FCC TEST REPORT

for

47 CFR, Part 15, Subpart C

Equipment	:	WLAN PCMCIA Adapter
Model No.	:	NWH1021, CNDS11g
FCC ID	:	IOU1021S01
Filing Type	:	Certification
Applicant	:	**National Datacomm Corporation** 4F, NO. 24-2, INDUSTRY EAST 4TH ROAD, SCIENCE PARK, HSINCHU, TAIWAN, R.O.C.

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SPORTON International Inc.

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

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History of this test report

Original Report Issue Date: Feb. 07, 2003

■ No additional attachment.

☐ Additional attachment were issued as following record:

Attachment No.	Issue Date	Description

Certificate No. : F310904

CERTIFICATE OF COMPLIANCE

for

47 CFR, Part 15, Subpart C

Equipment	:	WLAN PCMCIA Adapter
Model No.	:	NWH1021, CNDS11g
FCC ID	:	IOU1021S01
Filing Type	:	Certification
Applicant	:	**National Datacomm Corporation** 4F, NO. 24-2, INDUSTRY EAST 4TH ROAD, SCIENCE PARK, HSINCHU, TAIWAN, R.O.C.

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. 28, 2003 at **SPORTON International Inc.** LAB.

K. J. Lin Feb. 14, 2003

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

National Datacomm Corporation
4F, NO. 24-2, INDUSTRY EAST 4TH ROAD, SCIENCE PARK, HSINCHU, TAIWAN, R.O.C.

1.2. Manufacturer

Same as 1.1.

1.3. Basic Description of Equipment under Test

Equipment	: WLAN PCMCIA Adapter
Model No.	: NWH1021, CNDS11g
FCC ID	: IOU1021S01
Trade Name	: NDC
Power Supply Type	: From Notebook
AC Power Cord	: N/A

1.4. Feature of Equipment under Test

Computer Slot Type	PCMCIA Type II or Type III
Standards	IEEE 802.11b, Wi-Fi compliant
Operating Systems Supported	Microsoft Windows 98/Me/2000/XP
Data Rate	22/11/5.5/2/1 Mbps, with auto fallback
Communication Method	Half-duplex
Security	40/128/256-bit WEP data encryption
LED Indicators	Power, Wireless Activity
Power	Voltage: 3.3V ±5% Power Consumption: 350mA
Dimensions	118 x 54 x 9 mm (L x W x H)
Temperature	Operating: 0 °to 50 ℃ (32 °to 122 °F) Storage: -30 °to 70 ℃ (-22 °to 158 °F)
Humidity	85% at 40 ℃ (104 °F)
Frequency Range	2400MHz~2483.5MHz

2. Test Configuration of Equipment under Test

2.1. Test Manner

a. The EUT has been associated with personal computer 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 LOGITECH USB Mouse, HP Printer, COMPAQ Notebook, VIEWSONIC Monitor, STATE USB Keyboard and EUT for EMI test.

c. The EUT equipped five types of antenna, the following modes were pretested:

a. Channel 1, antenna gain: 1dBi;
b. Channel 1, antenna gain: 2dBi;
c. Channel 1, antenna gain: 1.7dBi;
d. Channel 1, antenna gain: 1.8dBi;
e. Channel 1, antenna gain: 1.7dBi

cause "2dBi antenna gain" generated the worst test result, it was selected to measured the other two channels (one near middle and one near bottom), according to 15.31(m), as following:

Mode 1. Channel 1(2412MHz), antenna gain: 2dBi;
Mode 2. Channel 6(2437MHz), antenna gain: 2dBi;
Mode 3. Channel 11(2472MHz), antenna gain: 2dBi

d. Frequency range investigated: conduction 150 KHz to 30 MHz, radiation 30 MHz to 25000MHz.

2.2. Description of Test System

Support Unit 1. – USB Mouse (LOGITECH)

FCC ID	: N/A
Model No.	: M-BE58
Serial No.	: SP0032
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 2. -- Printer (HP)

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 3. -- Notebook (COMPAQ)

FCC ID	: N/A
Model No.	: M2080
Power Supply Type	: Switching
Power Cord	: Non-Shielded
Serial No.	: SP0040
Remark	: This support device was tested to comply with FCC standards and authorized under a declaration of conformity.

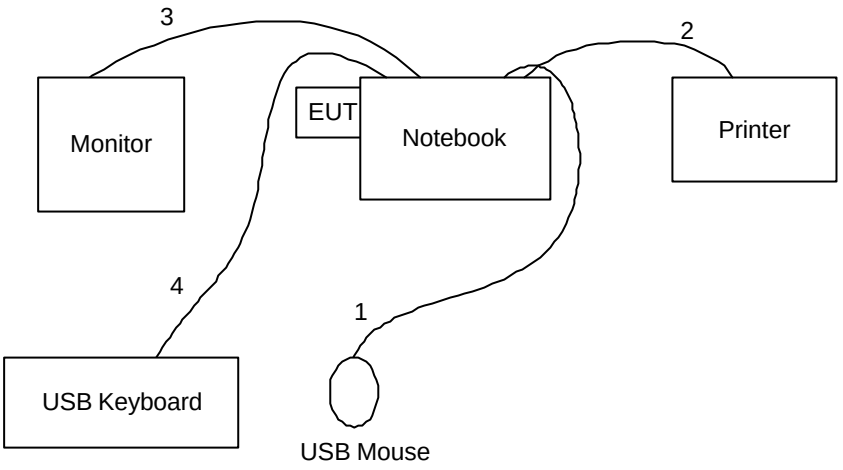
Support Unit 4. -- Monitor (VIEWSONIC)

FCC ID	: N/A
Model No.	: VCDTS21553-3P
Power Supply Type	: Switching
Power Cord	: Non-Shielded
Serial No.	: SP0013
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 5. -- USB Keyboard (STATE)

FCC ID	: N/A
Model No.	: KB-900ER
Serial No.	: SP0054
Data Cable	: Shielded, 1.7m
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 4.
4. The I/O cable is connected from Notebook to the support unit 5.

3. Operation of Equipment under Test

An executive program, EMCTEST.EXE under WIN 2000, which generates a complete line of continuously repeating " H" pattern was used as the test software.

The program was executed as follows:
a. Turn on the power of all equipment.
b. The PC reads the test program from the hard disk drive and runs it.
c. The PC sends " H" messages to the monitor, and the monitor displays " H" patterns on the screen.
d. The PC sends " H" messages to the printer, then the printer prints them on the paper.
e. The PC sends " H" messages to the internal Hard Disk, and the Hard Disk reads and writes the message.
f. Repeat the steps from c to e.

At the same time, “Radio Controller” was executed to keep transmitting signals at fixed frequency.

4. General Information of Test

4.1. 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, 03CH02-HY, 03CH03-HY

4.2. Test Voltage

115V/ 60Hz

4.3. Standard for Methods of Measurement

ANSI C63.4-1992

4.4. Test in Compliance with

FCC Part 15, Subpart C

4.5. Frequency Range Investigated

a. Conduction: from 150 KHz to 30 MHz
b. Radiation: from 30 MHz to 25000MHz

4.6. Test Distance

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

5. Report of Measurements and Examinations

5.1. List of Measurements and Examinations

FCC Rule	Description of Test	Result
15.207	Conducted Emission	Pass
15.247(a)(2)	6dB Bandwidth	Pass
15.247(b)	Maximum Peak Output Power	Pass
15.209	Radiated Emission	Pass
15.247(c)	100kHz Bandwidth of Frequency Band Edges	Pass
15.247(d)	Power Spectral Density	Pass
15.203	Antenna Requirement	Pass
1.1307 1.1310 2.1091 2.1093	RF Exposure Compliance	Pass

5.2. 6dB Bandwidth

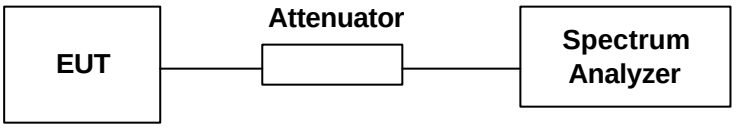
5.2.1. Measuring Instruments：

As described in chapter 6 of this test report.

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 6 dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 6 dB.

