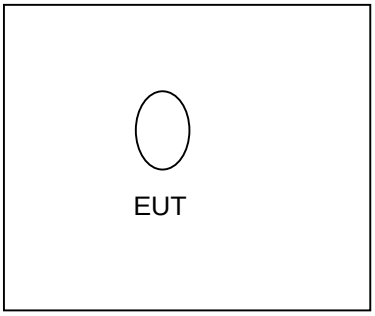
b) Radiated emission test: from 30 MHz to 25000 MHz

2.3. Details of the Supporting Units

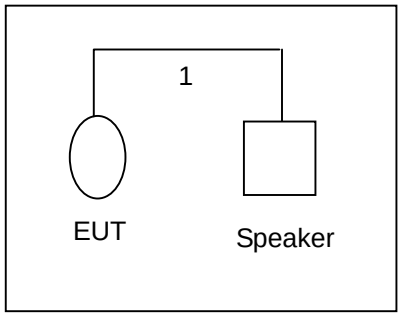
Unit No	Device	Brand	FCC ID /DoC	Model No.
1.	Speaker	Hi-Top	N/A	CB57MG39-IE
2.	Car Audio System	Panasonic	N/A	CQ-G156(C1)
3.	Speaker	Panasonic	N/A	CQ-G156(C1)
4.	Mute Device	Halfa	N/A	MB-01

2.4. Connection Diagram of Test System

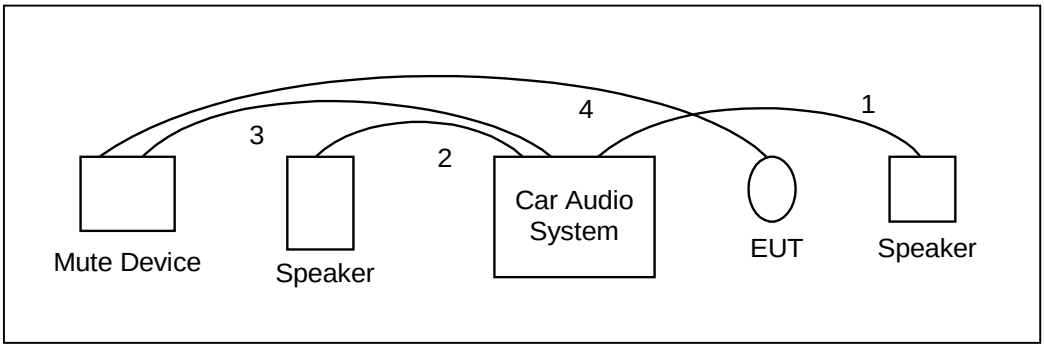
<Mode 1~6>



<Mode 10~12>



<Mode 7~9>



3. TEST SOFTWARE

During testing, the EUT's hopping function can be enabled or kept transmitting signals at fixed frequency, via the test software.

4. TEST LOCATION AND STANDARDS

4.1. Test Location

Test Location : Sporton Hwa Ya Testing Building

Address : No. 52, Hwa Ya 1st Rd., Hwa Ya Technology Park, Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C.
Tel: +886 3 327 3456 Fax: +886 3 318 0055

Test Site No. : CO01-HY, 03CH03-HY

4.2. Test Standards

Here is the list of the standards followed in this test report.

ANSI C63.4-2001

47 CFR Part 15 Subpart C (Section 15.247)

4.3. DoC Statement

This EUT is also classified as a device of computer peripheral Class B which DoC has to be followed. It has been verified according to the rule of 47 CFR part 15 Subpart B, and found that all the requirements has been fulfilled.

5. TEST RESULT AND DETAILS

5.1. Summary of the Test Results

FCC Rule	Description of Test	Result
15.247(a)(1)(ii)	Hopping Channel Bandwidth	Pass
15.247(a)(1)	Hopping Channel Separation	Pass
15.247(a)(1)(ii)	Number of Hopping Frequency Used	Pass
15.247(a)(1)(ii)	Dwell Time of Each Frequency within a 30 Second Period	Pass
15.247(b)	Output Power	Pass
15.247(c)	100KHz Bandwidth of Frequency Band Edges	Pass
15.107/15.207	Conducted Emission	Pass
15.209	Radiated Emission	Pass
15.203	Antenna Requirement	Pass

5.2. Hopping Channel Bandwidth

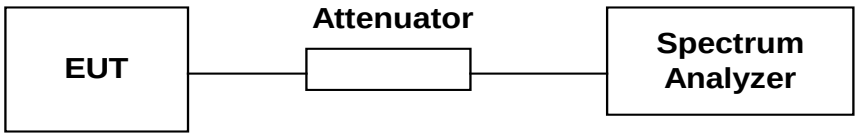
5.2.1. Measuring Instruments：

Item 9 of the table on section 6.

5.2.2. Test Procedure：

1. The transmitter output was connected to the spectrum analyzer through an attenuator.
2. Set RBW of spectrum analyzer to 100KHz and VBW to 100KHz.
3. The Hopping Channel bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20 dB.

5.2.3. Test Setup Layout：

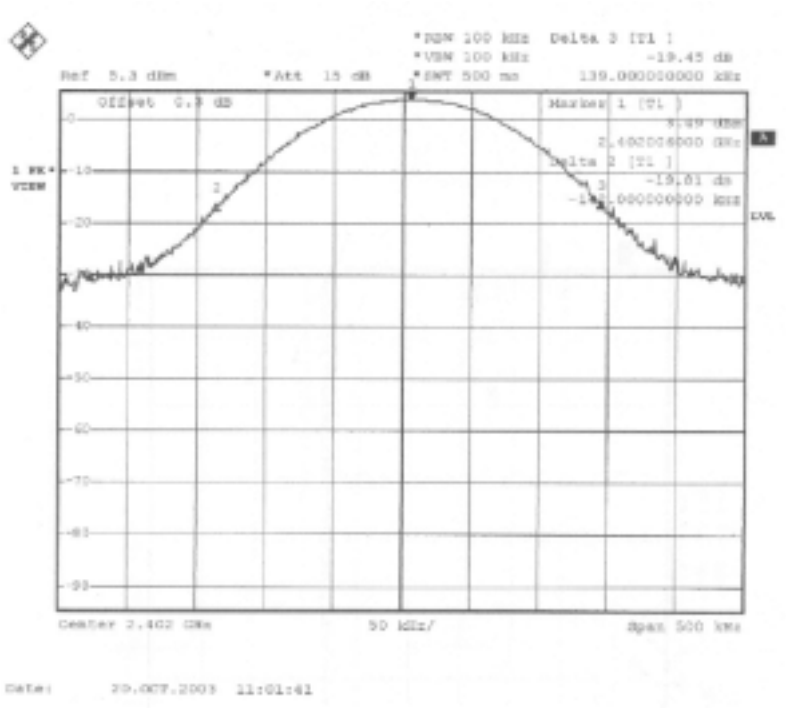


5.4.4. Test Result：See spectrum analyzer plots below

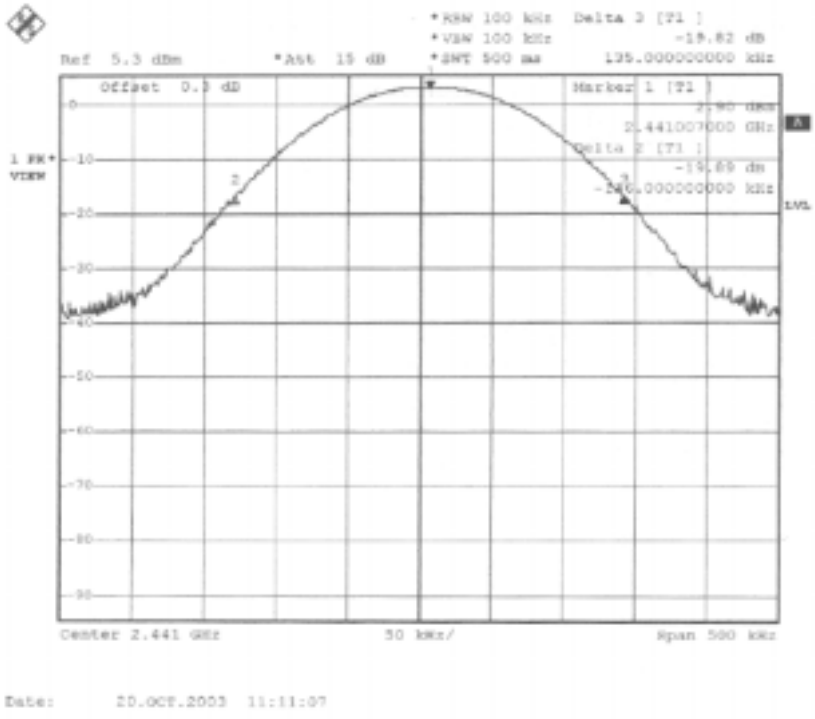
- Temperature: 27°C
- Relative Humidity: 62 %
- Duty cycle of the equipment during the test X ＝ 100%

Channel	Frequency (MHz)	Hopping Channel Bandwidth (MHz)	Limits (MHz)
00	2402	0.2810	1.0
39	2441	0.2710	1.0
78	2480	0.2710	1.0

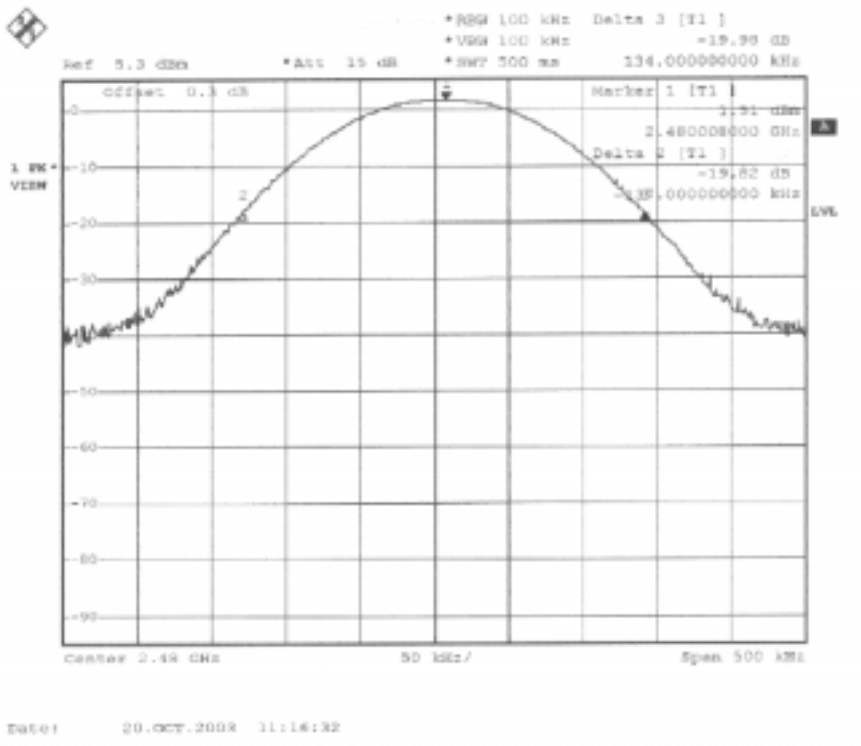
(Channel 00)：



(Channel 39)：



(Channel 78)：



Observation： All emissions in any 100kHz bandwidth outside the band edge are attenuated more then 20dB from the carrier.

