

**EXHIBIT 15:*****OCCUPIED BANDWIDTH DATA -----***

***Pursuant 47 CFR 2.989, 90.210(b), 90.210(g) and 90.691(a).***

Measured data on occupied bandwidth per 47CFR 2.989, 90.210(b), 90.210(g) and 90.691(a).is the subject of attached Technical Report No.9ELS029Sa.  
All occupied bandwidth tests were performed at +24dBm output power level.

## **ELECTROMAGNETIC COMPATIBILITY TEST REPORT**

### **Compliance with Occupied Bandwidth and Conducted Harmonics and Spurious Emissions Requirements of 47CFR Parts 2 and 90**

**Company Name:** Elisra Electronic Systems Ltd.  
**Equipment Under Test:** Series MW-CBDA-ESMR-1W60 BDA

**Report I.D.Number:** 9ELS029Sa.DOC  
**Total number of pages** 29  
**(including this page):**  
**Date:** 2 March, 2000

### **EMI TEST Ltd. EMC Test Laboratory**

**Moshav Hanniel, D.N.Lev Hasharon, Israel, 42865**  
**Phone:(972) 9-8987382 Fax:(972) 9-8987383**

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## Table of Content:

Description	Page
1. General Information. ....	5
2. Applicable Documents.....	6
3. Detailed Applicable Technical Requirements and Limits.....	7
3.1 Occupied Bandwidth Requirements.....	7
3.1.1 Emission Mask B. ....	7
3.1.2 Emission Mask G. ....	8
3.1.3 Emission Mask pursuant to 47CFR Section 90.691 .....	8
3.2 Conducted Spurious Emissions Requirements.....	9
4. Test Setups and Test Procedures.....	10
4.1 Occupied Bandwidth Measurements.....	10
4.2 Measurements of Conducted Spurious Emissions at Antenna Ports. .....	12
4.2.1 Out-of-Band Harmonics and Spurious Emissions.....	12
4.2.2 Measurement of In-Band Intermodulation Products.....	13
5. Description of Equipment Under Test. ....	15
5.1 Description of the Tested Equipment. ....	15
5.2 Cables Used During the Tests: .....	16
5.3 Modifications Required for Compliance.....	16
6. List of Test Equipment Used.....	17
7. Summary of Test Results. ....	18
7.1 Occupied Bandwidth Test.....	18
7.2 Conducted Spurious and Harmonics Emissions in Antenna Ports Out-Of-Band Products.....	18
7.3 Conducted Spurious Emissions in Antenna Ports: In-Band Two-Tone Intermodulation Products. ....	18
8. Details of Test Results. ....	18
8.1 Occupied Bandwidth Test.....	18
8.1.1 Up-Link (Mobile-to-Base) Transmit Mode.....	18
8.1.2 Down-Link (Base-to-Mobile) Transmit Mode. ....	19

8.2	Conducted Spurious and Harmonics Emissions in Antenna Ports: Out-Of-Band Products.....	19
8.2.1	Up-Link (Mobile-to-Base) Transmit Mode.....	19
8.2.2	Down-Link (Base-to-Mobile) Transmit Mode. ....	19
8.3	Conducted Spurious Emissions in Antenna Ports: In-Band Two-Tone Intermodulation Products. ....	19
9.	Signatures. ....	21

### List of Figures.

<b>Figure A-1a</b>	Occupied Bandwidth Test in Up-Link Transmission Mode. F=813MHz, Pout = 250mWatt+20% = 300mWatt; Performance relative to B-Mask per 47 CFR 90.210(b)	23
<b>Figure A-1b</b>	Occupied Bandwidth Test in Up-Link Transmission Mode. F=813MHz, Pout = 250mWatt+20% = 300mWatt; Performance relative to G-Mask per 47 CFR 90.210(g)	23
<b>Figure A-1c</b>	Occupied Bandwidth Test in Up-Link Transmission Mode. F=813MHz, Pout = 250mWatt+20% = 300mWatt; Performance relative to Mask per 47 CFR 90.691(a)	24
<b>Figure A-2a</b>	Occupied Bandwidth Test in Down-Link Transmission Mode. F=858MHz, Pout = 250mWatt+20% = 300mWatt; Performance relative to B-Mask per 47 CFR 90.210(b)	25
<b>Figure A-2b</b>	Occupied Bandwidth Test in Down-Link Transmission Mode. F=858MHz, Pout = 250mWatt+20% = 300mWatt; Performance relative to G-Mask per 47 CFR 90.210(g)	25
<b>Figure A-2c</b>	Occupied Bandwidth Test in Down-Link Transmission Mode. F=858MHz, Pout = 250mWatt+20% = 300mWatt; Performance relative to Mask per 47 CFR 90.691(a)	26
<b>Figure B-1</b>	Conducted Emissions at Antenna Port in Up-Link Transmission Mode. F=816MHz, Pout = 1000mWatt.	28
<b>Figure B-2</b>	Conducted Emissions at Antenna Port in Down-Link Transmission Mode. F=860MHz, Pout = 1000mWatt.	29

### List of Tables:

<b>Table 1.</b>	Summary of Two-Tone Intermodulation Test Results.	20
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## 1. General Information.

**Applicant:** Elisra Electronic Systems Ltd.

**Applicant Address:** 48 Mivtza Kadesh St., Bene Beraq 51203,  
Israel  
972-3-6175639

**Telephone:**

**FAX:** 972-3-6175299

**The testing was observed by the following applicant's personnel:** Mr.Shmuel Auster

**Date of reception for testing:** February 17, 2000

**Date of testing:** February 17, 2000

**Test Laboratory Location:** EMI TEST Ltd., Moshav Hanniel, D.N.Lev  
Hasharon, Israel, 42865.  
and Motorola Communications (Israel) Ltd.

**Equipment Under Test:** MW-CBDA-ESMR-1W60 BDA  
Bi-Directional Amplifier

**Series Number:** 00021058

**Mode of Operation:** Up-Link and Down-Link Receiving and  
Transmitting modes

**Year of Manufacture:** 2000

**Applicable  
EMC Specification:** Federal Communication Commission (FCC),  
**Occupied Bandwidth:**  
CFR 47, Part 2 Section 2.989 and  
Part 90, Sections 90.210 and 90.691.  
**Conducted Spurious Emissions:**  
CFR 47, Part 2 Section 2.991

## **2. Applicable Documents.**

- 2.1** Federal Communication Commission (FCC), Code of Federal Regulations 47, Ch.1, Parts 2 and 90.
- 2.2** American National Standard, "Specifications for Electromagnetic Noise and Field Strength Instrumentation, 10KHz to 1 GHz", ANSI C63.2, 1987.
- 2.3** American National Standard, "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9KHz to 40GHz", ANSI C63.4, 1992.