5.2.3. Test Setup Layout：



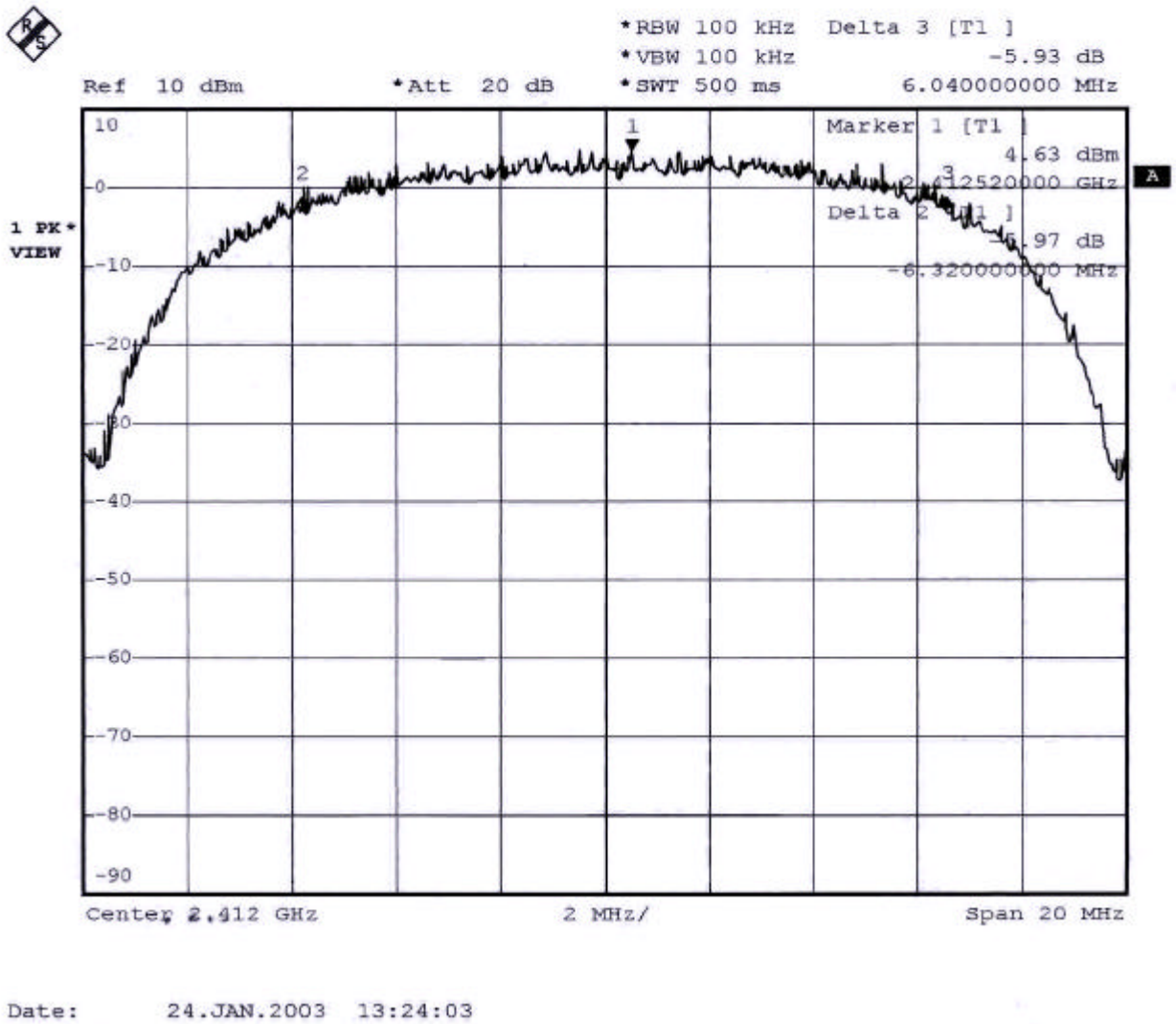
5.2.4. Test Result：The spectrum analyzer plots are attached as below

- Temperature : 21 °C
- Relative Humidity : 57 %

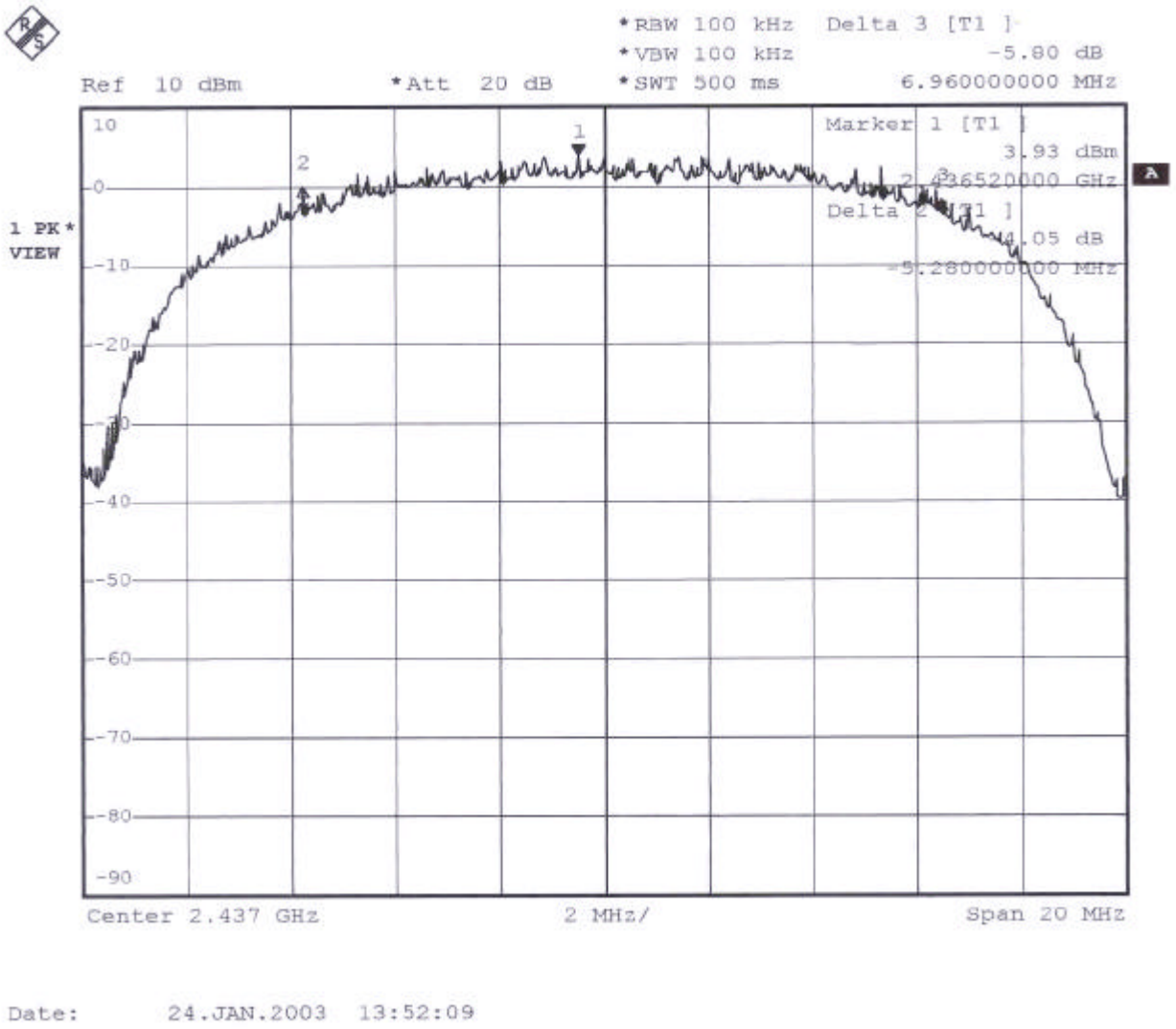
Channel	Frequency (MHz)	6dB Emission bandwidth (MHz)	Limits (MHz)	Plot Ref. No.
1	2412	12.36	0.5	1
6	2437	12.24	0.5	2
11	2472	12.04	0.5	3

