

FCC TEST REPORT

for

47 CFR, Part 15, Subpart C

Equipment : Bluetooth Modem
Model No. : BT56R-B(N)
FCC ID : NLFBT56R-BN
Filing Type : Certification
Applicant : **Billionton Systems Inc.**
No. 21, Sui-Lih Rd., Hsin-Chu, Taiwan

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SPORTON International Inc.

6F, No.106, Sec. 1, Hsin Tai Wu Rd., Hsi Chih, Taipei Hsien, Taiwan, R.O.C.

SPORTON International Inc.

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History of this test report

Original Report Issue Date: Feb. 10, 2003

No additional attachment.

Additional attachment were issued as following record:

Attachment No.	Issue Date	Description

CERTIFICATE OF COMPLIANCE

for

47 CFR, Part 15, Subpart C

Equipment : Bluetooth Modem
Model No. : BT56R-B(N)
FCC ID : NLFBT56R-BN
Filing Type : Certification
Applicant : **Billionton Systems Inc.**
No. 21, Sui-Lih Rd., Hsin-Chu, Taiwan

I HEREBY CERTIFY THAT:

The measurements shown in this test report were made in accordance with the procedures given in **ANSI C63.4 - 1992** and the equipment under test was **passed** all test items required in FCC Part 15 subpart C, relative to the equipment under test. Testing was carried out on Jan. 23, 2003 at **SPORTON International Inc. LAB.**



K. J. Lin
Manager

SPORTON International Inc.

6F, No.106, Sec. 1, Hsin Tai Wu Rd., Hsi Chih, Taipei Hsien, Taiwan, R.O.C.

1. General Description of Equipment under Test

1.1. Applicant

Billionton Systems Inc.
No. 21, Sui-Lih Rd., Hsin-Chu, Taiwan

1.2. Manufacturer

Same as 1.1

1.3. Basic Description of Equipment under Test

Equipment	: Bluetooth Modem
Model No.	: BT56R-B(N)
FCC ID	: NLFBT56R-BN
Trade Name	: Billionton
Telephone Cable	: Non-Shielded, 10 m
RS-232 Cable	: Shielded, 1.15 m
AC Power Cord	: Wall-mount, 2pin
DC Power Cable	: Non-Shield, 1.8m

1.4. Feature of Equipment under Test

V90 Modem Feature

Data modem

ITU-T V9.0 and K56flex

V.34 (33.6 kbps), V.32 bis, V.32, V.22 bis, V.22, V.23, and V. 21; Bell 212A and 103

V.42 LAPM, MNP 2-4, and MNP 10 error correction

V.42 bis and MNP 5 data compression

MNP 10ECTM enhanced cellular performance

V.250 and V.251 commands

Fax modem send and receive rates up to 14.4 kbps

V.17, V.29, V.27 ter, and V.21 channel 2

EIA/TIA 578 Class 1 and T.31 Class 1.0, and EIA/TIA 578 Class 2 commands

V.80 synchronous access mode supports host-based communication protocols with H.324 interface support.

Telephony/TAM , V.253 commands

2-bit and 4-bit Conexant ADPCM, 8-bit linear PCM, and 4-bit IMA coding

8 kHz sample rate , Concurrent DTMF and Ring

Communication software compatible AT command sets

3.3V low power consumption.

Flow control and speed buffering

Automatic format/speed sensing

V.22bis fast connect

Built-in host/DTE interface with speeds up to 230.4 kbps

Serial sync / Async data; parallel Async data

Bluetooth or D-SUB9 interface Switch

Provides LEDs for showing status information.

Meets worldwide DC VI Masks requirements

Bluetooth Feature

Using BlueCore2-External in conjunction with a host ARM processor.

The Bluetooth stack software is split at the conventional HCI point

Bluetooth Specification V1.X

CSR Blue Core2 , External Signal chip Bluetooth System.

Full speed Class2(1) .

Full embedded to RF COMM

Virtually Class 1 performance with no external power amplifier

System support Windows TM , Windows98SE, Windows Millenium, Windows

NT or Windows 2000. and Windows XP.

Authentication is a mandatory feature of the Dial-up Networking and fax profiles.

ADAPTOR : MW48-0602100 / I/P:120VAC / 60Hz / 25W

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

2. Test Configuration of Equipment under Test

2.1. Test Manner

- a. The EUT has been associated with Notebook PC and peripherals pursuant to ANSI C63.4-1992 and configuration operated in a manner which tended to maximize its emission characteristics in a typical application.
- b. The complete test system included remote workstation, LOGITECH PS/2 Keyborad, LOGITECH USB MOUSE, HP Printer, ViewSonic Monitor, Dell Notebook and EUT for EMI test. The remote workstation included Dell Notebook.
- b. The EUT can operate on 78 channels from 2402.0MHz to 2483MHz. (as listed in section 1.4). According to 15.31(m), three channels (one near top, one near middle and one near bottom) were performed as following:
Mode 1: 2402MHz Channel 00
Mode 2: 2441MHz Channel 39
Mode 3: 2480MHz Channel 78
- c. Frequency range investigated: conduction 150 KHz to 30 MHz, radiation 30 MHz to 24.83GHz.

2.2. Description of Test System

Support Unit 1. -- PS/2 Keyboard (LOGITECH) -- for local workstation

FCC ID	: N/A
Model No.	: Y-\$J17
Serial No.	: SP0054
Data Cable	: Shielded, 360 degree via metal backshells, 1.7m
Remark	: This support device was tested to comply with FCC standards and authorized under a declaration of conformity.

Support Unit 2. -- USB Mouse (LOGITECH) -- for local workstation

FCC ID	: N/A
Model No.	: M-BE58
Serial No.	: SP0041
Data Cable	: Shielded, 1.7m

Support Unit 3. -- Printer (HP) -- for local workstation

FCC ID	: B94C2642X
Model No.	: DJ 400
Power Supply Type	: Linear
Power Cord	: Non-Shielded
Serial No.	: SP0014
Data Cable	: Shielded, 360 degree via metal backshells, 1.35m

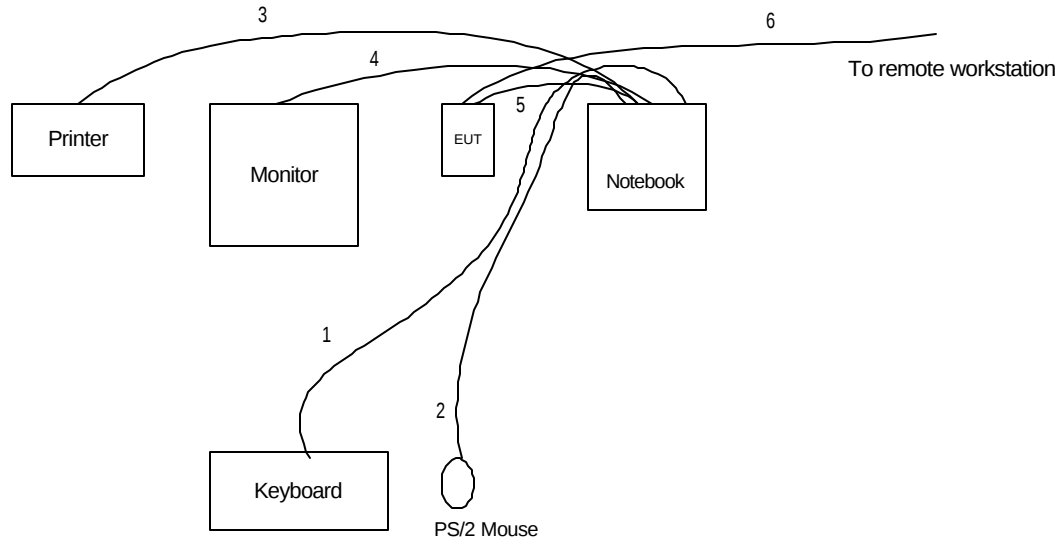
Support Unit 4. -- Monitor (VIEWSONIC) -- for local workstation

FCC ID : N/A
Model No. : VCDTS21553-3P
Power Supply Type : Switching
Power Cord : Non-Shielded
Serial No. : SP0051
Data Cable : Shielded, 1.7m
Remark : This support device was tested to comply with FCC standards and authorized under a declaration of conformity.

Support Unit 5. -- Notebook (DELL) -- for local and remote workstation

FCC ID : N/A
Model No. : PP01L
Power Supply Type : Switching
Power Cord : Non-Shielded
Serial No. : SP0037
Remark : This support device was tested to comply with FCC standards and authorized under a declaration of conformity.

2.3. Connection Diagram of Test System



1. The I/O cable is connected from Notebook to the support unit 1.
2. The I/O cable is connected from Notebook to the support unit 2.
3. The I/O cable is connected from Notebook to the support unit 3.
4. The I/O cable is connected from Notebook to the support unit 4.
5. The I/O cable is connected from EUT to the support unit 5 .
6. The RJ-11 cable is connected from EUT to the remote workstation.

3. General Information of Test

3.1. Test Facility

Test Site Location : No. 52, Hwa Ya 1St Road, Hwa Ya Technology Park,
Kwei-Shan Hsiang, TaoYuan Hsien, Taiwan, R.O.C.
TEL : 886-3-3273456
FAX : 886-3-3180055
Test Site No. : CO01-HY, 03CH03-HY

3.2. Test Voltage

115V/60Hz

3.3. Standard for Methods of Measurement

ANSI C63.4-1992

3.4. Test in Compliance with

FCC Part 15, Subpart C

3.5. Frequency Range Investigated

- a. Conduction: from 150 kHz to 30 MHz
- b. Radiation: from 30 MHz to 24.83GHz

3.6. Test Distance

The test distance of radiated emission from antenna to EUT is 3 M.

4. Report of Measurements and Examinations

4.1. List of Measurements and Examinations

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

4.2. Hopping Channel Separation

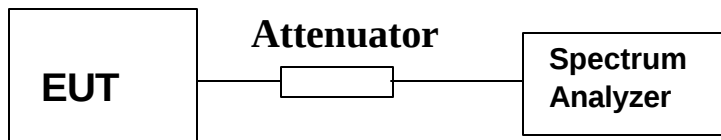
4.2.1. Measuring Instruments

As described in chapter 6 of this test report.

4.2.2. 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 Separation is defined as the channel is separated with the next channel.

