

Curtis-Straus

August 27, 1999

Federal Communications Commission

Re: FCC Part 15 Application for a class II permissive change for Zoom Telephonics
(FCC ID: BDNWLANPCCARD1)

Dear Sir or Madam:

Enclosed please find the above-referenced application, along with a check in the amount of \$45.00 to cover the change fee. Please note that we are simultaneously requesting the following services:

Class II permissive change \$45.00

Please feel free to contact me with any questions.

Best regards,



Paul Hare
EMC Manager

Curtis-Straus LLC
527 Great Road
Littleton, Massachusetts 01460
Tel: (978) 486-8880 Fax: (978) 486-8828
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MEASUREMENT/TECHNICAL REPORT

**Company - Model: Zoom Telephonics, Inc.
0230 Board
FCC ID: BDNWLANPCCARD1
August 26, 1999**

Description: This is a report to support a request for a class II permissive change of equipment authorization.

Equipment Type: Spread Spectrum Transmitter (DSS)

Report prepared for: Zoom Telephonics, Inc.
207 South St
Boston, MA, 02111
Phone: (617) 423-1072
Fax: (617) 542-8276

Report prepared by: Michael Buchholz
Curtis-Straus LLC
527 Great Road
Littleton, MA 01460 USA
Phone: 978-486-8880
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26-Aug-99

Letter of Agency

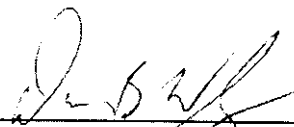
ZOOM

Letter of Agency

I appoint **Curtis-Straus LLC** to act as agent in the preparation of this application for registration of the equipment listed below, under Part 15 C of the Rules and Regulations of the Federal Communications Commission. I further certify that no party (as defined in 1.2002 of CFR 47, 1995) to this application including myself, is subject to denial of Federal benefits, pursuant to Section 5301 of the Anti-Drug abuse Act of 1998, 21 U.S.C., 853A.

Model: 0230 WIRELESS LAN WITH ANTENNAS

Dated: 10 day of August, 1999



Signature

Dana Whitney, VP, Engineering Dept.

Name/Title

ZOOM Telephonics, Inc.

Company

(617) 423-1072

Telephone

Zoom Telephonics, Inc.
207 South Street, Boston, MA 02111
Tel 617 423-1072
Fax 617 423-3923
Web Site: www.zoomtel.com

Introduction

This report is an application for a class II permissive change to Zoom Telephonics Wireless LAN PC Card FCC ID: BDNWLANPCCARD1. Zoom Telephonics has contracted with Curtis-Straus to test the Wireless LAN PC Card with three new external antennas in order to assess the compliance of the full system. Zoom will be marketing this transmitter with the three new antennas. The model numbers covered by this report include:

0230 Board to be sold under the following additional model numbers
4002 Zoom/Wireless LAN PC Card with Antenna
4007 Zoom/Wireless LAN PC Card and Adapter Card with Antenna

The 4002 and 4007 are available with three different antennas (dipole, patch and patch array) which carry the following zoom model numbers:

ZoomAir 2.2dBi Dipole Antenna Model 98110-02
ZoomAir 4.0dBi Omni-Directional Patch Antenna Model 98110-04
ZoomAir 13.0dBi Directional Patch Array Antenna Model 98110-13

This report is designed to demonstrate the continued compliance of this device with the requirements outlined in Part 15 of CFR 47 after the modifications necessary to facilitate the addition of the three external antenna types. Only the exhibits affected by the product modifications are included in this report. The current revision date, October 1, 1998, of each Part has been used for technical requirements.