-

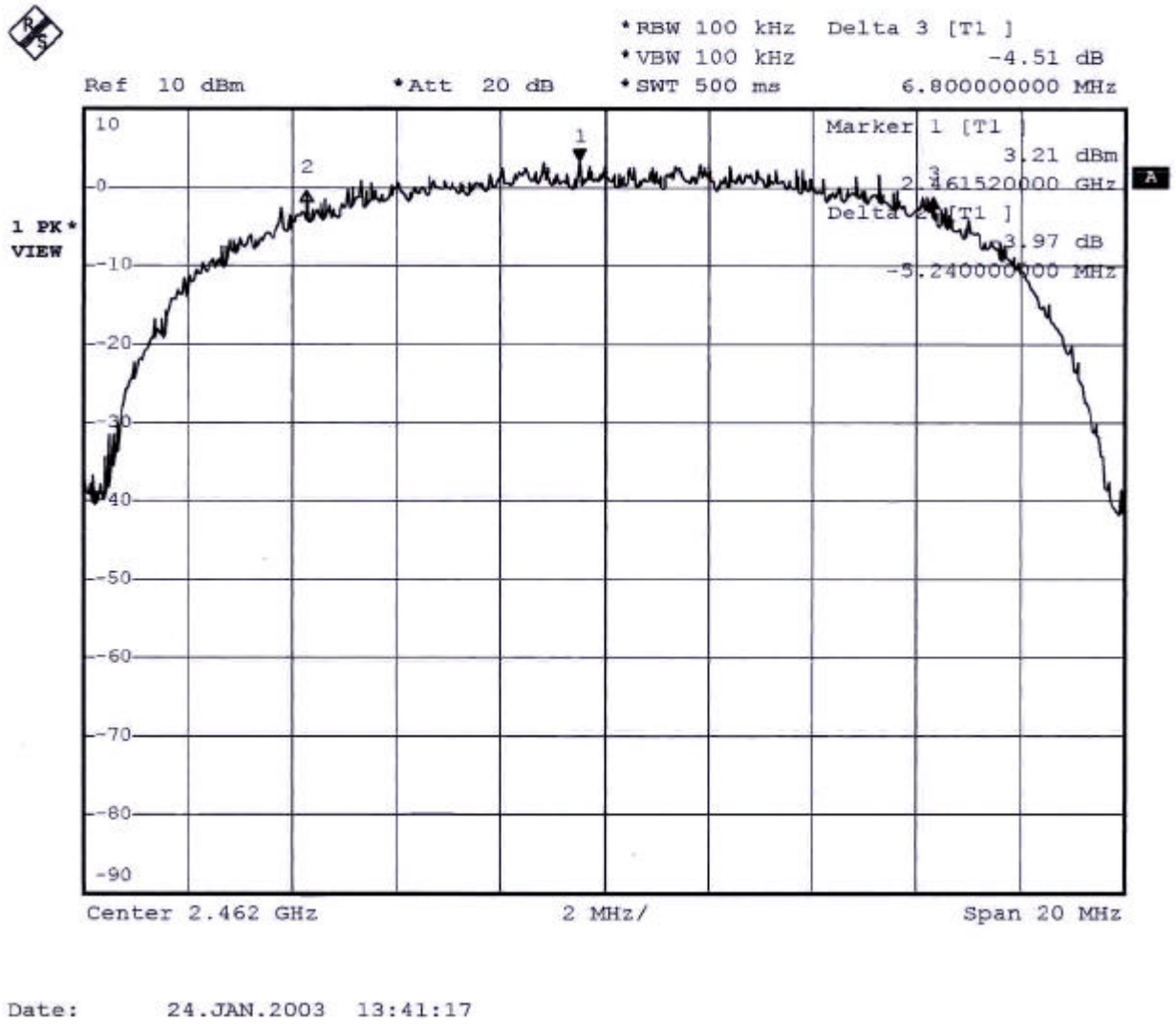
Plot1(Channel 1) :



Plot2(Channel 6) :



Plot3(Channel 11)：



Comments：6dB Emission bandwidth>500kHz

5.3. Peak Output Power

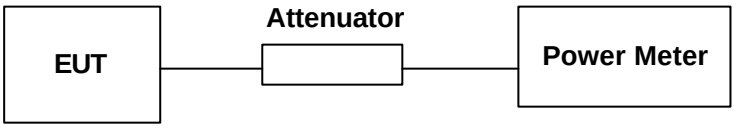
5.3.1. Measuring Instruments：

As described in chapter 6 of this test report.

5.3.2. Test Procedure：

The antenna port（RF output）of the EUT was connected to the input（RF input）of a power meter. Power was read directly from the meter and cable loss connection was added to the reading to obtain power at the EUT antenna terminal. The EUT Output Power was set to maximum to produce the worse case test result.

5.3.3. Test Setup Layout：



5.3.4. Test Result：See spectrum analyzer plots below

- Temperature : 21 °C
- Relative Humidity : 57 %
- Antenna Gain: 2 dBi

Channel	Frequency (MHz)	Measured Output Power (mWatt)	Measured Output Power (dBm)	Limits (Watt/dBm)
1	2412	49.3173804	16.93	1W/30 dBm
6	2437	44.05548635	16.44	1W/30 dBm
11	2472	40.3645393	16.06	1W/30 dBm

-
- Comments：Maximum Peak Output Power < 30dBm (1Watt)

5.4. Power Spectral Density

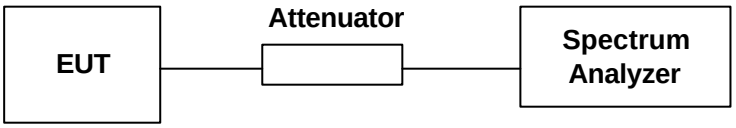
5.4.1. Measuring Instruments：

As described in chapter 6 of this test report.

5.4.2. Test Procedure：

1. The transmitter output was connected to spectrum analyzer through an attenuator.
2. The spectrum analyzer's resolution bandwidth were set at 3KHz RBW and 30KHz VBW as that of the fundamental frequency. Set the sweep time=span/3KHz.
3. The power spectral density was measured and recorded.
4. The Sweep time is allowed to be longer than span/3KHz for a full response of the mixer in the spectrum analyzer.

5.4.3. Test Setup Layout：



5.4.4. Test Result：See spectrum analyzer plots below

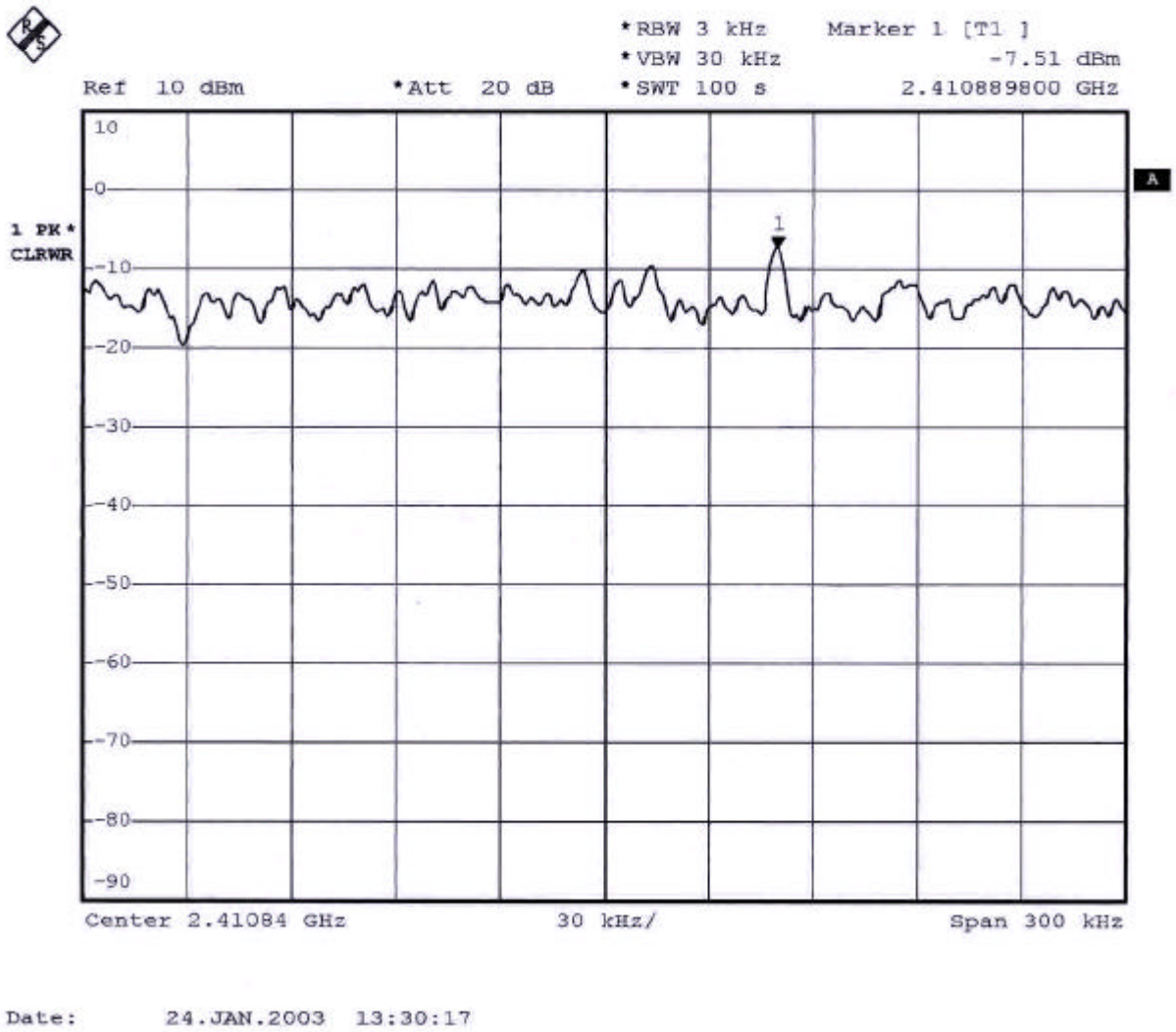
- Temperature : 21°C
- Relative Humidity : 57 %

