

Nemko Test Report: 3L0498RUS2

Applicant: Andrew Corporation

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

In Accordance With: **FCC Part 22, Subpart H**
Cellular Band Repeaters

Tested By: Nemko USA Inc.
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Lewisville, TX
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Authorized By:



Tom Tidwell, Frontline Manager

Date: 4/22/04

Total Number of Pages: 52

EQUIPMENT: **Optical Repeater**

PROJECT NO.: **3L0498R**

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

Section 1. Summary of Test ResultsManufacturer: **Andrew Corporation**Model No.: **MMR Optical Master Unit** **MMR 8A/19**Serial No.: **30** **14**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 22, Subpart H.



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	22.913(a)	500W	16.6W	Complies
Occupied Bandwidth	22.917(c)	Input/Output	Complies	Complies
Spurious Emissions at Antenna Terminals	22.917	-13 dBm	Complies	Complies
Field Strength of Spurious Emissions	22.917	-13 dBm E.I.R.P.	Complies	Complies
Frequency Stability	22.355	1.5 ppm		Complies

Footnotes:

Measurement uncertainty for each test configuration is expressed to 95% probability.

.

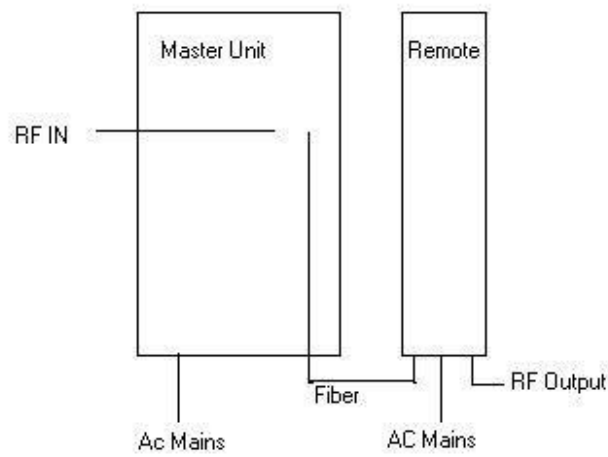
EQUIPMENT: **Optical Repeater**PROJECT NO.: **3L0498R****Section 2. General Equipment Specification**

Supply Voltage Input:	115V AC		
Frequency Range:	Downlink:	869 – 894 MHz	
Frequency Range:	Uplink:	NA	
Type of Modulation and Designator:	CDMA (F9W) ☒	GSM (GXW) ☐	NADC (DXW) ☒
	CDPD (F9W) ☐	AMPS (F8W, F1D) ☒	
Output Impedance:	50 ohms		
Max Input Power:	+20 dBm		
RF Output (Rated): (Per Carrier)	Downlink:	CDMA 34 dBm (2 Carriers) NADC 36 dBm (2 Carriers) AMPS 39 dBm (2 Carriers)	
	Uplink:	Per Channel: NA W Total: NA W	
Frequency Translation:	F1-F1 ☐	F1-F2 ☐	N/A ☒
Band Selection:	Software ☐	Duplexer Change ☐	Fullband Coverage ☒

EQUIPMENT: **Optical Repeater**

PROJECT NO.: **3L0498R**

System Diagram



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

Section 3. RF Power Output

NAME OF TEST: RF Power Output	PARA. NO.: 2.1046
TESTED BY: Dustin Oaks	DATE: 12/17/2003

Test Results: Complies.**Test Data:**

	Modulation Type	Power Output (dBm)	
Uplink	AMPS	NA	
Downlink	AMPS	39.99	
Uplink	CDMA	NA	
Downlink	CDMA	39.06	
Uplink	NADC	NA	
Downlink	NADC	42.21	

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.: 2.1049
TESTED BY: Dustin Oaks	DATE: 12/18/2003

Test Results: **Complies.**

Test Data: **See attached plots**

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

Measurement Uncertainty: **+/- 1.6** dB

Temperature: **21** °C

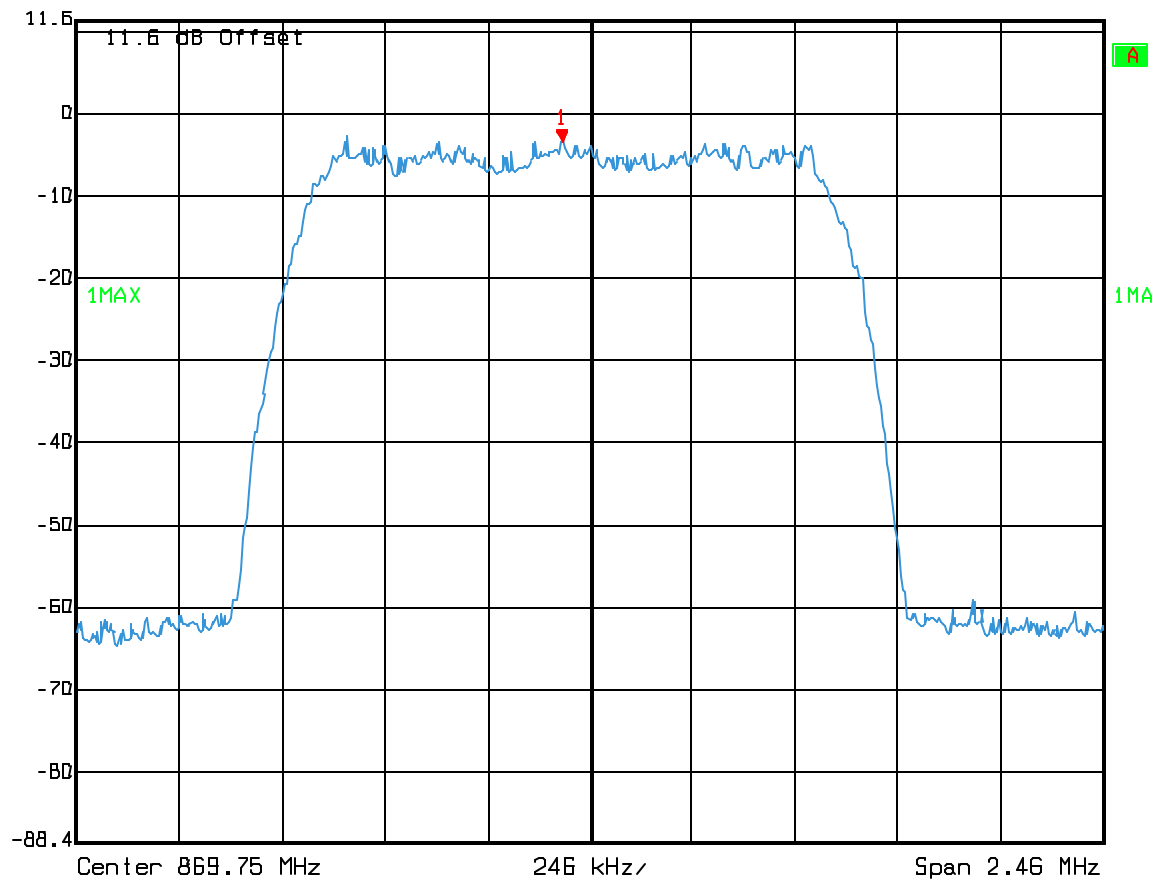
Relative Humidity: **51** %

EQUIPMENT: **Optical Repeater**PROJECT NO.: **3L0498R****Occupied Band Width / Input Output Plots**

CDMA Input



Ref Lvl	11.6 dBm	Marker 1 [T1]	869.68344689 MHz	RBW	30 kHz	RF Att	10 dB
				VBW	30 kHz	Mixer	-10 dBm
				SWT	7 ms	Unit	dBm

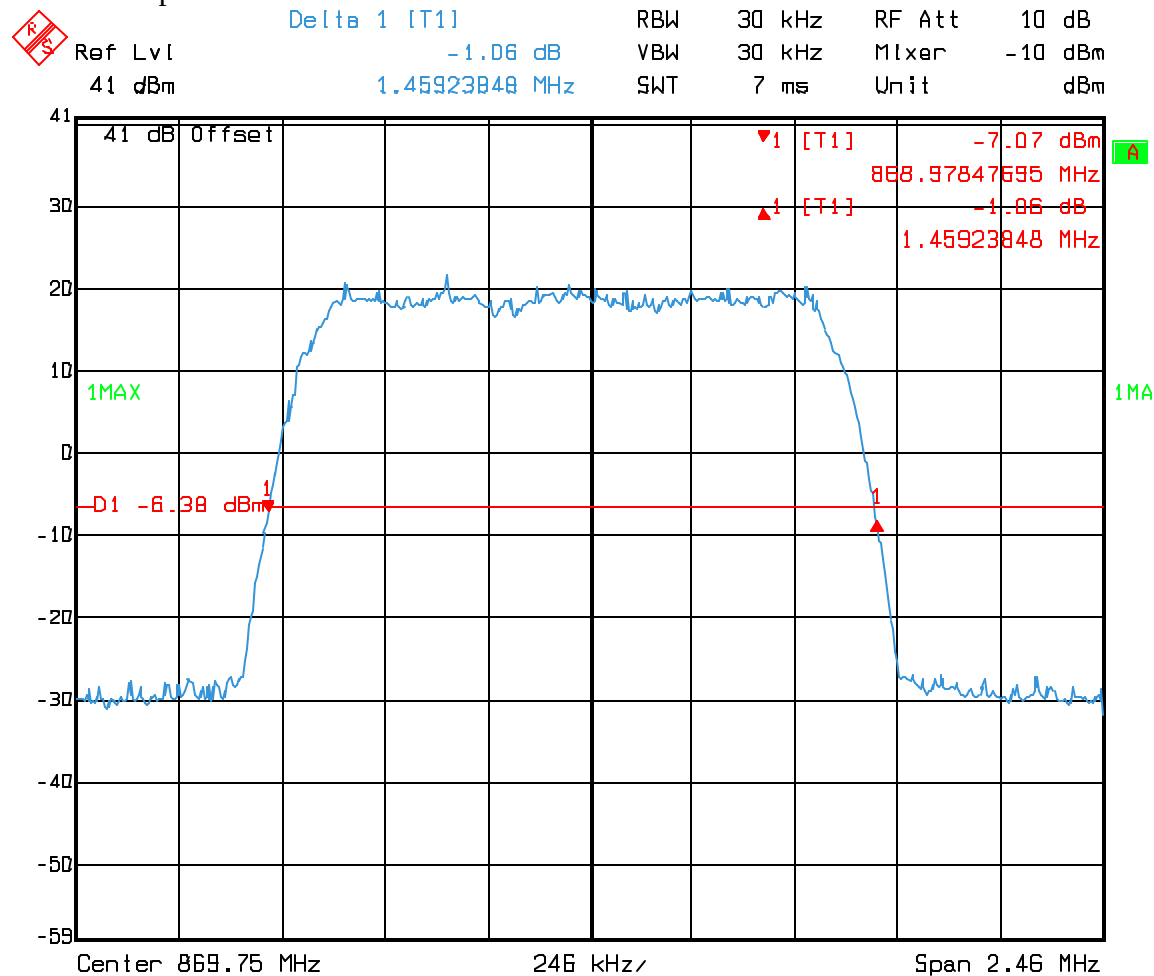


Date: 17.DEC.2003 17:09:13

EQUIPMENT: **Optical Repeater**

PROJECT NO.: **3L0498R**

CDMA Output



Date: 17.DEC.2003 17:05:12

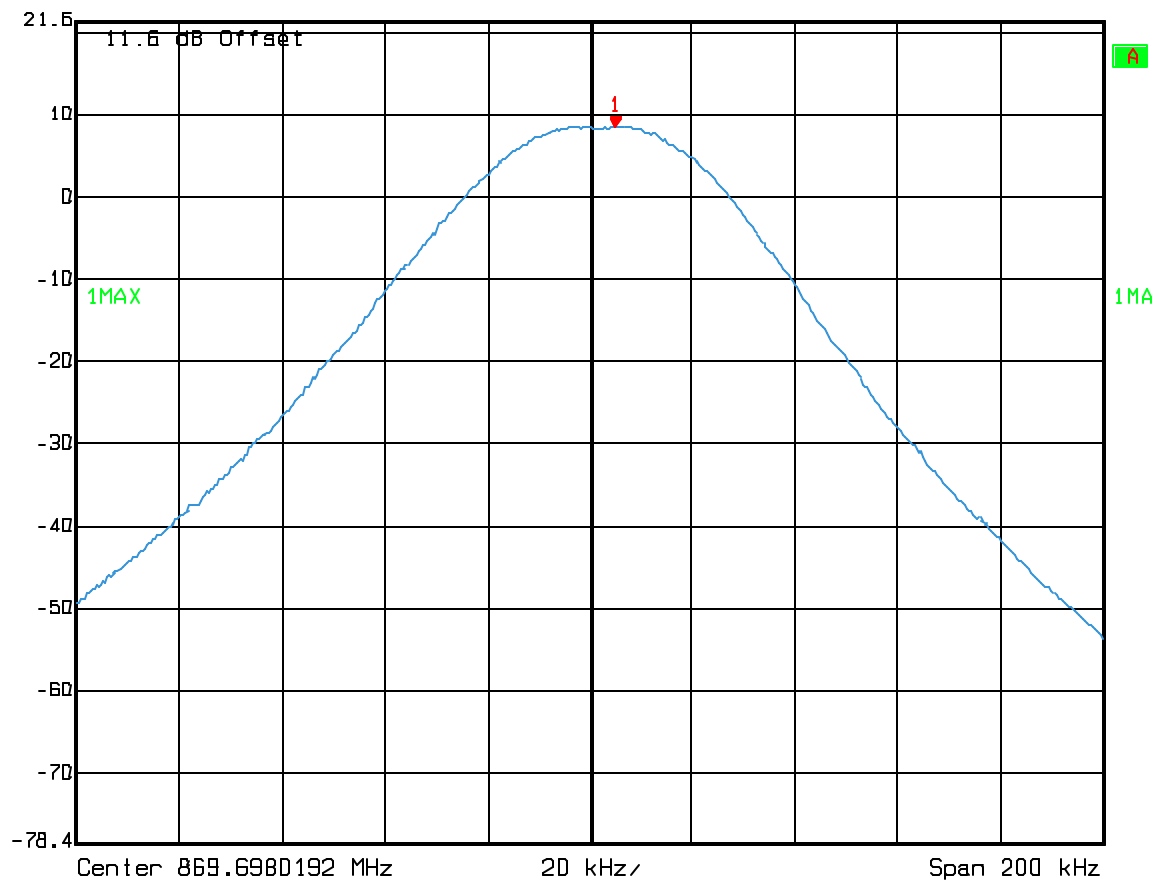
EQUIPMENT: **Optical Repeater**

PROJECT NO.: **3L0498R**

TDMA Input



Ref Lvl	Marker 1 [T1]	RBW	20 kHz	RF Att	30 dB
21.6 dBm	8.55 dBm	VBW	20 kHz	Mixer	-10 dBm
	869.70302926 MHz	SWT	7.5 ms	Unit	dBm

