



July 12, 2000

Federal Communications Commission  
Authorization and Evaluation Division  
7435 Oakland Mills Road  
Columbia, MD 21046

Attention: Applications Examiner

Applicant: Repeater Technologies  
300 S. Harbor Blvd.  
Suite 900  
Anaheim, CA 92805

Equipment: OC800 850 MHz OfficeCell Fiberoptic Distributed Antenna System

FCC ID: EK2OC80002

Specification: 47 CFR 22 Licensed Certification

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Dear Examiner:

The following application for Grant of Equipment Authorization is presented on behalf of Repeater Technologies for the Licensed Certification of their Model: OC800 850 MHz OfficeCell Fiberoptic Distributed Antenna System.

Enclosed, please find a complete data and documentation package demonstrating that this device complies with the technical requirements of 47 CFR, Part 22, for a Cellular Repeater.

If you have any questions, please contact the undersigned, who is authorized to act as Agent.

Sincerely,

Chris Harvey  
Director, EMC Laboratory



**MET Laboratories, Inc.** *Safety Certification - EMI - Telecom Environmental Simulation*

914 WEST PATAPSCO AVENUE ! BALTIMORE, MARYLAND 21230-3432 ! PHONE (410) 354-3300 ! FAX (410) 354-3313

# ENGINEERING TEST REPORT

in support of the

Application for Grant of Equipment Authorization

**EQUIPMENT:** OC800 850 MHz OfficeCell Fiberoptic Distributed Antenna System

**FCC ID::** EK2OC80002

**Specification:** 47 CFR 22

**On Behalf of the Applicant:** Repeater Technologies  
300 S. Harbor Blvd.  
Suite 900  
Anaheim, CA 92805

**Manufacturer:** Repeater Technologies  
300 S. Harbor Blvd.  
Suite 900  
Anaheim, CA 92805

**Manufacturer's Representative** Mr. Gary Grimes

**Test Date(s):** May 26 thru June 30

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## ENGINEERING STATEMENT

**I ATTEST:** the measurements shown in this report were made in accordance with the procedures indicated, and that the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements. On the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of Part 22 of the FCC Rules under normal use and maintenance.

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Liming Xu  
EMC Engineer, MET Laboratories



## 1.0 INTRODUCTION

The following data is presented on behalf of the Applicant, Repeater Technologies, as verification of the compliance of the Repeater Technologies OC800 850 MHz OfficeCell Fiberoptic Distributed Antenna System to the requirements of 47CFR 22.

## 2.0 TEST SITE

All testing was conducted at MET Laboratories, Inc., 914 West Patapsco Avenue, Baltimore, Maryland 21230-3493. Radiated emissions measurements were performed on a three-meter open area test site (OATS). A complete site description is on file with the FCC Laboratory Division as 31040/SIT/MET.

## 3.0 TEST EQUIPMENT USED

Manufacturer	Equipment	Calibration Due	Cal. Interval
Hewlett Packard	8563A Spectrum Analyzer	6/14/01	annual
EMCO	Biconical Antenna 3104	4/10/01	annual
EMCO	EMCO Log Periodic Antenna	4/10/01	annual
EMCO	Double Ridge Guided Horn	2/17/01	annual
Hewlett Packard	8594EM Analyzer	11/20/00	annual
Hewlett Packard	8591E Analyzer	8/12/00	annual
Solar	LISN	7/27/00	annual

## 4.0 EQUIPMENT UNDER TEST CONFIGURATION

The Cellular Repeater was configured with AC power supply modules and a digital signal generator was used to simulate various CDMA (i.e. QPSK Modulation type), NADC (DAMPS) and FM cellular RF input signals to the EUT. The EUT with host external computer was configured for maximum signal gain and bandwidth. The EUT was operated in a manner representative of the typical usage of the equipment. During all testing, system components were manipulated within the confines of typical usage to maximize each emission.

## 5.0 TEST TYPE(S)

- 5.1 Radiated Emissions: 47 CFR 2.1053, 22.901(d)(2), 22.917(e)
- 5.2 Occupied Bandwidth: 47 CFR 2.1049, Input vs. Output
- 5.3 RF Power Output: 47 CFR 2.1046, 22.913(a)
- 5.4 Spurious Emission at Antenna Terminals (uplink & downlink): 47 CFR 2.1051, 22.917(e)
- 5.5 Intermodulation Spurious Emissions-2 Tone Simultaneous RF Injection (uplink & downlink) at the lowest and highest sides of the band: 47 CFR 2.1051, 22.917(e).
- 5.6 AC Line Conducted Emissions: 47 CFR 2.1057



## 6.0 TEST RESULTS

### 6.1 TEST TYPE: Radiated Emissions

#### 6.1.1 TECHNICAL SPECIFICATION: 47 CFR 2.1053; 22.109(d); 22.917(e)

#### 6.1.2 TEST DATE(S): June 29, 2000

#### 6.1.3 MEASUREMENT PROCEDURES:

As required by §2.1053, *field strength of spurious radiation measurements* were made in accordance with the general procedures of ANSI C63.4-1992 "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40 GHz". Preliminary radiated emission measurements were performed inside a shielded chamber with all digital signal generators on and terminated. The frequency list from the preliminary measurements was used as a guide for making final measurements on a 10 meter open area test site. The unit was scanned over the frequency range of 30MHz to 9 GHz.

The Radiated Spurious Emissions *Limit* is obtained by the following:

Based on an output power (as measured at the output of the Amplifier) of 0.35 watts:

$$P_o = 0.35 \text{ W}$$

As per 2.993 (a), it is assumed this power is to be fed to a half-wave tuned dipole. Using a conversion formula for distance, the field strength at one meter can be derived:

$$E(V/m)_{1m} = \frac{\sqrt{49.2 \times 0.35}}{1}$$
$$E(V/m)_{1m} = 4.15 \text{ V/m or } 132.5 \text{ dB}\mu\text{V}$$

As per 22.917(e), the spurious emissions must be attenuated by  $43 + 10\log(P)$  which is:

$$43 + 10\log(0.35) = 38.44 \text{ dB}$$

Therefore, the limit for spurious emissions is:

$$132.5 \text{ dB}\mu\text{V} - 38.44 \text{ dB} = 94 \text{ dB}\mu\text{V} @ 1m$$

At 3 meters measurement distance, the limit is;

$$E(V/m)_{3m} = \frac{\sqrt{49.2 \times 0.35}}{3}$$
$$E(V/m)_{3m} = 1.38 \text{ V/m or } 122.8 \text{ dB}\mu\text{V}$$

According to 22.917(e), all signals must be attenuated by 49 dB. Therefore, the limit for spurious emissions for a test distance of 3 meters is:

$$122.8 - 38.44 = 84.38 \text{ dB}\mu\text{V} @ 3m$$



#### 6.1.4 RESULTS:

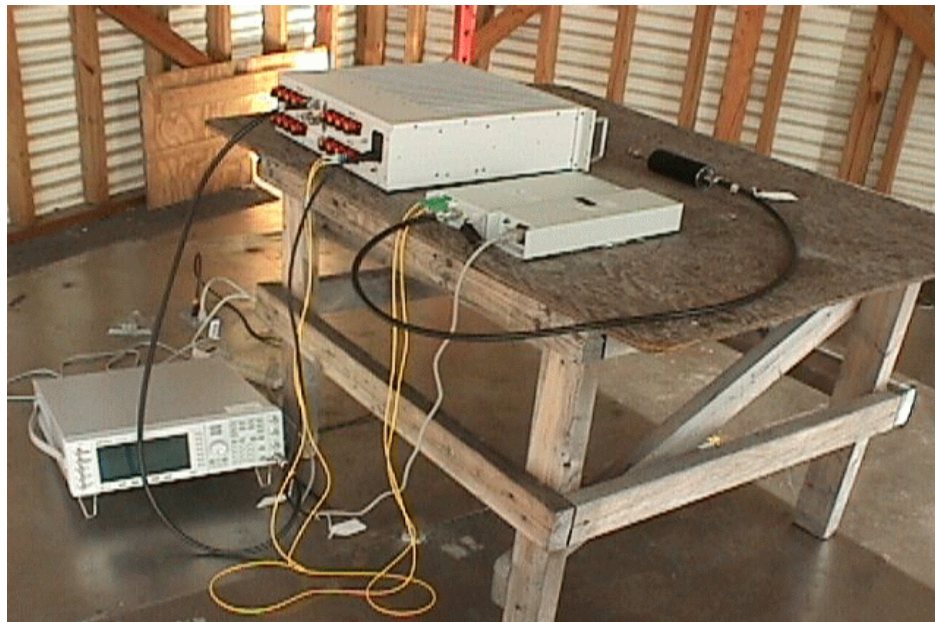
Carrier Emission: 0.35 Watts

Frequency (MHz)	Azimuth (°CCW-O°=EUT facing ant.)	Polarity	Height (m)	Raw Amplitude (dBuV)	Ant.Cor. Factor (db)	Cable Loss (db)	Distance Corr. 3m to 10m	Corrected Amplitude (dBuV/m)	Limit (dBuV/m) at 10 meters
217.250	90	H	1.5	23.23	16.675	2.824	0	42.73	46
217.250	90	V	1	22.12	16.675	2.824	0	41.62	46
206.380	90	H	1.6	18.11	17.2448	2.748	0	38.10	43.5
206.380	90	V	1	20.1	17.3724	2.748	0	40.22	43.5
209.530	90	H	1.6	19.2	17.1188	2.748	0	39.07	43.5
209.530	90	V	1	21.15	17.3094	2.748	0	41.21	43.5
230.130	90	H	1.6	15.69	15.6974	2.938	0	34.33	46
230.130	90	V	1	23.36	15.9078	2.938	0	42.21	46
403.100	90	H	1.8	13.67	16.793	3.95	0	34.41	46
403.100	90	V	1.8	13.64	16.555	3.95	0	34.15	46
580.000	90	H	1.8	12.58	18.9	4.966	0	36.45	46
580.000	90	V	1	12.63	18.9	4.966	0	36.50	46

No spurious emissions were observed above 550 MHz though 5 GHz.

