

Nemko Test Report No.:

3L0498RUS1

Applicant:

Andrew Corporation

Equipment Under Test:

Optical Repeater

In Accordance With:

FCC Part 24, Subpart E
Broadband PCS Repeaters

Tested By:

Nemko USA Inc.
802 N. Kealy
Lewisville, Texas 75057-3136



Authorized By:

Tom Tidwell, RF Group Manager

Date:

4/22/04

Total Number of Pages:

48

EQUIPMENT: **Optical Repeater**

FCC ID:

PROJECT NO.: **3L0498R**

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EQUIPMENT: Optical Repeater

FCC ID:

PROJECT NO.: 3L0498R

Section 1. Summary of Test Results

Manufacturer: Andrew Corporation

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

Serial No.: 30 14 30

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 24, Subpart E.



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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FCC PART 24, SUBPART E
BROADBAND PCS REPEATERS

EQUIPMENT: Optical Repeater

FCC ID:

PROJECT NO.: 3L0498R

Summary Of Test Data

NAME OF TEST	PARA. NO.	SPEC.	MEAS.	RESULT
RF Power Output	24.232	100W	24.83W	Complies
Occupied Bandwidth (CDMA)	24.238	Input/Output	NA	Complies
Occupied Bandwidth (GSM)	24.238	Input/Output	NA	Complies
Occupied Bandwidth (NADC)	24.238	Input/Output	NA	Complies
Spurious Emissions at Antenna Terminals	24.238(a)	-13 dBm	Plots	Complies
Field Strength of Spurious Emissions	24.238(a)	-13 dBm E.I.R.P.	E.I.R.P.	Complies
Frequency Stability	24.235			

Footnotes:

(1) Modulation characteristics were not tested since the E.U.T. processes but does not produce a modulated waveform.

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

EQUIPMENT: **Optical Repeater**

FCC ID:

PROJECT NO.: **3L0498R**

Section 2. General Equipment Specification

Supply Voltage Input:		115V AC		
Frequency Bands:	Downlink:	☒	Block A :	1930 – 1945 MHz
		☒	Block D :	1945 – 1950 MHz
		☒	Block B :	1950 – 1965 MHz
		☒	Block E :	1965 – 1970 MHz
		☒	Block F :	1970 – 1975 MHz
		☒	Block C :	1975 – 1990 MHz
Frequency Bands:	Uplink:	☐	Block A :	1850 – 1865 MHz
		☐	Block B :	1865 – 1870 MHz
		☐	Block C :	1870 – 1885 MHz
		☐	Block D :	1885 – 1890 MHz
		☐	Block E :	1890 – 1895 MHz
		☐	Block F :	1895 – 1910 MHz
Type of Modulation and Designator:		CDMA (F9W)	GSM (GXW)	NADC (DXW)
		☒	☒	☒
Output Impedance:		50 ohms		
Max Input:		+20 dBm		
RF Output (Rated):	Uplink	Per channel:	NA	W
		Total:	NA	W
RF Output (Rated):	Downlink	CDMA	33	dBm (2 Carrier)
(Per Carrier)		NADC	36	dBm (2 Carrier)
		GSM	39	dBm (2 Carrier)
Frequency Translation:		F1-F1	F1-F2	N/A
		☐	☐	☒
Band Selection:		Software	Duplexer	Fullband

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FCC PART 24, SUBPART E
BROADBAND PCS REPEATERS

EQUIPMENT: **Optical Repeater**

FCC ID:

PROJECT NO.: **3L0498R**

	☐	☐	☒
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BROADBAND PCS REPEATERS

EQUIPMENT: **Optical Repeater**

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PROJECT NO.: **3L0498R**

Modifications Made During Testing

No modifications made during testing.

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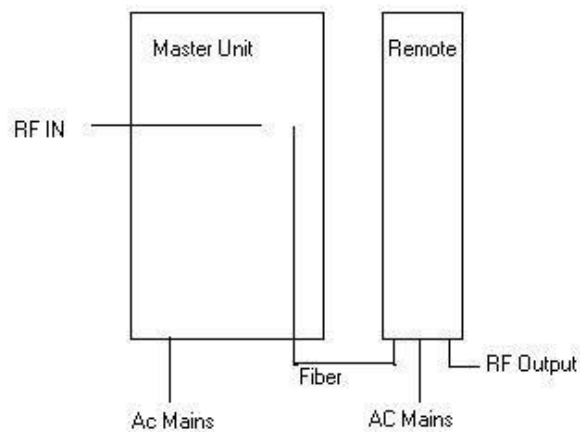
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BROADBAND PCS REPEATERS

EQUIPMENT: Optical Repeater

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PROJECT NO.: **3L0498R**

System Diagram



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EQUIPMENT: Optical Repeater

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PROJECT NO.: 3L0498R

Section 3. RF Power Output

NAME OF TEST: RF Power Output	PARA. NO.: 2.1046
TESTED BY: Dustin Oaks	DATE: 12/18/2003

Test Results: Complies.

Measurement Data:

	Modulation Type	Output Power (dBm)	
Uplink	CDMA	NA	
Downlink	CDMA	39.05	
Uplink	GSM	NA	
Downlink	GSM	43.95	
Uplink	NADC	NA	
Downlink	NADC	41.05	

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

Measurement Uncertainty: +/- 1.6 dB

Temperature: 21 °C

Relative Humidity: 51 %

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FCC PART 24, SUBPART E
BROADBAND PCS REPEATERS

EQUIPMENT: Optical Repeater

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PROJECT NO.: 3L0498R

Section 4. Occupied Bandwidth

NAME OF TEST: Occupied Bandwidth (CDMA)	PARA. NO.: 2.1049
TESTED BY: Dustin Oaks	DATE: 12/17/2003

Test Results: Complies.

Test Data: See attached plot(s).

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

Measurement Uncertainty: +/- 1.6 dB

Temperature: 21 °C

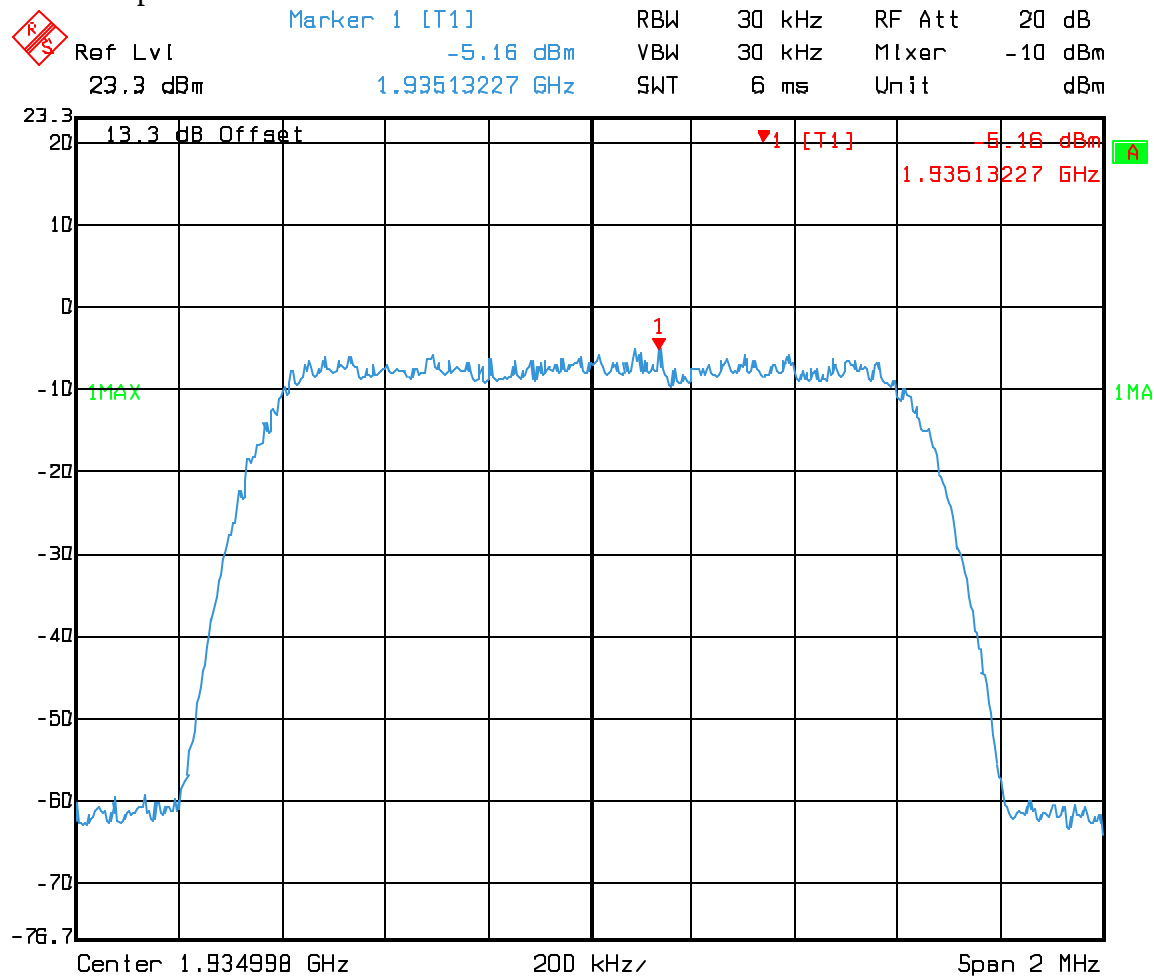
Relative Humidity: 51 %

EQUIPMENT: **Optical Repeater**

FCC ID:

PROJECT NO.: **3L0498R**

CDMA Input



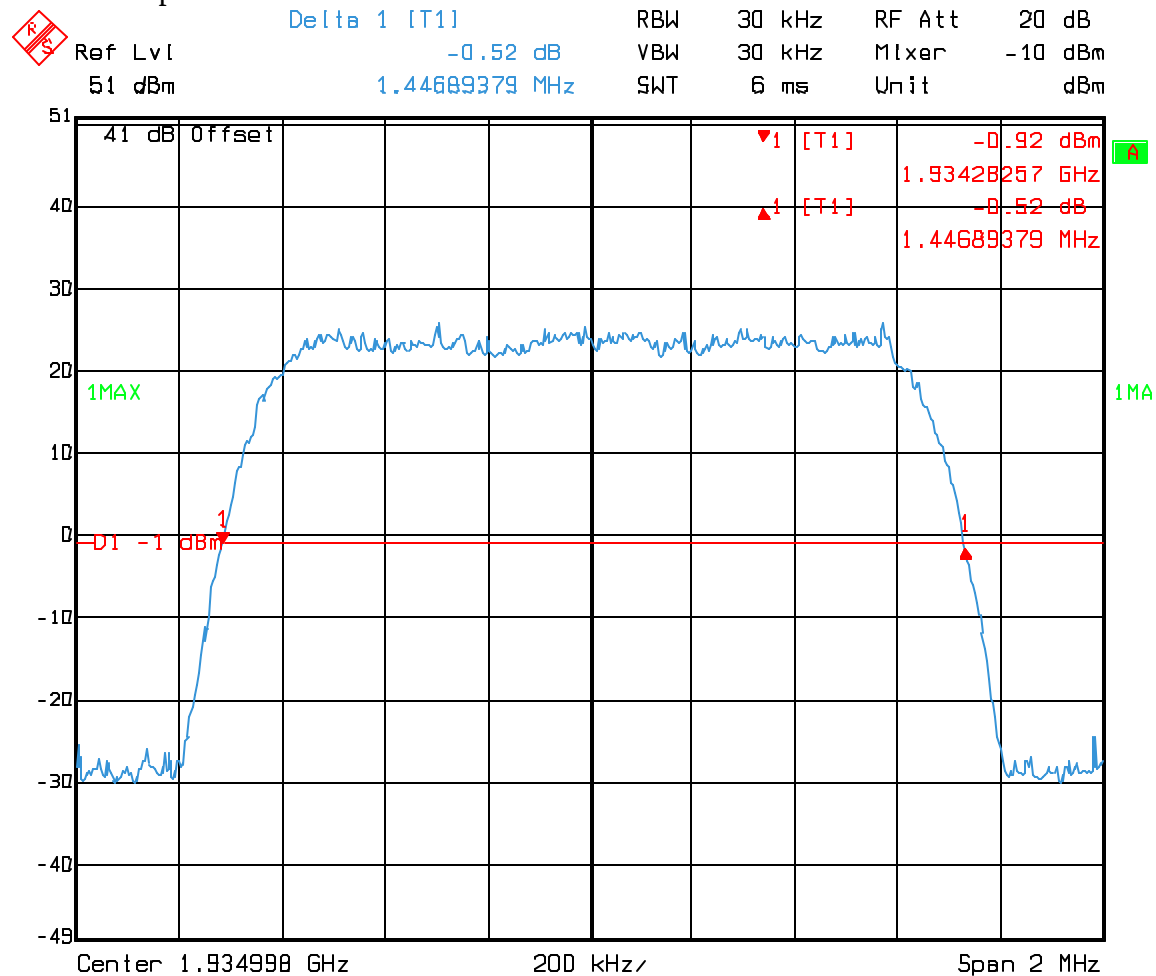
Date: 17.DEC.2003 14:40:10

EQUIPMENT: **Optical Repeater**

FCC ID:

PROJECT NO.: **3L0498R**

CDMA Output



Date: 17.DEC.2003 14:36:54

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FCC PART 24, SUBPART E
BROADBAND PCS REPEATERS

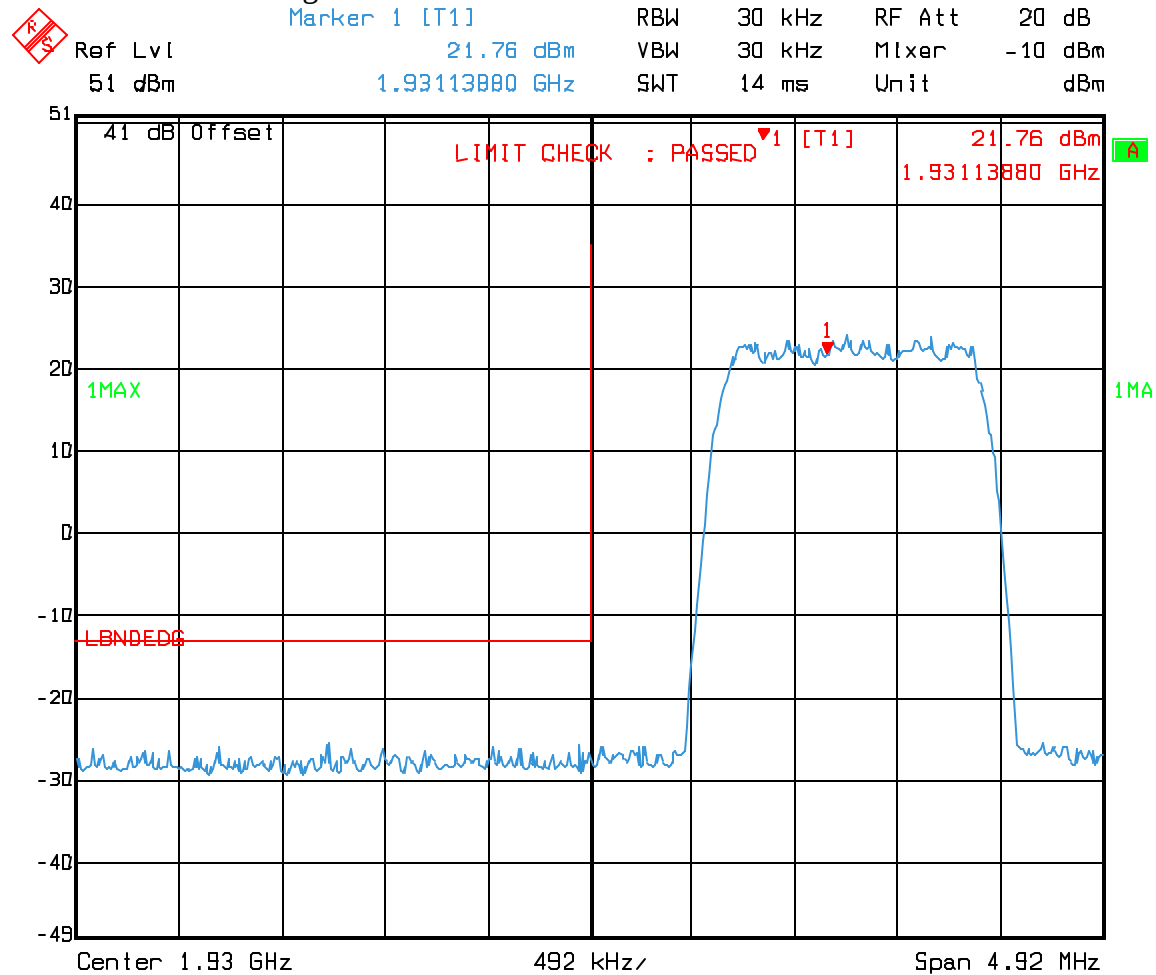
EQUIPMENT: **Optical Repeater**

FCC ID:

PROJECT NO.: **3L0498R**

Band Edge

CDMA Lower Band edge



Date: 18.DEC.2003 13:38:55

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Dallas

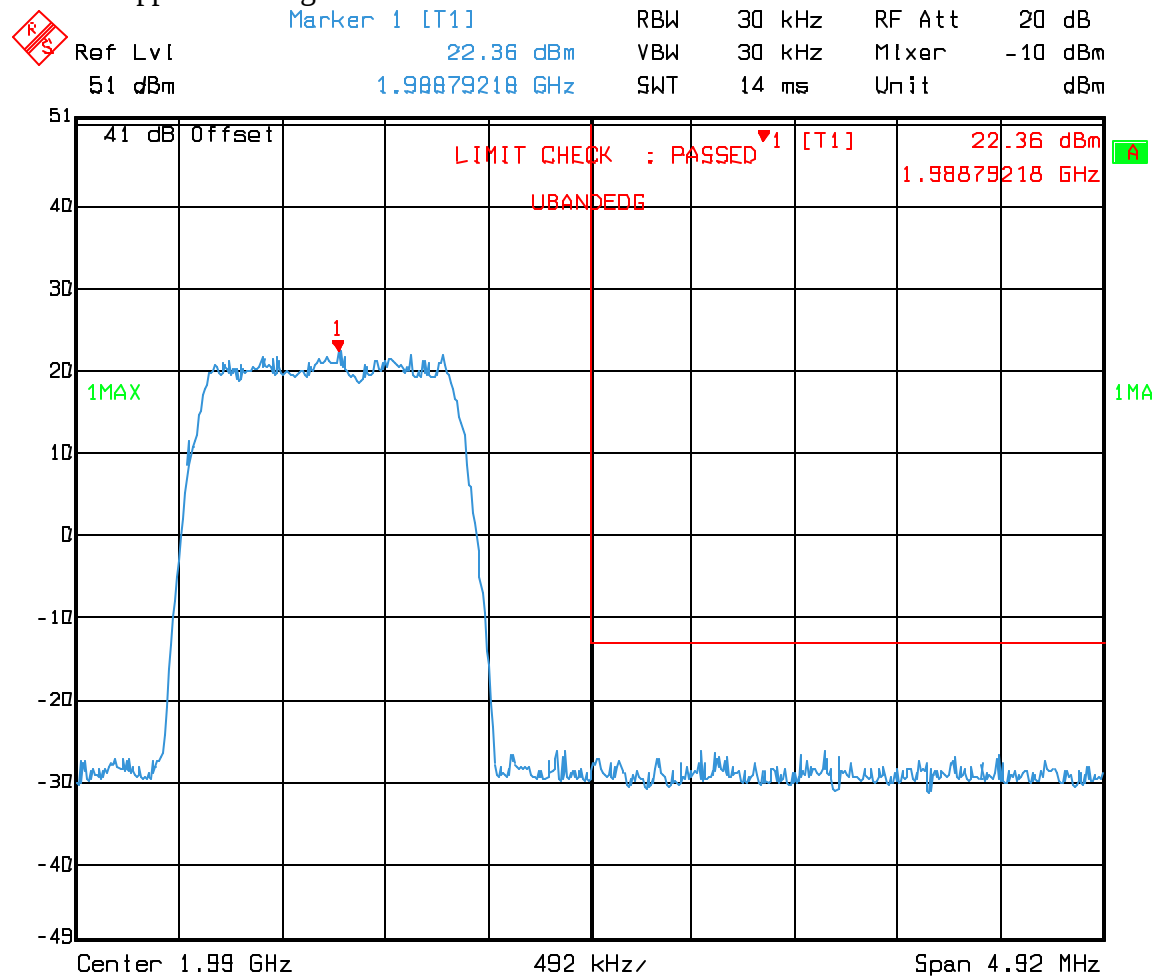
FCC PART 24, SUBPART E
BROADBAND PCS REPEATERS

EQUIPMENT: **Optical Repeater**

FCC ID:

PROJECT NO.: **3L0498R**

CDMA Upper Band edge



Date: 18.DEC.2003 13:39:50

EQUIPMENT: **Optical Repeater**

FCC ID:

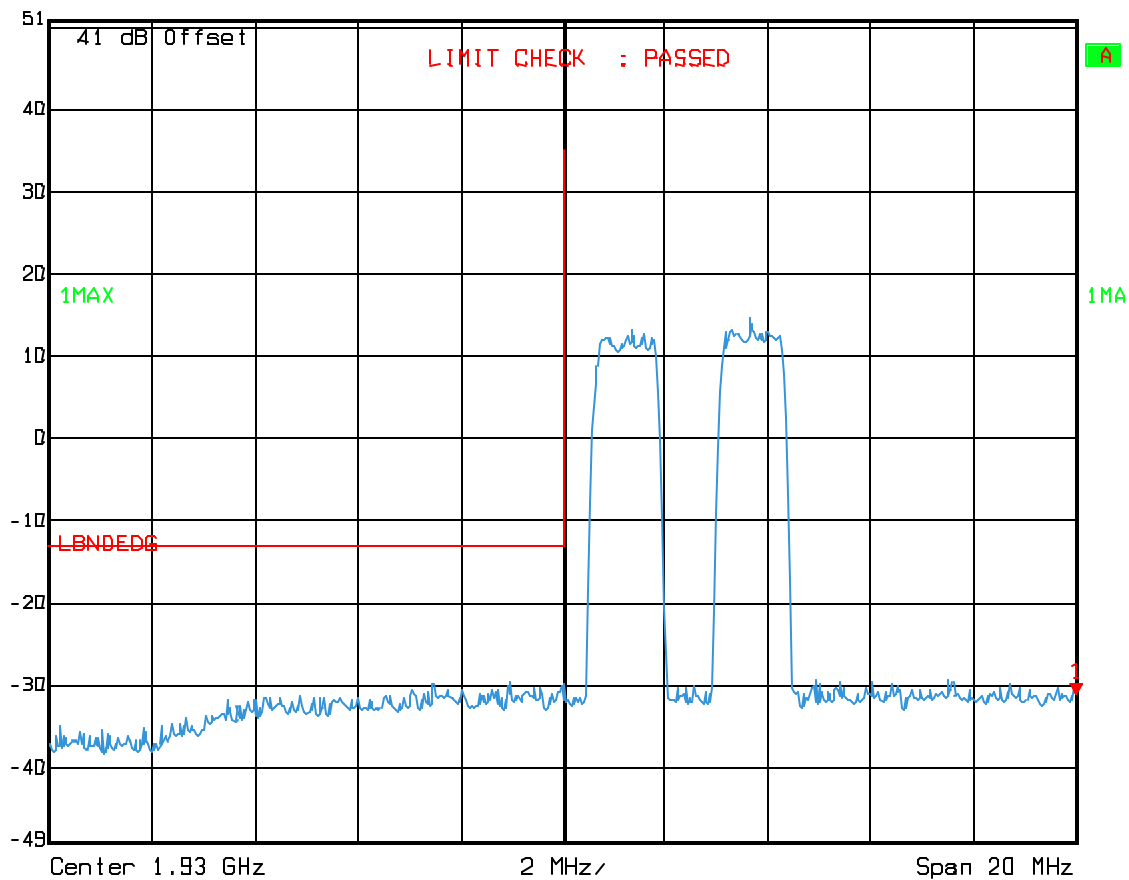
PROJECT NO.: **3L0498R**

Intermodulation

CDMA Lower



Ref Lvl	Marker 1 [T1]	RBW	30 kHz	RF Att	20 dB
51 dBm	-31.23 dBm	VBW	30 kHz	Mixer	-10 dBm
	1.94000000 GHz	SWT	56 ms	Unit	dBm



