

Nemko Test Report: 1L0655RUS1

Applicant: Matrics, Inc.
8850 Stanford Blvd. Suite 3000
Columbia, Md. 21045

Equipment Under Test: RDR-MP-001
(E.U.T.)

In Accordance With: FCC Part 15, Subpart C, 15.247
Frequency Hopping Transmitters

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

Authorized By: 
Tom Tidwell, RF Group Manager

Date: 12/18/01

Total Number of Pages: 45

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. Channel Separation	11
Section 5. Pseudorandom Hopping Algorithm.....	13
Section 6. Time of Occupancy.....	14
Section 7. Occupied Bandwidth.....	16
Section 8. Peak Power Output	21
Section 9. Spurious Emissions (Antenna Conducted).....	22
Section 10. Spurious Emissions (Radiated).....	26
Section 11. Test Equipment List.....	32
ANNEX A - TEST DETAILS	33
ANNEX B - TEST DIAGRAMS.....	43

Section 1. Summary of Test Results

Manufacturer: Telenexus, Inc.

Model No.: RDR-MP-001

Serial No.: P-0005

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 Frequency Hopping 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.

<input checked="" type="checkbox"/>	New Submission	<input checked="" type="checkbox"/>	Production Unit
<input type="checkbox"/>	Class II Permissive Change	<input type="checkbox"/>	Pre-Production Unit
<input type="checkbox"/>	Family Listing		

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.

Nemko Dallas

FCC PART 15, SUBPART C

FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

EQUIPMENT: RDR-MP-001

PROJECT NO. 1L0655RUS1:

Summary Of Test Data

NAME OF TEST	PARA. NO.	SPEC.	RESULT
Powerline Conducted Emissions	15.207(a)	48 dB μ V	Complies
Channel Separation	15.247(a)(1)	Greater of 25 kHz or 20 dB Bandwidth	Complies
Pseudorandom Hopping Algorithm	15.247(a)(1)		
Time of Occupancy	15.247(a)(1)(ii)	\leq 0.4 sec in 30 sec	Complies
20 dB Occupied Bandwidth	15.247(a)(1)	\leq 1 MHz	Complies
Peak Power Output	15.247(b)	1 Watt	Complies
Spurious Emissions (Antenna Conducted)	15.247(c)	-20 dBc	Complies
Spurious Emissions (Radiated)	15.247(c)	Table 15.209(a)	Complies

Footnotes:

Section 2. Equipment Under Test (E.U.T.)**General Equipment Information**

Frequency Band: 902 – 928 MHz
 2400 – 2483.5 MHz

Number of Channels: >50

Channel Spacing: 500 kHz

Emissions Designator: AM/OOK

User Frequency Adjustment: Software controlled

Nemko Dallas

FCC PART 15, SUBPART C

FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

EQUIPMENT: RDR-MP-001

PROJECT NO. 1L0655RUS1:

Description of Modification for Modification Filing

Not Applicable

Family List Rational

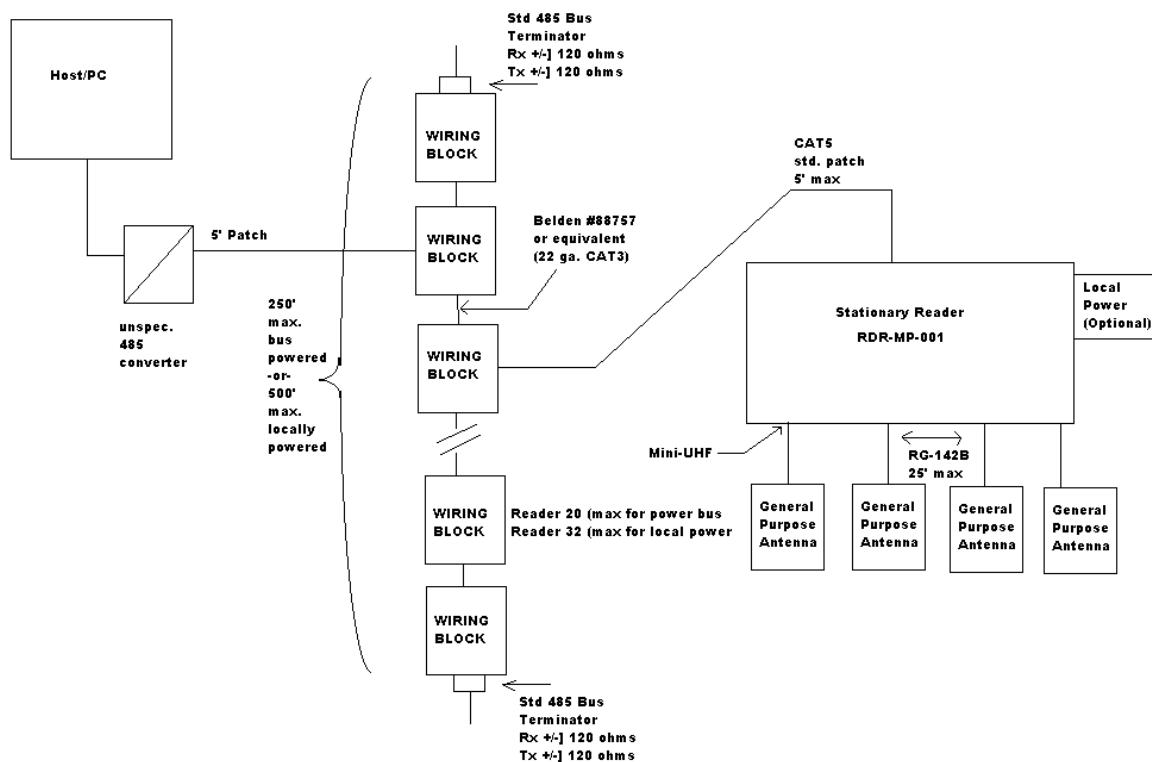
Not Applicable

Theory of Operation

Using a unique communication protocol, the 915 MHz frequency hopping spread spectrum reader can read a passive tag over a distance of more than 10 feet. The communication protocol greatly simplifies the tag circuitry and provides the ability to passively power the tag to greater distances.

The tag is completely passive and is powered by the energy it receives from the reader. Digital data is sent to the tag on a pulse width modulated On Off Keyed (OOK) transmitter signal. Data is communicated from the tag to the reader by modulated backscattered radiation.

System Diagram



Nemko Dallas

FCC PART 15, SUBPART C

FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

EQUIPMENT: RDR-MP-001

PROJECT NO. 1L0655RUS1:

Section 3. Powerline Conducted Emissions

NAME OF TEST: Powerline Conducted Emissions	PARA. NO.: 15.207(a)
TESTED BY: David Light	DATE: 12/07/2001

Test Results: Complies.

Measurement Data: See attached data.

Measurement Uncertainty: +/- 0.7 dB

Test Data – Powerline Conducted Emissions



Nemko Dallas, Inc.

