April 21, 2000

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

Attention: Applications Examiner

Applicant: Allen Telecom, Inc.
140 Vista Centre Drive
Forest , VA 24551

Equipment: MR Booster Model LMR 800

FCC ID: BCR-MRB-LMR

Specification: 47 CFR 90 Licensed Certification

Dear Examiner:

The following application for Grant of Equipment Authorization is presented on behalf of Allen Telecom, Inc. for the Licensed Certification of their Model: LMR 800 MR Booster.

Enclosed, please find a complete data and documentation package demonstrating that this device complies with the technical requirements of 47 CFR 90, for a MR Booster.

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:	MR Booster , Model LMR800
FCC ID:	BCR-MRB-LMR
Specification:	47 CFR 90
On Behalf of the Applicant:	Allen Telecom, Inc. 140 Vista Centre Drive Forest, VA 24551
Manufacturer:	Allen Telecom, Inc. 140 Vista Centre Drive Forest, VA 24551
Manufacturer's Representative	Mr. Howard Giannapolis
Test Date(s):	January 13 through February 2, 2000

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 90 of the FCC Rules under normal use and maintenance.

_____

Liming Xu

Project Engineer, MET Laboratory

1.0 INTRODUCTION

The following data is presented on behalf of the Applicant, Allen Telecom, Inc., as verification of the compliance of the Allen Telecom MR Booster, Model LMR 800 to the requirements of 47 CFR 90.

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	1/29/01	annual
EMCO	Biconical Antenna 3104	2/9/01	annual
EMCO	EMCO Log Periodic Antenna	3/20/00	annual
EMCO	Double Ridge Guided Horn	3/20/00	annual
Hewlett Packard	8591E Analyzer	08/12/00	annual
Hewlett Packard	E4433B Digital Signal Gen. E4432A Digital Signal Gen.	09/02/2001 01/08/2002	annual
Solar	LISN	6/30/00	annual

4.0 EQUIPMENT UNDER TEST CONFIGURATION

The MR Booster was configured with an AC power supply module and a digital signal generator were used to simulate various TDMA/FM RF input signals to the EUT. The EUT with host external computer was configured for maximum signal gain and bandwidth. In addition, 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.

Emission Designator: AMP

Four Configurations were tested and all data was recorded during testing. For the sake of simplicity only representative and/or worst case data is presented in this test report
:
4 PA w/ 8 watt (4 power amplifiers with 8 watt drive)
4 PA w/o 8 watt (4 power amplifiers without 8 watt drive)
2 PA w/ 8 watt (2 power amplifiers with 8 watt drive)
2 PA w/o 8 watt (4 power amplifiers without 8 watt drive)

5.0 TEST TYPE(S)

5.1 Radiated Emissions: 47CFR2.1053, 90.210(h), and 90.691(a)
5.2 Occupied Bandwidth: 47CFR2.1049
5.3 RF Power Output: 47CFR 2.1046, 90.205(i), and 90.635
5.4 Spurious Emission at Antenna Terminals:(downlink) 47CFR 2.1051, 90.210(h), 90.691(a)
5.5 Emissions Masks: 47CFR90.210
5.6 Intermodulations Spurious Emissions - 2 Tone Simultaneous RF Injection at low and high end of the Channel band: 47CFR2.1051, 90.210(h), and 90.691(a)
5.7 Line conducted Emissions: 47CFR15.107(b)

6.0 TEST RESULTS

6.1 TEST TYPE: Radiated Emissions

6.1.1 TECHNICAL SPECIFICATION: 2.1053; 90.210(h); 90.691(a)

6.1.2 TEST DATE(S): Feb 1 . 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 a digital signal generator on and terminated. The frequency list from the preliminary measurements were used as a guide for making final measurements on an 10 meter open area test site. The unit was scanned over the frequency range of 9 kHz to 9 GHz. The Radiated Spurious Emissions *Limit* is obtained by the following:

Based on an input power (as measured at the output of the Amplifier) of 31 watts:

$$P_o = 31 \text{ W}$$

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:

$$E(V/m)_{1m} = \frac{\sqrt{49.2 \ X \ 31}}{1}$$
$$E(V/m)_{1m} = 39 \ V/m \ or \ 151.9 \ db\mu V$$

As per 90.691(a), the spurious emissions must be attenuated by 43 + log(P) which is:

$$43 + 10Log(31) = 57.91 \ dB$$

Therefore, the limit for spurious emissions is:

$$151.9 \ dB\mu V - 57.91 \ dB = 93.91 \ dB\mu V \ @ \ 1m$$

At 3 meters measurement distance, the limit is;

$$E(V/m)_{3m} = \frac{\sqrt{49.2 \ X \ 31}}{3}$$
$$E(V/m)_{3m} = 13 \ V/m \ or \ 142.3 \ db\mu V$$

Again, according to 90.691, all signals must be attenuated by 46.01 dB;
Therefore, the limit for spurious emissions for a test distance of 3 meters is:

$$142.3 - 59.7 = 84.37 \ dB\mu V \ @ \ 3m$$

6.1.4 RESULTS:

Carrier Emission: 31 Watts

FREQUENCY (MHz)	EUT AZIMUTH (Degrees)	ANTENNA		EUT RADIATION (dBµV) (Quasi-Peak)	ANTENNA FACTOR (dB/m)	TEST DISTANCE (m)	CABLE LOSS (dB)	FIELD STRENGTH (dBuV/m)	LIMITS @ 3 m (dBuV/m)
		POL (H/V)	HGT (m)						
47.830	90	H	1.5	14.1	10.9	3.0	1.2	23.3	84.37
47.830	90	V	1.0	19.7	11.1	3.0	1.2	29.0	84.37
51.750	90	H	1.5	14.13	10.6	3.0	1.3	23.1	84.37
51.750	90	V	1.0	26.55	10.7	3.0	1.3	35.6	84.37
89.500	0	H	1.0	31.3	8.0	3.0	1.7	38.0	84.37
89.500	0	V	1.0	37.3	9.6	3.0	1.7	45.6	84.37
145.130	0	H	2.0	18.5	13.3	3.0	2.3	31.1	84.37
145.130	0	V	1.0	14.7	13.1	3.0	2.3	27.1	84.37
146.200	0	H	1.0	21.9	13.3	3.0	2.3	34.5	84.37
146.200	0	V	1.0	14.6	13.2	3.0	2.3	27.1	84.37
207.500	270	H	1.0	15.55	17.9	3.0	2.7	33.1	84.37
207.500	270	V	1.0	15.66	18.0	3.0	2.7	33.4	84.37
381.500	0	H	1.0	13.6	17.7	3.0	3.8	32.1	84.37
381.500	0	V	1.0	13.7	18.0	3.0	3.8	32.5	84.37
603.700	270	H	1.0	16.13	20.2	3.0	5.1	38.3	84.37
603.700	270	V	1.0	13.6	19.5	3.0	5.1	35.1	84.37
823.700	90	H	1.0	14.3	23.1	3.0	6.0	40.4	84.37
823.700	90	V	1.0	14.2	22.7	3.0	6.0	40.0	84.37
991.500	90	H	1.0	14.4	25.3	3.0	6.8	43.5	84.37
991.500	90	V	1.0	14.6	24.4	3.0	6.8	42.8	84.37
1720.000	45	H	1.0	22.83	26.0	1.0	2.0	50.8	84.37
1720.000	45	V	1.0	29.33	26.0	1.0	2.0	57.3	84.37
3440.000	45	H	1.0	17.33	31.0	1.0	2.0	50.3	84.37
3440.000	45	V	1.0	22.5	31.0	1.0	2.0	54.5	84.37
7740.000	45	H	1.0	12.1	37.0	1.0	3.0	52.1	84.37
7740.000	45	V	1.0	11.5	37.0	1.0	3.0	51.5	84.37
9000.000	45	H	1.0	10.5	38.2	1.0	3.0	51.7	84.37
9000.000	45	V	1.0	10.0	38.0	1.0	3.0	51.0	84.37

Equipment meets the specifications of 2.1046; 2.1053

Photograph of Radiated Emissions Test Configuration

6.2 TEST TYPE: Occupied Bandwidth

6.2.1 TECHNICAL SPECIFICATION: 47CFR2.1049

6.2.2 TEST DATE(S): 19 Jan. 2000

6.2.3 MEASUREMENT PROCEDURES:

As required by §2.1049 of CFR 47, *occupied bandwidth measurements* were made on the MR Booster pre- and post- Booster. A digital signal generator was configured to transmit a TDMA (simulated iDEN) and a FM modulated carrier signal. Using a resolution bandwidth of 300Hz, we determined the occupied bandwidth of the emission at the middle of the channel range.

The unit was exercised using the signal types required by §2.1049.

6.2.4 RESULTS:

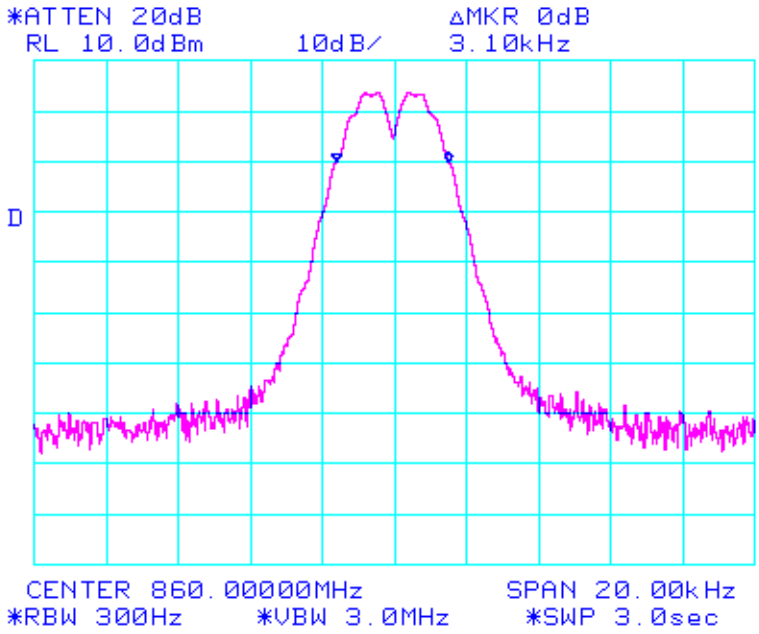
Equipment complies with Section 2.1049. Plots of the occupied bandwidth, as measured at the Booster RF input port and at the antenna RF output port (post amplification) for both downlink frequency bands.

