



**KTL Ottawa**

*Safety - EMI - Telecom - ISO Guide 25*

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**CLASS II PERMISSIVE CHANGE  
ENGINEERING TEST REPORT**

**ON:  
THE ADC TELECOMMUNICATIONS  
"MICROLINK 1900 BI-DIRECTIONAL AMPLIFIER"**

**FCC ID: NFRML1900**

**IN ACCORDANCE WITH:  
FCC PART 24, SUBPART E  
BROADBAND PCS REPEATERS**

**PROJECT NO.: 8R00382**

**ADC TELECOMMUNICATIONS  
700 WEST GEORGIA STREET, SUITE 1500  
VANCOUVER, BC V7Y 1A1**

**TESTED BY:**

**KTL OTTAWA INC.  
3325 RIVER ROAD, R.R. 5  
OTTAWA, ONTARIO K1V 1H2**



**NVLAP LAB CODE: 100351-0**

**JUNE 1998**

**This document contains 54 pages including this one.**

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**This report applies only to the items tested.**

*EQUIPMENT: Microlink 1900 Bi-Directional Amplifier*  
*FCC ID: NFRML1900*

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*EQUIPMENT: Microlink 1900 Bi-Directional Amplifier*  
*FCC ID: NFRML1900*

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EQUIPMENT: *Microlink 1900 Bi-Directional Amplifier*  
FCC ID: *NFRML1900*

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**Section 1. Summary of Test Results**

Manufacturer: ADC Telecommunications

Model No.: ML1900

Serial No.: None

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".

**NVLAP****NVLAP LAB CODE: 100351-0**TESTED BY: Kevin Carr  
Kevin Carr, TechnologistDATE: 09 June 1998TECHNICAL REVIEW: Tom Tidwell  
Tom Tidwell, Senior TechnologistDATE: 9 June 1998APPROVED BY: W. Waterhouse  
W. Waterhouse, RF Engineering Lab ManagerDATE: 9th June 1998

EQUIPMENT: Microlink 1900 Bi-Directional Amplifier  
FCC ID: NFRML1900

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**Summary Of Test Data**

NAME OF TEST	PARA. NO.	SPEC.	MEAS.	RESULT
RF Power Output	24.232	100W	+22 dBm	Complies
Occupied Bandwidth (CDMA)	24.238	Input/Output	N/A	N/A
Occupied Bandwidth (GSM)	24.238	Input/Output	N/A	N/A
Occupied Bandwidth (NADC)	24.238	Input/Output	N/A	N/A
Spurious Emissions at Antenna Terminals	24.238(a)	-13 dBm	-23 dBm	Complies
Field Strength of Spurious Emissions	24.238(a)	-13 dBm E.I.R.P.	-29.9 dBm	Complies
Frequency Stability	24.235		N/A	N/A

**Footnotes For N/A's:**

Since the only component modification is to add 5 MHz and 10 MHz SAW filter options; only one direction was tested (Uplink), and only RF Power Output and Spurious Emissions were tested.

Field Strength of Spurious was re-measured to verify compliance with PCB Shield (SH18) removed.

**Test Conditions:**

Temperature: 24 °C  
Humidity: 23 %

EQUIPMENT: Microlink 1900 Bi-Directional Amplifier  
FCC ID: NFRML1900

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## Section 2. General Equipment Specification

Supply Voltage Input:	120 VAC			
Frequency Range:	Downlink:	1930 - 1990 MHz		
Frequency Range:	Uplink:	1850 - 1910 MHz		
20 dB Bandwidth:		2.5 MHz Nominal (1.25 MHz IF) 6.5 MHz Nominal (5 MHz IF) 12 MHz Nominal (10 MHz IF)		
Type of Modulation and Designator:		CDMA (F9W) <input checked="" type="checkbox"/>	GSM (GXW) <input checked="" type="checkbox"/>	NADC (DXW) <input checked="" type="checkbox"/>
AGC Threshold:		+17 dBm(CW)		
Output Impedance:		50 ohms		
Gain:		40 - 70 dB		
Max Input Power:		-30 dBm		
RF Output (Rated):	Single: Composite:	N/A +21.0 dBm (CDMA) +17 dBm (GSM) +18.5 dBm (NADC)		
Frequency Translation:		F1-F1 <input checked="" type="checkbox"/>	F1-F2 <input type="checkbox"/>	N/A <input type="checkbox"/>
Band Selection:		Software <input checked="" type="checkbox"/>	Duplexer Change <input type="checkbox"/>	Fullband Coverage <input type="checkbox"/>

*EQUIPMENT: Microlink 1900 Bi-Directional Amplifier*  
*FCC ID: NFRML1900*

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### **Description of Modifications For Class II Permissive Change**

This filing is to add as alternate construction the replacement of the SAW filters (FL5 and FL8) in the forward and reverse IF sections with 1.25 MHz, 5 MHz or 10 MHz SAW filters.

In addition, the overall PCB Shield (SH18) was removed. Radiated spurious (case leakage) testing was performed for FCC Part 24 approval and there was no change in field strength levels when compared to results with this shield installed.

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FCC PART 24, SUBPART E  
BROADBAND PCS REPEATERS  
PROJECT NO.: 8R00382

*EQUIPMENT: Microlink 1900 Bi-Directional Amplifier*  
*FCC ID: NFRML1900*

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**Modifications Made During Testing**

**NOT APPLICABLE**

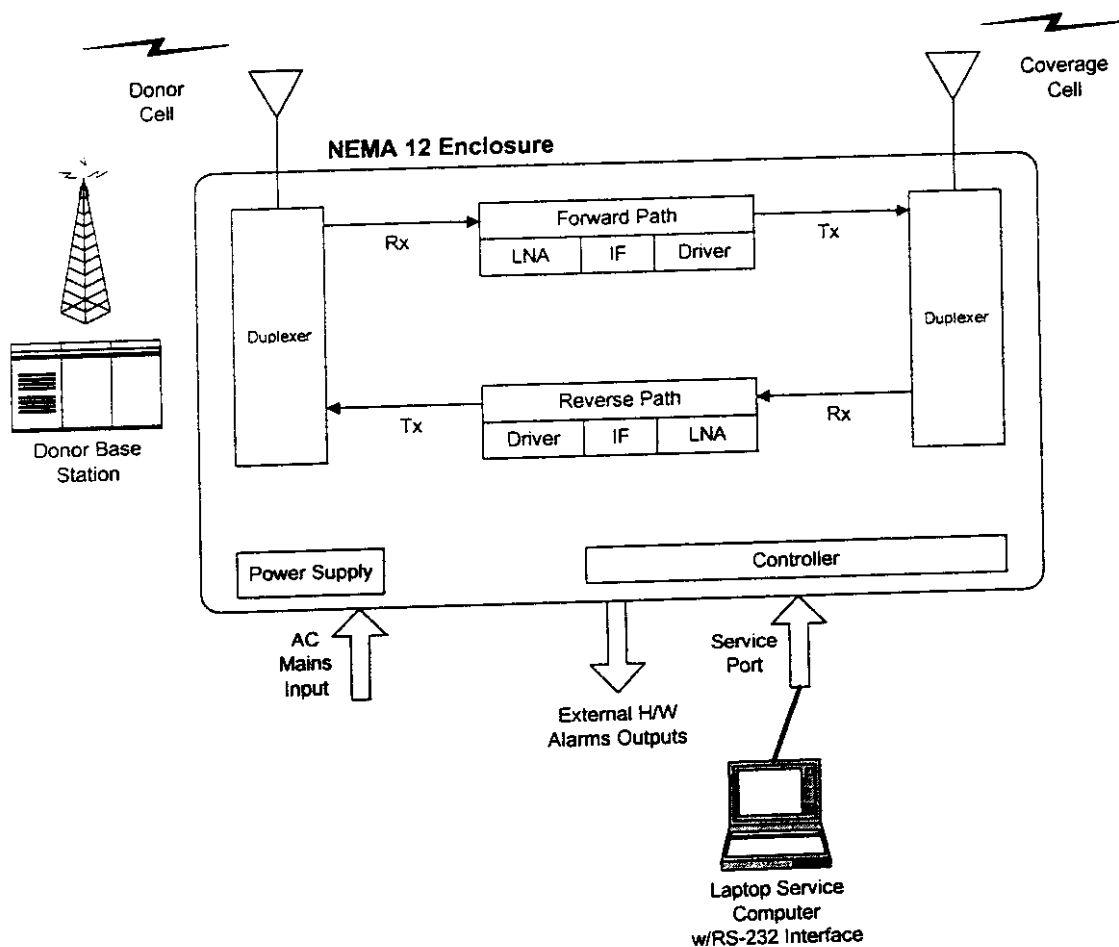


EQUIPMENT: Microlink 1900 Bi-Directional Amplifier  
FCC ID: NFRML1900

## Theory of Operation

The E.U.T. is used to extend coverage of a PCS band donor cell. The IF bandwidth can be configured by the manufacturer to be 1.25 MHz, 5 MHz or 10 MHz. Multiple CDMA, GSM or NADC (IS-136) channels can be accommodated. The radiated power output is a composite power. Each time the channel loading is doubled, the power output per channel is reduced to maintain the rated composite power output.

## System Diagram



EQUIPMENT: Microlink 1900 Bi-Directional Amplifier  
FCC ID: NFRML1900

### Section 3. RF Power Output

NAME OF TEST: RF Power Output	PARA. NO.: 2.985
TESTED BY: Tom Tidwell / Kevin Carr	DATE: June 5 & 8, 1998

Test Results: Complies.

