

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

A handwritten signature in blue ink, appearing to read "Tom Tidwell", is positioned above the "Authorized By:" field.

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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Summary Of Test Data

NAME OF TEST	PARA. NO.	SPEC.	RESULT
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****Supply Voltage Input:** 115 Vac**Frequency Range:** 473.2125, 473.2625 and 485.2375 MHz
Individual channels

Type(s) of Modulation:	F3E (Voice)	F1D	F2D	D7W (QAM)	Other
	☒	☐	☐	☐	☐

Gain: 40 dB**Maximum Input:** -19 dBm**Output Impedance:** 50 ohms

RF Power Output (rated):	Single:	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	F1-F2	N/A
	☒	☐	☐

Band Selection:	Software	Duplexer Change	Fullband Coverage
	☐	☒	☐

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**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:**

Frequency (MHz)	Measured Power (dBm)
473.2125	20
473.2625	20
485.2375	20

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

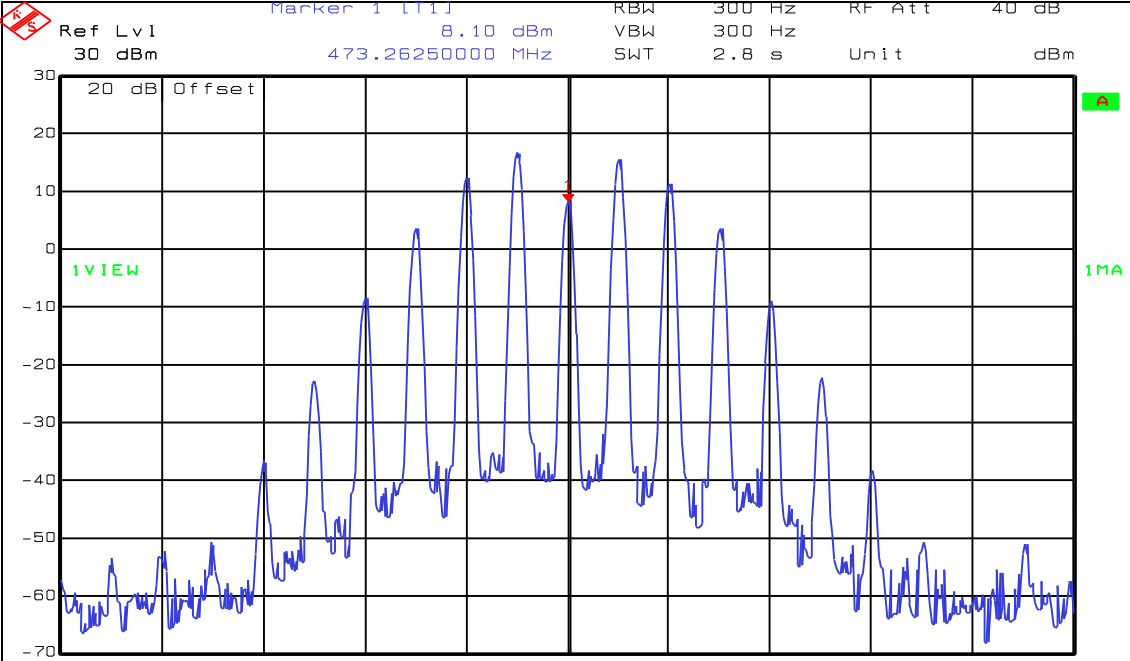
Test Data – Occupied Bandwidth (Input/Output)



