

Report Of Intermodulation Product Findings

**Philadelphia, PA.
Domino Lane
American Tower Site**

WRDW	96.5 MHz.
WOGL	98.1 MHz.
WPPZ	103.9 MHz.

October 7, 2006

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TABLE OF CONTENTS

Philadelphia, Pennsylvania

Report of Findings for Intermodulation Product Measurements

Page 3.....Introduction
Page 4.....Carrier Reference Levels
Page 3.....Table of Third order Products Expected
Page 6,7Intermodulation Product Measurements
Page 8Conclusion
Page 9Affidavit

Exhibits Accompanying This Report

EXHIBIT A.....Antenna and Combiner Specification Sheet and Drawing
A-1.....Drawing Depicting Antenna
A-2.....ERI Antenna Specification Sheet
A-3.....Drawing Depicting Combiner Module
A-4.....ERI Combiner Specification Sheet
A-5.....Theoretical Vertical Plane Relative Field Antenna Plots

EXHIBIT B-1.....Intermodulation Product Measurement Equipment Layout
B-2.....Broadcasting Scheme of the Multiplexed System

REPORT OF FINDINGS
WRDW/WOGL/WPPZ
96.5 MHz. /98.1 MHz. /103.9 MHz.

Introduction: This report of findings is based on data collected at the WRDW, WOGL, and WPPZ Domino Lane American Tower broadcast facility located in Philadelphia, Pennsylvania. The report includes measurements offered as proof that the combined operations of WRDW (96.5 MHz.), WOGL (98.1 MHz.), and WPPZ (103.9) transmitters are in compliance with the FCC Rules and Regulations as required by the Code of Federal Regulations (CFR) Title 47 section 73.317 paragraph (b) through (d). In brief, the collection of measurements presented in this report shows that all possible third order inter-modulation (IM) products generated by this multiplex system are less than the maximum allowable level as required by section 73.317 (b) through (d). Jeff Taylor of Electronics Research, Inc. located in Chandler, Indiana performed the measurements summarized herein on

The following exhibits are provided:

Exhibit A:

- A-1 Drawing Depicting Antenna.
- A-2 1087-4CP Antenna Specification Sheet.
- A-3 Drawing Depicting Multiplexing Scheme.
- A-4 CI970-32/8-GD Constant Impedance Combiner Multiplexer Specification Sheet.
- A-5 Theoretical Vertical Plane Relative Field Antenna Plots

Exhibit B:

- B-1 Equipment Employed In Intermodulation Product Measurement.
- B-2 Broadcasting Scheme of the Multiplexed Systems.
- Table 1. Carrier Reference Levels.
- Table 2. Calculated Third Order Products.
- Table 3. Intermodulation Analysis Measurements.

Exhibits Accompanying Report: Exhibit A provides comprehensive information on both antenna and filters used by these radio stations. Exhibit B illustrates the broadcasting scheme of each station, the layout of the equipment used to isolate and measure potential intermodulation products and forward carrier reference levels. Found within Table 1 are the narrow band carrier frequency measurements that provide relative output signal levels for the IM analysis. Table 2 lists the calculated third order products that can be generated from FM transmitters broadcasting from the multiplexed system. The IM Analysis Measurements, in Table 3, provides detailed information obtained from the product frequency investigation.

The Nature of Intermodulation Products (IM): Intermodulation products result from inadequate transmitter-to-transmitter isolation. Intermodulation products are commonly generated from radio stations operating into multiplexed facilities and congested antenna broadcast sites. The mechanics associated with the phenomenon have been well documented. When two or more transmitters are coupled to each other, new spectral components are produced by the mixing of the station frequencies in the active circuits of each transmitter. The common term used to describe this phenomenon is third order product denoted by the mathematical expression $[2(F_1)-(F_2)]$, where F_1 signifies the frequency of the transmitter that is generating the intermodulation product, and F_2 signifies the frequency causing the interference.

The Multiplexed System: These measurements were taken with three FM stations operating from the combined antenna system. The WRDW, WOGL, and WPPZ multiplexed system is fundamentally comprised of antenna, feed line and multiplexer unit. The 1087-4CP (antenna) and CI970-32/8-GD constant impedance combiner units are products of Electronics Research, Inc, whereas the feed line is manufactured by Myat. Refer to Exhibit B-1, for an illustration of the Broadcasting Scheme of these stations.

To accomplish the aggregation of three transmitter signals into a common antenna feed and provide transmitter-to-transmitter isolation, a multiplexing scheme consisting of a Constant Impedance Combiner was installed. Specifically, the Multiplexer utilizes two ERI Model CI970-8-GD and one ERI Model CI970-8 constant impedance modules for each transmitter. An interconnecting U-link is required to complete the multiplexer which is illustrated in the attached Exhibit A-3. The multiplexer, fully assembled, exhibited transmitter port-to-port isolation in excess of -80 dB. Other performance measurements, such as match, loss, group-delay, etc, revealed that the multiplexer unit was in proper working condition. Refer to Exhibit A-4 for the Combiner Specification Sheet.

The IM Investigation: Directional Couplers were placed at key locations throughout the combiner to monitor and maintain the multiplexer's performance. All couplers furnished with the system are factory calibrated and capable of delivering accurate and repeatable RF measurements. To facilitate the taking of the measurements, the coupler located at the antenna output of the multiplexed system was used. Care was taken in the selection of the measurement location to insure that the measurements would be made far removed from transmitters and any filtering used to reduce broadcast emissions. The coupler selected would normally be used for antenna reflection measurements and thus would provide greater than -35 dB directivity and a forward signal sample of -60 dB.

The forward port of the coupler was used for sampling the outgoing carrier levels and IM products. The IM sampled signal was fed by shielded cable into a Band Pass Filter where all extraneous energy was steeply attenuated. Various attenuation pads were used, when needed, on the band pass filter and/or the FIM71 to ensure an adequate signal level for measurements without overloading the measurement equipment. A Potomac Instruments FIM-71 Field Strength Receiver Serial # 242 was employed to record the level of all signals investigated. To facilitate the selective tuning of the Receiver and Band Pass Filter a Wavetek Model 3000 Serial # 7512028 signal generator was used. A IFR Model 2399A Spectrum Analyzer Serial # 02113071 was used to measure the close in spectral attenuation of each carrier and wide band search for any anomalies that may need further investigation. See attached Exhibit B-1 for an illustration of the measurement equipment.

