

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

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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

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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)	≤ 0.4 sec in 30 sec	Complies
20 dB Occupied Bandwidth	15.247(a)(1)	≤ 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

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EQUIPMENT: RDR-MP-001

PROJECT NO. 1L0655RUS1:

Description of Modification for Modification Filing

Not Applicable

Family List Rational

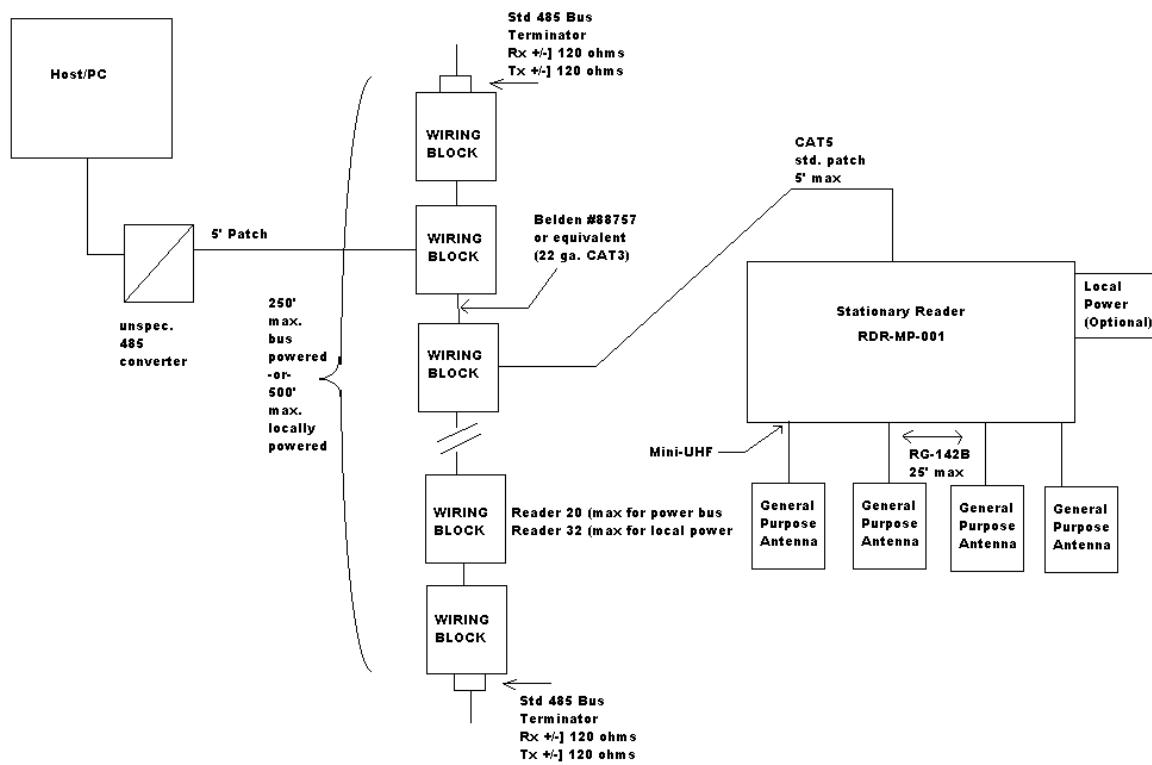
Not Applicable

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



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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



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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)