5.2.5. Test Configuration（EUT Operating Condition）：

The software provided by client enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies respectively.

5.3. Number of Hopping Frequency

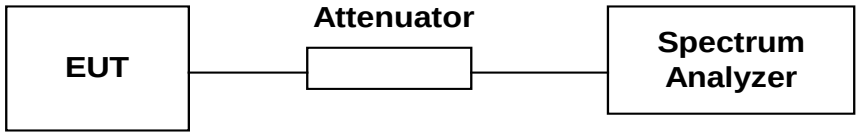
5.3.1. Measuring Instruments：

Item 9 of the table on section 6.

5.3.2. Test Procedures：

1. The transmitter output was connected to the spectrum analyzer through an attenuator.
2. Set RBW of spectrum analyzer to 100KHz and VBW to 100KHz.
3. The number of hopping frequency used is defined total number of the channels avaiable on the spectrum.

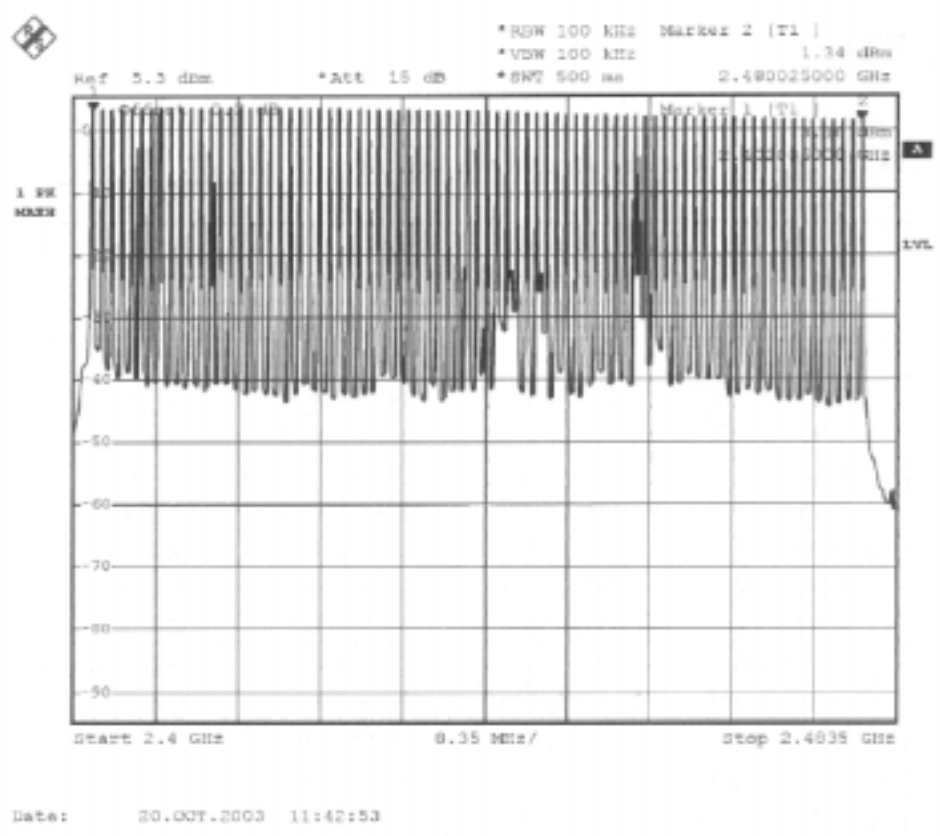
5.3.3. Test Setup Layout：



5.3.4. Test Result：See spectrum analyzer plots below

- Temperature: 27°C
- Relative Humidity: 62 %
- Duty cycle of the equipment during the test X ＝ 100%

Number of Hopping Frequencies (Channel)	Limits (Channel)
79	75



5.3.5. Test Configuration（EUT Operating Condition）：

The software provided by client enable the EUT under continuous transmission condition.
The EUT have its hopping function enabled.

5.4. Hopping Channel Separation

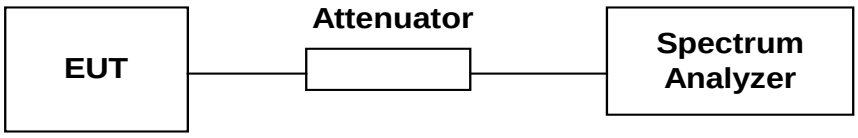
5.4.1. Measuring Instruments：

Item 9 of the table on section 6.

5.4.2. Test Procedures：

1. The transmitter output was connected to the spectrum analyzer through an attenuator.
2. Set RBW of spectrum analyzer to 100KHz and VBW to 100KHz.
3. The Hopping Channel Separation is defined as the separation between 2 neighboring hopping frequencies.

5.4.3. Test Setup Layout：



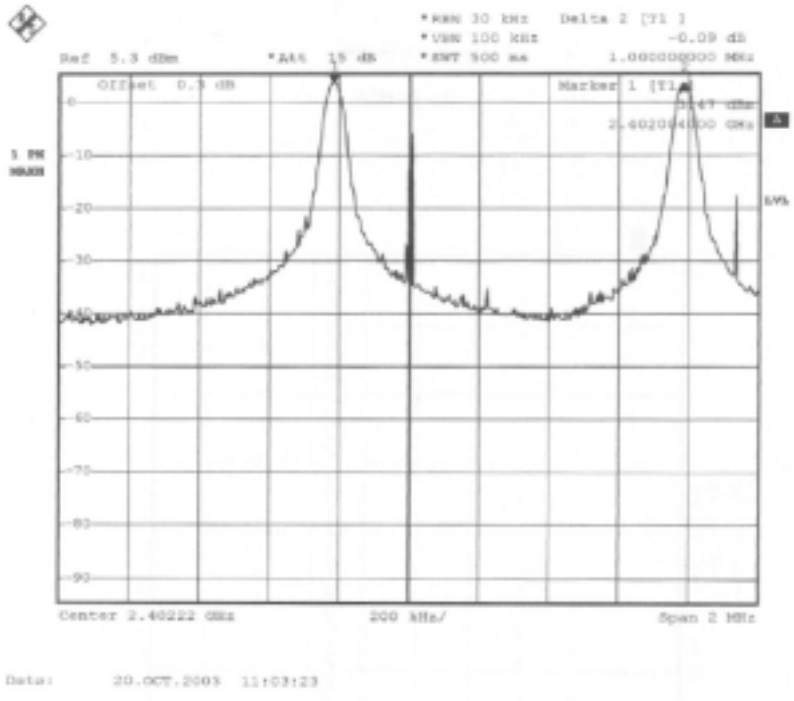
5.4.4. Test Result：The spectrum analyzer plots are attached as below

- Temperature: 27°C
- Relative Humidity: 62 %
- Duty cycle of the equipment during the test X ＝ 100%

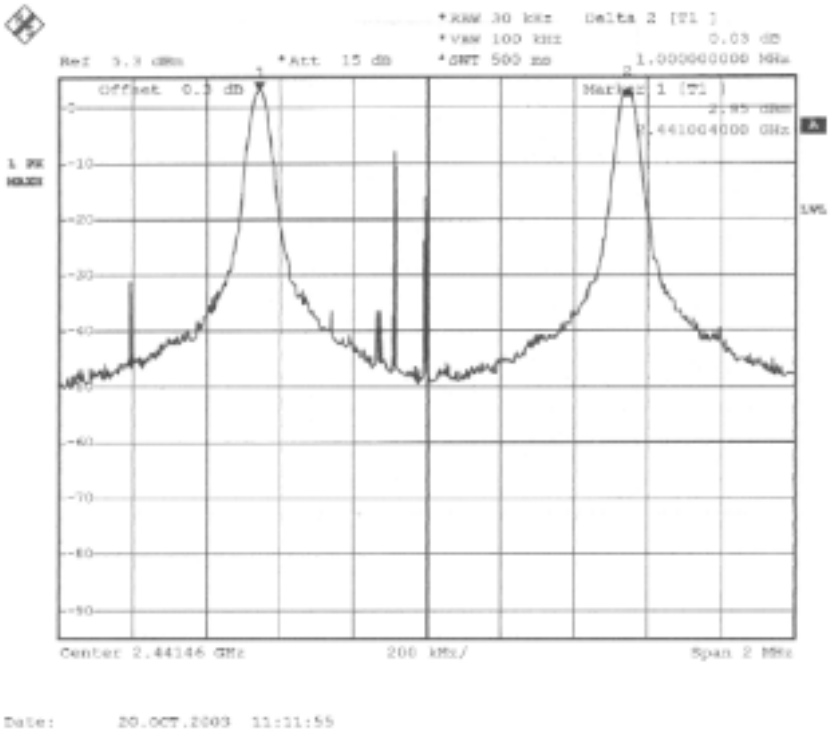
Channel	Frequency (MHz)	Hopping Channel Separation (KHz)	Limits (KHz)
00	2402	1000.0000	0.2810
39	2441	1000.0000	0.2710
78	2480	1000.0000	0.2710

Note: The limit is the min of 25KHz or 20dB bandwidth , which is greater.