Date: 17.DEC.2003 15:40:07

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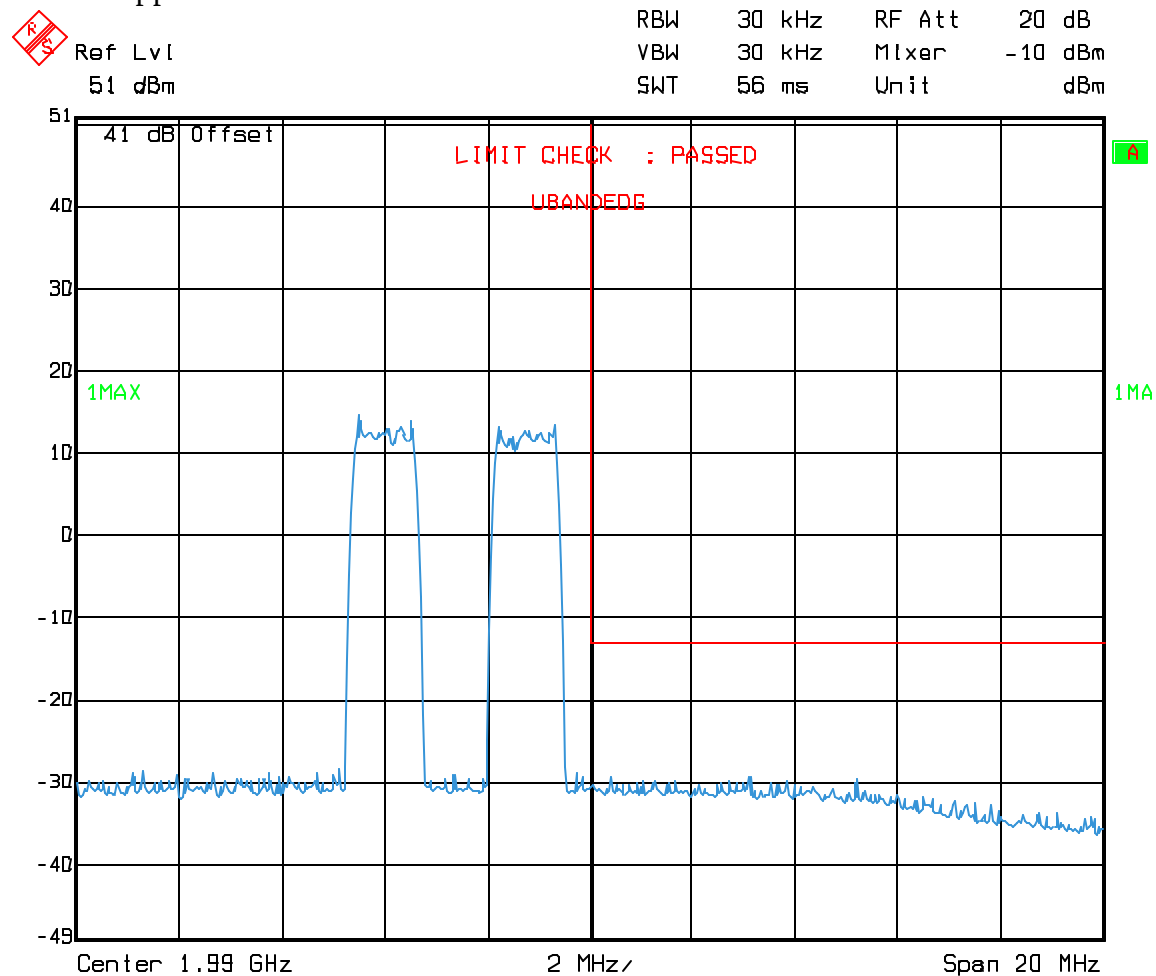
FCC PART 24, SUBPART E
BROADBAND PCS REPEATERS

EQUIPMENT: **Optical Repeater**

FCC ID:

PROJECT NO.: **3L0498R**

CDMA Upper



Date: 17.DEC.2003 15:38:32

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FCC PART 24, SUBPART E
BROADBAND PCS REPEATERS

EQUIPMENT: **Optical Repeater**

FCC ID:

PROJECT NO.: **3L0498R**

NAME OF TEST: Occupied Bandwidth (GSM)

PARA. NO.: 2.1049

TESTED BY: Dustin Oaks

DATE: 12/17/2003

Test Results: Complies.

Test Data: See attached plot(s).

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

Measurement Uncertainty: +/- 1.6 dB

Temperature: 21 °C

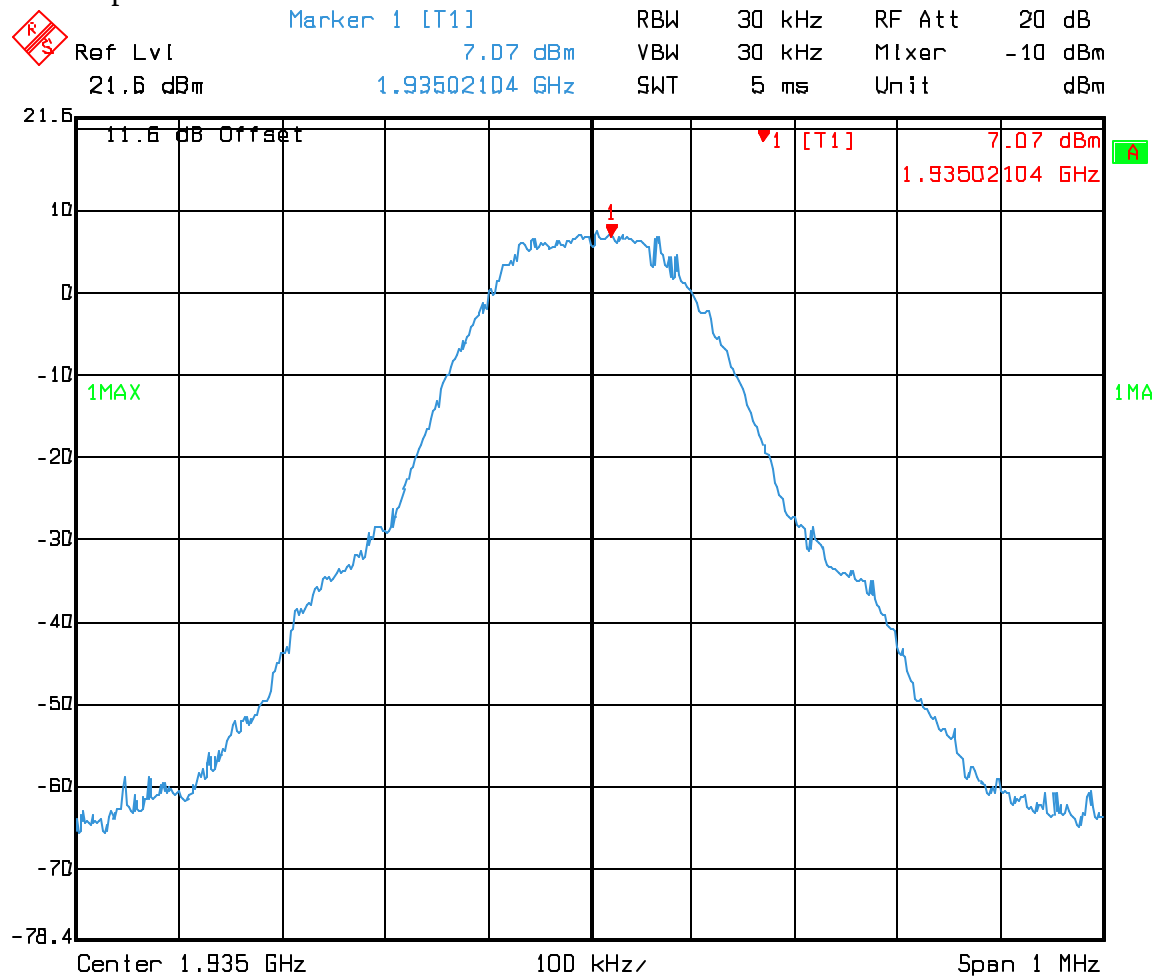
Relative Humidity: 51 %

EQUIPMENT: **Optical Repeater**

FCC ID:

PROJECT NO.: **3L0498R**

GSM Input



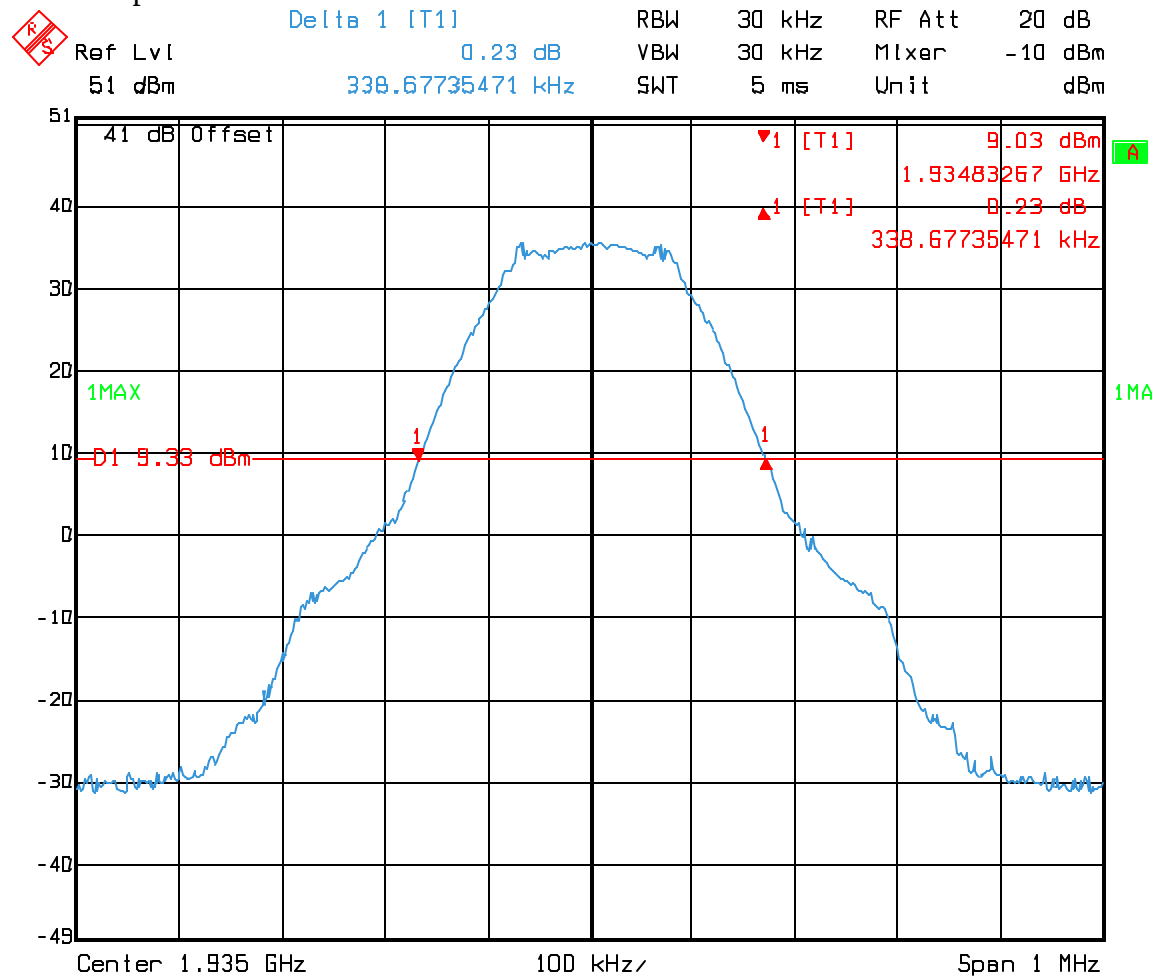
Date: 17.DEC.2003 16:27:23

EQUIPMENT: **Optical Repeater**

FCC ID:

PROJECT NO.: **3L0498R**

GSM Output



Date: 17.DEC.2003 16:25:05

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FCC PART 24, SUBPART E
BROADBAND PCS REPEATERS

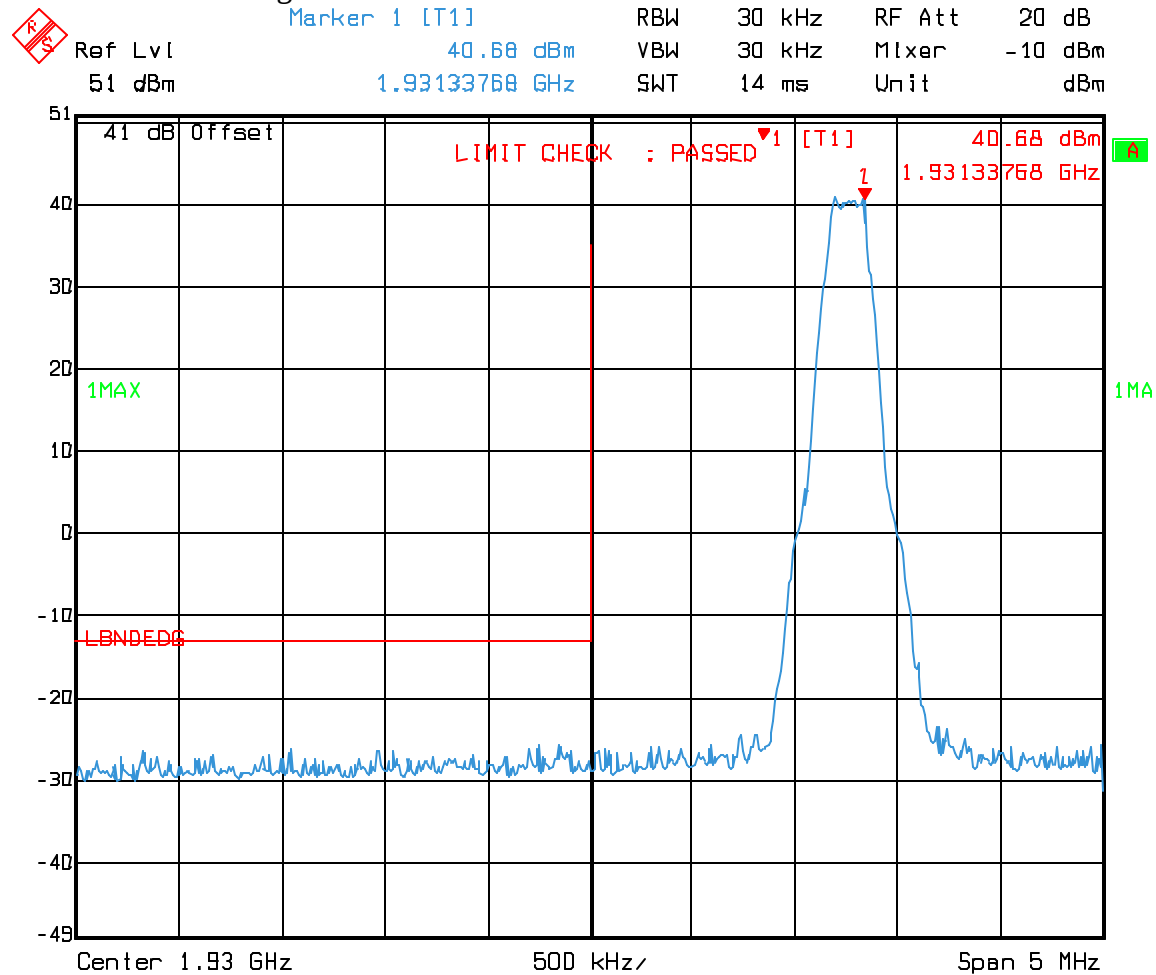
EQUIPMENT: **Optical Repeater**

FCC ID:

PROJECT NO.: **3L0498R**

Band Edge

GSM Lower Band edge



Date: 18.DEC.2003 13:33:11

Nemko
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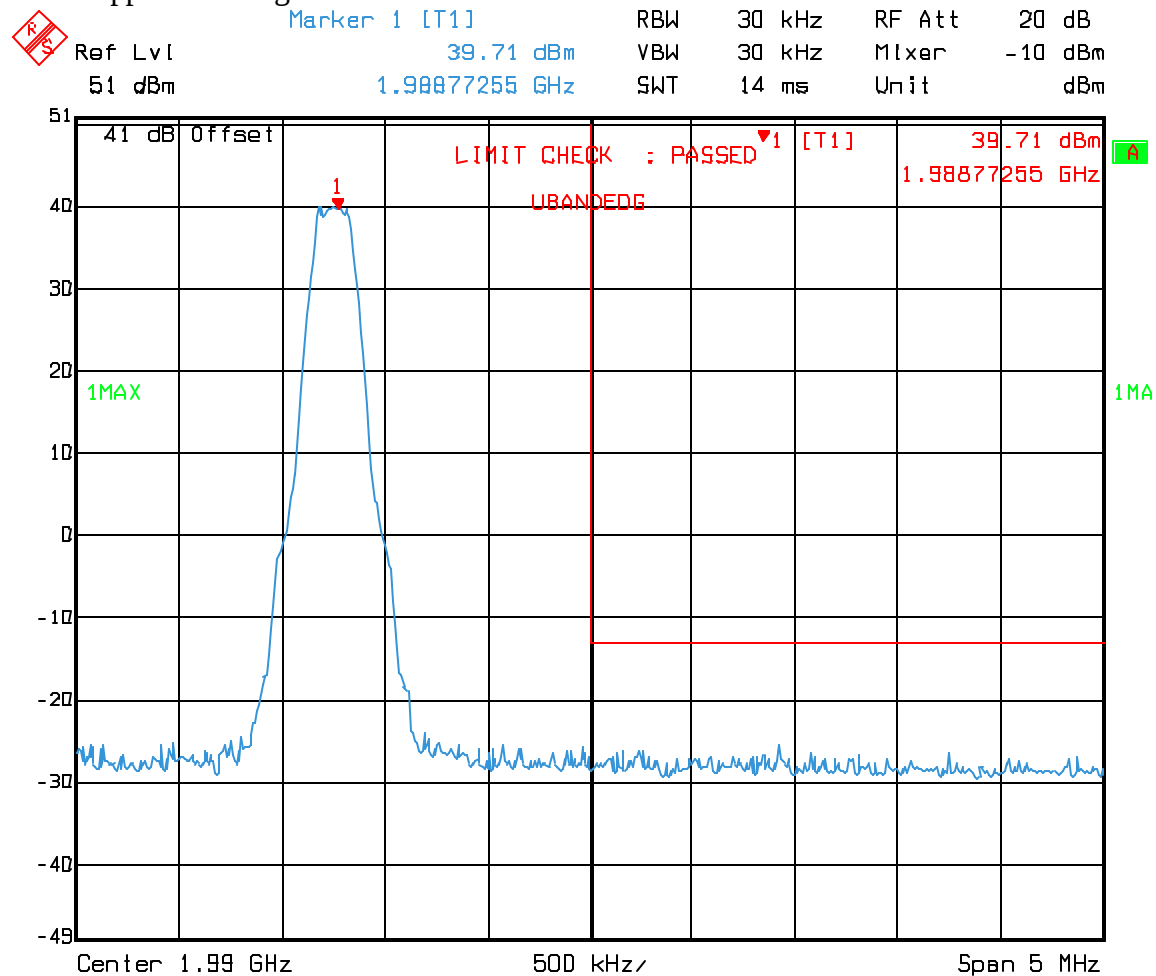
FCC PART 24, SUBPART E
BROADBAND PCS REPEATERS

EQUIPMENT: **Optical Repeater**

FCC ID:

PROJECT NO.: **3L0498R**

GSM Upper Band edge



Date: 18.DEC.2003 13:32:13

EQUIPMENT: **Optical Repeater**

FCC ID:

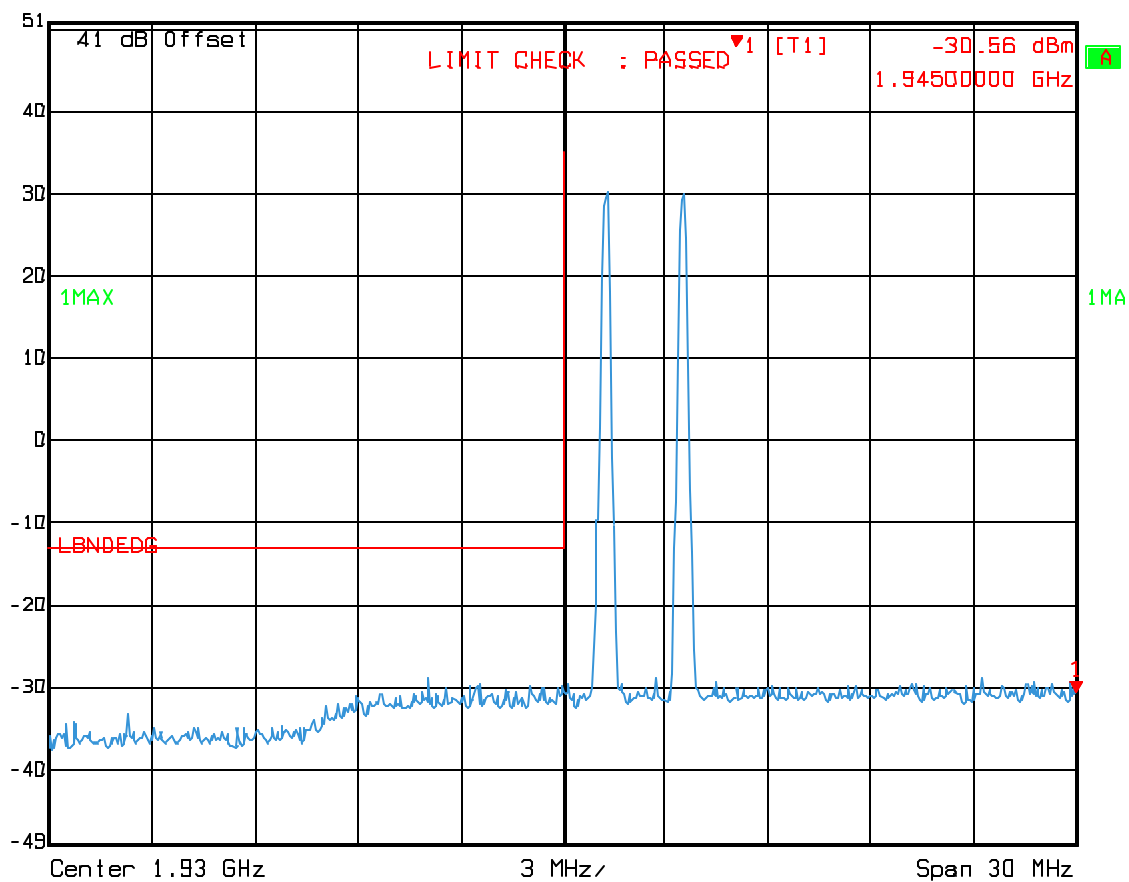
PROJECT NO.: **3L0498R**

Intermodulation

GSM Lower



Ref Lvl 51 dBm
Marker 1 [T1]
-30.56 dBm
1.94500000 GHz
RBW 30 kHz
VBW 30 kHz
SWT 84 ms
RF Att 20 dB
Mixer -10 dBm
Unit dBm



Date: 17.DEC.2003 16:37:23

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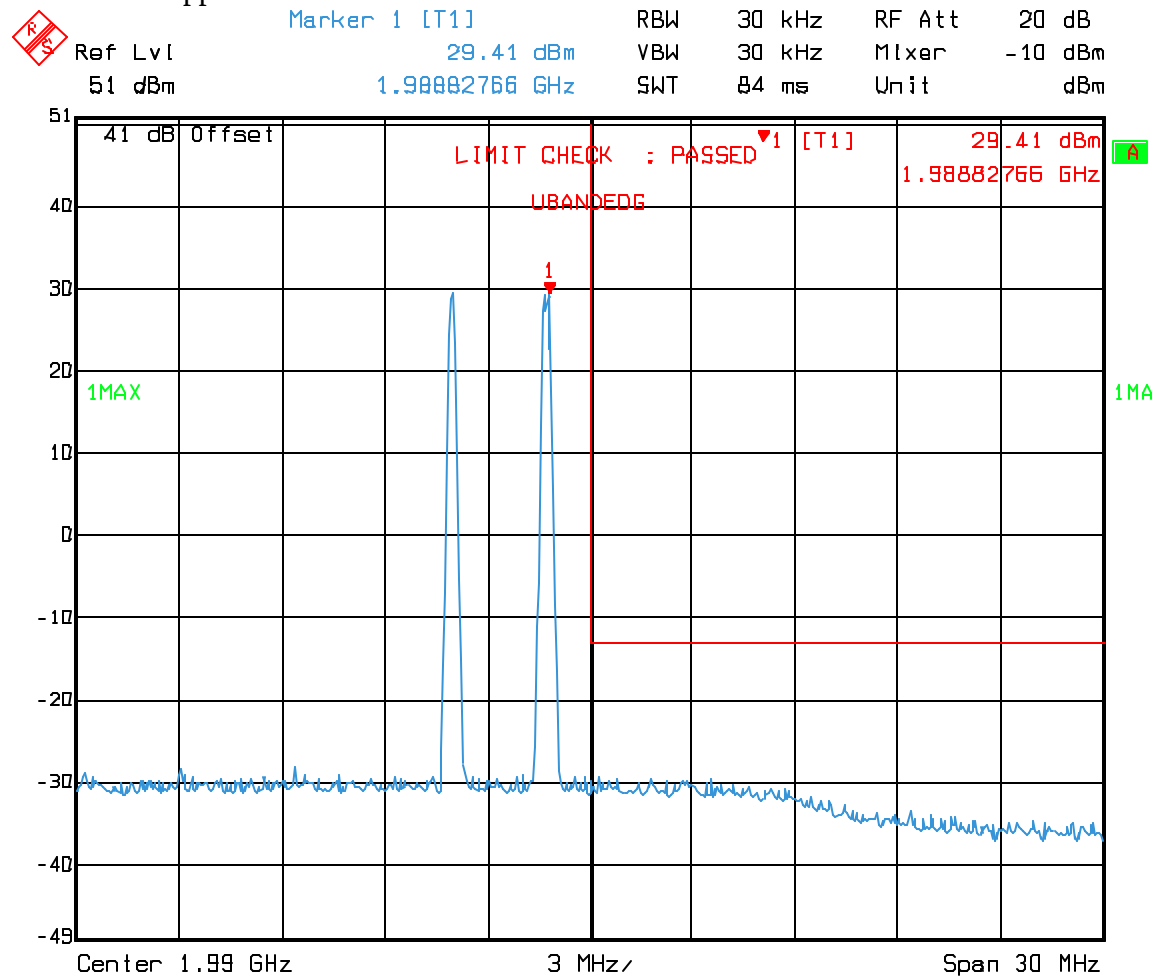
FCC PART 24, SUBPART E
BROADBAND PCS REPEATERS

EQUIPMENT: **Optical Repeater**

FCC ID:

PROJECT NO.: **3L0498R**

1900 GSM Upper



Date: 17.DEC.2003 16:35:57

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FCC PART 24, SUBPART E
BROADBAND PCS REPEATERS

EQUIPMENT: **Optical Repeater**

FCC ID:

PROJECT NO.: **3L0498R**

NAME OF TEST: Occupied Bandwidth (NADC)

PARA. NO.: 2.1049

TESTED BY: Dustin Oaks

DATE: 12/17/2003

Test Results: Complies.