Equipment meets the specifications of 2.993; 22.917(e)

Photograph of Radiated Emissions Test Configuration





## **6.2 TEST TYPE:** Occupied Bandwidth

### **6.2.1 TECHNICAL SPECIFICATION:** 47 CFR 2.1049

### **6.2.2 TEST DATE(S):** June 29, 2000

### **6.2.3 MEASUREMENT PROCEDURES:**

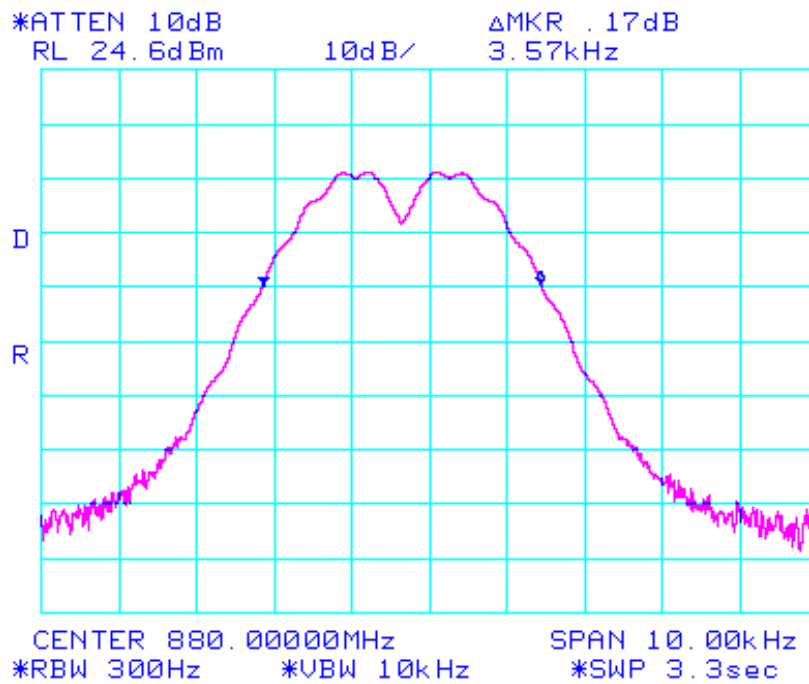
As required by §2.1049 of CFR 47, *occupied bandwidth measurements* were made on the Cellular Repeater pre- and post- repeater. A digital signal generator was configured to transmit an AMPS QPSK modulated carrier signal. Using a bandwidth of 300Hz for AMPS (FM) and 1 kHz for NADC (DAMPS) and CDMA (digital), we determined the occupied bandwidth of the emission at the lowest and highest selectable channel range was determined.

### **6.2.4 RESULTS:**

Equipment complies with Section 2.1049. Plots of the occupied bandwidth, as measured at the Repeater/Booster RF input port and at the antenna RF output port (post amplification) follow:

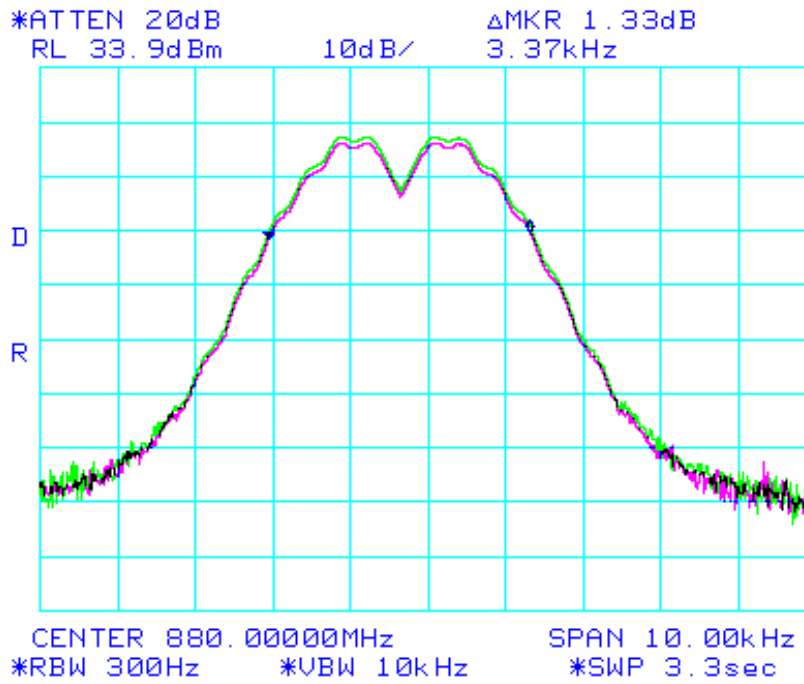


**FM Occupied B/W at input to HUB unit Downlink  
(Amps) emi9752**





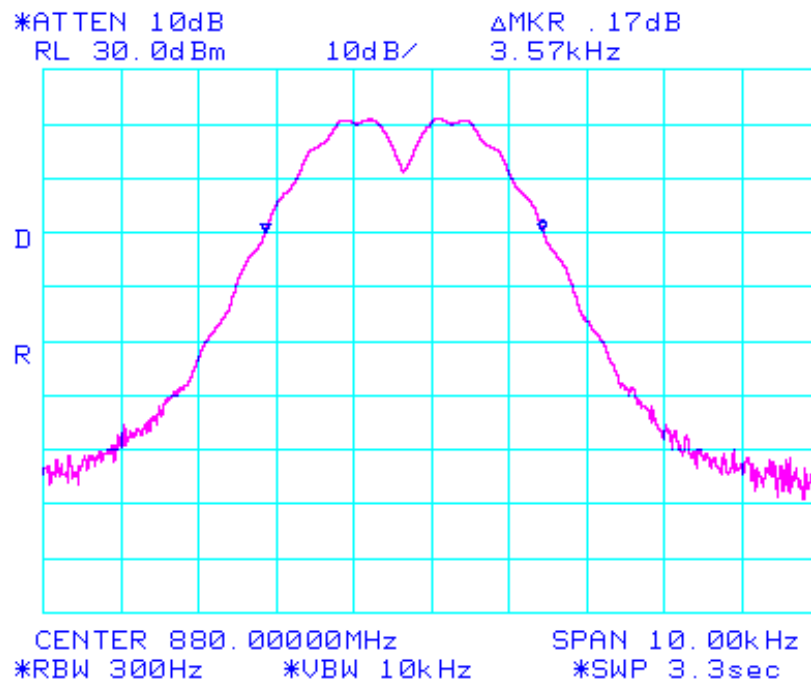
Occupied B/W w/FM Input vs Output Downlink Amps  
emi9752





