

FCC TEST REPORT

for

47 CFR, Part 15, Subpart C

Equipment : Wireless Broadband Router
Model No. : GN-BR402W
FCC ID : JCK-GN-BR402W
Filing Type : Certification
Applicant : **GIGA-BYTE TECHNOLOGY CO., LTD.**
No.6, Bau Chiang Road, Hsin-Tien,
Taipei Hsien, 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: Oct. 29, 2002

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 : Wireless Broadband Router
Model No. : GN-BR402W
FCC ID : JCK-GN-BR402W
Applicant : **GIGA-BYTE TECHNOLOGY CO., LTD.**
No.6, Bau Chiang Road, Hsin-Tien,
Taipei Hsien, 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 Oct. 14, 2002 at **SPORTON International Inc.** LAB.

 Nov. 04, 2002

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

GIGA-BYTE TECHNOLOGY CO., LTD.
No.6, Bau Chiang Road, Hsin-Tien, Taipei Hsien, Taiwan, R.O.C.

1.2. Manufacturer

Same as 1.1.

1.3. Basic Description of Equipment under Test

Equipment	: Wireless Broadband Router
Model No.	: GN-BR402W
FCC ID	: JCK-GN-BR402W
Trade Name	: GIGA, G-MAX
TP Cable	: Non-Shielded, 10m
TP Cable x 4	: Non-Shielded, 2m
USB Cable	: Non-Shielded, 2m
Power Supply Type	: Linear
AC Power Input	: Wall-mount, 2 pin
DC Power Cable	: Non-Shielded, 1.9m, 2 pin

Feature of Equipment under Test

Items	Contents
1. Modulation type	DSSS
2. How to move out the modulation	Software Control
3. Number of channels	Default: 11,
4. Carrier frequency of each channel	2412, 2417, 2422, 2427, 2432, 2437, 2442, 2447, 2452, 2457, 2462,
5. Bandwidth of each channel	5 MHz
6. Transmitter or Transceiver	Transceiver
7. Power Rating (DC or AC, Volt)	5 VDC / 3.3A
8. Maximum output power to Antenna	8 dBm
9. Duty Cycle	100%
10. Basic function of product	802.11b Wireless LAN
11. Operation Temperature	0 40
12. Antenna Connector Type	MMCX
13. Antenna Type	1/4 Dipole Antenna
14. Antenna Gain	2dBi
15. Adapter	FAIRWAY / WN10A-050 I/P: 100-240V ~1.0A MAX / 50-60HZ O/P: +0.5V / 2.0A

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 remote workstation, HP PC, HITACHI Monitor, LOGITECH PS/2 Keyboard, LOGITECH USB Mouse, HP Printer, ACEEX Modem and EUT for EMI test. The remote workstation Included ASUS PC, REALsync Monitor, HP PS/2 Keyboard and HP PS/2 Mouse.
- b. The EUT can operate on eleven channels from 2412.0MHz to 2462.0MHz. (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: 2412MHz (Channel 1)
 - Mode 2: 2437MHz (Channel 6)
 - Mode 3: 2462MHz (Channel 11)
- c. Frequency range investigated: conduction 150 KHz to 30 MHz, radiation 30 MHz to 25000MHz.

2.2. Description of Test System

Support Unit 1. -- Monitor (HITACHI) for local workstation

FCC ID	: N/A
Model No.	: CM823F
Power Supply Type	: Switching
Power Cord	: Non-Shielded
Serial No.	: SP0022
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. -- PS/2 Keyboard (LOGITECH) for local workstation

FCC ID	: N/A
Model No.	: Y-SJ17
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.

Support Unit 3. -- USB Mouse (LOGITECH) for local workstation

FCC ID : N/A
Model No. : M-BE58
Serial No. : SP0096
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 4. -- Printer (HP) for local workstation

FCC ID : B94C2642X
Model No. : DJ 400
Serial No. : SP0051
Data Cable : Shielded, 1.35m

Support Unit 5. -- Modem (ACEEX) for local workstation

FCC ID : IFAXDM1414
Model No. : DM1414
Serial No. : SP0059
Data Cable : Shielded, 1.15m

Support Unit 6. -- Personal Computer (HP) for local workstation

FCC ID : N/A
Model No. : VECTRAL VL420DT
Power Supply Type : Switching
Power Cord : Non-Shielded
Serial No. : SP0015
Data Cable : Shielded, 360 degree via metal backshells
Remark : This support device was tested to comply with FCC standards and authorized under a declaration of conformity.

Support Unit 7. -- Personal Computer (ASUS) for remote workstation

FCC ID : N/A
Model No. : A7V133
Power Supply Type : Switching
Power Cord : Non-Shielded
Serial No. : SP0015
Data Cable : Shielded, 360 degree via metal backshells
Remark : This support device was tested to comply with FCC standards and authorized under a declaration of conformity.

Support Unit 8. -- Monitor (REALsync) for remote workstation

FCC ID : N/A
Model No. : DJ72
Power Supply Type : Switching
Power Cord : Non-Shielded
Serial No. : SP0022
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.

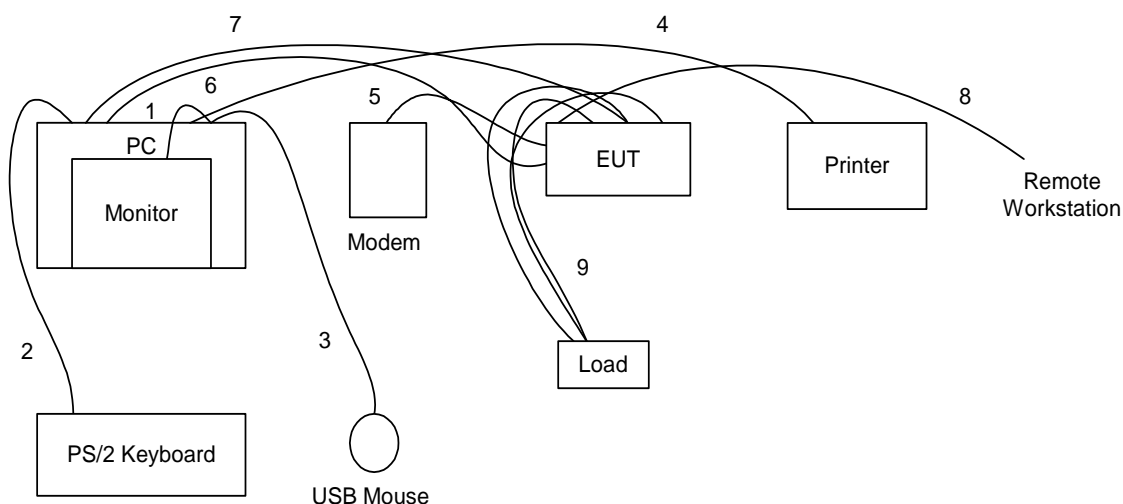
Support Unit 9. -- PS/2 Keyboard (HP) for remote workstation

FCC ID : N/A
Model No. : SK-2502C
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.

Support Unit 10. -- PS/2 Mouse (HP) for remote workstation

FCC ID : N/A
Model No. : M-S48a
Serial No. : SP0096
Data Cable : Non-Shielded, 1.8m
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 PC to the support unit 1.
2. The I/O cable is connected from PC to the support unit 2
3. The I/O cable is connected from PC to the support unit 3.
4. The I/O cable is connected from PC to the support unit 4.
5. The I/O cable is connected from EUT to the support unit 5.
6. The USB cable is connected from PC to the EUT.
7. The TP cable is connected from PC to the EUT.
8. The TP cable is connected from EUT to the remote workstation.
9. These are loop-back TP cables.

3. Operation of Equipment under Test

During testing, the software provided by the applicant enable the EUT under transmission condition continuously.