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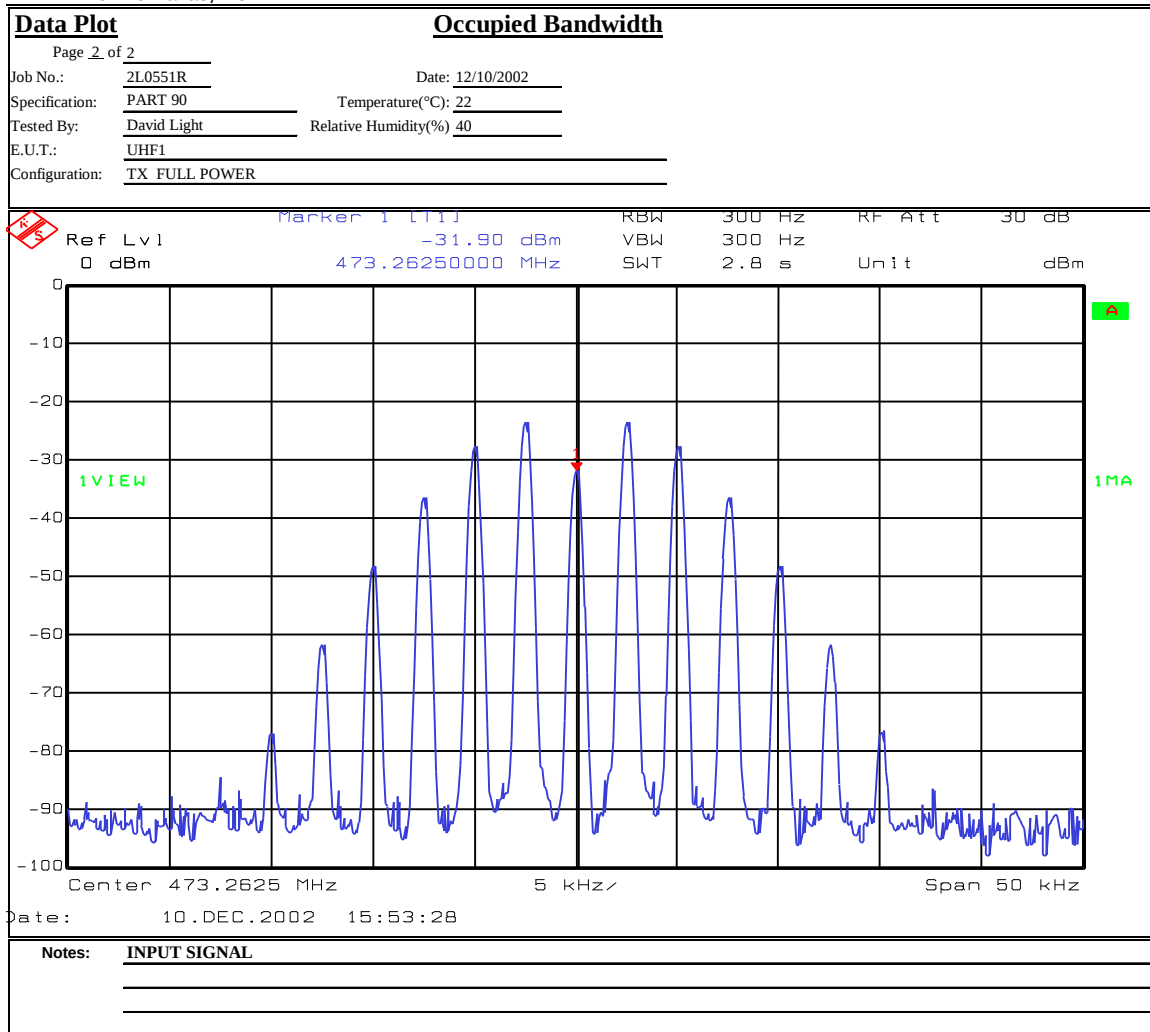
Data Plot		Occupied Bandwidth	
Page 1 of 2		Complete <u>X</u>	
Job No.:	2L0551R	Date:	12/10/2002
Specification:	PART 90	Temperature(°C):	22
Tested By:	David Light	Relative Humidity(%):	40
E.U.T.:	UHF1		
Configuration:	TX FULL POWER		
Sample Number:	1		
Location:	Lab 1	RBW:	Refer to plots
Detector Type:	Peak	VBW:	Refer to plots
		Measurement	Distance: <u>NA</u> 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		
			
Ref Lvl 1 30 dBm Marker 1 [11] 8.10 dBm 473.2625000 MHz RBW 300 Hz RF Att 40 dB VBW 300 Hz Unit dBm SWT 2.8 s			
Center 473.2625 MHz 5 kHz Span 50 kHz			
Date: 10.DEC.2002 15:51:58			
Notes: OUTPUT SIGNAL 473.2625 MHz			
2.5 kHz TONE / 5 kHz DEVIATION			

