Nemko Test Report:	2L0466RUS1
Applicant:	Navini Networks 2240 Campbell Creek Blvd. Suite # 110 Richardson, TX 75082
Equipment Under Test: (E.U.T.)	2.4 GHz BTS with 17 dBi Panel Antenna
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:	Jon- Till
	Tom Tidwell, RF Group Manager
Date:	10/9/03
Total Number of Pages:	44

# **Table of Contents**

Section 1.	Summary of Test Results	. 3
Section 2.	Equipment Under Test (E.U.T.)	. 5
Section 3.	Powerline Conducted Emissions	. 8
Section 4.	Minimum 6 dB Bandwidth	13
Section 5.	Maximum Peak Output Power	17
Section 6.	RF Exposure	18
Section 7.	Spurious Emissions (conducted)	19
Section 8.	Spurious Emissions (radiated)	24
Section 9.	Peak Power Spectral Density	28
Section 10	. Test Equipment List	32
ANNEX A	- TEST DETAILS	33
ANNEX B	- TEST DIAGRAMS	42

Section 1.	Summary	$^{\prime}$ of T	est Re	esults

Manufacturer: Navini Networks

Model No.: 2400-BTS with 2400-RFS-P

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 is 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.

$\boxtimes$	New Submission		Production Unit
	Class II Permissive Change	$\boxtimes$	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** 

Nemko Dallas Inc. authorizes the above named company to reproduce this report provided it is reproduced in its entirety and for use by the company's employees only.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Nemko Dallas Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report. This report applies only to the items tested.

# **Summary Of Test Data**

NAME OF TEST	PARA. NO.	SPEC.	RESULT
Powerline Conducted Emissions	15.207(a)	48 dB?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:**

The MPE prediction is submitted as a separate exhibit.

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

General Equipment Information	
Frequency Band:	902 – 928 MHz 2400 – 2483.5 MHz (2.4035 to 2.4775 GHz) 5725 – 5850 MHz
Channel Spacing	250 kHz
<b>User Frequency Adjustment:</b>	Software controlled

### **Description of Operation and Approval Notes**

The EUT is part of a high speed wireless LAN system. Then transmitter uses Direct Sequence Spread Spectrum techniques.

The antenna for this product is mounted on a fixed outdoor structure. The antenna consists of multiple radiating elements fed by multiple transmitters. The antenna system uses beam-forming techniques to optimize the efficiency and coverage of the system.

The following points were agreed between the manufacturer and the FCC for the approval of this equipment under 15.247 rules.

- 1. The individual transmitters in the system will be subject to the technical requirements set forth in Section 15.247;
- 2. Section 15.31 will not apply;
- 3. The system will be considered "point to point" under Section 15.247(b)(3)(i) and (iii);
- 4. Total antenna gain per transmitter will be computed as the sum of (a) the actual gain of the antenna used, and (b) the beam-forming gain (18dBi) of the system determined by the formula 20log10 N, where N is the number of transmitters in the array; and
- 5. The peak output power for each transmitter will be reduced per Section 15.247(b)(3)(i) based on the total antenna gain, however, a "phase coherence loss" correction factor of 2dB for the 8 transmitter array will be subtracted from this reduction.

#### Example:

In accordance with the foregoing, the peak output power of each transmitter in the Navini beam-forming array will be reduced as follows for the 17dBi antenna system:

Total antenna $gain(17 + 18)$	35dB
Free gain per 15.247(b)(3)	- 6dB
Gain subject to power reduction	29dB

Power reduction per 15.247(b)(3)(i) 9.66dB Correction for coherence loss -2dB

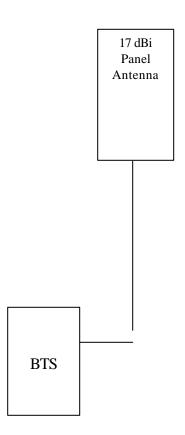
Total reduction in transmitter power 7.66dB

This agreement is summarized in correspondence submitted with the application for equipment approval.

