ELECTRONICS RESEARCH, INC.
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Report Of Intermodulation Product Findings

COMBINED BROADCAST FACILITY
MT. PLEASANT, SOUTH CAROLINA

WCSQ	*92.5 MHz.*
WAVF	*96.1 MHz.*
WJZX	*99.7 MHz.*

June 2003

Electronics Research Inc.
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Chandler, Indiana 47610
Phone (812) 925-6000 Fax (812) 925-4030

EXHIBIT #B
MODIFY STATION LICENSE
APEX BROADCASTING, INC.
WCSQ RADIO STATION
CH 223C1 - 100.0 KW
MONCKS CORNER, SC
July 2003

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Mt. Pleasant, South Carolina

Report of Findings for Intermodulation Product Measurements

Exhibits Accompanying This Report

REPORT OF FINDINGS
WCSQ / WAVF / WJZX / BROADCAST FACILITY
MT. PLEASANT, SOUTH CAROLINA

Introduction : This report of findings is based on data collected at the WCSQ, WAVF and WJZX, FM broadcast facility located in Mt. Pleasant, SC. The report includes measurements offered as proof that the transmitters for the combined operations of WCSQ (92.5 MHz.), WAVF (96.1 MHz.), and WJZX (99.7 MHz.) 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). WFCH (88.5 MHz.) WSSP (94.3 MHz.) and WEZL (103.5 MHz.) operate into separate antennas located on another tower within 100' of the combined antenna. Their effects on the stations operating from the multiplexed system has been considered in this report. Mark Steapleton of Electronics Research, Inc. located in Chandler, Indiana performed the measurements summarized herein on June 25, 2003.

The following exhibits are provided:

Exhibit A:

A-1 Drawing Depicting Antenna.
A-2 SHPX-10AC6-SP Antenna Specification Sheet.
A-3 Drawing Depicting Multiplexing Scheme.
A-4 963-9 Branch 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 : At the time of my measurements three FM stations were operating from the combined antenna system. The WCSQ, WAVF, and WJZX multiplexed system is fundamentally comprised of antenna, feed line and multiplexer unit. The SHPX-10AC6-SP antenna and 963-9 Branch multiplexer are products of Electronics Research, Inc, whereas the feed line is manufactured by Dielectric. 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 branch combiner was installed. Specifically, the Multiplexer utilizes three ERI Model 963 Bandpass filters for each transmitter. Interconnecting TEE's were required to complete the multiplexer module. which is illustrated in the attached Exhibit A-3. The multiplexer, fully assembled, exhibited transmitter port-to-port isolation in excess of -57 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 multiplexers 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 33 dB directivity and a forward signal sample of -47 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 the Spectrum Analyzer to ensure an adequate signal level for measurements without overloading the measurement equipment. An IFR 2399A Spectrum Analyzer was employed to record the level of all signals investigated. To facilitate the selective tuning of the Band Pass Filter the Tracking Generator option built into the Spectrum analyzer was used. Also, the Spectrum Analyzer 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-2 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)	Measured Level (dBm)	Adjusted Level (dBμ)	Notes
WCSQ (92.5)	10	---	15.9	**25.9**	
WAVF (96.1)	10	---	16.3	**26.3**	
WJZX (99.7)	10	---	14.1	**24.1**	

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.

	Carrier Frequency (MHz)		
Interfering Frequency (MHz)	WCSQ 92.5	WAVF 96.1	WJZX 99.7
WCSQ 92.5	---	99.7	106.9
WAVF 96.1	88.9	---	103.3
WJZX 99.7	85.3	92.5	---
WFCH 88.5	96.5	103.7	110.9
WSSP 94.3	90.7	97.9	105.1
WEZL 103.5	81.5	88.7	95.9

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 for a layout of the measurement equipment.

Table 3 Intermodulation Measurements

Product Frequency (MHz)	Carrier Freq. (MHz)	Interferin Freq. (MHz)	Pad (dB)	Bandpass Filter Loss (dB)	Measured Level (dBm)	Carrier Reference Level (dBm) (See Table 1)	**Level Referenced to Carrier (dB)**	Notes*
81.5	92.5	103.5	10	12.8	-116.4	25.9	**-119.5**	
				11.3	-104.0	25.9	**-108.6**	
				11.0	-110.9	26.3	**-116.2**	
				11.0	-99.7	25.9	**-104.6**	
90.7	92.5	94.3	10	10.9	-78.7	25.9	**-83.7**	
92.5	96.1	99.7	10	9.9	-95.6	26.3	**-102.0**	
			10	10.2	-94.8	24.1	**-98.7**	
96.5	92.5	88.5	10	10.2	-85.2	25.9	**-90.9**	
97.9	96.1	94.3	10	10.2	-110.9	26.3	**-117.0**	
99.7	96.1	92.5	10	9.5	-97.0	26.3	**-103.8**	4
103.3	99.7	96.1	10	9.6	-89.5	24.1	**-94.0**	
103.7	96.1	88.5	10	9.5	-100.3	26.3	**-107.1**	
105.1	99.7	94.3	10	9.3	-101.9	24.1	**-106.7**	
106.9	99.7	92.5	10	9.3	-102.5	24.1	**-107.3**	
110.9	99.7	88.5	10	9.0	-116.0	24.1	**-121.1**	