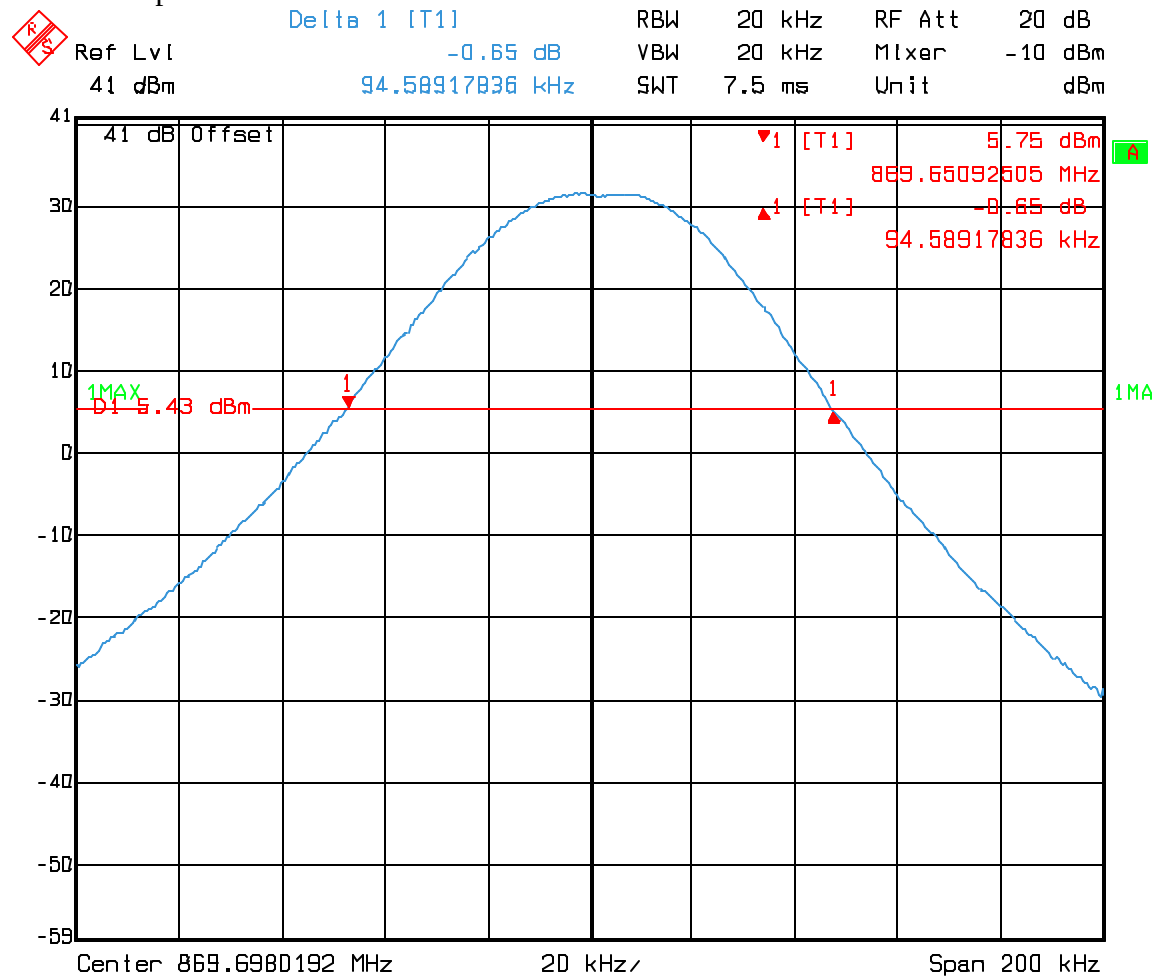


Date: 17.DEC.2003 18:16:05

EQUIPMENT: **Optical Repeater**

PROJECT NO.: **3L0498R**

TDMA Output

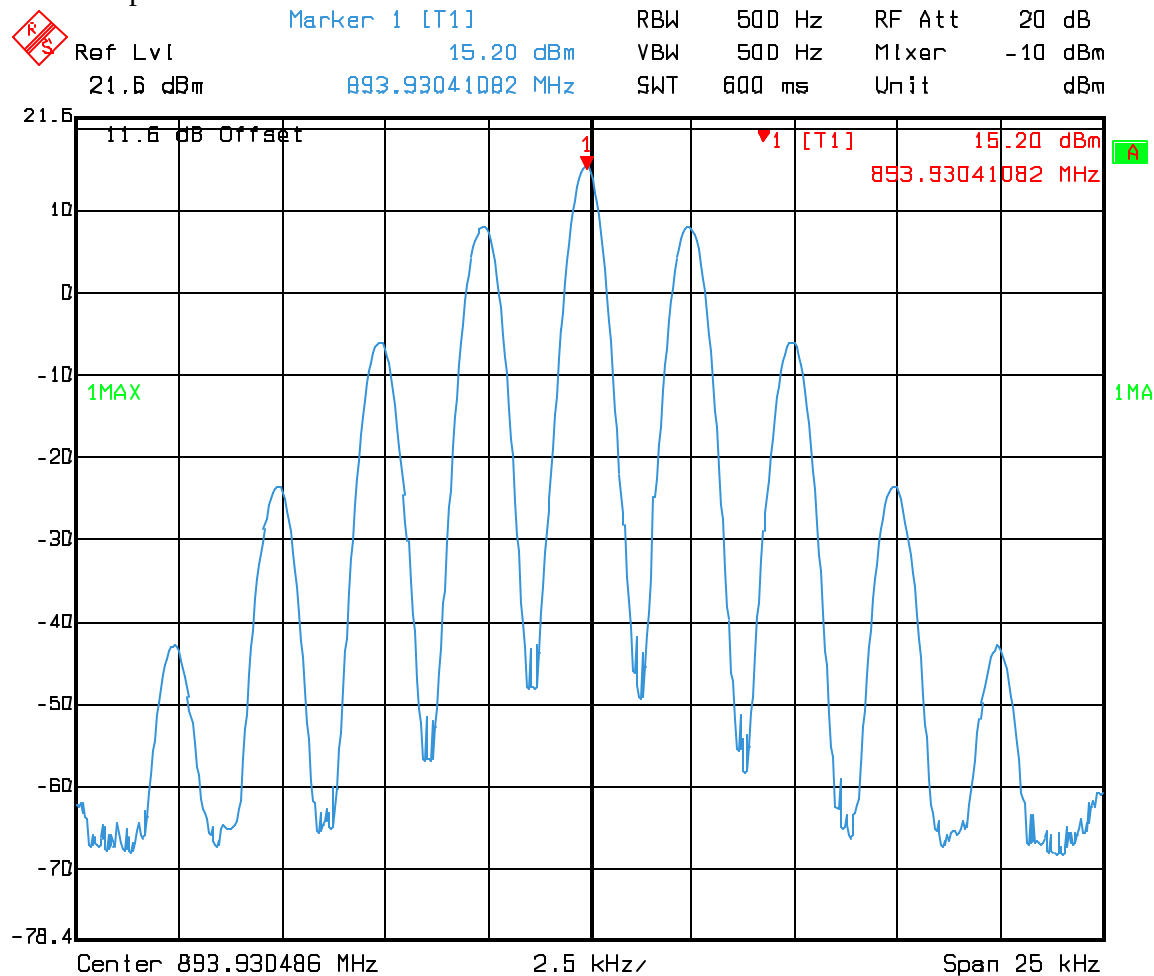


Date: 17.DEC.2003 18:13:53

EQUIPMENT: **Optical Repeater**

PROJECT NO.: **3L0498R**

AMPS Input

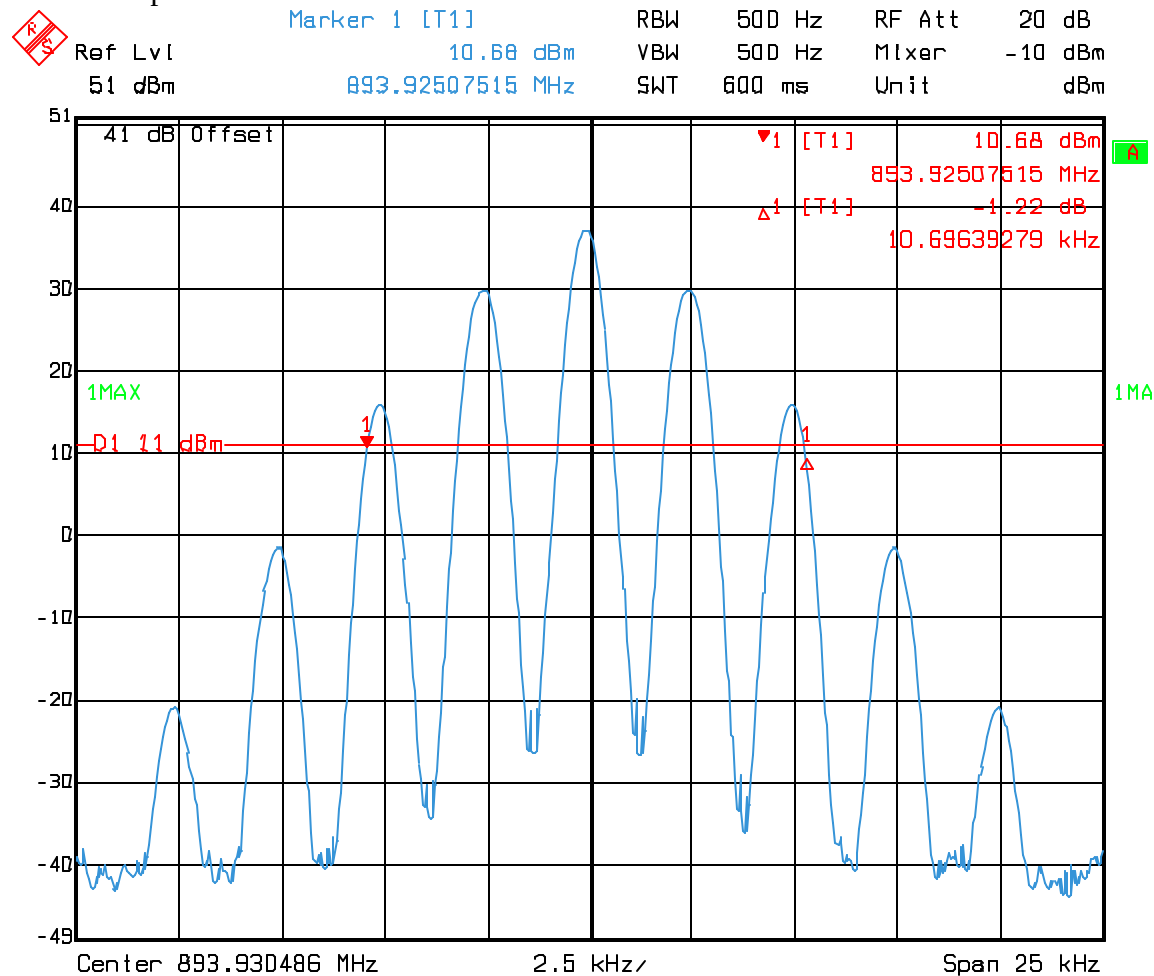


Date: 18.DEC.2003 09:16:46

EQUIPMENT: **Optical Repeater**

PROJECT NO.: **3L0498R**

AMPS Output



Date: 18.DEC.2003 09:14:19

EQUIPMENT: **Optical Repeater**

PROJECT NO.: **3L0498R**

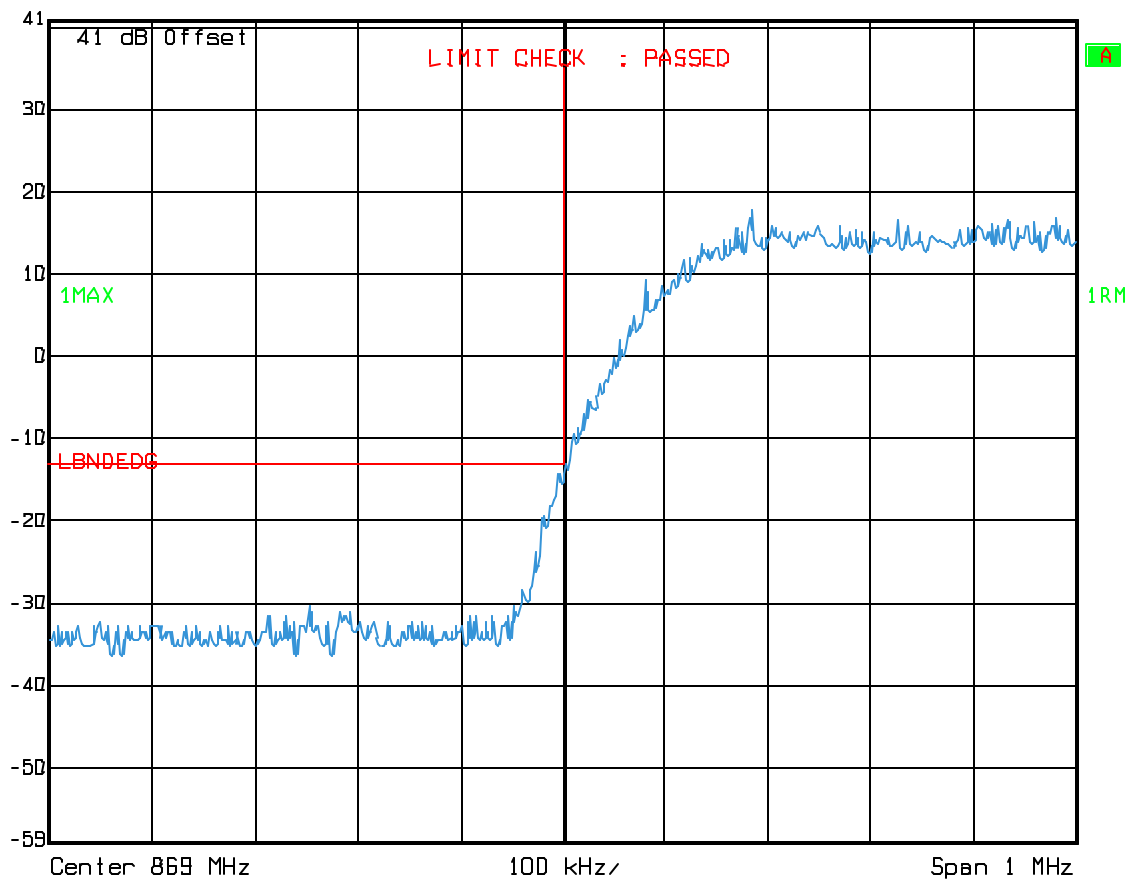
Band Edge

CDMA LOWER 869.73Mhz (Full Power)