Test Data: See attached plot(s).

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

Measurement Uncertainty: +/- 1.6 dB

Temperature: 21 °C

Relative Humidity: 51 %

EQUIPMENT: **Optical Repeater**

FCC ID:

PROJECT NO.: **3L0498R**

TDMA Input



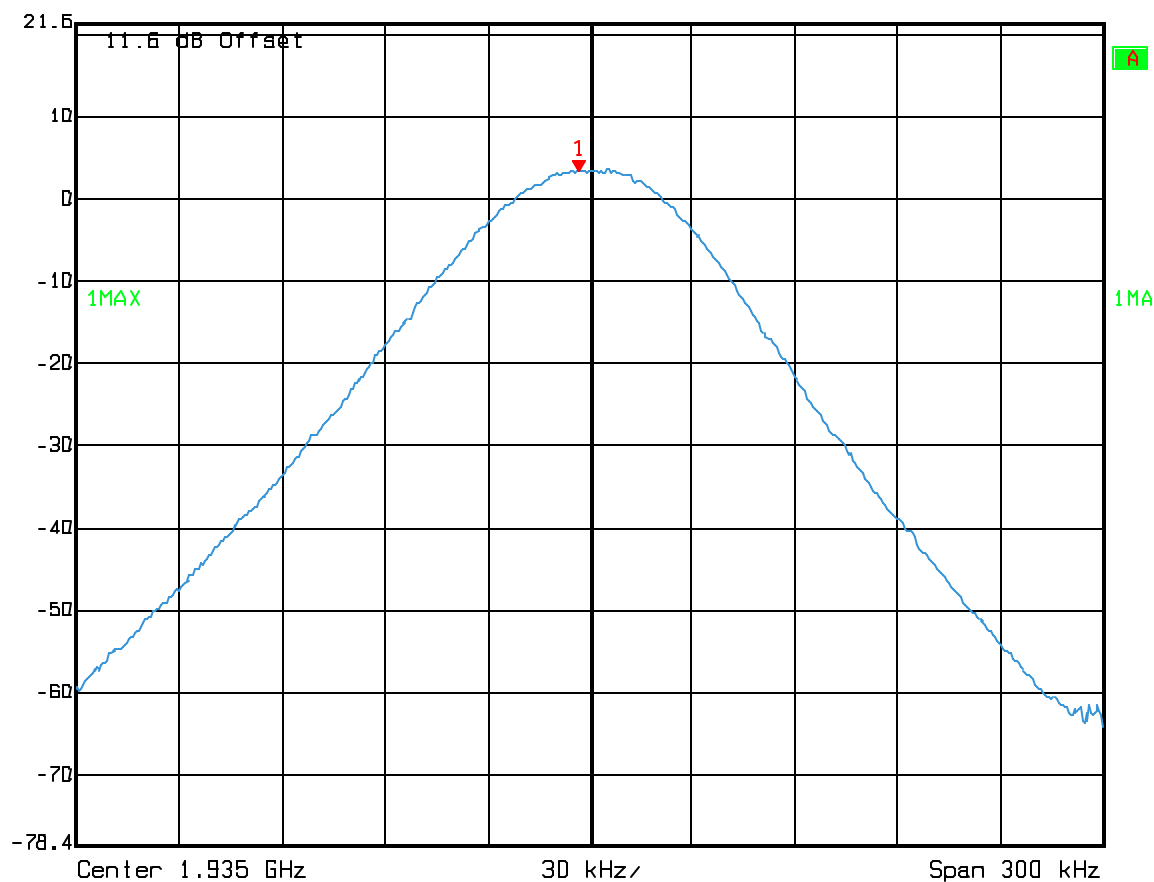
Ref Lvl
21.6 dBm

Marker 1 [T1]

3.55 dBm

1.93499669 GHz

RBW	30 kHz	RF Att	20 dB
VBW	30 kHz	Mixer	-10 dBm
SWT	5 ms	Unit	dBm



Date: 17.DEC.2003 16:16:35

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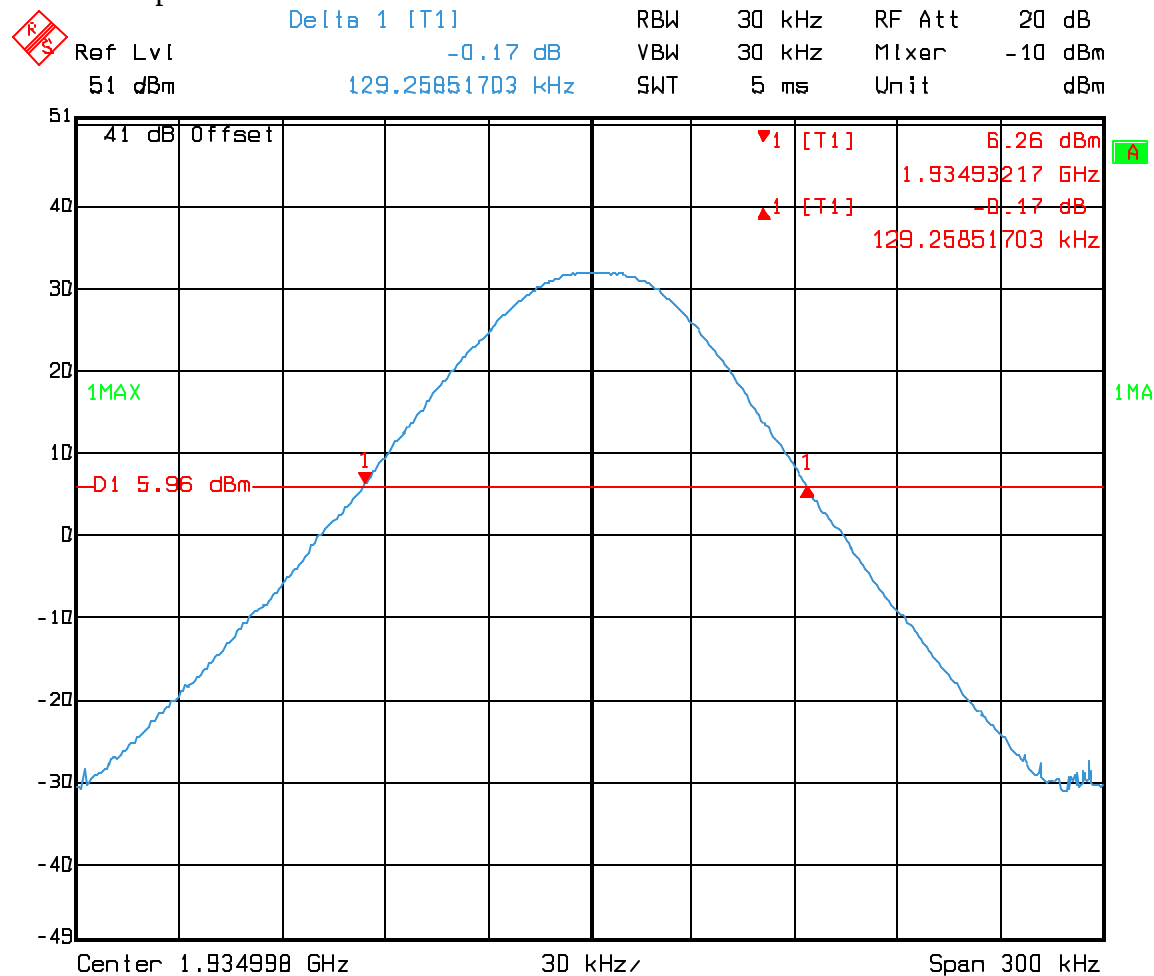
FCC PART 24, SUBPART E
BROADBAND PCS REPEATERS

EQUIPMENT: **Optical Repeater**

FCC ID:

PROJECT NO.: **3L0498R**

TDMA Output



Date: 17.DEC.2003 15:58:57

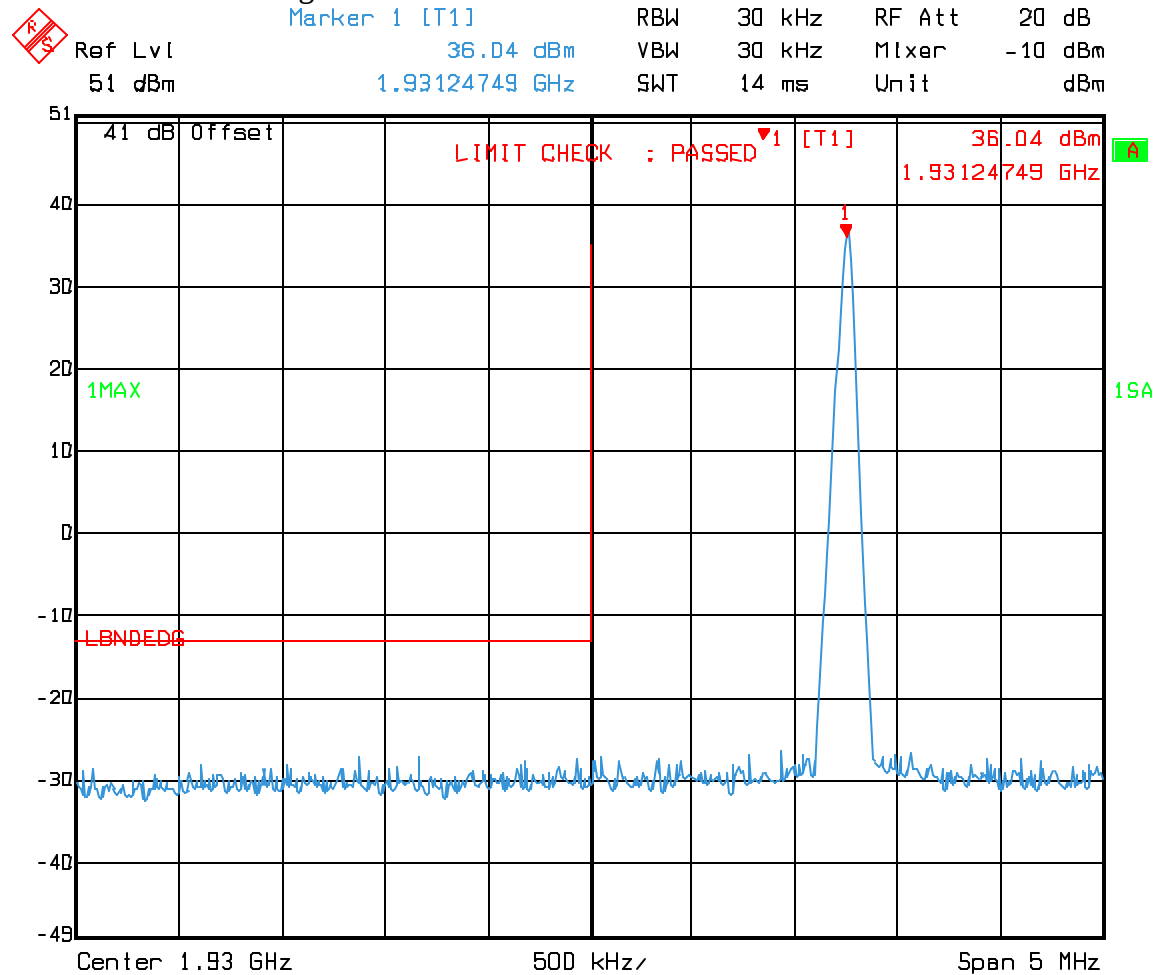
EQUIPMENT: **Optical Repeater**

FCC ID:

PROJECT NO.: **3L0498R**

Band Edge

TDMA Lower Band edge



Date: 18.DEC.2003 13:22:36

Nemko
Dallas

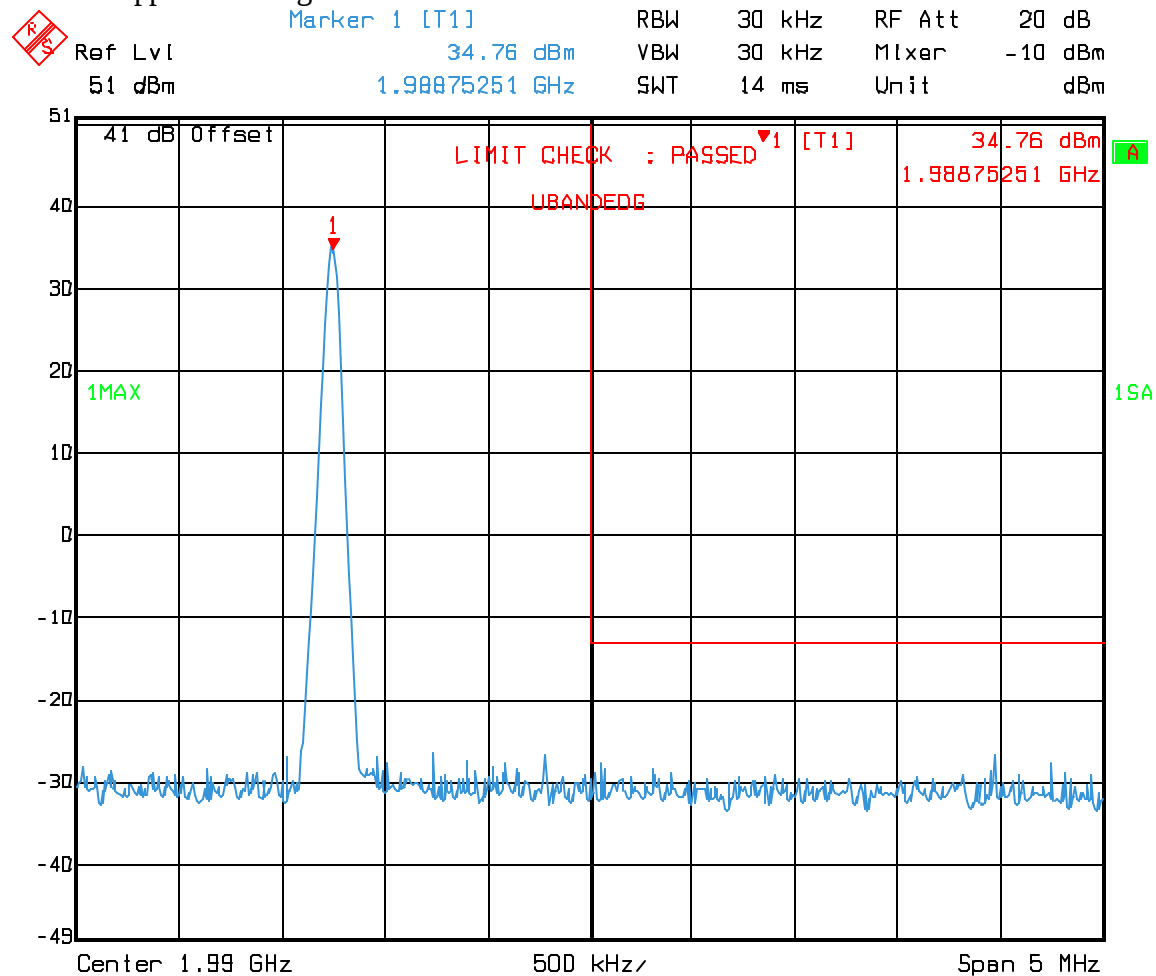
FCC PART 24, SUBPART E
BROADBAND PCS REPEATERS

EQUIPMENT: **Optical Repeater**

FCC ID:

PROJECT NO.: **3L0498R**

TDMA Upper Band edge



Date: 18.DEC.2003 13:25:00

EQUIPMENT: **Optical Repeater**

FCC ID:

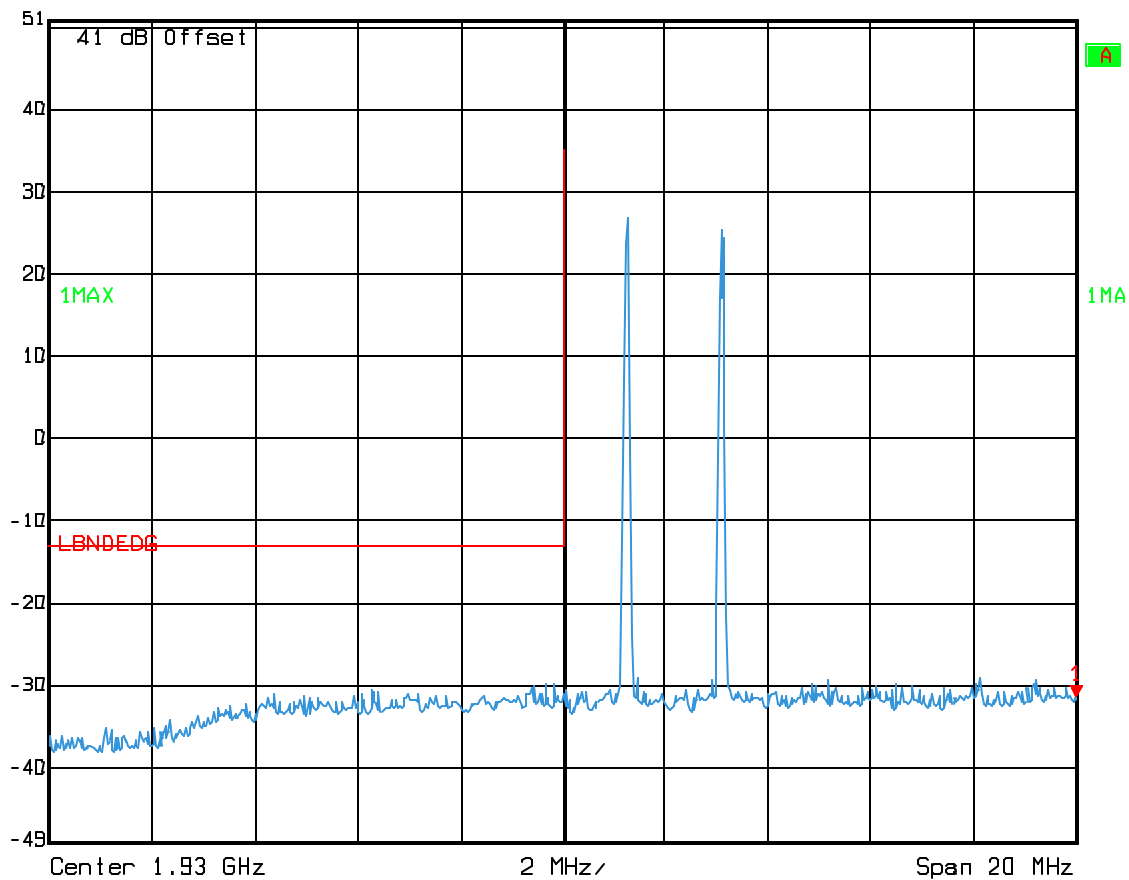
PROJECT NO.: **3L0498R**

Intermodulation

TDMA Lower



Ref Lvl	Marker 1 [T1]	RBW	30 kHz	RF Att	20 dB
51 dBm	-31.42 dBm	VBW	30 kHz	Mixer	-10 dBm
	1.94000000 GHz	SWT	56 ms	Unit	dBm



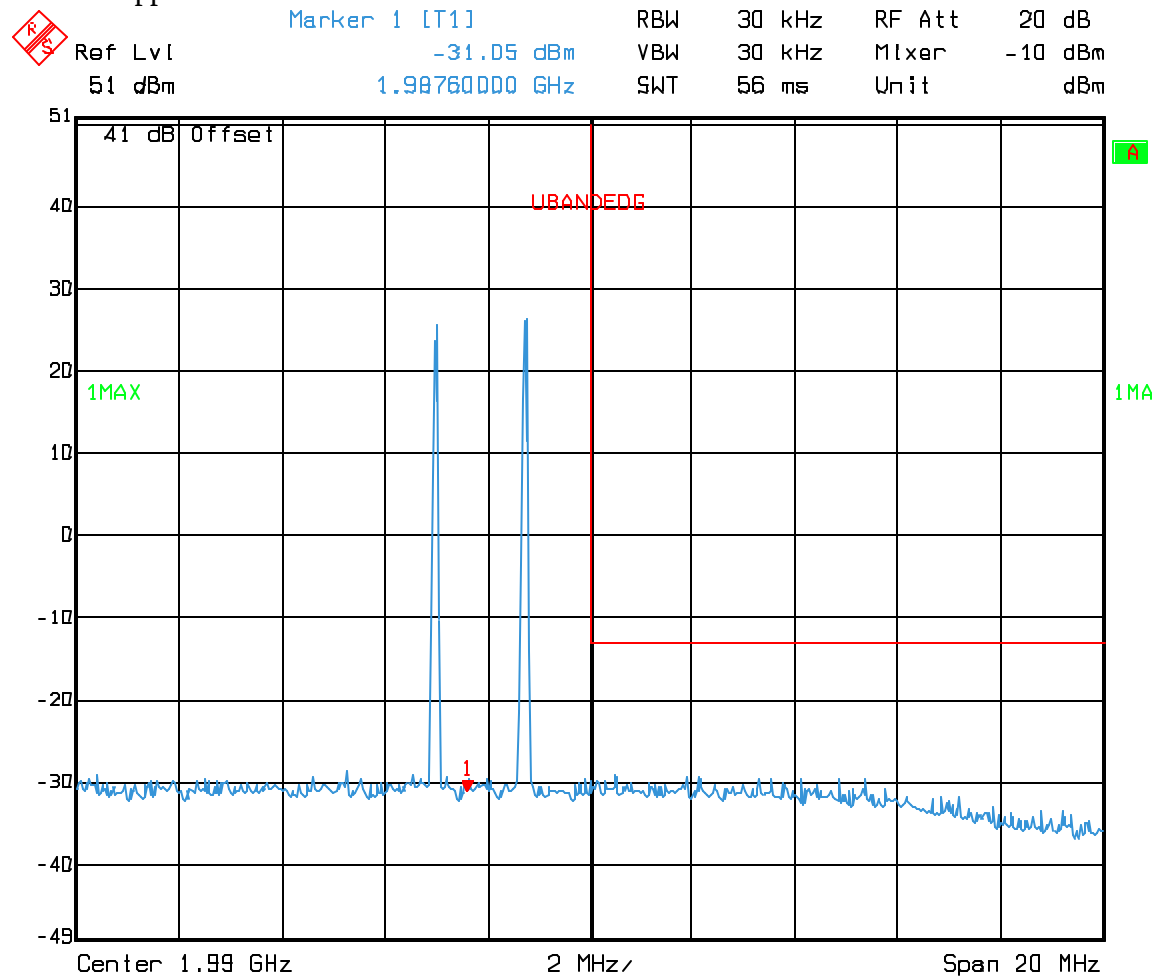
Date: 17.DEC.2003 16:09:05

EQUIPMENT: **Optical Repeater**

FCC ID:

PROJECT NO.: **3L0498R**

TDMA Upper



Date: 17.DEC.2003 16:07:25

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FCC PART 24, SUBPART E
BROADBAND PCS REPEATERS

EQUIPMENT: Optical Repeater

FCC ID:

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: 12/17/2003

Test Results: Complies.

Test Data: See attached plot(s).

