

FCC TEST REPORT

for

47 CFR, Part 15, Subpart C

Equipment : USB Wireless LAN Card

Model No. : 73-TMWBS-002

FCC ID : QS3WBSZP2

Filing Type : Certification

Applicant : **TwinMOS Technologies Inc.**
303 No. 3, Tzu Chiang Rd.,
Hu Kou Xiang, Hsin Chu, 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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CERTIFICATE OF COMPLIANCE

for

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Filing Type : Certification
Applicant : **TwinMOS Technologies Inc.**
303 No. 3, Tzu Chiang Rd.,
Hu Kou Xiang, Hsin Chu, 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 - 2001** 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 Nov. 28, 2003 at **SPORTON International Inc.** LAB.



Alex Chen
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

TwinMOS Technologies Inc.
303 No. 3, Tzu Chiang Rd.,
Hu Kou Xiang, Hsin Chu, Taiwan, R.O.C.

1.2. Manufacturer

Same as 1.1

1.3. Basic Description of Equipment under Test

Equipment : USB Wireless LAN Card
Model No. : 73-TMWBS-002
FCC ID. : QS3WBSZP2
Trade Name : TwinMOS
Power Supply Type : From notebook
AC Power Input : N/A

1.4. Feature of Equipment under Test

Host/Radio Interface	DSSS
Type of Modulation	DBPSK,DQPSK,CCK
Number of Channels	11
Frequency Band	2412Mhz-2484Mhz
Carrier Frequency of each channel	2412,2417,2422,2427,2432,2437,2442,2447,2452,2457,2462,2467,2472,2484
Bandwidth of each channel	22MHz
Output Power to Antenna	13.31dBm
Antenna Type / Class and Gain	Chip antenna / 2dBi
Function Type	Transceiver
Power Rating (DC/AC , Voltage)	5V
Duty Cycle	45%~55%
Basic function of product	Wireless LAN
Temperature Range (Operating)	0-55
Humidity	15%~95%

2. Test Configuration of Equipment under Test

2.1. Test Manner

- a. The EUT has been associated with notebook and peripherals pursuant to ANSI C63.4-2001 and configuration operated in a manner, which tended to maximize its emission characteristics in a typical application.
- b. The complete test system included COMPAQ NOTEBOOK, VIEWSONIC Monitor, BTC PS/2 Keyboard, LOGITECH USB Mouse, EPSON Printer and EUT for EMI test.
- c. 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: CH01 2412MHz
 Mode 2: CH06 2437MHz
 Mode 3: CH11 2462MHz
- d. Frequency range investigated: conduction 150 KHz to 30 MHz, radiation 30 MHz to 25000MHz.

2.2. Description of Test System

Support Unit 1. – Notebook (COMPAQ)

FCC ID	: N/A
Model No.	: PRESARIO 1500
Power Supply Type	: Switching
Power Cord	: Non-Shielded
Serial No.	: SP0039
Remark	: This support device was tested to comply with FCC standards and authorized under a declaration of conformity.

Support Unit 2. -- Monitor (VEIWSONIC)

FCC ID	: N/A
Model No.	: VCDTS21553-3P
Power Supply Type	: Switching
Power Cord	: Non-Shielded
Serial No.	: SP0050
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. -- PS/2 Keyboard (BTC)

FCC ID : N/A
Model No. : 9110
Serial No. : SP0055
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.

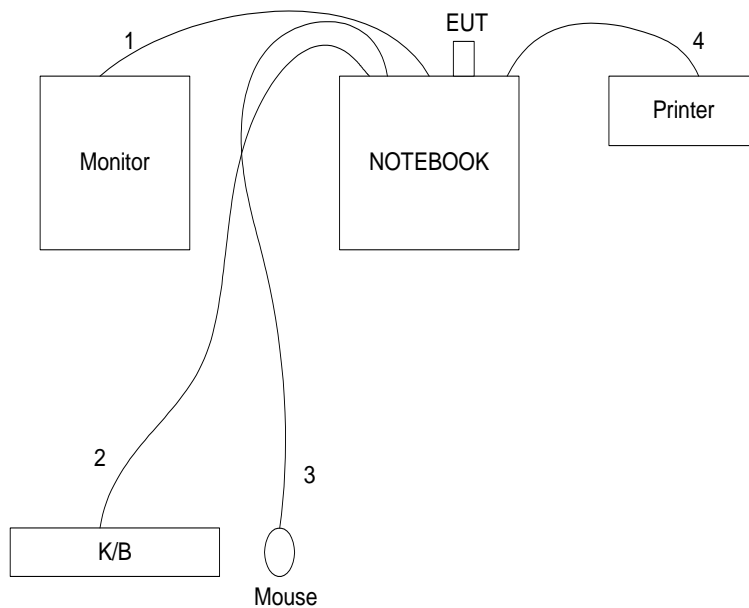
Support Unit 4. -- USB Mouse (LOGITECH)

