

Nemko Test Report: 1L0183RUS1

Applicant: Contec Co. Ltd.
3-9-31 Himesato, Nishiyodogawa-ku
Osaka 555-0025, Japan

Equipment Under Test: FX-DS110-APL
(E.U.T.)

In Accordance With: **FCC Part 15, Subpart C, 15.247**
Direct Sequence Spread Spectrum Transmitters

Tested By: Nemko Dallas Inc.
802 N. Kealy
Lewisville, Texas 75057-3136

Authorized By:



Tom Tidwell, RF Group Manager

Date: 7/31/01

Total Number of Pages: 46

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Section 1. Summary of Test Results

Manufacturer: Contec Co. Ltd.

Model No.: FX-DS110-APL

Serial No.: None

General: **All measurements are traceable to national standards.**

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, Subpart C, Paragraph 15.247 for Direct Sequence Spread Spectrum devices. Radiated tests were conducted in accordance with ANSI C63.4-1992. Radiated emissions are made on an open area test site. A description of the test facility is on file with the FCC.



New Submission



Production Unit



Class II Permissive Change



Pre-Production Unit

THIS TEST REPORT RELATES ONLY TO THE ITEM(S) TESTED.

THE FOLLOWING DEVIATIONS FROM, ADDITIONS TO, OR EXCLUSIONS FROM THE TEST SPECIFICATIONS HAVE BEEN MADE.

See " Summary of Test Data".

**NVLAP LAB CODE: 100426-0**

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Summary Of Test Data

NAME OF TEST	PARA. NO.	SPEC.	MEAS.	RESULT
Powerline Conducted Emissions	15.207(a)	48 dB μ V	< 48 dBuV	Complies
Minimum 6 dB Bandwidth	15.247(a)(2)	>500 kHz	10 MHz	Complies
Maximum Peak Power Output	15.247(b)(1)	<1 Watt	<1 Watt	Complies
Spurious Emissions (Antenna Conducted)	15.247(c)	-20 dBc/100kHz	< -20 dBc	Complies
Spurious Emissions (Restricted Bands)	15.247(c)	< 74 dBuV/m Peak < 54 dBuV/m Avg	< 74 dBuV/m Peak < 54 dBuV/m Avg	Complies
Peak Power Spectral Density	15.247(d)	+8 dBm/3kHz	< +8 dBm	Complies
Processing Gain	15.247(e)	10 dB	> 10 dB	Complies

Footnotes:

Section 2. Equipment Under Test (E.U.T.)

General Equipment Information

Frequency Band:

- ☐ 902 – 928 MHz
☒ 2400 – 2483.5 MHz
☐ 5725 – 5850 MHz

Tuning Range:

2411.93 - 2471.61

User Frequency Adjustment:

Software controlled

Description of Modification for Modification Filing

Not Applicable

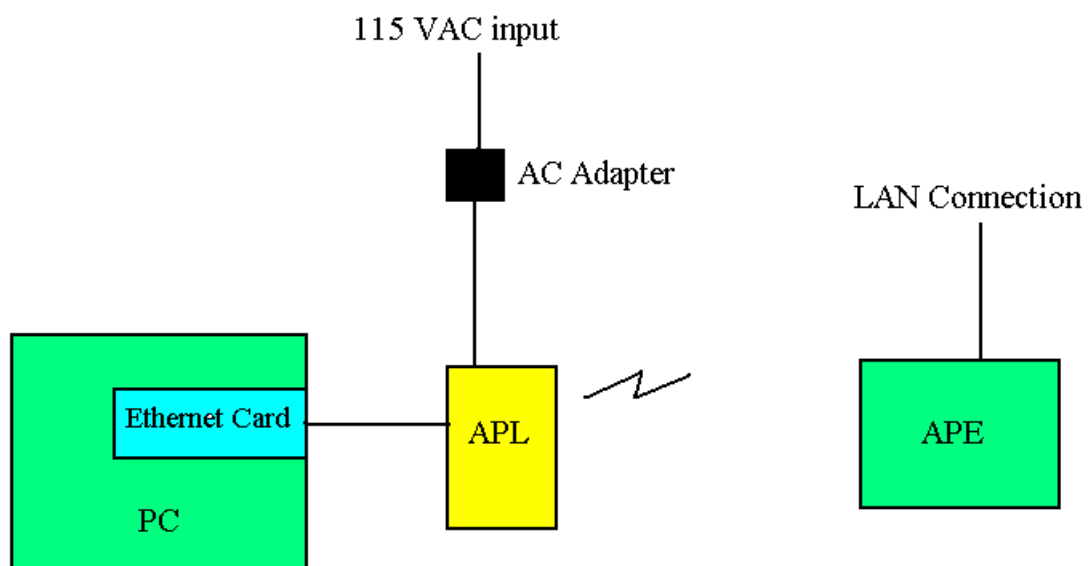
Family List Rational

Not Applicable

Theory of Operation

The equipment is a wireless LAN transmitter and receiver for use in an indoor environment. The equipment includes an integral antenna.

System Diagram



Section 3. Powerline Conducted Emissions

NAME OF TEST: Powerline Conducted Emissions

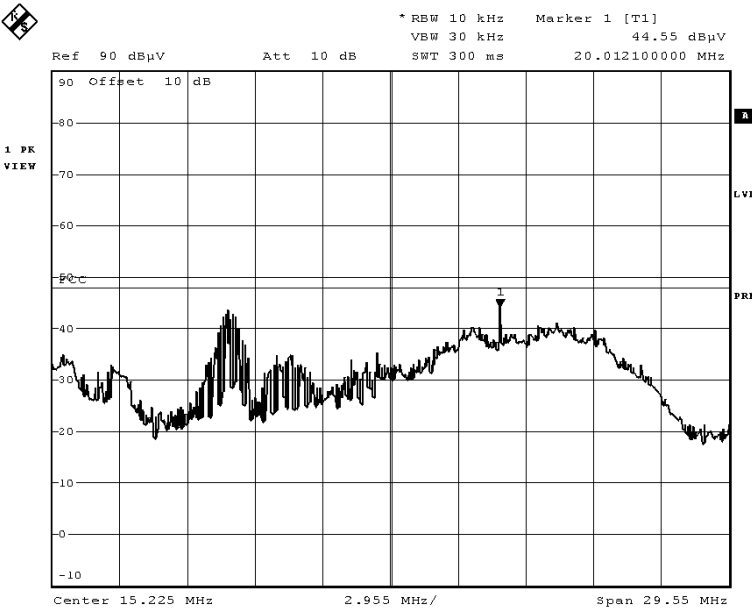
PARA. NO.: 15.207(a)

TESTED BY: David Light

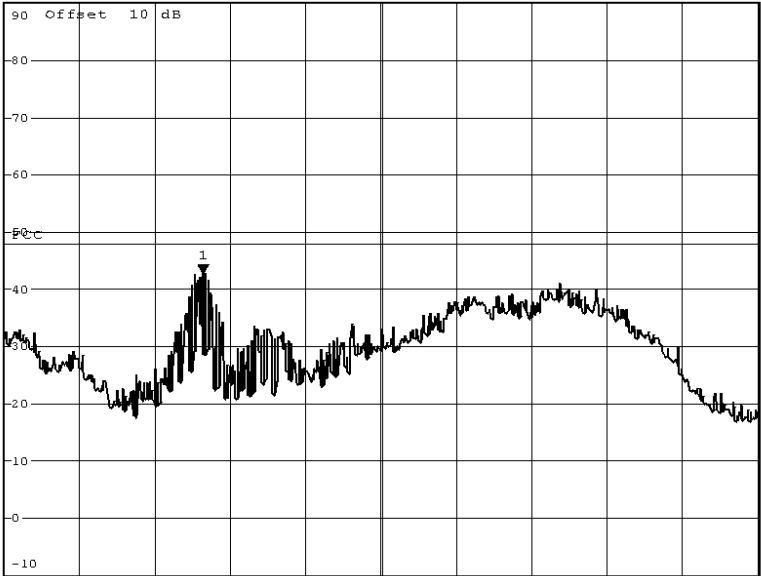
DATE:7/23/01

Test Results: Complies.**Measurement Data:** See attached plots.**Measurement Uncertainty:** +/- 1.7 dB

