FCC TEST REPORT

for

47 CFR, Part 15, Subpart C

Equipment	:	Wireless Router
Model No.	:	F5D7230-4
FCC ID	:	K7SF5D7230-4
Filing Type	:	Certification
Applicant	:	**Belkin Corporation** 501 West Walnut Street, Compton, CA, 90220-5221, U.S.A.

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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: Nov. 20, 2003

■ No additional attachment.

□ Additional attachment were issued as following record:

Attachment No.	Issue Date	Description

Certificate No. : F391912-01

CERTIFICATE OF COMPLIANCE

for

47 CFR, Part 15, Subpart C

Equipment : Wireless Router

Model No. : F5D7230-4

FCC ID : K7SF5D7230-4

Filing Type : Certification

Applicant : **Belkin Corporation**
501 West Walnut Street, Compton,
CA, 90220-5221, U.S.A.

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 Oct. 29, 2003 at **SPORTON International Inc.** LAB.

K. J. Lin
Manager

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

1. General Description of Equipment under Test

1.1. Applicant

Belkin Corporation
501 West Walnut Street, Compton,
CA, 90220-5221, U.S.A.

1.2. Manufacturer

Same as 1.1

1.3. Basic Description of Equipment under Test

Equipment	: Wireless Router
Model No.	: F5D7230-4
FCC ID	: K7SF5D7230-4
Trade Name	: Belkin
RJ45 Cable	: Non-Shielded, 1 m
RJ45 Cable	: Non-Shielded, 13 m
Power Supply Type	: Switching
AC Power Input	: Wall-mount, 2 pin
DC Power Cable	: Non-Shielded, 1.8 m, 2 pin

1.4. Feature of Equipment under Test

Hardware

- 125MHz MIPS CPU
- 16MB SDRAM
- 4MB Flash Memory
- 802.11g: Broadcom (BCM4306, BCM2050)
- Two external antenna for each wireless technology

Interface

- One 10/100 Base-Tx RJ-45 WAN port for Broadband connection (Cable/DSL or direct Ethernet) and Support HP Auto-MDIX
- Four RJ-45 LAN ports for 10/100Base-Tx Ethernet Switch support HP Auto-MDIX

Physical

- Front Panel: 8 LEDs (Power x 1, LAN x 4, WAN x 1, Wireless x 1, Connected x 1)
- Back Panel: Reset Button, Power Jack, RJ-45 LAN Port x 4, RJ-45 WAN Port x 1
- Dimensions: 145 mm(L) x 240 mm(W) x 40 mm(H)
- Case types: Support Lay down only

Power Adapter and Environmental Requirement

- DC Adaptor: Input AC100V – 240V, Output 5V DC, 2A
- Temperature: 0 to 40°C (operation), -20 to 70 °C (storage)
- Relative Humidity: 5% to 90% (non-condensing)

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 remote workstation, LOGITECH PS/2 Keyboard, LOGITECH USB Mouse, EPSON Printer, VIEWSONIC Monitor, COMPAQ Notebook and EUT for EMI test. The remote workstation included COMPAQ Notebook.

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. -- PS/2 Keyboard (LOGITECH) – for local workstation

FCC ID	: N/A
Model No.	: Y-SJ17
Serial No.	: SP0054
Data Cable	: Shielded, 360 degree via metal backshells, 1.7m
Remark	: This support device was tested to comply with FCC standards and authorized under a declaration of conformity.

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

FCC ID	: N/A
Model No.	: M-BE58
Serial No.	: SP0041
Data Cable	: Shielded, 1.7m
Remark	: This support device was tested to comply with FCC standards and authorized under a declaration of conformity.

Support Unit 3. -- Printer (EPSON) – for local workstation

FCC ID	: N/A
Model No.	: STYLUS COLOR S680
Power Supply Type	: Linear
Power Cord	: Non-Shielded
Serial No.	: SP0048
Data Cable	: Shielded, 1.35m
Remark	: This support device was tested to comply with FCC standards and authorized under a declaration of conformity.