Channel	Frequency (MHz)	Power Spectral Density (dBm)	Limits (dBm)	Plot Ref. No.
1	2412	-7.51	8	1
6	2437	-8.18	8	2
11	2472	-9.06	8	3

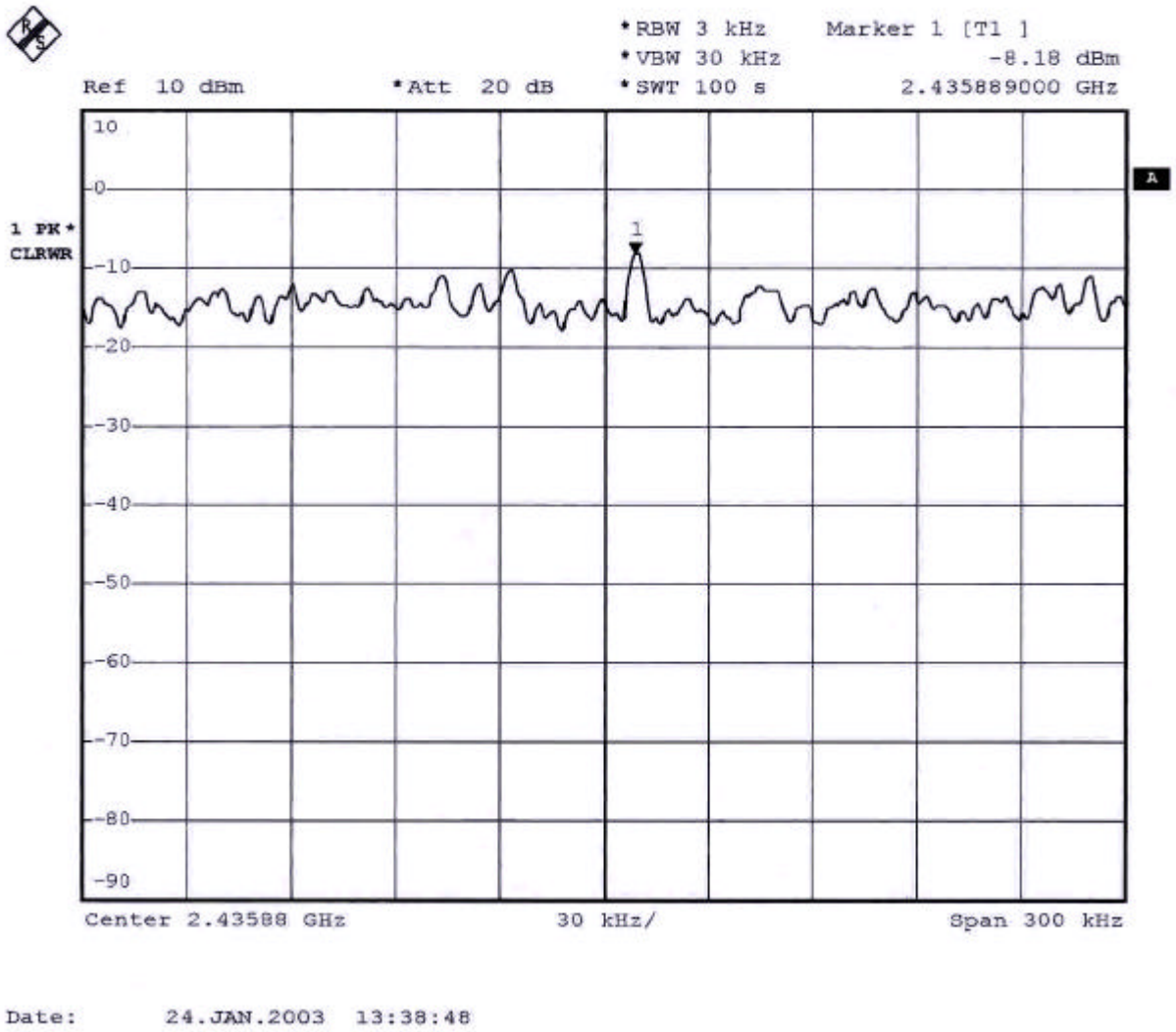
-

.

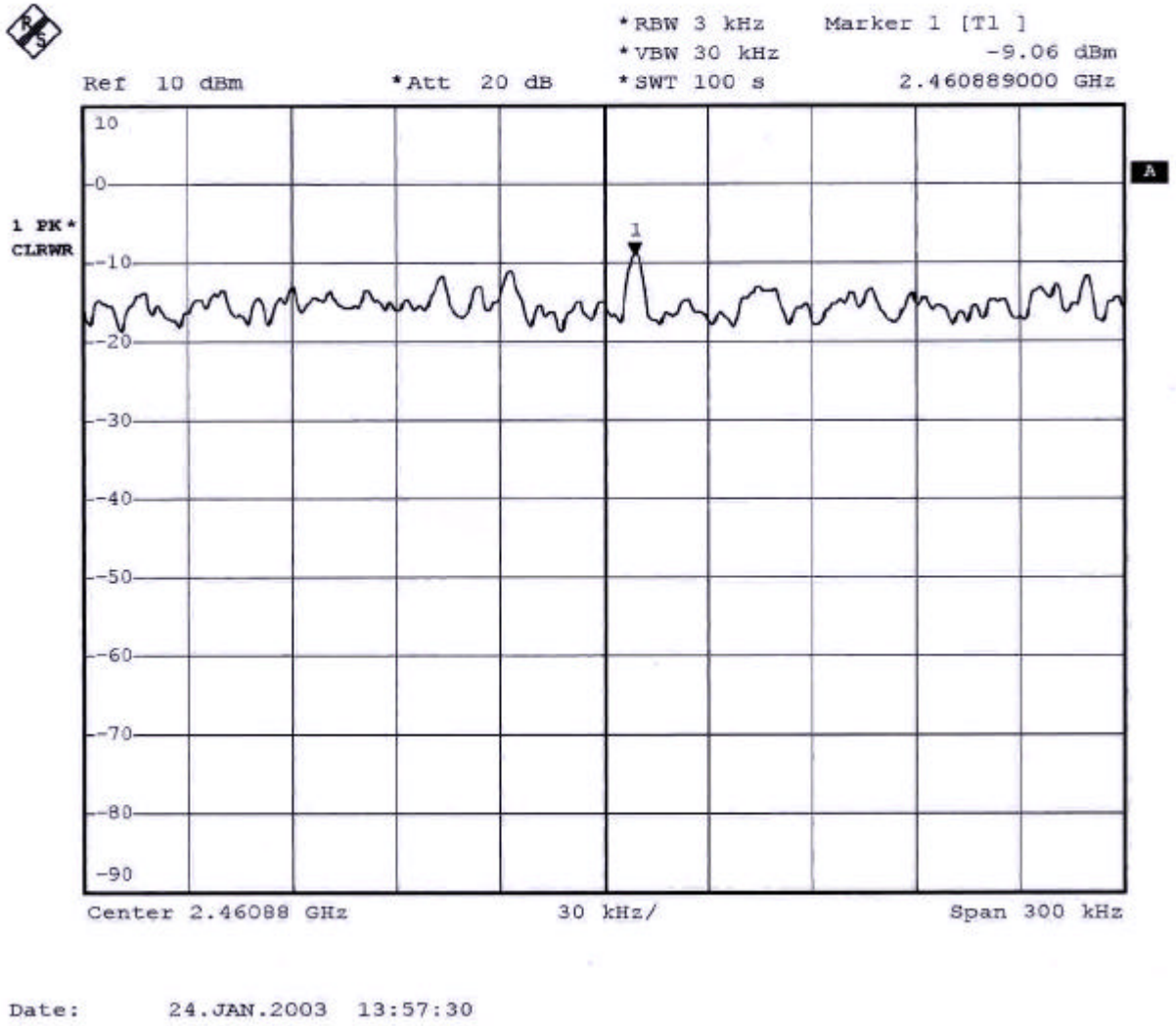
Plot1(Channel 1):



Plot2(Channel 6):



Plot3(Channel 11):



5.5. 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. The interface cables and equipment positioning were varied within limits of reasonable applications to determine the position produced maximum conducted emissions.