4.2.3. Test Setup Layout

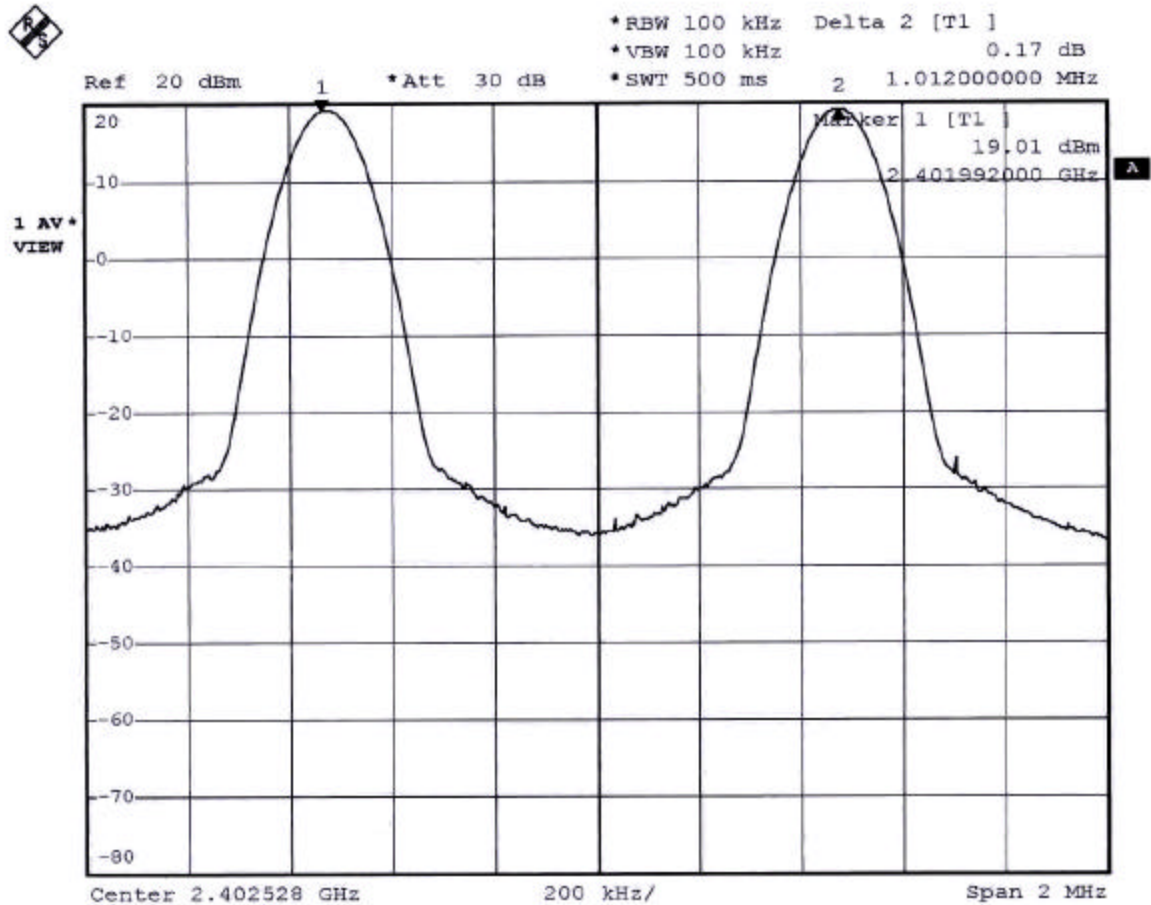


4.2.4. Test Result The spectrum analyzer plots are attached as below

- Temperature: 20°C
- Relative Humidity: 53 %
- Duty cycle of the equipment during the test X 36%
-

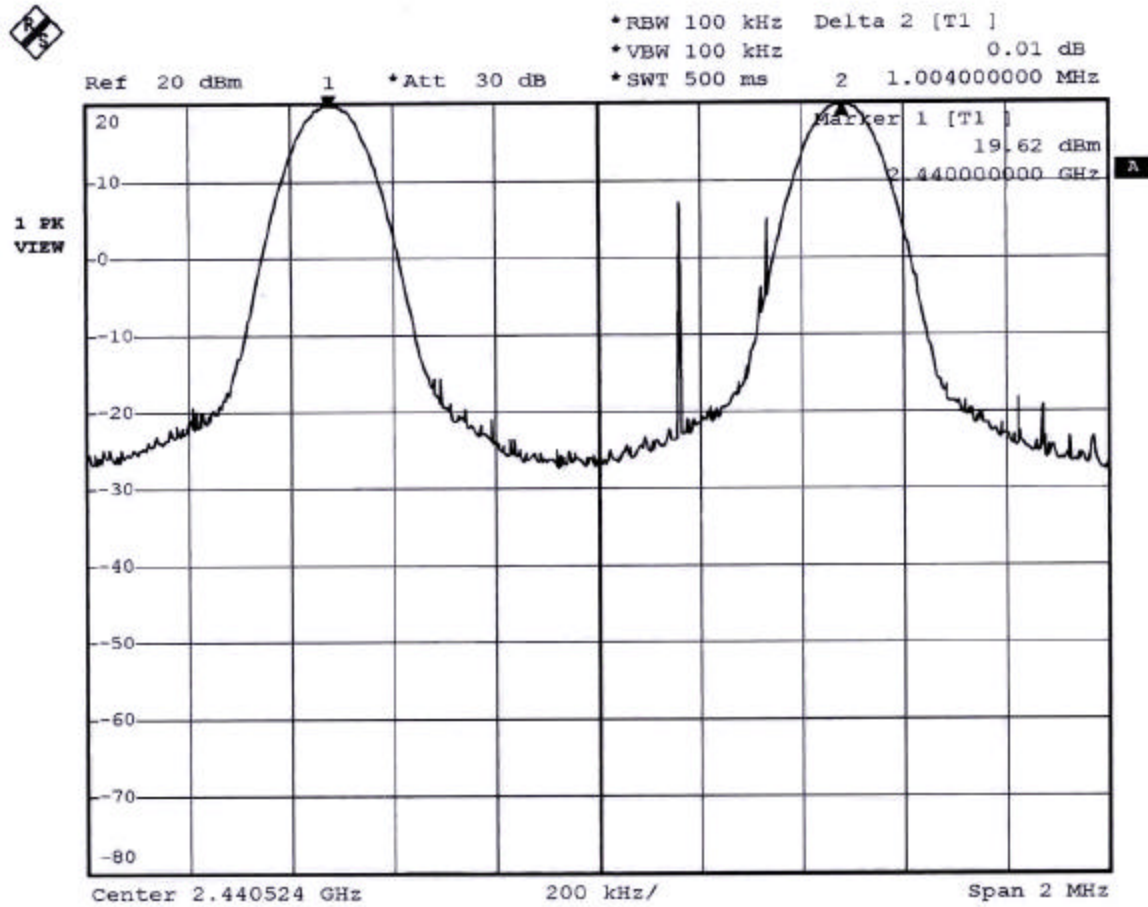
Channel	Frequency (MHz)	Hopping Channel Separation (KHz)	Limits (KHz)	Plot Ref. No.
00	2402	1.0120	25	1
39	2441	1.0040	25	2
78	2480	1.0000	25	3

Plot 1 (Channel 00)



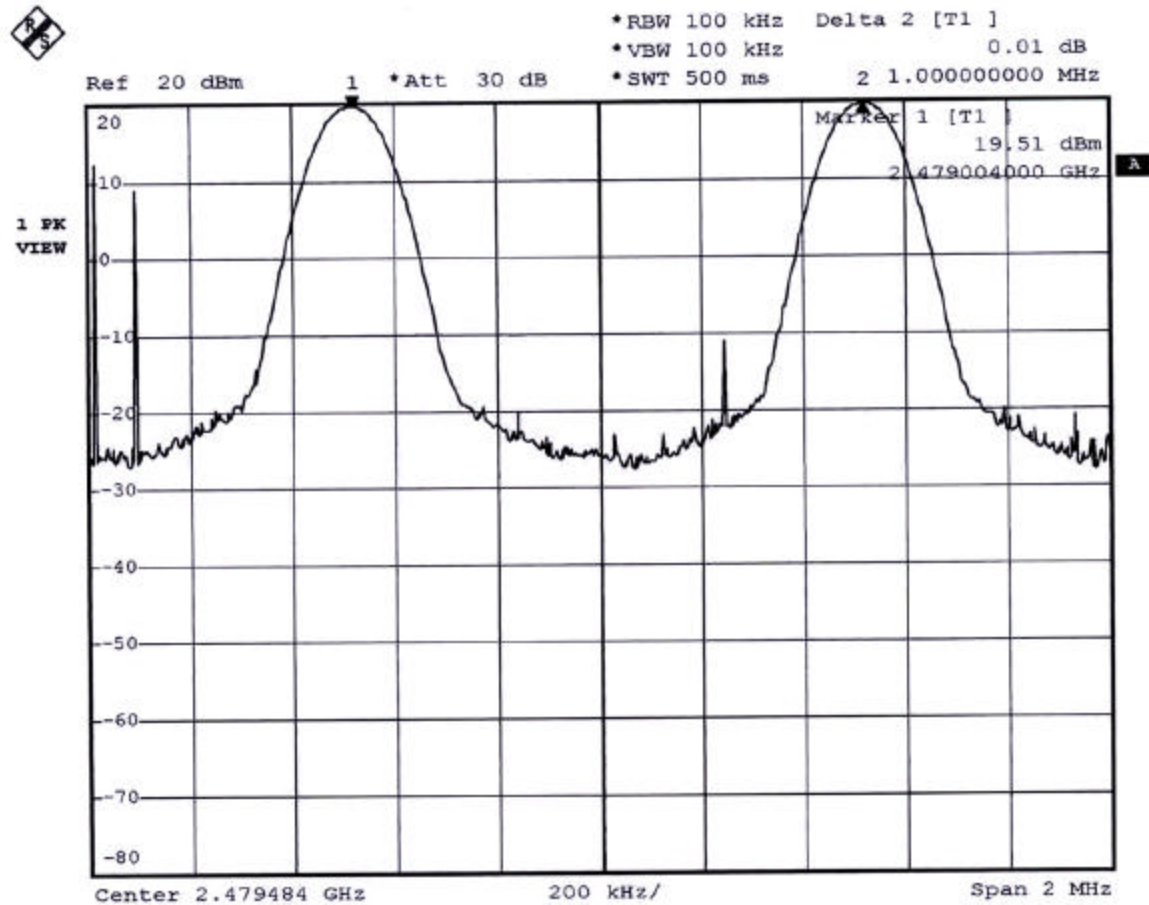
Date: 21.JAN.2003 20:15:12

Plot 2 (Channel 39)



Date: 21.JAN.2003 20:34:47

Plot 3 (Channel 78)



Date: 21.JAN.2003 20:32:09

4.2.5. Test Configuration EUT Operating Condition

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

4.3. Number of Hopping Frequency

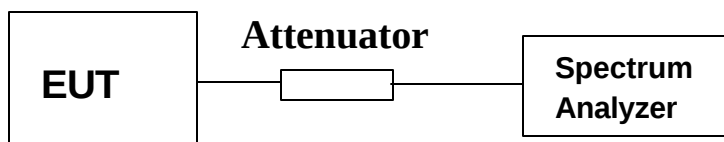
4.3.1. Measuring Instruments

As described in chapter 6 of this test report.

4.3.2. 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 number of hopping frequency used is defined as the device has the numbers of total channel.

