

FCC PART 15.247 REPORT

On Model:

HomePortal 100W, HomePortal 1500W,
HomePortal 1500CW, HomePortal 2000W and
HomePortal 2000CW

Prepared for 2Wire, Inc.

According to CFR 15.247 Requirements

FCC ID #: PGRHPL000W

Test Report #: 2WI-0102-2844-FCC

Prepared by: Paul Chen

Table of Contents

DISCLAIMER NOTICE	1
REPRODUCTION CLAUSE	1
ADMINISTRATIVE DATA	2
EUT DESCRIPTION	2
TEST SUMMARY	3
TEST LOCATION	5
ACCREDITATION BODIES	5
EUT EXERCISE SOFTWARE	6
EQUIPMENT MODIFICATION	6
TEST SYSTEM DETAILS	6
CONFIGURATION OF TESTED SYSTEM	7
ATTACHMENT A – PRODUCT INFORMATION	8
ATTACHMENT B – CFR15.205 RESTRICTED BAND	9
ATTACHMENT C – CFR15.203 ANTENNA REQUIREMENT	10
ATTACHMENT D – CFR 15.247(A)(2) – DIRECT SEQUENCE BANDWIDTH (CONDUCTED)	11
ATTACHMENT E – CFR15.247(B) MAXIMUM PEAK OUTPUT POWER MEASUREMENT & CFR15.31(E) VOLTAGE VARIATION (CONDUCTED)	12
ATTACHMENT F – CFR15.247(C) RADIATED EMISSION MEASUREMENT 1GHZ - 25GHZ (FUNDAMENTAL AND HARMONICS)	13
ATTACHMENT F – CFR15.247 (C) RADIATED EMISSION MEASUREMENT 1GHZ - 25GHZ (FUNDAMENTAL AND HARMONICS) (CONT.)	14
ATTACHMENT F – CFR15.247(C) RADIATED EMISSION MEASUREMENT 1GHZ - 25GHZ (FUNDAMENTAL AND HARMONICS) (CONT.)	15
ATTACHMENT G - CFR 15.247(D) POWER DENSITY (CONDUCTED)	16
ATTACHMENT H – CFR15.209(A) RADIATED EMISSION MEASUREMENT 212-R-01)	17
ATTACHMENT I - CFR15.207 (A) CONDUCTED EMISSION TEST RESULTS	20
ATTACHMENT J - TEST EQUIPMENT	23
ATTACHMENT K – LISN SPECIFICATIONS	24
ATTACHMENT L – SAMPLE PHOTOS	25
ATTACHMENT M – PROPOSED FCC ID LABEL AND LOCATION	28
ATTACHMENT N – PROCESSING GAIN	29
ATTACHMENT O – PLOTS OF TESTS	30

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Administrative Data

Manufacturer : 2Wire, Inc.
1704 Automation Parkway,
San Jose, CA 95131

FCC ID : **PGRHPL000W**

Class : Spread Spectrum Transceiver

Interface Type : Mini PCI

Frequency Range : 2412 – 2462MHz

Method : Direct Sequence Spread Spectrum System

Model Name(s) : 1500CW

Part Number : N/A

Max RF Output (W) : 0.01 Watts

Power Supply : Through external AC/DC adapter

CFR Part(s) : CFR15.247

Date(s) of Tests : January 23 - February 04, 2001

Report Number : 2WI-0102-2844-FCC

EUT Description

The ORiNOCO MiniPCI radio module in combination with antennas connected externally to the units provides a wireless connection for portable and mobile computers in accordance with IEEE standard 802.11 Direct Sequence Spread Spectrum. Operation is in the 2.4GHz frequency band at 11 sub channels, 2412 through 2462 MHz. The data rate is 11Mbps with fallback rates of 5.5Mbps, 2Mbps and 1Mbps. The operation is in accordance with IEEE 802.11. The radio module will be installed in a standard Mini PCI card slot located inside the PC. Two antennas are factory-installed in the screen of the PC. One of the antennas is used as TX/RX antenna. The other is used as RX antenna. By diversity switching the best receiving antenna is selected.

Test Summary

Test Summary (CFR 15.247)			
Specifications	Requirement	Results	Note
CFR15.247(a)(2)	For direct sequence systems, the minimum 6dB bandwidth shall be at least 500kHz.	Complied	Attachment D
CFR15.247(b)(1)	For frequency hopping systems operating in the 2400-2483.5 MHz or 5725-5850 MHz band and for all direct sequence systems: 1 watt.	Complied	Attachment E
CFR15.247(b)(4)	Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines. Sec 1.1307(b)(1) of this chapter.	N/A	Attachment H
CFR15.247(c)	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, base on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).	Complied	Attachment B & F, (no emissions fell within restricted bands)
CFR15.35(b)	On any frequency or frequencies above 1GHz, unless otherwise stated, the radiated limits shown are based on the use of measurement instrumentation employing an average detector function. When average radiated emission measurements are specified in the regulations, including emission measurements below 1000MHz, there is also a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit for the frequency being investigated. Unless otherwise specified, measurements above 1000MHz shall be performed using a minimum resolution bandwidth of 1MHz. Measurements of AC power line conducted emissions are performed using a CISPR quasi-peak detector, even for device for which average radiated emission measurements are specified	Complied	Attachment B & F
CFR15.247(d)	For direct sequence systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.	Complied	Attachment G
CFR15.247(e)	The processing gain of a direct sequence system shall be at least 10dB. The processing gain represents the improvement of to the received signal-to-noise ratio, after filtering to the information bandwidth, from the spreading / despreading function.	Complied	Attachment O
CFR15.203	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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the	Complied	Attachment C