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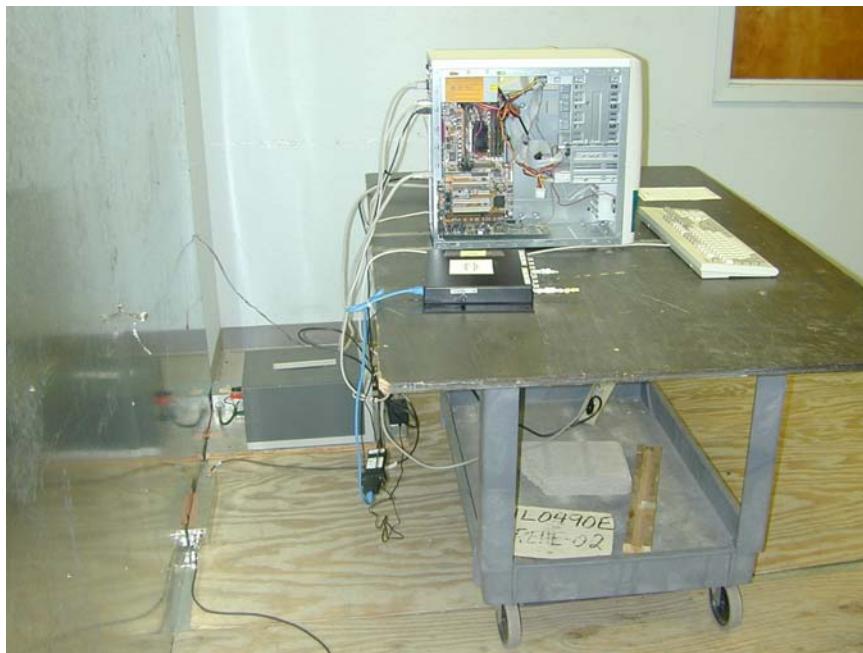
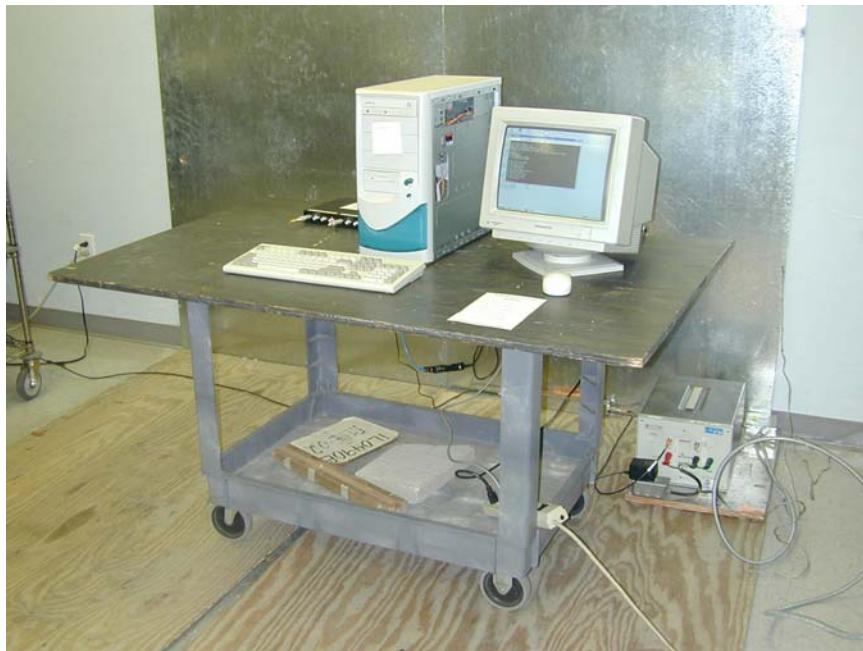
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FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

EQUIPMENT: RDR-MP-001

PROJECT NO. 1L0655RUS1:

Photos – Powerline Conducted Emissions



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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.

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EQUIPMENT: RDR-MP-001

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Data

Page 1 of 1

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

Complete

Preliminary

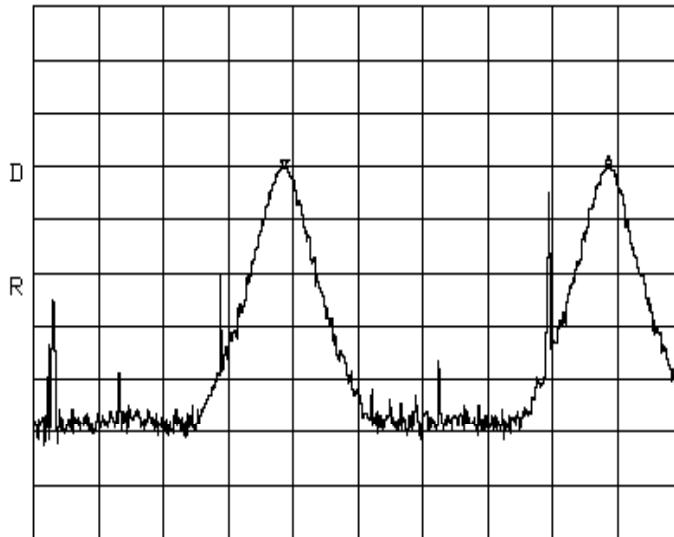
CHANNEL SEP

Test Equipment Used

Antenna: Directional Coupler: _____
Pre-Amp: Cable #1: 1626
Filter: Cable #2: _____
Receiver: 1464 Cable #3: _____
Attenuator #1: 1477 Cable #4: _____
Attenuator #2: 1465 Mixer: _____

Additional equipment used: 1469
Measurement Uncertainty: +/-3.6 dB

ATTEN 30dB VAVG 7 ΔMKR 0dB
RL 50. 9dBm 10dB/ 500kHz



CENTER 915.000MHz SPAN 1.000MHz
*RBW 30kHz VBW 30kHz SWP 50.0ms

Notes: CHANNEL SEPARATION = 500 kHz

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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+