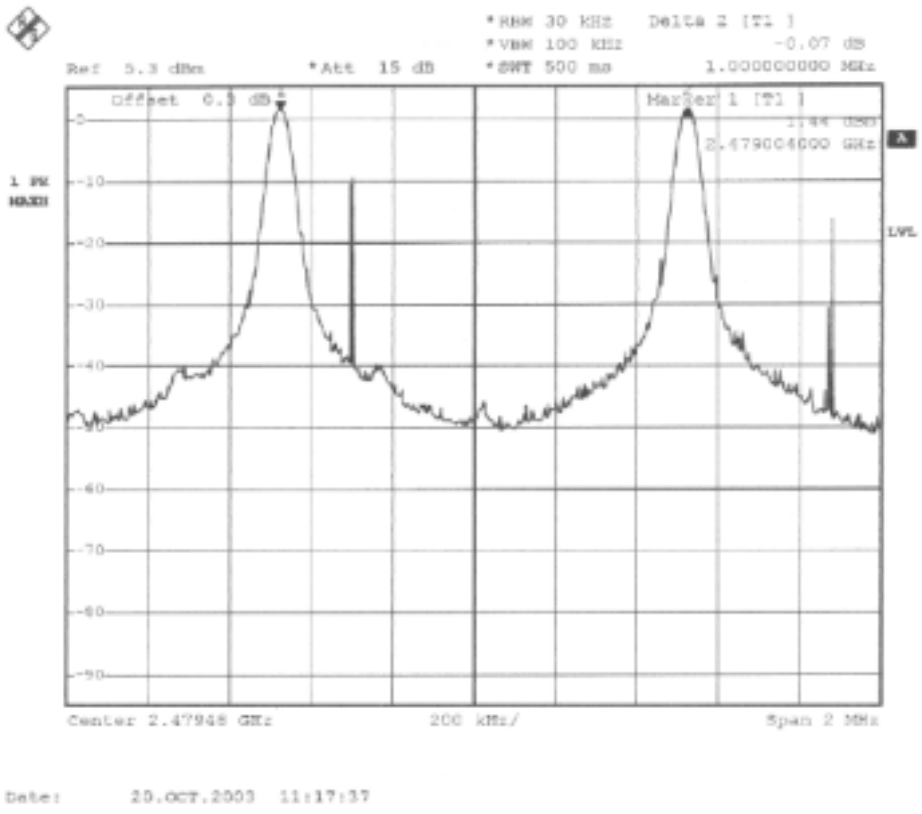
(Channel 00)：



(Channel 39)：



(Channel 78)：



5.4.5. Test Configuration（EUT Operating Condition）：

The software provided by client enable the EUT under continuous transmission condition.
The EUT have its hopping function enabled.

.

5.5. Dwell Time of Each Frequency within a 30 Seconds Period

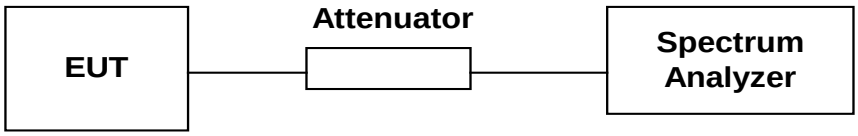
5.5.1. Measuring Instruments：

Item 9 of the table on section 6.

5.5.2. Test Procedure：

1. The transmitter output was connected to the spectrum analyzer through an attenuator.
2. Set RBW of spectrum analyzer to 1MHz and VBW to 1MHz.
3. Set the center frequency on any carrier frequency would be measure and set the frequency span to zero span.
4. Measure the maximum time duration, t , of one single pulse.
5. Assume the system is hopping on highest hopping rate, which is the worst case, 1600 pps. The Dwell time on 30 seconds ＝ 30 X (1600/79) X t

5.5.3. Test Setup Layout：

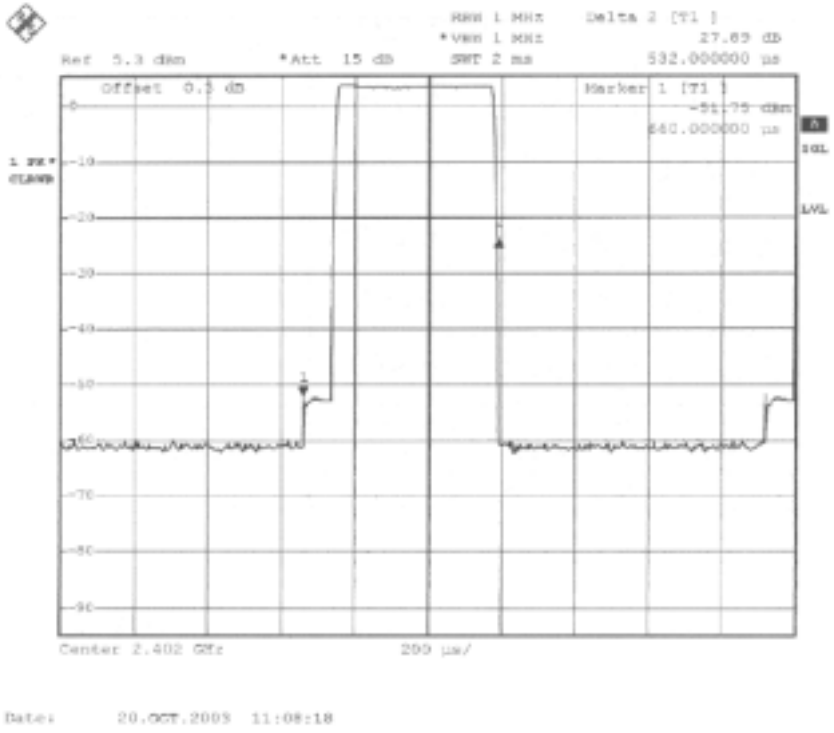


5.5.4. Test Result：See spectrum analyzer plots below

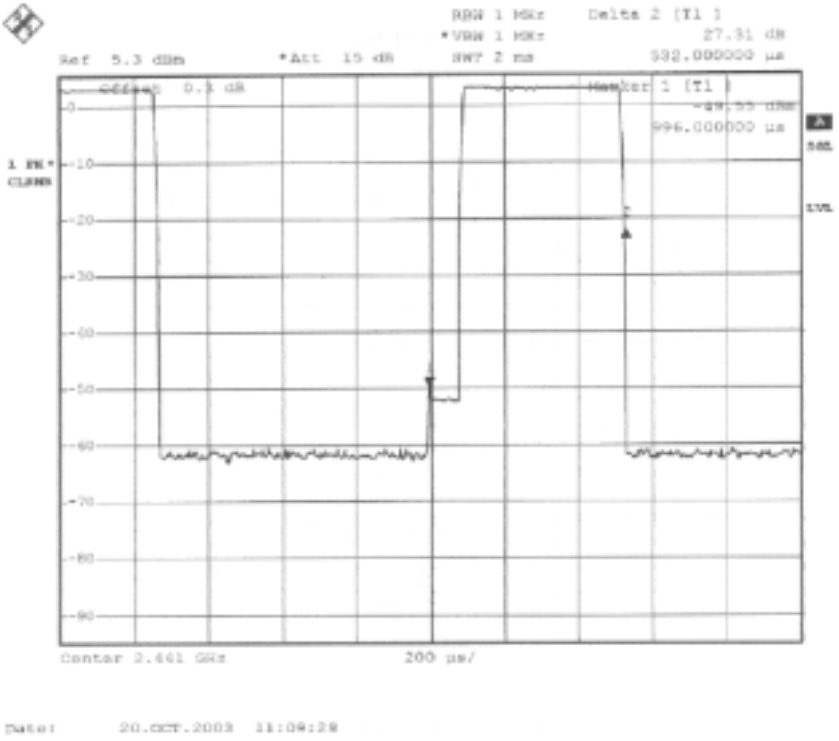
- Temperature: 27°C
- Relative Humidity: 62 %
- Duty cycle of the equipment during the test X ＝ 100%

Channel	Frequency (MHz)	Dwell Time (s)	Limits (s)
00	2402	0.323	0.4
39	2441	0.323	0.4
78	2480	0.323	0.4

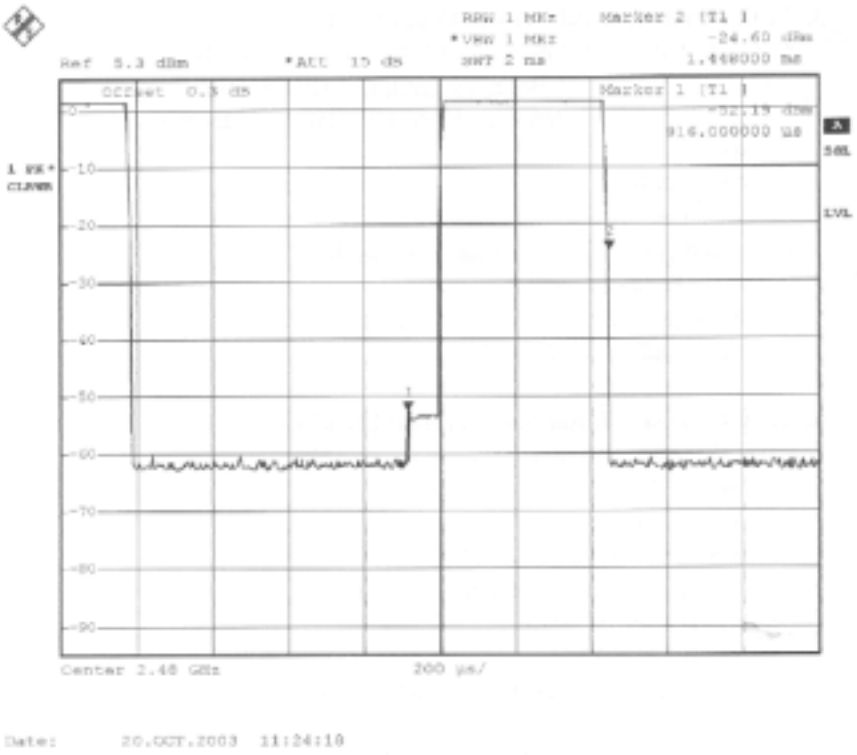
(Channel 00)：



(Channel 39)：



(Channel 78)：



5.5.5. Test Configuration（EUT Operating Condition）：

Same as Section 5.2.5.

5.6. Output Power

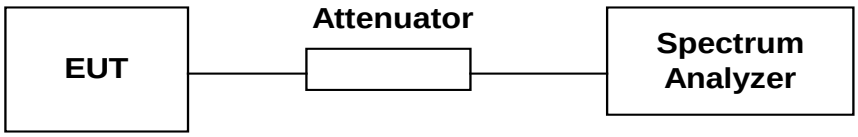
5.6.1. Measuring Instruments：

Item 9 of the table on section 6.