Test Report #: 2WI-0102-2844-FCC

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Page 3 of 30

	intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may designed the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §15.211, §15.213, §15.217, §15.219, or §15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.																										
CFR15.209.a	Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table: <table><tr><th>Frequency (MHz)</th><th>Field strength (microvolts/meter)</th><th>Measurement distance (meters)</th></tr><tr><td>0.009-0.490.....</td><td>2400/F(kHz)</td><td>300</td></tr><tr><td>0.490-1.705.....</td><td>24000/F(kHz)</td><td>30</td></tr><tr><td>1.705-30.0.....</td><td>30</td><td>30</td></tr><tr><td>30-88.....</td><td>100**</td><td>3</td></tr><tr><td>88-216.....</td><td>150**</td><td>3</td></tr><tr><td>216-960.....</td><td>200**</td><td>3</td></tr><tr><td>Above 960.....</td><td>500</td><td>3</td></tr></table> **Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g. §§15.230 and 15.241.	Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)	0.009-0.490.....	2400/F(kHz)	300	0.490-1.705.....	24000/F(kHz)	30	1.705-30.0.....	30	30	30-88.....	100**	3	88-216.....	150**	3	216-960.....	200**	3	Above 960.....	500	3	Complied	Attachment I
Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)																									
0.009-0.490.....	2400/F(kHz)	300																									
0.490-1.705.....	24000/F(kHz)	30																									
1.705-30.0.....	30	30																									
30-88.....	100**	3																									
88-216.....	150**	3																									
216-960.....	200**	3																									
Above 960.....	500	3																									
CFR15.207(a)	For an intentional radiator which is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequency within the band 450kHz to 30MHz shall not exceed 250 microvolts.	Complied	Attachment J																								
CFR15.31(e)	For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.	Complied	Attachment E																								

Test Location

EMC Compliance Management Group is located at 670 National Ave., Mountain View, CA 94043, USA.

Accreditation Bodies

EMC Compliance Management Group is a fully accredited Test Laboratory.



In compliance with the site registration requirements of Section 2.948 of the FCC Rules to perform EMI measurements for the general public.



Accredited by the National Voluntary Laboratory Accreditation Program for the specific scope of accreditation under Lab Code # 200068-0.

EUT Exercise Software

The client supplied the Test software at TX Rate up to 11MB. The software was used to exercise during conducted and radiated testing. No other data was transmitted to the EUT during testing.

Equipment Modification

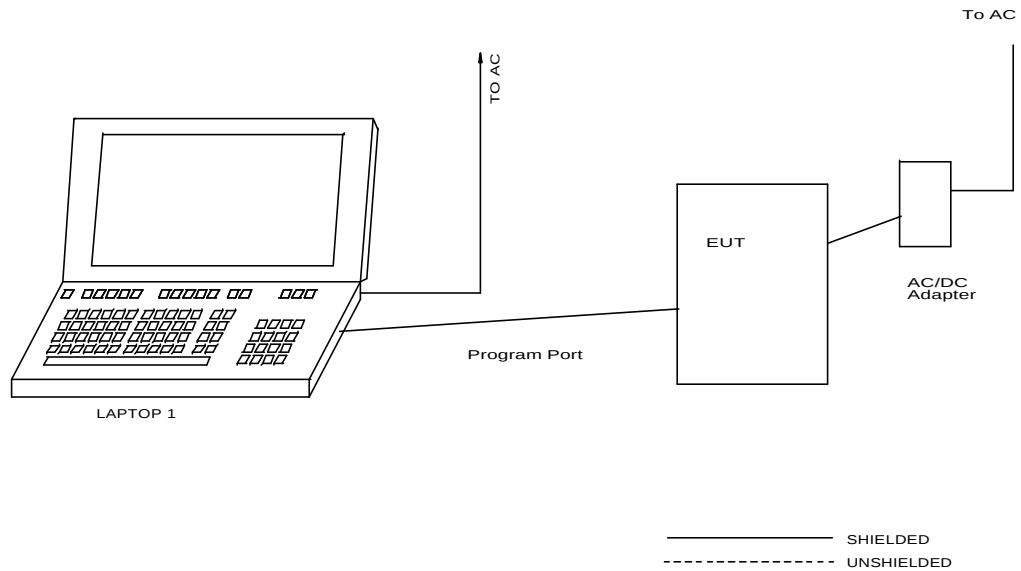
Any modifications installed previous to testing by Action Tec Electronic will be incorporated in each production model sold or leased in Europe.

There were no modifications installed by EMC Compliance Management Group.

Test System Details

EUT	
Model Number:	1500CW
Description:	DS Spread Spectrum Transceiver
Manufacturer:	2Wire, Inc.

