

FCC TEST REPORT

for

47 CFR Part 15 Subpart C

Equipment : RF Hand Track

Model No. : FDM-M32-H

FCC ID : F4Z4K3FDM-M32-H

Filing Type : Certification

Applicant : **FORWARD ELECTRONICS CO., LTD**
393 Chung Cheng Rd. Sec.1 San-Hsia Town,
Taipei County. Taiwan, 237, 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.

Table of Contents

History of this test report.....	ii
CERTIFICATE OF COMPLIANCE.....	1
1. General Description of Equipment under Test.....	2
1.1. Applicant.....	2
1.2. Manufacturer	2
1.3. Basic Description of Equipment under Test	2
1.4. Feature of Equipment under Test	2
2. Test Configuration of Equipment under Test	3
2.1. Test Manner	3
2.2. Description of Test System	3
2.3. Connection Diagram of Test System	5
3. General Information of Test.....	6
3.1. Test Facility	6
3.2. Standard for Methods of Measurement.....	6
3.3. Test in Compliance with	6
3.4. Frequency Range Investigated	6
3.5. Test Distance	6
4. Test of Conducted Emission.....	7
4.1. Major Measuring Instruments.....	7
4.2. Test Procedures	7
4.3. Typical Test Setup Layout of Conducted Powerline	8
4.4. Test Result of Conducted Emission	9
4.5. Photographs of Conducted Powerline Test Configuration	11
5. Test of Radiated Emission.....	13
5.1. Major Measuring Instruments.....	13
5.2. Test Procedures	14
5.3. Typical Test Setup Layout of Radiated Emission.....	15
5.4. Test Result of Radiated Emission	16
5.5. Photographs of Radiated Emission Test Configuration	20
6. Antenna Factor & Cable Loss	21
7. List of Measuring Equipments Used	22
8. Uncertainty of Test Site	23
Appendix A. Photographs of EUT.....	A1 ~ A4
Appendix B. Normalized Site Attenuation.....	Annex 3/1 ~ Annex 3/3

History of this test report

Original Report Issue Date: Nov. 11, 2002

No additional attachment.

Additional attachment were issued as following record:

Certificate No. : F291202

CERTIFICATE OF COMPLIANCE

for

47 CFR Part 15 Subpart C

Equipment : RF Hand Track

Model No. : FDM-M32-H

FCC ID : F4Z4K3FDM-M32-H

Applicant : **FORWARD ELECTRONICS CO., LTD**
393 Chung Cheng Rd. Sec.1 San-Hsia Town,
Taipei County. Taiwan,237,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 energy emitted by this equipment was **passed** both radiated and conducted emission limits. Testing was carried out on Sep. 14, 2002 at **SPORTON International Inc. LAB**.

K. J. Lin Nov 30, 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

FORWARD ELECTRONIC CO., LTD
393 Chung Cheng Rd.Sec.1 San-Hsia Town,
Taipei County. Taiwan, 237, R.O.C.

1.2. Manufacturer

Same as 1.1.

1.3. Basic Description of Equipment under Test

Equipment : RF Hand Track
Model No. : FDM-M32-H
FCC ID : F4Z4K3FDM-M32-H
Trade Name : 3G
Power Supply Type : From Battery (3VDC, A.A.A)

1.4. Feature of Equipment under Test

Product Features:

- ◆ 4D Laser RF Hand Track (Mouse)
- ◆ Shield interface cable
- ◆ NiMH Re-chargeable Battery (Any other type of battery is not suitable for this function.)
- ◆ System Requirement: Available Computer's USB-port, CD or DVD-ROM Drive,
- ◆ Microsoft Windows 98 or higher, Macintosh OS 8.6 or higher etc.

Product Specification:

- ◆ Channel: one
- ◆ Security ID: 8 Sets
- ◆ Cordless Technology: Radio Frequency
- ◆ Carry Frequency: 27.045MHZ
- ◆ Modulation: FSK (Frequency Shift Key)
- ◆ Transfer Rate: 2 kbps
- ◆ Input Power: 3VDC
- ◆ RF Power: 460uv/m at 3m
- ◆ RF Out Power: 0.001mW
- ◆ Buttons: 3-Button Type
- ◆ Encoder Technology: Mechanical
- ◆ Resolution: 200 DPI
- ◆ Operation Switch: 1 Link Switch (Tact switch)
- ◆ Effective Distance: 3 M
- ◆ Battery Life: 6 Months

2. Test Configuration of Equipment under Test

2.1. Test Manner

- a. The EUT has been configured personal computer and operated pursuant to ANSI C63.4-1992 in a manner which tended to maximize its emission characteristics in a typical application.
- b. The complete test system included HP PC, HITACHI Monitor, HP PS/2 Keyboard, HP Printer, ACEEX Modem, 3G Receiver and EUT for EMI test.
- c. Frequency range investigated: conduction 150 KHz to 30 MHz, radiation 30 MHz to 1000MHz.