4. General Information of Test

Test Site Location : No. 52, Hwa Ya 1st Rd., Hwa Ya Technology Park,
Kwei-Shan Hsiag, Tao Yuan Hsien, Taiwan, R.O.C.
TEL : 886-3-327-3456
FAX : 886-3-318-0055

Test Site No : CL01, SH03

4.1. Standard for Methods of Measurement

ANSI C63.4-1992

4.2. Test in Compliance with

FCC Part 15, Subpart C

4.3. Frequency Range Investigated

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

4.4. 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
<u>15.247(a)(2)</u>	6dB Bandwidth	Pass
<u>15.247(b)</u>	Maximum Peak Output Power	Pass
15.209	Radiated Emission	Pass
<u>15.247(c)</u>	100kHz Bandwidth of Frequency Band Edges	Pass
<u>15.247(d)</u>	Power Spectral Density	Pass
<u>15.203</u>	Antenna Requirement	Pass
1.1307 1.1310 2.1091 2.1093	RF Exposure Compliance	Pass

5.2. 6dB Bandwidth

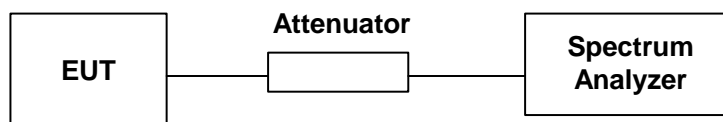
5.2.1. Measuring Instruments :

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 :

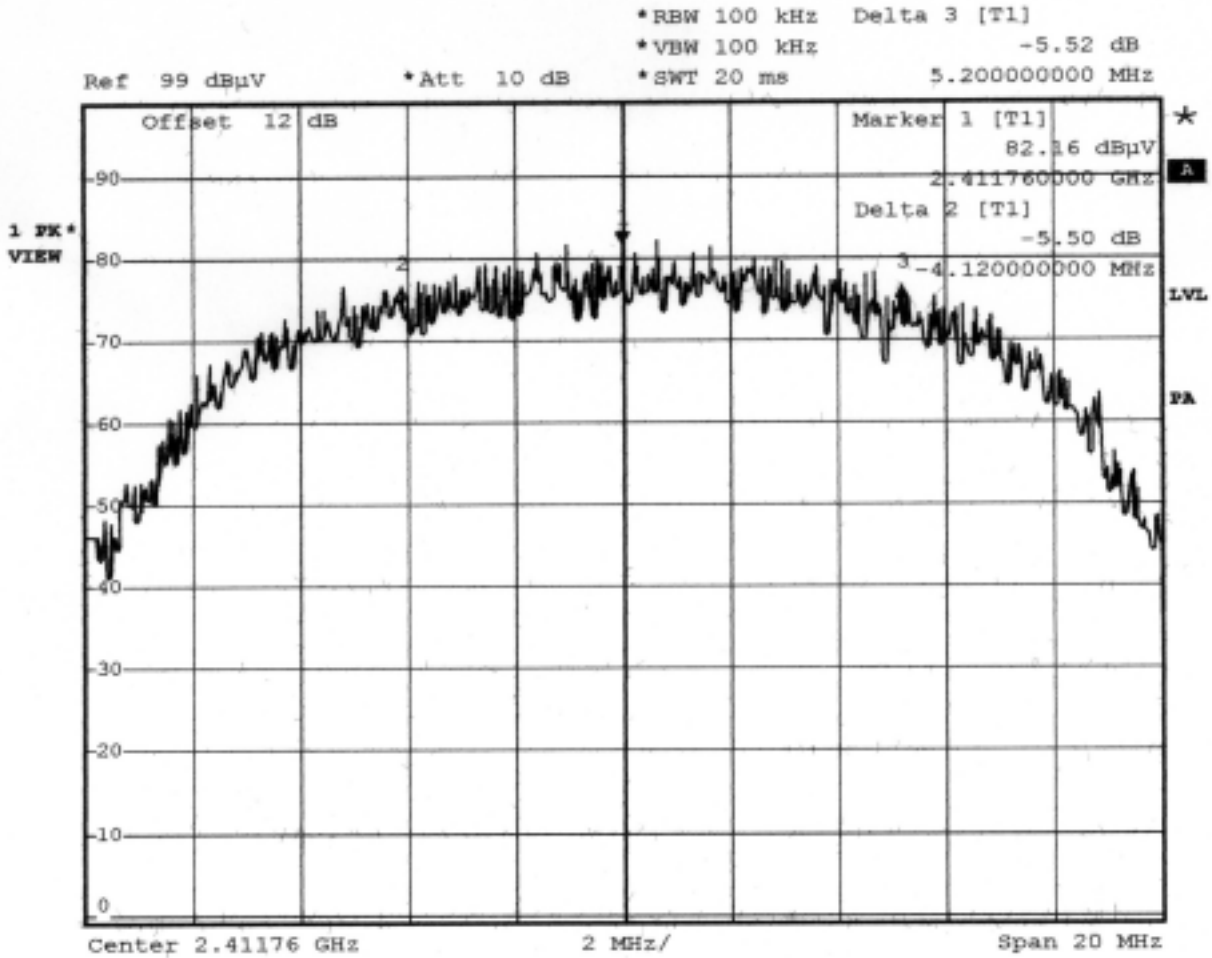


5.2.4. Test Result : The spectrum analyzer plots are attached as below

- Temperature : 28.5°C
- Relative Humidity : 59 %

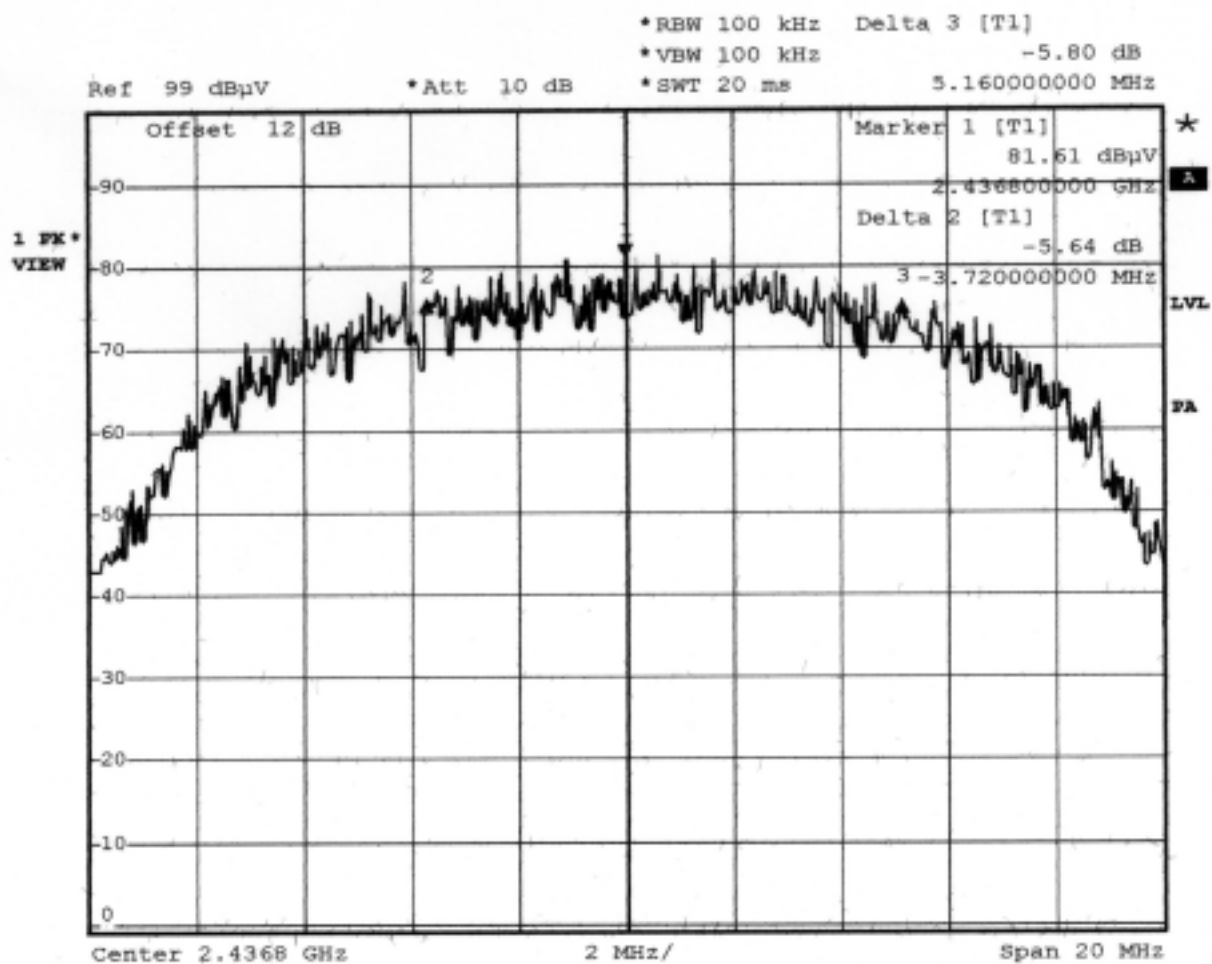
Channel	Frequency (MHz)	6dB Emission bandwidth (MHz)	Limits (MHz)	Plot Ref. No.
1	2412	9.32	0.5	1
6	2437	8.88	0.5	2
11	2462	10.2	0.5	3

