

Nemko Test Report: 2L0389RUS1

Applicant: Kemp-Meek Mfg.
101 Park Central
Mineola, TX 75773

**Equipment Under Test:
(E.U.T.)** TruckRadio

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:

A handwritten signature in blue ink, appearing to read "Tom Tidwell", is positioned above the name of the authorized person.

Tom Tidwell, Frontline Manager

Date: 10/01/03

Total Number of Pages: 37

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Section 1. Summary of Test Results

Manufacturer: Kemp-Meek Mfg

Model No.: TruckRadio

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 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. NONE

**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	N/A (1)
Channel Separation	15.247(a)(1)	Greater of 25 kHz or 20 dB Bandwidth	Complies
Pseudorandom Hopping Algorithm	15.247(a)(1)		Complies
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	N/A (2)
Spurious Emissions (Radiated)	15.247(c)	Table 15.209(a)	Complies

Footnotes:

- (1) The device is battery powered.
- (2) The device has an integral antenna.

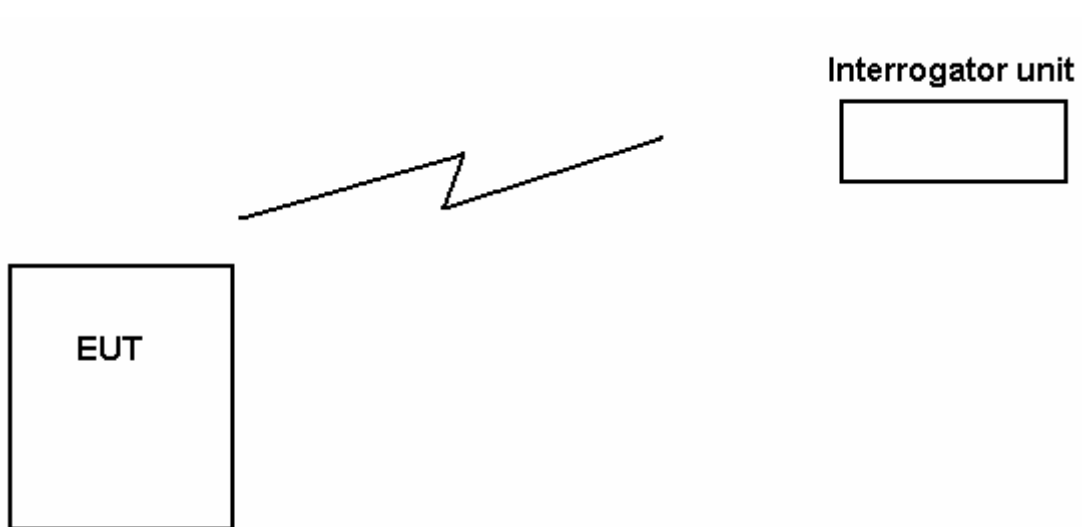
Section 2. Equipment Under Test (E.U.T.)**General Equipment Information**

Frequency Band:	Transmitt: 922.8 – 927.9 MHz Receive: 902.1 – 907.8 MHz
Number of Channels:	50
Channel Spacing:	100 kHz
User Frequency Adjustment:	Software controlled
Supply Voltage	12 Vdc battery

Description of EUT

Wireless meter interrogation device.

System Diagram



Section 3. Channel Separation

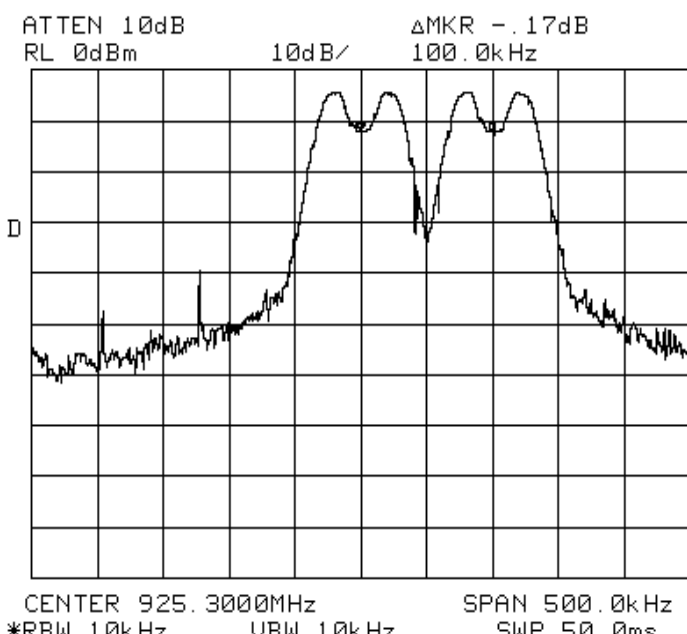
NAME OF TEST: Channel Separation	PARA. NO.: 15.247(a)(1)
TESTED BY: Eldon Berry	DATE: 02Sep03

Test Results: Complies.