#### Measurement Data:

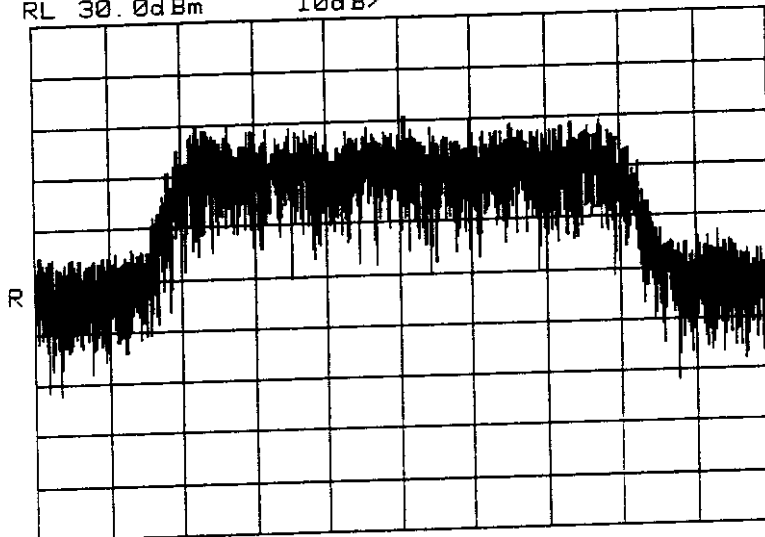
	Modulation Type	Per Channel Output Power (dBm)	Composite Output Power (dBm)
Uplink	CDMA	+ 19.4	+22.0
Downlink	CDMA	Not Tested	Not Tested
Uplink	GSM	+15.0	+18.0
Downlink	GSM	Not Tested	Not Tested
Uplink	NADC	+15.5	+18.0
Downlink	NADC	Not Tested	Not Tested

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FCC PART 24, SUBPART E  
BROADBAND PCS REPEATERS  
PROJECT NO.: 8R00382

EQUIPMENT: Microlink 1900 Bi-Directional Amplifier  
FCC ID: NFRML1900

\*ATTEN 10dB  
RL 30.0dBm 10dB/



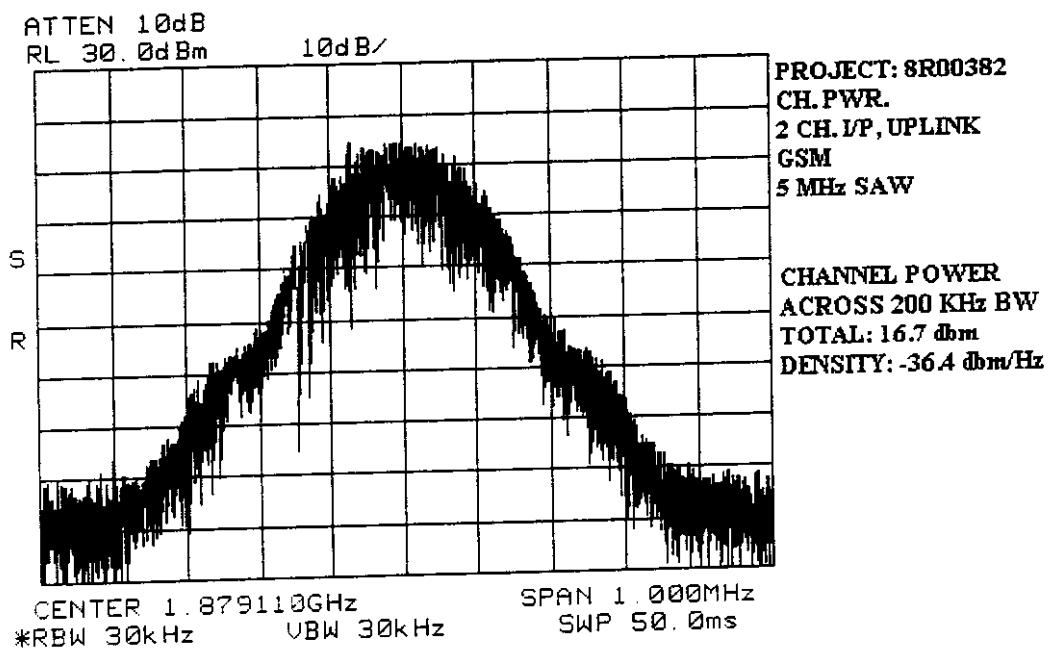
PROJECT: 8R00382  
CH. POWER OVER BW  
2 CH. INPUT  
CDMA, UPLINK  
5 MHz SAW

CHANNEL POWER  
ACROSS 1.25 MHz BW  
TOTAL: 19.4 dBm  
DENSITY: -41.6 dBm/Hz

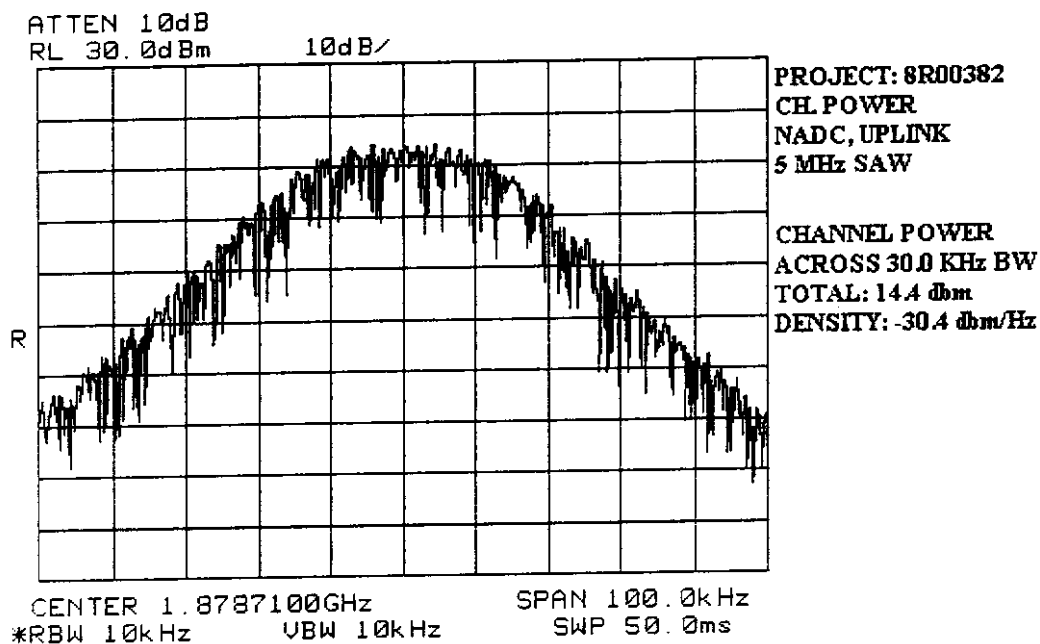
CENTER 1.879107GHz  
\*RBW 30kHz VBW 30kHz

SPAN 2.000MHz  
SWP 50.0ms

EQUIPMENT: Microlink 1900 Bi-Directional Amplifier  
FCC ID: NFRML1900



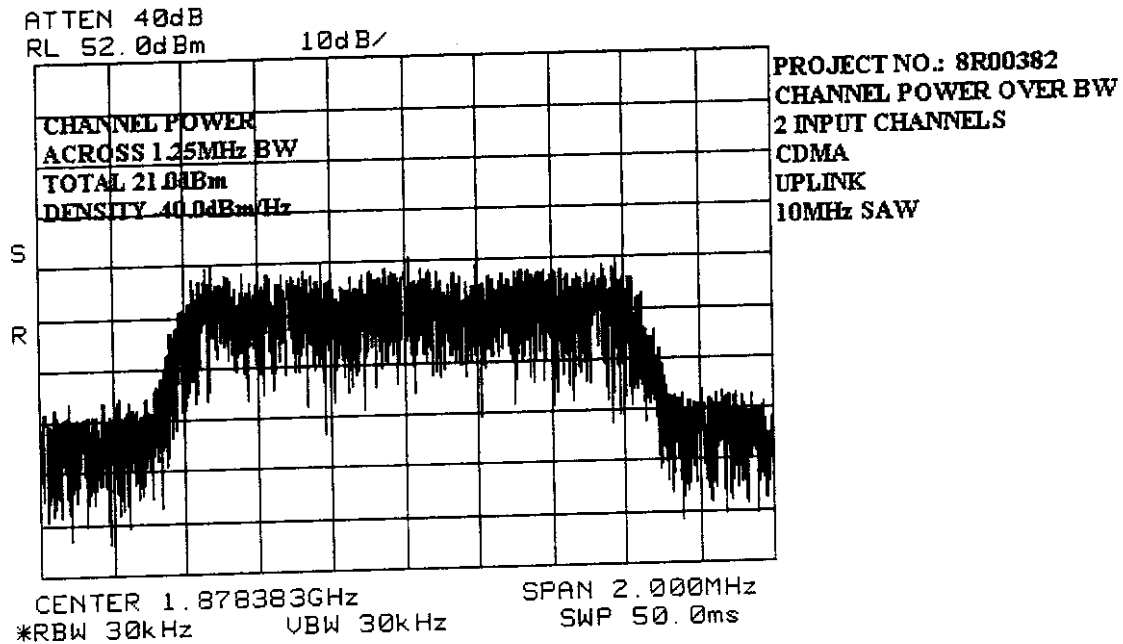
EQUIPMENT: Microlink 1900 Bi-Directional Amplifier  
FCC ID: NFRML1900



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FCC PART 24, SUBPART E  
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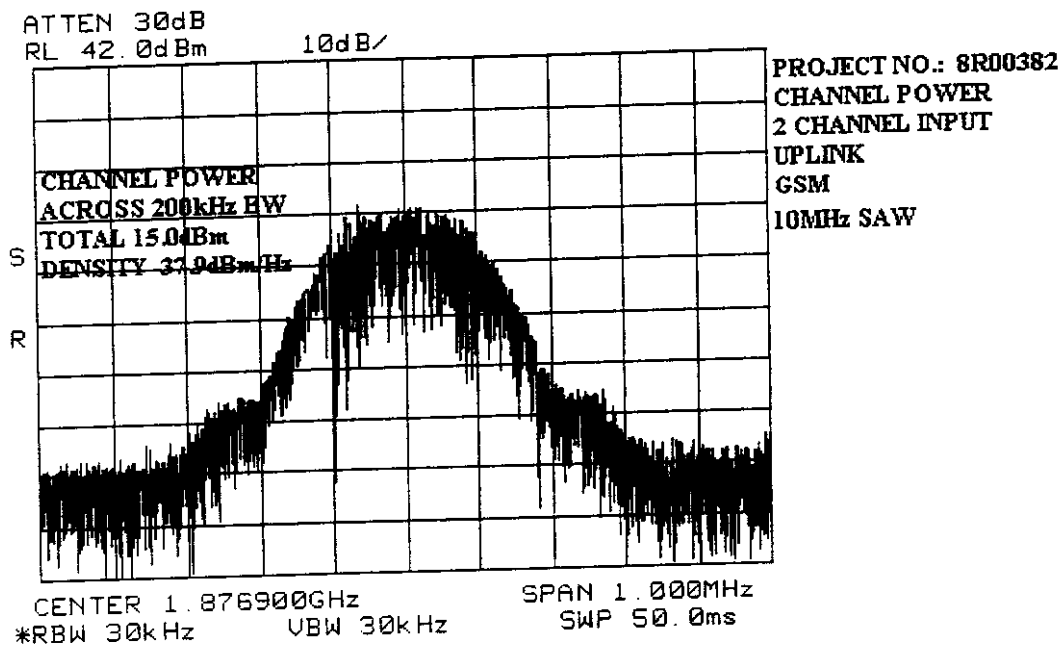
EQUIPMENT: Microlink 1900 Bi-Directional Amplifier  
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FCC PART 24, SUBPART E  
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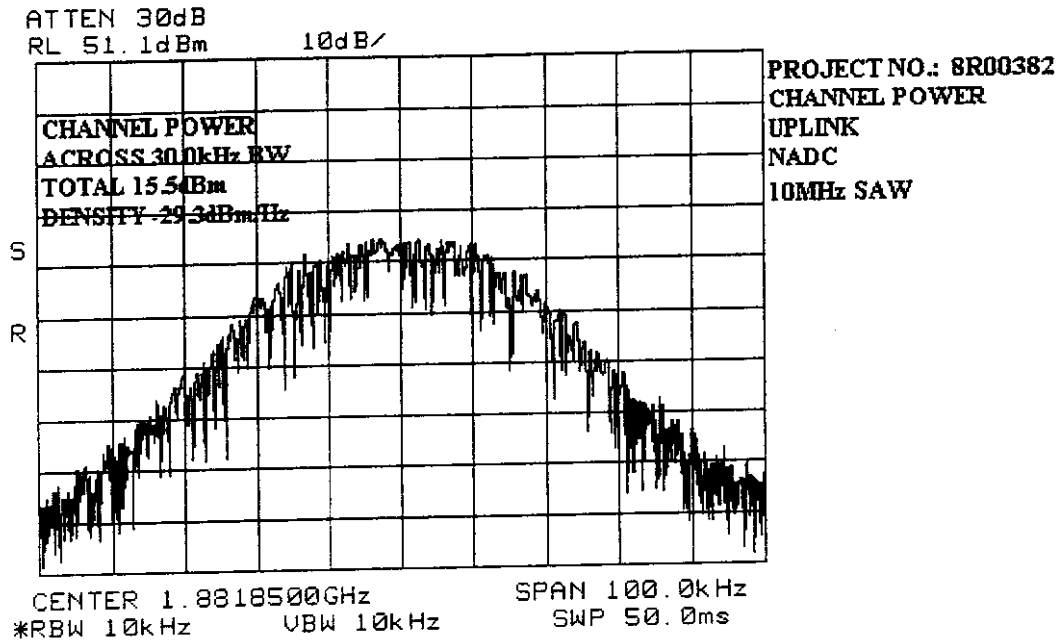
EQUIPMENT: Microlink 1900 Bi-Directional Amplifier  
FCC ID: NFRML1900