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

Conducted Emissions Data
(CISPR Quasi-Peak Detector)

Complete
Preliminary

FCC (CFR 47)

Page 1 of 1Client: TELENEXUSW.O.#: 1L0655RDate: 12/7/2001EUT: RDR-MP-001S/N: P-0005Specification: FCC PART 15Tech: LIGHTTest #: 1 Lab: 6 Photo ID: 1L0655 1Equipment Used: 970-1553-1188-1505-969Configuration: TABLETOP - TX FULL POWER INTO 50 OHM LOADIF Bandwidth: 10 kHz Video Bandwidth: N/A Detector: Peak CISPRAmbient Temperature: 22 C EUT Power: 115 V.A.C. 60 Hz 1 PhaseRelative Humidity: 50 % 230 V.A.C. 50 Hz 3 PhaseAtmospheric Pressure: 998 mbar

Other

Freq. (MHz)	Meter Reading (dBuV)	Attn. (dB)	Cable Loss (dB)	Probe Factor (dB)	Corrected Reading (dBuV)	Spec.limit (dBuV)	Pol.	Comments:
0.45	47	0	0	0	47	48	H	(QP detector)
0.45	10	0	0	0	10	N/A	H	Average detector reading
0.45	34	0	0	0	34	48	H	13 dB relaxation
0.711	48	0	0	0	48	48	H	(QP detector)
0.711	42	0	0	0	42	N/A	H	Average detector reading
0.711	35	0	0	0	35	48	H	13 dB relaxation
1.422	42	0	0	0	42	48	H	
29.9	22	0	0	0	22	48	H	
0.45	48.5	0	0	0	48.5	48	N	(QP detector)
0.45	10	0	0	0	10	N/A	N	Average detector reading
0.45	35.5	0	0	0	35.5	48	N	13 dB relaxation
0.711	50	0	0	0	50	48	N	(QP detector)
0.711	43	0	0	0	43	N/A	N	Average detector reading
0.711	37	0	0	0	37	48	N	13 dB relaxation
1.422	42	0	0	0	42	48	N	
29.9	18	0	0	0	18	48	N	
								Scanned 450 kHz to 30 MHz
								13 dB relaxation per 15.107(d) &
								15.207(b)

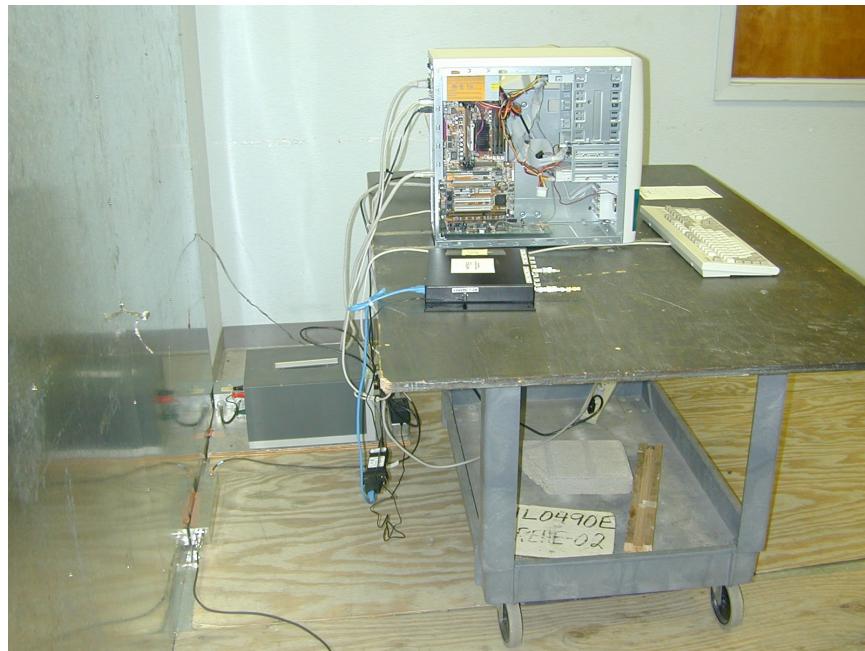
Nemko Dallas

FCC PART 15, SUBPART C

FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

EQUIPMENT: RDR-MP-001 PROJECT NO. 1L0655RUS1:

Photos – Powerline Conducted Emissions



Nemko Dallas

FCC PART 15, SUBPART C

FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

EQUIPMENT: RDR-MP-001

PROJECT NO. 1L0655RUS1:

Section 4. Channel Separation

NAME OF TEST: Channel Separation	PARA. NO.: 15.247(a)(1)
TESTED BY: Lance Walker	DATE: 11/30/2001

Test Results: Complies.



Nemko Dallas, Inc.

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

Data		CHANNEL SEP	
Page <u>1</u> of <u>1</u>			
Job No.:	1L0655R	Date:	11/30/01
Specification:	15.247	Temperature(°C):	22
Tested By:	Lance Walker	Relative Humidity(%)	50
E.U.T.:	RFID Reader		
Configuration:	Transmit modulated data		
Sample Number:	S08		
Location:	Lab 1	RBW:	30 kHz
Detector Type:	Peak	VBW:	30 kHz
Test Equipment Used			
Antenna:	Directional Coupler:		
Pre-Amp:	Cable #1: 1626		
Filter:	Cable #2:		
Receiver:	Cable #3:		
Attenuator #1	Cable #4:		
Attenuator #2:	Mixer:		
Additional equipment used:	1469		
Measurement Uncertainty:	+/-3.6 dB		
ATTN 30dB VAVG 7 ΔMKR 0dB RL 50.9dBm 10dB/ 500kHz			
CENTER 915.000MHz SPAN 1.000MHz *RBW 30kHz VBW 30kHz SWP 50.0ms			
Notes: <u>CHANNEL SEPARATION = 500 kHz</u>			

Nemko Dallas

FCC PART 15, SUBPART C

FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

EQUIPMENT: RDR-MP-001

PROJECT NO. 1L0655RUS1:

Section 5. Pseudorandom Hopping Algorithm

NAME OF TEST: Pseudorandom Hopping Algorithm	PARA. NO.: 15.247(a)(1)
TESTED BY:	DATE:

Test Results: Complies.

Measurement Data: See sample hopping sequence.
Number of Hopping Frequencies: 50+

Nemko Dallas

FCC PART 15, SUBPART C

FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

EQUIPMENT: RDR-MP-001

PROJECT NO. 1L0655RUS1:

Section 6. Time of Occupancy

NAME OF TEST: Time of Occupancy	PARA. NO.: 15.247(a)(1)
TESTED BY: Lance Walker	DATE: 11/30/2001

Test Results: Complies.

Refer to Duty Cycle plot



Nemko Dallas, Inc.