5.6.2. Test Procedures：

1. The transmitter output was connected to the spectrum analyzer through an attenuator.
2. The center frequency of the spectrum analyzer was set to the fundamental frequency and set RBW to 1MHz and VBW to 1MHz.

5.6.3. Test Setup Layout：

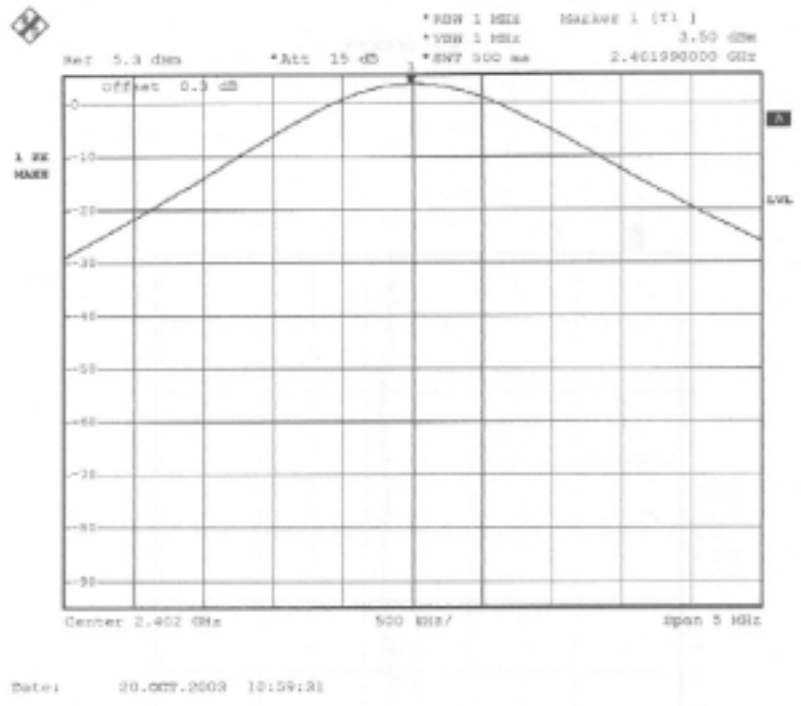


5.6.4. Test Result：See spectrum analyzer plots below

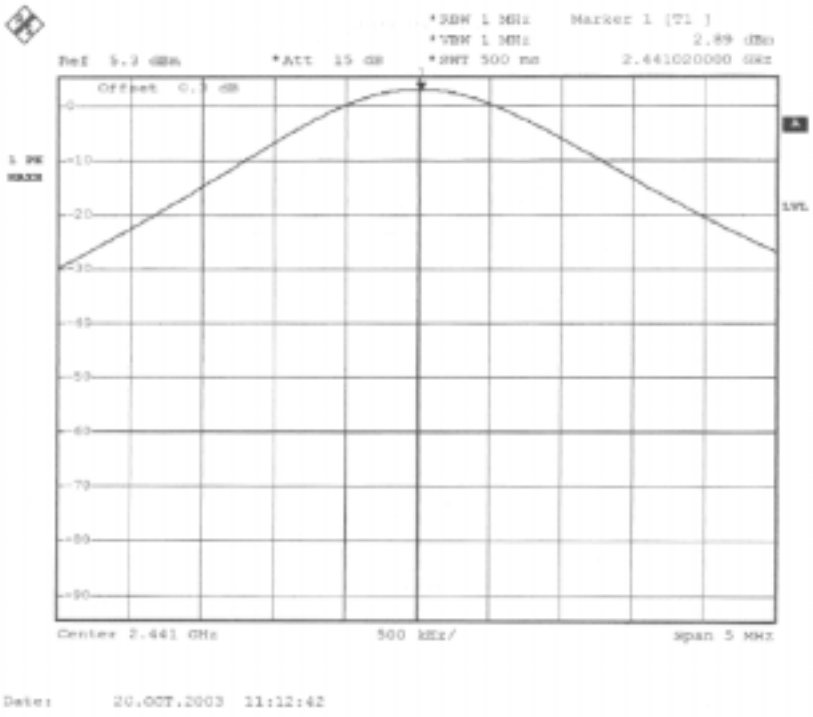
- Temperature: 27°C
- Relative Humidity: 62 %
- Duty cycle of the equipment during the test X ＝ 100%

Channel	Frequency (MHz)	Measured Output Power (dBm)	Measured Output Power (mWatt)	Limits (Watt/dBm)
00	2402	3.50	2.24	1W/30 dBm
39	2441	2.89	1.95	1W/30 dBm
78	2480	1.53	1.42	1W/30 dBm

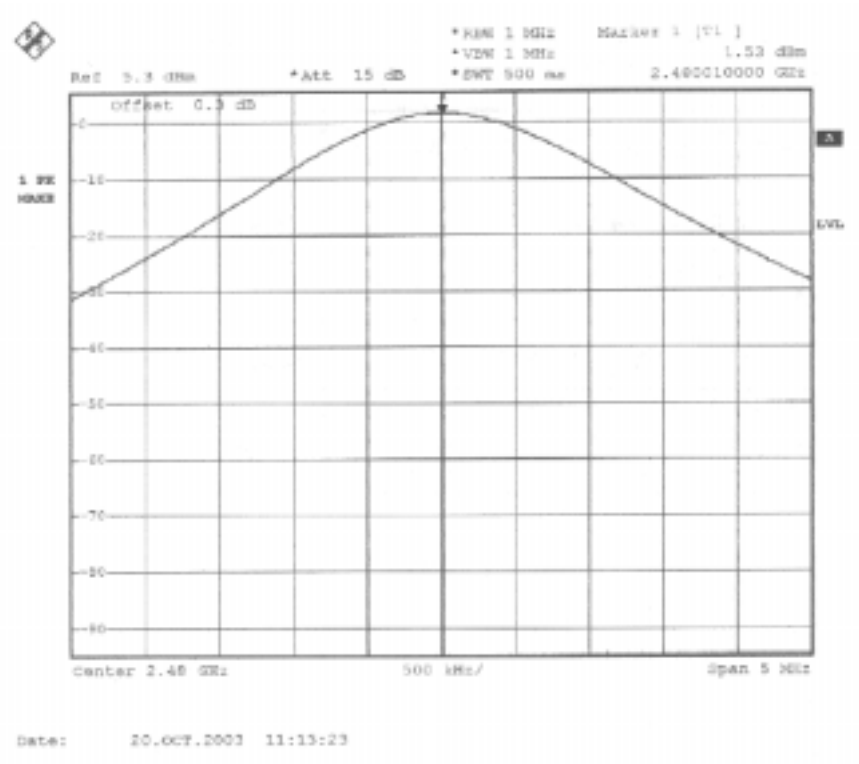
(Channel 00)：



(Channel 39)：



(Channel 78)：



5.6.5. Test Configuration（EUT Operating Condition）：

Same as Section 5.4.5.

5.7. 100KHz Bandwidth of Frequency Band Edges

5.7.1. Measuring Instruments：

Item 9 of the table on section 6.

5.7.2. Test Procedure：

1. The transmitter output was connected to the spectrum analyzer via a low lose cable.
2. Set both RBW and VBW of spectrum analyzer to 100KHz with convenient frequency span including 100 KHz bandwidth from band edge.
3. The band edges was measured and recorded.

5.7.3. Test Result：

Test Result in lower band (Channel 00)： PASS

Test Result in higher band(Channel 78)： PASS

5.7.4. Note on Band edge Emission

<5V Adapter>

(A) Left Edge

The band edge emission plot shows 57.86dB delta between carrier maximum power and local maximum emission in the restricted band.

CH 00 Carrier power strength (dBμV/m)	Dalta (dB)	The maximum field strength in restrict band (dBμV/m)	Limit (dBμV/m)	Margin (dB)
76.88	57.86	19.02	54.00	-34.98

(B) Right Edge

The band edge emission plot shows 58.57dB delta between carrier maximum power and local maximum emission in the restricted band.

CH 78 Carrier power strength (dBμV/m)	Dalta (dB)	The maximum field strength in restrict band (dBμV/m)	Limit (dBμV/m)	Margin (dB)
72.39	58.57	13.82	54.00	-40.18

＊The maximum field strength in restricted band is the emission of carrier power strength subtract to the delta between carrier maximum power and local maximum emission in the restricted band.

<12V Adapter>

(A) Left Edge

The band edge emission plot shows 57.86dB delta between carrier maximum power and local maximum emission in the restricted band.

CH 00 Carrier power strength (dB μ V/m)	Dalta (dB)	The maximum field strength in restrict band (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
75.26	57.86	17.40	54.00	-36.60

(B) Right Edge

The band edge emission plot shows 58.57dB delta between carrier maximum power and local maximum emission in the restricted band.

CH 78 Carrier power strength (dB μ V/m)	Dalta (dB)	The maximum field strength in restrict band (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
73.50	58.57	14.93	54.00	-39.07

<Car Audio System>

(A) Left Edge

The band edge emission plot shows 57.86dB delta between carrier maximum power and local maximum emission in the restricted band.

CH 00 Carrier power strength (dB μ V/m)	Dalta (dB)	The maximum field strength in restrict band (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
74.53	57.86	16.67	54.00	-37.33

(B) Right Edge

The band edge emission plot shows 58.57dB delta between carrier maximum power and local maximum emission in the restricted band.

CH 78 Carrier power strength (dB μ V/m)	Dalta (dB)	The maximum field strength in restrict band (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
73.28	58.57	14.71	54.00	-39.29

<Car Charger>

(A) Left Edge

The band edge emission plot shows 57.86dB delta between carrier maximum power and local maximum emission in the restricted band.