Test Data – Occupied Bandwidth (Input/Output)



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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

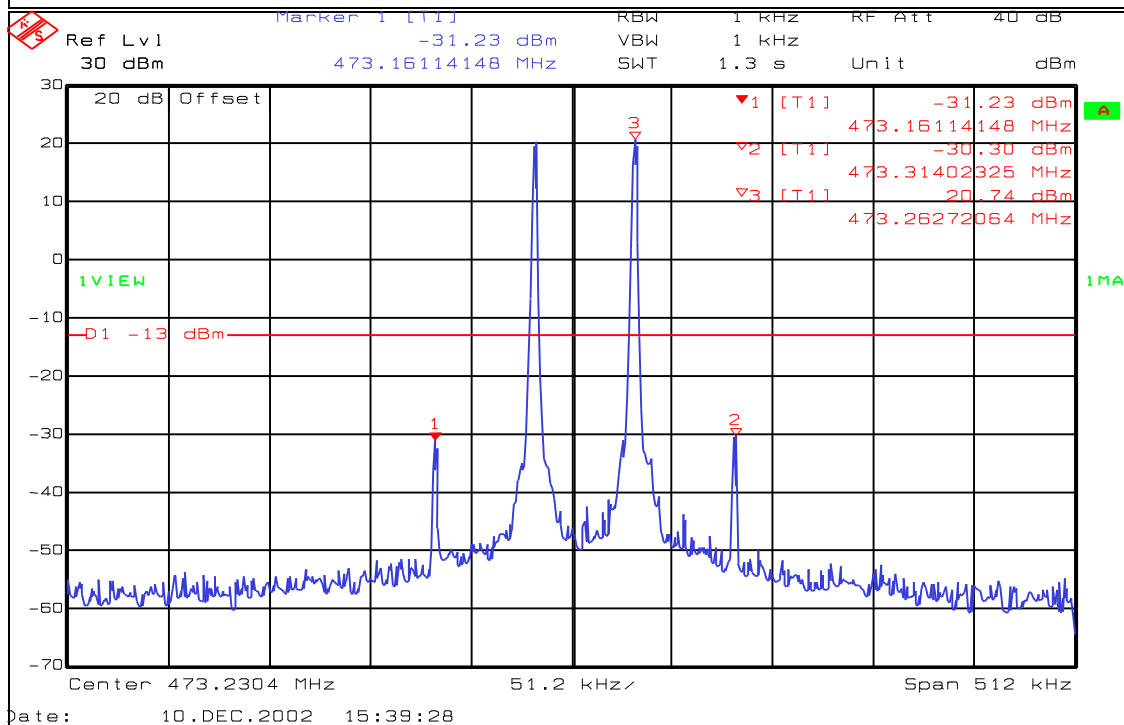
Intermodulation Characteristics

Page 1 of 2

Job No.: 2L0551R Date: 12/10/2002 Complete X
Specification: PART 90 Temperature(°C): 22 Preliminary: _____
Tested By: David Light Relative Humidity(%): 40
E.U.T.: UHF1
Configuration: TX 3 CHANNELS 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