2.2. Description of Test System

Support Unit 1. -- Personal Computer (HP)

FCC ID	: N/A
Model No.	: VECTRA VL420 DT
Power Supply Type	: Switching
Power Cord	: Non-Shielded
Serial No.	: SP0039
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 2. -- Monitor (HITACHI)

FCC ID	: N/A
Model No.	: CM823F
Power Supply Type	: Switching
Power Cord	: Non-Shielded
Serial No.	: SP0023
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 3. – PS/2 Keyboard (HP)

FCC ID	: N/A
Model No.	: SK-2502C
Serial No.	: SP0032
Data Cable	: Shielded, 1.7m
Remark	: This support device was tested to comply with FCC standards and authorized under a declaration of conformity.

Support Unit 4. -- Printer (HP)

FCC ID	: B94C2642X
Model No.	: DJ 400
Power Supply Type	: Linear
Power Cord	: Non-Shielded
Serial No.	: SP0048
Data Cable	: Braided-Shielded, 1.35m

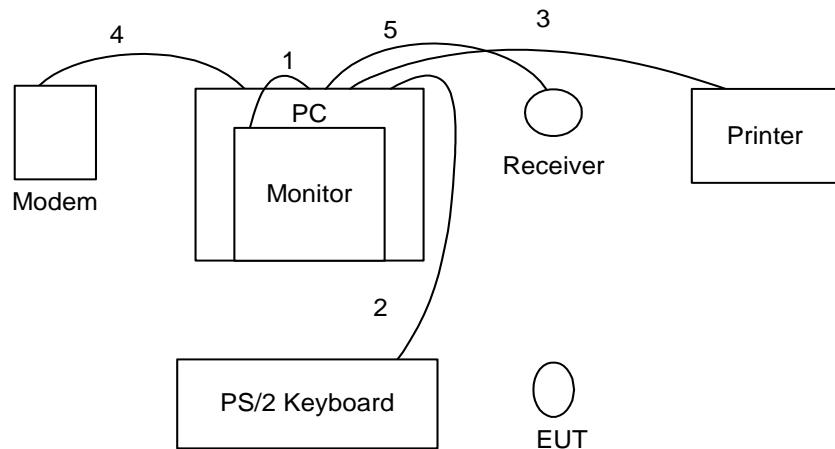
Support Unit 5. -- Modem (ACEEX)

FCC ID	: IFAXDM1414
Model No.	: DM1414
Power Supply Type	: Linear
Power Cord	: Non-Shielded
Serial No.	: SP0015
Data Cable	: Shielded, 1.15m

Support Unit 6. -- Receiver (3G)

FCC ID	: N/A
Model No.	: FDM-M31-R
Serial No.	: N/A

2.3. Connection Diagram of Test System



1. The I/O cable is connected from PC to the support unit 2
2. The I/O cable is connected from PC to the support unit 3.
3. The I/O cable is connected from PC to the support unit 4.
4. The I/O cable is connected from PC to the support unit 5.
5. The I/O cable is connected from PC to the support unit 6.

3. General Information of Test

3.1. Test Facility

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, SH04

3.2. Standard for Methods of Measurement

ANSI C63.4-1992

3.3. Test in Compliance with

FCC Part 15, Subpart C

3.4. Frequency Range Investigated

- a. Conduction: from 150 kHz to 30 MHz
- b. Radiation: from 30 MHz to 1 GHz

3.5. Test Distance

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

4. 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.