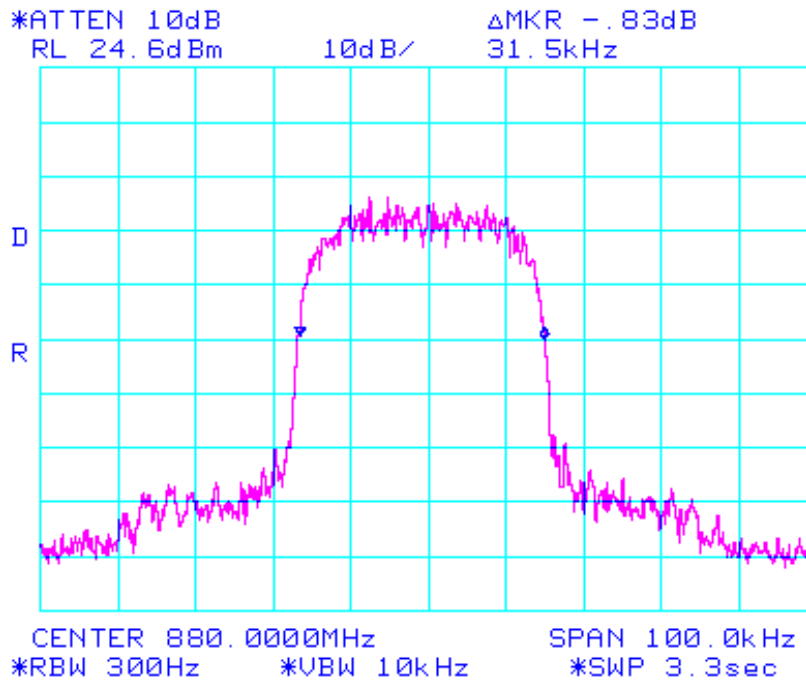


FM Occupied B/W at Remote Antenna terminal Downlink  
(Amps) emi9752



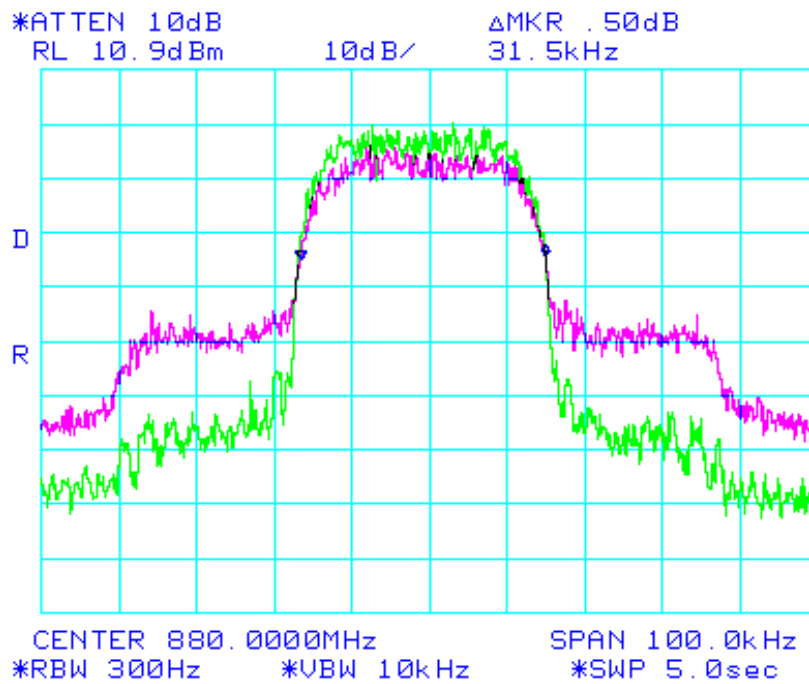


**NADC Occupied B/W at input to Hub unit Downlink  
(DAMPS)    emi9752**



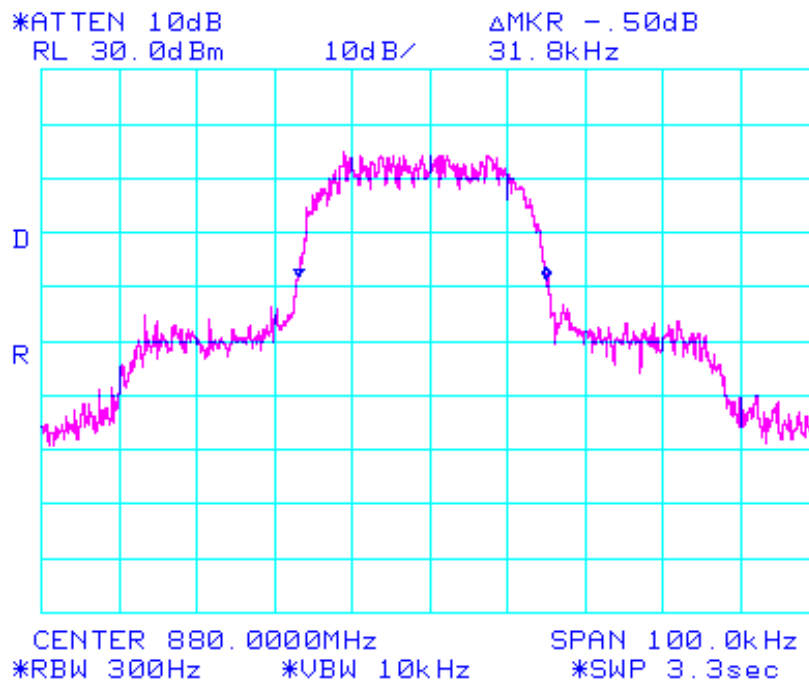


Occupied B/W w/NADC Input vs output Downlink (Damps)  
emi9752



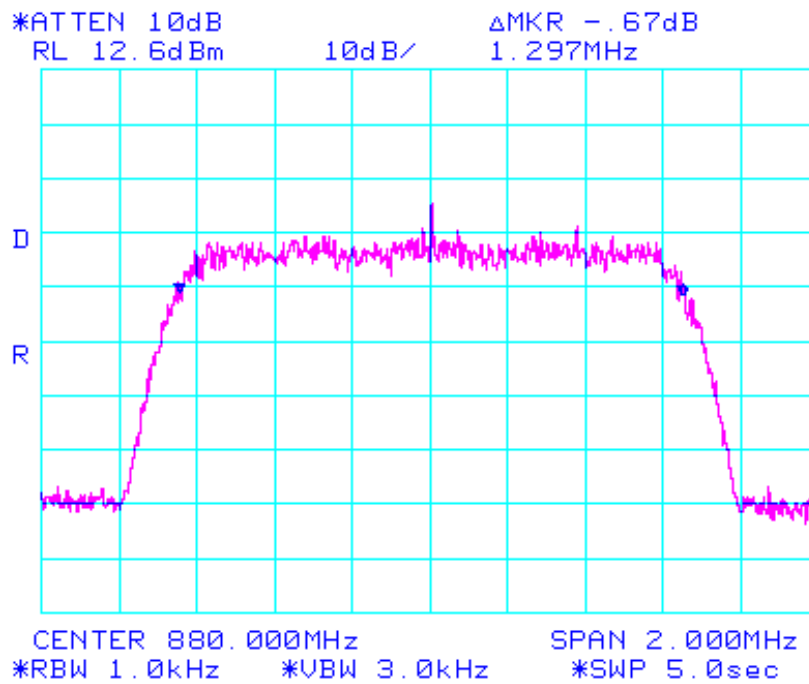


**NADC Occupied B/W at Remote Antenna terminal Downlink  
(Damps) emi9752**



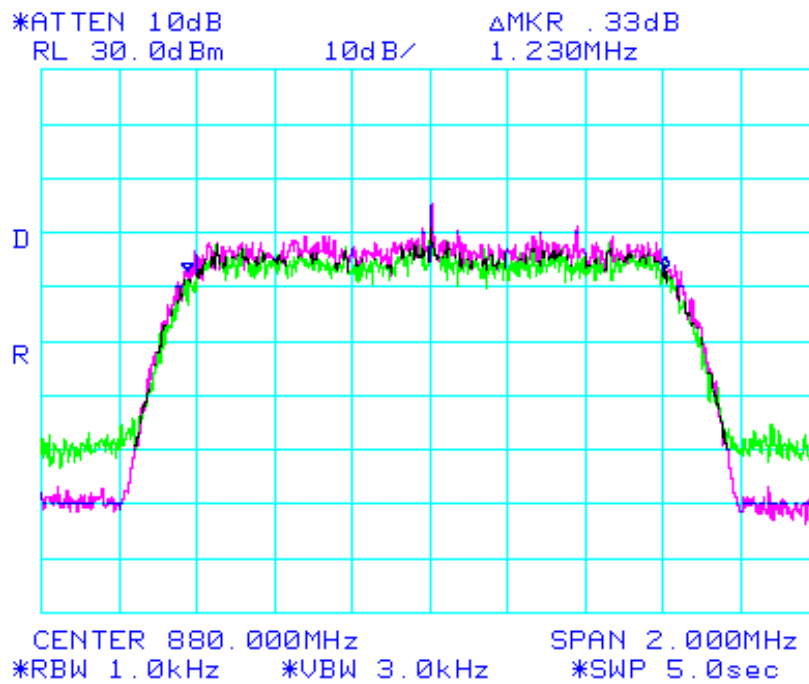


**CDMA Occupied B/W at input to Hub unit Downlink IS-95  
emi9752**



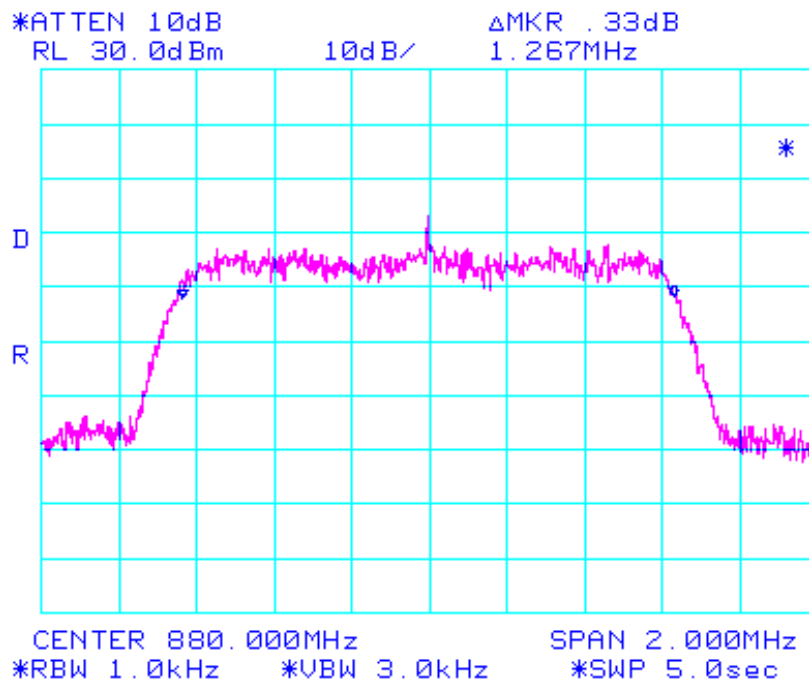


Occupied B/W w/CDMA Input vs output Downlink IS-95  
emi9752



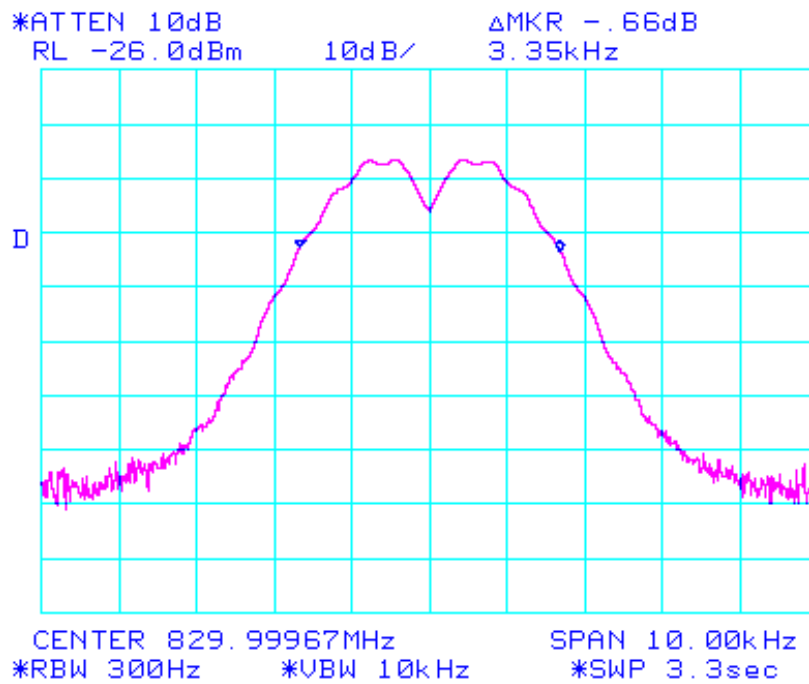


**CDMA Occupied B/W at remote Antenna terminal Downlink**  
**emi9752 IS-95**





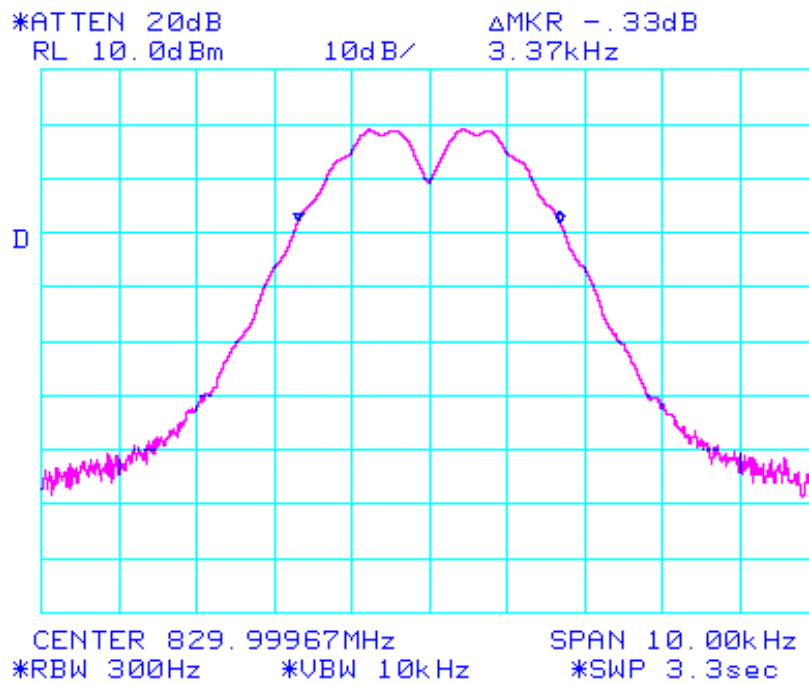
**FM Occupied B/W at Input side Uplink emi9752**