*** NOTES**

1) Measured signal is a local carrier WYFH transmitting at 90.7 MHz: No discernable signal was measured.

2) The 92.5 MHz. System carrier was turned off for this measurement.

3) Measurement taken using averaging option built into the spectrum analyzer

4) The 99.7 MHz. System carrier was turned OFF for this measurement.

5) Measured signal is a local carrier WEZL transmitting at 103.5 MHz: No discernable signal was measur

The Spectrum Analyzer was used to check the close in spectral attenuation of each carrier to confirm the operation of these transmitters are 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

. **Conclusion :** Based upon my observations and measurements taken June 25th. 2003 as summarized in this document, I, Mark Steapleton, find the subject multiplexed system- specifically the transmitters and combiner system for the operation of the WCSQ, WAVF and WJZX, into the SHPX-10AC6-SP 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 stations operating on the installed system. Also, based on this recorded data. I conclude that WCSQ, WAVF and WJZX are in compliance with the requirements of Section 73.317 paragraph (b) through (d) of the FCC Rules and Regulations.

Respectfully submitted,
Electronics Research. In

By Mark Steapleton
Mark Steapleton Field Technician

WARRICK COUNTY

SS

STATE OF INDIANA)

AFFIDAVIT

I, Mark Steapleton, 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 22 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.

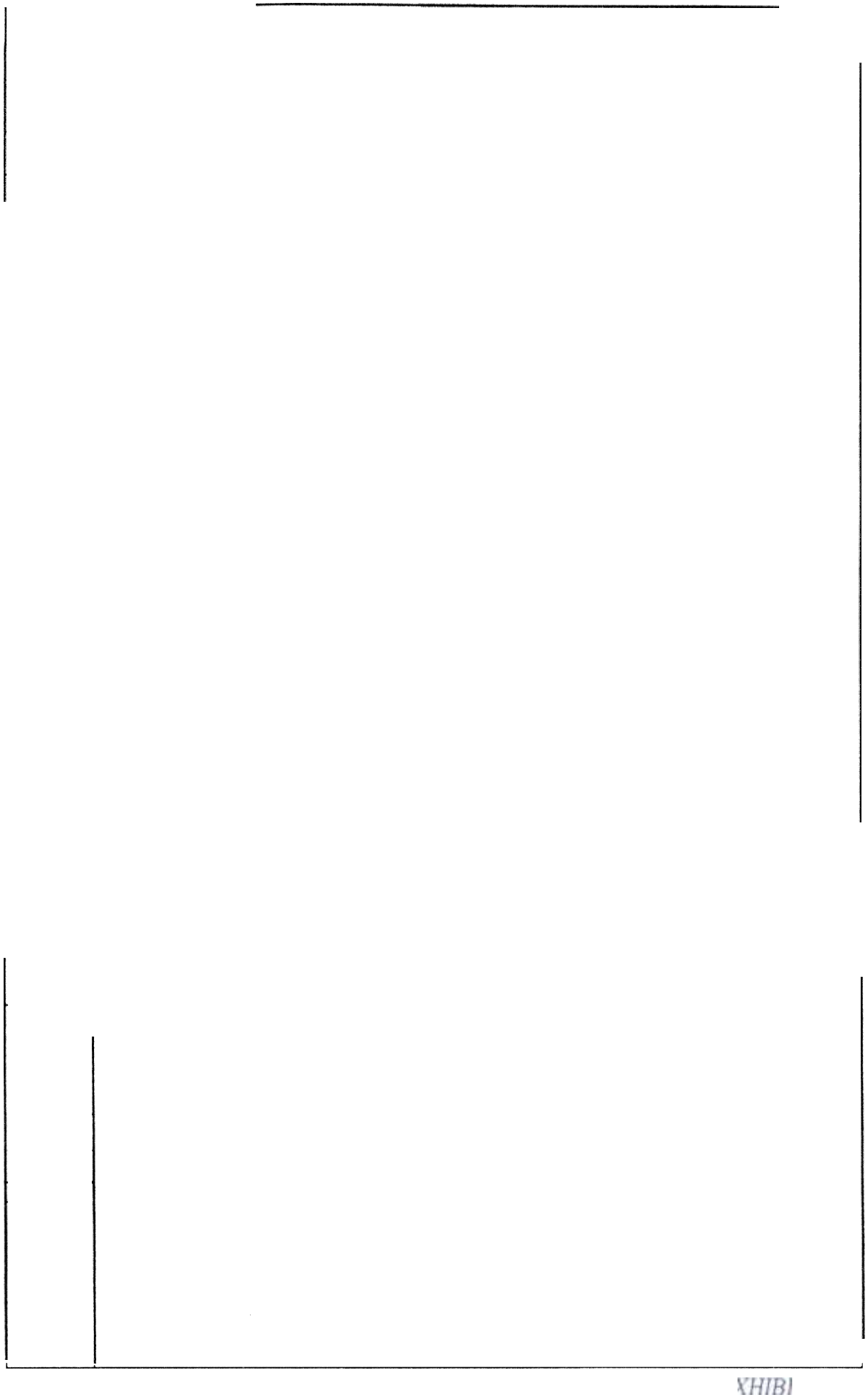
2.) I have either prepared and/or directly supervised the preparation of all technical information contained in this Report Of Findings and to my knowledge to be accurate and true.