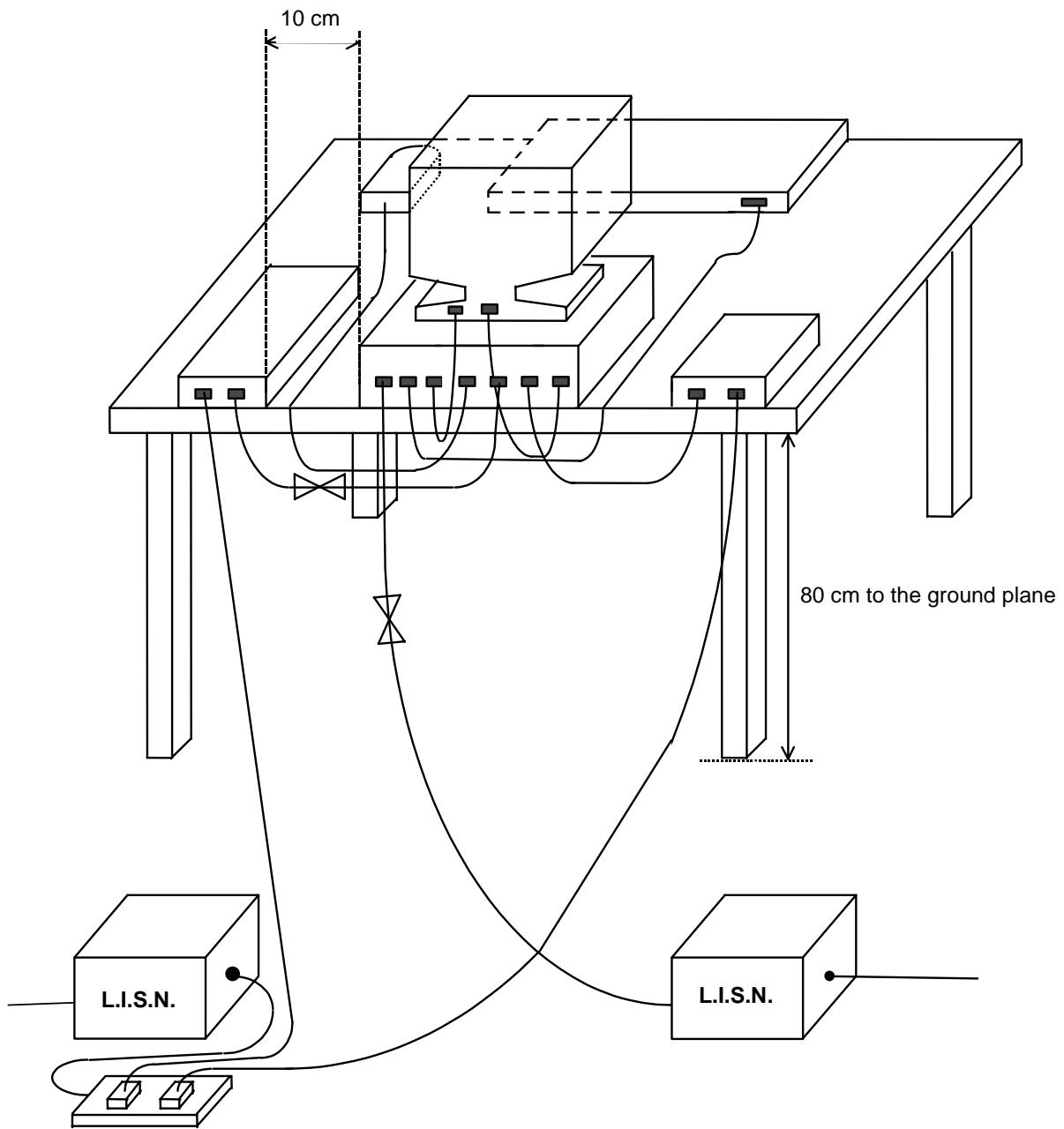
4.1. Major Measuring Instruments

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

4.2. Test Procedures

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

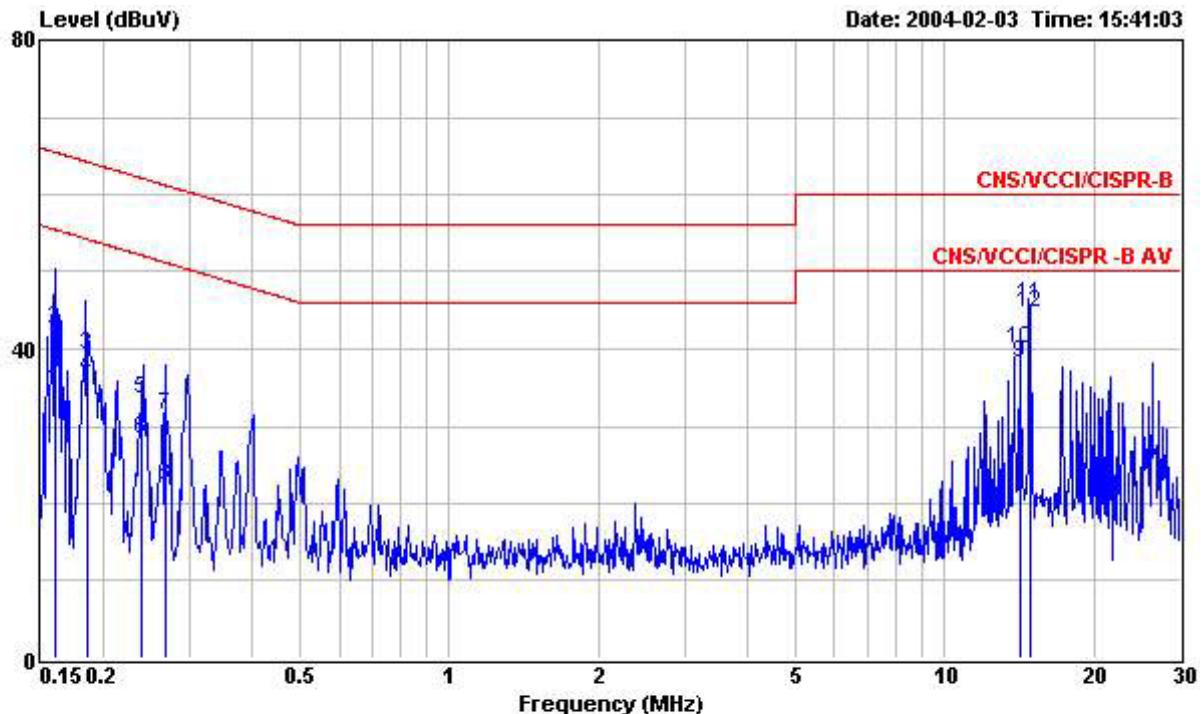
