

Nemko Test Report: 2L0551RUS2

Applicant: Aerial Facilities Limited

**Equipment Under Test:
(E.U.T.)** UHF2

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: UHF2

Section 1. Summary of Test Results

Manufacturer: Aerial Facilities Limited

Model No.: UHF2

Serial No.: 13401 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: **UHF2**

Summary Of Test Data

NAME OF TEST	PARA. NO.	RESULT
RF Power Output	90.205	Complies
Audio Frequency Response	TIA EIA-603.3.2.6	N/A
Audio Low-Pass Filter Response	TIA EIA-603.3.2.6	N/A
Modulation Limiting	TIA EIA-603.3.2.6	N/A
Occupied Bandwidth	90.210	Complies
Spurious Emissions at Antenna Terminals	90.210	Complies
Field Strength of Spurious Emissions	90.210	Complies
Frequency Stability	90.213	N/A
Transient Frequency Behavior	90.214	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: UHF2

Section 2. General Equipment Specification

Transmitter

Supply Voltage Input:	115 Vac				
Frequency Range:	486.0625, 486.2875, 486.3125, and 486.5625 MHz				
Tunable Bands:	Single fixed channels				
Type(s) of Modulation:	F3E (Voice) <input checked="" type="checkbox"/>	F1D <input type="checkbox"/>	F2D <input type="checkbox"/>	D7W (QAM) <input type="checkbox"/>	Other <input type="checkbox"/>
Gain:	35 dB min.				
Maximum Input:	-19 dBm				
Output Impedance:	50 ohms				
RF Power Output (rated):	Single Channel:	20 dBm (100 mW)			
	Composite:	26 dBm (400 mW)			
Channel Spacing(s):	25 kHz				
Operator Selection of Operating Frequency:	Fixed				
Power Output Adjustment Capability:	Manual (Attenuators)				
Frequency Translation:	F1-F1 <input checked="" type="checkbox"/>	F1-F2 <input type="checkbox"/>	N/A <input type="checkbox"/>		
Band Selection:	Software <input type="checkbox"/>	Duplexer Change <input checked="" type="checkbox"/>	Fullband Coverage <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: **UHF2**

Section 3. RF Power Output

NAME OF TEST: RF Power Output	PARA. NO.: 2.985
TESTED BY: David Light	DATE:12/11/2002

Test Results: Complies.

Measurement Data:

Frequency (MHz)	Measured Power (dBm)
486.0625	20
486.2875	20
486.3125	20
486.5625	20

EQUIPMENT: **UHF2**

Section 4. Occupied Bandwidth

NAME OF TEST: Occupied Bandwidth	PARA. NO.: 2.989
TESTED BY: David Light	DATE: 12/11/2002

Test Results: Complies.

Test Data: See attached graph(s).

EQUIPMENT: UHF2

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> 12/11/2002 </u>		Preliminary: <u> </u>																			
Job No.:	<u> 2L0551R </u>	Temperature(°C):	<u> 20 </u>																				
Specification:	<u> PART 90 </u>	Relative Humidity(%):	<u> 45 </u>																				
Tested By:	<u> David Light </u>																						
E.U.T.:	<u> UHF2 </u>																						
Configuration:	<u> TX FULL POWER </u>																						
Sample Number:	<u> 1 </u>																						
Location:	<u> Lab 1 </u>	RBW:	<u> Refer to plots </u>	Measurement	<u> </u>																		
Detector Type:	<u> Peak </u>	VBW:	<u> Refer to plots </u>	Distance:	<u> NA </u> m																		
Test Equipment Used																							
Antenna:	<u> </u>	Directional Coupler:	<u> </u>																				
Pre-Amp:	<u> </u>	Cable #1:	<u> 1083 </u>																				
Filter:	<u> </u>	Cable #2:	<u> </u>																				
Receiver:	<u> 1036 </u>	Cable #3:	<u> </u>																				
Attenuator #1:	<u> 1064 </u>	Cable #4:	<u> </u>																				
Attenuator #2:	<u> </u>	Mixer:	<u> </u>																				
Additional equipment used:	<u> </u>																						
Measurement Uncertainty:	<u> +/-1.7 dB </u>																						
<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td style="width:15%;">Ref Lvl</td> <td style="width:35%;">7.00 dBm</td> <td style="width:15%;">RBW</td> <td style="width:15%;">500 Hz</td> <td style="width:15%;">RF Att</td> <td style="width:15%;">30 dB</td> </tr> <tr> <td>25 dBm</td> <td>486.2875000 MHz</td> <td>VBW</td> <td>500 Hz</td> <td>Unit</td> <td>dBm</td> </tr> <tr> <td></td> <td></td> <td>SWT</td> <td>1 s</td> <td></td> <td></td> </tr> </table>						Ref Lvl	7.00 dBm	RBW	500 Hz	RF Att	30 dB	25 dBm	486.2875000 MHz	VBW	500 Hz	Unit	dBm			SWT	1 s		
Ref Lvl	7.00 dBm	RBW	500 Hz	RF Att	30 dB																		
25 dBm	486.2875000 MHz	VBW	500 Hz	Unit	dBm																		
		SWT	1 s																				
Date: <u> 11.DEC.2002 </u> <u> 10:07:59 </u>																							
Notes: <u> OUTPUT SIGNAL 486.2875 MHz </u> <u> 2.5 kHz TONE / 5 kHz DEVIATION </u>																							