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

Measurement Uncertainty: +/- 1.6 dB

Temperature: 21 °C

Relative Humidity: 51 %

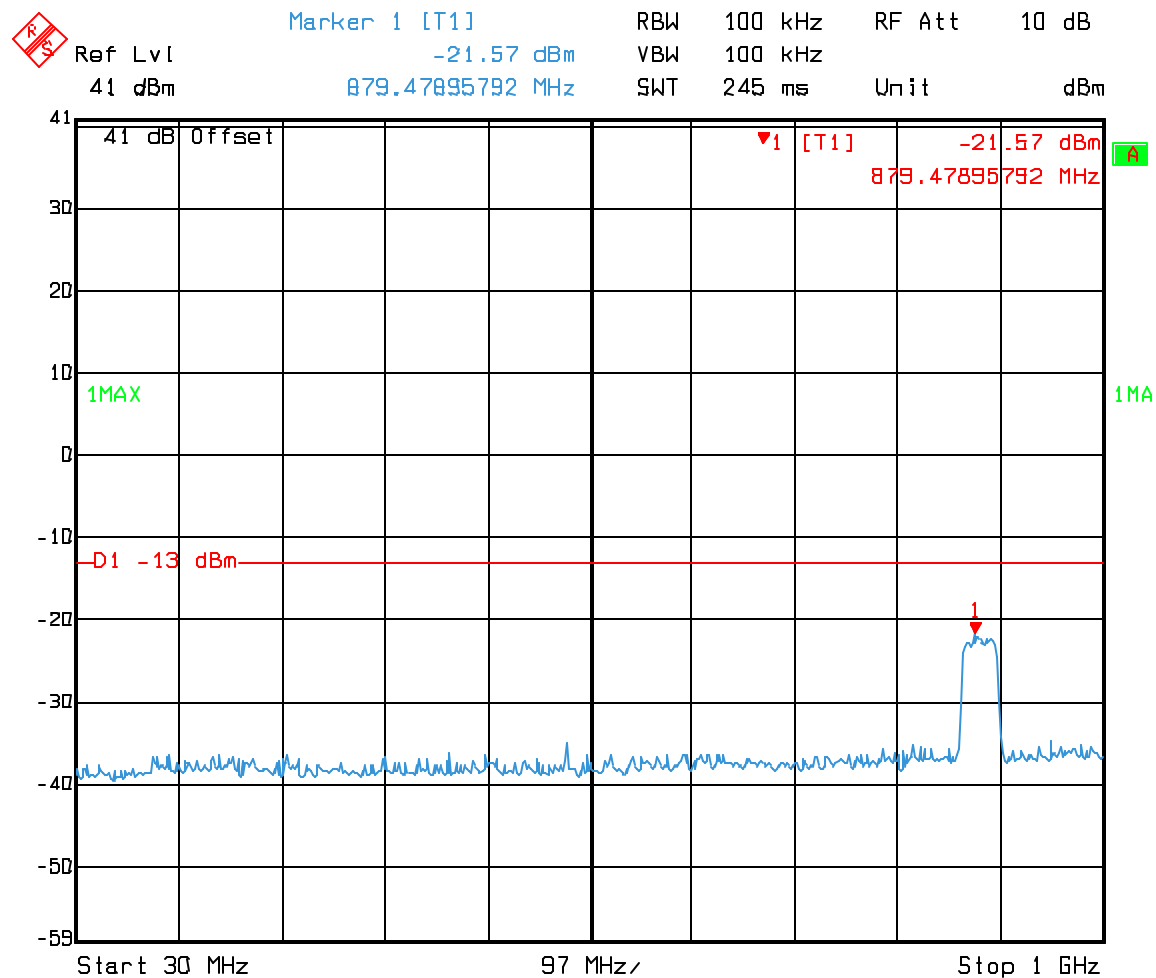
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FCC PART 24, SUBPART E
BROADBAND PCS REPEATERS

EQUIPMENT: **Optical Repeater**

FCC ID:

PROJECT NO.: **3L0498R**



Date: 16.DEC.2003 17:48:08

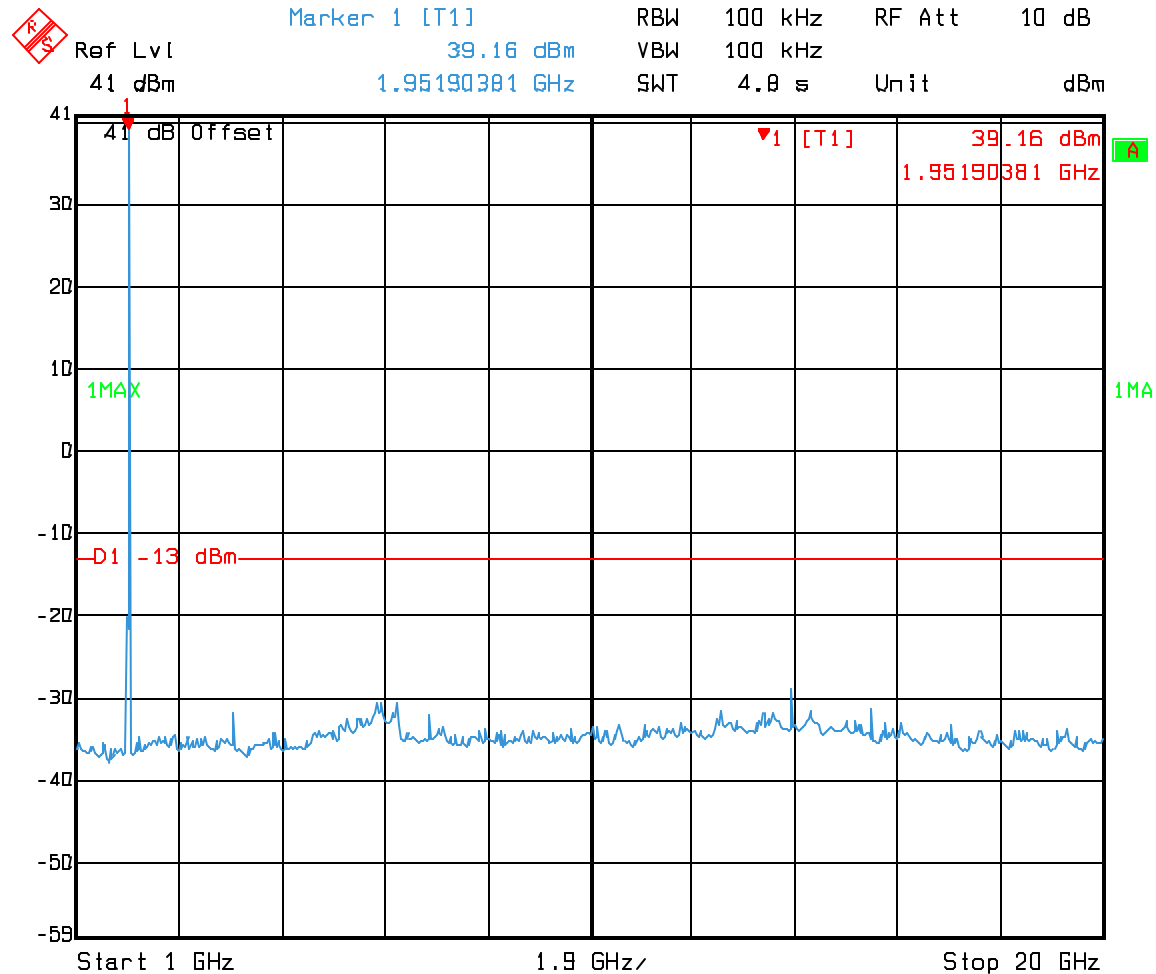
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FCC PART 24, SUBPART E
BROADBAND PCS REPEATERS

EQUIPMENT: **Optical Repeater**

FCC ID:

PROJECT NO.: **3L0498R**



Date: 16.DEC.2003 17:51:08

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FCC PART 24, SUBPART E
BROADBAND PCS REPEATERS

EQUIPMENT: Optical Repeater

FCC ID:

PROJECT NO.: 3L0498R

Section 6. Field Strength of Spurious

NAME OF TEST: Field Strength of Spurious Emissions

PARA. NO.: 2.1051

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: +/- 6 dB

Temperature: 21 °C

Relative Humidity: 51 %

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BROADBAND PCS REPEATERS

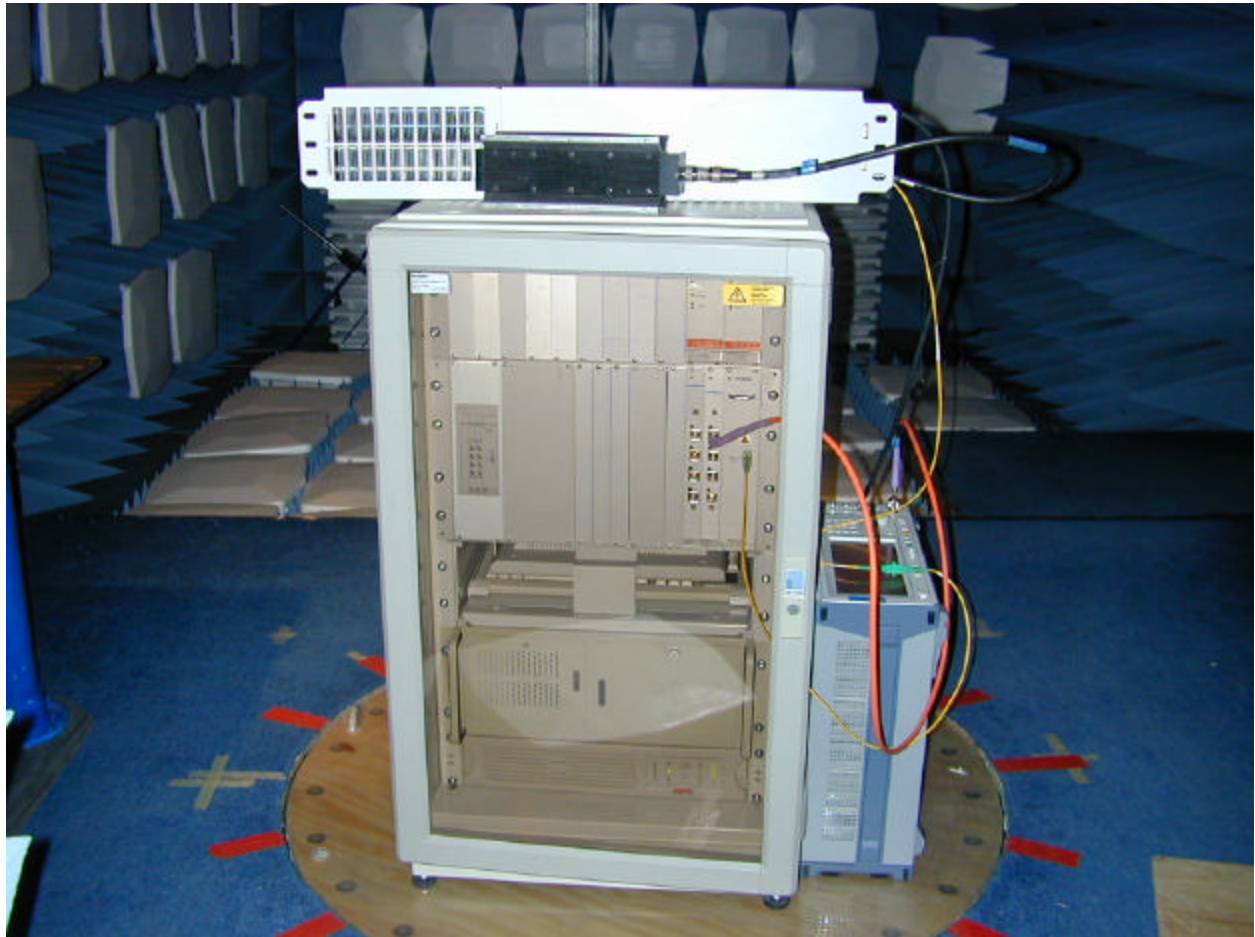
EQUIPMENT: **Optical Repeater**

FCC ID:

PROJECT NO.: **3L0498R**

Photographs of Test Setup

FRONT VIEW



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BROADBAND PCS REPEATERS

EQUIPMENT: **Optical Repeater**

FCC ID:

PROJECT NO.: **3L0498R**

REAR VIEW



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FCC PART 24, SUBPART E
BROADBAND PCS REPEATERS

EQUIPMENT: Optical Repeater

FCC ID:

PROJECT NO.: 3L0498R

Section 7. Frequency Stability

NAME OF TEST: Frequency Stability	PARA. NO.: 2.1055
TESTED BY:	DATE:

Test Results: Not Applicable

Measurement Data: See attached table.

