



**ELECTRONICS RESEARCH, INC.**

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# Report Of Intermodulation Product Findings

*COMBINED BROADCAST FACILITY  
PANAMA CITY BEACH, FLORIDA*

*WVVE 100.1  
WYOO 101.1*

*October 2003*

**EXHIBIT E**  
**APPLICATION FOR STATION LICENSE**  
**STYLES MEDIA GROUP, LLC**  
**WVVE (FM) RADIO STATION**  
**CH 261C3 - 100.1 MHZ - 12.0 KW**  
**PANAMA CITY BEACH, FLORIDA**  
**October 2003**

**Electronics Research Inc.**  
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# REPORT OF FINDINGS

## WVVE / WYOO BROADCAST FACILITY

### PANAMA CITY BEACH, FLORIDA

**Introduction :** This report of findings is based on data collected at the WVVE and WYOO FM broadcast facility located in Panama City Beach, FL. The report includes measurements offered as proof that the combined operations of WVVE (100.1 MHz.) and WYOO (101.1 MHz.) 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). WASJ (105.1 MHz.) and WILN (105.9 MHz.) operates into separate side mounted antennas located lower on the same tower. 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 October 9, 2003.

**The following exhibits are provided:**

Exhibit A:

- A-1 Drawing Depicting Antenna.
- A-2 MP-3E-DA-HW-SP Antenna Specification Sheet.
- A-3 Drawing Depicting Multiplexing Scheme.
- A-4 963-8 TEE 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 two FM stations were operating from the combined antenna system. The WVVE and WYOO multiplexed system is fundamentally comprised of antenna, feed line and multiplexer unit. The MP-3E-DA-HW-SP antenna and 963-8 TEE Bandpass multiplexer unit 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 two transmitter signals into a common antenna feed and provide transmitter-to-transmitter isolation, a multiplexing scheme consisting of a Tee Combiner module was installed. Specifically, the Multiplexer utilizes four ERI Model 963 Bandpass filters with non adjacent coupling and a group delay compensating module for each transmitter. An interconnecting TEE is required to complete the multiplexer module. The multiplexer is illustrated in the attached Exhibit A-3. The multiplexer, fully assembled, exhibited transmitter port-to-port isolation in excess of -54 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 -57 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. A Potomac Instruments FIM-71 Field Strength Receiver 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 signal generator was used. See attached Exhibit B-1 for an illustration of the measurement equipment. 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. An IFR Model 2399A 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. WVVE were operating at their full licensed power levels. WYOO was operating at 7.00 KW for the duration of all IM measurements. 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**

<b>Carrier Frequency (MHz)</b>	<b>Pad One (dB)</b>	<b>Bandpass Filter Loss (dB)</b>	<b>Full Scale Range (dBμ)</b>	<b>Scale Reading (dB)</b>	<b>Adjusted Level (dBμ)</b>	<b>Notes</b>
<b>WVVE (100.1)</b>	---	---	140	-18.2	<b>121.8</b>	
<b>WYOO (101.1)</b>	---	---	140	-19.7	<b>120.3</b>	

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.**

<b>Interfering Frequency (MHz)</b>	<b>Carrier Frequency (MHz)</b>	
	<b>WVVE 100.1</b>	<b>WYOO 101.1</b>
<b>WVVE 100.1</b>	---	102.1
<b>WYOO 101.1</b>	99.1	---
<b>WASJ 105.1</b>	95.1	97.1
<b>WILN 105.9</b>	94.3	96.3

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**

<b>Product Frequency (MHz)</b>	<b>Carrier Frequency (MHz)</b>	<b>Interfering Frequency (MHz)</b>	<b>Pad (dB)</b>	<b>Bandpass Filter Loss (dB)</b>	<b>Full Scale Range (dBμ)</b>	<b>Scale reading (dB)</b>	<b>Adjusted Level (dBμ)</b>	<b>Carrier Reference Level (dBμ) (See Table 1)</b>	<b>Level Referenced to Carrier (dB)</b>	<b>Notes *</b>
94.3	100.1	105.9	-	10.0	20	<-20.0	10.0	121.8	<-111.8	
95.1	100.1	105.1	-	10.0	20	<-20.0	10.0	121.8	<-111.8	
96.3	101.1	105.9	-	9.8	20	-14.2	15.6	120.3	-104.7	
97.1	101.1	105.1	-	9.2	20	<-20.0	9.2	120.3	<-111.1	
99.1	100.1	101.1	-	9.1	20	-2.2	26.9	121.8	-94.9	
102.1	101.1	100.1	-	9.1	20	-3.8	25.3	120.3	-95.0	

\* NOTES

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 October 9th. 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 WVVE and WYOO into the MP-3E-DA-HW-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 WVVE and WYOO are in compliance with the requirements of Section 73.317 paragraph (b) through (d) of the FCC Rules and Regulations.