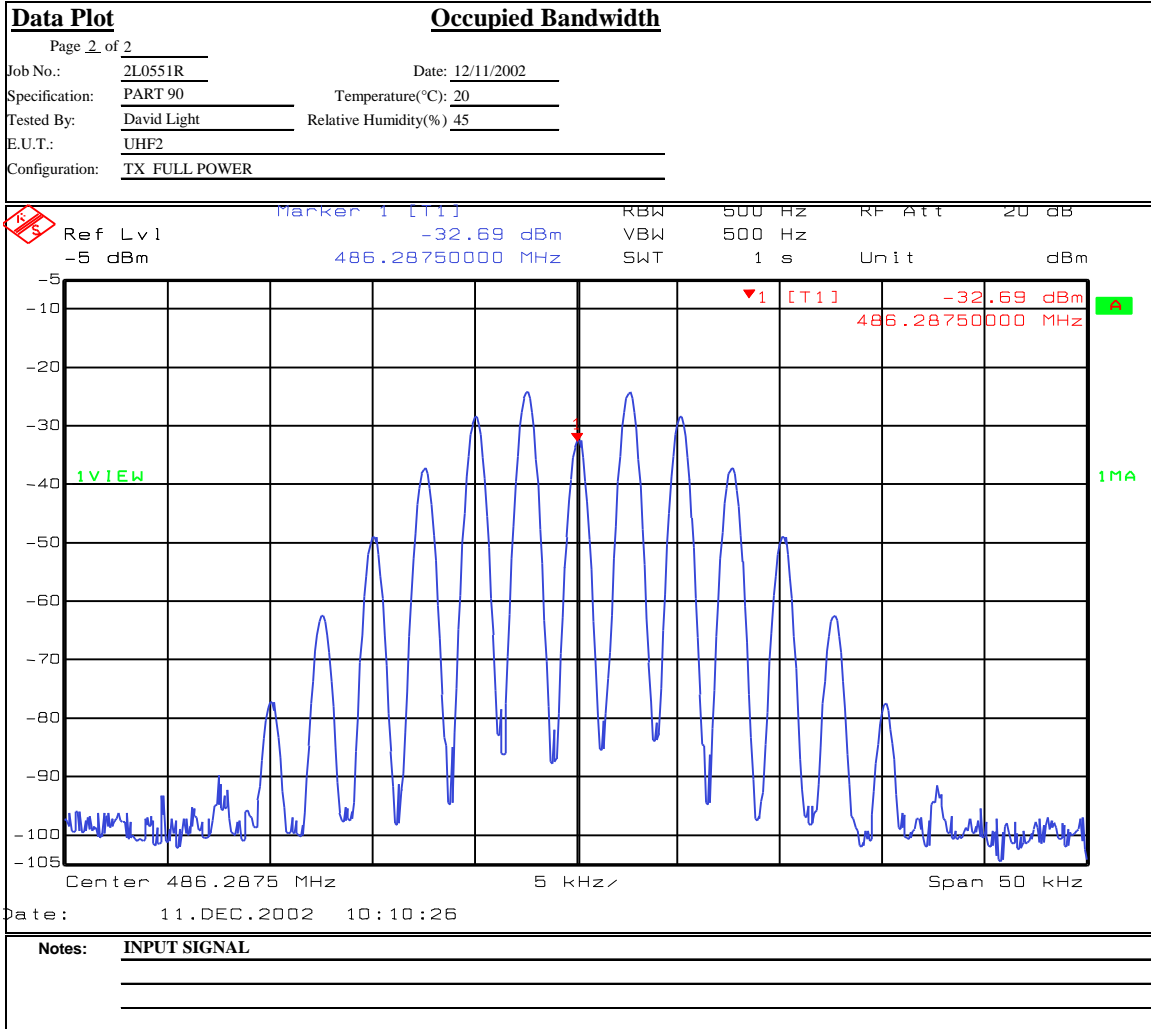
EQUIPMENT: UHF2

Test Data – Occupied Bandwidth (Input/Output)



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EQUIPMENT: **UHF2**

Section 5. Spurious Emissions at Antenna Terminals

NAME OF TEST: Spurious Emissions @ Antenna Terminals	PARA. NO.: 2.991
TESTED BY: David Light	DATE:12/11/2002

Test Results: Complies.

Test Data: See attached graph(s).