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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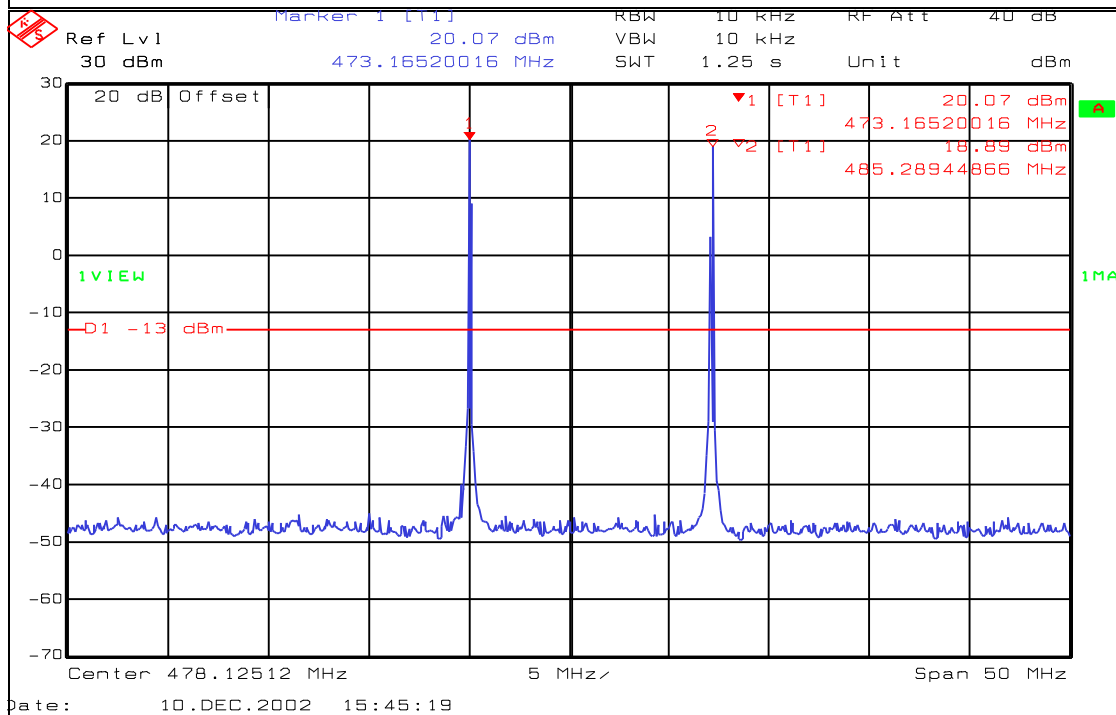
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Data Plot

Intermodulation Characteristics

Page 2 of 2

Job No.: 2L0551R Date: 12/10/2002
Specification: PART 90 Temperature(°C): 22
Tested By: David Light Relative Humidity(%) 40
E.U.T.: UHF1
Configuration: TX 3 CHANNELS FULL POWER



Notes: Markers indicate carriers

Test Data – Spurious Emissions at Antenna Terminals



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Data Plot

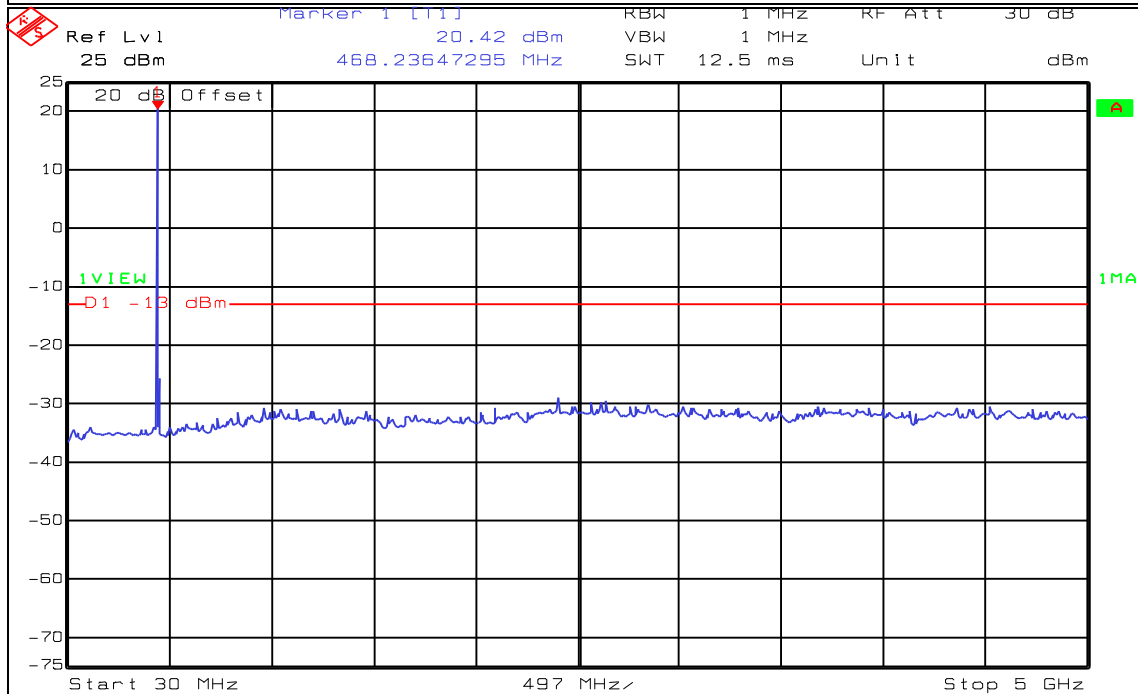
Spurious Emissions at Antenna Terminals

Page 1 of 1

Job No.: 2L0551R Date: 12/10/2002 Complete X
Specification: PART 90 Temperature(°C): 22 Preliminary: _____
Tested By: David Light Relative Humidity(%): 40
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