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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



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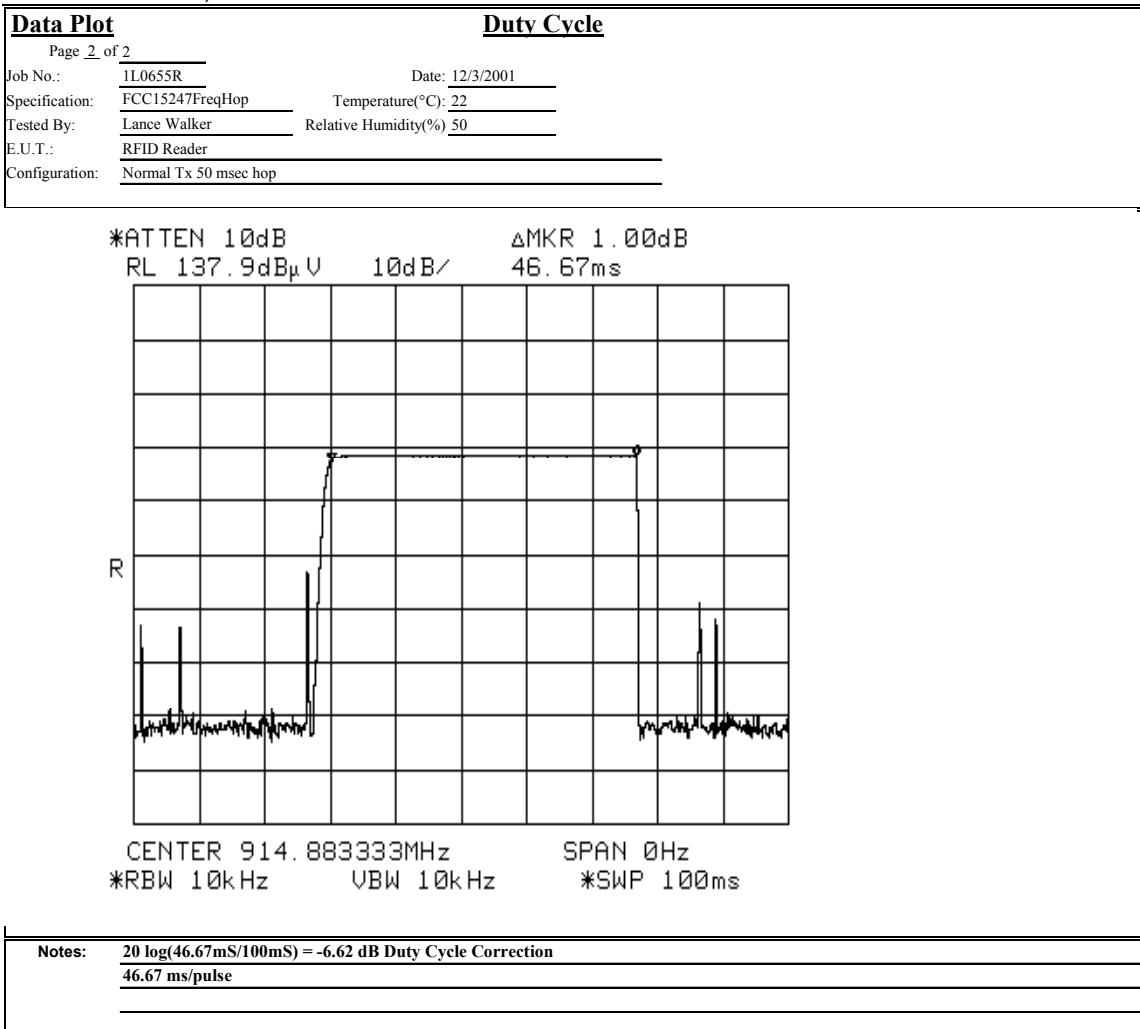
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PROJECT NO. 1L0655RUS1:

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.



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Data Plot		Bandedges			
Page 1 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 ΔMKR -38.67dB RL 50.9dBm 617kHz 					
Notes:	marker indicates upper bandedge, delta indicates highest frequency of carrier				

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EQUIPMENT: RDR-MP-001

PROJECT NO. 1L0655RUS1:



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Test Plot:

Page 4 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.: 915 MHz RFID Reader
Configuration: sweep time at 1000mSec Tx power 1 W