Prior to recording measurements, all pertinent broadcasting equipment including Transmitters, Multiplexer, Feed Line and Antenna were adjusted to optimal performance. Also, it was confirmed before taking any measurements that all stations of concern were operating at their full licensed power level. From the equipment setup described above, the relative output signal level of each stations forward carrier was made. The resulting signal levels of these measurements are listed in Table 1, column labeled "Adjusted Level". This level will be used as the reference level for possible IM products of each carrier and was necessary to confirm that no significant levels of spurious energy, referenced to each carrier, were present from any transmitter operating from the multiplexed system.

Table 1 - Carrier Reference Levels.

Carrier Frequency (MHz)	Pad One (dB)	Bandpass Filter Loss (dB)	Full Scale Range (dBμ)	Scale Reading (dB)	Adjusted Level (dBμ)	Notes
WRDW (96.5)		-	120	5.5	114.5	
WOGL (98.1)		-	120	6.0	114.0	
WPPZ (103.9)		-	120	1.0	99.0	

Predictable third-order products due to system harmonics mixed with all on-site interfering frequencies that could be generated from the multiplexed system are calculated and listed in Table 2.

Table 2 - Third order Products.

Product Number	Product Frequency (MHz)	Transmitter Frequency (MHz)	Interfering Frequency (MHz)
1	87.7	96.5	105.3
2	88.5	96.5	104.5
3	89.1	96.5	103.9
4	90.1	96.5	102.9
5	90.9	98.1	105.3
6	91.7	98.1	104.5
7	91.9	96.5	101.1
8	92.3	98.1	103.9
9	93.3	98.1	102.9
10	94.9	96.5	98.1
11	95.1	98.1	101.1
12	97.3	96.5	95.7
13	98.9	96.5	94.1
14	99.7	98.1	96.5
15	100.5	98.1	95.7
16	100.5	96.5	92.5
17	102.1	96.5	90.9
18	102.1	98.1	94.1
19	102.5	103.9	105.3
20	102.9	96.5	90.1
21	103.3	103.9	104.5
22	103.7	98.1	92.5
23	104.9	103.9	102.9
24	105.3	98.1	90.9
25	106.1	98.1	90.1
26	106.7	103.9	101.1
27	109.7	103.9	98.1
28	111.3	103.9	96.5
29	112.1	103.9	95.7
30	113.7	103.9	94.1
31	115.3	103.9	92.5
32	116.9	103.9	90.9
33	117.7	103.9	90.1

Using the equipment previously described the IM product measurements were recorded and are listed in Table 3. The signal levels referenced to the carriers are calculated and listed in the column labeled "Level Referenced to Carrier". Refer to Exhibit B-2 for a layout of the measurement equipment.

IM Measurements Taken in

Product Frequency (MHz)	Transmitter Frequency (MHz)	Interfering Frequency (MHz)	Pad (dB)	Bandpass Filter Loss (dB)	Total Loss	Full Scale Range (dBμ)	Scale Reading (dBμ)	Adjusted Level (dBμ)	Carrier Reference Level (dBμ)	Level Referenced to Carrier (dB)	Notes*
Transmitter Mixes											
	96.5	Ref.	0		0	120	5.5		114.5		
	98.1	Ref.	0		0	120	6		114		
	103.9	Ref.	0		0	100	1		99		
87.7	96.5	105.3	3	6.8	9.8	60	17.5	52.3	114.5	-62.2	Channel 6 Audio.
88.5	96.5	104.5	3	7	10	40	8	42	114.5	-72.5	Local Carrier 88.5 MHz. WXPB
89.1	96.5	103.9	3	6.9	9.9	20	20	9.9	114.5	-104.6	
90.1	96.5	102.9	3	6.8	9.8	60	20	49.8	114.5	-64.7	Local Carrier 90.1 MHz. WRTI
90.9	98.1	105.3	3	7	10	60	11	59	114	-55	Local Carrier 90.9 MHz. WHYI
91.7	98.1	104.5	3	6.8	9.8	20	19	10.8	114	-103.2	
91.9	96.5	101.1	3	7	10	20	20	10	114.5	-104.5	
92.3	98.1	103.9	3	6.8	9.8	60	19.8	50	114	-84	
93.3	98.1	102.9	3	6.7	9.7	40	8.7	41	114	-73	Local Carrier 93.3 MHz. WMMR
94.9	96.5	98.1	3	7.1	10.1	20	16.5	13.6	114.5	-100.9	
95.1	98.1	101.1	3	7	10	20	15.5	14.5	114	-99.5	
97.3	96.5	95.7	3	7	10	20	5.3	24.7	114.5	-89.8	
98.9	96.5	94.1	3	7	10	60	6.8	63.2	114.5	-51.3	Local Carrier 98.9 MHz. WUSL
99.7	98.1	96.5	3	6.7	9.7	20	0.5	29.2	114	-84.8	
100.5	98.1	95.7	3	6.6	9.6	60	2.7	66.9	114	-87.1	
100.5	96.5	92.5	3	6.6	9.6	60	2.7	66.9	114.5	-87.6	
102.1	96.5	90.9	3	7	10	60	6.8	63.2	114.5	-51.3	Local Carrier 102.1 MHz. WIOQ
102.1	98.1	94.1	3	7	10	60	6.8	63.2	114	-50.8	Local Carrier 102.1 MHz. WIOQ
102.5	103.9	105.3	3	6.3	9.3	40	6.8	42.5	99	-86.5	
102.9	96.5	90.1	3	7	10	60	14.5	55.5	114.5	-59	Local Carrier 102.9 MHz. WMGK
103.3	103.9	104.5	3	6.5	9.5	40	15	34.5	99	-84.5	
103.7	98.1	92.5	3	7.1	10.1	20	11.1	19	114	-95	Turned 103.9 MHz. WPPZ off.
104.9	103.9	102.9	3	6.8	9.8	60	13.7	56.1	99	-82.9	