Test Data – Powerline Conducted Emissions

		Dallas Headquarters:	
		802 N. Kealy Lewisville, TX 75057 Tel: (972) 436-9600 Fax: (972) 436-2667	
Nemko Dallas, Inc.			
Data Plot		Powerline Conducted Emissions	
Page 1 of 2		Complete	x
Job No.: 1L0183R	Date: 7/23/01	Preliminary	
Specification: 15.207	Temperature(°C): 22		
Tested By: David Light	Relative Humidity(%) 50		
E.U.T.: Wireless LAN			
Configuration: Transmit - Wireless link established			
Sample Number: S01			
Location: Lab 3	RBW: 10 kHz	Measurement	
Detector Type: Peak	VEW: 30 kHz	Distance: N/A	m
Test Equipment Used			
Antenna:	Directional Coupler:		
Pre-Amp:	Cable #1: 970		
Filter: 704	Cable #2: 1976		
Receiver:	LISN: 1258		
Attenuator #1:	Limiter: 674		
Attenuator #2:	Mixer:		
Additional equipment used: Tology Asset 86329 (Rohde & Schwarz Spectrum analyzer FSP Cal'd 4/9/01)			
Measurement Uncertainty: +/-1.7 dB			
			
Date: 23.JUL.2001 23:19:09			
Notes: L1			

Test Data – Powerline Conducted Emissions

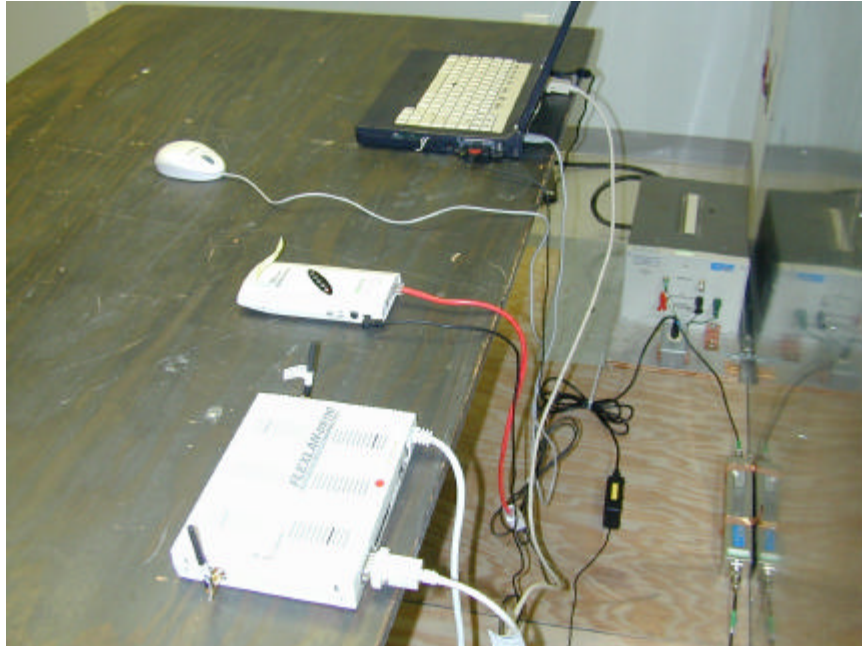
		Dallas Headquarters:	
		802 N. Kealy Lewisville, TX 75057 Tel: (972) 436-9600 Fax: (972) 436-2667	
Nemko Dallas, Inc.			
Data Plot Powerline Conducted Emissions			
Page 2 of 2			
Job No.:	1L0183R	Date:	7/23/01
Specification:	15.2	Temperature(°C):	22
Tested By:	David Light	Relative Humidity(%)	50
E.U.T.:	Wireless LAN		
Configuration:	Transmit - Wireless link established		
 * RBW 10 kHz Marker 1 [T1] VBW 30 kHz 43.15 dBµV SWT 300 ms 8.251200000 MHz Ref 90 dBµV Att 10 dB 90 Offset 10 dB 1 PK VIEW  Start 450 kHz 2.955 MHz/ Stop 30 MHz Date: 23.JUL.2001 23:17:34			
Notes:	L2		

Photos – Powerline Conducted Emissions

Front



Side



Section 4. Minimum 6 dB Bandwidth

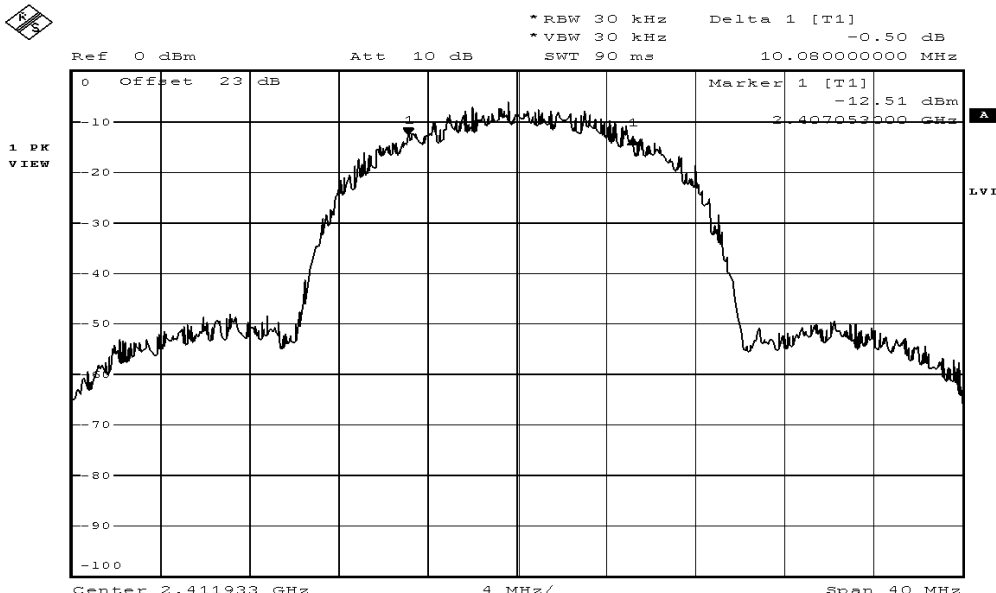
NAME OF TEST: Minimum 6 dB Bandwidth	PARA. NO.: 15.247(a)(2)
TESTED BY: David Light	DATE: 7/18/01

Test Results: Complies.

Measurement Data: See 6 dB BW plot
Measured 6 dB bandwidth: 10.08 MHz
Channel Separation: 5 MHz

Measurement Uncertainty: +/- 1.7 dB

Test Data – Minimum 6 dB Bandwidth

		Dallas Headquarters: 802 N. Kealy Lewisville, TX 75057 Tel: (972) 436-9600 Fax: (972) 436-2667	
Nemko Dallas, Inc.			
Data Plot		OCCUPIED BANDWIDTH	
Page 1 of 2		Complete X	
Job No.:	1L0183R	Date:	7/18/2001
Specification:	15.247	Temperature(°C):	22
Tested By:	David Light	Relative Humidity(%)	50
E.U.T.:	WIRELESS LAN		
Configuration:	CONTINUOUS TRANSMIT		
Sample Number:	S01		
Location:	Lab 1	RBW:	30 kHz
Detector Type:	Peak	VBW:	30 kHz
		Measurement Distance:	N/A m
Test Equipment Used			
Antenna:		Directional Coupler:	
Pre-Amp:		Cable #1:	1046
Filter:		Cable #2:	
Receiver:	FSP RENTAL	Cable #3:	
Attenuator #1:	1473	Cable #4:	
Attenuator #2:		Mixer:	
Additional equipment used: GENERIC TEST CABLE SUPPLIED BY CLIENT 1.5 dB LOSS			
Measurement Uncertainty: +/-1.7 dB			
			