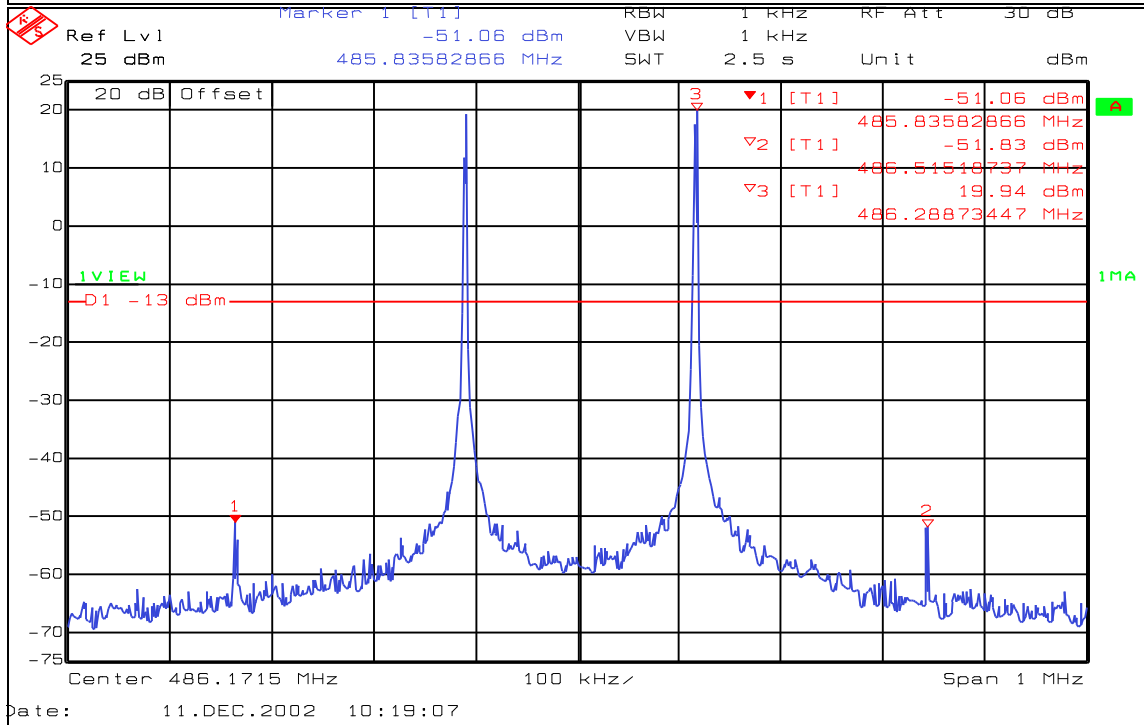
Test Data – Spurious Emissions at Antenna Terminals



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Data Plot		Intermodulation Characteristics		Complete <u>X</u>	
Page <u>1</u> of <u>2</u>		Date: <u>12/11/2002</u>		Preliminary: _____	
Job No.: <u>2L0551R</u>		Temperature(°C): <u>20</u>			
Specification: <u>PART 90</u>		Relative Humidity(%): <u>45</u>			
Tested By: <u>David Light</u>					
E.U.T.: <u>UHF2</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	
Test Equipment Used					
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>					