Plot1(Channel 1) :



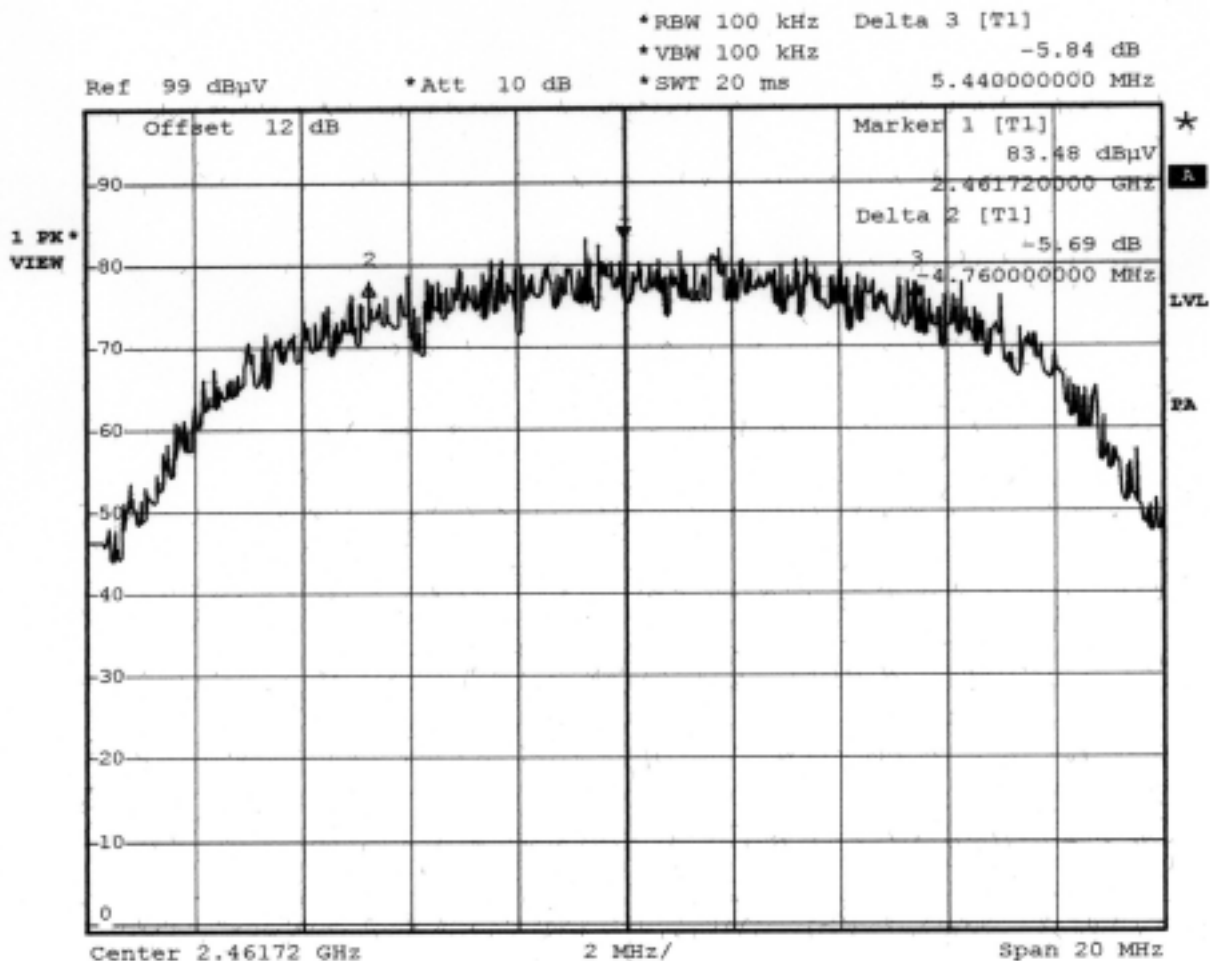
Date: 21.AUG.2002 10:01:32

Plot2(Channel 6) :



Date: 21.AUG.2002 10:00:19

Plot3(Channel 11) :



Date: 21.AUG.2002 09:57:56

Comments : 6dB Emission bandwidth>500kHz

5.3. Peak Output Power

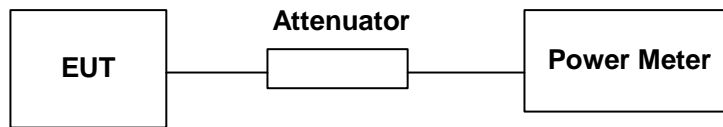
5.3.1. Measuring Instruments :

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 : 28.5°C
- Relative Humidity : 59 %
- Antenna Gain: 2 dBi

Channel	Frequency (MHz)	Measured Output Power (mWatt)	Measured Output Power (dBm)	Limits (Watt/dBm)
1	2412	3.92	5.93	1W/30 dBm
6	2437	4.18	6.21	1W/30 dBm
11	2462	5.88	7.69	1W/30 dBm

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

5.4. Power Spectral Density

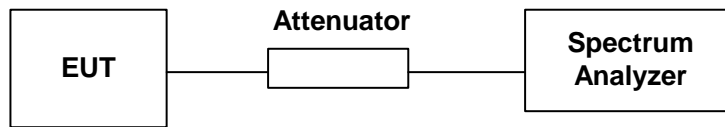
5.4.1. Measuring Instruments :

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 :