4.3.3. Test Setup Layout

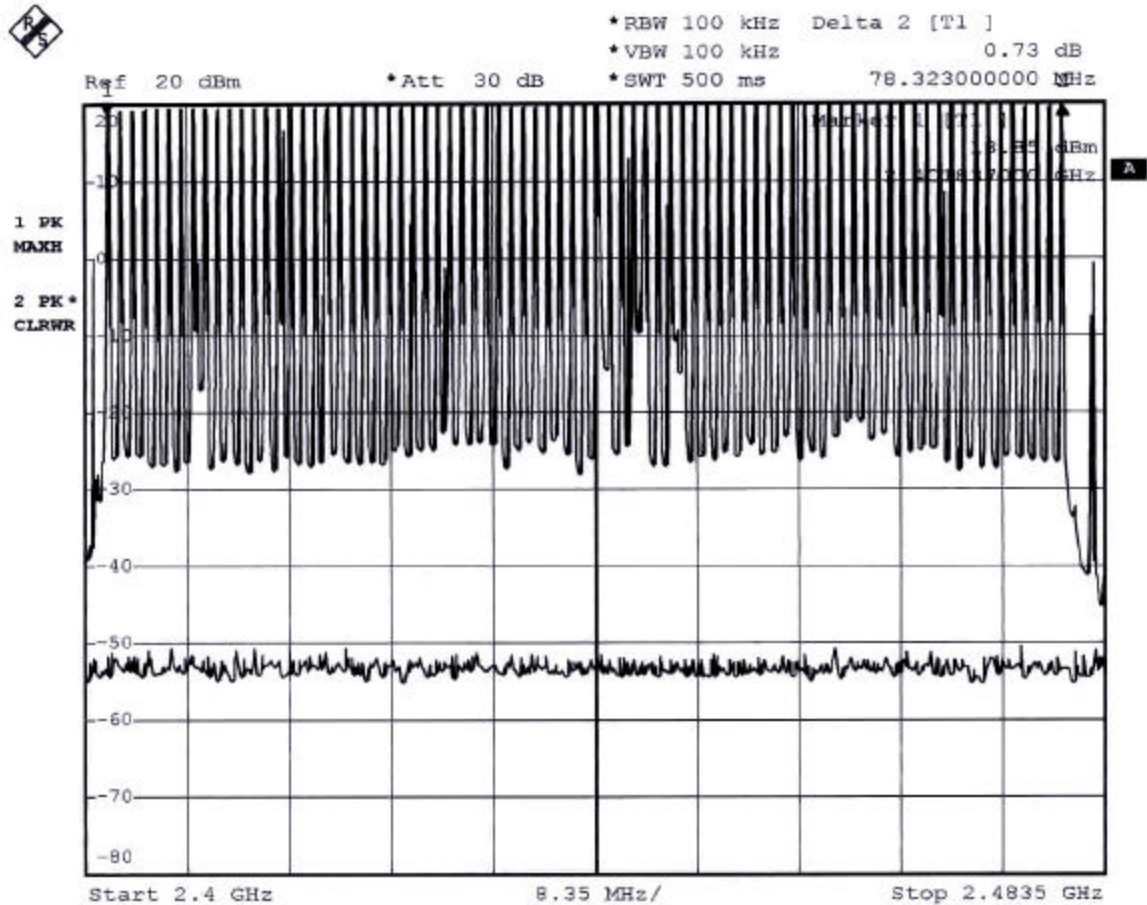


4.3.4. Test Result See spectrum analyzer plots below

- Temperature: 20°C
- Relative Humidity: 53 %
- Duty cycle of the equipment during the test X 36%

Number of Hopping Frequency (Channel)	Limits (Channel)	Plot Ref. No.
79	75	1

Plot 1



Date: 21.JAN.2003 20:45:09

4.4. Hopping Channel Bandwidth

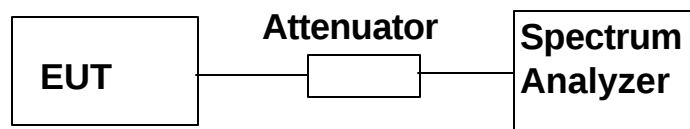
4.4.1. Measuring Instruments

As described in chapter 6 of this test report.

4.4.2. 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.

4.4.3. Test Setup Layout

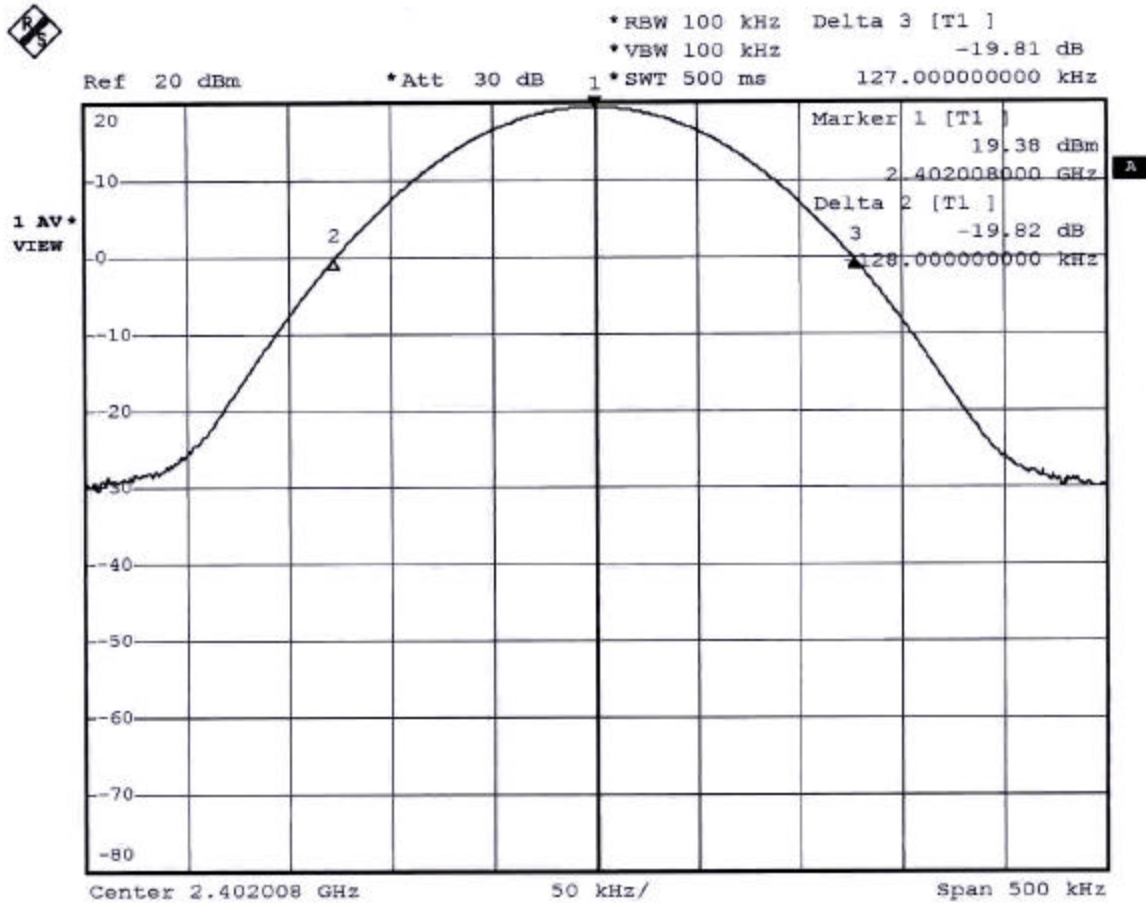


4.4.4. Test Result See spectrum analyzer plots below

- Temperature: 20°C
- Relative Humidity: 53 %
- Duty cycle of the equipment during the test X 36%

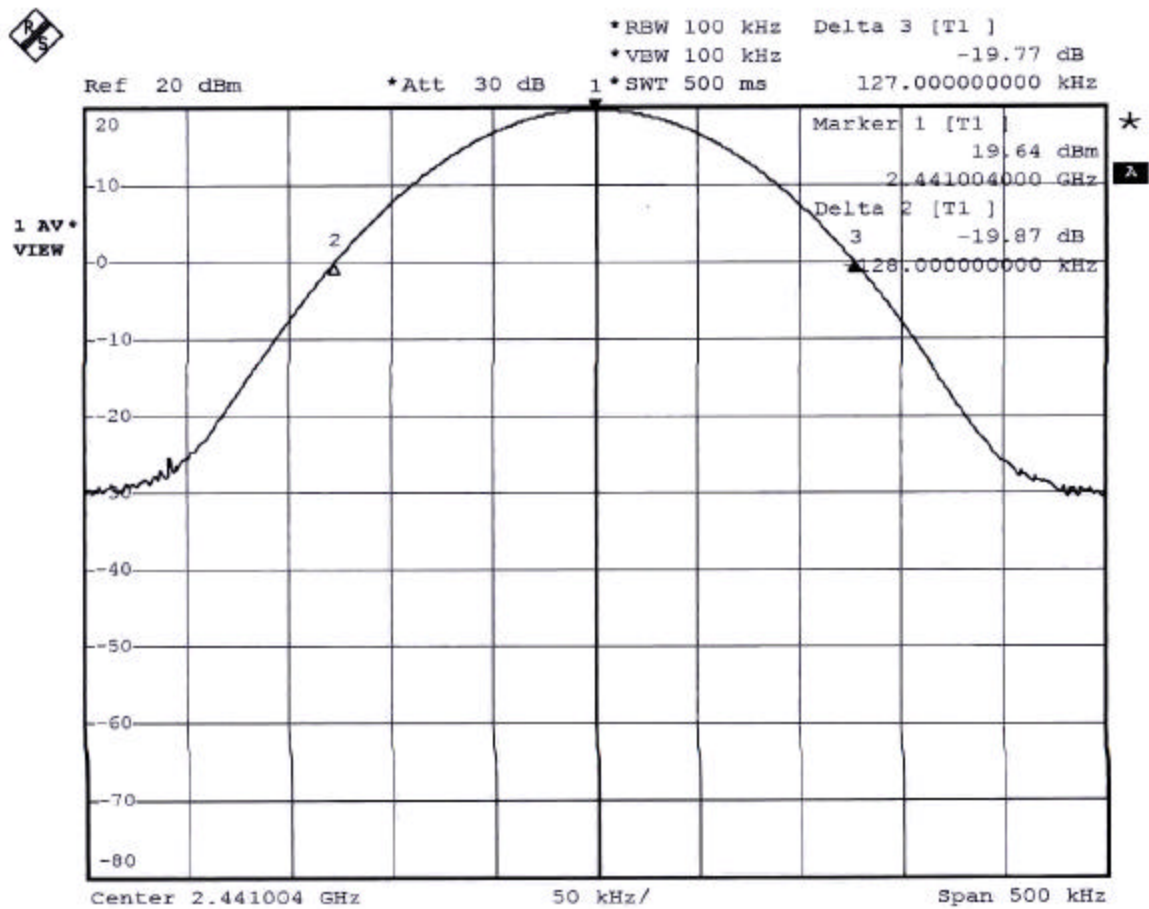
Channel	Frequency (MHz)	Hopping Channel Bandwidth (KHz)	Limits (KHz)	Plot Ref. No.
00	2402	0.2550	1000	1
39	2441	0.2550	1000	2
78	2480	0.3190	1000	3