105.3	98.1	90.9	3	6.8	9.8	80	15.7	74.1	114	-39.9	Local Carrier 105.3 MHz. WDAS
106.1	98.1	90.1	3	6.7	9.7	40	1	48.7	114	-65.3	Local Carrier 106.1 MHz. WISX
106.7	103.9	101.1	3	6.7	9.7	20	4	25.7	99	-83.3	
109.7	103.9	98.1	3	6.5	9.5	20	20	9.5	99	-89.5	
111.3	103.9	96.5	3	6.7	9.7	20	20	9.7	99	-89.3	
112.1	103.9	95.7	3	6.7	9.7	20	20	9.7	99	-89.3	
113.7	103.9	94.1	3	6.1	9.1	20	20	9.1	99	-89.9	
115.3	103.9	92.5	3	6	9	20	20	9	99	-90	
116.9	103.9	90.9	3	5.8	8.8	20	20	8.8	99	-90.2	
117.7	103.9	90.1	3	6	9	20	20	9	99	-90	
Local Stations in the Area											

The Spectrum Analyzer was used to check the close in spectral attenuation of the carrier to confirm the operation of the transmitter is in compliance with Sections (b) and (c) of the FCC Rules and Regulations.

As a final proof of the systems IM Product performance, a wide band search was undertaken using the Spectrum Analyzer. The purpose for this measurement was to look for suspicious anomalies that may warrant further investigation. My search ranged the complete frequency span of the receiver and resulted in no additional investigations.

Please note that on the combiner drawing there is a 92.5 MHz.(WXTU) combiner module incorporated into the multiplexed system. This station is not operational from the multiplexed site at this time.

Conclusion: Based upon my observations and measurements taken on October 7, 2006 as summarized in this document, I, Jeff Taylor, find the subject system- specifically the transmitter and filter system for the operation of WRDW, WOGL and WPPZ into the antenna to be in proper working order. Furthermore, based on the measured data, it is my opinion that there are no inter-modulation products in excess of 80 dB below carrier levels generated from or within the station operating on the installed system. Based on this recorded data, I conclude that WRDW, WOGL, and WPPZ is in compliance with the requirements of Section 73.317 paragraph (b) through (d) of the FCC Rules and Regulations.

Respectfully submitted,
Electronics Research, Inc.

Jeff Taylor, Field Technician

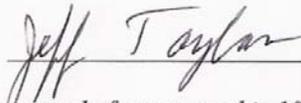
State of Indiana)) SS:
County of Warrick)

AFFIDAVIT

I, Jeff Taylor, hereby declare that the following statements are true and correct to the best of my knowledge and belief :

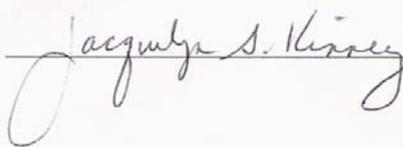
- 1.) I am a Field Technician for Electronics Research, Inc (“ERI “) and have been employed by ERI for ten years. I am familiar with and have assisted in the design, manufacturing and installation of FM Antennas and FM Multiplexers in my long tenure with ERI.
- 2.) I have either prepared and/or directly supervised the preparation of all technical information contained in this Report Of Findings and to my knowledge to be accurate and true.
- 3.) ERI has been requested by American Tower, on behalf of radio Stations WRDW, WOGL and WPPZ to prepare this Report of Findings.

Jeff Taylor; Field Technician



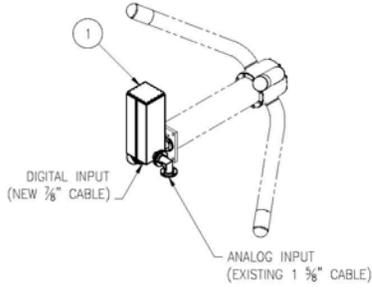
Subscribed and sworn to before me on this 10th, day of October 2006.