Measurement Data: See 20 dB BW plot

Measured 20 dB bandwidth:	57.5 kHz
Channel Separation:	100 kHz

Test Data – Channel Separation

Data Plot		Channel Separation	
Page 1 of 4		Complete <u>x</u>	
Job No.: 3L0389R	Date: 9/2/2003	Preliminary: _____	
Specification: 15.247	Temperature(°C): 22		
Tested By: Eldon Berry	Relative Humidity(%): 65		
E.U.T.: TruckRadio			
Configuration: TX			
Sample Number: 1			
Location: AC 3	RBW: Refer to plots	Measurement	
Detector Type: Peak	VBW: Refer to plots	Distance: NA m	
Test Equipment Used			
Antenna: 1304	Directional Coupler: _____		
Pre-Amp: _____	Cable #1: 1484		
Filter: _____	Cable #2: 1485		
Receiver: 1464	Cable #3: _____		
Attenuator #1: _____	Cable #4: _____		
Attenuator #2: _____	Mixer: _____		
Additional equipment used: _____			
Measurement Uncertainty: +/-1.7 dB			
			
Notes: CHANNEL SEPERATION			

Section 4. Pseudorandom Hopping Algorithm

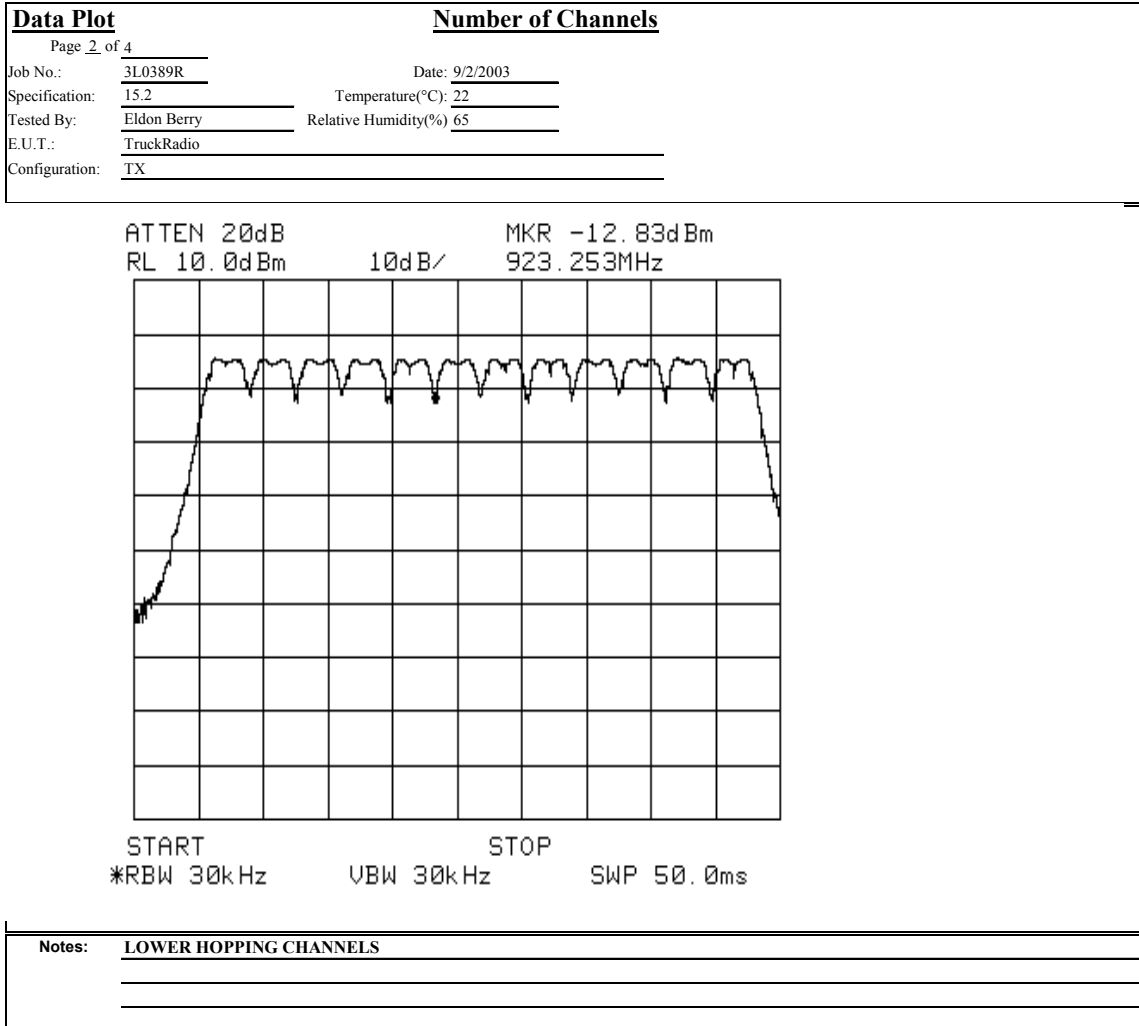
NAME OF TEST: Pseudorandom Hopping Algorithm	PARA. NO.: 15.247(a)(1)
TESTED BY: Supplied by applicant	DATE:

Test Results: Complies.