Ref Lvl
41 dBm

RBW	20 kHz	RF Att	20 dB
VBW	20 kHz	Mixer	-10 dBm
SWT	7.5 ms	Unit	dBm



Date: 17.DEC.2003 17:38:20

EQUIPMENT: **Optical Repeater**

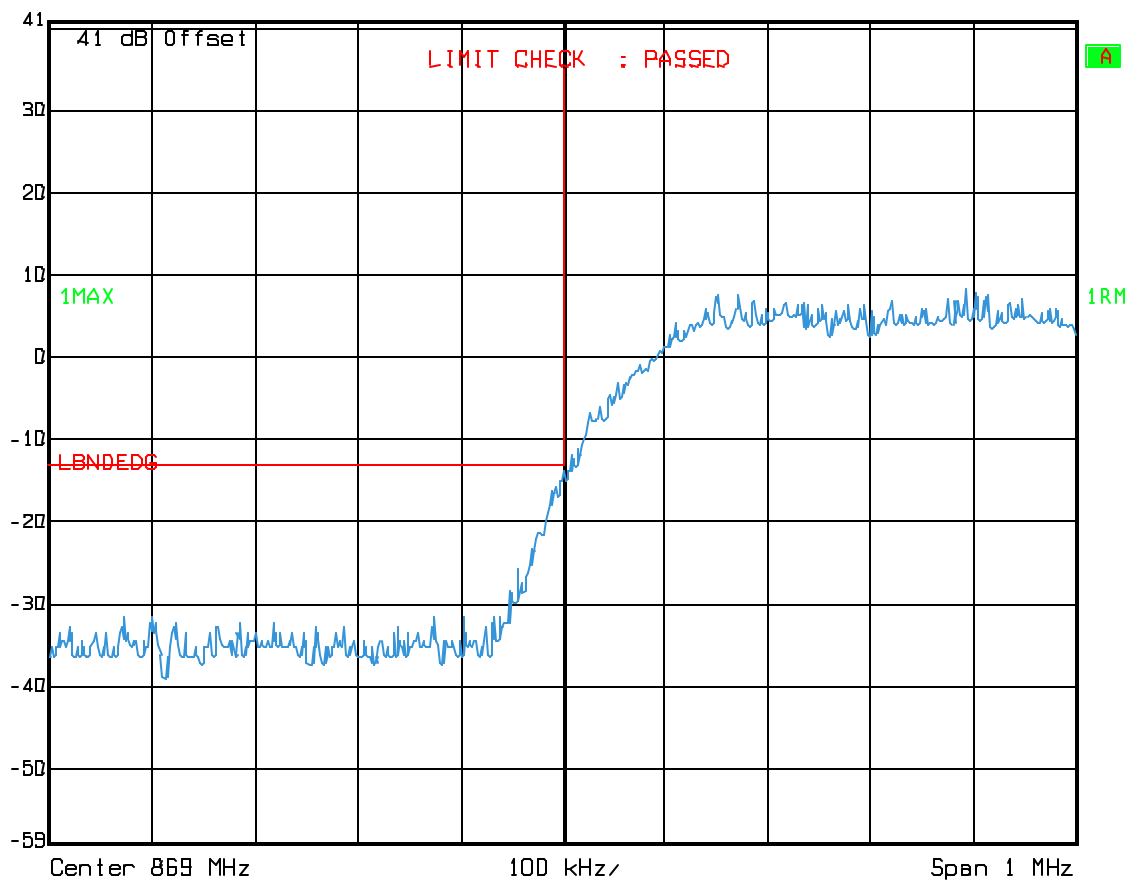
PROJECT NO.: **3L0498R**

869.70Mhz (Power reduced to 25.57dBm)



Ref Lvl
41 dBm

RBW	20 kHz	RF Att	20 dB
VBW	20 kHz	Mixer	-10 dBm
SWT	7.5 ms	Unit	dBm



Date: 17.DEC.2003 17:37:14

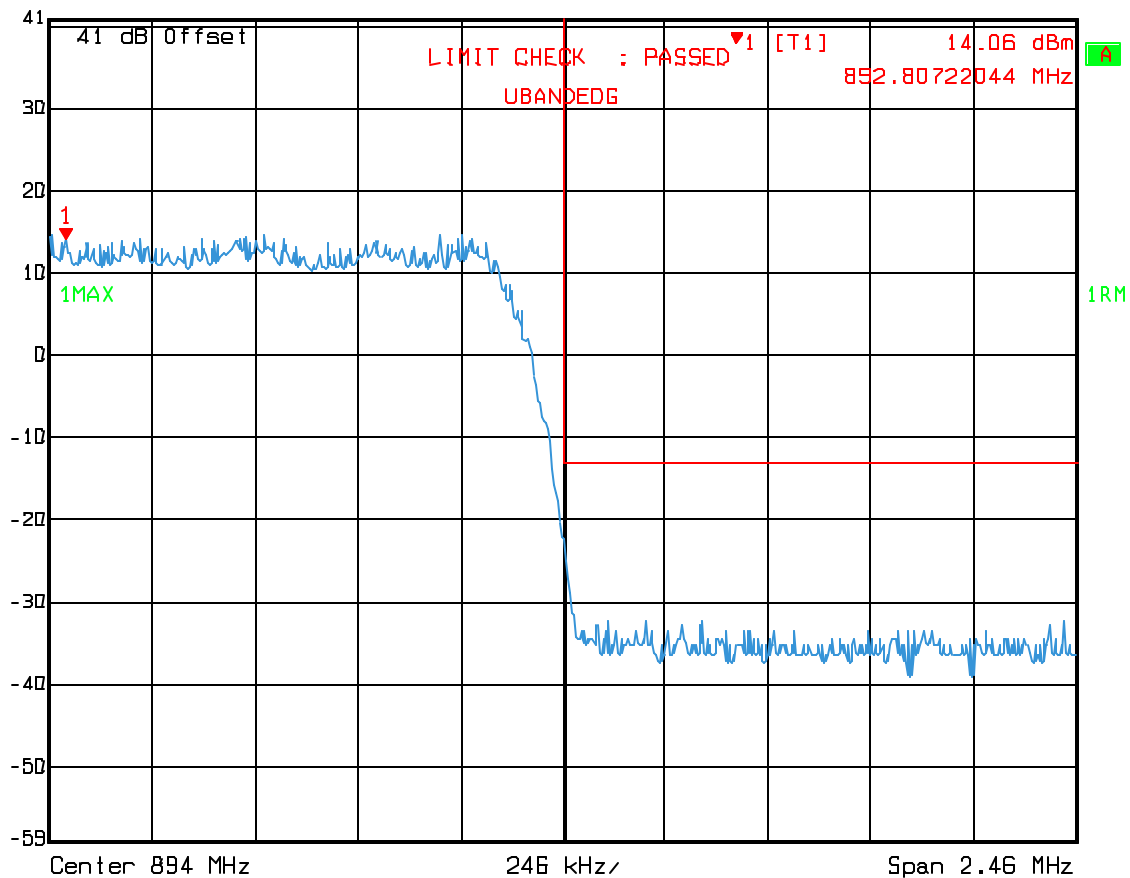
EQUIPMENT: **Optical Repeater**

PROJECT NO.: **3L0498R**

CDMA UPPER (893.25MHz, Full Power)



Ref Lvl	Marker 1 [T1]	RBW	20 kHz	RF Att	20 dB
41 dBm	14.06 dBm	VBW	20 kHz	Mixer	-10 dBm
	892.80722044 MHz	SWT	15.5 ms	Unit	dBm

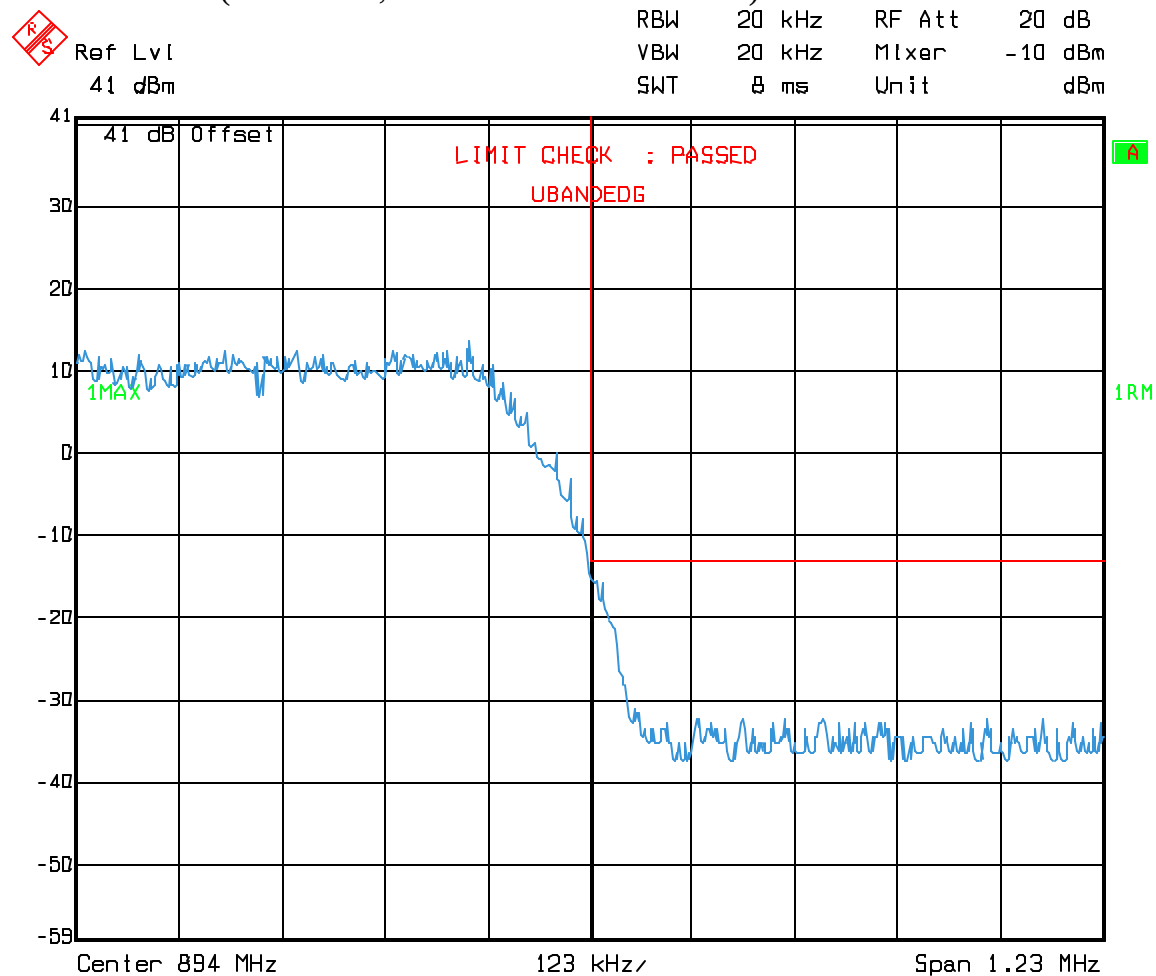


Date: 17.DEC.2003 18:04:14

EQUIPMENT: **Optical Repeater**

PROJECT NO.: **3L0498R**

CDMA UPPER (893.28MHz, Power reduced to 30.64dBm)