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*EQUIPMENT: Microlink 1900 Bi-Directional Amplifier*  
*FCC ID: NFRML1900*

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**Section 4.      Occupied Bandwidth**

NAME OF TEST: Occupied Bandwidth (CDMA)	PARA. NO.: 2.917(c)
TESTED BY:	DATE:

**Test Results:**                      Complies/Does Not Comply.

**Test Data:**                        See attached graph(s).

**NOT APPLICABLE**

*EQUIPMENT: Microlink 1900 Bi-Directional Amplifier*  
*FCC ID: NFRML1900*

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NAME OF TEST: Occupied Bandwidth (GSM)	PARA. NO.: 2.917(c)
TESTED BY:	DATE:

Test Results: Complies/Does Not Comply.

Test Data: See attached graph(s).

**NOT APPLICABLE**

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BROADBAND PCS REPEATERS  
PROJECT NO.: 8R00382

*EQUIPMENT: Microlink 1900 Bi-Directional Amplifier*  
*FCC ID: NFRML1900*

NAME OF TEST: Occupied Bandwidth (NADC)	PARA. NO.: 2.917(c)
TESTED BY:	DATE:

**Test Results:**

Complies/Does Not Comply.

**Test Data:**

See attached graph(s).

**NOT APPLICABLE**

EQUIPMENT: *Microlink 1900 Bi-Directional Amplifier*  
FCC ID: *NFRML1900*

## Section 5. Spurious Emissions at Antenna Terminals

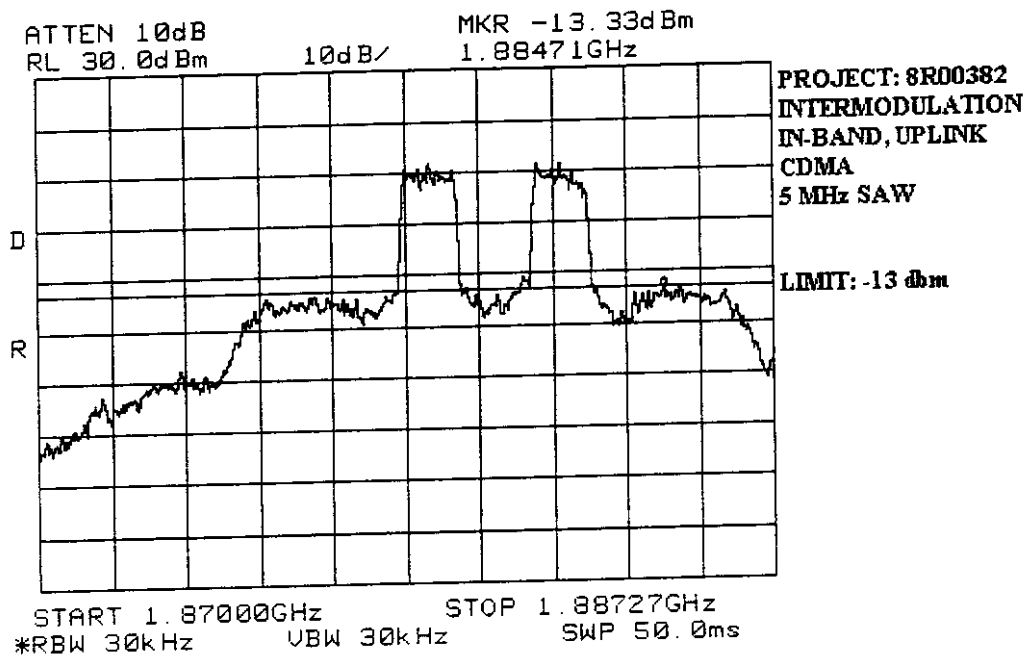
NAME OF TEST: Spurious Emissions @ Antenna Terminals	PARA. NO.: 2.917(e)
TESTED BY: Tom Tidwell & Kevin Carr	DATE: June 5 & 8, 1998

Test Results: Complies.

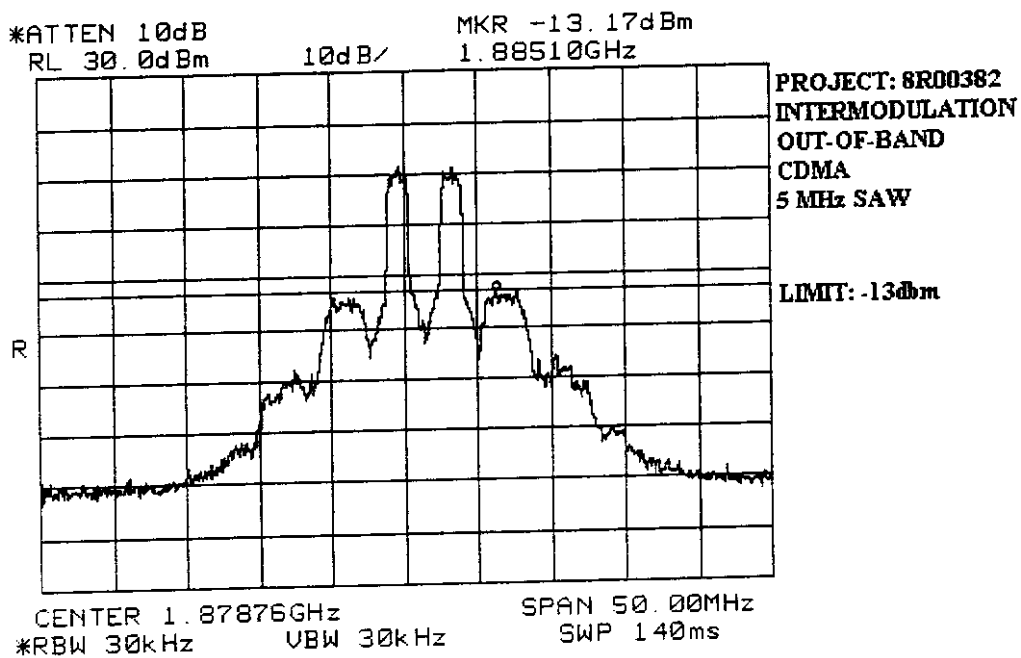
### Test Data:

NAME OF TEST	WORST-CASE SPURIOUS LEVEL(dBm)
0 to 20 GHz spurious (Uplink)	-25.3
0 to 20 GHz spurious (Downlink)	Not Tested
3 - signal intermodulation (Uplink)	-13.0
3 - signal intermodulation (Downlink)	Not Tested
Lower band edge spurious (Uplink)	Not Tested
Lower band edge spurious (Downlink)	Not Tested
Upper band edge spurious (Uplink)	Not Tested
Upper band edge spurious (Downlink)	Not Tested

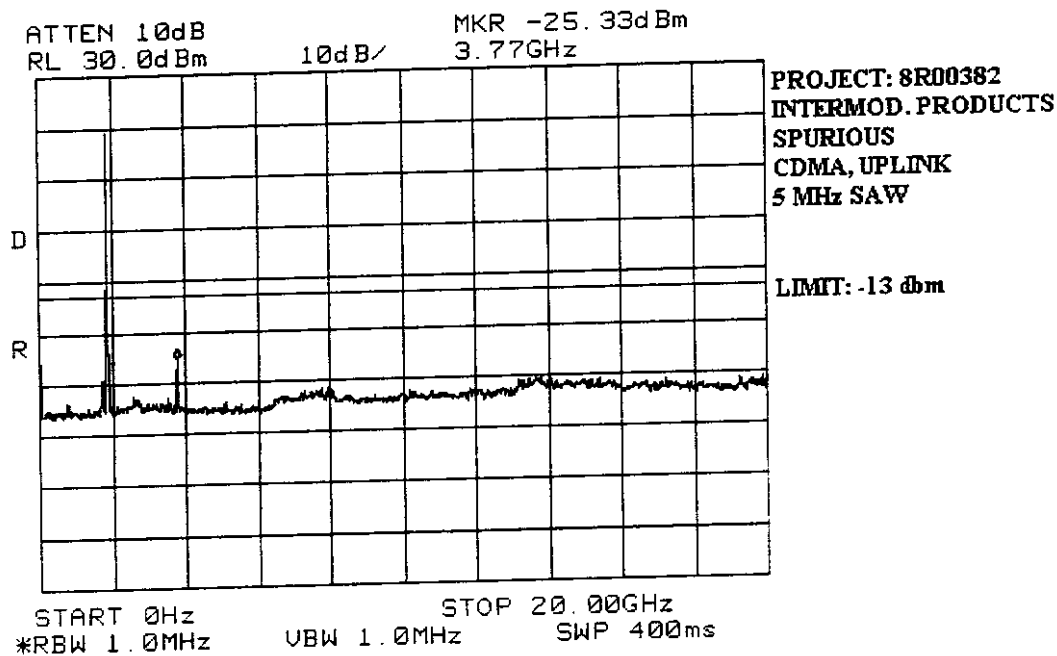
EQUIPMENT: Microlink 1900 Bi-Directional Amplifier  
FCC ID: NFRML1900