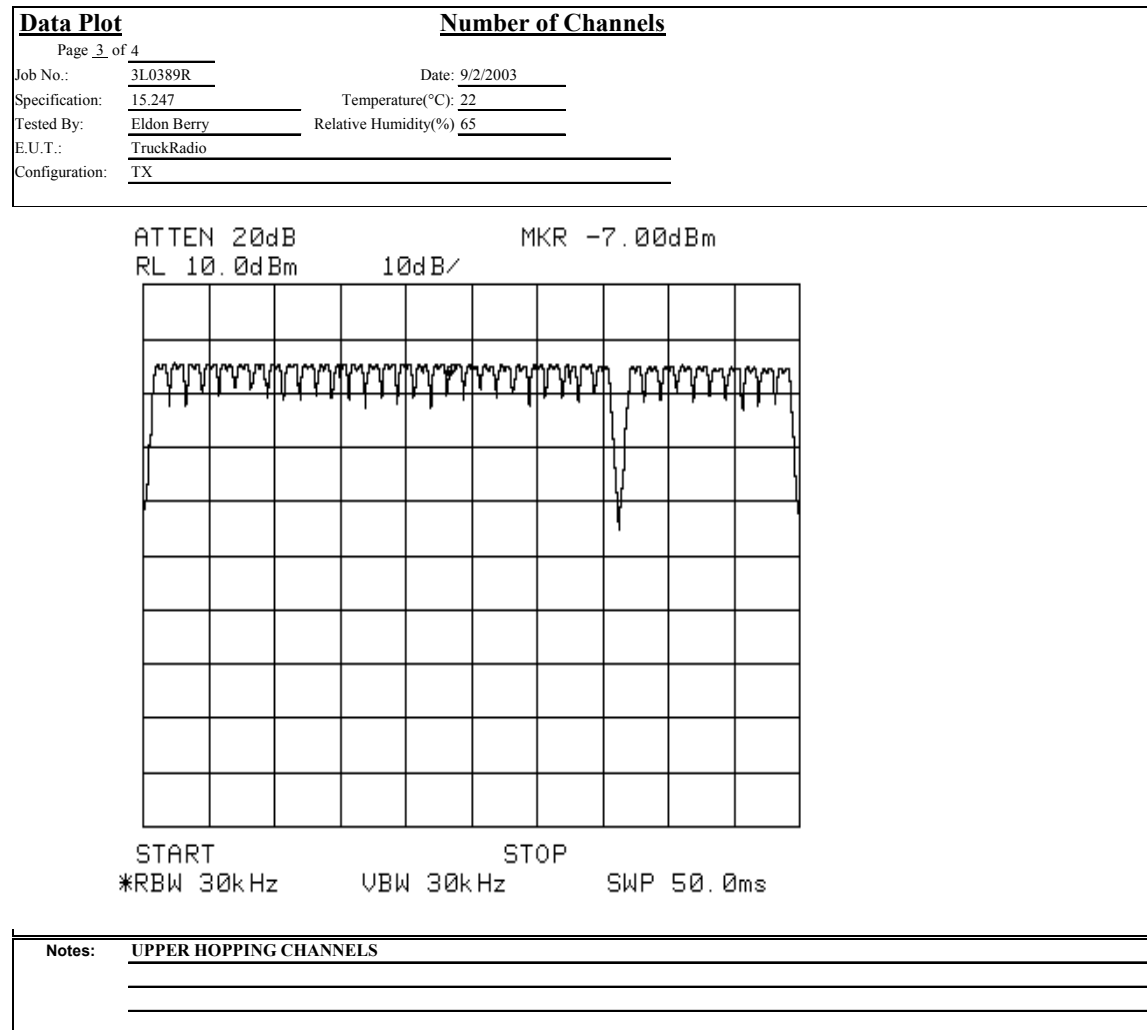
Measurement Data: See sample hopping sequence.
Number of Hopping Frequencies: 50 (See attached plots)

[Refer to separate exhibit.](#)