Date: 18.JUL.2001 18:24:42			
Notes: CHANNEL 1			

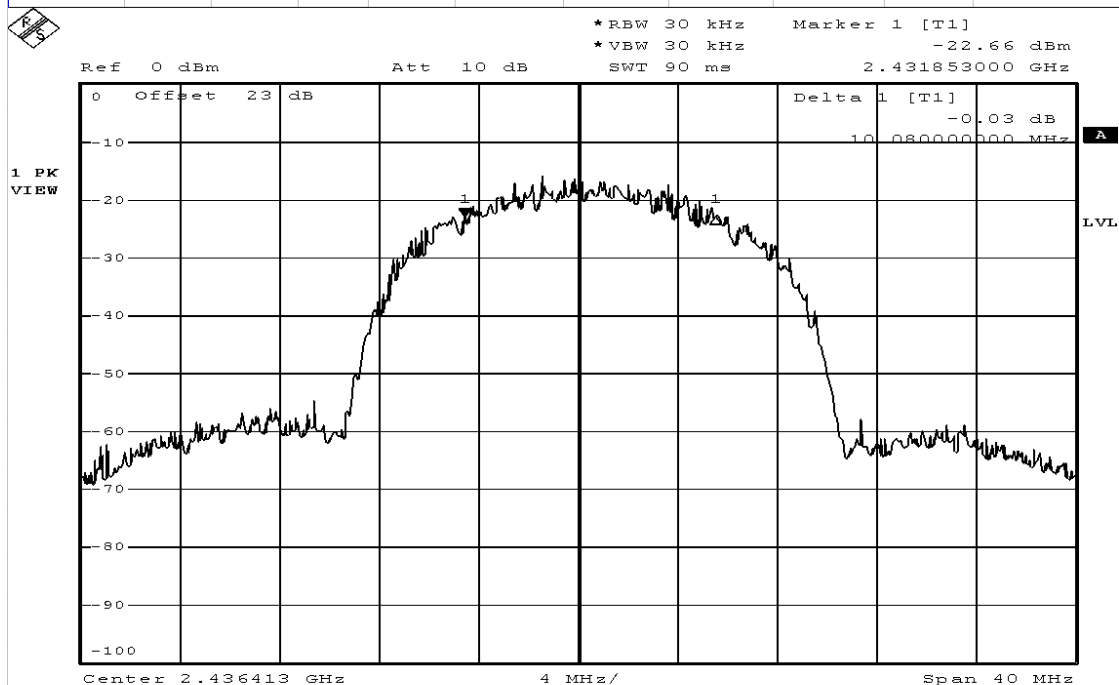
Nemko

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Page 2 of 3

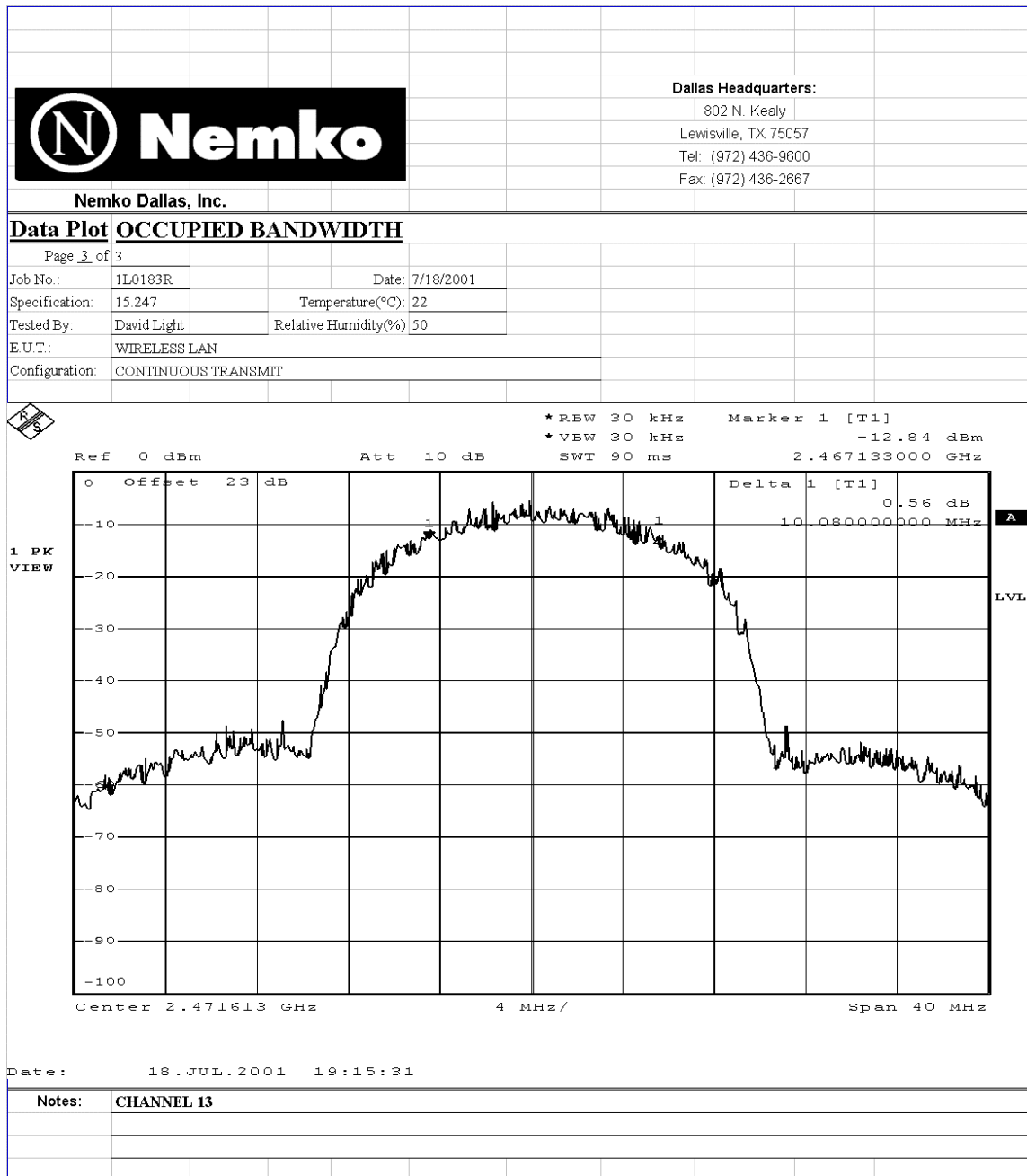
Job No.:	1L0183R	Date:	7/18/2001
Specification:	15.2	Temperature(°C):	22
Tested By:	David Light	Relative Humidity(%)	50
E.U.T.:	WIRELESS LAN		
Configuration:	CONTINUOUS TRANSMIT		



Date: 18.JUL.2001 18:39:03

Notes:	CHANNEL 6
--------	-----------

Test Data – Minimum 6 dB Bandwidth



Section 5. Maximum Peak Output Power

NAME OF TEST: Maximum Peak Output power	PARA. NO.: 15.247(b)(1)
TESTED BY: David Light	DATE: 7/24/01

Test Results: Complies.

Measurement Data: Complies

Antennas: Integral

Channel	Frequency (MHz)	Power Output (dBm)	Antenna Gain (dBi)	E.I.R.P. (dBm)
1	2412	16.3	2.14	18.44
6	2437	15.6	2.14	17.74
13	2472	15.3	2.14	17.44

Note – The AC adapter supplied with the device operates from 100-250 Vac. The device was tested at +/-15% of U.S. normal voltage (98 & 132 Vac) with no effect on output power.

Equipment Used: 1473-1046-Telogy asset #86329 (Rohde & Schwarz FSP spectrum analyzer cal'd 4/9/01)

Measurement Uncertainty: +/- 1.7 dB

Temperature: 22 °C

Relative Humidity: 50 %

Section 6. RF Exposure

NAME OF TEST: RF Exposure	PARA. NO.: 15.247(b)(4)
TESTED BY: David Light	DATE: 7/25/01

Test Results: Complies.

Measurement Data:**Prediction of MPE limit at a given distance**

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = \frac{PG}{4\pi R^2}$$

where: S = power density

P = power input to the antenna

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna

Maximum peak output power at antenna input terminal: 16.30

Maximum peak output power at antenna input terminal: 42.65795 (mW)

Antenna gain(typical): 2.14 (dBi)

Maximum antenna gain: 1.636817 (numeric)

Prediction distance: 5 (cm)

Prediction frequency: 2400 (MHz)

MPE limit for uncontrolled exposure at prediction frequency: 1 (mW/cm²)

Power density at prediction frequency: 0.222254 (mW/cm²)

Maximum allowable antenna gain: 8.671499 (dBi)

Section 7. Spurious Emissions (conducted)

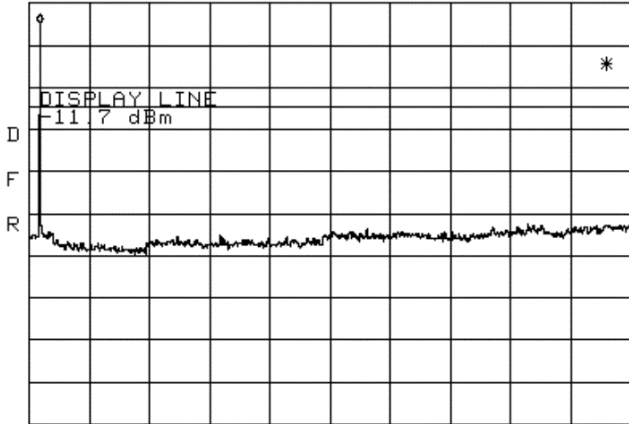
NAME OF TEST: Spurious Emissions (conducted)	PARA. NO.: 15.247(c)
TESTED BY: David Light	DATE: 7/19/01

Test Results: Complies.