4.3. Typical Test Setup Layout of Conducted Powerline



4.4. Test Result of Conducted Emission

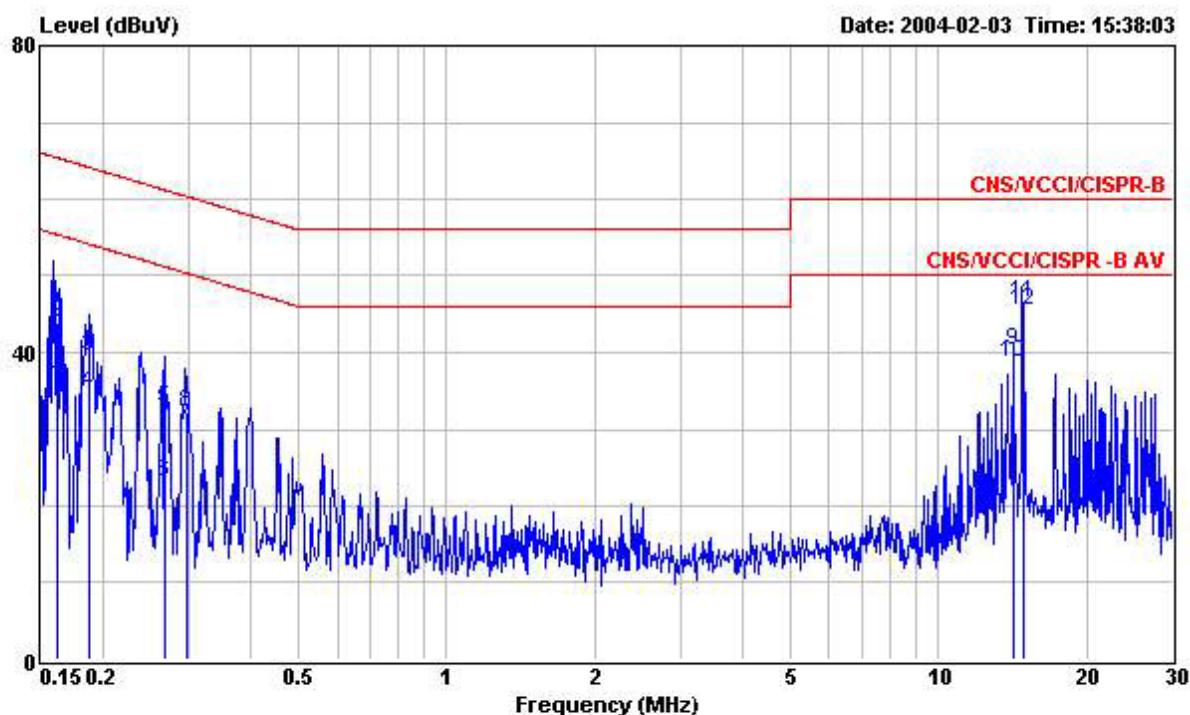
- Frequency Range of Test: from 150KHz to 30 MHz
- Temperature: 25.5°C
- Relative Humidity: 55 %