Configuration of Tested System



ATTACHMENT A – PRODUCT INFORMATION

Frequency Range: 2.412GHz – 2.462GHz

Channels: 11, see table below

Channel Separation: 5MHz

Aggregate bit rate: up to 11mb/s

Transmitting Method: Direct Sequence Spread Spectrum

Transmitting Power: 10dBm

Antenna: Loop antennas (TX/RX and RX)

Interface: MiniPCI

Power Supply: AC to DC adapter

External Connections: 100BaseT, Home Link Port and USB Ports.

Channel ID	Frequency (MHz)	Channel ID	Frequency (MHz)
1	2412	7	2442
2	2417	8	2447
3	2422	9	2452
4	2427	10	2457
5	2432	11	2462
6	2437		

ATTACHMENT B – CFR15.205 RESTRICTED BAND

Special attention is made for the EUT's harmonic and spurious radiated emission in the restricted bands of operation. The EUT was tested from 150kHz and up to the 10th harmonic of the fundamental frequency of the transmitter using CISPR quasi peak detector below 1GHz. Above 1GHz, average measurements was used using RBW 1MHz-VBW 10Hz and linearly polarized horn antennas. In addition, peak measurements were taken to ensure that the peak levels are not more than 20dB above the average limit. All out of band emissions, other than those created by the spreading frequency, data sequence, and the carrier modulation must not exceed the limits show in Table 2 per 15.209.

Frequency (MHz)	Field strength (microvolts/meter)	Measure distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100**	3
88-216	150**	3
216-960	200**	3
Above 960	500	3

ATTACHMENT C – CFR15.203 ANTENNA REQUIREMENT

An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the applicant can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with this requirement.

The 2Wire, Inc. Model 1500CW complies with the requirement of 15.203. The antennas are permanent mounted loop antennas, no users accessible parts.



Conclusion: Pass, EUT meet 15.203 requirements. There are no provisions for connection to an external antenna or antenna replacement for users.

**ATTACHMENT D – CFR 15.247(a)(2) – DIRECT SEQUENCE BANDWIDTH
(CONDUCTED)**

6dB bandwidth for Direct Sequence systems must be at least 500 kHz

R. Bandwidth = 100 kHz
 Video Bandwidth = 100 kHz
 Frequency Span = 20 MHz
 Reference Level = 13 dBm
 Sweep Time = 20 mS
 RF Attenuation = 25 dB
 External Attenuator = 0 dB

		6 dB Bandwidth (MHz)			Plot #
CHANNEL	FREQUENCY (MHz)	TX Rate = 1MHz	TX Rate = 5.5MHz	TX Rate = 11MHz	
1	2412.25	8.66	8.66	8.66	Plot 1
6	2437.11	8.41	8.40	8.41	Plot 2
11	2462.03	8.60	8.60	8.60	Plot 3

Result Table 1 - 6dB Bandwidth Measurement Results

Test Result: Pass, EUT meets minimum requirement.

ATTACHMENT E – CFR15.247(b) MAXIMUM PEAK OUTPUT POWER MEASUREMENT & CFR15.31(e) VOLTAGE VARIATION (CONDUCTED)

The maximum peak output power of the transmitter shall not exceed 1 watt (+30 dBm).

R. Bandwidth = 100 kHz
 Video Bandwidth = 100 kHz
 Frequency Span = 100 MHz
 Reference Level = 13 dBm
 Sweep Time = 20 mS
 RF Attenuation = 25 dB
 External Attenuator = 0 dB

Peak Output Power = Power Meter Reading + Power Sensor Factor

TX Rate	CHANNEL	CENTER FREQUENCY (MHz)	POWER METER READING (dBm)	POWER SENSOR FACTOR (dB)	PEAK OUTPUT POWER (dBm)	Plot #
1 MB	1	2412.25	9.8	-0.2	9.6	Plot 4
	6	2437.11	9.1	-0.2	8.9	
	11	2462.03	9.1	-0.2	8.9	
5.5 MB	1	2412.25	9.8	-0.2	9.6	Plot 5
	6	2437.11	9.5	-0.2	9.3	
	11	2462.03	9.1	-0.2	8.9	
11 MB	1	2412.25	10.0	-0.2	9.8	Plot 6
	6	2437.11	9.9	-0.2	9.7	
	11	2462.03	9.3	-0.2	9.1	

Result Table 2. Output Power Measurements

TX Rate	CHANNEL	CENTER FREQUENCY (MHz)	POWER METER READING (dBm)	POWER SENSOR FACTOR (dB)	PEAK OUTPUT POWER (dBm)	AC SUPPLY TO HOST
11MB	1	2412.25	10.0	-0.2	9.8	102VAC
11MB	1	2412.25	10.0	-0.2	9.8	138VAC

Result Table 2a. CFR15.31(e) Voltage Variation Output Power Measurements

Test Result: Pass, EUT meets minimum requirement.