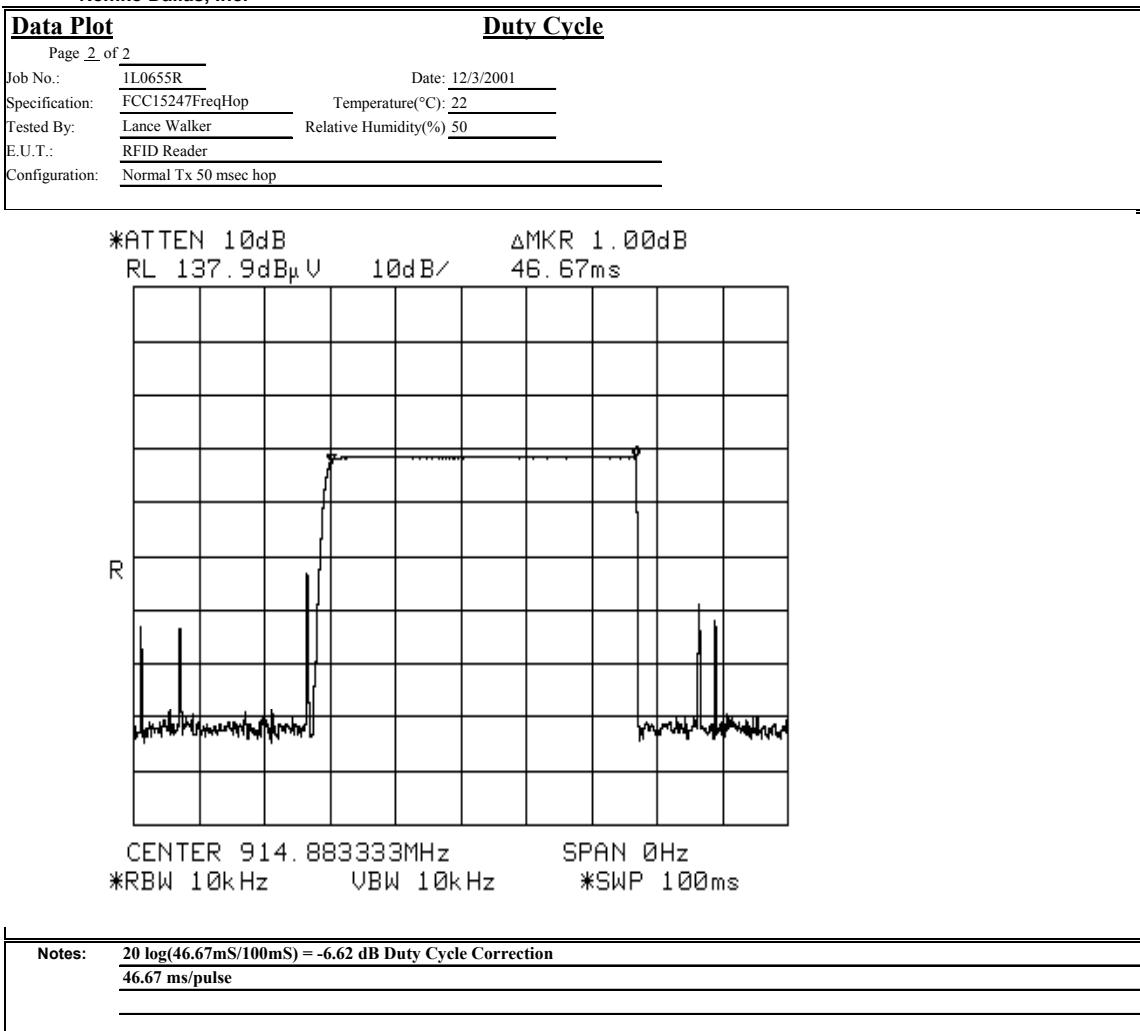
Dallas Headquarters:

802 N. Kealy

Lewisville, TX 75057

Tel: (972) 436-9600

Fax: (972) 436-2667



Nemko Dallas

FCC PART 15, SUBPART C

FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

EQUIPMENT: RDR-MP-001

PROJECT NO. 1L0655RUS1:

Section 7. Occupied Bandwidth

NAME OF TEST: Occupied Bandwidth	PARA. NO.: 15.247(a)(1)(i)
TESTED BY:	DATE:

Test Results: Complies.

Measurement Data: See attached plots.



Nemko Dallas, Inc.

Dallas Headquarters:

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

Data Plot		Bandedges			
Page <u>1</u> of					
Job No.:	1L0655R	Date:	11/30/2001	Complete	<input checked="" type="checkbox"/>
Specification:	FCC15247 Freq Hop	Temperature(°C):	22	Preliminary:	<input type="checkbox"/>
Tested By:	Lance Walker	Relative Humidity(%):	50		
E.U.T.:	915 MHz RFID Reader				
Configuration:	sweep time at 1000mSec Tx power 1 W				
Sample Number:					
Location:	Lab 2	RBW:	Refer to plots	Measurement	
Detector Type:	Peak	VBW:	Refer to plots	Distance: N/A m	
Test Equipment Used					
Antenna:	Directional Coupler:				
Pre-Amp:	Cable #1: 1626				
Filter:	Cable #2:				
Receiver:	Cable #3:				
Attenuator #1	Cable #4:				
Attenuator #2:	Mixer:				
Additional equipment used:	1477				
Measurement Uncertainty:	+/-1.7 dB				
ATTEN 30dB RL 50.9dBm		ΔMKR -38.67dB 617kHz			
Notes:	marker indicates upper bandedge, delta indicates highest frequency of carrier				



Nemko Dallas, Inc.

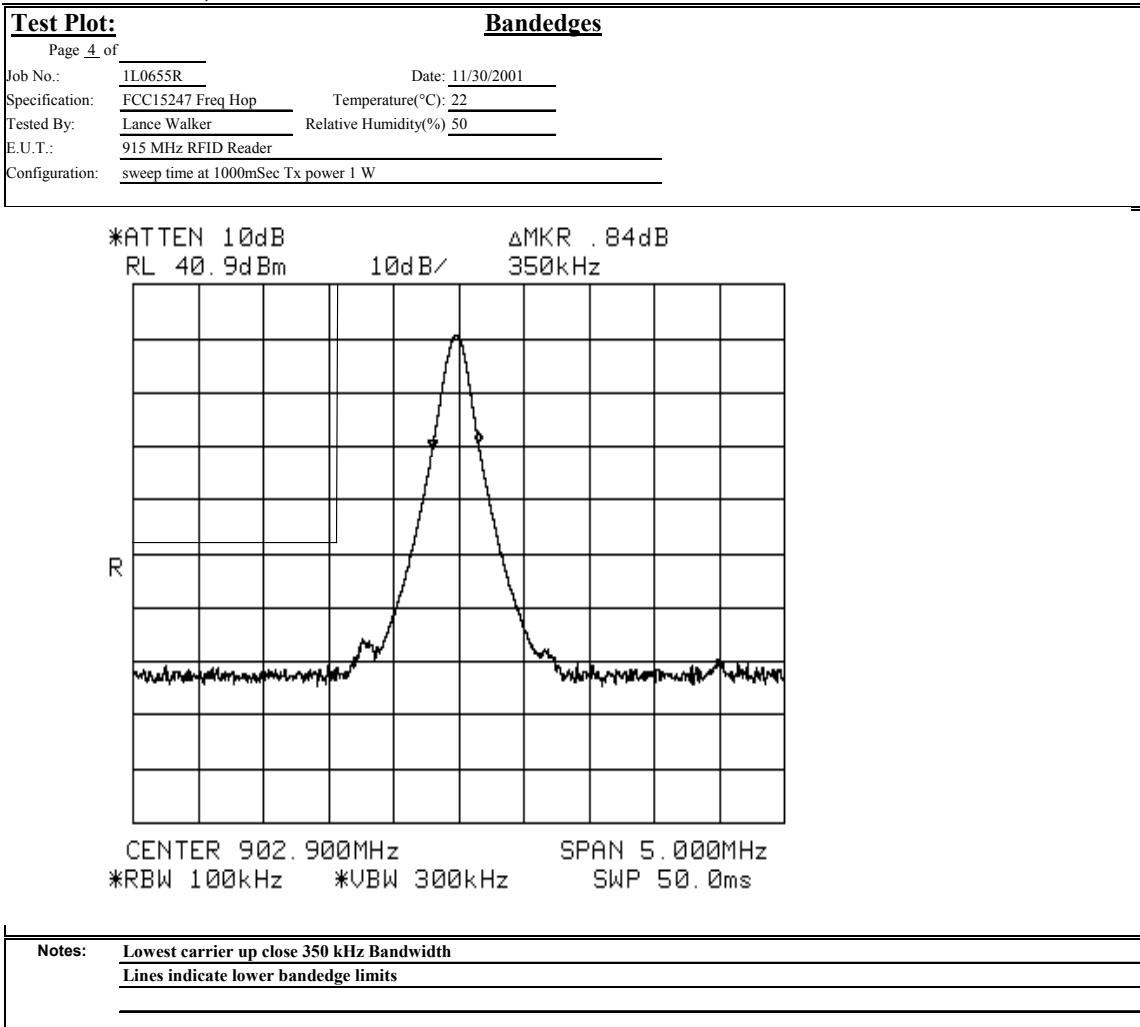
Dallas Headquarters:

802 N. Kealy

Lewisville, TX 75057

Tel: (972) 436-9600

Fax: (972) 436-2667





Nemko Dallas, Inc.