2L0466RUS1

PROJECT NO.:

# **System Diagram**



# DIRECT SEQUENCE SPREAD SPECTRUM TRANSMITTER

EQUIPMENT: 2.4 GHz BTS w/ 17 dBi Panel PROJECT NO.: 2L0466RUS1

# **Section 3.** Powerline Conducted Emissions

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

TESTED BY: David Light DATE: 9/6/2002

**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. **POWERLINE CONDUCTED** Data Plot Page-1 of 2 Complete X Job No.: 2L0466R Date:\_\_ 9/6/02 Preliminary: Specification: 15.207 24 Temperature(°C): \_ Relative Humidity(%)\_ Tested By: <u>David Light</u> 2.4 GHz BTS Configuration: TX FULL POWER AT 8 PORTS - POWERED WITH HP DC POWER SUPPLY Sample Number:\_\_\_ Location: Lab 4 RBW: <u>10 kHz</u> Measurement Detector Type: Peak VBW: 10 kHz Distance:NA Test Equipment L.I.S.N :. 703 Antenna: Pre-Amp: Cable #1: 1112 Filter: Cable #2:\_\_\_ 758 Receiver: 1036 Cable #3: Cable #4:\_ Attenuator #1 Attenuator #2: Additional equipment used: Measurement Uncertainty: \_\_\_\_\_+/-1.7 dB RF Att 10 dB Marker 1 R□f Lv1 VΒW 42.85 dB4V 10 kHz 97 dB<sub>4</sub>V 12.64899800 MHz 5WT 740 mæ Umīt dBµ∨ 97 10 dB Offset Α 90 80 70 1 MAX 1MA 60 50 -D1 48 40 ЭΠ 20 10 Start 450 kHz 2.955 MHz/ Stop 30 MHz D6.5EP.2002 16:05:27

### **Test Data – Powerline Conducted Emissions**



#### Dallas Headquarters:

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

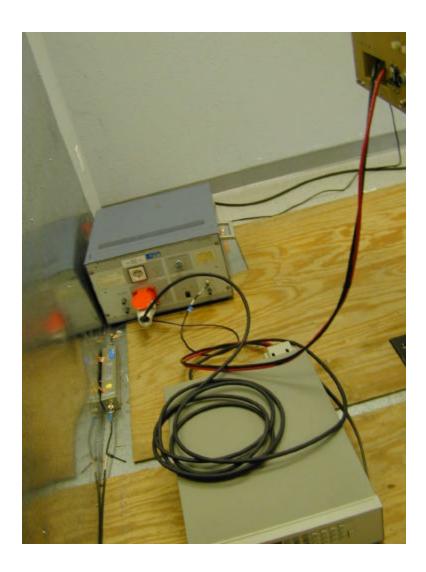
Nemko Dallas, Inc. Data Plot **POWERLINE CONDUCTED** Page 2 of 2 Job No.: 2L0466R Date: 9/6/02 Specification: 15.2 Temperature(°C): 24 David Light Relative Humidity(%) 40 E.U.T.: 2.4 GHz BTS Configuration: TX FULL POWER AT 8 PORTS - POWERED WITH HP DC POWER SUPPLY RBU 10 KHZ RF Att 10 aB Ref Lvl 42.50 dB#V VΒW 10 KHz 12.64899800 MHz 97 dB#V 5WT 740 ms U⊓īt ᄸᄝᄱ 18 Offset Α 90 80 LVIEW 1MA 60 40 30 Start 450 kHz 2.955 MHz/ Stop 30 MHz 06.5EP.2002 16:06:28 late: Peak measurement meets QP limit of 48 dBuV