3.) ERI has been requested by Clear Channel Communications, on behalf of radio Stations WCSQ, WAVF and WJZX in Mt. Pleasant, SC. to prepare this Report Of Findings.

Mark Steapleton; Field Technician

Subscribed and sworn to before me on this 2nd. day of July 2003.

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



XHIBI

A-2 ERI Antenna Specification Sheet
MT. PLEASANT, SOUTH CAROLINA

General Specifications

Antenna Type	High Power FM-Broadcast, Suitable For Diplexing
Model Number	SHPX-10AC6-SP
Number Of Bay Levels	Ten
Polarization	Right Hand Circular

Electrical Specifications

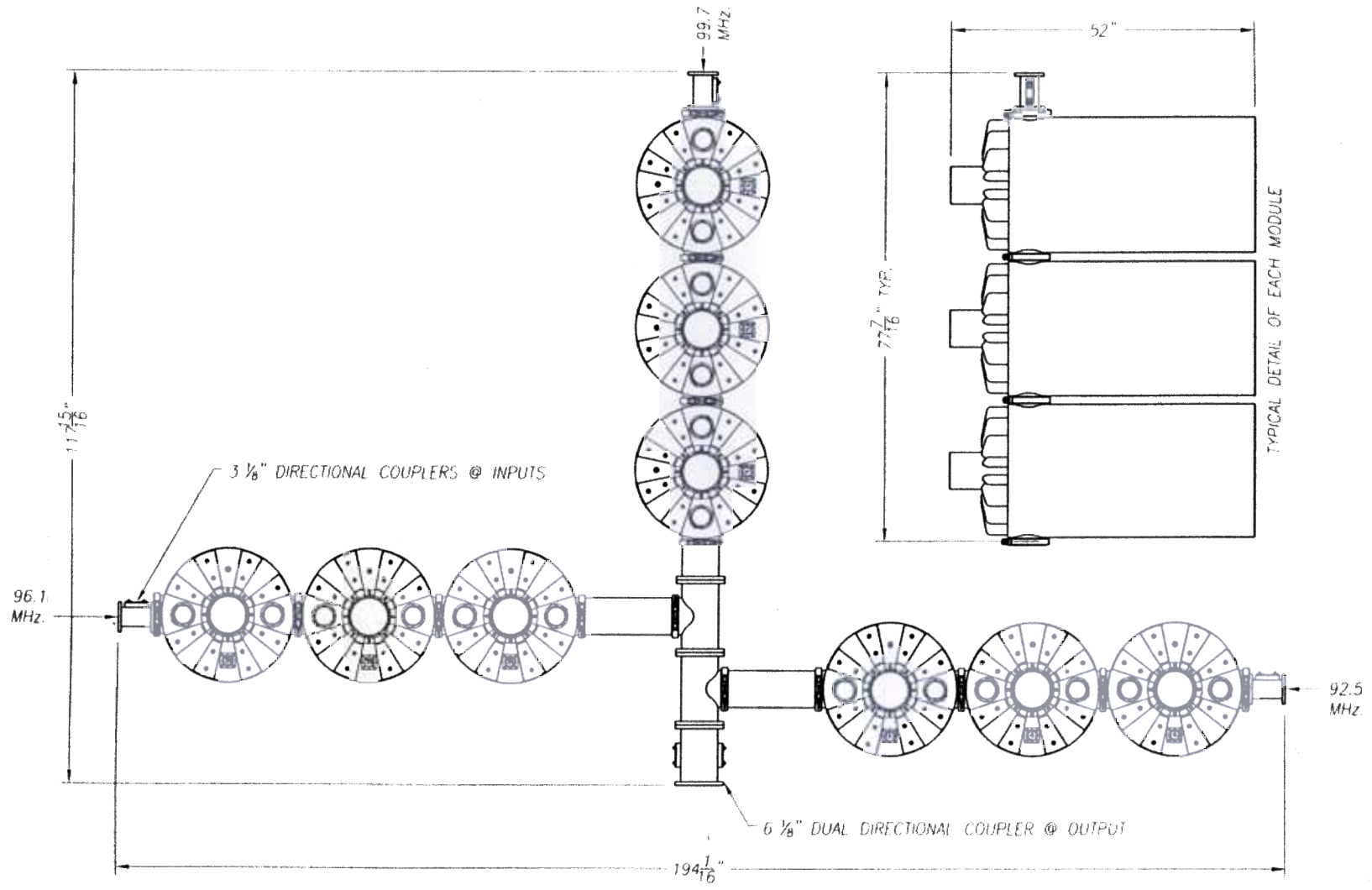
Antenna Input Power Capability	64 KW. Maximum [1]
Operating Frequency Band	92.5, 96.1 and 99.7 Megahertz.
VSWR	1 : 1 @ Operating Frequencies.[2]
Azimuthal Pattern Circularity	+/- 2dB From RMS (Free Space)
Power Split	50/50 (Horizontal & Vertical)
Quarter Wave Shorting Stub	*Yes*
Frequency Specific Information:	