Bandedges

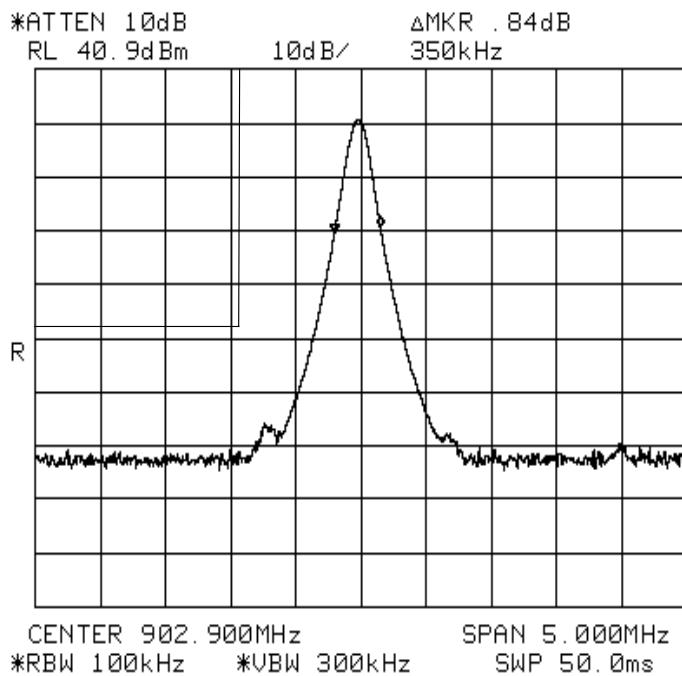
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Notes: Lowest carrier up close 350 kHz Bandwidth
Lines indicate lower bandedge limits

SPAN 5.000MHz
SWP 50.0ms

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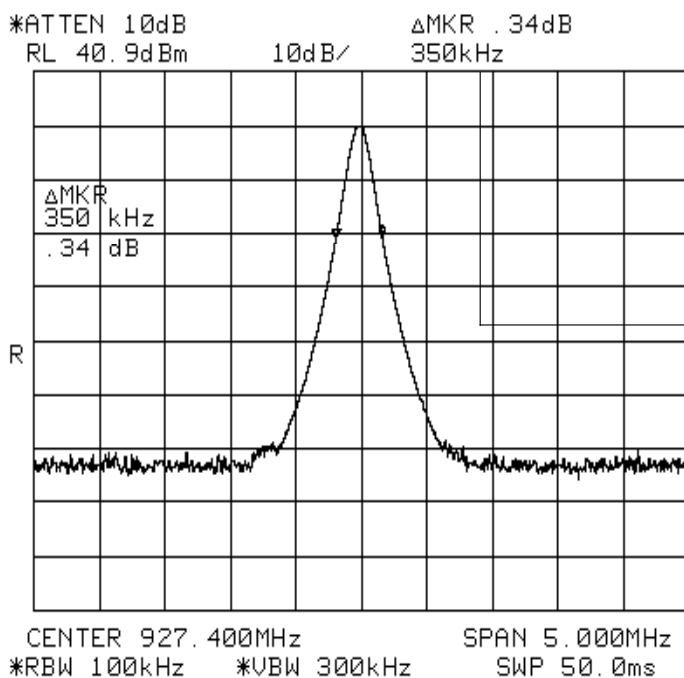
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Data Plot

Bandedges

Page 3 of 1
Job No.: 1L0655R Date: 11/30/2001
Specification: FCC15247 Freq Hop Temperature($^{\circ}$ C): 22
Tested By: Lance Walker Relative Humidity(%): 50
E.U.T.: 915 MHz RFID Reader
Configuration: sweep time at 1000mSec Tx power 1 W