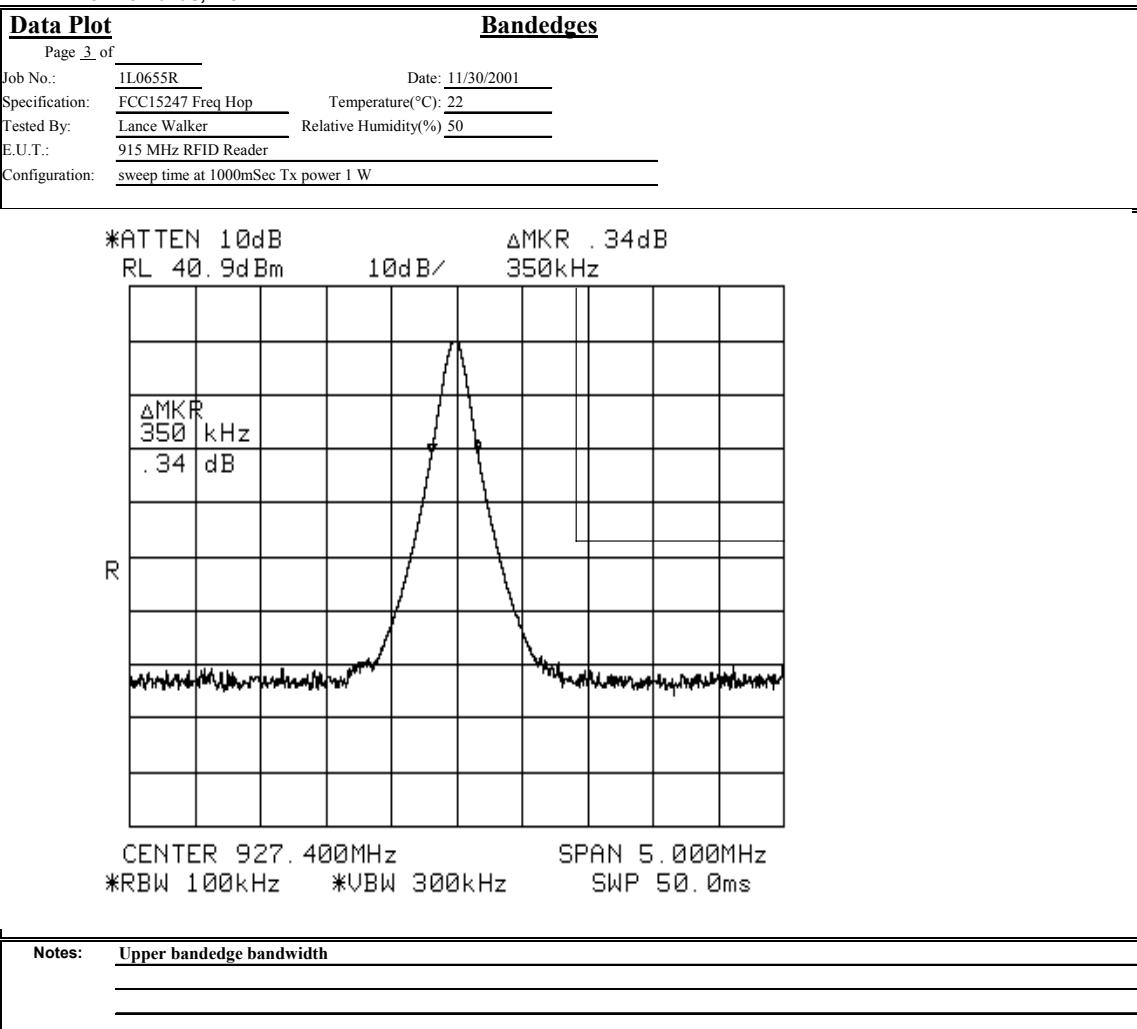
Dallas Headquarters:

802 N. Kealy

Lewisville, TX 75057

Tel: (972) 436-9600

Fax: (972) 436-2667





Nemko Dallas, Inc.

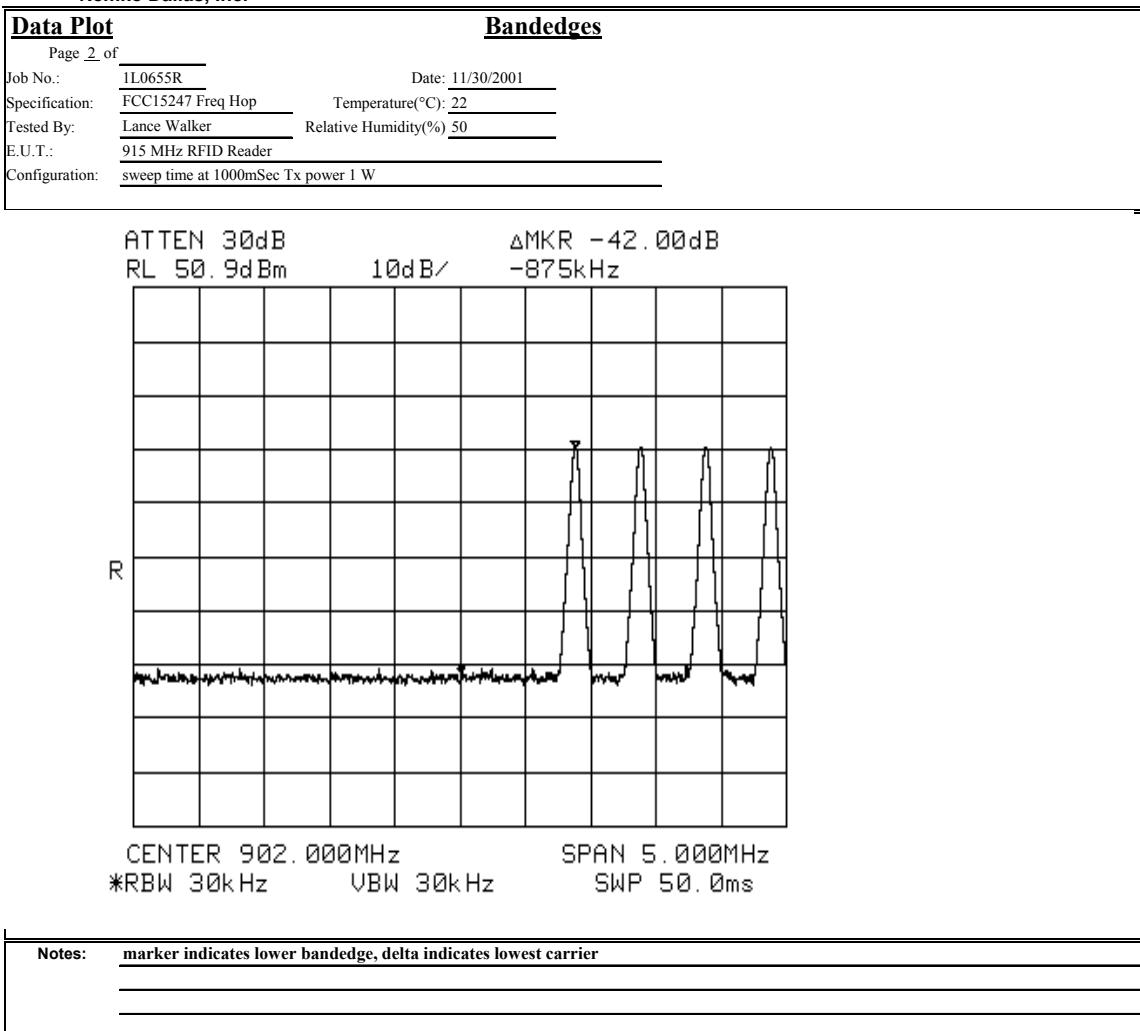
Dallas Headquarters:

802 N. Kealy

Lewisville, TX 75057

Tel: (972) 436-9600

Fax: (972) 436-2667



Nemko Dallas

FCC PART 15, SUBPART C

FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

EQUIPMENT: RDR-MP-001

PROJECT NO. 1L0655RUS1:

Section 8. Peak Power Output

NAME OF TEST: Peak Power Output	PARA. NO.: 15.247 (b)
TESTED BY: Lance Walker	DATE: 11/30/2001

Test Results: Complies.

Detachable antenna? Yes No

Channel	Gain (dBi)	Measured Peak Power (dBm)	E.I.R.P. (dBm)
Low (902.9 MHz)	6	29.9	35.9
Mid (914.9 MHz)	6	30.0	36.0
High (924.7 MHz)	6	29.9	35.9

Equipment Used: 1029, 1030, 1465, 1469, 1470

Measurement Uncertainty: +/- 0.7 dB

Temperature: 22 °C

Relative Humidity: 50 %

Nemko Dallas

FCC PART 15, SUBPART C

FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

EQUIPMENT: RDR-MP-001

PROJECT NO. 1L0655RUS1:

Section 9. Spurious Emissions (Antenna Conducted)

NAME OF TEST: Spurious Emissions (Antenna Conducted)	PARA. NO.: 15.247(c)
TESTED BY: Lance Walker	DATE: 11/30/2001

Test Results: Complies.

Measurement Data: See attached plots.



Nemko Dallas, Inc.

Data Plot

Page 1 of 1
Job No.: 1L0655R Date: 11/30/2001
Specification: FCC15247 Freq Hop Temperature(°C): 22
Tested By: Lance Walker Relative Humidity(%): 50
E.U.T.: RFID Reader
Configuration: Tx 1W @ 1.5 Second Sweep time
Sample Number: _____
Location: Lab 2 RBW: Refer to plots
Detector Type: Peak VBW: Refer to plots

Antenna Port Spurious Emissions

11. *What is the primary purpose of the following statement?*

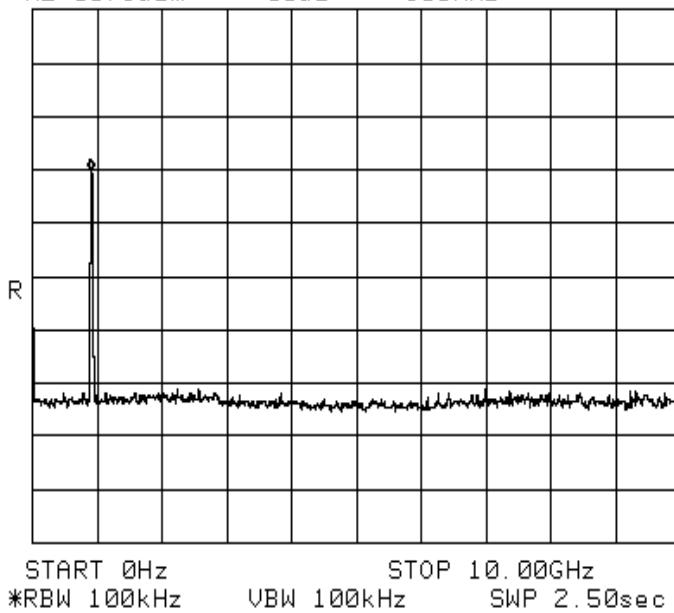
802 N. Kealy
Lewisville, TX 75057
Tel: (972) 436-9600
Fax: (972) 436-2667

Test Equipment Used

Antenna: _____ Directional Coupler: _____
Pre-Amp: _____ Cable #1: 1626
Filter: _____ Cable #2: _____
Receiver: 1464 Cable #3: _____
Attenuator #1 1465 Cable #4: _____
Attenuator #2: 1469 Mixer: _____
Additional equipment used: 1477
Measurement Uncertainty: +/- 1.7 dB

Measurement
Distance: N/A m

ATTEN 30dB MKR 20.90dBm
RL 50.9dB 10dB/ 900MHz



Notes: Marker indicates carrier, limit of 20 dB less on spurious emissions easily met

Nemko Dallas

FCC PART 15, SUBPART C

FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

EQUIPMENT: RDR-MP-001

PROJECT NO. 1L0655RUS1:



Nemko Dallas, Inc.

Data Plot

Page 2 of

Antenna Port Spurious Emissions

Job No.: 1L0655R

Date: 11/30/2001

FCC15247

—

Specification: Freq Hop

Tested By: Lance Walker

Dallas Headquarters:

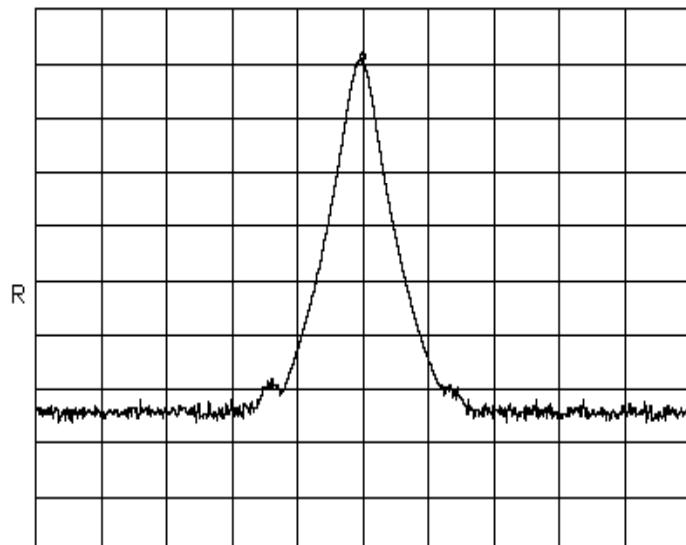
802 N. Kealy

Lewisville, TX 75057

Tel: (972) 436-9600

Fax: (972) 436-2667

*ATTEN 10dB RL 40.9dB 10dB/ MKR 31.23dBm



CENTER 902.900MHz SPAN 5.000MHz
*RBW 100kHz VBW 100kHz SWP 50.0ms

Notes: close up lower bandedge spurious

Nemko Dallas

FCC PART 15, SUBPART C

FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

EQUIPMENT: RDR-MP-001

PROJECT NO. 1L0655RUS1:



Nemko Dallas, Inc.