Frequency	Station ERP	Beam Tilt	First Null Fill	Second Null Fill	Power Gain	Line Loss [3]	Filter Loss [4]	Computed TPO
92.5	100 (KW)	0.0°			5.473	.534 dB	164 dB	21.46 (KW)
96.1	100 (KW)	0.0°	0 %		5.680	.543 dB	151 dB	20.66 (KW)
	70 (KW)	0.0°	7 %		5.278	.551 dB	169 dB	15.66 (KW)

Mechanical Specifications

Antenna Feed System	2) Center feed (5) Bay Antennas Fed With Single 6" Feed Line
Input Connector	6-1/8" 50- Ohm EIA Flanged
Element Deicing	Not Ordered [5]
Interbay Spacing	122.375 Inch Center to Center
Array Length	96 Feet
Construction Material Antenna)	All Noncorrosive
Construction Material Mounting)	All Stainless Steel
Mounting	Tower

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 835 Feet, Dielectric HT Rigid 4 1/16" Coax.
4) Losses Taken From Actual Multiplexer Measurements Taken At The Factory.
5) With Low Q Element Design, Moderate Icing Will Not Cause Appreciable VSWR Rise.



ELECTRONICS RESEARCH, INC.

Established 1943

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NO	REVISION	APP'D	DATE
6			
5			
4			
3			
2			
1			

NAME INTERMODULATION REPORT
FOR MT. PLEASANT, S.C.
PATH G:\DRAFTING\ALL\PROJECTS\09917\3
FILE IR-2 | DRAWN BAM | FACTOR 1/25
DATE 6/17/03 | APP'D
MAT'L NON-APPLICABLE | CUT N/A
IR-2
ON 2MD

A-4 ERI Combiner Specification Sheet
MT. PLEASANT, SOUTH CAROLINA

General Specifications:

Multiplexer Type	TB 63-9/6 Branch Combiner
Number Of Combining Units	Three
Injected Port to Injected Port Isolation	- 57 dB
Output Connector	6 1/8 " 50 Ohm EIA (Flanged)
Output Power	65 KW
Combiner Units, Size and Weight :	
Type 963-3 Tuned To 92.5 MHz.	5' ht. X 2' 'd. X 6' lg. & 578 Lbs.
Type 963-3 Tuned To 96.1 MHz.	5' ht. X 2' 'd. X 6' lg. & 578 Lbs.
Type 963-3 Tuned To 99.7 MHz.)	5' ht. X 2' 'd. X 6' lg. & 578 Lbs.
Heat Removal (All Multiplexer Components)	Natural Convection
Physical Arrangement	All Components Floor Standing