Jacquelyn Kinney; Notary Public
My commission expires July 5, 2007

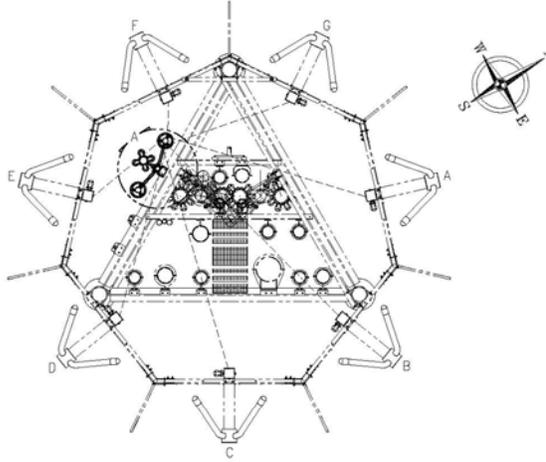




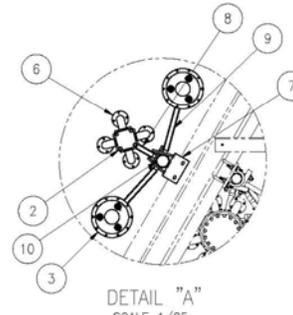
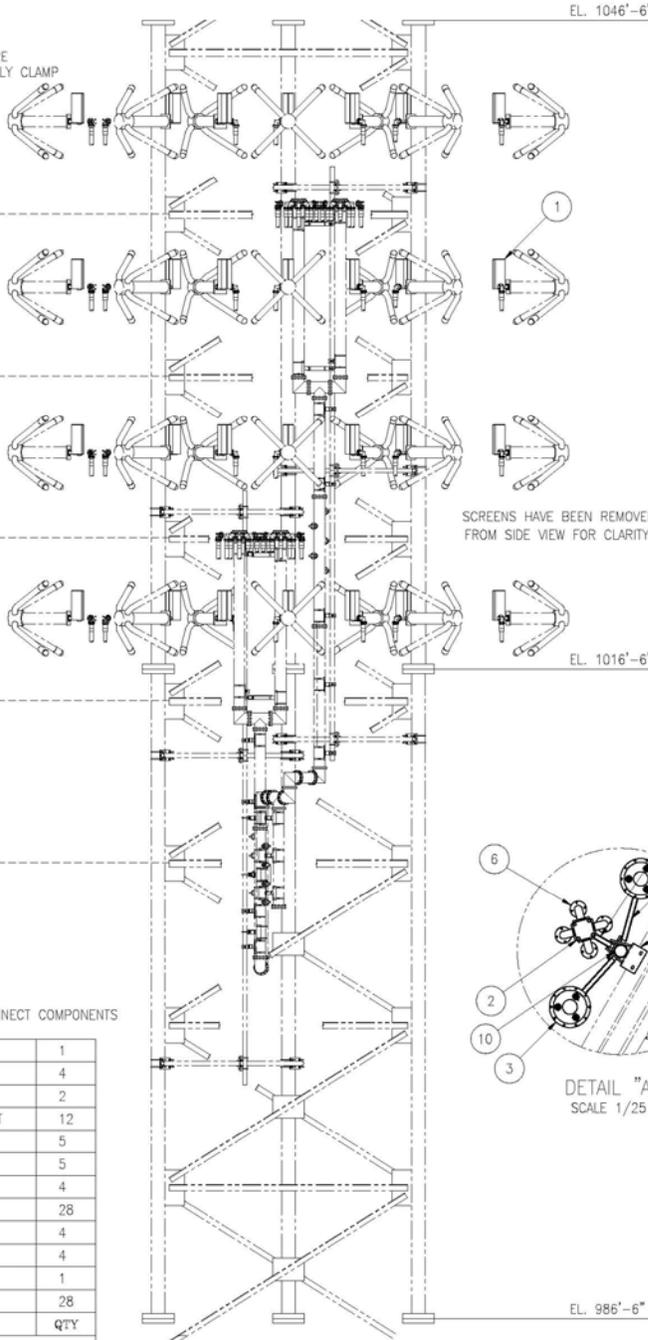
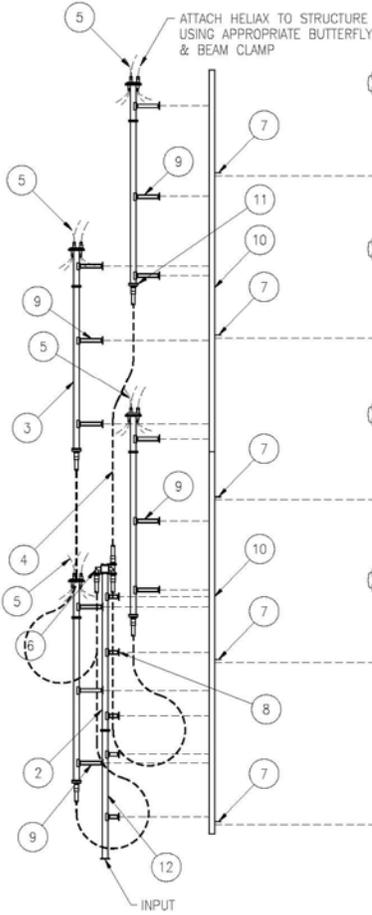
ELEMENT ATTACHMENT DETAIL
SCALE 1/25



EXISTING ANTENNA COMPONENTS ARE SHOWN IN PHANTOM



DIGITAL FEED HARNESS CONFIGURATION
(SEE DETAIL "A" FOR LOCATION & TOP VIEW)



SEE SHEET IA-1.2 FOR HARDWARE REQUIRED TO CONNECT COMPONENTS

IT NO.	PART NO.	DESCRIPTION	QTY
12	CL3031	3 1/8" MATCHING SECTION	1
11	1861	3 1/8" TO 1 5/8" PLATE REDUCER	4
10	BT-4	POWER DIVIDER MOUNTING POLE	2
9	BT-3	BAY LEVEL POWER DIVIDER BRACKET	12
8	BT-2	MAIN POWER DIVIDER BRACKET	5
7	BT-1	POLE MOUNTING ANGLE	5
6	CE1022A	1-5/8" ELBOW SSF TO RSF	4
5	N/A	7/8" HELIAX CABLE 18' LONG	28
4	N/A	1-5/8" HELIAX CABLE 16' LONG	4
3	CQ307	BAY LEVEL POWER DIVIDER	4
2	PD3341	MAIN POWER DIVIDER	1
1	HY0221	IBOC 4 PORT HYBRID	28

BILL OF MATERIAL

ELECTRONICS RESEARCH, INC.
 ESTABLISHED 1943
 7777 GARDNER RD.
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 PHONE: (812) 925-6000
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ERI

NAME: INSTALLATION DETAIL
 FOR: PHILADELPHIA, PA. IBOC RETROFIT
 DRAWN BY: G. DRAFFING/ALL PROJECTS 11/27/05
 FILE: IA-1.1 IBOC/ERI BAY SHEET 1 OF 2
 DATE: 11/21/05 SCALE: 1/65
 TOLERANCES: DIM. IN MATL. AS LISTED

APPROVED: _____ DATE: _____
 DRAWN: _____
 CHECKED: _____
 MATERIAL: _____

SUPERSIDES PART #: _____
 SUPERSIDES FILE #: _____

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A-2 ERI Antenna Specification Sheet

American Tower, Domino Lane
Philadelphia, Pennsylvania

General Specifications

Antenna Type High Power FM-Broadcast, Suitable For Multiplexing
Model Number 1087-4CP (Cogwheel)
Number of Bay Levels Four
Polarization Right Hand Circular