Test Plots – Number of Channels



Test Plots – Number of Channels



Section 5. Time of Occupancy

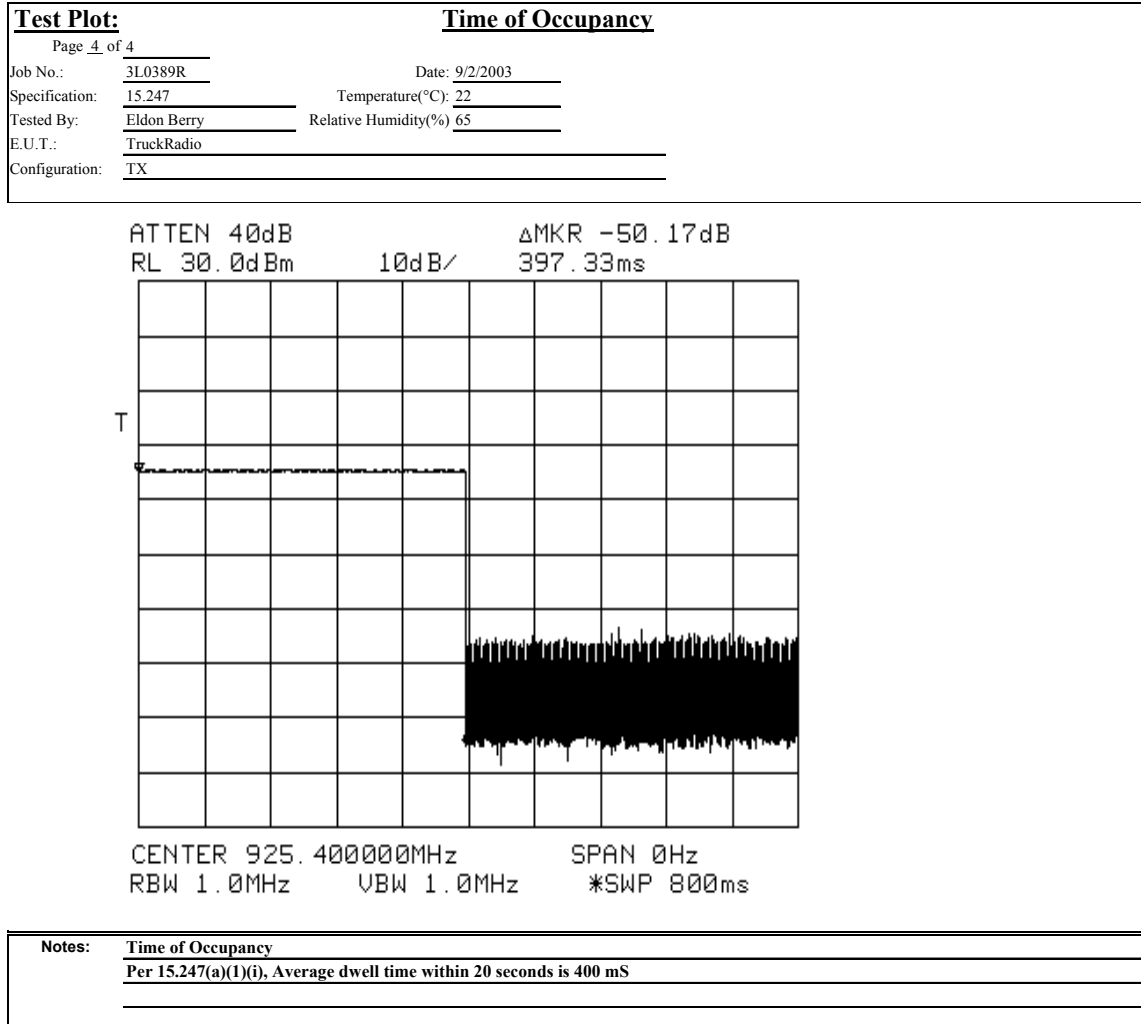
NAME OF TEST: Time of Occupancy	PARA. NO.: 15.247(a)(1)
TESTED BY: Eldon Berry	DATE: 9/2/2003

Test Results: Complies.

Measurement Data:

Maximum Measured Dwell Time: 397.33 mS

Test Data – Time of Occupancy



Section 6. Occupied Bandwidth

NAME OF TEST: Occupied Bandwidth	PARA. NO.: 15.247(a)(1)(i)
TESTED BY: Eldon Berry	DATE: 9/2/2003

Test Results: Complies.

Measurement Data: See attached plots.

Test Data – Occupied Bandwidth

Data Plot		Occupied Bandwidth	
Page 1 of 3		Complete _____	
Job No.:	3L0389R	Date:	9/2/2003
Specification:	15.247	Temperature(°C):	22
Tested By:	Eldon Berry	Relative Humidity(%):	24
E.U.T.:	TruckRadio		
Configuration:	TX		
Sample Number:	1		
Location:	AC 3	RBW: Refer to plots	Measurement
Detector Type:	Peak	VBW: Refer to plots	Distance: NA m
Test Equipment Used			
Antenna:	1304	Directional Coupler:	
Pre-Amp:		Cable #1:	1484
Filter:		Cable #2:	1485
Receiver:	1464	Cable #3:	
Attenuator #1:		Cable #4:	
Attenuator #2:		Mixer:	
Additional equipment used:			
Measurement Uncertainty:	+/-1.7 dB		