Plot 1 (Channel 00)



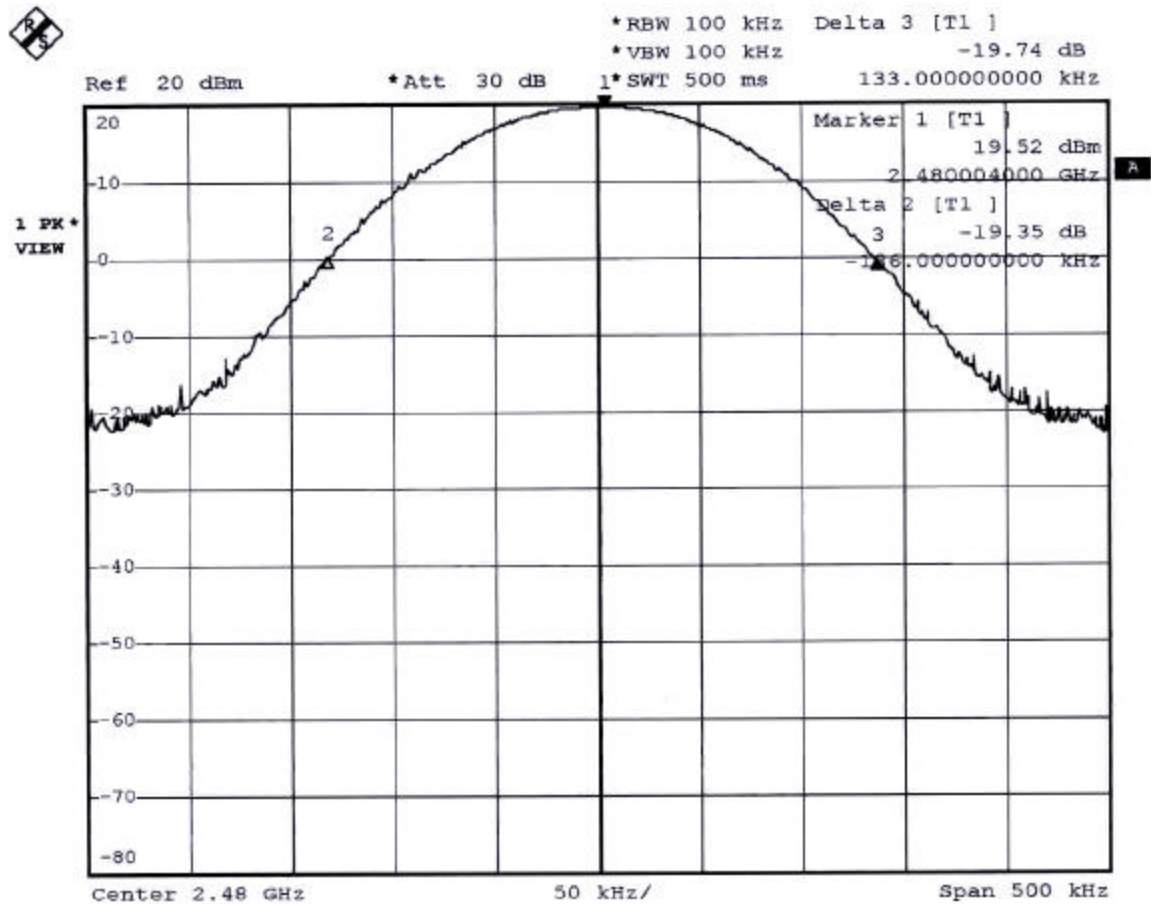
Date: 21.JAN.2003 20:07:04

Plot 2 (Channel 39)



Date: 21.JAN.2003 20:21:41

Plot 3 (Channel 78)



Date: 21.JAN.2003 20:30:19

4.4.5. Test Configuration EUT Operating Condition

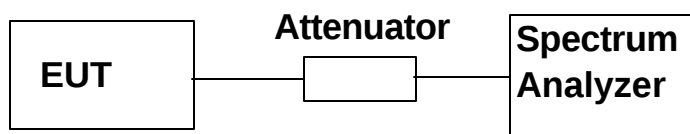
Same as Section 4.2.5.

4.5. Dwell Time of Each Frequency within a 30 Seconds Period**4.5.1. Measuring Instruments**

As described in chapter 6 of this test report.

4.5.2. Test Procedure

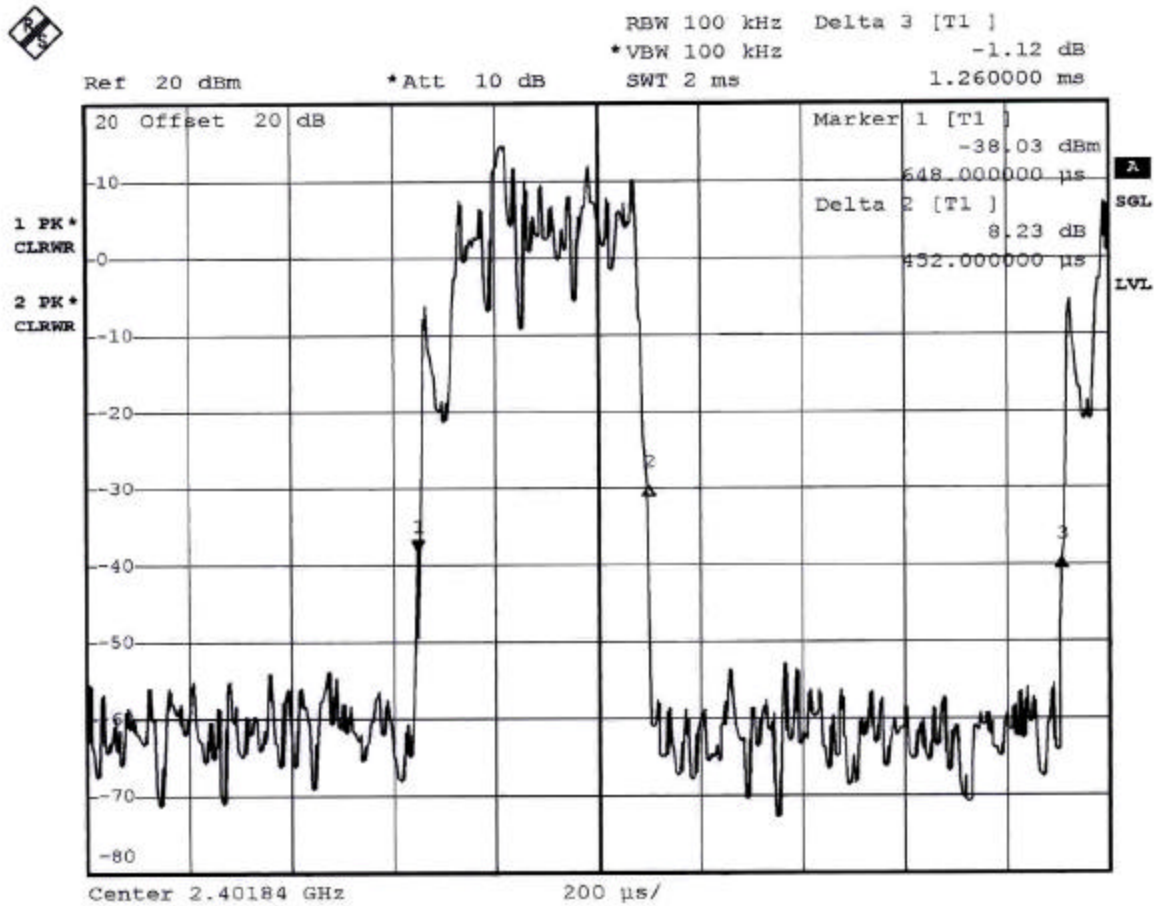
1. The transmitter output was connected to the spectrum analyzer through an attenuator.
2. Set RBW of spectrum analyzer to 100KHz and VBW to 100KHz.
3. Set the center frequency on any frequency would be measure and set the frequency span to zero span.

4.5.3. Test Setup Layout**4.5.4. Test Result** See spectrum analyzer plots below

- Temperature: 20°C
- Relative Humidity: 53 %
- Duty cycle of the equipment during the test X 36%

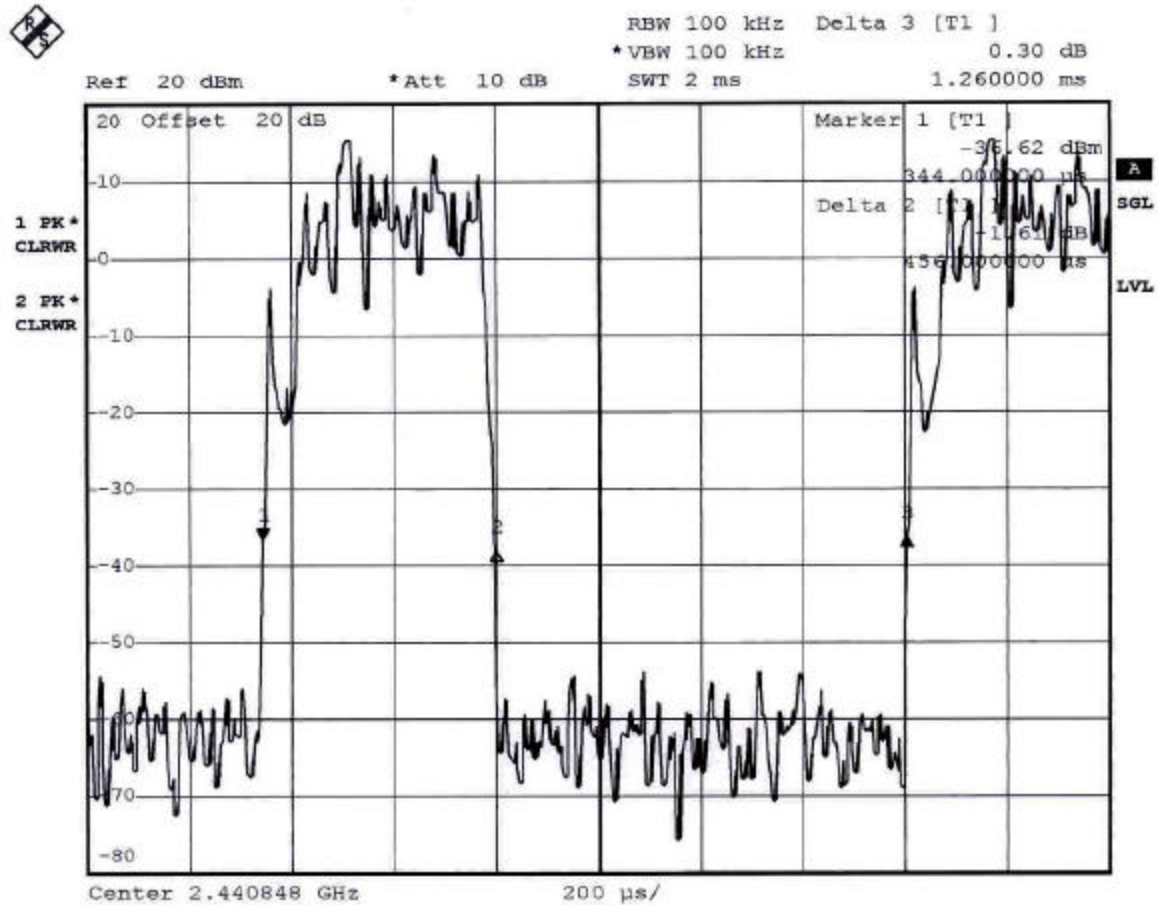
Channel	Frequency	Dwell Time	Limits	Plot
	(MHz)	(s)	(s)	Ref. No.
00	2402	0.136226643	0.4	1
39	2441	0.137432188	0.4	2
78	2480	0.137432188	0.4	3