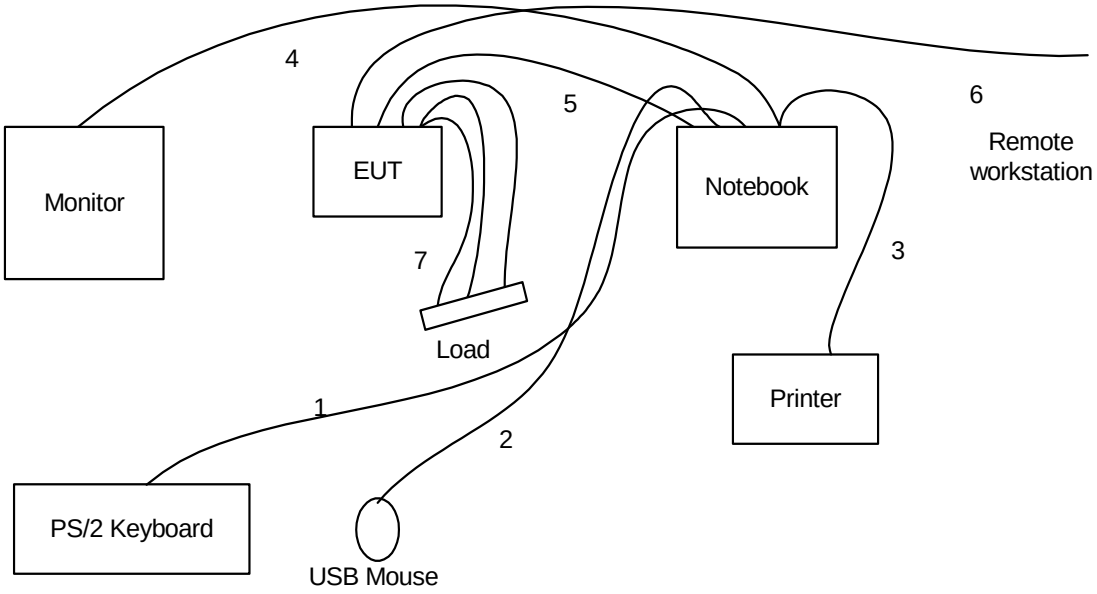
Support Unit 4. -- Monitor (VIEWSONIC) – for local workstation

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

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

FCC ID	: N/A
Model No.	: Presario 1500
Power Supply Type	: Switching
Power Cord	: Non-Shielded
Serial No.	: SP0257
Remark	: This support device was tested to comply with FCC standards and authorized under a declaration of conformity.

2.3. Connection Diagram of Test System



1. The I/O cable is connected from Notebook to the support unit 1.
2. The I/O cable is connected from Notebook to the support unit 2.
3. The I/O cable is connected from Notebook to the support unit 3.
4. The I/O cable is connected from Notebook to the support unit 4.
5. The TP cable is connected from Notebook to EUT.
6. The TP cable is connected from EUT to the remote workstation.
7. These are loop-back TP cables.

3. Operation of Equipment under Test

An executive program, EMCTEST.EXE under WIN XP, 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, “MFGTEST.EXE & Explor.exe” were 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, 15.247

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
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

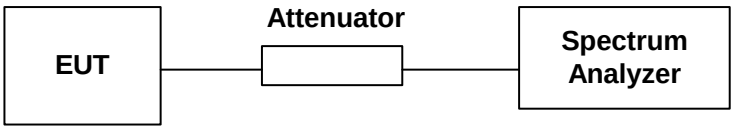
5.2.1. Measuring Instruments：

As described in chapter 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 : 26°C
- Relative Humidity : 54 %

Channel	Frequency (MHz)	6dB Emission bandwidth (MHz)	Limits (MHz)	Plot Ref. No.
1	2412	10.12	0.5	1
6	2437	10.12	0.5	2
11	2462	10.12	0.5	3

-

5.3. Peak Output Power

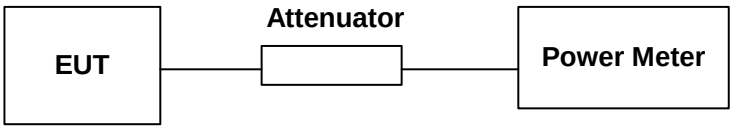
5.3.1. Measuring Instruments：

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 : 26°C
- Relative Humidity : 54 %
- Antenna Gain: 2 dBi