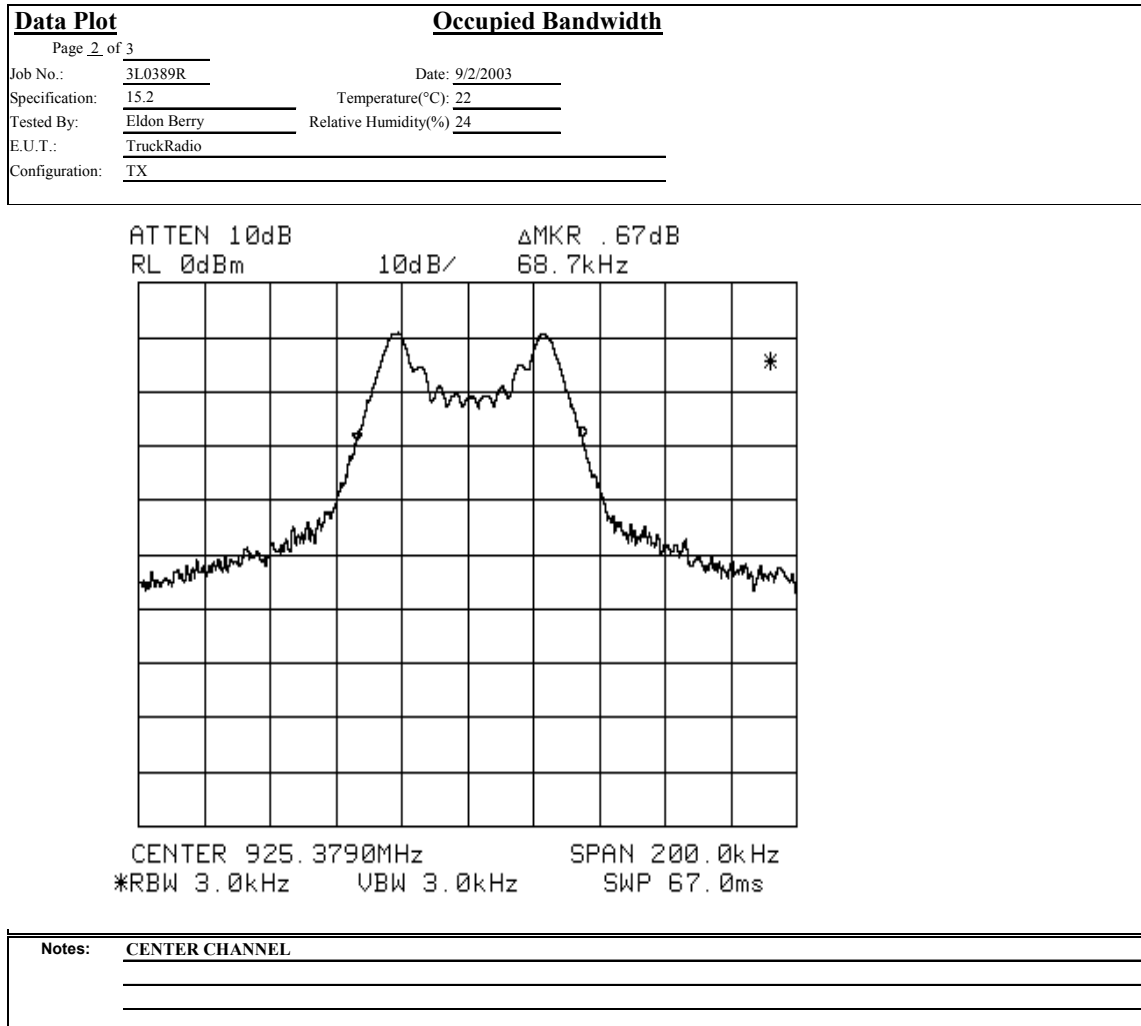
ATTEN 10dB ΔMKR .17dB
RL 0dBm 10dB/ 67.3kHz

A spectrum plot showing the frequency response of the transmitter. The plot is on a grid with 10 vertical divisions and 10 horizontal divisions. The signal is centered around the 5th vertical division. The peak of the signal is at approximately 922.8 MHz. The signal has a bandwidth of 200 kHz. The plot shows a noisy signal with a clear peak and side lobes.