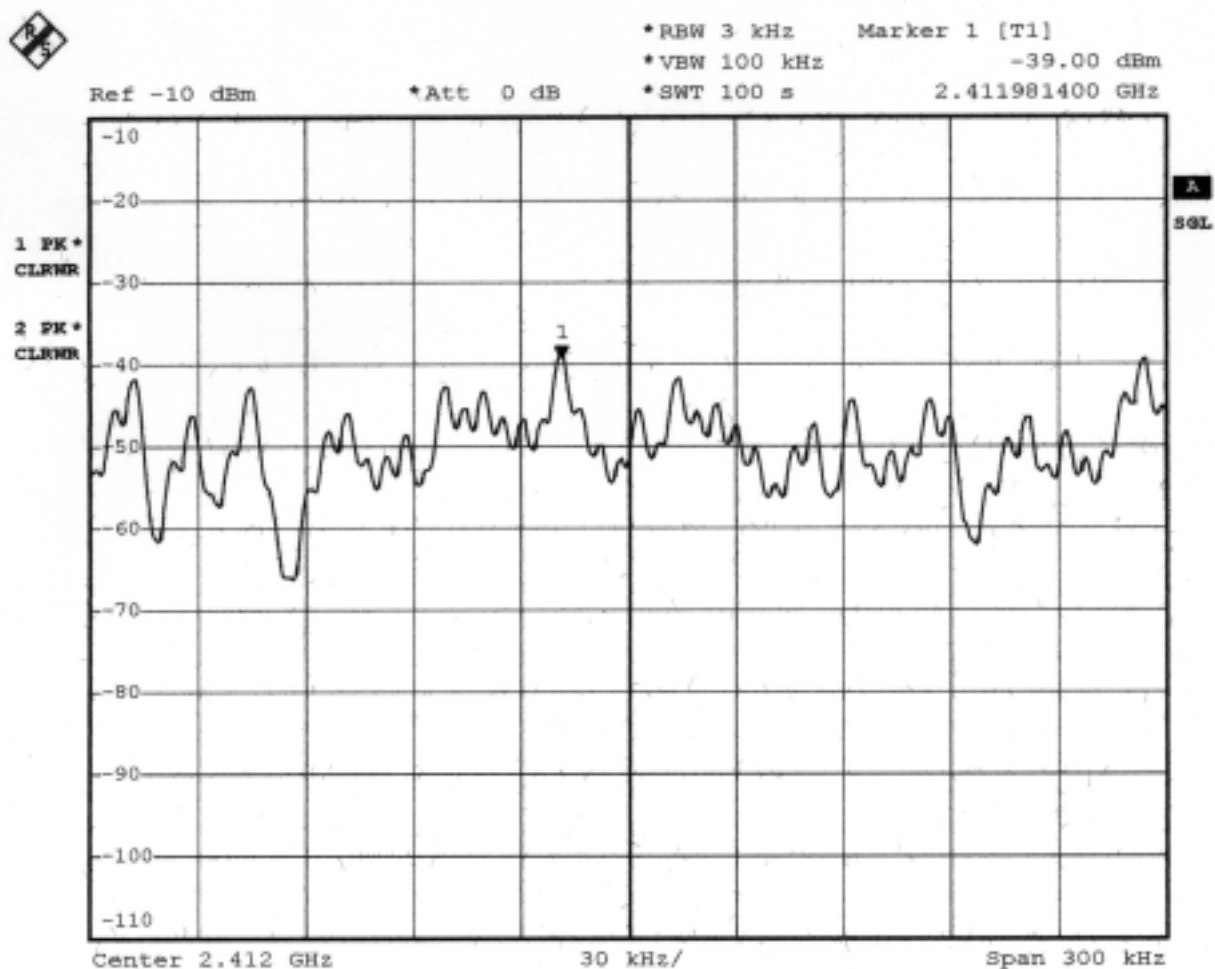


5.4.4. Test Result : See spectrum analyzer plots below

- Temperature : 28.5°C
- Relative Humidity : 59 %

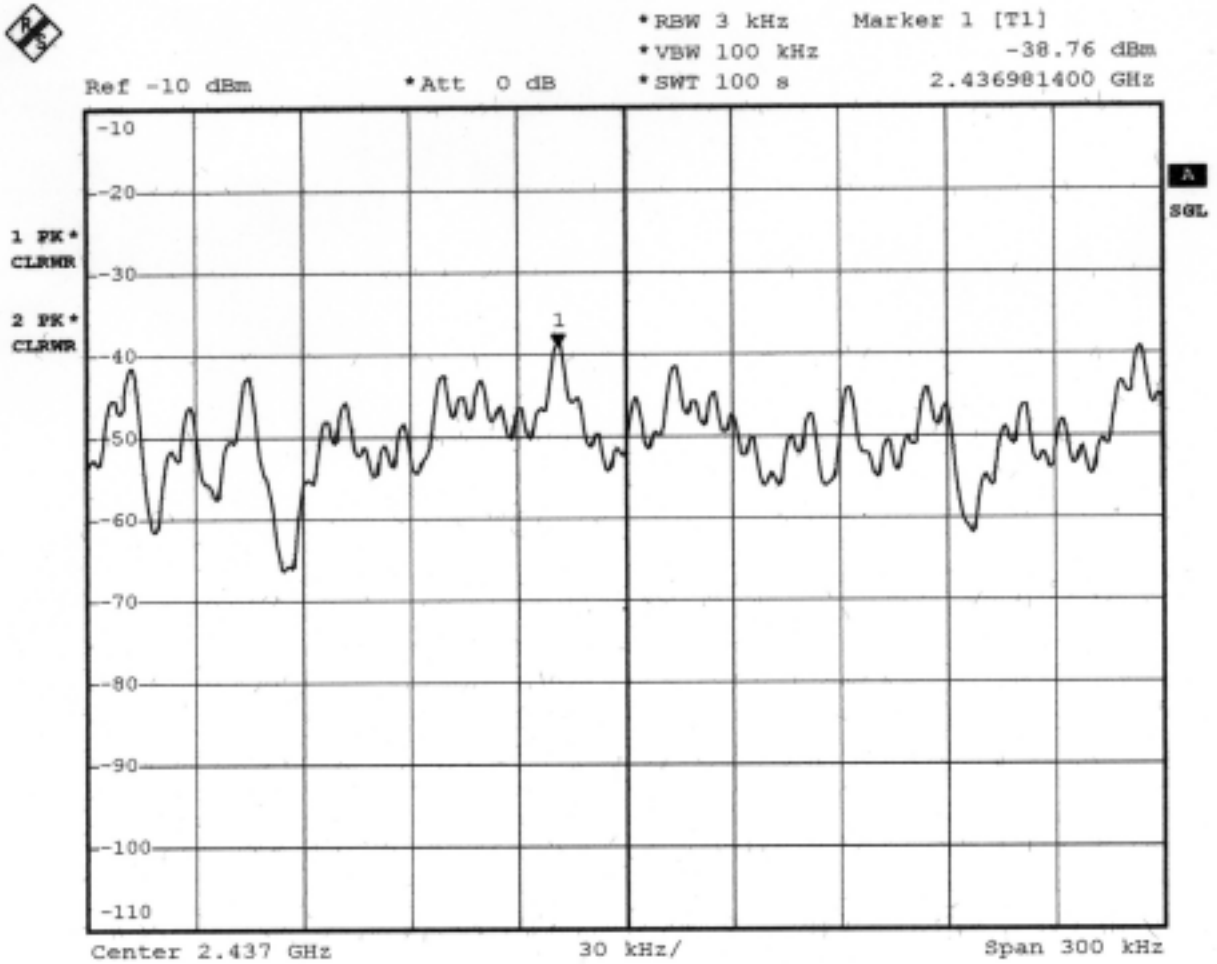
Channel	Frequency (MHz)	Power Spectral Density (dBm)	Limits (dBm)	Plot Ref. No.
1	2412	-39.00	8	1
6	2437	-38.76	8	2
11	2462	-35.58	8	3

Plot1(Channel 1):