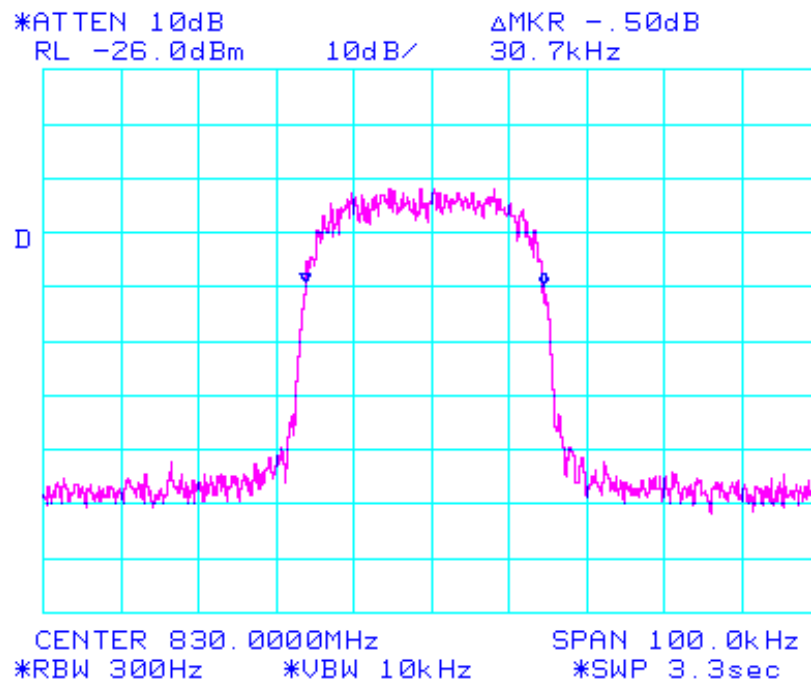


**FM Occupied B/W at Hub's output Uplink emi9752**



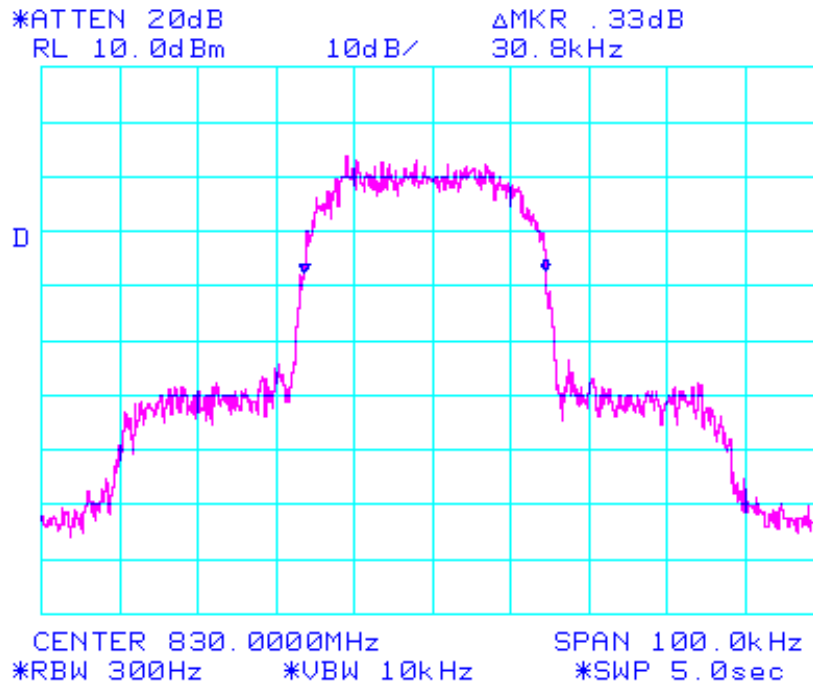


**NADC Occupied B/W at input side Uplink emi9752**



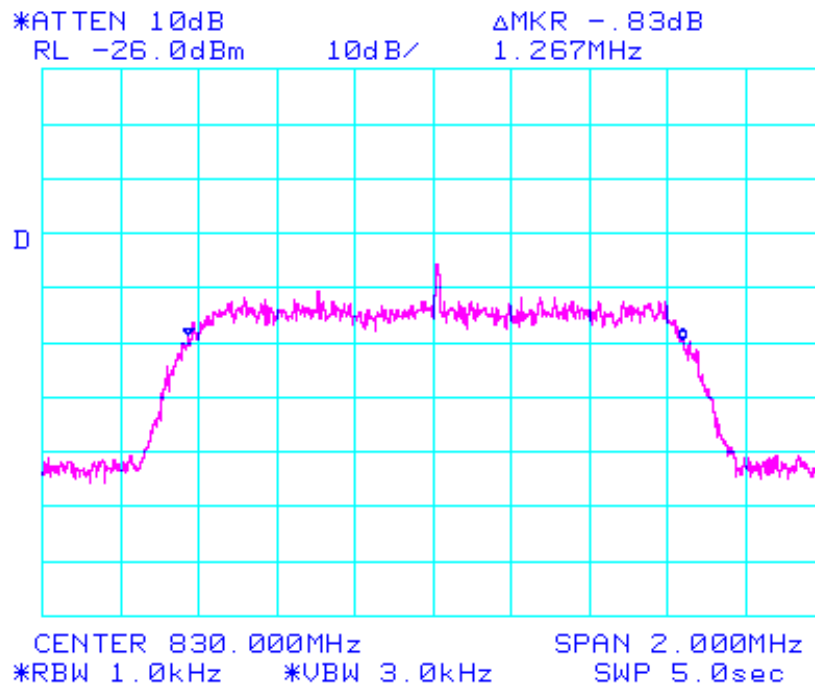


**NADC Occupied B/W at Hub's RF output Uplink emi9752**



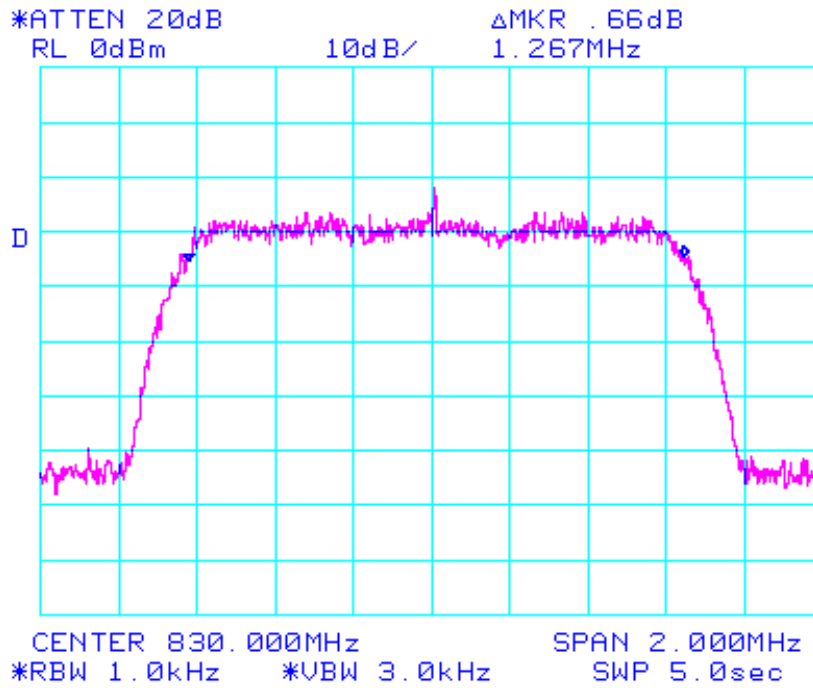


# **CDMA Occupied B/W at Input side Uplink emi9752**





**CDMA Occupied B/W at Hub's output Uplink emi9752**





### **6.3 TEST TYPE:** RF Power Output

#### **6.3.1 TECHNICAL SPECIFICATION:** 47 CFR 2.1046 and 22.913(a)

#### **6.3.2 TEST DATE(S):** June 29, 2000

#### **6.3.3 MEASUREMENT PROCEDURES:**

As required by 47 CFR 2.1046, *RF power output measurements* were made at the RF output terminals using an attenuator and spectrum analyzer.

Plots of the RF output Power level, as measured at the RF output of the signal generator and at the RF output terminals of the EUT are included in this application as file attachment

#### **6.3.4 RESULTS:**

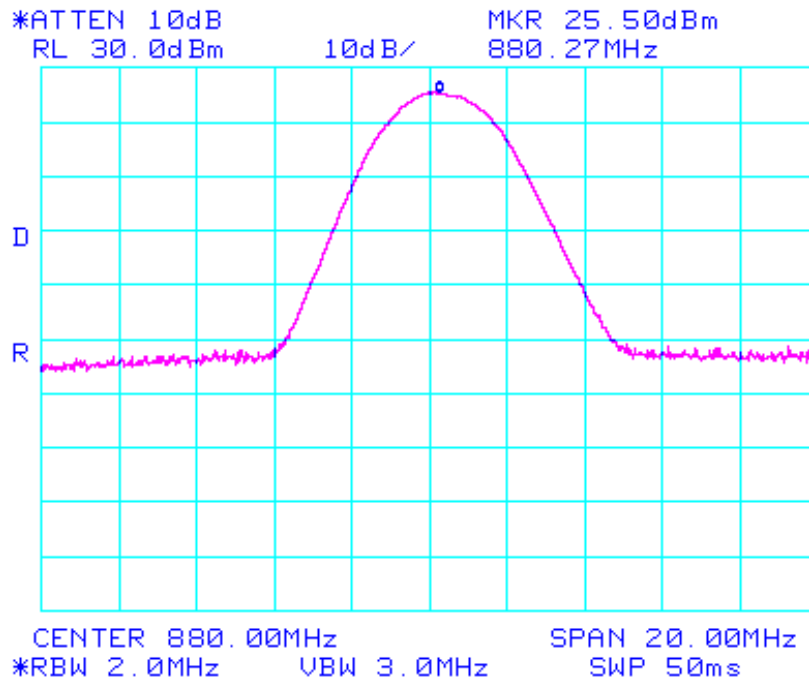
Equipment complies with 47 CFR 2.1046 and 22.913(a). The Cellular repeater/booster power does not exceed 500 W (57 dBm) at the carrier frequency.

Photograph of Antenna Conducted Spurious Emissions and  
RF Power Output Test Configuration



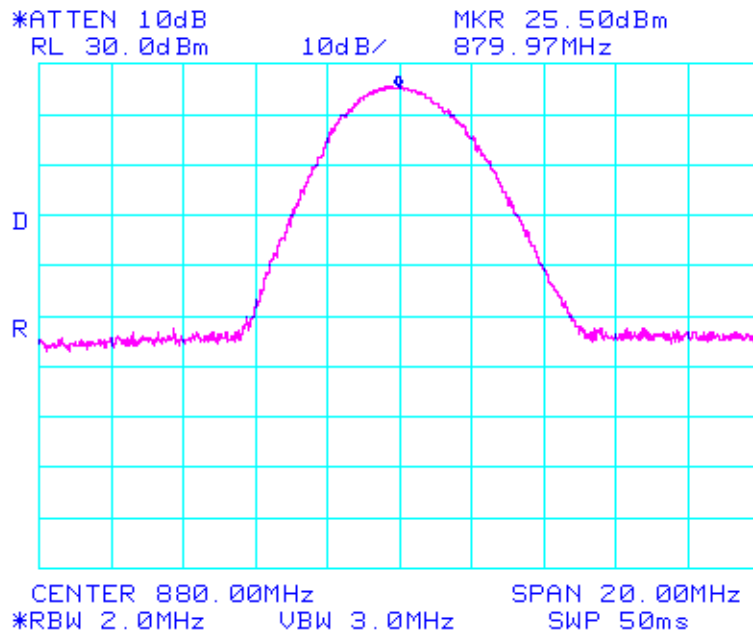


**RF output power unmodulated Downlink  
emi9752**





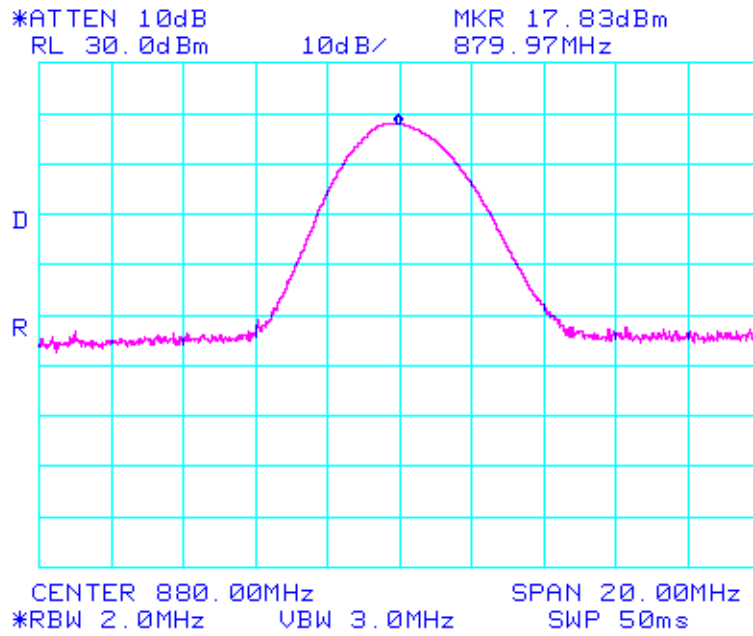
**RF output power CDMA modulated Downlink  
emc9752**