EXHIBIT 1:

1.0 Statement of Conformity

The Zoom Telephonics 0230 Board has been found to conform with the following parts of the 47 CFR after the addition of the three new antennas:

Part 2	Part 15	Comments
2.925	15.19	There are no labeling changes to the product.
	15.21	Information to the user is shown in the instruction manual exhibit.
	15.203	The supplied antennas have proprietary reverse polarity SMA connectors.
	15.205 15.209	The fundamental is not in a Restricted band and the spurious and harmonic emissions in the Restricted bands comply with the general emission limits of 15.209.
	15.247(a)(2)	The unit has a 6dB bandwidth greater than 500kHz as shown in Exhibit 3.
	15.247(b)	The maximum peak output power of the unit does not exceed the limits given in 15.247 as shown in Exhibit 3.
	15.247(b)(4)	This unit does not expose the public to radio frequency levels in excess of the Commission's guidelines when installed properly.
	15.247(c)	All harmonics outside of the band in which the intentional radiator operates are at least 20dB below the highest level of in band desired power. Emissions falling in restricted bands also comply with the radiated emissions limits specified in 15.209(a).
	15.247(d)	The peak power spectral density is less than 8dBm in any 3kHz band.

EXHIBIT 2

2.0 General Description

2.1 Product Description

EUT Configuration				
Work Order: E990762 Company: Zoom Contact: Fred Grund Person(s) Present: Fred Grund				
EUT	MN	SN		
Wireless LAN Card	0230	Prototype		
Dipole Antenna	2435	1		
Patch Antenna	MP24013FC	1		
Patch Array Antenna	ANP-C-116	1		
EUT Description: Wireless LAN EUT Max Clock Frequency: 2.48GHz				
Support Equipment:	MN	SN	FCC ID	
Dell Monitor	828FI	22794E07PG19	not labeled	
Panasonic Printer	KX-PI080i	not labeled	ACJ5Z6KX-P1080I	
Dell Keyboard	AT101	K9601-015820	GYUM95SK	
Microsoft Mouse	90516	00017482	C3KKMP1	
HP Vectra VL	5/90 Series 3	US54359823	K4UVECTRAVL5	
Host/ EUT Cables:	Qty	Shielded?	Length	Ferrites
Antenna SMA (patch antennas)	1	yes	10ft	none
AC Power	1	no	2m	none
Printer DB15	1	yes	6ft	none
Serial DB25	1	yes	10ft	none
Keyboard/Mouse (MiniDin)	2	yes	4ft	none
VGA	1	yes	4ft	2 - one each end
Unpopulated EUT Ports:	Qty	Reason		
none				
Software / Operating Mode Description:				
EUT is transmitting continuously on each of three channels (1,6,11). Each of three antenna types were tested				

2.3 Test Methodology

Radiated emission testing was performed according to the procedures in ANSI C63.4 (1992). Radiated testing was performed at an antenna to EUT distance of 3 meters below 1 GHz, and at a distance of 3 or 1 meter(s) above 1 GHz. The actual test distance used is noted in the test data sheets. The device's performance was investigated to 10 times the fundamental frequency.

All other performance tests were made in accordance with the procedures outlined in Part 15 of CFR 47. The applicable sections provided under Part 15 are provided in the measurement section of this report, Exhibit 3.

2.4 Test Facility

The open area test site used to collect the radiated data is located at 527 Great Road, Littleton, MA 01460. Site "T" was used. This test facility has been fully described in a report submitted to your office, and a letter from your office dated August 8, 1997 verified receipt of these reports and confirmed compliance of these sites. Please reference your file # 31040/SIT 1300F2 should you have any questions regarding the test site construction.

2.5 Test Equipment Used

SPECTRUM ANALYZERS

x	Analyzer	Model No.	Company	Serial No.	Calibration Due
	RED 9kHz-1.8GHz	8591E	HP	3441A03559	06-MAY-2000
	WHITE 9kHz-22GHz	8593E	HP	3547U01252	05-JAN-2000
	BLUE 9kHz-1.8GHz	8591E	HP	3223A00227	02-FEB-2000
	YELLOW 9kHz-2.9GHz	8594E	HP	3523A01958	19-MAR-2000
x	GREEN 9kHz-26.5GHz	8593E	HP	3829A03618	31-AUG-1999
	BLACK 9kHz-12.8GHz	8596E	HP	3710A00944	27-MAY-2000
	YELLOW-BLACK 20Hz-40.0MHz	3585A	HP	A183438	11-NOV-1999

