Class II Permissive Change
Test Report

FOR

FCC Part 15 Subpart B & C

of

Wireless LAN Module

Model/ Type/ Machine Type

MPCI-101

Applied by:

Acer Inc.
7 Hsin Ann Rd., Science-Based Industrial Park
Hsinchu 30077
Taiwan, R. O. C.

Test Performed by:

(NVLAP Lab. Code: 200234-0)

International Standards Laboratory

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Hsiwan Rd. Hsichih Chen
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Report Number: ISL-01A114RF **Test Date: 2001/12/27**

NVLAP Lab. Code: 200234-0; VCCI: R-341, C-354; NEMKO Aut. No: ELA 113; BSMI Lab. Code: SL2-IN-E-0013

Contents of Report

1. . General

1.1 Certification of Accuracy of Test Data

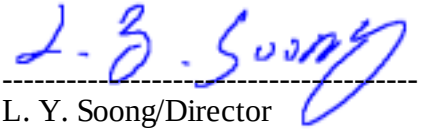
The electromagnetic interference tests which this report describes were conducted by an independent electromagnetic compatibility consultant, International Standards Laboratory in accordance with the test procedure specified in CFR 47 Part 15 Subpart C (Section 15.247), and Subpart B and/or CISPR 22 / EN55022.

The test results contained in this report accurately represent the measurements of the EMC characteristics and the energy generated by sample equipment under test at the time of the test.

Equipment Tested:	Wireless LAN Module Model/ Type/ Machine Type: MPCI-101 Applied by Acer Inc.
Sample received Date:	2001/12/27
Final test Date :	2001/12/28
Temperature	15ºC(Conduction Test); 17ºC (Radiation Test)
Humidity:	47% (Conduction Test); 68% (Radiation Test)
Test Engineer:	W. H. Chang

The results show that the sample equipment tested as described in this report is in compliance the Class B conducted and radiated emission limits of FCC Rules Part 15 Subpart B; and the limits of FCC Part 15 Subpart C (Section 15.247).

Approve & Signature



L. Y. Soong/Director

1.2 Description of Equipment Under Test (EUT)

Description:	Wireless LAN Module
Model No.:	MPCI-101
Granted FCC ID:	HLZMPCI-101
Reason for : Permissive Change	Change New Notebook PC for Acer Inc. Model: MS2103 and Change new Antenna The EUT was applied to FCC on 2/7/2001 and was granted on 3/1/2001.
Frequency Range:	2.412~2.462 GHz
Support channel:	11 Channels
Modulation Skill	DBPSK(1Mbps), DQPSK(2Mbps), CCK(5.5/11Mbps)
Style Interface:	MINI-PCI
Antenna Type:	Redstar (made byWistron Neweb Corp.)
Antenna Connected: Construction	The antenna is used to connected with the PCB inside the notebook. The user is not possible to change the antenna without disassembling the notebook.
FCC Part 15 subpart B:	Declaration of Conformity
FCC Part 15 subpart C:	Certification
Power Type:	5V DC (from Notebook PC)
Applicant:	Acer Inc. 7 Hsin Ann Rd., Science-Based Industrial Park Hsinchu 30077 Taiwan, R. O. C.

A more detailed, technical description of the EUT is contained in appendix H.

1.3 Description of EUT and Support Equipment Included in Tests

The EUT is a Wireless LAN Module (Model: MPCI-101), which was tested with the following support units:

1. Wireless LAN/Broadband/ISDN Router Model: 914I
2. Broadband Router Model: Router 904
3. Sony Digital Video Camera Model: DCR-PC100
4. Acer Digital Camera Model: DVC-VII
5. Acer USB Mouse Model: MUSXT
6. Koka Headphone Model: ST-8
7. SONY radio cassette player Model: WM-FX50
8. HP Printer Model: 2225C
9. Sony Video Monitor Model: PVM-14M2U
10. Acer Monitor Model: 7377xe
11. IBM Personal Computer Model: IBM2170
12. Acer Notebook PC Model: MS2103

A more detailed technical description of the support equipment is contained in Appendix H.

1.4 Test Standards and Procedure

Test Specification: FCC Part 15 subpart C (Section 15.247) and subpart B and/or CISPR 22/EN55022

Test procedure: ANSI C63.4, CFR 47 Sec. 15.247, as detailed in Appendices C , D.

1.5 Frequency and Channel

Channel	Frequency (GHz)
1	2.412
2	2.417
3	2.422
4	2.427
5	2.432
6	2.437
7	2.442
8	2.447
9	2.452
10	2.457
11	2.462

Note: The operating frequencies are in 2.412 GHz to 2.462GHz. According to FCC Part 15 Sec. 15.31 (m), all the items as followed in this testing report are need to test three frequencies: top: channel 1; middle: channel 6; bottom: channel 11.

1.6 General Test Conditions

During the test, the EUT was set in high power and continuously transmitting mode that Controlled by notebook computer. The channel 1, 6, 11 of EUT were all tested.

2. Power Line Conducted Emissions [Section 15.207]

2.1 EUT Configuration

The conducted emission test setups are in accordance with Figs 9, 10(a) and 10(b) of ANSI C63.4-1992, CFR 47 Part 15 Subpart B; or EN55022:1994/ A1:1995/A2:1997; CISPR 22:1993/A1:1995/A2:1996.

The EUT was set up in the shielded room on the non-conductive table which is 1.0 by 1.5 meter, 80cm above ground. The wall of the shielded room was located 40cm to the rear of the EUT.

Power to the EUT was provided through the LISN. The impedance vs. frequency characteristic of the LISN is complied with the limit shown on the figure 1 of ANSI C63.4-1992.

Both lines (neutral and hot) were connected to the LISN in series at testing. A coaxial-type connector which provides a 50 OHM terminating impedance was provided for connecting the test instrument. The excess length of the power cord was folded back and forth at the center of the lead so as to form a bundle not exceeding 40cm in length.

Any changes made to the configuration, or modifications made to the EUT, during testing are noted in the following test record.

If the EUT is a Personal Computer or a peripheral of personal computer, and the personal computer has an auxiliary AC outlet which can be used for providing power to an external monitor, then all measurements will be made with the monitor power from first the computer-mounted AC outlet and then a floor-mounted AC outlet.

2.2 Test Procedure

The system was set up as described above, with the EMI diagnostic software running. The power line conducted EMI tests were run on the hot and neutral conductors of the power cord and the results were recorded.

The highest emissions were analyzed in details by operating the spectrum analyzer in fixed tuned mode to determine the nature of the emissions and to provide information which could be useful in reducing their amplitude.

2.3 EMI Receiver/Spectrum Analyzer Configuration (for the frequencies tested)

Frequency Range:	150KHz--30MHz
Detector Function:	Quasi-Peak / Average Mode
Resolution Bandwidth (RBW):	9KHz

2.4 Test Data:

Table 2.2.1 Power Line Conducted Emissions (Hot) Channel 1, 6, 11

	LISN	Quasi-Peak			Average		
Frequency (KHz/MHz)	Insertion Loss (dB)	Amplitude (dBuV)	Limit (dBuV)	Margin (dB)	Amplitude (dBuV)	Limit (dBuV)	Margin (dB)
203.60KHz	0.19	44.47	64.47	-19.81	34.85	54.47	-19.43
272.51KHz	0.21	38.24	62.50	-24.05	30.20	52.50	-22.09
340.58KHz	0.23	35.27	60.55	-25.06	26.41	50.55	-23.92
409.85KHz	0.24	31.99	58.58	-26.34	25.74	48.58	-22.59
476.83KHz	0.26	30.27	56.66	-26.14	22.16	46.66	-24.25
5.3559MHz	0.76	17.75	60.00	-41.49	6.17	50.00	-43.07
15.362MHz	1.24	31.92	60.00	-26.84	25.27	50.00	-23.48
16.044MHz	1.30	32.10	60.00	-26.60	24.42	50.00	-24.28
16.247MHz	1.32	31.77	60.00	-26.91	25.60	50.00	-23.07
17.067MHz	1.40	31.28	60.00	-27.32	24.74	50.00	-23.87

Table 2.2.2 Power Line Conducted Emissions (Neutral) Channel 1, 6, 11

	LISN	Quasi-Peak			Average		
Frequency (KHz/MHz)	Insertion Loss (dB)	Amplitude (dBuV)	Limit (dBuV)	Margin (dB)	Amplitude (dBuV)	Limit (dBuV)	Margin (dB)
151.79KHz	0.17	44.54	65.95	-21.24	17.05	55.95	-38.73
158.56KHz	0.17	43.00	65.76	-22.58	35.96	55.76	-19.63
162.26KHz	0.17	41.86	65.65	-23.61	32.48	55.65	-23.00
205.80KHz	0.19	43.25	64.41	-20.96	35.24	54.41	-18.97
273.11KHz	0.24	37.48	62.48	-24.76	29.62	52.48	-22.62
5.3242MHz	0.74	30.99	60.00	-28.27	21.95	50.00	-27.31
15.571MHz	1.05	32.35	60.00	-26.60	24.70	50.00	-24.25
15.706MHz	1.06	32.45	60.00	-26.49	25.06	50.00	-23.88
15.775MHz	1.06	32.28	60.00	-26.66	24.44	50.00	-24.49
15.910MHz	1.07	31.83	60.00	-27.10	25.05	50.00	-23.88

* NOTE: During the test, the EMI receiver was set to Max. Hold then switch the EUT Channel between 1 , 6, 11 to get the maximum reading of all these channels.
Margin = Amplitude + Insertion Loss- Limit
A margin of -8dB means that the emission is 8dB below the limit

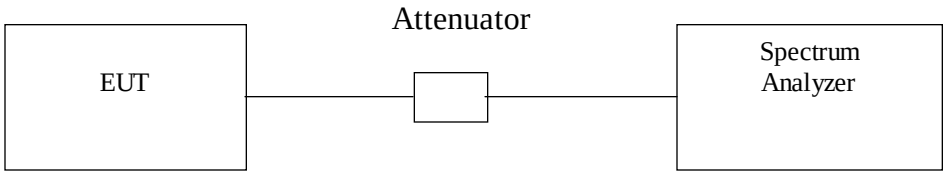
3. Bandwidth for DSS [Section 15.247 (a)(2)]

3.1 Test Procedure

The Transmitter output of EUT was connected to the spectrum analyzer through an attenuator. The 6 dB bandwidth of the fundamental frequency was measured. The setting of spectrum analyzer is as follows

Equipment mode: Spectrum analyzer
Detector function: Peak mode
RBW: 100KHz
VBW: 100KHz

3.2 Test Setup



3.3 Test Data:

Table 3.3.1 6dB Bandwidth

Channel	Frequency (MHz)	6dB bandwidth in TxRate 11Mbps (kHz)	6dB bandwidth in TxRate 2 Mbps (kHz)	6dB bandwidth in TxRate 1 Mbps (kHz)	Limit (kHz)	Pass/ Fail
1	2412	9430	10030	10140	500	Pass
6	2437	11160	10000	8330	500	Pass
11	2462	10330	10200	8840	500	Pass

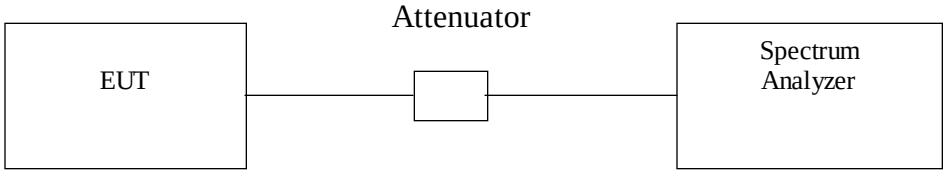
4. DSS Maximum Peak Output Power [Section 15.247 (b)(1)]

4.1 Test Procedure

1. The Transmitter output of EUT was connected to the spectrum analyzer through an attenuator.
   Equipment mode: Spectrum analyzer
   Detector function: Peak mode
   RBW: 3MHz
   VBW: 3MHz
   Center frequency: fundamental frequency tested.
   Span: large than 6dB bandwidth plus 20MHz
2. Using Peak Search to read the peak power after Maximum Hold function is completed.
3. Move the Marker to +/- 3MHz and +/-6MHz and record the reading.
4. The Maximum Peak Output Power is the linear summation of the 5 reading in (2) and (3).