The attached plots illustrate that the introduction of the MR Booster, as implemented will not significantly broaden the signal bandwidth.

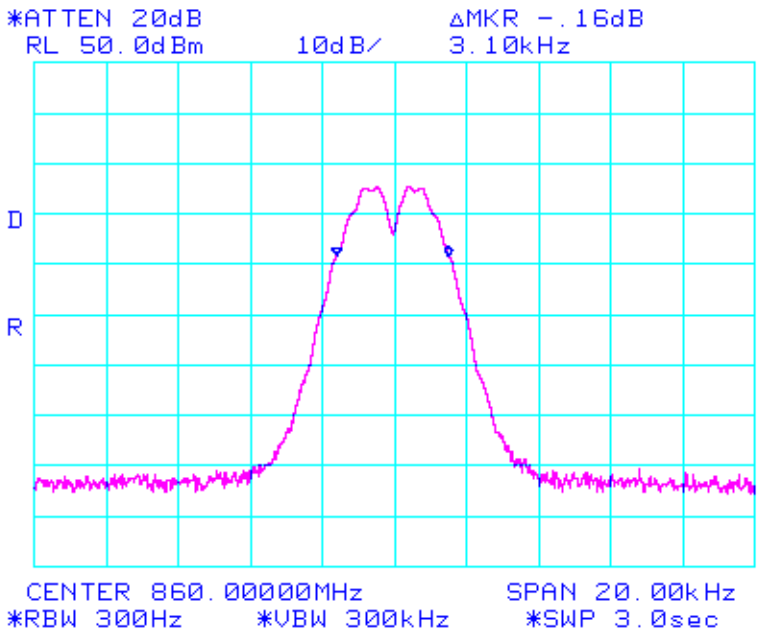
	4PA w/8watt	**4PA w/o 8watt**	**2PA w/8watt**	**2PA w/o 8watt**
Modulation:	**TDMA**	**TDMA**	**TDMA**	**TDMA**
BW out-851MHz	25.8 kHz	26.3 kHz	26.3 kHz	26.3 kHz
BW in-851MHz	25.5 k	26.3k	26.3k	26.3k
BW out-860MHz	26.5 k *	26.5k *	26.3k *	26.3k *
BW in-860MHz	26.5k *	26.3k *	26.3k *	26.3k *
BW out-869MHz	26.8k	26.0k	26.3k	26.3k
BW in-869MHz	26.5k	26.3k	26.3k	26.3k
Modulation:	**FM**	**FM**	**FM**	**FM**
BW out-851MHz	3.1k	3.1k	3.2k	3.25k
BW in-851MHz	3.1k	3.1k	3.2k	3.2k
BW out-860MHz	3.1k *	3.1k *	3.2k *	3.25k *
BW in-860MHz	3.1k *	3,1k *	3,1k *	3.2k *
BW out-869MHz	3.1k	3.1k	3.2k	3.25k
BW in-869MHz	3.1k	3.1k	3.2k	3.2k

* The Plots are attached. See follow pages:

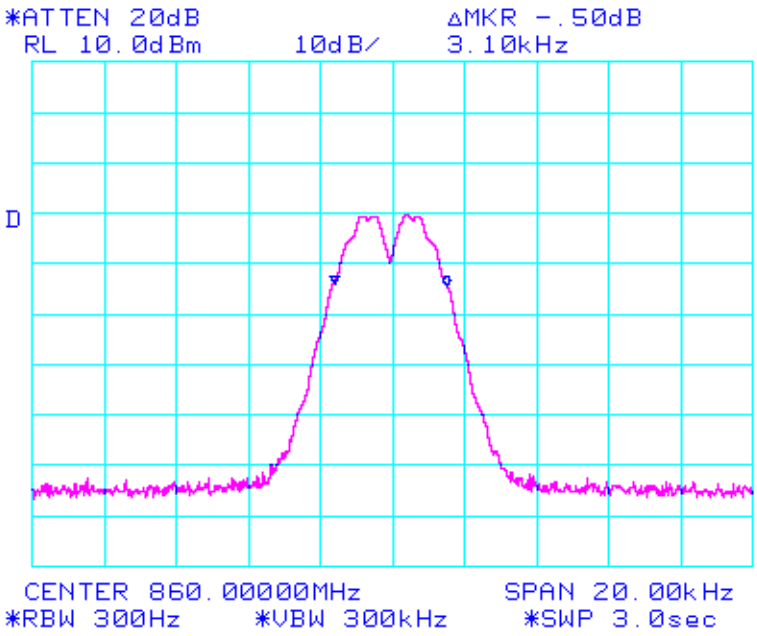
Occupied BW FM mid-band 4PA w/o 8watt
emi1303



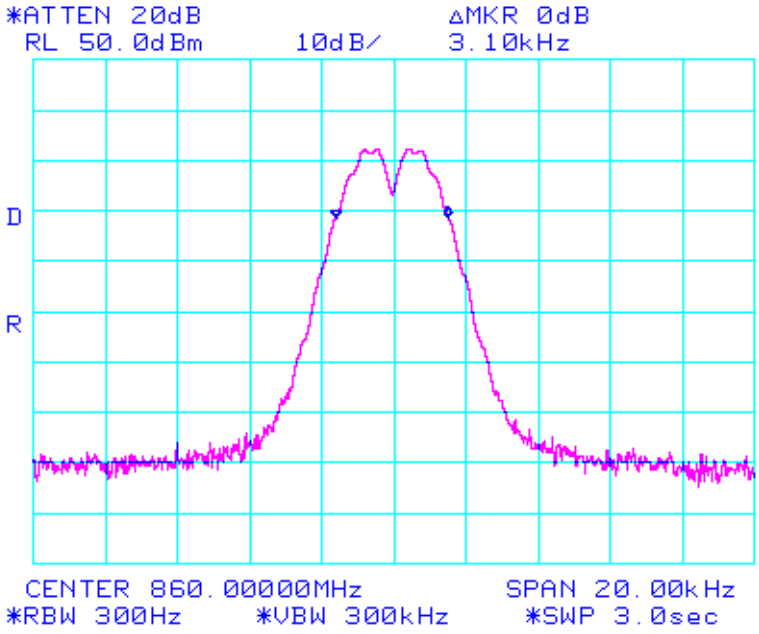
Occupied BW FM med-band 4 PA w/o 8watt
emi1303



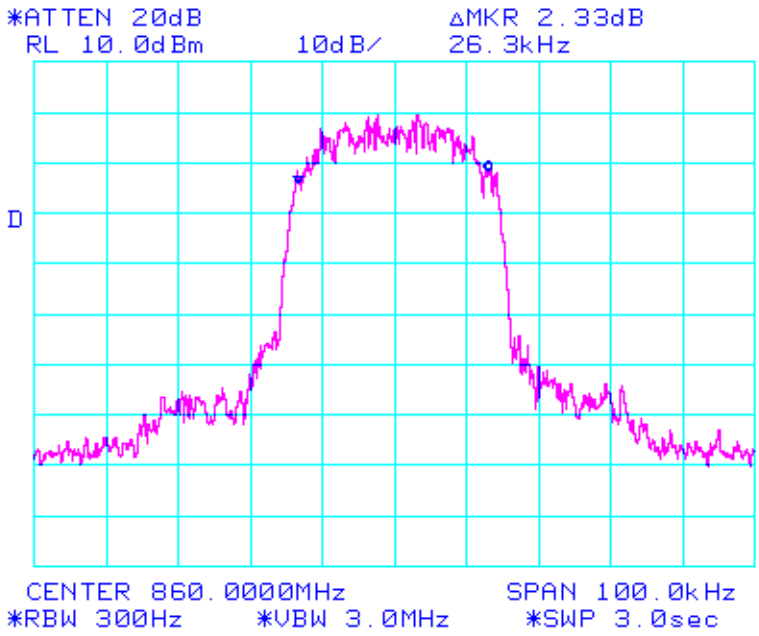
Occupied BW FM mid-band 4 PA w/ 8watt



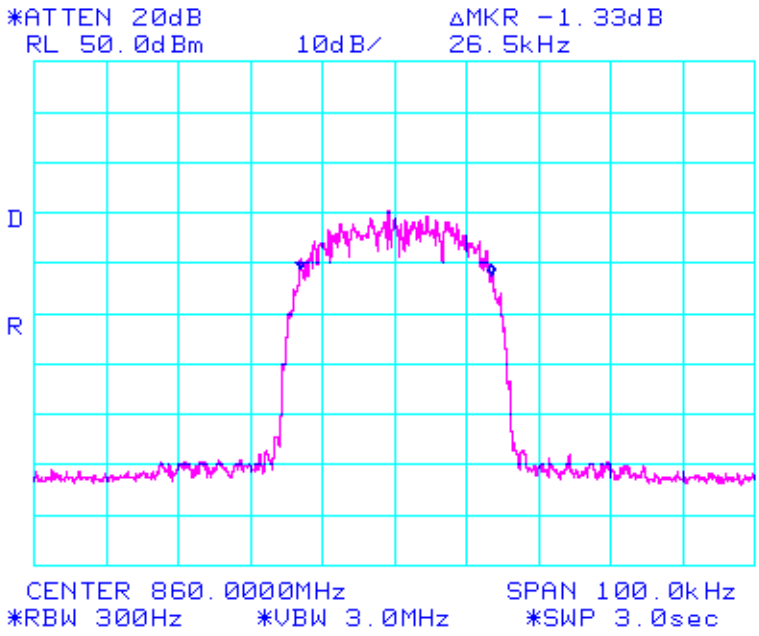
Occupied BW FM med-band 4PA w/ 8watt
emi1303