### **3. Detailed Applicable Technical Requirements and Limits.**

Requirements of Federal Communications Commission (FCC), Parts 2 and 90 are applicable for the tested equipment. All tests must be performed in the Up-Link and Down-Link Transmit operational mode.

#### **3.1 Occupied Bandwidth Requirements.**

In accordance with 47CFR Section 2.989, the occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission.

Type of modulation used during the occupied bandwidth tests is specified in Para.2.989. Definition of 47CFR Section 2.989(h) is applicable for the tested equipment. Specific modulation used during the tests is described in Para.4 of this test report.

Table in 47CFR Section 90.210 specifies the emission masks for each frequency band. For the operational frequency bands 806-821/851-866 B-Mask is applicable for equipment with audio low pass filter, and G-Mask for equipment without audio low pass filter. In addition, equipment used in this band licensed to EA or non-EA systems shall comply with the emission mask provisions of 47CFR Section 90.691.

##### **3.1.1 Emission Mask B.**

For transmitters that are equipped with an audio low-pass filter pursuant to Para.90.211(a), the power of any emission must be below the unmodulated carrier power (P) as follows:

(1) On any frequency removed from the assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth:

At least 25dB.

(2) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth:

At least 35dB.

(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth:

At least  $43 + 10\log(P)$  dB.

### 3.1.2 Emission Mask G.

For transmitters that are not equipped with an audio low-pass filter pursuant to Para.90.211(b), the power of any emission must be below the unmodulated carrier power (P) as follows:

- (1) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (Fd in kHz) of more than 5kHz but no more than 10kHz::

At least  $83 \log (F_d/5)$  dB;

- (2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (Fd kHz) of more than 10kHz but no more than 250 percent of the abandwidth:

At least  $118 \log (F_d/6.1)$  dB,  
or  $50 + 10 \log (P)$  dB,  
or 70dB,

whis the lesser attenuation;

- (3) On any frequency removed from the center of the authorized bandwidth by more than 250 percent of the authorized bandwidth:

At least  $43 + 10 \log (P)$  dB.

**Note:** Authorized bandwidth for the transmitters operating in 806-821/851-866 frequency band is specified in Table given in 47CFR90 Section 208, and equals to 20kHz.

### 3.1.3 Emission Mask pursuant to 47CFR Section 90.691

In accordance with 47CFR Section 90.691,

- (a) Out-of-band emission requirement shall apply only to the “outer” channels included in an EA license and to spectrum adjacent to interior channels used by incumbent licensees. The emission limits are as follows:

- (1) For any frequency removed from the EA licensee’s frequency block by up to and including 37kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by

at least  $116 \log (F/6.1)$  dB  
or  $50 + 10 \log (P)$  dB,  
or 80 dB,

whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 12.5kHz.



(2) For any frequency removed from the EA licensee's frequency block greater than 37kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by

$$\text{At least } 43 + 10\log(P) \text{ dB} \\ \text{or } 80\text{dB},$$

whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 37.5kHz.

In the case of the MW-CBDA-ESMR-1W60 BDA the carrier frequency is radiated at the maximum  $P = 0.25\text{Watt} = 24\text{dBm}$  level, and as a result any emission removed by more than 37.5kHz, shall be attenuated below the transmitter power P by more than

$$43 + \log(P) = 43 - 6 = 37\text{dB},$$

$$\text{or to be below } (P(\text{watts}) - 37\text{dB}) = -13\text{dBm}.$$

All cases of conducted emissions exceeding the level 20dB below the level radiated by the substitution generator must be recorded and reported to FCC.

### **3.2 Conducted Spurious Emissions Requirements.**

Measurements of spurious emissions at antenna terminals must be performed in accordance with the requirements of 47CFR Section 2.991.

The frequency spectrum which must be investigated is specified in 47CFR Section 2.997. The spectrum shall be investigated from the lowest radio frequency signal generated in the equipment, without going below 9kHz, up to the tenth harmonic of the highest fundamental frequency or to 40GHz, whichever is lower. In the case of the tested BDA the frequency band from 806MHz to 8660MHz must be investigated.

Limits for conducted spurious emissions are specified in 47CFR 90 Sections 90.210(b),(g) and 47CFR Section 90.691, and are copied in Para. 3.1.1 through 3.1.3 of this report.

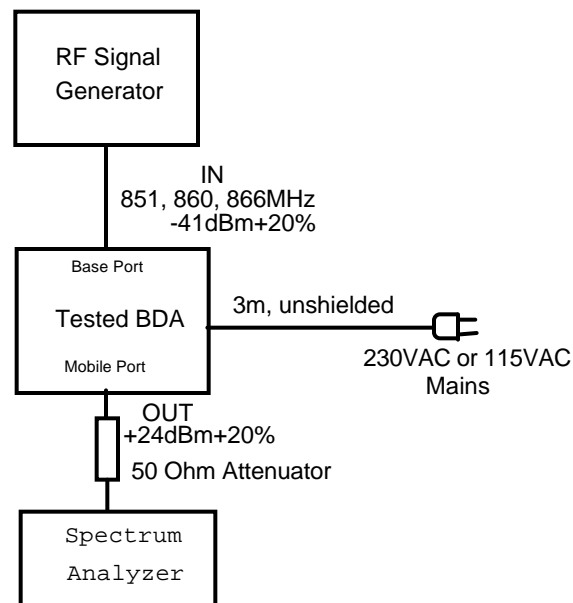
## 4. Test Setups and Test Procedures.

### 4.1 Occupied Bandwidth Measurements.

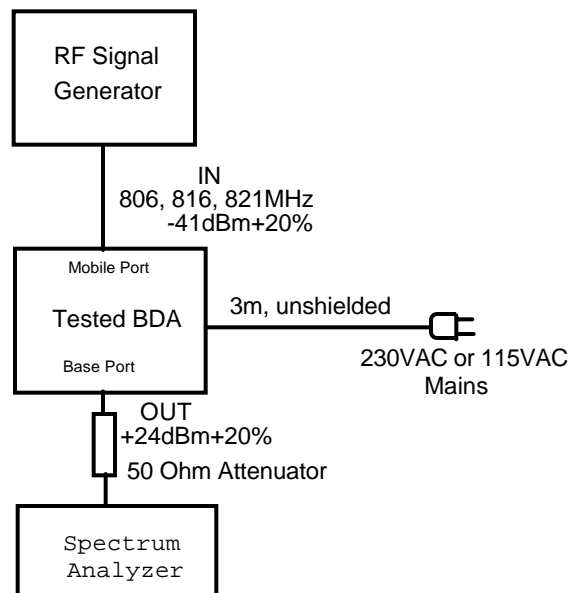
Procedure specified in ANSI C63.4:1992 Para.13.1.7 was used during the tests. The bandwidth was measured relative to the reference level, which is equal to power (P) of unmodulated carrier.