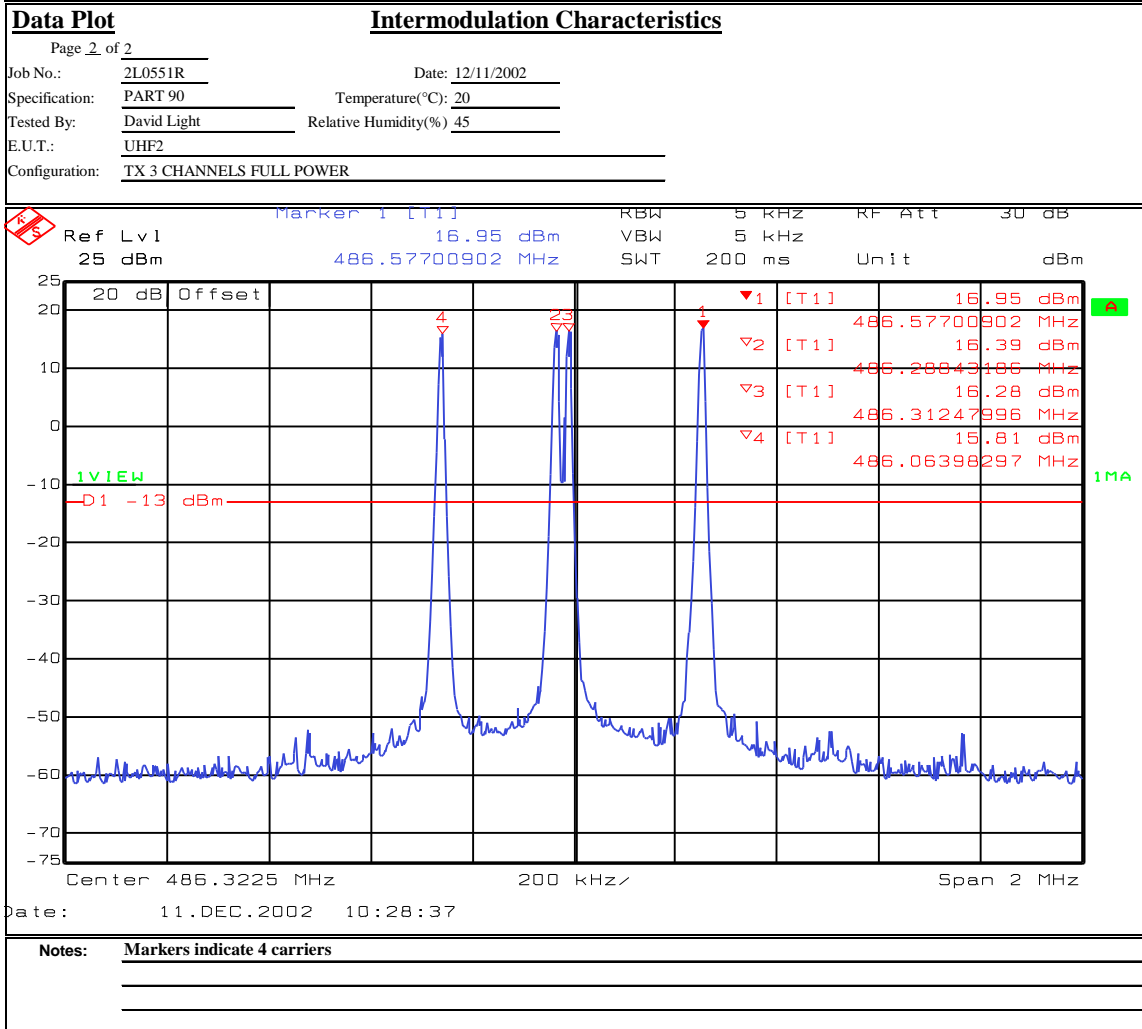
Notes: **MARKERS 1 AND 2 INDICATE INTERMOD LEVELS**
MARKER 3 INDICATES CARRIER LEVEL
INPUT SIGNALS 486.2875 MHz and 486.0625 MHz

Test Data – Spurious Emissions at Antenna Terminals



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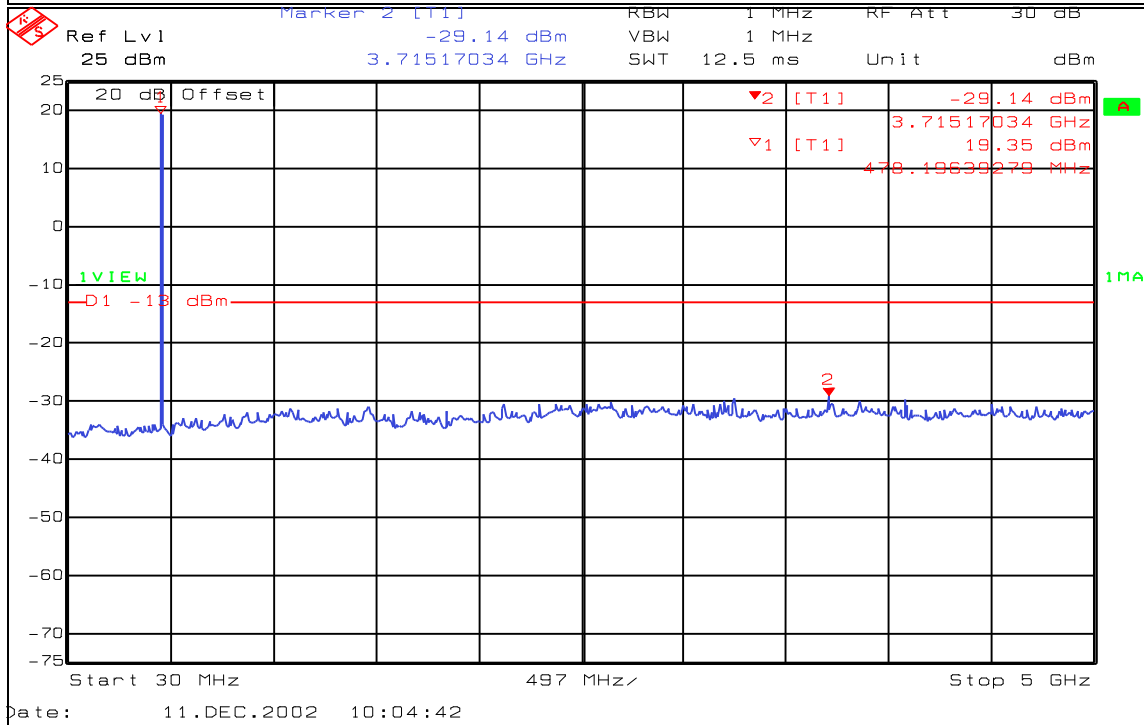
Test Data – Spurious Emissions at Antenna Terminals



