ITS Intertek Testing Services
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FCC Part 15.247 Test Report
for
Acer NeWeb Corporation
on the
Wireless LAN Access Point
Model: WarpLink 2412
FCC ID: NKRNWARPLINKA

Test Report #: 20244302
Date of Report: September 15, 2000

Job #: J20024430
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NVLAP

Lab Code: 200201-01

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Table of Contents

1.0 Summary of Tests

MODEL: WarpLink 2412
FCC ID:NKRNWARPLINKA

TEST	REFERENCE	RESULTS
Max. Output power	15.247(b)	Passed
6 dB Bandwidth	15.247(a)(2)	Passed
Max. Power Density	15.247(d)	Passed
Out of Band Antenna Conducted Emission	15.247(c)	Passed
Out of Band Radiated Emission	15.247(c)	Not Applicable*
Radiated Emission in Restricted Bands	15.35(b)(c)	Passed
AC Conducted Emission	15.207	Passed
Radiated Emission from Digital Part	15.109	Passed
Radiated Emission from Receiver L.O.	15.109	Not Applicable**
Processing Gain Measurements	15.247(e)	Provided by applicant
Antenna Requirement	15.203	Passed

*Not Applicable due to Out of Band conducted emissions results.
**Not Applicable because the EUT operates above 960 MHz.

Test Engineer: _____ Date: 02/16/01
Bruce Gordon for
Test Engineer

EMC Site Manager: David Chernomordik Date: 02/16/01
David Chernomordik, Ph.D.
EMC Site Manager

2.0 General Description

2.1 Product Description

The EUT is a 2.4 GHz transceiver used for wireless data communications.

A production version of the sample was received on September 11, 2000 in good condition.

Overview of Wireless LAN Access Point

Applicant	Acer NeWeb Corporation
Trade Name & Model No.	Acer NeWeb Corporation / WarpLink 2412
FCC Identifier	NKRNWARPLINKA
Use of Product	Wireless LAN
Manufacturer & Model of Spread Spectrum Module	Intersil, HWB3163
Type of Transmission	Direct Sequence Spread Spectrum
Rated RF Output	14.8 dBm
Frequency Range	2412 to 2462 MHz
Number of Channel(s)	11
Antenna(s) & Gain,	Internal Acer NeWeb proprietary, G = 2.13dB
Processing Gain Measurements	[X] Will be provided to ITS for submission with the application [ ] Will be provided directly to the FCC reviewing engineer by the client or manufacturer of the spread spectrum module
Antenna Requirement	[X] The EUT uses a permanently connected antenna. [ ] The antenna is affixed to the EUT using a unique connector which allows for replacement of a broken antenna, but DOES NOT use a standard antenna jack or electrical connector. [ ] The EUT requires professional installation (attach supporting documentation if using this option).
Manufacturer name & address	Acer NeWeb Corporation 399 W. Trimble Rd. San Jose CA 95131

2.2 Related Submittal(s) Grants

None

2.3 Test Methodology

Both AC mains line-conducted and radiated emissions measurements were performed according to the procedures in ANSI C63.4 (1992). Radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the **"Data Sheet"** of this Application. All other measurements were made in accordance with the procedures in part 2 of CFR 47.

2.4 Test Facility

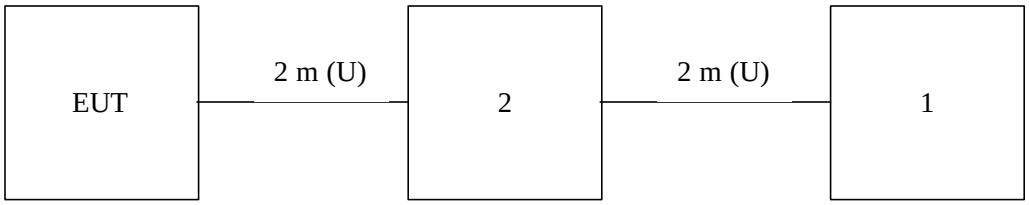
The open area test site and conducted measurement facility used to collect the radiated data is site 2. This test facility and site measurement data have been fully placed on file with the FCC and are NVLAP accredited.