Notes: Upper bandwidth

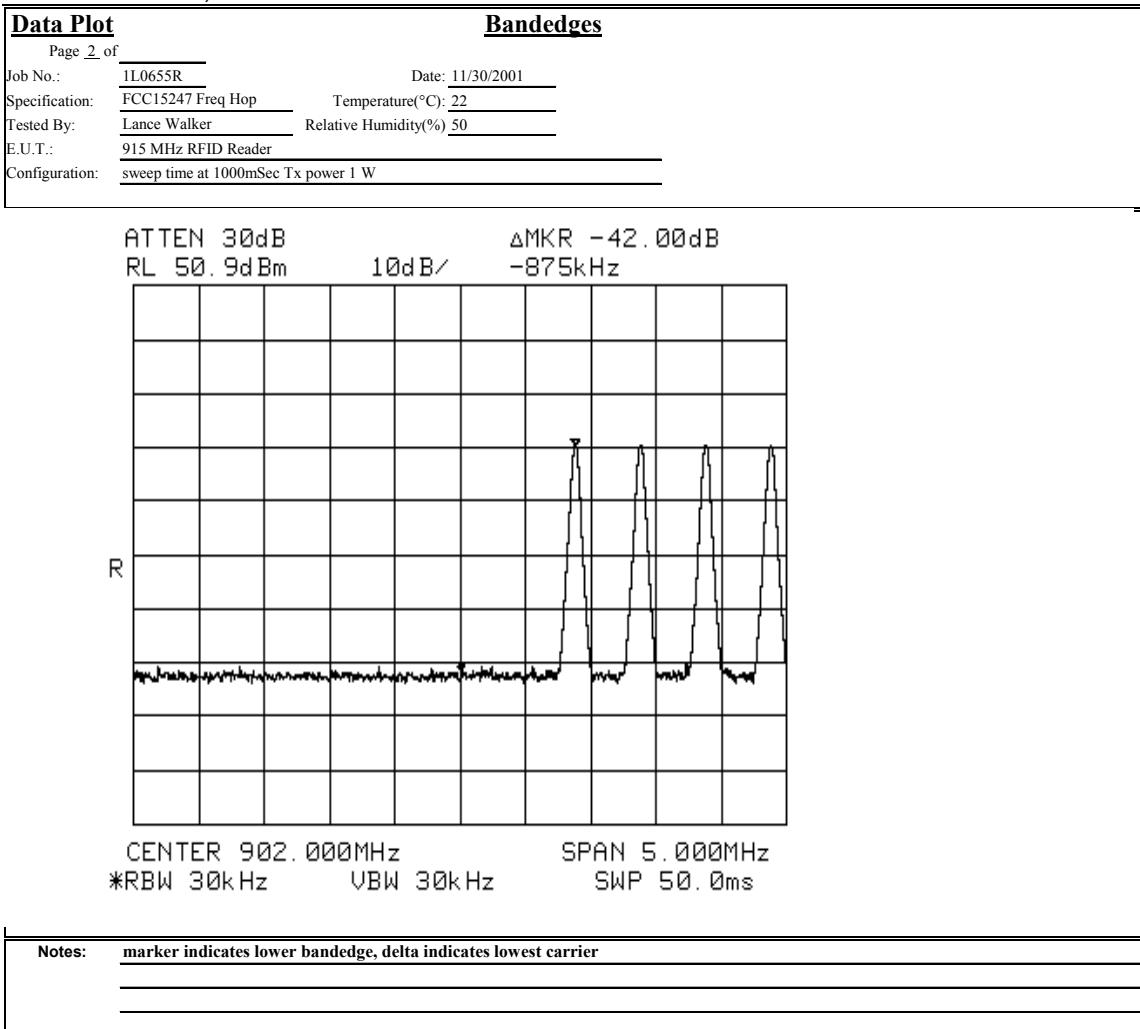
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EQUIPMENT: RDR-MP-001

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.

Note: This device was tested at +/- 15% nominal voltage with no effect on RF emission levels.

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 %

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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.

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FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

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PROJECT NO. 1L0655RUS1:



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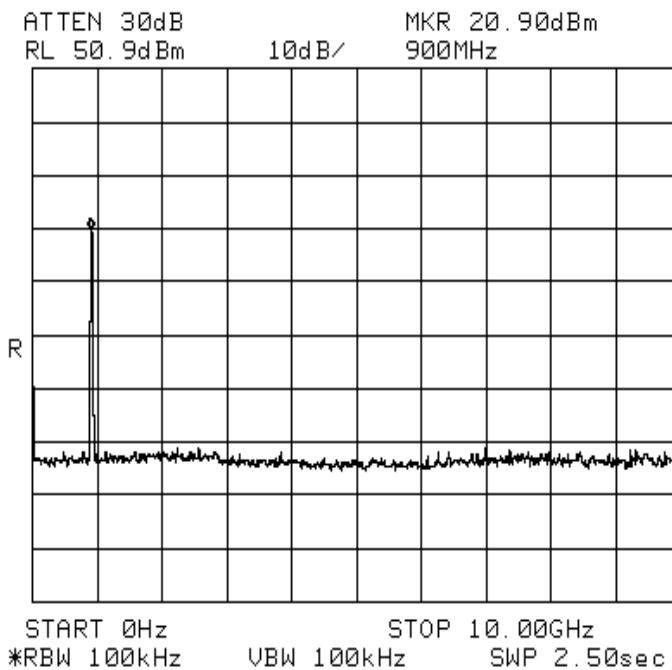
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Data Plot		Antenna Port Spurious Emissions	
Page <u>1</u> of		Complete <u> X </u>	
Job No.:	1L0655R	Date:	<u>11/30/2001</u>
Specification:	FCC15247 Freq Hop	Temperature(°C):	<u>22</u>
Tested By:	<u>Lance Walker</u>	Relative Humidity(%):	<u>50</u>
E.U.T.:	<u>RFID Reader</u>		
Configuration:	<u>Tx 1W @ 1.5 Second Sweep time</u>		
Sample Number:			
Location:	<u>Lab 2</u>	RBW:	<u>Refer to plots</u>
Detector Type:	<u>Peak</u>	VBW:	<u>Refer to plots</u>
		Measurement	
		Distance:	<u>N/A</u> <u>m</u>