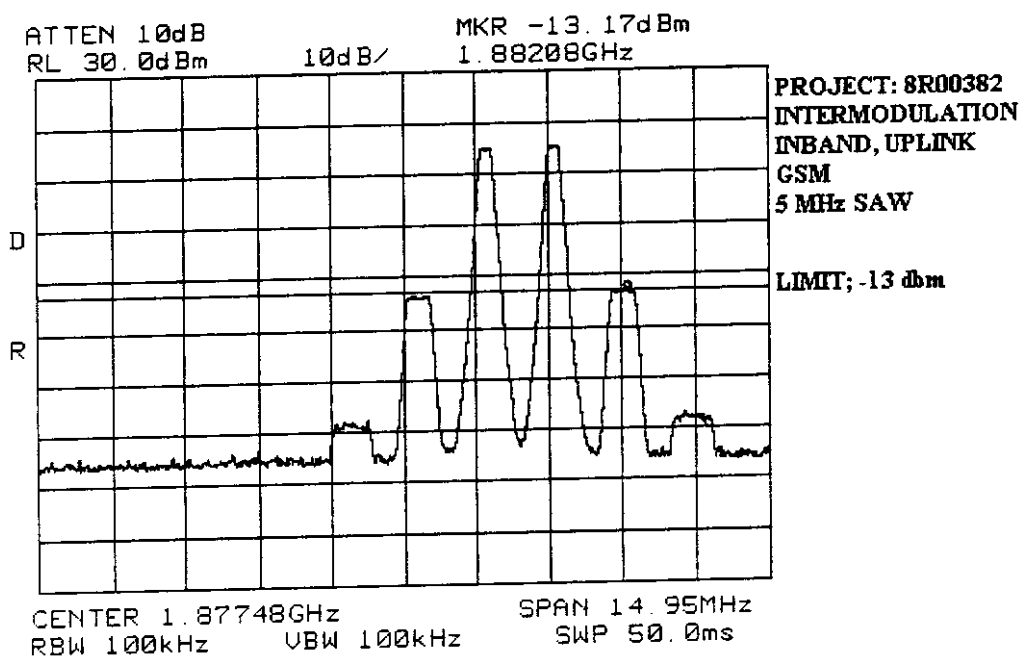
EQUIPMENT: Microlink 1900 Bi-Directional Amplifier  
FCC ID: NFRML1900



EQUIPMENT: Microlink 1900 Bi-Directional Amplifier  
FCC ID: NFRML1900

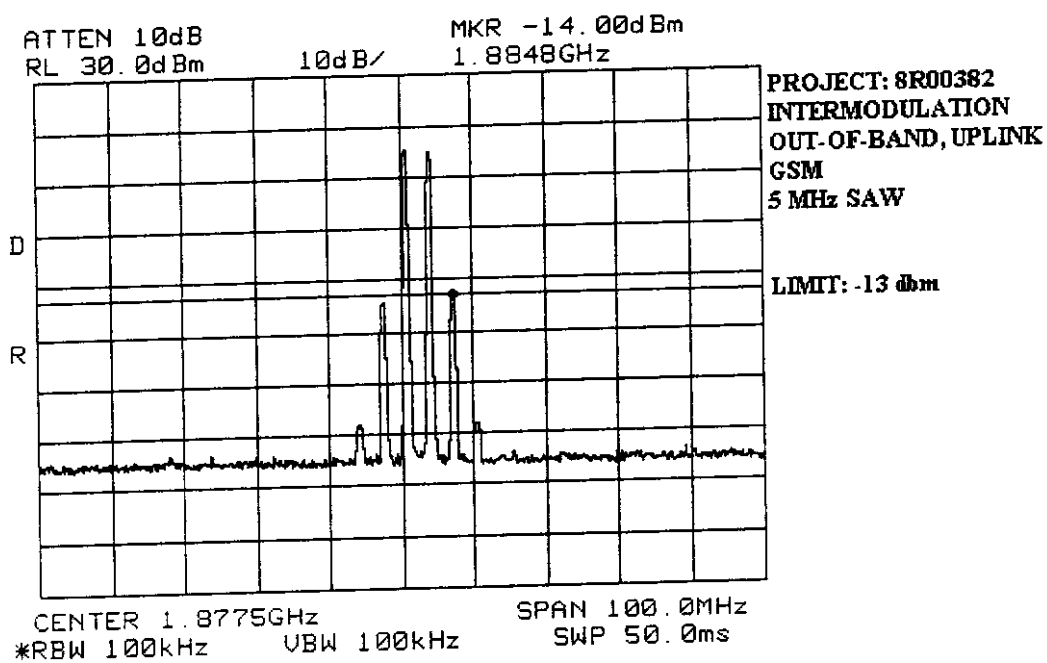


EQUIPMENT: Microlink 1900 Bi-Directional Amplifier  
FCC ID: NFRML1900

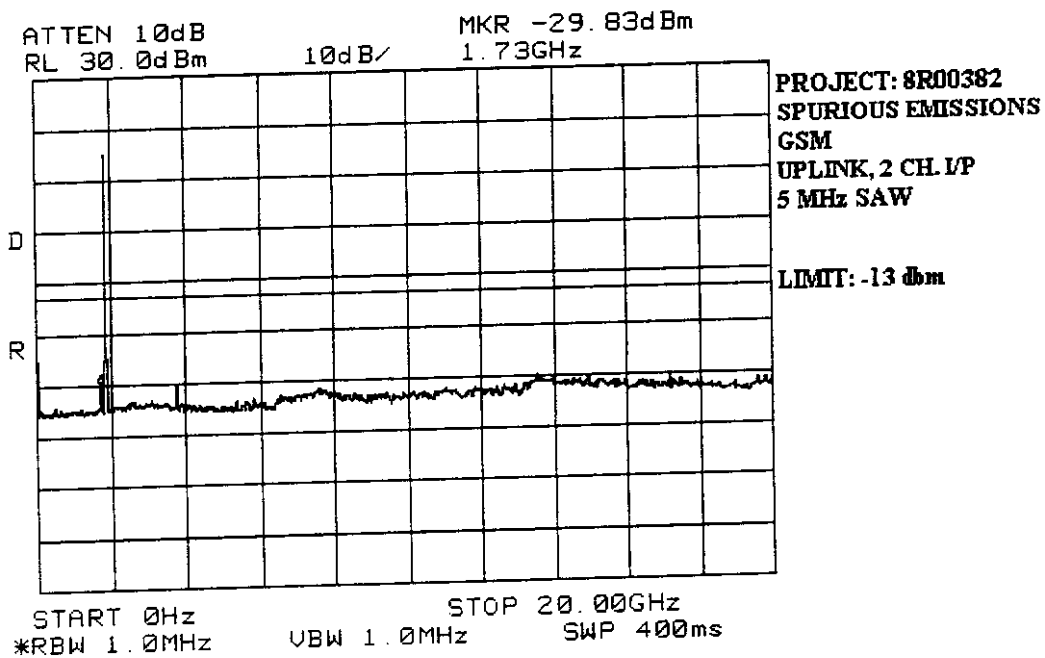




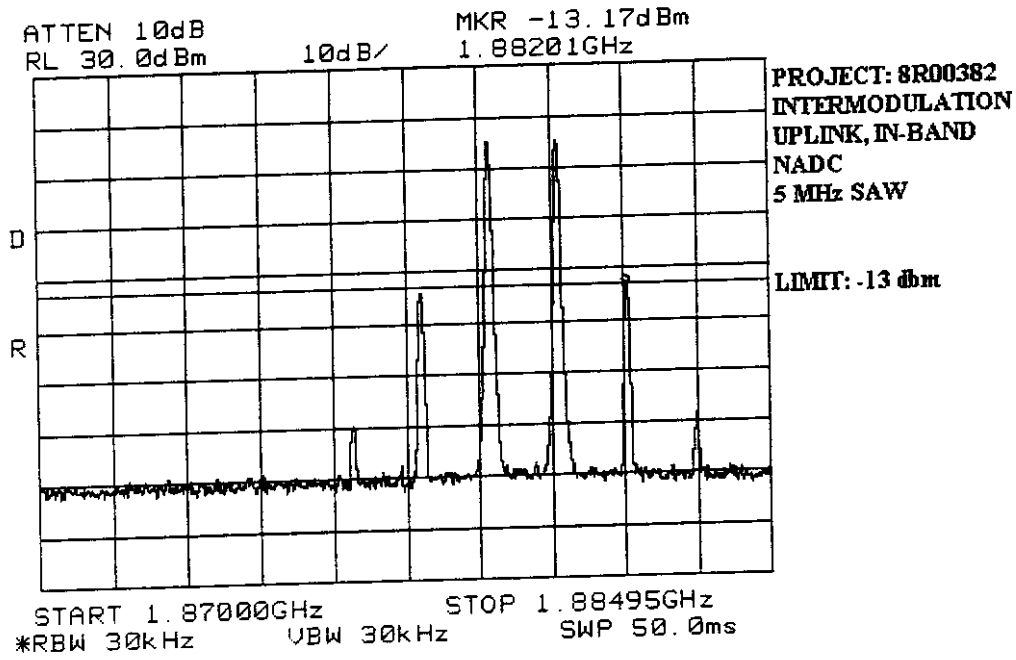
EQUIPMENT: Microlink 1900 Bi-Directional Amplifier  
FCC ID: NFRML1900



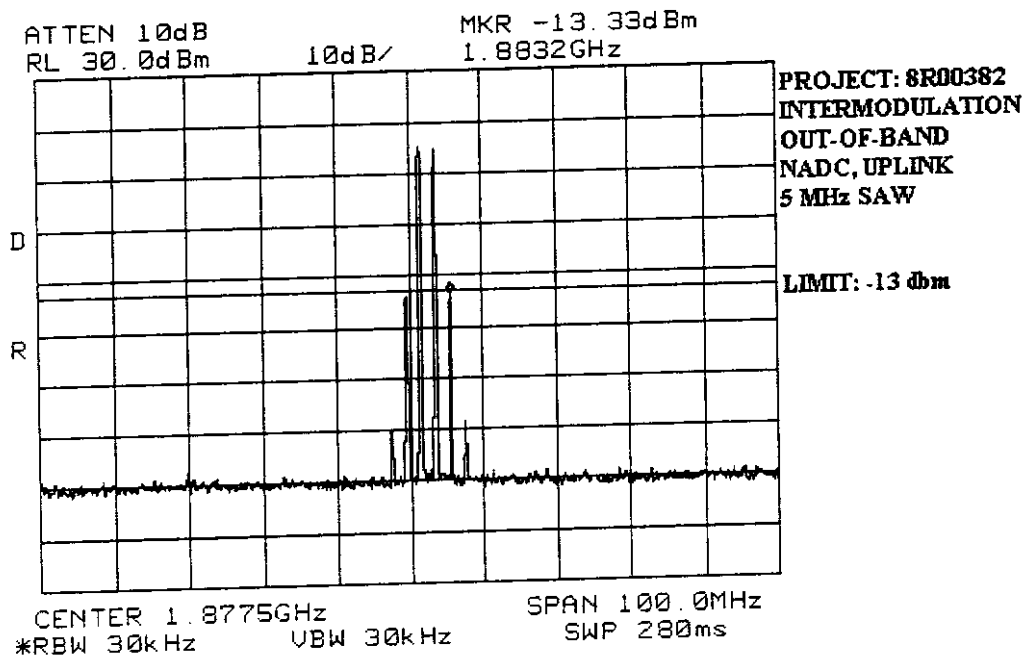
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FCC ID: NFRML1900