5.5.1. Major Measuring Instruments：

• Test Receiver	(R&S ESCS 30)
Attenuation	10 dB
Start Frequency	0.15 MHz
Stop Frequency	30 MHz
IF Bandwidth	9 KHz

5.5.2. 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.

5.5.3. Test Result of Conducted Emission：

- Frequency Range of Test: from 150KHz to 30 MHz
- 6dB Bandwidth: 9KHz
- Test Mode: Mode 1
- Temperature: 23.9°C
- Relative Humidity: 42 %
- Test Date: Jan.28, 2003

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

Frequency	Line	Meter Reading		Limits		Margin	
	or	Q.P.	A.V.	Q.P.	A.V.	Q.P.	A.V.
(MHz)	Neutral	(dBuV)	(dBuV)	(dBuV)	(dBuV)	(dB)	(dB)
0.150	L	55.04	25.99	66.00	56.00	-10.96	-30.01
0.204	L	48.96	30.50	63.45	53.45	-14.49	-22.95
0.246	L	46.09	19.46	61.89	51.89	-15.80	-32.43
0.340	L	39.43	30.21	59.20	49.20	-19.77	-18.99
3.880	L	34.28	30.91	56.00	46.00	-21.72	-15.09
12.870	L	39.30	39.01	60.00	50.00	-20.70	-10.99
0.160	N	55.01	27.25	65.46	55.46	-10.45	-28.21
0.205	N	49.18	29.42	63.41	53.41	-14.23	-23.99
0.273	N	43.17	28.87	61.03	51.03	-17.86	-22.16
0.341	N	38.25	29.00	59.18	49.18	-20.93	-20.18
0.476	N	32.30	27.73	56.41	46.41	-24.11	-18.68
3.880	N	33.62	30.84	56.00	46.00	-22.38	-15.16

Test Engineer: Wayne

Wayne Hsu

- Frequency Range of Test: from 150KHz to 30 MHz
- 6dB Bandwidth: 9KHz
- Test Mode: Mode 2
- Temperature: 23.9°C
- Relative Humidity: 42 %
- Test Date: Jan.28, 2003

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

Frequency	Line	Meter Reading		Limits		Margin	
	or	Q.P.	A.V.	Q.P.	A.V.	Q.P.	A.V.
(MHz)	Neutral	(dBuV)	(dBuV)	(dBuV)	(dBuV)	(dB)	(dB)
0.158	L	55.15	27.20	65.57	55.57	-10.42	-28.37
0.205	L	49.06	28.29	63.41	53.41	-14.35	-25.12
0.272	L	43.31	32.96	61.06	51.06	-17.75	-18.10
0.342	L	38.31	25.94	59.15	49.15	-20.84	-23.21
4.835	L	31.97	30.12	56.00	46.00	-24.03	-15.88
12.458	L	39.39	38.80	60.00	50.00	-20.61	-11.20
0.159	N	55.39	27.47	65.52	55.52	-10.13	-28.05
0.203	N	49.54	30.57	63.49	53.49	-13.95	-22.92
0.273	N	43.00	28.14	61.03	51.03	-18.03	-22.89
0.409	N	34.51	24.75	57.67	47.67	-23.16	-22.92
3.743	N	34.58	31.82	56.00	46.00	-21.42	-14.18
13.274	N	37.78	35.50	60.00	50.00	-22.22	-14.50

Test Engineer: Wayne

Wayne Hsu

- Frequency Range of Test: from 150KHz to 30 MHz
- 6dB Bandwidth: 9KHz
- Test Mode: Mode 3
- Temperature: 23.9°C
- Relative Humidity: 42 %
- Test Date: Jan.28, 2003

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

Frequency	Line	Meter Reading		Limits		Margin	
	or	Q.P.	A.V.	Q.P.	A.V.	Q.P.	A.V.
(MHz)	Neutral	(dBuV)	(dBuV)	(dBuV)	(dBuV)	(dB)	(dB)
0.164	L	54.09	26.22	65.26	55.26	-11.17	-29.04
0.203	L	48.90	28.59	63.49	53.49	-14.59	-24.90
0.273	L	42.78	32.85	61.03	51.03	-18.25	-18.18
0.341	L	38.33	28.44	59.18	49.18	-20.85	-20.74
3.744	L	33.06	29.83	56.00	46.00	-22.94	-16.17
13.274	L	38.06	37.30	60.00	50.00	-21.94	-12.70
0.163	N	54.15	26.29	65.31	55.31	-11.16	-29.02
0.205	N	48.66	27.89	63.41	53.41	-14.75	-25.52
0.271	N	42.44	30.87	61.09	51.09	-18.65	-20.22
0.343	N	37.10	25.34	59.13	49.13	-22.03	-23.79
3.744	N	32.72	29.65	56.00	46.00	-23.28	-16.35
12.457	N	39.62	38.80	60.00	50.00	-20.38	-11.20

Test Engineer: Wayne

Wayne Hsu

5.6. Test of Radiated Emission

Radiated emissions from 30 MHz to 25 GHz were measured according to the methods defines 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 4.6.3. The interface cables and equipment positions were varied within limits of reasonable applications to determine the positions producing maximum radiated emissions

5.6.1. Major Measuring Instruments

- From 30MHz to 1GHz

● Amplifier	(ADVANTEST BB525C)
RF Gain	30 dB
Signal Input	9 KHz to 3 GHz
● Spectrum Analyzer	(R&S FSP7)
Attenuation	10 dB
Start Frequency	30 MHz
Stop Frequency	1000 MHz
Resolution Bandwidth	120 KHz
Signal Input	9 KHz to 7 GHz

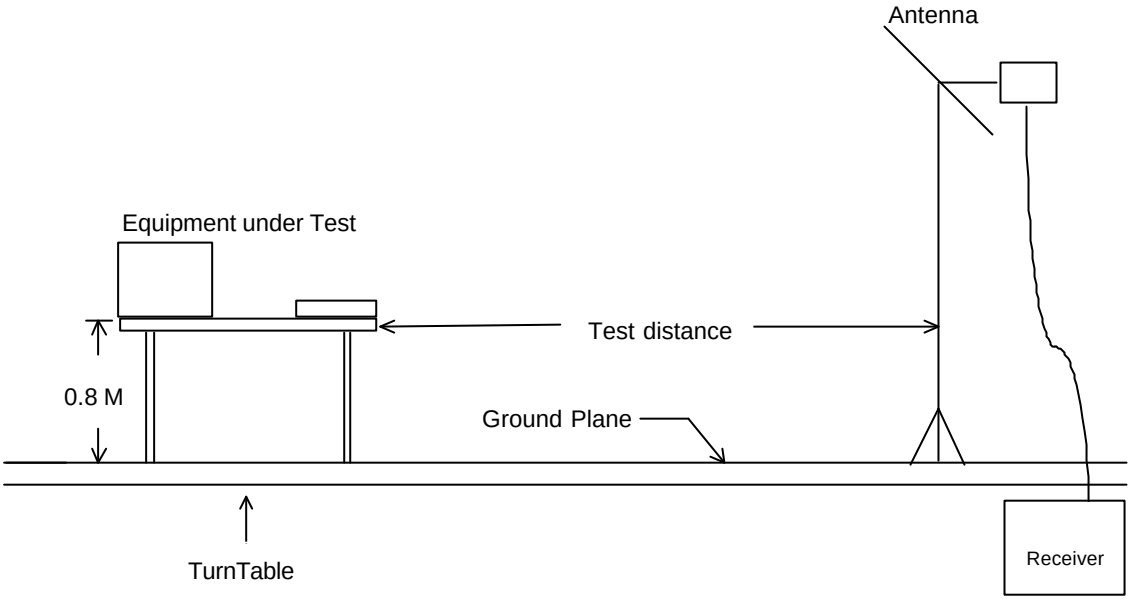
- Above 1GHz

● Spectrum analyzer	(R&S FSP40)
Attenuation	10 dB
Start Frequency	1 GHz
Stop Frequency	25 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

5.6.2. 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.