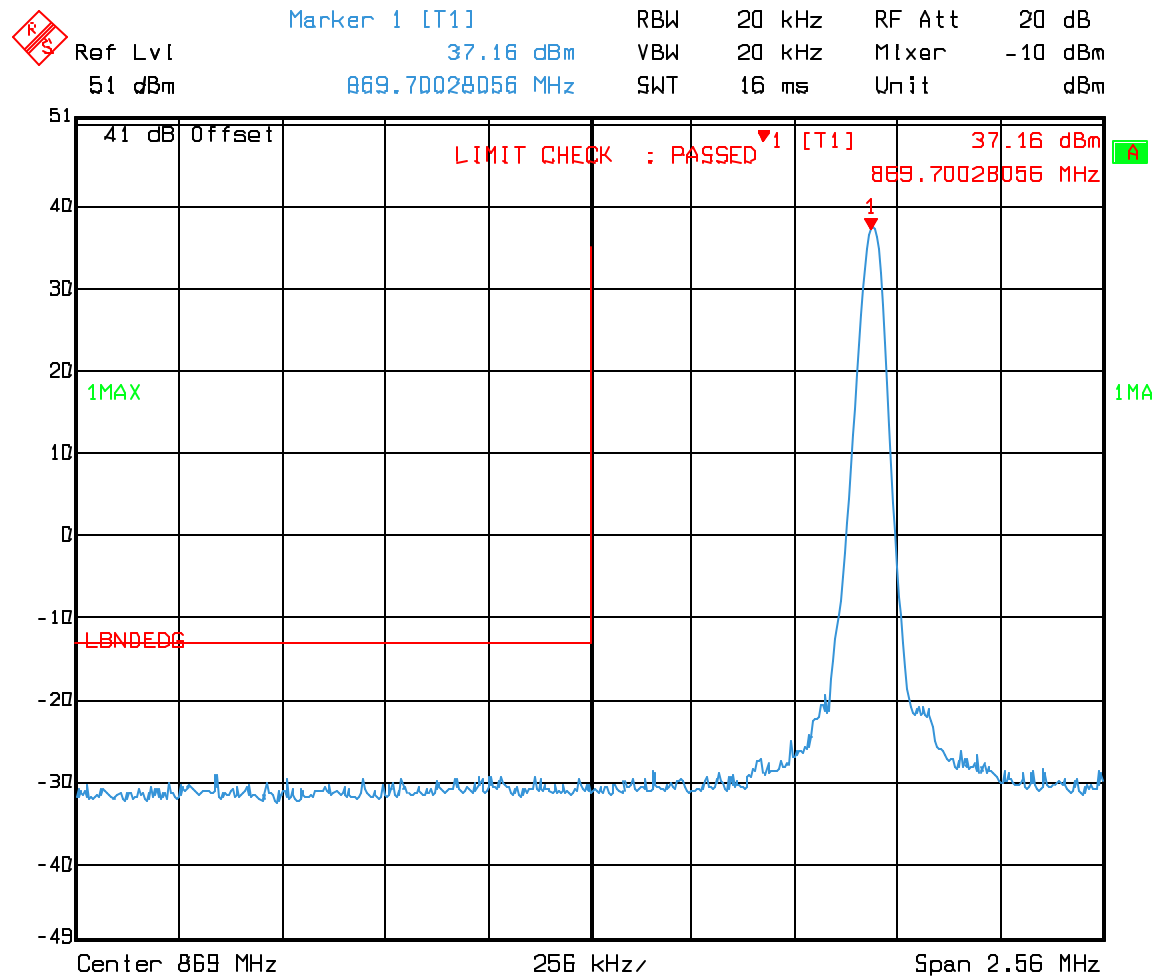


Date: 17.DEC.2003 17:59:15

EQUIPMENT: **Optical Repeater**

PROJECT NO.: **3L0498R**

TDMA LOWER

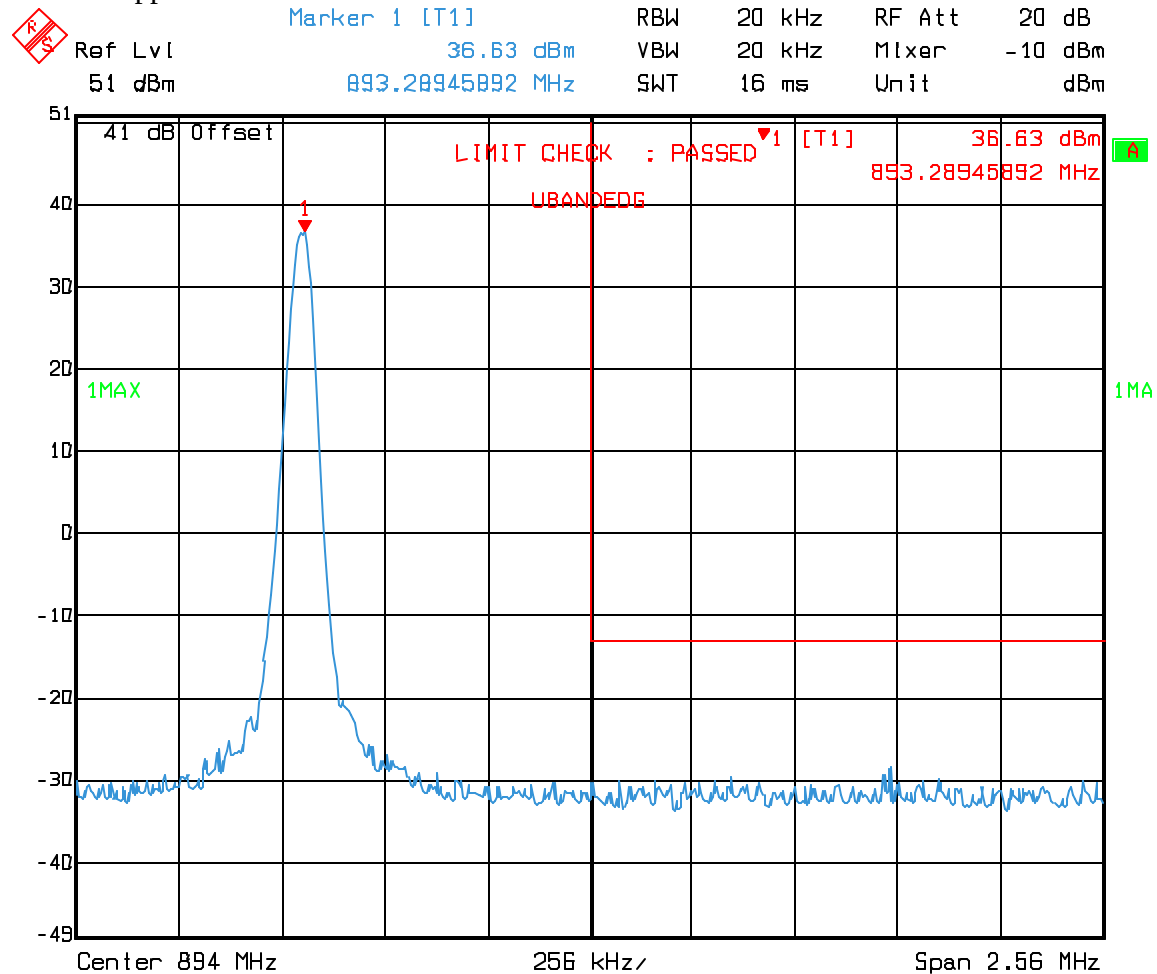


Date: 18.DEC.2003 13:12:57

EQUIPMENT: **Optical Repeater**

PROJECT NO.: **3L0498R**

TDMA Upper

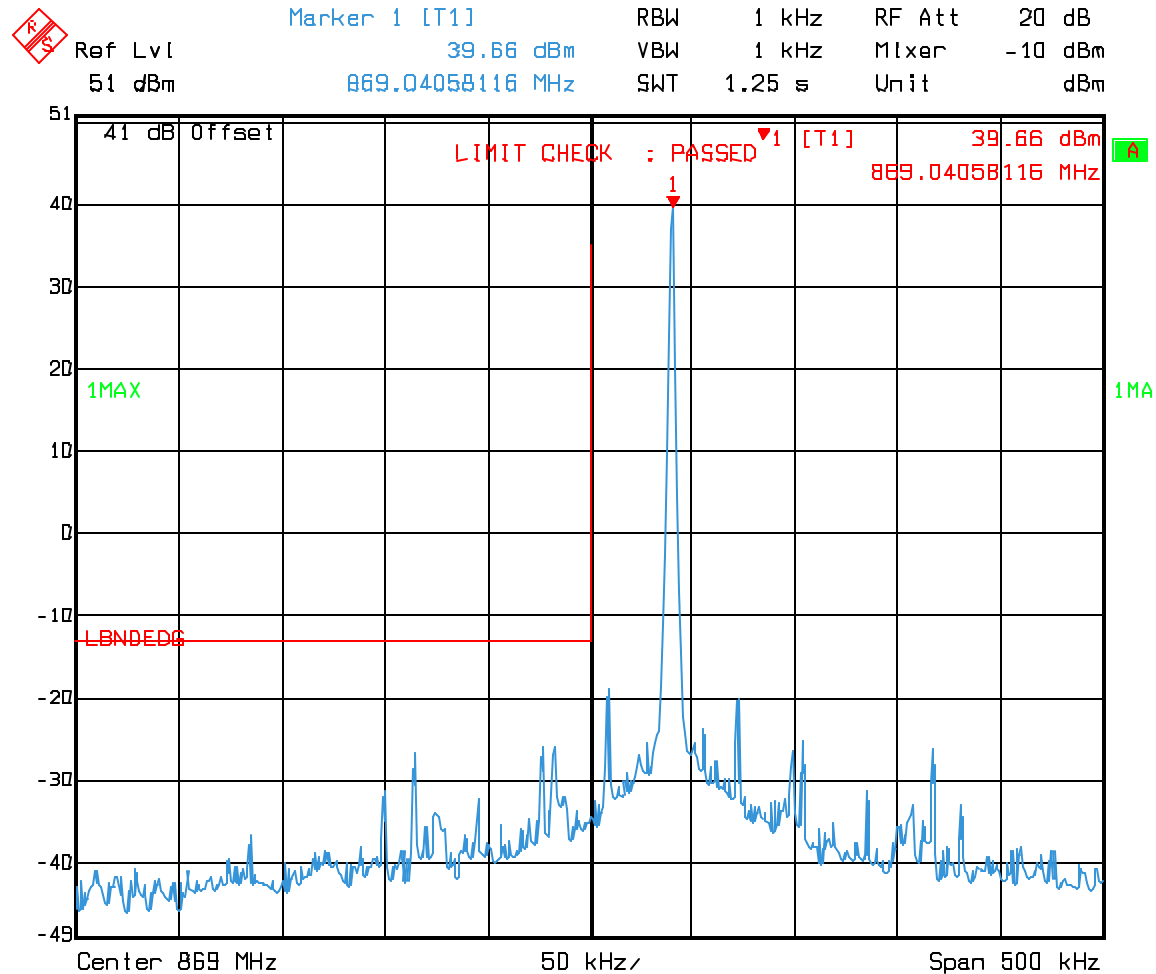


Date: 18.DEC.2003 13:14:27

EQUIPMENT: **Optical Repeater**

PROJECT NO.: **3L0498R**

AMPS Lower

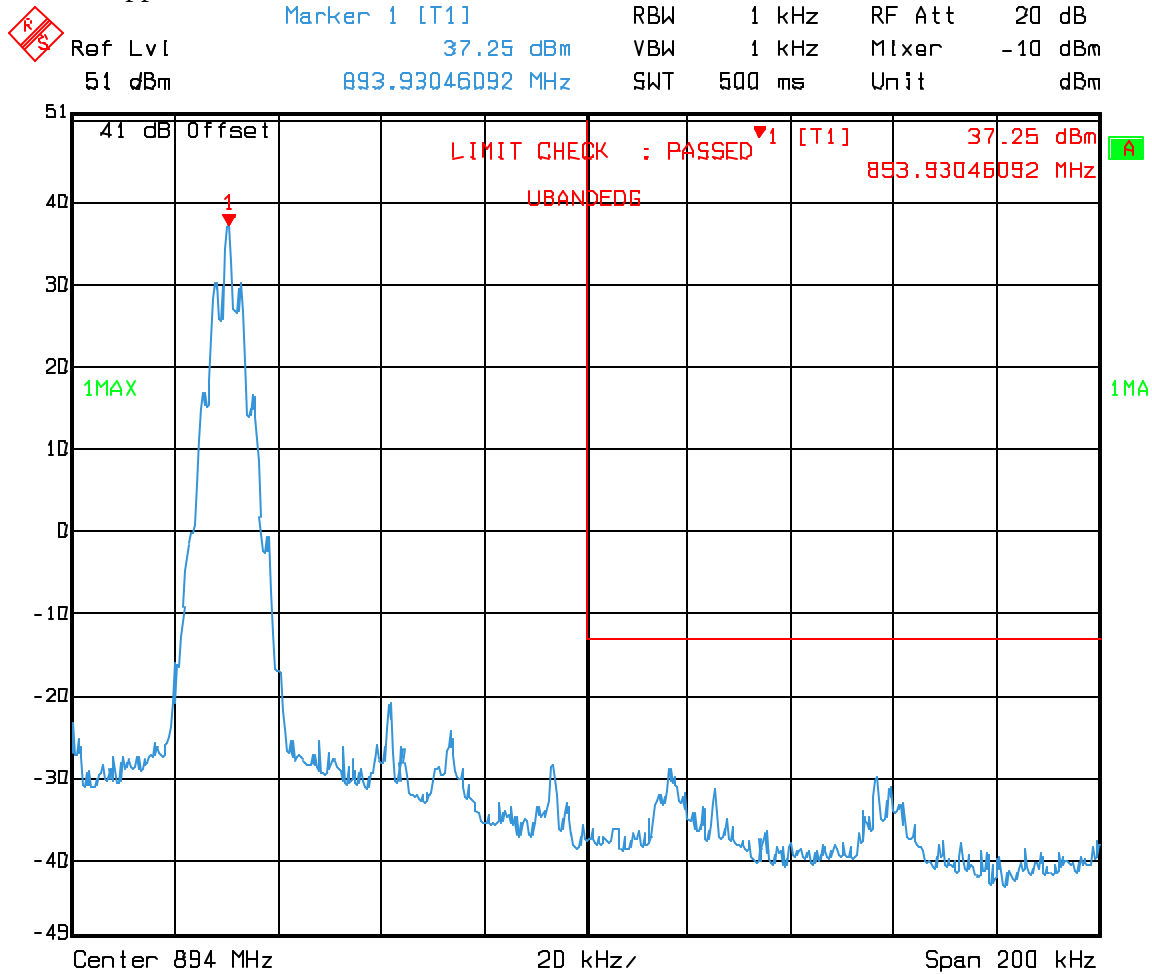


Date: 18.DEC.2003 09:28:54

EQUIPMENT: **Optical Repeater**

PROJECT NO.: **3L0498R**

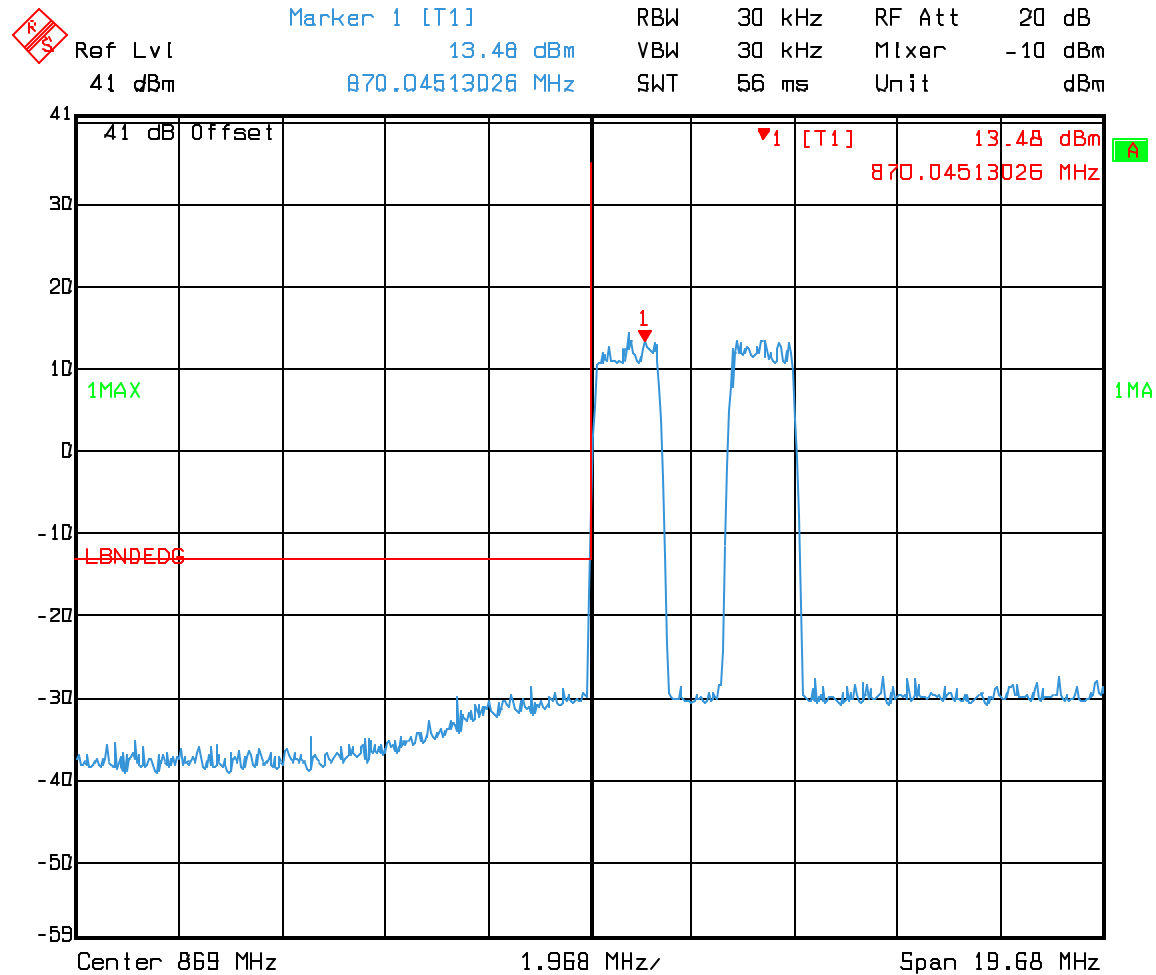
AMPS Upper



Date: 18.DEC.2003 09:20:07

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