ATTACHMENT F – CFR15.247(c) RADIATED EMISSION MEASUREMENT 1GHz - 25GHz (FUNDAMENTAL AND HARMONICS)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

Operating Channel = 1

Operation Frequency = 2412 MHz

TX Rate = 1, 5.5 and 11MB

Test Distance = 3 Meters

100kHz Out-of-band plot = **Plot 7**, RBW/VBW = 100kHz, RF Att.= 20dB / Span = 200MHz

Freq. (MHz)	RAW Reading (dBuV)	Correction Factors (dB/m)	Polar. (V/H)	Detector (Peak/Ave)	Field Strength (dBuV/m)	Margin (dB)	Notes
2411.6	56.11	10.49	V	Peak	66.60	-	OF
2411.6	57.84	10.49	H	Peak	68.35	-	OF
4824.2	38.61	14.26	H	Ave	52.87	-1.13	RB
7238.1	25.63	22.5	H	Ave	48.13	-5.87	NRB
9645.7	<20.00	-	V	Peak	-	-	NRB

Result Table 3. Radiated Emission Measurements (Fundamental & Harmonics)

Legends:

OF = Operating Frequency.

NRB = Non Restricted Band, Limits should be 20 dB below the "OF".

RB = Frequency within the Restricted Bands according to CFR15.205, Limits shall comply with CFR15.209. In this case the limit is 500uV/m (54dBuV/m).

Notes:

1. An EMI receiver peak scan is made from 1 – 25 GHz frequency range using RBW/VBW = 100kHz.
2. Average measurements above 1 GHz are using RBW = 1 MHz, VBW = 10 Hz.
3. During this test EUT is manipulated through typical positions, polarity and length, the worst case emissions are reported above.

Test Report #: 2WI-0102-2844-FCC

Prepared for 2Wire, Inc.

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Page 13 of 30

ATTACHMENT F – CFR15.247 (c) RADIATED EMISSION MEASUREMENT 1GHz - 25GHz (FUNDAMENTAL AND HARMONICS) (CONT.)

Operating Channel = 6

Operation Frequency = 2437 MHz

TX Rate = 1, 5.5 and 11MB

Test Distance = 3 Meters

Freq. (MHz)	RAW Reading (dBuV)	Correction Factors (dB/m)	Polar. (V/H)	Detector (Peak/Ave)	Field Strength (dBuV/m)	Margin (dB)	Notes
2437.6	51.39	10.56	H	Peak	61.95	-	OF
2437.6	48.57	10.56	V	Peak	59.13	-	OF
4875.3	38.33	14.3	H	Ave	52.63	-1.37	RB
7312.9	27.32	22.50	H	Ave	49.82	-4.18	RB
9650.6	<20.00	-	H	Peak	-	-	NRB
1208.83	<20.00	-	H	Peak	-	-	NRB

Result Table 4. Radiated Emission Measurements (Fundamental & Harmonics)

Legends:

OF = Operating Frequency.

NRB = Non Restricted Band, Limits should be 20 dB below the "OF".

RB = Frequency within the Restricted Bands according to CFR15.205, Limits shall comply with CFR15.209. In this case the limit is 500uV/m (54dBuV/m).

Notes:

1. An EMI receiver peak scan is made from 1 – 25 GHz frequency range using RBW/VBW = 100kHz.
2. Average measurements above 1 GHz are using RBW= 1 MHz, VBW = 10 Hz.
3. During this test EUT is manipulated through typical positions, polarity and length, the worst case emissions are reported above.

ATTACHMENT F – CFR15.247(c) RADIATED EMISSION MEASUREMENT 1GHz - 25GHz (FUNDAMENTAL AND HARMONICS) (CONT.)

Operating Channel = 11

Operation Frequency = 2412.25 MHz

TX Rate = 1, 5.5 and 11MB

Test Distance = 3 Meters

Out-of-band plot = **Plot 8**, RBW/VBW = 100kHz, RF Att.= 20dB / Span = 200MHz

Freq. (MHz)	RAW Reading (dBuV)	Correction Factors (dB/m)	Polar. (V/H)	Detector (Peak/Ave)	Field Strength (dBuV/m)	Margin (dB)	Notes
2461.7	53.75	10.63	V	Peak	64.38	-	OF
2461.7	54.26	10.63	H	Peak	64.89	-	OF
4923.4	36.89	14.35	H	Ave	51.24	-2.76	RB
7385.7	26.82	22.50	H	Ave	49.32	-4.68	RB
9747.7	< 30.00	-	H	Peak	-	-	NRB
12309.7	< 30.00	-	H	Peak	-	-	NRB

Result Table 5. Radiated Emission Measurements (Fundamental & Harmonics)

Legends:

OF = Operating Frequency.

NRB = Non Restricted Band, Limits should be 20 dB below the “OF”.

RB = Frequency within the Restricted Bands according to CFR15.205, Limits shall comply with CFR15.209. In this case the limit is 500uV/m (54dBuV/m).

Notes:

1. An EMI receiver peak scan is made from 1 – 25 GHz frequency range using RBW/VBW = 100kHz.
2. Average measurements above 1 GHz are using RBW = 1 MHz, VBW = 10 Hz.
3. During this test EUT is manipulated through typical positions, polarity and length, the worst case emissions are reported above.

Test Result: Pass, EUT meet minimum requirements.

Test Report #: 2WI-0102-2844-FCC

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Page 15 of 30

ATTACHMENT G - CFR 15.247(d) POWER DENSITY (CONDUCTED)

The transmitted power density averaged over any 1 second interval shall not be 8dBm in any 3kHz bandwidth within these bands.

