

Nemko Test Report: 3L0498RUS3

Applicant: Andrew Corporation

**Equipment Under Test:
(E.U.T.)** Optical Repeater

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

Tested By: Nemko USA Inc.
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Lewisville, TX 75057-3136

Authorized By: 
Tom Tidwell, Frontline Manager

Date: 4/22/04

Total Number of Pages: 33

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EQUIPMENT: Optical Repeater**PROJECT NO.:** 3L0498R

Section 1. Summary of Test Results

Manufacturer: Andrew Corporation

Model No.: MMR Optical Master Unit MMR 8/19

Serial No.: 30 12

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.**

See " Summary of Test Data".

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EQUIPMENT: Optical Repeater**PROJECT NO.: 3L0498R**

Summary Of Test Data

NAME OF TEST	PARA. NO.	SPEC.	MEAS.	RESULT
RF Power Output	90.205		39.02	Complies
Audio Frequency Response	TIA EIA-603.3.2.6	N/A	N/A	N/A
Audio Low-Pass Filter Response	TIA EIA-603.3.2.6	N/A	N/A	N/A
Modulation Limiting	TIA EIA-603.3.2.6	N/A	N/A	N/A
Occupied Bandwidth	90.210	Plots	Plots	Complies
Spurious Emissions at Antenna Terminals	90.210	-13 dBm	Plots	Complies
Field Strength of Spurious Emissions	90.210	-13 dBm E.R.P.	E.R.P.	Complies
Frequency Stability	90.213			Complies
Transient Frequency Behavior	90.214	N/A	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.

Indoor Temperature: _____ 21°C
 Humidity: _____ 51%

Outdoor Temperature: _____ 19 °C
 Humidity: _____ 65 %

.

EQUIPMENT: Optical Repeater

PROJECT NO.: 3L0498R

Section 2. General Equipment Specification**Transmitter**

Supply Voltage Input: 115V AC

Frequency Range: 451-466MHz

Tunable Bands: 451-466MHz

20 dB Passband:

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

Maximum Input: +20dBm

Output Impedance: NA

RF Power Output (rated):	Single:	39dBm
	Composite:	34dBm

Frequency Translation:	F1-F1	F1-F2	N/A
	☐	☐	☒

Band Selection:	Software	Duplexer Change	Fullband Coverage
	☐	☐	☒

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FCC PART 90, SUBPART I
PRIVATE LAND MOBILE REPEATER

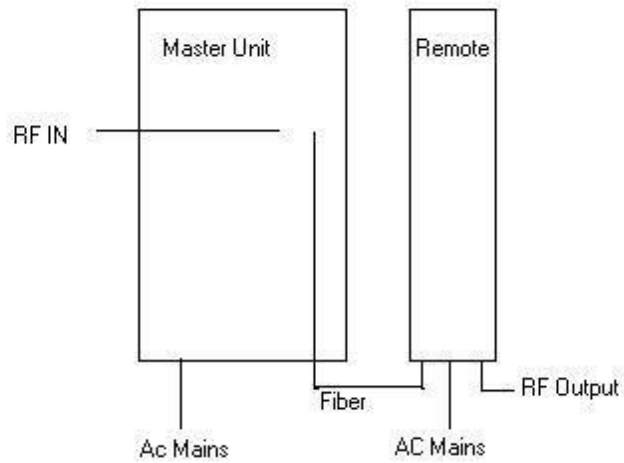
EQUIPMENT: **Optical Repeater**

PROJECT NO.: **3L0498R**

Modifications Made During Testing

No Modifications made during testing

System Diagram



EQUIPMENT: Optical Repeater**PROJECT NO.:** 3L0498R

Section 3. RF Power Output

NAME OF TEST: RF Power Output	PARA. NO.: 2.985
TESTED BY: Dustin Oaks	DATE: 12/17/2003

Test Results: Complies**Measurement Data:**

Frequency (MHz)	Measured Power (dBm)	Rated Power (dBm)	Measured/Rated (dB)
851.0125	39.02	39	+0.02
865.9875	39.01	39	+0.01

Equipment Used: 1036, 1625, 1629, 1604, 1474, 1053**Measurement Uncertainty:** +/- 1.6 dB**Temperature:** 21 °C**Relative Humidity:** 51 %

EQUIPMENT: **Optical Repeater**PROJECT NO.: **3L0498R**

Section 4. Occupied Bandwidth

NAME OF TEST: Occupied Bandwidth	PARA. NO.: 2.989
TESTED BY: Dustin Oaks	DATE: 12/18/2003