CH 00 Carrier power strength (dB μ V/m)	Dalta (dB)	The maximum field strength in restrict band (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
77.45	57.86	19.59	54.00	-34.41

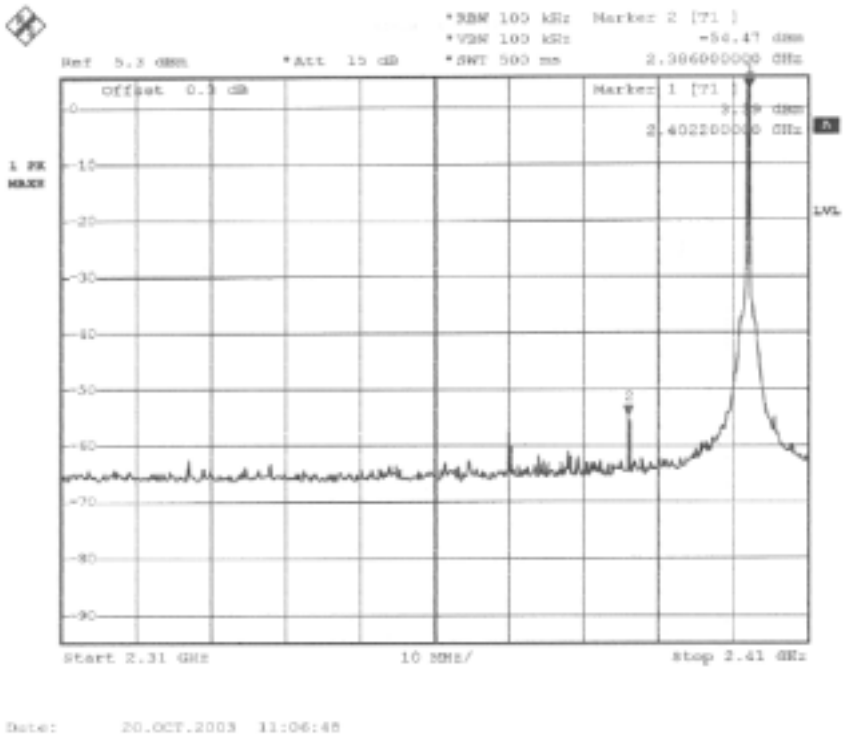
(B) Right Edge

The band edge emission plot shows 58.57dB delta between carrier maximum power and local maximum emission in the restricted band.

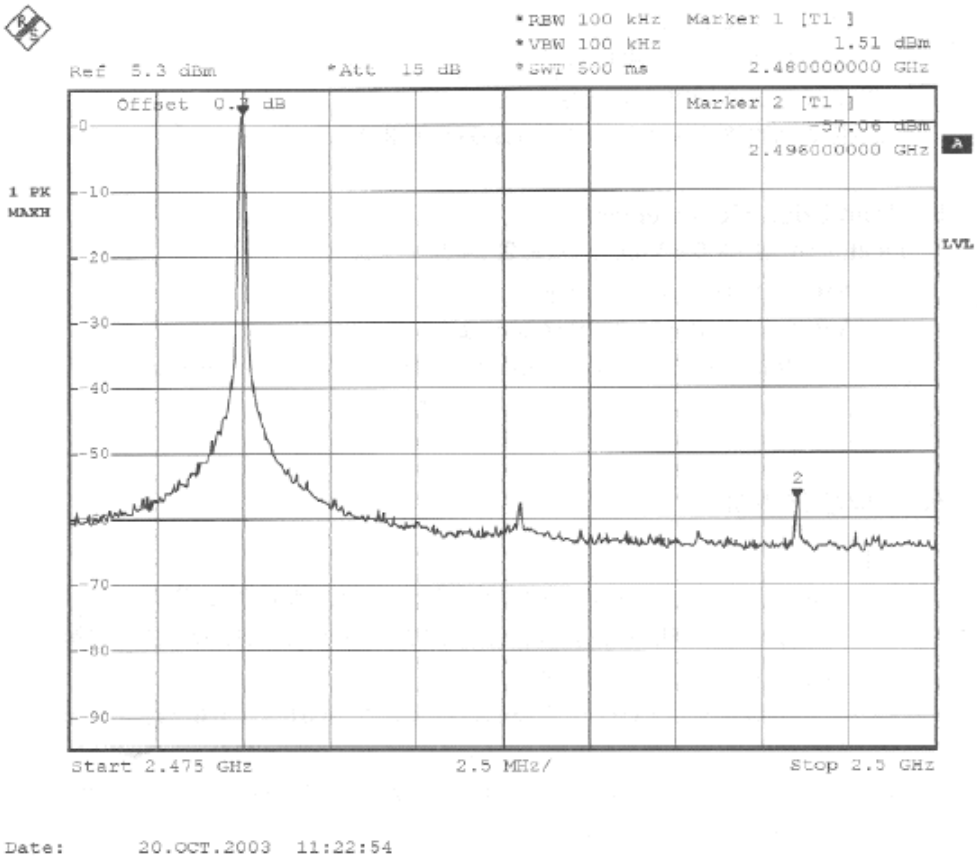
CH 78 Carrier power strength (dB μ V/m)	Dalta (dB)	The maximum field strength in restrict band (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
71.78	58.57	13.21	54.00	-40.79

＊The maximum field strength in restricted band is the emission of carrier power strength subtract to the delta between carrier maximum power and local maximum emission in the restricted band.

(Channel 00)：



(Channel 78)：



5.7.5. Test Configuration（EUT Operating Condition）：

The software provided by client enable the EUT under continuous transmission condition.
The EUT have its hopping function enabled.

5.8. Conducted Emission

5.8.1. Measuring Instruments

Please reference item 1~7 in chapter 6 for the instruments used for testing.

5.8.2. Test Procedures

a) Configure the EUT according to ANSI C63.4.
b) The EUT has to be placed 0.4 meter far from the conducting wall of the shielding room and at least 80 centimeters from any other grounded conducting surface.
c) Connect EUT to the power mains through a line impedance stabilization network (LISN).
d) All the support units are connected to the other LISNs. The LISN should provides 50uH/50ohms coupling impedance.
e) The frequency range from 150 KHz to 30 MHz was searched.
f) Use the Channel & Power Controlling software to make the EUT working on selected channel and expected output power, then use the “H” Patter Generator software to make the supporting equipments stay on working condition.
g) Set the test-receiver system to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
h) The measurement has to be done between each power line and ground at the power terminal for each RF channel. Only one RF channel has to be investigated since this test is independent with the RF channel selection.

5.8.3. Test Result of Conducted Emission

Test Mode	Mode 1	Tested By	John Huang
Temperature / Humidity	27 deg. C / 58 %		

Line to Ground

	Freq	Level	Over Limit	Limit Line	Read Level	Probe Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.164	32.46	-32.80	65.26	32.20	0.10	0.16	QP
2	0.164	17.95	-37.31	55.26	17.69	0.10	0.16	Average
3	0.175	9.19	-45.53	54.72	8.92	0.10	0.17	Average
4	0.175	32.47	-32.25	64.72	32.20	0.10	0.17	QP
5	0.267	12.05	-39.16	51.21	11.80	0.10	0.15	Average
6	0.267	28.65	-32.56	61.21	28.40	0.10	0.15	QP
7	0.350	8.55	-40.41	48.96	8.33	0.10	0.12	Average
8	0.350	27.66	-31.30	58.96	27.44	0.10	0.12	QP
9	0.442	9.52	-37.50	47.02	9.33	0.10	0.09	Average
10	0.442	28.04	-28.98	57.02	27.85	0.10	0.09	QP
11	0.497	27.36	-28.69	56.05	27.18	0.10	0.08	QP
12	0.497	6.72	-39.33	46.05	6.54	0.10	0.08	Average

Neutral to Ground

	Freq	Level	Over Limit	Limit Line	Read Level	Probe Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.163	16.17	-39.13	55.30	15.91	0.10	0.16	Average
2	0.163	32.42	-32.88	65.30	32.16	0.10	0.16	QP
3	0.182	32.29	-32.10	64.39	32.02	0.10	0.17	QP
4	0.182	9.53	-44.86	54.39	9.26	0.10	0.17	Average
5	0.233	7.41	-44.93	52.34	7.15	0.10	0.16	Average
6	0.233	29.35	-32.99	62.34	29.09	0.10	0.16	QP
7	0.292	28.26	-32.21	60.47	28.02	0.10	0.14	QP
8	0.292	6.97	-43.50	50.47	6.73	0.10	0.14	Average
9	0.375	27.18	-31.21	58.39	26.97	0.10	0.11	QP
10	0.375	7.81	-40.58	48.39	7.60	0.10	0.11	Average
11	0.497	26.84	-29.21	56.05	26.66	0.10	0.08	QP
12	0.497	6.44	-39.61	46.05	6.26	0.10	0.08	Average

Test Mode	Mode 6	Tested By	John Huang
Temperature / Humidity	27 deg. C / 58%		

Line to Ground

	Freq	Level	Over Limit	Limit Line	Read Level	Probe Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.152	36.57	-29.32	65.89	36.31	0.10	0.16	QP
2	0.152	26.15	-29.74	55.89	25.89	0.10	0.16	Average
3	0.288	44.80	-15.78	60.58	44.56	0.10	0.14	QP
4	0.288	41.36	-9.22	50.58	41.12	0.10	0.14	Average
5	0.434	40.62	-16.57	57.19	40.43	0.10	0.09	QP
6	0.434	35.84	-11.35	47.19	35.65	0.10	0.09	Average
7	0.577	35.00	-21.00	56.00	34.83	0.10	0.07	QP
8	0.577	31.83	-14.17	46.00	31.66	0.10	0.07	Average
9	0.720	36.31	-19.69	56.00	36.16	0.10	0.05	QP
10	0.720	32.86	-13.14	46.00	32.71	0.10	0.05	Average
11	1.008	38.07	-17.93	56.00	37.95	0.10	0.02	QP
12	1.008	34.72	-11.28	46.00	34.60	0.10	0.02	Average

Neutral to Ground

	Freq	Level	Over Limit	Limit Line	Read Level	Probe Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.288	50.88	-9.69	60.57	50.64	0.10	0.14	QP
2	0.288	46.27	-4.30	50.57	46.03	0.10	0.14	Average
3	0.432	46.29	-10.93	57.22	46.10	0.10	0.09	QP
4	0.432	41.47	-5.75	47.22	41.28	0.10	0.09	Average
5	0.576	43.15	-12.85	56.00	42.98	0.10	0.07	QP
6	0.576	37.91	-8.09	46.00	37.74	0.10	0.07	Average
7	0.721	43.50	-12.50	56.00	43.35	0.10	0.05	QP
8	0.721	38.88	-7.12	46.00	38.73	0.10	0.05	Average
9	1.010	45.54	-10.46	56.00	45.42	0.10	0.02	QP
10	1.010	40.72	-5.28	46.00	40.60	0.10	0.02	Average
11	1.441	42.72	-13.28	56.00	42.56	0.10	0.06	QP
12	1.441	37.89	-8.11	46.00	37.73	0.10	0.06	Average