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: 10.DEC.2002 15:56:36

Notes:

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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Dallas Headquarters:

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ERP Substitution Method

Page 1 of 1

Job No.: 2L0551R Date: 12/10/2002 Complete X
 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

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

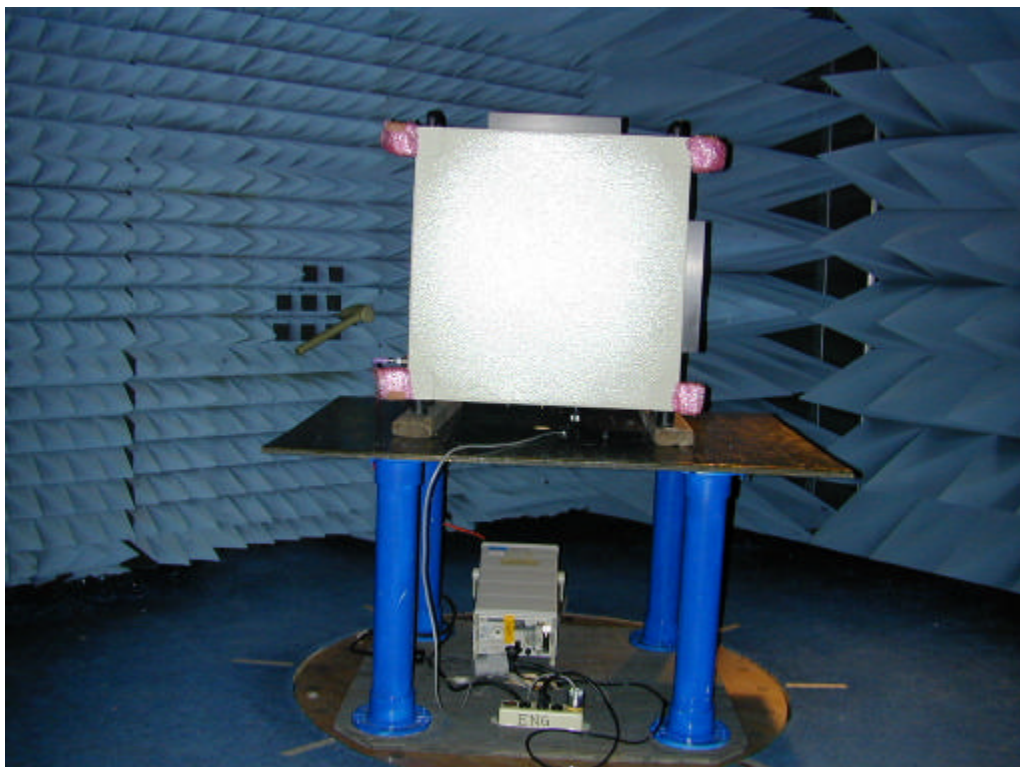
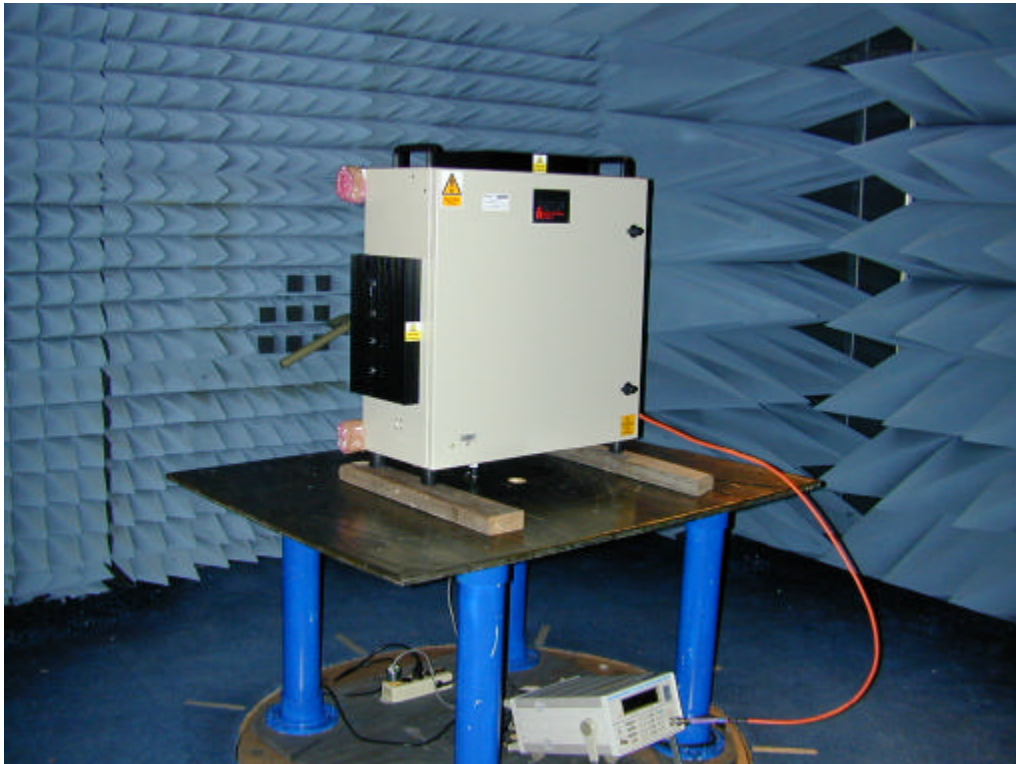
Measurement Uncertainty: +/-1.7 dB

