

**Nemko Test Report:** 2L0551RUS1

**Applicant:** Aerial Facilities Limited

**Equipment Under Test:  
(E.U.T.)** UHF1

**In Accordance With:** **FCC Part 90, Subpart I**  
Private Land Mobile Repeater

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



**Authorized By:**

Tom Tidwell, Wireless Group Manager

**Date:** 12/11/02

**Total Number of Pages:** 28

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EQUIPMENT: UHF1

**Section 1. Summary of Test Results**

Manufacturer: Aerial Facilities Limited

Model No.: UHF1

Serial No.: 13400 G

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 FCC Part 90, Subpart I.

New Submission

Production Unit

Class II Permissive Change

Pre-Production Unit

**THIS TEST REPORT RELATES ONLY TO THE ITEM(S) TESTED.**

**THE FOLLOWING DEVIATIONS FROM, ADDITIONS TO, OR EXCLUSIONS FROM THE TEST SPECIFICATIONS HAVE BEEN MADE. None**

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*EQUIPMENT:* **UHF1**

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**Summary Of Test Data**

<b>NAME OF TEST</b>	<b>PARA. NO.</b>	<b>SPEC.</b>	<b>RESULT</b>
RF Power Output	90.205		Complies
Audio Frequency Response	TIA EIA-603.3.2.6	N/A	N/A
Audio Low-Pass Filter Response	TIA EIA-603.3.2.6	N/A	N/A
Modulation Limiting	TIA EIA-603.3.2.6	N/A	N/A
Occupied Bandwidth	90.210	Plots	Complies
Spurious Emissions at Antenna Terminals	90.210	Plots	Complies
Field Strength of Spurious Emissions	90.210		Complies
Frequency Stability	90.213		N/A
Transient Frequency Behavior	90.214	N/A	N/A

**Footnotes For N/A's:**

- (1) Since the E.U.T. does not contain modulation circuitry modulation testing was not performed.
- (2) Since the E.U.T. is not a keyed carrier system, Transient Frequency Behavior was not performed.

EQUIPMENT: UHF1

## Section 2. General Equipment Specification

### Transmitter

<b>Supply Voltage Input:</b>	115 Vac				
<b>Frequency Range:</b>	473.2125, 473.2625 and 485.2375 MHz Individual channels				
<b>Type(s) of Modulation:</b>	<b>F3E (Voice)</b> <input checked="" type="checkbox"/>	<b>F1D</b> <input type="checkbox"/>	<b>F2D</b> <input type="checkbox"/>	<b>D7W (QAM)</b> <input type="checkbox"/>	<b>Other</b> <input type="checkbox"/>
<b>Gain:</b>	40 dB				
<b>Maximum Input:</b>	-19 dBm				
<b>Output Impedance:</b>	50 ohms				
<b>RF Power Output (rated):</b>	<b>Single:</b>	20 dBm (100 mW)			
	<b>Composite:</b>	26 dBm (400 mW)			
<b>Channel Spacing(s):</b>	25 kHz				
<b>Operator Selection of Operating Frequency:</b>	Fixed				
<b>Power Output Adjustment Capability:</b>	Manual (Attenuators)				
<b>Frequency Translation:</b>	<b>F1-F1</b> <input checked="" type="checkbox"/>	<b>F1-F2</b> <input type="checkbox"/>	<b>N/A</b> <input type="checkbox"/>		
<b>Band Selection:</b>	<b>Software</b> <input type="checkbox"/>	<b>Duplexer Change</b> <input checked="" type="checkbox"/>	<b>Fullband Coverage</b> <input type="checkbox"/>		

## **Theory of Operation**

The AFL Off air Amplifiers for the Pasadena Blue line project are 2 way on-band RF amplifiers. Their application is as an interface between the donor radio sites and the Fibre optic receivers and transmitters which will extend coverage to the locations via the fibre optic link. There are two units one designated for the 'UHF1' frequencies the other for the 'UHF2' frequencies.

*EQUIPMENT:* **UHF1**

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**Section 3. RF Power Output**

NAME OF TEST: RF Power Output	PARA. NO.: 2.985
TESTED BY: David Light	DATE:12/10/2002

**Test Results:** Complies.

**Measurement Data:**

<b>Frequency (MHz)</b>	<b>Measured Power (dBm)</b>
473.2125	20
473.2625	20
485.2375	20

*EQUIPMENT:* **UHF1**

---

**Section 4. Occupied Bandwidth**

NAME OF TEST: Occupied Bandwidth	PARA. NO.: 2.989
TESTED BY: David Light	DATE: 12/10/2002

**Test Results:** Complies.

**Test Data:** See attached graph(s).

Compliance is demonstrated by comparing the rf input signal with the rf output signal.



EQUIPMENT: UHF1

Test Data – Occupied Bandwidth (Input/Output)