Standard Test Frequency: MHz
Standard Test Voltage:

Equipment Used:

Measurement Uncertainty: +/- 1.6 dB

Lab Temperature: ?C

Relative Humidity: %

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FCC PART 24, SUBPART E
BROADBAND PCS REPEATERS

EQUIPMENT: Optical Repeater

FCC ID:

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

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FCC PART 24, SUBPART E
BROADBAND PCS REPEATERS

EQUIPMENT: **Optical Repeater**

FCC ID:

PROJECT NO.: **3L0498R**

ANNEX A - TEST DETAILS

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FCC PART 24, SUBPART E
BROADBAND PCS REPEATERS

EQUIPMENT: Optical Repeater

FCC ID:

PROJECT NO.: 3L0498R

NAME OF TEST: RF Power Output

PARA. NO.: 2.1046

Minimum Standard:

Para. No.24.232. Base stations are limited to 1640 watts peak E.I.R.P. with an antenna height up to 300 meters HAAT. In no case may the peak output power of a base station transmitter exceed 100 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:

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

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 24, SUBPART E
BROADBAND PCS REPEATERS

EQUIPMENT: Optical Repeater

FCC ID:

PROJECT NO.: 3L0498R

NAME OF TEST: Occupied Bandwidth

PARA. NO.: 2.1047

Minimum Standard:

Para. No. 24.238(b). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB.

Method Of Measurement:

CDMA

Spectrum analyzer settings:

RBW: 30 kHz

VBW: ? RBW

Span: 5 MHz

Sweep: Auto

Mask: Set markers to -26 dB from peak of CW.

GSM

RBW: 3 kHz

VBW: ? RBW

Span: 2 MHz

Sweep: Auto

Mask: Set markers to -26 dB from peak of CW.

NADC

RBW: 1 kHz

VBW: ? RBW

Span: 1 MHz

Sweep: Auto

Mask: Set markers to -26 dB from peak of CW.

EQUIPMENT: Optical Repeater

FCC ID:

PROJECT NO.: 3L0498R

NAME OF TEST: Spurious Emission at Antenna Terminals

PARA. NO.: 2.1051

Minimum Standard:

Para. No.24.238(a). On any frequency outside a licensee's frequency block, the power of any emission shall be attenuated below the transmitter power by at least $43 + 10 \log (P)$ dB.

Method Of Measurement:

Spectrum analyzer settings:

CDMA

RBW: 1 MHz (> 1 MHz from Band Edge)
RBW: 30 kHz (< 1MHz from Band Edge)
VBW: ? RBW
Sweep: Auto
Video Avg: 6 Sweeps

GSM

RBW: 1 MHz (> 1 MHz from Band Edge)
RBW: 3 kHz (< 1 MHz from Band Edge)
VBW: ? RBW
Sweep: Auto
Video Avg: Disabled

NADC

RBW: 1 MHz (> 1 MHz from Band Edge)
RBW: 3 kHz (< 1 MHz from Band Edge)
VBW: ? RBW
Sweep: Auto
Video Avg: Disabled

To demonstrate compliance at band edges the frequency of the input signal is set to the bwest and highest assigned channel and the center frequency of the spectrum analyzer is set to the upper and lower edges of the appropriate frequency block.

EQUIPMENT: Optical Repeater

FCC ID:

PROJECT NO.: 3L0498R

NAME OF TEST: Field Strength of Spurious Radiation

PARA. NO.: 2.1053

Minimum Standard:

Para. No.24.238(a). On any frequency outside a licensee's frequency block, the power of any emission shall be attenuated below the transmitter power by at least $43 + 10 \log (P)$ dB.

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)

$R = 3m$ (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)

$R = 3m$ (Measurement Distance)

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

EQUIPMENT: Optical Repeater

FCC ID:

PROJECT NO.: 3L0498R

NAME OF TEST: Frequency Stability	PARA. NO.: 2.1055
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Minimum Standard:

Para. No. 24.235. The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

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.

Nemko
Dallas

FCC PART 24, SUBPART E
BROADBAND PCS REPEATERS

EQUIPMENT: **Optical Repeater**

FCC ID:

PROJECT NO.: **3L0498R**

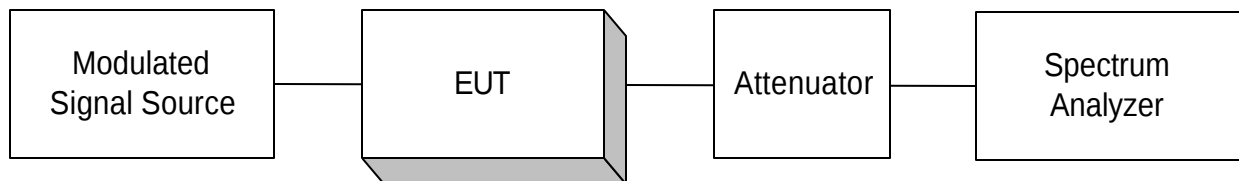
ANNEX B - TEST DIAGRAMS

EQUIPMENT: Optical Repeater

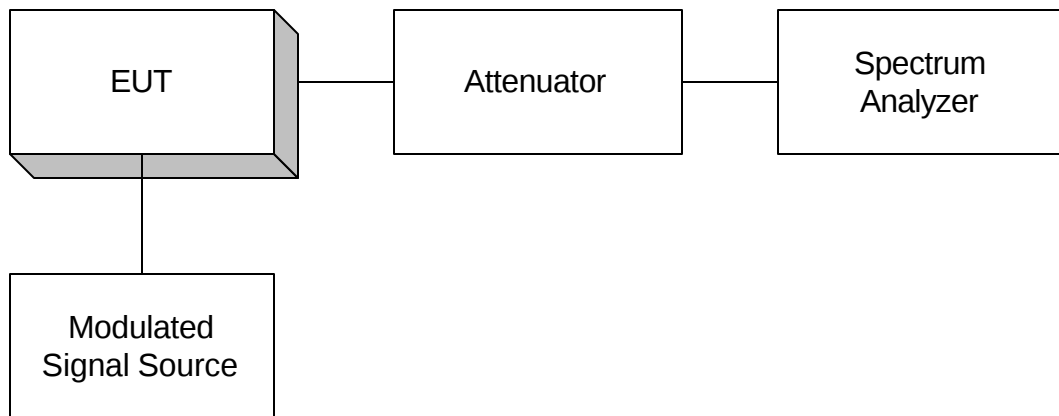
FCC ID:

PROJECT NO.: 3L0498R

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



Para. No. 2.989 - Occupied Bandwidth

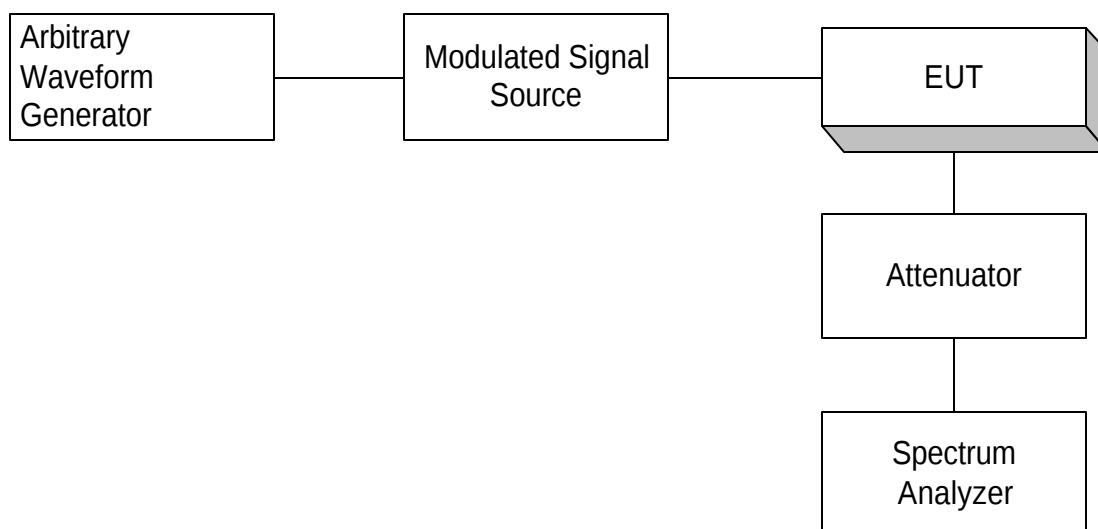
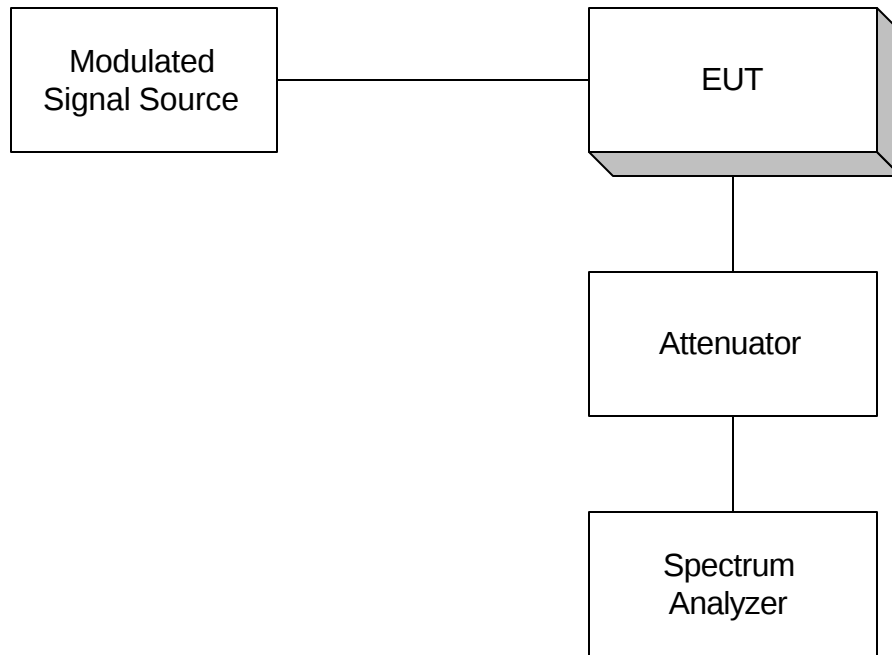


EQUIPMENT: **Optical Repeater**

FCC ID:

PROJECT NO.: **3L0498R**

Para. No. 2.991 Spurious Emissions at Antenna Terminals

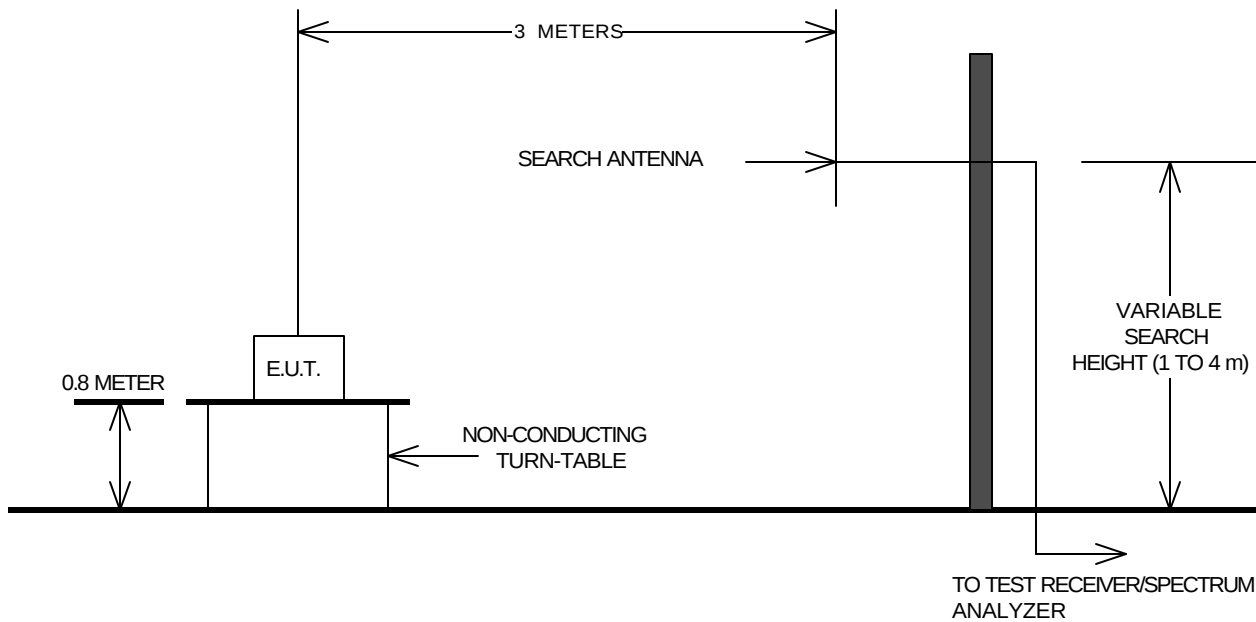


EQUIPMENT: Optical Repeater

FCC ID:

PROJECT NO.: 3L0498R

Para. No. 2.993 - Field Strength of Spurious Radiation



Para. No. 2.995 - Frequency Stability

EQUIPMENT: Optical Repeater

FCC ID:

PROJECT NO.: 3L0498R

