

Nemko Test Report: 1L0655RUS1

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

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

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.



New Submission



Production Unit



Class II Permissive Change



Pre-Production Unit



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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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:	<input checked="" type="checkbox"/> 902 – 928 MHz <input type="checkbox"/> 2400 – 2483.5 MHz
Number of Channels:	>50
Channel Spacing:	500 kHz
Emissions Designator:	AM/OOK
User Frequency Adjustment:	Software controlled

Description of Modification for Modification Filing

Not Applicable

Family List Rational

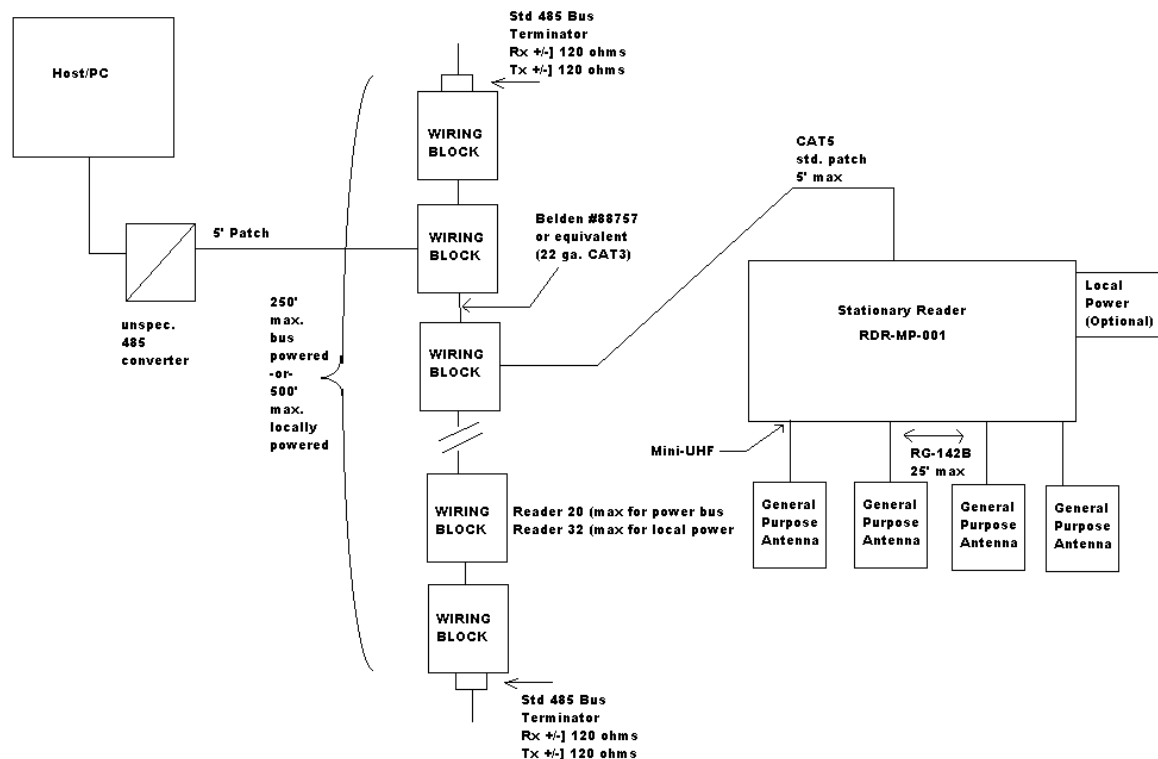
Not Applicable

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



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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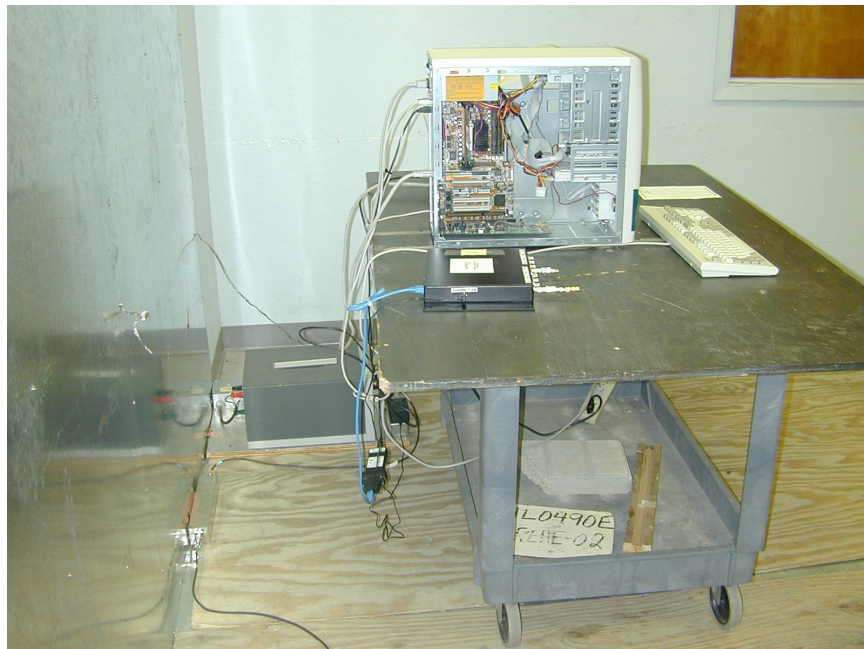
Conducted Emissions Data
(CISPR Quasi-Peak Detector)
FCC (CFR 47)

Complete X
Preliminary