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Data Plot		Occupied Bandwidth		Complete <u>X</u>																						
Page <u>1</u> of <u>2</u>		Date: <u>12/10/2002</u>		Preliminary: _____																						
Job No.: <u>2L0551R</u>		Temperature(°C): <u>22</u>																								
Specification: <u>PART 90</u>		Relative Humidity(%) <u>40</u>																								
Tested By: <u>David Light</u>																										
E.U.T.: <u>UHF1</u>																										
Configuration: <u>TX FULL POWER</u>																										
Sample Number: <u>1</u>																										
Location: <u>Lab 1</u>		RBW: <u>Refer to plots</u>		Measurement																						
Detector Type: <u>Peak</u>		VBW: <u>Refer to plots</u>		Distance: <u>NA</u> m																						
<b>Test Equipment Used</b>																										
Antenna: _____		Directional Coupler: _____																								
Pre-Amp: _____		Cable #1: <u>1083</u>																								
Filter: _____		Cable #2: _____																								
Receiver: <u>1036</u>		Cable #3: _____																								
Attenuator #1: <u>1064</u>		Cable #4: _____																								
Attenuator #2: _____		Mixer: _____																								
Additional equipment used: _____																										
Measurement Uncertainty: <u>+/-1.7 dB</u>																										
<table border="1"> <tr> <td>Ref</td> <td>Lvl</td> <td>8.10 dBm</td> <td>RBW</td> <td>300 Hz</td> <td>RF Att</td> <td>40 dB</td> </tr> <tr> <td>30 dBm</td> <td></td> <td>473.2625000 MHz</td> <td>VBW</td> <td>300 Hz</td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td>SWT</td> <td>2.8 s</td> <td>Unit</td> <td>dBm</td> </tr> </table>						Ref	Lvl	8.10 dBm	RBW	300 Hz	RF Att	40 dB	30 dBm		473.2625000 MHz	VBW	300 Hz						SWT	2.8 s	Unit	dBm
Ref	Lvl	8.10 dBm	RBW	300 Hz	RF Att	40 dB																				
30 dBm		473.2625000 MHz	VBW	300 Hz																						
			SWT	2.8 s	Unit	dBm																				
Date: 10.DEC.2002 15:51:58																										
<b>Notes:</b> OUTPUT SIGNAL 473.2625 MHz 2.5 kHz TONE / 5 kHz DEVIATION																										

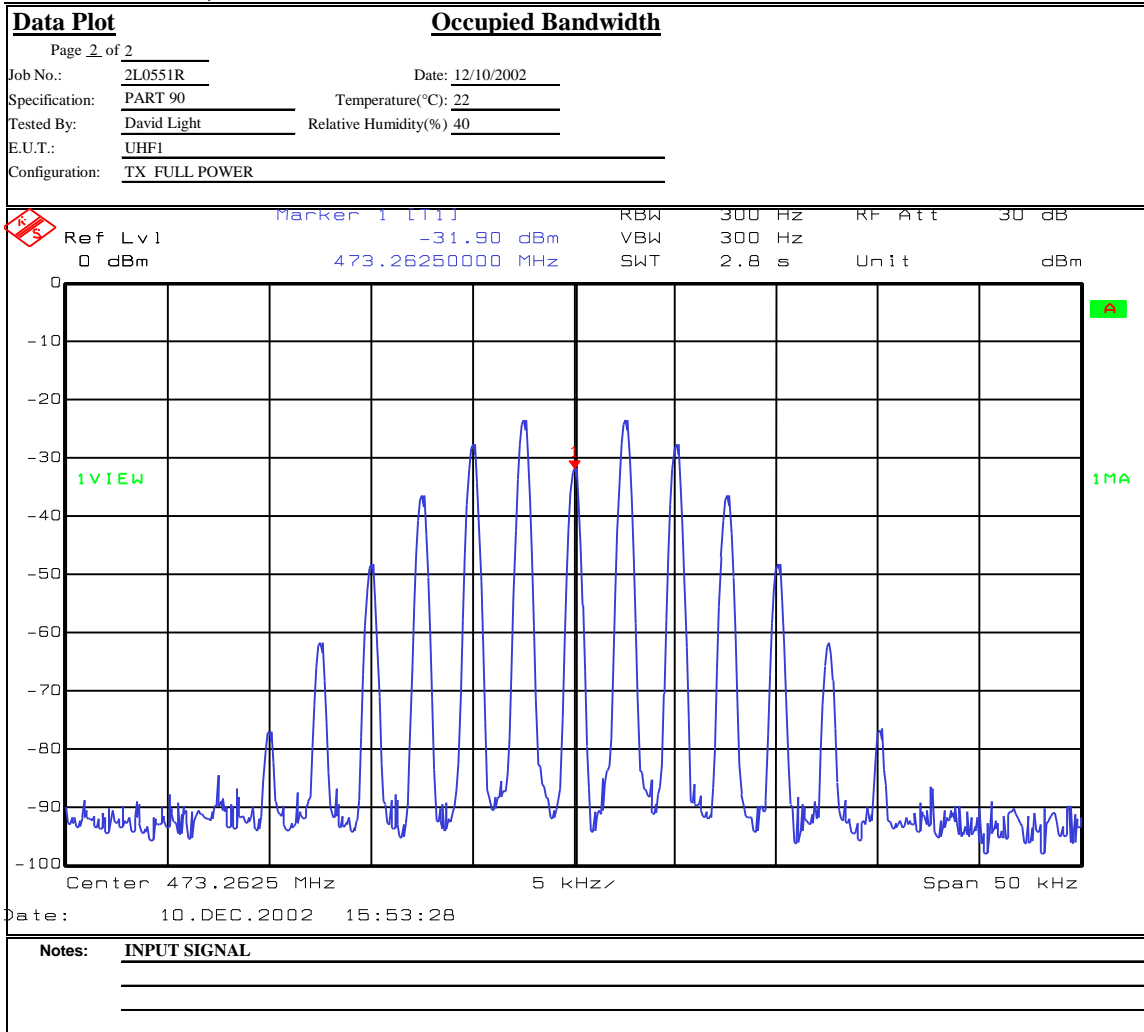
EQUIPMENT: UHF1

Test Data – Occupied Bandwidth (Input/Output)



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*EQUIPMENT:* **UHF1**

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**Section 5. Spurious Emissions at Antenna Terminals**

NAME OF TEST: Spurious Emissions @ Antenna Terminals	PARA. NO.: 2.991
TESTED BY: David Light	DATE:12/10/2002