Electrical Specifications

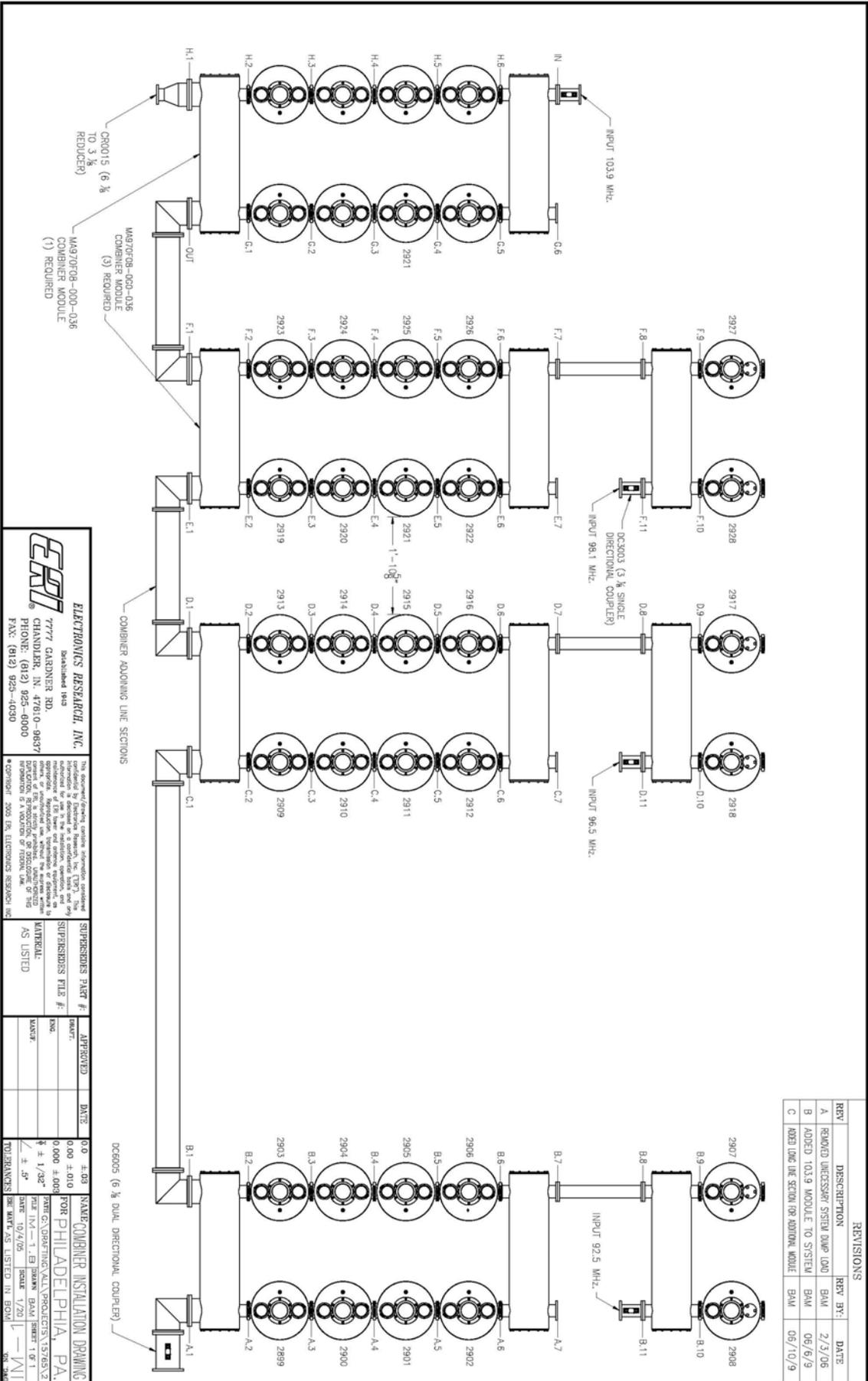
Antenna Input Power Capability 55 KW Max ⁽¹⁾
Operating Frequency Band 88 ~ 108 Megahertz.
VSWR <1.15:1 @ Operating Frequencies⁽²⁾
Azimuthal Pattern Circularity Better Than +/- 2dB From RMS (Free Space)
Power Split 50/50 (Horizontal & Vertical)
Frequency Specific Information:

<u>Frequency</u>	<u>Station ERP</u>	<u>Beam Tilt</u>	<u>First Null Fill</u>	<u>Second Null Fill</u>	<u>Power Gain</u>	<u>Line Loss</u> ⁽³⁾	<u>Filter Loss</u> ⁽⁴⁾	<u>Computed TPO</u>
96.5	9.6 KW	0°	0 %	0%	1.760	.8067 db	.477 db	7.56 KW
98.1	9.6 KW	0°	0 %	0%	1.784	.8175 db	.712 db	7.87 KW
103.9	.27 KW	0°	0 %	0%	1.872	.8414 db	.452 db	.20 KW

Mechanical Specifications

Antenna Feed System Fed With One 6 1/8” Line
Input Connector 6 1/8”-50 Ohm EIA Flanged
Element Deicing None
Interbay Spacing 92” Center to Center
Array Length 30’
Construction Material (Antenna) All Noncorrosive
Construction Material (Mounting) All Stainless Steel

1) Power Capability Has Been Rated Assuming an Operating Transmission VSWR of 1.5:1
2) VSWR Specification Achieved After On Site Tuning For User Specific Frequencies.
3) Line Loss Assumes A Feed Run of 1120.05 Feet, 4 1/16” Myat Rigid.
4) Losses Taken From Actual Combiner.



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SUPPENSORS PART #
 SUPPENSORS FILE #:
MATERIAL:
 AS LISTED

APPROVED
 DATE:
 NAME: COMBINER INSTALLATION DRAWING
 FOR PHILADELPHIA, PA.
 DATE: 10/4/05
 SCALE: 1/20
 SHEET: 1 OF 1

TOLERANCES
 UNLESS OTHERWISE SPECIFIED:
 DIMENSIONS AS LISTED IN BOM

REVISIONS			
REV	DESCRIPTION	REV BY:	DATE
A	REMOVED NECESSARY SYSTEM AMP LOAD	BAM	2/3/06
B	ADDED 103.9 MODULE TO SYSTEM	BAM	06/6/9
C	ADDED DUAL LINE SECTION FOR ADDITIONAL MODULE	BAM	06/10/9

A-4 ERI Combiner Specification Sheet

American Tower, Domino Lane
Philadelphia, Pennsylvania

General Specifications:

Multiplexer Type Constant Impedence “Series 970”
Number of Combining Units Three
Injected Port to Injected Port Isolation..... < - 80 dB
Output Connector 6 1/8 “50 Ohm EIA (Flanged)
Output Power (Designed) 50 KW⁽¹⁾

