

Nemko Test Report: 2L0041RUS6

Applicant: Navini Networks
2240 Campbell Creek Blvd. Suite 110
Richardson, TX 75082

**Equipment Under Test:
(E.U.T.)** 2.4 GHz CPE, Release 1

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, Wireless Group Manager

Date: 8/28/02

Total Number of Pages: 48

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Section 1. Summary of Test Results

Manufacturer: Navini Networks

Model No.: 2.4 GHz CPE, Release 1

Serial No.: 001

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.	RESULT
Powerline Conducted Emissions	15.207(a)	48 dB μ V	Complies
Minimum 6 dB Bandwidth	15.247(a)(2)	>500 kHz	Complies
Maximum Peak Power Output	15.247(b)(1)	<1 Watt	Complies
Spurious Emissions (Antenna Conducted)	15.247(c)	-20 dBc/100kHz	Complies
Spurious Emissions (Restricted Bands)	15.247(c)	< 74 dBuV/m Peak < 54 dBuV/m Avg	Complies
Peak Power Spectral Density	15.247(d)	+8 dBm/3kHz	Complies

Footnotes:

¹It is Navini's understanding that measurements to determine the minimum processing gain will not be required subsequent to the Commission's adoption of the Second Report and Order in ET Docket No. 99231.

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

General Equipment Information

Operating Band: 2.4012 GHz – 2.4785 GHz

User Frequency Adjustment: Software controlled. Not adjustable by user.

Description of Modification for Modification Filing

Not Applicable

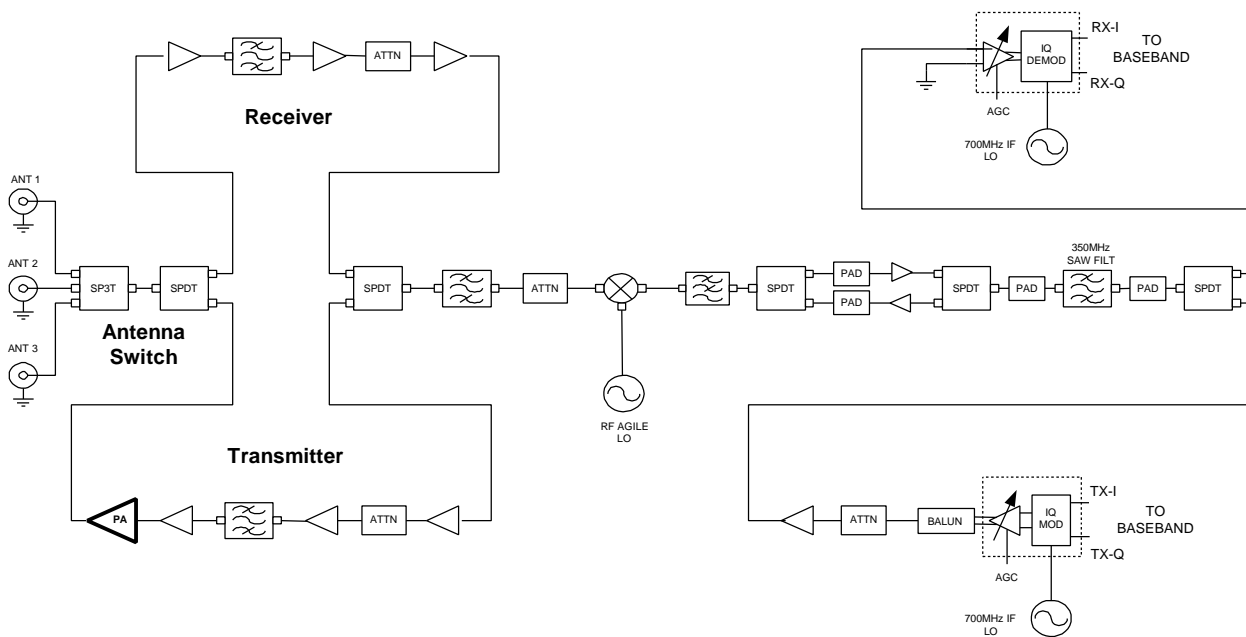
Family List Rational

Not Applicable

Description of Operation

The EUT is a CPE (Customer Premise Equipment) transceiver operating in the 2.4 GHz band. The transceiver serves as a wireless link between a BTS and a customer site. The EUT uses a multi-antenna system for improved coverage and diversity. **Only one antenna transmits at any time.** The transmitter is digitally modulated and produces a spread spectrum waveform.

System Diagram



Section 3. Powerline Conducted Emissions

NAME OF TEST: Powerline Conducted Emissions	PARA. NO.: 15.207(a)
TESTED BY: David Light	DATE:4/10/2002

Test Results: Complies.

Measurement Data: See attached plots.

Measurement Uncertainty: +/- 1.7 dB

NOTE: The device can be supplied with one of three possible power supplies. In the following data tables these are identified as shown below:

- Power Supply #1 – Phihong PSA10A-050**
- Power Supply #2 – Phihong PSC15A-050S**
- Power Supply #3 – Achme AM138B05S10**

Test Data – Powerline Conducted Emissions, Power Supply #1



Dallas Headquarters: 802 N. Kealy, Lewisville, TX 75057, Tel: (972) 436-9600, Fax: (972) 436-2667

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Data Plot **Powerline Conducted Emissions**

Page 1 of 2 Complete X
Preliminary: _____

Job No.: 2L0041R Date: 4/10/2002
Specification: 15.207 Temperature(°C): 22
Tested By: David Light Relative Humidity(%): 40
E.U.T.: 2.4 GHz CPE
Configuration: TX FULL POWER

Sample Number: 1
Location: Lab 4 RBW: 10 kHz Measurement
Detector Type: Peak VBW: 10 kHz Distance: _____ m

Test Equipment Used

Antenna: _____ L.I.S.N. 1258
Pre-Amp: _____ Cable #1: 1534
Filter: 1555 Cable #2: 1038
Receiver: 1036 Cable #3: _____
Attenuator #1: _____ Cable #4: _____
Attenuator #2: _____ Limiter 674

Additional equipment used: _____
Measurement Uncertainty: +/-1.7 dB

Marker 1 [11] RBW 10 kHz RF Att 10 dB
Ref Lvl 44.05 dBμV VBW 10 kHz
93.9 dBμV 3.05561122 MHz SWT 740 ms Unit dBμV