**Test Results:** Complies.

**Test Data:** See attached graph(s).

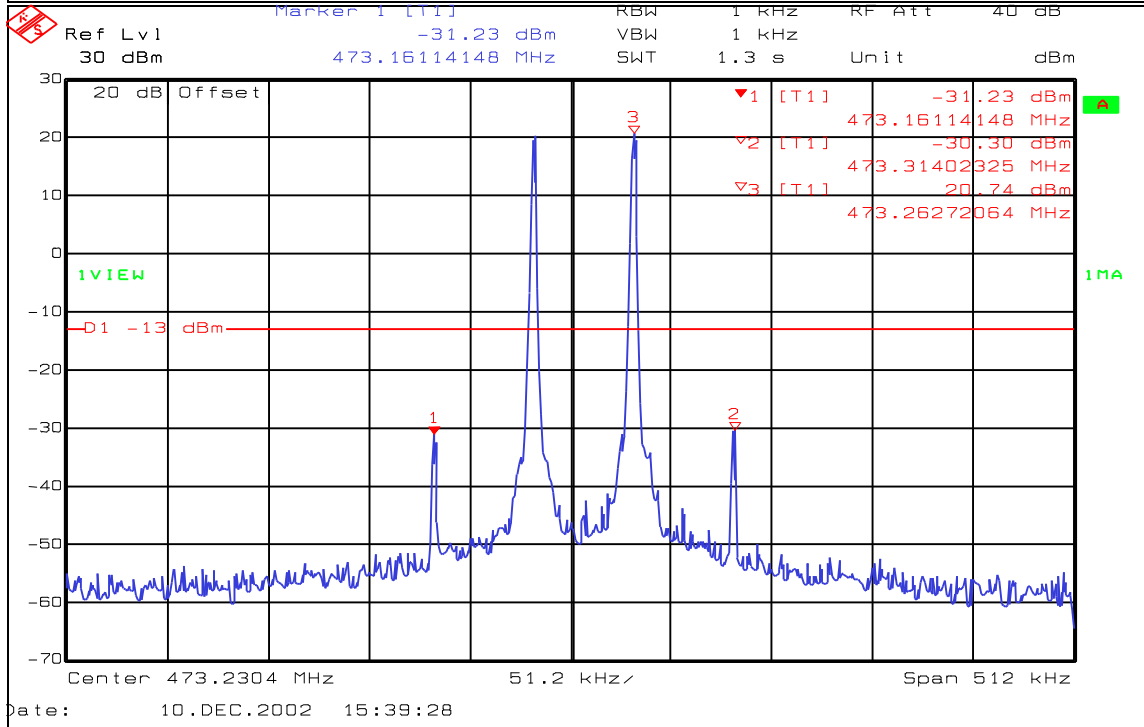
Test Data – Spurious Emissions at Antenna Terminals



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Data Plot		Intermodulation Characteristics		Complete <u>X</u>	
Page <u>1</u> of <u>2</u>		Date: <u>12/10/2002</u>		Preliminary: _____	
Job No.: <u>2L0551R</u>		Temperature(°C): <u>22</u>			
Specification: <u>PART 90</u>		Relative Humidity(%): <u>40</u>			
Tested By: <u>David Light</u>					
E.U.T.: <u>UHF1</u>					
Configuration: <u>TX 3 CHANNELS FULL POWER</u>					
Sample Number: <u>1</u>					
Location: <u>Lab 1</u>		RBW: <u>Refer to plots</u>		Measurement	
Detector Type: <u>Peak</u>		VBW: <u>Refer to plots</u>		Distance: <u>NA</u> m	
<b>Test Equipment Used</b>					
Antenna: _____		Directional Coupler: _____			
Pre-Amp: _____		Cable #1: <u>1083</u>			
Filter: _____		Cable #2: _____			
Receiver: <u>1036</u>		Cable #3: _____			
Attenuator #1: <u>1064</u>		Cable #4: _____			
Attenuator #2: _____		Mixer: _____			
Additional equipment used: _____					
Measurement Uncertainty: <u>+/-1.7 dB</u>					



Notes: **MARKERS 1 AND 2 INDICATE INTERMOD LEVELS**  
**MARKER 3 INDICATES CARRIER LEVEL**  
**INPUT SIGNALS 473.2125 MHz and 473.2625 MHz**