OPEN AREA TEST SITES (OATS)

x	Site	FCC Code	IC Code	VCCI Code	Calibration Due
	"F" Florida	1300F2	IC 2762-F	R-468/ C-480	18-OCT-1999
x	"T" Texas	1300F2	IC 2762-T	R-905/ C-480	13-DEC-1999
	"A" Alaska	1300F2	IC 2762-A	R-903/ C-480	08-MAY-2000
	"M" Maine	93448	IC 2762-M	R-904/ C-480	03-APR-2000
	"J" Jamaica	n/a	n/a	n/a	21-MAY-2000

POWER METERS

x	Meter	Model No.	Company	Serial No.	Calibration Due
x	POWER METER	435B	HP	2445A11012	11-MAR-00
x	POWER SENSOR	8481A	HP	2702A61351	11-MAR-00

ANTENNAS					
x	Antenna	Model No.	Company	Serial No.	Calibration Due
	GREEN Bilog: 30MHz-2GHz	CBL6112B	Chase	2435	14-JUL-2000
	GREEN-BLACK Bilog: 30MHz-2GHz	CBL6112B	Chase	2412	27-MAY-2000
x	GREEN-WHITE Bilog: 30MHz-2GHz	CBL6112B	Chase	2574	13-MAY-2000
	RED Bilog: 30MHz-1.1GHz	3143	EMCO	1270	27-MAY-2000
	BLUE Bilog: 30MHz-1.1GHz	3143	EMCO	1271	27-MAY-2000
	GREY Bilog: 26MHz-2GHz	3141	EMCO	9703-1038	27-MAY-2000
	YELLOW-BLACK X-Wing Bilog: 20-2000MHz	CBL6140A	Chase	1112	27-MAY-2000
x	YELLOW Horn: 1-18GHz	3115	EMCO	9608-4989	10-MAY-2000
	BLACK Horn: 1-18GHz	3115	EMCO	9703-5148	26-APR-2000
x	WHITE Std Gain Horn: 18-26.5GHz	3160-09	EMCO	9610-1068	06-MAY-2000
	SMALL LOOP Passive Loop: 9kHz-30MHz	PLA-130/A	ARA	1024	17-SEPT-1999
	LARGE LOOP Passive Loop: 20Hz-5MHz	6511	EMCO	9704-1154	11-AUG-1999
	MONOPOLE Act Monopole: 30Hz-30MHz	3301B	EMCO	3824	30-MAR-2000
	DIPOLE Adj Dipole: 30-1000MHz	3121C	EMCO	1370	26-MAR-2000
	DIPOLE Adj Dipole: 30-1000MHz	3121C	EMCO	1371	26-MAR-2000

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PREAMPLIFIERS

x	Preamplifier	Model No.	Company	Serial No.	Calibration Due
	RED 0.10-2000MHz	ZFL-1000-LN	MiniCircuits	n/a	06-FEB-2000
	BLUE 0.05-2000MHz	ZFL-1000-LN	MiniCircuits	n/a	14-OCT-1999
	GREEN 0.01-2000MHz	ZFL-1000-LN	MiniCircuits	n/a	04-FEB-2000
x	GOLD 0.10-2000MHz	ZFL-1000-LN	MiniCircuits	n/a	25-AUG-1999
	BLACK 0.01-2000MHz	ZFL-1000-LN	MiniCircuits	n/a	01-MAR-2000
	ORANGE 0.01-2000MHz	ZFL-1000-LN	MiniCircuits	n/a	24-JUN-2000
x	WHITE 2-18GHz	SMC-12A	MITEQ	426643	30-OCT-1999
	YELLOW 18-26.5GHz	AFS4-18002650- 60-8P-4	MITEQ	467559	16-JUN-2000
	HP8449B 1-20GHz	HP8449B	HP	3008A01266	09-JUN-2000