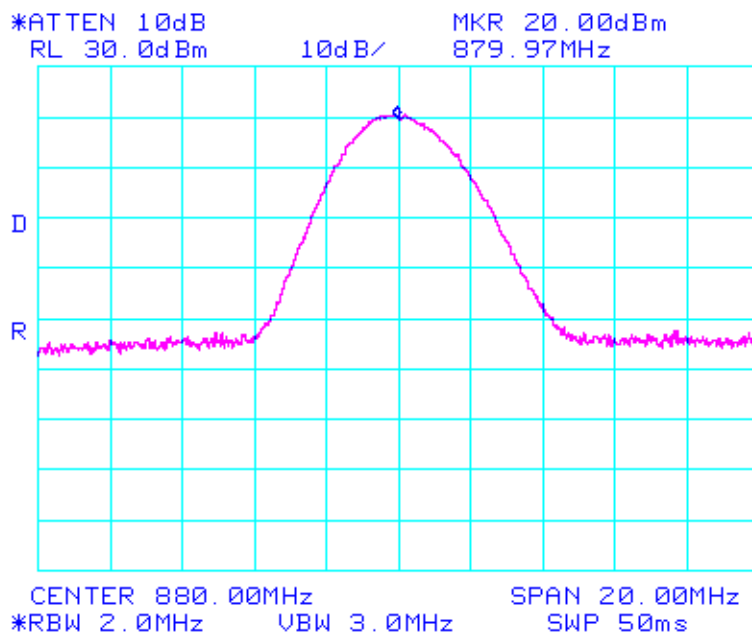


**RF output power FM modulated Downlink  
emc9752**



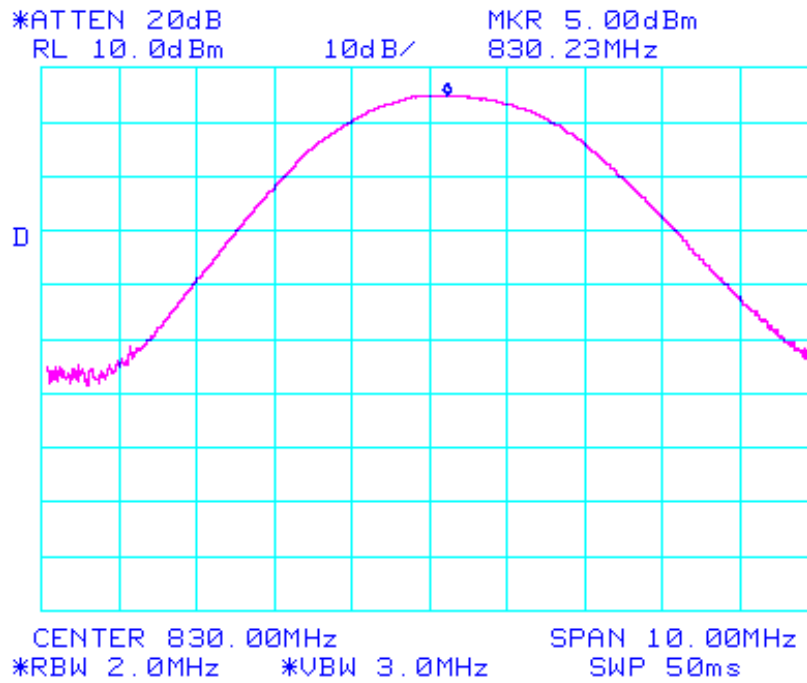


**RF output power NADC modulated Downlink  
emc9752**





## RF Power output Uplink emi9752





#### **6.4 TEST TYPE:** Spurious Emissions at Antenna Terminals— Uplink Channels

##### **6.4.1 TECHNICAL SPECIFICATION:** 47 CFR 2.1051; 22.917(e)

##### **6.4.2 TEST DATE(S):** June 29, 2000

##### **6.4.3 MEASUREMENT PROCEDURES:**

As required by 47 CFR 2.1051, *spurious emissions at antenna terminal measurements* were made at the RF output terminals using a 50  $\Omega$  attenuator and spectrum analyzer set for a 30 kHz bandwidth. This test was performed with Digitally modulated carrier signals. The Digital signal generator was adjusted for continuous transmit on frequencies in both the uplink and down-link frequency bands. The frequency spectrum was investigated from 9.0 KHz to 9.0 GHz. For measuring emissions above 2 GHz, a high-pass filter was used to eliminate the fundamental transmit frequency to prevent possible saturation effects on the front end of the spectrum analyzer.

##### **6.4.4 RESULTS:**

Equipment complies with Sections 2.1051 and 22.917(e)

As recommended in 47 CFR 22.917(h)(ii), a 100kHz bandwidth was chosen to measure the peak of any spurious emission. The unit was exercised using signal types required by 47 CFR 2.1049.

Spur limit =  $P_o - (43 + 10\log P) = 132.5 \text{ dB}\mu\text{V} - (38.44 \text{ dB}) = 94 \text{ dB}\mu\text{V} = -13.1 \text{ dBm}$

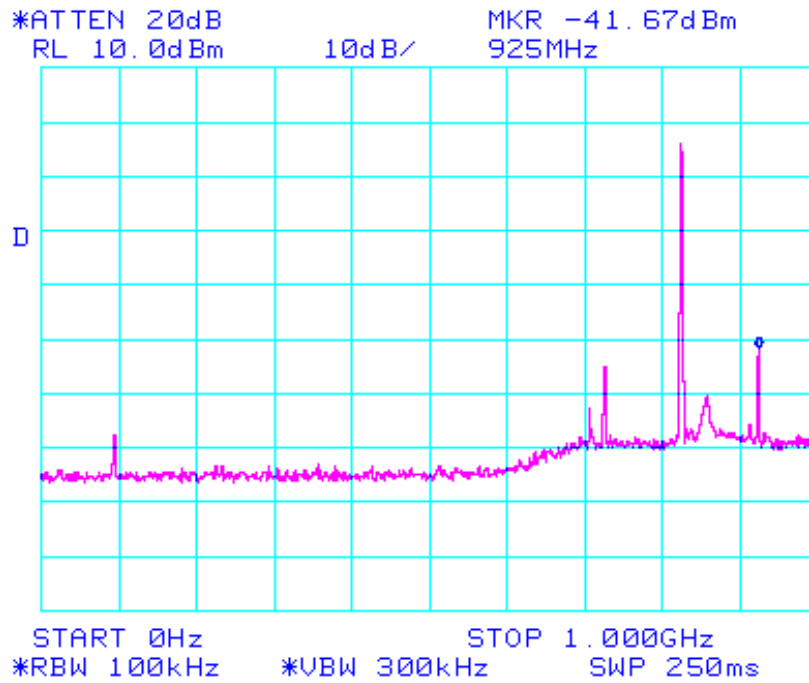
#### **SUMMARY OF SPURIOUS EMISSIONS AT ANTENNA TERMINALS - UpLink**

Frequency Range	Emission Frequency	Emission Level (dBm)	Limit (dBm)
0 kHz - 1 GHz	925 MHz	-41.67	-13.1
1 GHz - 2.9 GHz	1.652 GHz	-47.83	-13.1
2.9 GHz - 9.0 GHz	7.53 GHz	-55.33	-13.1

The following plots are included to illustrate compliance with the requirements of 47 CFR 22.917(e):