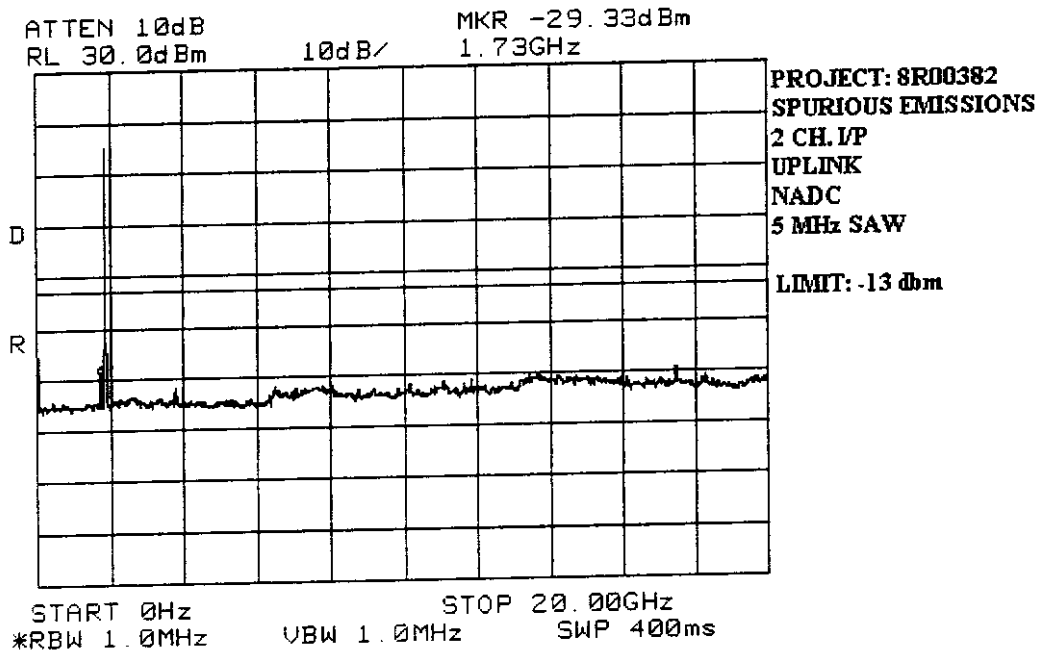
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FCC ID: NFRML1900



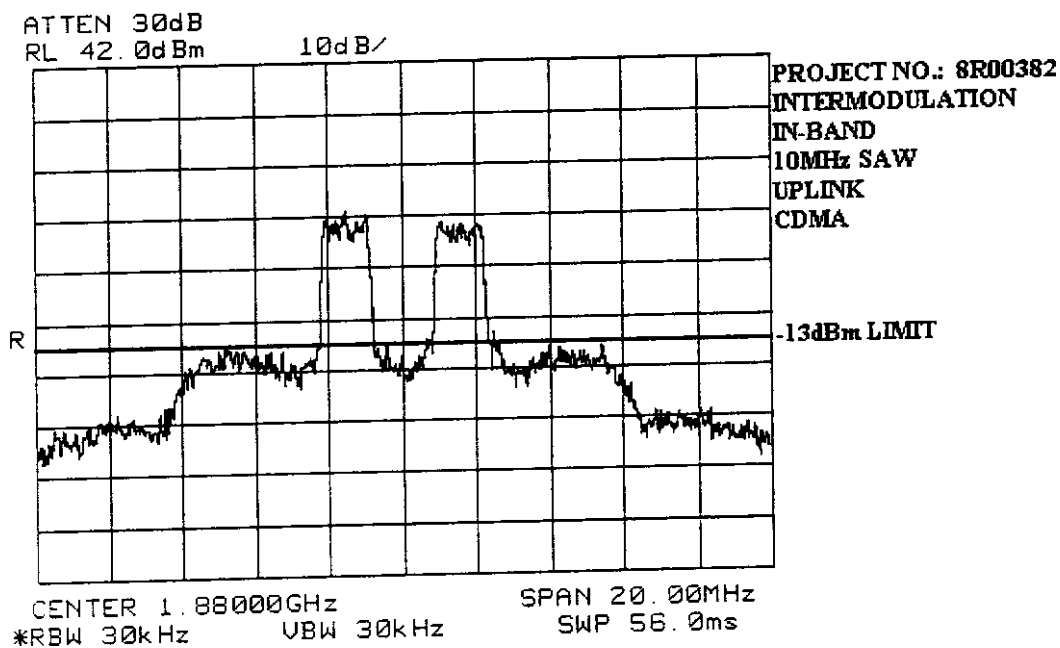
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FCC ID: NFRML1900



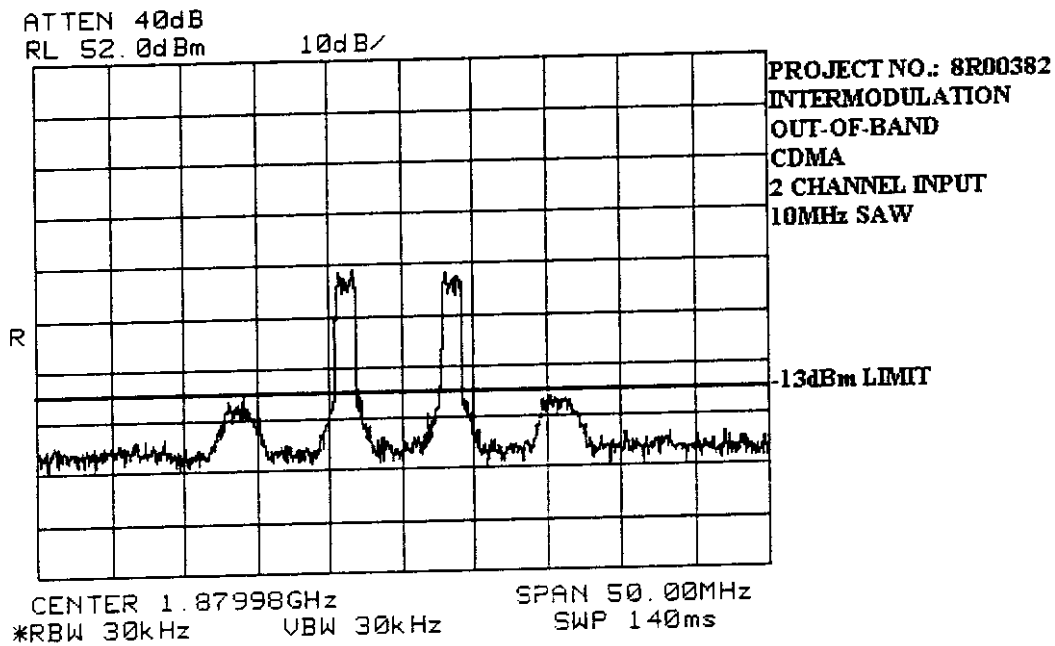
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FCC ID: NFRML1900



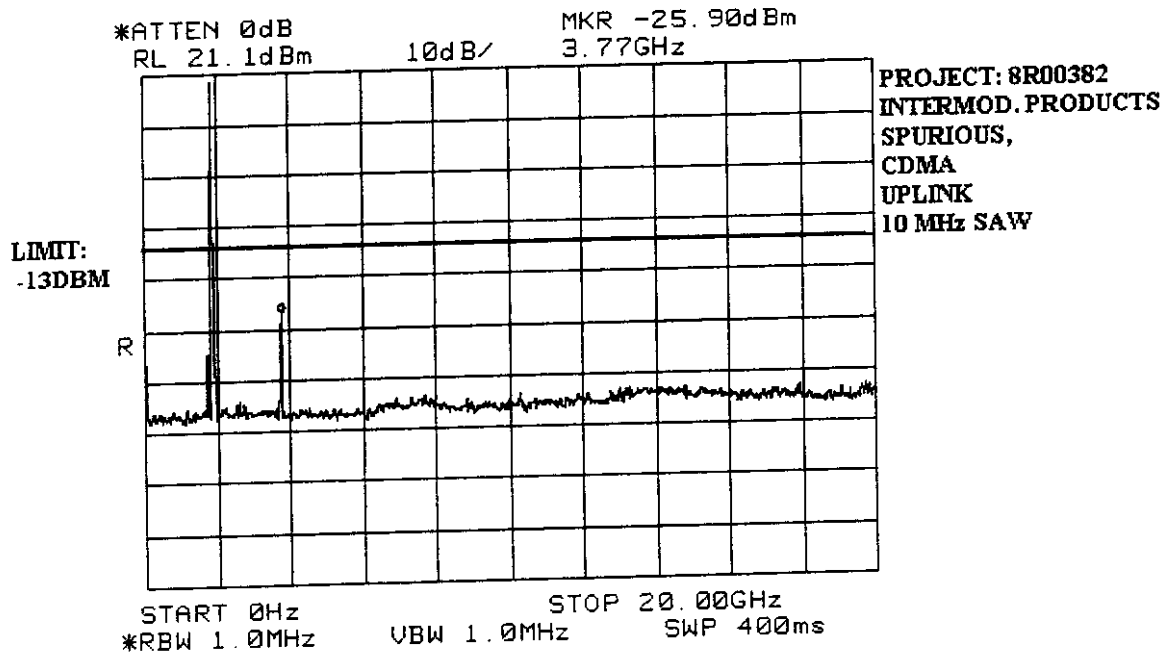
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FCC ID: NFRML1900



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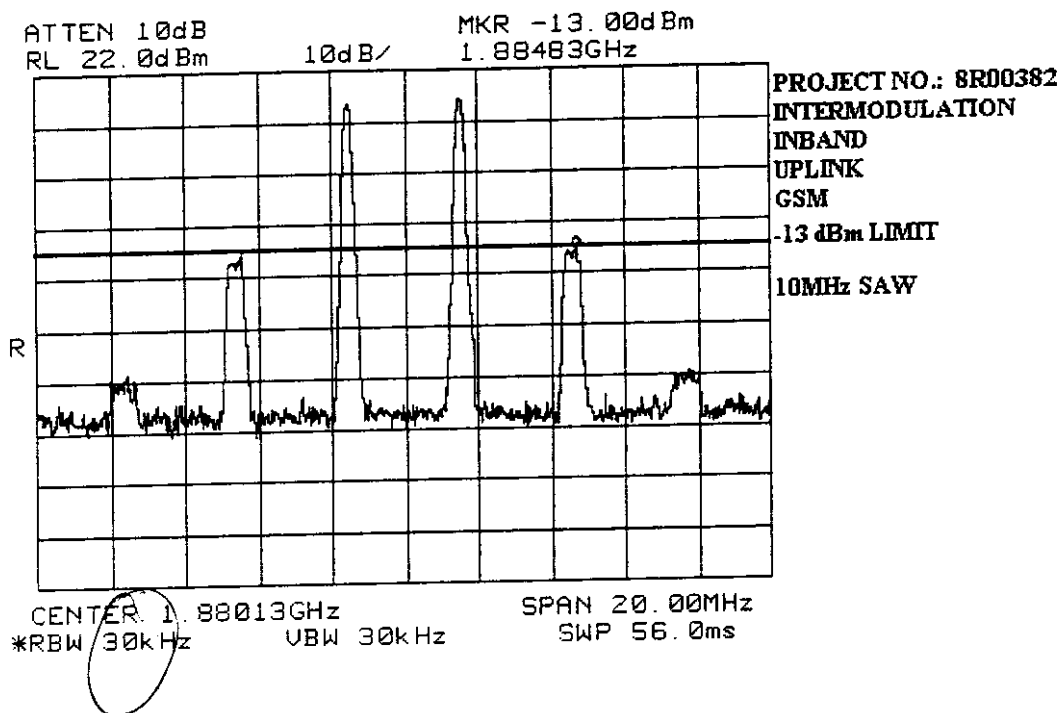