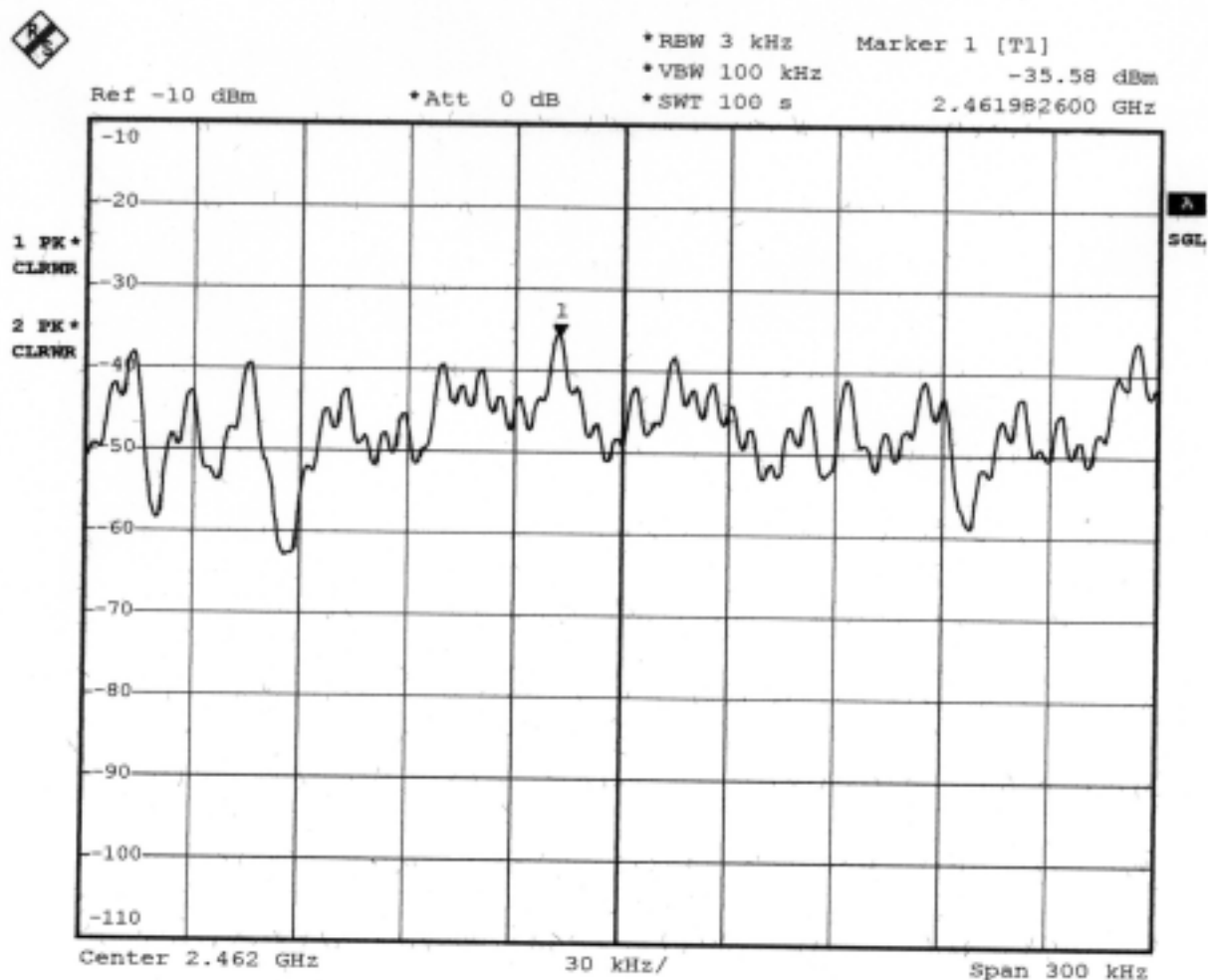
Date: 29.AUG.2002 10:03:02

Plot2(Channel 6):



Date: 29.AUG.2002 10:00:49

Plot3(Channel 11):



Date: 29.AUG.2002 09:58:28

Comments : Maximum Power Spectral Density < 8dBm

5.5. Test of Conducted Emission

Conducted Emissions were measured from 150 KHz to 30 MHz with a bandwidth of 9 KHz on the 115 VAC power 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 :

• EMC Analyzer	(HP 8591EM)
Attenuation	10 dB
Start Frequency	0.15 MHz
Stop Frequency	30 MHz
IF Bandwidth	9KHz

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 :

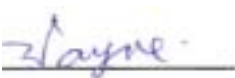
Frequency Range of Test : from 150KHz to 30 MHz

6dB Bandwidth : 9KHz

- Test Mode : Mode 1
- Temperature : 28.5°C
- Relative Humidity : 59 %
- Test Date: Oct.14, 2002

The Conducted Emission test was passed at minimum margin NEUTRAL 0.358 MHz / 39.95 dBuV.

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)
0.629	L	42.32	33.58	56.00	46.00	-13.68	-12.42
0.716	L	42.40	33.69	56.00	46.00	-13.60	-12.31
0.898	L	44.13	32.45	56.00	46.00	-11.87	-13.55
0.983	L	41.28	32.07	56.00	46.00	-14.72	-13.93
1.054	L	44.80	33.41	56.00	46.00	-11.20	-12.59
1.180	L	46.22	33.03	56.00	46.00	-9.78	-12.97
0.358	N	42.91	39.95	58.77	48.77	-15.86	-8.82
0.447	N	39.87	34.38	56.93	46.93	-17.06	-12.55
0.625	N	44.12	36.68	56.00	46.00	-11.88	-9.32
0.724	N	42.34	30.78	56.00	46.00	-13.66	-15.22
0.891	N	42.78	33.71	56.00	46.00	-13.22	-12.29
1.060	N	43.90	33.01	56.00	46.00	-12.10	-12.99

Test Engineer : 
Wayne Hsu

- Test Mode : Mode 2
- Temperature : 28.5°C
- Relative Humidity : 59 %
- Test Date: Oct.14, 2002

The Conducted Emission test was passed at minimum margin LINE 0.634 MHz / 36.58 dBuV

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)
0.451	L	40.50	35.51	56.86	46.86	-16.36	-11.35
0.634	L	44.04	36.58	56.00	46.00	-11.96	-9.42
0.723	L	44.65	36.49	56.00	46.00	-11.35	-9.51
0.912	L	45.13	36.04	56.00	46.00	-10.87	-9.96
1.073	L	45.00	33.72	56.00	46.00	-11.00	-12.28
1.187	L	46.81	34.24	56.00	46.00	-9.19	-11.76
0.449	N	40.99	34.45	56.89	46.89	-15.90	-12.44
0.535	N	41.29	34.84	56.00	46.00	-14.71	-11.16
0.627	N	43.94	36.24	56.00	46.00	-12.06	-9.76
0.890	N	44.35	34.24	56.00	46.00	-11.65	-11.76
1.059	N	44.59	33.50	56.00	46.00	-11.41	-12.50
1.159	N	42.86	31.14	56.00	46.00	-13.14	-14.86

Test Engineer : Wayne Hsu
Wayne Hsu

- Test Mode : Mode 3
- Temperature : 28.5°C
- Relative Humidity : 59 %
- Test Date: Oct. 14, 2002

The Conducted Emission test was passed at minimum margin NEUTRAL 0.355 MHz / 40.20dBuV.

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)
0.625	L	42.78	34.55	56.00	46.00	-13.22	-11.45
0.884	L	44.98	35.38	56.00	46.00	-11.02	-10.62
0.981	L	42.52	31.61	56.00	46.00	-13.48	-14.39
1.050	L	45.61	33.81	56.00	46.00	-10.39	-12.19
1.143	L	45.94	34.56	56.00	46.00	-10.06	-11.44
1.226	L	43.95	30.65	56.00	46.00	-12.05	-15.35
0.355	N	44.07	40.20	58.84	48.84	-14.77	-8.64
0.623	N	44.49	36.79	56.00	46.00	-11.51	-9.21
0.801	N	41.66	32.10	56.00	46.00	-14.34	-13.90
0.890	N	43.84	33.56	56.00	46.00	-12.16	-12.44
1.059	N	44.78	33.10	56.00	46.00	-11.22	-12.90
1.139	N	42.27	30.83	56.00	46.00	-13.73	-15.17

Test Engineer : Wayne Hsu
Wayne Hsu

5.6. Test of Radiated Emission

Radiated emissions from 30 MHz to 24.62 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 (HP 8447D)
 - Attenuation 0 dB
 - RF Gain 25 dB
 - Signal Input 10MHz – 1.3GHz