Channel	Frequency (MHz)	Measured Output Power (mWatt)	Measured Output Power (dBm)	Limits (Watt/dBm)
1	2412	27.353	14.37	1W/30 dBm
6	2437	27.227	14.35	1W/30 dBm
11	2462	25.882	14.13	1W/30 dBm

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

5.4. Power Spectral Density

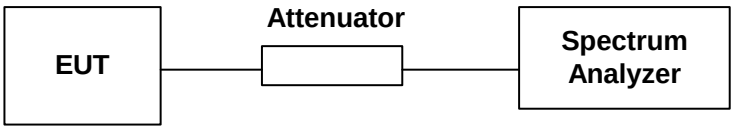
5.4.1. Measuring Instruments：

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 : 26°C
- Relative Humidity : 54 %

Channel	Frequency (MHz)	Power Spectral Density (dBm)	Limits (dBm)	Plot Ref. No.
1	2412	-12.91	8	1
6	2437	-11.50	8	2
11	2462	-11.21	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：

Test Mode: Mode 1

- Frequency Range of Test: from 150KHz to 30 MHz
- 6dB Bandwidth: 9KHz
- Temperature: 21.8°C
- Relative Humidity: 43 %
- Test Date: Oct. 29, 2003

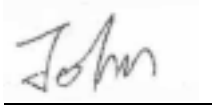
■ The test was passed at the minimum margin that marked by the frame in the following table

Site : C001-HY
Condition : CNS/VCCI/CISPR-B 2003 2001/008 LINE
EUT : Wireless Router
Power : 110V/60Hz
Model : RT210W
Memo : TX CH01

	Freq	Level	Over Limit	Limit Line	Read Level	Probe Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.243	45.18	-16.81	61.99	45.01	0.10	0.07	QP
2	0.243	38.76	-13.23	51.99	38.59	0.10	0.07	Average
3	0.601	25.54	-10.46	46.00	25.35	0.10	0.09	Average
4	0.601	41.90	-14.10	56.00	41.71	0.10	0.09	QP
5	0.839	21.12	-14.88	46.00	20.92	0.10	0.10	Average
6	0.839	39.73	-16.27	56.00	39.53	0.10	0.10	QP
7	0.964	22.48	-13.52	46.00	22.28	0.10	0.10	Average
8	0.964	41.70	-14.30	56.00	41.50	0.10	0.10	QP
9	1.079	29.75	-16.25	46.00	29.55	0.10	0.10	Average
10	1.079	40.13	-15.87	56.00	39.93	0.10	0.10	QP
11	2.130	38.26	-17.74	56.00	38.02	0.10	0.13	QP
12	2.130	22.85	-23.15	46.00	22.62	0.10	0.13	Average

Site : C001-HY
Condition : CNS/VCCI/CISPR-B 2003 2001/008 NEUTRAL
EUT : Wireless Router
Power : 110V/60Hz
Model : RT210W
Memo : TX CH01

	Freq	Level	Over Limit	Limit Line	Read Level	Probe Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.238	44.10	-18.05	62.15	43.93	0.10	0.07	QP
2	0.238	40.27	-11.79	52.15	40.20	0.10	0.07	Average
3	0.597	40.63	-15.37	56.00	40.44	0.10	0.09	QP
4	0.597	33.67	-12.33	46.00	33.48	0.10	0.09	Average
5	0.959	21.21	-14.69	46.00	21.11	0.10	0.10	Average
6	0.958	40.98	-15.02	56.00	40.78	0.10	0.10	QP
7	1.084	40.51	-15.49	56.00	40.31	0.10	0.10	QP
8	1.084	30.41	-15.59	46.00	30.21	0.10	0.10	Average
9	1.200	28.55	-17.45	46.00	28.34	0.10	0.11	QP
10	1.200	28.04	-17.96	46.00	27.83	0.10	0.11	Average
11	1.319	39.30	-16.70	56.00	39.09	0.10	0.11	QP
12	1.319	28.09	-17.91	46.00	27.88	0.10	0.11	Average

Test Engineer : 

John Huang

- Test Mode: Mode 2
- Frequency Range of Test: from 150KHz to 30 MHz
- 6dB Bandwidth: 9KHz
- Temperature: 21.8°C
- Relative Humidity: 43 %
- Test Date: Oct. 29, 2003

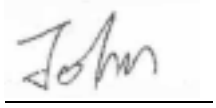
■ The test was passed at the minimum margin that marked by the frame in the following table