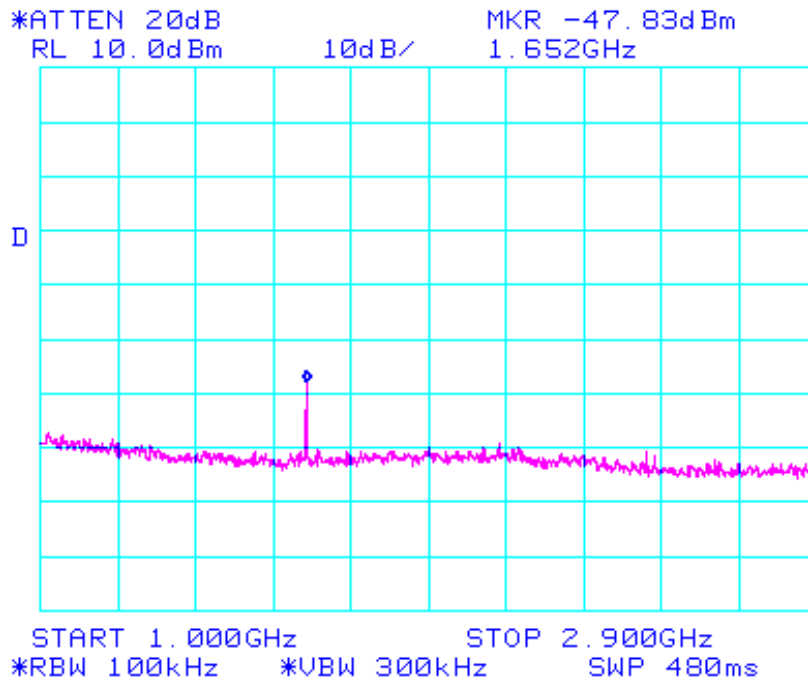


## Spur emissions at Uplink emi9752



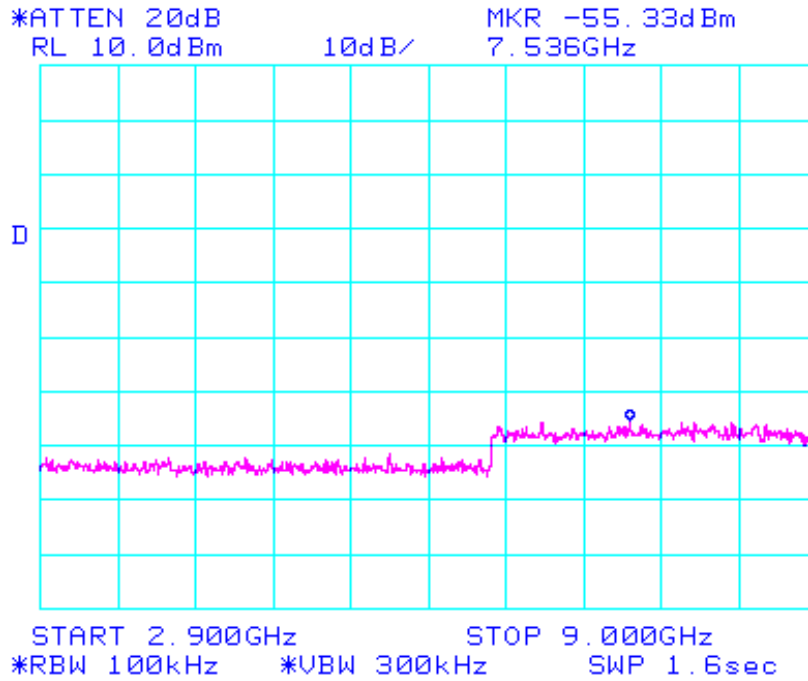


## Spur emissions at Uplink emi9752





## Spur emissions at Uplink emi9752





## **6.5 TEST TYPE: Spurious Emissions at Antenna Terminals— Downlink Channels**

### **6.5.1 TECHNICAL SPECIFICATION: 47 CFR 2.1051; 22.917(e)**

### **6.5.2 TEST DATE(S): June 29, 2000**

### **6.5.3 MEASUREMENT PROCEDURES:**

As required by 47 CFR 2.1051, *spurious emissions at antenna terminal measurements* were made at the RF output terminals using a 50  $\Omega$  attenuator and spectrum analyzer set for a 30 kHz bandwidth. This test was performed with Digitally modulated carrier signals. The Digital signal generator was adjusted for continuous transmit on frequencies in both the uplink and down-link frequency bands. The frequency spectrum was investigated from 9.0 KHz to 9.0 GHz. For measuring emissions above 2 GHz, a high-pass filter was used to eliminate the fundamental transmit frequency to prevent possible saturation effects on the front end of the spectrum analyzer.

### **6.5.4 RESULTS:**

Equipment complies with Section 2.1051 and 22.917(e)

As recommended in 47 CFR 22.917(h)(ii), a 100kHz bandwidth was chosen to measure the peak of any spurious emission. The unit was exercised using signal types required by 47 CFR 2.1049.

Spur limit =  $P_o - (43 + 10\log P) = 132.5 \text{ dB}\mu\text{V} - (38.44 \text{ dB}) = 94 \text{ dB}\mu\text{V} = -13.1 \text{ dBm}$

### **SUMMARY OF SPURIOUS EMISSIONS AT ANTENNA TERMINALS - DownLink (Base)**

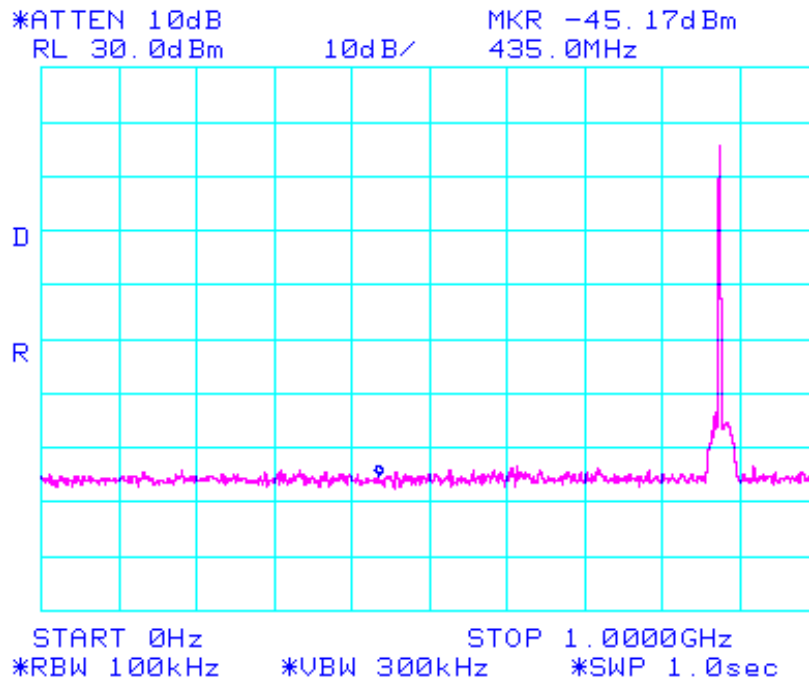
Frequency Range	Emission Frequency	Emission Level (dBm)	Limit (dBm)
0 kHz - 1 GHZ	435.0 MHz	-45.17	-13.1
1 GHz - 2.9 GHZ	1.827 GHz	-44.67	-13.1
2.9 GHZ - 9 GHZ	7.262 GHz	-39.17	-13.1

Plots on the following pages illustrate compliance to the required rule parts.



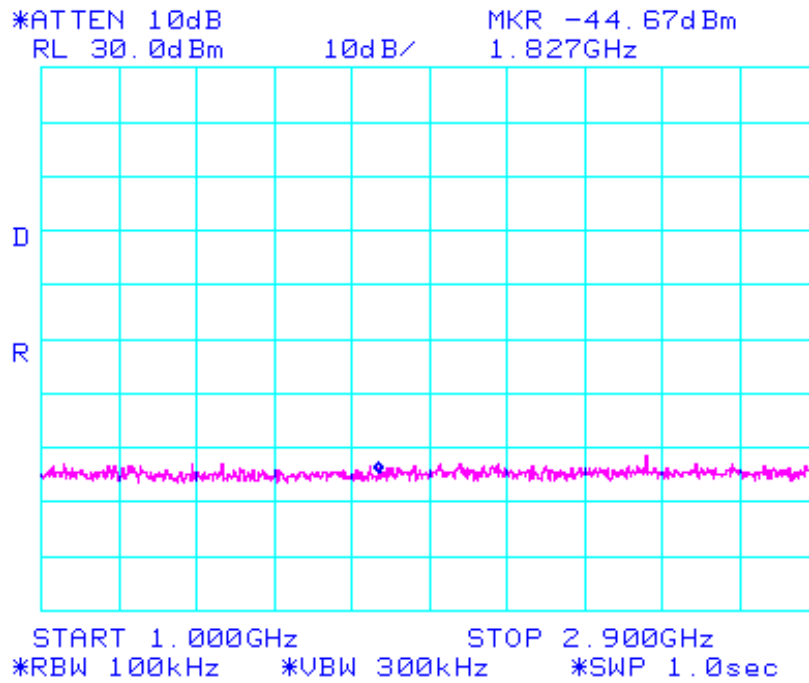


## Spur emissions Downlink emi9752



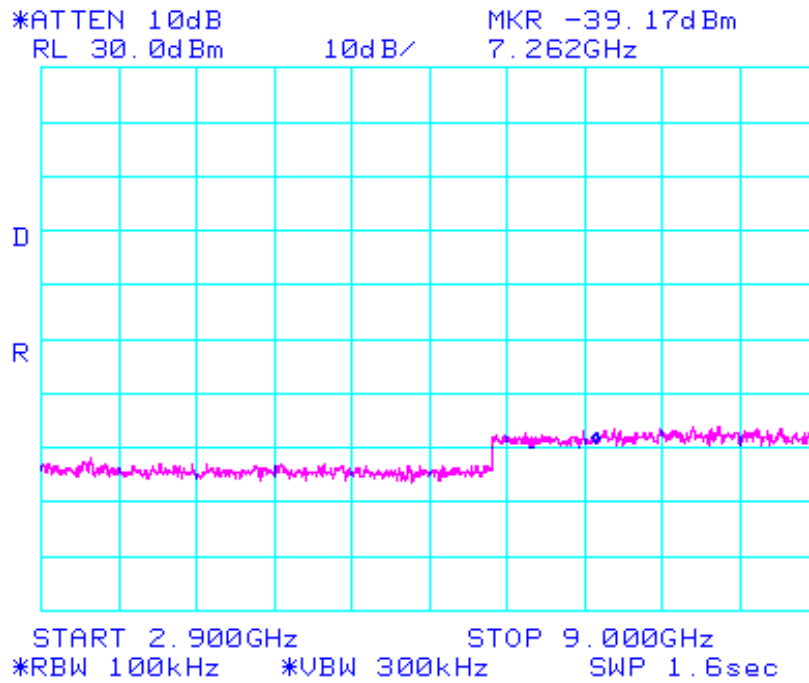


**Spur emissions emi9752**





## Spur emissions emi9752





**6.6 TEST TYPE:** Intermodulation Spurious Emissions Antenna Terminals— Uplink

**6.6.1 TECHNICAL SPECIFICATION:** 47 CFR 2.1051, 22.917(e)

**6.6.2 TEST DATE(S):** June 30, 2000

**6.6.3 MEASUREMENT PROCEDURES:** (UPLINK)

Spurious emissions were measured at the antenna terminal with the Digital signal generator tuned to transmit on a frequency in the uplink of its tuneable range.

**6.6.4 RESULTS:**

Equipment complies with 47CFR 2.1051 and 22.917(e). Plots of the spurious emissions as measured at the antenna port are included in this application as file attachment:

**Intermodulation Spurious Products from 2-tone Simultaneous RF Injection** At low side and high side of Cellular band. **Uplink**

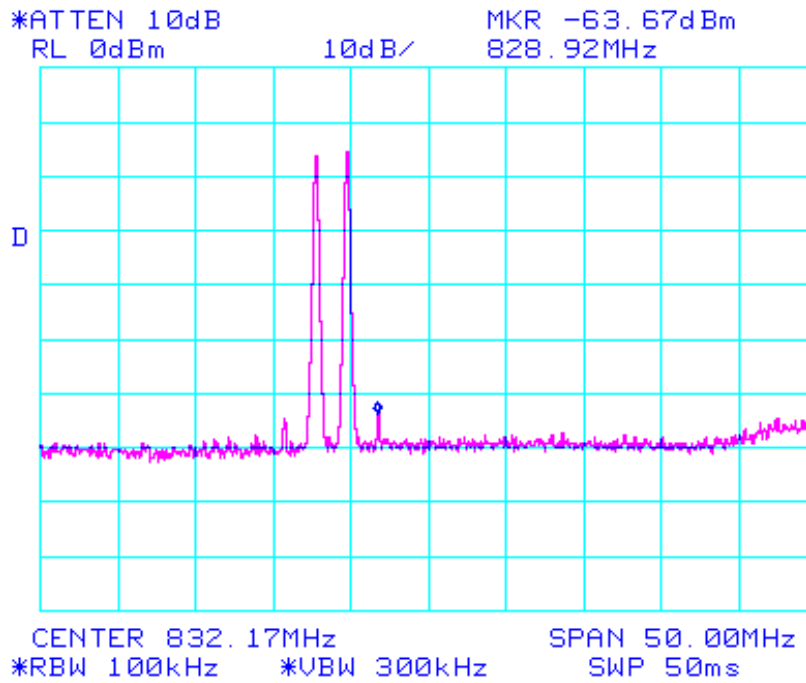
$$\text{Spur limit} = P_o - (43 + 10\log P) = 132.5 \text{ dB}\mu\text{V} - (38.44 \text{ dB}) = 94 \text{ dB}\mu\text{V} = -13.1 \text{ dBm}$$