Heat Removal (All Multiplexer Components Except Group Delay)Natural Convection
Heat Removal (Group Delay) Forced Air
Physical Arrangement.....All Components floor standing

Injected Port Specifications:

Frequency Assignment 96.5, 98.1, and 103.9 MHz.
Power Rating, Each Injected Port (Designed) 8 KW
Input Connector 3-1/8" 50 Ohm EIA (Flanged)
VSWR < 1.08:1 @ +/-150 KHz.⁽²⁾
Group Delay Less than 75 ns Overall Variation, Carrier @ +/- 150 KHz.
Insertion Loss (Measured):

96.5 MHz..... - 0.477 dB
 98.1 MHz..... - 0.712 dB
 103.9 MHz..... - 0.452 dB

1) Power Rating Listed is as Designed Only. Actual Power Capabilities May Vary.
 2) When Terminated in 50 Ohm Resistive Load.

ELECTRONICS RESEARCH, INC.
7777 GARDNER ROAD
CHANDLER, IN. 47610

FIGURE 1D

-----THEORETICAL-----
VERTICAL PLANE RELATIVE FIELD

ERI TYPE 1007-4CP FM BROADCAST ANTENNA
0 DEGREE BEAM TILT
0 PERCENT NULL FILL

9/13/2002

96.5 MHz.

BAY SPACING:
92.00 INCHES

POWER GAIN IS 1.760 IN THE HORIZONTAL PLANE(1.760 IN THE MAX.)
[POWER GAINS AT 95% ANTENNA EFFICIENCY]

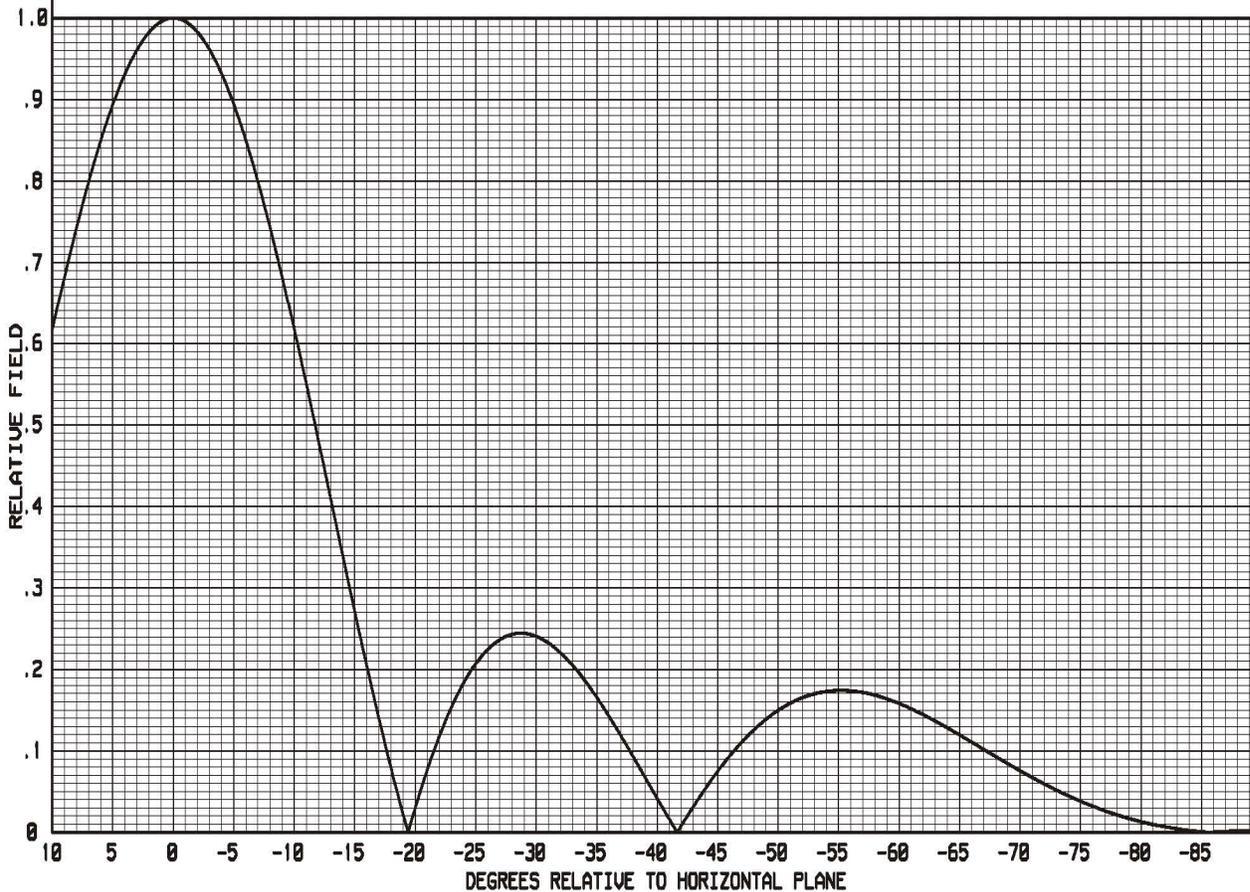


EXHIBIT A - 5

ELECTRONICS RESEARCH, INC.
7777 GARDNER ROAD
CHANDLER, IN. 47610

-----THEORETICAL-----
VERTICAL PLANE RELATIVE FIELD

9/13/2002

FIGURE 1E

ERI TYPE 1087-4CP FM BROADCAST ANTENNA
0 DEGREE BEAM TILT
0 PERCENT NULL FILL

98.1 MHz.

BAY SPACING:
92.00 INCHES

POWER GAIN IS 1.784 IN THE HORIZONTAL PLANE (1.784 IN THE MAX.)
[POWER GAINS AT 95% ANTENNA EFFICIENCY]