Site : C001-HY
Condition : CNS/VCCI/CISPR-B 2003 2001/008 NEUTRAL
EUT : Wireless Router
Power : 110V/60Hz
Model : RT210W
Memo : TX CH06

	Freq	Level	Over Limit	Limit Line	Read Level	Probe Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.238	43.78	-18.38	62.16	43.61	0.10	0.07	QP
2	0.238	40.23	-11.93	52.16	40.06	0.10	0.07	Average
3	0.597	40.59	-15.41	56.00	40.40	0.10	0.09	QP
4	0.597	33.77	-12.23	46.00	33.58	0.10	0.09	Average
5	0.958	41.04	-14.96	56.00	40.84	0.10	0.10	QP
6	0.958	31.05	-14.95	46.00	30.85	0.10	0.10	Average
7	1.080	40.45	-15.55	56.00	40.25	0.10	0.10	QP
8	1.080	30.34	-15.66	46.00	30.14	0.10	0.10	Average
9	1.200	38.64	-17.36	56.00	38.43	0.10	0.11	QP
10	1.200	27.99	-18.01	46.00	27.78	0.10	0.11	Average
11	1.774	37.42	-18.58	56.00	37.20	0.10	0.12	QP
12	1.774	24.34	-21.66	46.00	24.12	0.10	0.12	Average

Site : C001-HY
Condition : CNS/VCCI/CISPR-B 2003 2001/008 LINE
EUT : Wireless Router
Power : 110V/60Hz
Model : RT210W
Memo : TX CH06

	Freq	Level	Over Limit	Limit Line	Read Level	Probe Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.239	44.51	-17.62	62.13	44.34	0.10	0.07	QP
2	0.239	40.84	-11.29	52.13	40.67	0.10	0.07	Average
3	0.601	35.46	-10.54	46.00	35.27	0.10	0.09	Average
4	0.601	41.65	-14.35	56.00	41.46	0.10	0.09	QP
5	0.836	30.53	-15.47	46.00	30.33	0.10	0.10	Average
6	0.836	39.53	-16.47	56.00	39.33	0.10	0.10	QP
7	0.958	41.74	-14.26	56.00	41.54	0.10	0.10	QP
8	0.958	32.32	-13.68	46.00	32.12	0.10	0.10	Average
9	1.080	40.13	-15.87	56.00	39.93	0.10	0.10	QP
10	1.080	29.98	-16.02	46.00	29.78	0.10	0.10	Average
11	1.775	37.88	-18.12	56.00	37.66	0.10	0.12	QP
12	1.775	24.11	-21.89	46.00	23.89	0.10	0.12	Average

Test Engineer : 

John Huang

- Test Mode: Mode 3
- Frequency Range of Test: from 150KHz to 30 MHz
- 6dB Bandwidth: 9KHz
- Temperature: 21.8°C
- Relative Humidity: 43 %
- Test Date: Oct. 29, 2003

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

Site : C001-HY
Condition : CNS/VCCI/CISPR-B 2003 2001/008 LINE
EUT : Wireless Router
Power : 110V/60Hz
Model :
Memo : TX CH11

	Freq	Level	Over Limit	Limit Line	Read Level	Probe Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.238	40.67	-11.51	52.18	40.50	0.10	0.07	Average
2	0.238	44.34	-17.84	62.18	44.17	0.10	0.07	QP
3	0.479	35.48	-10.88	46.36	35.30	0.10	0.08	Average
4	0.479	40.32	-16.04	56.36	40.14	0.10	0.08	QP
5	0.601	41.73	-14.27	56.00	41.54	0.10	0.09	QP
6	0.601	35.07	-10.93	46.00	34.88	0.10	0.09	Average
7	0.830	38.10	-17.90	56.00	37.90	0.10	0.10	QP
8	0.830	28.85	-17.15	46.00	28.65	0.10	0.10	Average
9	0.958	41.70	-14.30	56.00	41.50	0.10	0.10	QP
10	0.958	32.20	-13.80	46.00	32.00	0.10	0.10	Average
11	1.080	30.12	-15.88	46.00	29.92	0.10	0.10	Average
12	1.080	40.07	-15.93	56.00	39.87	0.10	0.10	QP