5.6.3. Typical Test Setup Layout of Radiated Emission



5.6.4. Test Result of Radiated Emission

- Test Mode: Mode 1
- Test Distance: 3 M
- Temperature: 21 °C
- Relative Humidity: 57 %
- Test Date: Jan. 25, 2003
- Emission level (dBuV/m) = 20 log Emission level (uV/m)
- Corrected Reading: Antenna Factor + Cable Loss + 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_1_m, turn table degree is _83_°**

■ Spurious Emission

- For 30MHz to 1GHz

Frequency (MHz)	Polarity	Antenna Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Limits (dBuV/m)	Limits (uV/m)	Emission (dBuV/m)	Level (uV/m)	Margin (dB)	Detect Mode
166.620	H	9.06	2.41	27.55	43.50	149.62	39.02	89.33	-4.48	Peak
175.530	H	8.81	2.46	28.80	43.50	149.62	40.07	100.81	-3.43	Peak
200.100	H	8.80	2.63	30.42	43.50	149.62	41.85	123.74	-1.65	Peak
332.200	H	14.18	3.38	17.43	46.00	199.53	34.99	56.17	-11.01	Peak
200.100	V	8.80	2.63	22.92	43.50	149.62	34.35	52.18	-9.15	Peak
666.100	V	19.09	4.89	11.99	46.00	199.53	35.97	62.88	-10.03	Peak

- For above 1GHz

Frequency (MHz)	Polarity	Antenna Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Limits (dBuV/m)	Limits (uV/m)	Emission (dBuV/m)	Level (uV/m)	Margin (dB)	Detect Mode
1196.000	H	25.90	3.20	15.76	74.00	5011.87	44.86	174.98	-29.14	Peak
2038.000	H	31.01	4.91	11.70	74.00	5011.87	47.62	240.44	-26.38	Peak
2788.000	H	29.77	6.37	13.08	74.00	5011.87	49.22	289.07	-24.78	Peak
1196.000	V	25.90	3.20	12.50	74.00	5011.87	41.60	120.23	-32.40	Peak
2036.000	V	31.01	4.91	14.91	74.00	5011.87	50.83	347.94	-23.17	Peak
2350.000	V	30.31	5.51	14.67	74.00	5011.87	50.49	334.58	-23.51	Peak
2788.000	V	29.77	6.37	22.87	74.00	5011.87	59.01	892.28	-14.99	Peak
2788.000	V	29.77	6.37	15.18	54.00	501.19	51.32	368.13	-2.68	A.V.
4524.000	V	33.07	8.64	9.79	74.00	5011.87	51.50	375.84	-22.50	Peak

■ Field strength of fundamental and harmonics

Frequency (MHz)	Polarity	Antenna Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Limits (dBuV/m)	Limits (uV/m)	Emission (dBuV/m)	Level (uV/m)	Margin (dB)	Detect Mode
2414.000	H	30.17	5.63	56.17	-	-	91.97	39673.45		Peak
2414.000	H	30.17	5.63	48.64	-	-	84.44	16672.47		A.V.
2414.000	V	30.17	5.63	60.81	-	-	96.61	67686.18		Peak
2414.000	V	30.17	5.63	55.74	-	-	91.54	37757.22		A.V.
4828.000	V/H						-			Peak, A.V.
7242.000	V/H						-			Peak, A.V.
9656.000	V/H						-			Peak, A.V.
12070.000	V/H						-			Peak, A.V.
14484.000	V/H						-			Peak, A.V.
16898.000	V/H						-			Peak, A.V.
19312.000	V/H						-			Peak, A.V.
21726.000	V/H						-			Peak, A.V.
24140.000	V/H						-			Peak, A.V.

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

Test Engineer : Wayne

Wayne Hsu

- Test Mode: Mode 2
- Test Distance: 3 M
- Temperature: 21 °C
- Relative Humidity: 57 %
- Test Date: Jan. 25, 2003
- Emission level (dBuV/m) = 20 log Emission level (uV/m)
- Corrected Reading: Antenna Factor + Cable Loss + 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_1_m, turn table degree is _50_°**

■ Spurious Emission

- For 30MHz to 1GHz

Frequency (MHz)	Polarity	Antenna Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Limits (dBuV/m)	Limits (uV/m)	Emission (dBuV/m)	Level (uV/m)	Margin (dB)	Detect Mode
166.620	H	9.06	2.41	26.75	43.50	149.62	38.22	81.47	-5.28	Peak
175.530	H	8.81	2.46	28.25	43.50	149.62	39.52	94.62	-3.98	Peak
200.100	H	8.80	2.63	29.41	43.50	149.62	40.84	110.15	-2.66	Peak
399.400	H	15.43	3.63	14.79	46.00	199.53	33.85	49.26	-12.15	Peak
199.290	V	8.76	2.63	21.85	43.50	149.62	33.24	45.92	-10.26	Peak
666.100	V	19.09	4.89	11.52	46.00	199.53	35.50	59.57	-10.50	Peak

- For above 1GHz

Frequency (MHz)	Polarity	Antenna Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Limits (dBuV/m)	Limits (uV/m)	Emission (dBuV/m)	Level (uV/m)	Margin (dB)	Detect Mode
1196.000	H	25.90	3.20	16.27	74.00	5011.87	45.37	185.57	-28.63	Peak
2062.000	H	30.95	4.96	11.08	74.00	5011.87	46.99	223.61	-27.01	Peak
2310.000	H	30.40	5.43	15.06	74.00	5011.87	50.89	350.35	-23.11	Peak
2356.000	H	30.30	5.52	14.10	74.00	5011.87	49.92	313.33	-24.08	Peak
2812.000	H	29.75	6.42	15.18	74.00	5011.87	51.35	369.40	-22.65	Peak
1598.000	V	27.07	4.15	12.60	74.00	5011.87	43.82	155.24	-30.18	Peak
2062.000	V	30.95	4.96	10.19	74.00	5011.87	46.10	201.84	-27.90	Peak
2252.000	V	30.53	5.32	12.92	74.00	5011.87	48.77	274.47	-25.23	Peak
2308.000	V	30.40	5.43	14.27	74.00	5011.87	50.10	319.89	-23.90	Peak
2812.000	V	29.75	6.42	19.69	74.00	5011.87	55.86	620.87	-18.14	Peak
2812.000	V	29.75	6.42	16.21	54.00	501.19	52.38	415.91	-1.62	A.V.

■ Field strength of fundamental and harmonics

Frequency (MHz)	Polarity	Antenna Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Limits (dBuV/m)	Limits (uV/m)	Emission (dBuV/m)	Level (uV/m)	Margin (dB)	Detect Mode
2438.000	H	30.11	5.67	59.16	-	-	94.94	55847.02		Peak
2438.000	H	30.11	5.67	53.43	-	-	89.21	28873.54		A.V.
2438.000	V	30.11	5.67	57.87	-	-	93.65	48139.33		Peak
4876.000	V/H						-			Peak, A.V.
7314.000	V/H						-			Peak, A.V.
9752.000	V/H						-			Peak, A.V.
12190.000	V/H						-			Peak, A.V.
14628.000	V/H						-			Peak, A.V.
17066.000	V/H						-			Peak, A.V.
19504.000	V/H						-			Peak, A.V.
21942.000	V/H						-			Peak, A.V.
24380.000	V/H						-			Peak, A.V.