# **Photos – Powerline Conducted Emissions**

Front



Side



**Nemko Dallas** 

FCC PART 15, SUBPART C

DIRECT SEQUENCE SPREAD SPECTRUM TRANSMITTER

EQUIPMENT: 2.4 GHz BTS w/ 17 dBi Panel PROJECT NO.: 2L0466RUS1

# Section 4. Minimum 6 dB Bandwidth

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

TESTED BY: David Light DATE: 9/9/2002

**Test Results:** Complies.

**Measurement Data:** See 6 dB BW plot

Measured 6 dB bandwidth: 5 MHz

**Measurement Uncertainty:** +/- 1.7 dB

### Plots - 6 dB Bandwidth



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

Ner	nko Da	illas, Inc.									
Data Pl	ot		Spuri	ous Em	nissions	at Ant	enna				
Page-1- o	f 3		•					Complet	eX		
Job No.:	2L0466	R		Date:	9/9/02			Preliminar	y <del>.</del>		
Specification:	15.207		Tem	perature(°C):					,		
Tested By:	David L	ight		Humidity(%)							
E.U.T.:	2.4 GH	Z BTS									
Configuration:	TX FUL	L POWER									
Sample Number	r: <u>        1</u>										
Location:	Lab	4			RBW: <u>1</u>	00 kHz		Measureme	nt		
Detector Type:	Pea	ık			VBW: <u>1</u>	00 kHz		Distanc	e:	m	
Test Equipr	nent	_									
Antenna:				Directi	onal Coupler:						
Pre-Amp:					Cable #1:	1045					
Filter:					Cable #2:						
Receiver:	103	6									
Attenuator #1	146	<u>5</u>			Cable #4:						
Attenuator #2:					Mixer:						
Additional equip	ment use	ed:									
Measurement U	ncertainty	/: <u>+/-1.7 (</u>	dB_								
Ŕ			Marker	1 [71]		RBW	100	kHz R¹	Att	10 dB	
Ref	<b>!∨</b> ∟			-3.	46 dBm	VBW	100	KHZ			
10	dΒπ		2	2.438046	09 GHz	SWT	5	ma U	ı i t	dBm	
10 21	. 1	IB Offse	e t				<b>▼</b> 1	[T1]	-3	.46 dBm	1
	· · · · [		-				, ,	7171	_	609 GHz	A
5							. 1	1111		.53 dB	
				Malaka Kali	التد ألاتما	MAN ANN	1  .	A		980 MHz	
п				That I had	/ VI / IN O GIV	\	May had				
"				1		,	/ 4/	The state of	1		
				<u>'</u>	ν Ι		, ,	γ	<u>^</u>		
-5	+										
1 V I	EΜ										1MA
-10											
-15											
-20											
-25											
-25											
		1									
-30	1.	JI x I A							<del>                                     </del>		
المرالات	MAN	Myryhh							Whi the Ma	hanny	
-35		A 1	V						THE THE PART	lan Alba	
								1			
[								1			
_4 <b>11</b>	tor 3	2.44 GH:		-	1 M	Hz/	1	_1		10 MHz	l
					1 11	114/			эран	10 /172	
late:	ים:	3.SEP.2	002 10	:31:03							

#### Plots - 6 dB Bandwidth



#### Dallas Headquarters:

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

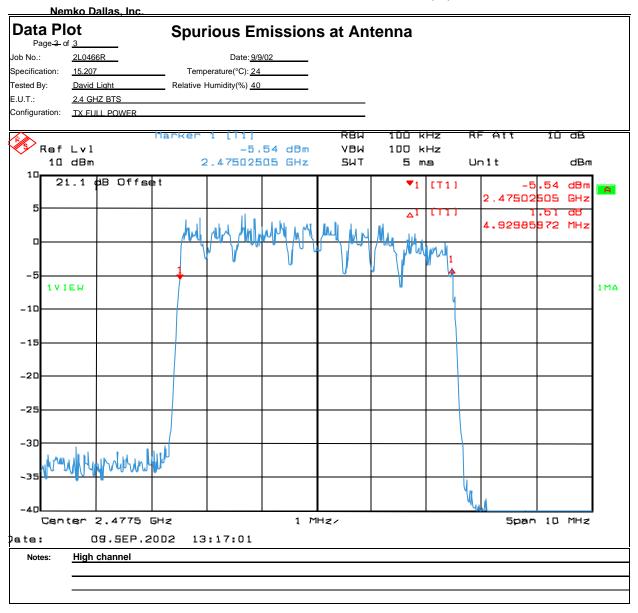
Nemko Dallas, Inc. **Spurious Emissions at Antenna Data Plot** Page 2 of 3 Job No.: 2L0466R Date: 9/9/02 Specification: 15.2 Temperature(°C): 24 David Light Relative Humidity(%) 40 Tested By: E.U.T.: 2.4 GHZ BTS Configuration: TX FULL POWER KBM 100 kHz RF Att Ref Lvl VBW 100 kHz -2.94 dBm 2.40004509 GHz 10 dBm 5WT 5 ma Unit dBm 21.1 dB Offset [T1] -2.94 dBm 2.4D004<u>5</u>09 GHz 4.90981<mark>9</mark>64 MHz 1MA 1 V I E W -1D -2D -25 -3D Center 2.4D25 GHz 1 MHz/ Span 10 MHz ate: U9.5EP.2002 11:25:48 Notes: Lower Band

### Plots - 6 dB Bandwidth



#### Dallas Headquarters:

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



# Section 5. Maximum Peak Output Power

NAME OF TEST: Maximum Peak Output power PARA. NO.: 15.247(b)(1)

TESTED BY: David Light DATE: 9/9/2002

**Test Results:** Complies.

### **Measurement Data:**

Frequency (MHz)	Antenn a Type	Manufactur er	Peak Output Power (dBm)	Gain (dBi)	E.I.R. P. (dBm)	
2440.5	Panel	Navini	22.3	17	39.3	
2403.5	Panel	Navini	22.3	17	39.3	
2477.5	Panel	Navini	22.3	17	39.3	

The supply voltage was varied +/- 15% with no effect on output power.