Site : C001-HY
Condition : CNS/VCCI/CISPR-B 2003 2001/008 NEUTRAL
EUT : Wireless Router
Power : 110V/60Hz
Model :
Memo : TX CH11

	Freq	Level	Over Limit	Limit Line	Read Level	Probe Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.240	43.96	-18.14	62.10	43.79	0.10	0.07	QP
2	0.240	29.95	-12.15	52.10	29.78	0.10	0.07	Average
3	0.601	40.44	-15.56	56.00	40.25	0.10	0.09	QP
4	0.601	32.77	-13.23	46.00	32.58	0.10	0.09	Average
5	0.953	40.62	-15.38	56.00	40.42	0.10	0.10	QP
6	0.953	30.10	-15.90	46.00	29.90	0.10	0.10	Average
7	1.080	40.43	-15.57	56.00	40.23	0.10	0.10	QP
8	1.080	29.90	-16.10	46.00	29.70	0.10	0.10	Average
9	1.190	38.30	-17.70	56.00	38.09	0.10	0.11	QP
10	1.190	26.55	-19.45	46.00	26.34	0.10	0.11	Average
11	1.311	39.28	-16.72	56.00	39.07	0.10	0.11	QP
12	1.311	27.26	-18.74	46.00	27.05	0.10	0.11	Average

Test Engineer : _____

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 on a nonmetallic stand 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

- from 30MHz to 1GHz

  - Amplifier (HP 8447D)
    RF Gain 30 dB
    Signal Input 100 KHz to 1.3 GHz

  - Spectrum Analyzer (R&S FSP)
    Attenuation 10 dB
    Start Frequency 30 MHz
    Stop Frequency 1000 MHz
    Resolution Bandwidth 120 KHz
    Signal Input 9 KHz to 7 GHz

- above 1GHz

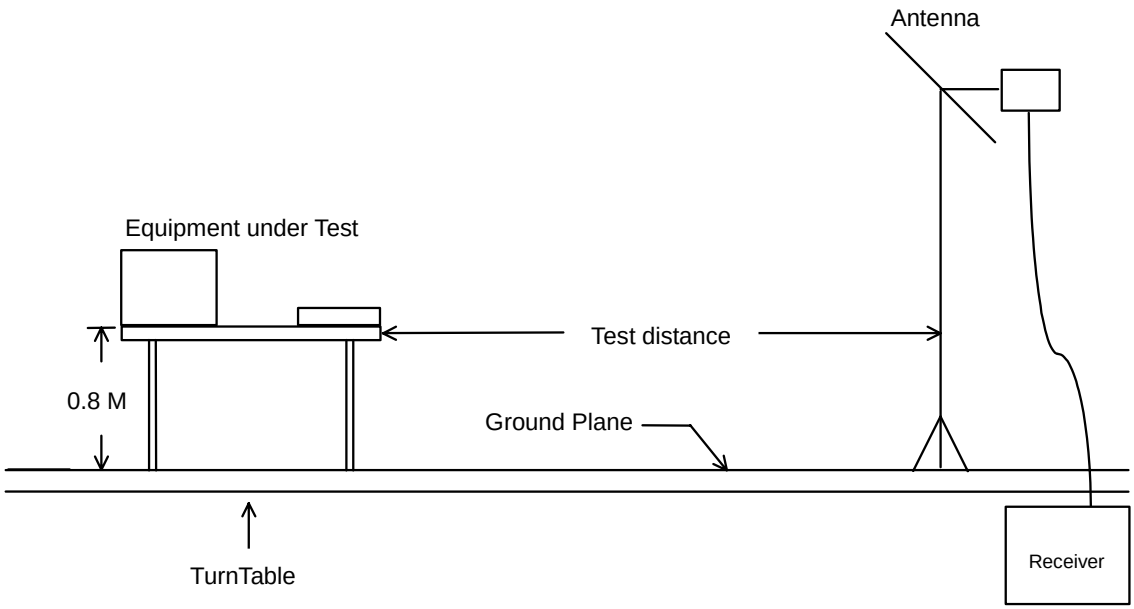
  - Spectrum analyzer (R&S FSP40)
    Attenuation 10 dB
    Start Frequency 1 GHz
    Stop Frequency 25 GHz
    Resolution Bandwidth 1 MHz
    Video Bandwidth 1 MHz
    Signal Input 9 KHz to 40 GHz