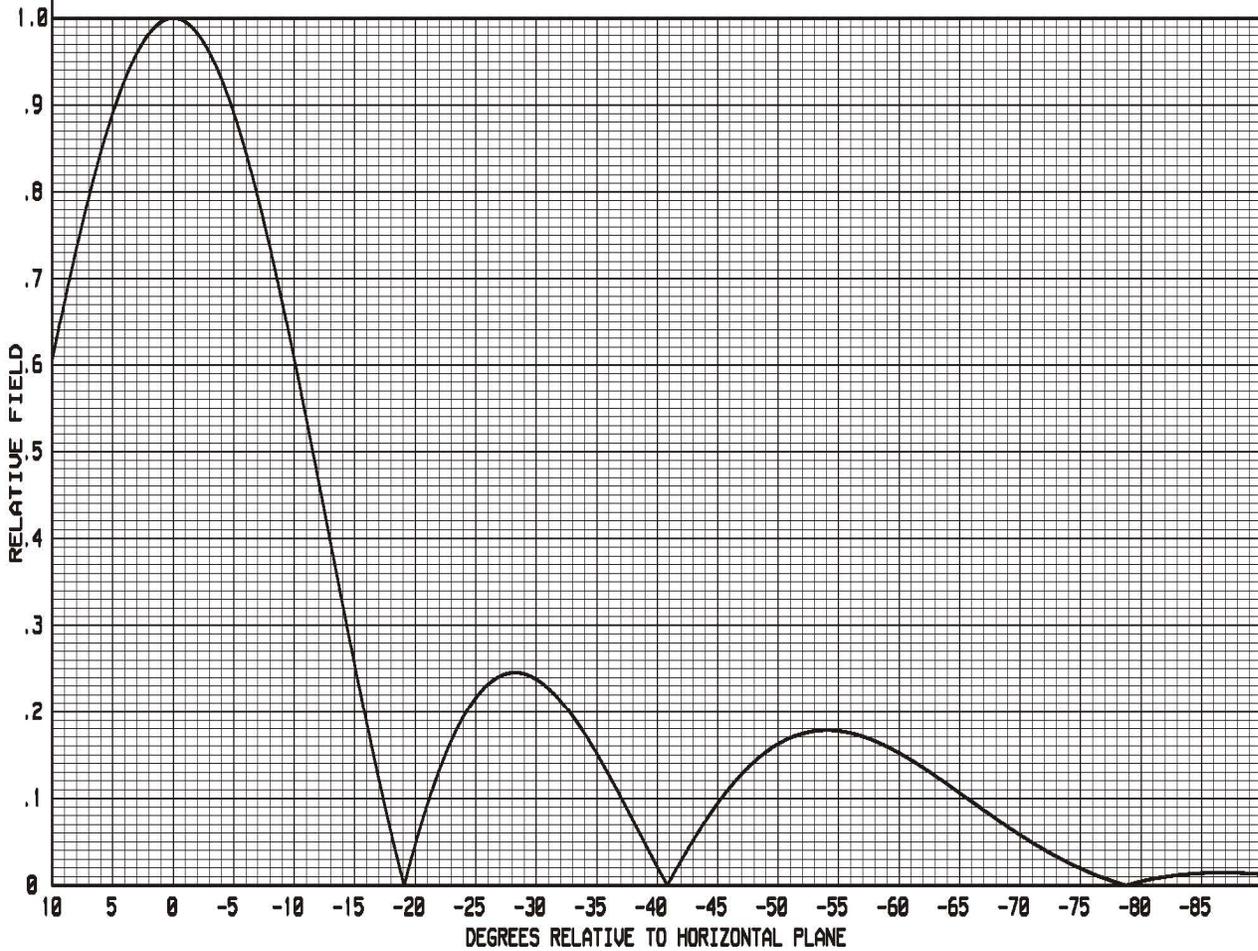


EXHIBIT A - 5

ELECTRONICS RESEARCH, INC.
7777 GARDNER ROAD
CHANDLER, IN. 47618

-----THEORETICAL-----
VERTICAL PLANE RELATIVE FIELD

OCTOBER 25, 2005

103.9 MHz.

FIGURE 10

ERI TYPE 1007-4CP BROADCAST ANTENNA
0 DEGREE BEAM TILT
0 PERCENT FIRST NULL FILL
0 PERCENT SECOND NULL FILL

BAY SPACING:
92.00 INCHES

POWER GAIN IS 1.872 IN THE HORIZONTAL PLANE(1.872 IN THE MAX.)
[POWER GAINS AT 95% ANTENNA EFFICIENCY]