Line



Freq	Level	Over Limit	Limit Line	Read		Cable Loss	Remark
				dB	dBuV		
	MHz	dBuV	dB	dBuV	dB	dB	
1	0.160	34.91	-20.55	55.46	34.69	0.10	0.12 Average
2	0.160	42.60	-22.86	65.46	42.38	0.10	0.12 QP
3	0.187	39.29	-24.90	64.19	39.06	0.10	0.13 QP
4	0.187	36.46	-17.73	54.19	36.23	0.10	0.13 Average
5	0.240	33.62	-28.48	62.10	33.41	0.10	0.11 QP
6	0.240	28.32	-23.78	52.10	28.11	0.10	0.11 Average
7	0.267	31.32	-29.89	61.21	31.12	0.10	0.10 QP
8	0.267	22.21	-29.00	51.21	22.01	0.10	0.10 Average
9	14.205	38.29	-11.71	50.00	37.92	0.20	0.17 Average
10	14.205	39.91	-20.09	60.00	39.54	0.20	0.17 QP
11	14.846	45.70	-14.30	60.00	45.32	0.20	0.18 QP
12	14.846	44.61	-5.39	50.00	44.23	0.20	0.18 Average

Neutral



Freq	Level	Over	Limit	Read	Probe	Cable	Remark
		Limit	Line	Level	Factor	Loss	
MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.161	35.63	-19.76	55.39	35.41	0.10	0.12 Average
2	0.161	43.93	-21.46	65.39	43.71	0.10	0.12 QP
3	0.187	39.55	-24.62	64.17	39.32	0.10	0.13 QP
4	0.187	34.70	-19.47	54.17	34.47	0.10	0.13 Average
5	0.267	32.71	-28.50	61.21	32.51	0.10	0.10 QP
6	0.267	23.20	-28.01	51.21	23.00	0.10	0.10 Average
7	0.297	30.48	-19.85	50.33	30.30	0.10	0.08 Average
8	0.297	32.25	-28.08	60.33	32.07	0.10	0.08 QP
9	14.207	40.38	-19.62	60.00	39.92	0.29	0.17 QP
10	14.207	38.76	-11.24	50.00	38.30	0.29	0.17 Average
11	14.845	46.46	-13.54	60.00	45.98	0.30	0.18 QP
12	14.845	45.56	-4.44	50.00	45.08	0.30	0.18 Average