**Uplink**

modulation type	Intermodulation products (MHZ)	Emission Level (dBm)	Limit (dBm)
FM	829.00 844.08	-64.17 -65.67	-13.1
NADC (DAMPS)	828.92 844.08	-63.67 -62.67	-13.1

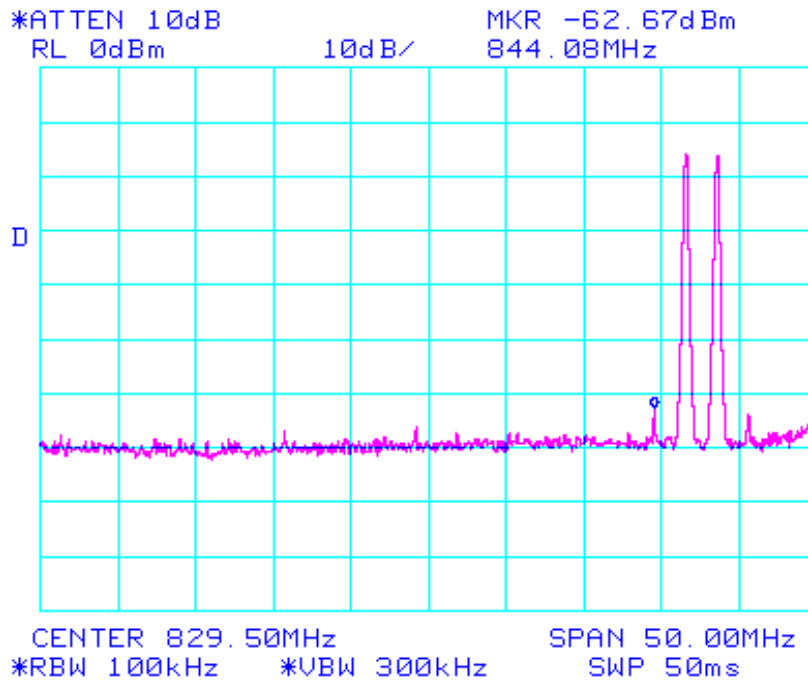


IMD NADC emi9752 Uplink



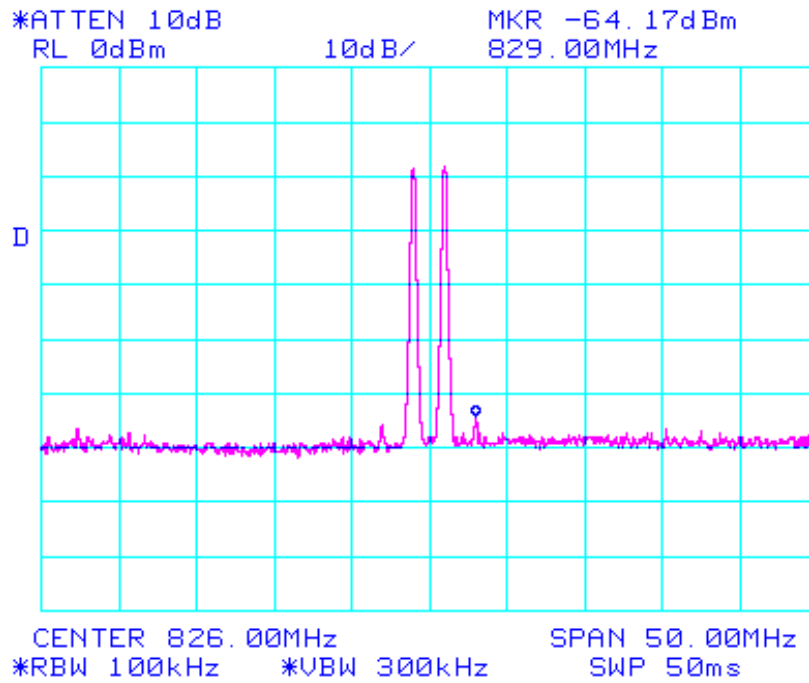


IMD NADC Uplink emi9752



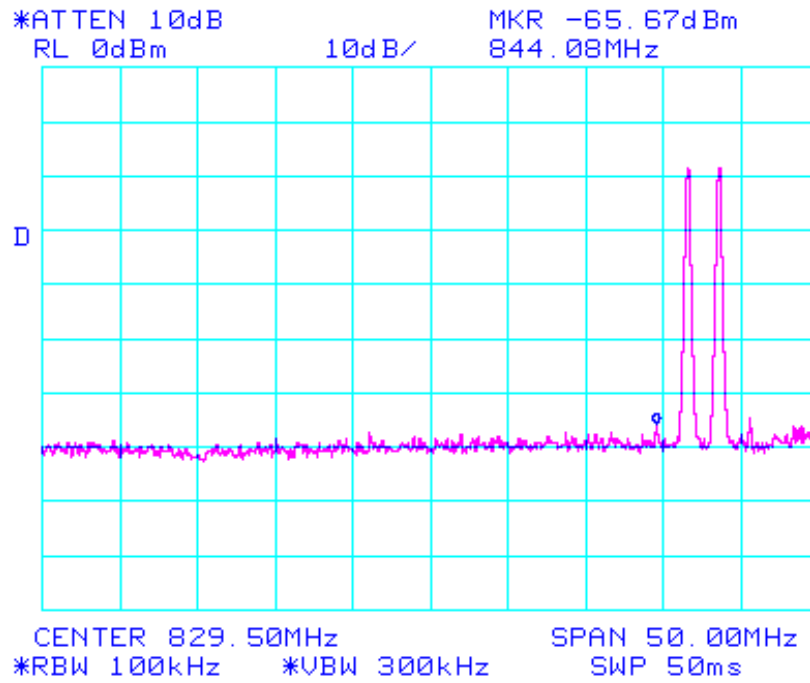


## IMD Analog emi9752





## IMD Analog Uplink emi9752







**6.7 TEST TYPE:** Intermodulation Spurious Emissions Antenna Terminals

**6.7.1 TECHNICAL SPECIFICATION:** 47 CFR 2.1051; 22.917(e)

**6.7.2 TEST DATE(S):** June 30, 2000

**6.7.3 MEASUREMENT PROCEDURES:** (DOWNLINK)

Modulation products outside of the authorized band are attenuated at least  $43 + 10 \log(P)$  below the level of the modulated carrier.

**6.7.4 RESULTS:**

Equipment complies with 47CFR 2.1051 and 22.917(e). Plots of the spurious emissions as measured at the antenna port are included in this application as follows:

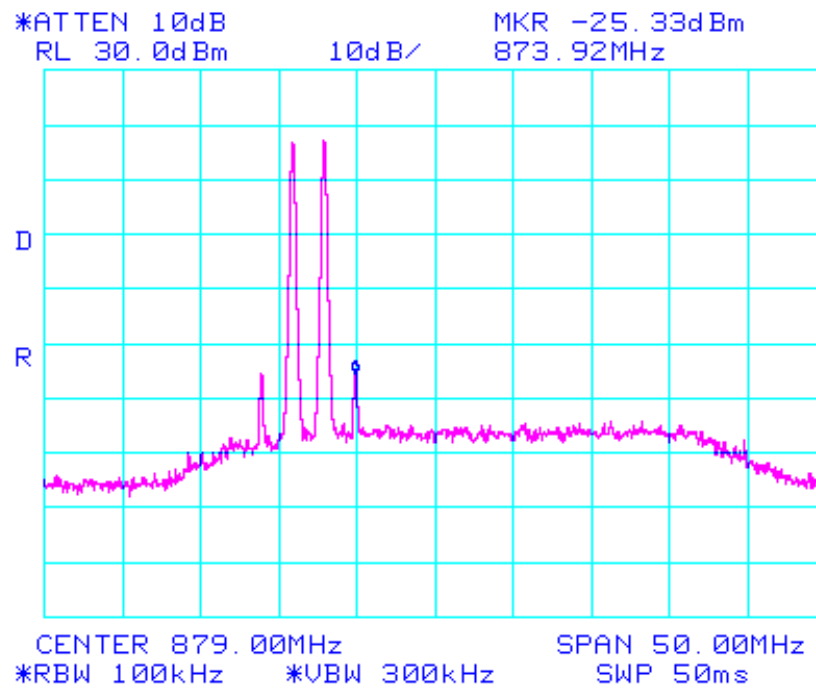
**Intermodulation Spurious Products from 2-tone Simultaneous RF Injection** At low side and high side of Cellular band. **Downlink**

$$\text{Spur limit} = P_o - (43 + 10\log P) = 132.5 \text{ dB}\mu\text{V} - (38.44 \text{ dB}) = 94 \text{ dB}\mu\text{V} = -13.1 \text{ dBm}$$

modulation type	Intermodulation products (MHZ)	Emission Level (dBm)	Limit (dBm)
FM	873.92 889.00	-25.33 -27.50	-13.1
NADC (DAMPS)	878.00 888.92	-25.33 -23.00	-13.1