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

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FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

EQUIPMENT: RDR-MP-001

PROJECT NO. 1L0655RUS1:



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Data Plot

Page 2 of

Job No.: 1L0655R

Antenna Port Spurious Emissions

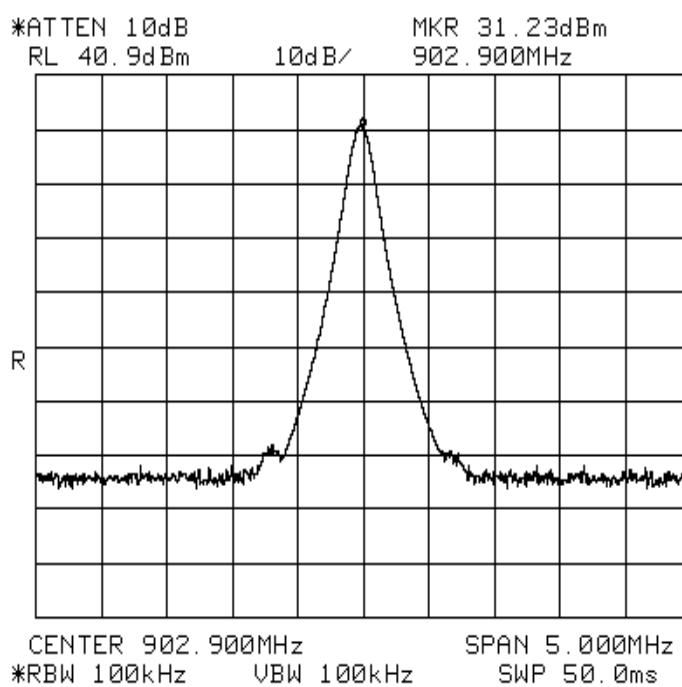
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Notes: close up lower bandedge spurious

SPAN 5.000MHz

*RBW 1000 kHz VBW 1000 kHz

HR 3.000m
SLIP 50.0ms

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FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

EQUIPMENT: RDR-MP-001

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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



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Data		Duty			
Page <u>1</u> of					
Job No.:	1L0655R	Date:	12/3/2001	Complete	<input checked="" type="checkbox"/>
Specification:	FCC15247FreqHop	Temperature(°C):	22	Preliminary:	<input type="checkbox"/>
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: <u>3 m</u>	
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: <u>+/-1.7 dB</u>					
<p style="text-align: center;">*ATTEN 10dB RL 137.9dBμV 10dB/ ΔMKR -.17dB 2.500sec</p>					
Notes:	<u>4 pulses in 10 seconds</u> <u>46.67 ms/pulse</u>				