800 CDMA Lower



Date: 17.DEC.2003 17:47:03

EQUIPMENT: **Optical Repeater**

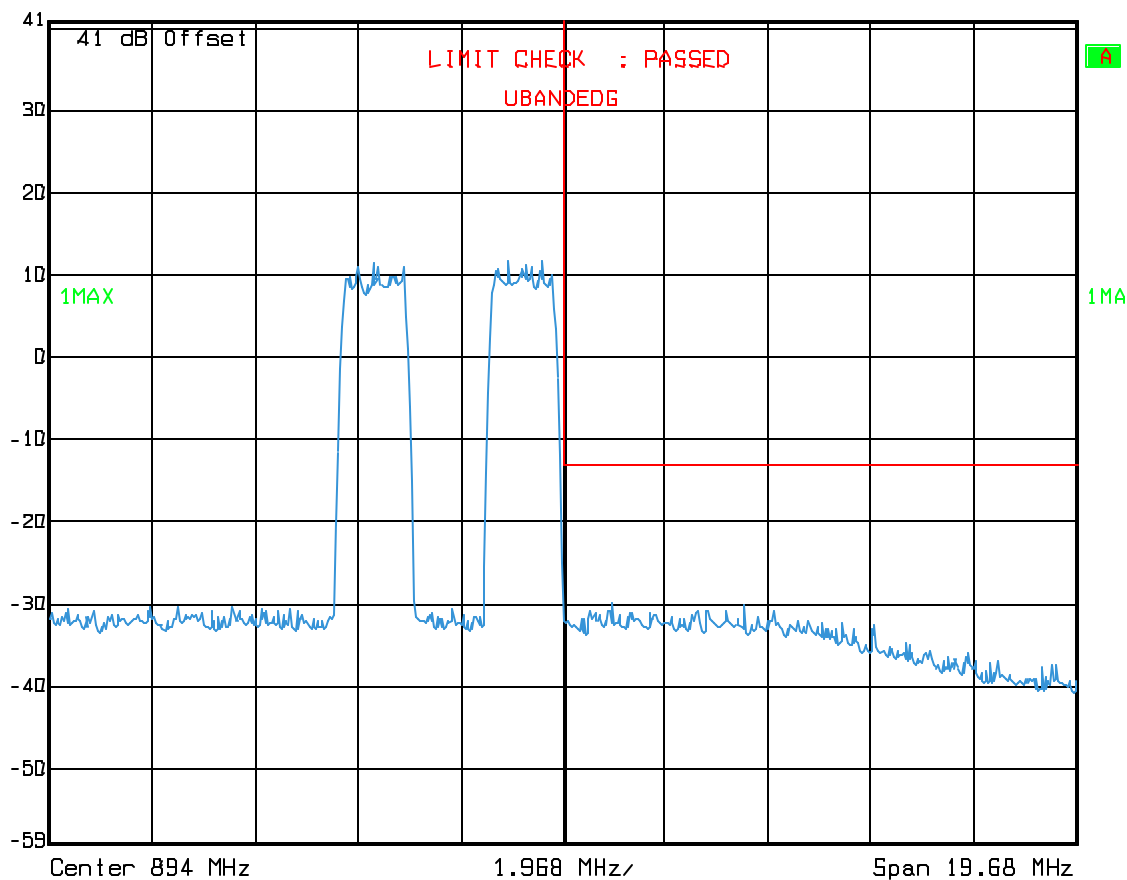
PROJECT NO.: **3L0498R**

800 CDMA Upper



Ref Lvl
41 dBm

RBW	20 kHz	RF Att	20 dB
VBW	20 kHz	Mixer	-10 dBm
SWT	125 ms	Unit	dBm

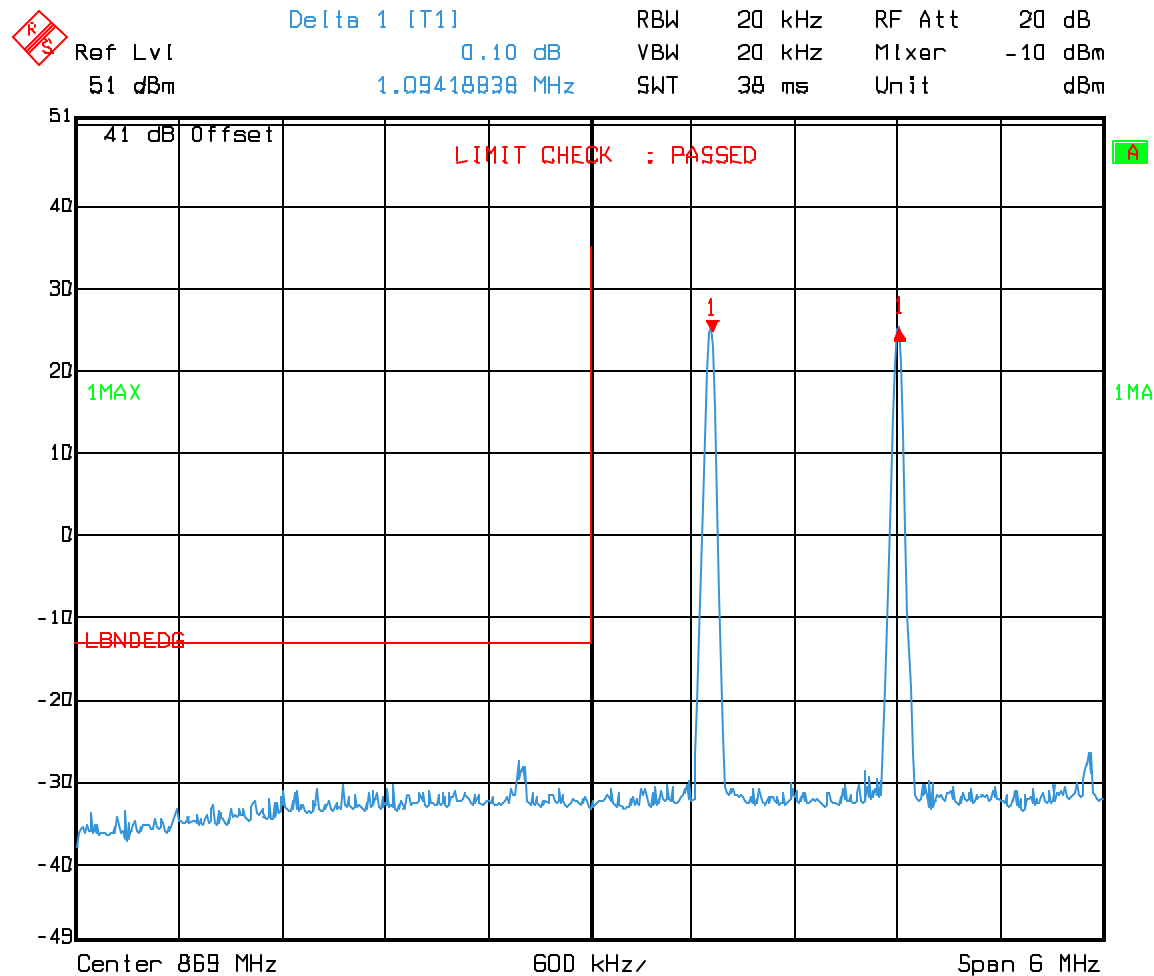


Date: 17.DEC.2003 18:05:57

EQUIPMENT: **Optical Repeater**

PROJECT NO.: **3L0498R**

800 TDMA Lower



Date: 17.DEC.2003 18:22:37

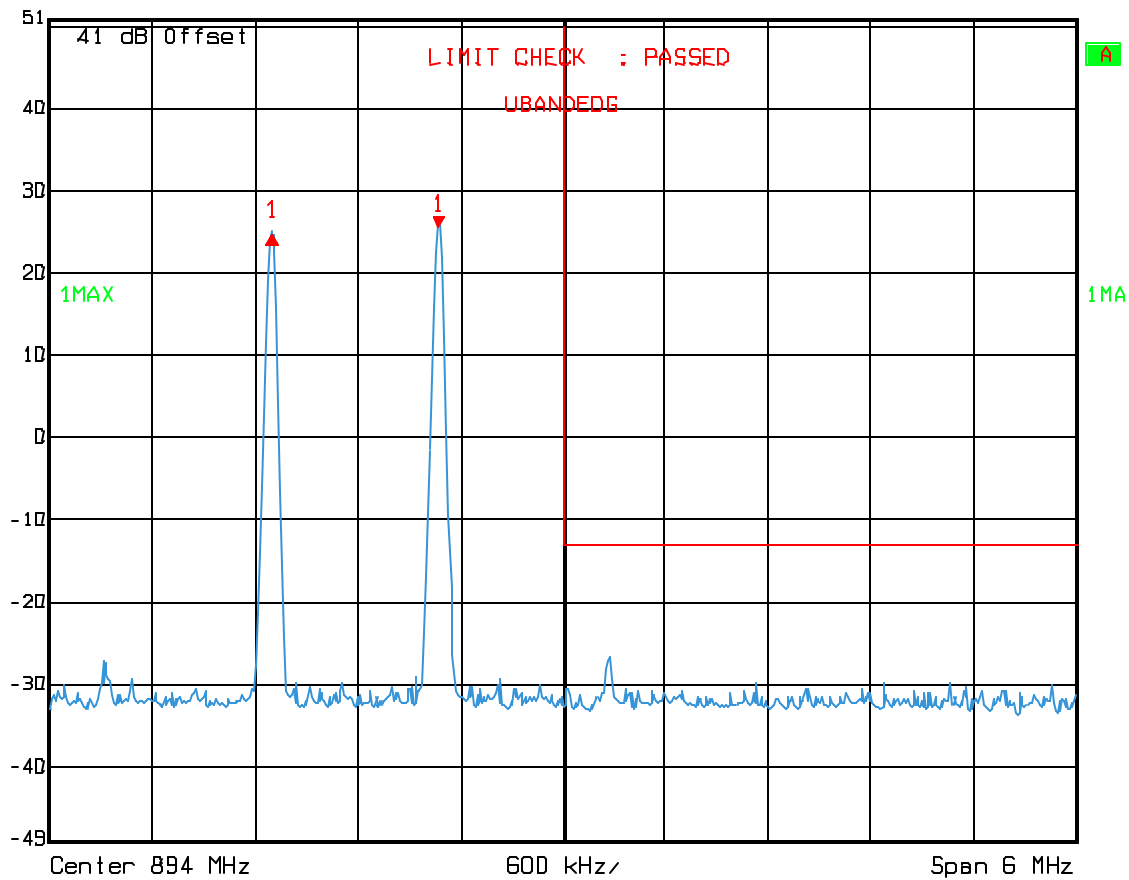
EQUIPMENT: **Optical Repeater**

PROJECT NO.: **3L0498R**

800 TDMA Upper



Ref Lvl	Delta 1 [T1]	RBW	20 kHz	RF Att	20 dB
51 dBm	-0.72 dB	VBW	20 kHz	Mixer	-10 dBm
	-973.94789579 kHz	SWT	38 ms	Unit	dBm