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

Test Engineer: Wayne Hsu

- Test Mode: Mode 3
- Test Distance: 3 M
- Temperature: 21 °C
- Relative Humidity: 57 %
- Test Date: Jan. 25, 2003
- Emission level (dBuV/m) = 20 log Emission level (uV/m)
- Corrected Reading: Antenna Factor + Cable Loss + 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_1_m, turn table degree is _120_°**

■ Spurious Emission

- For 30MHz to 1GHz

Frequency (MHz)	Polarity	Antenna Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Limits (dBuV/m)	Limits (uV/m)	Emission (dBuV/m)	Level (uV/m)	Margin (dB)	Detect Mode
166.620	H	9.06	2.41	27.69	43.50	149.62	39.16	90.78	-4.34	Peak
175.530	H	8.81	2.46	29.50	43.50	149.62	40.77	109.27	-2.73	Peak
200.100	H	8.80	2.63	30.05	43.50	149.62	41.48	118.58	-2.02	Peak
332.200	H	14.18	3.38	16.53	46.00	199.53	34.09	50.64	-11.91	Peak
200.100	V	8.80	2.63	21.53	43.50	149.62	32.96	44.46	-10.54	Peak
666.100	V	19.09	4.89	12.13	46.00	199.53	36.11	63.90	-9.89	Peak

- For above 1GHz

Frequency (MHz)	Polarity	Antenna Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Limits (dBuV/m)	Limits (uV/m)	Emission (dBuV/m)	Level (uV/m)	Margin (dB)	Detect Mode
1196.000	H	25.90	3.20	13.42	74.00	5011.87	42.52	133.66	-31.48	Peak
1532.000	H	27.15	4.03	8.50	74.00	5011.87	39.68	96.38	-34.32	Peak
2086.000	H	30.90	5.00	12.07	74.00	5011.87	47.97	250.32	-26.03	Peak
2332.000	H	30.35	5.47	9.79	74.00	5011.87	45.61	190.77	-28.39	Peak
2836.000	H	29.73	6.46	12.16	74.00	5011.87	48.35	261.52	-25.65	Peak
1204.000	V	25.96	3.21	16.29	74.00	5011.87	45.46	187.50	-28.54	Peak
2086.000	V	30.90	5.00	10.61	74.00	5011.87	46.51	211.59	-27.49	Peak
2252.000	V	30.53	5.32	13.71	74.00	5011.87	49.56	300.61	-24.44	Peak
2332.000	V	30.35	5.47	15.39	74.00	5011.87	51.21	363.50	-22.79	Peak
2836.000	V	29.73	6.46	17.30	74.00	5011.87	53.49	472.61	-20.51	Peak
2836.000	V	29.73	6.46	13.19	54.00	501.19	49.38	294.44	-4.62	A.V.

■ Field strength of fundamental and harmonics

Frequency (MHz)	Polarity	Antenna Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Limits (dBuV/m)	Limits (uV/m)	Emission (dBuV/m)	Level (uV/m)	Margin (dB)	Detect Mode
2462.000	H	30.06	5.72	49.58	-	-	85.36	18535.32		Peak
2462.00	H	30.06	5.72	43.97	-	-	79.75	9716.28		A.V.
2462.000	V	30.06	5.72	56.47	-	-	92.25	40973.21		Peak
2462.00	V	30.06	5.72	48.10	-	-	83.88	15631.48		A.V.
4924.000	V/H						-			Peak, A.V.
7386.000	V/H						-			Peak, A.V.
9848.000	V/H						-			Peak, A.V.
12310.000	V/H						-			Peak, A.V.
14772.000	V/H						-			Peak, A.V.
17234.000	V/H						-			Peak, A.V.
19696.000	V/H						-			Peak, A.V.
22158.000	V/H						-			Peak, A.V.
24620.000	V/H						-			Peak, A.V.

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

Test Engineer : Wayne Hsu

5.7. Band Edges Measurement

5.7.1. Measuring Instruments：

As described in chapter 6 of this test report.

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 1) ：PASS
- Test Result in higher band(Channel 11)：PASS

5.7.4. Note on Band edge Emission

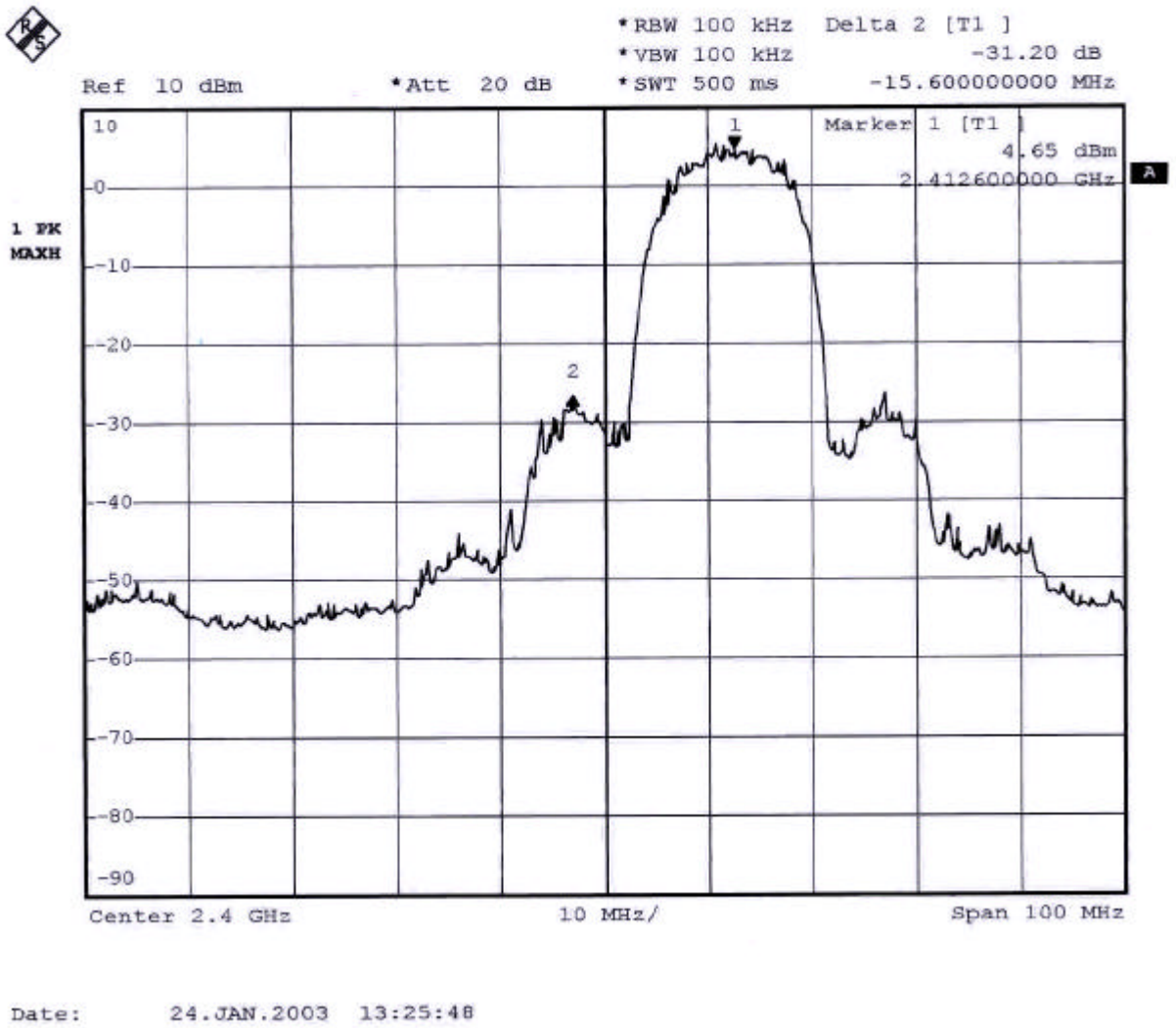
The band edge emission plot on page 37. shows 45.10dB delta between carrier maximum power and local maximum emission in the restricted band (2.4835GHz).

Polarity	The emission of carrier power strength (dB μV/m)	The maximum field strength in restrict band (dB μV/m)	Limit (dB μV/m)	Margin (dB)	Result
H	85.36	36.24	74.00	-37.76	Peak
H	79.75	30.63	54.00	-23.37	Average
V	92.25	43.13	74.00	-30.87	Peak
V	83.88	34.76	54.00	-19.24	Average