The test setup is shown in the following figure:

#### a) Down-Link Configuration.



#### b) Up-Link Configuration.



The tested equipment was conditioned with typical modulating signals to produce the worst case (i.e. the widest) bandwidth. In the case of MW-CBDA-ESMR-1W60 BDA 64kbps Per Second Pseudo-Random Digital Modulation was used.

The tests were performed at the following level of output radiated power (P): 300mWatt (+24dBm+20%).

The spectrum analyzer was set for:

Reference Level = Maximum Output Radiated Power (P)

Horizontal: 10kHz/div

Vertical: 10dB/div.

Two traces were plotted on the screen of the spectrum analyzer:

- trace 1 (reference level), measured with resolution bandwidth of 30kHz, and
- trace 2 (transmitter performance), measured with resolution bandwidth of 300Hz.

The tested BDA was configured, installed and operated in a manner typical for its application. The BDA was tested in Up-Link and Down-Link operational modes. In both cases the input signals were at level -41dBm+20% resulting in maximum output power of +24dBm+20%. The output port was loaded with 50Ohm matched load.

The BDA was placed on a non-conducting table, the top of which is 80cm above the ground plane.

The BDA was supplied with 230VAC nominal ac voltage.

Step 1. The BDA was turned-on, and the unmodulated signal was applied to the Base input power port at Up-Link 806MHz test frequency at -41dBm+20%=-40.22dBm level to produce +24dBm+20%=24.78dBm output power at Mobile output port. Trace #1 was recorded by the spectrum analyzer using 30kHz resolution bandwidth.

Step 2. The signal generator was set to generate modulated signal, without changing setting of frequency and output power. Trace #2 was recorded by the spectrum analyzer using 300Hz resolution bandwidth.

Step 3. Steps 1 and 2 were repeated for 816MHz and 821MHz Up-Link test frequencies at 300mWatts (+20% above the nominal 250mWatts) levels of output power.

Step 4. The BDA was turned-on, and the unmodulated signal was applied to the Mobile input power port at Down-Link 851MHz test frequency at -40.22dBm level to produce +24.78dBm output power at the Base output port. Trace #1 was recorded by the spectrum analyzer using 30kHz resolution bandwidth.

Step 5. The signal generator was set to generate modulated signal, without changing setting of output power. Trace #2 was recorded by the spectrum analyzer using 300Hz resolution bandwidth.

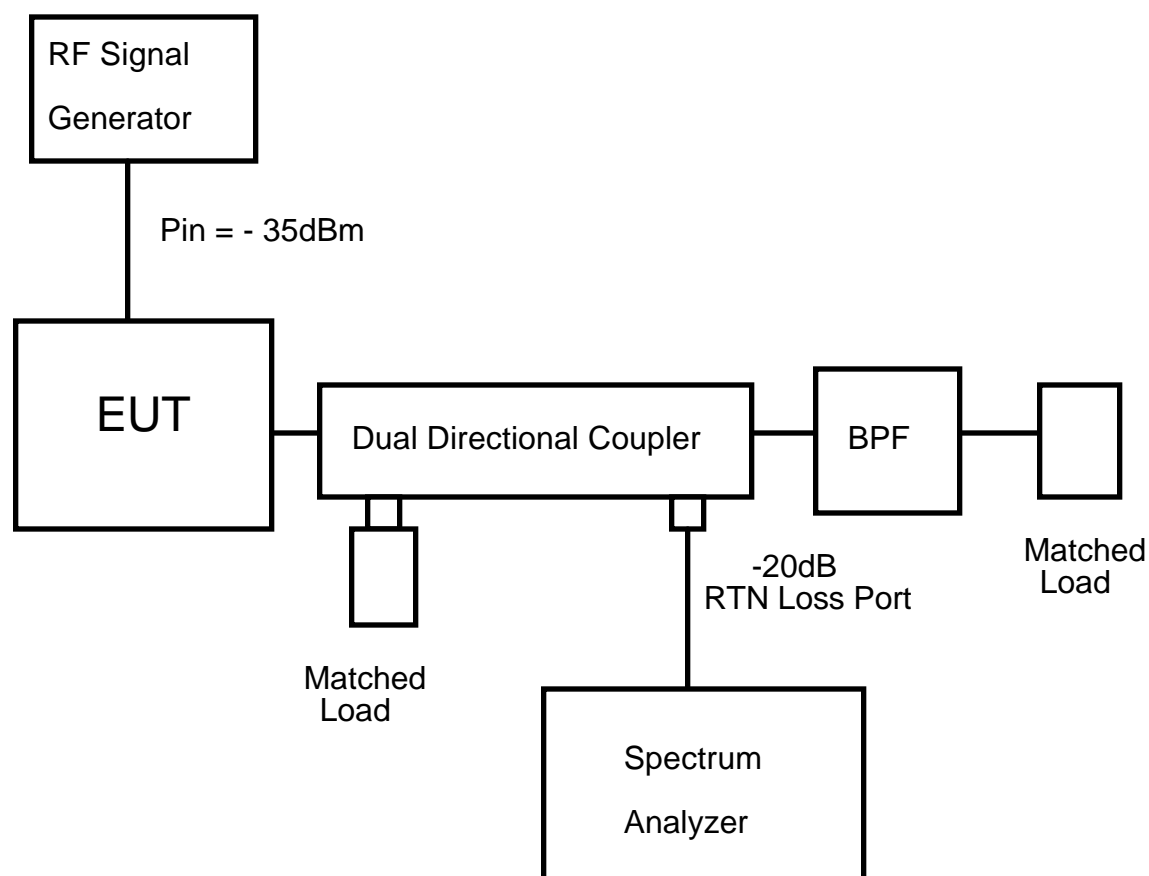
Step 6. Steps 1 and 2 were repeated for 860 and 866MHz Down-Link test frequencies at 300mWatts levels of output power.