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Data Plot		Spurious Emissions at Antenna Terminals	
Page 1 of 1		Complete <u>X</u>	
Job No.: 2L0551R	Date: 12/11/2002	Preliminary: _____	
Specification: PART 90	Temperature(°C): 20		
Tested By: David Light	Relative Humidity(%): 45		
E.U.T.: UHF2			
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	
Test Equipment Used			
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			



Date: 11 . DEC . 2002 10 : 04 : 42

Notes: **Marker 1 indicates carrier**
Marker 2 indicates highest emission (Noise floor)

Section 6. Field Strength of Spurious Emissions

NAME OF TEST: Field Strength of Spurious Emissions	PARA. NO.: 2.993
TESTED BY: David Light	DATE:12/11/2002

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: UHF2

Test Data - Radiated Emissions

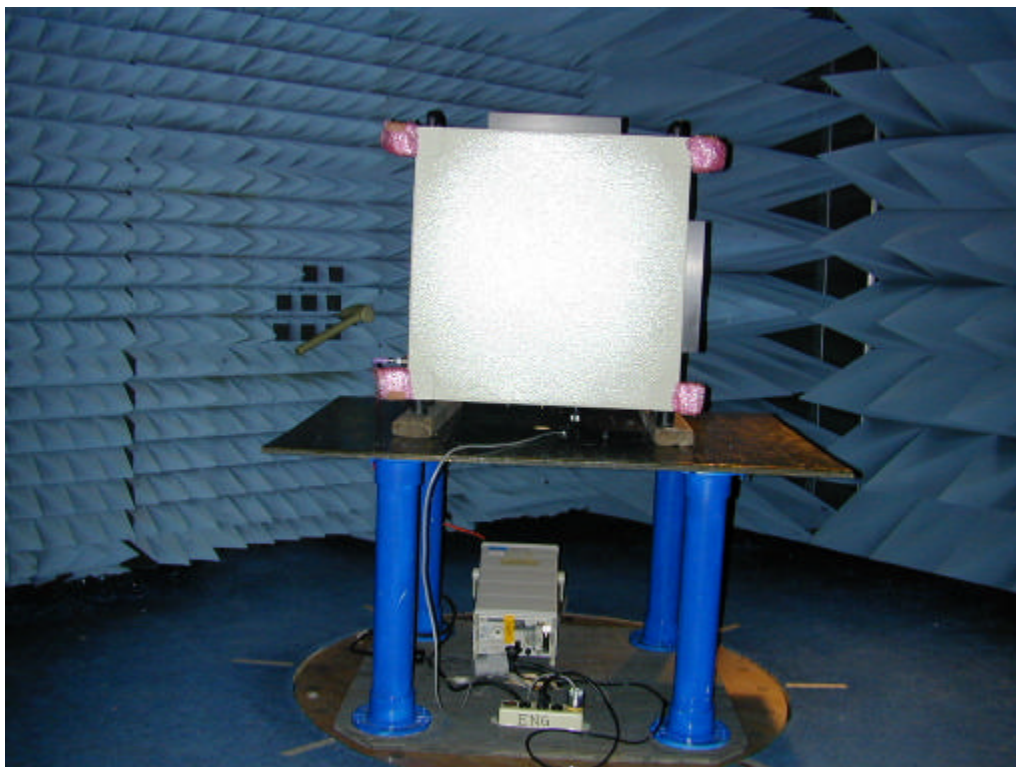
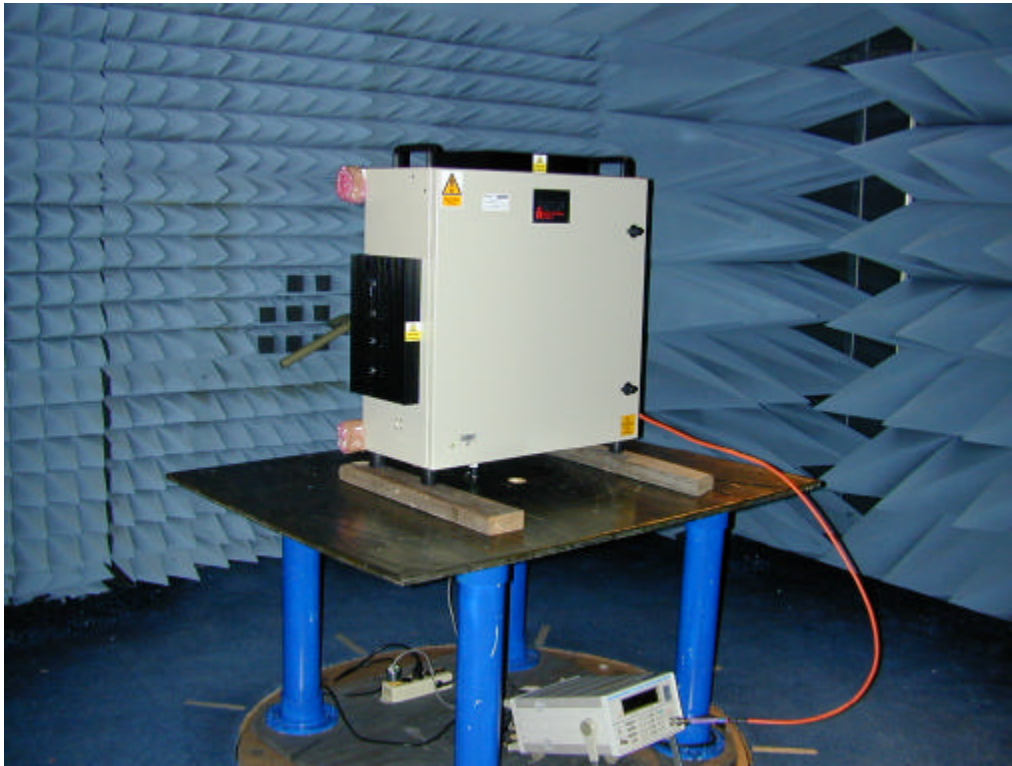