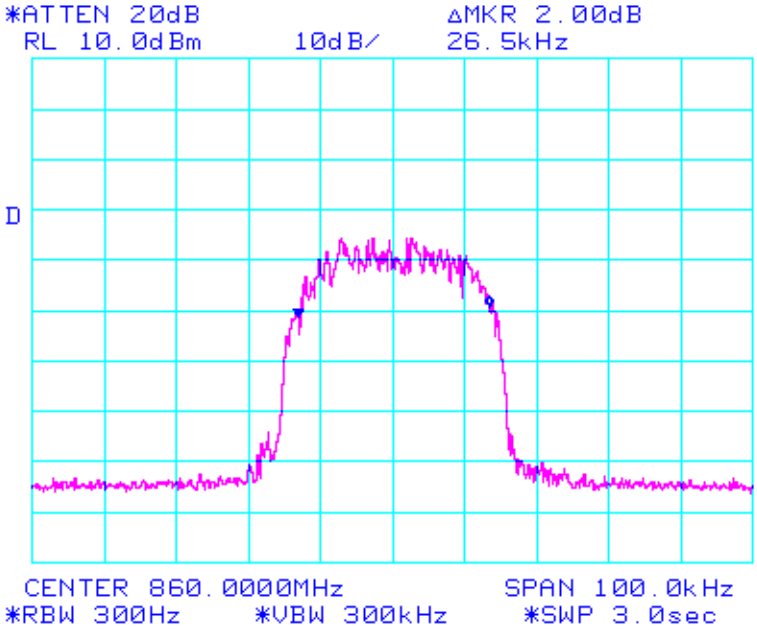
Occupied BW TDMA mid-band 4PA w/o 8watt
emi1303



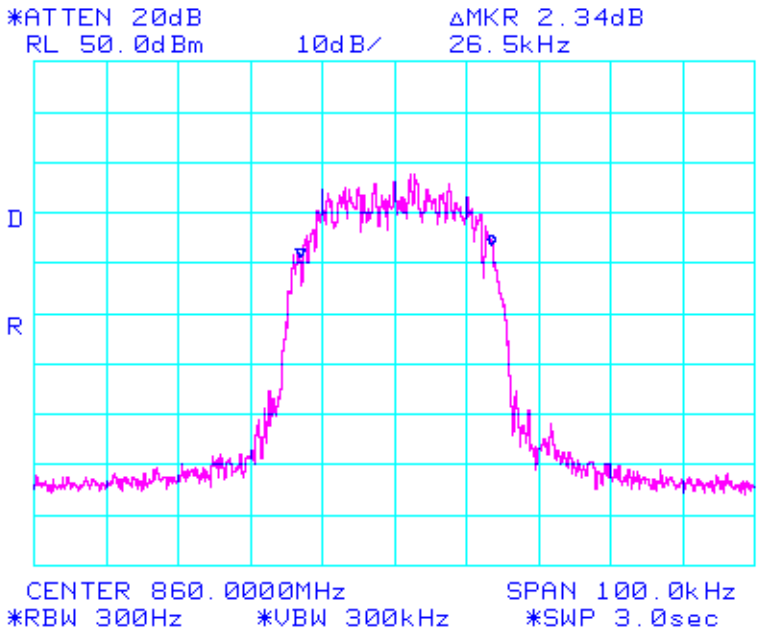
Occupied BW TDMA output 4PA w/o 8watt m-band
emi1303



Occupied BW TDMA mid-band 4PA w/ 8watt
emi1303



Occupied BW TDMA mid-band 4PA w/ 8watt
emi1303



6.3 TEST TYPE: RF Power Output

6.3.1 TECHNICAL SPECIFICATION: 47CFR2.1046 and 90.205(i); 90.635

6.3.2 TEST DATE(S): 19 Jan. 2000

6.3.3 MEASUREMENT PROCEDURES:

As required by §2.1046 of CFR 47, *RF power output measurements* were made at the RF output terminals using an attenuator and spectrum analyzer. This test was performed with carrier modulated by a TDMA -OR- by an FM modulation signal.

Plots of the RF output Power level of the Digitally modulated carrier, as measured at the RF output of the signal generator and at the RF output terminals of the EUT are included:

The power output was measured for Channels at the center of the downlink authorized ranges.

The power output was maximized for testing by increasing the input level to the point that the output level ceased to increase with it.

6.3.4 RESULTS:

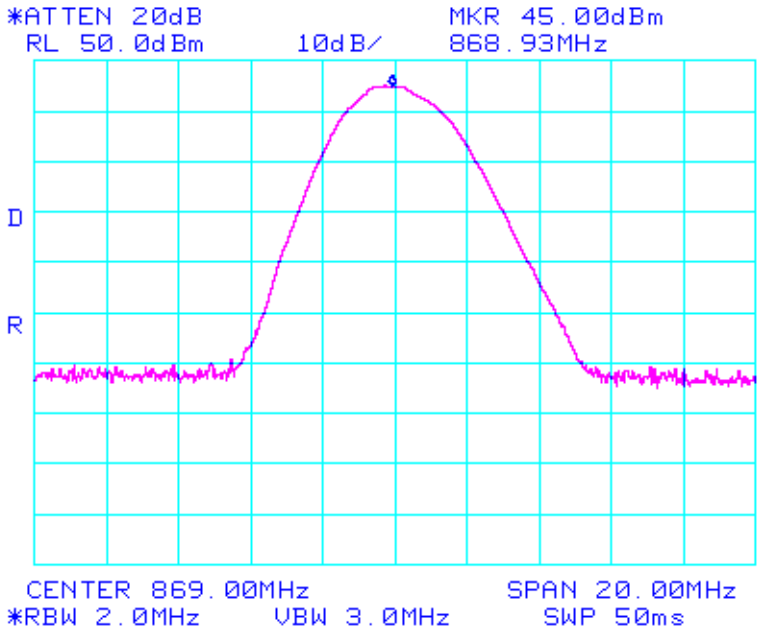
Equipment complies with 47CFR 2.1046 and 90.205(i) and 90.635 (a) and (d). The repeater/booster power does not exceed downlink of 500 W, or uplink of 100W, at the carrier frequency.

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

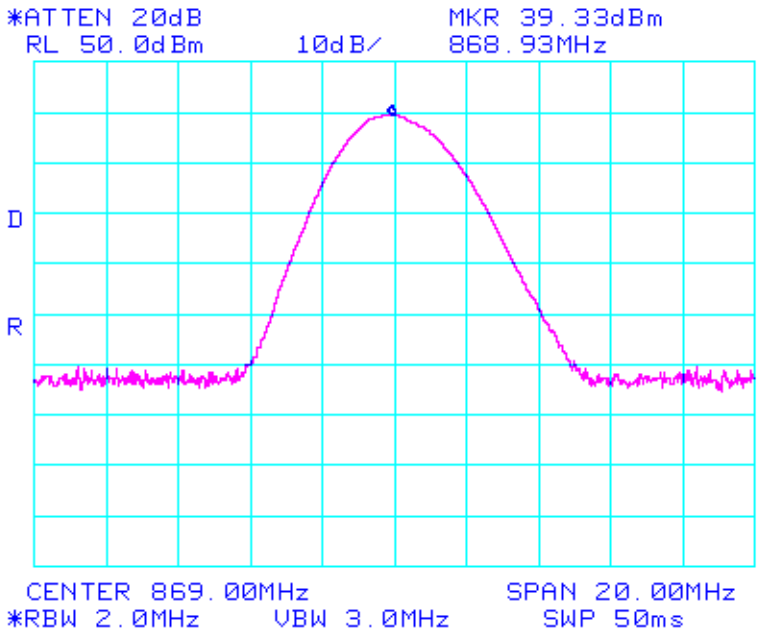
RF-Power Measurements (in dBm)				
	4PA w/ 8watt	**4PA w/o 8watt**	**2PA w/ 8watt**	**2PA w/o 8watt**
Modulation	TDMA	TDMA	TDMA	TDMA
P out-851MHz	41.33	38.5	38.24	31.78
P in-851MHz	-12	18.1	-15	9.3
P out-860MHz	42.0	39.33	39.2 *	32.59 *
P in-860MHz	-12	18.1	-15.3	9.3
P out-869MHz	42.0 *	39.33 *	39.2	32.59
P in-869MHz	-12	18.1	-15.3	9.3
Maximum Power for each configuration	**42 dBm = 16 Watts**	**39.33 dBm = 9 Watts**	**39.2 dBm = 9 Watts**	**32.59 dBm = 2 Watts**
Modulation	FM	FM	FM	FM
P out-851MHz	44.17	38.38	41.12	29.33
P in-851MHz	-6.6	18.1	-9.8	9.3
P out-860MHz	45.0	39.33	41.87 *	30.06 *
P in-860MHz	-6.6	18.1	-9.8	9.3
P out-869MHz	45.0 *	39.33 *	41.93	30.01
P in-869MHz	-6.6	18.1	-9.8	9.3
Maximum Power for each configuration	**45 dBm = 31 Watts**	**39.33 dBm = 10 Watts**	**41.93 dBm = 16 Watts**	**30.06 dBm = 1 Watt**