3.0 System Test Configuration

3.1 Support Equipment and description

Item #	Description	Model No.	Serial No.
1	Acer laptop computer	340	9140F0144C01901 19CM
2	Accton network hub	Venus	716AG0178EH204 4S (USA)345138-000

3.2 Block Diagram of Test Setup



m: Length in meters

***** = EUT ****** = No ferrites on video cable	**S** = Shielded; **U** = Unshielded	**F** = With Ferrite

3.3 Justification

For emission testing, the equipment under test (EUT) was configured for testing in a typical fashion (as a customer would normally use it). During testing, all cables were manipulated to produce worst case emissions.

For radiated emission measurements, the EUT is attached to a cardboard box (if necessary) and placed on the wooden turntable. If the EUT attaches to peripherals, they are connected and operational (as typical as possible). The EUT is wired to transmit full power with modulation.

The signal is maximized through rotation and placement in the three orthogonal axes. The antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters.

Radiated emissions are taken at three meters unless the signal level is too low for measurement at that distance. If necessary, a pre-amplifier is used and/or the test is conducted at a closer distance. All readings are extrapolated back to the equivalent three meter reading using inverse scaling with distance.

3.4 Software Exercise Program

The EUT exercise program used during radiated and conducted testing was designed to exercise the various system components in a manner similar to a typical use. For emissions testing, the units were setup to transmit continuously to simplify the measurement methodology. Care was taken to ensure proper power supply voltages during testing.

3.5 Mode of Operation During Test

The EUT was set to continuously transmit and / or receive.

3.6 Modifications Required for Compliance

The following modifications were installed during compliance testing in order to bring the product into compliance (Please note that this list does not include changes made specifically by Acer NeWeb Corporation prior to compliance testing):

No modifications were installed by Intertek Testing Services.

3.7 Additions, deviations and exclusions from standards

No additions, exclusions, or deviations to the standard were made.

4.0 Measurement Results

4.1 Maximum Conducted Output Power at Antenna Terminals, FCC Rules 15.247(b):

Requirements

For antennas with gains of 6 dBi or less , maximum allowed transmitter output is 1 watt (+30 dBm).
For antennas with gains greater than 6 dBi, transmitter output level must be decreased the amount in excess of 6dBi.

Procedure

[X] The antenna port of the EUT was connected to the input of a spectrum analyzer. The analyzer was set for Resolution Bandwidth 10 MHz which is 5 times wider than the bandwidth of the signal (2.1 MHz, see section 4.2). The peak power was read directly from the spectrum analizer in dBm. External attenuation and cable loss were compensated for using the OFFSET function of the analyzer.

Test Result

Frequency (MHz)	Output in dBm	Output in mWatt
2412	12.3	17.0
2437	12.5	17.8
2462	12.7	18.6

Cable loss: 0 dB External Attenuation: 0 dB

Cable loss, external attenuation: [X] included in OFFSET function
[ ]added to SA raw reading

Please refer to the attached plots for details:

Plot 4.1.a: Low Channel Output Power
Plot 4.1.b: Middle Channel Output Power
Plot 4.1.c: High Channel Output Power

4.2 6 dB RF Bandwidth, FCC Rule 15.247(a)(2):

Requirements

The minimum 6 dB bandwidth shall be at least 500 kHz

Procedure

The antenna port of the EUT was connected to the input of a spectrum analyzer. Analyzer RES BW was set to 100 kHz. For each RF output channel investigated, the spectrum analyzer center frequency was set to the channel carrier. A PEAK output reading was taken, a DISPLAY line was drawn 6 dB lower than PEAK level. The 6 dB bandwidth was determined from where the channel output spectrum intersected the display line.