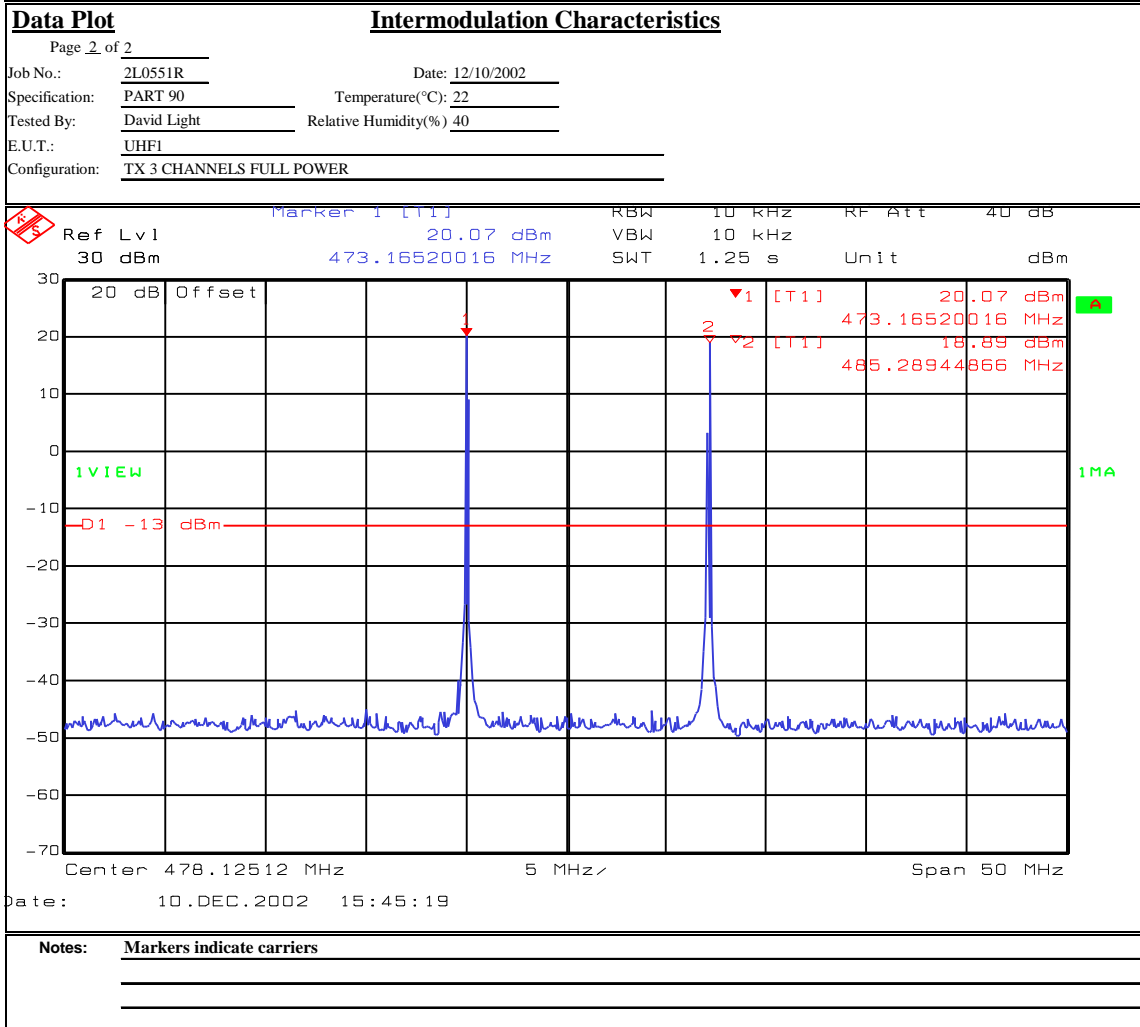
EQUIPMENT: UHF1

Test Data – Spurious Emissions at Antenna Terminals



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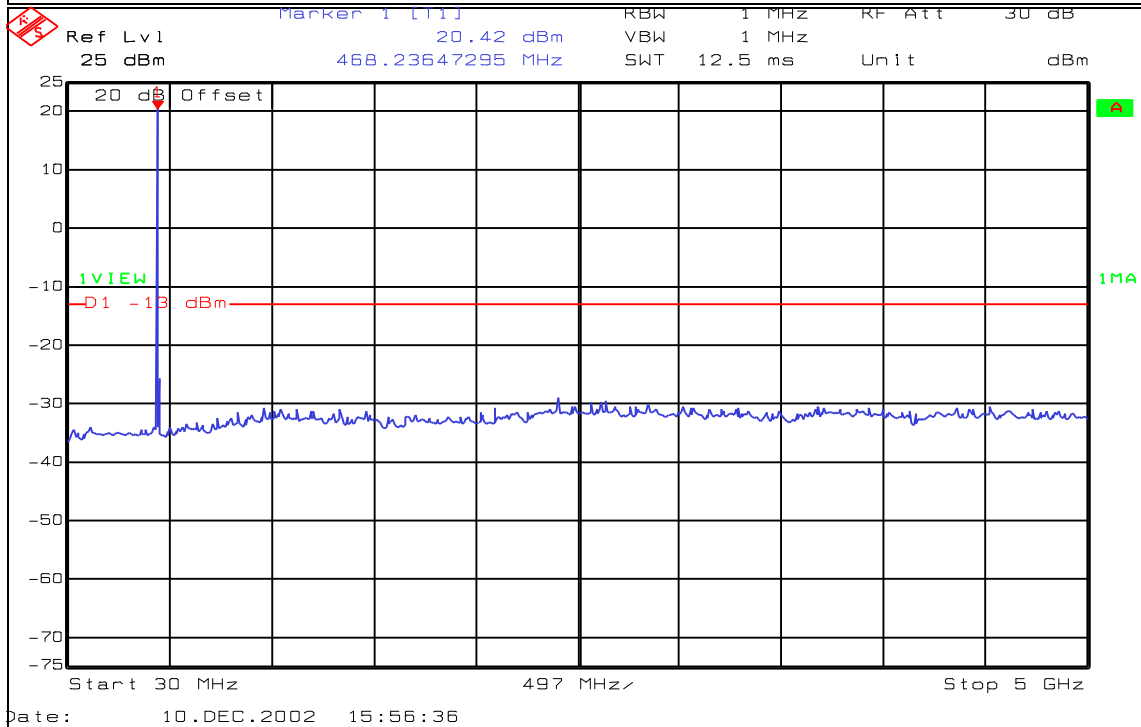
Test Data – Spurious Emissions at Antenna Terminals



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Data Plot		Spurious Emissions at Antenna Terminals	
Page 1 of 1		Date: 12/10/2002	Complete <u>X</u>
Job No.: 2L0551R		Temperature(°C): 22	Preliminary: _____
Specification: PART 90		Relative Humidity(%): 40	
Tested By: David Light			
E.U.T.: UHF1			
Configuration: TX FULL POWER			
Sample Number: 1			
Location: Lab 1		RBW: Refer to plots	Measurement
Detector Type: Peak		VBW: Refer to plots	Distance: NA m
<b>Test Equipment Used</b>			
Antenna: _____		Directional Coupler: _____	
Pre-Amp: _____		Cable #1: 1083	
Filter: _____		Cable #2: _____	
Receiver: 1036		Cable #3: _____	
Attenuator #1: 1064		Cable #4: _____	
Attenuator #2: _____		Mixer: _____	
Additional equipment used: _____			
Measurement Uncertainty: +/-1.7 dB			



Notes:

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**Section 6. Field Strength of Spurious Emissions**

NAME OF TEST: Field Strength of Spurious Emissions	PARA. NO.: 2.993
TESTED BY: David Light	DATE:12/10/2002

**Test Results:** Complies.

**Test Data:** See attached table.

There were no emissions detected above the ambient threshold of sensitivity. The ambient threshold of sensitivity is sufficient to measure emissions within 20 dB of the specification limit.