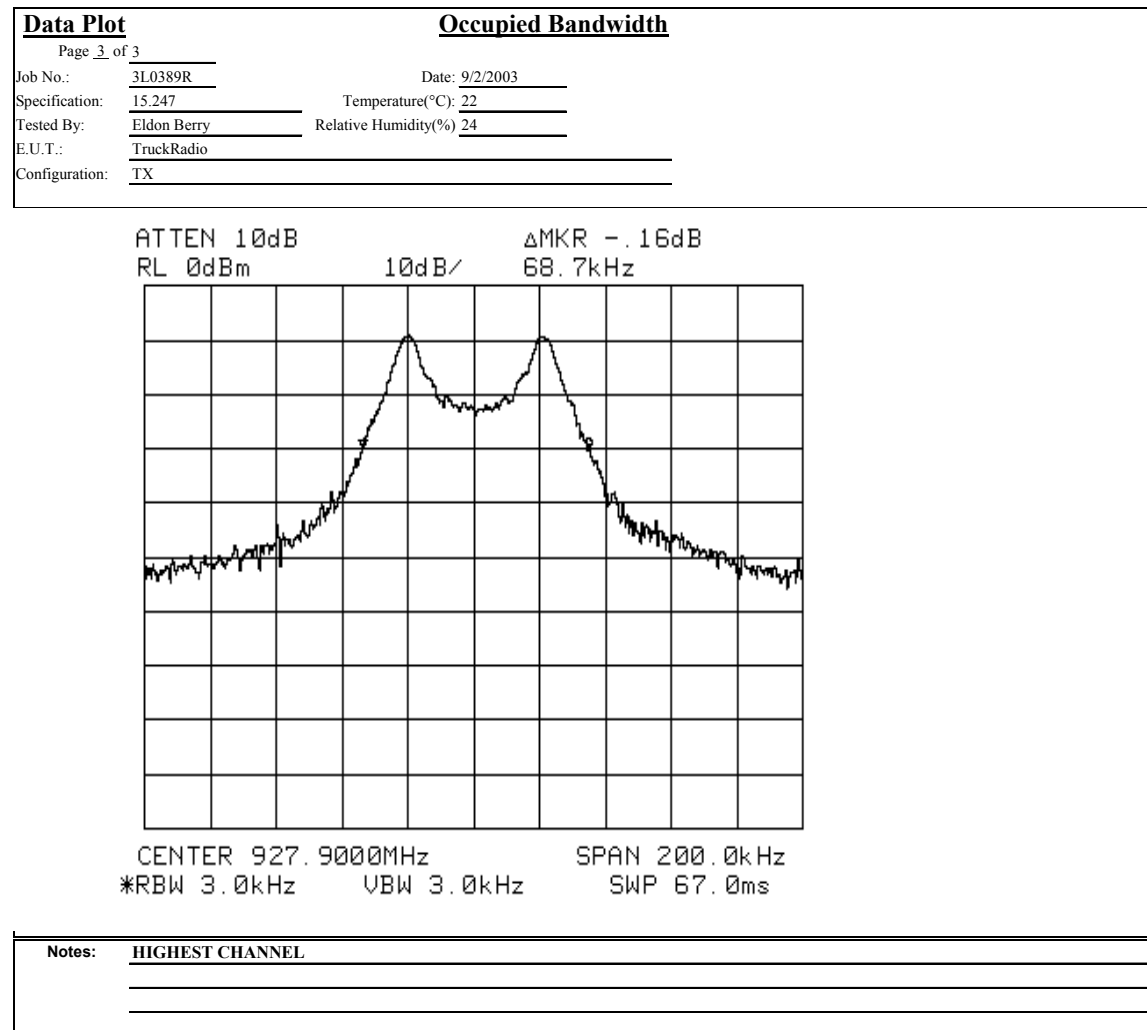
CENTER 922.8000MHz SPAN 200.0kHz
*RBW 3.0kHz VBW 3.0kHz SWP 67.0ms

Notes:	Lowest channel

Test Data – Occupied Bandwidth



Test Data – Occupied Bandwidth



Section 7. Peak Power Output

NAME OF TEST: Peak Power Output	PARA. NO.: 15.247 (b)
TESTED BY: Eldon Berry	DATE: 3/3/2003

Test Results: Complies.

Measurement Data: See attached data.

Detachable antenna? ☐ Yes ☒ No
If yes, state the type of non-standard connector
used:

The input power was varied +/- 15% with no increase in output power>

Test Data – Peak Power Output

[illegible]

Section 8. Spurious Emissions (Radiated)

NAME OF TEST: Spurious Emissions (Radiated)	PARA. NO.: 15.247(c)
TESTED BY: Eldon Berry	DATE: 9/3/2003

Test Results: Complies.

Measurement Data: See attached table.

Duty Cycle Calculation:

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

$20 \log (50 \text{ mS}/100 \text{ mS}) = 6 \text{ dB (worst case)}$

Frequency spectrum investigated from 19MHz to 10GHz.

Test Data - Radiated Emissions

Radiated Emissions								
Page <u>1</u> of <u>2</u>								
Job No.: 3L0389R		Date: 3/3/2003						
Specification: 15.247		Temperature(°C): 22						
Tested By: Eldon Berry		Relative Humidity(%) 55						
E.U.T.: TruckRadio								
Configuration: Typical installation - Tx full power								
Sample Number: 1								
Location: AC 3		RBW: 1 MHz						
Detector Type: Peak		VBW: 1 MHz						
Test Equipment Used								
Antenna: 993		Directional Coupler: #N/A						
Pre-Amp: 1016		Cable #1: 1484						
Filter: 1481		Cable #2: 1485						
Receiver: 1464		Cable #3: #N/A						
Attenuator #1: #N/A		Cable #4: #N/A						
Attenuator #2: #N/A		Mixer: #N/A						
Frequency (GHz)	Meter Reading (dBuV)	Antenna Factor (dB)	Cable Loss (dB)	Pre-Amp Gain (dB)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Comment
								Tx at 922.8 MHz
2.7684	48.2	29.4	3.4	32.9	48.1	54	-5.9	P -H
3.6912	47.7	30.4	4	33	49.1	54	-4.9	P -H
4.614	48.3	32.4	4.8	32.8	52.7	54	-1.3	P -H
7.3824	42	35.8	6.1	31.9	52.0	54	-2.0	P -H
2.7684	54.9	29.4	3.4	32.9	54.8	74	-19.2	P -V
2.7684	44.8	29.4	3.4	32.9	44.7	54	-9.3	A -V
3.6912	56.4	30.4	4.0	33.0	57.8	74	-16.2	P -V
3.6912	49	30.4	4.0	33.0	50.4	54	-3.6	A -V
4.614	52.2	32.4	4.8	32.8	56.7	74	-17.4	P -V
4.614	48.5	32.4	4.8	32.8	52.9	54	-1.1	A -V
7.3824	42.7	35.8	6.1	31.9	52.7	54	-1.3	noise
Notes: * With cable shield bonded to enclosure.								
Scanned to the 10th harmonic.								