Note: Using power meter for this measurement will get smaller result due to the average function of power meter.

4.2 Test Setup



4.3 Test Data:

Table 4.3.1 Maximum Peak Output Power

Channel	Frequency (MHz)	Peak Output Power in Tx Rate 11Mbps (dBm)	Peak Output Power in Tx Rate 2Mbps (dBm)	Peak Output Power in Tx Rate 1Mbps (dBm)	Limit (dBm)	Pass/ Fail
1	2412	17.36	17.49	17.41	30	Pass
6	2437	17.71	17.43	16.75	30	Pass
11	2462	18.96	17.97	17.97	30	Pass

5. RF Exposure Measurement [Section 15.247(b)(4) & 1.1307(b)(1) MPE]

5.1 Limits for Maximum Permissible Exposure (MPE)

A. Limits for Occupational/Controlled Exposure

Frequency Range (MHz)	Electric Field Strength(V/m)	Magnetic Field Strength (A/m)	Power Density (S) (mW/cm2)	Averaging Time (Minutes)
300-1500	----	-----	f/300	30
1500-100,000	----	-----	5	30

B. Limits for Occupational/Controlled Exposure

Frequency Range (MHz)	Electric Field Strength(V/m)	Magnetic Field Strength (A/m)	Power Density (S) (mW/cm2)	Averaging Time (Minutes)
300-1500	----	-----	f/1500	30
1500-100,000	----	-----	1.0	30

5.2 RF Exposure Calculations:

From FCC 1.1310, the maximum perissible RF exposure for an uncontrolled environment is 1 mW/cm^2.

The Minimum Allowable Distance, R, of EUT is calculated as follows:

Friis Transmission Formula: $Pd = (Pout*G)/(4* *R^2)$

$R= [(Pout*G)/(4* *Pd)]^{1/2}$

Where Pd = power density in mW/cm^2 = $1mW/ cm^2$

G = antenna numeric gain = Log^{-1}(dB gain/10) = 1.995 (refer to antenna spec. in appendix M)

Pout = output power to antenna in mW (Refer to table 4.3.1)

= 3.1416

Since the host equipment is notebook computer, the normal use distance is more than 20cm, the suitable standrad for RF exporsure is §1.1307(b)(1) MPE test. According to the result of 4.3.1, the calulated minimum allowance distance of EUT is listed below:

Table 5.2.1 MPE Minimum Allowance Distance of EUT (Tx Rate 1Mbps)

Channel	Frequency (MHz)	Maximum output power (mW)	Minimum Allowance Distance (cm)
1	2412	55.08	2.09
6	2437	47.31	1.94
11	2462	62.66	2.23

Table 5.2.2 MPE Minimum Allowance Distance of EUT (Tx Rate 2Mbps)

Channel	Frequency (MHz)	Maximum output power (mW)	Minimum Allowance Distance (cm)
1	2412	56.10	2.11
6	2437	55.33	2.09
11	2462	62.66	2.23

Table 5.2.3 MPE Minimum Allowance Distance of EUT (Tx Rate11Mbps)

Channel	Frequency (MHz)	Maximum output power (mW)	Minimum Allowance Distance (cm)
1	2412	54.45	2.08
6	2437	59.02	2.16
11	2462	78.70	2.50

The minimum allowable distance is very close to the enclosure of the antenna and also very far away from the human being under normal use condition. So, the RF exposure warning or SAR Measurement is not needed.

6. Radiated Emission Measurement [Section [15.247(c)(4)]

6.1 EUT Configuration

The radiated emissions test setups are in accordance with Figs 10(c) and 10(d) of ANSI C63.4-1992, CFR 47 Part 15 Subpart C; or EN55022:1994/ A1:1995/A2:1997; CISPR 22:1993/A1:1995/A2:1996.

The equipment under test was set up on the 10 meter open field test non-conductive table 80cm above ground, same as conducted Excess data cable was folded back and forth to form a 30cm by 40cm bundle.

Any changes made to the configuration, or modifications made to the EUT, during testing are noted in the following test record.

If the host equipment of EUT is a Notebook Computer or a peripheral of personal computer, and the personal computer has an auxiliary AC outlet which can be used for providing power to an external monitor, then all measurements will be made with the monitor power from first the computer-mounted AC outlet and then a floor-mounted AC outlet.

6.2 Test Procedure

The system was set up as described above, with the EMI diagnostic software running. We found the maximum readings by varying the height of antenna and then rotating the turntable. Both polarization of antenna, horizontal and vertical, are measured.

30M to 1GHz: The highest emissions between 30 MHz to 1000 MHz were also analyzed in details by operating the spectrum analyzer and/or EMI receiver in quasi-peak mode to determine the precise amplitude of the emissions. While doing so, the interconnecting cables and major parts of the system were moved around, the antenna height was varied between one and four meters, its polarization was varied between vertical and horizontal, and the turntable was slowly rotated, to maximize the emission.

1G to 12GHz: The highest emissions between 1GHz to 12GHz were also analyzed in details by operating the spectrum analyzer and/or EMI receiver in peak mode to determine the precise amplitude of the emission. While doing so, the interconnecting cables and major parts of the system were moved around, the antenna height was varied between one and four meters, its polarization was varied between vertical and horizontal, and the turntable was slowly rotated, to maximize the emission. For the harmonic frequency, RBW and VBW were set to the 100KHz.

6.3 EMI Receiver/Spectrum Analyzer Configuration (for the frequencies tested)

Frequency Range A:	30MHz--1000MHz
Detector Function:	Quasi-Peak Mode
Bandwidth (RBW):	120KHz
Frequency Range B:	1GHz—25GHz
Detector Function:	Peak Mode
Bandwidth (RBW):	1 MHz

6.4 Test Data:.

Table 6.4.1 30M – 1GHz Open Field Radiated Emissions (Horizontal) Channel 1,6,11

Meter Reading		Correction Factor			Corrected Emissions			Antenna	Turntable
Freq. (MHz)	Ampl. (dBuV)	Ant. (dB/m)	Cable (dB)	Pre-Ampl. (dB)	Ampl. (dBuV/m)	Limit (dBuV/m)	Margin* (dB)	Height (cm)	Position (°)
119.88	14.12	11.60	1.49	0.00	27.21	30.00	-2.79	400.00	219.00
132.88	12.80	11.03	1.59	0.00	25.42	30.00	-4.58	400.00	238.00
219.58	11.20	8.23	2.29	0.00	21.71	30.00	-8.29	400.00	10.00
234.06	17.30	9.65	2.38	0.00	29.33	37.00	-7.67	400.00	195.00
479.02	7.80	16.99	3.95	0.00	28.74	37.00	-8.26	341.00	116.00
762.24	3.70	20.38	5.93	0.00	30.01	37.00	-6.99	320.00	212.00

Table 6.4.2 30M – 1GHz Open Field Radiated Emissions (Vertical) Channel 1,6,11

Meter Reading		Correction Factor			Corrected Emissions			Antenna	Turntable
Freq. (MHz)	Ampl. (dBuV)	Ant. (dB/m)	Cable (dB)	Pre-Ampl. (dB)	Ampl. (dBuV/m)	Limit (dBuV/m)	Margin* (dB)	Height (cm)	Position (°)
244.14	19.20	10.84	2.45	0.00	32.49	37.00	-4.51	161.00	253.00
300.01	13.40	12.60	2.82	0.00	28.82	37.00	-8.18	123.00	351.00
334.21	16.50	13.42	3.01	0.00	32.93	37.00	-4.07	100.00	229.00
400.02	12.70	15.80	3.43	0.00	31.93	37.00	-5.07	101.00	114.00
456.27	13.50	16.21	3.85	0.00	33.56	37.00	-3.44	369.00	102.00
480.06	10.28	17.02	3.96	0.00	31.26	37.00	-5.74	321.00	15.00

* NOTE: Margin = Corrected Amplitude – Limit
Corrected Amplitude = Radiated Amplitude + Antenna Correction Factor + Cable Loss - Pre-Amplifier Gain
A margin of -8dB means that the emission is 8dB below the limit
BILOG Antenna Distance: 10 meter, Frequency: under 1000MHz
Horn Antenna Distance: 3 meter, Frequency: 1GHz—25GHz

Table 6.4.7 1GHz~ 25GHz Open Field Radiated Emissions (Horizontal) Channel 1

Meter Reading		Correction Factor			Corrected Emissions			Antenna	Turntable
Freq. (MHz)	Ampl. (dBuV)	Ant. (dB/m)	Cable (dB)	Pre-Ampl. (dB)	Ampl. (dBuV/m)	Limit (dBuV/m)	Margin* (dB)	Height (cm)	Position (°)
4823.50	38.70	33.07	8.90	44.50	36.17	54.00	-17.83	100.00	105.00
7236.10	39.80	35.85	11.30	42.80	43.15	54.00	-9.85	100.00	112.00

Table 6.4.8 1GHz~25GHz Open Field Radiated Emissions (Vertical) Channel 1

Meter Reading		Correction Factor			Corrected Emissions			Antenna	Turntable
Freq. (MHz)	Ampl. (dBuV)	Ant. (dB/m)	Cable (dB)	Pre-Ampl. (dB)	Ampl. (dBuV/m)	Limit (dBuV/m)	Margin* (dB)	Height (cm)	Position (°)
4823.40	42.90	33.07	8.90	44.50	40.37	54.00	-13.63	100.00	120.00
7236.20	43.40	35.85	11.30	42.80	47.65	54.00	-6.35	100.00	135.00

* NOTE: Margin = Corrected Amplitude – Limit
Corrected Amplitude = Radiated Amplitude + Antenna Correction Factor + Cable Loss - Pre-Amplifier Gain
A margin of -8dB means that the emission is 8dB below the limit
BILOG Antenna Distance: 10 meter, Frequency: under 1000MHz
Horn Antenna Distance: 3 meter, Frequency: 1GHz—25GHz