EQUIPMENT: UHF1

Test Data - Radiated Emissions



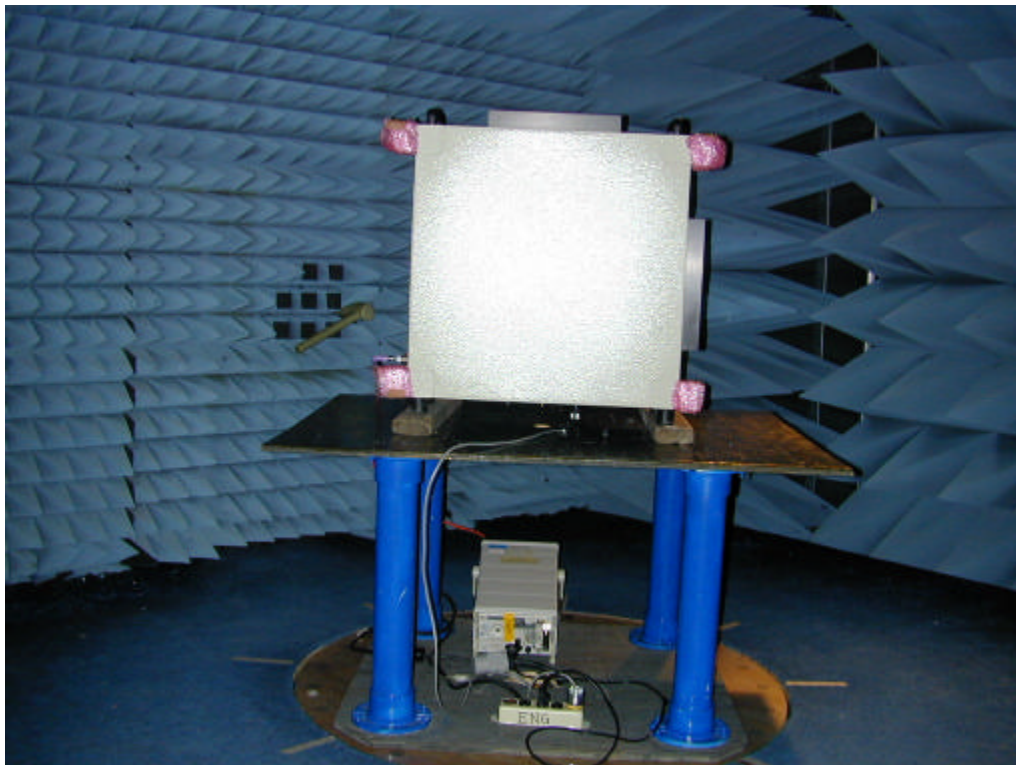
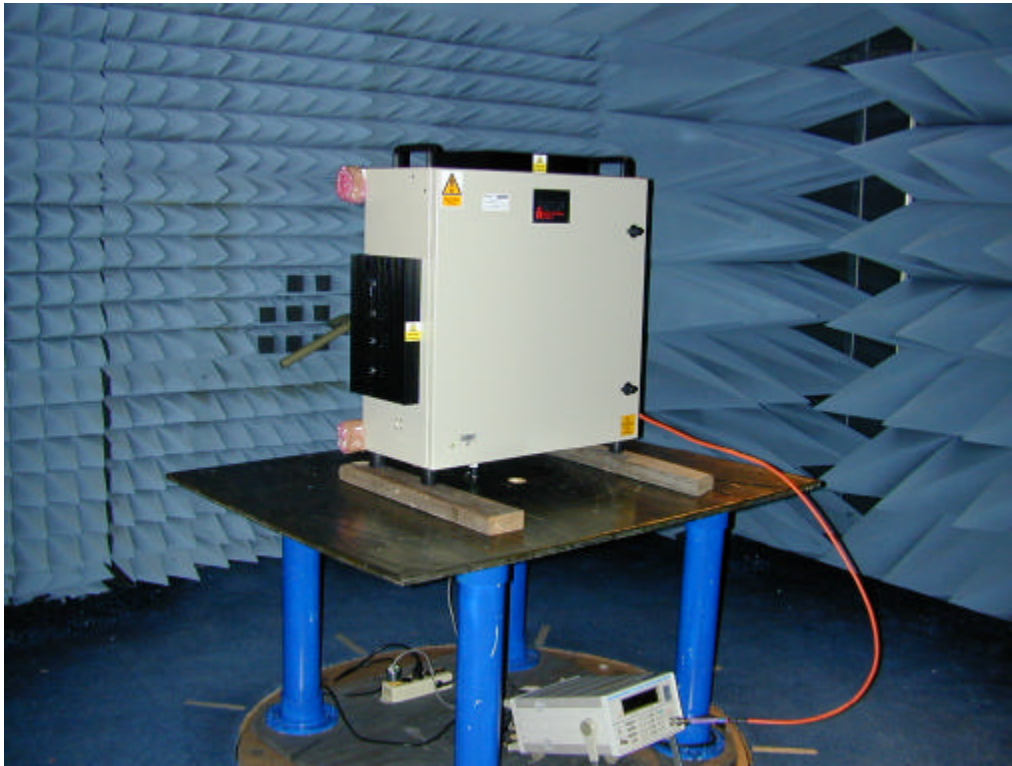
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<b>ERP Substitution Method</b>											
Page 1 of 1									Complete	<u>X</u>	
Job No.:	2L0551R		Date:		12/10/2002		Preliminary				
Specification:	PART 90		Temperature(°C):		22						
Tested By:	David Light		Relative Humidity(%)		40						
E.U.T.:	REPEATER										
Configuration:	TX FULLP POWER INTO LOAD										
Sample No:	1										
Location:	AC 3			RBW:	30 kHz		Measurement				
Detector Type:	Peak			VBW:	30 kHz		Distance:	3 m			
<b>Test Equipment Used</b>											
Antenna:	1304		Directional Coupler:								
Pre-Amp:	791		Cable #1:		1484						
Filter:			Cable #2:		1485						
Receiver:	1464		Cable #3:								
Attenuator #1:			Cable #4:								
Attenuator #2:			Mixer:								
Additional equipment used:	1016										
Measurement Uncertainty:	+/-1.7 dB										
Frequency (MHz)	Meter Reading (dBm)	Correction Factor (dB)	Pre-Amp Gain (dB)	Substitution Antenna Gain (dBd)	Limit (dBm)	ERP (dBm)	ERP (mW)	Polarity	Comments		
946.4250	-74.0	29.3	24.1	5.0	-13	-63.8	0.0000	V	Noise floor		
1419.6375	-72.0	31.5	32.4	4.9	-13	-68.1	0.0000	V	Noise floor		
1892.8500	-72.0	31.0	32.9	7.3	-13	-66.7	0.0000	V	Noise floor		
2366.0625	-72.0	34.2	33.0	6.8	-13	-64.1	0.0000	V	Noise floor		
2839.2750	-71.0	35.5	32.7	8.0	-13	-60.3	0.0000	V	Noise floor		
3312.4875	-73.0	39.8	32.6	8.0	-13	-57.8	0.0000	V	Noise floor		
3785.7000	-73.0	43.3	33.0	8.6	-13	-54.1	0.0000	V	Noise floor		
4258.9125	-73.0	45.3	33.2	8.2	-13	-52.7	0.0000	V	Noise floor		
4732.1250	-73.0	44.0	33.1	8.7	-13	-53.5	0.0000	V	Noise floor		
946.4250	-74.0	31.0	24.1	5.0	-13	-62.1	0.0000	H	Noise floor		
1419.6375	-72.0	30.7	32.4	4.9	-13	-68.9	0.0000	H	Noise floor		
1892.8500	-72.0	33.0	32.9	7.3	-13	-64.7	0.0000	H	Noise floor		
2366.0625	-72.0	37.0	33.0	6.8	-13	-61.3	0.0000	H	Noise floor		
2839.2750	-71.0	35.5	32.7	8.0	-13	-60.3	0.0000	H	Noise floor		
3312.4875	-73.0	36.3	32.6	8.0	-13	-61.3	0.0000	H	Noise floor		
3785.7000	-73.0	35.5	33.0	8.6	-13	-62.0	0.0000	H	Noise floor		
4258.9125	-73.0	34.8	33.2	8.2	-13	-63.2	0.0000	H	Noise floor		
4732.1250	-73.0	35.5	33.1	8.7	-13	-62.0	0.0000	H	Noise floor		
Notes: No emission were detected above the noise floor which was at least 20 dB below the spec limit.											