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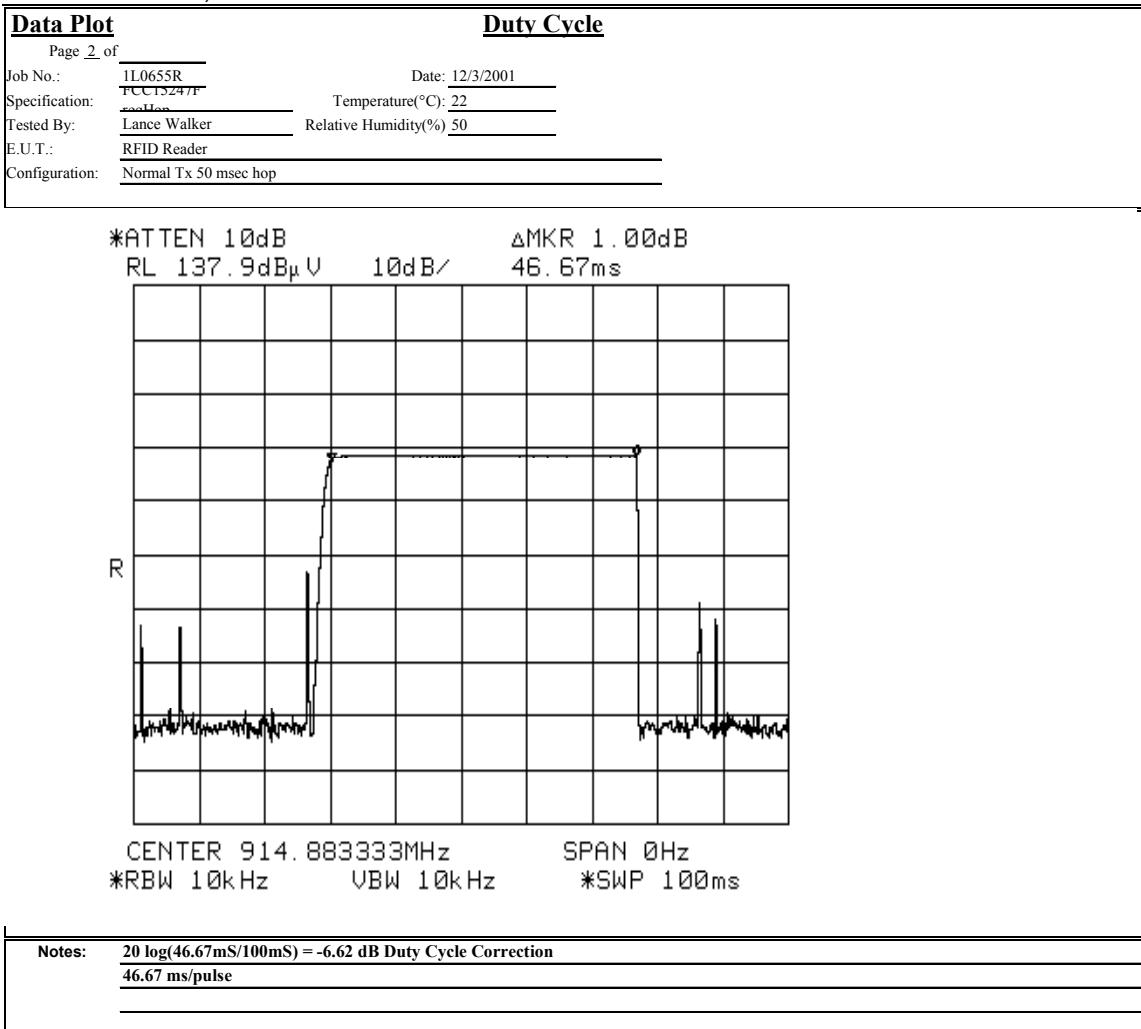
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Test Data - Radiated Emissions



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<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

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FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

EQUIPMENT: RDR-MP-001

PROJECT NO. 1L0655RUS1:



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FCC PART 15, SUBPART C

FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

EQUIPMENT: RDR-MP-001

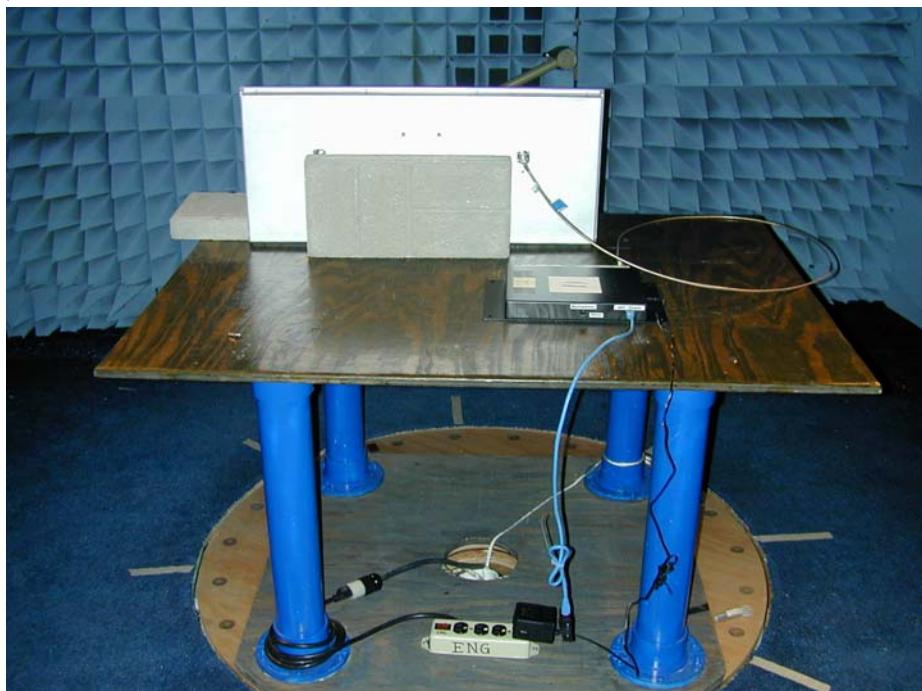
PROJECT NO. 1L0655RUS1:

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

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FCC PART 15, SUBPART C

FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

EQUIPMENT: RDR-MP-001

PROJECT NO. 1L0655RUS1:

ANNEX A - TEST DETAILS

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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.