Table 6.4.9 1GHz~ 25GHz Open Field Radiated Emissions (Horizontal) Channel 6

Meter Reading		Correction Factor			Corrected Emissions			Antenna	Turntable
Freq. (MHz)	Ampl. (dBuV)	Ant. (dB/m)	Cable (dB)	Pre-Ampl. (dB)	Ampl. (dBuV/m)	Limit (dBuV/m)	Margin* (dB)	Height (cm)	Position (°)
4873.40	43.40	33.07	9.00	44.5	40.76	54.00	-13.24	100.00	102.00
7311.20	40.90	35.85	11.40	42.8	46.34	54.00	-7.66	100.00	115.00

Table 6.4.10 1GHz~25GHz Open Field Radiated Emissions (Vertical) Channel 6

Meter Reading		Correction Factor			Corrected Emissions			Antenna	Turntable
Freq. (MHz)	Ampl. (dBuV)	Ant. (dB/m)	Cable (dB)	Pre-Ampl. (dB)	Ampl. (dBuV/m)	Limit (dBuV/m)	Margin* (dB)	Height (cm)	Position (°)
4873.40	46.40	33.07	9.00	44.5	43.76	54.00	-10.24	100.00	114.00
7311.30	43.20	35.85	11.40	42.8	47.45	54.00	-6.55	100.00	130.00

* NOTE: Margin = Corrected Amplitude – Limit
Corrected Amplitude = Radiated Amplitude + Antenna Correction Factor + Cable Loss - Pre-Amplifier Gain
A margin of -8dB means that the emission is 8dB below the limit
BILOG Antenna Distance: 10 meter, Frequency: under 1000MHz
Horn Antenna Distance: 3 meter, Frequency: 1GHz—25GHz

Table 6.4.11 1GHz~ 25GHz Open Field Radiated Emissions (Horizontal) Channel 11

Meter Reading		Correction Factor			Corrected Emissions			Antenna	Turntable
Freq. (MHz)	Ampl. (dBuV)	Ant. (dB/m)	Cable (dB)	Pre-Ampl. (dB)	Ampl. (dBuV/m)	Limit (dBuV/m)	Margin* (dB)	Height (cm)	Position (°)
4923.60	43.40	33.07	9.10	44.50	40.66	54.00	-13.34	100.00	108.00
7386.20	40.90	35.85	11.50	42.80	45.05	54.00	-8.95	100.00	125.00

Table 6.4.12 1GHz~25GHz Open Field Radiated Emissions (Vertical) Channel 11

Meter Reading		Correction Factor			Corrected Emissions			Antenna	Turntable
Freq. (MHz)	Ampl. (dBuV)	Ant. (dB/m)	Cable (dB)	Pre-Ampl. (dB)	Ampl. (dBuV/m)	Limit (dBuV/m)	Margin* (dB)	Height (cm)	Position (°)
4923.60	45.90	33.07	9.10	44.50	43.16	54.00	-10.84	100.00	107.00
7386.20	44.50	35.85	11.50	42.80	48.65	54.00	-5.35	100.00	116.00

* NOTE: Margin = Corrected Amplitude – Limit
Corrected Amplitude = Radiated Amplitude + Antenna Correction Factor + Cable Loss - Pre-Amplifier Gain
A margin of -8dB means that the emission is 8dB below the limit
BILOG Antenna Distance: 10 meter, Frequency: under 1000MHz
Horn Antenna Distance: 3 meter, Frequency: 1GHz—25GHz

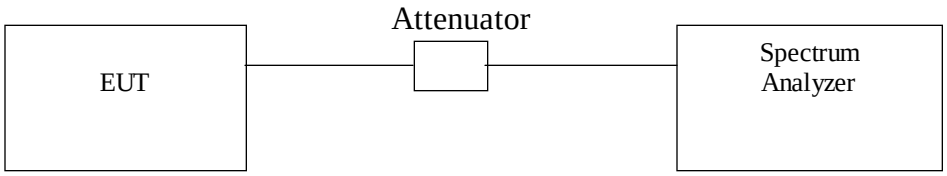
7. DSS Peak Power Spectral Density [Section 15.247(d)]

7.1 Test Procedure

1. The Transmitter output of EUT was connected to the spectrum analyzer through an attenuator.
   Equipment mode: Spectrum analyzer
   Detector function: Peak mode
   RBW: 3kHz
   VBW: 30kHz
   Center frequency: fundamental frequency tested.
   Sweep time= 100 sec.
   Span:

2. Using Peak Search to read the peak power after Maximum Hold function is completed.

7.2 Test Setup



7.3 Test Data:

Table 7.3.1 Maximum Peak Output Power

Channel	Frequency(MHz)	Peak Power Output in Tx Rate 11Mbps (dBm)	Peak Power Output in Tx Rate 2Mbps (dBm)	Peak Power Output in Tx Rate 1Mbps (dBm)	Limit (dBm)	Pass/ Fail
1	2412	-9.41	-9.35	-9.43	8	Pass
6	2437	-8.77	-8.6	-9.51	8	Pass
11	2462	-8.59	-9.18	-9.48	8	Pass

8. Processing Gain of a Direct Sequence Spread Spectrum

Test Instruments and Support Units Description & Manufacturer	Model No.	Serial No.
Portable PC (Zenith)	Z-lite	3GSAZW000061
Portable PC (NCR)	3150	17-26106224
PC + IEEE interface card (NCR)	PC6	17-17039925
Power supply (HP)	HP9592B	SN 3009UOO102
Power Meter (R&S)	URV5	893430/070
Power Sensor (R&S)	NRV-Z2 828218.02	860925/005
CW Generator (Gigatronics)	7200	746604
Variable Attenuator (Midwest)	1044	NA
Fixed Attenuator (Inmet)	18AH-10	NA
RF Power Splitter (ARRA)	3-9200-2	2001

8.1 Method of Measurement

The processing gain may be measured using the CW jamming margin method. Figure 1 shows the test configuration.

The test takes place at the product Functional Specification (Ref.[2], Ref.[5]) specified conditions for BER rate measurements, specifying a BER equal or better than JOA -8 at a receiver input level of -55 dBm. For practical reasons these test are performed at -55 dBm or -53 dBm. This small deviation from the Functional Specification should not cause any deviation from the specified Bit Error Rate, since the received levels are well above the thermal noise.

The test criteria for meeting the minimal processing gain is such that it takes the theoretical calculated SNR for the applied modulation technique and specified BER as a reference. From this given SNR the processing gain is subtracted, yielding the CW Jammer to Signal ratio J/S. From Ref. [4], likewise as Ref.[3] consulted in Ref. [1], it is determined that for a BER of 10^{-}-8 the SNR (S/N)o equals:

13 dB @ 1 Mbit/s,
15 dB @ 2 Mbit/s,
15 dB @ 5.5 Mbit/s,
18 dB @ 11 Mbit/s.

Thus the J/S ratio for a processing gain of 10 dB that must be met is calculated as:

-13 + 10 = -3 dB @ 1 Mbit/s (DBPSK),
-15 + 10 = -5 dB @ 2 Mbit/s (DQPSK),
-15 + 10 = -5 dB @ 5.5 Mbit/s (CCK),
-18 + 10 = -8 dB @ 11 Mbit/s (CCK).

Two types of measurement corrections are allowed for as described in Ref.[l]. The first, taking into account 2 dB implementation losses, thus increasing the absolute J/S ratio by 2 dB. The second correction allows for deleting the 20% worst-case frequencies in the processing gain test that causes the test at that CW interference to fail. This implies that for the considered 14 MHz wide measurement interval, the worst case 57 CW jammer frequencies can be ignored, being those that result in received data errors/missing frames (20% of 14 MHz *(l MHz/50 KHz) + 1 = (20% * 281) + 1 = 57).

The measurements are performed at a 50 KHz CW jammer raster. For each CW jammer frequency JOA 8 bits are transmitted by the reference transmitter, and received by the product under test. For practical reasons 50.000 messages are transmitted. After blanking out frame overhead 1927 bits per frame are monitored. This results in 50.000 * 1927 = 9650000 transmitted bits for a BER test, which is a mere 1.4% less than the targeted JOA 8 bits. Though it would be more elegant to show BER compliance for at least say ten times JOA 8 transmitted / received bits, the time involved with this grows significantly. Since the CW interferer is stepped in a 50 KHz raster, covering the receiver bandwidth of 14 MHz, it is considered that the BER requirement is sufficiently met since such a multitude of measurements are taken.

Consider the implementation losses, we have the following J/S:
-3 - 2 = -5 dB @ 1 Mbit/s (DBPSK),
-5 - 0 = -5 dB @ 2 Mbit/s (DQPSK),
-5 - 1 = -6 dB @ 5.5 Mbit/s (CCK),
-8 - 1 = -9 dB @ 1 1 Mbit/s (CCK).

In this test report, we are going to prove that the percentage of worst case is smaller than 20%. Only channel 2, the worst case, is shown here in this test report.

8.2 Applicable Reference Documents:

A. Document FCC 97-114, Appendix C, Guidance on Measurements for Direct Sequence Spread Spectrum Systems.
B. Hardware Functional Specification for WaveLAN-11 Embedded, High Speed, Doc. No. 011735, Rev. A, Source Organization Lucent Technologies WCND Utrecht.
C. Viterbi, A. J., Principles of Coherent Communications, New York, McGraw-Hill 1966.
D. Proakis, J.G., Digital Communications, New York, McGraw-Hill 1989, page 270.
E. Hardware Functional Specification for the Lucent Technologies ORINOCO Mini PCI, Doc. No. 01 5143, Source Organization Lucent Technologies WCND Utrecht.