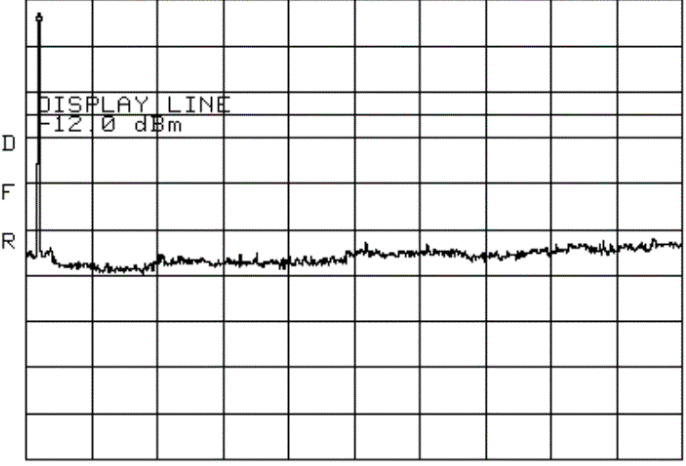
Measurement Data: See attached plots.

Measurement Uncertainty: ± 1.7 dB

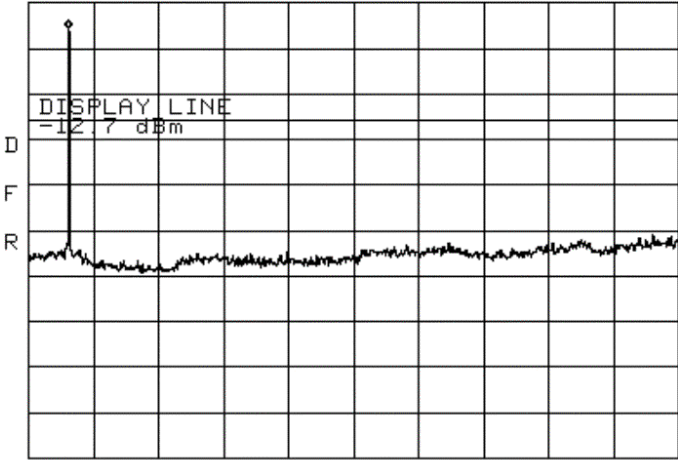
Test Data – Spurious Emissions (Conducted)

		Dallas Headquarters:	
		802 N. Kealy Lewisville, TX 75057 Tel: (972) 436-9600 Fax: (972) 436-2667	
Nemko Dallas, Inc.			
Data Plot		SPURIOUS EMISSIONS AT ANTENNA TERMINALS	
Page 1 of 3		Complete X	
Job No.: 1L0183R	Date: 7/19/2001	Preliminary	
Specification: 15.247	Temperature(°C): 22		
Tested By: David Light	Relative Humidity(%) 50		
E.U.T.: WIRELESS LAN			
Configuration: TRANSMIT FULL POWER			
Sample Number: S01			
Location: Lab 1	RBW: 1 MHz	Measurement	
Detector Type: Peak	VBW: 1 MHz	Distance: N/A m	
Test Equipment Used			
Antenna:	Directional Coupler:		
Pre-Amp:	Cable #1: 1046		
Filter:	Cable #2:		
Receiver: 1464	Cable #3:		
Attenuator #1: 1473	Cable #4:		
Attenuator #2:	Mixer:		
Additional equipment used:			
Measurement Uncertainty: +/-1.7 dB			
ATTEN 10dB MKR 8.33dBm RL 13.0dBm 10dB/ 2.42GHz  START 2.00GHz STOP 25.00GHz RBW 1.0MHz VBW 1.0MHz SWP 460ms			
Notes: CHANNEL 1			

Test Data – Spurious Emissions (Conducted)

		Dallas Headquarters:	
		802 N. Kealy Lewisville, TX 75057 Tel: (972) 436-9600 Fax: (972) 436-2667	
Nemko Dallas, Inc.			
Data Plot <u>SPURIOUS EMISSIONS AT ANTENNA TERMINALS</u>			
Page 2 of 3			
Job No.:	1L0183R	Date:	7/19/2001
Specification:	15.2	Temperature(°C):	22
Tested By:	David Light	Relative Humidity(%)	50
E.U.T.:	WIRELESS LAN		
Configuration:	TRANSMIT FULL POWER		
ATTEN 10dB MKR 8.00dBm RL 13.0dBm 10dB/ 2.46GHz  START 2.00GHz STOP 25.00GHz RBW 1.0MHz VBW 1.0MHz SWP 460ms			
Notes:	CHANNEL 6		

Test Data – Spurious Emissions (Conducted)

		Dallas Headquarters:	
		802 N. Kealy Lewisville, TX 75057 Tel: (972) 436-9600 Fax: (972) 436-2667	
Nemko Dallas, Inc.			
Data Plot SPURIOUS EMISSIONS AT ANTENNA TERMINALS			
Page 3 of 3			
Job No.:	1L0183R	Date:	7/19/2001
Specification:	15.247	Temperature(°C):	22
Tested By:	David Light	Relative Humidity(%)	50
E.U.T.:	WIRELESS LAN		
Configuration:	TRANSMIT FULL POWER		
ATTEN 10dB MKR 7.33dBm RL 13.0dBm 10dB/ 2.48GHz  START 1.00GHz STOP 25.00GHz RBW 1.0MHz VBW 1.0MHz SWP 480ms			
Notes:	CHANNEL 13		

Section 8. Spurious Emissions (radiated)

NAME OF TEST: Peak Power Output	PARA. NO.: 15.247 (c)
TESTED BY: David Light	DATE: 7/23/01

Test Results: Complies.

Measurement Data: See attached table.

Duty Cycle Calculation: N/A

Duty Cycle correction factor(dB) = $20 \log (rf_{ON} \text{ in ms}/100\text{ms})$

Measurement Uncertainty: +/- 3.6 dB

Test Data – Spurious Emissions (Radiated)



Nemko Dallas, Inc.

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Fax: (972) 436-2667

Radiated Emissions								
Page <u>1</u> of <u>2</u>								
Job No.:	1L0183R			Date: 7/23/01				
Specification:	CFR 47, Part 15			Temperature(°C): <u>22</u>				
Tested By:	David Light			Relative Humidity(%) <u>50</u>				
E.U.T.:	Wireless LAN							
Configuration:	Transmit - Wireless link w/base unit							
Sample Number:	S01							
Location:	AC 3			RBW:		1 MHz		
Detector Type:	Peak			VBW:		100 kHz		
Test Equipment Used								
Antenna:	#N/A			Directional Coupler:		#N/A		
Pre-Amp:	1016			Cable #1:		1484		
Filter:	1482			Cable #2:		1485		
Receiver:	1464			Cable #3:		#N/A		
Attenuator #1:	#N/A			Cable #4:		#N/A		
Attenuator #2:	#N/A			Mixer:		#N/A		
Measurement Uncertainty:	+/- 3.6 dB							
Frequency (GHz)	Meter Reading (dBuV)	Antenna Factor (dB)	Cable Loss (dB)	Pre-Amp Gain (dB)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Comment
								Device lying flat - Channel 1
4.824	31.8	33.9	5	33.7	37.0	54	-17.0	Horizontal - Noise floor (NF)
7.236	30.7	36.5	6.1	33	40.3	54	-13.7	Horizontal - NF
12.06	32.5	39.4	8.5	35.7	44.7	54	-9.3	Horizontal - NF
14.472	30.5	42.7	7.5	32.7	48.0	54	-6.0	Horizontal - NF
4.824	31.8	33.9	5	33.7	37.0	54	-17.0	Vertical - NF
7.236	30.7	36.5	6.1	33	40.3	54	-13.7	Vertical - NF
12.06	32.5	39.4	8.5	35.7	44.7	54	-9.3	Vertical - NF
14.472	30.5	42.7	7.5	32.7	48.0	54	-6.0	Vertical - NF
								Channel 1 - Upright
4.824	31.8	33.9	5	33.7	37.0	54	-17.0	Horizontal - (NF)
7.236	30.7	36.5	6.1	33	40.3	54	-13.7	Horizontal - NF
12.06	32.5	39.4	8.5	35.7	44.7	54	-9.3	Horizontal - NF
14.472	30.5	42.7	7.5	32.7	48.0	54	-6.0	Horizontal - NF
4.824	31.8	33.9	5	33.7	37.0	54	-17.0	Vertical - NF
7.236	30.7	36.5	6.1	33	40.3	54	-13.7	Vertical - NF
12.06	32.5	39.4	8.5	35.7	44.7	54	-9.3	Vertical - NF
14.472	30.5	42.7	7.5	32.7	48.0	54	-6.0	Vertical - NF
								Channel 6 - Upright
4.872	34.5	33.9	5	33.7	39.7	54	-14.3	Horizontal - NF
7.308	33.3	36.5	6.1	33	42.9	54	-11.1	Horizontal - NF
12.18	35	39.4	8.5	35.7	47.2	54	-6.8	Horizontal - NF
4.872	34.5	33.9	5	33.7	39.7	54	-14.3	Vertical - NF
7.308	33.3	36.5	6.1	33	42.9	54	-11.1	Vertical - NF
12.18	35	39.4	8.5	35.7	47.2	54	-6.8	Vertical - NF
Notes:	Checked all harmonics in the restricted bands of operation per 15.205							
	Scanned to 10th harmonic.							