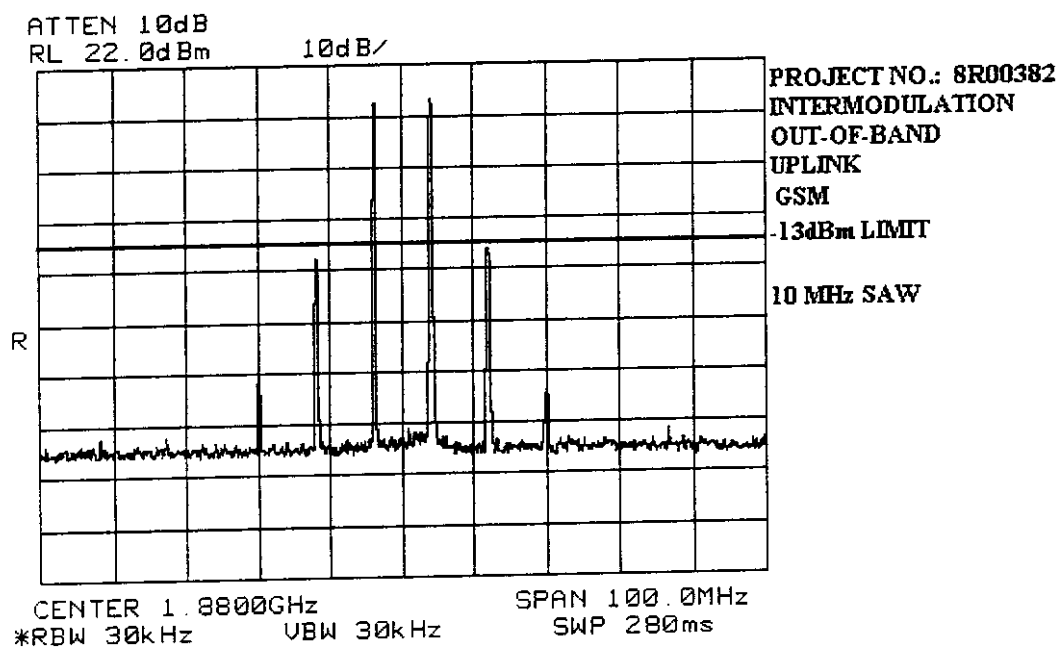
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BROADBAND PCS REPEATERS  
PROJECT NO.: 8R00382

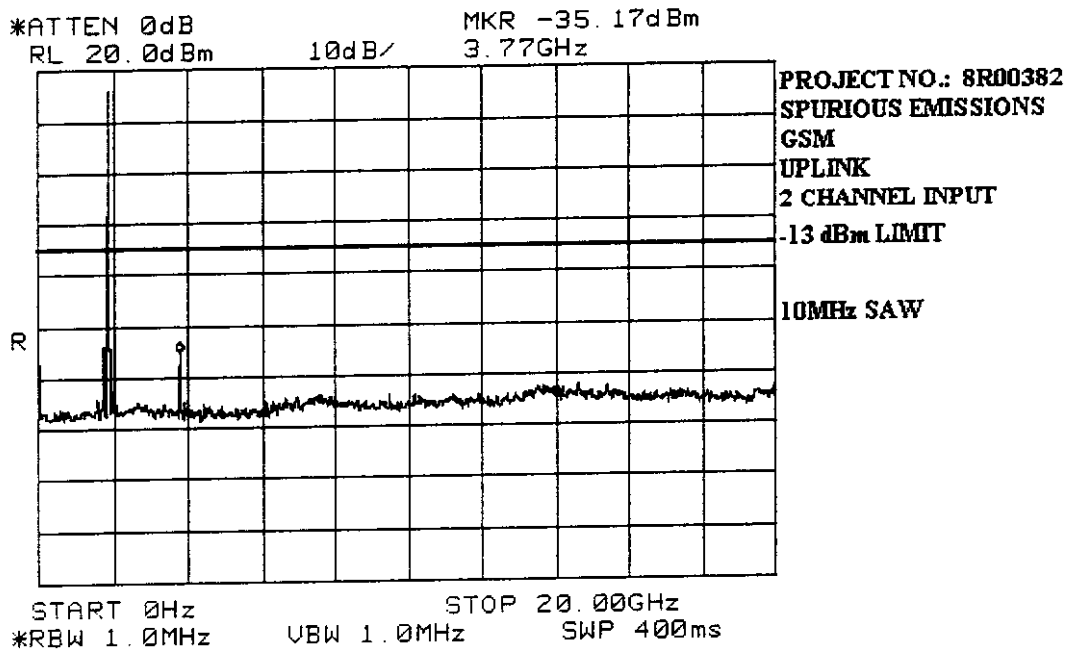
EQUIPMENT: Microlink 1900 Bi-Directional Amplifier  
FCC ID: NFRML1900



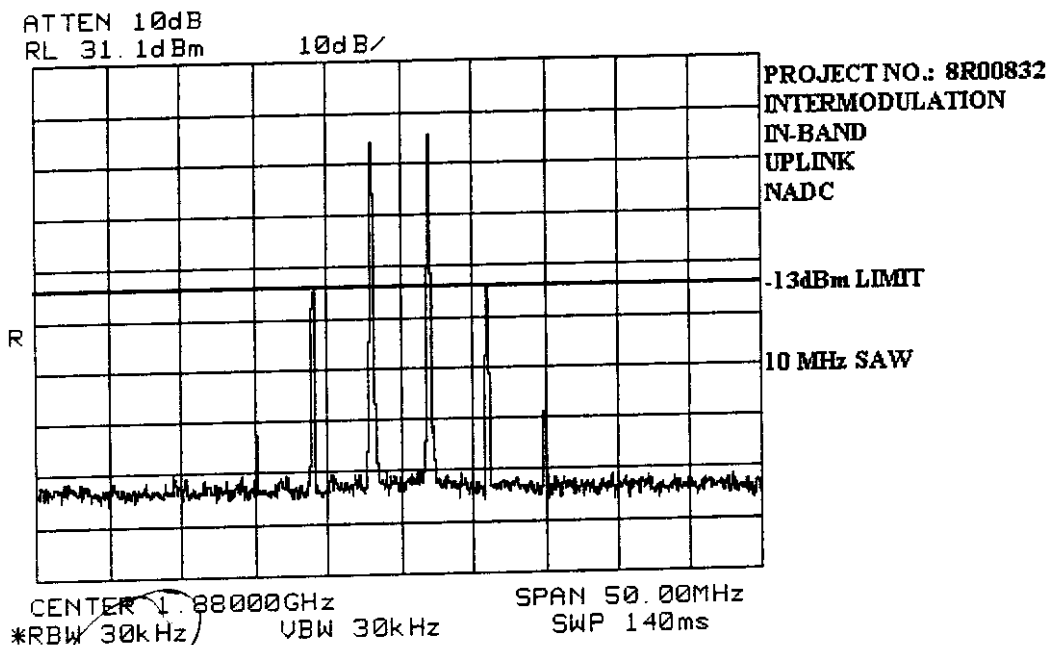
EQUIPMENT: Microlink 1900 Bi-Directional Amplifier  
FCC ID: NFRML1900



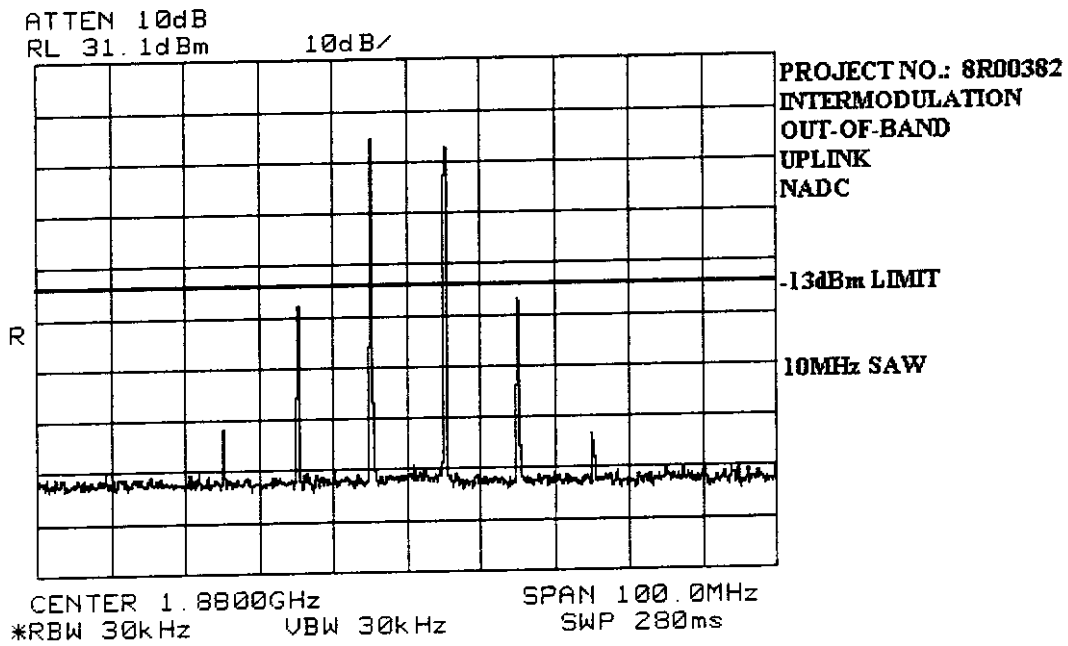
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FCC ID: NFRML1900