FCC ID : N/A
Model No. : M-BE58
Serial No. : SP0041
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. -- Printer (EPSON)

FCC ID : N/A
Model No. : STYLUS COLOR 680
Power Supply Type : Linear
Power Cord : Non-Shielded
Serial No. : SP0048
Data Cable : Shielded, 1.35m

2.3. Connection Diagram of Test System



1. The I/O cable is connected from the NOTEBOOK to the support unit 2.
2. The I/O cable is connected from the NOTEBOOK to the support unit 3.
3. The I/O cable is connected from the NOTEBOOK to the support unit 4.
4. The I/O cable is connected from the NOTEBOOK to the support unit 5.

3. Operation of Equipment under Test

An executive programs, EMCTEST.EXE under WIN XP, which generate 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, "ZyDas" was executed to keep transmitting signals at fixed frequency.

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 : CO01-HY, 03CH03-HY

4.1. Test Voltage

110V/ 60Hz

4.2. Standard for Methods of Measurement

ANSI C63.4-2001 for conducted power line test and radiated emission test,
"Guidance on Measurements for Direct Sequence Spread Spectrum Systems" for test of 6dB Bandwidth
"Guidance on Measurements for Direct Sequence Spread Spectrum Systems" for test of Maximum Peak Output Power
"Guidance on Measurements for Direct Sequence Spread Spectrum Systems" for test of 100kHz Bandwidth of Frequency Band Edges
"Guidance on Measurements for Direct Sequence Spread Spectrum Systems" for test of Power Spectral Density

4.3. Test in Compliance with

FCC Part 15, Subpart C

4.4. Frequency Range Investigated

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

4.5. 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

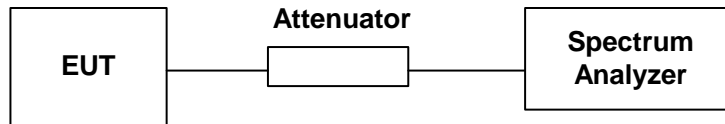
5.2.1. Measuring Instruments :

As described in chapter 7 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 : 27 °C
- Relative Humidity : 62%

Channel	Frequency (MHz)	6dB Emission bandwidth (MHz)	Limits (MHz)	Plot Ref. No.
01	2412	11.04	0.5	1
06	2437	11.04	0.5	2
11	2462	11.04	0.5	3

5.3. Peak Output Power

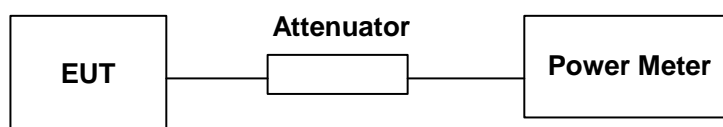
5.3.1. Measuring Instruments :

As described in chapter 7 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 : 27°C
- Relative Humidity : 62 %
- Antenna Gain: 2 dBi

Channel	Frequency (MHz)	Measured Output Power (mWatt)	Measured Output Power (dBm)	Limits (Watt/dBm)
01	2412	21.42890601	13.31	1W/30 dBm
06	2437	18.28100216	12.62	1W/30 dBm
11	2462	16.40589773	12.15	1W/30 dBm

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

5.4. Power Spectral Density

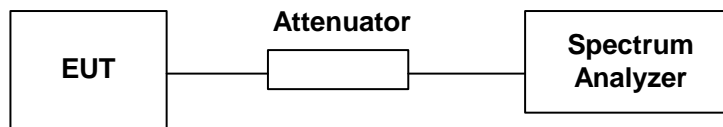
5.4.1. Measuring Instruments :

As described in chapter 7 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 : 27°C
- Relative Humidity : 62%

Channel	Frequency (MHz)	Power Spectral Density (dBm)	Limits (dBm)	Plot Ref. No.
01	2412	-12.31	8	1
06	2437	-12.99	8	2
11	2462	-13.58	8	3

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 C63.4-2001 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 : 27°C
- Relative Humidity : 56 %

The test was passed at the minimum margin that marked by the frame in the following table

LINE

	Freq	Level	Over Limit	Limit Line	Read Level	Probe Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.154	17.52	-38.26	55.78	17.26	0.10	0.16	Average
2	0.154	31.53	-34.25	65.78	31.27	0.10	0.16	QP
3	0.199	15.02	-38.63	53.65	14.74	0.10	0.18	Average
4	0.199	26.95	-36.70	63.65	26.67	0.10	0.18	QP
5	1.790	29.58	-26.42	56.00	29.39	0.10	0.09	QP
6	1.790	22.02	-23.98	46.00	21.83	0.10	0.09	Average
7	2.130	29.32	-26.68	56.00	29.11	0.10	0.11	QP
8	2.130	22.56	-23.44	46.00	22.35	0.10	0.11	Average
9	4.200	26.32	-19.68	46.00	26.04	0.11	0.17	Average
10	4.200	31.53	-24.47	56.00	31.25	0.11	0.17	QP
11	12.250	34.19	-25.81	60.00	33.67	0.20	0.32	QP
12	12.250	29.49	-20.51	50.00	28.97	0.20	0.32	Average