Plot 1 (Channel 00)



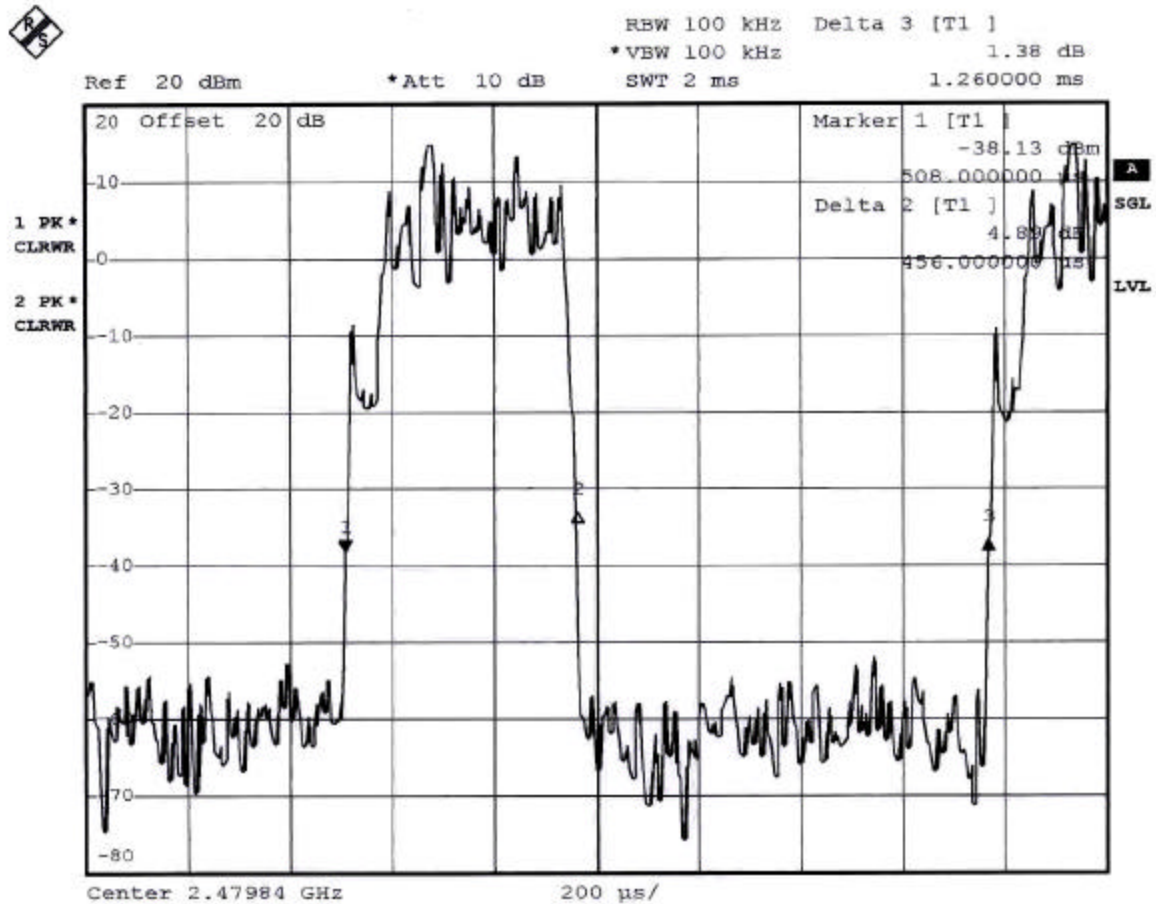
Date: 30.JAN.2003 14:40:55

Plot 2 (Channel 39)



Date: 30.JAN.2003 14:39:55

Plot 3 (Channel 78)



Date: 30.JAN.2003 14:41:51

4.5.5. Test Configuration EUT Operating Condition

Same as Section 4.2.5.

4.6. Output Power

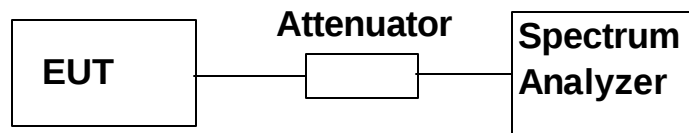
4.6.1. Measuring Instruments

As described in chapter 6 of this test report.

4.6.2. Test Procedure

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 using 1MHz RBW and 1MHz VBW.
3. Use the channel power function of the spectrum analyzer to measured peak output power.
4. The channel bandwidth set 1MHz.

4.6.3. Test Setup Layout



4.6.4. Test Result See spectrum analyzer plots below

- Temperature: 20°C
- Relative Humidity: 53 %
- Duty cycle of the equipment during the test X 36%

Channel	Frequency	Measured Output Power	Measured Output Power	Limits
	(MHz)	(mWatt)	(dBm)	(Watt/dBm)
00	2402	84.53	19.27	1W/30 dBm
39	2441	92.47	19.66	1W/30 dBm
78	2480	91.62	19.62	1W/30 dBm

4.6.5. Test Configuration EUT Operating Condition

Same as Section 4.2.5.

4.7. 100KHz Bandwidth of Frequency Band Edges**4.7.1. Measuring Instruments**

As described in chapter 6 of this test report.

4.7.2. 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.

4.7.3. Test Result

Test Result in lower band (Channel 00)	PASS
Test Result in higher band(Channel 78)	PASS

4.7.4. Note on Band edge Emission

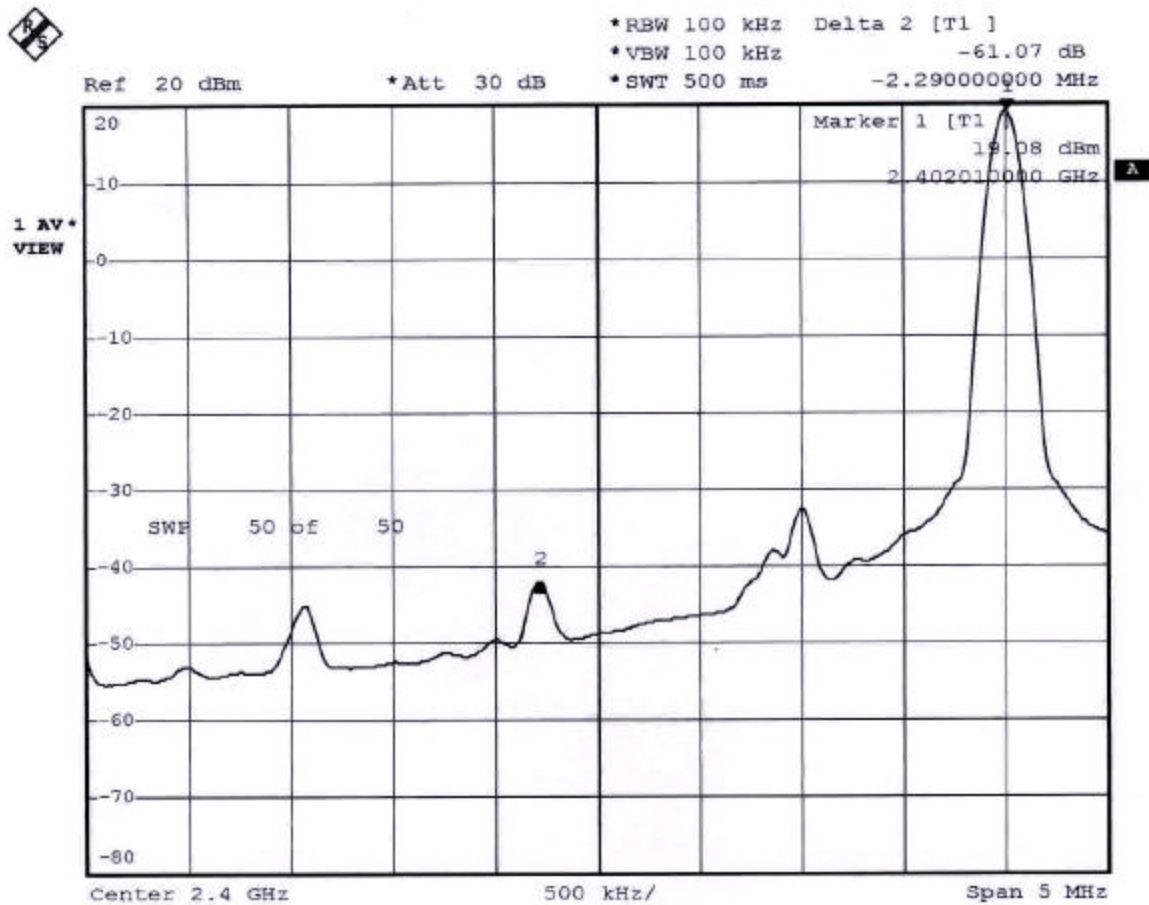
The band edge emission plot on page 37. shows 45.10dB delta between carrier maximum power and local maximum emission in the restricted band (2.4835GHz).

Polarity	The emission of carrier power strength (dB V/m)	The maximum field strength in restrict band (dB V/m)	Limit (dB V/m)	Margin (dB)	Detector	Result
V	67.27	7.61	74.00	-66.39	Peak	Pass
V	58.45	-1.21	54.00	-55.21	Average	Pass
H	69.77	10.11	74.00	-63.89	Peak	Pass
H	60.51	0.85	54.00	-53.15	Average	Pass

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.