* These plots are attached on the following pages:

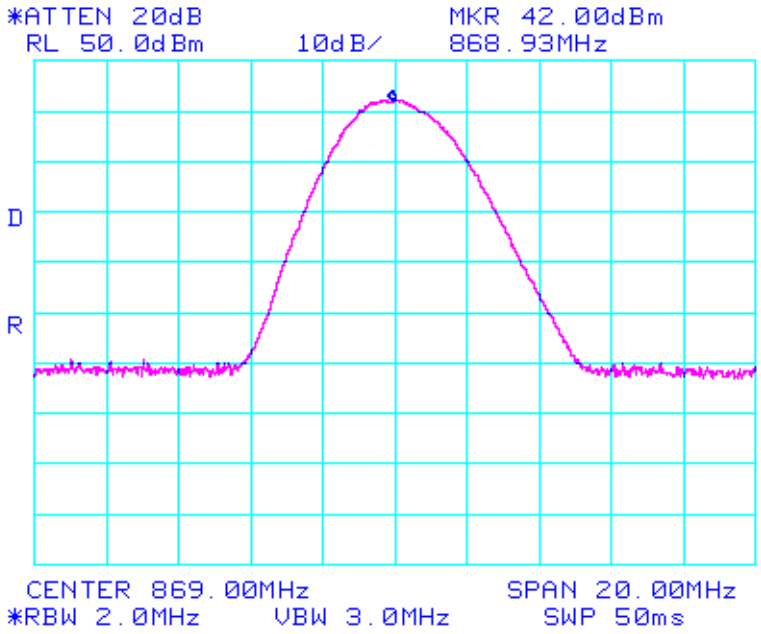
RF-Power out FM 4PA w/ 8watt
emi1303



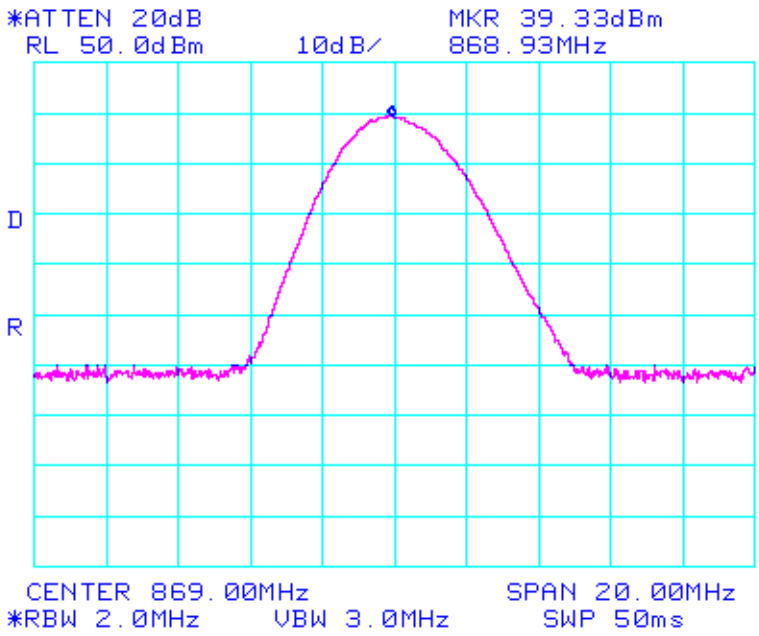
RF Power out FM 4PA w/o 8watt
emi1303

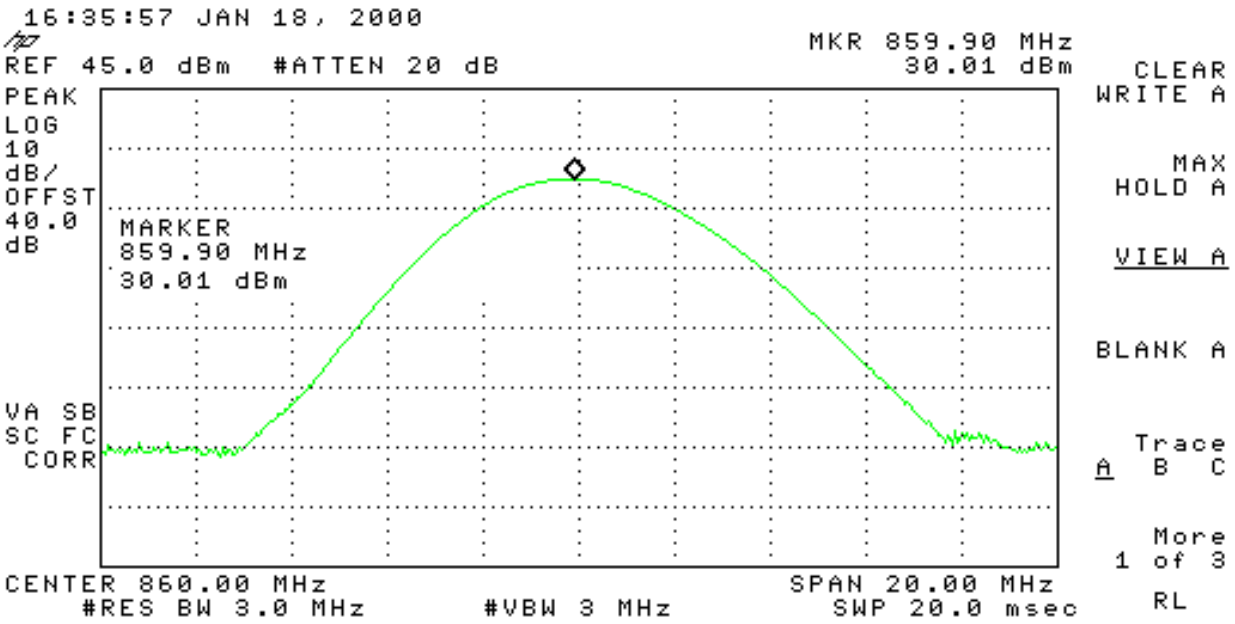


RF-Power out TDMA 4PA w/ 8watt
emi1303

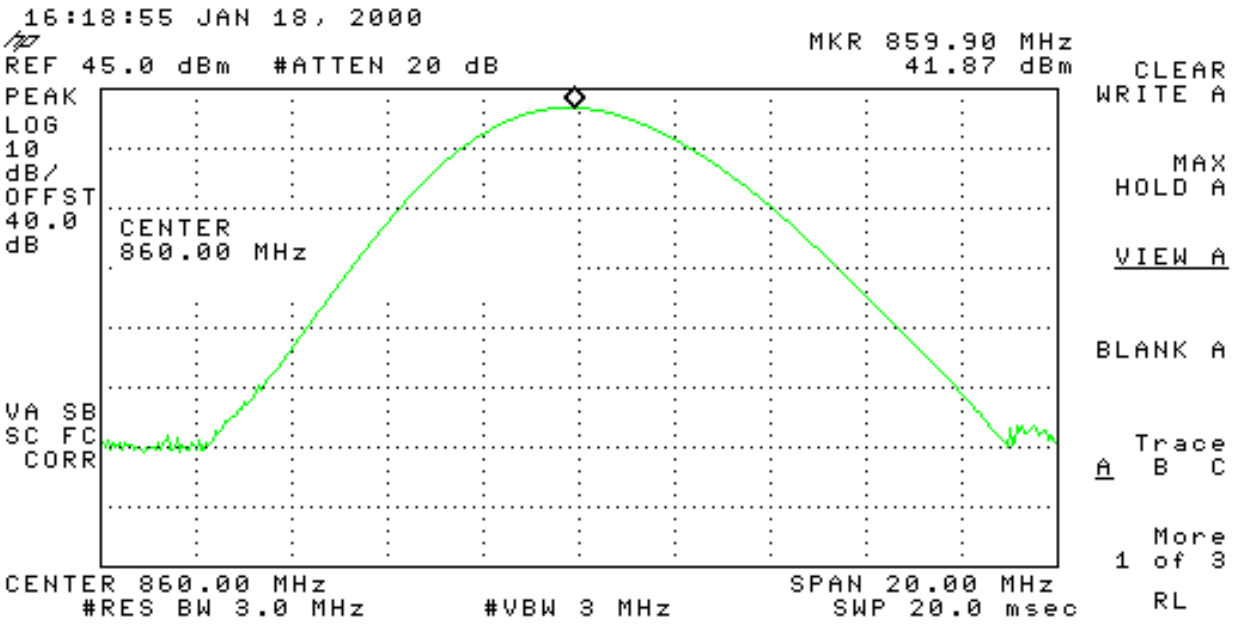


RF Power out TDMA 4PA w/o 8watt
emi1303

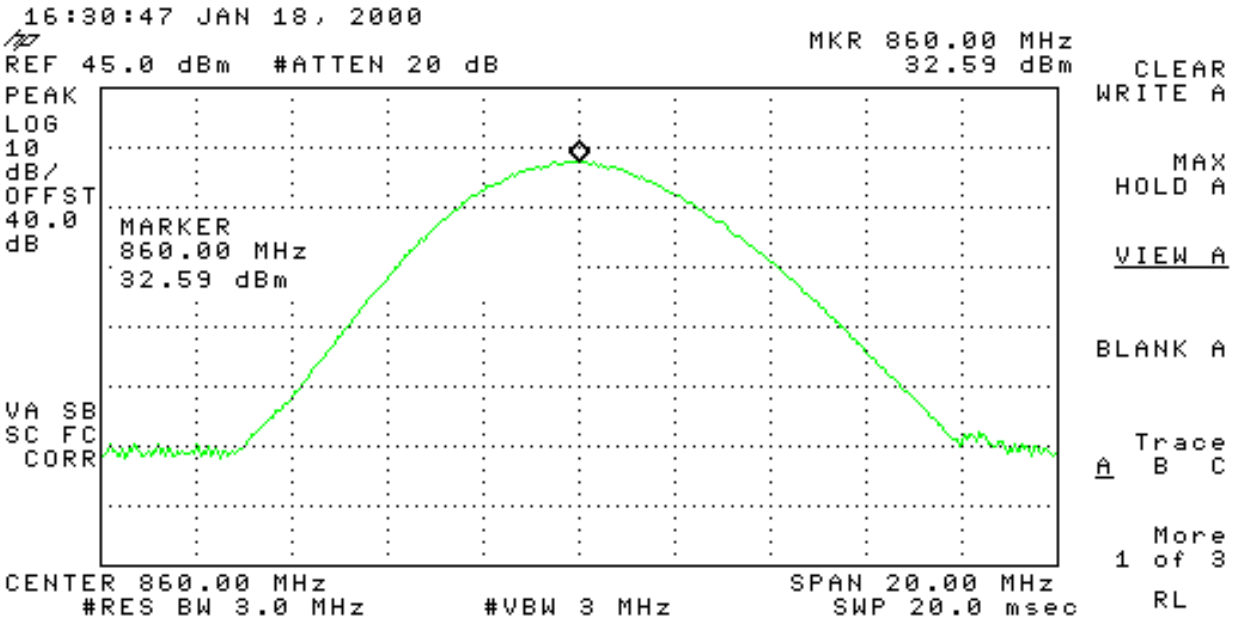




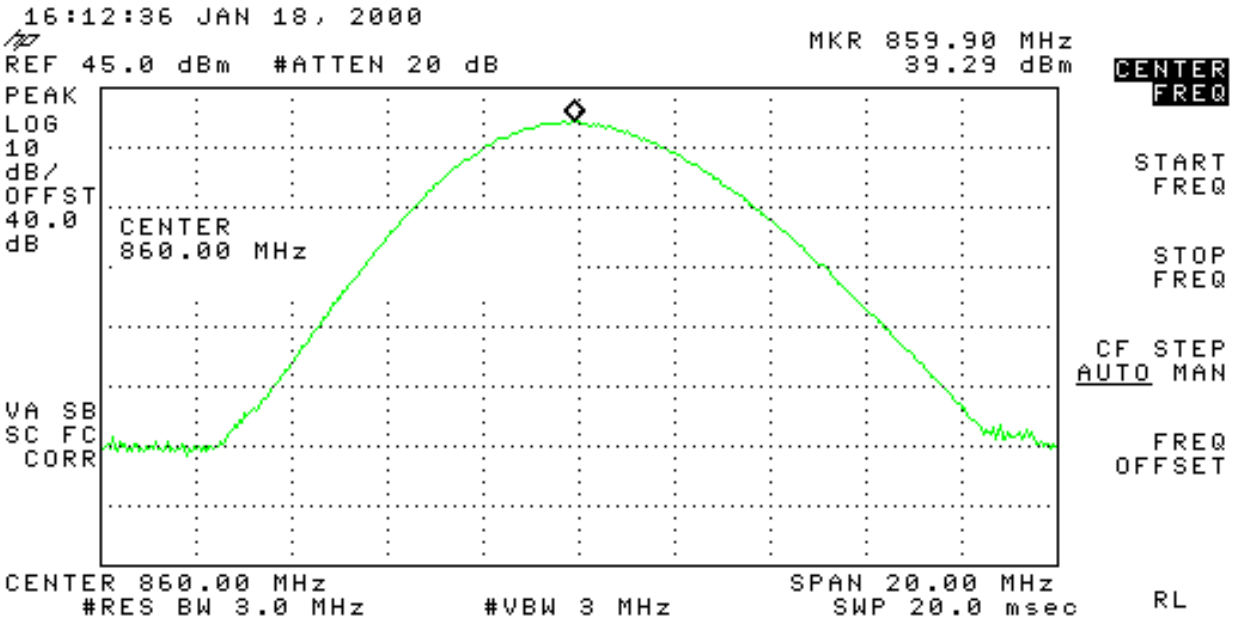
RF Power output FM 2 PA w/o 8watt
emi1303



RF-power output FM 2 PA w/8watt
emi1303



RF Power output TDMA 2 PA w/o 8watt
emi1303



RF-power output TDMA 2PA w/8watt
emi1303

6.4 TEST TYPE: Spurious Emissions at Antenna Terminals

6.4.1 TECHNICAL SPECIFICATION: 2.1051 ; 90.21(h) ; 90.691(a)

6.4.2 TEST DATE(S): 13 Jan. 2000

6.4.3 MEASUREMENT PROCEDURES:

As required by §2.1051 of CFR 47, *spurious emissions at antenna terminal measurements* were made at the RF output terminals using a 50 Ω 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 the