Test Data – Spurious Emissions (Radiated)



Nemko Dallas, Inc.

Dallas Headquarters:

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 Lewisville, TX 75057
 Tel: (972) 436-9600
 Fax: (972) 436-2667

Radiated Spurious Emissions								
Page 1 of		Continuation Page						
Job No.:		Date: 7/24/01						
Specification:		CFR 47, Part 15	Temperature(°F): 72					
Tested By:		#N/A	Relative Humidity(%) 50					
E.U.T.:								
Configuration:								
Frequency (GHz)	Meter Reading (dBuV)	Antenna Factor (dB)	Cable Loss (dB)	Pre-Amp Gain (dB)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Comment
								Channel 6 - Lying flat
4.872	34.5	33.9	5	33.7	39.7	54	-14.3	Horizontal - NF
7.308	33.3	36.5	6.1	33	42.9	54	-11.1	Horizontal - NF
12.18	35	39.4	8.5	35.7	47.2	54	-6.8	Horizontal - NF
4.872	34.5	33.9	5	33.7	39.7	54	-14.3	Vertical - NF
7.308	33.3	36.5	6.1	33	42.9	54	-11.1	Vertical - NF
12.18	35	39.4	8.5	35.7	47.2	54	-6.8	Vertical - NF
								Channel 13 - Upright
2.4835	38	29.1	3.5	33.8	36.8	54	-17.2	Horizontal - Bandedge
4.942	32	33.9	5	33.7	37.2	54	-16.8	Horizontal - NF
7.413	31	36.5	6.1	33	40.6	54	-13.4	Horizontal - NF
12.355	32.2	39.4	8.5	35.7	44.4	54	-9.6	Horizontal - NF
2.4835	41	29.1	3.5	33.8	39.8	54	-14.2	Vertical - Bandedge
4.942	32	33.9	5	33.7	37.2	54	-16.8	Vertical - NF
7.413	31	36.5	6.1	33	40.6	54	-13.4	Vertical - NF
12.355	32.2	39.4	8.5	35.7	44.4	54	-9.6	Vertical - NF
								Channel 13 - Lying flat
2.4835	34.3	29.1	3.5	33.8	33.1	54	-20.9	Horizontal - Bandedge
4.942	32	33.9	5	33.7	37.2	54	-16.8	Horizontal - NF
7.413	31	36.5	6.1	33	40.6	54	-13.4	Horizontal - NF
12.355	32.2	39.4	8.5	35.7	44.4	54	-9.6	Horizontal - NF
2.4835	40.3	29.1	3.5	33.8	39.1	54	-14.9	Vertical - Bandedge
4.942	32	33.9	5	33.7	37.2	54	-16.8	Vertical - NF
7.413	31	36.5	6.1	33	40.6	54	-13.4	Vertical - NF
12.355	32.2	39.4	8.5	35.7	44.4	54	-9.6	Vertical - NF
Notes: Checked all harmonics in the restricted bands of operation per 15.205								
Scanned to 10th harmonic.								

Radiated Photographs (Worst Case Configuration)

Front



Rear



Section 9. Peak Power Spectral Density

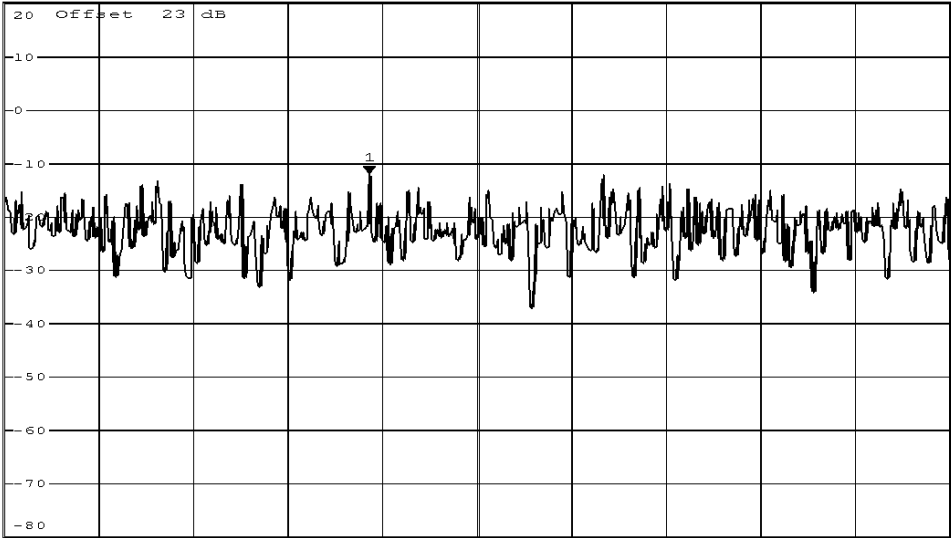
NAME OF TEST: Peak Power Spectral Density	PARA. NO.: 15.247(d)
TESTED BY: David Light	DATE: 7/18/01

Test Results: Complies.

Measurement Data: See attached plots.

Measurement Uncertainty: +/- 1.7 dB

Test Data – Peak Power Spectral Density

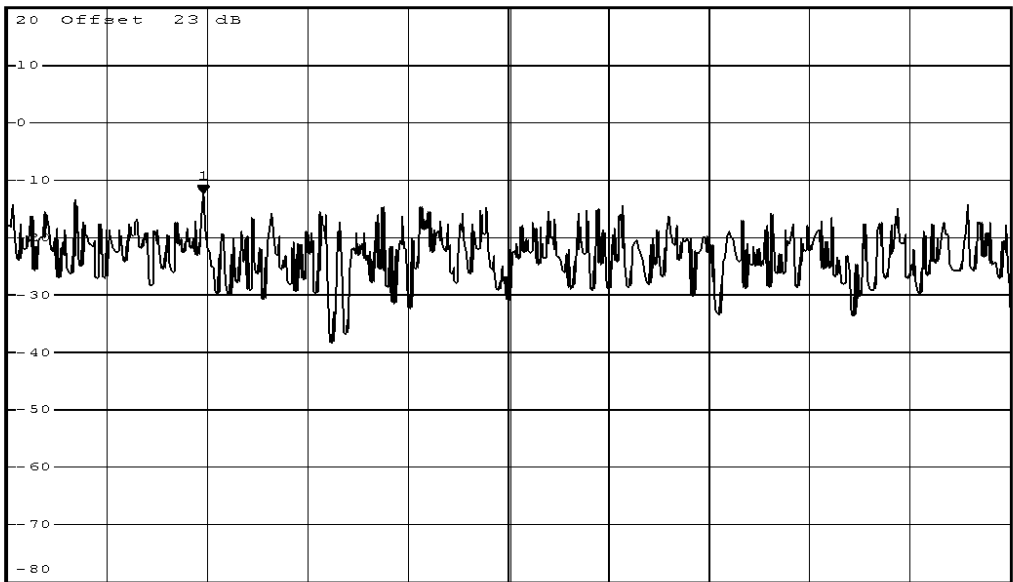
		Dallas Headquarters:	
		802 N. Kealy Lewisville, TX 75057 Tel: (972) 436-9600 Fax: (972) 436-2667	
Nemko Dallas, Inc.			
Data Plot		SPECTRAL DENSITY	
Page 1 of 3		Complete X	
Job No.:	1L0183R	Date:	7/18/2001
Specification:	15.247	Temperature(°C):	22
Tested By:	David Light	Relative Humidity(%):	50
E.U.T.:	WIRELESS LAN		
Configuration:	CONTINUOUS TRANSMIT		
Sample Number:	S01		
Location:	Lab 1	RBW:	30 kHz
Detector Type:	Peak	VBW:	30 kHz
		Measurement	Distance: N/A m
Test Equipment Used			
Antenna:		Directional Coupler:	
Pre-Amp:		Cable #1:	1046
Filter:		Cable #2:	
Receiver:	FSP RENTAL	Cable #3:	
Attenuator #1:	1473	Cable #4:	
Attenuator #2:		Mixer:	
Additional equipment used: GENERIC TEST CABLE SUPPLIED BY CLIENT 1.5 dB LOSS			
Measurement Uncertainty: +/-1.7 dB			
			