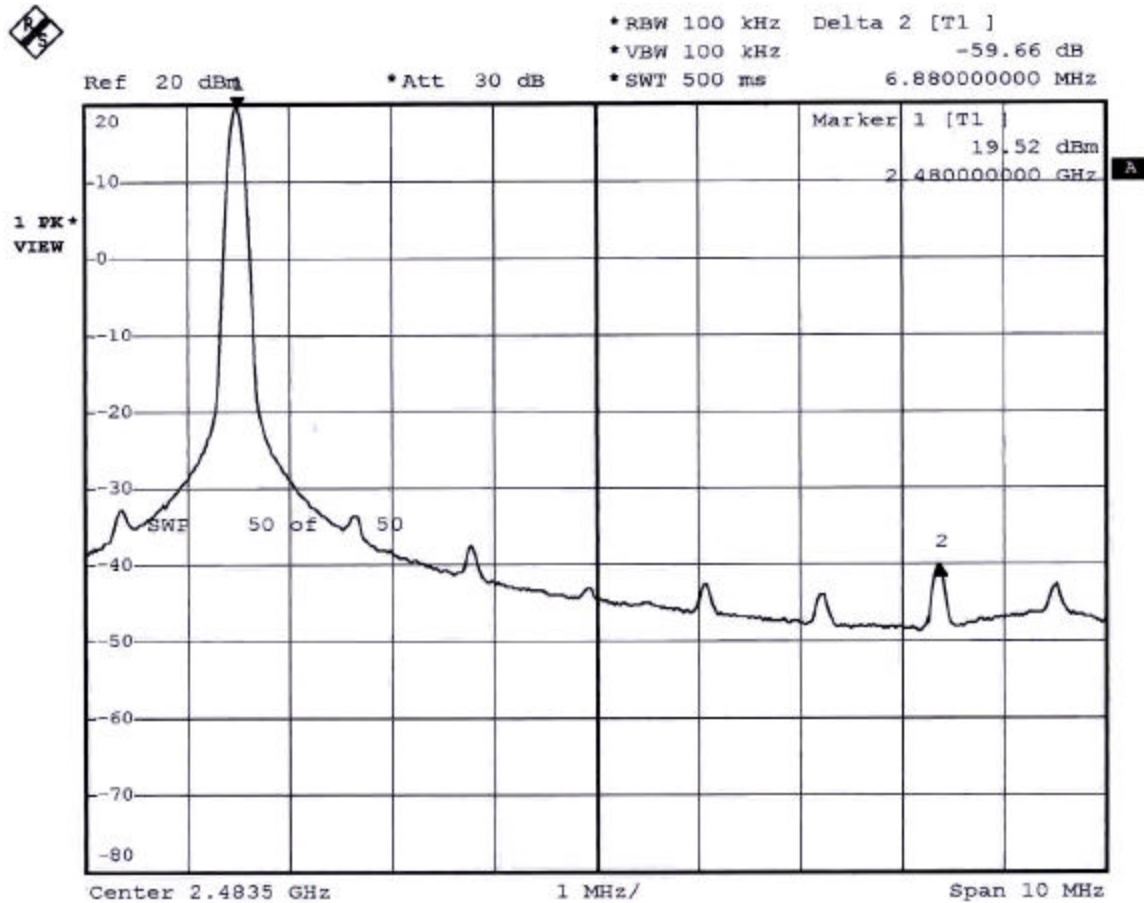
The spectrum analyzer plots are attached as below

Plot 1 (Channel 00)



Date: 21.JAN.2003 20:17:12

Plot 2 (Channel 78)



Date: 21.JAN.2003 20:33:22

Comments All emissions in those 100kHz bandwidth are attenuated more then 20dB from the carrier.

4.7.5. Test Configuration EUT Operating Condition

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

4.8. Test of Conducted Emission

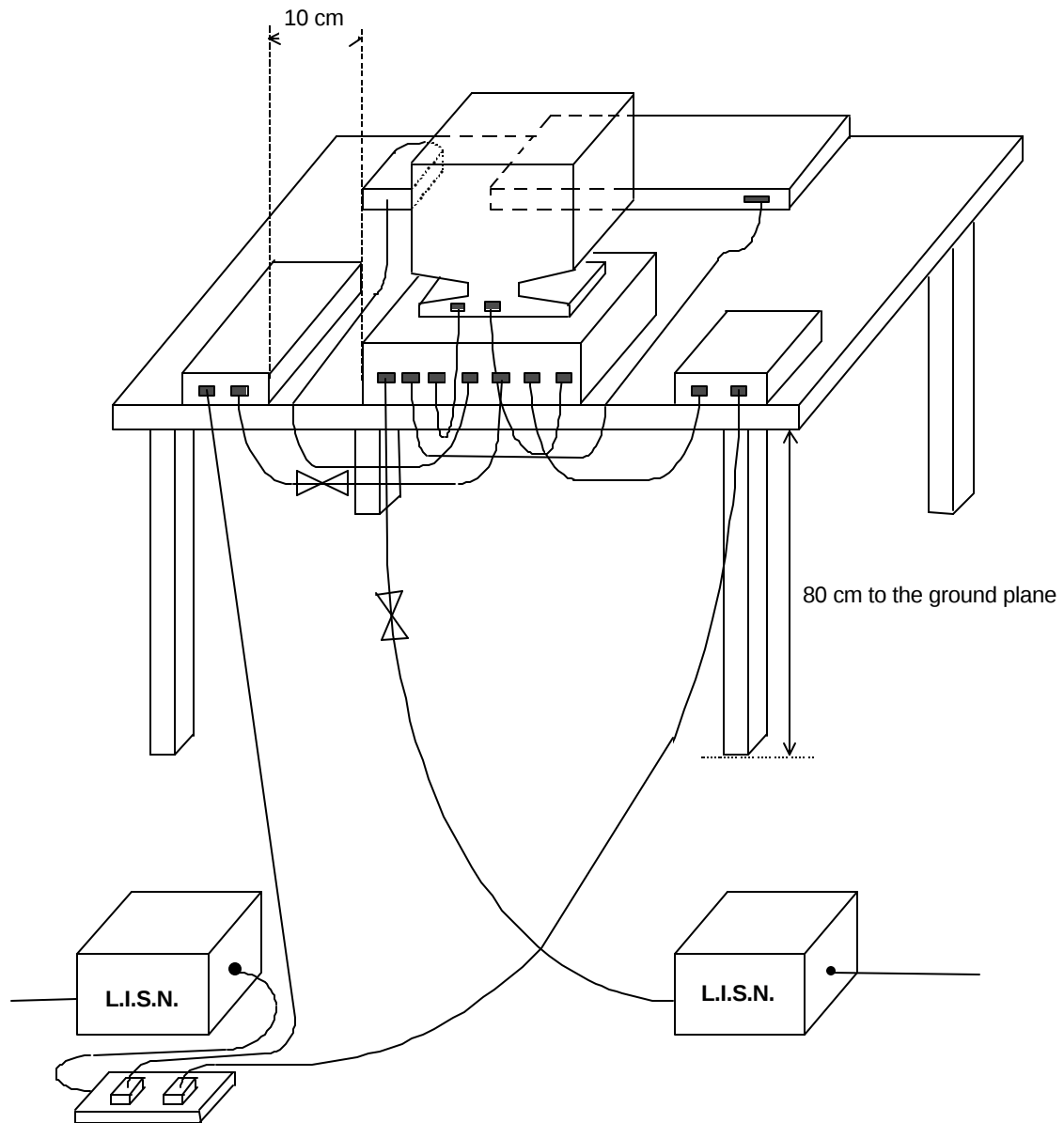
Conducted Emissions were measured from 150 kHz to 30 MHz with a bandwidth of 9 KHz and return leads of the EUT according to the methods defined in ANSI C63.4 -1992 Section 3.1. The EUT was placed on a nonmetallic stand in a shielded room 0.8 meters above the ground plane as shown in section 4.5.3. The interface cables and equipment positioning were varied within limits of reasonable applications to determine the position produced maximum conducted emissions.

4.8.1. Major Measuring Instruments

Test Receiver	HP 8591EM
Attenuation	10 dB
Start Frequency	0.15 MHz
Stop Frequency	30 MHz
IF Bandwidth	9 kHz

4.8.2. Test Procedures

- a. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
- b. Connect EUT to the power mains through a line impedance stabilization network (LISN).
- c. All the support units are connect to the other LISN.
- d. The LISN provides 50 ohm coupling impedance for the measuring instrument.
- e. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
- f. Both sides of AC line were checked for maximum conducted interference.
- g. The frequency range from 150 kHz to 30 MHz was searched.
- h. Set the test-receiver system to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.



4.8.4. Test Software

1. EMCTEST Software
2. CSR Bluetooth TEST Software (Blue Suit)

4.8.5. Test Result of Conducted Emission

- Test Mode: Mode 1 (CH00)
- 6dB Bandwidth: 10KHz
- Temperature: 20°C
- Relative Humidity: 53 %
- Test Date: Jan. 23, 2003

The test was passed at the minimum margin that marked under gray area in the following table

Frequency (MHz)	Line or Neutral	Meter Reading		Limits		Margin	
		Q.P. (dBuV)	A.V. (dBuV)	Q.P. (dBuV)	A.V. (dBuV)	Q.P. (dB)	A.V. (dB)
0.162	L	40.18	18.31	65.36	55.36	-25.18	-37.05
0.195	L	38.06	13.59	63.82	53.82	-25.76	-40.23
0.336	L	35.15	23.07	59.30	49.30	-24.15	-26.23
0.491	L	32.93	16.34	56.15	46.15	-23.22	-29.81
0.672	L	31.79	23.94	56.00	46.00	-24.21	-22.06
1.110	L	25.27	6.02	56.00	46.00	-30.73	-39.98
0.166	N	39.58	15.05	65.16	55.16	-25.58	-40.11
0.336	N	33.53	25.19	59.30	49.30	-25.77	-24.11
0.440	N	30.61	8.73	57.06	47.06	-26.45	-38.33
0.672	N	30.17	25.38	56.00	46.00	-25.83	-20.62
0.938	N	26.26	6.52	56.00	46.00	-29.74	-39.48
12.120	N	15.45	10.52	60.00	50.00	-44.55	-39.48

Test Engineer :

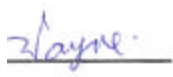

Wayne Hsu

- Test Mode: Mode 2 (CH39)
- Temperature: 20°C
- Relative Humidity: 53 %
- Test Date: Jan. 23, 2003

The test was passed at the minimum margin that marked under gray area in the following table

Frequency (MHz)	Line or Neutral	Meter Reading		Limits		Margin	
		Q.P. (dBuV)	A.V. (dBuV)	Q.P. (dBuV)	A.V. (dBuV)	Q.P. (dB)	A.V. (dB)
0.161	L	40.95	18.49	65.41	55.41	-24.46	-36.92
0.338	L	35.15	22.67	59.25	49.25	-24.10	-26.58
0.417	L	33.87	14.19	57.51	47.51	-23.64	-33.32
0.495	L	32.90	13.80	56.08	46.08	-23.18	-32.28
0.703	L	30.87	14.11	56.00	46.00	-25.13	-31.89
10.740	L	21.04	16.46	60.00	50.00	-38.96	-33.54
0.160	N	40.83	18.15	65.46	55.46	-24.63	-37.31
0.336	N	34.93	25.60	59.30	49.30	-24.37	-23.70
0.422	N	33.12	17.16	57.41	47.41	-24.29	-30.25
0.494	N	32.32	17.18	56.10	46.10	-23.78	-28.92
0.672	N	31.27	25.33	56.00	46.00	-24.73	-20.67
0.923	N	27.57	7.11	56.00	46.00	-28.43	-38.89