*EQUIPMENT:* UHF1

**Photographs of Test Setup**



## Section 7. Test Equipment List

Nemko ID	Description	Manufacturer Model Number	Serial Number	Calibration Date	Calibration Due
1464	Spectrum analyzer	Hewlett Packard 8563E	3551A04428	01/02/01	01/03/03
1304	HORN ANTENNA	ELECTRO METRICS RGA-60	6151	07/30/01	07/31/03
1016	Pre-Amp	HEWLETT PACKARD 8449A	2749A00159	07/15/02	07/15/03
791	PREAMP, 25dB	ICC LNA25	398	09/30/02	09/30/03
1484	Cable 2.0-18.0 Ghz	Storm PR90-010-072	N/A	07/15/02	07/15/03
1485	Cable 2.0-18.0 Ghz	Storm PR90-010-216	N/A	07/15/02	07/15/03
1036	SPECTRUM ANALYZER	ROHDE & SCHWARZ FSEK30	830844/006	12/18/01	12/19/03
1083	Cable 2m	Astrolab 32027-2-29094-72TC	N/A	CBU	N/A
1064	ATTENUATOR	NARDA 776B-20	NONE	CBU	N/A

## **ANNEX A - TEST METHODOLOGIES**

<b>NAME OF TEST: RF Power Output</b>	<b>PARA. NO.: 2.985</b>
--------------------------------------	-------------------------

**Minimum Standard:** Para. No. 90.205(a). The maximum allowable station ERP is dependent upon the stations HAAT and required service area and will be authorized in accordance with Table 1 of 90.205(d).

**Method Of Measurement:**

Detachable Antenna:

The peak power at antenna terminals is measured using an in-line peak power meter. Power output is measured with the maximum rated input level.

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

**Nemko Dallas**

FCC PART 90, SUBPART I  
PRIVATE LAND MOBILE REPEATER  
PROJECT NO.: 2L0551RUS1

*EQUIPMENT:* UHF1

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<b>NAME OF TEST: Spurious Emissions at Antenna Terminals</b>	<b>PARA. NO.: 2.991</b>
--	-------------------------

**Test Method:** RBW: 1% of emission bandwidth in the 0 - 1 GHz range.  
1 MHz at frequencies above 1 GHz.

VBW: = or > RBW

The spectrum is searched up to 10 times the fundamental frequency.

EQUIPMENT: UHF1

<b>NAME OF TEST: Occupied Bandwidth</b>	<b>PARA. NO.: 2.989</b>
---	-------------------------

**Minimum Standard:** Para. No. 90.210, see table 1 below for applicable mask.

**Table 1**

Frequency Band (MHz)	Mask for equipment with Low Pass Filter	Mask for equipment without Low Pass Filter
Below 25	A or B	A or C
25 - 50	B	C
72 - 76	B	C
150 - 174	B, D or E	C, D or E
150 Paging only	B	C
220 - 222	F	F
421 - 512	B, D or E	C, D or E
450 paging only	B	H
806 - 821/ 851 - 866	B	G
821 - 824/ 866 - 869	B	H
896 - 901/ 935 - 940	I	J
902 - 928	K	K
929 - 930	B	G
Above 940	B	C
All other bands	B	C

*EQUIPMENT:* UHF1

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**NAME OF TEST: Field Strength of Spurious**

**PARA. NO.: 2.993**

**Minimum Standard:** Para. No. 90.210, see table 1 for applicable mask.

**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 a dipole. 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 erp is the signal level fed to the reference antenna corrected for gain referenced to a dipole.