* RBW 3 kHz Marker 1 [T1] -11.65 dBm * VBW 3 kHz 2.411730000 GHz * SWT 680 s			
Ref 20 dBm Att 30 dB			
20 Offset 23 dB			
			
Center 2.411958 GHz 200 kHz/ Span 2 MHz			
Date: 18.JUL.2001 22:24:19			
Notes: CHANNEL 1			

Test Data – Peak Power Spectral Density

		Dallas Headquarters:	
		802 N. Kealy Lewisville, TX 75057 Tel: (972) 436-9600 Fax: (972) 436-2667	
Nemko Dallas, Inc.			
Data Plot SPECTRAL DENSITY			
Page 2 of 3			
Job No.:	1L0183R	Date:	7/18/2001
Specification:	15.2	Temperature(°C):	22
Tested By:	David Light	Relative Humidity(%)	50
E.U.T.:	WIRELESS LAN		
Configuration:	CONTINUOUS TRANSMIT		

	* RBW 3 kHz	Marker 1 [T1]
	* VBW 3 kHz	-12.05 dBm
	* SWT 680 s	2.438392000 GHz

Ref 20 dBm	Att 30 dB
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Center 2.439 GHz 200 kHz/ Span 2 MHz

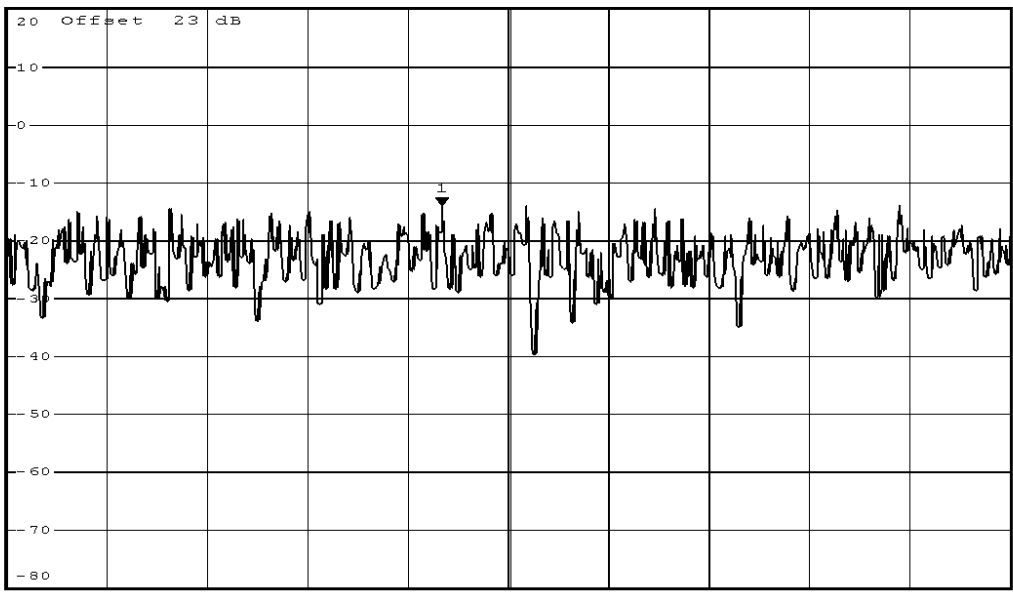
Date:	18.JUL.2001 22:40:30
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Notes:	CHANNEL 6

Test Data – Peak Power Spectral Density

		Dallas Headquarters:	
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Nemko Dallas, Inc.			
Data Plot SPECTRAL DENSITY			
Page 3 of 3			
Job No.:	1L0183R	Date:	7/18/2001
Specification:	15.247	Temperature(°C):	22
Tested By:	David Light	Relative Humidity(%)	50
E.U.T.:	WIRELESS LAN		
Configuration:	CONTINUOUS TRANSMIT		

Ref 20 dBm		Att 30 dB		*RBW 3 kHz		Marker 1 [T1]	
				*VBW 3 kHz		-13.69 dBm	
				*SWT 680 s		2.472228000 GHz	



1 PK * CLRWR

Center 2.47236 GHz 200 kHz/ Span 2 MHz

Date: 18.JUL.2001 23:00:13

Notes:	CHANNEL 13

Section 10. Minimum Processing Gain

NAME OF TEST: Minimum Processing Gain	PARA. NO.: 15.247(e)
TESTED BY: Tom Tidwell	DATE: 7/31/01

Test Results: Complies.

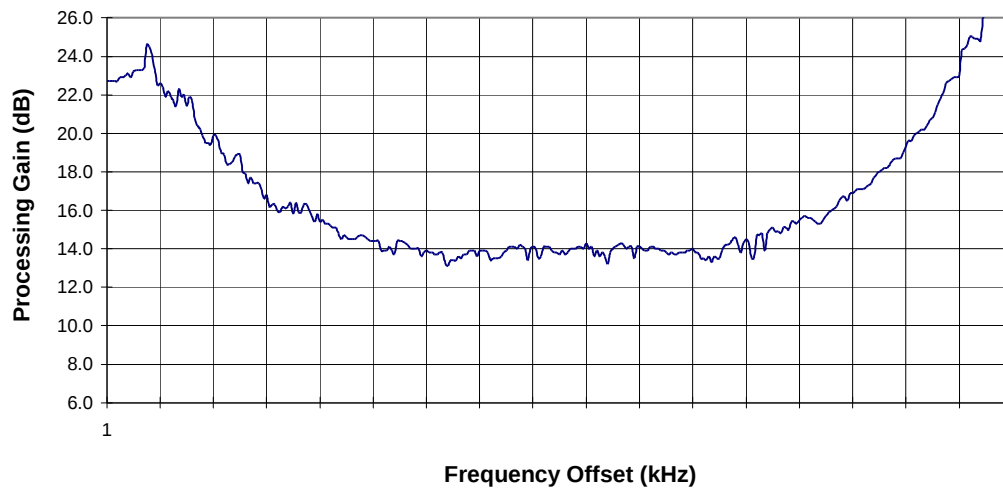
Measurement Data: See attached data.