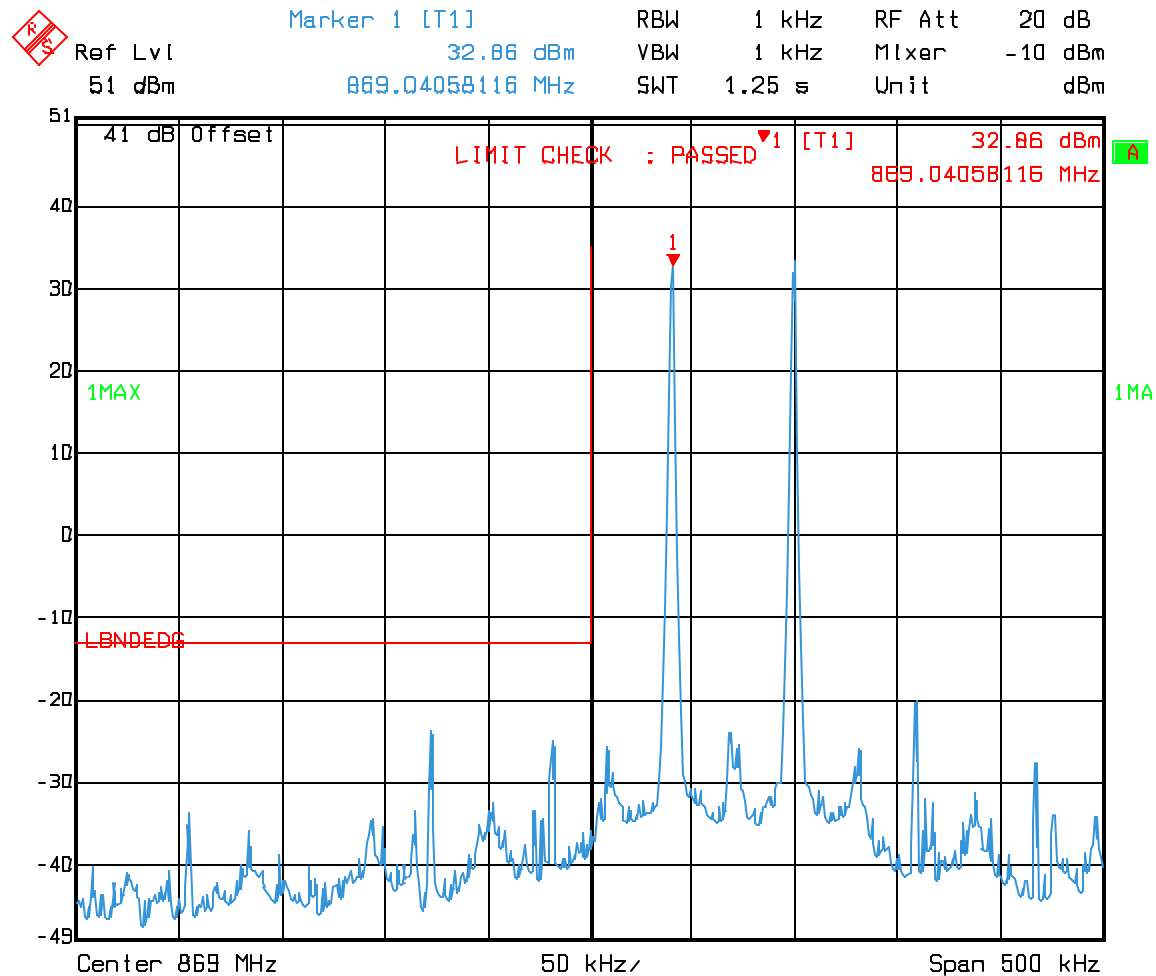


Date: 17.DEC.2003 18:27:52

EQUIPMENT: **Optical Repeater**

PROJECT NO.: **3L0498R**

AMPS Lower

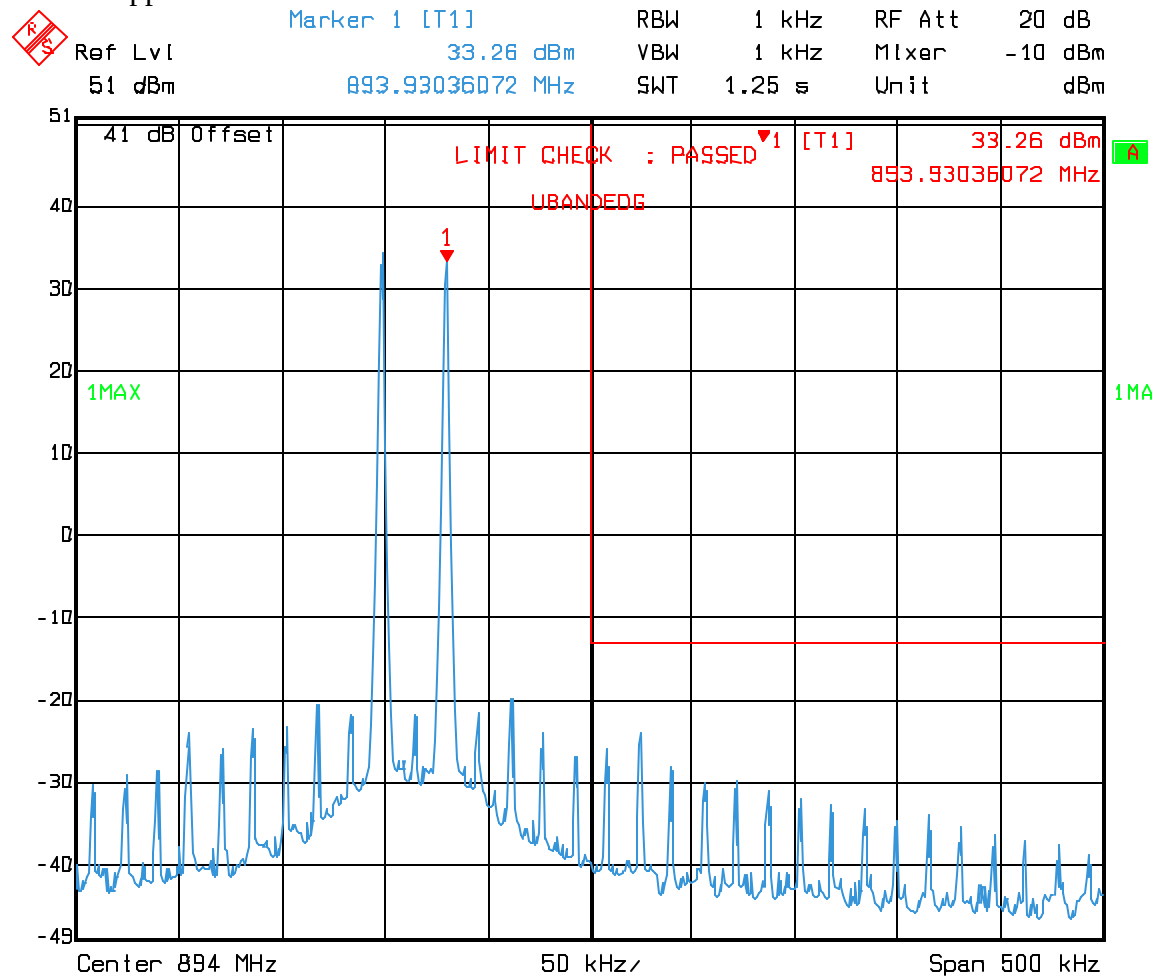


Date: 18.DEC.2003 09:32:11

EQUIPMENT: **Optical Repeater**

PROJECT NO.: **3L0498R**

AMPS Upper



Date: 18.DEC.2003 09:34:48

EQUIPMENT: **Optical Repeater**

PROJECT NO.: **3L0498R**

Section 5. Spurious Emissions at Antenna Terminals

NAME OF TEST: Spurious Emissions @ Antenna Terminals	PARA. NO.: 2.1051
TESTED BY: Dustin Oaks	DATE: 12/18/2003

Test Results: **Complies.**

Test Data: **See attached plots**

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

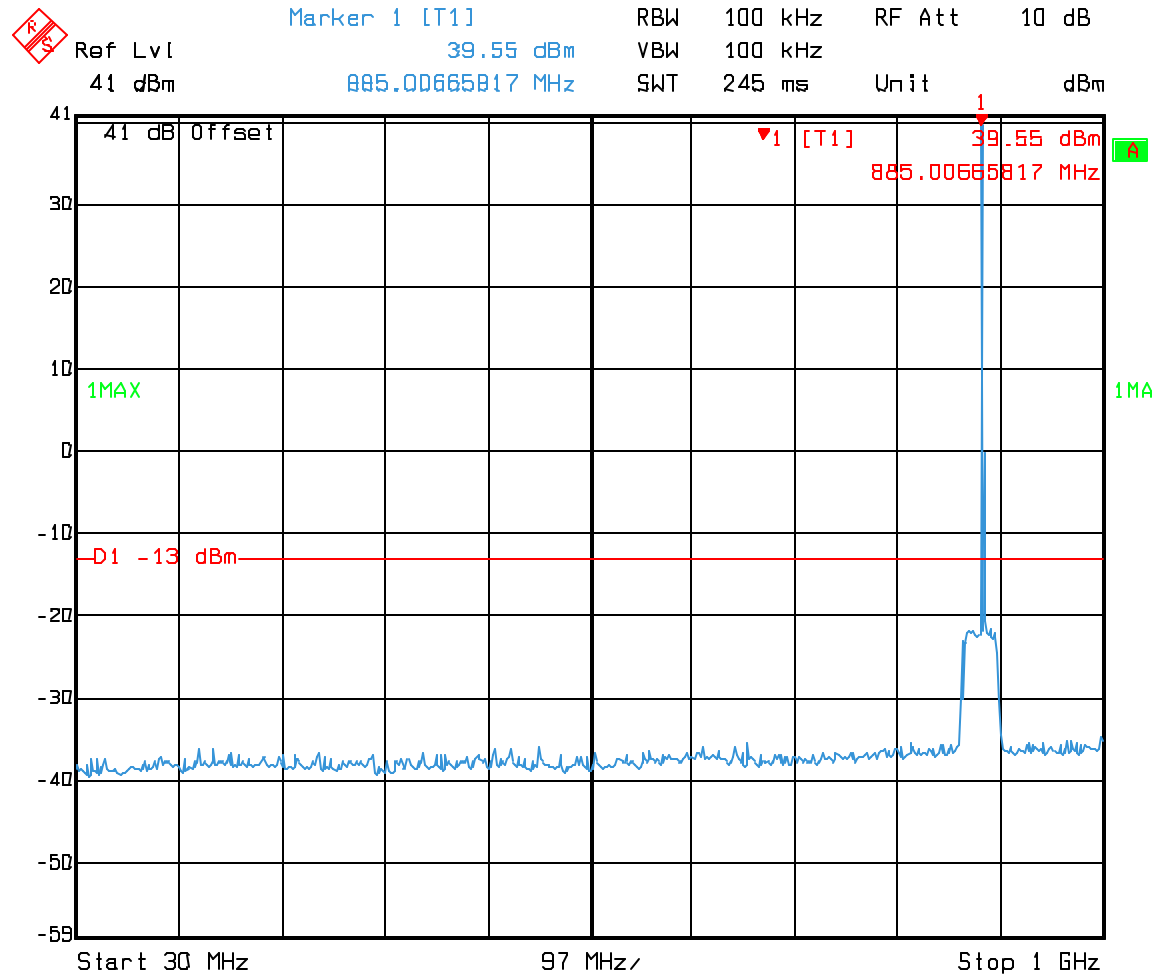
Measurement Uncertainty: **+/- 1.6 dB**

Temperature: **21 °C**

Relative Humidity: **51 %**

EQUIPMENT: **Optical Repeater**

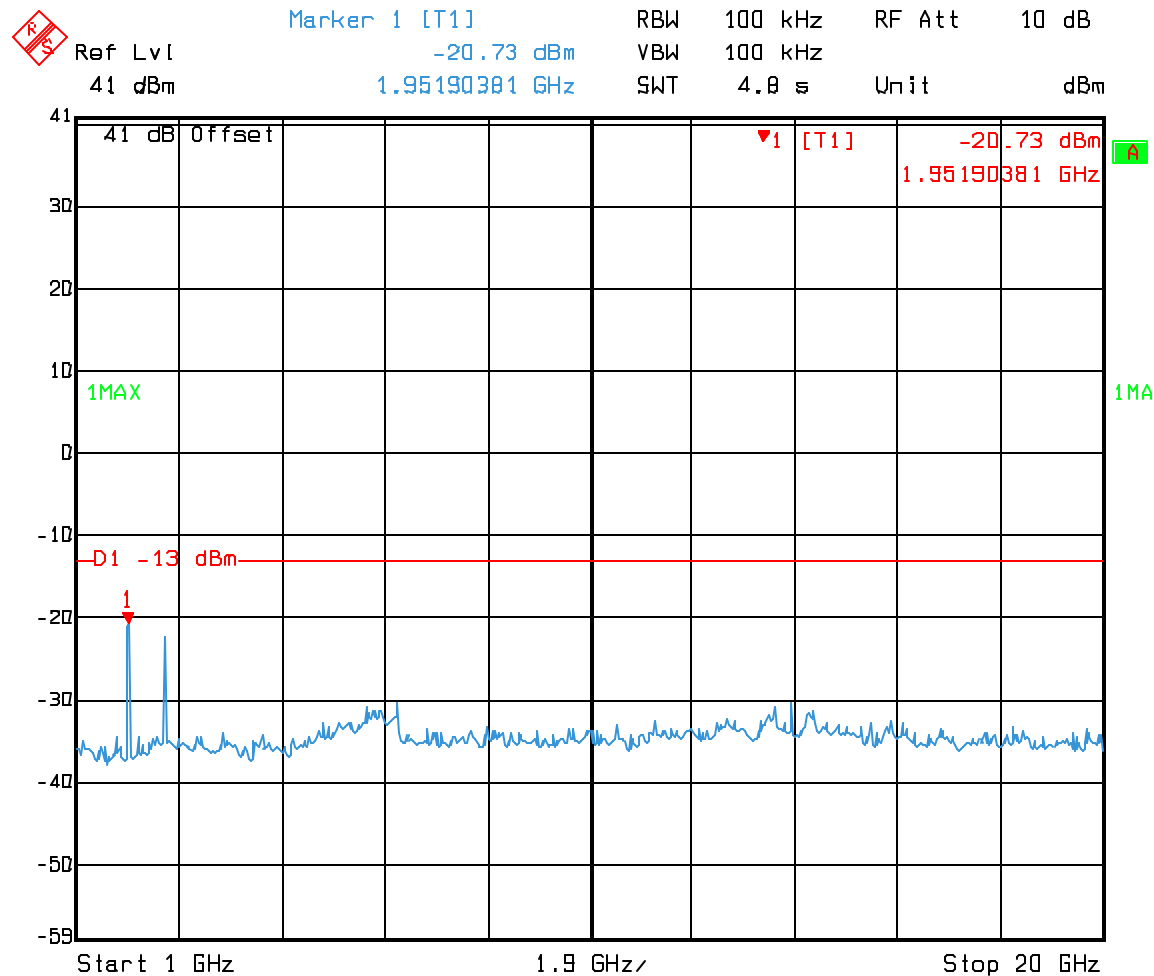
PROJECT NO.: **3L0498R**



Date: 16.DEC.2003 17:57:02

EQUIPMENT: **Optical Repeater**

PROJECT NO.: **3L0498R**



Date: 16.DEC.2003 17:57:39

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

Section 6. Field Strength of Spurious

NAME OF TEST: Field Strength of Spurious	PARA. NO.: 2.1053
TESTED BY: Dustin Oaks	DATE: 12/18/2003