NEUTRAL

	Freq	Level	Over Limit	Limit Line	Read Level	Probe Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.169	37.80	-27.21	65.01	37.53	0.10	0.17	QP
2	0.169	24.68	-30.33	55.01	24.41	0.10	0.17	Average
3	0.216	28.08	-34.89	62.97	27.81	0.10	0.17	QP
4	0.216	16.36	-36.61	52.97	16.09	0.10	0.17	Average
5	1.810	29.21	-26.79	56.00	29.02	0.10	0.09	QP
6	1.810	21.68	-24.32	46.00	21.49	0.10	0.09	Average
7	2.300	29.64	-26.36	56.00	29.41	0.12	0.11	QP
8	2.300	22.69	-23.31	46.00	22.46	0.12	0.11	Average
9	4.380	30.87	-25.13	56.00	30.50	0.20	0.17	QP
10	4.380	25.58	-20.42	46.00	25.21	0.20	0.17	Average
11	13.060	30.11	-19.89	50.00	29.52	0.26	0.33	Average
12	13.060	34.86	-25.14	60.00	34.27	0.26	0.33	QP

Test Engineer : John
 John Huang

- Test Mode : Mode 2
- Temperature : 27°C
- Relative Humidity : 56 %

The test was passed at the minimum margin that marked by the frame in the following table

LINE

	Freq	Level	Over Limit	Limit Line	Read Level	Probe Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.175	37.15	-27.57	64.72	36.88	0.10	0.17	QP
2	0.175	21.80	-32.92	54.72	21.53	0.10	0.17	Average
3	0.195	35.22	-28.60	63.82	34.94	0.10	0.18	QP
4	0.195	24.24	-29.58	53.82	23.96	0.10	0.18	Average
5	1.890	29.45	-26.55	56.00	29.26	0.10	0.09	QP
6	1.890	22.47	-23.53	46.00	22.28	0.10	0.09	Average
7	2.170	29.09	-26.91	56.00	28.88	0.10	0.11	QP
8	2.170	22.05	-23.95	46.00	21.84	0.10	0.11	Average
9	4.180	31.55	-24.45	56.00	31.28	0.10	0.17	QP
10	4.180	25.96	-20.04	46.00	25.69	0.10	0.17	Average
11	12.190	28.91	-21.09	50.00	28.39	0.20	0.32	Average
12	12.190	33.81	-26.19	60.00	33.29	0.20	0.32	QP

NEUTRAL

	Freq	Level	Over Limit	Limit Line	Read Level	Probe Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.169	21.77	-33.24	55.01	21.50	0.10	0.17	Average
2	0.169	36.80	-28.21	65.01	36.53	0.10	0.17	QP
3	0.224	29.00	-33.67	62.67	28.73	0.10	0.17	QP
4	0.224	17.41	-35.26	52.67	17.14	0.10	0.17	Average
5	1.710	29.33	-26.67	56.00	29.15	0.10	0.08	QP
6	1.710	21.56	-24.44	46.00	21.38	0.10	0.08	Average
7	1.810	28.82	-27.18	56.00	28.63	0.10	0.09	QP
8	1.810	21.68	-24.32	46.00	21.49	0.10	0.09	Average
9	4.160	31.67	-24.33	56.00	31.31	0.20	0.16	QP
10	4.160	26.04	-19.96	46.00	25.68	0.20	0.16	Average
11	12.060	30.00	-20.00	50.00	29.43	0.25	0.32	Average
12	12.060	34.90	-25.10	60.00	34.33	0.25	0.32	QP

Test Engineer : John
John Huang

- Test Mode : Mode 3
- Temperature : 27°C
- Relative Humidity : 56 %

The test was passed at the minimum margin that marked by the frame in the following table

LINE

LINE	Freq	Level	Over Limit	Limit Line	Read Level	Probe Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.175	18.24	-36.48	54.72	17.97	0.10	0.17	Average
2	0.175	35.68	-29.04	64.72	35.41	0.10	0.17	QP
3	0.192	30.81	-33.14	63.95	30.53	0.10	0.18	QP
4	0.192	19.96	-33.99	53.95	19.68	0.10	0.18	Average
5	1.670	28.91	-27.09	56.00	28.73	0.10	0.08	QP
6	1.670	20.92	-25.08	46.00	20.74	0.10	0.08	Average
7	1.890	29.25	-26.75	56.00	29.06	0.10	0.09	QP
8	1.890	21.63	-24.37	46.00	21.44	0.10	0.09	Average
9	4.180	31.42	-24.58	56.00	31.15	0.10	0.17	QP
10	4.180	25.78	-20.22	46.00	25.51	0.10	0.17	Average
11	13.200	29.75	-20.25	50.00	29.22	0.20	0.33	Average
12	13.200	34.48	-25.52	60.00	33.95	0.20	0.33	QP