Test Mode	Mode 8	Tested By	John Huang
Temperature / Humidity	27 deg. C / 58%		

Line to Ground

	Freq	Level	Over Limit	Limit Line	Read Level	Probe Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.162	47.94	-17.42	65.36	47.68	0.10	0.16	QP
2	0.162	21.96	-33.40	55.36	21.70	0.10	0.16	Average
3	0.184	18.49	-35.81	54.30	18.22	0.10	0.17	Average
4	0.184	47.59	-16.71	64.30	47.32	0.10	0.17	QP
5	0.247	14.96	-36.90	51.86	14.70	0.10	0.16	Average
6	0.247	43.50	-18.36	61.86	43.24	0.10	0.16	QP
7	0.336	41.53	-17.77	59.30	41.31	0.10	0.12	QP
8	0.336	13.77	-35.53	49.30	13.55	0.10	0.12	Average
9	0.398	13.32	-34.58	47.90	13.12	0.10	0.10	Average
10	0.398	40.44	-17.46	57.90	40.24	0.10	0.10	QP
11	0.489	38.68	-17.50	56.18	38.50	0.10	0.08	QP
12	0.489	11.82	-34.36	46.18	11.64	0.10	0.08	Average

Neutral to Ground

	Freq	Level	Over Limit	Limit Line	Read Level	Probe Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.163	47.13	-18.20	65.33	46.87	0.10	0.16	QP
2	0.163	22.34	-32.99	55.33	22.08	0.10	0.16	Average
3	0.220	43.78	-19.04	62.82	43.51	0.10	0.17	QP
4	0.220	15.43	-37.39	52.82	15.16	0.10	0.17	Average
5	0.272	41.07	-19.99	61.06	40.83	0.10	0.14	QP
6	0.272	14.79	-36.27	51.06	14.55	0.10	0.14	Average
7	0.325	39.41	-20.17	59.58	39.19	0.10	0.12	QP
8	0.325	13.59	-35.99	49.58	13.37	0.10	0.12	Average
9	0.381	37.96	-20.30	58.26	37.75	0.10	0.11	QP
10	0.381	12.24	-36.02	48.26	12.03	0.10	0.11	Average
11	0.466	10.61	-35.97	46.58	10.42	0.10	0.09	Average
12	0.466	35.48	-21.10	56.58	35.29	0.10	0.09	QP

5.9. Test of Radiated Emission

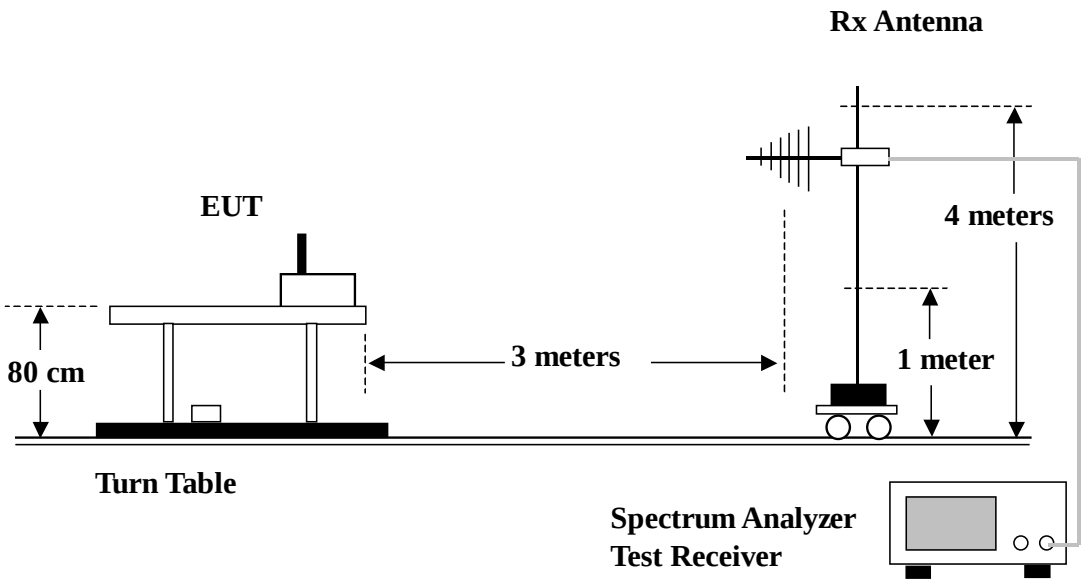
5.9.1. Measuring Instruments

Please reference item 8~19 in chapter 6 for the instruments used for testing.

5.9.2. Test Procedures

a) Configure the EUT according to ANSI C63.4.
b) The EUT was placed on the top of the turn table 0.8 meter above ground.
c) The phase center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turn table.
d) Power on the EUT and all the supporting units.
e) The turn table was rotated 360 degrees to determine the position of the highest radiation.
f) The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emission field strength of both horizontal and vertical polarization.
g) For each suspected emission, the antenna tower was scan (from 1 M to 4 M) and then the turn table was rotated (from 0 degree to 360 degrees) to find the maximum reading.
h) Set the test-receiver system to Peak or CISPR quasi-peak Detect Function with specified bandwidth under Maximum Hold Mode.
i) For emission above 1GHz, use 1MHz VBW & RBW for peak reading and 1MHz RBW & 300Hz VBW for average reading in spectrum analyzer.
j) If the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 3 dB margin will be repeated one by one using the quasi-peak method and reported.
k) For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than average limit (that means the emission level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.

5.9.3. Test Setup Layout



5.9.4. Test Results and Limit

Note:
Emission level (dBuV/m) = 20 log Emission level (uV/m)
Corrected Reading: Probe Factor + Cable Loss + Read Level - Preamp Factor = Level

Test Mode	Mode 3 (CH78)	**Temperature**	27 deg. C	**Tested By**	Steve Chen
Freq. Range	30MHz~1GHz	**Humidity**	62%		

(A) Polarization: Horizontal

	Freq	Level	Over Limit	Limit Line	Read Level	Probe Factor	Cable Loss	Preamp Factor	Remark	Ant Pos	Table Pos
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB	dB	dB		cm	deg
1	30.000	16.05	-23.95	40.00	27.83	15.35	0.92	28.05	Peak	---	---
2	136.380	13.29	-30.21	43.50	28.64	10.38	2.10	27.83	Peak	---	---
3	295.140	20.75	-25.25	46.00	33.50	11.41	3.16	27.32	Peak	---	---
1	442.100	20.14	-25.86	46.00	29.43	15.23	3.65	28.17	Peak	---	---
2	603.800	21.45	-24.55	46.00	28.42	17.32	4.51	28.80	Peak	---	---
3	903.400	25.71	-20.29	46.00	29.30	19.43	5.28	28.30	Peak	100	115

(B) Polarization: Vertical

	Freq	Level	Over Limit	Limit Line	Read Level	Probe Factor	Cable Loss	Preamp Factor	Remark	Ant Pos	Table Pos
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB	dB	dB		cm	deg
1	36.210	17.79	-22.21	40.00	32.39	12.38	1.05	28.03	Peak	---	---
2	55.380	12.84	-27.16	40.00	33.53	5.76	1.54	27.99	Peak	---	---
3	61.050	18.34	-21.66	40.00	39.92	5.09	1.31	27.98	Peak	---	---
1	620.600	21.35	-24.65	46.00	28.39	17.44	4.30	28.78	Peak	---	---
2	766.200	23.54	-22.46	46.00	28.79	18.53	4.99	28.77	Peak	---	---
3	911.800	24.97	-21.03	46.00	28.61	19.46	5.19	28.29	Peak	---	---

Test Mode	Mode 6 (CH78)	Temperature	27 deg. C	Tested By	Steve Chen
Freq. Range	30MHz~1GHz	Humidity	62%		

(A) Polarization: Horizontal

	Freq	Level	Over Limit	Limit Line	Read Level	Probe Factor	Cable Loss	Preamp Factor	Remark	Ant Pos	Table Pos
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB	dB	dB		cm	deg
1	54.570	9.06	-30.94	40.00	29.49	5.87	1.69	27.99	Peak	---	---
2	61.050	7.98	-32.02	40.00	29.56	5.09	1.31	27.98	Peak	---	---
3	137.460	12.52	-30.98	43.50	27.87	10.35	2.12	27.82	Peak	---	---
1	430.900	20.77	-25.23	46.00	30.11	15.07	3.66	28.07	Peak	---	---
2	813.800	23.79	-22.21	46.00	28.60	18.87	5.05	28.73	Peak	---	---
3	878.900	24.35	-21.65	46.00	28.09	19.28	5.38	28.40	Peak	---	---

(B) Polarization: Vertical

	Freq	Level	Over Limit	Limit Line	Read Level	Probe Factor	Cable Loss	Preamp Factor	Remark	Ant Pos	Table Pos
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB	dB	dB		cm	deg
1	53.490	13.02	-26.98	40.00	33.47	6.02	1.52	27.99	Peak	---	---
2	61.050	14.05	-25.95	40.00	35.63	5.09	1.31	27.98	Peak	---	---
3	66.450	8.47	-31.53	40.00	29.98	4.67	1.79	27.97	Peak	---	---
1	430.900	21.04	-24.96	46.00	30.38	15.07	3.66	28.07	Peak	---	---
2	682.200	22.18	-23.82	46.00	28.43	17.88	4.59	28.72	Peak	---	---
3	892.200	24.69	-21.31	46.00	28.15	19.37	5.51	28.34	Peak	100	126

Test Mode	Mode 9 (CH78)	Temperature	27 deg. C	Tested By	Steve Chen
Freq. Range	30MHz~1GHz	Humidity	62%		

(A) Polarization: Horizontal

	Freq	Level	Over Limit	Limit Line	Read Level	Probe Factor	Cable Loss	Preamp Factor	Remark	Ant Pos	Table Pos
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB	dB	dB		cm	deg
1	42.420	18.61	-21.39	40.00	35.50	9.74	0.77	27.40	Peak	---	---
2	61.050	20.47	-19.53	40.00	41.45	5.09	1.31	27.38	Peak	---	---
3	66.180	18.96	-21.04	40.00	40.02	4.69	1.62	27.37	Peak	---	---
1	397.300	24.28	-21.72	46.00	33.77	14.54	3.45	27.48	Peak	---	---