Start 450 kHz 2.955 MHz Stop 30 MHz

Date: 10.APR.2002 12:31:17

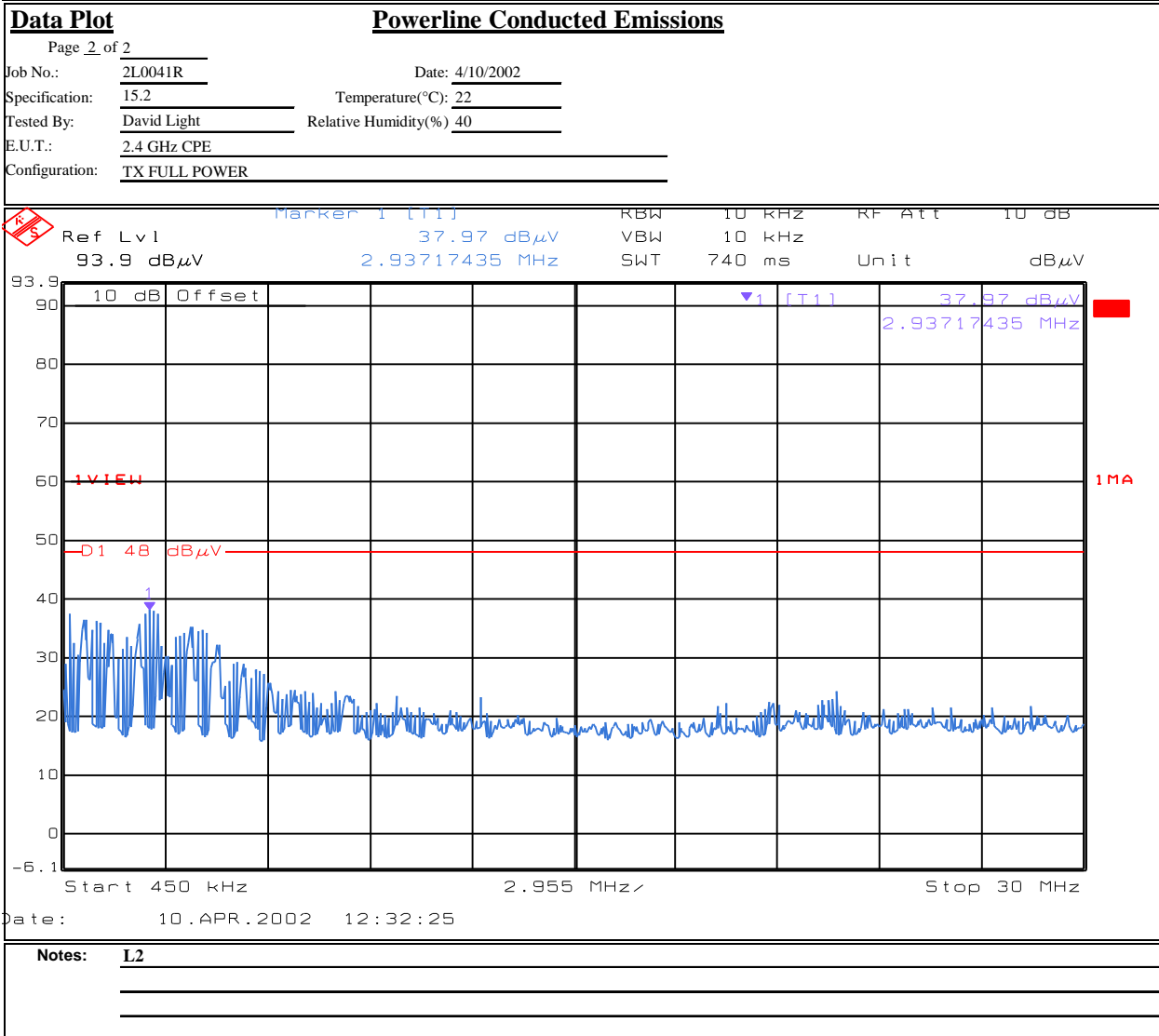
Notes: L1

Test Data – Powerline Conducted Emissions, Power Supply #1



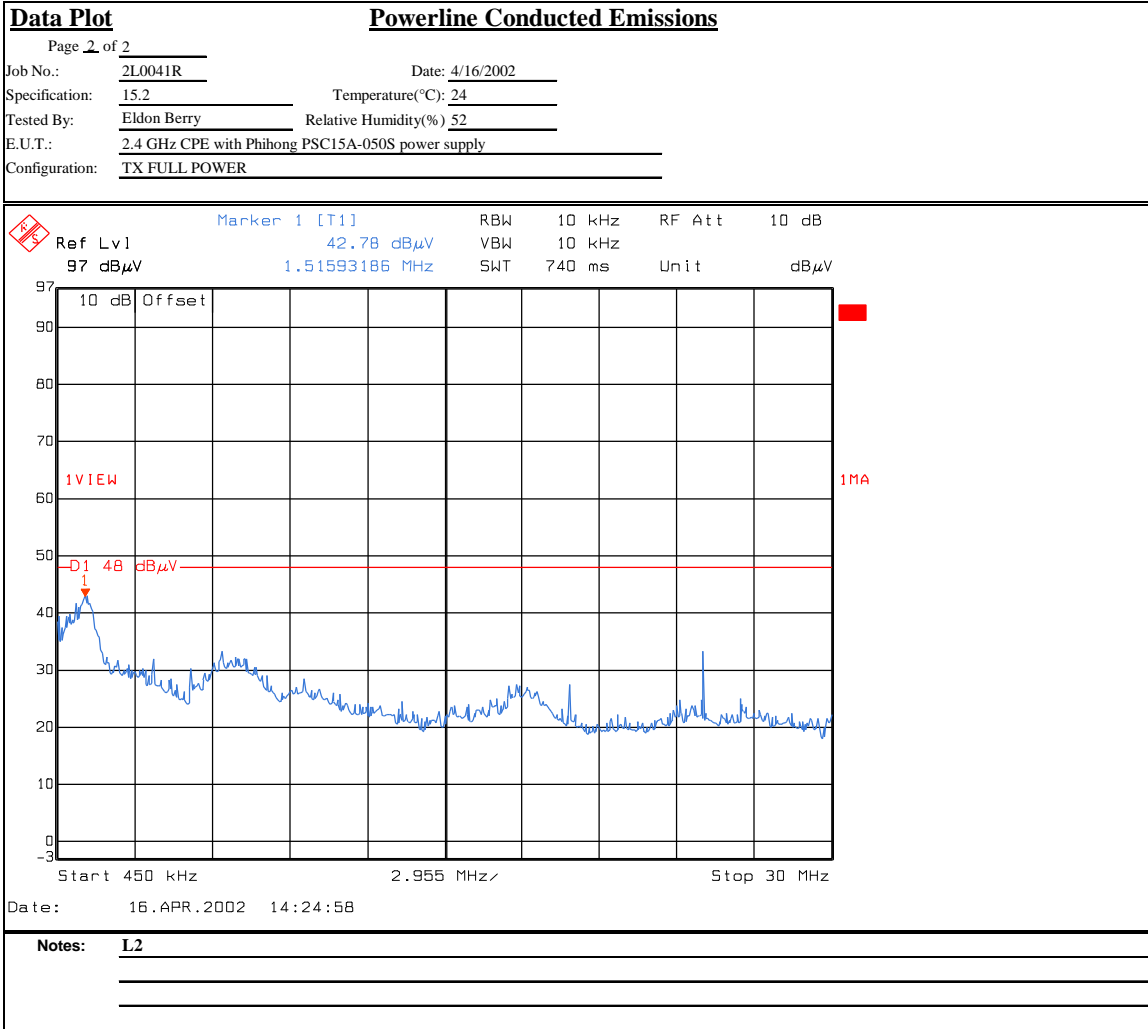
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Test Data – Powerline Conducted Emissions, Power Supply #2

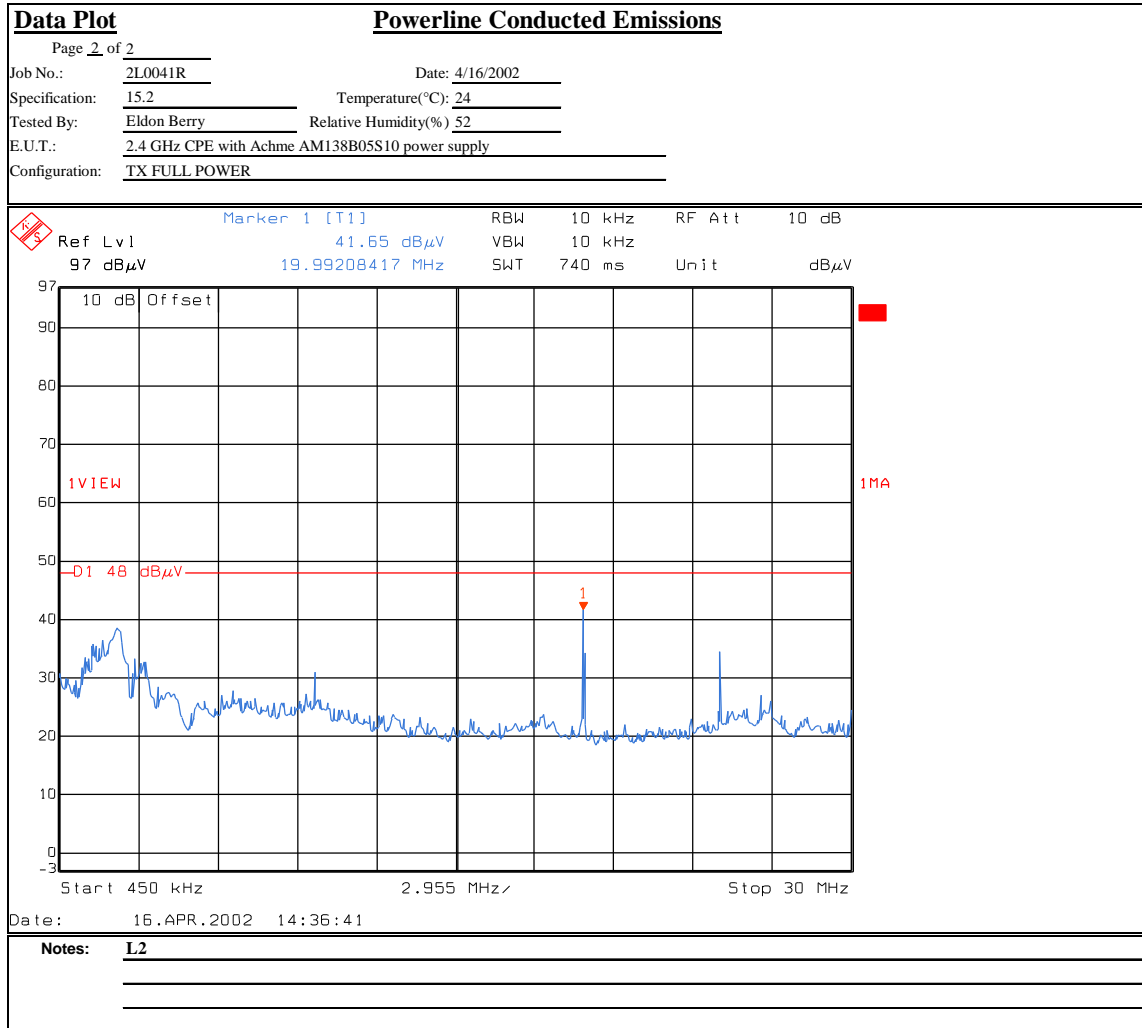
<u>Data Plot</u>		<u>Powerline Conducted Emissions</u>	
Page 1 of 2		Complete <u> X </u>	
Job No.:	2L0041R	Date:	4/16/2002
Specification:	15.207	Temperature(°C):	24
Tested By:	Eldon Berry	Relative Humidity(%):	52
E.U.T.:	2.4 GHz CPE with Pihong PSC15A-050S power supply		
Configuration:	TX FULL POWER		
Sample Number:	1		
Location:	Lab 4	RBW:	10 kHz
Detector Type:	Peak	VBW:	10 kHz
		Measurement Distance:	_____ m
Test Equipment Used			
Antenna:	_____	L.I.S.N.:	1258
Pre-Amp:	_____	Cable #1:	1534
Filter:	1555	Cable #2:	1038
Receiver:	1036	Cable #3:	_____
Attenuator #1:	_____	Cable #4:	_____
Attenuator #2:	_____	Limiter:	674
Additional equipment used:	_____		
Measurement Uncertainty:	+/-1.7 dB		
Marker 1 [T1] Ref Lvl 97 dBµV 40.10 dBµV 1.63436874 MHz		RBW 10 kHz VBW 10 kHz SWT 740 ms	RF Att 10 dB Unit dBµV
Start 450 kHz 2.955 MHz Stop 30 MHz			
Date: 16.APR.2002 14:28:47			
Notes: <u> L1 </u>			