 - Spectrum Analyzer (R&S FSP7)
 - Attenuation 10 dB
 - Start Frequency 30 MHz
 - Stop Frequency 1 GHz
 - Resolution Bandwidth 120 kHz
 - Signal Input 9KHz – 7GHz

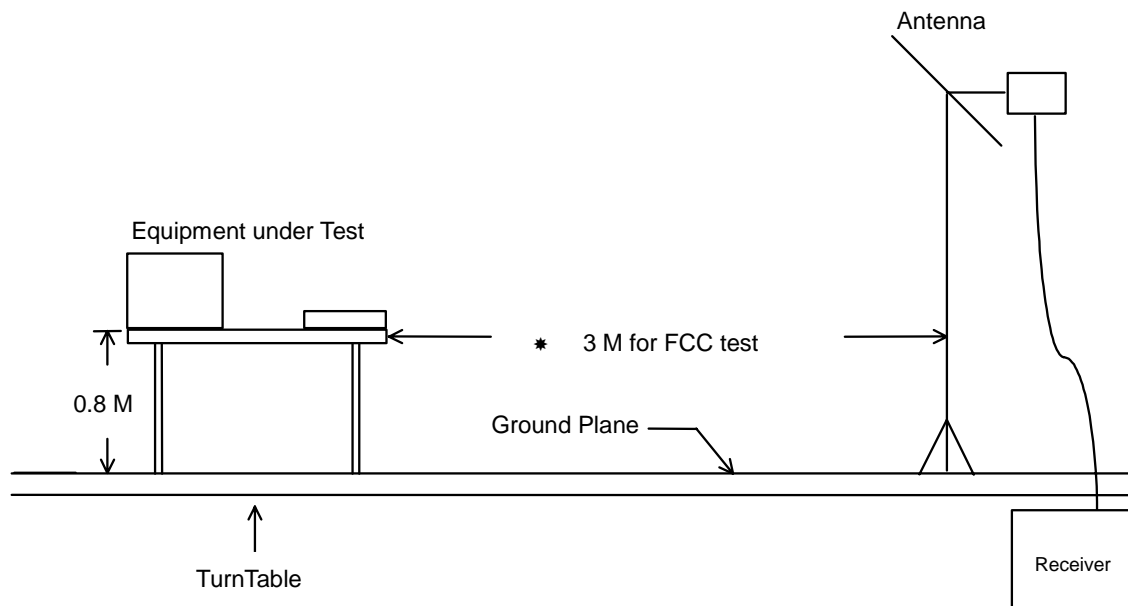
- above 1GHz
 - Spectrum (R&S FSP30)
 - Attenuation 10 dB
 - Start Frequency 1000 MHz
 - Stop Frequency 30GHz
 - Resolution Bandwidth 1 MHz
 - Video Bandwidth For peak mode: 1MHz
 - Signal Input 30 MHz to 30 GHz

 - Amplifier (MITEQ 805858)
 - Attenuation 0 dB
 - RF Gain 30 dB
 - Signal Input 100KHz – 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.

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 : 27.6°C
- Relative Humidity : 65 %
- Test Date : Oct.12, 2002
- Emission level (dBuV/m) = 20 log Emission level (uV/m)

The Radiated Emission test was passed at minimum margin:

Vertical 43.500 MHz / 37.82 dBuV/m Antenna Height 1 Meter , Turntable Degree 174 °

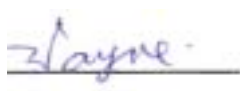
- For 30MHz to 1GHz
- Corrected Reading : Antenna Factor + Cable Loss + Reading = Emission

Frequency (MHz)	Antenna Polarity	Antenna Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Limits (dBuV/m)	Emission (uV/m)	Level (dBuV/m)	Margin (uV/m)	Detect (dB)	Mode
183.090	H	8.77	2.43	58.20	43.50	149.62	38.94	88.51	-4.56	Peak
243.570	H	11.32	2.80	57.04	46.00	199.53	40.96	111.69	-5.04	Peak
250.050	H	12.04	2.83	56.31	46.00	199.53	40.98	111.94	-5.02	Peak
300.000	H	12.96	3.11	52.50	46.00	199.53	38.50	84.14	-7.50	Peak
500.200	H	17.29	4.01	49.86	46.00	199.53	41.56	119.67	-4.44	Q.P.
875.400	H	20.28	5.21	41.43	46.00	199.53	37.90	78.52	-8.10	Peak
37.29	V	14.39	1.10	48.88	40.00	100.00	33.66	48.19	-6.34	Q.P.
43.500	V	11.10	1.19	56.24	40.00	100.00	37.82	77.80	-2.18	Q.P.
250.050	V	12.04	2.83	52.62	46.00	199.53	37.29	73.20	-8.71	Peak
500.200	V	17.29	4.01	48.87	46.00	199.53	40.57	106.78	-5.43	Peak
649.300	V	18.86	4.72	44.19	46.00	199.53	38.58	84.92	-7.42	Peak
875.400	V	20.28	5.21	42.14	46.00	199.53	38.61	85.21	-7.39	Peak

- For above 1000MHz
- Corrected Reading : Antenna Factor + Cable Loss + Reading = Emission

Frequency (MHz)	Polarity	Antenna Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Limits		Emission Level		Margin (dB)	Detect Mode
					(dBuV/m)	(uV/m)	(dBuV/m)	(mV/m)		
1494.000	H	27.19	4.02	40.04	54.00	501.19	44.75	172.78	-9.25	Peak
2414.000	H	30.17	5.20	90.48	-	-	99.29	92151	-	Peak
1468.000	V	27.14	3.98	45.49	54.00	501.20	50.11	320.26	-3.89	Peak
1494.000	V	27.19	4.02	40.84	54.00	501.20	45.55	189.45	-8.45	Peak
2412.000	V	30.17	5.20	97.76	-	-	106.57	213059.06	-	Peak,

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 2
- Test Distance : 3 M
- Temperature : 27.6°C
- Relative Humidity : 65%
- Test Date : Oct.12, 2002
- Emission level (dBuV/m) = 20 log Emission level (uV/m)

The Radiated Emission test was passed at minimum margin:

Vertical 38.370 MHz / 38.46 dBuV/m Antenna Height 1 Meter , Turntable Degree 190 °

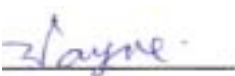
- For 30MHz to 1GHz
- Corrected Reading : Antenna Factor + Cable Loss + Reading = Emission

Frequency (MHz)	Polarity	Antenna Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Limits (dBuV/m)	Emission Level (uV/m)	Emission Level (dBuV/m)	Margin (dB)	Detect Mode	
223.050	H	9.05	2.66	54.76	46.00	199.53	36.18	64.42	-9.82	Peak
243.570	H	11.32	2.80	55.71	46.00	199.53	39.63	95.83	-6.37	Peak
250.050	H	12.04	2.83	54.81	46.00	199.53	39.48	94.20	-6.52	Peak
500.200	H	17.29	4.01	46.88	46.00	199.53	38.58	84.92	-7.42	Peak
811.700	H	20.04	5.26	42.42	46.00	199.53	38.73	86.40	-7.27	Peak,
875.400	H	20.28	5.21	42.50	46.00	199.53	38.97	88.82	-7.03	Peak
38.370	V	13.80	1.12	54.25	40.00	100.00	38.46	83.75	-1.54	Q.P.
47.820	V	8.93	1.24	56.49	40.00	100.00	35.95	62.73	-4.05	Q.P.
250.050	V	12.04	2.83	55.28	46.00	199.53	39.95	99.43	-6.05	Peak
811.700	V	20.04	5.26	41.69	46.00	199.53	38.00	79.43	-8.00	Peak
875.400	V	20.28	5.21	43.09	46.00	199.53	39.56	95.06	-6.44	Peak
895.000	V	20.30	5.21	42.18	46.00	199.53	38.89	88.00	-7.11	Peak