down-link frequency bands. The frequency spectrum was investigated from 30 MHz to 9.0 GHz (9.0 GHz ensures the tenth harmonic of the highest frequency, 869 MHz, is investigated). 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.

As recommended in §90.917(h)(ii), a 30kHz bandwidth was chosen to measure the peak of any spurious emission at 45 kHz removed from the carrier.

6.4.4 RESULTS:

Equipment complies with Section 2.1051; 90.210(h) ; 90.691(a)

Spur limit = Po - (43 + 10logP) = 151.9 dBµV - (57.9 dB) = 94 dBµV = -13.1 dBm

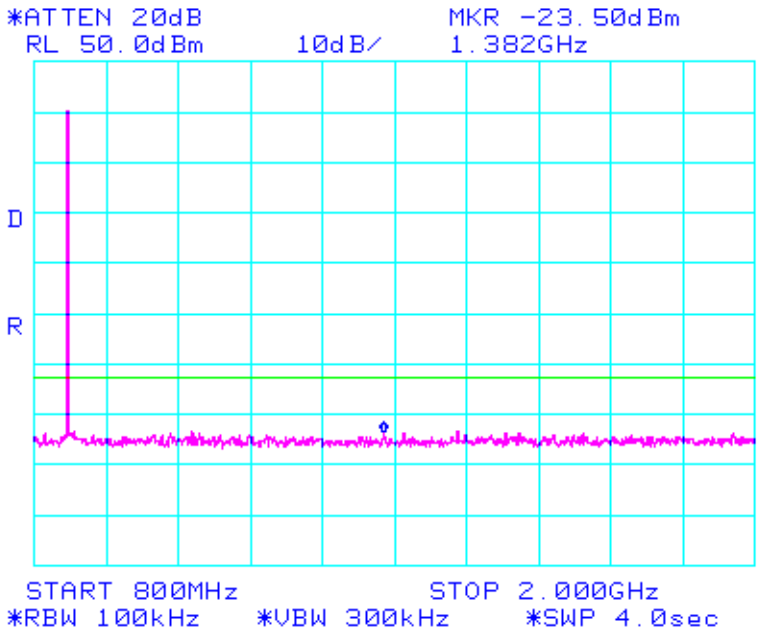
SUMMARY OF SPURIOUS EMISSIONS AT ANTENNA TERMINALS -Downlink

Frequency Range (GHz)	Emission Frequency (GHz)	Emission Level (dBm)	Limit (dBm)
0.8-2.0 TDMA	1.7	-27.7	-13.1
FM	1.38	-23.5	-13.1
2.0 - 2.9 TDMA	2.18	-21.7	-13.1
FM	2.29	-22.5	-13.1
2.9 - 4.0 TDMA	3.3	-22.67	-13.1
FM	3.17	-22.8	-13.1
4.0 - 9.0 TDMA	8.1	-16.67	-13.1
FM	8.83	-15.67	-13.1

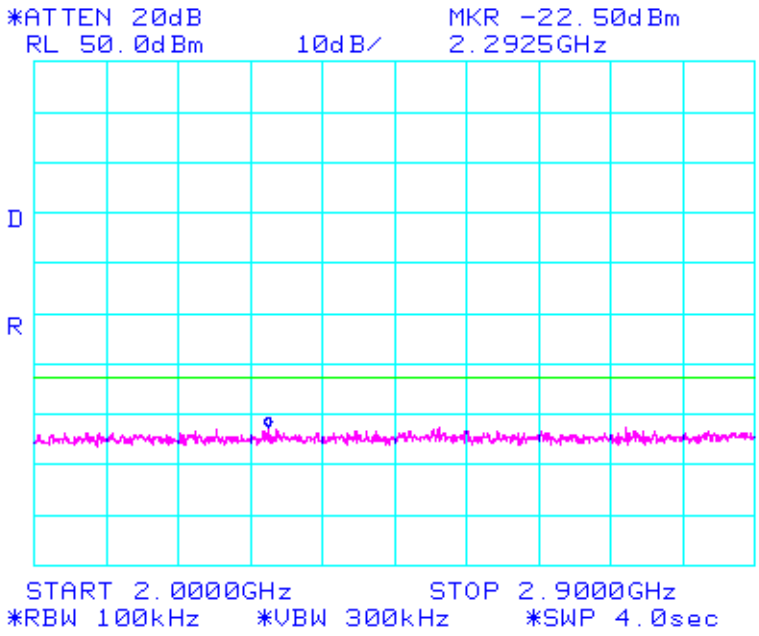
There were no observed emissions below 800 MHz.