Test Data – Powerline Conducted Emissions, Power Supply #3

<u>Data Plot</u>		<u>Powerline Conducted Emissions</u>																
Page 1 of 2																		
Job No.: 2L0041R	Date: 4/16/2002	Complete: <u>X</u>	Preliminary: _____															
Specification: 15.207	Temperature(°C): <u>24</u>																	
Tested By: Eldon Berry	Relative Humidity(%): <u>52</u>																	
E.U.T.: 2.4 GHz CPE with Achme AM138B05S10 power supply																		
Configuration: TX FULL POWER																		
Sample Number: <u>1</u>																		
Location: <u>Lab 4</u>	RBW: <u>10 kHz</u>	Measurement Distance: _____ m																
Detector Type: <u>Peak</u>	VBW: <u>10 kHz</u>																	
Test Equipment Used																		
Antenna: _____	L.I.S.N.: <u>1258</u>																	
Pre-Amp: _____	Cable #1: <u>1534</u>																	
Filter: <u>1555</u>	Cable #2: <u>1038</u>																	
Receiver: <u>1036</u>	Cable #3: _____																	
Attenuator #1: _____	Cable #4: _____																	
Attenuator #2: _____	Limiters: <u>674</u>																	
Additional equipment used: _____																		
Measurement Uncertainty: <u>+/-1.7 dB</u>																		
<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td style="width:30%;"></td> <td style="width:30%;">Marker 1 [T1]</td> <td style="width:10%;">RBW 10 kHz</td> <td style="width:10%;">RF Att 10 dB</td> <td style="width:10%;"></td> </tr> <tr> <td>Ref Lvl</td> <td>40.25 dBµV</td> <td>VBW 10 kHz</td> <td></td> <td></td> </tr> <tr> <td>97 dBµV</td> <td>19.99208417 MHz</td> <td>SWT 740 ms</td> <td>Unit dBµV</td> <td></td> </tr> </table>					Marker 1 [T1]	RBW 10 kHz	RF Att 10 dB		Ref Lvl	40.25 dBµV	VBW 10 kHz			97 dBµV	19.99208417 MHz	SWT 740 ms	Unit dBµV	
	Marker 1 [T1]	RBW 10 kHz	RF Att 10 dB															
Ref Lvl	40.25 dBµV	VBW 10 kHz																
97 dBµV	19.99208417 MHz	SWT 740 ms	Unit dBµV															
Start 450 kHz 2.955 MHz Stop 30 MHz																		
Date: 16.APR.2002 14:35:01																		
Notes: <u>L1</u>																		

Test Data – Powerline Conducted Emissions, Power Supply #3



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: 4/10/2002

Test Results: Complies.

Measurement Data:

Measured 6 dB bandwidth: **1.96 MHz**

Measurement Uncertainty: +/- 0.7 dB

Test Data – 6 dB Bandwidth



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 Tel: (972) 436-9600
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Data Plot		Occupied Bandwidth		Complete <u>X</u>																													
Page <u>1</u> of <u>3</u>		Date: <u>4/10/2002</u>		Preliminary: _____																													
Job No.:	<u>2L0041R</u>	Specification:	<u>15.247</u>	Temperature(°C):	<u>22</u>																												
Tested By:	<u>David Light</u>	Relative Humidity(%):	<u>40</u>																														
E.U.T.:	<u>2.4 GHz CPE</u>																																
Configuration:	<u>Tx IN TEST FIXTURE</u>																																
Sample Number:	<u>1</u>																																
Location:	<u>Lab 2</u>	RBW:	<u>100 kHz</u>	Measurement																													
Detector Type:	<u>Peak</u>	VBW:	<u>100 kHz</u>	Distance:	<u>N/A</u> m																												
Test Equipment Used																																	
Antenna:	_____	Directional Coupler:	_____																														
Pre-Amp:	_____	Cable #1:	<u>1629</u>																														
Filter:	_____	Cable #2:	_____																														
Receiver:	<u>1036</u>	Cable #3:	_____																														
Attenuator #1:	<u>1469</u>	Cable #4:	_____																														
Attenuator #2:	_____	Mixer:	_____																														
Additional equipment used:	<u>Anaren 20 dB Directional coupler Model IC0872-20, 0.5-4.0 GHz</u>																																
Measurement Uncertainty:	<u>+/-1.7 dB</u>																																
<table border="1"> <thead> <tr> <th>Ref</th> <th>Lvl</th> <th>Marker 1 [T1]</th> <th>RBW</th> <th>100 kHz</th> <th>RF Att</th> <th>30 dB</th> </tr> </thead> <tbody> <tr> <td></td> <td><u>37.8 dBm</u></td> <td><u>12.87 dBm</u></td> <td></td> <td><u>100 kHz</u></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td><u>2.43901303 GHz</u></td> <td></td> <td><u>100 kHz</u></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td><u>5 ms</u></td> <td></td> <td><u>dBm</u></td> </tr> </tbody> </table>						Ref	Lvl	Marker 1 [T1]	RBW	100 kHz	RF Att	30 dB		<u>37.8 dBm</u>	<u>12.87 dBm</u>		<u>100 kHz</u>					<u>2.43901303 GHz</u>		<u>100 kHz</u>							<u>5 ms</u>		<u>dBm</u>
Ref	Lvl	Marker 1 [T1]	RBW	100 kHz	RF Att	30 dB																											
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		<u>2.43901303 GHz</u>		<u>100 kHz</u>																													
				<u>5 ms</u>		<u>dBm</u>																											
<p>Center <u>2.44 GHz</u> <u>500 kHz</u> Span <u>5 MHz</u></p>																																	
Date: <u>10.APR.2002 10:37:33</u>																																	
Notes: <u>Mid channel</u>																																	