## 4.2 Measurements of Conducted Spurious Emissions at Antenna Ports.

Spurious conducted emission tests covered out-of-band harmonics and spurious emissions and in-band two-tone intermodulation emissions.

### 4.2.1 Out-of-Band Harmonics and Spurious Emissions.

The test setup for measurement of out-of-band harmonics and spurious emissions is shown in the following figures:

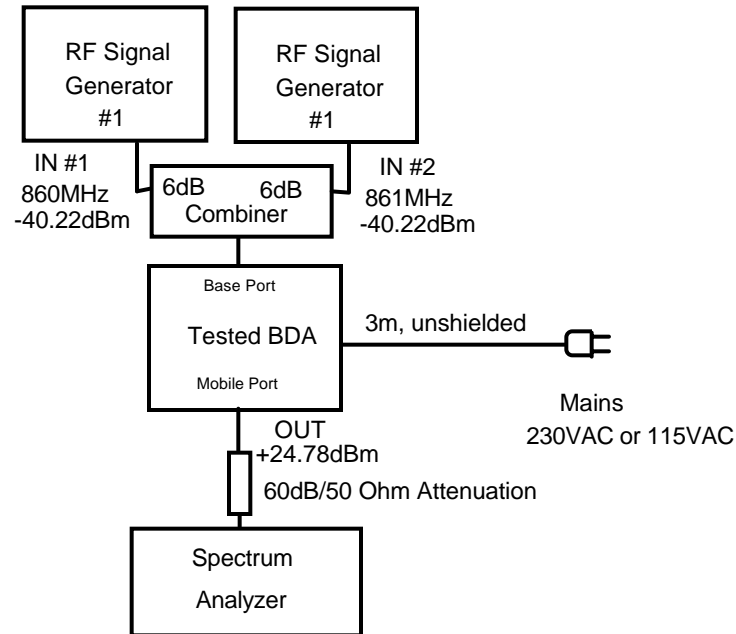
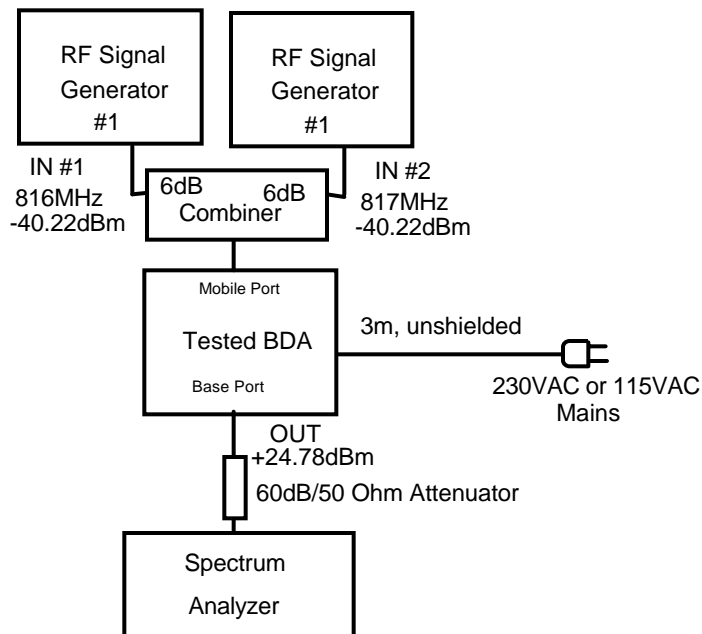


This setup was used in order to increase the dynamic range of the measurements, and in order to avoid spurious responses of the spectrum analyzer. The BPF was tuned to the transmitter operational frequency, in order to conduct its in-band radiated power into matched load. All out-of-band emissions were reflected from the BPF and monitored by Spectrum Analyzer connected to -20dB Return Loss port of the Dual Directional Coupler. In this way the in-band radiated power was attenuated by above 40dB (directivity of the Directional Coupler), while all out-of-band spurious emissions were attenuated by only 20dB (Coupling Factor of Directional Coupler).

Conducted emission tests of harmonics and spurious of signal amplified by the BDA was performed with a single-tone input signal at -35dBm level, resulting in +30dBm output signal. This test was performed for Up-Link and Down-Link operational modes for three frequencies for each operational frequency band (the upper, center and lower operational frequencies).

#### **4.2 2 Measurement of In-Band Intermodulation Products.**

Radiated emission tests of spurious signals generated in the BDA due to intermodulation of two Up-Link or two Down-Link signals was performed with two -40.22dBm, each input signals, resulting in +24.78dBm output power for each one of processed signals. This test was performed with one signal located at a center frequency of the operational frequency band, and the second signal at frequency 1MHz higher. Output signal at the BDA antenna port was attenuated by 30dB in order to prevent overloading and appearance of intermodulation in the spectrum analyzer itself.

**a) Down-Link Configuration.****b) Up-Link Configuration.**

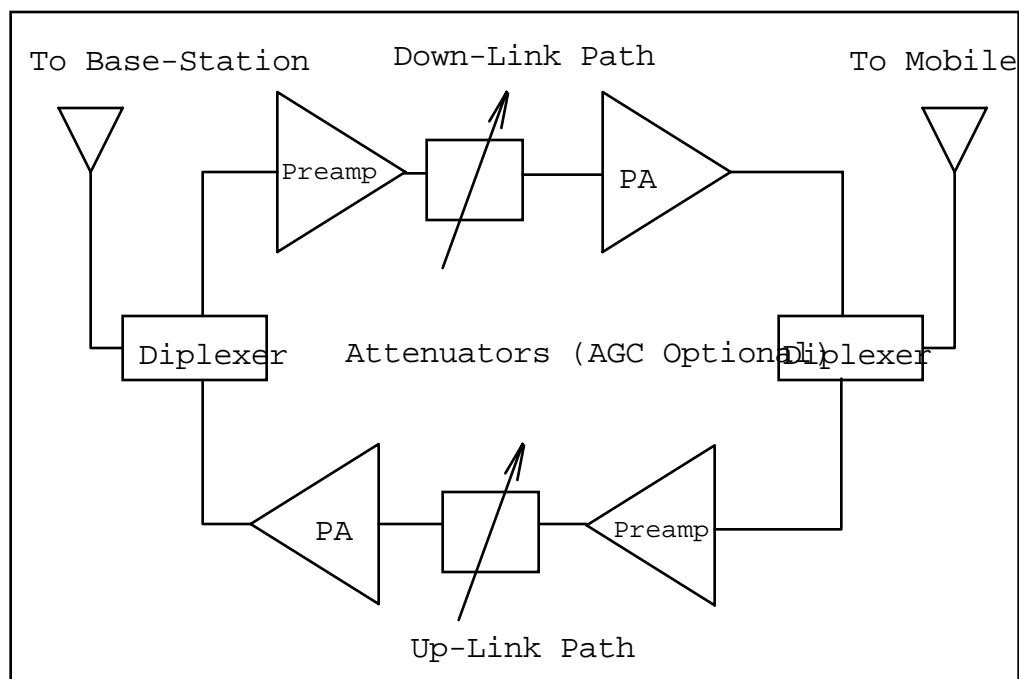
## 5. Description of Equipment Under Test.