Frequency (MHz)	Meter Reading (dBm)	Correction Factor (dB)		Pre-Amp Gain (dB)	Substitution Antenna Gain (dBd)	Limit (dBm)	ERP (dBm)	ERP (mW)	Polarity	Comments
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

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

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

PROJECT NO.: 2L0551RUS1

PARA. NO.: 2.991

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

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

NAME OF TEST: Field Strength of Spurious	PARA. NO.: 2.993
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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

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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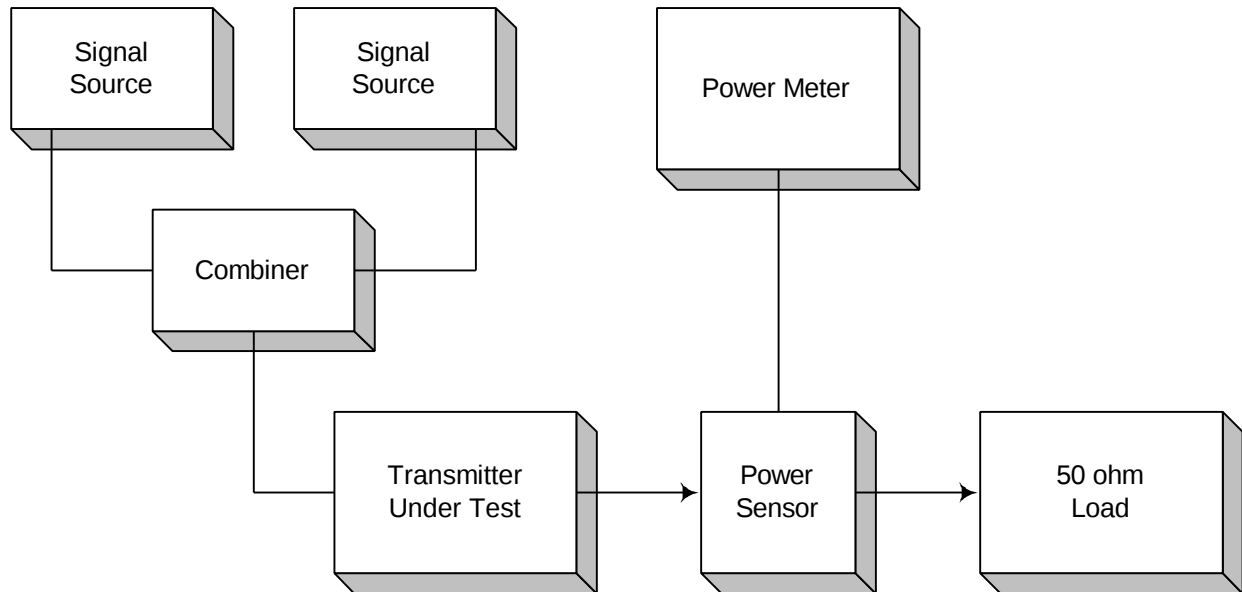
FCC PART 90, SUBPART I
PRIVATE LAND MOBILE REPEATER