8.3 Test Setup

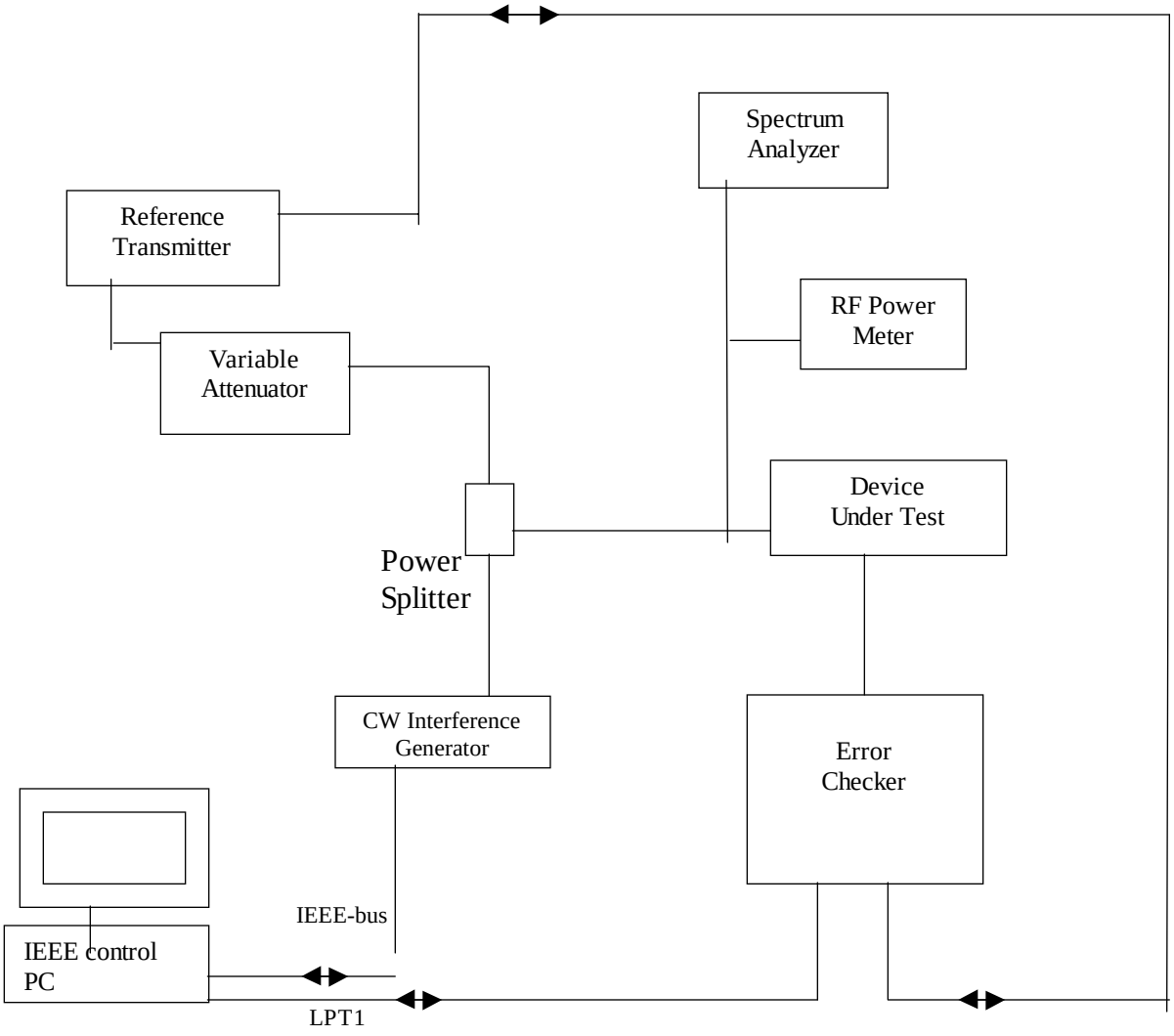


Fig.1 Test Setup

8.4 Test Procedures

Obtain the simplex link shown in Fig. 1. Perform all independent instrumentation calibrations prior to this procedure.

1 . Issue a request to the transmitter for 1 000 frames to be transmitted by computer.
2. The computer reads the number of received frames and number of erroneous received frames.
3. If no missing frames or received data errors detected, ask the computer to increases the CW jamming level by 1 dB, and repeat 1 and 2 .
4. Repeat this sequence until error data or missing frames are detected, or required J/S is reached.
5. If the J/S is smaller than required one, then this frequency point fail the test. Denote "l " on the record.
6. Issue a request to the transmitter for 50,000 frames to be transmitted by the computer.
7. If error data is detected, then the limit of BER is not met, denote "l " on the record.
8. Raise the CW jamming frequency by 50KHz, and repeat (1) - (7)

8.5 Test Results

Channel	Bit Rage	Error Percentage	Limit	Result
2	1 1 Mbps	52/280 = 18.57%	20%	Pass

SN (dB)	J/S (dB)	Lsys(dB)	Jammer (dBm)
18	-9	1	-62

Freq. (GHz)	Detected Error	Freq. (GHz)	Detected Error	Freq. (GHz)	Detected Error	Freq. (GHz)	Detected Error
2.41000	0	2.41150	0	2.41295	0	2.41440	1
2.41005	0	2.41155	0	2.41300	0	2.41445	1
2.41450	0	2.41160	0	2.41305	0	2.41450	0
2.41015	1	2.41165	0	2.41310	0	2.41455	0
2.41020	0	2.41170	0	2.41315	0	2.41460	0
2.41025	0	2.41175	0	2.41320	0	2.41465	1
2.41030	0	2.41180	0	2.41325	0	2.41470	0
2.41035	0	2.41185	0	2.41330	0	2.41475	0
2.41040	0	2.41190	0	2.41335	0	2.41480	1
2.41045	0	2.41195	0	2.41340	0	2.41485	1
2.41050	0	2.41200	0	2.41345	0	2.41490	1
2.41055	0	2.41205	0	2.41350	0	2.41495	0
2.41065	0	2.41215	1	2.41360	0	2.41505	0
2.41070	0	2.41220	1	2.41365	0	2.41510	0
2.41075	0	2.41225	0	2.41370	0	2.41515	0
2.41080	0	2.41230	0	2.41375	0	2.41520	0
2.41085	0	2.41235	0	2.41380	0	2.41525	0
2.41090	0	2.41240	0	2.41385	0	2.41530	0
2.41095	0	2.41245	0	2.41390	0	2.41535	0
2.41100	0	2.41250	0	2.41395	0	2.41540	0
2.41105	1	2.41255	0	2.41400	0	2.41545	0
2.41115	1	2.41260	0	2.41405	0	2.41550	0
2.41120	1	2.41265	0	2.41410	0	2.41555	0
2.41125	1	2.41270	0	2.41415	0	2.41560	0
2.41130	1	2.41275	0	2.41420	0	2.41565	0
2.41135	0	2.41280	0	2.41425	0	2.41570	0
2.41140	0	2.41285	0	2.41430	0	2.41575	1
2.41145	0	2.41290	0	2.41435	1	2.41580	1

Freq. (GHz)	Detected Error	Freq. (GHz)	Detected Error	Freq. (GHz)	Detected Error	Freq. (GHz)	Detected Error
2.41585	0	2.41790	1	2.41995	0	2.42205	0
2.41590	0	2.41795	0	2.42000	0	2.42210	1
2.41595	1	2.41800	0	2.42005	0	2.42215	1
2.41600	0	2.41805	0	2.42010	0	2.42220	1
2.41605	1	2.41810	1	2.42015	1	2.42225	0
2.41610	0	2.41815	0	2.42020	0	2.42230	0
2.41615	0	2.41820	1	2.42025	0	2.42235	0
2.41620	0	2.41825	0	2.42030	0	2.42240	0
2.41625	0	2.41830	0	2.42035	1	2.42245	0
2.41630	0	2.41835	0	2.42040	1	2.42250	0
2.41635	0	2.41840	0	2.42045	0	2.42255	0
2.41640	0	2.41845	0	2.42050	0	2.42260	0
2.41645	0	2.41850	0	2.42055	0	2.42265	1
2.41650	1	2.41855	1	2.42060	0	2.42270	1
2.41655	0	2.41860	0	2.42065	0	2.42275	0
2.41660	0	2.41865	0	2.42070	0	2.42280	0
2.41665	0	2.41870	0	2.42075	0	2.42290	0
2.41670	0	2.41875	0	2.42080	0	2.42295	0
2.41675	0	2.41880	0	2.42085	0	2.42300	0
2.41680	1	2.41885	0	2.42090	0	2.42305	0
2.41685	0	2.41890	0	2.42100	0	2.42310	0
2.41690	1	2.41895	1	2.42105	0	2.42315	0
2.41695	0	2.41900	1	2.42110	0	2.42320	0
2.41700	0	2.41905	1	2.42115	0	2.42325	1
2.41705	0	2.41910	0	2.42120	0	2.42330	0
2.41710	1	2.41915	0	2.42125	0	2.42335	0
2.41715	0	2.41920	1	2.42130	0	2.42340	0
2.41720	0	2.41925	0	2.42135	0	2.42345	1
2.41725	0	2.41930	0	2.42140	0	2.42350	0
2.41730	1	2.41935	1	2.42145	0	2.42355	0
2.41735	1	2.41940	0	2.42150	0	2.42360	0
2.41740	0	2.41945	1	2.42155	0	2.42365	1
2.41745	1	2.41950	0	2.42160	0	2.42370	0
2.41750	1	2.41955	0	2.42165	0	2.42375	0
2.41755	0	2.41960	0	2.42170	0	2.42380	0
2.41760	0	2.41965	0	2.42175	0	2.42385	1
2.41765	1	2.41970	0	2.42180	0	2.42390	0
2.41770	0	2.41975	0	2.42185	0	2.42395	0
2.41775	0	2.41980	0	2.42190	0	2.42390	0
2.41780	0	2.41985	0	2.42195	1	2.42395	0
2.41785	0	2.41990	0	2.42200	0	2.42400	1

Channel	Bit Rage	Error Percentage	Limit	Result
2	5.5 Mbps	45/280 = 16.07%	20%	Pass

SN (dB)	J/S (dB)	Lsys (dB)	Jammer (dBm)
15	-6	1	-59

Freq. (GHz)	Detected Error	Freq. (GHz)	Detected Error	Freq. (GHz)	Detected Error	Freq. (GHz)	Detected Error
2.41000	0	2.41150	0	2.41295	0	2.41440	0
2.41005	0	2.41155	0	2.41300	0	2.41445	0
2.41010	0	2.41160	0	2.41305	0	2.41450	0
2.41015	0	2.41165	0	2.41310	0	2.41455	0
2.41020	0	2.41170	0	2.41315	0	2.41460	0
2.41025	0	2.41175	0	2.41320	0	2.41465	1
2.41030	0	2.41180	0	2.41325	0	2.41470	0
2.41035	0	2.41185	0	2.41330	0	2.41475	0
2.41040	0	2.41190	0	2.41335	0	2.41480	0
2.41045	0	2.41195	0	2.41340	0	2.41485	0
2.41050	0	2.41200	0	2.41345	0	2.41490	0
2.41055	0	2.41205	0	2.41350	0	2.41495	0
2.41060	0	2.41210	0	2.41355	0	2.41500	0
2.41065	0	2.41215	0	2.41360	0	2.41505	0
2.41070	0	2.41220	0	2.41365	0	2.41510	0
2.41075	0	2.41225	0	2.41370	0	2.41515	0
2.41080	0	2.41230	0	2.41375	0	2.41520	0
2.41085	0	2.41235	0	2.41380	0	2.41525	1
2.41090	0	2.41240	0	2.41385	0	2.41530	0
2.41095	0	2.41245	0	2.41390	0	2.41535	0
2.41100	0	2.41250	0	2.41395	0	2.41540	1
2.41105	0	2.41255	0	2.41400	1	2.41545	0
2.41115	0	2.41260	0	2.41405	0	2.41550	0
2.41120	0	2.41265	0	2.41410	1	2.41555	0
2.41125	0	2.41270	0	2.41415	1	2.41560	0
2.41130	0	2.41275	0	2.41420	1	2.41565	0
2.41135	0	2.41280	0	2.41425	0	2.41570	0
2.41140	0	2.41285	0	2.41430	0	2.41575	0
2.41145	0	2.41290	0	2.41435	1	2.41580	0