### 5.1 Description of the Tested Equipment.

MW-CBDA-ESMR-1W60 BDA is cellular repeater/booster, and may be used in order to enlarge coverage of cellular base stations. The MW-CBDA-ESMR-1W60 BDA incorporates high-linear power amplifiers and diplexers with sharp out-of band rejection, which assists in avoiding interfering signals and intermodulations.

The tested MW-CBDA-ESMR-1W60 BDA operated without AGC provisions.

The block-diagram of the MW-CBDA-ESMR-1W60 BDA is in the following figure:



## 5.2 Cables Used During the Tests:

No.	Description	Length (m)	Shielding
1	50Ohm coaxial cable from Signal Generator to the EUT.	1.0	85-95% braided + foil overall shield
2	50Ohm coaxial cable from the EUT to 50Ohm matched load.	0.5	85-95% braided + foil overall shield
3	Power cable	3.0	Unshielded

## 5.3 Modifications Required for Compliance.

The MW-CBDA-ESMR-1W60 BDA in its original design complied with the occupied bandwidth and conducted spurious and harmonics emission requirements of 47CFR Parts 2 and 90. Therefore no corrective actions were required.



**6. List of Test Equipment Used.**

No.	Description	Manufacturer and Model Number	Series No.
Occupied Bandwidth Test			
1	Spectrum Analyzer 9KHz to 26.5GHz	HP Model 8563E	3821A09026
2	ESG-D Series Signal Generator, Opt.1E5, H60, UN8, UN9, 250kHz - 2.0GHz	HP Model E4431B	US38440181
3	Power Meter	Gigatronics Model 8541C, Opt.11	1834386
4	Sensor 0.01-18GHz	Gigatronics Model 80401A	1831947
5	Plotter	HP, Model 7440A	2929A17765
Conducted Spurious and Harmonics Emissions Test			
6	RF Signal Generator 0.1-990MHz	HP Model 8656A	
7	Microwave Sweep Generator Mainframe	HP, Model 8350B	2517U01367
8	Microwave Sweep Generator Plug In Unit 0.01-20GHz	HP Model 83592B	2509A00667
9	Dual Directional Coupler -20dB, 0.1-2.0GHz	HP Model 778D	1144A05983
10	Dual Directional Coupler -20dB, 2.0-18GHz	HP Model 11692D, Opt.001	1212/00839
11	Power Splitter DC-18GHz	HP Model 11667A	00182
12	Tunable Bandpass Filter 500-1000MHz	N/A	N/A

## **7. Summary of Test Results.**

### **7.1 Occupied Bandwidth Test.**

Occupied bandwidth tests in Up-Link and Down-Link transmit operational modes demonstrated full compliance of the MW-CBDA-ESMR-1W60 BDA with the requirements of 47CFR Parts 2 and 90.

### **7.2 Conducted Spurious and Harmonics Emissions in Antenna Ports:**

#### **Out-Of-Band Products.**

No spurious or harmonic emission exceeding the limit of  $43+10\log(P)$  below the unmodulated carrier power (P), or -13dBm, were detected. In general, conducted emissions at harmonic frequencies were below the noise floor of the spectrum analyzer.

### **7.3 Conducted Spurious Emissions in Antenna Ports:**

#### **In-Band Two-Tone Intermodulation Products.**

Third and higher order two-tone intermodulation products were detected during the tests. All emissions were below the limit of -13dBm. The lowest safety margin of 15dB was measured in the case of 3-ed order intermodulation during Up-Link transmission @ 806 and 821MHz and Down-Link transmission @ 866MHz.

## **8. Details of Test Results.**

### **8.1 Occupied Bandwidth Test.**

Occupied bandwidth tests were performed in Up-Link operational mode at frequencies 806, 816 and 821MHz and in Down-Link operational mode at frequencies 851, 858 and 866MHz.

The test results were compared with B-Mask (pursuant 47CFR 90.210(b)), G-Mask (pursuant 47CFR 90.210(g)), and mask specified in 47CFR 90.961(a).

Experimental plots of the occupied bandwidth test are given in Appendix A.

#### **8.1.1 Up-Link (Mobile-to-Base) Transmit Mode.**

Test results in Up-Link (Mobile-to-Base) transmit mode for the center frequency 816MHz are given in Figures A-1a through A-1c for the tests performed at 300mWatts level of output power. All emissions were at levels below the B-mask, G-mask and the mask specified in 47CFR 90.961(a).

### **8.1.2 Down-Link (Base-to-Mobile) Transmit Mode.**

Test results in Down-Link (Base-to-Mobile) transmit mode for the center frequency 858MHz are given in Figures A-2a through A-2c for the tests performed at 300mWatts level of output power. All emissions were at levels below the B-mask, G-mask and the mask specified in 47CFR 90.961(a).

## **8.2 Conducted Spurious and Harmonics Emissions in Antenna Ports: Out-Of-Band Products.**

The tests were conducted in Up-Link and Down-Link operational modes. All experimental plots are given in Appendix B.

### **8.2.1 Up-Link (Mobile-to-Base) Transmit Mode.**

No emissions exceeding the noise floor of the spectrum analyzer were detected at harmonic and other frequencies in the tested frequency band up to 9000MHz. The test results for center 816MHz frequency are given in Figures B-1(a) through B-1(c).

In summary, the power of all out-of-band harmonics and spurious emissions was below the -13dBm standard limit.

### **8.2.2 Down-Link (Base-to-Mobile) Transmit Mode.**

No emissions exceeding the noise floor of the spectrum analyzer were detected at harmonic and other frequencies in the tested frequency band up to 9000MHz. The test results for center 860MHz frequency are given in Figures B-2(a) through B-2(c).

In summary, the power of all out-of-band harmonics and spurious emissions was below the -13dBm standard limit.

## **8.3 Conducted Spurious Emissions in Antenna Ports:**

### **In-Band Two-Tone Intermodulation Products.**

Two-tone intermodulation test was conducted in Up-Link and Down-Link transmission operational modes at three frequencies for each mode.