Test Engineer :

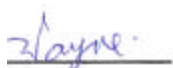

Wayne Hsu

- Test Mode: Mode 3 (CH78)
- 6dB Bandwidth: 10KHz
- Temperature: 20°C
- Relative Humidity: 53 %
- Test Date: Jan. 23, 2003

The test was passed at the minimum margin that marked under gray area in the following table

Frequency (MHz)	Line or Neutral	Meter Reading		Limits		Margin	
		Q.P. (dBuV)	A.V. (dBuV)	Q.P. (dBuV)	A.V. (dBuV)	Q.P. (dB)	A.V. (dB)
0.162	L	40.93	17.76	65.36	55.36	-24.43	-37.60
0.209	L	39.23	13.44	63.24	53.24	-24.01	-39.80
0.336	L	35.05	23.14	59.30	49.30	-24.25	-26.16
0.492	L	32.84	16.56	56.13	46.13	-23.29	-29.57
0.631	L	31.54	12.00	56.00	46.00	-24.46	-34.00
1.010	L	27.42	17.58	56.00	46.00	-28.58	-28.42
0.163	N	40.91	17.69	65.31	55.31	-24.40	-37.62
0.209	N	39.05	14.14	63.24	53.24	-24.19	-39.10
0.336	N	34.73	25.65	59.30	49.30	-24.57	-23.65
0.416	N	33.21	11.30	57.53	47.53	-24.32	-36.23
0.493	N	32.16	18.02	56.12	46.12	-23.96	-28.10
0.704	N	30.21	15.24	56.00	46.00	-25.79	-30.76

Test Engineer :


Wayne Hsu

4.9. Test of Radiated Emission

Radiated emissions from 30 MHz to 24.83 GHz were measured with a bandwidth of 120 kHz according to the methods defined in ANSI C63.4 -1992. The EUT was placed on a nonmetallic stand in the open-field site, 0.8 meter above the ground plane, as shown in section 4.9.3. The interface cables and equipment positions were varied within limits of reasonable applications to determine the positions producing maximum radiated emissions.

4.9.1. Major Measuring Instruments

From 30MHz to 1GHz

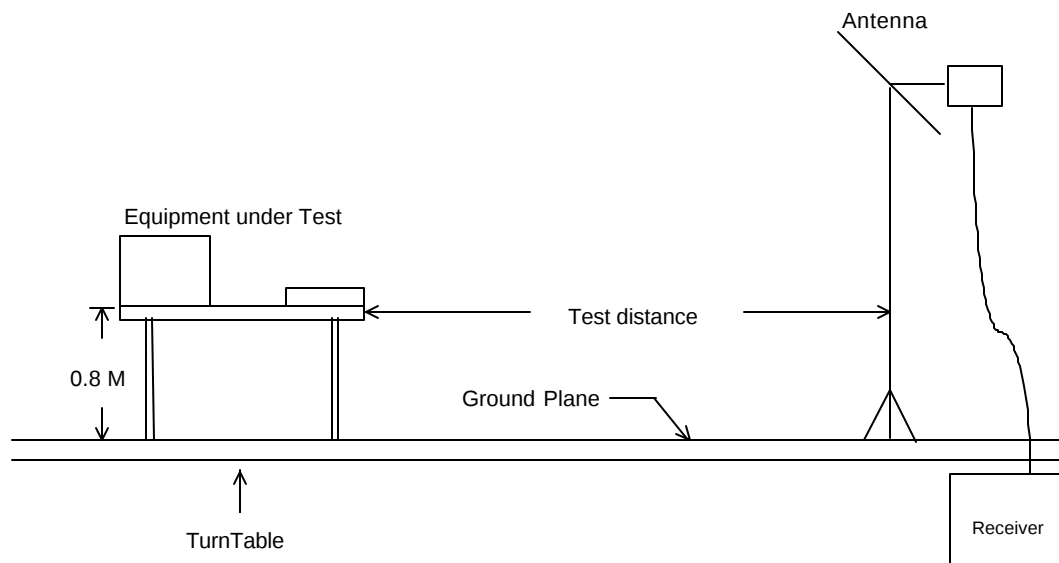
- Amplifier (HP 8447D)
 - RF Gain 30 dB
 - Signal Input 100 KHz to 1.3 GHz
- Spectrum Analyzer (R&S FSP)
 - Attenuation 10 dB
 - Start Frequency 30 MHz
 - Stop Frequency 1000 MHz
 - Resolution Bandwidth 120 KHz
 - Signal Input 9 KHz to 7 GHz

Above 1GHz

- Spectrum analyzer (R&S FSP40)
 - Attenuation 10 dB
 - Start Frequency 1 GHz
 - Stop Frequency 24.83 GHz
 - Resolution Bandwidth 1 MHz
 - Video Bandwidth 1 MHz
 - Signal Input 9 KHz to 40 GHz
- Amplifier (MITEQ AFS44)
 - RF Gain 40 dB
 - Signal Input 100 MHz to 26.5GHz

4.9.2. Test Procedures

1. The EUT was placed on a rotatable table top 0.8 meter above ground.
2. The EUT was set 3 meters from the interference receiving antenna which was mounted on the top of a variable height antenna tower.
3. The table was rotated 360 degrees to determine the position of the highest radiation.
4. The antenna is a broadband antenna and its height is varied between one meter and four meters above ground to find the maximum value of the field strength both horizontal polarization and vertical polarization of the antenna are set to make the measurement.
5. For each suspected emission the EUT was arranged to its worst case and then tune the antenna tower (from 1 M to 4 M) and turn table (from 0 degree to 360 degrees) to find the maximum reading.
6. Set the test-receiver system to Peak or CISPR quasi-peak Detect Function and specified bandwidth with Maximum Hold Mode.
7. 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.
8. 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.

4.9.3. Typical Test Setup Layout of Radiated Emission

4.9.4. Test Result of Radiated Emission

- Frequency Range: 30 - 24835 MHz
- Test Mode: Mode 1 (2402MHz)
- Test Distance: 3 M
- Temperature: 20°C
- Relative Humidity: 53 %
- Test Date: Jan. 22, 2003
- Emission level (dBuV/m) = 20 log Emission level (uV/m)
- Corrected Reading : Antenna Factor + Cable Loss –Pre-Amp.+ Reading = Emission

The test was passed at the minimum margin that marked under gray area in the following table, and its antenna height is 2m, turn table degree is 85°

■ Spurious Emission

- For 30MHz to 1GHz

Frequency (MHz)	Antenna Polarity	Cable Factor	Reading Loss	Limits	Emission	Level	Margin	Detect	
		(dB/m)	(dB)	(dBuV)	(dBuV/m)	(uV/m)	(dBuV/m)	(uV/m)	(dB) Mode
30.810	V	14.92	1.02	17.37	40.00	100	33.31	46.29	-6.69 Peak
52.140	V	6.18	1.34	25.51	40.00	100	33.03	44.82	-6.97 Peak
32.700	H	14.23	1.05	16.66	40.00	100	31.94	39.54	-8.06 Peak
335.000	H	12.52	3.71	20.81	46.00	200	37.04	71.12	-8.96 Peak
383.300	H	14.11	4.01	20.90	46.00	200	39.02	89.33	-6.98 Peak
564.600	H	16.84	5.22	17.57	46.00	200	39.63	95.83	-6.37 Peak

- For above 1GHz

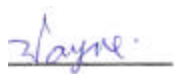
Frequency (MHz)	Antenna Polarity	Cable Factor	Reading Loss	Limits	Emission	Level	Margin	Detect	
		(dB/m)	(dB)	(dBuV)	(dBuV/m)	(uV/m)	(dBuV/m)	(uV/m)	(dB) Mode
2108.000	V	30.89	4.84	6.15	74.00	5012	41.88	124.17	-32.12 Peak
4804.000	V	33.54	7.46	6.56	74.00	5012	47.56	238.78	-26.44 Peak
3924.000	H	31.25	6.78	5.24	74.00	5012	43.27	145.71	-30.73 Peak

■ Field strength of fundamental and harmonics

Frequency	Antenna	Cable	Reading	Limits	Emission	Level	Margin	Detect
Polarity	Factor	Loss						
(MHz)	(dB/m)	(dB)	(dBuV)	(dBuV/m)	(uV/m)	(dBuV/m)	(uV/m)	(dB) Mode
2404.000	V	30.58	5.19	49.75	-	-	85.52	18879.91 Peak
2404.000	V	30.58	5.19	41.09	-	-	76.86	6966.27 Peak
2404.000	H	30.58	5.19	36.05	-	-	71.82	3899.42 Peak
2404.000	H	30.58	5.19	26.88	-	-	62.65	1356.75 Peak
4804.000	V/H					-		AV/ Peak
7206.000	V/H					-		AV/ Peak
9608.000	V/H					-		AV/ Peak
12010.000	V/H					-		AV/ Peak
14412.000	V/H					-		AV/ Peak
16814.000	V/H					-		AV/ Peak
19216.000	V/H					-		AV/ Peak
21618.000	V/H					-		AV/ Peak
24020.000	V/H					-		AV/ Peak

Remark: The emission emitted by the EUT is too low to be measured except the emission listed above,

Test Engineer :



Wayne Hsu

- Frequency Range: 30 - 24835 MHz
- Test Mode: Mode 2 (2441MHz)
- Test Distance: 3 M
- Temperature: 20°C
- Relative Humidity: 53 %
- Test Date: Jan. 22, 2003
- Emission level (dBuV/m) = 20 log Emission level (uV/m)
- Corrected Reading: Antenna Factor + Cable Loss –Pre-Amp.+ Reading = Emission

The Radiated Emission test was passed at minimum margin:

The test was passed at the minimum margin that marked under gray area in the following table, and its antenna height is 2m, turn table degree is 90°

■ Spurious Emission

- For 30MHz to 1GHz

Frequency (MHz)	Antenna Polarity	Cable Factor	Loss	Reading (dBuV)	Limits (dBuV/m)	Emission (uV/m)	Level (dBuV/m)	Margin (uV/m)	Detect (dB)	Mode
52.140	V	6.18	1.34	25.85	40.00	100	33.37	46.61	-6.63	Peak
124.770	V	10.60	2.13	17.20	43.50	150	29.93	31.37	-13.57	Peak
564.600	V	16.84	5.22	12.02	46.00	200	34.08	50.58	-11.92	Peak
351.800	H	13.07	3.87	18.71	46.00	200	35.65	60.60	-10.35	Peak
383.300	H	14.11	4.01	20.17	46.00	200	38.29	82.13	-7.71	Peak
564.600	H	16.84	5.22	18.54	46.00	200	40.60	107.15	-5.40	Peak

- For above 1GHz

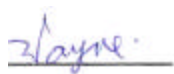
Frequency (MHz)	Antenna Polarity	Cable Factor	Loss	Reading (dBuV)	Limits (dBuV/m)	Emission (uV/m)	Level (dBuV/m)	Margin (uV/m)	Detect (dB)	Mode
4884.000	V	33.79	7.49	8.29	74.00	5012	49.57	300.95	-24.43	Peak
1462.000	H	27.29	3.97	5.15	74.00	5012	36.41	66.15	-37.59	Peak
3806.000	H	31.02	6.62	5.37	74.00	5012	43.01	141.42	-30.99	Peak