Test Result

Frequency (MHz)	Min. 6 dB Bandwidth (MHz)
2437	2.1

Refer to the following plots for 6 dB RF bandwidth:

Plot 4.2.a: Low Channel 6 dB RF Bandwidth
Plot 4.2.b: Middle Channel 6 dB RF Bandwidth
Plot 4.2.c: High Channel 6 dB RF Bandwidth

Note: The bandwidth is 2.1MHz for all data rates: 1, 2, 5.5, 11Mbps. Since the chip rate is the same for all data rate operations. This chip rate is combined with coding, I_Q_modulation, and spreading scheme.

4.3 Power Density Reading, FCC Rule 15.247(d):

Requirements

The peak power spectral density shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

Procedure

The spectrum analyzer RES BW was set to 3 kHz. The START and STOP frequencies were set to the band edges of the maximum output passband. If there is no clear maximum amplitude in any given portion of the band, it may be necessary to make measurements at a number of bands defined by several START and STOP frequency pairs. Total SWEEP TIME is calculated as follows:

SWEEP TIME (SEC) = [Fstop(kHz) - Fstart(kHz)] / 3 kHz

Antenna output of the EUT was coupled directly to spectrum analyzer; if an external attenuator and/or cable was used, these losses are compensated for with the analyzer OFFSET function.

Test Result

Frequency (MHz)	Power Density (dBm)
2461.316	-11.8

Frequency Span = 600 kHz

Sweep Time = Frequency Span/3 kHz
= 200 seconds

Refer to the following plots for power density data:

Plot 4.3.a.1 – 4.3.a.2: Low Channel Power Density
Plot 4.3.b.1 – 4.3.b.2: Middle Channel Power Density
Plot 4.3.c.1 – 4.3.c.2: High Channel Power Density

4.4 Out-of-Band Conducted Emissions, FCC Rule 15.247(c):

Requirements

In any 100 kHz bandwidth outside the EUT passband, the RF power shall be at least 20 dB below that of the maximum in-band 100 kHz emission.

Refer to the following plots for out of band conducted emissions data:

Plot 4.4.a.1 – 4.4.a.8: Low Channel Emissions
Plot 4.4.b.1 – 4.4.b.6: Middle Channel Emissions
Plot 4.4.c.1– 4.4.c.5: High Channel Emissions

4.5 Out of Band Radiated Emissions (for emissions in report section 4.4 that are less than 26 dB below carrier), FCC Rule 15.247(c):

For out of band emissions that are close to or that exceed the 20 dB attenuation requirement described in the specification, radiated measurements were performed at a 3 m separation distance to determine whether these emissions complied with the general radiated emission requirement.

[X] Not required
[ ] See attached data sheet

4.6 Transmitter Radiated Emissions in Restricted Bands, FCC Rule 15.35(b), (c):

Radiated emission measurements were performed from 30 MHz to the 10th harmonic of the EUT transmit frequency. The spectrum analyzers resolution bandwidth was 100 KHz for measurements below 1 GHz and 1 MHz for measurements above 1 GHz.

Data is included of the worst case configuration (the configuration which resulted in the highest emission levels). A sample calculation, configuration photographs and data tables of the emissions are included. All measurements were performed with peak detection unless otherwise specified.

The data on the following pages list the significant emission frequencies, the limit and the margin of compliance.

Additional tests were performed to show compliance with the requirement at the band-edge frequency 2483.5 MHz and up to 2500 MHz and at 2390.0 MHz and down to 2310 MHz. The "delta" method was used.

The field strength at 2412 MHz and 2462 MHz was calculated as follows:

$$E_O = \frac{\sqrt{30(EIRP)}}{D}$$

Where:

E_O = Volts/meter
EIRP = Peak or Average in Watts
D = Distance in meters

OR

$E_O = EIRP_{dBm} + 95.3$
E_O = dBuV/m

Average output power at the antenna terminal at 2412 MHz is 0.99 dBm (includes antenna gain 2.5 dB)
Average output power at the antenna terminal at 2462 MHz is 1.46 dBm (includes antenna gain 2.5 dB)

The field strength at the Bandedge frequencies was calculated as $E_F = E_o - \Delta$.