Summary of the test results are given in the following Table 1. Safety margins were calculated relative to the standard limit -13dBm.

**Table 1. Summary of Two-Tone Intermodulation Test Results.**

F1 (MHz)	F2 (MHz)	Intermode Product	Intermode Product Frequency (MHz)	Measured Level (dBm)	Safety Margin (dB)
Up-Link Transmission Mode					
806	807	2F1-F2=F1-Δ	805	-28	15
		2F2-F1=F2+Δ	808	-28	15
		3F1-2F2=F1-2Δ	804	L.T.-70	G.T.57
		3F2-2F1=F2+2Δ	809	L.T.-70	G.T.57
		4F1-3F2=F1-3Δ	803	L.T.-70	G.T.57
		4F2-3F1=F2+3Δ	810	L.T.-70	G.T.57
816	817.06	2F1-F2=F1-Δ	814.94	-29	16
		2F2-F1=F2+Δ	818.06	-29	16
		3F1-2F2=F1-2Δ	813.74	L.T.-70	G.T.57
		3F2-2F1=F2+2Δ	819.26	L.T.-70	G.T.57
		4F1-3F2=F1-3Δ	812.70	L.T.-70	G.T.57
		4F2-3F1=F2+3Δ	820.30	L.T.-70	G.T.57
821	822	2F1-F2=F1-Δ	820	-28	15
		2F2-F1=F2+Δ	823	-28	15
		3F1-2F2=F1-2Δ	819	L.T.-70	G.T.57
		3F2-2F1=F2+2Δ	824	L.T.-70	G.T.57
		4F1-3F2=F1-3Δ	818	L.T.-70	G.T.57
		4F2-3F1=F2+3Δ	825	L.T.-70	G.T.57
Down-Link Transmission Mode					
851	852 Δ=1.0	2F1-F2=F1-Δ	850	-29	16
		2F2-F1=F2+Δ	853	-29	16
		3F1-2F2=F1-2Δ	849	L.T.-70	G.T.57
		3F2-2F1=F2+2Δ	854	L.T.-70	G.T.57
		4F1-3F2=F1-3Δ	848	L.T.-70	G.T.57
		4F2-3F1=F2+3Δ	855	L.T.-70	G.T.57
860	858.5 Δ=1.5	2F1-F2=F1+Δ	861.5	-29	16
		2F2-F1=F2-Δ	857.0	-29	16
		3F1-2F2=F1+2Δ	863.0	L.T.-70	G.T.57
		3F2-2F1=F2-2Δ	855.5	L.T.-70	G.T.57
		4F1-3F2=F1+3Δ	864.5	L.T.-70	G.T.57
		4F2-3F1=F2-3Δ	854.0	L.T.-70	G.T.57
866	865 Δ=1.0	2F1-F2=F1+Δ	867	-28	15
		2F2-F1=F2-Δ	864	-28	15
		3F1-2F2=F1+2Δ	868	L.T.-70	G.T.57
		3F2-2F1=F2-2Δ	863	L.T.-70	G.T.57
		4F1-3F2=F1+3Δ	869	L.T.-70	G.T.57
		4F2-3F1=F2-3Δ	862	L.T.-70	G.T.57

## 9. Signatures.

Test measurements were  
performed by:

Dr.A.Axelrod  
(EMI Test Ltd.)

2 March 2000

-----  
(Date, )

Test report was prepared by:

Dr.A.Axelrod  
(EMI Test Ltd.)

2 March 2000

-----  
(Date, Signature)

Approved by:

Dr. A.Axelrod  
(EMI Test Ltd.)

2 March 2000

-----  
(Date, Signature)

The testing was observed by:

Mr.Shmuel Auster  
(Elisra Electronic Systems Ltd.

2 March 2000

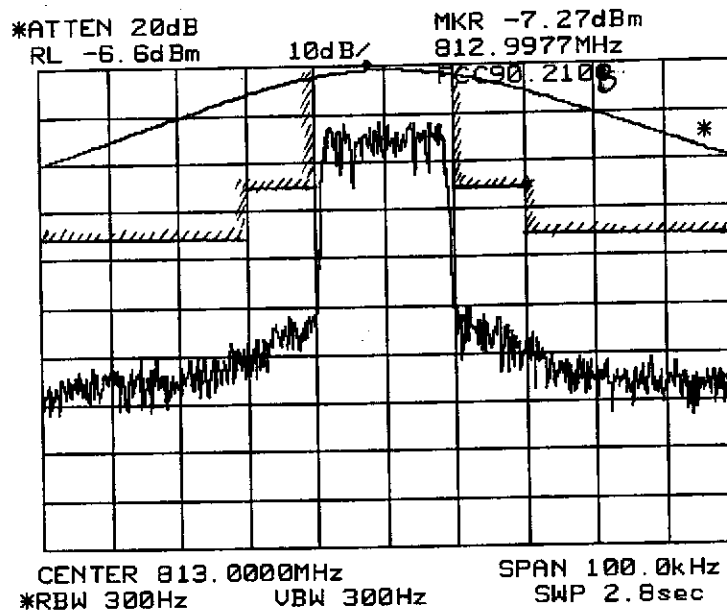
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(Date, Signature)

# **Appendix A**

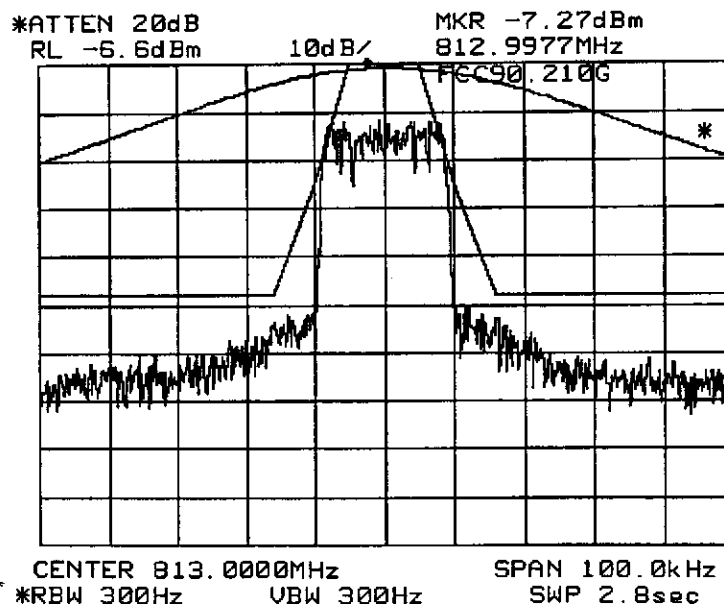
## **Experimental Results of Occupied Bandwidth Test.**