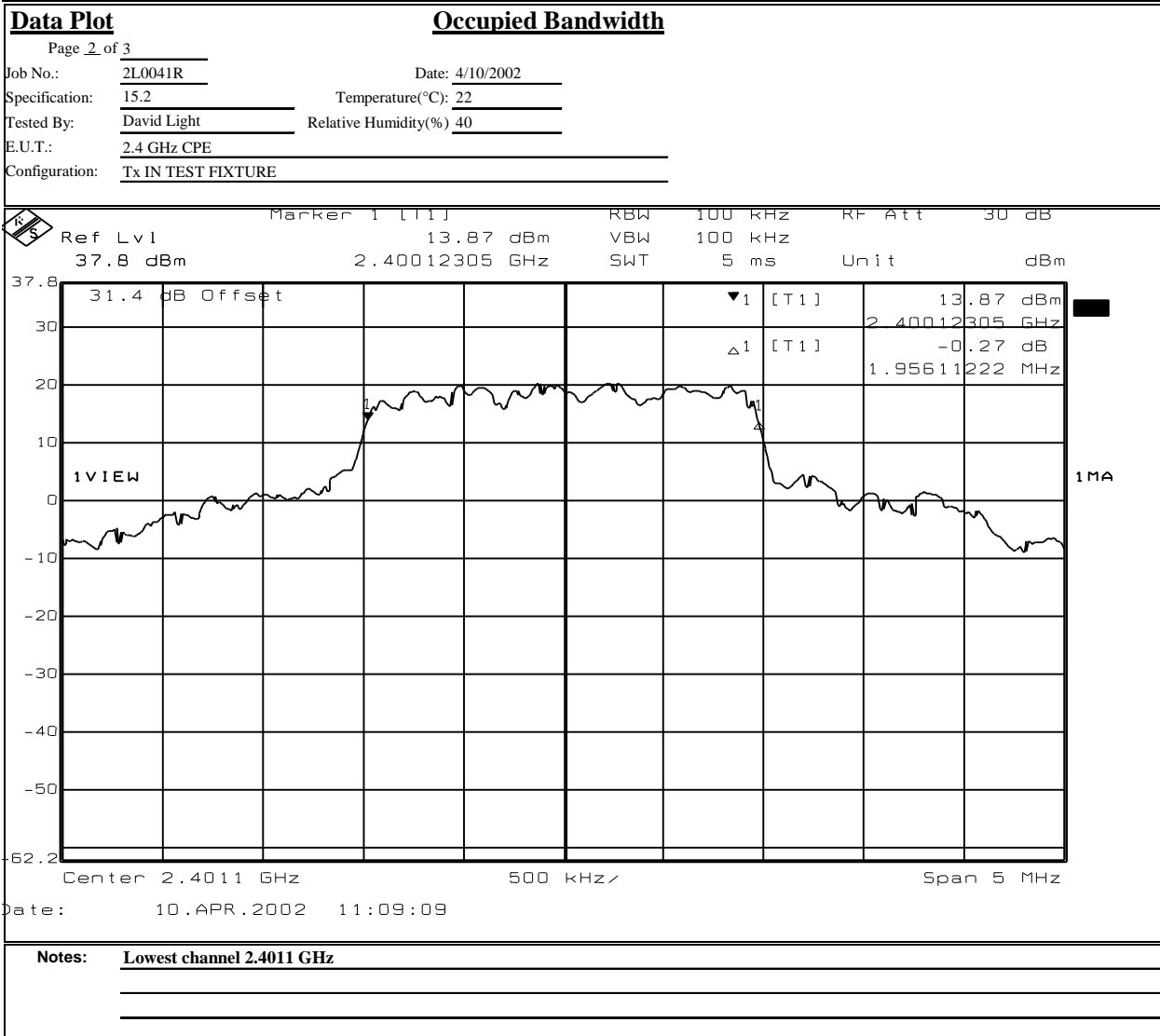
Test Data – 6 dB Bandwidth



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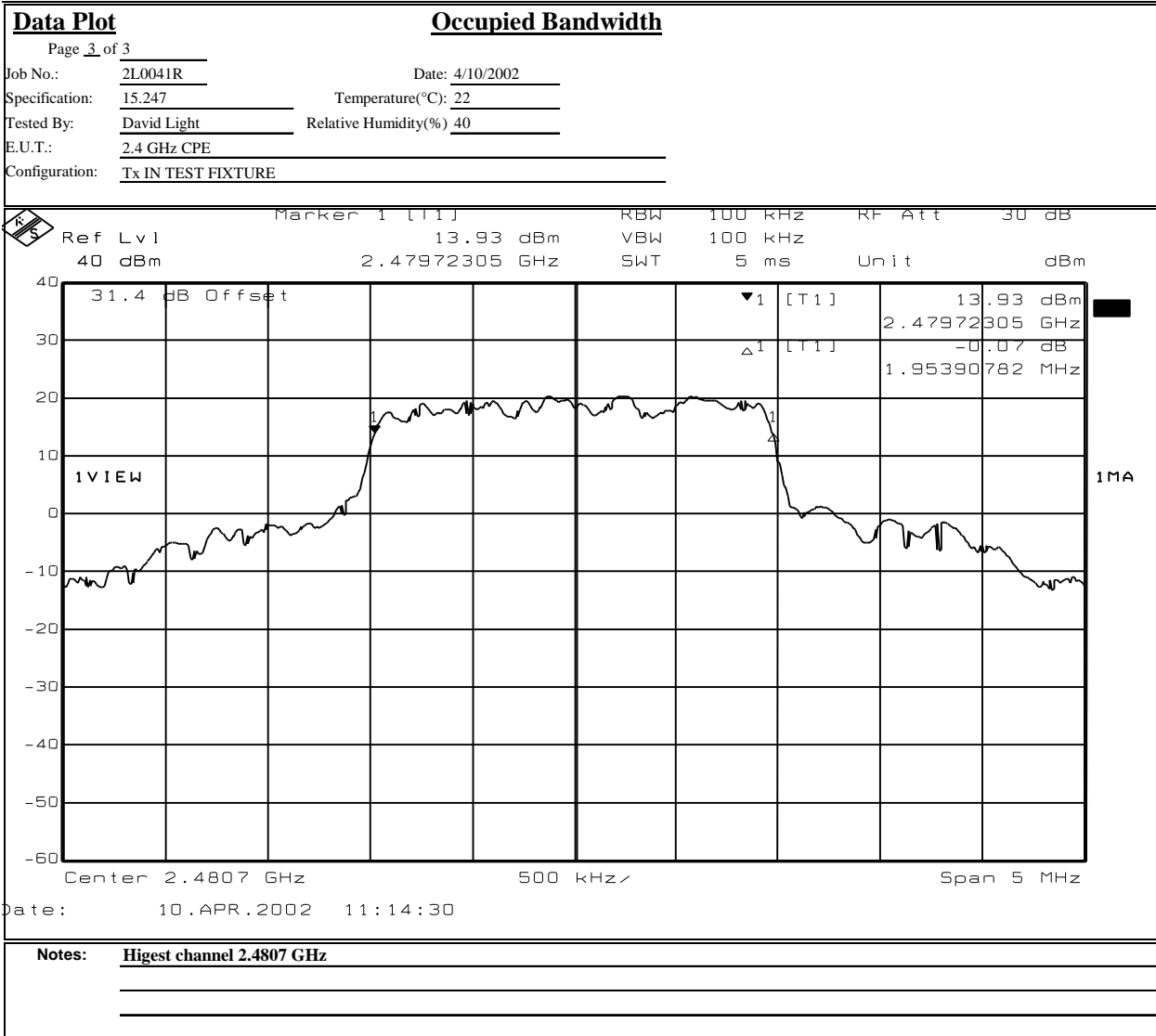
Test Data – 6 dB Bandwidth



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Section 5. Maximum Peak Output Power

NAME OF TEST: Maximum Peak Output power	PARA. NO.: 15.247(b)(1)
TESTED BY: David Light	DATE: 04/10/2002

Test Results: Complies.

Measurement Data:

Channel	Freq (GHz)	Measurement (dBm)	Measurement (Watts)
High	2.4785	28.3	0.676
Mid	2.4400	28.3	0.676
Low	2.4011	28.3	0.676

Note – AC supply voltage was varied +/- 15% with no effect on output power

Equipment Used: 1036-1469-1926
Anaren 20 dB directional coupler Model 1C0870-20 (0.5-4.0 GHz)

Measurement Uncertainty: +/- 0.67 dB

Temperature: 22 °C

Relative Humidity: 40 %

Section 6. RF Exposure

NAME OF TEST: RF Exposure	PARA. NO.: 15.247(b)(4)
TESTED BY:	DATE:

Test Results: Complies.

Measurement Data: See attached data sheet.

FCC ID: PL6-ISM-CPE-R1
Prediction of MPE Limit
OET Bulletin 65, Edition 97-01

Equation from page 18

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

$$R = \sqrt{\frac{PG}{4\pi S}}$$

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

Choose

↓

Occupational/Controlled -(BTS)

General Population/Uncontrolled -(CPE)

ENTER

↓

Tx Frequency: (MHz)

Maximum Peak Power at Antenna Input Terminal: (dBm)

Antenna gain (typical) of highest gain antenna (Patch): (dBi)

S= 1.00 (mW/cm²)

P= 676.08 (mW)

G= 5.01 (numeric)

R = 16.42 (cm)

NOTE: The following warning must appear in the installation manual.

CAUTION:

This device is a radio frequency transmitter. It is required to comply with FCC RF exposure requirements for mobile transmitting devices. A minimum separation distance of **20.00** cm or more must be maintained between the antenna and all persons during device operations to ensure compliance with the FCC's rules for Radio Frequency Exposure. If this minimum distance cannot be maintained, exposure to RF levels that exceed the FCC's limits may result.

Section 7. Spurious Emissions (conducted)

NAME OF TEST: Spurious Emissions (conducted)	PARA. NO.: 15.247(c)
TESTED BY: David Light	DATE: 4/10/2002

Test Results: Complies.

Measurement Data: See attached plots.

Measurement Uncertainty: +/- 0.7 dB

Test Data – Spurious Emissions at Antenna Terminals



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Data Plot		Spurious Emissions at Antenna Terminals																									
Page <u>1</u> of <u>3</u>		Complete <u>X</u>	Preliminary: _____																								
Job No.: 2L0041R	Date: <u>4/10/2002</u>																										
Specification: 15.247	Temperature(°C): <u>22</u>																										
Tested By: <u>David Light</u>	Relative Humidity(%): <u>40</u>																										
E.U.T.: <u>2.4 GHz CPE</u>																											
Configuration: <u>Tx IN TEST FIXTURE</u>																											
Sample Number: <u>1</u>																											
Location: <u>Lab 2</u>	RBW: <u>100 kHz</u>	Measurement																									
Detector Type: <u>Peak</u>	VBW: <u>100 kHz</u>	Distance: <u>N/A</u> m																									
Test Equipment Used																											
Antenna: _____	Directional Coupler: _____																										
Pre-Amp: _____	Cable #1: <u>1629</u>																										
Filter: _____	Cable #2: _____																										
Receiver: <u>1036</u>	Cable #3: _____																										
Attenuator #1: <u>1469</u>	Cable #4: _____																										
Attenuator #2: _____	Mixer: _____																										
Additional equipment used: <u>Anaren 20 dB Directional coupler Model 1C0872-20, 0.5-4.0 GHz</u>																											
Measurement Uncertainty: <u>+/-1.7 dB</u>																											
<table border="1"> <tr> <td>Ref Lvl</td> <td>27.8 dBm</td> <td>Marker 1 [T1]</td> <td>19.49 dBm</td> <td>RBW</td> <td>100 kHz</td> <td>RF Att</td> <td>20 dB</td> </tr> <tr> <td></td> <td></td> <td></td> <td>2.44000000 GHz</td> <td>VBW</td> <td>100 kHz</td> <td>Unit</td> <td>dBm</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td>SWT</td> <td>6.4 s</td> <td></td> <td></td> </tr> </table>				Ref Lvl	27.8 dBm	Marker 1 [T1]	19.49 dBm	RBW	100 kHz	RF Att	20 dB				2.44000000 GHz	VBW	100 kHz	Unit	dBm					SWT	6.4 s		
Ref Lvl	27.8 dBm	Marker 1 [T1]	19.49 dBm	RBW	100 kHz	RF Att	20 dB																				
			2.44000000 GHz	VBW	100 kHz	Unit	dBm																				
				SWT	6.4 s																						
<p>Center 12.515 GHz 2.497 GHz/ Span 24.97 GHz</p> <p>Date: 10.APR.2002 10:33:00</p>																											
<p>Notes: <u>Mid Channel - 2.4400 GHz</u> <u>Display line indicates -20 dBc</u> <u>Marker indicates Carrier</u></p>																											

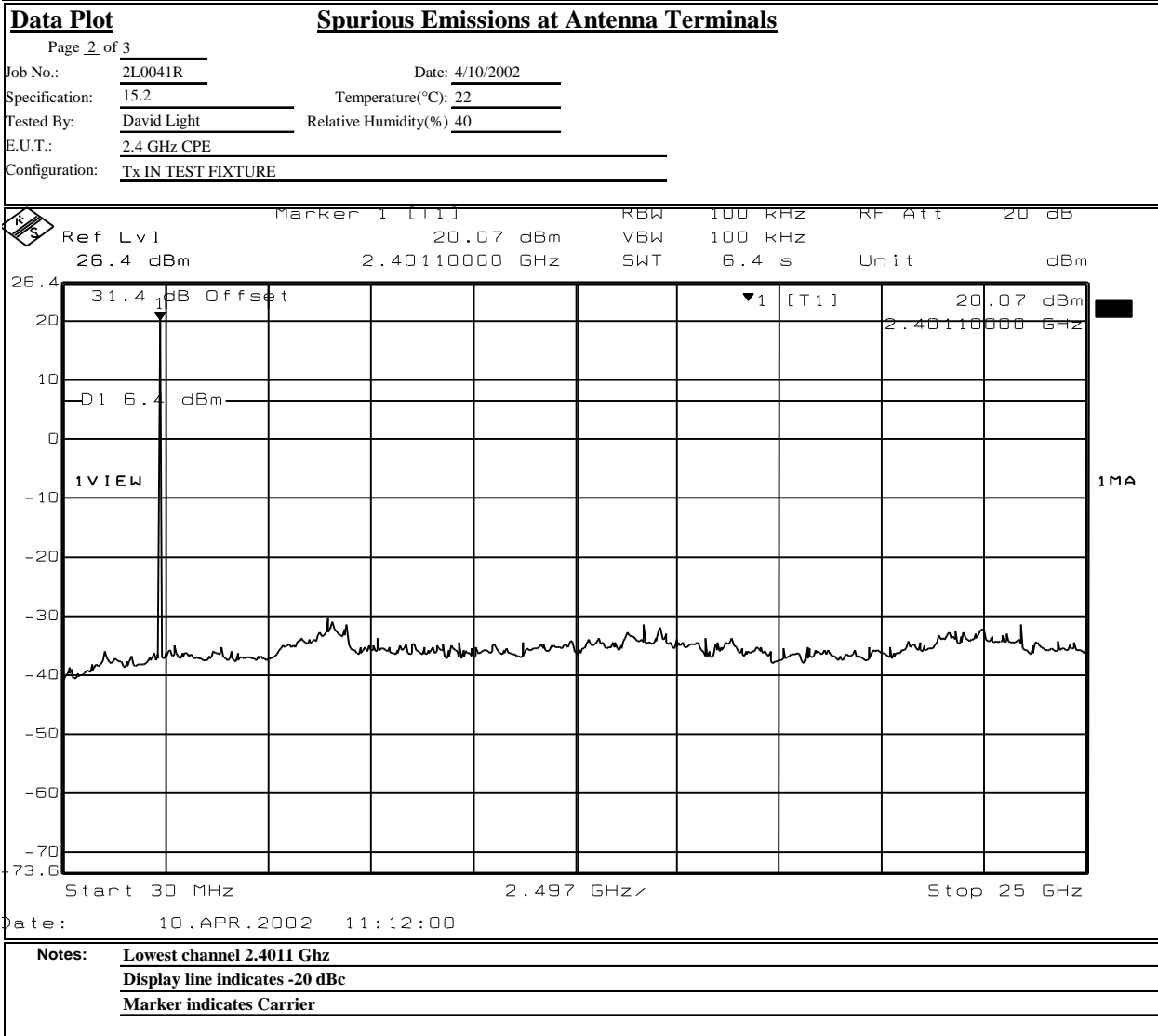
Test Data – Spurious Emissions at Antenna Terminals