Freq. (GHz)	Detected Error	Freq. (GHz)	Detected Error	Freq. (GHz)	Detected Error	Freq. (GHz)	Detected Error
2.41585	0	2.41790	1	2.41995	0	2.42205	0
2.41590	0	2.41795	0	2.42000	0	2.42210	0
2.41595	0	2.41800	0	2.42005	0	2.42215	0
2.41600	0	2.41805	0	2.42010	0	2.42220	0
2.41605	0	2.41810	0	2.42015	0	2.42225	0
2.41610	1	2.41815	0	2.42020	0	2.42230	0
2.41615	1	2.41820	0	2.42025	0	2.42235	0
2.41620	1	2.41825	0	2.42030	0	2.42240	0
2.41625	1	2.41830	0	2.42035	0	2.42245	0
2.41630	1	2.41835	1	2.42040	0	2.42250	0
2.41635	1	2.41840	0	2.42045	0	2.42255	0
2.41640	1	2.41845	1	2.42050	0	2.42260	0
2.41645	1	2.41850	0	2.42055	0	2.42265	0
2.41650	1	2.41855	0	2.42060	0	2.42270	0
2.41655	1	2.41860	1	2.42065	0	2.42275	0
2.41660	1	2.41865	0	2.42070	0	2.42280	0
2.41665	1	2.41870	0	2.42075	0	2.42290	0
2.41670	1	2.41875	0	2.42080	0	2.42295	0
2.41675	1	2.41880	0	2.42085	0	2.42300	0
2.41680	0	2.41885	0	2.42090	0	2.42305	0
2.41685	0	2.41890	0	2.42100	0	2.42310	0
2.41690	0	2.41895	0	2.42105	0	2.42315	0
2.41695	0	2.41-900	0	2.42110	0	2.42320	0
2.41700	0	2.41905	0	2.42115	1	2.42325	0
2.41705	0	2.41910	0	2.42120	0	2.42330	0
2.41710	0	2.41915	0	2.42125	0	2.42335	0
2.41715	0	2.41920	0	2.42130	0	2.42340	0
2.41720	1	2.41925	0	2.42135	0	2.42345	0
2.41725	1	2.41930	0	2.42140	0	2.42350	0
2.41730	1	2.41935	0	2.42145	0	2.42355	0
2.41735	1	2.41940	0	2.42150	0	2.42360	0
2.41740	1	2.41945	0	2.42155	0	2.42365	0
2.41745	1	2.41950	0	2.42160	0	2.42370	0
2.41750	1	2.41955	1	2.42165	0	2.42375	0
2.41755	1	2.41960	0	2.42170	0	2.42380	0
2.41760	1	2.41965	1	2.42175	0	2.42385	0
2.41765	1	2.41970	1	2.42180	0	2.42390	0
2.41770	1	2.41975	0	2.42185	0	2.42395	0
2.41775	1	2.41980	0	2.42190	0	2.42390	0
2.41780	1	2.41985	0	2.42195	0	2.42395	0
2.41785	1	2.41990	0	2.42200	0	2.42400	0

Channel	Bit Rage	Error Percentage	Limit	Result
2	2 Mbps	52/280 = 18.57%	20%	Pass

SN (dB)	J/S (dB)	Lsys (dB)	Jammer (dBm)
15	-5	0	-60

Freq. (GHz)	Detected Error	Freq. (GHz)	Detected Error	Freq. (GHz)	Detected Error	Freq. (GHz)	Detected Error
2.41000	0	2.41150	0	2.41295	0	2.41440	0
2.41005	0	2.41155	0	2.41300	0	2.41445	0
2.41010	0	2.41160	0	2.41305	0	2.41450	0
2.41015	0	2.41165	0	2.41310	0	2.41455	0
2.41020	0	2.41170	0	2.41315	0	2.41460	0
2.41025	0	2.41175	0	2.41320	0	2.41465	0
2.41030	0	2.41180	0	2.41325	0	2.41470	0
2.41035	0	2.41185	0	2.41330	0	2.41475	0
2.41040	0	2.41190	0	2.41335	0	2.41480	0
2.41045	0	2.41195	0	2.41340	0	2.41485	0
2.41050	0	2.41200	0	2.41345	0	2.41490	0
2.41055	0	2.41205	0	2.41350	0	2.41495	0
2.41060	0	2.41210	0	2.41355	0	2.41500	0
2.41065	0	2.41215	0	2.41360	0	2.41505	0
2.41070	0	2.41220	0	2.41365	0	2.41510	0
2.41075	0	2.41225	0	2.41370	0	2.41515	0
2.41080	0	2.41230	0	2.41375	0	2.41520	0
2.41085	0	2.41235	0	2.41380	0	2.41525	0
2.41090	0	2.41240	0	2.41385	0	2.41530	0
2.41095	0	2.41245	0	2.41390	0	2.41535	0
2.41100	0	2.41250	0	2.41395	0	2.41540	0
2.41105	0	2.41255	0	2.41400	0	2.41545	0
2.41115	0	2.41260	0	2.41405	0	2.41550	0
2.41120	0	2.41265	0	2.41410	0	2.41555	0
2.41125	0	2.41270	0	2.41415	0	2.41560	0
2.41130	0	2.41275	0	2.41420	0	2.41565	0
2.41135	0	2.41280	0	2.41425	0	2.41570	0
2.41140	0	2.41285	0	2.41430	0	2.41575	0
2.41145	0	2.41290	0	2.41435	0	2.41580	0

Freq. (GHz)	Detected Error	Freq. (GHz)	Detected Error	Freq. (GHz)	Detected Error	Freq. (GHz)	Detected Error
2.41585	0	2.41790	0	2.41995	0	2.42205	0
2.41590	0	2.41795	0	2.42000	0	2.42210	0
2.41595	0	2.41800	1	2.42005	0	2.42215	0
2.41600	1	2.41805	0	2.42010	0	2.42220	0
2.41605	0	2.41810	0	2.42015	0	2.42225	0
2.41610	0	2.41815	0	2.42020	0	2.42230	0
2.41615	0	2.41820	0	2.42025	0	2.42235	0
2.41620	0	2.41825	0	2.42030	0	2.42240	0
2.41625	1	2.41830	0	2.42035	0	2.42245	0
2.41630	0	2.41835	0	2.42040	0	2.42250	0
2.41635	0	2.41840	0	2.42045	0	2.42255	0
2.41640	0	2.41845	0	2.42050	0	2.42260	0
2.41645	0	2.41850	0	2.42055	0	2.42265	0
2.41650	1	2.41855	0	2.42060	0	2.42270	0
2.41655	0	2.41860	0	2.42065	0	2.42275	0
2.41660	0	2.41865	0	2.42070	0	2.42280	0
2.41665	0	2.41870	0	2.42075	0	2.42290	0
2.41670	0	2.41875	0	2.42080	0	2.42295	0
2.41675	0	2.41880	0	2.42085	0	2.42300	0
2.41680	0	2.41885	0	2.42090	0	2.42305	0
2.41685	0	2.41890	0	2.42100	0	2.42310	0
2.41690	0	2.41895	0	2.42105	0	2.42315	0
2.41695	1	2.41900	0	2.42110	0	2.42320	0
2.41700	1	2.41905	0	2.42115	0	2.42325	0
2.41705	1	2.41910	0	2.42120	0	2.42330	0
2.41710	0	2.41915	0	2.42125	0	2.42335	0
2.41715	0	2.41920	0	2.42130	0	2.42340	0
2.41720	0	2.41925	0	2.42135	0	2.42345	0
2.41725	0	2.41930	0	2.42140	0	2.42350	0
2.41730	0	2.41935	0	2.42145	0	2.42355	0
2.41735	0	2.41940	0	2.42150	0	2.42360	0
2.41740	0	2.41945	0	2.42155	0	2.42365	0
2.41745	0	2.41950	0	2.42160	0	2.42370	0
2.41750	1	2.41955	0	2.42165	0	2.42375	0
2.41755	0	2.41960	0	2.42170	0	2.42380	0
2.41760	0	2.41965	0	2.42175	0	2.42385	0
2.41765	0	2.41970	0	2.42180	0	2.42390	0
2.41770	0	2.41975	0	2.42185	0	2.42395	0
2.41775	1	2.41980	0	2.42190	0	2.42390	0
2.41780	0	2.41985	0	2.42195	0	2.42395	0
2.41785	0	2.41990	0	2.42200	0	2.42400	0

Channel	Bit Rage	Error Percentage	Limit	Result
2	1 Mbps	52/280 = 18.57%	20%	Pass

SN (dB)	J/S (dB)	Lsys (dB)	Jammer (dBm)
13	-5	2	-60

Freq. (GHz)	Detected Error	Freq. (GHz)	Detected Error	Freq. (GHz)	Detected Error	Freq. (GHz)	Detected Error
2.41000	0	2.41150	0	2.41295	0	2.41440	0
2.41005	0	2.41155	0	2.41300	0	2.41445	0
2.41010	0	2.41160	0	2.41305	0	2.41450	0
2.41015	0	2.41165	0	2.41310	0	2.41455	0
2.41020	1	2.41170	0	2.41315	0	2.41460	0
2.41025	0	2.41175	0	2.41320	0	2.41465	0
2.41030	0	2.41180	0	2.41325	0	2.41470	0
2.41035	1	2.41185	0	2.41330	0	2.41475	0
2.41040	0	2.41190	0	2.41335	0	2.41480	0
2.41045	0	2.41195	0	2.41340	0	2.41485	0
2.41050	0	2.41200	0	2.41345	0	2.41490	0
2.41055	0	2.41205	0	2.41350	0	2.41495	0
2.41060	0	2.41210	0	2.41355	0	2.41500	0
2.41065	1	2.41215	0	2.41360	0	2.41505	0
2.41070	0	2.41220	0	2.41365	0	2.41510	0
2.41075	0	2.41225	0	2.41370	0	2.41515	0
2.41080	1	2.41230	0	2.41375	0	2.41520	0
2.41085	0	2.41235	0	2.41380	0	2.41525	0
2.41090	0	2.41240	0	2.41385	0	2.41530	0
2.41095	0	2.41245	0	2.41390	0	2.41535	0
2.41100	0	2.41250	0	2.41395	0	2.41540	0
2.41105	0	2.41255	0	2.41400	0	2.41545	0
2.41115	0	2.41260	0	2.41405	0	2.41550	0
2.41120	0	2.41265	0	2.41410	0	2.41555	0
2.41125	0	2.41270	0	2.41415	0	2.41560	0
2.41130	0	2.41275	0	2.41420	0	2.41565	0
2.41135	0	2.41280	0	2.41425	0	2.41570	0
2.41140	0	2.41285	0	2.41430	0	2.41575	0
2.41145	0	2.41290	0	2.41435	0	2.41580	0