Respectfully submitted,  
Electronics Research, Inc.

By   
Mark Steapleton Field Technician





**A-2 ERI Antenna Specification Sheet**  
**PANAMA CITY BEACH, FLORIDA**

**General Specifications**

Antenna Type ..... Medium Power FM-Broadcast, Suitable For Diplexing  
 Model Number ..... MP-3E-DA-HW-SP  
 Number Of Bay Levels ..... Three  
 Polarization ..... Right Hand Circular

**Electrical Specifications**

Antenna Input Power Capability ..... 32 KW. Maximum <sup>(1)</sup>  
 Operating Frequency Band ..... 100.1 and 101.1 Megahertz.  
 VSWR ..... 1.1 : 1 @ Operating Frequencies.<sup>(2)</sup>  
 Azimuthal Pattern Circularity ..... Directional  
 Power Split ..... 50/50 ( Horizontal & Vertical )  
 Quarter Wave Shorting Stub ..... Yes  
 Frequency Specific Information:

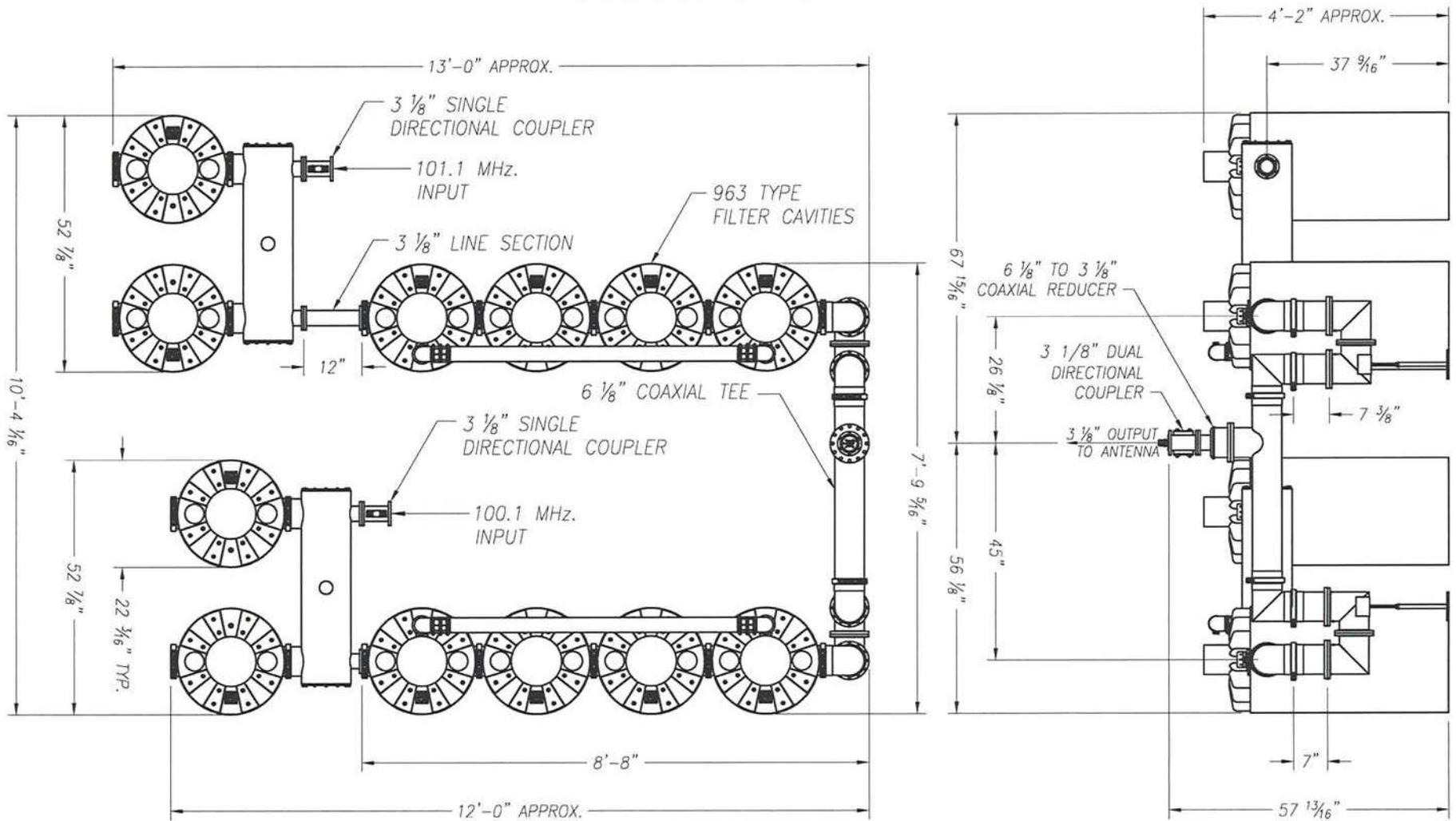
<u>Frequency</u>	<u>Station ERP</u>	<u>Beam Tilt</u>	<u>First Null Fill</u>	<u>Second Null Fill</u>	<u>Power Gain</u>	<u>Line Loss</u> <sup>(3)</sup>	<u>Filter Loss</u> <sup>(4)</sup>	<u>Computed TPO</u>
100.1	12 (KW)	-0.53°	0 %	0%	1.548	0.465 dB	0.423 dB	9.51 (KW)
101.1	12 (KW)	-0.03°	0 %	0%	1.525	0.468 dB	0.402 dB	9.61 (KW)