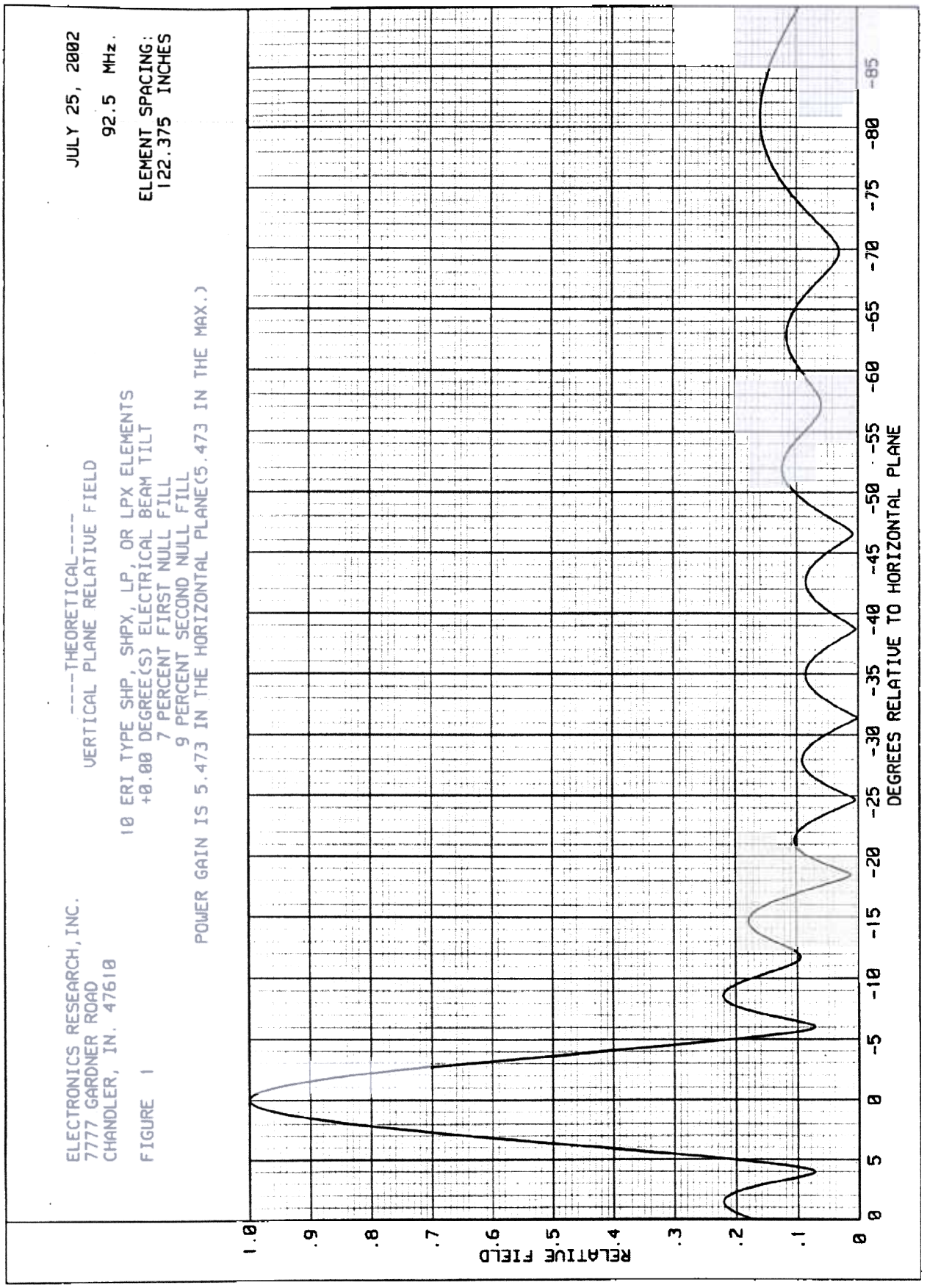
Injected Port Specifications:

Frequency Assignment	92.5 MHz. 96.1 MHz. And 99.7 MHz.
Power Rating, Each Injected Port (Maximum)	22 KW
Input Connector	3-1/8" 50 Ohm EIA (Flanged)
VSWR	Less than 1.08:1 @ +/-150 KHz[1]
Group Delay	Less than 75 ns Overall Variation, Carrier @ +/- 150 KHz.