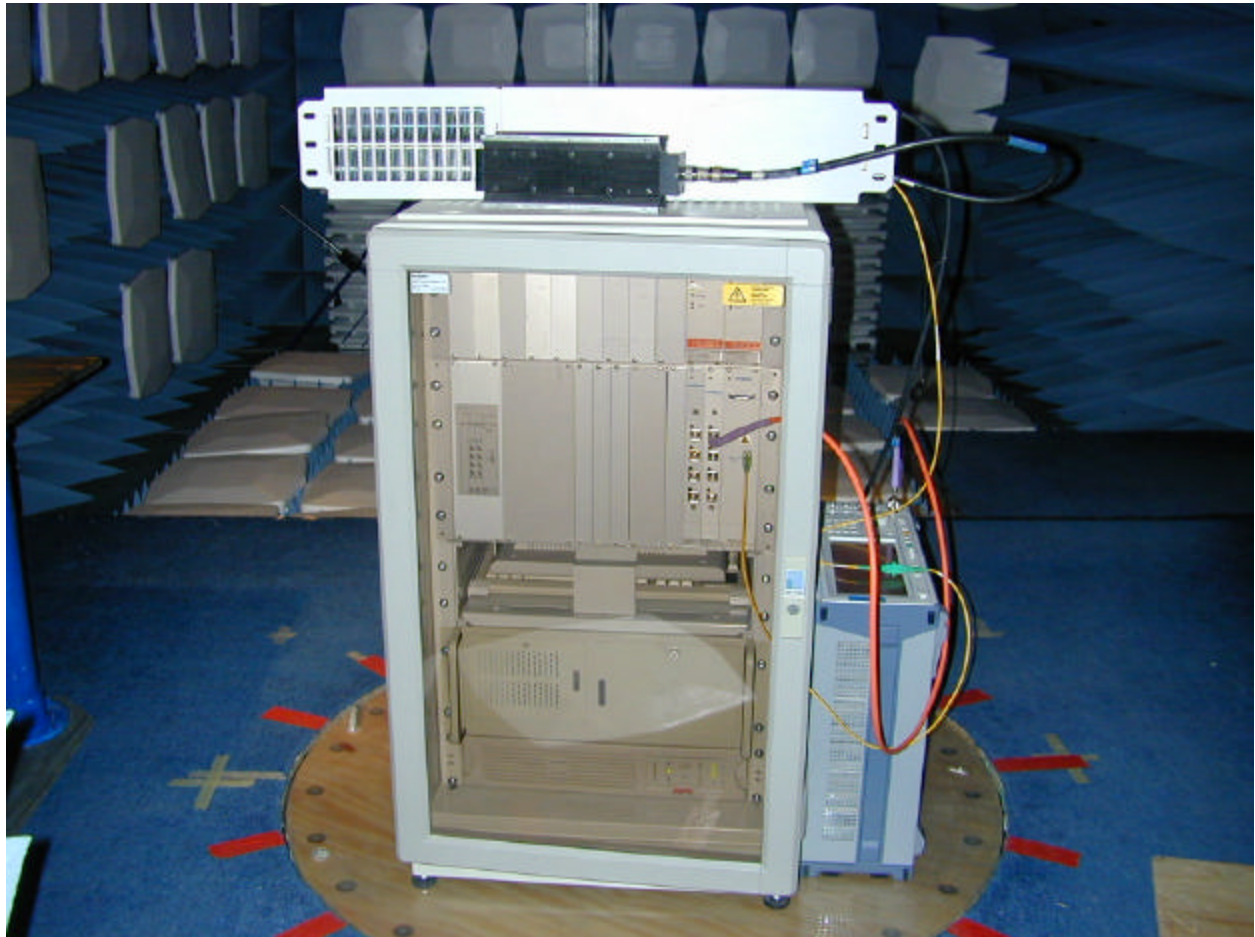
Test Results: **Complies.****Test Data:** No Emissions found within 20dB of Limit. Noise from was greater than 20dB below limit. Frequency range scanned from 30MHz to 20GHz**Equipment Used:** 1016, 1484, 1485, 1304, 791, 1480**Measurement Uncertainty:** +/- **3.6** dB**Temperature:** **21** °C**Relative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

EQUIPMENT: **Optical Repeater**

PROJECT NO.: **3L0498R**

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.: 2.1055

TESTED BY:

DATE:

Test Results: **Not Applicable****Test Data:** **See attached table.**

Standard Test Frequency:

MHz

Standard Test Voltage:

Equipment Used:**Measurement Uncertainty:** **+/- 1×10^{-7}** ppm**Temperature:** ?C**Relative Humidity:** %

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

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

Section 8. Test Equipment List

EQUIPMENT: **Optical Repeater**

PROJECT NO.: **3L0498R**

ANNEX A - TEST DETAILS

EQUIPMENT: **Optical Repeater**PROJECT NO.: **3L0498R****NAME OF TEST: RF Power Output****PARA. NO.: 2.1046**

Minimum Standard: Para. No. 22.913(a). The maximum effective radiated power (ERP) of base transmitters and cellular repeaters must not exceed 500 watts.

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:

$$P \leq \frac{E^2 R^2}{30G} \leq \frac{E^2 3^2}{30G}$$

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

EQUIPMENT: **Optical Repeater**PROJECT NO.: **3L0498R****NAME OF TEST: Occupied Bandwidth (Voice & SAT)****PARA. NO.: 2.1049****Minimum Standard:**

22.917(c) The mean power of any emission removed from the carrier frequency by a displacement frequency (f_d in kHz) must be attenuated below the mean power of the unmodulated carrier (P) as follows:

- (i) On any frequency removed from the carrier frequency by more than 12 kHz but not more than 20 kHz:

at least $117 \log (f_d/12)$

- (ii) On any frequency removed from the carrier frequency by more than 20 kHz, up to the first multiple of the carrier frequency:

at least $100 \log (f_d/11)$ dB or $43 + 10 \log (P)$ dB, whichever is the lesser attenuation.

Method Of Measurement:Spectrum Analyzer Settings:

RBW: 300 Hz

VBW: ? RBW

Span: 100 kHz

Sweep: Auto

Input Signal Characteristics (F3E/F3D):

RF level: Maximum recommended by manufacturer

AF1 frequency: 6 kHz

AF1 level: sufficient to produce 2 kHz deviation

AF2 frequency: 2.5 kHz

AF2 level: sufficient to produce 12 kHz deviation.

EQUIPMENT: **Optical Repeater**PROJECT NO.: **3L0498R****NAME OF TEST: Occupied Bandwidth (WB Data)****PARA. NO.: 2.1049****Minimum Standard:**

22.917(c) The mean power of any emission removed from the carrier frequency by a displacement frequency (f_d in kHz) must be attenuated below the mean power of the unmodulated carrier (P) as follows:

- (1) On any frequency removed from the carrier frequency by more than 20 kHz but not more than 45 kHz:

at least 26 dB

- (2) On any frequency removed from the carrier frequency by more than 45 kHz but not more than 90 kHz:

at least 45 dB

- (3) On any frequency removed from the carrier frequency by more than 90 kHz, up to the first multiple of the carrier frequency:

at least 60 dB or $43 + 10 \log (P)$ dB, whichever is the lesser attenuation.

Method Of Measurement:Spectrum Analyzer Settings:

RBW: 300 Hz

VBW: ? RBW

Span: 200 kHz

Sweep: Auto

Input Signal Characteristics:

RF level: Maximum recommended by manufacturer

AF1 frequency: 10 kHz, random bit sequence

AF1 level: sufficient to produce 8 kHz deviation

EQUIPMENT: **Optical Repeater**PROJECT NO.: **3L0498R****NAME OF TEST: Occupied Bandwidth (ST)****PARA. NO.: 2.1049****Minimum Standard:**

22.917(c) The mean power of any emission removed from the carrier frequency by a displacement frequency (f_d in kHz) must be attenuated below the mean power of the unmodulated carrier (P) as follows:

- (1) On any frequency removed from the carrier frequency by more than 20 kHz but not more than 45 kHz:

at least 26 dB

- (2) On any frequency removed from the carrier frequency by more than 45 kHz but not more than 90 kHz:

at least 45 dB

- (3) On any frequency removed from the carrier frequency by more than 90 kHz, up to the first multiple of the carrier frequency:

at least 60 dB or $43 + 10 \log (P)$ dB, whichever is the lesser attenuation.

Method Of Measurement:Spectrum Analyzer Settings:

RBW: 300 Hz

VBW: ? RBW

Span: 200 kHz

Sweep: Auto

Input Signal Characteristics:

RF level: Maximum recommended by manufacturer

AF1 frequency: 10 kHz tone

AF1 level: sufficient to produce 8 kHz deviation

EQUIPMENT: **Optical Repeater**

PROJECT NO.: **3L0498R**

NAME OF TEST: Occupied Bandwidth (Digital Modulation)	PARA. NO.: 2.1049
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Minimum Standard: Not defined by FCC. Input vs. Output.

Method Of Measurement:

Spectrum Analyzer Settings:

RBW: CDMA (30 kHz), GSM (30 kHz), NADC (1 kHz) and CDPD (1 kHz)

VBW: ? RBW

Span: As required

Sweep: Auto

Input Signal Characteristics:

RF level: Maximum recommended by manufacturer

EQUIPMENT: **Optical Repeater**

PROJECT NO.: **3L0498R**

NAME OF TEST: Spurious Emission at Antenna Terminals	PARA. NO.: 2.1051
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Minimum Standard:

Para. No. 22.917(e). The mean power of emissions must be attenuated below the mean power of the unmodulated carrier on any frequency twice or more than twice the fundamental emission by at least $43 + 10 \log P$. This is equivalent to -13 dBm absolute power.

Method Of Measurement:

Spectrum Analyzer Settings:

RBW: 30 kHz (AMPS). As required for digital modulations.

VBW: ? RBW

Start Frequency: 0 MHz

Stop Frequency: 10 GHz

Sweep: Auto

EQUIPMENT: **Optical Repeater**PROJECT NO.: **3L0498R****NAME OF TEST: Field Strength of Spurious Radiation****PARA. NO.: 2.1053****Minimum Standard:**

Para. No. 22.917(e). The mean power of emissions must be attenuated below the mean power of the unmodulated carrier on any frequency twice or more than twice the fundamental emission by at least $43 + 10 \log P$. This is equivalent to -13 dBm absolute power.

Calculation Of Field Strength Limit:

An example of attenuation requirement of $43 + 10 \log P$ is equivalent to -13 dBm (5×10^{-5} Watts) at the antenna terminal. We determine the field strength limit by using the plane wave relation.

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

For emissions ≤ 1 GHz:

$G = 1.64$ (Dipole Gain)

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

$R = 3\text{m}$ (Measurement Distance)

$$E \leq \frac{\sqrt{30GP}}{R}$$

$$E \leq \frac{\sqrt{30 \times 1.64 \times 5 \times 10^{-5}}}{3} \leq 0.016533 \text{ V / m} \leq 84.4 \text{ dB}\mu\text{V / m}$$

For emissions > 1 GHz:

$G = 1$ (Isotropic Gain)

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

$R = 3\text{m}$ (Measurement Distance)

$$E \leq 84.4 - 20 \log \sqrt{1.64} \leq 82.3 \text{ dB}\mu\text{V / m} @ 3\text{m}$$

The spectrum is searched to 10 GHz.

EQUIPMENT: **Optical Repeater**PROJECT NO.: **3L0498R****NAME OF TEST: Frequency Stability****PARA. NO.: 2.1055**

Minimum Standard: Para. No. 22.355. The transmitter carrier frequency shall remain within the tolerances given in Table C-1.

Table C-1

Freq. Range (MHz)	Base, fixed	Mobile > 3 W	Mobile ? 3 W
821 to 896	1.5	2.5	2.5

Method Of Measurement:Frequency Stability With Voltage Variation:

The E.U.T. is placed in an environmental chamber and allowed to stabilize at +20 degrees Celsius for at least 15 minutes. The frequency counter and signal generator are phase locked with the same 10 MHz reference frequency by connecting the 10 MHz ref. out of the counter to the 10 MHz ref. in of the signal generator. With the voltage input to the E.U.T. set to 85% S.T.V., the frequency is measured in 30 second intervals for a period of 5 minutes. This procedure is repeated at 100% S.T.V. and 115% S.T.V.

Frequency Stability With Temperature Variation:

The input voltage to the E.U.T. is set to S.T.V. and the temperature of the environmental chamber is varied in 10 degree steps from -30 degrees C to +50 degrees C. The E.U.T. is allowed to stabilize at each temperature and the frequency is measured in 30 second intervals for a period of 5 minutes.