Freq. (GHz)	Detected Error	Freq. (GHz)	Detected Error	Freq. (GHz)	Detected Error	Freq. (GHz)	Detected Error
2.41585	0	2.41790	0	2.41995	0	2.42205	0
2.41590	0	2.41795	0	2.42000	0	2.42210	0
2.41595	0	2.41800	1	2.42005	0	2.42215	0
2.41600	1	2.41805	0	2.42010	0	2.42220	0
2.41605	0	2.41810	0	2.42015	1	2.42225	0
2.41610	0	2.41815	0	2.42020	0	2.42230	0
2.41615	0	2.41820	0	2.42025	0	2.42235	0
2.41620	0	2.41825	0	2.42030	1	2.42240	0
2.41625	1	2.41830	0	2.42035	0	2.42245	0
2.41630	0	2.41835	0	2.42040	0	2.42250	0
2.41635	0	2.41840	1	2.42045	1	2.42255	1
2.41640	0	2.41845	0	2.42050	0	2.42260	1
2.41645	1	2.41850	0	2.42055	0	2.42265	0
2.41650	1	2.41855	0	2.42060	1	2.42270	0
2.41655	0	2.41860	0	2.42065	0	2.42275	0
2.41660	0	2.41865	0	2.42070	0	2.42280	0
2.41665	1	2.41870	0	2.42075	0	2.42290	0
2,41670	1	2.41875	0	2.42080	0	2.42295	0
2.41675	1	2.41880	0	2.42085	0	2.42300	0
2.41680	1	2.41885	0	2.42090	0	2.42305	0
2.41685	1	2.41890	0	2.42100	0	2.42310	0
2.41690	1	2.41895	0	2.42105	0	2.42315	0
2.41695	1	2.41900	1	2.42110	0	2.42320	0
2.41700	1	2.41905	0	2.42115	0	2.42325	0
2.41705	1	2.41910	0	2.42120	0	2.42330	0
2.41710	1	2.41915	0	2.42125	0	2.42335	0
2.41715	1	2.41920	0	2.42130	0	2.42340	0
2.41720	1	2.41925	0	2.42135	0	2.42345	0
2.41725	1	2.41930	0	2.42140	0	2.42350	0
2.41730	1	2.41935	0	2.42145	0	2.42355	0
2.41735	1	2.41940	0	2.42150	0	2.42360	0
2.41740	1	2.41945	0	2.42155	0	2.42365	0
2.41745	1	2.41950	0	2.42160	0	2.42370	0
2.41750	1	2.41955	0	2.42165	0	2.42375	0
2.41755	1	2.41960	0	2.42170	1	2.42380	0
2.41760	1	2.41965	0	2.42175	0	2.42385	0
2.41765	1	2.41970	1	2.42180	0	2.42390	0
2.41770	0	2.41975	0	2.42185	0	2.42395	0
2.41775	1	2.41980	0	2.42190	0	2.42390	0
2.41780	0	2.41985	0	2.42195	0	2.42395	0
2.41785	0	2.41990	1	2.42200	0	2.42400	1

9. Appendix

9.1 Appendix A: Warning Labels

Label Requirements

An intentional radiator device subject to certification by the FCC shall carry a warning label which includes the following statement:

The sample label shown shall be permanently affixed at a conspicuous location on the device and be readily visible to the user at the time of purchase.

FCC ID: HLZMPCI-101
This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

9.2 Appendix B: Warning Statement

Statement Requirements

The operators manual for a Class B digital device shall contain the following statements or their equivalent:

*** * * W A R N I N G * * ***

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instruction manual may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio TV technician for help.

Notice: The changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equivalent.

*** * * * * * * * ***

If the EUT was tested with special shielded cables the operators manual for such product shall also contain the following statements or their equivalent:

Shielded interface cables and/or AC power cord, if any, must be used in order to comply with the emission limits.

9.3 Appendix C: Measurement Procedure for Power Line Conducted Emissions

The EUT is set up in accordance with the suggested configuration given in ANSI C63.4-1992, CFR 47 Part 15 Subpart B; or EN55022:1994/A1:1995/A2:1997; CISPR 22:1993/A1:1995/A2:1997. The measurements are performed in a 3.5 x 3.4 x 2.5 (m) shielded room. The EUT was placed on a non-conduction 1.0 x 1.5 (m) table, which is 0.8 meters above an earth-grounded.

Power to the EUT was provided through the LISN which has the Impedance vs. Frequency Characteristic in accordance with the Figure 1 of the ANSI C63.4-1992. Power to the LISNs were filtered to eliminate ambient signal interference and these filters were bonded to the ground plane. Peripheral equipment required to provide a functional system (support equipment) for EUT testing was powered from the second LISN through a ganged, metal power outlet box which is bonded to the ground plane at the LISN.

If the EUT is supplied with a flexible power cord, the power cord length in excess of the distance separating the EUT from the LISN shall be folded back and forth at the center of the lead so as to form a bundle not exceeding 40cm in length. If the EUT is provided with a permanently coiled power cord, bundling of the cord is not required. If the EUT is supplied without a power cord, the EUT shall be connected to the LISN by a power cord of the type specified by the manufacturer which shall not be longer than 1 meter. The excess power cord shall be bundled as described above. If a non-flexible power cord is provided with the EUT, it shall be cut to the length necessary to attach the EUT to the LISN and shall not be bundled.

The interconnecting cables were arranged and moved to get the maximum according to ANSI C63.4-1992, CFR 47 Part 15 Subpart B; or EN55022:1994/A1:1995/A2:1997; CISPR 22:1993/A1:1995/A2:1997. Both the line of power cord, hot and neutral, were measured.

The highest emissions were analyzed in details by operating the spectrum analyzer in fixed tuned mode to determine the nature of the emissions and to provide information which could be useful in reducing their amplitude.

9.4 Appendix D: Test Procedure for Radiated Emissions

Preliminary Measurements in the Anechoic Chamber

The radiated emissions are initially measured in the anechoic chamber at a measurement distance of 3 meters. Desktop EUTs are placed on a wooden stand 0.8 meter in height. The measurement antenna is 3 meters from the EUT. The test setup in anechoic chamber is the same as open site. The turntable rotated 360°C. The antenna height is varied from 1-2.5m. The primary objective of the radiated measurements in the anechoic chamber is to identify the frequency spectrum in the absence of the electromagnetic environment existing on the open test site. The frequencies can then be preselected on the open test site to obtain the corresponding amplitude. The initial scan is made with the spectrum analyzer in automatic sweep mode. The spectrum peaks are then measured manually to determine the exact frequencies.

Measurements on the Open Site

The radiated emissions test will then be repeated on the open site to measure the amplitudes accurately and without the multiple reflections existing in the shielded room. The EUT and support equipment are set up on the turntable of one of the 3 or 10 meter open field sites. Desktop EUTs are set up on a wooden stand 0.8 meter above the ground.

For the initial measurements, the receiving antenna is varied from 1-4 meter height and is changed in the vertical plane from vertical to horizontal polarization at each frequency. Both reading are recorded with the quasi-peak detector and with the 120 kHz bandwidth. For frequency between 30 MHz and 1000MHz, the reading are recorded with peak detector and with the 1 MHz bandwidth.

At the highest amplitudes observed, the EUT is rotated in the horizontal plane while changing the antenna polarization in the vertical plane to maximize the reading. The interconnecting cables were arranged and moved to get the maximum according to ANSI C63.4-1992, and/or EN55022:1994/A1:1995/A2:1997 / CISPR 22:1993/A1:1995/A2:1996. Once the maximum reading is obtained, the antenna elevation and polarization will be varied between specified limits to maximize the readings.

During the open site measurements, the peaks are selected, the scan frequency span width is reduced to 0--1MHz, the audible modulation is monitored with a loudspeaker and the quasi-peak reading or peak is recorded at the indicated frequency and at the specified bandwidth.

9.5 Appendix E: Description of Open Field Test Site

The open field test site is located on a valley in Hsichih Chen and adjacent to Taipei City. The direct distance to Taipei City is about 12 Km. It is surrounded by hills measuring about 100 meters high.

The test platform is located on the top of the office building, approximately 12 meters wide and 17 meters long. The platform is located on the top of a very large ground metal plane to enhance a homogeneous reflective surface according to ANSI C63.4-1992, CFR 47 Part 15 Subpart B; or EN55022:1994/ A1:1995/A2:1997; CISPR 22:1993/A1:1995/A2:1996.

The office building houses the test laboratory, the shielded room, for performing Line conducted test, test personal and other support staff.

9.6 Appendix F: Test Equipment

9.6.1 Test Equipment List

Equipment	Brand	Model	Start Service Date	Last Cal. Date	Next Cal. Date
EMI Receiver	R&S	ESMI; rev. 02.80 S/N: 849182/003	Nov. 09, 1999	June. 13, 2001	June. 13, 2002
EMI Receiver	HP	8546A; S/N: 3520A00236	Oct. 28, 2000	Oct. 27, 2001	Oct. 27, 2002
BILOG Antenna	Chase	CBL6112B S/N: 2487	Nov. 23, 1998	Nov. 03, 2001	Nov. 02, 2002
Horn Antenna	EMCO	3115 S/N: 9504-4462	Nov. 06, 1999	Dec. 02, 2001	Dec.01, 2002
Pre Amplifier	R&S	ESMI-Z7	1045.5020	Apr. 06, 2001	Apr. 06, 2002
Coaxial Cables	RICHTEC	TWB4001 S/N: 3F-10M	Aug. 31, 1995	Jul. 24, 2001	Jul. 24, 2002
Coaxial Cables	RICHTEC	9913 S/N: 3F-3M	Dec. 20, 1998	Jan. 18, 2001	Jan. 18, 2002
Thermo-Hygro Meter	CRECER	HD-30 S/N: ISL-C-001	Nov. 26, 1999	Nov. 28, 2001	Nov. 27, 2002
Horn Antenna	COM-Power	AH-826 S/N: 1088	Oct. 21, 200	Sep. 27, 2001	Sep. 27, 2002
RF Preamplifier	MITEQ	AFS44-00102650-40-10P-44 S/N: 728229	Mar. 21, 2001	Mar. 14, 2001	Mar. 14, 2002
EMI Receiver	HP	8546A; S/N: 3441A00208	Sep. 08, 1997	Dec. 13, 2001	Dec. 13, 2002
LISN 1	R & S	ESH2-Z5 S/N: 890485/013	Dec. 15, 1988	Oct. 27, 2001	Oct. 27, 2002
LISN 2	EMCO	3825/2 S/N: 1407	Oct. 20, 1990	Oct. 27, 2001	Oct. 27, 2002
Terminator	RICHTEC	S/N: ISL-T-001	Oct. 19, 1999	Apr. 29, 2001	Apr. 28, 2002
Terminator	RICHTEC	S/N: ISL-T-002	Oct. 19, 1999	Apr. 29, 2001	Apr. 28, 2002
ISN	Schaffner	ISN T400	Mar. 13, 2001	Sep. 11, 2001	Sep. 11, 2002
Coaxial Cables	RICHTEC	RG400 S/N: 1F-C1	Aug. 31, 1995	Feb. 28, 2001	Feb. 28, 2002
Coaxial Cables	RICHTEC	RG400 S/N: 1F-C2	Aug. 31, 1995	Feb. 28, 2001	Feb. 28, 2002
Digital Thermo-Hygro Meter	MICROLIFE	S/N: ISL-C-002	Nov. 26, 1999	Nov. 27, 2001	Nov. 27, 2002