Insertion Loss (Measured at the Factory)

92.5 MHz.	- 0.164 dB
96.1 MHz.	- 0.151 dB
99.7 MHz.	- 0.169 dB

When Terminated in 50 Ohm Resistive Load.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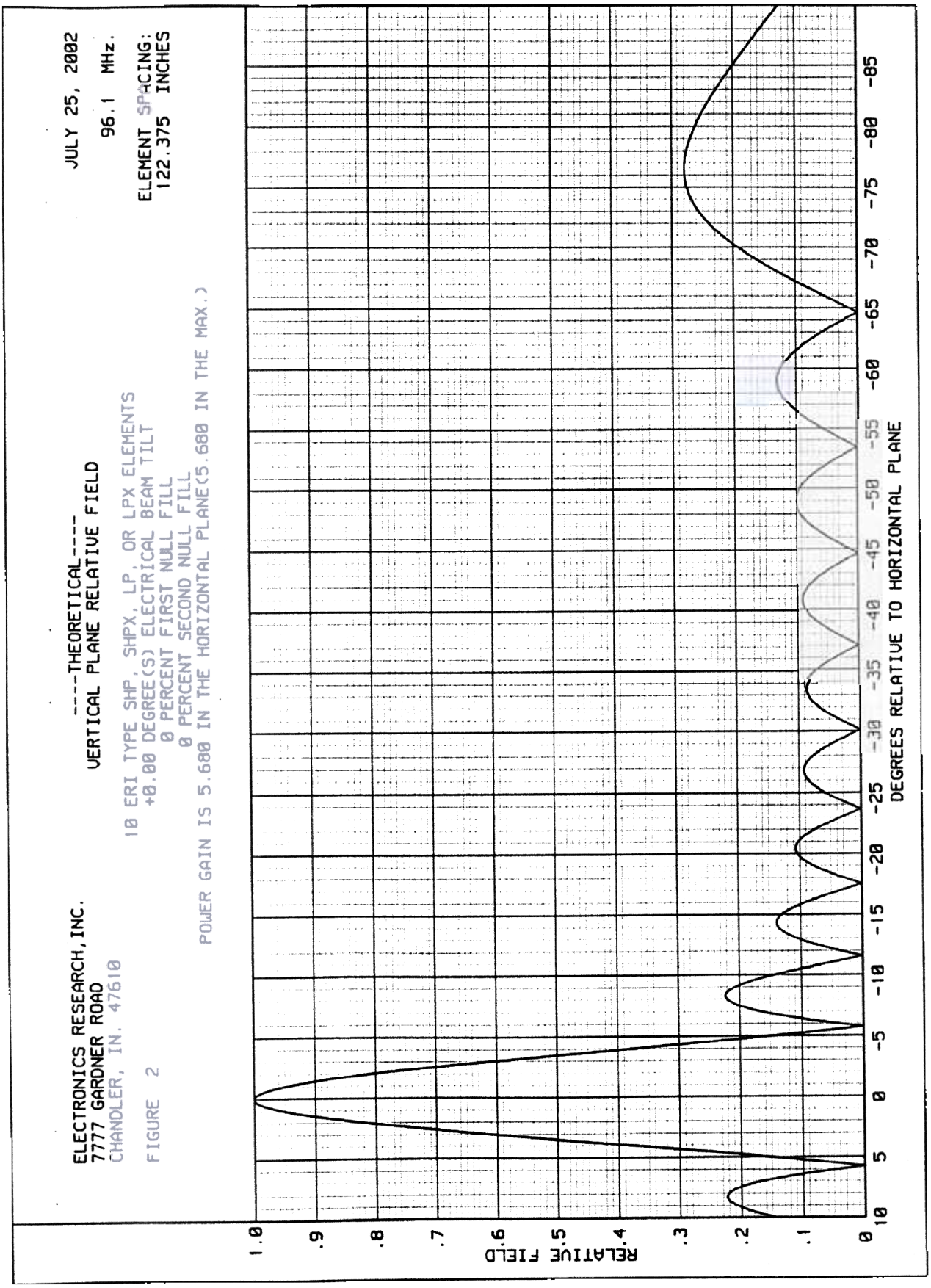
7777 GARDNER ROAD
CHANDLER, IN. 47610
FIGURE 1
---THEORETICAL---
VERTICAL PLANE RELATIVE FIELD
10 ERI TYPE SHP, SHPX, LP, OR LPX ELEMENTS
+0.00 DEGREE(S) ELECTRICAL BEAM TILT
7 PERCENT FIRST NULL FILL
9 PERCENT SECOND NULL FILL
POWER GAIN IS 5.473 IN THE HORIZONTAL PLANE(5.473 IN THE MAX.)
JULY 25, 2002
92.5 MHz.
ELEMENT SPACING:
122.375 INCHES
RELATIVE FIELD
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
0
0 5 0 -5 -10 -15 -20 -25 -30 -35 -40 -45 -50 -55 -60 -65 -70 -75 -80 -85
DEGREES RELATIVE TO HORIZONTAL PLANE