Plots are included on the following pages:

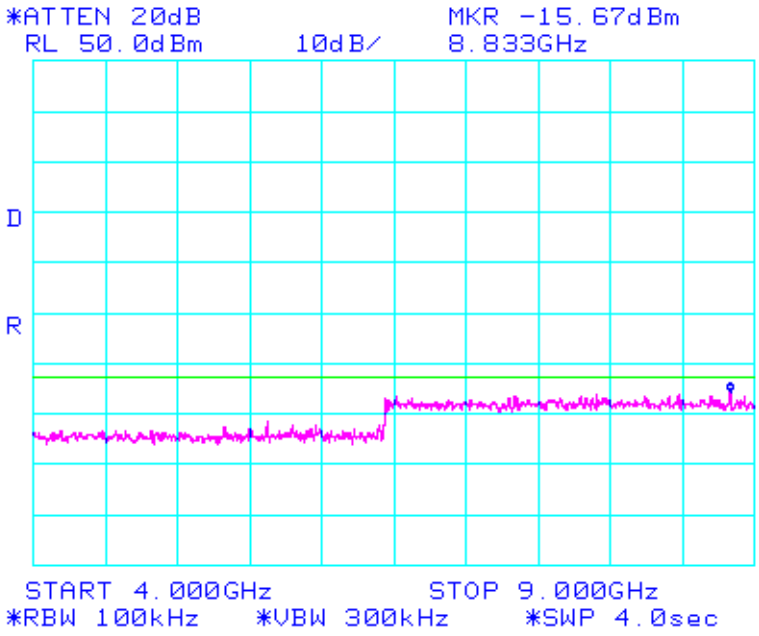
Conducted spur at antenna terminal
emi1303



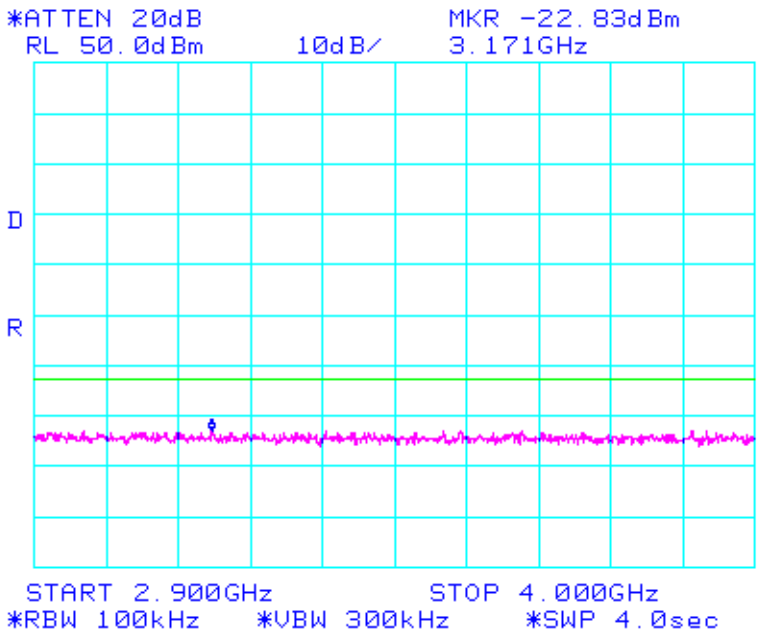
Conducted spur at antenna terminal FM
emi1303



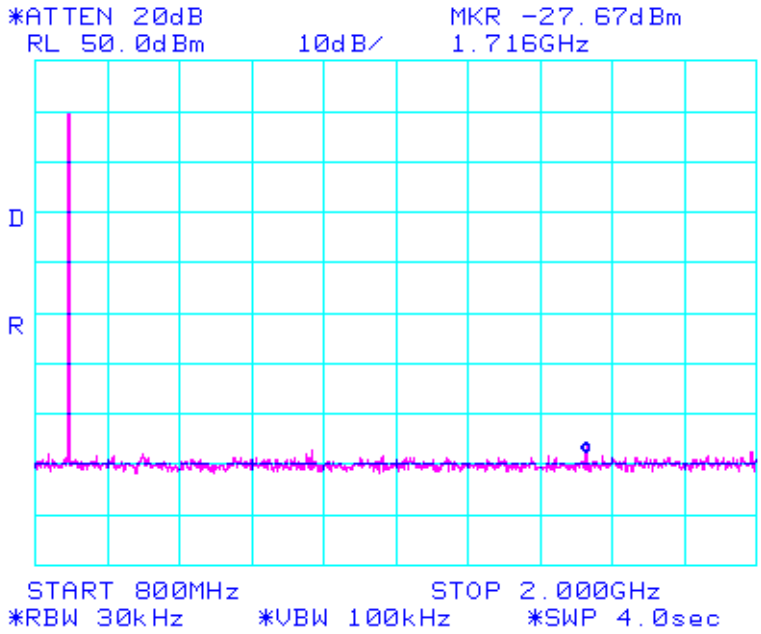
Conducted spur at antenna terminal FM
emi1303



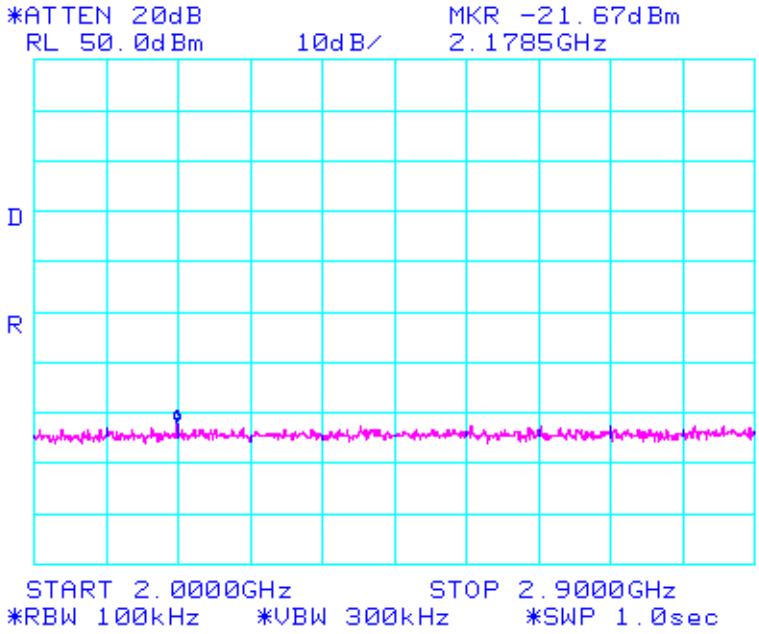
Conducted spur at antenna terminal FM
emi1303



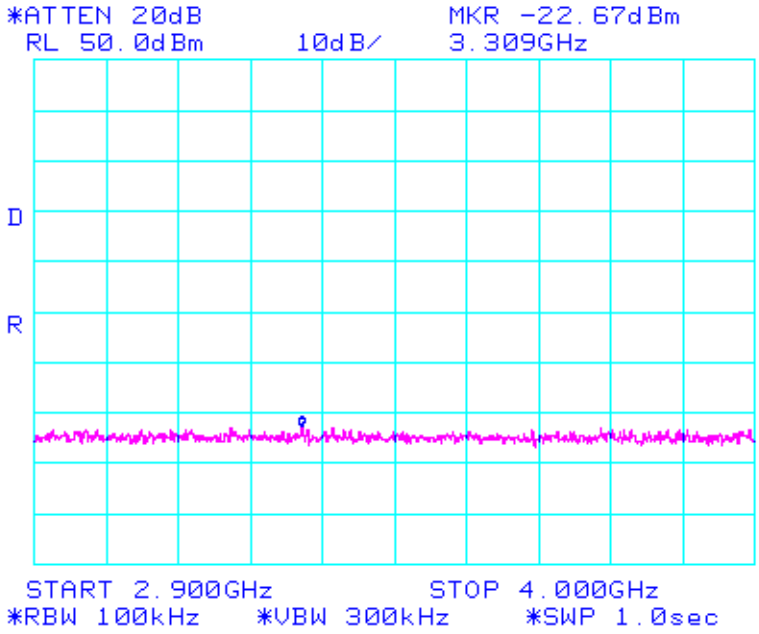
TDMA Spur emissions at antenna terminal
emi1303



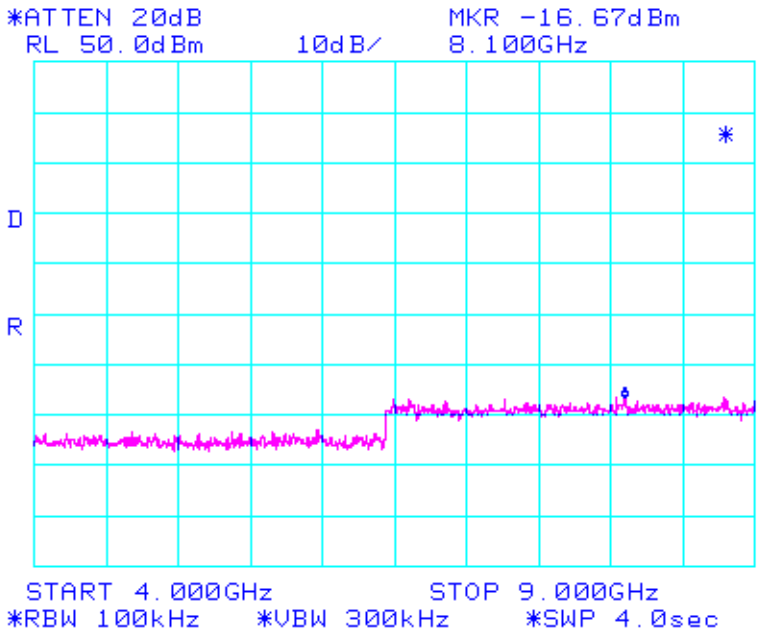
TDMA Spur emssions at antenna terminal
emi1303