- For above 1000MHz
- Corrected Reading : Antenna Factor + Cable Loss + Reading = Emission

Frequency (MHz)	Polarity	Antenna	Cable	Reading	Limits		Emission Level		Margin (dB)	Detect Mode
		Factor (dB/m)	Loss (dB)	(dBuV)	(dBuV/m)	(uV/m)	(dBuV/m)	(mV/m)		
1454.000	H	27.08	3.96	39.56	54.00	501.20	44.11	160.51	-9.89	Peak
1494.000	H	27.19	4.02	39.35	54.00	501.20	44.06	159.60	-9.94	Peak.
2438.000	H	30.11	5.23	89.18	-	-	97.96	79067.86	-	Peak
1324.000	V	26.59	3.77	39.92	54.00	501.20	43.81	155.06	-10.19	Peak
1462.000	H	27.11	3.97	43.79	54.00	501.20	48.37	262.12	-5.63	Peak.
1494.000	H	27.19	4.02	40.16	54.00	501.20	44.87	175.20	-9.13	Peak
2438.000	H	30.11	5.23	97.09	-	-	105.87	196562.20	-	Peak

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 : 27.6°C
- Relative Humidity : 65 %
- Test Date : Oct. 12, 2002
- 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:

Vertical 35.940 MHz / 39.44 dBuV/m Antenna Height 1 Meter , Turntable Degree 190 °

- For 30MHz to 1GHz
- Corrected Reading : Antenna Factor + Cable Loss + Reading = Emission

Frequency (MHz)	Polarity	Antenna Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Limits (dBuV/m)	Emission Level (uV/m)	Emission Level (dBuV/m)	Margin (dB)	Detect Mode	
85.620	H	8.14	1.70	57.05	40.00	100.00	36.07	63.61	-3.93	Peak
124.770	H	11.51	2.00	55.20	43.50	149.62	38.25	81.75	-5.25	Peak
250.050	H	12.04	2.83	55.30	46.00	199.53	39.97	99.66	-6.03	Peak
500.200	H	17.29	4.01	47.76	46.00	199.53	39.46	93.97	-6.54	Peak
811.700	H	20.04	5.26	42.85	46.00	199.53	39.16	90.78	-6.84	Peak
875.400	H	20.28	5.21	43.10	46.00	199.53	39.57	99.17	-6.43	Peak
35.940	V	15.17	1.09	53.89	40.00	100.00	39.44	93.76	-0.56	Q.P.
47.820	V	8.93	1.24	56.20	40.00	100.00	35.66	60.67	-4.34	Q.P.
250.00	V	12.04	2.83	54.61	46.00	199.53	39.28	92.05	-6.72	Peak
318.200	V	13.44	3.19	51.25	46.00	100.00	37.81	77.71	-8.19	Peak
875.400	V	20.28	5.21	42.68	46.00	100.00	39.15	90.68	-6.85	Peak
895.000	V	20.30	5.21	42.27	46.00	100.00	38.98	88.92	-7.02	Peak

- For above 1000MHz
- Corrected Reading : Antenna Factor + Cable Loss + Reading = Emission

Frequency (MHz)	Polarity	Antenna Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Limits		Emission Level		Margin (dB)	Detect Mode
					(dBuV/m)	(uV/m)	(dBuV/m)	(mV/m)		
1494.000	H	27.19	4.02	38.92	54.00	501.20	43.63	151.90	-10.37	Peak
2462.000	H	30.06	5.25	88.62	-	-	97.38	73960.53	-	Peak
2462.000	H	30.06	5.25	68.14	-	-	76.90	6998.42	-	A.V.
1494.000	V	27.19	4.02	40.35	54.00	501.20	45.06	179.06	-8.94	Peak
1750.000	V	27.06	4.37	39.49	54.00	501.20	44.37	159.17	-9.63	Peak
2462.000	V	30.06	5.25	96.91	-	-	105.67	192087.9	-	Peak
2462.000	V	30.06	5.25	78.45	-	-	87.21	22935.07	-	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

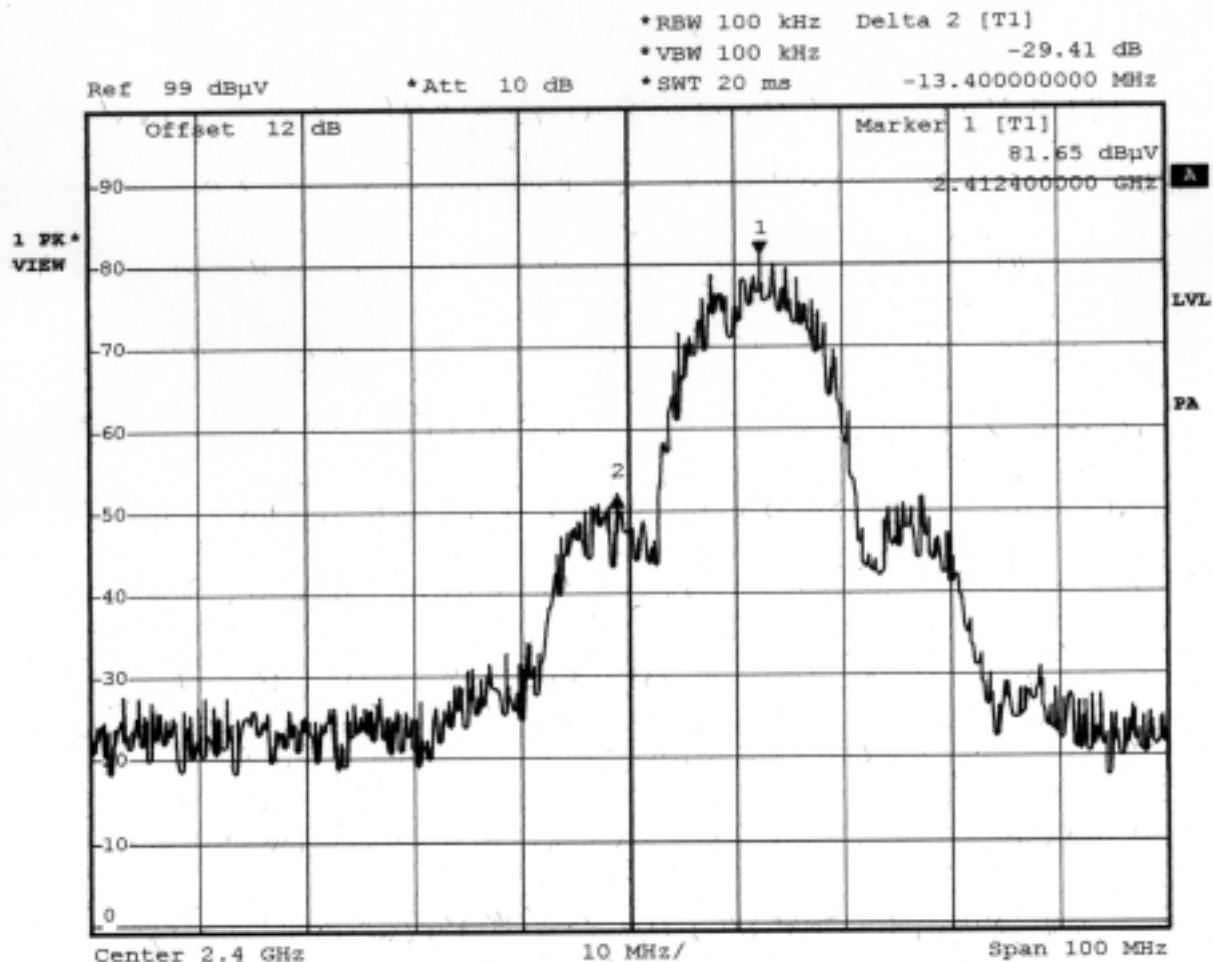
The band edge emission plot on page 37. shows 45.10dB delta between carrier maximum power and local maximum emission in the restricted band (2.4835GHz).