EQUIPMENT: **UHF1**

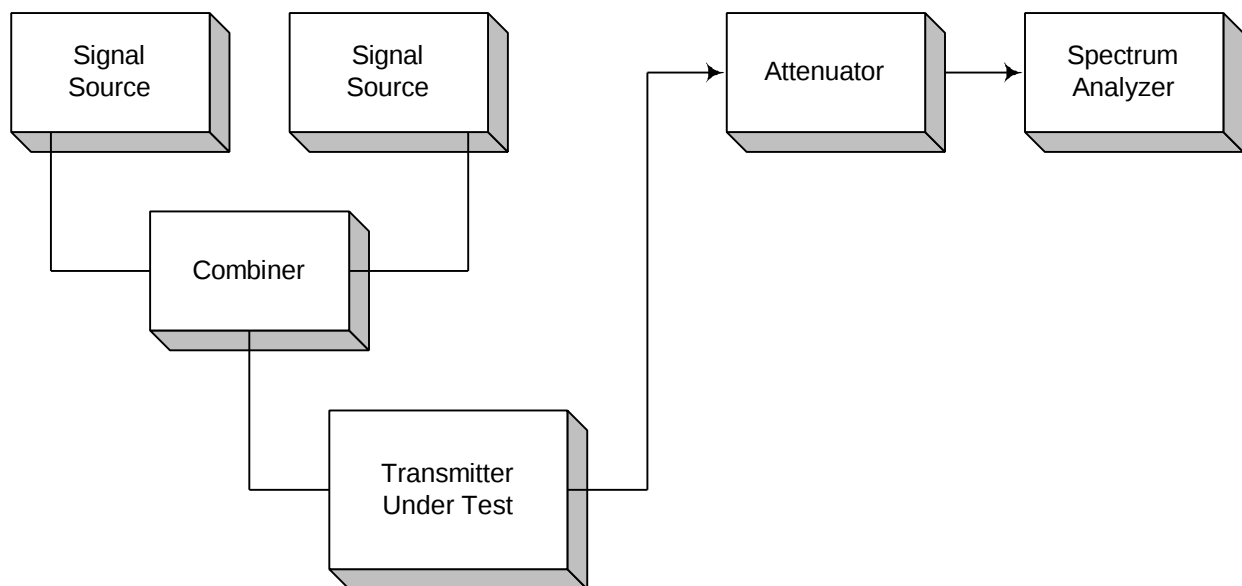
PROJECT NO.: **2L0551RUS1**

ANNEX B - TEST DIAGRAMS

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

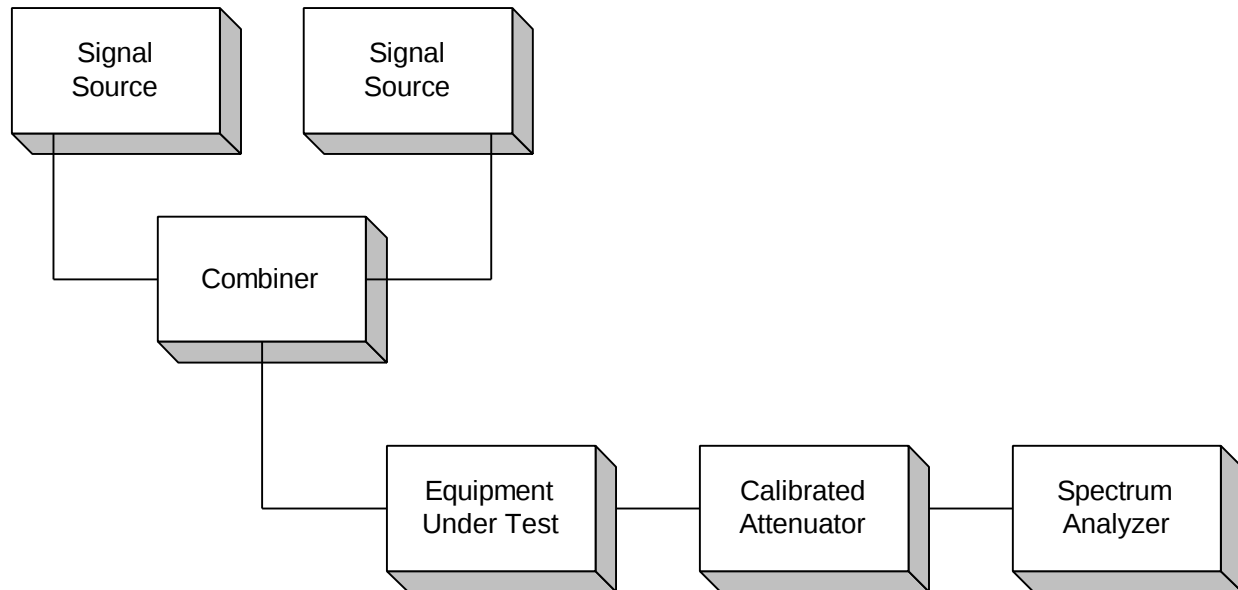


Para. No. 2.989 - Occupied Bandwidth