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ERP Substitution Method											
Page 1 of 1									Complete	<u>X</u>	
Job No.:	2L0551R		Date:		12/11/2002		Preliminary				
Specification:	PART 90		Temperature(°C):		20						
Tested By:	David Light		Relative Humidity(%):		50						
E.U.T.:	UHF2 REPEATER										
Configuration:	TX FULL POWER INTO LOAD										
Sample No:	1										
Location:	AC 3			RBW:	30 kHz		Measurement				
Detector Type:	Peak			VBW:	30 kHz		Distance:		3 m		
Test Equipment Used											
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		
										Tx @ 486.0625 MHz	
972.1250	-74.0	29.3	24.1	5.0	-13	-63.8	0.0000	V	Noise floor		
1458.1875	-72.0	31.5	32.4	4.9	-13	-68.1	0.0000	V	Noise floor		
1944.2500	-72.0	31.0	32.9	7.3	-13	-66.7	0.0000	V	Noise floor		
2430.3125	-72.0	34.2	33.0	6.8	-13	-64.1	0.0000	V	Noise floor		
2916.3750	-71.0	35.5	32.7	8.0	-13	-60.3	0.0000	V	Noise floor		
3402.4375	-73.0	39.8	32.6	8.0	-13	-57.8	0.0000	V	Noise floor		
3888.5000	-73.0	43.3	33.0	8.6	-13	-54.1	0.0000	V	Noise floor		
4374.5625	-73.0	45.3	33.2	8.2	-13	-52.7	0.0000	V	Noise floor		
4860.6250	-73.0	44.0	33.1	8.7	-13	-53.5	0.0000	V	Noise floor		
972.1250	-74.0	31.0	24.1	5.0	-13	-62.1	0.0000	H	Noise floor		
1458.1875	-72.0	30.7	32.4	4.9	-13	-68.9	0.0000	H	Noise floor		
1944.2500	-72.0	33.0	32.9	7.3	-13	-64.7	0.0000	H	Noise floor		
2430.3125	-72.0	37.0	33.0	6.8	-13	-61.3	0.0000	H	Noise floor		
2916.3750	-71.0	35.5	32.7	8.0	-13	-60.3	0.0000	H	Noise floor		
3402.4375	-73.0	36.3	32.6	8.0	-13	-61.3	0.0000	H	Noise floor		
3888.5000	-73.0	35.5	33.0	8.6	-13	-62.0	0.0000	H	Noise floor		
4374.5625	-73.0	34.8	33.2	8.2	-13	-63.2	0.0000	H	Noise floor		
4860.6250	-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: UHF2

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

NAME OF TEST: RF Power Output	PARA. NO.: 2.985
--------------------------------------	-------------------------

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

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FCC PART 90, SUBPART I
PRIVATE LAND MOBILE REPEATER
PROJECT NO.: **2L0551RUS2**

EQUIPMENT: **UHF2**

NAME OF TEST: Spurious Emissions at Antenna Terminals	PARA. NO.: 2.991
--	-------------------------