ELECTRONICS RESEARCH, INC.
7777 GARDNER ROAD
CHANDLER, IN. 47610
FIGURE 2
----THEORETICAL----
VERTICAL PLANE RELATIVE FIELD
10 ERI TYPE SHP, SHPX, LP, OR LPX ELEMENTS
+0.00 DEGREE(S) ELECTRICAL BEAM TILT
0 PERCENT FIRST NULL FILL
0 PERCENT SECOND NULL FILL
POWER GAIN IS 5.680 IN THE HORIZONTAL PLANE(5.680 IN THE MAX.)
JULY 25, 2002
96.1 MHz.
ELEMENT SPACING:
122.375 INCHES
RELATIVE FIELD
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
0
10 5 0 -5 -10 -15 -20 -25 -30 -35 -40 -45 -50 -55 -60 -65 -70 -75 -80 -85
DEGREES RELATIVE TO HORIZONTAL PLANE

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

FIGURE 3

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

10 ERI TYPE SHP, SHPX, LP, OR LPX ELEMENTS
+0.00 DEGREE(S) ELECTRICAL BEAM TILT
7 PERCENT FIRST NULL FILL
10 PERCENT SECOND NULL FILL
POWER GAIN IS 5.278 IN THE HORIZONTAL PLANE(5.278 IN THE MAX.)