Polarity	The emission of carrier power strength (dB μ V/m)	The maximum field strength in restrict band (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
V	87.21	42.11	54	-11.89	Pass
H	76.90	31.80	54	-22.20	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.

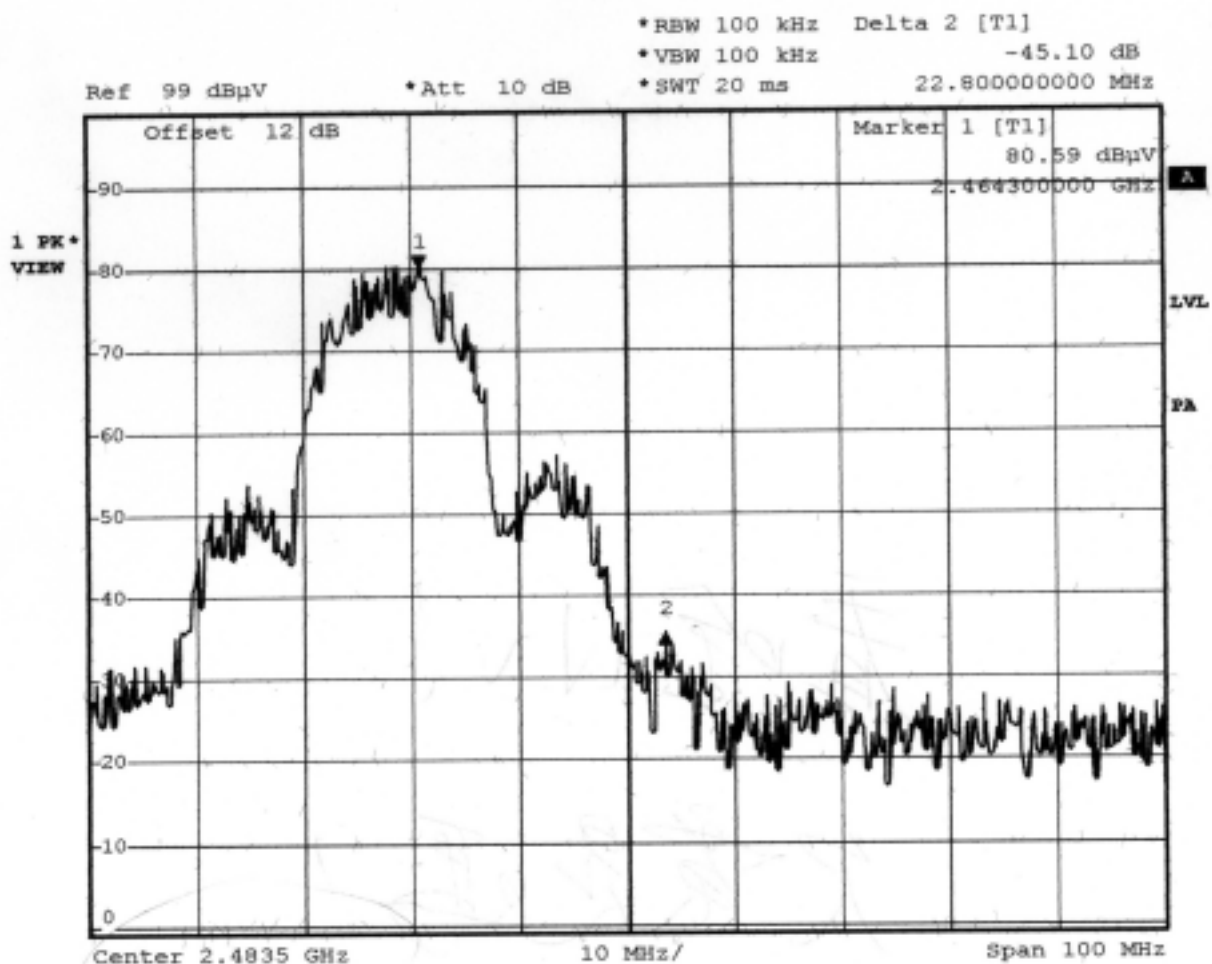
The spectrum analyzer plots are attached as below :

Plot1 (Channel 1) :



Date: 21.AUG.2002 09:35:27

Plot2 (Channel 11) :



Date: 21.AUG.2002 09:33:48

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

5.8. Antenna Requirements

The EUT use a detachable antenna via TNC-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. The antenna connector type is MMCX.

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/ cm ²)	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/cm ²)	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

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

- 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.	Gain (dBi)	Gain Numeric	Peak Output Power (mW)	Calculated RF Exposure Separation Distance (cm)	Minimum RF Exposure Separation Distance (cm)
Channel 1	2	1.58	3.92	0.222	20
Channel 6	2	1.58	4.18	0.229	20
Channel 11	2	1.58	5.87	0.272	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	18.10	0.99
35	16.00	1.07
40	13.29	1.13
45	10.75	1.20
50	8.10	1.26
55	6.40	1.32
60	5.36	1.40
65	4.94	1.41
70	5.19	1.51
75	6.05	1.57
80	6.96	1.60
85	8.04	1.70
90	8.76	1.70
95	9.70	1.75
100	10.30	1.79
110	11.17	1.93
120	11.60	1.95
130	11.23	2.01
140	10.61	2.12
150	10.10	2.20
160	9.20	2.26
170	9.01	2.33
180	8.71	2.40
190	8.80	2.52
200	8.24	2.55
220	8.80	2.64
240	10.72	2.78
260	13.20	2.89
280	12.50	2.98
300	12.96	3.11
320	13.50	3.20
340	13.93	3.25
360	14.39	3.44
380	14.70	3.63
400	15.76	3.50
450	16.35	3.82
500	17.29	4.01
550	18.50	4.16
600	18.43	4.39
650	18.85	4.72
700	18.93	4.71
750	19.75	4.83
800	19.92	5.27
850	20.24	5.22
900	20.30	5.22
950	20.46	5.54
1000	20.80	5.81

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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
10000	38.90	11.20
11000	41.10	12.11
12000	42.70	12.37

8. List of Measuring Equipments Used

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
Spectrum analyzer	R&S	FSP30	100024	9KHZ~30GHZ	Apr. 02, 2002	Radiation (SH04)
Amplifier	HP	8447D	2944A09072	100KHz – 1.3GHz	Oct. 21, 2002	Radiation (SH04)
Amplifier	MITEQ	NSP2650-NF	805858	100KHz~26.5GHz	Jul. 11, 2002	Radiation (SH04)
Bilog Antenna	SCHAFFNER	CBL6112B	2687	30MHz –2GHz	Dec. 23, 2001	Radiation (SH04)
Horn Antenna	COM-POWER	AH-118	10094	1GHz – 18GHz	Apr. 09, 2002	Radiation (SH04)
Turn Table	HD	DS 420	420/650/00	0 ~ 360 degree	N/A	Radiation (SH04)
Antenna Mast	HD	MA 240	240/560/00	1 m - 4 m	N/A	Radiation (SH04)
Temp. and Humidity Chamber	KSON	THS-C3L	612	N/A	Oct. 02, 2002	Conducted
Power Meter	R&S	NRVS	1020.1809.02	DC-40GHz	May. 13, 2002	Conducted
Power Sensor	R&S	NRV-Z32	1031.6807.04 1/.05	30MHz-6GHz	Apr. 29, 2002	Conducted
Power Sensor	R&S	NRV-Z55	1081.2005.02	DC-40GHz	May. 07, 2002	Conducted

Calibration Interval of instruments listed above is one year.

9. Uncertainty of Test Site

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 Ue(y)	normal	±1.66
Measuring uncertainty for a level of confidence of 95% U=2Ue(y)	normal (k=2)	±3.32

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