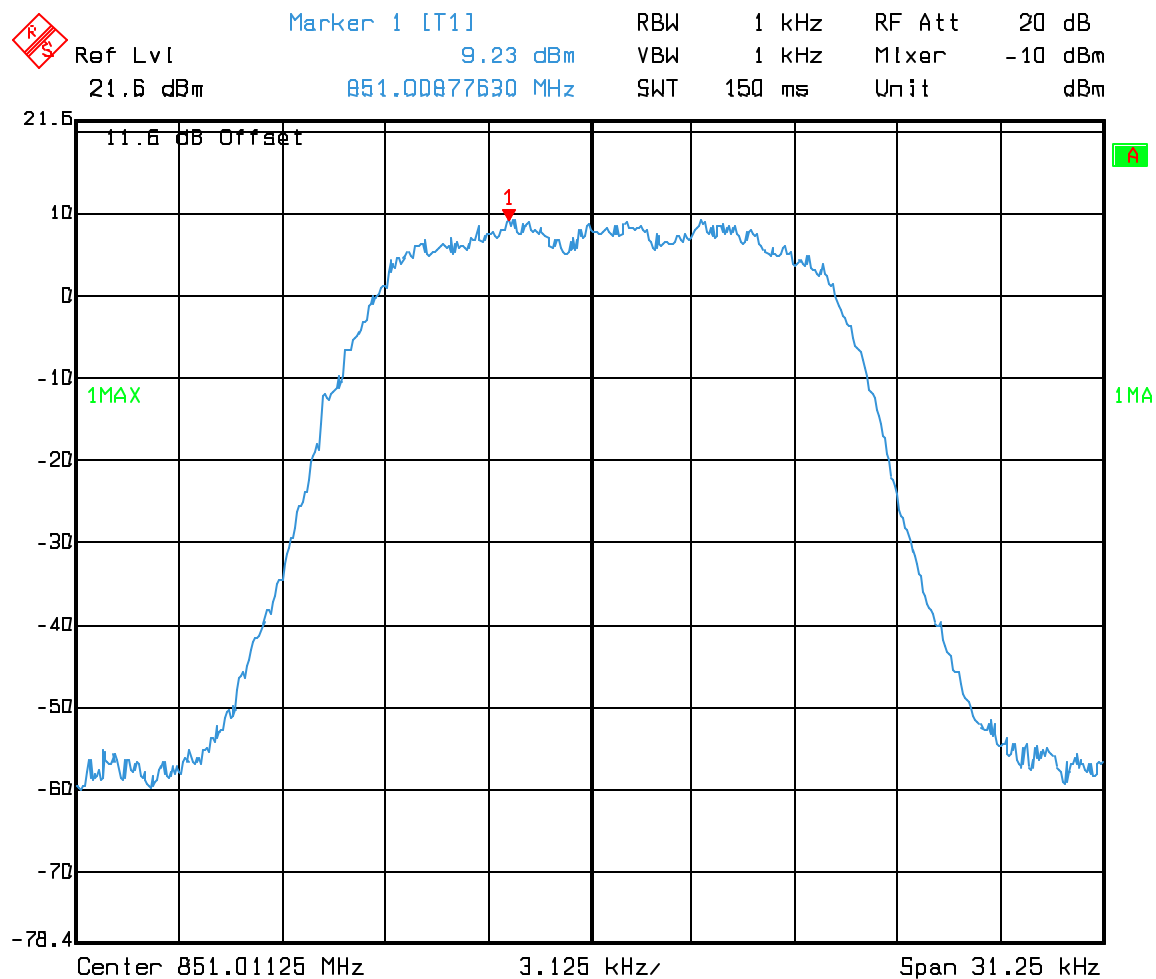
Test Results: Complies**Test Data:** See attached graph(s).**Equipment Used:** 1036, 1625, 1629, 1604, 1474, 1053**Measurement Uncertainty:** +/- 1.6 dB**Temperature:** 21 ?C**Relative Humidity:** 51 %