**Equipment Used:** 1029-1030-1477

Measurement Uncertainty: +/- 0.7 dB

Temperature: 24 ?C

Relative Humidity: 40 %

Nemko Dallas

FCC PART 15, SUBPART C

# DIRECT SEQUENCE SPREAD SPECTRUM TRANSMITTER

EQUIPMENT: 2.4 GHz BTS w/ 17 dBi Panel PROJECT NO.: 2L0466RUS1

# Section 6. RF Exposure

NAME OF TEST: RF Exposure

PARA. NO.: 15.247(b)(4)

TESTED BY:

DATE:

**Test Results:** Complies.

**Note - Refer to separate exhibit.** 

# DIRECT SEQUENCE SPREAD SPECTRUM TRANSMITTER

EQUIPMENT: 2.4 GHz BTS w/ 17 dBi Panel PROJECT NO.: 2L0466RUS1

# Section 7. Spurious Emissions (conducted)

NAME OF TEST: Spurious Emissions (conducted) PARA. NO.: 15.247(c)

TESTED BY: David Light DATE: 9/9/2002

**Test Results:** Complies.

**Measurement Data:** See attached plots.

**Measurement Uncertainty:** +/- 1.7 dB

# **Test Plots – Spurious Emissions at Antenna Terminals**



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

Data P	lot		Spu	rious Fm	nissions	at Ante	nna				
Page 1 c			Opui	ious En	113310113	at Aiite	iiiia	Con	npleteX		
b No.:	2L0466R	•		Date:	9/9/02				inary:		
ecification:	15.247	•	т	emperature(°C):_				i ieiiiii	iriai y	-	
ested By:	David Lic	aht		ive Humidity(%)_							
U.T.:	2.4 GHZ			10 · iaiiiaii (70) _							
onfiguration:		POWER									
imple Numbe	•	FOWLK									
				_	DDW: 40	00 kl l=		Manager			
cation:	Lab 4				RBW: 10			Measur			
tector Type:	Peak	<u> </u>			VBW: <u>10</u>	00 kHz		DIS	tance:	_m	
est Equip	<del>ment</del>	•									
tenna:		_		Direc	ctional Coupler:						
e-Amp:					Cable #1:	1045					
ter:					Cable #2:						
eceiver:	1036				Cable #3:						
tenuator #1	1465	_			Cable #4:						
tenuator #2:					Mixer:						
ditional equip	oment used	l:									
easurement U	Incertainty:	+/-1.7	dB								
_			Morko	n 1 [T1]		RBN	10D F	/H <del>7</del>	RF Att	10 dB	
Apf	Lv1		riai ka		.87 dBm	VBW	100 +		IN HEL	10 05	
~	dBm				958 GHz	5WT		8	Um i t	dBr	
10	ubin_			2.35470	300 GHZ	JMI	ш	0	0/17 [		
2	1 م 1 ط	3 Offa	e t				<b>▼</b> 1	[T1]		2.87 dBm	n
	÷								2.3947	8958 GHz	-
υ	+		<u> </u>		+		Δ1	[[1]		2.61 dB	-
							Δ-			5671 GHz	_
4.5									7	T	
~10											
-20			<u> </u>								4
1 ∨ 1	EW										11
-30			1								
_40											
							1				
-50	+		, ~~	_	<del>                                     </del>	. MI A .	<u> </u>		٠,٨٠	A. J. Halled J.	-
Mara	Munda	What was	~ ~~	My Market	Mary Mary	w w w	my my	while	~~~	an change	N.
-60		•									
_70			<del>                                     </del>		_					_	-
				-			1			_	1
-80											
-80											
-80 -90											