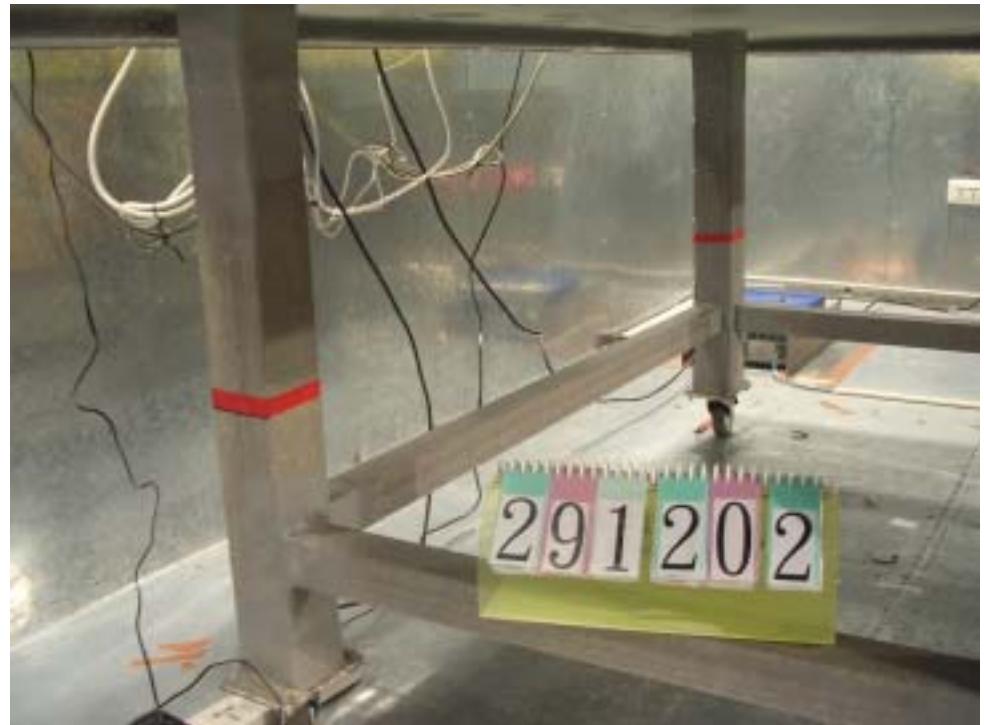
Test Engineer: Wayne Hsu
Wayne Hsu

4.5. Photographs of Conducted Powerline Test Configuration

- The photographs show the configuration that generates the maximum emission.

FRONT VIEW**REAR VIEW**

SIDE VIEW



5. Test of Radiated Emission

Radiated emissions from 30 MHz to 1 GHz were measured with a bandwidth of 120 kHz 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 5.3. The interface cables and equipment positions were varied within limits of reasonable applications to determine the positions producing maximum radiated emissions.

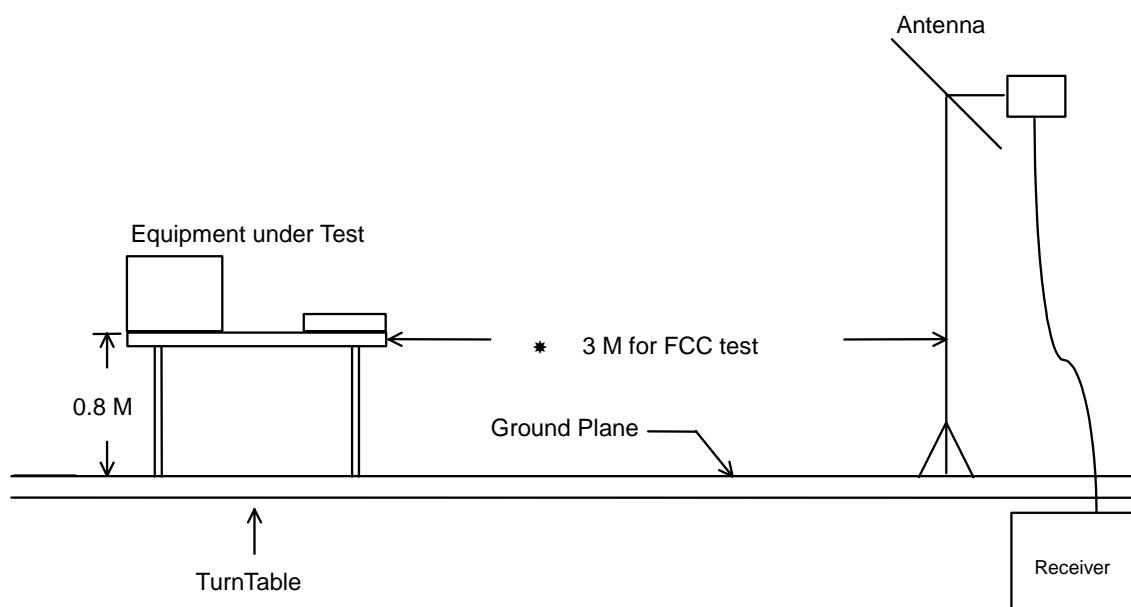
5.1. Major Measuring Instruments

● 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

5.2. Test Procedures

- a. The EUT was placed on a rotatable table top 0.8 meter above ground.
- b. The EUT was set 3 meters from the interference receiving antenna which was mounted on the top of a variable height antenna tower.
- c. The table was rotated 360 degrees to determine the position of the highest radiation.
- d. The antenna is a half wave dipole 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.
- e. 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.
- f. Set the test-receiver system to Peak or CISPR quasi-peak Detect Function and specified bandwidth with Maximum Hold Mode.
- g. 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.