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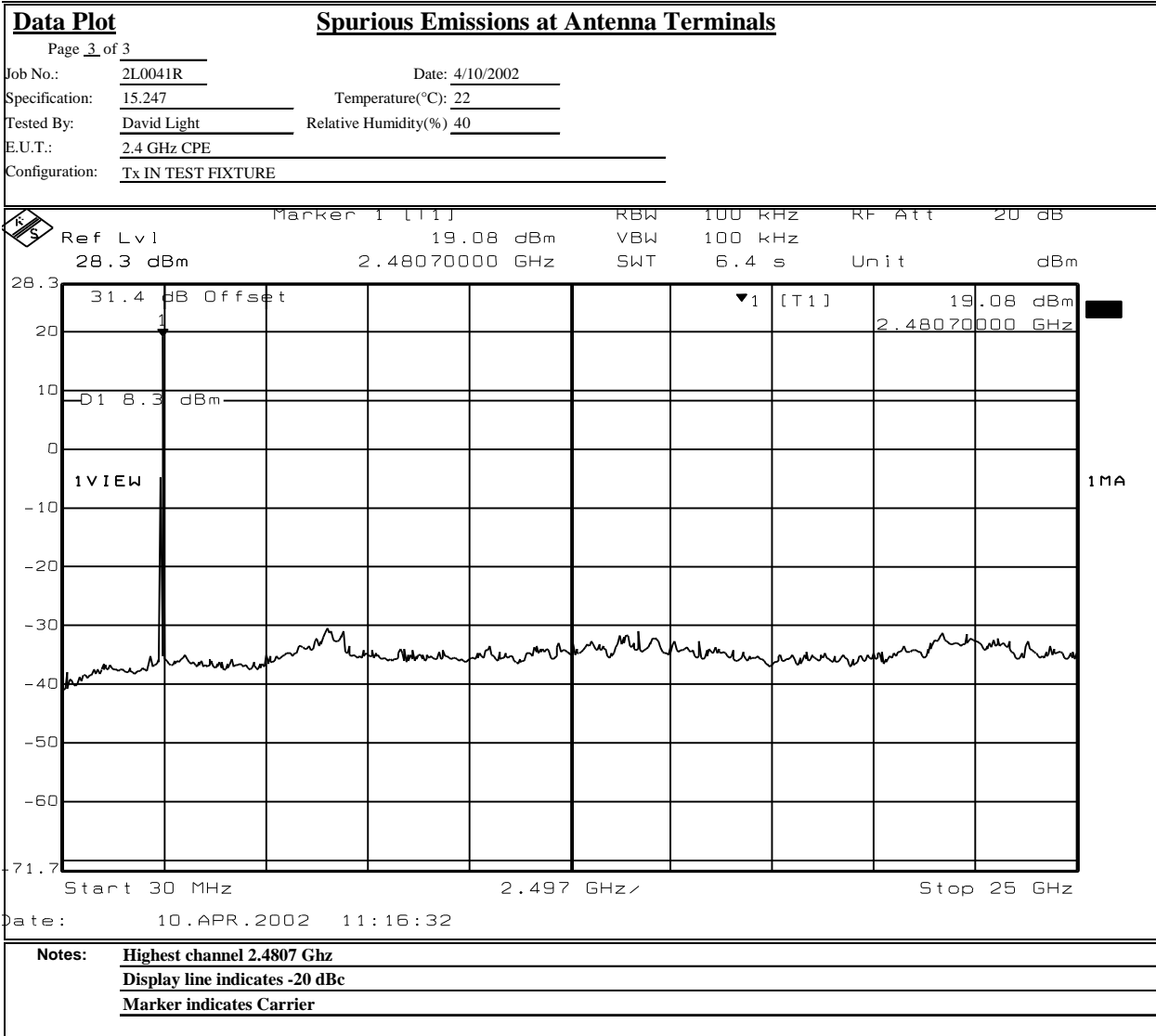
Test Data – Spurious Emissions at Antenna Terminals



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Dallas Headquarters:

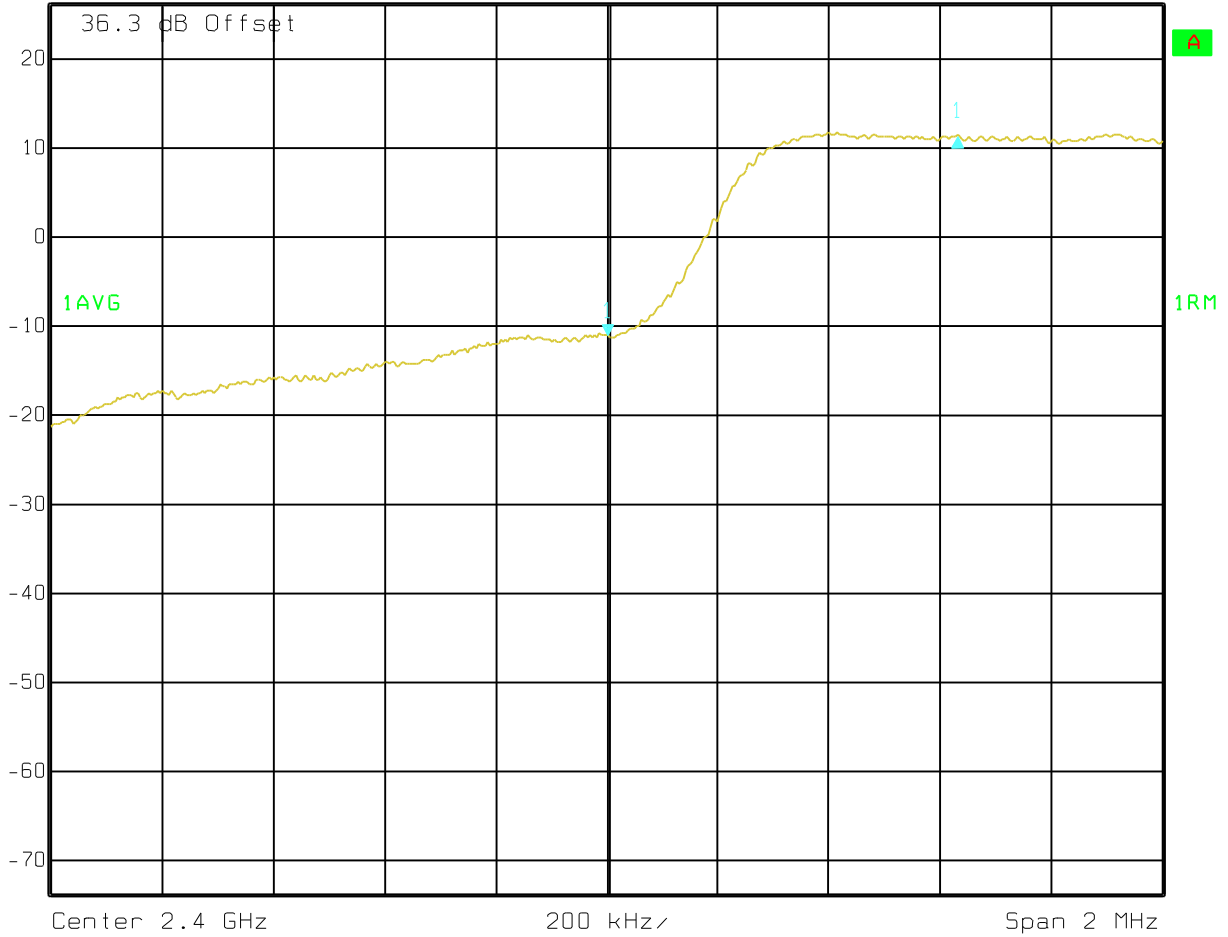
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Test Data – Spurious Emissions at Antenna Terminals



Ref Lvl	Delta 1 [T1]	RBW	100 kHz	RF Att	0 dB
26.3 dBm	22.44 dB	VBW	100 kHz	Mixer	-10 dBm
	631.26252505 kHz	SWT	5 ms	Unit	dBm



Date: 28.AUG.2002 10:39:36
Center of TX channel is 2.4012 GHz

Section 8. Spurious Emissions (radiated)

NAME OF TEST: Spurious Emissions (radiated)	PARA. NO.: 15.247 (c)
TESTED BY: David Light	DATE:4/9/2002

Test Results: Complies.