EQUIPMENT: **Optical Repeater**

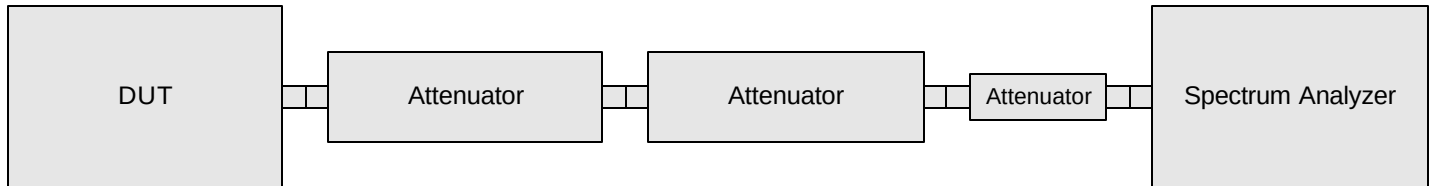
PROJECT NO.: **3L0498R**

ANNEX B - TEST DIAGRAMS

EQUIPMENT: **Optical Repeater**

PROJECT NO.: **3L0498R**

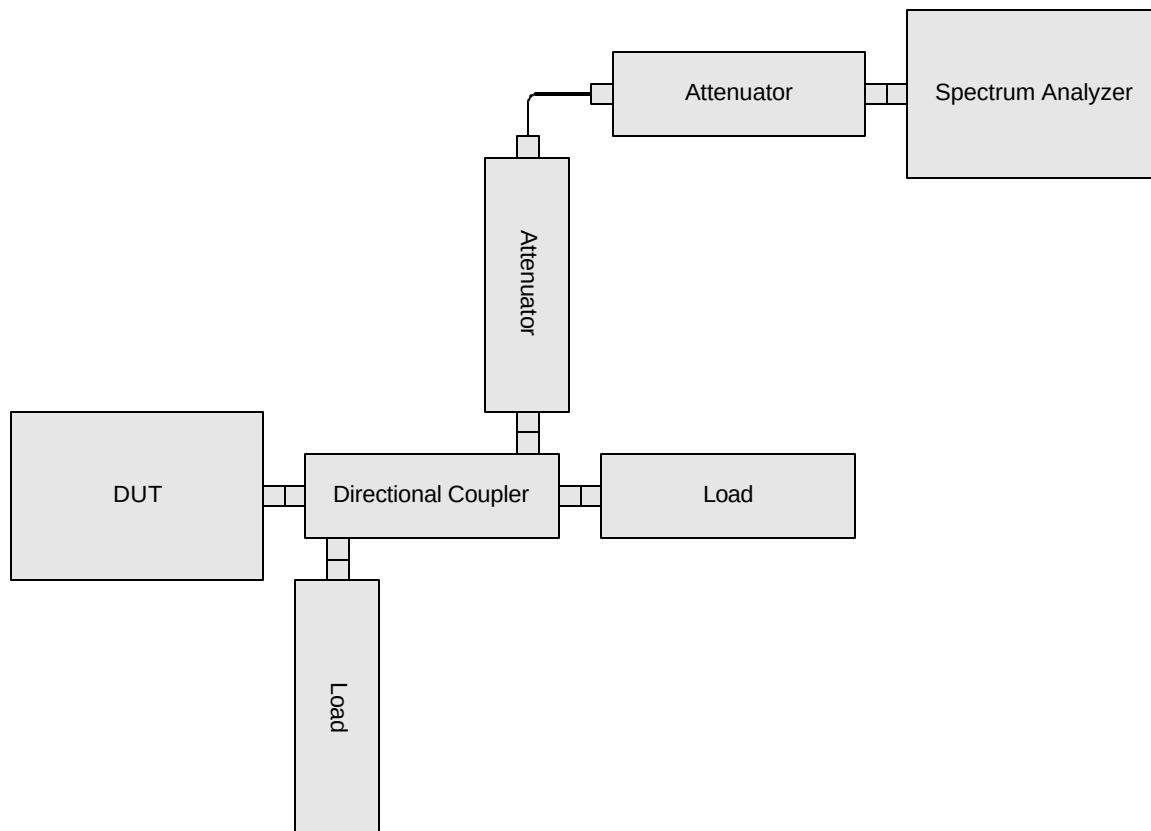
Para. No. 2.1046 - R.F. Power Output



Para. No. 2.1049 - Occupied Bandwidth

EQUIPMENT: **Optical Repeater**

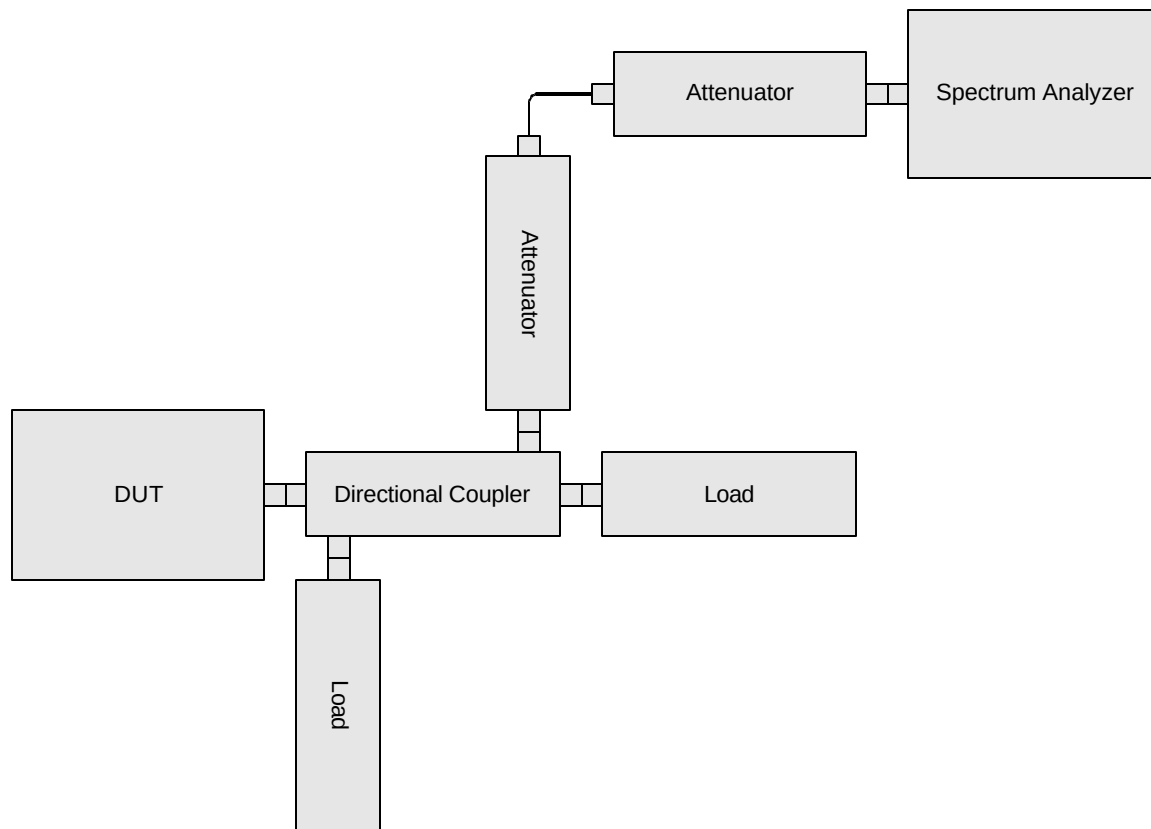
PROJECT NO.: **3L0498R**



Para. No. 2.1051 Spurious Emissions at Antenna Terminals

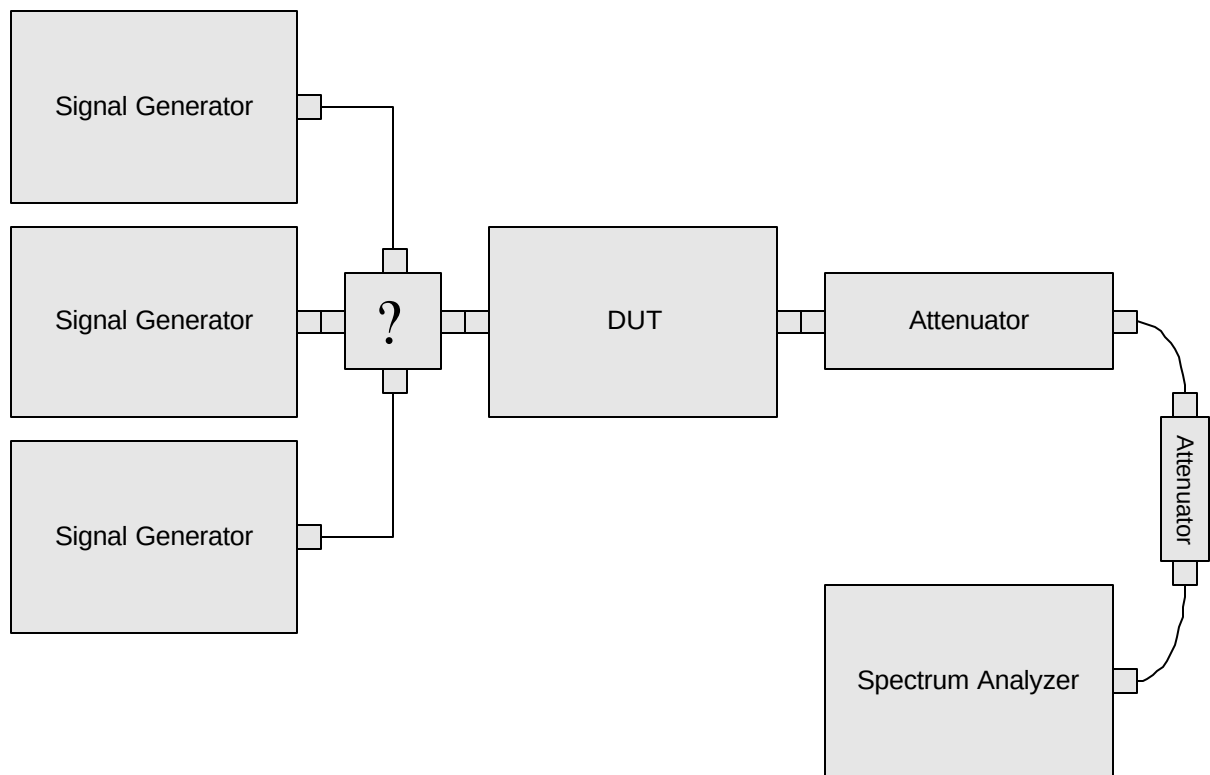
EQUIPMENT: **Optical Repeater**

PROJECT NO.: **3L0498R**



EQUIPMENT: **Optical Repeater**

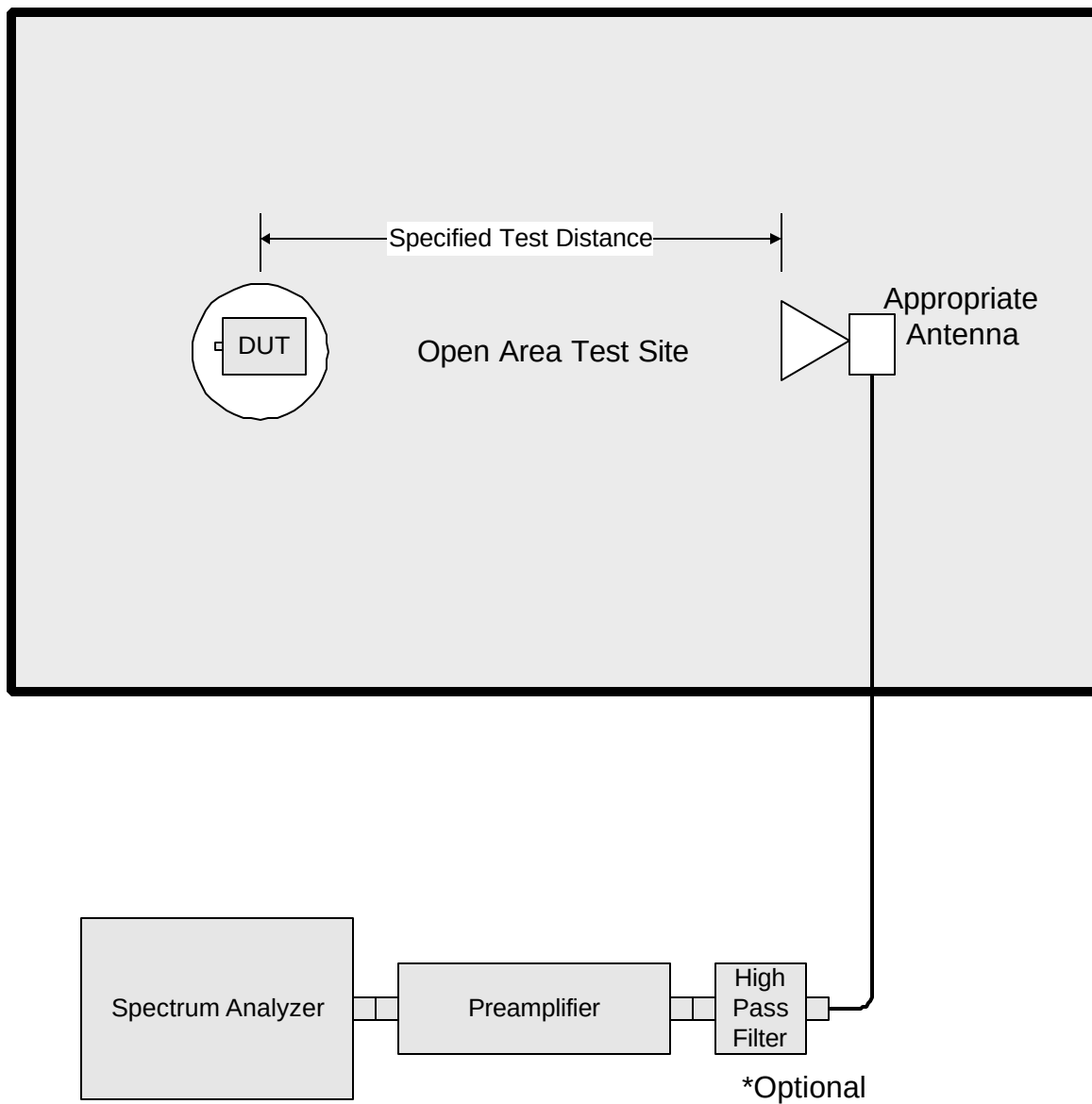
PROJECT NO.: **3L0498R**



EQUIPMENT: **Optical Repeater**

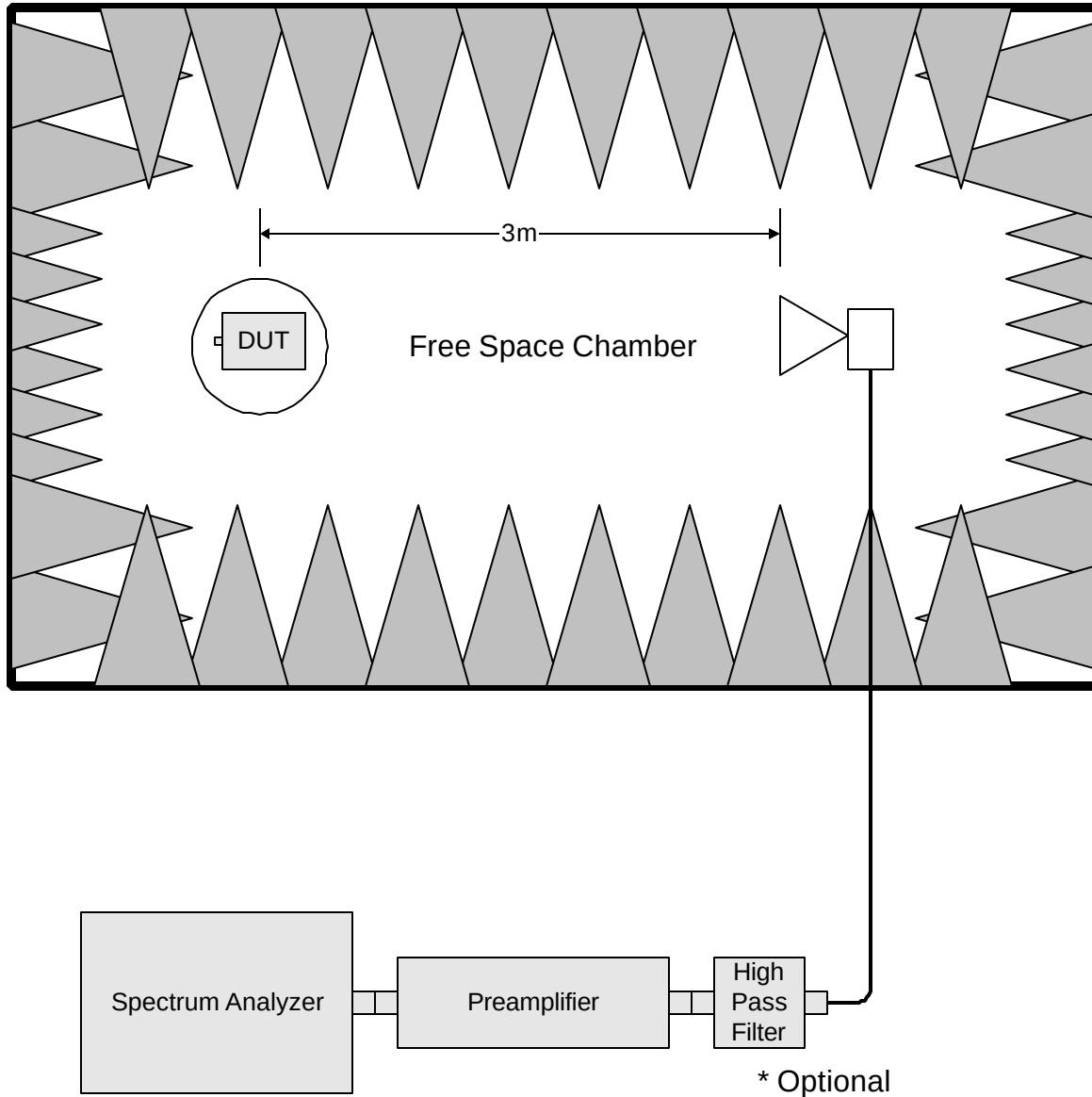
PROJECT NO.: **3L0498R**

Para. No. 2.1053 - Field Strength of Spurious Radiation



EQUIPMENT: **Optical Repeater**

PROJECT NO.: **3L0498R**



EQUIPMENT: **Optical Repeater**

PROJECT NO.: **3L0498R**

Para. No. 2.1055 - Frequency Stability