*EQUIPMENT:* UHF1

<b>NAME OF TEST: Frequency Stability</b>	<b>PARA. NO.: 2.995</b>
--	-------------------------

**Minimum Standard:** Para. No. 990.213. The transmitter carrier frequency shall remain within the assigned frequency below in ppm.

**Table 2**

Frequency Band (MHz)	Fixed And Base Stations	Mobile Stations	
		> 2 Watts o/p pwr	< 2 Watts o/p pwr
Below 25	100	100	200
25 - 50	20	20	50
72 - 76	5	-	50
150 - 174	5	5	5
220 - 222	0.1	1.5	1.5
421 - 512	2.5	5	5
806 - 821	1.5	2.5	2.5
821 - 824	1.0	1.5	15
851 - 866	1.5	2.5	2.5
866 - 869	1.0	1.5	1.5
869 - 901	0.1	1.5	1.5
902 - 928	2.5	2.5	2.5
929 - 930	1.5	-	-
935 - 940	0.1	1.5	1.5
1427 - 1435	300	300	300
Above 2450	-	-	-



**Nemko Dallas**

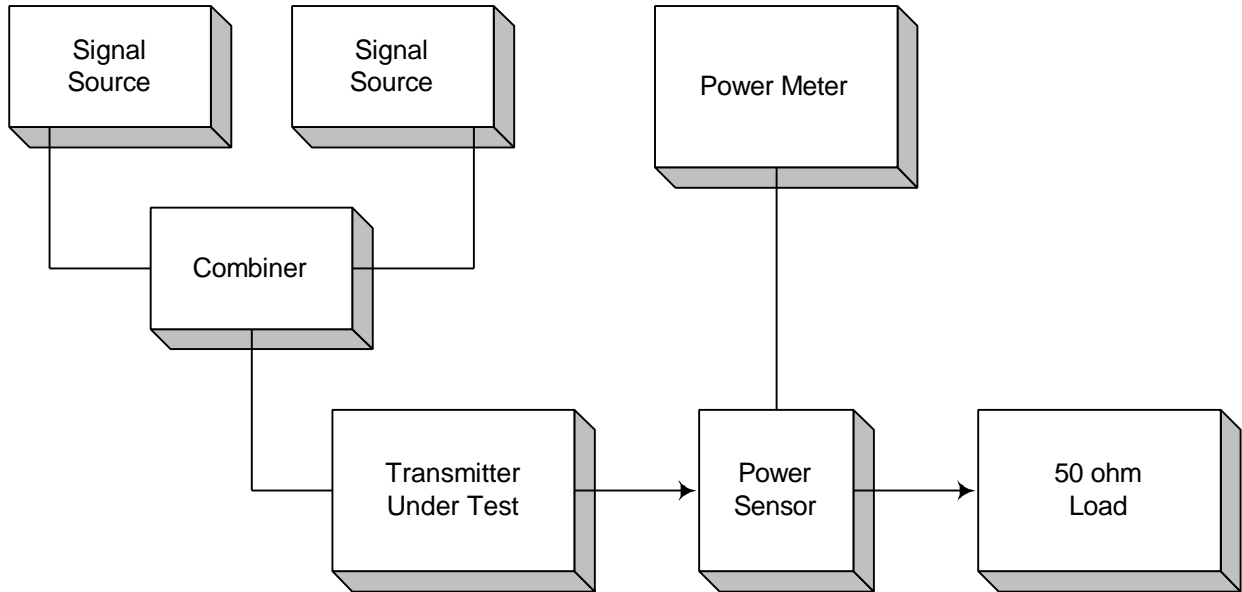
FCC PART 90, SUBPART I  
PRIVATE LAND MOBILE REPEATER  
PROJECT NO.: **2L0551RUS1**

*EQUIPMENT:* **UHF1**

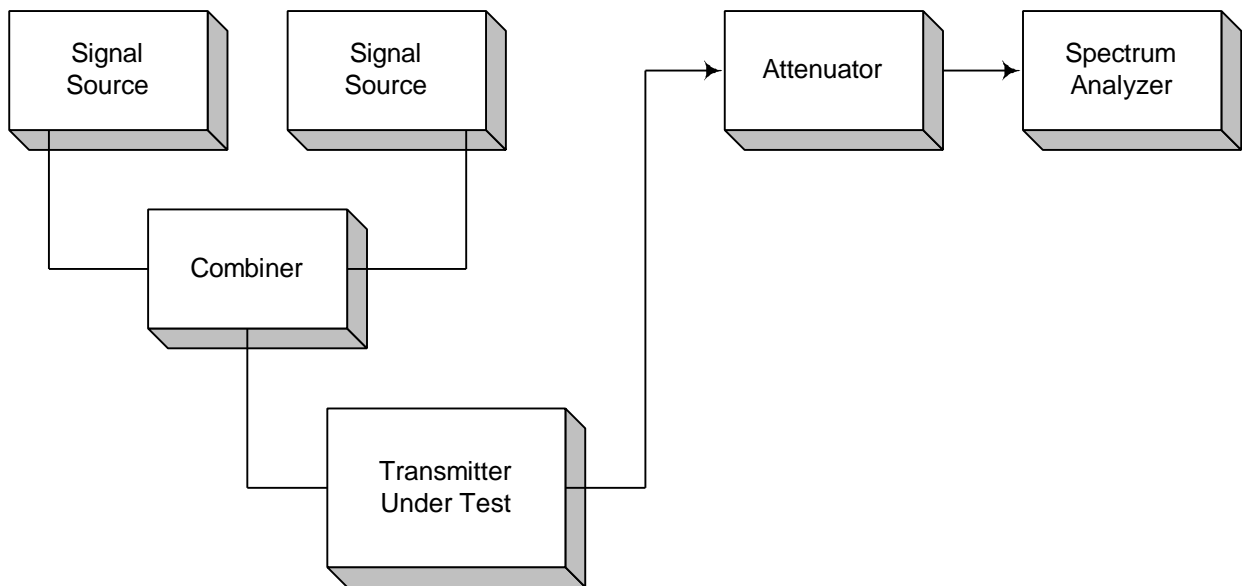
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## **ANNEX B - TEST DIAGRAMS**