Measurement Data: See attached table.

NOTE: Where the measured peak value of an emission was found to be below the average limit, an average measurement was not taken.

Duty Cycle Calculation:

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

The transceiver was tested in CW mode for test purposes. In normal operation the transmitter is in TDD mode (50 ms transmit, 50 ms receive). The duty cycle factor for average measurements is – 6dB. The 6 dB correction factor was only used when measuring compliance at the band edge.

Measurement Uncertainty: +/- 0.7 dB

Test Data – Radiated Spurious Emissions (Restricted Bands)



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Radiated Emissions

Page 1 of 3

Job No.: _____ Date: 4/9/02
 Specification: _____ Temperature(°C): 22
 Tested By: David Light Relative Humidity(%) 40
 E.U.T.: _____ 2.4 GHz CPE
 Configuration: _____ TYPICAL / Tx Full Power
 Sample Number: 1
 Location: AC 3 RBW: 1 MHz
 Detector Type: Peak VBW: 1 MHz

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
 Anaron 20 dB directional coupler Model 1C0870-20 (0.5-4.0 GHz)

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
Tx @ 2.480 GHz								
4.960	48.5	33.9	4.3	33.5	53.2	74	-20.8	Patch 0 - Vertical Peak
4.960	37.5	33.9	4.3	33.5	42.2	54	-11.8	Average
7.440	41.3	36.3	5.3	33	49.9	54	-4.1	Peak
12.400	40.2	39.9	7.3	34.7	52.7	54	-1.3	Peak
Patch 0 - Horizontal								
4.960	44.5	33.9	4.3	33.5	49.2	54	-4.8	Peak
7.440	42.3	36.3	5.3	33	50.9	54	-3.1	Peak
12.400	40.2	39.9	7.3	34.7	52.7	54	-1.3	Peak
Patch 1 - Vertical								
4.960	45.5	33.9	4.3	33.5	50.2	54	-3.8	Peak
7.440	42.2	36.3	5.3	33	50.8	54	-3.2	Peak
12.400	40.8	39.9	7.3	34.7	53.3	54	-0.7	Peak
Patch 1 - Horizontal								
4.960	46.3	33.9	4.3	33.5	51.0	54	-3.0	Peak
7.440	41.8	36.3	5.3	33	50.4	54	-3.6	Peak
12.400	40.8	39.9	7.3	34.7	53.3	54	-0.7	Peak
Omni - Vertical								
4.960	50.5	33.9	4.3	33.5	55.2	74	-18.8	Peak
4.960	39.2	33.9	4.3	33.5	43.9	54	-10.1	Average
7.440	42	36.3	5.3	33	50.6	54	-3.4	Peak
12.400	40.8	39.9	7.3	34.7	53.3	54	-0.7	Peak
Omni - Horizontal								
4.960	45.2	33.9	4.3	33.5	49.9	54	-4.1	Peak
7.440	42	36.3	5.3	33	50.6	54	-3.4	Peak
12.400	40.8	39.9	7.3	34.7	53.3	54	-0.7	Peak
Notes:								

Test Data – Radiated Spurious Emissions (Restricted Bands)



Nemko Dallas, Inc.

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Radiated Spurious Emissions	
Page <u>1</u> of	Continuation Page
Job No.:	Date: 4/10/02
Specification: CFR 47, Part 15	Temperature(°F): <u>72</u>
Tested By: <u>#N/A</u>	Relative Humidity(%) <u>50</u>
E.U.T.:	<u>2.4 GHz CPE</u>
Configuration:	<u>TYPICAL / Tx Full Power</u>

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
Tx @ 2.44 Ghz								Patch 0 - Vertical
4.880	51.7	33.9	4.3	33.5	56.4	74	-17.6	Peak
4.880	43.2	33.9	4.3	33.5	47.9	54	-6.1	Average
7.320	38.2	36.3	5.3	33	46.8	54	-7.2	Peak
12.200	41	39.9	7.3	34.7	53.5	54	-0.5	Peak
Patch 0 - Horizontal								
4.880	45	33.9	4.3	33.5	49.7	54	-4.3	Peak
7.320	38.2	36.3	5.3	33	46.8	54	-7.2	Peak
12.200	41	39.9	7.3	34.7	53.5	54	-0.5	Peak
Patch 1 - Vertical								
4.880	46	33.9	4.3	33.5	50.7	54	-3.3	Peak
7.320	38.2	36.3	5.3	33	46.8	54	-7.2	Peak
12.200	41	39.9	7.3	34.7	53.5	54	-0.5	Peak
Patch 1 - Horizontal								
4.880	43.3	33.9	4.3	33.5	48.0	54	-6.0	Peak
7.320	38.2	36.3	5.3	33	46.8	54	-7.2	Peak
12.200	41	39.9	7.3	34.7	53.5	54	-0.5	Peak
Omni - Vertical								
4.880	48	33.9	4.3	33.5	52.7	74	-21.3	Peak
4.880	32.7	33.9	4.3	33.5	37.4	54	-16.6	Average
7.320	38.2	36.3	5.3	33	46.8	54	-7.2	Peak
12.200	41	39.9	7.3	34.7	53.5	54	-0.5	Peak
Omni - Horizontal								
4.880	45.3	33.9	4.3	33.5	50.0	54	-4.0	Peak
7.320	38.2	36.3	5.3	33	46.8	54	-7.2	Peak
12.200	41	39.9	7.3	34.7	53.5	54	-0.5	Peak
Notes:								

Test Data – Radiated Spurious Emissions (Restricted Bands)



Dallas Headquarters:

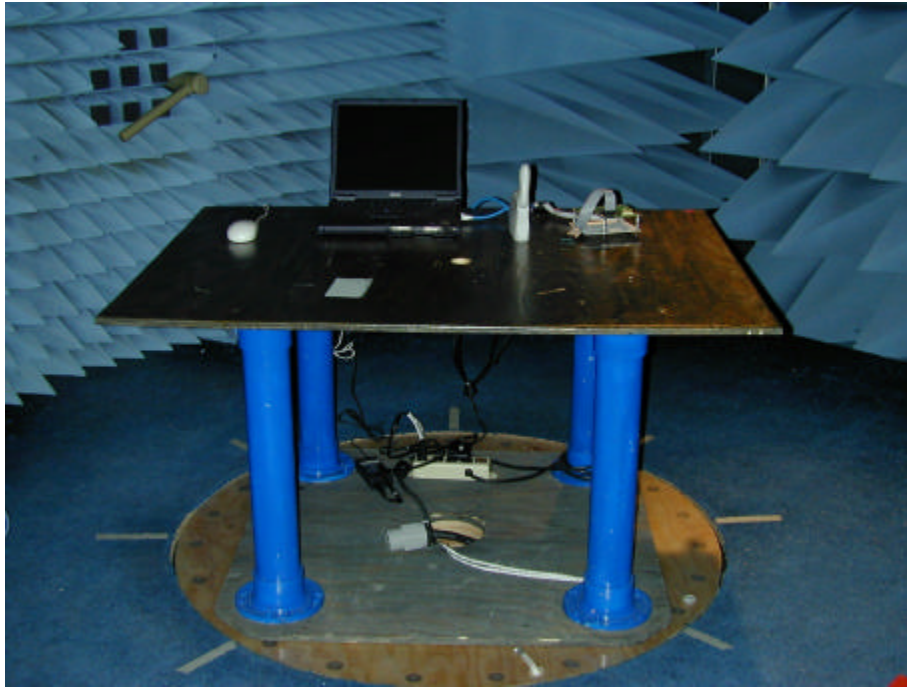
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 Lewisville, TX 75057
 Tel: (972) 436-9600
 Fax: (972) 436-2667

Nemko Dallas, Inc.

Radiated Spurious Emissions								
Page 3 of 3			Continuation Page					
Job No.:	2L0041R		Date: 4/9/02					
Specification:	CFR 47, Part 15		Temperature(°C): 22					
Tested By:	David Light		Relative Humidity(%) 40					
E.U.T.:	2.4 GHz CPE							
Configuration:	TYPICAL / Tx Full Power							
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
Tx @ 2.412 Ghz								
								Patch 0 - Vertical
4.824	45	33.9	4.3	33.5	49.7	54	-4.3	Peak
7.236	38	36.3	5.3	33	46.6	54	-7.4	Peak
12.060	41	39.9	7.3	34.7	53.5	54	-0.5	Peak
Patch 0 - Horizontal								
4.824	46.3	33.9	4.3	33.5	51.0	54	-3.0	Peak
7.236	38	36.3	5.3	33	46.6	54	-7.4	Peak
12.060	41	39.9	7.3	34.7	53.5	54	-0.5	Peak
Patch 1 - Vertical								
4.824	45.3	33.9	4.3	33.5	50.0	54	-4.0	Peak
7.236	38	36.3	5.3	33	46.6	54	-7.4	Peak
12.060	41	39.9	7.3	34.7	53.5	54	-0.5	Peak
Patch 1 - Horizontal								
4.824	41	33.9	4.3	33.5	45.7	54	-8.3	Peak
7.236	38	36.3	5.3	33	46.6	54	-7.4	Peak
12.060	41	39.9	7.3	34.7	53.5	54	-0.5	Peak
Omni - Vertical								
4.824	45.8	33.9	4.3	33.5	50.5	74	-23.5	Peak
7.236	38	36.3	5.3	33	46.6	54	-7.4	Peak
12.060	41	39.9	7.3	34.7	53.5	54	-0.5	Peak
Omni - Horizontal								
4.824	40	33.9	4.3	33.5	44.7	54	-9.3	Peak
7.236	38	36.3	5.3	33	46.6	54	-7.4	Peak
12.060	41	39.9	7.3	34.7	53.5	54	-0.5	Peak
Tx @ 2.480 Ghz								
Vertical								
2.4835	62.5	28.2	3.1	33.8	60.0	74	-14.0	Patch 0 - Peak
2.4835	52	28.2	3.1	33.8	49.5	54	-4.5	Patch 0 - Average
2.4835	41.7	28.2	3.1	33.8	39.2	74	-34.8	Patch 1 - Peak
2.4835	32.3	28.2	3.1	33.8	29.8	54	-24.2	Patch 1 - Average
2.4835	65.7	28.2	3.1	33.8	63.2	74	-10.8	Omni - Peak
2.4835	54.8	28.2	3.1	33.8	52.3	54	-1.7	Omni - Average
Horizontal								
2.4835	52.7	28.2	3.1	33.8	50.2	74	-23.8	Patch 0 - Peak
2.4835	42.5	28.2	3.1	33.8	40.0	54	-14.0	Patch 0 - Average
2.4835	34	28.2	3.1	33.8	31.5	74	-42.5	Patch 1 - Peak
2.4835	26	28.2	3.1	33.8	23.5	54	-30.5	Patch 1 - Average
2.4835	58	28.2	3.1	33.8	55.5	74	-18.5	Omni - Peak
2.4835	48	28.2	3.1	33.8	45.5	54	-8.5	Omni - Average
Notes: Used -6 dB correction at bandedge only								

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: 4/10/2002

Test Results: Complies.