Measurement Uncertainty: +/- 0.7 dB

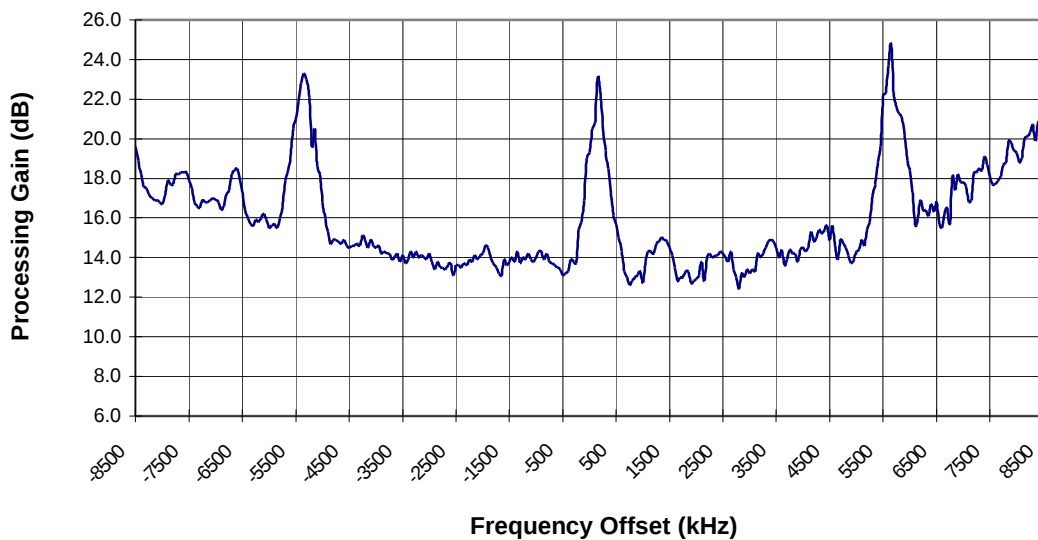
Temperature: 31 °C

Relative Humidity: 23 %

Processing Gain
Channel 6 (fc=2437MHz) @ 11Mbps



Processing Gain
Channel 6 (fc=2437MHz) @ 1Mbps



Section 11. Test Equipment List

ASSET	Description	Manufacturer Model Number	Serial Number	Cal. Date	Cal. Due
674	LIMITER	HP 11947A	3107A02200	11/04/00	11/04/01
970	CABLE, 14.8m	KTL RG223	N/A	05/29/01	05/29/02
1258	LISN .15mhz-30mhz	EMCO 0	1305	04/04/01	04/04/02
1976	CABLE .5m	KTL RG223	N/A	12/16/00	12/16/01
704	FILTER, HIGH PASS, 5 KHz	SOLAR 7930-5.0	933126	11/04/00	11/04/01
1473	20db Attenuator DC 18 Ghz	Midwest Microwave 290-20db	NONE	CBU	N/A
1046	Flex cable 1m	Astrolab Inc. 32022-2-29094K-1M	N/A	01/29/01	01/29/02
1464	Spectrum analyzer	Hewlett Packard 8563E	3551A04428	01/02/01	01/02/02
1016	Pre-Amp	HEWLETT PACKARD 8449A	2749A00159	05/30/01	05/30/02
1482	Band Pass Filter	K & L 11SH10-4000/T12000-0/0	2	Cal B4 Use	N/A
1464	Spectrum analyzer	Hewlett Packard 8563E	3551A04428	01/02/01	01/02/02
1484	Cable 2.0-18.0 Ghz	Storm PR90-010-072	N/A	06/01/01	06/01/02
1485	Cable 2.0-18.0 Ghz	Storm PR90-010-216	N/A	06/01/01	06/01/02
Telogy Asset 86329	Spectrum analyzer	Rohde & Schwarz FSP7	100124	04/09/01	04/09/02

ANNEX A - TEST DETAILS

NAME OF TEST: Powerline Conducted Emissions	PARA. NO.: 15.207(a)
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Minimum Standard:

The R.F. that is conducted back onto the AC power line on any frequency within the band 0.45 to 30 MHz shall not exceed 250 μ V (48 dB μ V) across 50 ohms.

Nemko Dallas

FCC PART 15, SUBPART C

DIRECT SEQUENCE SPREAD SPECTRUM TRANSMITTER

EQUIPMENT: [FX-DS110-APL](#)

PROJECT NO.: [1L0183RUS1](#)

NAME OF TEST: Minimum 6 dB bandwidth	PARA. NO.: 15.247(a)(2)
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Minimum Standard:

The minimum 6 dB bandwidth shall be at least 500 kHz

NAME OF TEST: Maximum Peak Output Power

PARA. NO.: 15.247(b)(1)

Minimum Standard:

The maximum peak output power shall not exceed 1 watt.

If transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Systems operating in the 2400-2483.5 MHz band that are used exclusively for fixed, point to point operation may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceed 6 dBi.

Systems operating in the 5725 – 5850 MHz band that are used exclusively for fixed, point-to-point operation may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter peak output power.

Direct Measurement Method For Detachable Antennas:

If the antenna is detachable, a peak power meter is used to measure the power output with the transmitter operating into a 50 ohm load. The dBi gain of the antenna(s) employed shall be reported.

Calculation Of EIRP For Integral Antenna:

If the antenna is not detachable from the circuit then the Peak Power Output is derived from the peak radiated field strength of the fundamental emission by using the plane wave relation $GP/4\pi R^2 = E^2/120\pi$ and proceeding as follows:

$$P = \frac{E^2 R^2}{30G} = \frac{E^2 3^2}{30G}$$

where,

P = the equivalent isotropic radiated power in watts

E = the maximum measured field strength in V/m

R = the measurement range (3 meters)

G = the numeric gain of the transmit antenna in relation to an isotropic radiator

The RBW of the spectrum analyzer shall be set to a value greater than the measured 6 dB occupied bandwidth of the E.U.T.

Number of channels tested:

Tuning range	Number of channels tested	Channel location in band
1 MHz or less	1	middle
1 to 10 MHz	2	top and bottom
more than 10 MHz	3	top, middle, bottom

NAME OF TEST: RF Exposure	PARA. NO.: 15.247(b)(4)
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Minimum Standard:

Systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines stipulated in 1.1307(b)(1) of CFR 47.

NAME OF TEST: Spurious Emissions(conducted)

PARA. NO.: 15.247(c)

Minimum Standard:

In any 100kHz bandwidth outside the frequency band in which the transmitter is operating, emissions shall be at least 20 dB below the fundamental emission or shall not exceed the following field strength limits. Emissions falling in the restricted bands of 15.205 shall not exceed the following field strength limits:

Frequency (MHz)	Field Strength (mV/m @ 3m)	Field Strength (dB @ 3m)
30 - 88	100	40.0
88 - 216	150	43.5
216 - 960	200	46.0
Above 960	500	54.0

THE SPECTRUM IS SEARCHED TO THE 10th HARMONIC OF THE HIGHEST FREQUENCY GENERATED IN THE EUT.

Method Of Measurement:

30 MHz - 10th harmonic plot

RBW: 100 kHz

VBW: 300 kHz

Sweep: Auto

Display line: -20 dBc

Lower Band Edge

RBW: At least 1% of span/div.

VBW: >RBW

Span: As necessary to display any spurious at band edge.

Sweep: Auto

Center Frequency: 902 MHz, 2400 MHz, or 5725 MHz

Marker: Peak of fundamental emission

Marker Δ: Peak of highest spurious level below center frequency.

Upper Band Edge

RBW: At least 1% of span/div.

VBW: >RBW

Span: As necessary to display any spurious at band edge.

Sweep: Auto

Center Frequency: 928 MHz, 2483.5 MHz, or 5850 MHz

Marker: Peak of fundamental emission

Marker Δ: Peak of highest spurious level above center frequency.

Number of channels tested:

Tuning range	Number of channels tested	Channel location in band
1 MHz or less	1	middle
1 to 10 MHz	2	top and bottom
more than 10 MHz	3	top, middle, bottom

NAME OF TEST: Radiated Spurious Emissions

PARA. NO.: 15.247(c)

Minimum Standard:

In any 100kHz bandwidth outside the frequency band in which the transmitter is operating, emissions shall be at least 20 dB below the fundamental emission or shall not exceed the following field strength limits:

Emissions falling in the restricted bands of 15.205 shall not exceed the following field strength limits:

Frequency (MHz)	Field Strength (mV/m @ 3m)	Field Strength (dB @ 3m)
30 - 88	100	40.0
88 - 216	150	43.5
216 - 960	200	46.0
Above 960	500	54.0

THE SPECTRUM WAS SEARCHED TO THE 10th HARMONIC

15.205 Restricted Bands

MHz	MHz	MHz	GHz
0.09-0.11	16.42-16.423	399.9-410	4.5-5.25
0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.125-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2655-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	Above 38.6
13.36-13.41	1718		

Number of channels tested:

Tuning range	Number of channels tested	Channel location in band
1 MHz or less	1	middle
1 to 10 MHz	2	top and bottom
more than 10 MHz	3	top, middle, bottom

NAME OF TEST: Transmitter Power Density

PARA. NO.: 15.247(d)

Minimum Standard: The transmitted power density averaged over any 1 second interval shall not be greater than +8 dBm in any 3 kHz bandwidth.

Method Of Measurement: The spectrum analyzer is set as follows:

RBW: 3 kHz

VBW: >3 kHz

Span: => measured 6 dB bandwidth

Sweep: Span(kHz)/3 (i.e. for a span of 1.5 MHz the sweep rate is $1500/3 = 500$ sec.