**Para. No. 2.985 - R.F. Power Output**

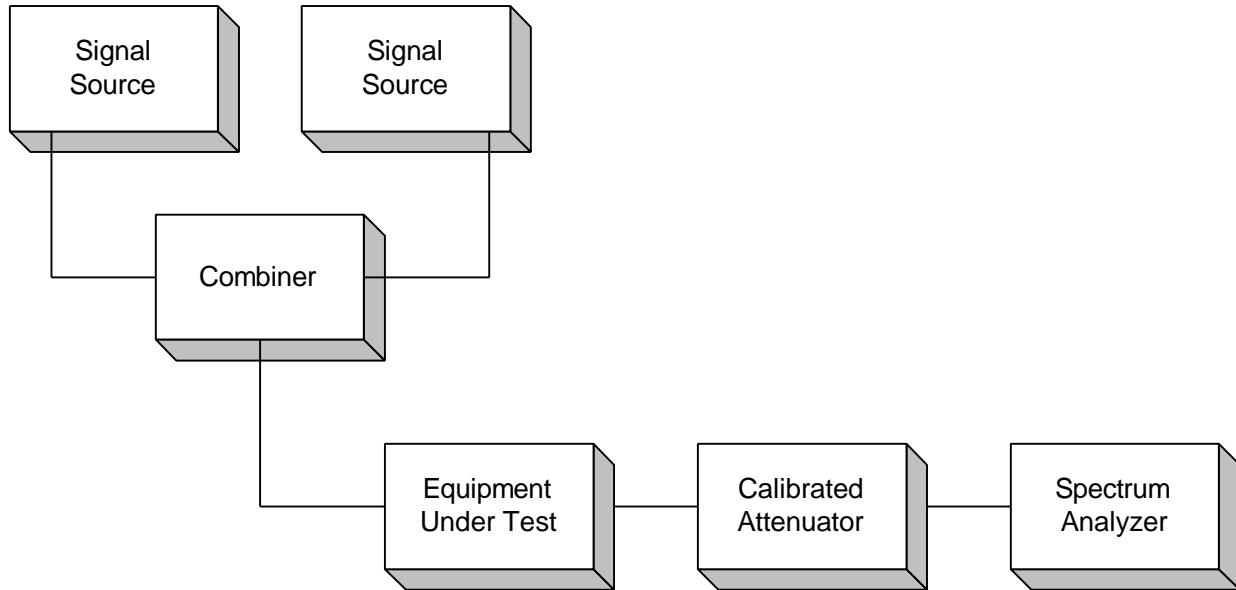


**Para. No. 2.989 - Occupied Bandwidth**

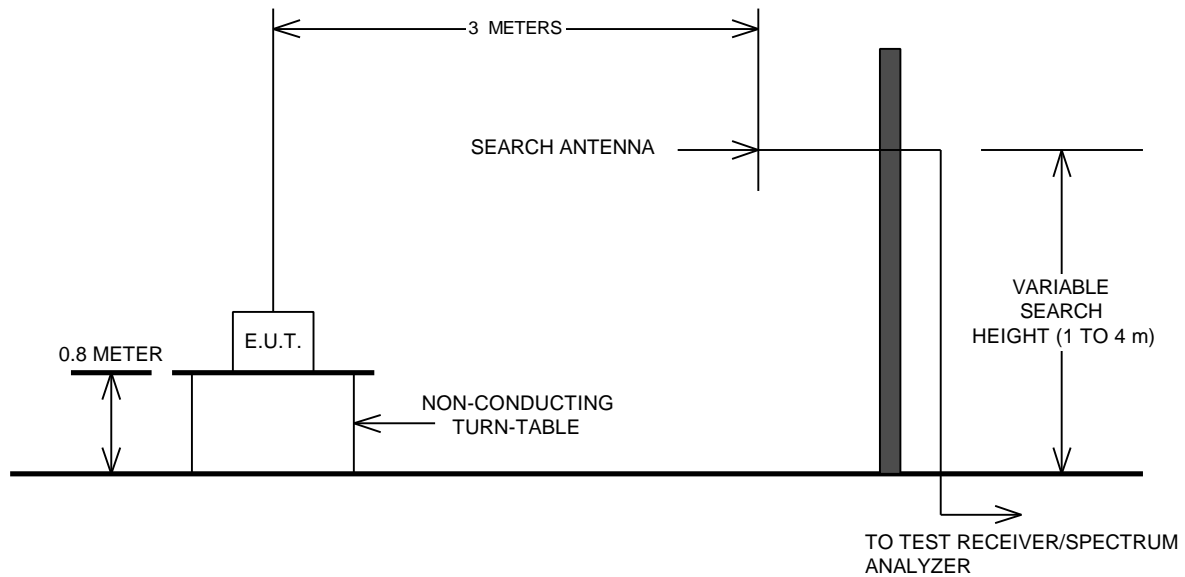


EQUIPMENT: UHF1

**Para. No. 2.991 - Spurious Emissions at Antenna Terminals**



**Para. No. 2.993 - Field Strength of Spurious Radiation**



**Para. No. 2.995 - Frequency Stability**