Page 1 of 1 Client: TELENEXUS W.O.#: 1L0655R Date: 12/7/2001EUT: RDR-MP-001 S/N: P-0005 Specification: FCC PART 15Tech: LIGHT Test #: 1 Lab: 6 Photo ID: 1L0655 1 Equipment Used: 970-1553-1188-1505-969Configuration: TABLETOP - TX FULL POWER INTO 50 OHM LOADIF Bandwidth: 10 kHz Video Bandwidth: N/A Detector: Peak X CISPRAmbient Temperature: 22 C EUT Power: X 115 V.A.C. X 60 Hz X 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)

Photos – Powerline Conducted Emissions



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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Data		CHANNEL SEP	
Page 1 of 1		Complete <u>X</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:	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 SEPERATION = 500 kHz

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+

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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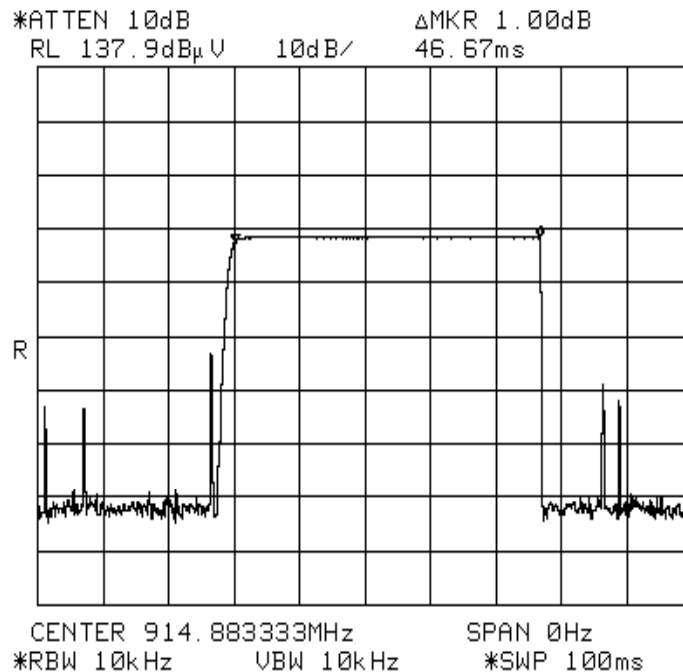
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Data Plot

Page 2 of 2

Duty Cycle

Job No.: 1L0655R Date: 12/3/2001
Specification: FCC15247FreqHop Temperature(°C): 22
Tested By: Lance Walker Relative Humidity(%) 50
E.U.T.: RFID Reader
Configuration: Normal Tx 50 msec hop



Notes: $20 \log(46.67\text{ms}/100\text{ms}) = -6.62 \text{ dB Duty Cycle Correction}$
46.67 ms/pulse

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.