■ Field strength of fundamental and harmonics

Frequency	Antenna	Cable	Reading	Limits	Emission	Level	Margin	Detect
Polarity	Factor	Loss						
(MHz)	(dB/m)	(dB)	(dBuV)	(dBuV/m)	(uV/m)	(dBuV/m)	(uV/m)	(dB)
2444.000	V	30.54	5.23	37.48	-	-	73.25	4597.27
								Peak
2444.000	V	30.54	5.23	29.03	-	-	64.80	1737.80
								Peak
2444.000	H	30.54	5.23	36.15	-	-	71.92	3944.57
								Peak
2444.000	H	30.54	5.23	25.62	-	-	61.39	1173.55
								Peak
4882.000	V/H					-		
								AV/ Peak
7323.000	V/H					-		
								AV/ Peak
9764.000	V/H					-		
								AV/ Peak
12205.000	V/H					-		
								AV/ Peak
14646.000	V/H					-		
								AV/ Peak
17087.000	V/H					-		
								AV/ Peak
19528.000	V/H					-		
								AV/ Peak
21969.000	V/H					-		
								AV/ Peak
24410.000	V/H					-		
								AV/ Peak

Remark: The emission emitted by the EUT is too low to be measured except the emission listed above,

Test Engineer :



Wayne Hsu

- Frequency Range: 30 - 24835 MHz
- Test Mode: Mode 3 (2480 MHz)
- Test Distance: 3 M
- Temperature: 20°C
- Relative Humidity: 53 %
- Test Date: Jan. 22, 2003
- Emission level (dBuV/m) = 20 log Emission level (uV/m)
- Corrected Reading : Antenna Factor + Cable Loss –Pre-Amp.+ Reading = Emission

The Radiated Emission test was passed at minimum margin:

The test was passed at the minimum margin that marked under gray area in the following table, and its antenna height is 2m, turn table degree is 90°

■ Spurious Emission

- For 30MHz to 1GHz

Frequency (MHz)	Polarity	Antenna Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Limits (dBuV/m)	(uV/m)	Emission (dBuV/m)	Level (uV/m)	Margin (dB)	Detect Mode
30.810	V	14.92	1.02	16.89	40.00	100	32.83	43.80	-7.17	Peak
52.140	V	6.18	1.34	24.90	40.00	100	32.42	41.78	-7.58	Peak
564.600	V	16.84	5.22	11.76	46.00	200	33.82	49.09	-12.18	Peak
335.000	H	12.52	3.71	20.24	46.00	200	36.47	66.60	-9.53	Peak
383.300	H	14.11	4.01	20.23	46.00	200	38.35	82.70	-7.65	Peak
564.600	H	16.84	5.22	18.26	46.00	200	40.32	103.75	-5.68	Peak

- For above 1GHz

Frequency (MHz)	Polarity	Antenna Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Limits (dBuV/m)	(uV/m)	Emission (dBuV/m)	Level (uV/m)	Margin (dB)	Detect Mode
3972.000	V	31.34	6.84	5.39	74.00	5012	43.57	150.83	-30.43	Peak
1636.000	H	28.47	4.22	5.13	74.00	5012	37.82	77.80	-36.18	Peak

■ Field strength of fundamental and harmonics

Frequency	Antenna	Cable	Reading	Limits			Emission	Level	Margin	Detect
	Polarity	Factor	Loss							
(MHz)		(dB/m)	(dB)	(dBuV)	(dBuV/m)	(uV/m)	(dBuV/m)	(uV/m)	(dB)	Mode
2478.000	V	30.51	5.27	31.49	-	-	67.27	2309.40		Peak
2478.000	V	30.51	5.27	22.67	-	-	58.45	836.57		Peak
2478.000	H	30.51	5.27	33.99	-	-	69.77	3079.64		Peak
2478.000	H	30.51	5.27	24.73	-	-	60.51	1060.47		Peak
4964.000	V	34.03	7.52	10.81	-	-	52.36	414.95		Peak
4964.000	V	34.03	7.52	3.04	-	-	44.59	169.63		Peak
4964.000	H	34.03	7.52	10.10	-	-	51.65	382.38		Peak
4964.000	H	34.03	7.52	3.97	-	-	45.52	188.80		Peak
7440.000	V/H						-			AV/ Peak
9920.000	V/H						-			AV/ Peak
12400.000	V/H						-			AV/ Peak
14880.000	V/H						-			AV/ Peak
17360.000	V/H						-			AV/ Peak
19840.000	V/H						-			AV/ Peak
22320.000	V/H						-			AV/ Peak
24800.000	V/H						-			AV/ Peak

Remark: The emission emitted by the EUT is too low to be measured except the emission listed above,

Test Engineer :


Wayne Hsu

4.10. Antenna Requirements

The EUT use an integral transmitting antenna, which is permitted as the system is intended for professional installation.

4.10.1. Standard Applicable

For intentional device, according to FCC 47 CFR 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.

And according to FCC 47 CFR Section 15.247 (b), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

4.10.2. Antenna Connected Construction

The maximum Gain antenna used in this product is dipole antenna. And Antenna Connected is 1.8dBi .

5. EMI Suppression Component List

No EMI suppression components.

6. Antenna Factor & Cable Loss

Frequency (MHz)	Antenna Factor (dB)	Cable Loss (dB)
30	18.10	0.90
35	16.00	0.90
40	13.19	1.09
45	10.57	1.10
50	8.00	1.21
55	6.30	1.30
60	5.30	1.30
65	4.95	1.40
70	5.19	1.40
75	6.05	1.49
80	6.86	1.50
85	7.94	1.60
90	8.60	1.60
95	9.70	1.60
100	10.26	1.69
110	11.19	1.70
120	11.60	1.81
130	11.42	1.90
140	10.92	1.99
150	10.20	2.00
160	9.20	2.11
170	9.00	2.20
180	8.60	2.29
190	8.70	2.30
200	8.10	2.40
220	8.86	2.51
240	10.70	2.60
260	13.10	2.71
280	12.50	2.80
300	13.00	2.90
320	13.51	3.00
340	13.90	3.10
360	14.43	3.30
380	14.79	3.30
400	15.80	3.40
450	16.37	3.59
500	17.40	3.80
550	18.57	3.90
600	18.50	4.20
650	18.93	4.40
700	19.03	4.40
750	19.84	4.71
800	19.82	4.90
850	20.30	5.00
900	20.32	5.11
950	20.82	5.60
1000	21.20	5.50
1000	24.30	3.28
2000	31.10	4.69
3000	29.60	5.84
4000	30.80	6.87
5000	34.20	7.53
6000	33.30	8.60
7000	37.80	9.33
8000	39.40	9.84
9000	38.40	10.67

7. List of Measuring Equipments Used

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
EMC Receiver	R&S	ESCS 30	100132	9 KHz – 2.75 GHz	Jun. 03, 2002	Conduction (CO01-HY)
LISN	MessTec	NNB-2/16Z	2001-008	9 KHz – 30 MHz	Apr. 30, 2002	Conduction (CO01-HY)
LISN (Support Unit)	MessTec	NNB-2/16Z	2001-009	9 KHz – 30 MHz	Apr. 30, 2002	Conduction (CO01-HY)
EMI Filter	LINDGREN	LRE-2060	1004	< 450 Hz	N/A	Conduction (CO01-HY)
EMI Filter	LINDGREN	N6006	201052	0 ~ 60 Hz	N/A	Conduction (CO01-HY)
Spectrum Analyzer	R&S	FSP	838858/037	9KHz - 7GHz	Jan. 07, 2003	Radiation (03CH03-HY)
Amplifier	HP	8447D	2944A09072	10MHz-1.3GHz	Sep. 25, 2002	Radiation (03CH03-HY)
Bilog Antenna (SH04)	SCHAFFNER	CBL61128	2687	30MHz -2GHz	Dec. 22, 2002	Radiation (03CH03-HY)
Signal Generator	R&S	SMR40	1104.0002.40	10MHz-40GHz	Nov. 09, 2002	Radiation (03CH03-HY)
Halfwave dipole antenna	Schwarzbeck	VHAP/UHAP	995 + 996 1024 + 1025	30 MHz - 1GHz	Sep. 27, 2001	Radiation (03CH03-HY)
Temp. and Humidity Chamber	KSON	THS-C3L	612	N/A	Sep. 27, 2001	Radiation (03CH03-HY)
Turn Table	HD	DS630	CH100011	0 ~ 360 degree	N/A	Radiation
Antenna Mast	HD	MA240	MA240/557	1 m - 4 m	N/A	Radiation (03CH03-HY)

Calibration Interval of instruments listed above is one year.

8. Uncertainty of Test Site

Uncertainty of Radiated Emission Measurement

Contribution	Probability Distribution	3m
Antenna factor calibration	normal(k=2)	1
cable loss calibration	normal(k=2)	0.3
RCV/SPA specification	rectangular	2
Antenna Directivity	rectangular	3
Antenna Factor V.S. Height	rectangular	2
Antenna Factor Interpolation for Frequency	rectangular	0.25
site imperfection	rectangular	2
Mismatch Receiver VSWR $\Gamma_1=0.09$ Antenna VSWR $\Gamma_2=0.67$ Uncertainty= $20\log(1-\Gamma_1\Gamma_2)$	U-shaped	0.54
combined standard uncertainty $U_e(y)$	normal	2.7
Measuring uncertainty for a level of confidence of 95% $U=2U_e(y)$	normal (k=2)	5.4

$$U = \{(1/2)^2 + (0.3/2)^2 + (2^2 + 0.5^2 + 2^2 + 0.25^2 + 2^2)/3 + (0.54)^2/2\} = 2.2 \text{ for 10m test distance}$$

$$U = \{(1/2)^2 + (0.3/2)^2 + (2^2 + 3^2 + 2^2 + 0.25^2 + 2^2)/3 + (0.54)^2/2\} = 2.7 \text{ for 3m test distance}$$

Uncertainty of Conducted Emission Measurement

Contribution	Probability Distribution	150KHz – 30MHz
Cable and I/P attenuator calibration	normal(k=2)	0.3
RCV/SPA specification	rectangular	2
LISN coupling specification	rectangular	1.5
Transducer factor frequency interpolation	rectangular	0.2
Mismatch Receiver VSWR $\Gamma_1=0.09$ LISN VSWR $\Gamma_2=0.33$ Uncertainty= $20\log(1-\Gamma_1\Gamma_2)$	U-shaped	0.2
combined standard uncertainty $U_e(y)$	normal	1.66
Measuring uncertainty for a level of confidence of 95% $U=2U_e(y)$	normal (k=2)	3.32

$$U = \{(0.3/2)^2 + (2^2 + 1.5^2 + 0.2^2)/3 + (0.2)^2/2\} = 1.66$$