R. Bandwidth = 3 kHz
 Video Bandwidth = 3 kHz
 Frequency Span = 3.0 MHz
 Reference Level = 8 dBm
 Sweep Time = 1000 S (100 S)
 RF Attenuation = 20 dB
 External Attenuator = 0 dB

TX Rate	CHANNEL	CENTER FREQUENCY (MHz)	POWER DENSITY (dBm)	Plot
1 MB	1	2412.69	-13.1	Plot 9
	6	2437.68	-13.2	Plot 10
	11	2462.68	-13.4	Plot 11
5.5 MB	1	2412.68	-13.3	Plot 12
	6	2437.68	-13.2	Plot 13
	11	2462.68	-13.4	Plot 14
11 MB	1	2412.68	-13.1	Plot 15
	6	2437.68	-13.1	Plot 16
	11	2462.03	-13.3	Plot 17

Result Table 6. Power Density Conducted Measurements

Test Result: Pass, EUT meets minimum requirement.

ATTACHMENT H – CFR15.209(a) RADIATED EMISSION MEASUREMENT 212-R-01)

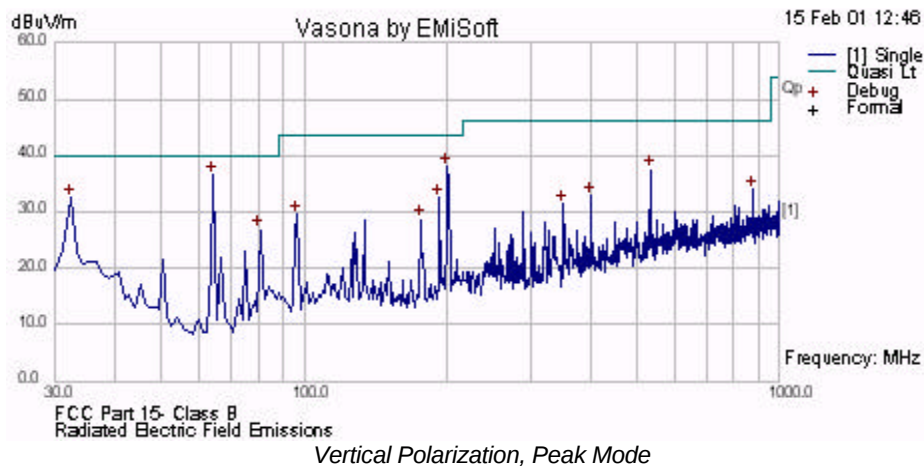
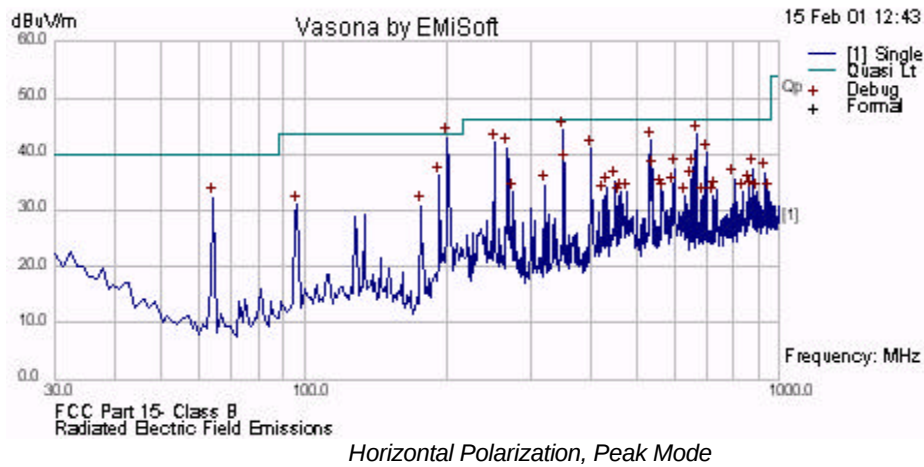
The emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Operating Frequency = 2412, 2437 and 2462MHz

Res. Bandwidth = 120 kHz

Sweep Time = 30 mS



Test Report #: 2WI-0102-2844-FCC

Prepared for 2Wire, Inc.

Prepared by EMC Compliance Management Group

Page 17 of 30

Frequency [MHz]	Antenna Polarization [V/H]	Corrected Reading [dBμV/m]	Delta, QP [dB]	3 Meters Limits [dBμV/m]	Correction Factors [dB/m]
Set-up/Configuration: EN55022:1998, CISPR 16-1:1993					
200.289	V	41.5	-2.00	43.5	-7.08
668.044	V	43.55	-2.45	46.0	2.78
351.178	V	43.31	-2.69	46.0	-2.35
64.520	H	36.57	-3.43	40.0	-11.4
533.340	V	42.36	-3.64	46.0	3.14
250.032	V	42.11	-3.89	46.0	-4.52
1. All Emissions were investigated from 30 to 1000 MHz the 6 worst emissions are reported. 2. Plots from chamber are included, plot 18 (vertical polarization) & 19 (horizontal polarization). 3. For handheld devices, the EUT is rotated through three orthogonal axes to obtain the maximum emissions.					

Result Table 8. CFR15.209 (a) Radiated Emission Test Results



ATTACHMENT I - CFR15.207 (a) CONDUCTED EMISSION TEST RESULTS

For an intentional radiator which is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is back onto the AC power line on frequency within the band 450 kHz to 30 MHz shall not exceed 250 microvolts.