**Figure A-1a**

Occupied Bandwidth Test in Up-Link Transmission Mode.  
 $F=813\text{MHz}$ ,  $P_{\text{out}} = 250\text{mWatt} + 20\% = 300\text{mWatt}$   
 Performance relative to B-Mask per 47 CFR 90.210(b)

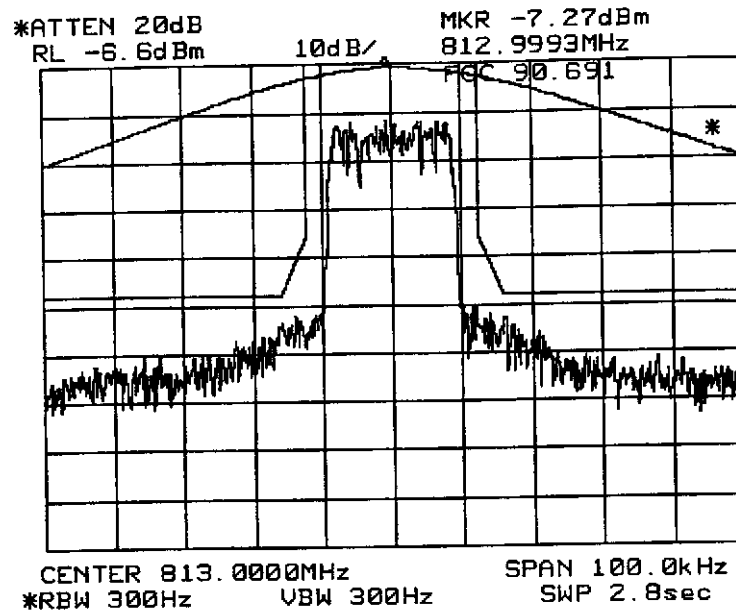
**Figure A-1b**

Occupied Bandwidth Test in Up-Link Transmission Mode.  
 $F=813\text{MHz}$ ,  $P_{\text{out}} = 250\text{mWatt} + 20\% = 300\text{mWatt}$   
 Performance relative to G-Mask per 47 CFR 90.210(g)



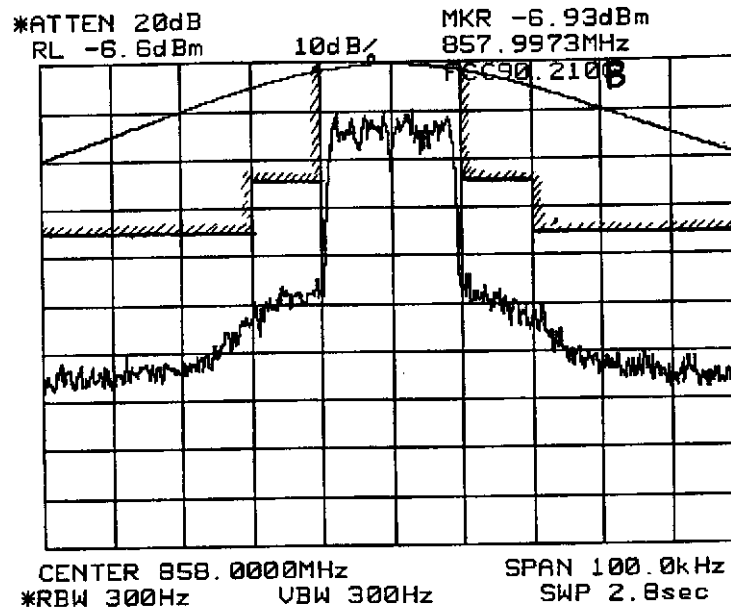
**Figure A-1c**

Occupied Bandwidth Test in Up-Link Transmission Mode.  
F=813MHz, Pout = 250mWatt+20% = 300mWatt  
Performance relative to Mask per 47 CFR 90.691(a)

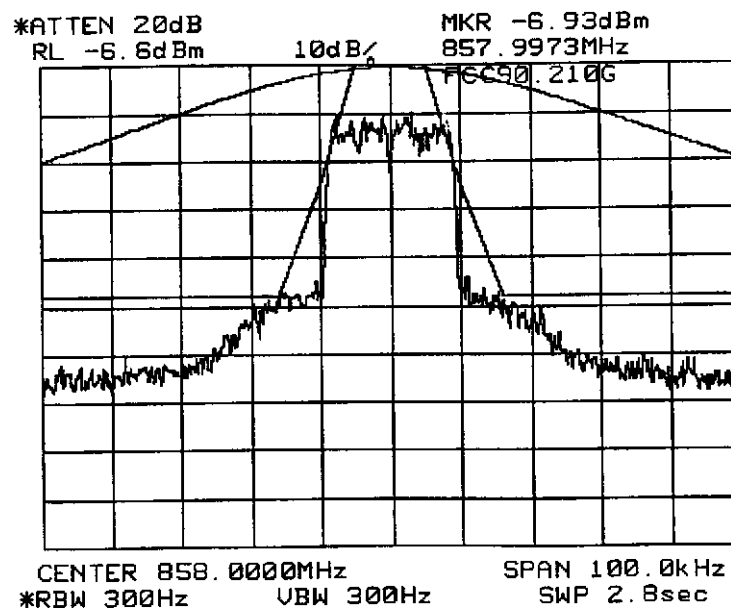




**Figure A-2a** Occupied Bandwidth Test in Down-Link Transmission Mode.  
 $F=858\text{MHz}$ ,  $P_{\text{out}} = 250\text{mWatt} + 20\% = 300\text{mWatt}$   
 Performance relative to B-Mask per 47 CFR 90.210(b)