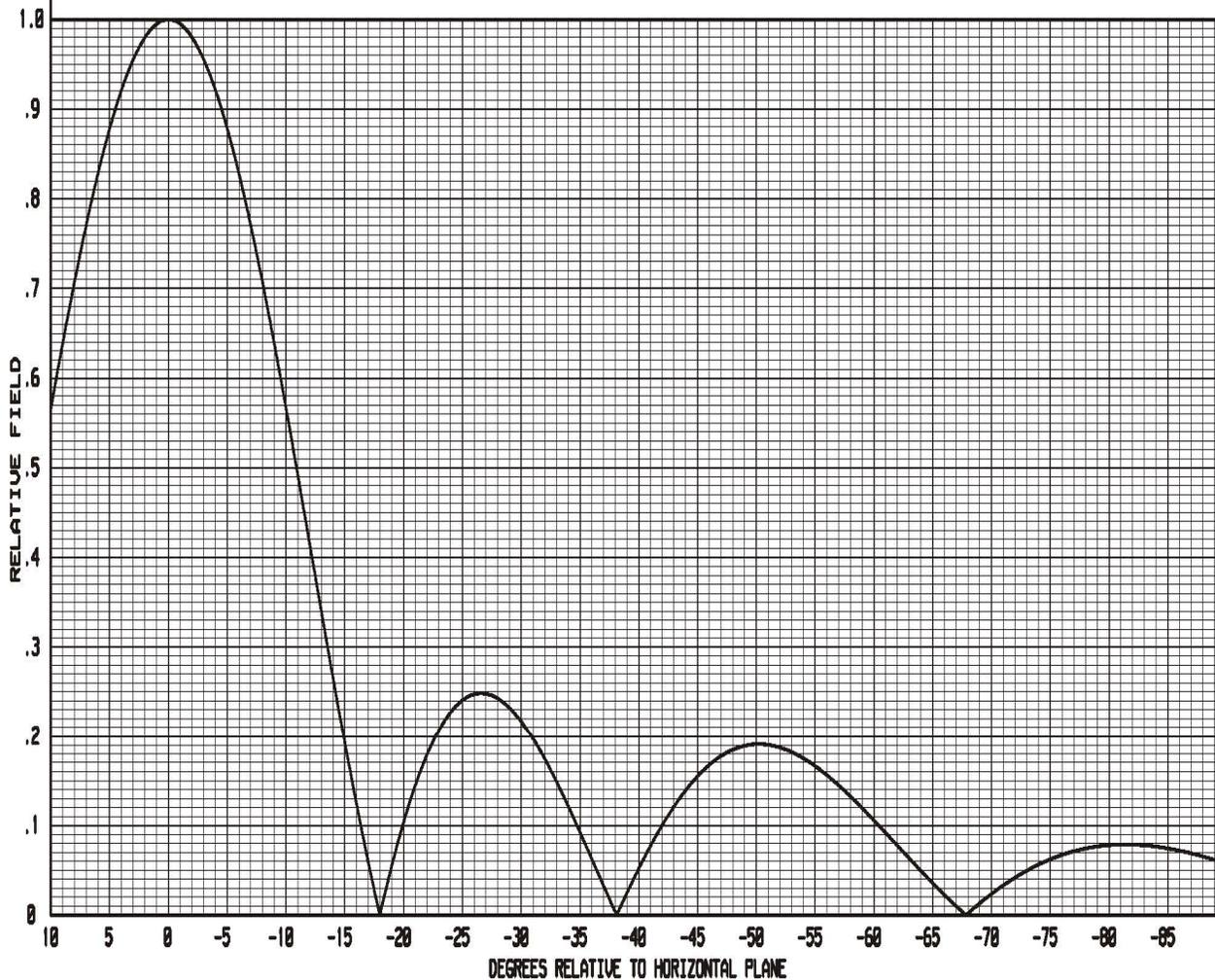
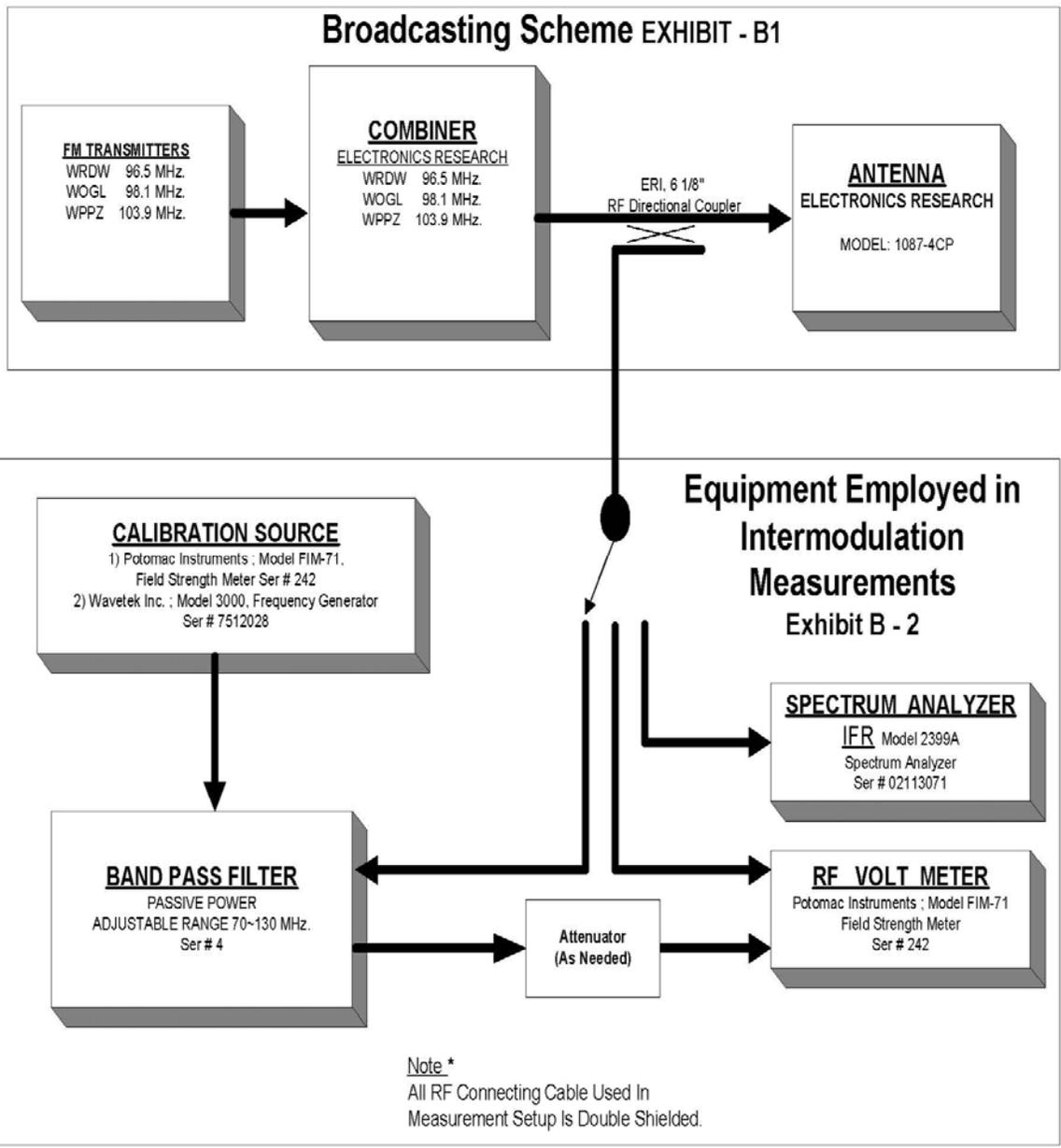


EXHIBIT A - 5



Broadcasting Scheme and Equipment Employed in Intermodulation Measurements

EXHIBIT B