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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.

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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.

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FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

EQUIPMENT: RDR-MP-001

PROJECT NO. 1L0655RUS1:

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:

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

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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

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 (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

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

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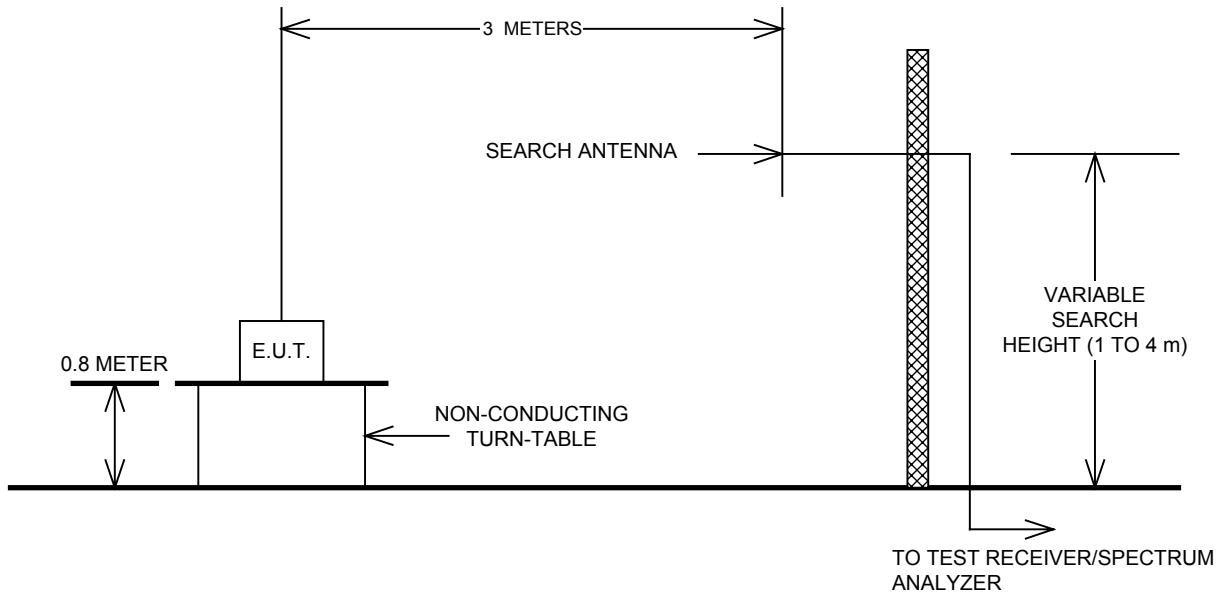
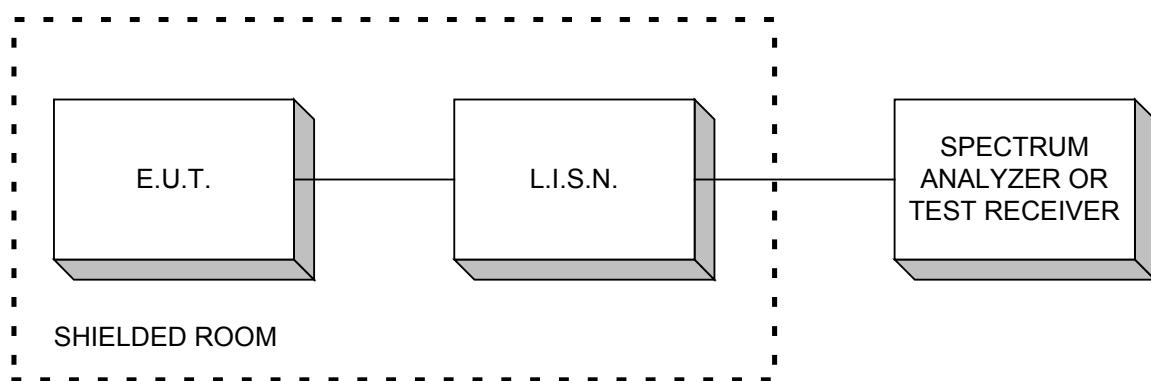
FCC PART 15, SUBPART C

FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

EQUIPMENT: RDR-MP-001

PROJECT NO. 1L0655RUS1:

ANNEX B - TEST DIAGRAMS

Test Site For Radiated Emissions**Conducted Emissions**

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FCC PART 15, SUBPART C

FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

EQUIPMENT: RDR-MP-001

PROJECT NO. 1L0655RUS1:

Peak Power At Antenna Terminals