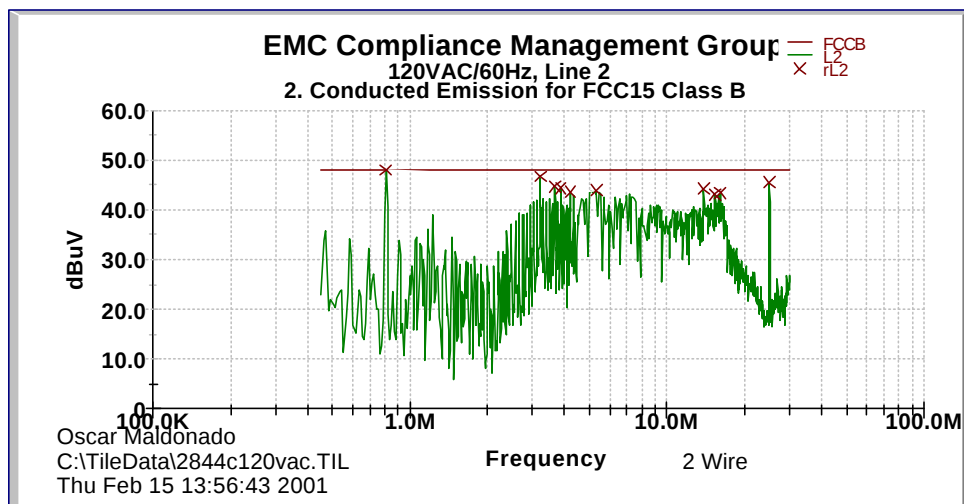
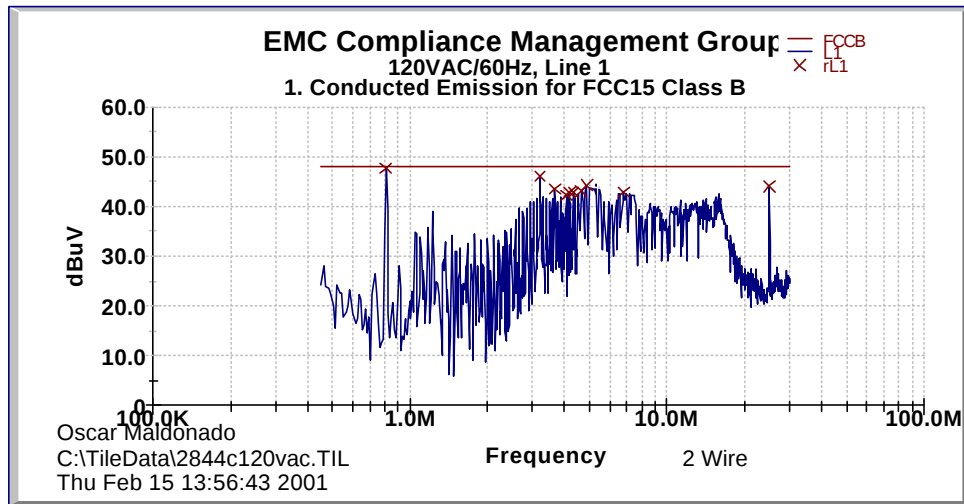
Operating Frequency = 2412, 2437 and 2462MHz

AC / DC Adapter =

Res. Bandwidth = 9 kHz

Sweep Time = 30 mS

Line	Frequency [MHz]	Corrected QP Reading [dB(μV)]	Delta QP [dB]
L1	4.632	42.54	-5.46
L1	4.184	38.33	-9.67
L1	3.207	36.58	-11.42
L2	3.211	36.22	-11.78
L2	16.100	35.31	-12.69
L2	13.926	34.60	-13.40
Note: All reading are using a bandwidth of 9 kHz, with a 30 ms sweep time. A video filter was not used.			