(B) Polarization: Vertical

	Freq	Level	Over Limit	Limit Line	Read Level	Probe Factor	Cable Loss	Preamp Factor	Remark	Ant Pos	Table Pos
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB	dB	dB		cm	deg
1	41.340	22.81	-17.19	40.00	39.06	10.16	0.99	27.40	Peak	100	100
2	76.980	20.21	-19.79	40.00	40.50	5.54	1.51	27.34	Peak	---	---
3	96.420	18.88	-24.62	43.50	35.35	9.15	1.69	27.31	Peak	---	---
1	400.100	25.09	-20.91	46.00	34.16	14.63	3.80	27.50	Peak	---	---

Test Mode	Mode 12 (CH78)	Temperature	27 deg. C		Steve Chen
Freq. Range	30MHz~1GHz		62%		

(A) Polarization: Horizontal

	Freq	Level	Over Limit	Limit Line	Read Level	Probe Factor	Cable Loss	Preamp Factor	Remark	Ant Pos	Table Pos
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB	dB	dB		cm	deg
1	32.970	16.94	-23.06	40.00	29.52	13.80	1.02	27.40	Peak	---	---
2	57.540	17.78	-22.22	40.00	38.41	5.48	1.27	27.38	Peak	---	---
3	62.940	17.27	-22.73	40.00	38.39	4.94	1.31	27.37	Peak	---	---

(B) Polarization: Vertical

	Freq	Level	Over Limit	Limit Line	Read Level	Probe Factor	Cable Loss	Preamp Factor	Remark	Ant Pos	Table Pos
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB	dB	dB		cm	deg
1	31.620	19.95	-20.05	40.00	32.34	14.40	0.61	27.40	Peak	---	---
2	57.810	21.25	-18.75	40.00	41.93	5.44	1.26	27.38	Peak	100	102
3	67.260	19.22	-20.78	40.00	40.15	4.62	1.81	27.36	Peak	---	---
1	300.000	19.26	-26.74	46.00	31.51	11.36	2.99	26.60	Peak	---	---
2	335.000	21.03	-24.97	46.00	32.28	12.52	3.15	26.92	Peak	---	---

Test Mode	Mode 1 (CH00)	Temperature	27 deg. C	Tested By	Steve Chen
Freq. Range	1GHz~5GHz	Humidity	62%		

(A) Polarization: Horizontal

	Freq	Level	Over Limit	Limit Line	Read Level	Probe Factor	Cable Loss	Preamp Factor	Remark	Ant Pos	Table Pos
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB	dB	dB		cm	deg
1 X	2404.000	91.13			101.11	28.23	2.94	41.15	Peak	---	---
2 X	2404.000	68.19			78.17	28.23	2.94	41.15	Average	---	---
1	4804.000	47.25	-26.75	74.00	52.33	33.03	4.23	42.34	Peak	---	---
2	4804.000	34.34	-19.66	54.00	39.42	33.03	4.23	42.34	Average	---	---

(B) Polarization: Vertical

	Freq	Level	Over Limit	Limit Line	Read Level	Probe Factor	Cable Loss	Preamp Factor	Remark	Ant Pos	Table Pos
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB	dB	dB		cm	deg
1	1062.000	35.42			49.41	24.27	1.91	40.17	Peak	---	---
2	1062.000	21.23			35.22	24.27	1.91	40.17	Average	---	---
3 X	2404.000	76.88	22.88	54.00	86.86	28.23	2.94	41.15	Average	---	---
4 X	2404.000	100.59	26.59	74.00	110.57	28.23	2.94	41.15	Peak	---	---
1	4804.000	48.46	-25.54	74.00	53.54	33.03	4.23	42.34	Peak	---	---
2	4804.000	34.33	-19.67	54.00	39.41	33.03	4.23	42.34	Average	---	---

Remark : X : Fundamental Frequency

- For 5GHz ~ 25GHz

  Remark: Frequency from 5000MHz to 25000MHz, the emission emitted by the EUT is too low to be measured.

Test Mode	Mode 2 (CH39)	Temperature	27 deg. C	Tested By	Steve Chen
Freq. Range	1GHz~5GHz	Humidity	62%		

(A) Polarization: Horizontal

	Freq	Level	Over Limit	Limit Line	Read Level	Probe Factor	Cable Loss	Preamp Factor	Remark	Ant Pos	Table Pos
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB	dB	dB		cm	deg
1	1220.000	36.86			50.60	24.65	1.94	40.33	Peak	---	---
2	1220.000	21.69			35.43	24.65	1.94	40.33	Average	---	---
3 X	2444.000	89.25	15.25	74.00	99.23	28.31	2.88	41.17	Peak	---	---
4 X	2444.000	65.43	11.43	54.00	75.41	28.31	2.88	41.17	Average	---	---
1	4884.000	50.02	-23.98	74.00	55.17	33.19	4.11	42.45	Peak	---	---
2	4884.000	34.49	-19.51	54.00	39.64	33.19	4.11	42.45	Average	---	---

(B) Polarization: Vertical

	Freq	Level	Over Limit	Limit Line	Read Level	Probe Factor	Cable Loss	Preamp Factor	Remark	Ant Pos	Table Pos
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB	dB	dB		cm	deg
1 X	2438.000	98.77			108.75	28.30	2.89	41.17	Peak	---	---
2 X	2438.000	74.59			84.57	28.30	2.89	41.17	Average	---	---
1	4884.000	49.28	-24.72	74.00	54.43	33.19	4.11	42.45	Peak	---	---
2	4884.000	35.00	-19.00	54.00	40.15	33.19	4.11	42.45	Average	---	---

Remark : X : Fundamental Frequency

- For 5GHz ~ 25GHz

Remark: Frequency from 5000MHz to 25000MHz, the emission emitted by the EUT is too low to be measured.

Test Mode	Mode 3 (CH78)	Temperature	27 deg. C	Tested By	Steve Chen
Freq. Range	1GHz~5GHz	Humidity	62%		

(A) Polarization: Horizontal

	Freq	Level	Over Limit	Limit Line	Read Level	Probe Factor	Cable Loss	Preamp Factor	Remark	Ant Pos	Table Pos
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB	dB	dB		cm	deg
1 X	2478.000	87.35			97.28	28.38	2.88	41.19	Peak	---	---
2 X	2478.000	64.95			74.88	28.38	2.88	41.19	Average	---	---
1	4958.000	50.85	-23.15	74.00	55.93	33.34	4.14	42.56	Peak	---	---
2	4958.000	39.74	-14.26	54.00	44.82	33.34	4.14	42.56	Average	---	---

(B) Polarization: Vertical

	Freq	Level	Over Limit	Limit Line	Read Level	Probe Factor	Cable Loss	Preamp Factor	Remark	Ant Pos	Table Pos
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB	dB	dB		cm	deg
1 X	2478.000	96.32			106.25	28.38	2.88	41.19	Peak	---	---
2 X	2478.000	72.39			82.32	28.38	2.88	41.19	Average	---	---
1	4958.000	52.15	-21.85	74.00	57.23	33.34	4.14	42.56	Peak	---	---
2	4958.000	40.82	-13.18	54.00	45.90	33.34	4.14	42.56	Average	---	---

Remark : X : Fundamental Frequency

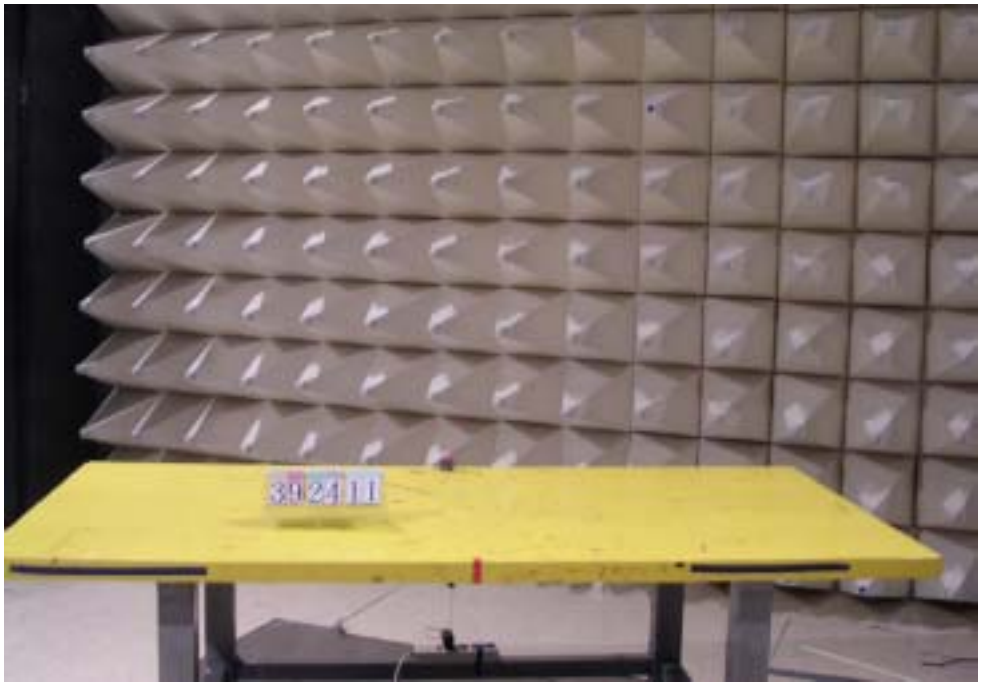
- For 5GHz ~ 25GHz

Remark: Frequency from 5000MHz to 25000MHz, the emission emitted by the EUT is too low to be measured.