### **Test Plots – Spurious Emissions at Antenna Terminals**



#### Dallas Headquarters:

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

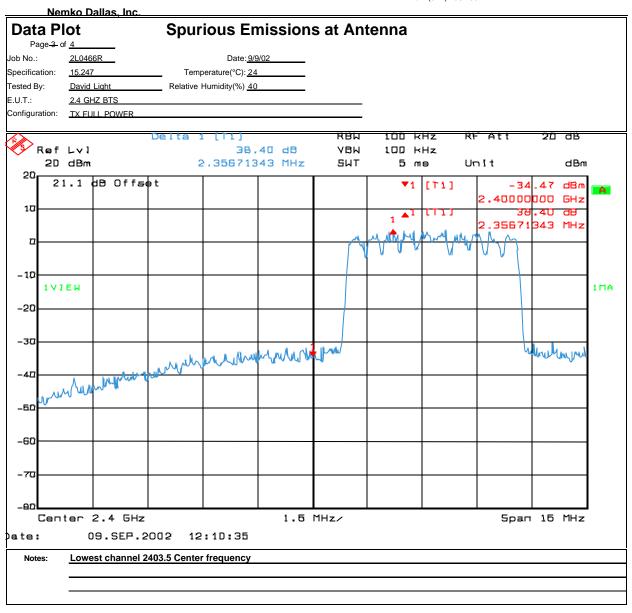
Nemko Dallas, Inc. **Spurious Emissions at Antenna Data Plot** Page 2 of 4 Job No.: 2L0466R Date: 9/9/02 15.2 Specification: Temperature(°C): 24 Tested By: David Light Relative Humidity(%) 40 E.U.T.: 2.4 GHZ BTS Configuration: TX FULL POWER RBW 100 KHZ RF Att 10 dB Ref Lvl -52.95 dB 10D kHz VBW 1D dBm 11.63927856 GHz SWT 6 s Unit dBm 21.1 dB Dffset ▼1 [T1] 2.65 dBm 2.39478<mark>958 GHz</mark> -52.95 dB 1.63927856 GHz -20 1 / [ | W 1MA -40 -6D -60 -80 -50l Start 1 GHz 2.4 GHz/ 5top 25 GHz 09.SEP.2D02 11:27:59 ete: Notes: Marker 1 indicates carrier - marker 2 indicates highest out of band emission

### **Test Plots – Spurious Emissions at Antenna Terminals**



#### Dallas Headquarters:

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



### **Test Plots – Spurious Emissions at Antenna Terminals**



Dallas Headquarters:

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

Nemko Dallas, Inc. Test Plot: **Spurious Emissions at Antenna** Page-4- of 4 Job No.: 2L0466R Date: 9/9/02 Specification: 15.247 Temperature(°C): 24 David Light Tested By: Relative Humidity(%) 40 E.U.T.: 2.4 GHZ BTS Configuration: TX FULL POWER 20 dB RBW 100 KHZ RF Att Ref Lvl VBW -44.33 dB 100 kHz 20 dBm 4.13627255 GHz SWT 8 8 Unit dBm 21.1 dB Offset Α 10 \_10 1 V I 🗗 W 1MA -2D \_30 -4D 1 Meliner -50 −<del>G</del>D -70 -en 2.4 GHz/ Stop 25 GHz Start 1 GHz ate: 09.SEP.2002 13:15:05 High channel Notes:

### DIRECT SEQUENCE SPREAD SPECTRUM TRANSMITTER

EQUIPMENT: 2.4 GHz BTS w/ 17 dBi Panel PROJECT NO.: 2L0466RUS1

# Section 8. Spurious Emissions (radiated)

NAME OF TEST: Peak Power Output PARA. NO.: 15.247 (c)

TESTED BY: David Light DATE: 9/12/2002

**Test Results:** Complies.

**Measurement Data:** See attached table.

**Duty Cycle Calculation:** 

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

**Measurement Uncertainty:** +/- 0.7 dB

### Test Data - Radiated Emissions

Measuremen Uncertainty:

+/- .7 dB



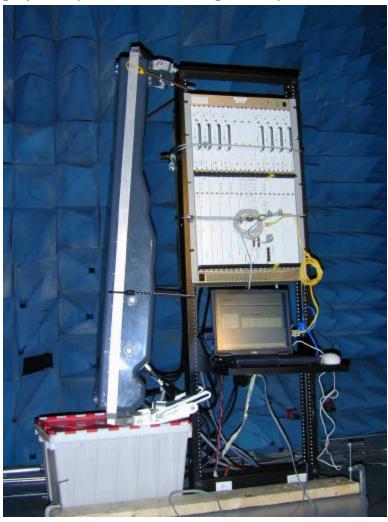
#### **Dallas Headquarters:**

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

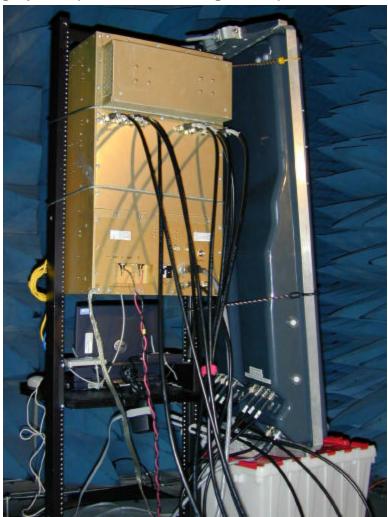
Radiated Emissions in Restricted Bands of Page1 of 1 Date:9/12/02 Job No.: 2L0466R Specification: 15.247 Temperature(°C24 Tested **David Light** Relative E.U.T.: Tx full power with full antenna array - Panel Configuration: Sample AC 1 RBW-1 MHz for PFAK and Location: VBW: 1 MHz PEAK / 10 HZ Detector See **Test Equipment** #N/A 1304 Antenna: Directional 1016 1484 Pre-Amp: Cable Filter: #N/A 1485 Cable 1036 #N/A Receiver: Cable #N/A #N/A Attenuator Cable Attenuator #N/A #N/A Mixer: Additional equipment

Frequency Pre-Amp Meter Antenna Cable Corrected Limit Delta (GHz) Gain (dB) Reading Reading Factor Loss Comment (dBuV/m) (dB) (dBuV) (dB) (dB) (dBuV/m) Tx at 2.4775 GHz 25.4 28.2 3.1 56.7 2.4835 0 74 -17.3 Peak reading-Horizontal 2.4835 17.8 28.2 3.1 0.0 49.1 54 -4.9 Average reading-Horizonta 4.9573 Peak reading-Horizontal 36.2 33.8 4.3 29.6 44.7 54 -9.3 Peak reading-Horizontal 7.4324 35.4 36.2 5.3 34.1 42.8 54 -11.2 12.387 37.3 39.9 7.3 32.7 51.8 54 -2.2 Peak reading-Horizontal 59.3 2.4835 28 28.2 3.1 0 74 -14.7 Peak reading-Vertical 50.7 54 19.4 28.2 3.1 0 -3.3 Average reading-Vertical 2.4835 37.4 4.3 45.9 4.9573 33.8 29.6 54 -8.1 Peak reading-Vertical 38.5 36.2 5.3 45.9 Peak reading-Vertical 7.4324 34.1 54 -8.1 Peak reading-Vertical 12.3874 37.2 39.9 7.3 32.7 51.7 54 -2.3 Tx at 2.4405 Ghz 36.5 33.5 4.3 29.9 44.4 54 Peak reading-Vertical 4.881 -9.6 Peak reading-Vertical 7.3215 35 36.1 5.2 34.2 42.1 54 -11.9 40.0 51.7 12.2025 37.4 7.3 33.0 54 -2.3 Peak reading-Vertical 4.881 36.8 33.5 4.3 29.9 44.7 54 -9.3 Peak reading-Horizontal 34.2 7.3215 35.6 36.1 5.2 42.7 54 -11.3 Peak reading-Horizontal 40.0 7.3 33.0 48.2 54 -5.8 Peak reading-Horizontal 12.2025 33.9 Tx at 2.4035 GHz 36.8 33.3 4.2 30.1 44.2 54 -9.8 Peak reading-Horizontal 4.8070 7.3 33.5 Peak reading-Horizontal 12 0175 37.1 40.0 50.9 54 -3.1 4.2 30.1 Peak reading-Vertical 36.6 44 0 54 -10 0 4.807 33.3 12.0175 40.0 33.5 51.5 Peak reading-Vertical

# Radiated Photographs (Worst Case Configuration)



# Radiated Photographs (Worst Case Configuration)



Nemko Dallas

FCC PART 15, SUBPART C

# DIRECT SEQUENCE SPREAD SPECTRUM TRANSMITTER

EQUIPMENT: 2.4 GHz BTS w/ 17 dBi Panel PROJECT NO.: 2L0466RUS1

# Section 9. Peak Power Spectral Density

NAME OF TEST: Peak Power Spectral Density PARA. NO.: 15.247(d)