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

VBW: \Rightarrow RBW

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

EQUIPMENT: UHF2

NAME OF TEST: Occupied Bandwidth	PARA. NO.: 2.989
---	-------------------------

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: UHF2

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: UHF2

NAME OF TEST: Frequency Stability	PARA. NO.: 2.995
--	-------------------------

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	-	-	-

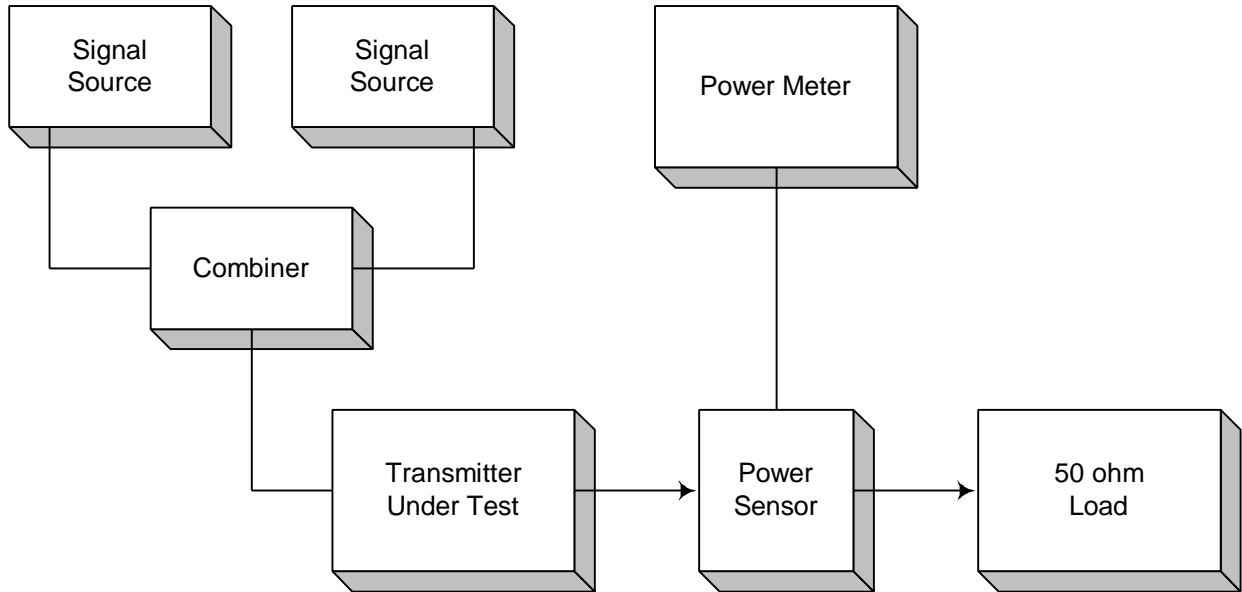
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FCC PART 90, SUBPART I
PRIVATE LAND MOBILE REPEATER
PROJECT NO.: **2L0551RUS2**