LOG dB/div.: 2 dB

Note: For devices with spectrum line spacing ≤ 3 kHz, the RBW of the analyzer is reduced until the spectral lines are resolved. The measurement data is normalized to 3 kHz by summing the power of all the individual spectral lines within a 3 kHz band in linear power units.

For Devices With Integral Antenna:

For devices with non-detachable antennas, the received field strength is peaked and the spectrum analyzer is set as above. The peak emission level is then measured and converted to a field strength by adding the appropriate antenna factor and cable loss. This field strength is then converted to an equivalent isotropic radiated power using the same method as described for Peak Power output.

Number of channels tested:

Tuning Range	Number Of Channels Tested	Channel Location In Band
1 MHz or Less	1	Middle
1 to 10 MHz	2	Top And Bottom
More Than 10 MHz	3	Top, Middle, Bottom

NAME OF TEST: Processing Gain

PARA. NO.: 15.247(e)

Minimum Standard: The processing gain shall be at least 10 dB.

Method Of Measurement: The CW jamming margin method was used to determine the processing gain. A CW signal generator is stepped across the passband of the receiver in 50 kHz increments. At each point the signal generator level required to obtain the recommended bit error rate is recorded. The jammer to signal ratio (J/S) is then calculated. The worst 20% of the J/S points is discarded. The lowest remaining J/S ratio is used to calculate the processing gain.

Calculation Of Processing Gain:

The processing gain was determined by measuring the jamming margin of the E.U.T. and using the following formula:

$$\text{Jamming Margin} = G_p - (S/N)_{\text{out}} - L_{\text{sys}}$$

For a receiver using non-coherent detection the value $(S/N)_{\text{out}}$ is calculated using the formula:

$P_e = (1/2)\text{EXP}\{-E/2N_o\}$ where P_e is the probability of error (minimum Bit Error Rate required for proper operation).

E/N_o is $(S/N)_{\text{out}}$

for example, for a bit error rate of 10^{-4} a S/N ratio of 12.3 dB is required.

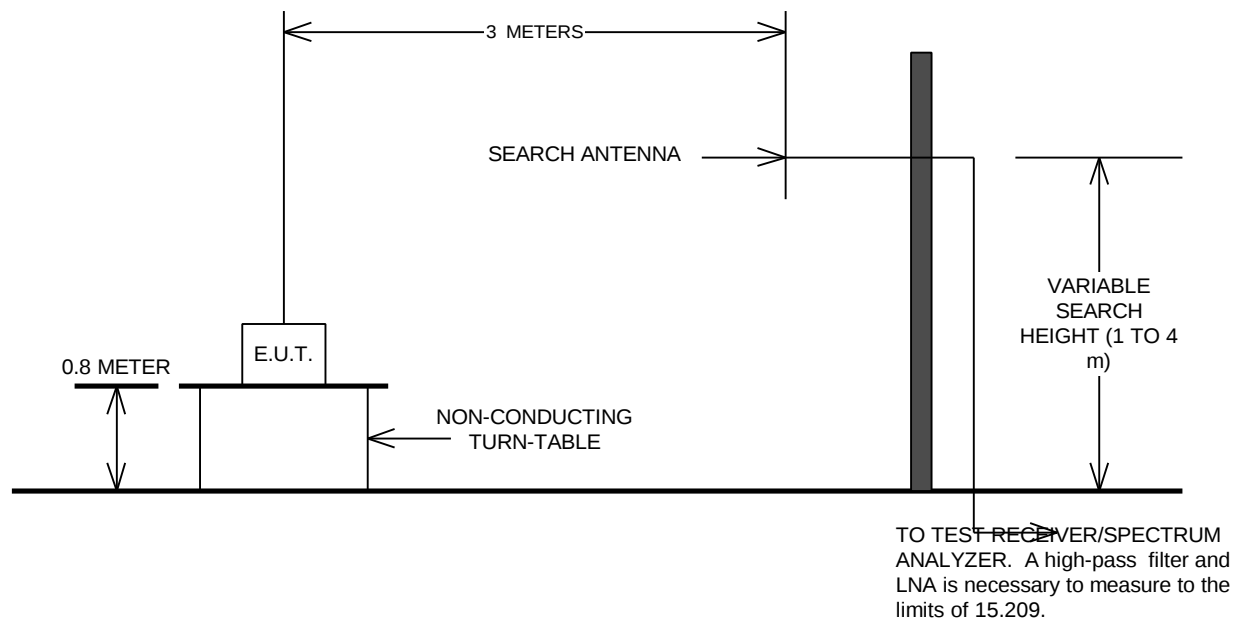
L_{sys} (system losses) is assumed to be 2 dB.

Therefore $G_p = M_j + (S/N)_{\text{out}} + L_{\text{sys}}$

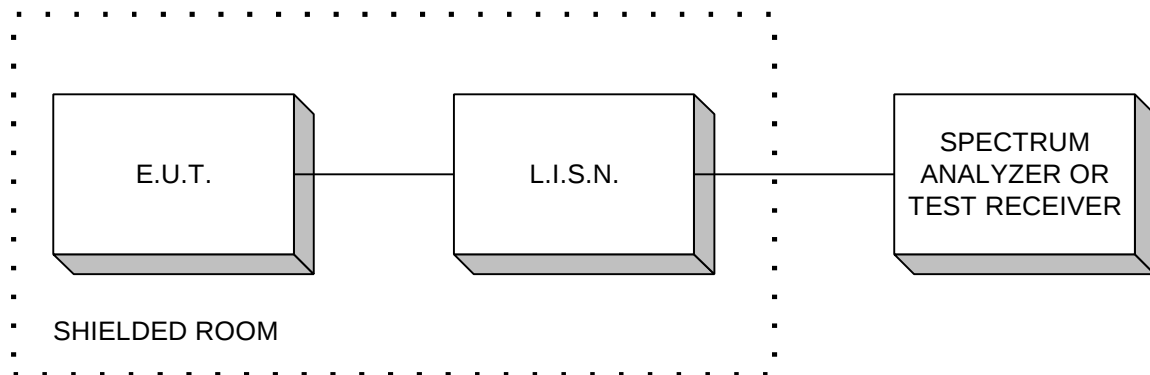
Measurement performed at a channel in the center of the operating band of the EUT.

ANNEX B - TEST DIAGRAMS

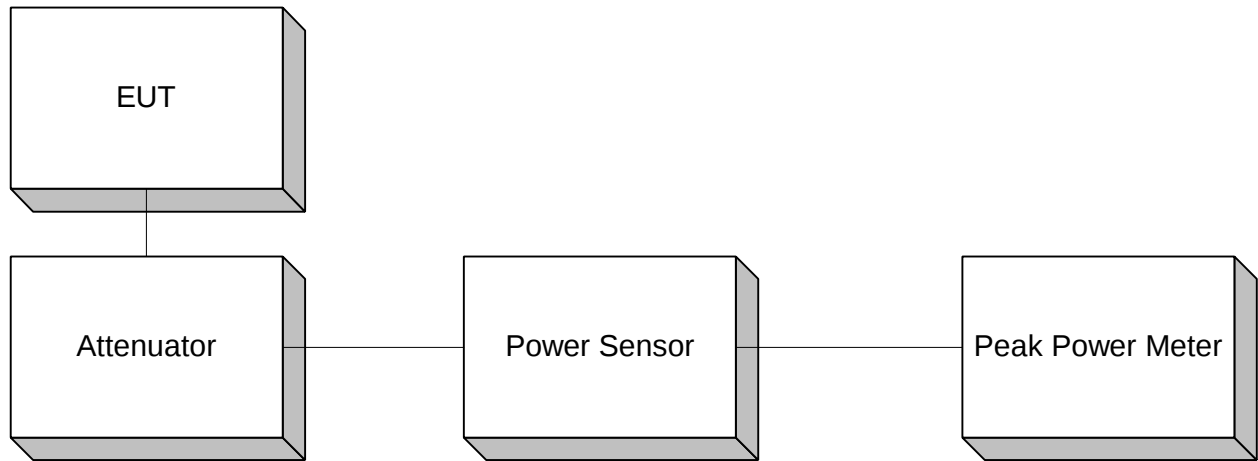
Test Site For Radiated Emissions



Conducted Emissions



Peak Power At Antenna Terminals



Minimum 6 dB Bandwidth Peak Power Spectral Density Spurious Emissions (conducted)



Processing Gain