EQUIPMENT: Optical Repeater

PROJECT NO.: 3L0498R

Band Width and Input/Output

Input

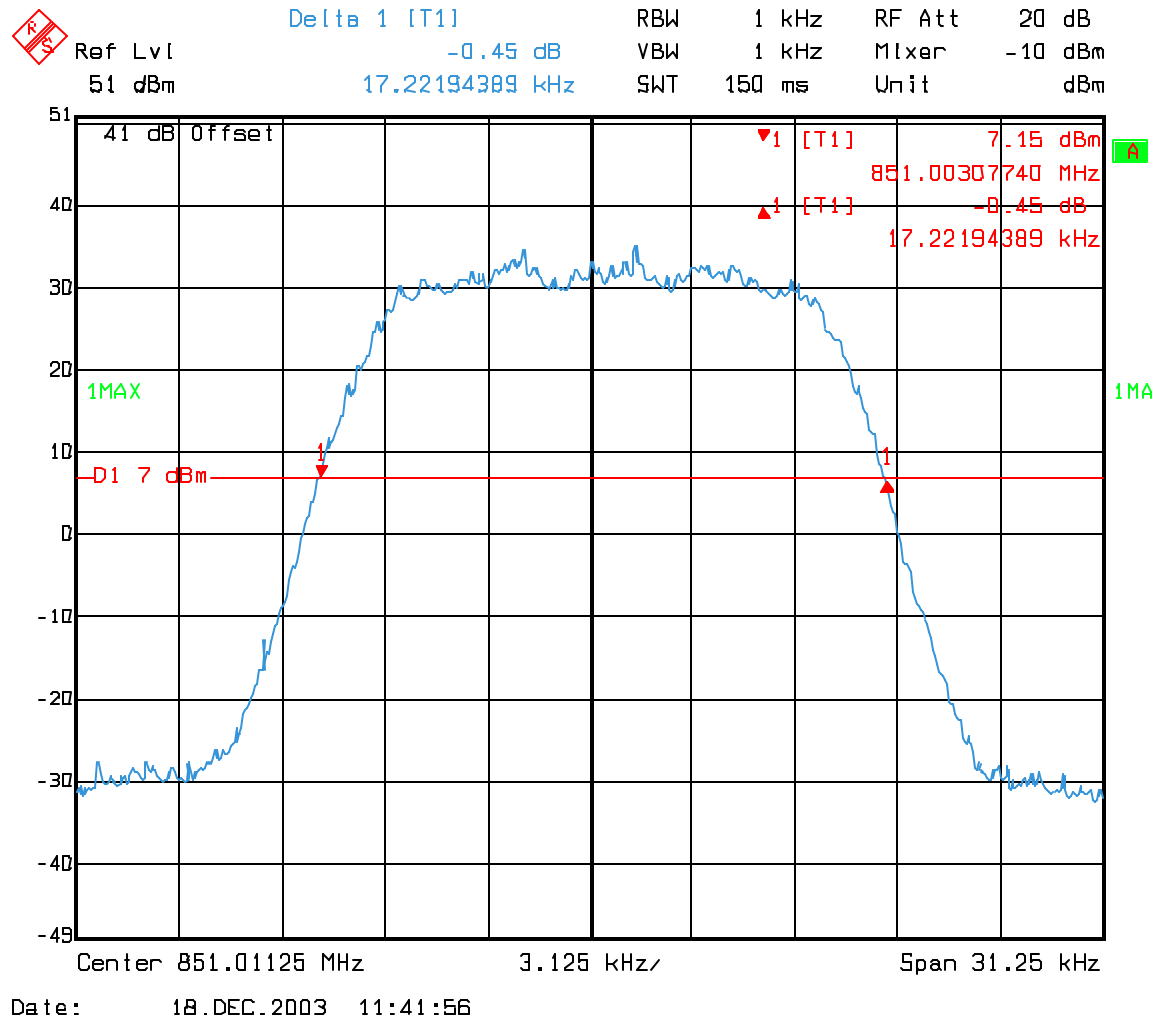


Date: 18.DEC.2003 11:45:22

EQUIPMENT: Optical Repeater

PROJECT NO.: 3L0498R

Output



EQUIPMENT: Optical Repeater

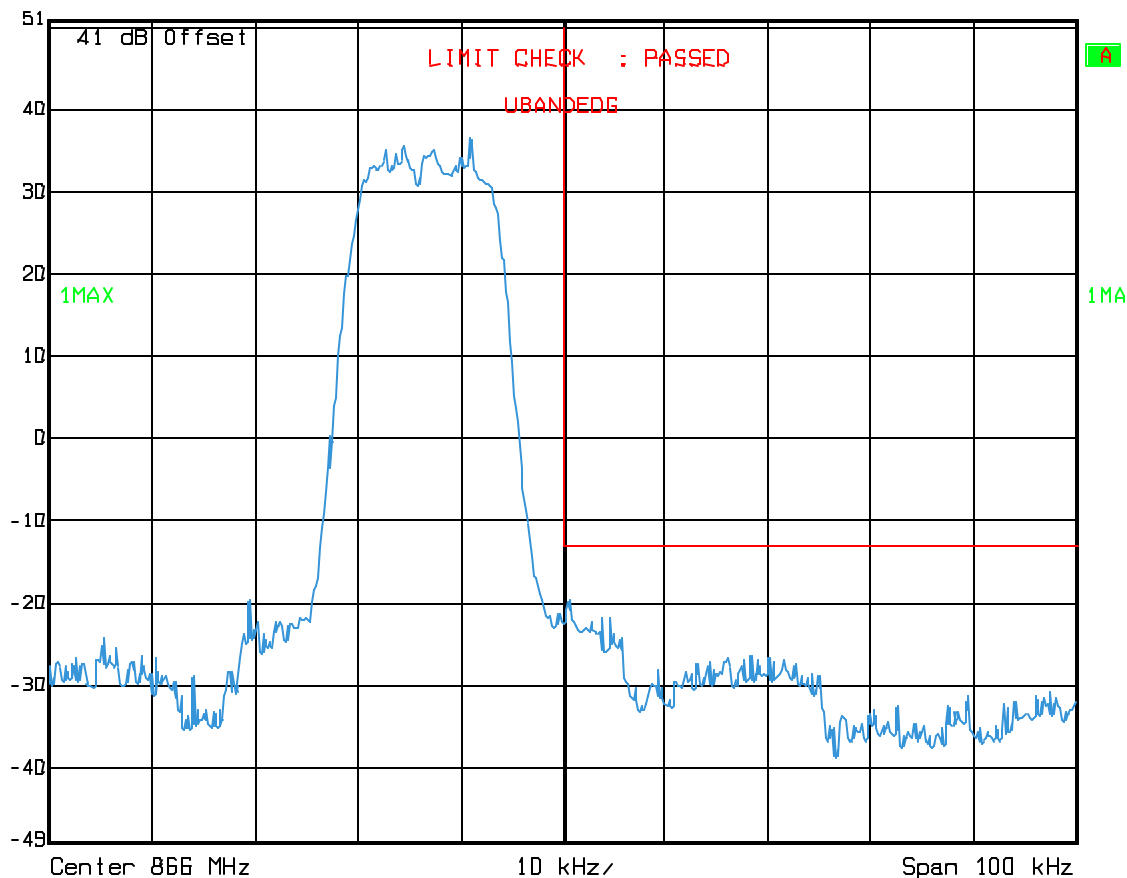
PROJECT NO.: 3L0498R

Upper



Ref Lvl
51 dBm

RBW	1 kHz	RF Att	20 dB
VBW	1 kHz	Mixer	-10 dBm
SWT	250 ms	Unit	dBm



Date: 18.DEC.2003 12:01:11

EQUIPMENT: Optical Repeater

PROJECT NO.: 3L0498R

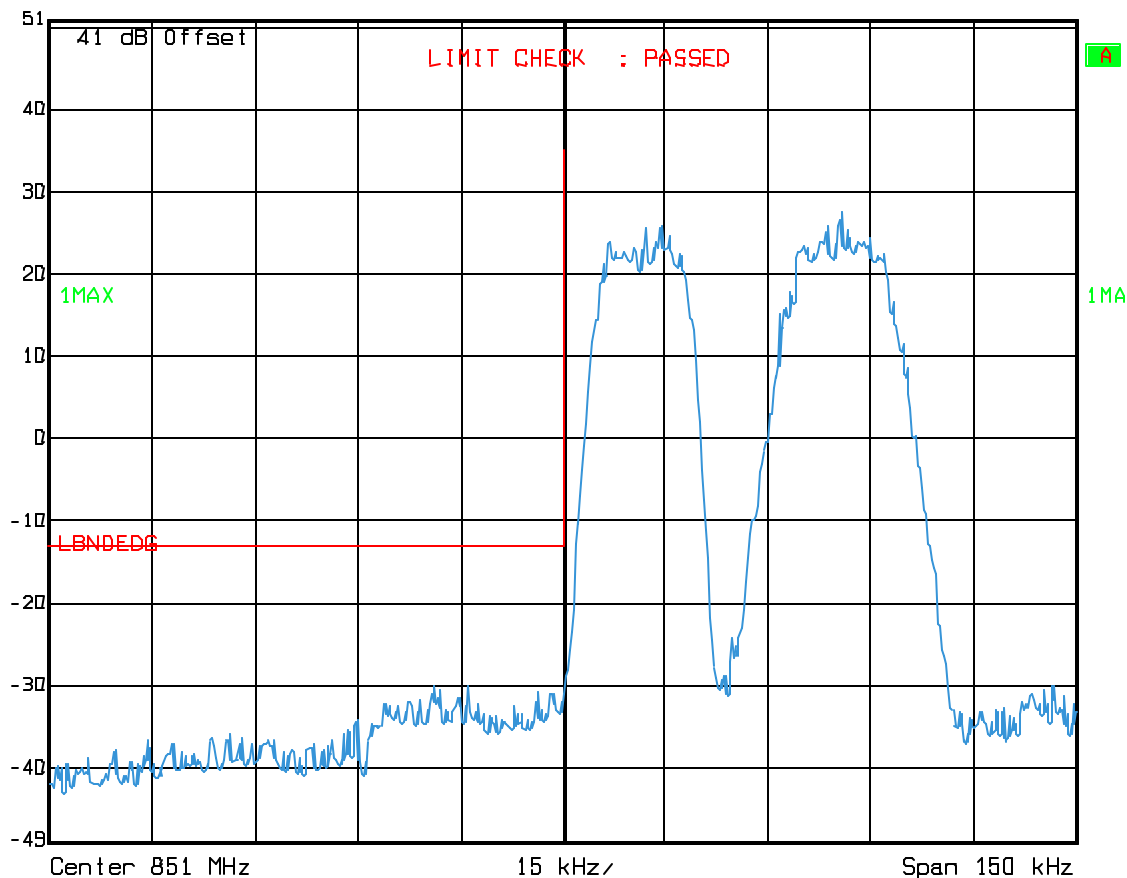
Intermodulation

Lower



Ref Lvl
51 dBm