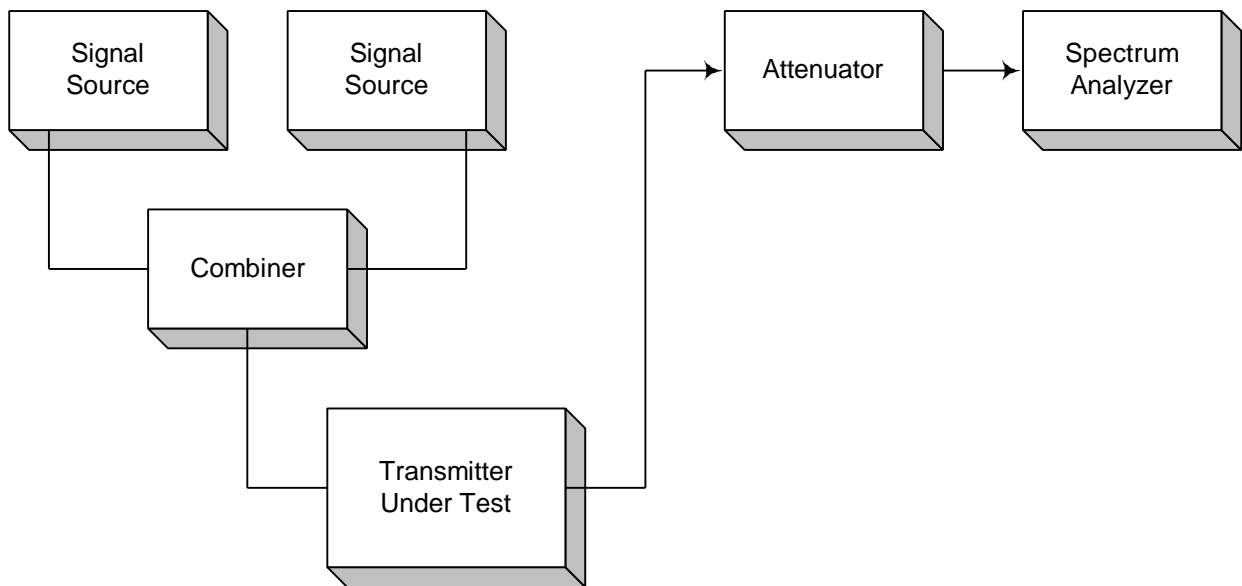
EQUIPMENT: **UHF2**

ANNEX B - TEST DIAGRAMS

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

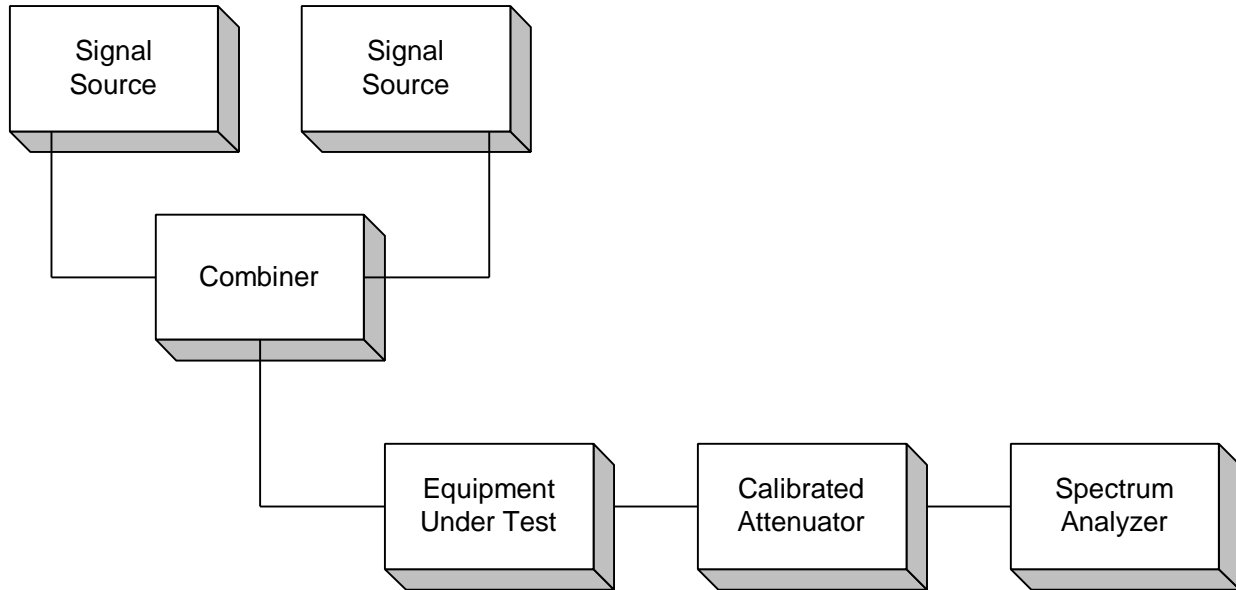


Para. No. 2.989 - Occupied Bandwidth

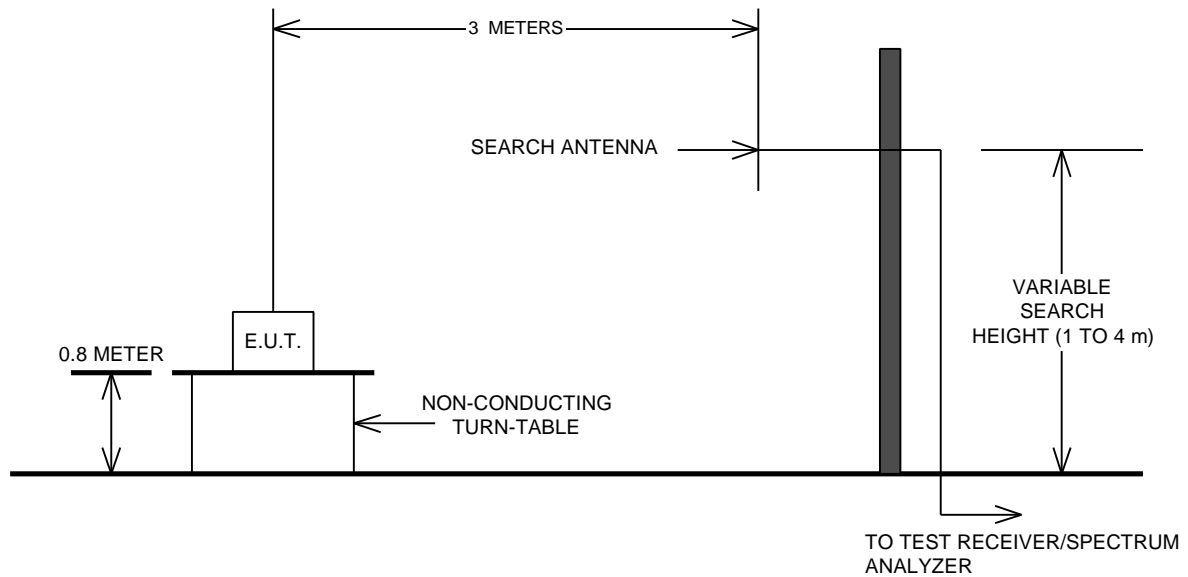


EQUIPMENT: UHF2

Para. No. 2.991 - Spurious Emissions at Antenna Terminals



Para. No. 2.993 - Field Strength of Spurious Radiation



EQUIPMENT: UHF2

Para. No. 2.995 - Frequency Stability