Measurement Data: See attached plots.

Measurement Uncertainty: +/- 1.7 dB

Test Data – Peak Power Spectral Density



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Data Plot		Peak Power Spectral Density		Complete <u>X</u>																			
Page <u>1</u> of <u>3</u>		Date: <u>4/10/2002</u>		Preliminary: _____																			
Job No.: 2L0041R		Temperature(°C): <u>22</u>																					
Specification: 15.247		Relative Humidity(%): <u>40</u>																					
Tested By: <u>David Light</u>																							
E.U.T.: <u>2.4 GHz CPE</u>																							
Configuration: <u>Tx IN TEST FIXTURE</u>																							
Sample Number: <u>1</u>																							
Location: <u>Lab 2</u>		RBW: <u>3 kHz</u>		Measurement																			
Detector Type: <u>Peak</u>		VBW: <u>3 kHz</u>		Distance: <u>N/A</u> m																			
Test Equipment Used																							
Antenna: _____		Directional Coupler: _____																					
Pre-Amp: _____		Cable #1: <u>1629</u>																					
Filter: _____		Cable #2: _____																					
Receiver: <u>1036</u>		Cable #3: _____																					
Attenuator #1: <u>1469</u>		Cable #4: _____																					
Attenuator #2: _____		Mixer: _____																					
Additional equipment used: <u>Anaren 20 dB directional coupler Model 1C0870-20 (0.5-4.0 GHz)</u>																							
Measurement Uncertainty: <u>+/-1.7 dB</u>																							
<table border="1"> <tr> <td>Ref Lvl</td> <td>Marker 1 [T1]</td> <td>RBW</td> <td>3 kHz</td> <td>RF Att</td> <td>40 dB</td> </tr> <tr> <td>41.4 dBm</td> <td>-0.20 dBm</td> <td>VBW</td> <td>3 kHz</td> <td></td> <td></td> </tr> <tr> <td></td> <td>2.48074509 GHz</td> <td>SWT</td> <td>680 s</td> <td>Unit</td> <td>dBm</td> </tr> </table>						Ref Lvl	Marker 1 [T1]	RBW	3 kHz	RF Att	40 dB	41.4 dBm	-0.20 dBm	VBW	3 kHz				2.48074509 GHz	SWT	680 s	Unit	dBm
Ref Lvl	Marker 1 [T1]	RBW	3 kHz	RF Att	40 dB																		
41.4 dBm	-0.20 dBm	VBW	3 kHz																				
	2.48074509 GHz	SWT	680 s	Unit	dBm																		
Center 2.4807 GHz 200 kHz/ Span 2 MHz																							
Date: 10.APR.2002 09:32:20																							
Notes: <u>HIGHEST CHANNEL</u>																							

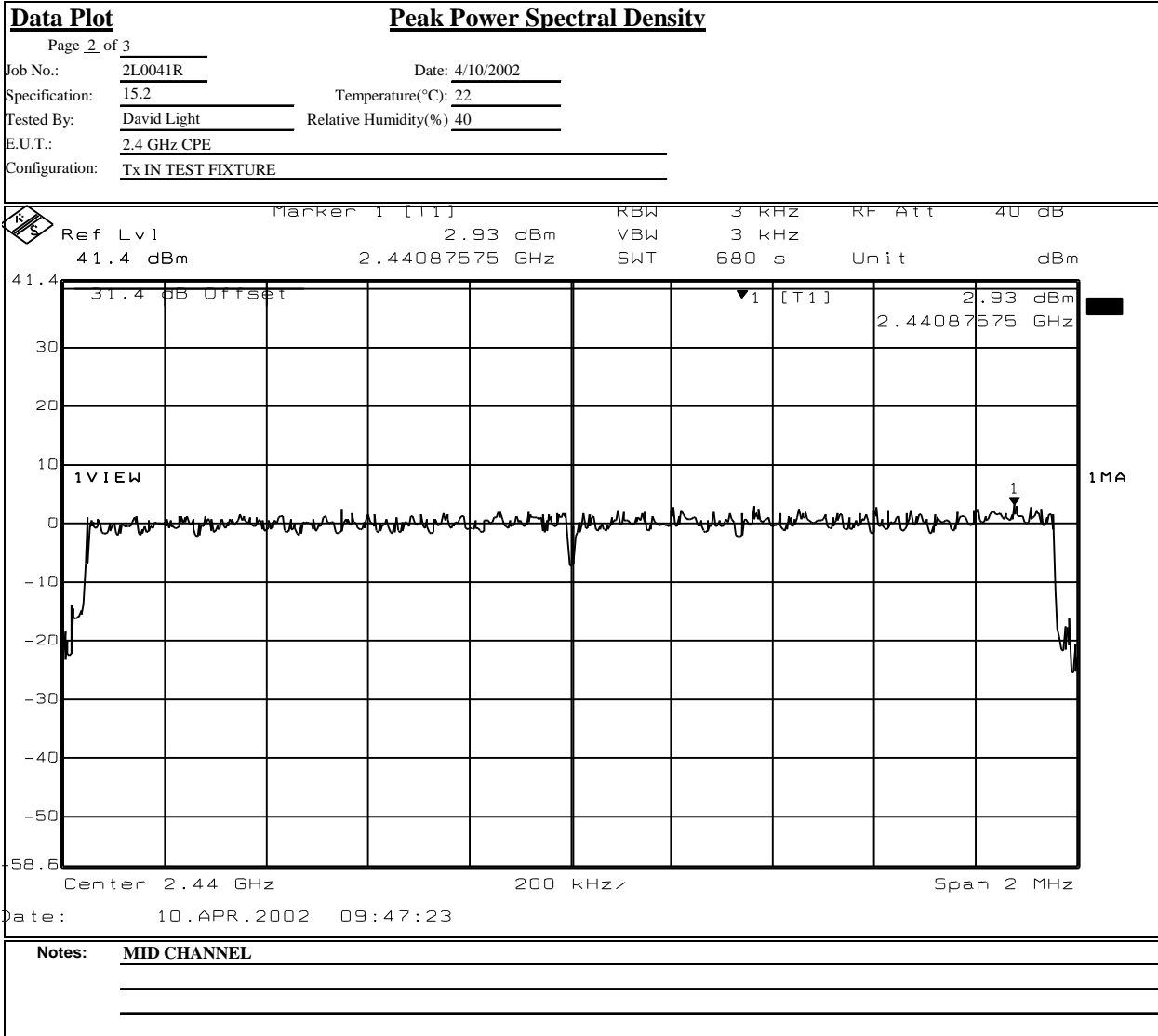
Test Data – Peak Power Spectral Density



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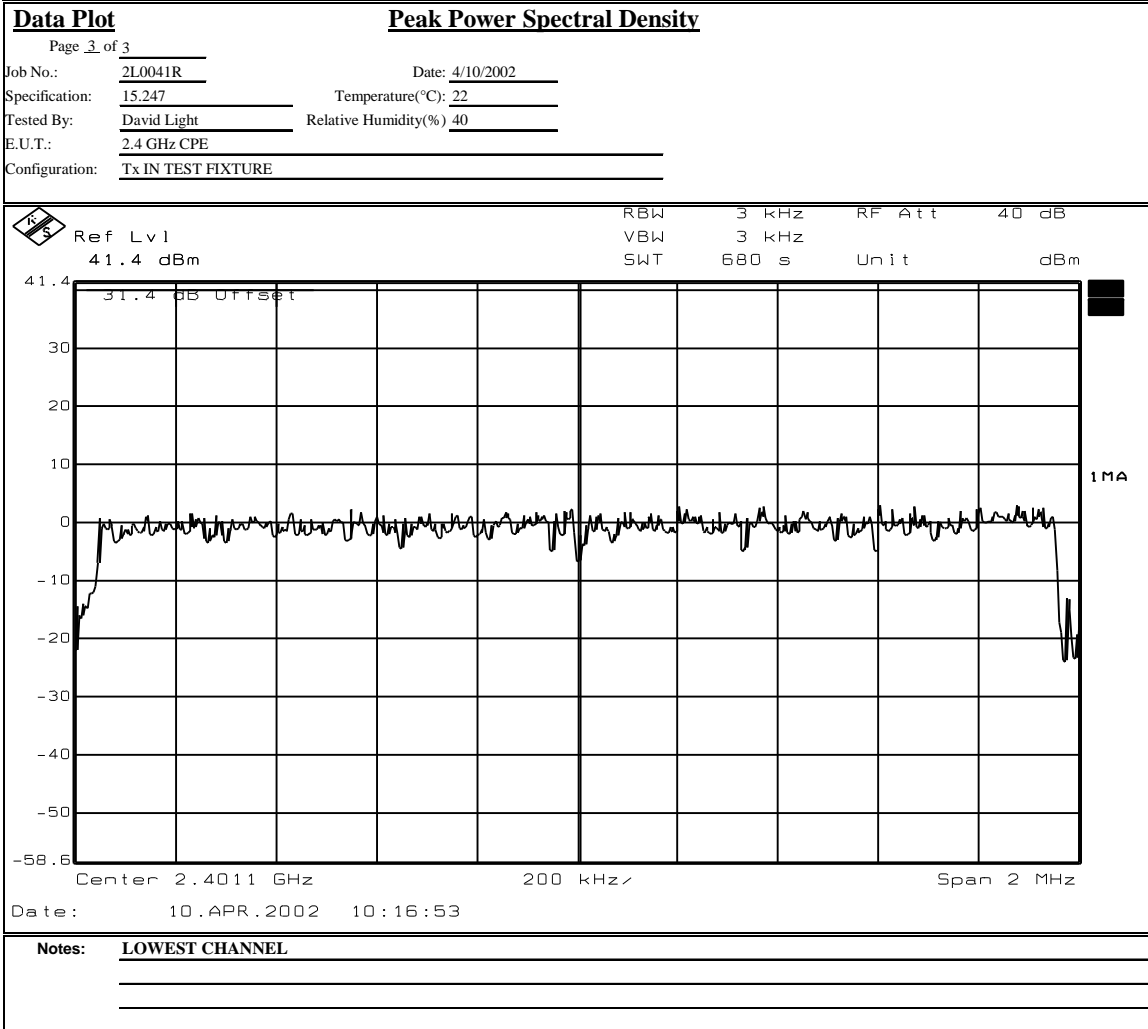
Test Data – Peak Power Spectral Density