RBW	1 kHz	RF Att	20 dB
VBW	1 kHz	Mixer	-10 dBm
SWT	380 ms	Unit	dBm



Date: 18.DEC.2003 11:55:53

EQUIPMENT: Optical Repeater

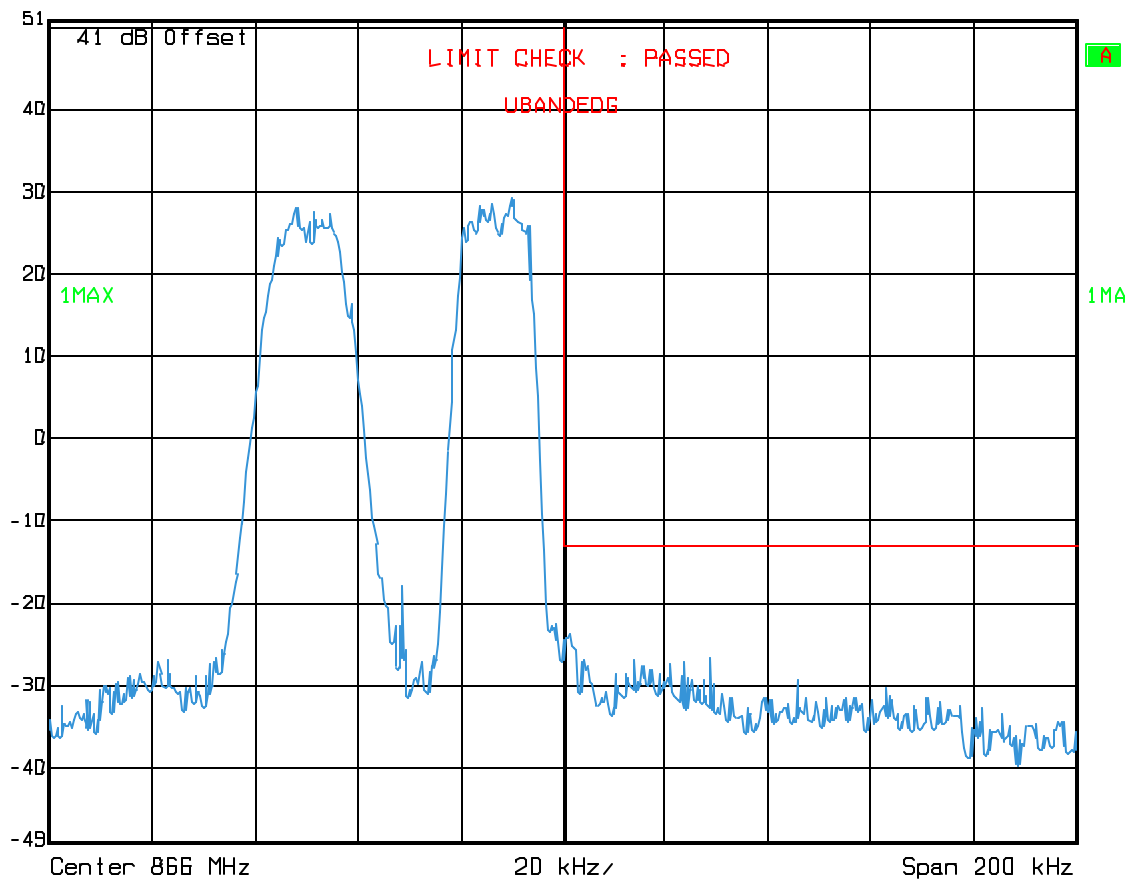
PROJECT NO.: 3L0498R

Upper



Ref Lvl
51 dBm

RBW 1 kHz RF Att 20 dB
VBW 1 kHz Mixer -10 dBm
SWT 500 ms Unit dBm



Date: 18.DEC.2003 12:03:28

EQUIPMENT: Optical Repeater

PROJECT NO.: 3L0498R

Section 5. Spurious Emissions at Antenna Terminals

NAME OF TEST: Spurious Emissions @ Antenna Terminals	PARA. NO.: 2.991
TESTED BY: Dustin Oaks	DATE: 12/17/2003

Test Results: Complies

Test Data: See attached graph(s).