SIGNAL GENERATORS

x	Generator	Model No.	Company	Serial No.	Calibration Due
	RED 0.09-2000MHz	HP8648B	HP	3537A01210	16-APR-2000
	BLUE 0.1-1000MHz	HP8648A	HP	3426A00548	18-JUN-2000
	GREEN 0.09-2000MHz	HP8648B	HP	3623A02072	17-AUG-1999
	WHITE 0.2Hz-2MHz	FG2A	Beckman	102037	02-FEB-2000
	BLACK 15MHz Function Gen.	HP33120A	HP	US36004674	02-FEB-2000
	YELLOW 15MHz Function Gen.	HP33120A	HP	US36014119	18-JUN-2000
x	HP83752A 0.01 -20.0GHz	HP83752A	HP	3610A01133	19-MAR-2000

Unless otherwise noted the calibration interval is one year. All equipment is calibrated using standards traceable to NIST or other nationally recognized calibration standard.

EXHIBIT 3

3.0 *Measurement Results*

3.1 Maximum Peak Output Power Measurement

The maximum gain provided by the three attachable antennas is given by the Patch Array antenna with a gain of 13dBi. This translates to a power limit of

$$30\text{dBm} - (13\text{dBm} - 6\text{dBm}) = 23\text{dBm}$$

The maximum peak output power as measured with a broadband power meter at the antenna port is:

Channel 1:	17.2 dBm	
Channel 6:	18.7 dBm	=> worst case 4.3dB margin
Channel 11:	18.2 dBm	

3.2 Electric Field Strength Radiation Measurements

Antenna Port Conducted Test							Curtis-Straus LLC					
Date: 08-Jul-99			Company: Zoom				Table 1					
Engineer: Michael Buchholz			EUT Desc: 0230 Board				Work Order: E990762					
Frequency Range: 2.4-25GHz							Measurement Distance: n/a					
Notes: First ten harmonics of TX fundamental (Channels 1, 6, and 11). 100kHz RBW												
Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Reading (dBµV)	---			FCC Class B		
							Limit (dBµV/m)	Margin (dB)	Result (Pass/Fail)	Limit (dBµV)	Margin (dB)	Result (Pass/Fail)
Channel 6												
n/a	2438.2	108.9	---	---	0.4	109.3	---	---	---	n/a	---	---
n/a	4874.3	37.4	---	---	0.7	38.1	---	---	---	89.3	-51.2	Pass
noise floor	7312.5	21.7	---	---	1.1	22.8	---	---	---	89.3	-66.5	Pass
n/a	9748.3	44.1	---	---	1.4	45.5	---	---	---	89.3	-43.8	Pass
n/a	12186.2	35.3	---	---	1.8	37.1	---	---	---	89.3	-52.2	Pass
noise floor	14624.3	27.4	---	---	2.1	29.5	---	---	---	89.3	-59.8	Pass
noise floor	17062.5	31.0	---	---	2.5	33.5	---	---	---	89.3	-55.8	Pass
noise floor	19500.7	31.8	---	---	2.8	34.6	---	---	---	89.3	-54.7	Pass
noise floor	21938.8	33.9	---	---	3.2	37.1	---	---	---	89.3	-52.2	Pass
noise floor	24377.0	34.3	---	---	3.5	37.8	---	---	---	89.3	-51.5	Pass
Channel 1												
n/a	2413.2	106.3	---	---	0.4	106.7	---	---	---	n/a	---	---
n/a	4824.3	21.8	---	---	0.7	22.5	---	---	---	86.7	-64.2	Pass
noise floor	7237.1	22.5	---	---	1.1	23.6	---	---	---	86.7	-63.1	Pass
n/a	9648.4	30.9	---	---	1.4	32.3	---	---	---	86.7	-54.4	Pass
n/a	12061.0	28.3	---	---	1.8	30.1	---	---	---	86.7	-56.6	Pass
noise floor	14474.1	27.4	---	---	2.1	29.5	---	---	---	86.7	-57.2	Pass
noise floor	16887.2	28.0	---	---	2.5	30.5	---	---	---	86.7	-56.2	Pass
noise floor	19300.2	29.1	---	---	2.8	31.9	---	---	---	86.7	-54.8	Pass
noise floor	21713.2	33.0	---	---	3.2	36.2	---	---	---	86.7	-50.5	Pass
noise floor	24126.3	33.5	---	---	3.5	37.0	---	---	---	86.7	-49.7	Pass
Channel 11												
n/a	2460.4	107.5	---	---	0.4	107.9	---	---	---	n/a	---	---
noise floor	4824.3	15.8	---	---	0.7	16.5	---	---	---	87.9	-71.4	Pass
noise floor	7237.1	21.4	---	---	1.1	22.5	---	---	---	87.9	-65.4	Pass
noise floor	9648.4	23.6	---	---	1.4	25.0	---	---	---	87.9	-62.9	Pass
noise floor	12061.0	24.2	---	---	1.8	26.0	---	---	---	87.9	-61.9	Pass
noise floor	14474.1	27.0	---	---	2.1	29.1	---	---	---	87.9	-58.8	Pass
noise floor	16887.2	28.7	---	---	2.5	31.2	---	---	---	87.9	-56.7	Pass
noise floor	19300.2	28.4	---	---	2.8	31.2	---	---	---	87.9	-56.7	Pass
noise floor	21713.2	33.3	---	---	3.2	36.5	---	---	---	87.9	-51.4	Pass
noise floor	24126.3	33.4	---	---	3.5	36.9	---	---	---	87.9	-51.0	Pass
Table Result: Pass by -43.8 dB Channel 6 Worst Freq: 9748.3 MHz												
Test Site: "T"			Pre-Amp: ---		Cable: 18 RG214 U		Analyzer: Green		Antenna: ---			