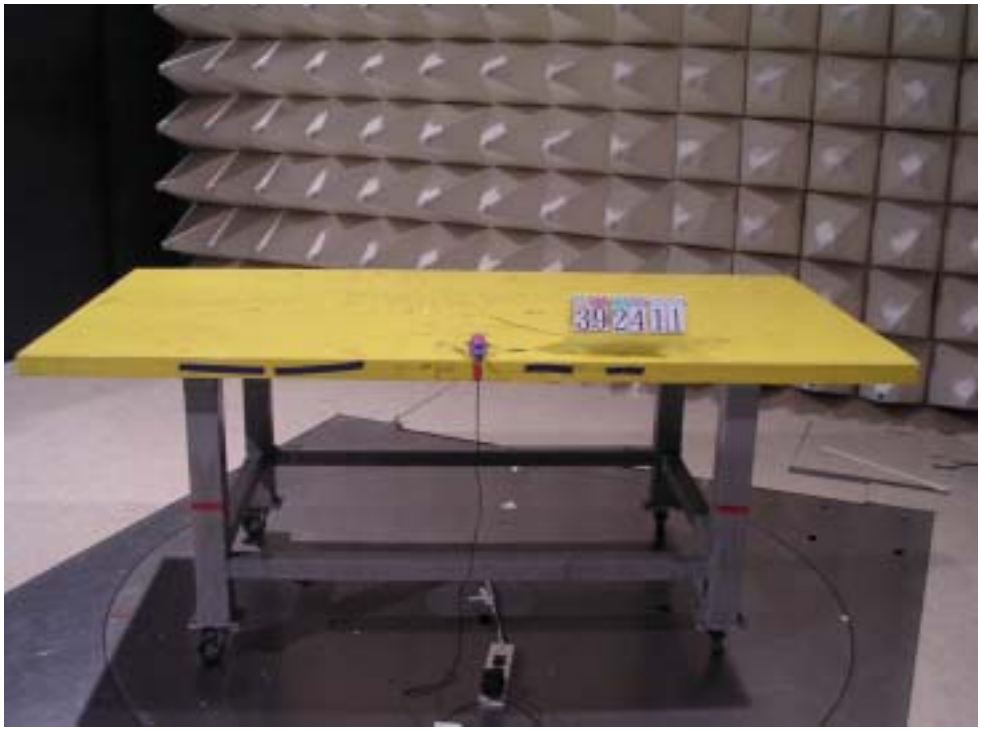
5.9.5. Photographs of Radiated Emission Test Configuration

- The photographs show the configuration that generates the maximum emission.
  <Mode 1~6>

FRONT VIEW



REAR VIEW



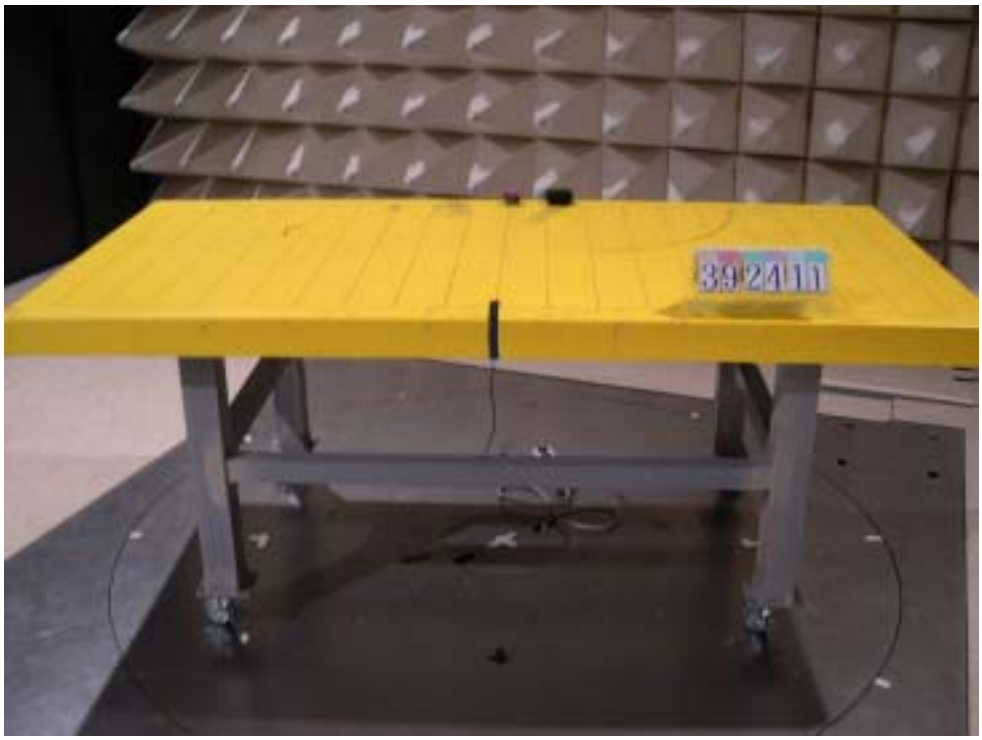
<Mode 7~9>

FRONT VIEW

REAR VIEW

<Mode 10~12>

FRONT VIEW



REAR VIEW

5.10. Antenna Requirements

5.10.1. Standard Applicable

47 CFR Part15 Section 15.203:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

47 CFR Part15 Section 15.247 (b):
If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.
If the intentional radiator is used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

5.10.2. Antenna Connected Construction

The antenna used in this product is dipole antenna. The antenna connector type is **Inverted-N** which fulfill the unique antenna connector requirement.

5.11. RF Exposure

5.11.1. Limit For Maximum Permissible Exposure (MPE)

This product can be classified as mobile device, so the 20cm separation distance warning is required. In this section, the power density at 20cm distance location is calculated to examine if it is lower than the limit.

(A) Limits for Occupational / Controlled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/ cm2)	Averaging Time |E|2,|H|2 or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842 / f	4.89 / f	(900 / f)*	6
30-300	61.4	0.163	1.0	6
300-1500			F/300	6
1500-100,000			5	6

(B) Limits for General Population / Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm2)	Averaging Time |E|2,|H|2 or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f)*	30
30-300	27.5	0.073	0.2	30
300-1500			F/1500	30
1500-100,000			1.0	30

F = frequency in MHz

*Plane-wave equivalent power density

5.11.2. MPE Calculation Method

$$\text{E (V/m)} = \frac{\sqrt{30 \times P \times G}}{d} \qquad \text{Power Density: } Pd \text{ (mW/cm}^2\text{)} = \frac{E^2}{377}$$

E = Electric field (V/m)

P = Peak RF output power (mW)

G = EUT Antenna numeric gain (numeric)

d = Separation distance between radiator and human body (m)

The formula can be changed to

$$Pd = \frac{30 \times P \times G}{377 \times d^2}$$

From the peak EUT RF output power, the minimum mobile separation distance, d=20cm, as well as the gain of the used antenna, the RF power density can be obtained.

5.11.3. Calculated Result and Limit

Channel No.	Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm2)	Limit of Power Density (S) (mW/cm2)
Channel 00	2.00	1.58	3.50	2.24	0.53	20
Channel 39	2.00	1.58	2.89	1.95	0.50	20
Channel 78	2.00	1.58	1.53	1.42	0.42	20

From the calculated result shown in above table, the power density is lower than limit at location 20cm far away.

6. List of Measuring Equipments Used

Items	Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
1	EMC Receiver	R&S	ESCS 30	100132	9 KHz – 2.75 GHz	Jun. 12, 2003	Conduction (CO01-HY)
2	LISN	MessTec	NNB-2/16Z	2001-008	9 KHz – 30 MHz	Apr. 29, 2003	Conduction (CO01-HY)
3	LISN (Support Unit)	MessTec	NNB-2/16Z	2001-009	9 KHz – 30 MHz	Apr. 29, 2003	Conduction (CO01-HY)
4	EMI Filter	LINDGREN	LRE-2060	1004	< 450 Hz	N/A	Conduction (CO01-HY)
5	EMI Filter	LINDGREN	N6006	201052	0 ~ 60 Hz	N/A	Conduction (CO01-HY)
6	RF Cable-CON	Suhner Switzerland	RG223/U	CB029	9KHz~30MHz	Jan. 07, 2003	Conduction (CO01-HY)
7	50 ohm BNC type Terminal	NOBLE	50ohm	TM013	50 ohm	Apr. 24, 2003	Conduction (CO01-HY)
8	3m Semi Anechoic Chamber	SIDT FRANKONIA	SAC-3M	03CH03-HY	30MHz~1GHz 3m	Jun. 21, 2003	Radiation (03CH03-HY)
9	Spectrum analyzer	R&S	FSP40	100004	9KHZ~40GHz	Aug. 23, 2003	Radiation (03CH03-HY)
10	Amplifier	HP	8447D	2944A09072	100KHz – 1.3GHz	Feb. 19, 2003	Radiation (03CH03-HY)
11	Bilog Antenna	SCHAFFNER	CBL6112B	2687	30MHz –2GHz	Dec. 21, 2002	Radiation (03CH03-HY)
12	RF Cable-R03m	Jye Bao	RG142	CB021	30MHz~1GHz	Jan. 02, 2003	Radiation (03CH03-HY)
13	Amplifier	MITEQ	AFS44	879981	100MHz~26.5GHz	Jul. 23, 2003	Radiation (03CH03-HY)
14	Horn Antenna	COM-POWER	3115	6741	1GHz – 18GHz	Apr. 08, 2003	Radiation (03CH03-HY)
15	Turn Table	HD	DS 420	420/650/00	0 ~ 360 degree	N/A	Radiation (03CH03-HY)
16	Antenna Mast	HD	MA 240	240/560/00	1 m - 4 m	N/A	Radiation (03CH03-HY)
17	Horn Antenna	Schwarzbeck	BBHA9170	154	15GHz~40GHz	Jun. 02, 2003	Radiation (03CH03-HY)
18	RF Cable-HIGH	Jye Bao	RG142	CB030-HIGH	1GHz~29.5GHz	Mar. 14, 2003	Radiation (03CH03-HY)
19	RF Cable-HIGH	Jye Bao	RG142	CB030-HIGH	1GHz~29.5GHz	Mar. 14, 2003	Radiation (03CH03-HY)

※ Calibration Interval of instruments listed above is one year.

Items	Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
1	Spectrum analyzer	R&S	FSP7	838858/014	9KHZ~7GHZ	Sep. 03, 2003	Conducted
2	Power meter	R&S	NRVS	100444	DC~40GHz	May 28, 2003	Conducted
3	Power sensor	R&S	NRV-Z55	100049	DC~40GHz	May 28, 2003	Conducted
4	Power Sensor	R&S	NRV-Z32	100057	30MHz-6GHz	May 28, 2003	Conducted
5	AC power source	HPC	HPA-500W	HPA-9100024	AC 0~300V	May 27, 2003	Conducted
6	AC power source	G.W.	GPC-6030D	C671845	DC 1V~60V	Nov. 06, 2003	Conducted
7	Temp. and Humidity Chamber	KSON	THS-C3L	612	N/A	Oct. 01, 2003	Conducted
8	RF CABLE-1m	Jye Bao	RG142	CB034-1m	20MHz~7GHz	Jan. 01, 2003	Conducted
9	RF CABLE-2m	Jye Bao	RG142	CB035-2m	20MHz~1GHz	Jan. 01, 2003	Conducted