Equipment Used: 1036, 1625, 1629, 1604, 1474, 1053

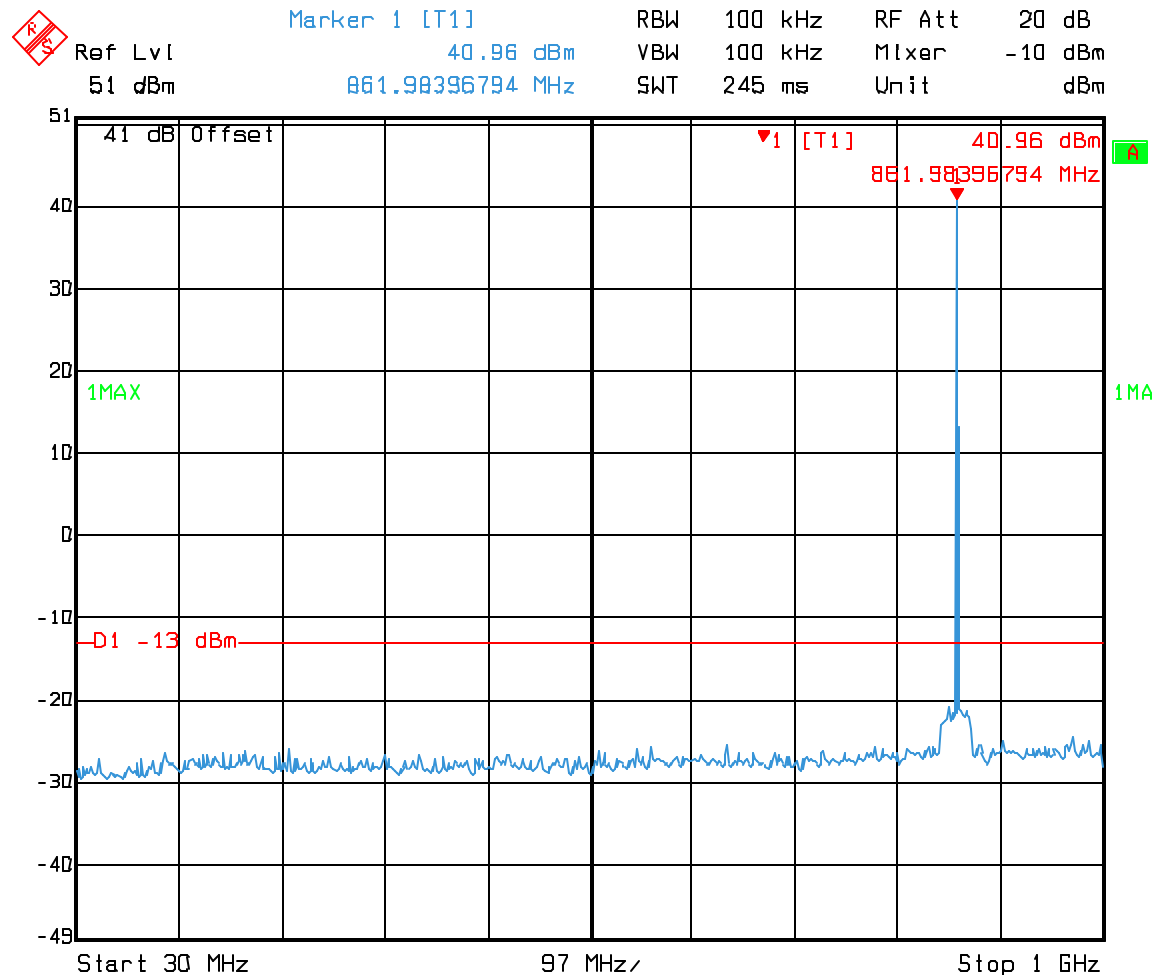
Measurement Uncertainty: +/- 1.6 dB

Temperature: 21 °C

Relative Humidity: 51 %

EQUIPMENT: Optical Repeater

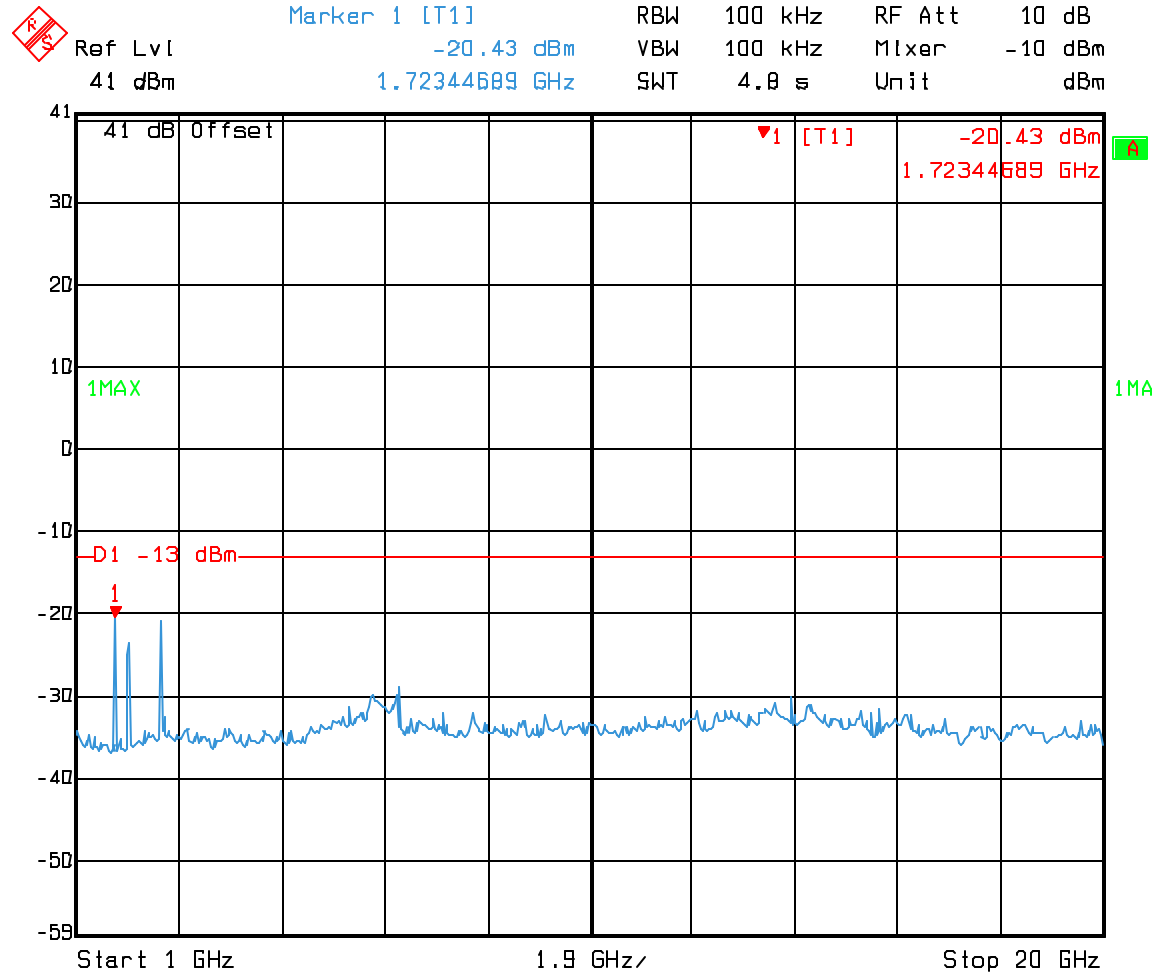
PROJECT NO.: 3L0498R



Date: 17.DEC.2003 13:10:03

EQUIPMENT: Optical Repeater

PROJECT NO.: 3L0498R



Date: 17.DEC.2003 13:11:32

EQUIPMENT: **Optical Repeater**PROJECT NO.: **3L0498R**

Section 6. Field Strength of Spurious Emissions

NAME OF TEST: Field Strength of Spurious Emissions

PARA. NO.: 2.993

TESTED BY: Dustin Oaks

DATE: 12/18/2003

Test Results: Complies**Test Data:** No Emissions found within 20dB of Limit. Noise from was greater than 20dB below limit. Frequency range scanned from 30MHz to 20GHz**Note:** See page A5 for applicable limit.**Equipment Used:** 1016, 1484, 1485, 1304, 791, 1480**Measurement Uncertainty:** +/- 3.6 dB**Temperature:** 21 °C**Relative Humidity:** 51 %

Photographs of Test Setup

FRONT VIEW



EQUIPMENT: **Optical Repeater**

PROJECT NO.: **3L0498R**

REAR VIEW



EQUIPMENT: **Optical Repeater**

PROJECT NO.: **3L0498R**

Section 7. Frequency Stability

NAME OF TEST: Frequency Stability	PARA. NO.: 2.995
TESTED BY:	DATE:

Test Results: Not Applicable.

Measurement Data: See attached tables.

EQUIPMENT: Optical Repeater

PROJECT NO.: 3L0498R

Section 8. Test Equipment List

Nemko ID	Description	Manufacturer Model Number	Serial Number	Calibration Date	Calibration Due
1036	SPECTRUM ANALYZER	ROHDE & SCHWARZ FSEK30	830844/006	12/18/01	12/19/03