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Fundamental Restricted Band Intrusion										Curtis-Straus LLC		
Date: 08-Jul-99			Company: Zoom Telephonics							Table 2		
Engineer: Michael Buchholz			EUT Desc: 0230 Board							Work Order: E990762		
Frequency Range: 2390-2483.5MHz							Measurement Distance: 3 m					
Notes: Using Patch Array Antenna (Highest Gain)												
Notes:	Frequency (MHz)	Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Reading (dBµV/m)	---			FCC Class B		
							Limit (dBµV/m)	Margin (dB)	Result (Pass/Fail)	Limit (dBµV/m)	Margin (dB)	Result (Pass/Fail)
Channel 1 (Lower Band Edge)			---	---	---	---	---	---	---	---	---	---
Peak	2412.9	81.6	20.3	30.4	1.5	93.2	---	---	---	---	---	---
Side Band Peak	2398.0	50.9	20.3	30.4	1.5	62.5	---	---	---	73.2	-10.7	Pass
Restric. Band	2390.0	31.7	20.3	30.3	1.5	43.2	---	---	---	54.0	-10.8	Pass
Channel 11 (Upper Band Edge)			---	---	---	---	---	---	---	---	---	---
Restric. Band	2483.5	29.7	20.3	30.6	1.5	41.5	---	---	---	54.0	-12.5	Pass
Test Site: T1			Pre-Amp: None		Cable: 15 ft RG8A U		Analyzer: Green			Antenna: Young Horn		

Radiated Emissions Table

Curtis-Straus LLC

Date: 13-Jul-99

Company: Zoom

Table 3

Engineer: Michael Buchholz

EUT Desc: 0230 Board

Work Order: E990762

Frequency Range: 30-2000MHz

Measurement Distance: 3 m

Notes: Full Scan for highest gain antenna (Patch Array), recheck worst 6 frequencies for other two antennas.

Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Reading (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result (Pass/Fail)	Limit (dBµV/m)	Margin (dB)	Result (Pass/Fail)
Patch Array Antenna												
H	220.0	36.6	22.5	10.3	1.6	26.0	---	---	---	46.0	-20.0	Pass
H	396.0	29.2	22.5	15.9	2.4	25.0	---	---	---	46.0	-21.0	Pass
Vbb	400.0	25.6	22.5	16.0	2.4	21.5	---	---	---	46.0	-24.5	Pass
H	484.0	39.4	21.8	17.1	2.7	37.4	---	---	---	46.0	-8.6	Pass
H	506.0	31.0	21.7	17.5	2.8	29.6	---	---	---	46.0	-16.4	Pass
H	572.0	43.9	21.6	18.3	3.0	43.6	---	---	---	46.0	-2.4	Pass
V	616.0	39.2	21.6	18.8	3.2	39.6	---	---	---	46.0	-6.4	Pass
H	660.0	36.5	21.5	19.0	3.3	37.3	---	---	---	46.0	-8.7	Pass
Array Antenna												
H	220.0	32.8	22.5	10.3	1.6	22.2	---	---	---	46.0	-23.8	Pass
H	484.0	36.0	21.8	17.1	2.7	34.0	---	---	---	46.0	-12.0	Pass
H	506.0	30.4	21.7	17.5	2.8	29.0	---	---	---	46.0	-17.0	Pass
H	572.0	39.4	21.6	18.3	3.0	39.1	---	---	---	46.0	-6.9	Pass
H	616.0	39.2	21.6	18.8	3.2	39.6	---	---	---	46.0	-6.4	Pass
H	660.0	34.8	21.5	19.0	3.3	35.6	---	---	---	46.0	-10.4	Pass
Dipole Antenna												
H	220.0	30.2	22.5	10.3	1.6	19.6	---	---	---	46.0	-26.4	Pass
H	484.0	41.4	21.8	17.1	2.7	39.4	---	---	---	46.0	-6.6	Pass
H	506.0	31.4	21.7	17.5	2.8	30.0	---	---	---	46.0	-16.0	Pass
H	572.0	42.9	21.6	18.3	3.0	42.6	---	---	---	46.0	-3.4	Pass
H	616.0	37.8	21.6	18.8	3.2	38.2	---	---	---	46.0	-7.8	Pass
H	660.0	33.6	21.5	19.0	3.3	34.4	---	---	---	46.0	-11.6	Pass

Table Result: Pass by -2.4 dB Patch Array Antenna Worst Freq: 572.0 MHz

Test Site: "T" Pre-Amp: Gold Cable: 65 ft RG8A U Analyzer: Green Antenna: Grn-Wht