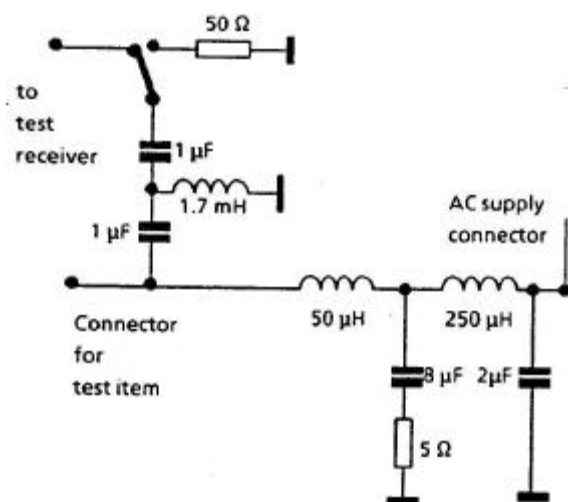


ATTACHMENT J - TEST EQUIPMENT

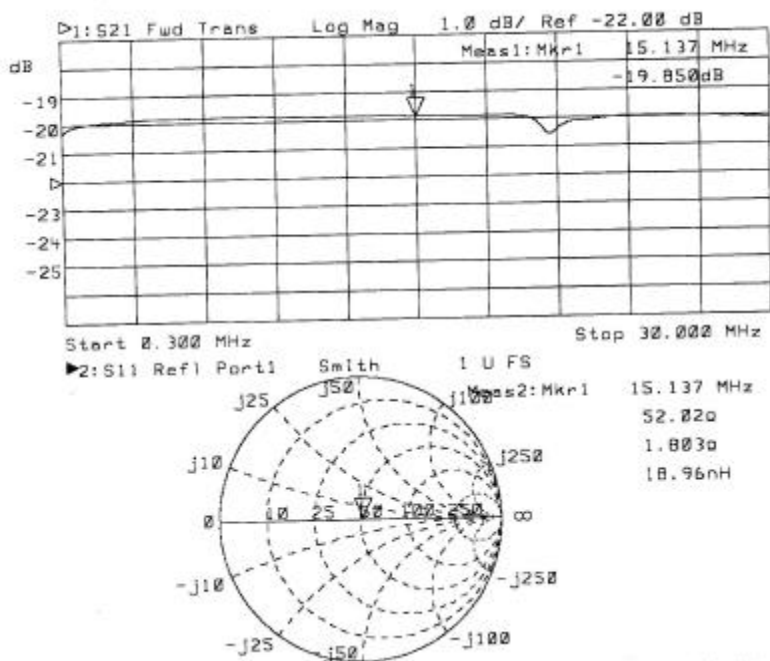
Test Equipment	Manufacturer/ Model	Serial No.	Last Cal.	Cal. Due Date
EMI Receiver	R&S / ESMI-RF	849937/006	03/01/00	03/01/01
EMI Receiver	R&S / ESAI-D	825035/005	03/01/00	03/01/01
Bilog Antenna	CHASE CBL6112A	2274	11/16/00	11/16/01
Horn Antenna	EMCO / 3115 w/ Miteq Amp	001	10/28/00	10/28/01
Horn Antenna	EMCO / 3116 w/ Miteq Amp	002	10/28/00	10/28/01
LISN	R & S / ESH3-Z5	844249/018	11/15/00	11/15/01
Signal Generator	HP / 83711B	3324A03288	08/29/00	08/29/01
RF Power Meter	Boonton / 42AD	09	03/08/00	03/08/01
RF Power Sensor	Boonton / 41-4B	157	03/08/00	03/08/01
RF Power Sensor	Boonton / 42004A	11544	03/08/00	03/08/01
Scope	Tektronix / TDS 360	B0120165	05/12/00	05/12/01
Attenuators	HP / 8491C	00423	VBU	VBU
Test Chamber	HumiTenn	A032331	VBU	VBU
Temp. Controller	Partlow Corp / MRC7000	94G86270	08/21/00	08/21/01
Note: All testing were performed using internationally recognized standards. All test instruments were calibrated and traceable to the National Institute of Standards and Technology (NIST).				

ATTACHMENT K - LISN SPECIFICATIONS

LISN use in this test is manufactured by R & S, model ESH3-Z5. This LISN complies with the FCC and CISPR requirements. The test frequency range is from 9kHz to 30MHz and impedance is 50 Ohms.

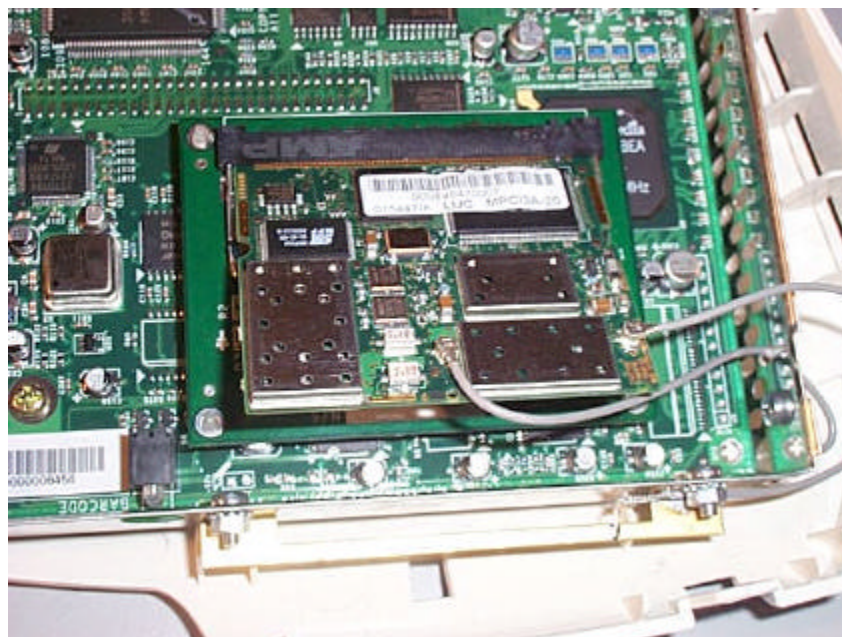
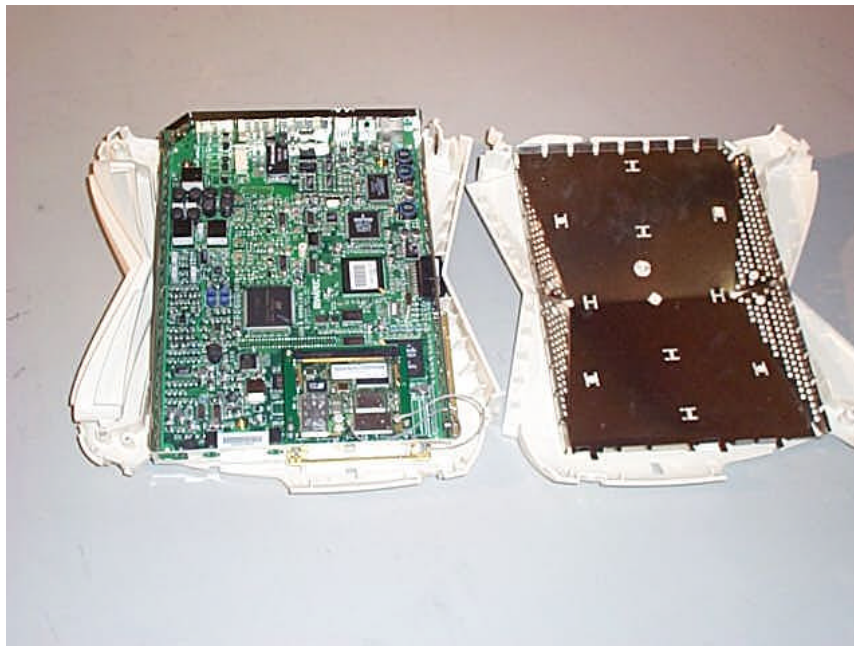