  - 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: 27 °C
- Relative Humidity: 61 %
- Test Date: Sep. 23, 2003
- Emission level (dBuV/m) = 20 log Emission level (uV/m)
- Corrected Reading: Antenna Factor + Cable Loss + Reading = Emission

■ 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 _75_°

■ Spurious Emission

- For 30MHz to 1GHz

Frequency	Polarity	Antenna Factor	Cable Loss	Reading	Limits		Emission	Level	Margin	Detect
(MHz)		(dB/m)	(dB)	(dBuV)	(dBuV/m)	(uV/m)	(dBuV/m)	(uV/m)	(dB)	Mode
59.970	H	5.16	1.44	29.48	40.00	100.00	36.08	63.68	-3.92	Peak
81.300	H	6.26	1.76	28.48	40.00	100.00	36.50	66.83	-3.50	Peak
358.100	H	13.28	3.99	24.11	46.00	199.53	41.38	117.22	-4.62	Peak
397.300	H	14.57	4.09	23.54	46.00	199.53	42.20	128.82	-3.80	Peak
35.670	V	13.00	1.10	22.70	40.00	100.00	36.80	69.18	-3.20	Peak
660.500	V	17.72	5.89	18.94	46.00	199.53	42.55	134.12	-3.45	Peak

- For above 1GHz

Frequency	Polarity	Antenna Factor	Cable Loss	Reading	Limits		Emission	Level	Margin	Detect
(MHz)		(dB/m)	(dB)	(dBuV)	(dBuV/m)	(uV/m)	(dBuV/m)	(uV/m)	(dB)	Mode
3214.000	H	29.91	7.30	10.61	74.00	5011.87	47.82	246.04	-26.18	Peak
1588.000	V	27.08	4.80	17.66	74.00	5011.87	49.54	299.92	-24.46	Peak
2478.000	V	30.02	6.06	16.22	74.00	5011.87	52.30	412.10	-21.70	Peak
2558.000	V	29.95	6.19	16.99	74.00	5011.87	53.13	453.42	-20.87	Peak
3214.000	V	29.91	7.30	14.98	74.00	5011.87	52.19	406.91	-21.81	Peak
4710.000	V	33.52	9.11	10.53	74.00	5011.87	53.16	454.99	-20.84	Peak

■ Field strength of fundamental and harmonics

Frequency	Polarity	Antenna Factor	Cable Loss	Reading	Limits		Emission Level		Margin	Detect
(MHz)		(dB/m)	(dB)	(dBuV)	(dBuV/m)	(uV/m)	(dBuV/m)	(uV/m)	(dB)	Mode
2414.000	H	30.17	5.98	55.36	-	-	91.51	37627.04		Peak
2414.000	H	30.17	5.98	51.15	-	-	87.30	23173.95		A.V.
2414.000	V	30.17	5.98	66.92	-	-	103.07	142396.72		Peak
2414.000	V	30.17	5.98	61.14	-	-	97.29	73198.13		A.V.
4824.000	V/H						-			Peak, A.V.
7236.000	V/H						-			Peak, A.V.
9648.000	V/H						-			Peak, A.V.
12060.000	V/H						-			Peak, A.V.
14472.000	V/H						-			Peak, A.V.
16884.000	V/H						-			Peak, A.V.
19296.000	V/H						-			Peak, A.V.
21708.000	V/H						-			Peak, A.V.
24120.000	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: Jay

Jay Zhong

- Test Mode: Mode 2
- Test Distance: 3 M
- Temperature: 27 °C
- Relative Humidity: 61 %
- Test Date: Sep. 23, 2003
- Emission level (dBuV/m) = 20 log Emission level (uV/m)
- Corrected Reading: Antenna Factor + Cable Loss + Reading = Emission