Test Data - Radiated Emissions

Radiated Spurious Emissions								
Page 2 of 2		Continuation Page						
Job No.: 2L0609R		Date: 3/3/2003						
Specification: 15.247		Temperature(°F): 22						
Tested By: #N/A		Relative Humidity(%) 16						
E.U.T.: TruckRadio								
Configuration: Typical installation - Tx full power								
Frequency (GHz)	Meter Reading (dBuV)	Antenna Factor (dB)	Cable Loss (dB)	Pre-Amp Gain (dB)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Comment
								Tx at 925.4MHz
2.7762	48.5	29.4	3.4	32.9	48.4	54	-5.6	P -V
3.7016	49.7	30.4	4	33	51.1	54	-2.9	P -V
4.627	52.3	32.4	4.8	32.8	56.7	54	2.7	P -V
4.627	48.3	32.4	4.8	32.8	52.7	54	-1.3	A -V
7.403	42.2	35.8	6.1	31.9	52.2	54	-1.8	P -V
8.3286	43.5	37.5	6.5	33.0	54.5	74	-19.5	P -V
8.3286	37.3	37.5	6.5	33.0	48.3	54	-5.7	A -V
9254	42.7	37.1	7.0	33.9	52.9	54	-1.1	P -V
2.7762	47.2	29.4	3.4	32.9	47.1	54	-6.9	P -H
3.7016	47.7	30.4	4	33	49.1	54	-4.9	P -H
4.627	48.5	32.4	4.8	32.8	52.9	54	-1.1	P -H
7.403	42.3	35.8	6.1	31.9	52.3	54	-1.7	P -H
8.3286	43.5	37.5	6.5	33.0	54.5	74	-19.5	P -H
8.3286	32.5	37.5	6.5	33.0	43.5	54	-10.5	A -H
9254	42.3	37.1	7.0	33.9	52.5	54	-1.5	P -H
								Tx at 927.9 MHz
2.7837	45.5	29.4	3.4	32.9	45.4	54	-8.6	P -H
3711.6	47.0	30.4	4	33	48.4	54	-5.6	P -H
4.6395	47.3	32.4	4.8	32.8	51.7	54	-2.3	P -H
7.4232	43	35.8	6.1	31.9	53.0	54	-1.0	P -H
8.3511	44.2	37.5	6.5	33	55.2	74	-18.8	P -H
8.3511	32	37.5	6.5	33	43.0	54	-11.0	A -H
9279	42.6	37.1	7.0	33.9	52.8	54	-1.2	P -H
2.7837	49	29.4	3.4	32.9	48.9	54	-5.1	P -V
3711.6	49.0	30.4	4	33	50.4	54	-3.6	P -V
4.6395	50.8	32.4	4.8	32.8	55.2	74	-18.8	P -V
4.6395	45.7	32.4	4.8	32.8	50.1	54	-3.9	A -V
7.4232	42	35.8	6.1	31.9	52.0	54	-2.0	P -V
8.3511	43	37.5	6.5	33	54.0	74	-20.0	P -V
8.3511	37.2	37.5	6.5	33	48.2	54	-5.8	P -V
9279	42.7	37.1	7.0	33.9	52.9	54	-1.1	P -V
Notes:		* With cable shield bonded to enclosure.						
Scanned to the 10th harmonic.								

Radiated Photographs (Worst Case Configuration)



Section 9. Test Equipment List

Nemko ID	Description	Manufacturer Model Number	Serial Number	Calibration Date	Calibration Due
1482	Band Pass Filter	K & L 11SH10-4000/T12000-0/0	2	Cal B4 Use	N/A
1484	Cable 2.0-18.0 Ghz	Storm PR90-010-072	N/A	07/24/03	07/23/04
1485	Cable 2.0-18.0 Ghz	Storm PR90-010-216	N/A	07/24/03	07/23/04
1464	Spectrum analyzer	Hewlett Packard 8563E	3551A04428	02/11/03	02/11/05
1016	Pre-Amp	HEWLETT PACKARD 8449A	2749A00159	07/15/02	07/15/03
1304	HORN ANTENNA	ELECTRO METRICS RGA-60	6151	09/22/03	09/22/05
966	Receiver	Rohde & Schwartz ESH2	880370/029	09/17/03	09/16/04
981	ANTENNA, LOOP	ROHDE & SCHWARZ HFH2-Z2	871336/20	Cal Not Req	N/A

ANNEX A - TEST DETAILS

NAME OF TEST: Powerline Conducted Emissions

PARA. NO.: 15.207(a)

Minimum Standard:

line on any

The R.F. that is conducted back onto the AC power

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

Minimum Standard:
channel carrier

Frequency hopping systems shall have hopping

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

Minimum Standard:
selected from

The system shall hop to channel frequencies that are

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.