NEUTRAL

LINE	Freq	Level	Over Limit	Limit Line	Read Level	Probe Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.176	33.29	-31.38	64.67	33.02	0.10	0.17	QP
2	0.176	16.34	-38.33	54.67	16.07	0.10	0.17	Average
3	0.206	34.25	-29.12	63.37	33.97	0.10	0.18	QP
4	0.206	24.79	-28.58	53.37	24.51	0.10	0.18	Average
5	1.810	30.23	-25.77	56.00	30.04	0.10	0.09	QP
6	1.810	22.39	-23.61	46.00	22.20	0.10	0.09	Average
7	2.220	22.26	-23.74	46.00	22.03	0.12	0.11	Average
8	2.220	29.67	-26.33	56.00	29.44	0.12	0.11	QP
9	4.140	31.50	-24.50	56.00	31.14	0.20	0.16	QP
10	4.140	25.86	-20.14	46.00	25.50	0.20	0.16	Average
11	13.060	34.96	-25.04	60.00	34.37	0.26	0.33	QP
12	13.060	30.04	-19.96	50.00	29.45	0.26	0.33	Average

Test Engineer : John
 John Huang

5.6. Test of Radiated Emission

Radiated emissions from 30 MHz to 25 GHz were measured according to the methods defines in ANSI C63.4-2001. The EUT was placed, 0.8 meter above the ground plane, as shown in section 5.6.3. 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

- 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

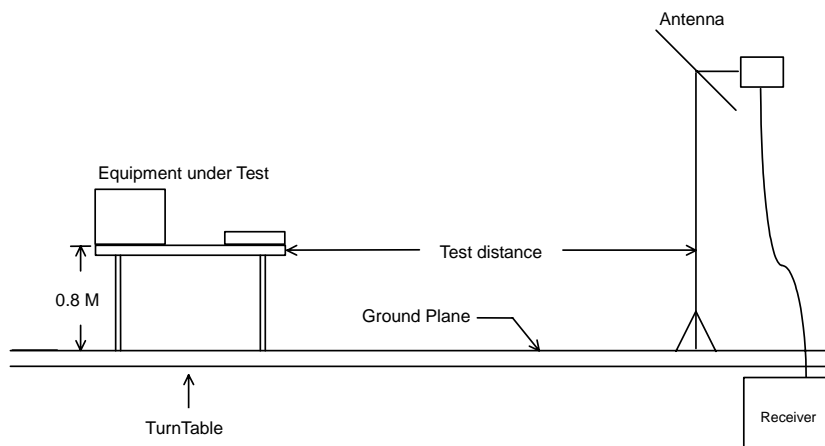
- Spectrum analyzer (R&S FSP40)
 - Attenuation 10 dB
 - Start Frequency 1 GHz
 - Stop Frequency 25 GHz
 - Resolution Bandwidth 1 MHz
 - Video Bandwidth 1 MHz
 - Signal Input 9 KHz to 40 GHz

- 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 (2412MHz)
- Test Distance : 3 M
- Temperature : 27°C
- Relative Humidity : 62 %
- Emission level (dBuV/m) = 20 log Emission level (uV/m)
- Corrected Reading : Probe Factor + Cable Loss + Read Level - Preamp Factor = Level

The test was passed at the minimum margin that marked by the frame in the following table

■ Spurious Emission

HORIZONTAL

	Freq	Level	Over Limit	Limit Line	Read Level	Probe Factor	Cable Loss	Preamp Factor	Remark	Ant Pos	Table Pos
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB	dB	dB		cm	deg
1	89.130	25.77	-17.73	43.50	43.26	8.74	1.69	27.92	Peak	---	---
2	245.730	29.70	-16.30	46.00	43.36	11.16	2.70	27.52	Peak	---	---
3	265.980	31.57	-14.43	46.00	44.45	11.69	2.87	27.44	Peak	---	---
1	343.400	34.68	-11.32	46.00	46.20	12.79	3.21	27.52	Peak	---	---
2	396.600	34.71	-11.29	46.00	44.53	14.52	3.44	27.78	Peak	---	---
3	430.900	35.06	-10.94	46.00	44.40	15.07	3.66	28.07	Peak	---	---
1	1196.000	39.52	-34.48	74.00	52.67	24.60	2.90	40.65	Peak	---	---
2	1196.000	25.35	-28.65	54.00	38.50	24.60	2.90	40.65	Average	---	---
3	1588.000	43.65	-30.35	74.00	55.45	25.72	3.38	40.90	Peak	---	---
4	1588.000	25.93	-28.07	54.00	37.73	25.72	3.38	40.90	Average	---	---