5.3. Typical Test Setup Layout of Radiated Emission



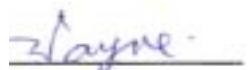
5.4. Test Result of Radiated Emission

5.4.1 Field strength of fundamental and harmonics

- Test Distance : 3 M
- Temperature : 26°C
- Relative Humidity : 57 %
- Test Date : Oct. 7, 2002
- Emission level (dB_uV/m) = 20 log Emission level (uV/m)
- Corrected Reading : Antenna Factor + Cable Loss + Reading = Emission

Frequency (MHz)	Antenna Polarity	Cable Factor	Reading Loss	Limits		Emission Level		Margin (dB)	Detect Mode
				(dB _u V)	(dB _u V/m)	(uV/m)	(dB _u V/m)		
26.960	H	15.40	0.93	52.12	69.54	2999.16	38.14	80.72	-31.40 Peak
27.050	H	15.40	0.93	65.67	80.00	10000	51.69	384.15	-28.31 Peak
27.280	H	15.40	0.93	27.94	69.54	2999.16	13.96	5.00	-55.58 Peak
26.960	V	15.40	0.93	40.65	69.54	2999.16	26.67	464.52	-42.87 Peak
27.050	V	15.40	0.93	51.96	80.00	10000	37.98	79.25	-42.02 Peak
27.280	V	15.40	0.93	27.31	69.54	2999.16	13.33	21.53	-56.21 Peak

Test Engineer:



Wayne Hsu

5.4.2 Orthogonal axes: X

- Test Distance: 3 M
- Temperature: 26°C
- Relative Humidity: 57 %
- Test Date: Oct. 7, 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

53.490MHz / 16.98 dBuV/m (VERTICAL) Antenna Height 2 Meter, Turntable Degree 173 °.

- Spurious Emissions:

Frequency (MHz)	Polarity	Antenna Factor	Cable Loss	Reading (dBuV)	Limits		Emission (dBuV/m)	Level (uV/m)	Margin (dB)	Detect Mode
					(dBuV/m)	(uV/m)				
53.490	H	6.80	0.70	7.74	40.00	100.00	15.24	5.78	-24.76	Peak
260.850	H	3.29	1.75	13.14	46.00	199.53	18.18	8.11	-27.82	Peak
53.490	V	6.80	0.70	41.10	40.00	100	16.98	7.06	-23.02	Peak
170.130	V	9.00	1.50	35.33	43.50	150	14.40	5.25	-29.10	Peak

Test Engineer:

Wayne
Wayne Hsu

5.4.3 Orthogonal axes: Y

- Test Distance : 3 M
- Temperature : 26°C
- Relative Humidity : 57 %
- Test Date : Oct. 7, 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

53.490 MHz / 15.35 dBuV/m (VERTICAL) Antenna Height 2 Meter, Turntable Degree 173 °.

- Spurious Emissions:

Frequency (MHz)	Polarity	Antenna Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Limits (dBuV/m)	Emission (uV/m)	Level (dBuV/m)	Margin (uV/m)	Detect Mode	
53.490	H	6.80	0.70	36.24	40.00	100	12.12	4.04	-27.88	Peak
53.490	V	6.80	0.70	39.47	40.00	100	15.35	5.85	-24.65	Peak

Test Engineer:

Wayne
Wayne Hsu

5.4.4 Orthogonal axes: Z

- Test Distance : 3 M
- Temperature : 26°C
- Relative Humidity : 57 %
- Test Date : Oct. 7, 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

53.490 MHz / 18.05 dBuV/m (VERTICAL) Antenna Height 2 Meter, Turntable Degree 173 °.

- Spurious Emissions:

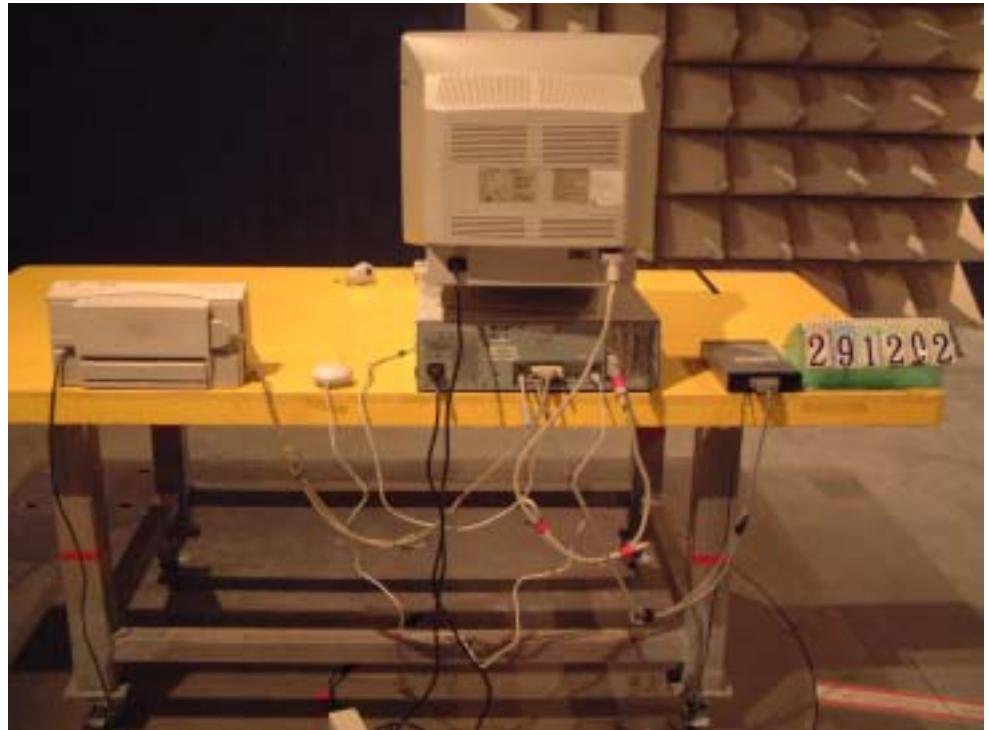
Frequency (MHz)	Polarity	Antenna Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Limits		Emission (dBuV/m)	Level (uV/m)	Margin (dB)	Detect Mode
					(dBuV/m)	(uV/m)				
53.490	H	6.80	0.70	37.74	40.00	100	13.62	4.80	-26.38	Peak
53.490	V	6.80	0.70	42.17	40.00	100	18.05	7.99	-21.95	Peak

Test Engineer:

Wayne
Wayne Hsu

5.5. Photographs of Radiated Emission Test Configuration

- The photographs show the configuration that generates the maximum emission.

FRONT VIEW**REAR VIEW**

6. Antenna Factor & Cable Loss

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

7. List of Measuring Equipments Used

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
EMC Receiver	R&S	ESCS 30	100132	9 KHz – 2.75 GHz	Jun. 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)
RF Cable-CON	Suhner Switzerland	RG223/U	CB029	9KHz~30MHz	Dec. 24, 2003	Conduction (CO01-HY)
50 ohm BNC type Terminal	NOBLE	50ohm	TM013	50 ohm	Apr. 24, 2003	Conduction (CO01-HY)
Spectrum Analyzer	R&S	FSP	838858/037	9KHz – 7GHz	Jan. 08, 2002	Radiation (SH04)
Receiver	ROHDE & SCHWARZ	ESCS30	838251/002	9KHz – 2750MHz	Nov. 28, 2001	Radiation (SH04)
Amplifier	HP	8447D	3207A01441	100KHz – 1.3GHz	Aug. 13, 2002	Radiation (SH04)
Bilog Antenna	SCHAFFNER	CBL6112B	2687	30MHz – 2GHz	Dec. 23, 2001	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)

Calibration Interval of instruments listed above is one year.

8. Uncertainty of Test Site

Uncertainty of Radiated Emission Measurement

Contribution	Probability Distribution	3m
Antenna factor calibration	normal(k=2)	±1
cable loss calibration	normal(k=2)	±0.3
RCV/SPA specification	rectangular	±2
Antenna Directivity	rectangular	±3
Antenna Factor V.S. Height	rectangular	±2
Antenna Factor Interpolation for Frequency	rectangular	±0.25
site imperfection	rectangular	±2
Mismatch Receiver VSWR 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= $\{(1/2)^2+(0.3/2)^2+(2^2+0.5^2+2^2+0.25^2+2^2)/3+(0.54)^2/2\}=2.2$ 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 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= $\{(0.3/2)^2+(2^2+1.5^2+0.2^2)/3+(0.2)^2/2\}=1.66$