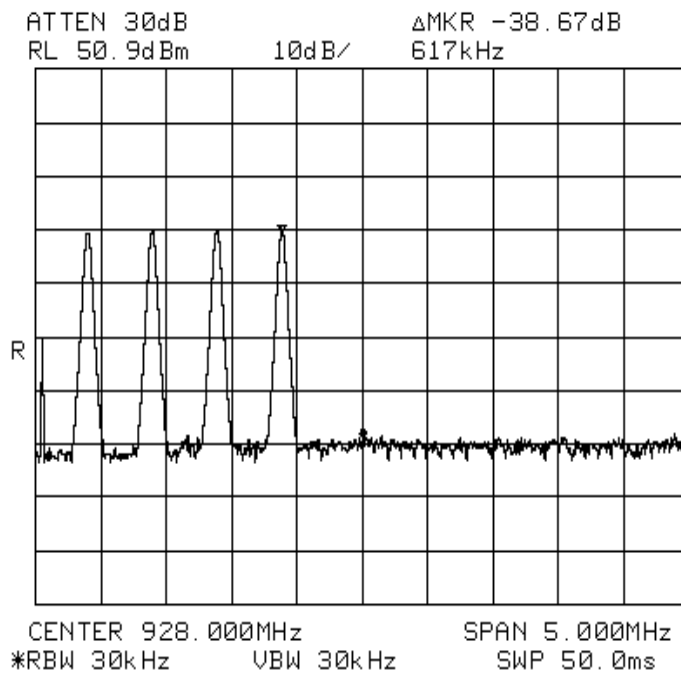


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Data Plot		Bandedges			
Page <u>1</u> of				Complete <u>X</u>	
Job No.: 1L0655R	Date: 11/30/2001			Preliminary: _____	
Specification: FCC15247 Freq Hop	Temperature(°C): 22				
Tested By: Lance Walker	Relative Humidity(%): 50				
E.U.T.: 915 MHz RFID Reader					
Configuration: sweep time at 1000mSec Tx power 1 W					
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: 1464	Cable #3: _____				
Attenuator #1: 1465	Cable #4: _____				
Attenuator #2: 1469	Mixer: _____				
Additional equipment used: 1477					
Measurement Uncertainty: +/-1.7 dB					



Notes: marker indicates upper bandedge, delta indicates highest frequency of carrier



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Test Plot:**Bandedges**

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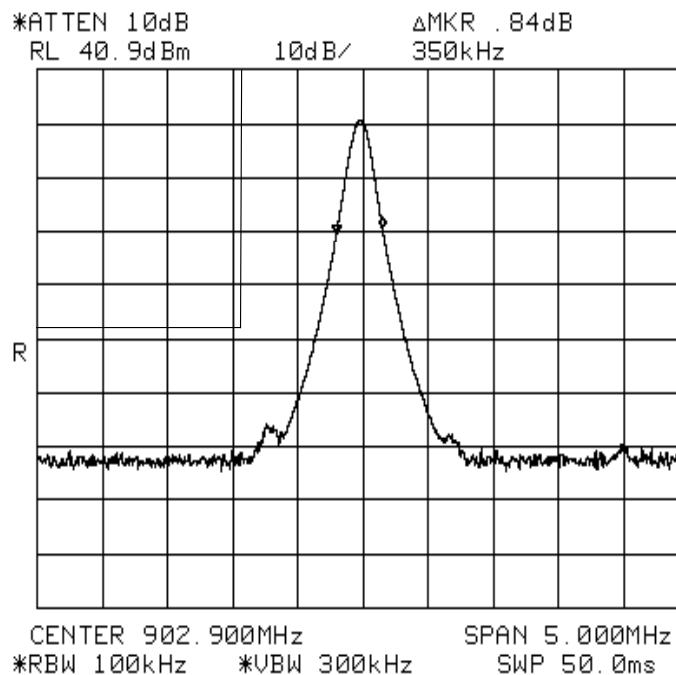
Job No.: 1L0655R Date: 11/30/2001