■ 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	Polarity	Antenna Factor	Cable Loss	Reading	Limits		Emission Level		Margin	Detect
(MHz)		(dB/m)	(dB)	(dBuV)	(dBuV/m)	(uV/m)	(dBuV/m)	(uV/m)	(dB)	Mode
155.820	H	8.62	2.11	24.95	40.00	100.00	35.68	60.81	-4.32	Peak
192.540	H	7.38	2.23	29.40	43.50	149.62	39.01	89.23	-4.49	Peak
399.400	H	14.60	3.51	20.50	46.00	199.53	38.61	85.21	-7.39	Peak
374.200	H	13.82	3.50	23.99	46.00	199.53	41.31	116.28	-4.69	Peak
81.300	V	6.48	1.58	28.57	40.00	100.00	36.63	67.84	-3.37	Peak
30.540	V	14.93	1.02	18.24	40.00	100.00	34.19	51.23	-5.81	Peak

- For above 1GHz

Frequency	Polarity	Antenna Factor	Cable Loss	Reading	Limits		Emission Level		Margin	Detect
(MHz)		(dB/m)	(dB)	(dBuV)	(dBuV/m)	(uV/m)	(dBuV/m)	(uV/m)	(dB)	Mode
2318.000	V	28.06	6.10	9.66	40.00	100.00	43.82	155.24	3.82	A.V.
2398.000	V	28.22	6.21	7.41	50.00	316.23	41.84	123.59	-8.16	A.V.
2478.000	V	28.38	6.31	10.15	50.00	316.23	44.84	174.58	-5.16	A.V.
2558.000	V	28.62	6.45	2.66	50.00	316.23	37.73	77.00	-12.27	A.V.

■ Field strength of fundamental and harmonics

Frequency	Polarity	Antenna Factor	Cable Loss	Reading	Limits		Emission Level		Margin	Detect
(MHz)		(dB/m)	(dB)	(dBuV)	(dBuV/m)	(uV/m)	(dBuV/m)	(uV/m)	(dB)	Mode
2438.000	H	28.30	6.26	59.98	-	-	94.54	53333.49		Peak
2438.000	H	28.30	6.26	24.17	-	-	85.73	19341.94		A.V.
2436.000	V	28.29	6.26	66.44	-	-	100.99	112072.74		Peak
2436.000	V	28.29	6.26	57.69	-	-	92.24	40926.07		A.V.
4874.000	V/H						-			Peak, A.V.
7311.000	V/H						-			Peak, A.V.
9748.000	V/H						-			Peak, A.V.
12185.000	V/H						-			Peak, A.V.
14622.000	V/H						-			Peak, A.V.
17059.000	V/H						-			Peak, A.V.
19496.000	V/H						-			Peak, A.V.
21933.000	V/H						-			Peak, A.V.
24370.000	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: Jay

Jay Zhong

- Test Mode: Mode 3
- Test Distance: 3 M
- Temperature: 27 °C
- Relative Humidity: 61 %
- Test Date: Oct. 23, 2003
- Emission level (dBuV/m) = 20 log Emission level (uV/m)
- Corrected Reading: Antenna Factor + Cable Loss + Reading = Emission

■ 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 _105_°

■ Spurious Emission

- For 30MHz to 1GHz

Frequency	Polarity	Antenna Factor	Cable Loss	Reading	Limits		Emission Level		Margin	Detect
(MHz)		(dB/m)	(dB)	(dBuV)	(dBuV/m)	(uV/m)	(dBuV/m)	(uV/m)	(dB)	Mode
59.970	H	5.16	1.44	28.87	40.00	100.00	35.47	59.36	-4.53	Peak
357.400	H	13.26	3.98	25.79	46.00	199.53	43.03	141.74	-2.97	Peak
397.300	H	14.57	4.07	23.43	46.00	199.53	42.07	126.91	-3.93	Peak
35.940	V	12.87	1.11	22.71	40.00	100.00	36.69	68.31	-3.31	Peak
148.260	V	9.56	2.33	26.55	43.50	149.62	38.44	83.56	-5.06	Peak
665.400	V	17.75	5.89	18.42	46.00	199.53	42.06	126.77	-3.94	Peak

- For above 1GHz

Frequency	Polarity	Antenna Factor	Cable Loss	Reading	Limits		Emission Level		Margin	Detect
(MHz)		(dB/m)	(dB)	(dBuV)	(dBuV/m)	(uV/m)	(dBuV/m)	(uV/m)	(dB)	Mode
3452.000	H	30.24	7.70	11.46	74.00	5011.87	49.40	295.12	-24.60	Peak
1590.000	V	27.08	4.80	12.61	74.00	5011.87	44.49	167.69	-29.51	Peak
4636.000	V	33.34	9.08	9.21	74.00	5011.87	51.63	381.50	-22.37	Peak