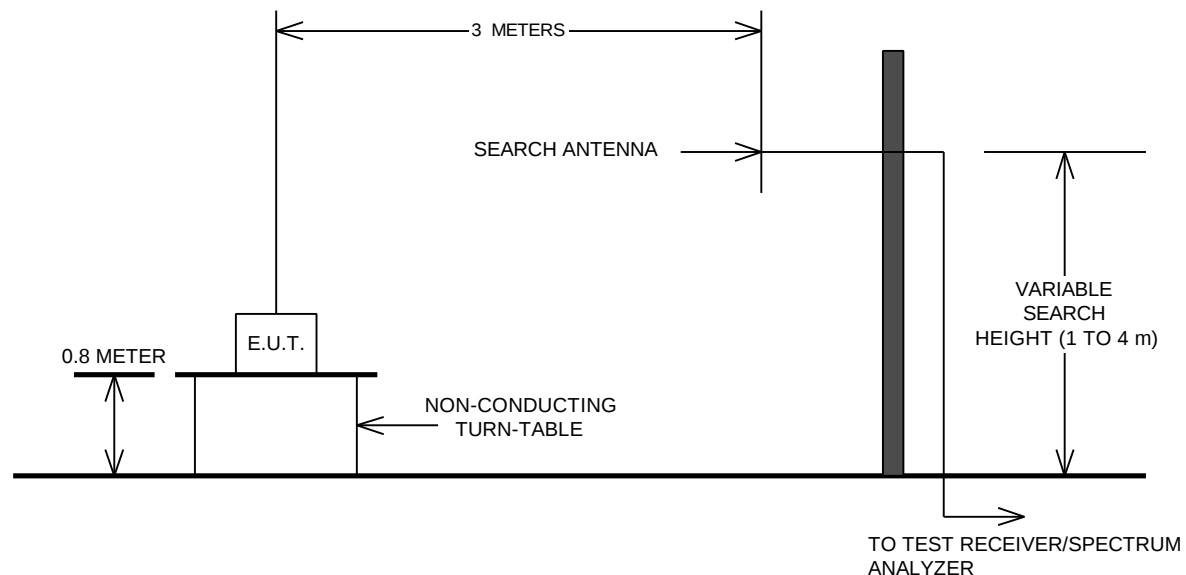


EQUIPMENT: UHF1

Para. No. 2.991 - Spurious Emissions at Antenna Terminals



Para. No. 2.993 - Field Strength of Spurious Radiation



Para. No. 2.995 - Frequency Stability