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



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



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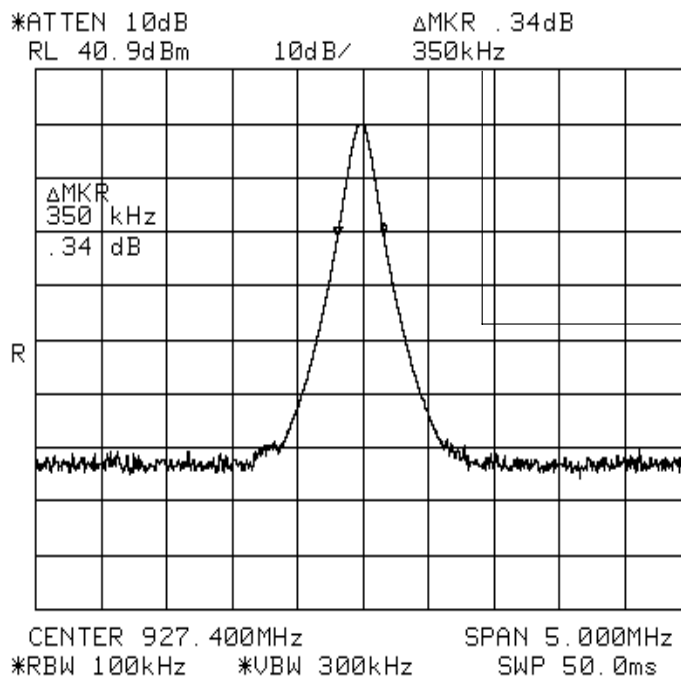
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Data Plot

Bandedges

Page 3 of 3
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



Notes: Upper bandedge bandwidth



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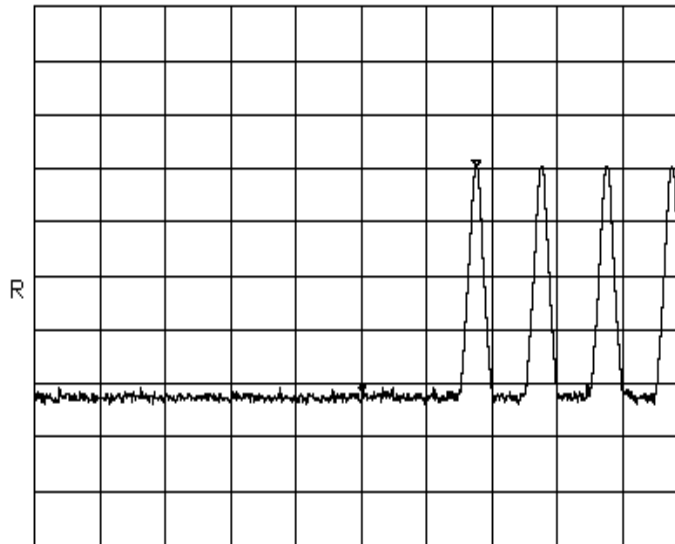
Data Plot

Page 2 of

Bandedges

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

ATTEN 30dB Δ MKR -42.00dB
RL 50.9dBm 10dB/ -875kHz



CENTER 902.000MHz SPAN 5.000MHz
*RBW 30kHz VBW 30kHz SWP 50.0ms

Notes: marker indicates lower bandedge, delta indicates lowest carrier

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 %

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.