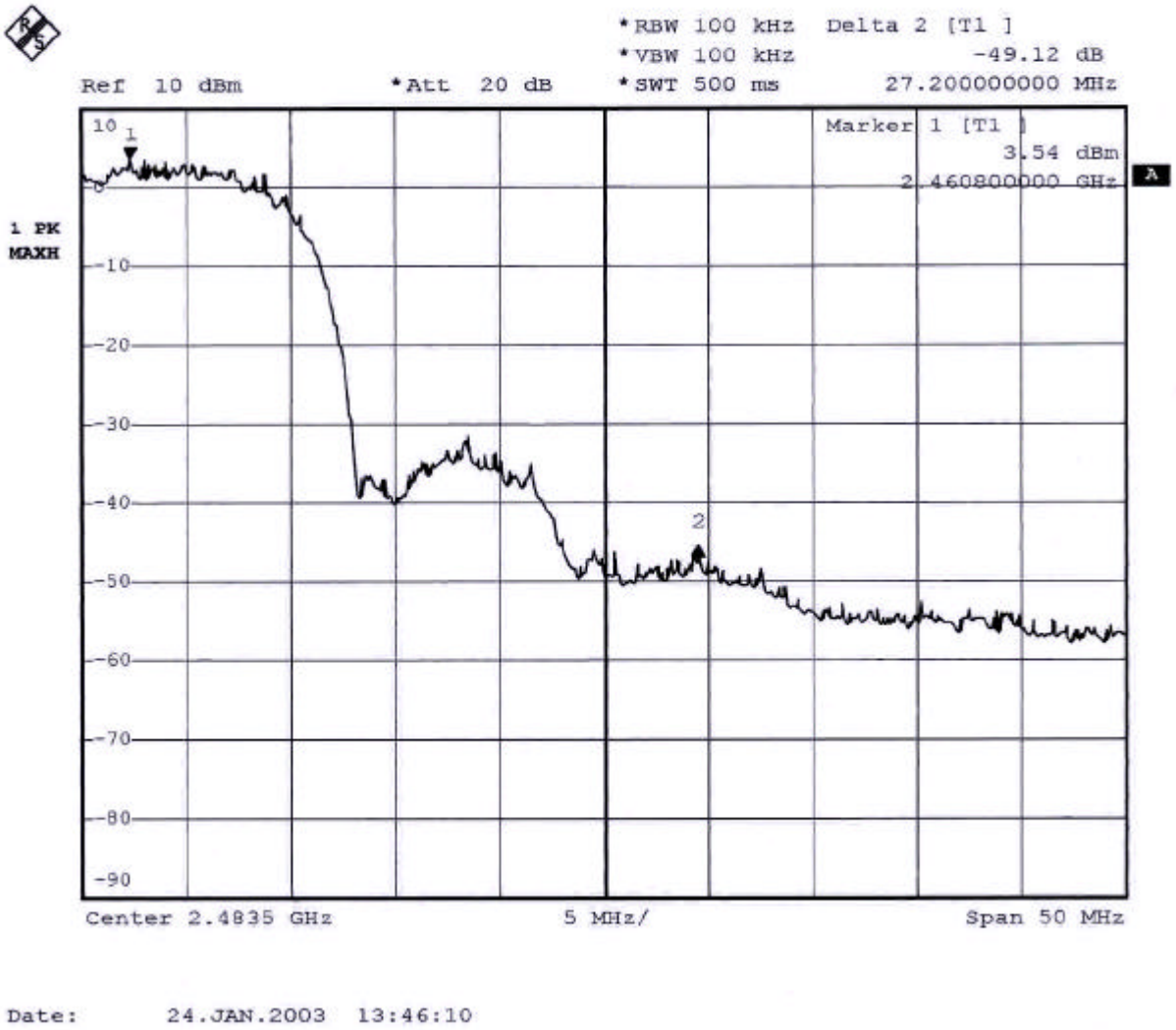
＊The maximum field strength in restricted band is the emission of carrier power strength subtract to the delta between carrier maximum power and local maximum emission in the restricted band.

The spectrum analyzer plots are attached as below：

Plot1 (Channel 1)：



Plot2 (Channel 11)：



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

5.8. Antenna Requirements

Antenna a: The EUT use an undetachable. It is considered meet antenna requirement of FCC.

Antenna b: The EUT use a detachable antenna via SMA-reversed external connector. It is considered meet antenna requirement of FCC.

Antenna c: The EUT use an undetachable. It is considered meet antenna requirement of FCC.

Antenna d: The EUT use a detachable antenna via SMA-reversed external connector. It is considered meet antenna requirement of FCC.

Antenna e: The EUT use a detachable antenna via SMA-reversed external connector. It is considered meet antenna requirement of FCC.

5.8.1. 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.

5.8.2. Antenna Connected Construction

The maximum Gain antenna used in this product is dipole antenna.

5.9. RF Exposure

FCC Rules and Regulations Part 1.1307,1.1310,2.1091,2.1093:

RF Exposure Compliance

5.9.1. Limit For Maximum Permissible Exposure (MPE)

(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

5.9.2. MPE Calculations

$$E\ (V/m) = \frac{\sqrt{30 \times P \times G}}{d} \qquad \text{Power Density: } Pd\ (mW/cm^2) = \frac{E^2}{3770}$$

E＝Electric field (V/m)

P＝Peak output power (mW)

G＝Antenna numeric gain (numeric)

d＝Separation distance (m)

Because the EUT is belong to General Population/ Uncontrolled Exposure. So the Limit of Power Density is 1.0 mW/cm2. We can change the formula to:

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

Channel NO.	Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Calculated RF Exposure Separation Distance (cm)	Minimum RF Exposure Separation Distance (cm)
Channel 1	2.00	1.58	16.93	49.32	0.79	20
Channel 6	2.00	1.58	16.44	44.06	0.75	20
Channel 11	2.00	1.58	16.06	40.36	0.71	20

5.9.3. FCC Radiation Exposure Statement

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. In order to avoid the possibility of exceeding the FCC radio frequency exposure limits, human proximity to the antenna shall not be less than 20cm (8 inches) during normal operation. Proposed RF exposure safety information to include in User's Manual.

6. EMI Suppression Component List

No EMI suppression components.

7. Antenna Factor & Cable Loss

Frequency (MHz)	Antenna Factor (dB)	Cable Loss (dB)
30	15.35	1.27
35	13.83	1.37
40	12.41	1.44
45	11.69	1.50
50	7.77	1.56
55	6.68	1.60
60	5.58	1.69
65	5.51	1.74
70	5.43	1.79
75	6.65	1.85
80	8.11	1.87
85	9.23	1.96
90	10.34	1.98
95	10.85	2.03
100	11.36	2.05
110	11.27	2.19
120	11.17	1.88
130	11.17	2.10
140	11.72	2.17
150	10.52	2.24
160	9.39	3.06
170	8.93	2.41
180	9.20	2.47
190	8.98	2.57
200	8.76	2.63
220	10.01	2.71
240	11.20	2.86
260	12.19	2.94
280	12.89	3.08
300	13.56	3.17
320	13.94	3.28
340	14.32	3.36
360	14.69	3.54
380	15.07	3.61
400	15.43	3.63
450	16.08	3.77
500	16.73	4.13
550	17.70	4.21
600	18.69	4.47
650	18.99	4.79
700	19.30	5.02
750	19.84	5.01
800	20.39	5.25
850	20.60	5.58
900	20.82	5.42
950	20.98	5.71
1000	21.15	6.04
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

8. 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 (03CH02-HY)
Amplifier	ADVANTEST	BB525C	BB525C-04	9KHz – 3GHz	Oct. 31, 2002	Radiation (03CH02-HY)
Bilog Antenna	SCHAFFNER	CBL61128	2681	30MHz –2GHz	Dec. 21, 2002	Radiation (03CH02-HY)
Turn Table	HD	DS 420	420/649/00	0 ~ 360 degree	N/A	Radiation (03CH02-HY)
Antenna Mast	HD	MA 240	240/559/00	1 m - 4 m	N/A	Radiation (03CH02-HY)
Half-wave dipole antenna	R&S	HZ12 HZ13	83924403 83924503	30MHz - 1GHz	Sep. 23, 2002	Radiation (03CH02-HY)
Horn Antenna	COM-POWER	AH-118	10094	1GHz – 18GHz	Apr. 09, 2002	Radiation
Spectrum analyzer	R&S	FSP40	100004/040	9KHZ~40GHZ	Aug. 07, 2002	Radiation
Amplifier	MITEQ	AFS44	879981	100MHz~26.5GHz	Aug. 12, 2002	Radiation

※ Calibration Interval of instruments listed above is one year.

9. 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 Γ1=0.09 Antenna VSWR Γ2=0.67 Uncertainty=20log(1-Γ1*Γ2)	U-shaped	±0.54
combined standard uncertainty Ue(y)	normal	±2.7
Measuring uncertainty for a level of confidence of 95% U=2Ue(y)	normal (k=2)	±5.4

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

$U=\sqrt{\{(1/2)^2+(0.3/2)^2+(2^2+3^2+2^2+0.25^2+2^2)/3+(0.54)^2/2\}}=2.7$ 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 Γ1=0.09 LISN VSWR Γ2=0.33 Uncertainty=20log(1-Γ1*Γ2)	U-shaped	0.2
combined standard uncertainty Ue(y)	normal	±1.66
Measuring uncertainty for a level of confidence of 95% U=2Ue(y)	normal (k=2)	±3.32

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