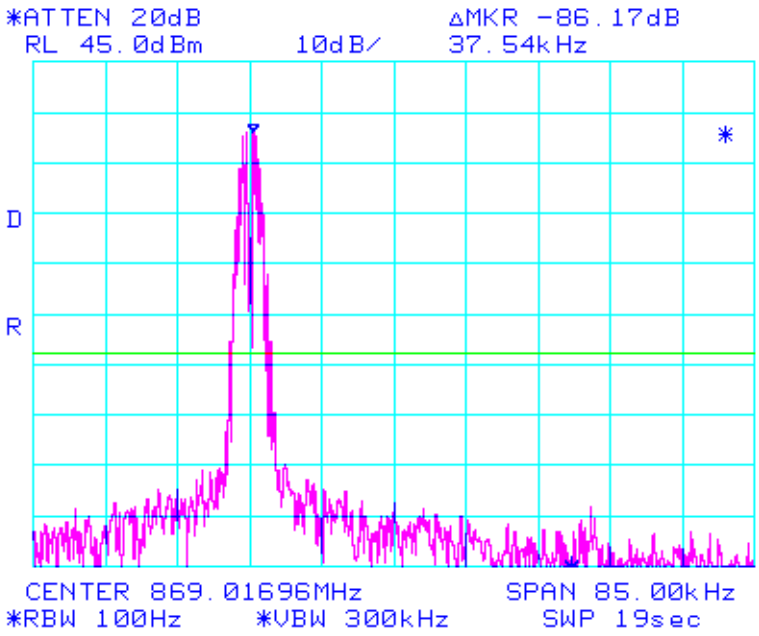
TDMA Spur emissions at antenna terminal
emi1303



TDMA Spur emissions at antenna terminal
emi1303



Emission mask (90.691) Downlink band.
High end out of band +37.5khz
emi1303



6.5 TEST TYPE: Emission Masks

6.5.1 TECHNICAL SPECIFICATION: 47CFR90.210(h)

6.5.2 TEST DATE(S): 18 Jan. 2000

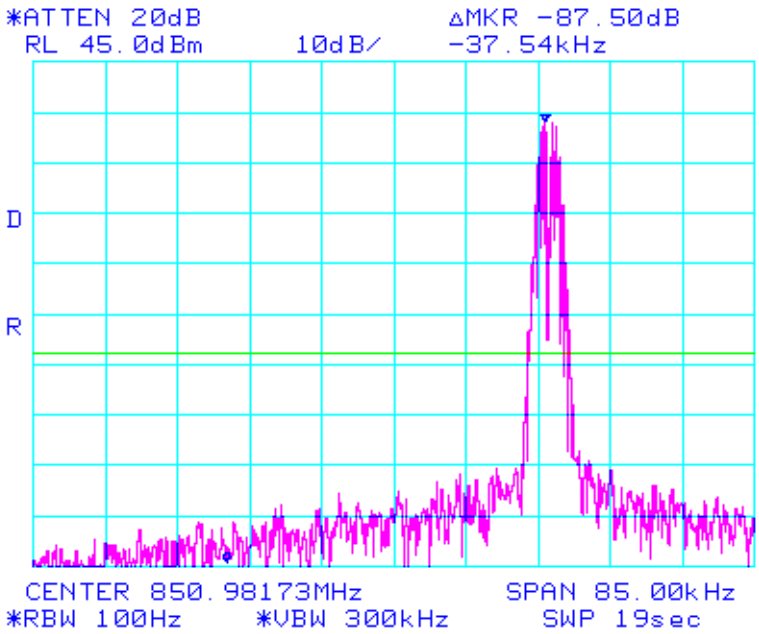
6.5.3 MEASUREMENT PROCEDURES(Downlink)

The Emissions Masks were measured at both the antenna terminal and at the input. The input measurement was evaluated in comparison with the output measurement according to the requirements of 47CFR90.210(h).

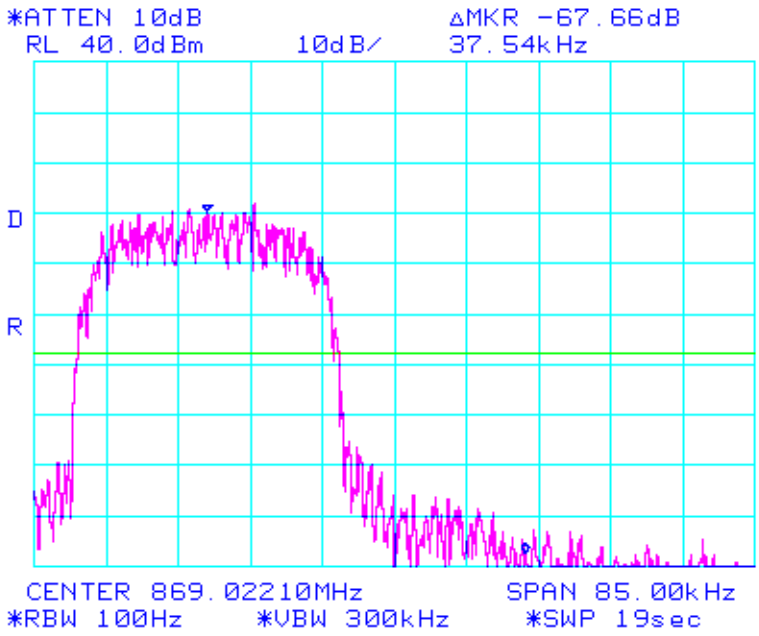
6.5.4 RESULTS:

Equipment complies with 47CFR 90.210(h);

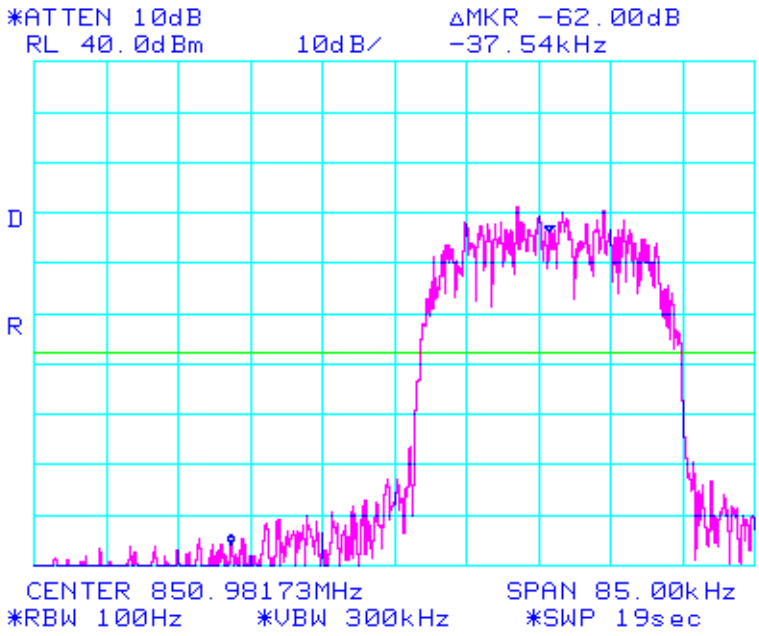
Emission mask (90.691) Downlink band (851-869 mhz).
Low end out of band -37.5khz FM
emi1303



Emission mask (90.691) Downlink band (851-869mhz)
High end out og band +37.5 khz
emi1303



Emission mask (90.691) Downlink band (851-869 mhz)
Low end out of band -37.5 khz
emi1303



6.6 TEST TYPE: Intermodulations Spurious Emissions at Antenna Terminal

6.6.1 TECHNICAL SPECIFICATION: 47CFR 90.210(h) ; 90.691(a)

6.6.2 TEST DATE(S): 18 Jan. 2000

6.6.3 MEASUREMENT PROCEDURES: (Downlink)

Intermodulation products were measured at the antenna terminal with the Digital signal generators tuned to transmit on two-tone frequency (867 MHZ and 869 MHz) at the high end of the Downlink band; and tuned to transmit on two-tone frequency (851 MHz and 853 MHz) at the low end of the Downlink band.

6.6.4 RESULTS:

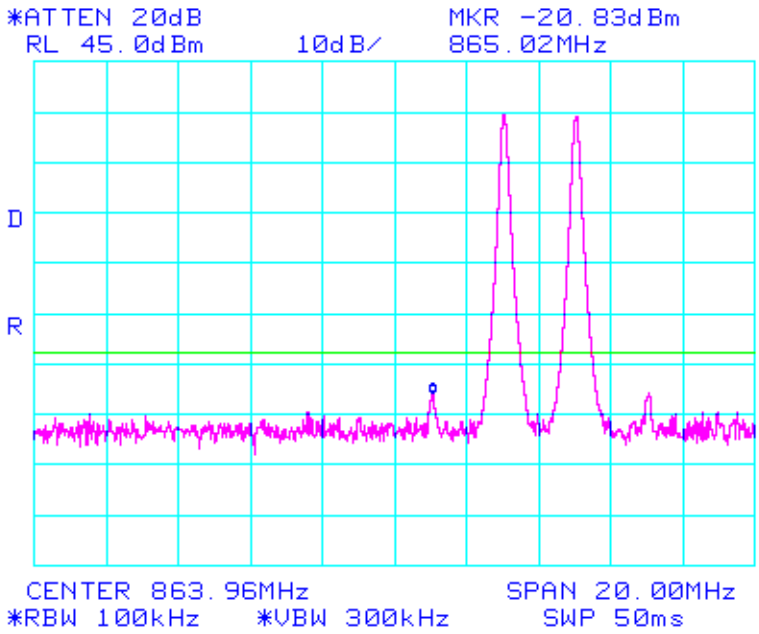
Spur limit = Po - (43 + 10logP) = 151.9 dBµV - (57.9 dB) = 94 dBµV = -13.1 dBm

Equipment complies with 47CFR 90.210(h); 90.691(a).