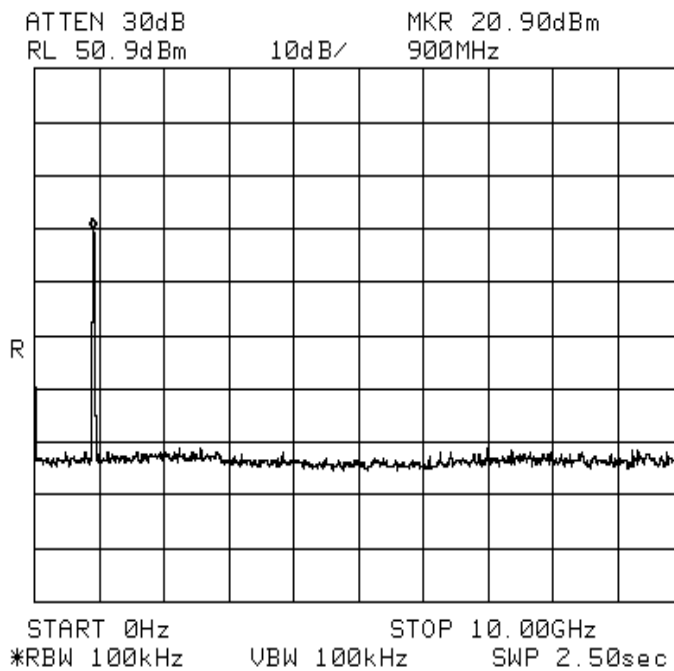


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Data Plot		Antenna Port Spurious Emissions	
Page <u>1</u> of			
Job No.: 1L0655R	Date: 11/30/2001	Complete <u>X</u>	
Specification: FCC15247 Freq Hop	Temperature(°C): 22	Preliminary: _____	
Tested By: Lance Walker	Relative Humidity(%): 50		
E.U.T.: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



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



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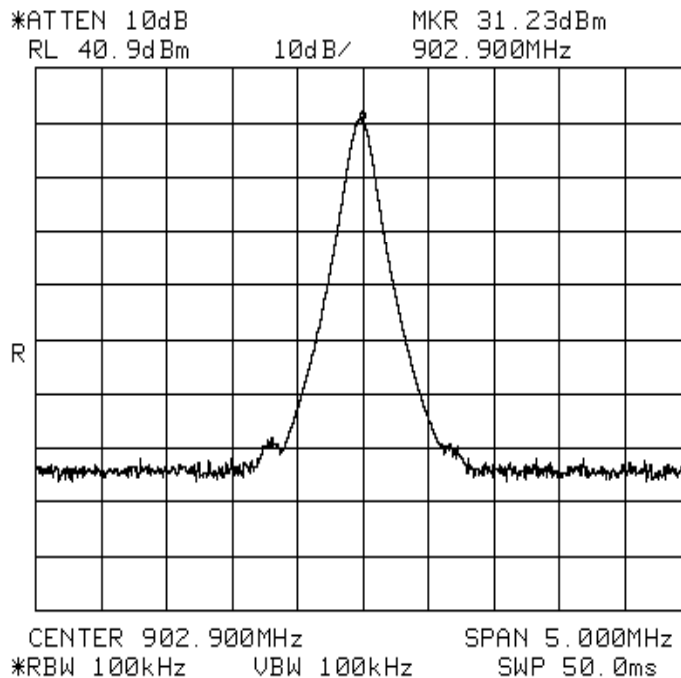
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Data Plot

Page 2 of

Antenna Port Spurious Emissions

Job No.: 1L0655R Date: 11/30/2001
FCC15247
Specification: 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