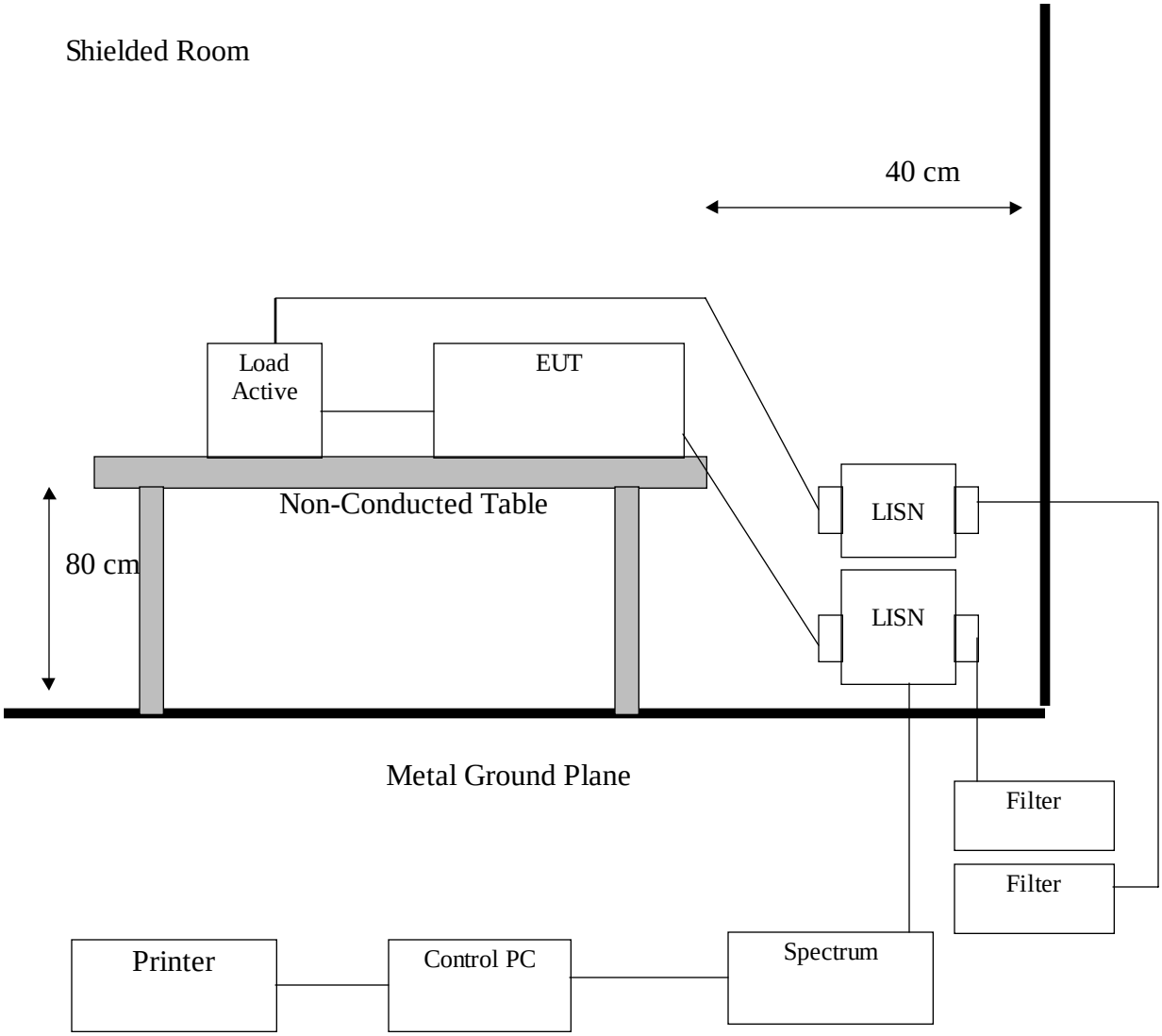
Note: Calibration traceable to NIST or national or international standards.

9.6.2 Software for Controlling Spectrum/Receiver and Calculating Test Data

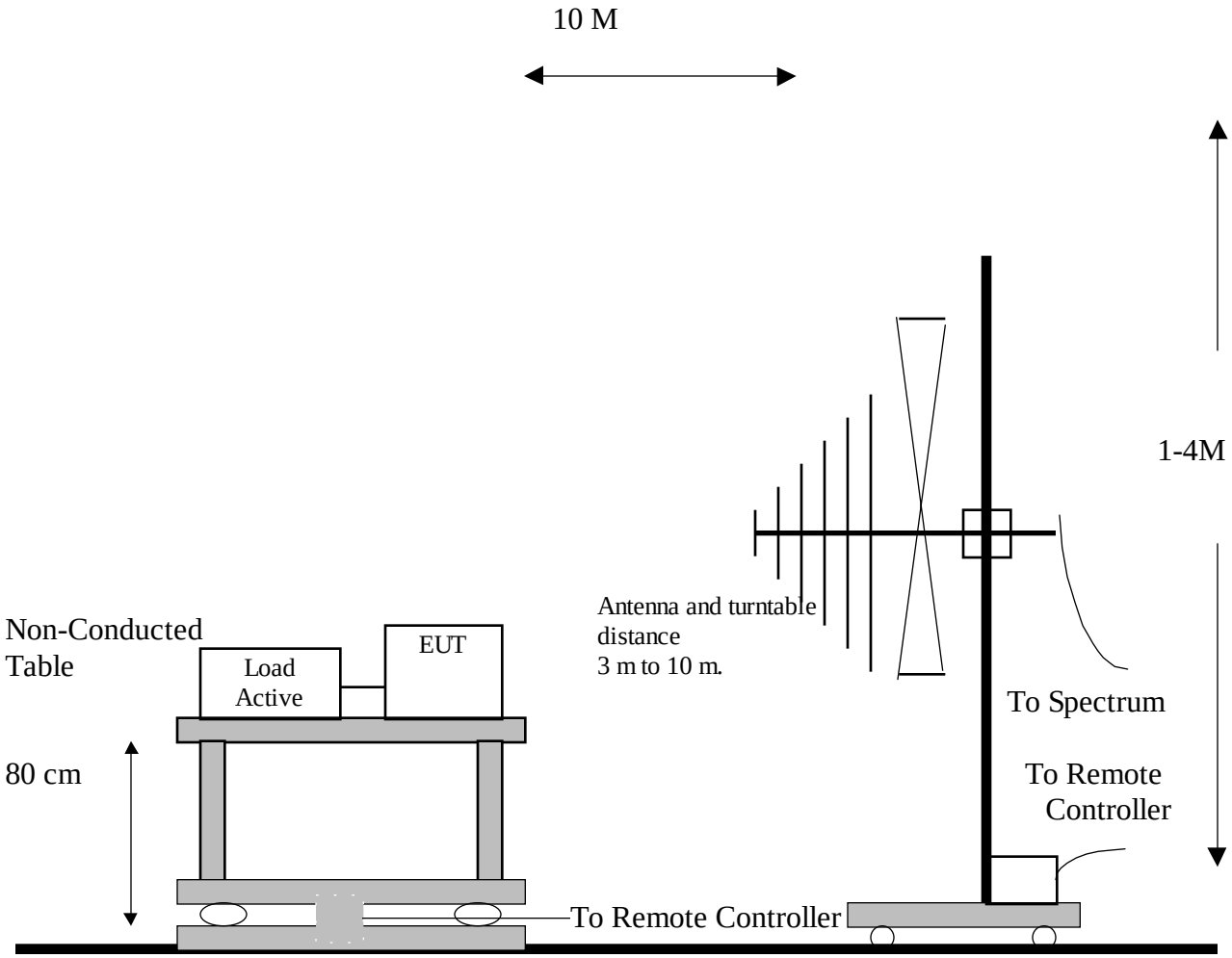
Radiation/Conduction	Filename	Version	Issued Date
Conduction	Tile.exe	1.12E	7/7/2000
Radiation	Tile.exe	1.12C	6/16/2000

9.7 Appendix G: Layout of EUT and Support Equipment

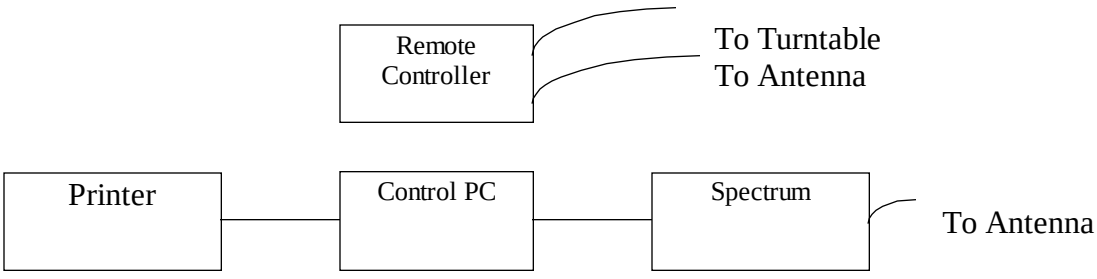
9.7.1 General Conducted Test Configuration



9.7.2 General Radiation Test Configuration



Metal Full Soldered Ground Plane



9.8 Appendix H: Description of Support Equipment

9.8.1 Description of Support Equipment

Support Unit 1.

Description:	Acer Notebook Personal Computer
Model:	MS2103
Serial Number:	N/A
Power Supply Type:	AC Adapter Delta (Model: ADP-65DB Ver-B) 3 pins
Hard Disk Driver:	IBM (Model: Diablo IC25N010ATDA04) 10.0 GB
SDRAM:	INFINEON (Model:HYS64V1622GDL-7.5-C2) 128MB or
DVD-ROM Driver:	MKE (Model: SR-8176-BBA-3)
CD-RW-ROM Driver:	KME (Model: UJDA330-AC2-Z)
DVD+RW Drive:	KME (Model: UJDA710-AC2-B)
CD-ROM Driver:	MKE (Model: CR-177-BAA-3)
MiniPCI:	Lucent Technologies (Model: MPCI3A-20)
Power In Port:	one
USB Connector:	two 4-pin
S-Port:	one
VGA Port:	one 15-pin
Port Replicator Connector:	one 100 pin
Parallel Port:	one 25-pin
Line Out Port:	one
Line In Port:	one
LAN/Modem Card:	Ambit (Model: T60M283 Rev.3L6)
LAN Connector:	one 8-pin
Modem Connector:	one 4-pin
1394 Port:	one 4-pin
PCMCIA Port:	one 68-pin
Battery (optional):	Sanyo Model: (BTP-39D1)
Power Cord:	Shielded, Detachable (3 pins)
LCD:	LG 13.3” TFT XGA (Model: LP133X8)
Display:	LCD & TV (640 X 480)

Support Unit 2.

Description•	Acer Wireless LAN/Broadband/ISDN Router
Model•	914I
Serial Number•	N/A
AC-AC Adaptor•	OEM (Model: AA-091ABM) 2-pin
Power Cord•	Non-shielded, Detachable

Support Unit 3.

Description•	Broadband Router
Model•	Router 904
Serial Number•	N/A
AC-AC Adaptor•	Linear, Power Adapter OEM (Model: AA-091A) 2-pin
Power Cord•	Non-shielded, Detachable

Support Unit 4.

Description:	Digital Video Camera
Model:	DCR-PC100
Serial Number:	173009
Power Supply Type:	AC Power Adaptor (SONY, Model: AC-L10A)
Power Cord:	Nonshielded, Detachable
FCC ID:	(Comply with FCC DOC)

Support Unit 5.

Description:	Acer Digital Camera
Model:	DVC-VII
Serial Number:	N/A
Power Supply Type:	From PC USB Port
Power Cord:	N/A
FCC ID:	(Comply with FCC DOC)

Support Unit 6.