EIRP For Integral Antenna:**Test Method:**

TIA/EIA-603-1992, Section 2.2.12

The antenna substitution method was used to determine the equivalent radiated power at spurious frequencies. The spurious emissions were measured at a distance of 3 meters. The EUT was then replaced with a reference substitution antenna with a known gain referenced to an isotropic. This antenna was fed with a signal at the spurious frequency. The level of the signal was adjusted to repeat the previously measured level. The resulting eirp is the signal level fed to the reference antenna corrected for gain referenced to an isotropic.

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

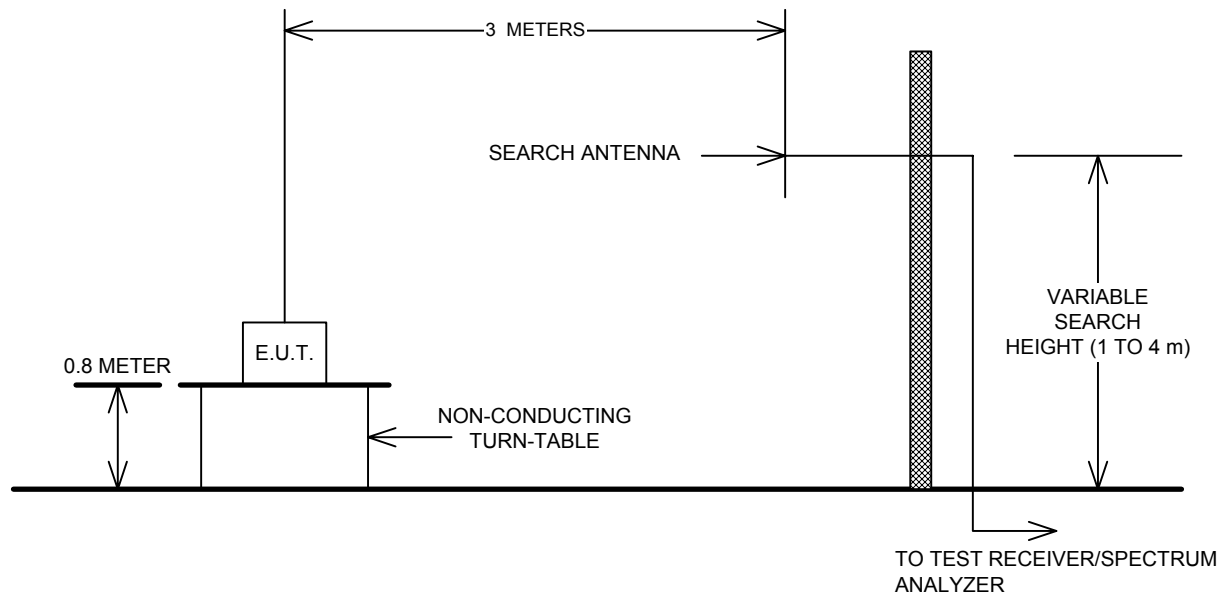
MHz	MHz	MHz	GHz
0.09-0.11	16.42-16.423	399.9-410	4.5-5.25
0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.125-6.218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

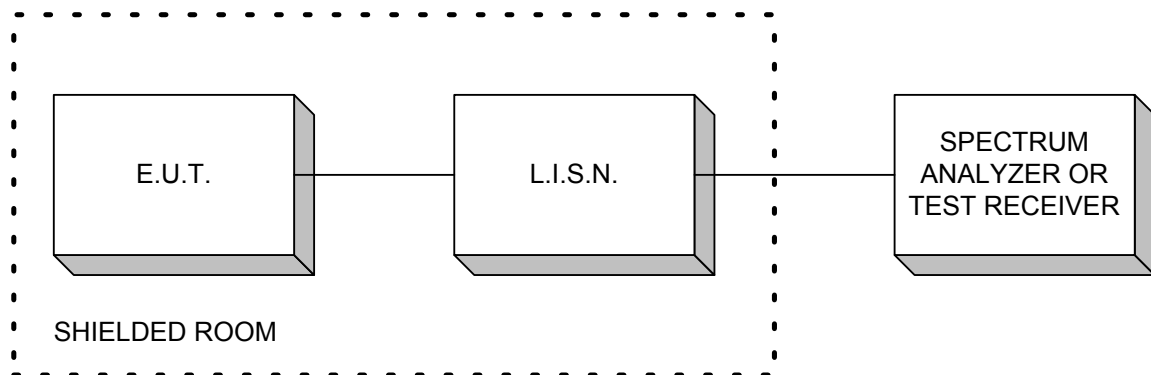
Tuning range	Number of channels tested	Channel location in band
1 MHz or less	1	middle
1 to 10 MHz	2	top and bottom
more than 10 MHz	3	top, middle, bottom

ANNEX B - TEST DIAGRAMS

Test Site For Radiated Emissions



Conducted Emissions



Peak Power At Antenna Terminals