Dallas Headquarters:

802 N. Kealy

Lewisville, TX 75057

Tel: (972) 436-9600

Fax: (972) 436-2667

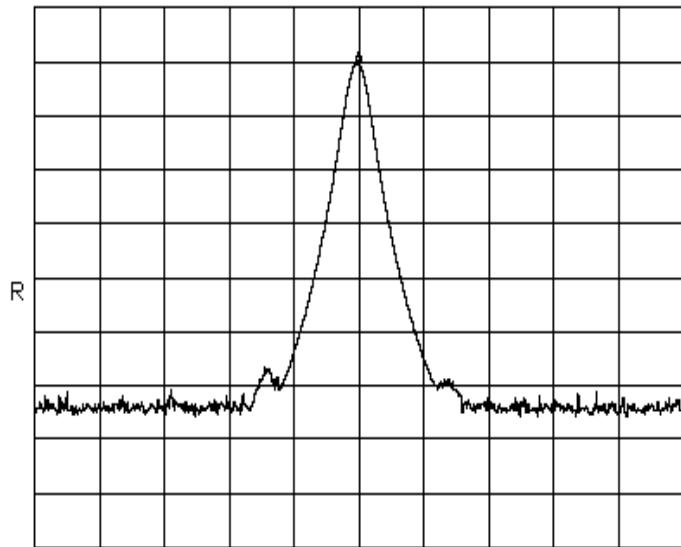
Data Plot

Page 3 of

Job No.:	1L0655R	Date:	11/30/2001
Specification:	FCC15247 Freq Hop	Temperature(°C):	22
Tested By:	Lance Walker	Relative Humidity(%):	50
E.U.T.:	RFID Reader		
Configuration:	Tx 1W @ 1.5 Second Sweep time		

Antenna Port Spurious Emissions

*ATTEN 10dB RL 40.9dB 10dB/ MKR 30.57dBm 927.400MHz



CENTER 927.400MHz SPAN 5.000MHz
*RBW 100kHz VBW 100kHz SWP 50.0ms

Notes: Upper bandedge spurious emissions plot.

Nemko Dallas

FCC PART 15, SUBPART C

FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

EQUIPMENT: RDR-MP-001

PROJECT NO. 1L0655RUS1:

Section 10. Spurious Emissions (Radiated)

NAME OF TEST: Spurious Emissions (Radiated)	PARA. NO.: 15.247(c)
TESTED BY: Lance Walker	DATE: 12/03/2001

Test Results: Complies.

Measurement Data: See attached table.

Duty Cycle Calculation:

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

$20 \log (46.67\text{ms}/100\text{ms}) = -6.6 \text{ dB}$ Correction factor



Nemko Dallas, Inc.

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

Data		Duty			
Page 1 of					
Job No.:	1L0655R	Date:	12/3/2001	Complete	<input checked="" type="checkbox"/>
Specification:	FCC15247FreqHop	Temperature(°C):	22	Preliminary:	
Tested By:	Lance Walker	Relative Humidity(%):	50		
E.U.T.:	RFID Reader				
Configuration:	Normal Tx 50 msec hop				
Sample Number:					
Location:	AC 3	RBW:	Refer to plots	Measurement	
Detector Type:	Peak	VBW:	Refer to plots	Distance:	3 m
Test Equipment Used					
Antenna:	1304	Directional Coupler:			
Pre-Amp:		Cable #1:	1484		
Filter:		Cable #2:	1485		
Receiver:	1464	Cable #3:			
Attenuator #1	1465	Cable #4:			
Attenuator #2:	1477	Mixer:			
Additional equipment used:					
Measurement Uncertainty: +/-1.7 dB					
*ATTEN 10dB RL 137.9dB _μ V 10dB/ Δ MKR -.17dB Δ MKR 2.500 sec					
Notes:	4 pulses in 10 seconds 46.67 ms/pulse				



Nemko Dallas, Inc.

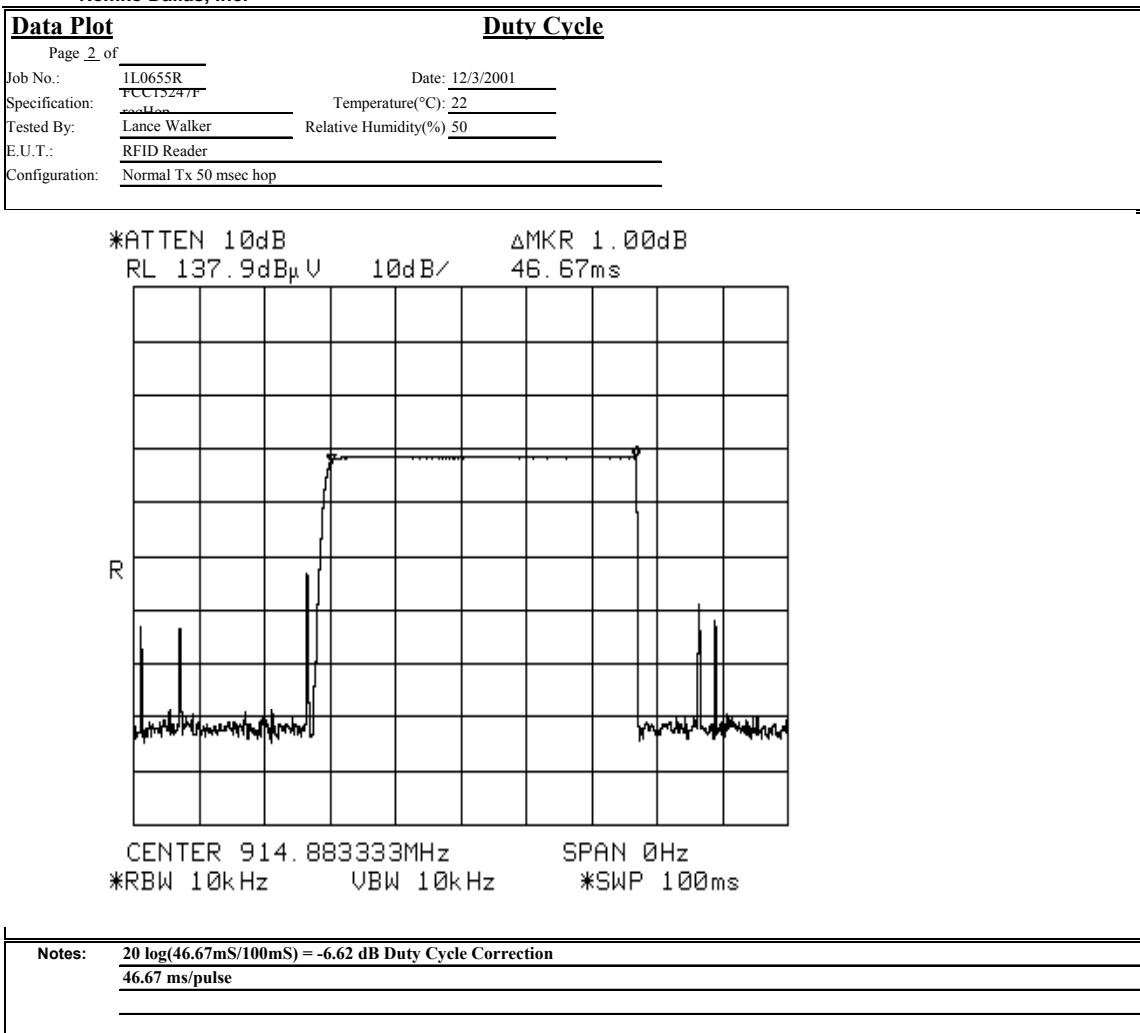
Dallas Headquarters:

802 N. Kealy

Lewisville, TX 75057

Tel: (972) 436-9600

Fax: (972) 436-2667



Test Data - Radiated Emissions



Nemko Dallas, Inc.