Description:	Acer USB Mouse
Model Number:	MUSXT
Serial Number:	81130159
Power Supply Type:	N/A
Power Cord:	N/A
FCC ID:	(comply with FCC DOC)

Support Unit 7.

Description:	Koka Headphone
Model Number:	ST-8
Serial Number:	N/A
Power Supply Type:	N/A
Power Cord:	N/A
FCC ID:	N/A

Support Unit 8.

Description:	SONY radio cassette player
Model Number:	WM-FX50
Serial Number:	N/A
Power Supply Type:	N/A
Power Cord:	N/A

Support Unit 9.

Description:	HP Printer (for parallel interface port)
Model Number:	2225C
Serial Number:	N/A
Power Supply Type:	Switching (AC to AC Xfmr, Wall Mounted Type)
Power Cord:	Nonshielded, Detachable With Grounding Pin
FCC ID:	DSI6XU2225

Support Unit 10.

Description:	Sony Video Monitor
Model Number:	PVM-14M2U
Serial Number:	RK08570317
Power Supply Type:	N/A
Power Cord:	N/A
FCC ID:	N/A

Support Unit 11.

Description:	Acer Monitor
Model:	7377xe
Serial Number:	999027100501700055P644E1 P
Power Supply Type:	Switching
Power Cord:	Nonshielded, Detachable
FCC ID:	(Comply with FCC DOC)

Support Unit 12.

Description:	Personal Computer
Model:	IBM 2170
Serial No.:	N/A
Power Supply Type :	Switching Delta (Model: DPS-145PB-80A)
Hard Disk Drive:	Maxtor (Model: 91303D6) 13.3GB
Floppy Driver:	Panasonic (Model: JU256A276P)
CD-ROM Drive:	AOpen (Model: CD-940E/TKU PRO)
ZIP Driver:	Iomega (Model:Z100ATAPI)
LAN Card	Accton (Model: EN1207D-TX1)
FDD/HDD Controller and VGA port/ Parallel/ Serial port:	Built on Motherboard
VGA port:	one 15-pin
Parallel Port:	one 25-pin
Serial Port:	one 9-pin
Keyboard Connector:	6-pin
Mouse Connector:	6-pin
USB Connector:	two 4-pin
Game Port:	one 15-pin
Speaker Port:	one
Microphone Port:	one
Line In Port:	one
Power Cord:	Nonshielded, Detachable
FCC ID:	N/A (comply witch FCC DOC)

9.8.2 Software for Controlling Support Unit

Test programs exercising various part of EUT were used. The programs were executed as follows:

A. Read and write to the disk drives.
B. Send package to Wireless Router.
C. Send package to the Router LAN port (Router).
D. Send package to the Router console port (Router).
E. Capture image from digital video camera than transfer to display (CCD).
F. Capture Video image from digital camera than playback to display.
G. Send audio signal to the headphone.
H. Receive audio signal from walkman.
I. Send H pattern to the parallel port device (Printer).
J. Send H pattern to the video port device (TV).
K. Send H pattern to the video port device (Monitor).
L. Send signal form EUT to server through LAN port.
M. Repeat the above steps.

	Filename	Issued Date
LAN	EMC.exe	11/22/1996
Monitor	HH.bat	8/20/1991
TV	HH.bat	8/20/1991
Printer1	Wordpad.exe	11/11/1999
Digital Camera	Acer Cap.exe	8/10/1998
Digital Video Camera	Divpcam.exe	12/10/1998
Router Console Port	Commtest.exe	8/20/2001
Router LAN Port	Ping.exe	5/5/1999
Wireless Router	Ping.exe	5/5/1999

9.8.3 I/O Cable Condition of EUT and Support Units

Description	Path	Cable Length	Cable Type	Connector Type
AC Power Cord	110V (~240V) to AC Power Cord Inlet (3-pin)	1.8M	Nonshielded, Detachable	Plastic Head Plastic Hood
Server Data Cable	Server to EUT LAN port	33 feet	Nonshielded, Detachable	RJ-45, with Plastic Head, Plastic Hood
Monitor Data Cable	Monitor to PC VGA port	1.6M	Shielded, Detachable	Metal Head Plastic Hood
TV Data Cable	TV to PC S Terminal	1.6M	Shielded, Detachable	Metal Head Plastic Hood
Printer Data Cable	Printer to PC Parallel port	1.5M	Shielded, Detachable	Metal Head Plastic Hood
Audio-in Data Cable	Walkman to PC Audio-In Port	1.5M	Nonshielded, Detachable to PC	Metal Head Plastic Hood
Headphone Data Cable	Headphone to Line-out jack of PC	1.5M	Nonshielded, Undetachable	Metal Head without Hood
USB Mouse Data Cable	USB Mouse to PC USB port	1.8M	Shielded, Undetachable	Metal Head without Hood
USB CCD Data Cable	Digital camera to PC USB port	1.6M	Shielded, Detachable	Metal Head Plastic Hood
Digital Video Camera 1394 Data Cable	Digital Video Camera to 1394 port of PC	1.0M	Shielded, Detachable	Metal Head Plastic Hood
Console Cable	EUT RS232 port to Router Console Port.	1.0M	Shielded, Detachable	Metal Head Plastic Hood
LAN Data Cable	EUT LAN Port to Router LAN Port.	1.0M	Nonshielded, Detachable	RJ-45, with Plastic Head, Plastic Hood

9.9 Appendix I: Accuracy of Measurement

Contribution	Contribution	Uncertainties			
		Radiation		Conduction	
		3 m	10 m	Phase	Neutral
System Repeatability (assessment from 20 repeat observation)	Normal (K=2)	±0.56	±0.5	±0.20	±0.20
Random (assessment from 20 random observation)	Normal (K=2)	±1.28	±1.14	±0.54	±0.58
Receiver Specification	Rectangular	±1	±1	±1	±1
Antenna Factor Calibration	Normal (K=2)	±2	±2	NA	NA
Cable Loss Calibration	Rectangular	±0.5	±0.5	±0.5	±0.5
Combined Standard Uncertainty Uc (y)	Normal	±1.38	±1.34	±0.70	±0.71
Total Uncertainty @95% min. confidence probability (U)	Normal (K=2)	±2.76	±2.68	±1.40	±1.42

Measurement Uncertainty Calculations:

Uc (y) = square root ($u_1 (y)^2 + u_2 (y)^2 + ...+u_n (y)^2$)
U = 2 * Uc (y)

Note: The measurement Uncertainties mentioned above also refer to NIS 81-1994 of NAMAS : The treatment of Uncertainty in EMC Measurement.

9.10 Appendix J: Photographs of EUT Configuration Test Set Up

According to ANSI C63.4-1992; or EN55022:1994/ A1:1995/ A2:1997; CISPR 22:1993/A1:1995/A2:1996:

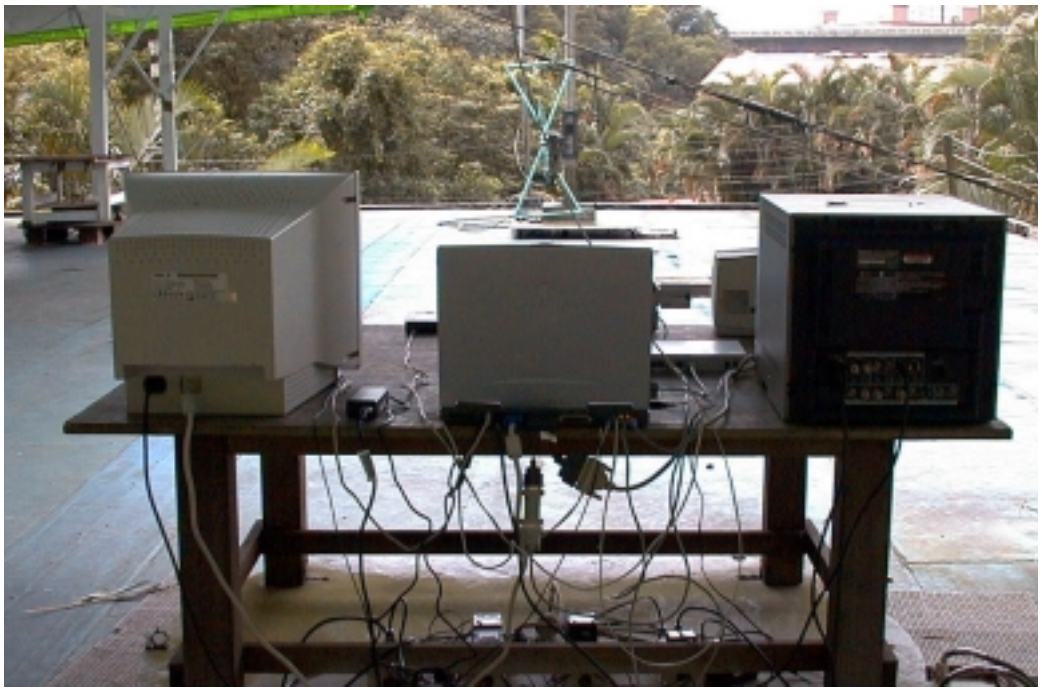
The measurement results along with the appropriate limits for comparison shall be presented in tabular form. If an alternate test method is used, the test report must identify that method and justification for its use shall be provided. Instrumentation, instrument attenuator and bandwidth settings, detector function, EUT arrangements, a sample calculation with all conversion factors and all other pertinent details shall be included along with the measurement results. When automatic scan techniques are used, an explanation of how each emission from the EUT was maximized shall be included in the test report along with the scan rate used to obtain each level.

The justification for selecting a particular EUT configuration and particular length of interface cable to produce maximized emissions must be documented in the test report. Photographs clearly showing the test set-up and interface cable arrangement for the highest radiated and line conducted emission measured shall be included.

Front View of Highest Main Power Port Conducted Emission

Front View of Highest Radiated Emission Test.

Back View of Highest Radiated Emission Test.



9.11 Appendix K: Antenna Spec.

Antenna Spec

Redstar

a. Average gain and peak gain

a.1 802.11b in elevation angle • •0 azimuth plane

	Average Gain (dBi)			Peak Gain (dBi)		
	2.4GHz	2.45GHz	2.5GHz	2.4GHz	2.45GHz	2.5GHz
Main	• -5	• -5	• -5	• 3	• 3	• 3
Aux	• -6	• -6	• -6	NA	NA	NA

a.2 802.11b in elevation angle -30 ^{o} • • • 30 ^{o} azimuth plane

	Average Gain (dBi)			Peak Gain (dBi)		
	2.4GHz	2.45GHz	2.5GHz	2.4GHz	2.45GHz	2.5GHz
Main	• -4	• -4	• -4	NA	NA	NA
Aux	• -5	• -5	• -5	NA	NA	NA

a. bluetooth in elevation angle –30 ^{o} • • • 30 ^{o} azimuth plane

	Average Gain (dBi)			Peak Gain (dBi)		
	2.4GHz	2.45GHz	2.5GHz	2.4GHz	2.45GHz	2.5GHz
Aux	• -4	• -4	• -4	• 3	• 3	• 3

b. VSWR • 2 from 2.4GHz to 2.5 GHz for 802.11b and bluetooth