JULY 25, 2002

99.7 MHz

ELEMENT SPACING:
122.375 INCHES

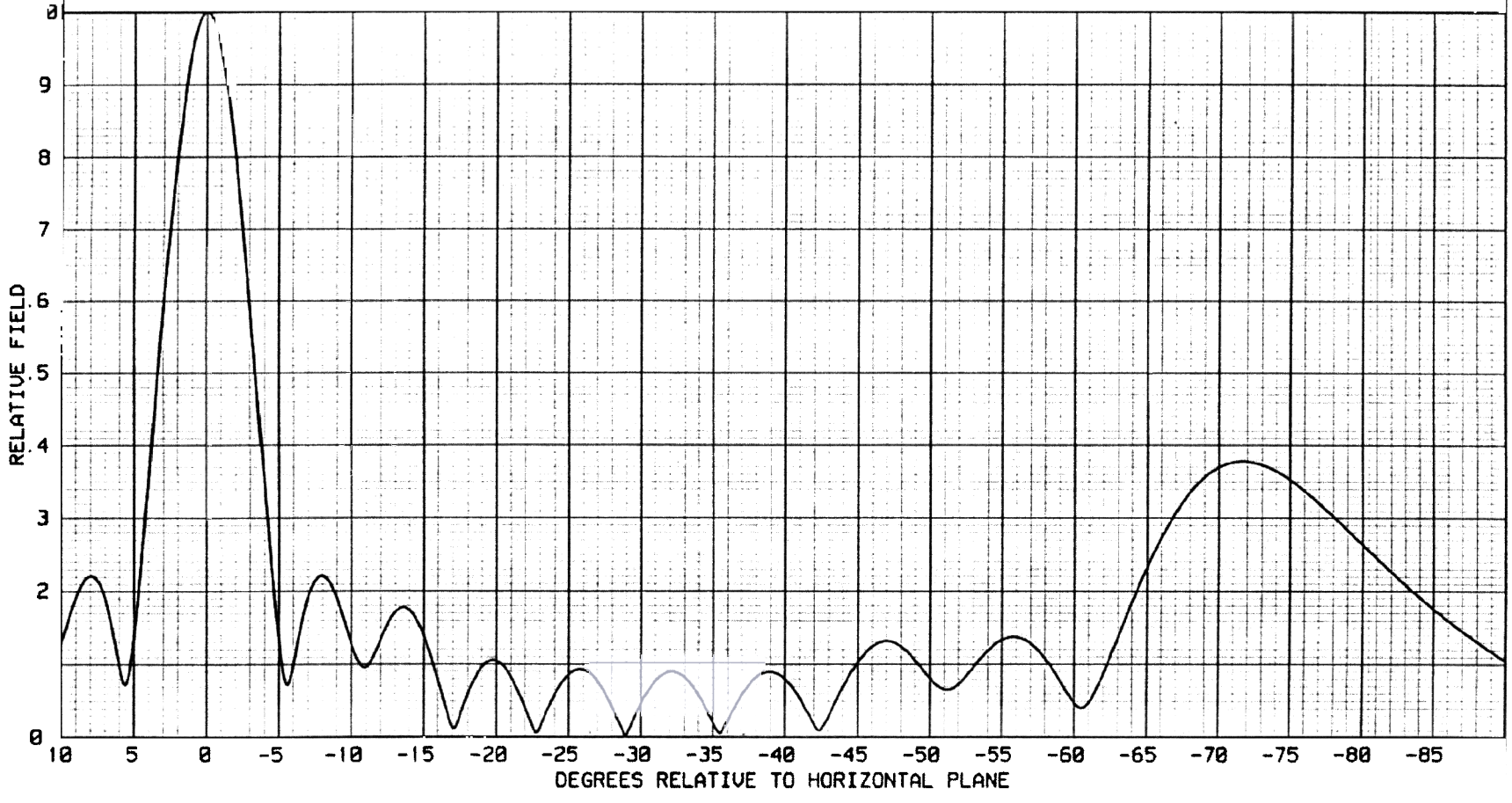
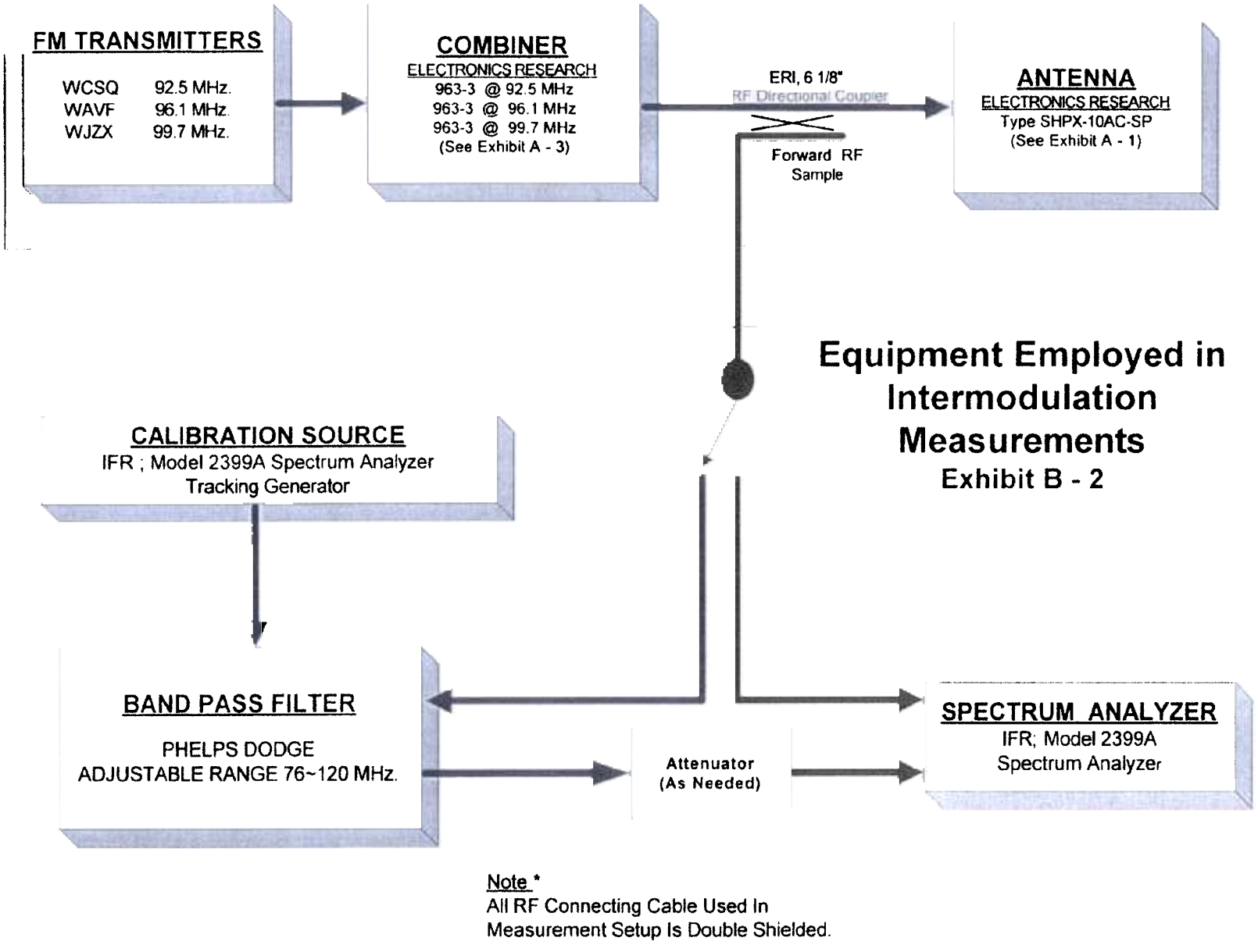


EXHIBIT A 5

WCSQ ~ WAVF ~ WJZX
Broadcasting Scheme EXHIBIT - B1



Note *
All RF Connecting Cable Used In
Measurement Setup Is Double Shielded.

Equipment Employed in Intermodulation Measurements
Exhibit B - 2

Broadcasting Scheme and Equipment Emp oyed in Intermodulation Measurements

EXHIBIT B