1464	Spectrum analyzer	Hewlett Packard 8563E	3551A04428	02/11/03	02/11/05
1625	CABLE, 18 ft	MEGAPHASE 10311 1GVT4	N/A	03/05/03	03/04/04
1629	CABLE, 6 ft	MEGAPHASE 10311 1GVT4	N/A	CBU	N/A
1604	ATTENUATOR	NARDA 776B-20	NONE	N/A	N/A
1474	20db Attenuator DC 18 Ghz	MCL Inc. BW-S20W2	NONE	CBU	N/A
1053	SIGNAL GENERATOR	ROHDE & SCHWARZ SMIQ 03	DE22081	06/10/03	06/09/04
1016	Pre-Amp	HEWLETT PACKARD 8449A	2749A00159	08/28/03	08/28/04
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
1304	HORN ANTENNA	ELECTRO METRICS RGA-60	6151	09/22/03	09/22/05
791	PREAMP, 25dB	ICC LNA25	398	10/27/03	10/26/04
1480	Bilog Antenna	Schaffner-Chase CBL6111C	2572	CalNotReq	N/A

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FCC PART 90, SUBPART I
PRIVATE LAND MOBILE REPEATER

EQUIPMENT: **Optical Repeater**

PROJECT NO.: **3L0498R**

ANNEX A - TEST METHODOLOGIES

EQUIPMENT: Optical Repeater

PROJECT NO.: 3L0498R

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 $GP/4\pi R^2 = E^2/120$ 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

EQUIPMENT: **Optical Repeater**

PROJECT NO.: **3L0498R**

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

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

VBW: ? RBW

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

EQUIPMENT: Optical Repeater**PROJECT NO.: 3L0498R**

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: Optical Repeater

PROJECT NO.: 3L0498R

NAME OF TEST: Field Strength of Spurious

PARA. NO.: 2.993

Minimum Standard: Para. No. 90.210, see table 1 for applicable mask.**Calculation of Field Strength Limit**