Notes: close up lower bandedge spurious



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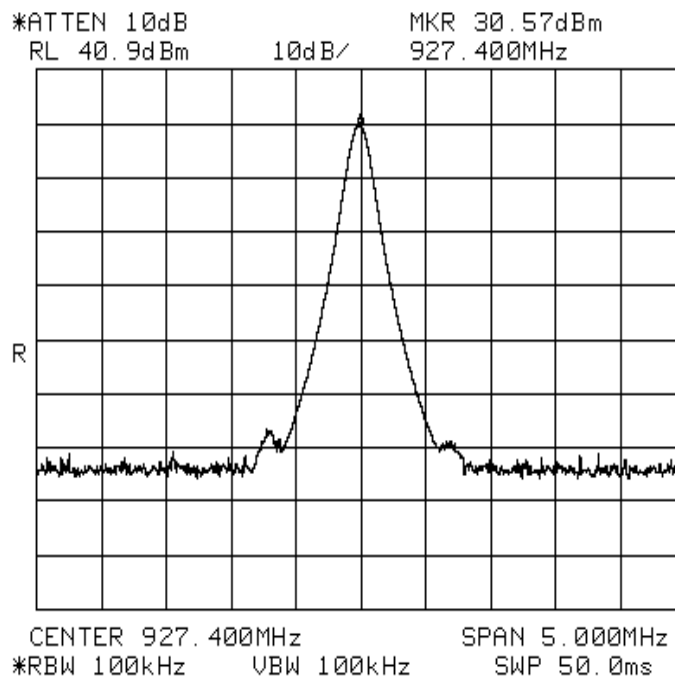
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Data Plot

Page 3 of 3

Antenna Port Spurious Emissions

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



Notes: Upper bandedge spurious emissions plot.

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) = $20 \log (r_{f_{ON}} \text{ in ms}/100\text{ms})$

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



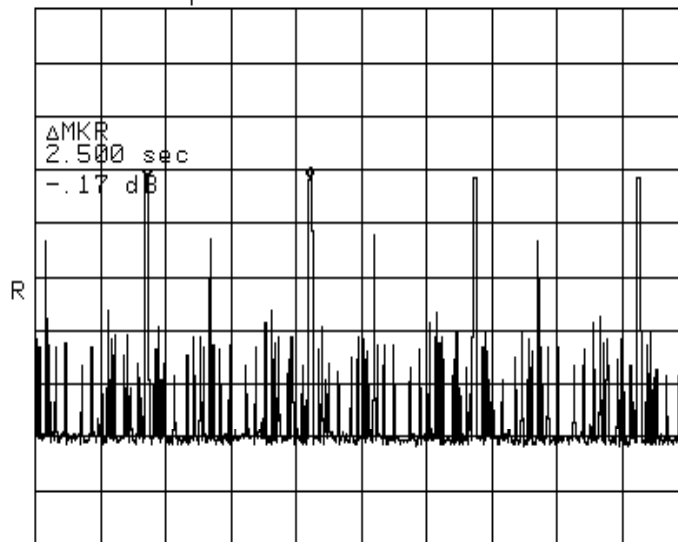
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Data		Duty	
Page 1 of 1			
Job No.: 1L0655R	Date: 12/3/2001	Complete: <u>X</u>	
Specification: FCC15247FreqHop	Temperature(°C): 22	Preliminary: <u> </u>	
Tested By: Lance Walker	Relative Humidity(%): 50		
E.U.T.: RFID Reader			
Configuration: Normal Tx 50 msec hop			
Sample Number: <u> </u>			
Location: AC 3	RBW: Refer to plots	Measurement	
Detector Type: Peak	VBW: Refer to plots	Distance: <u>3</u> m	
Test Equipment Used			
Antenna: 1304	Directional Coupler: <u> </u>		
Pre-Amp: <u> </u>	Cable #1: 1484		
Filter: <u> </u>	Cable #2: 1485		
Receiver: 1464	Cable #3: <u> </u>		
Attenuator #1: 1465	Cable #4: <u> </u>		
Attenuator #2: 1477	Mixer: <u> </u>		
Additional equipment used: <u> </u>			
Measurement Uncertainty: +/-1.7 dB			