■ Field strength of fundamental and harmonics

Frequency	Polarity	Antenna Factor	Cable Loss	Reading	Limits		Emission Level		Margin	Detect
(MHz)		(dB/m)	(dB)	(dBuV)	(dBuV/m)	(uV/m)	(dBuV/m)	(uV/m)	(dB)	Mode
2460.000	H	30.06	6.04	53.28	-	-	89.38	29444.22		Peak
2460.000	H	30.06	6.04	48.44	-	-	84.54	16865.53		A.V.
2462.000	V	30.06	6.04	63.91	-	-	100.01	100115.20		Peak
2462.000	V	30.06	6.04	58.29	-	-	94.39	52420.36		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: Jay

Jay Zhong

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 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
H	89.38	43.80	74.00	-30.20	Peak
H	84.54	38.96	54.00	-15.04	Average
V	100.01	54.43	74.00	-19.57	Peak
V	94.39	48.81	54.00	-5.19	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.

5.8. Antenna Requirements

The EUT use a undetachable antenna via U.FL 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. $3Q^{100}$

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 U.FL. The coaxial cable of the antenna is fixed to the 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

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

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 1.0 mW/cm^2. 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 1	2.00	1.58	14.37	27.35	1.86	20
Channel 6	2.00	1.58	14.35	27.23	1.85	20
Channel 11	2.00	1.58	14.13	25.88	1.81	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

1. Add a gasket on rear side of daughter board.
   (As the Internal photo No.7)

7. Antenna Factor & Cable Loss

Frequency (MHz)	Antenna Factor (dB)	Cable Loss (dB)
30	15.35	1.00
35	13.63	1.08
40	11.11	1.18
45	10.59	1.24
50	6.47	1.30
55	5.83	1.38
60	5.18	1.44
65	4.81	1.52
70	4.43	1.59
75	5.10	1.68
80	5.91	1.75
85	7.33	1.77
90	8.74	1.83
95	9.05	1.85
100	9.36	1.90
110	9.65	2.01
120	9.97	2.06
130	10.51	2.16
140	10.32	2.24
150	9.42	2.34
160	8.09	2.42
170	7.43	2.56
180	7.60	2.62
190	7.43	2.67
200	7.26	2.76
220	9.11	2.92
240	10.88	3.09
260	11.75	3.23
280	11.55	3.38
300	11.36	3.51
320	12.03	3.63
340	12.69	3.73
360	13.33	4.03
380	14.00	4.00
400	14.63	4.09
450	15.33	4.31
500	16.03	4.64
550	16.65	5.09
600	17.29	5.49
650	17.64	5.82
700	18.00	5.94
750	18.39	6.16
800	18.79	6.58
850	19.10	6.72
900	19.42	6.81
950	19.58	7.10
1000	19.75	7.41
1000	24.30	3.89
2000	31.10	5.41
3000	29.60	6.92
4000	30.80	8.24
5000	34.20	9.22

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. 30, 2003	Conduction (CO01-HY)
LISN (Support Unit)	MessTec	NNB-2/16Z	2001-009	9 KHz – 30 MHz	Apr. 30, 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)
Spectrum analyzer	R&S	FSP	100004/040	9KHZ~40GHZ	Aug. 23, 2003	Radiation (03CH03-HY)
Amplifier	HP	8447D	2944A09072	100KHz – 1.3GHz	Feb. 19, 2003	Radiation (03CH03-HY)
Bilog Antenna	SCHAFFNER	CBL6112B	2687	30MHz –2GHz	Dec. 21, 2002	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)
Half-wave dipole antenna	R&S	HZ12 HZ13	83924403 83924503	30MHz - 1GHz	N/A	Radiation (03CH03-HY)
Horn Antenna	COM-POWER	AH-118	10094	1GHz – 18GHz	Apr. 10, 2003	Radiation
Spectrum analyzer	R&S	FSP40	100004/040	9KHZ~40GHZ	Jul. 22, 2003	Radiation
Amplifier	MITEQ	AFS44	879981	100MHz~26.5GHz	Jul. 23, 2003	Radiation

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
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
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 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

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