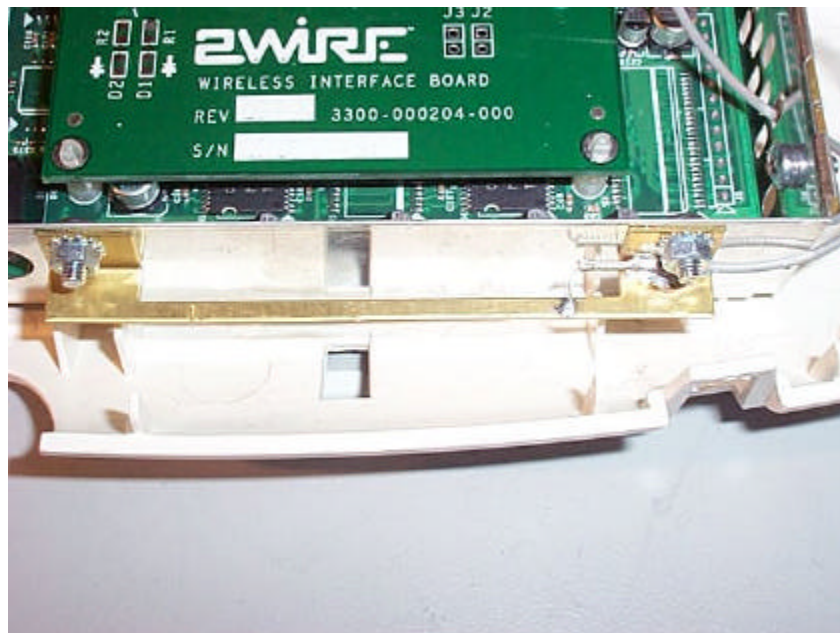
LISN Schematics (only 1 line shown)



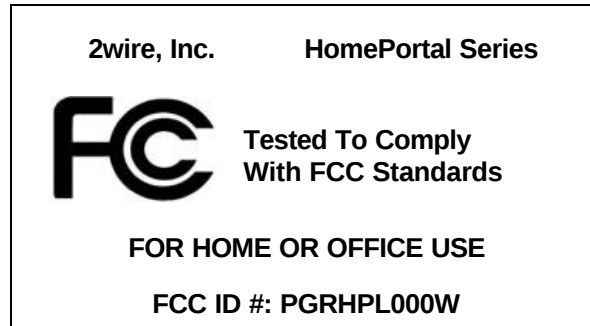
ATTACHMENT L – SAMPLE PHOTOS







ATTACHMENT M – PROPOSED FCC ID LABEL AND LOCATION



Proposed FCC ID Label



**Proposed FCC ID Location
FCC ID #: PGRHPL000W**

ATTACHMENT N – PROCESSING GAIN

The processing gain of a direct sequence system shall be at least 10dB. The processing gain represents the improvement of to the received signal-to-noise ratio, after filtering to the information bandwidth, from the spreading / despreading function.

For this test the discrete stepped CW jamming method was chosen. Therefore a receiver-input signal is applied to the product under test, in the presence of a Continuous Wave (CW) interference source, also referred to as CW jamming. The test takes place at the product Functional Specification (by Lucent Technologies) specified conditions for BER rate measurements, specifying a BER equal or better than 10^{-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 Jamming to Signal ratio it is determined that for a BER of 10^{-8} the SNR (S/N)₀ 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.[1]. 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 jamming frequencies can be ignored, being those that result in received data errors/missing frames (20% of 14 MHz $\times$ (1 MHz/50 KHz) + 1 = ($20\% \times 281$) + 1 = 57).

Test Result: **The tested product complies to the required Processing Gain of 10 dB for a data rate of 1, 2, 5.5 and 11 Mbit/s**

ATTACHMENT O – PLOTS OF TESTS