VERTICAL

	Freq	Level	Over Limit	Limit Line	Read Level	Probe Factor	Cable Loss	Preamp Factor	Remark	Ant Pos	Table Pos
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB	dB	dB		cm	deg
1	94.260	31.29	-12.21	43.50	48.50	9.04	1.66	27.91	Peak	---	---
2	103.980	31.71	-11.79	43.50	48.36	9.48	1.76	27.89	Peak	---	---
3	132.330	35.39	-8.11	43.50	50.79	10.45	1.98	27.83	Peak	100	125
1	631.800	32.07	-13.93	46.00	38.86	17.51	4.47	28.77	Peak	---	---
2	665.400	30.41	-15.59	46.00	36.34	17.75	5.05	28.73	Peak	---	---
3	786.500	34.66	-11.34	46.00	39.67	18.68	5.10	28.79	Peak	---	---
1	1324.000	39.38	-34.62	74.00	52.15	24.91	3.06	40.74	Peak	---	---
2	1324.000	26.75	-27.25	54.00	39.52	24.91	3.06	40.74	Average	---	---
3	1590.000	48.02	-25.98	74.00	59.81	25.73	3.38	40.90	Peak	---	---
4	1590.000	27.83	-26.17	54.00	39.62	25.73	3.38	40.90	Average	---	---

➤ For 3GHz ~ 25GHz

Remark: Frequency from 3000MHz to 25000MHz, the emission emitted by the EUT is too low to be measured

■ Field strength of fundamental and harmonics

Frequency (MHz)	Antenna Polarity	Cable Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Limits (dBuV/m)	Emission (uV/m)	Level (dBuV/m)	Margin (uV/m)	Detect (dB)	Mode
2414.000	H	28.25	4.16	44.62	-	-	77.03	7103.95		AV
2414.000	H	28.25	4.16	51.77	-	-	84.18	16180.80		Peak
2414.000	V	28.25	4.16	45.11	-	-	77.52	7516.23		AV
2414.000	V	28.25	4.16	51.46	-	-	83.87	15613.49		Peak
4822.000	H	33.06	7.28	17.21	74.00	5011.87	57.55	754.22	-16.45	Peak
4822.000	H	33.06	7.28	4.03	54.00	501.19	44.37	165.39	-9.63	AV
4822.000	V	33.06	7.28	16.19	74.00	5011.87	56.53	670.66	-17.47	Peak
4822.000	V	33.06	7.28	3.59	54.00	501.19	43.93	157.22	-10.07	AV
7236.000	V/H						-			AV/Peak
9648.000	V/H						-			AV/Peak
12060.000	V/H						-			AV/Peak
14472.000	V/H						-			AV/Peak
16884.000	V/H						-			AV/Peak
19296.000	V/H						-			AV/Peak
21708.000	V/H						-			AV/Peak
24120.000	V/H						-			AV/Peak

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

Test Engineer : Steve
Steve Chen

- Test Mode: Mode 2 (2437 MHz)
- Test Distance : 3 M
- Temperature : 27 °C
- Relative Humidity : 62 %
- Emission level (dBuV/m) = 20 log Emission level (uV/m)
- Corrected Reading : Probe Factor + Cable Loss + Read Level - Preamp Factor = Level

The test was passed at the minimum margin that marked by the frame in the following table

■ Spurious Emission

HORIZONTAL

	Freq	Level	Over Limit	Limit Line	Read Level	Probe Factor	Cable Loss	Preamp Factor	Remark	Ant Pos	Table Pos
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB	dB	dB		cm	deg
1	245.730	29.10	-16.90	46.00	42.76	11.16	2.70	27.52	Peak	---	---
2	265.980	31.00	-15.00	46.00	43.88	11.69	2.87	27.44	Peak	---	---
3	295.140	27.86	-18.14	46.00	40.61	11.41	3.16	27.32	Peak	---	---
1	343.400	36.15	-9.85	46.00	47.67	12.79	3.21	27.52	Peak	100	130
2	397.300	35.56	-10.44	46.00	45.36	14.54	3.45	27.79	Peak	---	---
3	441.400	35.15	-10.85	46.00	44.45	15.21	3.66	28.17	Peak	---	---
1	1196.000	39.62	-34.38	74.00	52.77	24.60	2.90	40.65	Peak	---	---
2	1196.000	26.48	-27.52	54.00	39.63	24.60	2.90	40.65	Average	---	---
3	1588.000	44.03	-29.97	74.00	55.83	25.72	3.38	40.90	Peak	---	---
4	1588.000	27.61	-26.39	54.00	39.41	25.72	3.38	40.90	Average	---	---