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Section 10. Test Equipment List

Nemko ID	Description	Manufacturer Model Number	Serial Number	Calibration Date
1555	Filter high pass 5KHz	Solar Electronics 7930-5.0	933125	06/06/02
1258	LISN .15mhz-30mhz	EMCO 0	1305	07/09/02
1534	CABLE, 9M	KTL RG223	NA	06/13/01
1038	CABLE, .5m	KTL RG223	N/A	06/06/02
674	LIMITER	HP 11947A	3107A02200	11/04/00
1469	10 db Attenuator DC 18 Ghz	MCL Inc. BW-S10W2 10db-2WDC	NONE	CBU
1036	SPECTRUM ANALYZER	ROHDE & SCHWARZ FSEK30	830844/006	12/18/01 2 yr cal
1464	Spectrum analyzer	Hewlett Packard 8563E	3551A04428	01/02/01
1484	Cable 2.0-18.0 Ghz	Storm PR90-010-072	N/A	06/01/01
1485	Cable 2.0-18.0 Ghz	Storm PR90-010-216	N/A	06/01/01
1016	Pre-Amp	HEWLETT PACKARD 8449A	2749A00159	05/30/01
1482	Band Pass Filter	K & L 11SH10-4000/T12000-0/0	2	Cal B4 Use
1629	CABLE, 6 ft	MEGAPHASE 10311 1GVT4	N/A	CBU
1304	HORN ANTENNA	ELECTRO METRICS RGA-60	6151	07/30/01
Prop of Navini	20 dB Directional coupler 0.5-4 GHz	Aneren 1C0870-20	None	CBU

ANNEX A - TEST DETAILS

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

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.

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

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)
---------------------------	-------------------------

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:

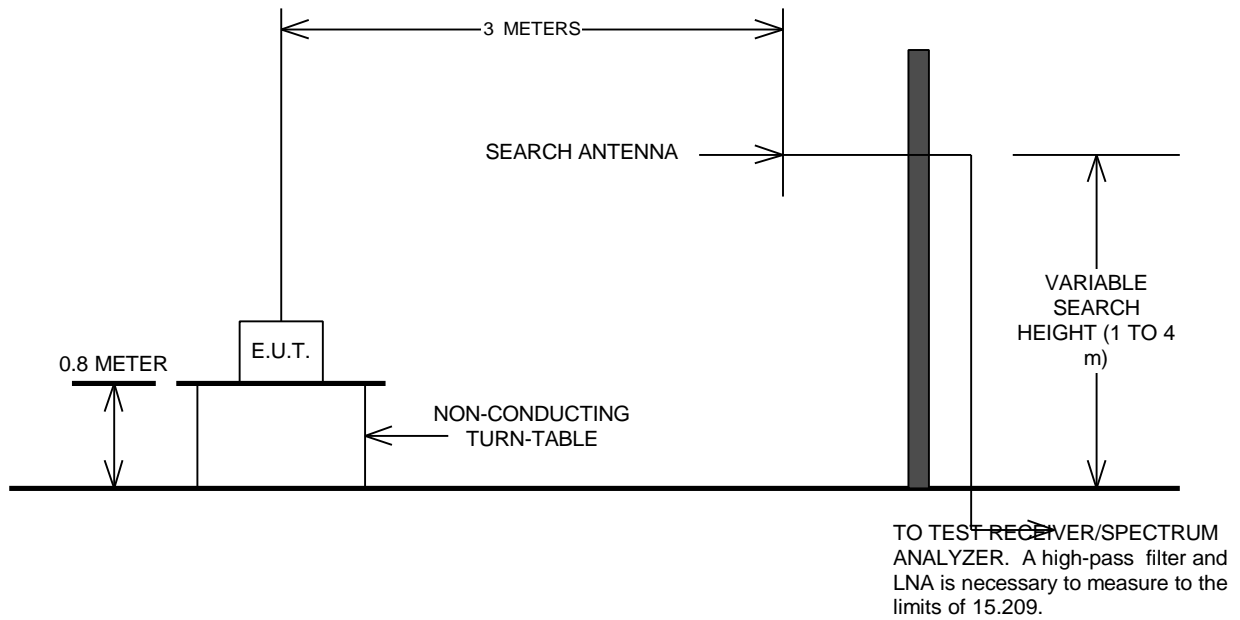
For devices with non-detachable antennas, the received field strength is peaked and the spectrum analyzer is set as above. The peak emission level is then measured and converted to a field strength by adding the appropriate antenna factor and cable loss. This field strength is then converted to an equivalent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

Number of channels tested:

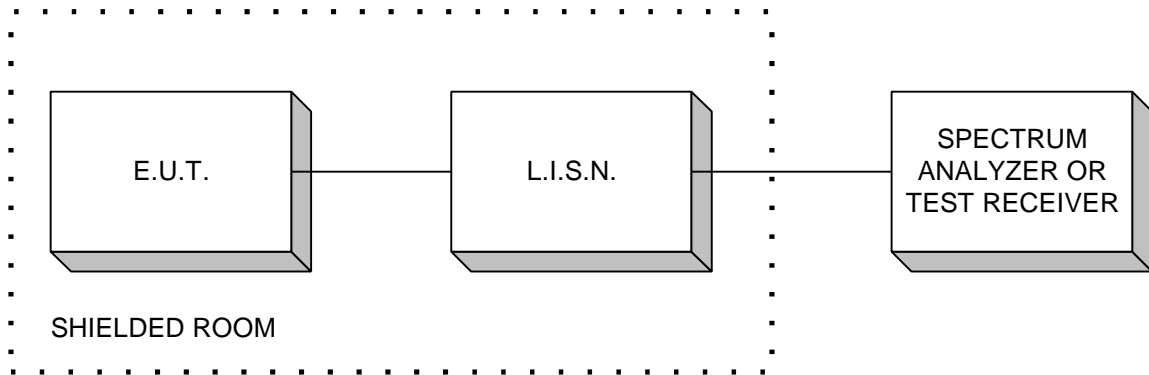
Tuning Range	Number Of Channels Tested	Channel Location In Band
1 MHz or Less	1	Middle
1 to 10 MHz	2	Top And Bottom
More Than 10 MHz	3	Top, Middle, Bottom

ANNEX B - TEST DIAGRAMS

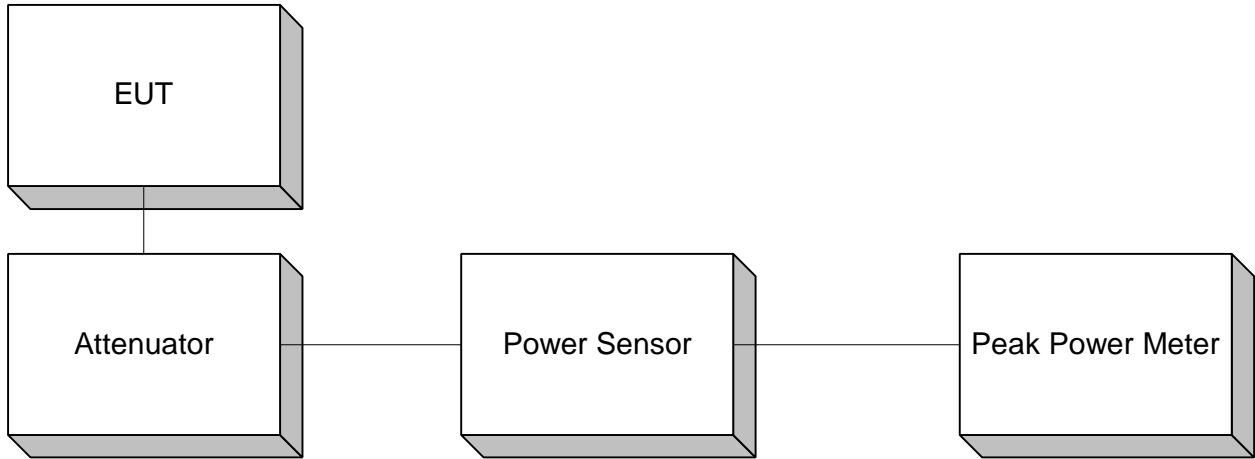
Test Site For Radiated Emissions



Conducted Emissions



Peak Power At Antenna Terminals



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