Dallas Headquarters:

802 N. Kealy

Lewisville, TX 75057

Tel: (972) 436-9600

Fax: (972) 436-2667

<u>Radiated Emissions</u>									
Page <u>1</u> of <u>2</u>									
Job No.:	1L0655R		Date: 12/5/01						
Specification:	CFR 47, Part 15		Temperature(°C): 22						
Tested By:	Lance Walker		Relative Humidity(%) 50						
E.U.T.:	RFID Reader								
Configuration:	CW on same frequency								
Sample Number:	S01								
Location:	AC 3		RBW: 1 MHz						
Detector Type:	Average		VBW: 10 Hz						
<u>Test Equipment Used</u>									
Antenna:	1304		Directional Coupler: #N/A						
Pre-Amp:	1016		Cable #1: 1485						
Filter:	1481		Cable #2: 1484						
Receiver:	1464		Cable #3: 1626						
Attenuator #1	#N/A		Cable #4: #N/A						
Attenuator #2:	#N/A		Mixer: #N/A						
Additional equipment used: _____									
Measurement Uncertainty:	+/- 3.6 dBuV								
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	
2.745	57.8	29	4.1	33.5	57.4	54	3.4	Vert Mid Ch*	
3.659	41	30.8	3.8	33.7	41.9	54	-12.1		
4.577	38.8	32	4.1	33.8	41.1	54	-12.9		
7.319	33.3	36.1	5.3	33	41.7	54	-12.3	Vert Mid Ch NF	
8.233	33.7	36.5	5.7	34.2	41.7	54	-12.3	Vert Mid Ch NF	
9.149	33.7	37.2	5.5	35.3	41.1	54	-12.9	Vert Mid Ch NF	
2.745	55.7	29	4.1	33.5	55.3	54	1.3	Horiz Mid Ch*	
3.659	37.2	30.8	3.8	33.7	38.1	54	-15.9		
4.577	33.5	32	4.1	33.8	35.8	54	-18.2	Horiz Mid Ch NF	
7.319	33.3	36.1	5.3	33	41.7	54	-12.3	Horiz Mid Ch NF	
8.233	33.7	36.5	5.7	34.2	41.7	54	-12.3	Horiz Mid Ch NF	
9.149	33.7	37.2	5.5	35.3	41.1	54	-12.9	Horiz Mid Ch NF	
2.782	51.1	29	4.1	33.5	50.7	54	-3.3	Vert High Ch	
3.710	35.3	30.8	3.8	33.7	36.2	54	-17.8		
4.637	34.1	32	4.1	33.8	36.4	54	-17.6		
7.419	31.6	36.1	5.3	33	40.0	54	-14.0	Vert High Ch NF	
8.347	40.1	36.5	5.7	34.2	48.1	54	-5.9	Vert High Ch NF	
2.782	52.6	29	4.1	33.5	52.2	54	-1.8	Horiz High Ch	
3.710	32.9	30.8	3.8	33.7	33.8	54	-20.2	Horiz High Ch NF	
4.637	33.3	32	4.1	33.8	35.6	54	-18.4		
7.419	31.6	36.1	5.3	33	40.0	54	-14.0	Horiz High Ch NF	
Notes: Checked up to the tenth harmonic of high, low, and mid frequencies.									
*with duty cycle correction factor of -6.6 passes by 3.2, and 5.3 dB									

Nemko Dallas

FCC PART 15, SUBPART C

FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

EQUIPMENT: RDR-MP-001

PROJECT NO. 1L0655RUS1:



Nemko Dallas, Inc.

Dallas Headquarters:

802 N. Kealy

Lewisville, TX 75057

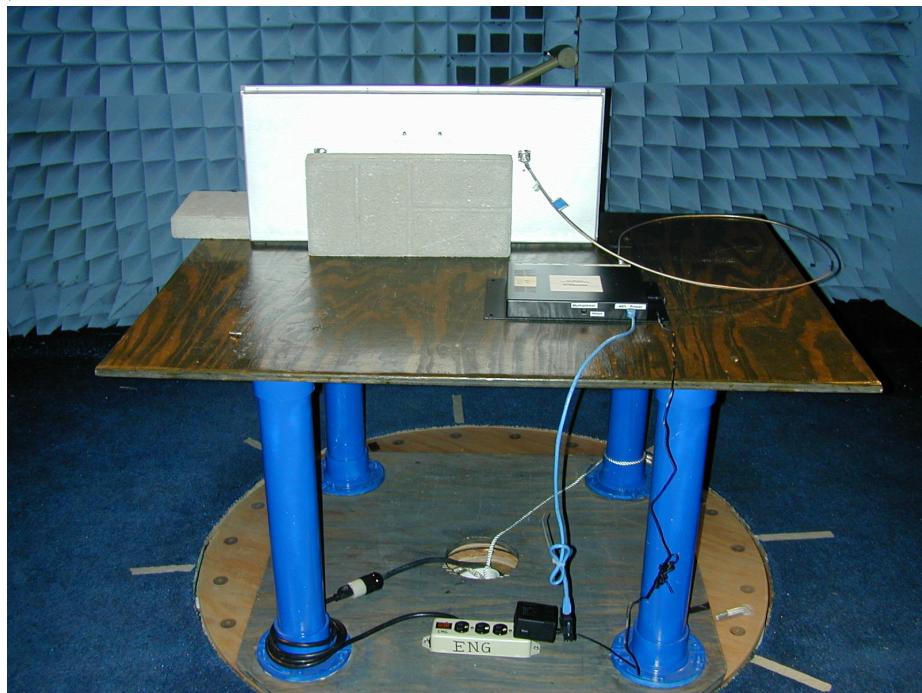
Tel: (972) 436-9600

Radiated Photographs (Worst Case Configuration)

FRONT VIEW



REAR VIEW



Section 11. Test Equipment List

Nemko ID	Description	Manufacturer Model Number	Serial Number	Calibration Date
1304	HORN ANTENNA	ELECTRO METRICS RGA-60	6151	07/30/01
1016	Pre-Amp	HEWLETT PACKARD 8449A	2749A00159	05/30/01
1481	Microwave Highpass Filter	K & L 3DH1-2000/T8000-0/0	4	Cal B4 Use
1464	Spectrum analyzer	Hewlett Packard 8563E	3551A04428	01/02/01
1485	Cable 2.0-18.0 Ghz	Storm PR90-010-216	N/A	06/01/01
1484	Cable 2.0-18.0 Ghz	Storm PR90-010-072	N/A	06/01/01
1626	CABLE, 5 ft	MEGAPHASE 10311 1GVT4	N/A	CBU
1465	10 db Attenuator DC 8.0 Ghz	Midwest Microwave 292/10db	NONE	CBU
1626	CABLE, 5 ft	MEGAPHASE 10311 1GVT4	N/A	CBU
1469	10 db Attenuator DC 18 Ghz	MCL Inc. BW-S10W2 10db-2WDC	NONE	CBU
1029	PEAK POWER METER	HP 8900D	3303U0012	03/12/01
1030	PEAK POWER SENSOR	HP 84811A	2539A03573	03/12/01
1470	10 db Attenuator DC 18 Ghz	MCL Inc. BW-S10W2 10db-2WDC	NONE	CBU

Nemko Dallas

FCC PART 15, SUBPART C

FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

EQUIPMENT: RDR-MP-001

PROJECT NO. 1L0655RUS1:

ANNEX A - TEST DETAILS

Nemko Dallas

FCC PART 15, SUBPART C

FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

EQUIPMENT: RDR-MP-001

PROJECT NO. 1L0655RUS1:

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.