An example of attenuation requirement of $50 + 10 \log P$ is equivalent to -20 dBm (1×10^{-5} Watts) at the antenna terminal. We determine the field strength limit by using the plane wave relation.

$$GP/4R^2 = E^2/120$$

For emissions ≤ 1 GHz:

G = 1.64 (Dipole Gain)

P = 10^{-5} Watts (Maximum spurious output power)

R = 3m (Measurement Distance)

$$E \leq \frac{\sqrt{30GP}}{R} = E \leq \frac{\sqrt{30 \times 1.64 \times 10^{-5}}}{3} \leq 0.00739 \text{ V/m} \leq 77.4 \text{ dB}\mu\text{V/m}$$

For emissions > 1 GHz:

G = 1 (Isotropic Gain)

P = 1×10^{-5} Watts (Maximum spurious output power)

R = 3m (Measurement Distance)

$$E \leq 77.4 - 20 \log \sqrt{1.64} \leq 75.2 \text{ dB}\mu\text{V/m@3m}$$

MASK	Spurious Limit	FS Limit Below 1 GHz	FS Limit Above 1 GHz
A,B,C,G,H,I	-13dBm	84.4 dB μ V/m@3m	82.2 dB μ V/m@3m
D,J	-20dBm	77.4 dB μ V/m@3m	75.2 dB μ V/m@3m
E,F,K	-25dBm	72.4 dB μ V/m@3m	70.2 dB μ V/m@3m

EQUIPMENT: Optical Repeater**PROJECT NO.: 3L0498R**

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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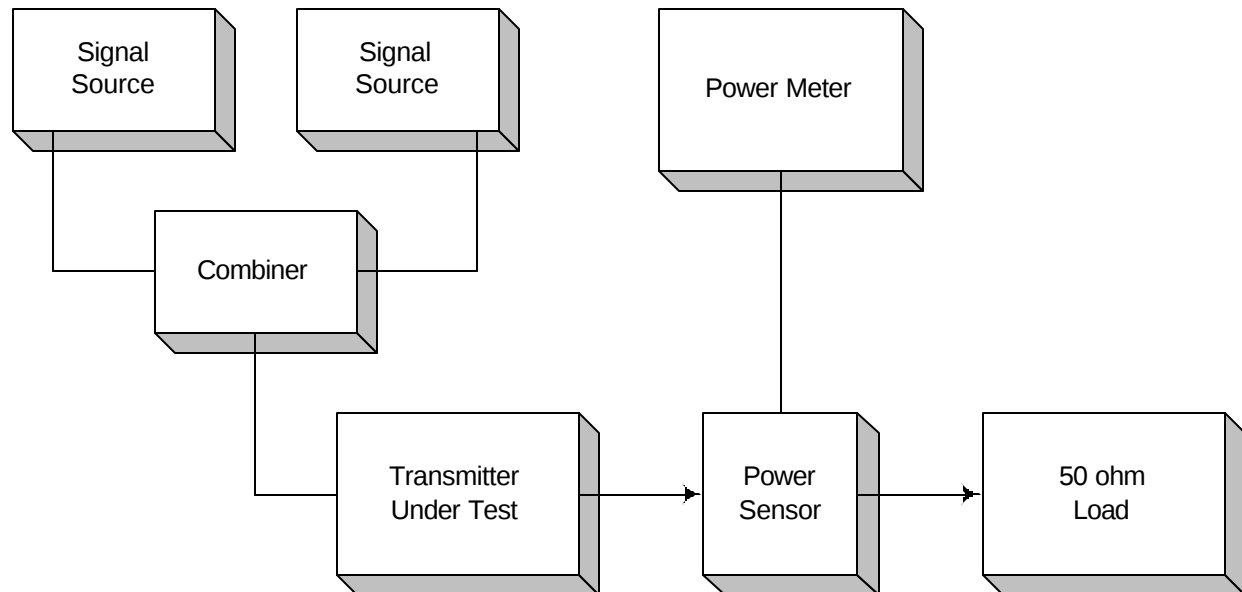
FCC PART 90, SUBPART I
PRIVATE LAND MOBILE REPEATER