*ATTEN 10dB ΔMKR -.17dB
RL 137.9dBμV 10dB/ 2.500sec



CENTER 914.883333MHz SPAN 0Hz
*RBW 10kHz VBW 10kHz *SWP 10.0sec

Notes: 4 pulses in 10 seconds
46.67 ms/pulse



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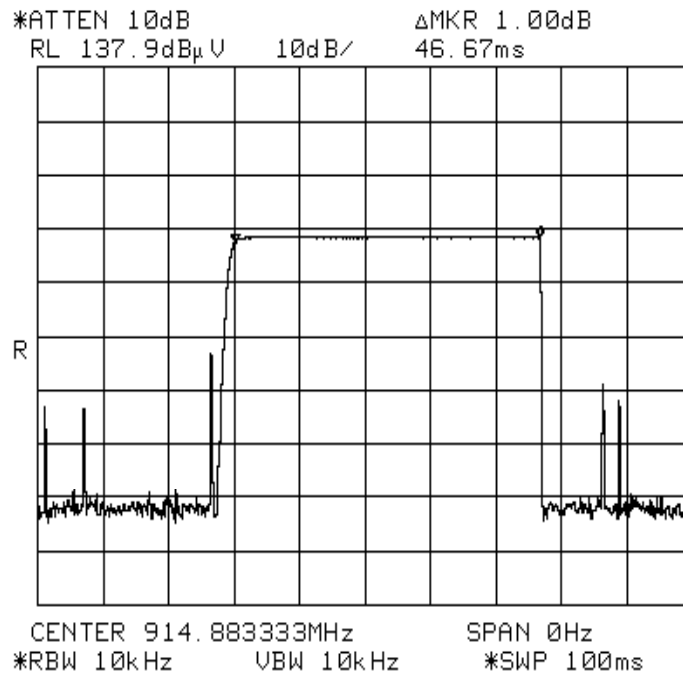
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Data Plot

Duty Cycle

Page 2 of 2
Job No.: 1L0655R Date: 12/3/2001
Specification: FCC15247F Temperature(°C): 22
Tested By: Lance Walker Relative Humidity(%) 50
E.U.T.: RFID Reader
Configuration: Normal Tx 50 msec hop



Notes: $20 \log(46.67\text{ms}/100\text{ms}) = -6.62 \text{ dB Duty Cycle Correction}$
46.67 ms/pulse

Test Data - Radiated Emissions



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Radiated Emissions

Page 1 of 2
Job No.: 1L0655R Date: 12/5/01
Specification: CFR 47, Part 15 Temperature(°C): 22
Tested By: Jance 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

Test Equipment Used

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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Radiated Spurious Emissions

Page 1 of _____ Continuation Page

Job No.: _____ Date: 12/5/01

Specification: CFR 47, Part 15 Temperature(°F) 72

Tested By: #N/A Relative Humidity(%) 50

E.U.T.: _____ RFID Reader

Configuration: _____ CW on same frequency

[illegible]

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

ANNEX A - TEST DETAILS

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

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

NAME OF TEST: Channel Separation	PARA. NO.: 15.247(a)(1)
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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.

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

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

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)
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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 ($\mu\text{V/m @ 3m}$)	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 ($\mu\text{V/m @ 3m}$)	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