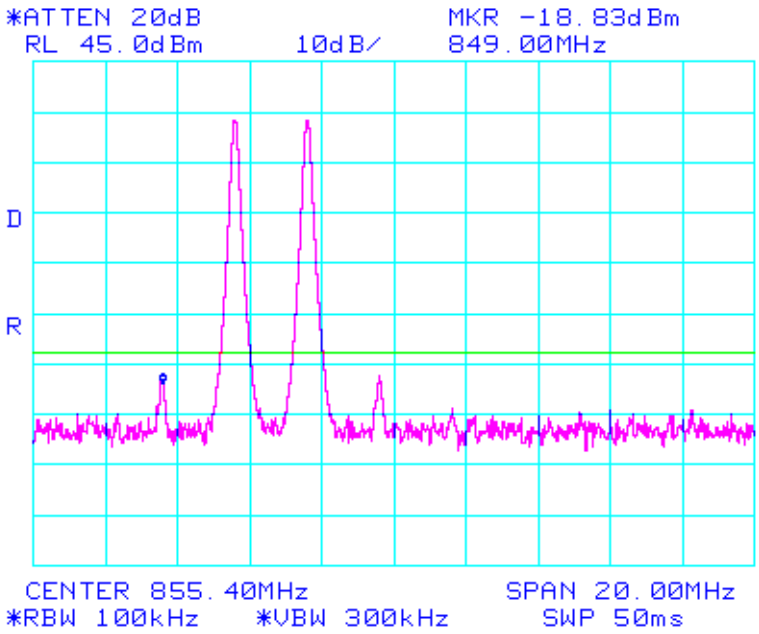
modulation type	Intermodulation products (MHz)	Emission Level (dBm)	Limit (dBm)
FM	849.0	-18.83	-13.1
FM	855.0	-17.17	-13.1
FM	865.0	--20.83	-13.1
FM	871.0	-20.83	-13.1

Plots of intermodulation spurious emissions as measured at the antenna port are included:

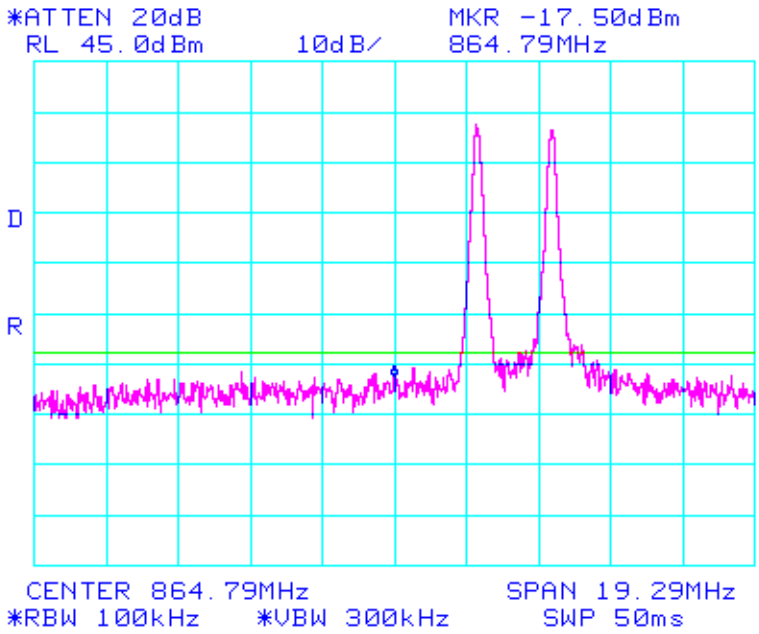
IMD FM Two-tone inject at High end band (f1=867mhz, f2=869mhz).
IMD Products: 871mhz(--20.83dbm) and 865(-20.83)
emi1303



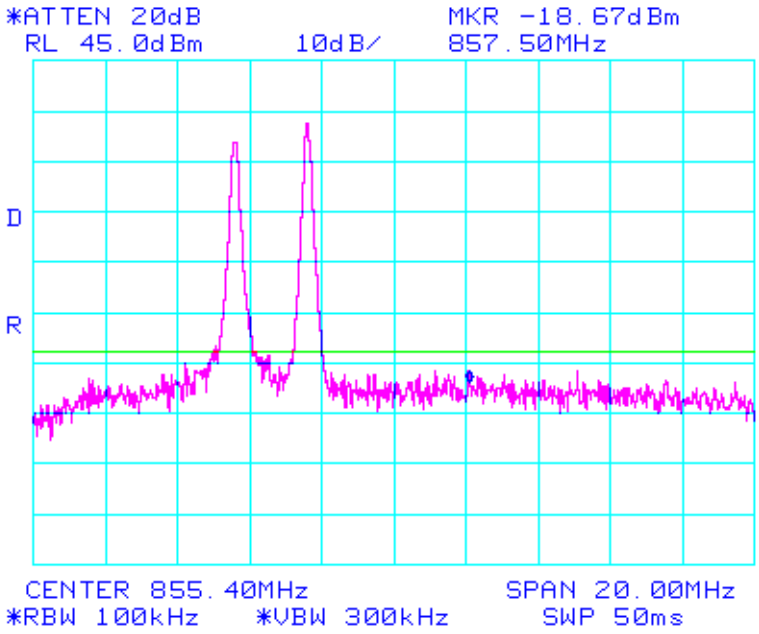
IMD FM Two-tone inject at L-end band (f1=851 mhz, f2=853 mhz)
IMD Products: 849 mhz(-18.83dbm) and 855mhz(-17.17dbm)
emi1303



IMD TDMA Two-tone inject at High end band f1=867 mhz , f2=869 mhz . emi1303



IMD TDMA Two tone inject at Low end band (f1=851 mhz, f2=853mhz)
emi1303



6.7 TEST TYPE: Line Conducted Emissions

6.7.1 TECHNICAL SPECIFICATION: 15.107(b)

6.7.2 TEST DATE(S): 14 Jan. 2000

6.7.3 MEASUREMENT PROCEDURES:

The measurements were performed over the frequency range of 0.45 MHz to 30 MHz using a 50 Ω/50 µH 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.

6.7.4 RESULTS:

Equipment complies with Section 15.107(b)

SUMMARY OF SPURIOUS EMISSIONS AT AC Mains Terminals - Phase

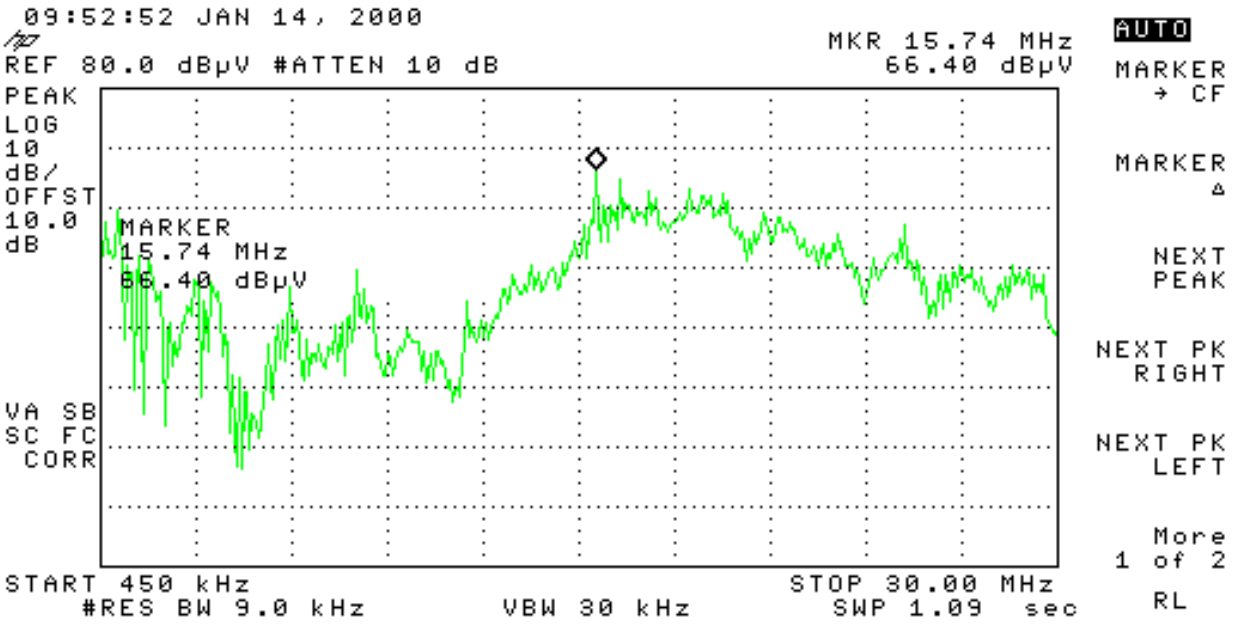
Frequency (MHz)	Emission Quasi-Peak Level (dBuV)	Limit (dBuV)
15.886	58.0	69.0
19.494	58.9	69.0
21.925	53.6	69.0

SUMMARY OF SPURIOUS EMISSIONS AT AC Mains Terminals - Neutral

Frequency (MHz)	Emission Quasi-Peak Level (dBuv)	Limit (dBuV)
16.616	59.7	69.0
18.599	57.4	69.0
20.020	57.7	69.0

Photograph of Line Conducted Emissions Test Configuration

emi1303 line conducted RE Phase



emi1303 line RE Neutral