TESTED BY: David Light DATE: 9/9/2002

**Test Results:** Complies.

**Measurement Data:** See attached plots.

**Measurement Uncertainty:** +/- 1.7 dB

# **Test Plots – Spectral Density**



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

Data Plo	ot			Peak	Power \$	Spectra	ı				
Page-1 of				. oan		<b>opoo</b> ti a	•	Complete	X		
lob No.:	2L0466R			Date:	9/9/02			Preliminary			
Specification:	15.247		Temp	erature(°C):				. rominically			
ested By:	David Light			lumidity(%)							
.U.T.:	2.4 GHZ BT	S									
Configuration:	TX FULL PO	WER									
Sample Number	:1										
ocation:	Lab 4	_			RBW: <u>31</u>	kHz		Measurement	İ		
Detector Type:	Peak	_			VBW: <u>3</u>	kHz		Distance	<u></u> r	n	
Fest Equipn	<del>nent </del>										
Antenna:		-		Directio	onal Coupler:						
Pre-Amp:		_			Cable #1:	1045					
ilter:		_			Cable #2:						
Receiver:	1036	-			Cable #3:						
Attenuator #1	1465	_			Cable #4:						
Attenuator #2:					Mixer:						
Additional equip	ment used:										
/leasurement Ur	ncertainty:	+/-1.7 d	IB								
			Merker	1 [T1]		RBU	3 K	Hz RI	- Att	20 dB	
Ref	LV[				13 dBm	VBW	3 K		,,,,,		
•	dBm		2	2.441153		SWT	1700		пīt	dB≡	T
20,					1				1		
21	1.1 dB	Offae	<b>e</b> t								A
4.5											
10 -D1	B dBm-										1
□⊩──											-
-10							1				
1/4/1/		Monthorn	ary who	White I	Wyhana .	MULMA	1 MM	mel pre	Mulhi.	Mylon	1 M A
7	Ų	f	The state of the s	_ \	V	M = M		Var.N		- · \	
-20				<del>                                     </del>			+		<del>                                     </del>	,	1
	M						$\mathcal{M}$		\/		
-30	V			\ <u>\</u>			V		V		
				4.					•		
-40											1
-50											ł
-80											
-80											
-70											
-80											

### **Test Plots – Spectral Density**



#### Dallas Headquarters:

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

#### Nemko Dallas, Inc. **Peak Power Spectral Data Plot** Page 2 of 3 Job No.: 2L0466R Date: 9/9/02 Specification: 15.2 Temperature(°C): 24 David Light Relative Humidity(%) 40 Tested By: E.U.T.: 2.4 GHZ BTS Configuration: TX FULL POWER <u>20 as</u> RBW 3 KHZ RF Att Ref Lvl -9.76 dBm VBW 3 kHz 20 dBm 2.40315331 GHz SWT 1700 s Unit dBm 21.1 dB Offset Α -D1 A dBm 1MJEWN MMMM 1MA -20 -30 -5D -GD -70 **-**₽П Center 2,4025 GHz 400 kHz/ 5pan 4 MHz ate: 09.5EP.2002 12:01:02 Notes: Lower band

2L0466RUS1

PROJECT NO.:

# **Test Plots – Spectral Density**



#### Dallas Headquarters:

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

#### Nemko Dallas, Inc. **Peak Power Spectral Data Plot** Page-3- of 3 Job No.: 2L0466R Date: 9/9/02 Specification: 15.247 Temperature(°C): 24 Tested By: David Light Relative Humidity(%) 40 E.U.T.: 2.4 GHZ BTS Configuration: <u>TX FULL POWER</u> RBU 3 kHz RF Att 20 dB Ref Lvi ~9.79 dBm VBU Э кн≥ 20 dBm 2.47552224 GHz **SMT** 1700 = dBm U⊓it 20 21.1 dB Offset A 10 -D1 8 dBm-1.Mars/XIIII Mull 1MA -20 -30 -4Q -50 -<del>6</del>0 -70 \_ 400 kHz/ Center 2.4775 GHz Span 4 MHz 09.5EP.2002 13:13:12 ate: Highest channel Notes:

# Section 10. Test Equipment List

Nemko ID	Description	Manufacturer Model Number	Serial Number	Calibration Date	Calibration Due
1036	SPECTRUM ANALYZER	ROHDE & SCHWARZ FSEK30	830844/006	12/18/01	12/19/03
1465	10 db Attenuator DC 8.0 Ghz	Midwest Microwave 292/10db	NONE	CBU	N/A
1045	CABLE 2m	Astrolab Inc. 32027-2-29094-72TC	N/A	CBU	N/A
1304	HORN ANTENNA	ELECTRO METRICS RGA-60	6151	07/30/01	07/31/03
1016	Pre-Amp HEWLETT PACKARD 8449A		2749A00159	07/15/02	07/15/03
1484	Cable 2.0-18.0 Ghz	Storm PR90-010-072	N/A	07/15/02	07/15/03
1485	Cable 2.0-18.0 Ghz		N/A	07/15/02	07/15/03
758	HIGH PASS FILTER	SOLAR 7930-5.0	197	07/18/01	07/18/02
703	LISN	Schwarz Beck 8020	8020350	08/09/02	08/09/03
1112	Cable 1.1m KTL RG223		0	03/05/02	03/05/03
1534	CABLE, 9M	KTL RG223	NA	08/06/02	08/06/03
674	LIMITER	HP 11947A	3107A02200	CBU	N/A

# **ANNEX A - TEST DETAILS**

**Nemko Dallas** 

FCC PART 15, SUBPART C

DIRECT SEQUENCE SPREAD SPECTRUM TRANSMITTER

EQUIPMENT: 2.4 GHz BTS w/ 17 dBi Panel PROJECT NO.: 2L0466RUS1

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? V

(48 dB?V) across 50 ohms.

Nemko Dallas

FCC PART 15, SUBPART C

DIRECT SEQUENCE SPREAD SPECTRUM TRANSMITTER

EQUIPMENT: 2.4 GHz BTS w/ 17 dBi Panel PROJECT NO.: 2L0466RUS1

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

Page 35 of 44

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?  $R^2 = E^2/120$ ? and proceeding as follows:

$$P ? \frac{E^2R^2}{30G} ? \frac{E^23^2}{30G}$$

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.

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

**Nemko Dallas** 

FCC PART 15, SUBPART C

DIRECT SEQUENCE SPREAD SPECTRUM TRANSMITTER

EQUIPMENT: 2.4 GHz BTS w/ 17 dBi Panel PROJECT NO.: 2L0466RUS1

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.

Page 38 of 44

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	Field Strength	Field Strength
(MHz)	(? V/m @ 3m)	(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 ?: 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 ?: Peak of highest spurious level above center frequency.

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	Field Strength	Field Strength
(MHz)	(? V/m @ 3m)	(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		

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.

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

Nemko Dallas FCC PART 15, SUBPART C

DIRECT SEQUENCE SPREAD SPECTRUM TRANSMITTER

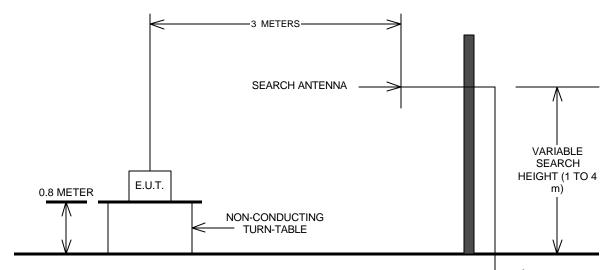
EQUIPMENT: 2.4 GHz BTS w/ 17 dBi Panel PROJECT NO.: 2L0466RUS1

**ANNEX B-TEST DIAGRAMS** 

2L0466RUS1

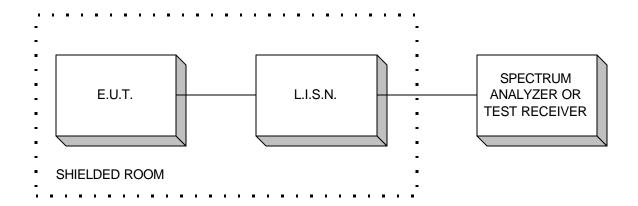
PROJECT NO.:

### **Test Site For Radiated Emissions**



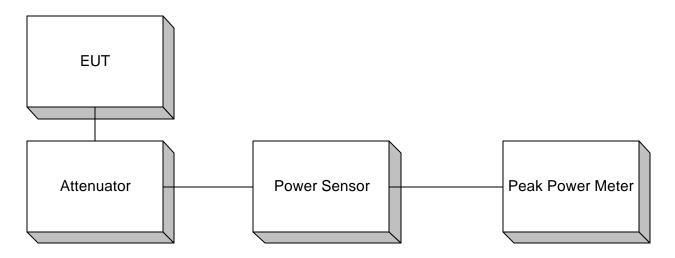
TO TEST RECEN/SPECTRUM ANALYZER. A high-pass filter and LNA is necessary to measure to the limits of 15.209.

### **Conducted Emissions**



2L0466RUS1

### **Peak Power At Antenna Terminals**



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