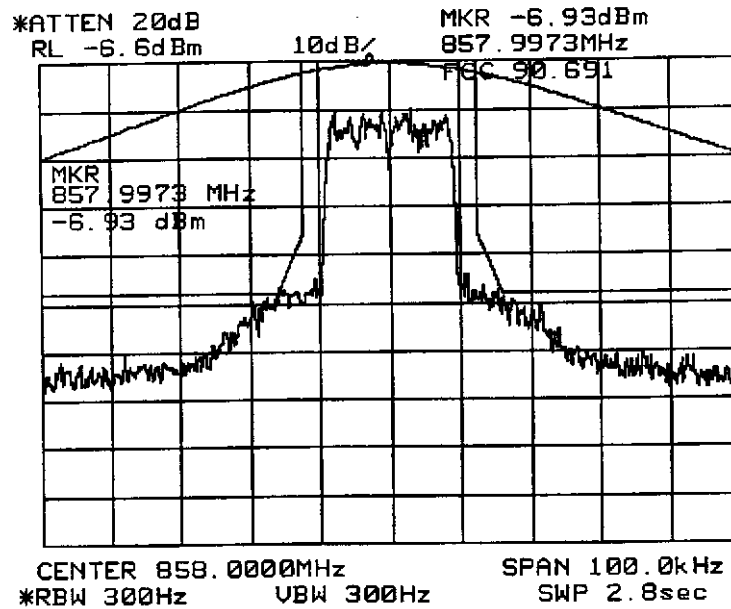


**Figure A-2b** Occupied Bandwidth Test in Down-Link Transmission Mode  
 $F=858\text{MHz}$ ,  $P_{\text{out}} = 250\text{mWatt} + 20\% = 300\text{mWatt}$   
 Performance relative to G-Mask per 47 CFR 90.210(g)



**Figure A-2c**

Occupied Bandwidth Test in Down-Link Transmission Mode.  
F=858MHz, Pout = 250mWatt+20% = 300mWatt  
Performance relative to Mask per 47 CFR 90.691(a)

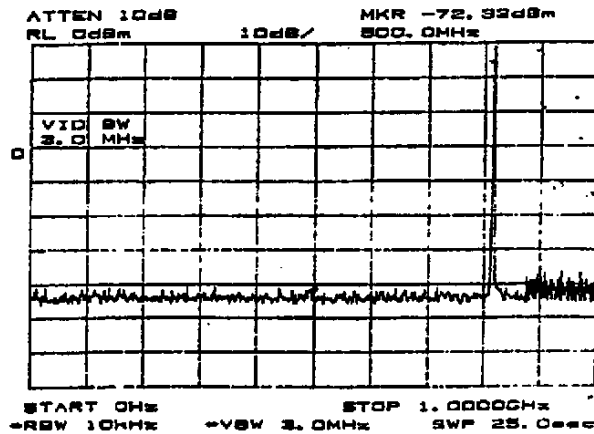


# **Appendix B**

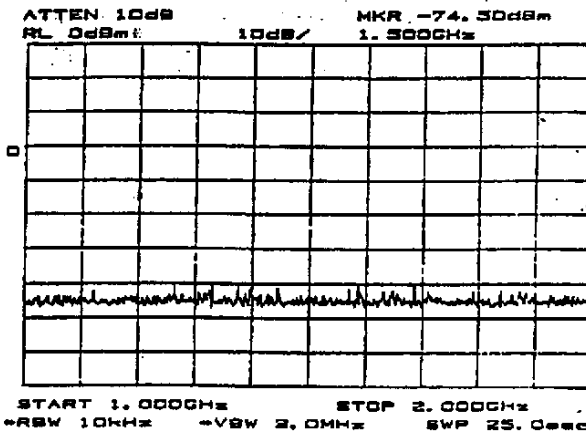
## **Experimental Results of Conducted Spurious and Harmonics Emissions Test.**

**Figure B-1** Conducted Emissions at Antenna Port  
in Up-Link Transmission Mode.  
F=816MHz, Pout = 1000mWatt

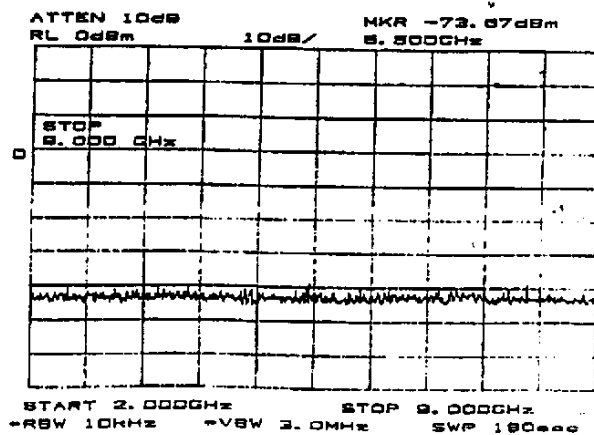
a) Below 1GHz.



b) 1GHz-to-2GHz Band



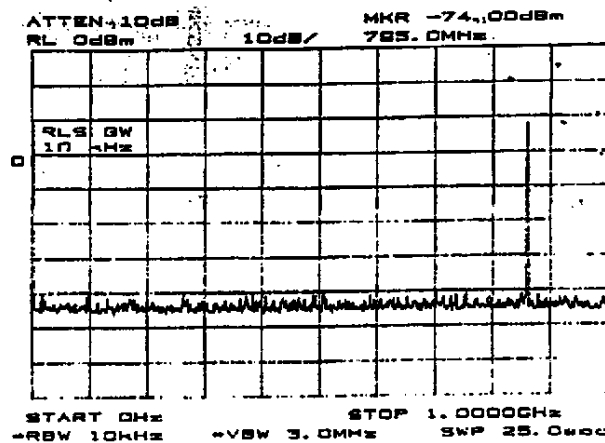
c) 2GHz-to-9GHz Band



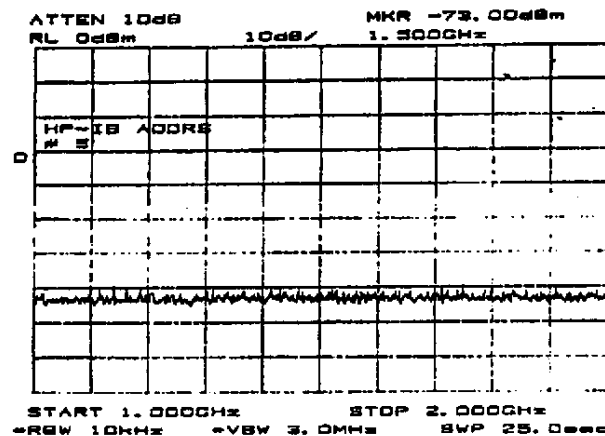
**Figure B-2** Conducted Emissions at Antenna Port  
in Up-Link Transmission Mode.  
F=860MHz, Pout = 1000mWatt

**Figure B-2** in Up-Link Transmission Mode.  
F=860MHz, Pout = 100mWatt+20% = 120mWatt

a) Below 1GHz.



b) 1GHz-to-2GHz Band



c) 2GHz-to-9GHz Band