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Spurious Emissions									Curtis-Straus LLC					
Date: 12-Jul-99			Company: Zoom						Table 4					
Engineer: Michael Buchholz			EUT Desc: 0230 Board						Work Order: E990762					
Frequency Range: 2.4-25GHz									Measurement Distance: 3m,1m					
Notes: All TX harmonics that appear in restricted bands plus any other emissions. Tested highest power channel (channel 6) with all antennas.														
Antenna Polarization (H / V)	Antenna Distance (m)	Frequency (MHz)	Reading (dBµV)	Sub. Power (dBm)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Reading (dBµV)	FCC Class B			Limit (dBµV)	Margin (dB)	Result (Pass/Fail)
									Limit (dBµV/m)	Margin (dB)	Result (Pass/Fail)			
Patch Array Antenna														
V	3m	2157.0	42.7	-83.2	---	29.8	---	53.6	---	---	---	99.2	-45.6	Pass
V	3m	2437.8	87.1	-18.3	---	30.5	---	119.2	---	---	---	n/a	---	---
V	3m	4314.0	32.6	-90.5	---	34.3	---	50.8	---	---	---	54.0	-3.2	Pass
noise floor	1m	4874.1	17.4	-90.0	---	35.9	---	52.9	---	---	---	63.5	-10.6	Pass
V	1m	6471.0	32.7	-77.5	---	37.0	---	66.5	---	---	---	108.7	-42.2	Pass
noise floor	1m	7311.0	23.4	-97.1	---	38.6	---	48.5	---	---	---	63.5	-15.0	Pass
noise floor	1m	12185.0	24.6	-92.3	---	40.8	---	55.5	---	---	---	63.5	-8.0	Pass
noise floor	1m	19484.0	36.9	---	21.4	40.3	---	55.8	---	---	---	63.5	-7.7	Pass
Patch Antenna														
V	3m	2157.0	42.7	-83.2	---	29.8	---	53.6	---	---	---	91.0	-37.4	Pass
V	3m	2437.8	78.9	-26.5	---	30.5	---	111.0	---	---	---	n/a	---	---
V	3m	4314.0	32.6	-90.5	---	34.3	---	50.8	---	---	---	54.0	-3.2	Pass
noise floor	1m	4874.1	18.9	-88.5	---	35.9	---	54.4	---	---	---	63.5	-9.1	Pass
V	1m	6471.0	32.7	-77.5	---	37.0	---	66.5	---	---	---	100.5	-34.0	Pass
noise floor	1m	7311.0	23.4	-97.1	---	38.6	---	48.5	---	---	---	63.5	-15.0	Pass
noise floor	1m	12185.0	25.0	-91.9	---	40.8	---	55.9	---	---	---	63.5	-7.6	Pass
noise floor	1m	19484.0	36.7	---	21.4	40.3	---	55.6	---	---	---	63.5	-7.9	Pass
Dipole Antenna														
V	3m	2157.0	42.7	-83.2	---	29.8	---	53.6	---	---	---	94.9	-41.3	Pass
V	3m	2437.8	82.8	-22.6	---	30.5	---	114.9	---	---	---	n/a	---	---
V	3m	4314.0	32.6	-90.5	---	34.3	---	50.8	---	---	---	54.0	-3.2	Pass
noise floor	1m	4874.1	18.9	-88.5	---	35.9	---	54.4	---	---	---	63.5	-9.1	Pass
V	1m	6471.0	32.7	-77.5	---	37.0	---	66.5	---	---	---	104.4	-37.9	Pass
noise floor	1m	7311.0	22.5	-98.0	---	38.6	---	47.6	---	---	---	63.5	-15.9	Pass
noise floor	1m	12185.0	25.3	-91.6	---	40.8	---	56.2	---	---	---	63.5	-7.3	Pass
noise floor	1m	19484.0	36.8	---	21.4	40.3	---	55.7	---	---	---	63.5	-7.8	Pass
Test Site: T1 Pre-Amp: 0dB Cable: 1.0dB @ 100MHz Analyzer: 0dBm Antenna: VNA 100														

3.3 Power Spectral Density Measurement

The peak power spectral density as measured through a 20dB attenuator is:

Channel 1 (2.4128GHz): $-28.6\text{dBm} + 20\text{dBm (attenuator)} = -8.6\text{dBm}$

Channel 6 (2.4378GHz): $-26.2\text{dBm} + 20\text{dBm (attenuator)} = -6.2\text{dBm}$

Channel 11 (2.4601GHz): $-28.6\text{dBm} + 20\text{dBm (attenuator)} = -8.6\text{dBm}$

3.4 Radiofrequency Radiation Exposure Evaluation

During the power output measurement, a maximum power output of **18.7dBm** was obtained on channel 6 at the antenna port. Adding the worst case manufacturer supplied antenna gain (**13dBi** for the Patch Array antenna) to the maximum power output gives an EIRP of **31.7dBm**.

Since the device operates with an EIRP that may exceed the FCC RF exposure limits, the user/installation manual will contain a warning similar to the following.

CAUTION:

To avoid any exposure to the radio frequency radiation, antennas should also be mounted to limit any user contact during operation. Finally, the following proximity limits should be met in order to stay within the acceptable FCC radio frequency exposure limits: 3.2cm for the dipole, 3.9cm for the omni-directional and 11cm for the directional patch.

A calculation based on the FCC's **Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields (Edition 97-01)** gives a minimum distance for human exposure of 11cm for the patch array antenna, 3.9cm for the patch antenna and 3.2cm for the dipole antenna. Equation (4) on page 19 of that document was used to calculate these distances using the 1mW/cm² limit found in the General Population Exposure Limits table on page 67. Due to the small distance and general installation practices, we feel that the preceding caution label is sufficient.