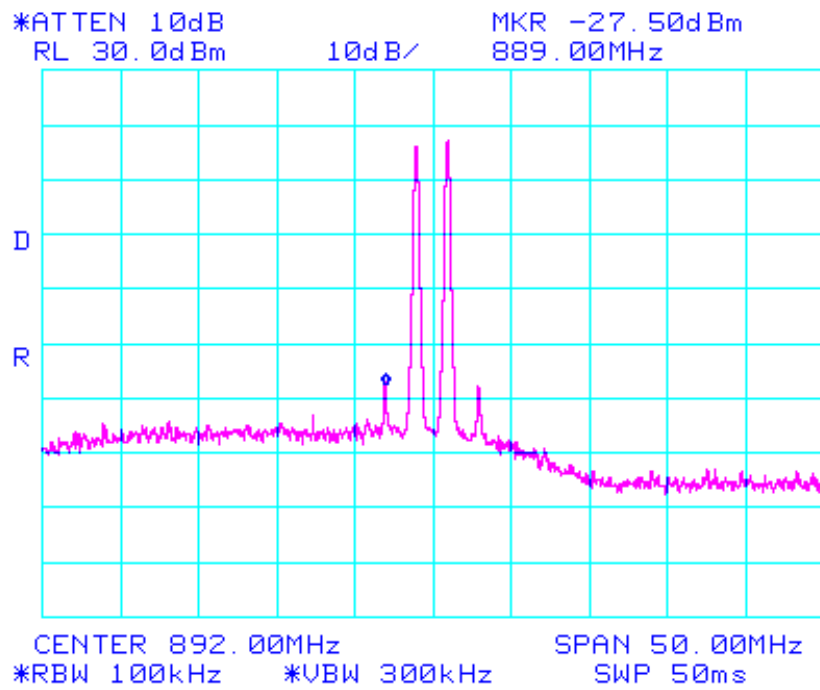


## IMD Analog Downlink emi9752



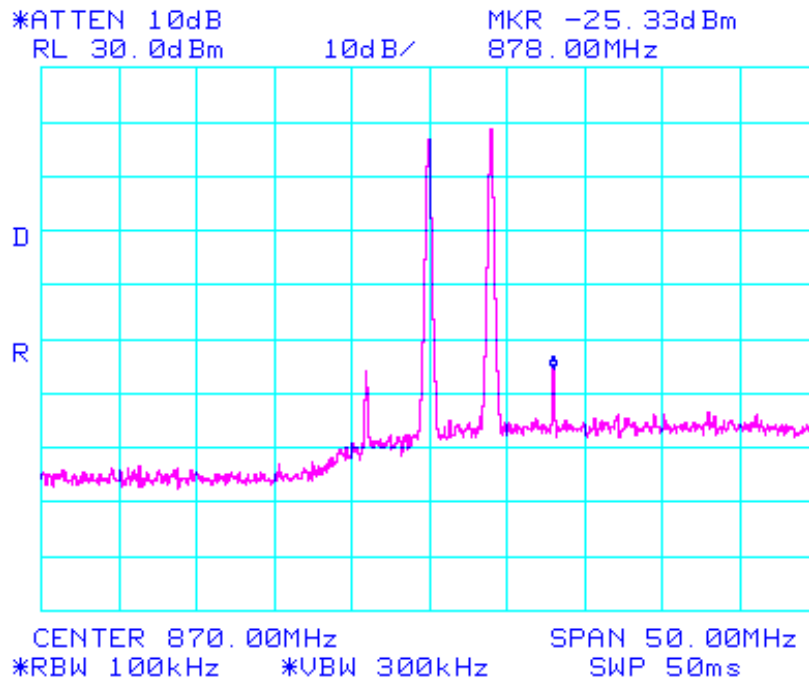


## IMD Analog emi9752



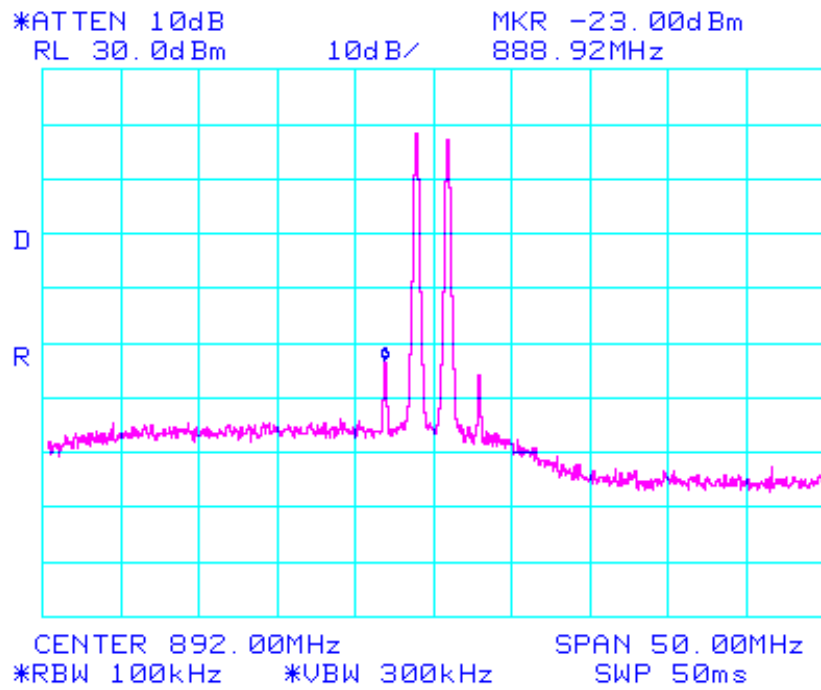


IMD NADC Downlink emi9752





IMD NADC Downlink emi9752





**6.8 TEST TYPE:** Line Conducted Emissions

**6.8.1 TECHNICAL SPECIFICATION:** 47 CFR 15.107(b)

**6.8.2 TEST DATE(S):** May 25, 2000

**6.8.3 MEASUREMENT PROCEDURES:**

The measurements were performed over the frequency range of 0.45 MHz to 30 MHz using a 50  $\Omega$ /50  $\mu$ H LISN as the input transducer to an EMI/Field Intensity Meter. The measurements were made with the detector set for "peak" amplitude within an IF bandwidth of 10 kHz or for "quasi-peak" within a bandwidth of 9 kHz. The tests were conducted in a RF-shielded enclosure.

**6.8.4 RESULTS:**

Equipment complies with Section 15.107(b)

**SUMMARY OF SPURIOUS EMISSIONS AT AC Mains Terminals - Phase**

Frequency (MHZ)	Emission Quasi-Peak Level (dBuV)	Limit (dBuV)
17.489	38.9	48.0
13.507	36.1	48.0
29.483	26.3	48.0

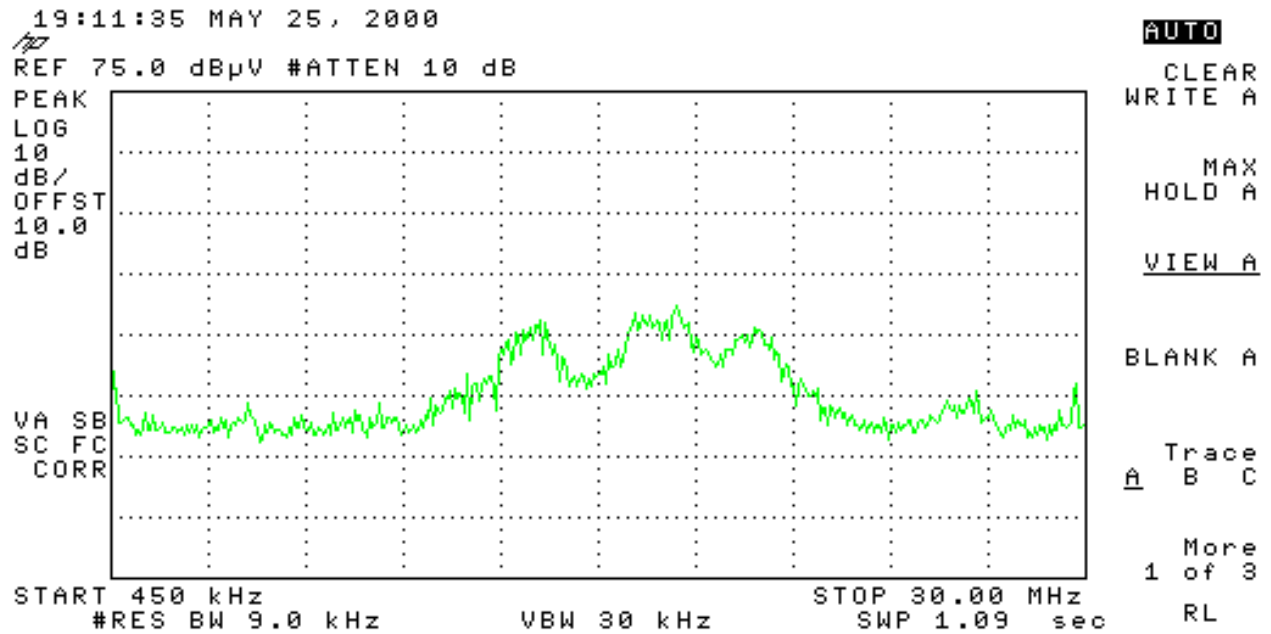
**SUMMARY OF SPURIOUS EMISSIONS AT AC Mains Terminals - Neutral**

Frequency (MHZ)	Emission Quasi-Peak Level (dBuV)	Limit (dBuV)
17.677	37.3	48.0
16.542	37.5	48.0
13.164	36.6	48.0

The following plots illustrate compliance with the applicable specification.

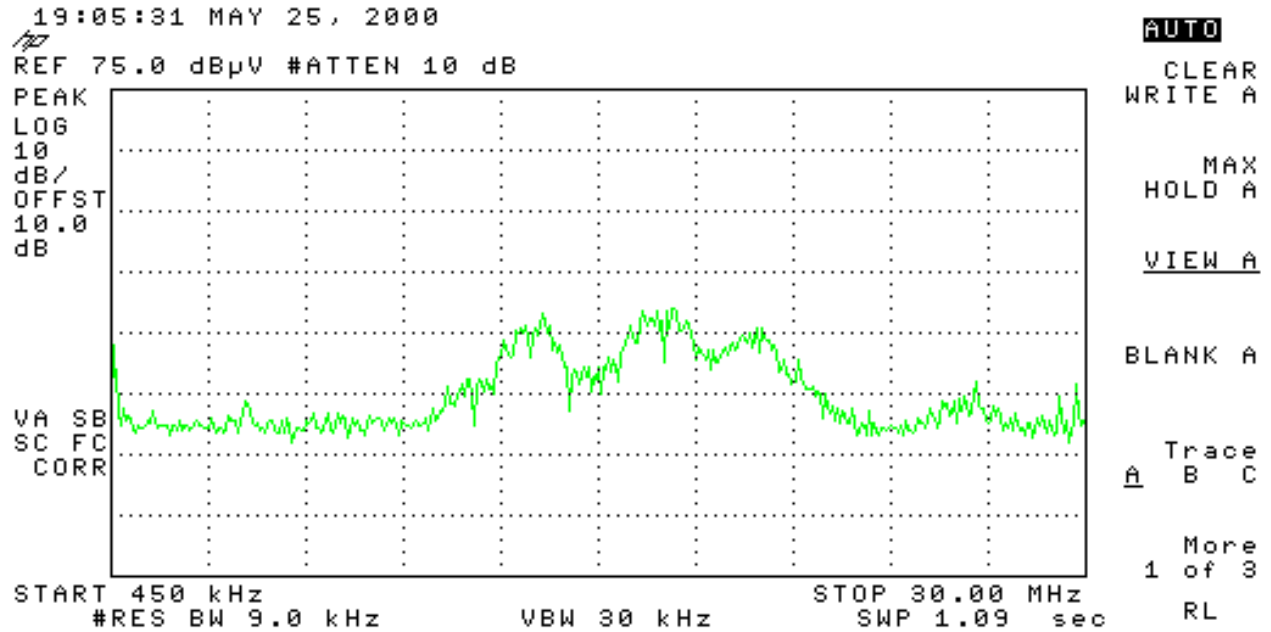


## Neutral Hub emi9752





## Phase Hub emi9752







## TEST SETUP OF LINE CONDUCTED EMISSIONS