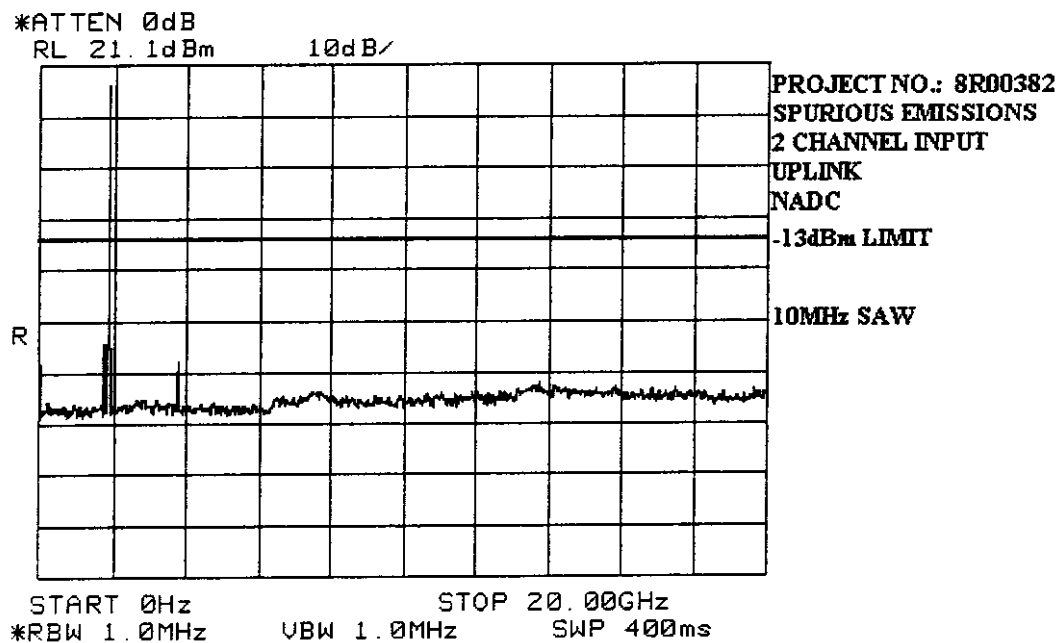
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*EQUIPMENT: Microlink 1900 Bi-Directional Amplifier*  
*FCC ID: NFRML1900*

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**Section 6.      Field Strength of Spurious**

NAME OF TEST: Spurious Emissions @ Antenna Terminals	PARA. NO.: 2.917(e)
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TESTED BY: Tom Tidwell
------------------------

DATE: June 3, 1998
--------------------

**Test Results:**

Complies.

The maximum field strength is 65.3 dB $\mu$ V/m @ 3m.

**Test Data:**

See attached table.

## Test Data - Radiated Emissions - Uplink

[illegible]

(5) 1 MHz RBW, VBW Peak, (6) 1 MHz RBW, 10 Hz VBW Peak, (7) 3 MHz RBW, 3 MHz VBW Peak



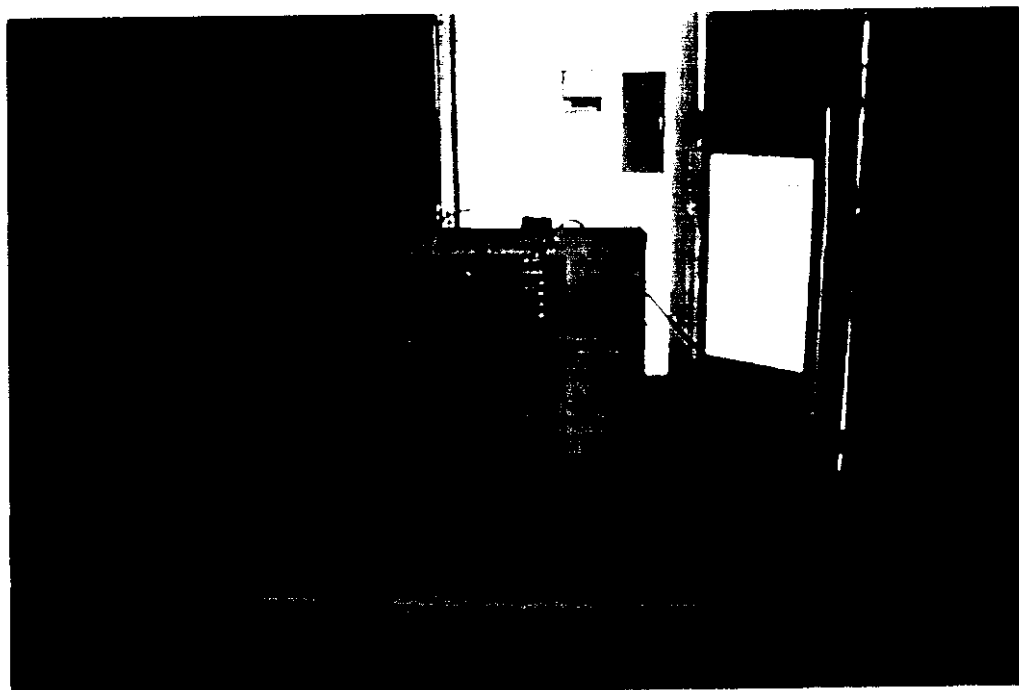
### Test Data - Radiated Emissions - Downlink

[illegible]

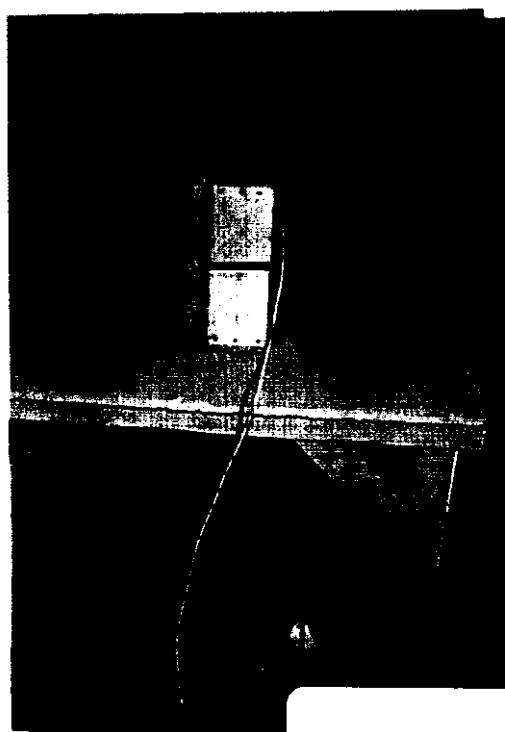
( ) Denotes failing emission level.

**RADIATED PHOTOGRAPHS (Worst Case)**

**FRONT VIEW**



**BACK VIEW**



EQUIPMENT: *Microlink 1900 Bi-Directional Amplifier*  
FCC ID: *NFRML1900*

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**Section 7.      Frequency Stability**

NAME OF TEST: Frequency Stability	PARA. NO.: 24.235
TESTED BY:	DATE:

**Test Results:**                      Complies/Does Not Comply.

**Measurement Data:**              Standard Test Frequency: \_\_\_\_\_ MHz  
    Standard Test Voltage: \_\_\_\_\_ Vdc

**NOT APPLICABLE**

*EQUIPMENT: Microlink 1900 Bi-Directional Amplifier*  
*FCC ID: NFRML1900***Section 8. Test Equipment List**

CAL CYCLE	EQUIPMENT	MANUFACTURER	MODEL	SERIAL	LAST CAL.	NEXT CAL.	
1 Year	Spectrum Analyzer	Hewlett Packard	8565E	865366	Feb. 27/98	Feb. 27/99	
1 Year	Quasi-peak adapter-1	Hewlett-Packard	85650A	2043A00302	Sept. 30/97	Sept. 30/98	
1 Year	Spectrum Analyzer-2	Hewlett Packard	8566B	1950A00400	Oct. 3/97	Oct. 3/98	
1 Year	Spectrum Analyzer Display-2	Hewlett Packard	85662A	1950A01177	Oct. 3/97	Oct. 3/98	
1 Year	Quasi Peak Adaptor-2	Hewlett Packard	85650A	2251A00620	Aug. 19/97	Aug. 19/98	
1 Year	Attenuator	Narda	765-20	9510	July 23/97	July 23/98	
1 Year	Attenuator	Weinschel	905	1919	July 23/97	July 23/98	
1 Year	Attenuator	Narda	768-10	9709	Oct. 1/97	Oct. 1/98	
1 Year	RF Millivoltmeter	Rohde & Schwarz	URV5	FA000420	July 23/97	July 23/98	
1 Year	Insertion Unit	Rohde & Schwarz	URV5-Z4	FA000905	July 23/97	July 23/98	
2 Year	Horn Antenna	EMCO #2	3115	4336	Oct. 30/97	Oct. 30/99	
1 Year	Log Periodic Antenna	EMCO	LPA-25	1141	July 10/97	July 10/98	
1 Year	Biconical (1) Antenna	EMCO	3109	9204-2708	July 11/97	July 11/98	
	50 $\Omega$ Termination	Wiltron	26N50	605248	N/A	N/A	
1 Year	50 ohm Combiner Pad	Mini Circuits	ZA3PD-2	9746	Dec. 12/97	Dec. 12/98	
1 Year	Low Noise Amplifier	Avantek	AWT-8035	1005	Oct. 24/97	Oct. 24/98	
1 Year	Low Noise Amplifier	DBS Microwave	DWT-13035	9623	Oct. 24/97	Oct. 24/98	
1 Year	Signal Generator	Rohde & Schwarz	SM1Q03	1084-8004-03	Sept. 18/97	Sept. 18/98	
1 Year	Arbitrary Waveform Gen.	Sony/Tektronix	AWG2021	J310495	May 15/97	May 15/98	
3 Year	Standard Gain Horn	Electro-Metrics	SH-50/60-1	FA000479	July 29/97	July 29/00	

NA: Not Applicable  
NCR: No Cal Required

*EQUIPMENT: Microlink 1900 Bi-Directional Amplifier*  
*FCC ID: NFRML1900*

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**ANNEX A**  
**TEST METHODOLOGIES**

EQUIPMENT: Microlink 1900 Bi-Directional Amplifier  
FCC ID: NFRML1900

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

**Test Conditions:** Standard Temperature & Humidity  
Standard Test Voltage

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

EQUIPMENT: Microlink 1900 Bi-Directional Amplifier  
FCC ID: NFRML1900

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**NAME OF TEST: Occupied Bandwidth**

**PARA. NO.: 2.989**

**Test Conditions:** Standard Temperature & Humidity  
Standard Test Voltage

**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:  $\geq$  RBW

Span: 5 MHz

Sweep: Auto

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

GSM

RBW: 3 kHz

VBW:  $\geq$  RBW

Span: 2 MHz

Sweep: Auto

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

NADC

RBW: 1 kHz

VBW:  $\geq$  RBW

Span: 1 MHz

Sweep: Auto

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

EQUIPMENT: Microlink 1900 Bi-Directional Amplifier  
FCC ID: NFRML1900

NAME OF TEST: Spurious Emission at Antenna Terminals	PARA. NO.: 2.991
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**Test Conditions:** Standard Temperature & Humidity  
Standard Test Voltage

**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 (< 1 MHz from Band Edge)  
VBW:  $\geq$  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:  $\geq$  RBW  
Sweep: Auto  
Video Avg: Disabled

NADC

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

To demonstrate compliance at band edges the frequency of the input signal is set to the lowest 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: Microlink 1900 Bi-Directional Amplifier  
FCC ID: NFRML1900

NAME OF TEST: Field Strength of Spurious Radiation	PARA. NO.: 2.993
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**Test Conditions:** Outdoor Range  
Standard Test Voltage

**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 ( $5 \times 10^{-5}$  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  $\leq 1$  GHz:

$G = 1.64$  (Dipole Gain)

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

$R = 3$ m (Measurement Distance)

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

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

For emissions  $> 1$  GHz:

$G = 1$  (Isotropic Gain)

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

$R = 3$ m (Measurement Distance)

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

*EQUIPMENT: Microlink 1900 Bi-Directional Amplifier*  
*FCC ID: NFRML1900*

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<b>NAME OF TEST: Frequency Stability</b>	<b>PARA. NO.: 2.995</b>
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**Test Conditions:** As per measurement data.