Nemko Dallas

FCC PART 15, SUBPART C

FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

EQUIPMENT: RDR-MP-001

PROJECT NO. 1L0655RUS1:

NAME OF TEST: Channel Separation

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

Minimum Standard: Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

Nemko Dallas

FCC PART 15, SUBPART C

FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

EQUIPMENT: RDR-MP-001

PROJECT NO. 1L0655RUS1:

NAME OF TEST: Pseudorandom Hopping Algorithm

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

Minimum Standard:

The system shall hop to channel frequencies that are selected from a pseudorandomly ordered list of hopping frequencies. Each frequency must be used equally on average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their transmitters and shall shift frequencies in synchronization with the transmitted signals.

NAME OF TEST: Time of Occupancy

PARA. NO.: 15.247(a)(1)(ii)

Minimum Standard:

Frequency Band (MHz)	20 dB Bandwidth	No. of Hopping Channels	Average Time of Occupancy
902 - 928	<250 kHz	50	=<0.4 sec. in 20 sec.
902 - 928	=>250 kHz	25	=<0.4 sec. in 10 sec.
2400 - 2483.5	-----	75	=<0.4 sec. in 30 sec.
5725 - 5850	-----	75	=<0.4 sec. in 30 sec.

Method Of Measurement:

The spectrum analyzer is set as follows:

RBW: 1 MHz

VBW: = RBW

Span: 0 Hz

LOG dB/div.: 10 dB

Sweep: Sufficient to see one hop time sequence.

Trigger: Video

The occupancy time of one hop is measured as above. The average time of occupancy is calculated over the appropriate period of time from above table (10, 20, or 30 seconds).

Avg. time of occupancy = (period from table/duration of one hop)/no. of channels multiplied by the duration of one hop.

For instance:

If a 2.4 GHz system has a measured hop duration time of 1 msec. and uses 75 channels, then the average time of occupancy would be:

$(30 \text{ sec.} / .001 \text{ sec.}) / 75 \text{ chan.} = 400 \times 1 \text{ msec.} = 400 \text{ msec. or } 0.4 \text{ sec. in 30 sec.}$

Nemko Dallas

FCC PART 15, SUBPART C

FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

EQUIPMENT: RDR-MP-001

PROJECT NO. 1L0655RUS1:

NAME OF TEST: Occupied Bandwidth

PARA. NO.: 15.247(a)(2)

Minimum Standard:

Frequency Band (MHz)	Maximum 20 dB Bandwidth
902 - 928	500 kHz
2400 – 2483.5	1 MHz
5725 – 5850	1 MHz

Method Of Measurement:

The spectrum analyzer is set as follows:

RBW: At least 1% of span/div.

VBW: >RBW

Span: Sufficient to display 20 dB bandwidth

LOG dB/div.: 10 dB

Sweep: Auto

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: Peak Power Output

PARA. NO.: 15.247(b)

Minimum Standard:

Frequency Band (MHz)	No. of Hopping Channels	Maximum Peak Power Output at Antenna Port
902 - 928	at least 50	1 watt
902 – 928	25 - 49	0.25 watts
2400 – 2483.5	75	1 watt
5725 – 5850	75	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 20 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: Spurious Emissions at Antenna Terminals 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 (μ V/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**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

Nemko Dallas**FCC PART 15, SUBPART C****FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER****EQUIPMENT: RDR-MP-001****PROJECT NO. 1L0655RUS1:**

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 (µV/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

Nemko Dallas

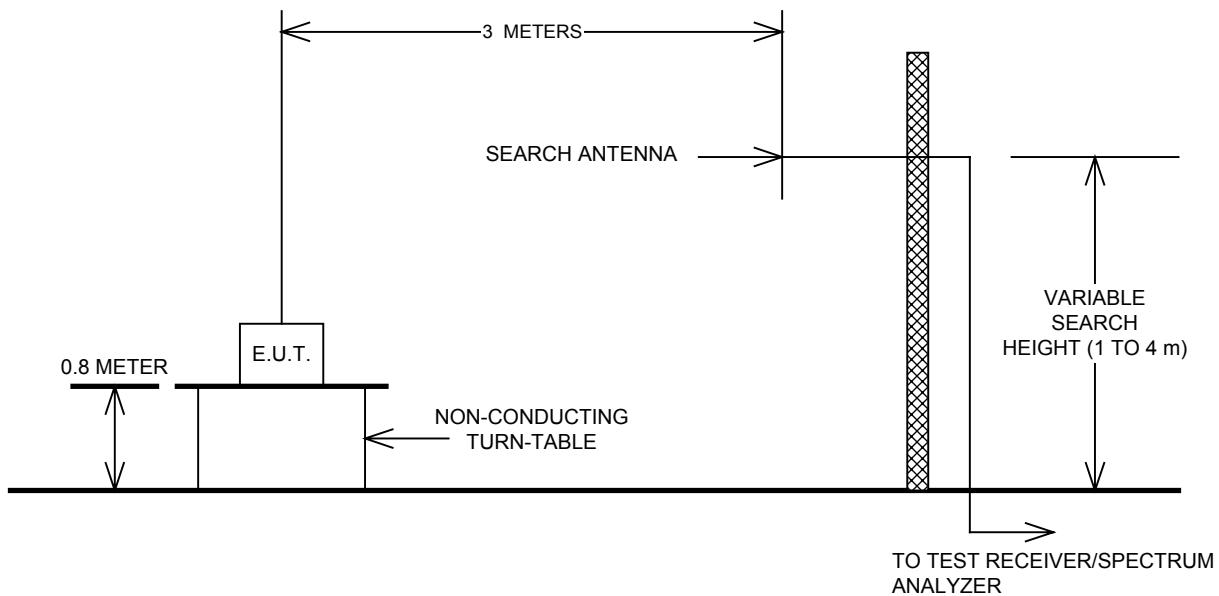
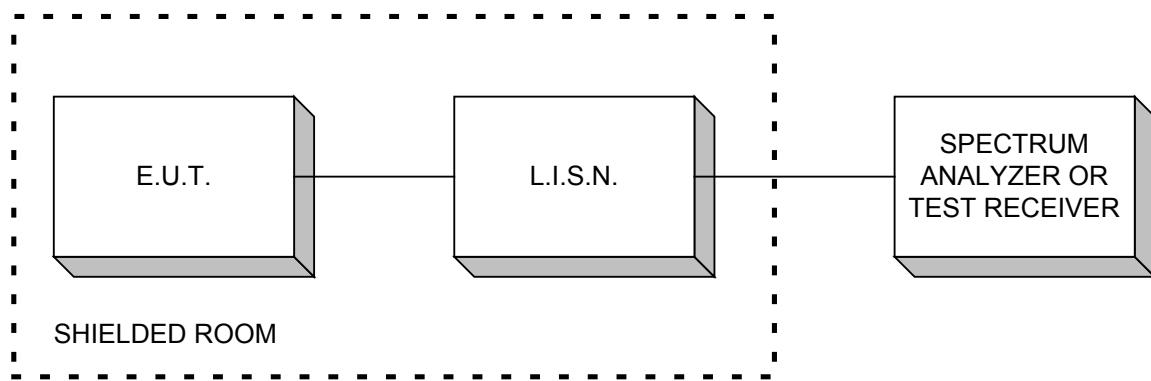
FCC PART 15, SUBPART C

FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

EQUIPMENT: RDR-MP-001

PROJECT NO. 1L0655RUS1:

ANNEX B - TEST DIAGRAMS

Test Site For Radiated Emissions**Conducted Emissions**

Peak Power At Antenna Terminals