VERTICAL

	Freq	Level	Over Limit	Limit Line	Read Level	Probe Factor	Cable Loss	Preamp Factor	Remark	Ant Pos	Table Pos
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB	dB	dB		cm	deg
1	89.130	30.24	-13.26	43.50	47.73	8.74	1.69	27.92	Peak	---	---
2	98.580	31.51	-11.99	43.50	48.41	9.28	1.72	27.90	Peak	---	---
3	133.140	32.08	-11.42	43.50	47.47	10.44	2.00	27.83	Peak	---	---
1	441.400	30.80	-15.20	46.00	40.10	15.21	3.66	28.17	Peak	---	---
2	564.600	29.85	-16.15	46.00	37.50	16.84	4.28	28.77	Peak	---	---
3	786.500	35.37	-10.63	46.00	40.38	18.68	5.10	28.79	Peak	---	---
1	1324.000	39.36	-34.64	74.00	52.13	24.91	3.06	40.74	Peak	---	---
2	1324.000	26.49	-27.51	54.00	39.26	24.91	3.06	40.74	Average	---	---
3	1590.000	47.98	-26.02	74.00	59.77	25.73	3.38	40.90	Peak	---	---
4	1590.000	27.66	-26.34	54.00	39.45	25.73	3.38	40.90	Average	---	---

➤ For 3GHz ~ 25GHz

Remark: Frequency from 3000MHz to 25000MHz, the emission emitted by the EUT is too low to be measured

■ Field strength of fundamental and harmonics

Frequency (MHz)	Antenna Polarity	Cable Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Limits (dBuV/m)	Emission (uV/m)	Level (dBuV/m)	Margin (uV/m)	Detect (dB)	Mode
2438.000	H	28.30	4.18	52.38	-	-	84.86	17498.47		Peak
2438.000	H	28.30	4.18	45.77	-	-	78.25	8175.23		AV
2438.000	V	28.30	4.18	51.03	-	-	83.51	14979.59		Peak
2438.000	V	28.30	4.18	45.36	-	-	77.84	7798.30		AV
4876.000	H	33.17	7.44	16.74	74.00	5011.87	57.35	737.06	-16.65	Peak
4876.000	H	33.17	7.44	3.97	54.00	501.19	44.58	169.43	-9.42	AV
4876.000	V	33.17	7.44	15.04	74.00	5011.87	55.65	606.04	-18.35	Peak
4876.000	V	33.17	7.44	1.76	54.00	501.19	42.37	131.37	-11.63	AV
7311.000	V/H						-			AV/Peak
9748.000	V/H						-			AV/Peak
12185.000	V/H						-			AV/Peak
14622.000	V/H						-			AV/Peak
17059.000	V/H						-			AV/Peak
19496.000	V/H						-			AV/Peak
21933.000	V/H						-			AV/Peak
24370.000	V/H						-			AV/Peak

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

Test Engineer : Steve
Steve Chen

- Test Mode: Mode 3 (2462 MHz)
- Test Distance : 3 M
- Temperature : 27 °C
- Relative Humidity : 62 %
- Emission level (dBuV/m) = 20 log Emission level (uV/m)
- Corrected Reading : Probe Factor + Cable Loss + Read Level - Preamp Factor = Level

The test was passed at the minimum margin that marked by the frame in the following table

■ Spurious Emission

HORIZONTAL

	Freq	Level	Over Limit	Limit Line	Read Level	Probe Factor	Cable Loss	Preamp Factor	Remark	Ant Pos	Table Pos
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB	dB	dB		cm	deg
1	245.730	28.81	-17.19	46.00	42.47	11.16	2.70	27.52	Peak	---	---
2	265.980	31.08	-14.92	46.00	43.96	11.69	2.87	27.44	Peak	---	---
3	298.380	30.71	-15.29	46.00	43.67	11.37	2.98	27.31	Peak	---	---
1	343.400	35.77	-10.23	46.00	47.29	12.79	3.21	27.52	Peak	100	126
2	399.400	34.24	-11.76	46.00	43.97	14.60	3.47	27.80	Peak	---	---
3	881.000	34.03	-11.97	46.00	37.70	19.30	5.42	28.39	Peak	---	---
1	1196.000	39.94	-34.06	74.00	53.09	24.60	2.90	40.65	Peak	---	---
2	1196.000	26.70	-27.30	54.00	39.85	24.60	2.90	40.65	Average	---	---
3	1590.000	44.47	-29.53	74.00	56.26	25.73	3.38	40.90	Peak	---	---
4	1590.000	27.31	-26.69	54.00	39.10	25.73	3.38	40.90	Average	---	---