EQUIPMENT: **Optical Repeater**

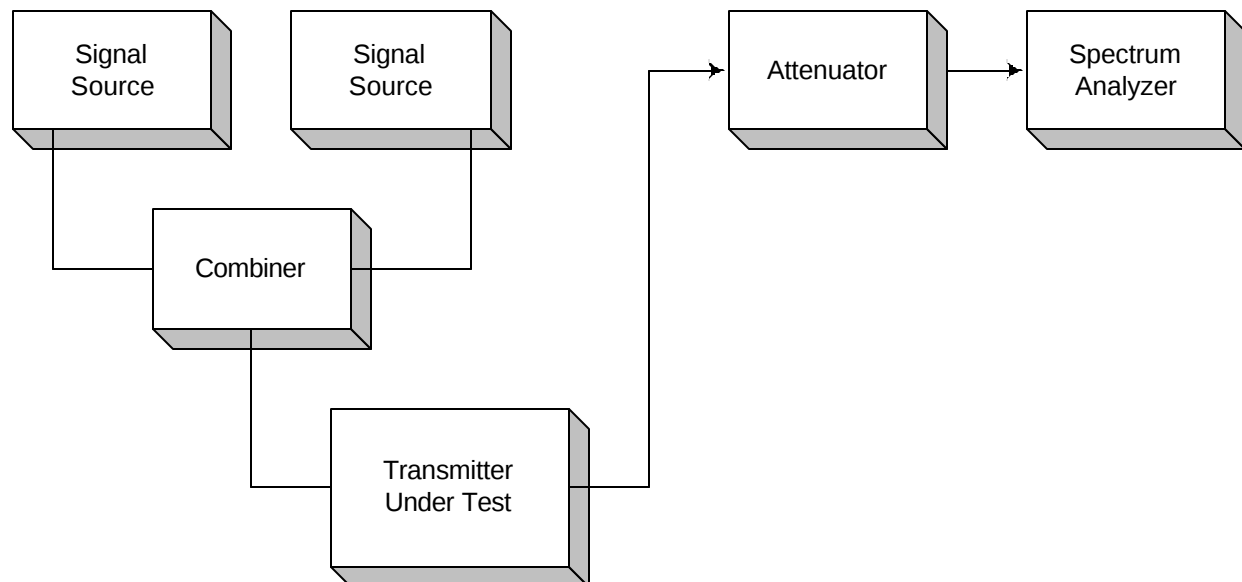
PROJECT NO.: **3L0498R**

ANNEX B - TEST DIAGRAMS

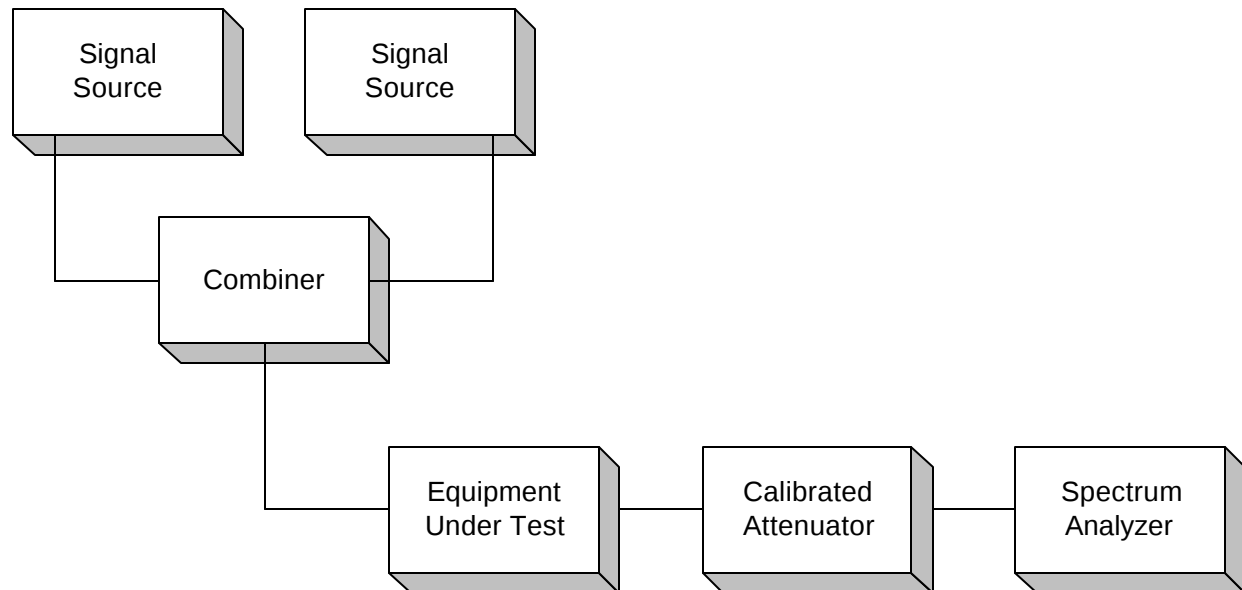
Para. No. 2.985 - R.F. Power Output



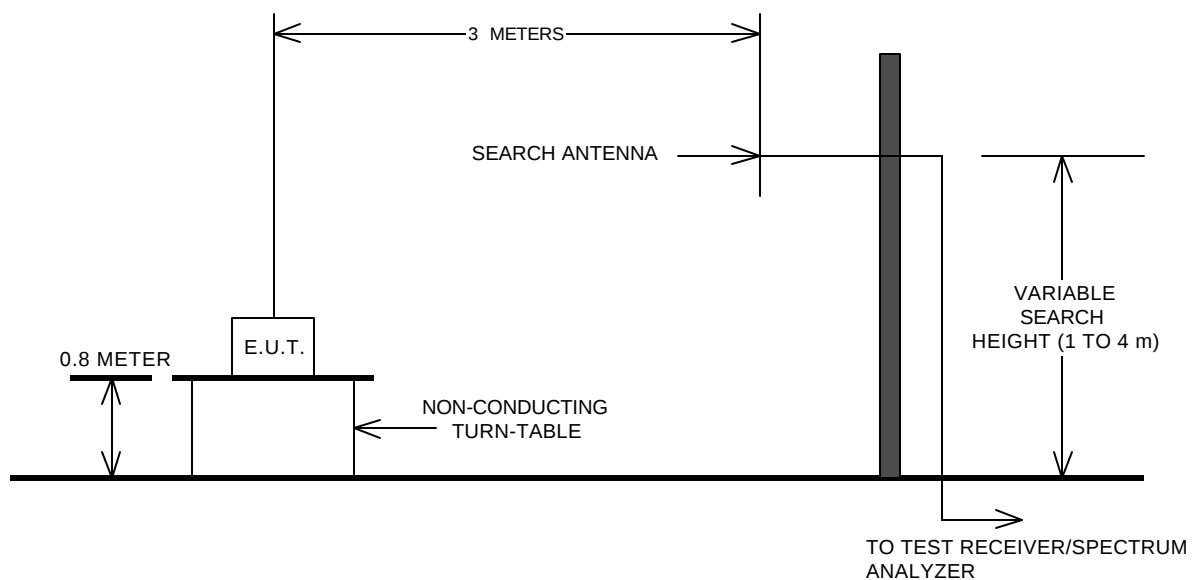
Para. No. 2.989 - Occupied Bandwidth



Para. No. 2.991 - Spurious Emissions at Antenna Terminals



Para. No. 2.993 - Field Strength of Spurious Radiation



Para. No. 2.995 - Frequency Stability