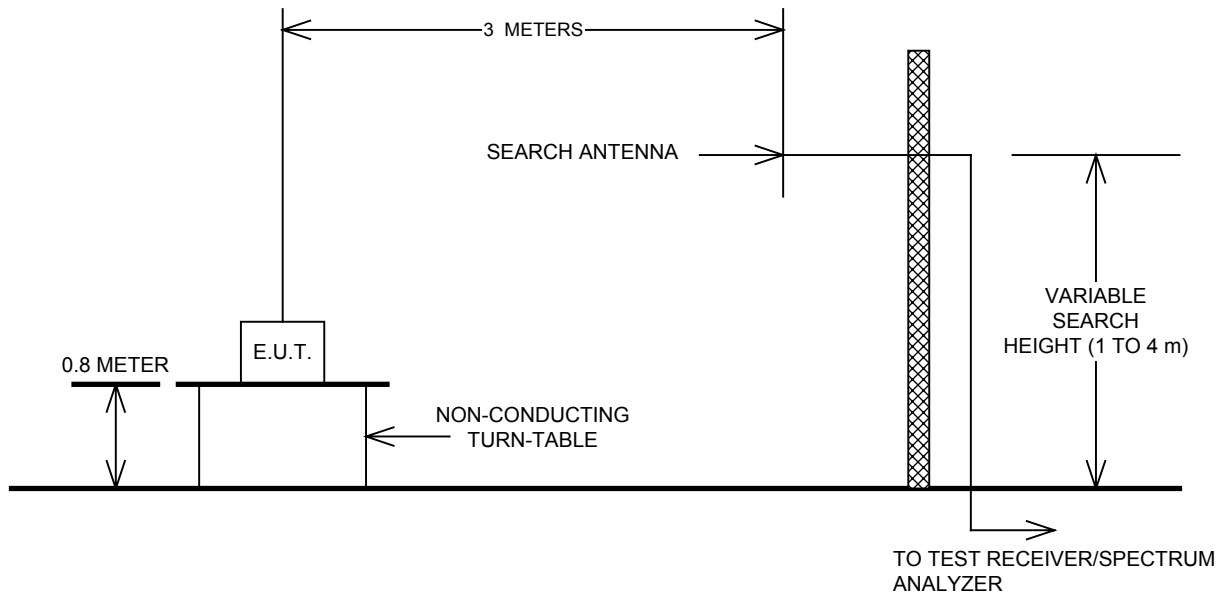
MHz	MHz	MHz	GHz
0.09-0.11	16.42-16.423	399.9-410	4.5-5.25
0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.125-6.218	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:

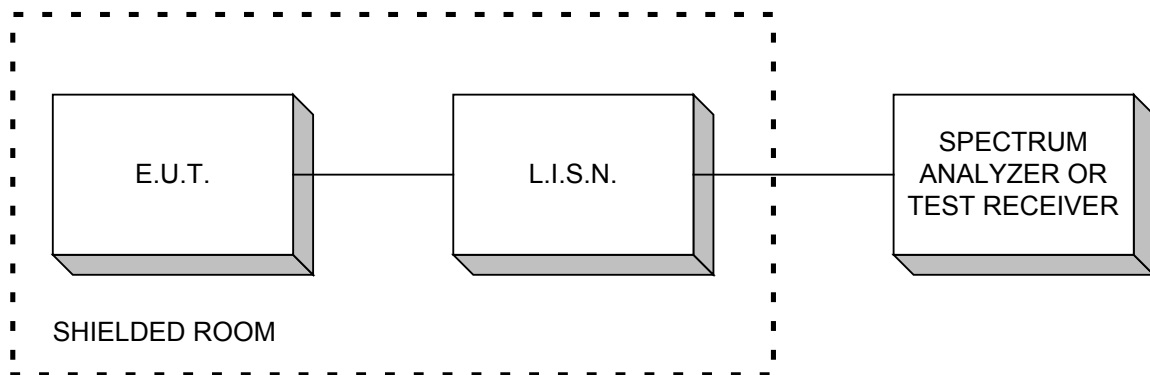
Tuning range	Number of channels tested	Channel location in band
1 MHz or less	1	middle
1 to 10 MHz	2	top and bottom
more than 10 MHz	3	top, middle, bottom

ANNEX B - TEST DIAGRAMS

Test Site For Radiated Emissions



Conducted Emissions



Peak Power At Antenna Terminals