VERTICAL

	Freq	Level	Over Limit	Limit Line	Read Level	Probe Factor	Cable Loss	Preamp Factor	Remark	Ant Pos	Table Pos
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB	dB	dB		cm	deg
1	99.930	31.78	-11.72	43.50	48.56	9.36	1.76	27.90	Peak	---	---
2	132.330	32.51	-10.99	43.50	47.91	10.45	1.98	27.83	Peak	---	---
3	165.540	30.26	-13.24	43.50	48.17	7.69	2.17	27.77	Peak	---	---
1	343.400	29.93	-16.07	46.00	41.45	12.79	3.21	27.52	Peak	---	---
2	441.400	30.02	-15.98	46.00	39.32	15.21	3.66	28.17	Peak	---	---
3	786.500	35.32	-10.68	46.00	40.33	18.68	5.10	28.79	Peak	---	---
1	1324.000	39.58	-34.42	74.00	52.35	24.91	3.06	40.74	Peak	---	---
2	1324.000	26.75	-27.25	54.00	39.52	24.91	3.06	40.74	Average	---	---
3	1588.000	48.05	-25.95	74.00	59.85	25.72	3.38	40.90	Peak	---	---
4	1588.000	27.86	-26.14	54.00	39.66	25.72	3.38	40.90	Average	---	---

➤ For 3GHz ~ 25GHz

Remark: Frequency from 3000MHz to 25000MHz, the emission emitted by the EUT is too low to be measured

■ Field strength of fundamental and harmonics

Frequency (MHz)	Antenna Polarity	Cable Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Limits (dBuV/m)	Emission (uV/m)	Level (dBuV/m)	Margin (uV/m)	Detect (dB)	Mode
2462.000	H	28.35	4.20	52.59	-	-	85.14	18071.74		Peak
2462.000	H	28.35	4.20	47.33	-	-	79.88	9862.79		AV
2462.000	V	28.35	4.20	52.31	-	-	84.86	17498.47		Peak
2462.000	V	28.35	4.20	46.08	-	-	78.63	8540.83		AV
4924.000	H	33.27	7.57	15.81	74.00	5011.87	56.65	679.99	-17.35	Peak
4924.000	H	33.27	7.57	2.50	54.00	501.19	43.34	146.89	-10.66	AV
4924.000	V	33.27	7.57	12.80	74.00	5011.87	53.64	480.84	-20.36	Peak
4924.000	V	33.27	7.57	-0.22	54.00	501.19	40.62	107.40	-13.38	AV
7386.000	V/H						-			AV/ Peak
9848.000	V/H						-			AV/ Peak
12310.000	V/H						-			AV/ Peak
14772.000	V/H						-			AV/ Peak
17234.000	V/H						-			AV/ Peak
19696.000	V/H						-			AV/ Peak
22158.000	V/H						-			AV/ Peak
24620.000	V/H						-			AV/ Peak

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

Test Engineer : Steve
Steve Chen

5.7. Band Edges Measurement

5.7.1. Measuring Instruments :

As described in chapter 7 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 appendix B page B8. shows 52.99dB 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
H	84.18	29.57	74.00	-44.43	Peak
H	85.14	32.15	74.00	-41.85	Peak
H	77.03	22.42	54.00	-31.85	Average
H	79.88	26.89	54.00	-27.11	Average
V	83.87	29.26	74.00	-44.74	Peak
V	84.86	31.87	74.00	-42.13	Peak
V	77.52	22.91	54.00	-31.09	Average
V	78.63	25.64	54.00	-28.36	Average

5.8. Antenna Requirements

The EUT use a undetachable chip antenna on PCB board no 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 chip antenna. On PCB board, No antenna connector.

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

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

- 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 10 W/m². We can change the formula to:

$$d = \sqrt{\frac{30 \times P \times G}{377}}$$

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 01	2.00	1.58	13.31	21.43	1.64	20
Channel 06	2.00	1.58	12.62	18.28	1.52	20
Channel 11	2.00	1.58	12.15	16.40	1.44	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)	Frequency (MHz)	Antenna Factor (dB)	Cable Loss (dB)
30	15.35	0.92	1000	24.10	3.92
35	13.63	1.05	2000	27.40	5.66
40	11.11	1.08	3000	30.00	7.20
45	10.59	1.15	4000	32.60	9.36
50	6.47	1.29	5000	33.40	9.16
55	5.83	1.63	6000	34.20	10.70
60	5.18	1.30	7000	35.30	12.16
65	4.81	1.36	8000	36.90	13.12
70	4.43	1.43	9000	38.10	13.81
75	5.10	1.48	10000	39.00	14.83
80	5.91	1.53	11000	38.60	15.83
85	7.33	1.61	12000	39.50	17.11
90	8.74	1.69	13000	39.30	17.62
95	9.05	1.67	14000	41.60	18.37
100	9.36	1.76	15000	40.60	19.10
110	9.65	1.80	16000	37.20	19.72
120	9.97	1.90	17000	40.20	21.98
130	10.51	1.61	18000	48.90	21.22
140	10.32	2.14	19000	37.60	23.90
150	9.42	2.16	20000	37.30	24.07
160	8.09	2.16	21000	37.00	25.49
170	7.43	1.99	22000	38.00	24.92
180	7.60	2.39	23000	38.70	25.60
190	7.43	2.38	24000	38.60	25.70
200	7.26	2.46	25000	24.10	3.92
220	9.11	2.59	14000	27.40	5.66
240	10.88	2.68	15000	30.00	7.20
260	11.75	2.91	16000	32.60	9.36
280	11.55	2.92	17000	33.40	9.16
300	11.36	2.99	18000	34.20	10.70
320	12.03	3.03	19000	35.30	12.16
340	12.69	3.22	20000	36.90	13.12
360	13.33	3.28	21000	38.10	13.81
380	14.00	3.80	22000	39.00	14.83
400	14.63	3.80	23000	38.60	15.83
450	15.33	3.69	24000	39.50	17.11
500	16.03	3.93	25000	39.30	17.62
550	16.65	3.56			
600	17.29	4.15			
650	17.64	4.58			
700	18.00	4.73			
750	18.39	4.71			
800	18.79	4.99			
850	19.10	5.24			
900	19.42	5.38			
950	19.58	5.57			
1000	19.75	5.62			

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. 12, 2003	Conduction (CO01-HY)
LISN	MessTec	NNB-2/16Z	2001-008	9 KHz – 30 MHz	Apr. 29, 2003	Conduction (CO01-HY)
LISN (Support Unit)	MessTec	NNB-2/16Z	2001-009	9 KHz – 30 MHz	Apr. 29, 2003	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)
RF Cable-CON	Suhner Switzerland	RG223/U	CB029	9KHz~30MHz	Jan. 07, 2003	Conduction (CO01-HY)
50 ohm BNC type Terminal	NOBLE	50ohm	TM009	50 ohm	Apr. 24, 2003	Conduction (CO01-HY)
3m Semi Anechoic Chamber	SIDT FRANKONIA	SAC-3M	03CH03-HY	30MHz~1GHz 3m	Jun. 21, 2003	Radiation (03CH03-HY)
Spectrum analyzer	R&S	FSP40	100004	9KHZ~40GHz	Aug. 07, 2003	Radiation (03CH03-HY)
Amplifier	MITEQ	AFS44	879981	100MHz~26.5GHz	Jul. 23, 2003	Radiation (03CH03-HY)
Horn Antenna	COM-POWER	AH-118	10094	1GHz – 18GHz	Apr. 10, 2003	Radiation (03CH03-HY)
Turn Table	HD	DS 420	420/650/00	0 ~ 360 degree	N/A	Radiation (03CH03-HY)
Antenna Mast	HD	MA 240	240/560/00	1 m - 4 m	N/A	Radiation (03CH03-HY)
RF Cable-HIGH	Jye Bao	RG142	CB030-HIGH	1GHz~29.5GHz	Mar. 14, 2003	Radiation (03CH03-HY)
Horn Antenna	Schwarzbeck	BBHA9170	154	15GHz~40GHz	Jun. 02, 2003	Radiation
Spectrum analyzer	R&S	FSP7	838858/014	9KHZ~7GHZ	Sep. 03, 2003	Conducted
Power meter	R&S	NRVS	100444	DC~40GHz	May 28, 2003	Conducted
Power sensor	R&S	NRV-Z55	100049	DC~40GHz	May 28, 2003	Conducted
Power Sensor	R&S	NRV-Z32	100057	30MHz-6GHz	May 28, 2003	Conducted
AC power source	HPC	HPA-500W	HPA-9100024	AC 0~300V	May 27, 2003	Conducted
AC power source	G.W.	GPC-6030D	C671845	DC 1V~60V	Nov. 06, 2003	Conducted
Temp. and Humidity Chamber	KSON	THS-C3L	612	N/A	Oct. 01, 2003	Conducted
RF CABLE-1m	Jye Bao	RG142	CB034-1m	20MHz~7GHz	Jan. 01, 2003	Conducted
RF CABLE-2m	Jye Bao	RG142	CB035-2m	20MHz~1GHz	Jan. 01, 2003	Conducted

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 $\Gamma_1=0.09$ 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

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

$U = \{((1/2)^2 + (0.3/2)^2 + (2^2 + 3^2 + 2^2 + 0.25^2 + 2^2)/3 + (0.54)^2/2)\} = 2.7$ 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 $\Gamma_1=0.09$ 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

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