Where:

E_F = Field Strength of Bandedge Frequency
E_O = Field Strength of Fundamental Frequency
Δ = Delta between Field Strength of Fundamental Frequency and Field Strength of Bandedge Frequency (see plots 4.4.a.4 and 4.4.a.6 for Low Channel and plots 4.4.c.4 and 4.4.c.5 for High Channel).

Average Field strength at Low Channel 2412.0 MHz = 0.99 + 95.3 = 96.3 dBuV/m
Field strength at Bandedge 2390.0 MHz = 96.3 – 49.5 = 46.8 dBuV/m

Field strength at High Channel 2462.0 MHz = 1.46 + 95.3 = 96.8 dBuV/m
Field strength at Bandedge 2483.5 MHz = 96.8 – 52.6 = 44.2 dBuV/m

4.7 AC Line Conducted Emission, FCC Rule 15.207:

[ ] Not required; battery operation only

[X] Test data attached

4.8 Radiated Emissions from Digital Section of Transceiver (Transmitter), FCC Ref: 15.109

[ ] Not required - No digital part
[X] Test results are attached
[ ] Included in the separate DOC report.

4.9 Radiated Emissions from Receiver Section of Transceiver (L.O. Radiation), FCC Ref: 15.109, 15.111

[X] Not required - EUT operation above 960 MHz only

4.10 Processing Gain Measurements, FCC Rule 15.247(e)

The processing gain shall be determined from the ratio in dB of the signal to noise ratio with the system spreading code turned OFF, to the signal to noise ratio with the system spreading code turned ON, as measured at the demodulated output of the receiver. The processing gain shall be at least 10 dB for a direct sequence spread spectrum system.

	Refer to attached test procedure and data sheets.
X	Refer to circuit analysis and processing gain calculations provided by manufacturer.

4.11 Transmitter Duty Cycle Calculation and Measurements, FCC Rule 15.35(b), (c)

The EUT antenna output port was connected to the input of the spectrum analyzer. The analyzer center frequency was set to EUT RF channel carrier. The SWEEP function on the analyzer was set to ZERO SPAN. The transmitter ON time was determined from the resultant time-amplitude display:

Duty cycle = Maximum ON time in 100 msec/100

Duty cycle correction, dB = 20 * log(DC)

	See attached spectrum analyzer chart(s) for transmitter timing
	See transmitter timing diagram provided by manufacturer
X	Not applicable. EUT correction factor for the duty cycle was not necessary to reach compliance.

5.0 List of Test Equipment

Emissions Test Equipment List

Equipment	Manufacturer	Model/Type	Serial #	Cal Int	Cal Due	USED
Biconical Antenna, #9	EMCO	3104	3789	12	4/10/01	X
Log Periodic Antenna, #7	EMCO	LPA-25	1079	12	4/10/01	X
Horn Antenna #8	EMCO	3115	9107-3712	12	1/5/01	X
Waveguide Antenna	EMCO	3160-9	001	#	#	X
Pre-Amplifier, #5	Hewlett Packard	8447D	1937A03096	12	4/28/01	X
Pre-Amplifier	CDI	P1000	N/A	12	10/4/00	X
Spectrum Analyzer w/85650 QP Adaptor	Hewlett Packard	8566B	2416A00317 2043A00251	6	2/03/01	X
Spectrum Analyzer	Tektronix	2784	B3020108	12	8/4/01	X
LISN	Solar Electronics	8028-50-TS-24-BNC	980235	12	2/9/01	X
LISN	Solar Electronics	8025-50-TS-24-BNC	912432	12	3/31/01	X
Filter Network	Solar	8907-250-TS-24-BP	806751	12	12/10/00	X

No Calibration Required

6.0 Document History

Revision/Job Number	Date	Change
1.0 / J20024430	September 26, 2000	Original document