**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.

*EQUIPMENT: Microlink 1900 Bi-Directional Amplifier*  
*FCC ID: NFRML1900*

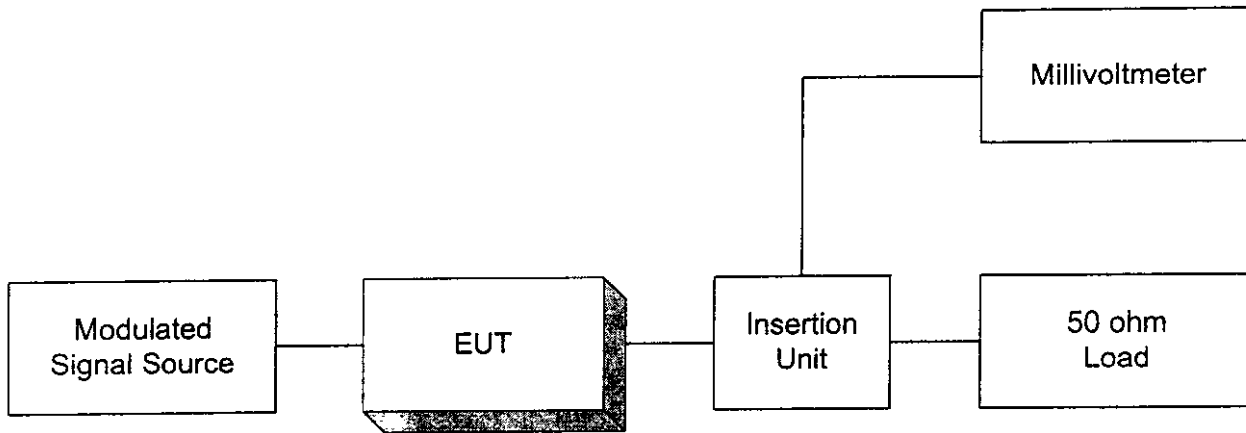
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**ANNEX B**  
**TEST DIAGRAMS**

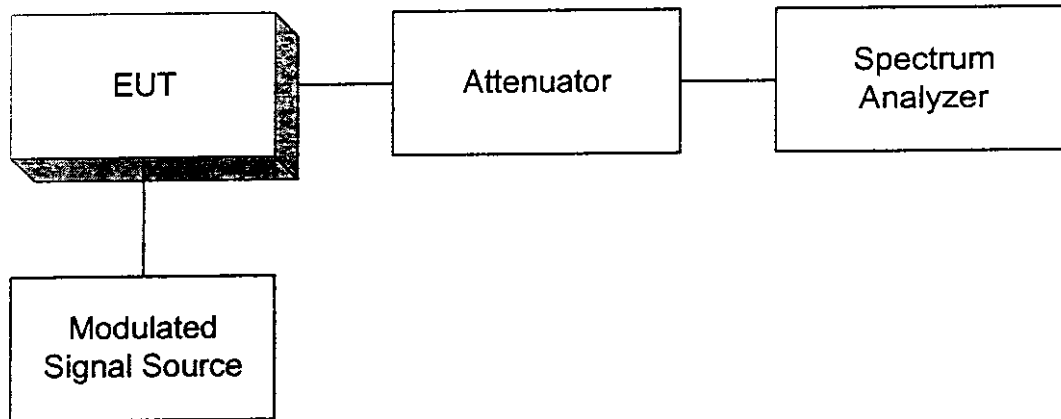
*EQUIPMENT: Microlink 1900 Bi-Directional Amplifier*  
*FCC ID: NFRML1900*

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



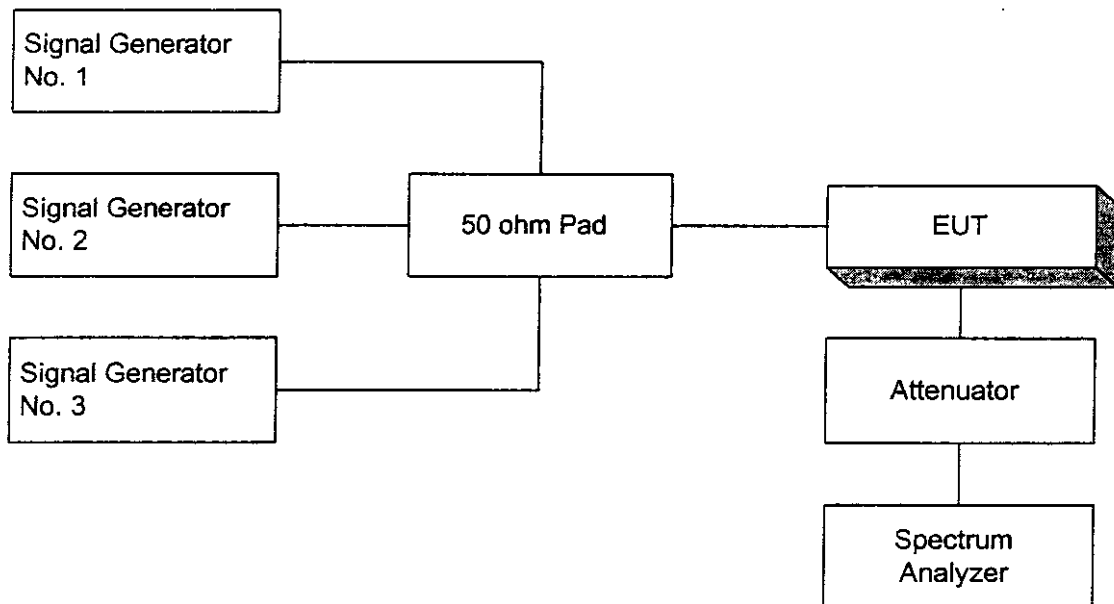
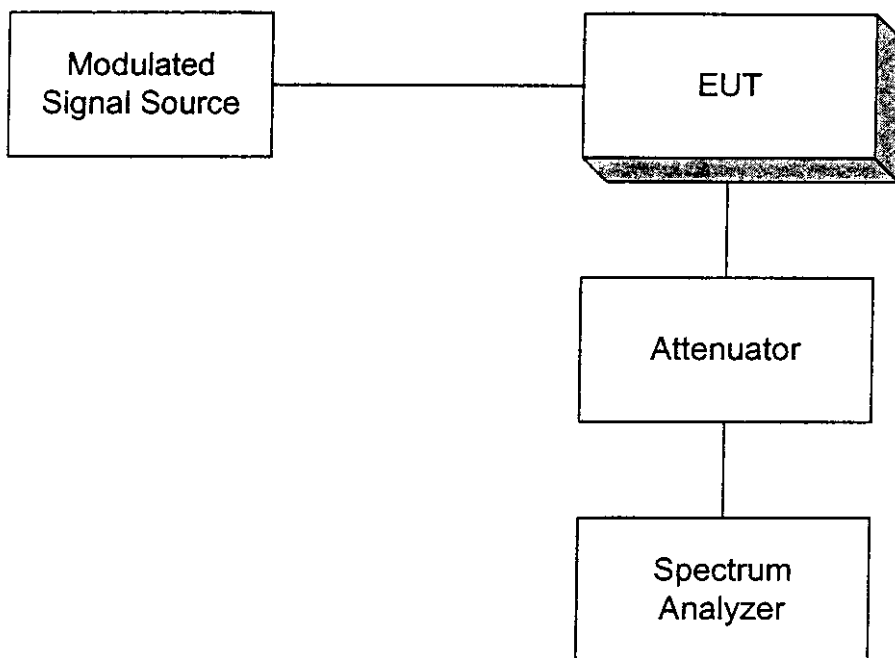
**Para. No. 2.989 - Occupied Bandwidth**



*EQUIPMENT: Microlink 1900 Bi-Directional Amplifier*  
*FCC ID: NFRML1900*

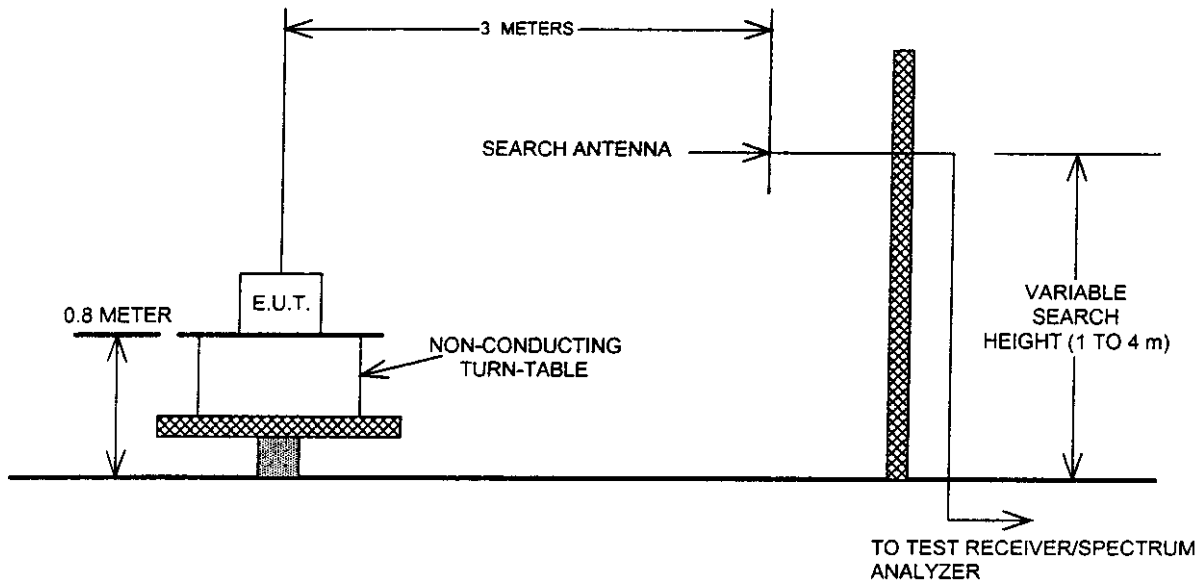
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**Para. No. 2.991 Spurious Emissions at Antenna Terminals**



*EQUIPMENT: Microlink 1900 Bi-Directional Amplifier*  
*FCC ID: NFRML1900*

**Para. No. 2.993 - Field Strength of Spurious Radiation**



**Para. No. 2.995 - Frequency Stability**