**Mechanical Specifications**

Antenna Feed System ..... Fed With Single Feed Lines  
 Input Connector ..... 3 1/8 " 50- Ohm EIA Flanged  
 Element Deicing ..... Not Ordered <sup>(5)</sup>  
 Interbay Spacing ..... 58 1/8" Center to Center  
 Array Length ..... 18 Feet 3 5/16"  
 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 500 Feet, Myat Type 301-007 Rigid 3 1/8" Coax.  
 4) Losses Taken From Actual Multiplexer Measurements.  
 5) With Low Q Element Design, Moderate Icing Will Not Cause Appreciable VSWR Rise.

COMBINER SYSTEM WEIGHT: 2420 LBS.



**ELECTRONICS RESEARCH, INC.**

Established 1943



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1				
NO	REVISION	APP'D	DATE	

NAME <i>COMBINER INTER-MODULATION REPORT</i>			
STATION: PANAMA CITY / SPRINGFIELD, FL			
FREQUENCY: 100.1 & 101.1 MHz PROJECT NO.: 10522\3			
PATH G:\DRAFTING\ALL\PROJECTS\10522\3			
FILE <i>IR-2</i>	DRAWN <i>S.DEOM</i>	FACTOR	NTS
DATE <i>10/14/03</i>	APP'D	DWG. NO.	
MODEL <i>MA963F08-OGN-U33</i>			<i>IR-2</i>

EXHIBIT A-3

**A-4 ERI Combiner Specification Sheet**  
**PANAMA CITY BEACH, FLORIDA**

**General Specifications:**

Multiplexer Type ..... 963 Band Pass TEE Combiner  
Number Of Combining Units ..... Two  
Injected Port to Injected Port Isolation ..... - 54 dB  
Output Connector ..... 6 1/8 " 50 Ohm EIA (Flanged)  
Output Power (Designed) ..... 20 KW  
Combiner Units, Size and Weight :

Type 963-4GD Tuned To 100.1 MHz. (With Non-Adjacent coupling) 5' ht. X 2' wd. X 8' lg. & 1,245 Lbs.  
Type 963-4GD Tuned To 101.1 MHz. (With Non-Adjacent coupling) 5' ht. X 2' wd. X 8' lg. & 1,245 Lbs.

Heat Removal (All Multiplexer Components) ..... Natural Convection  
Physical Arrangement ..... All Components Floor Standing

**Injected Port Specifications:**

Frequency Assignment ..... 100.1 MHz. And 101.1 MHz.  
Power Rating, Each Injected Port (Designed) ..... 10 KW  
Input Connector ..... 3-1/8" 50 Ohm EIA (Flanged)  
VSWR ..... Less than 1.08:1 @ +/-150 KHz<sup>(1)</sup>  
Group Delay ..... Less than 50 ns Overall Variation, Carrier @ +/- 150 KHz  
Both Combiner Inputs Have Group Delay Compensation Modules  
Insertion Loss (Measured):

100.1 MHz. .... - 0.423 dB  
101.1 MHz. .... - 0.402 dB

1) When Terminated in 50 Ohm Resistive Load.

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FIGURE 3

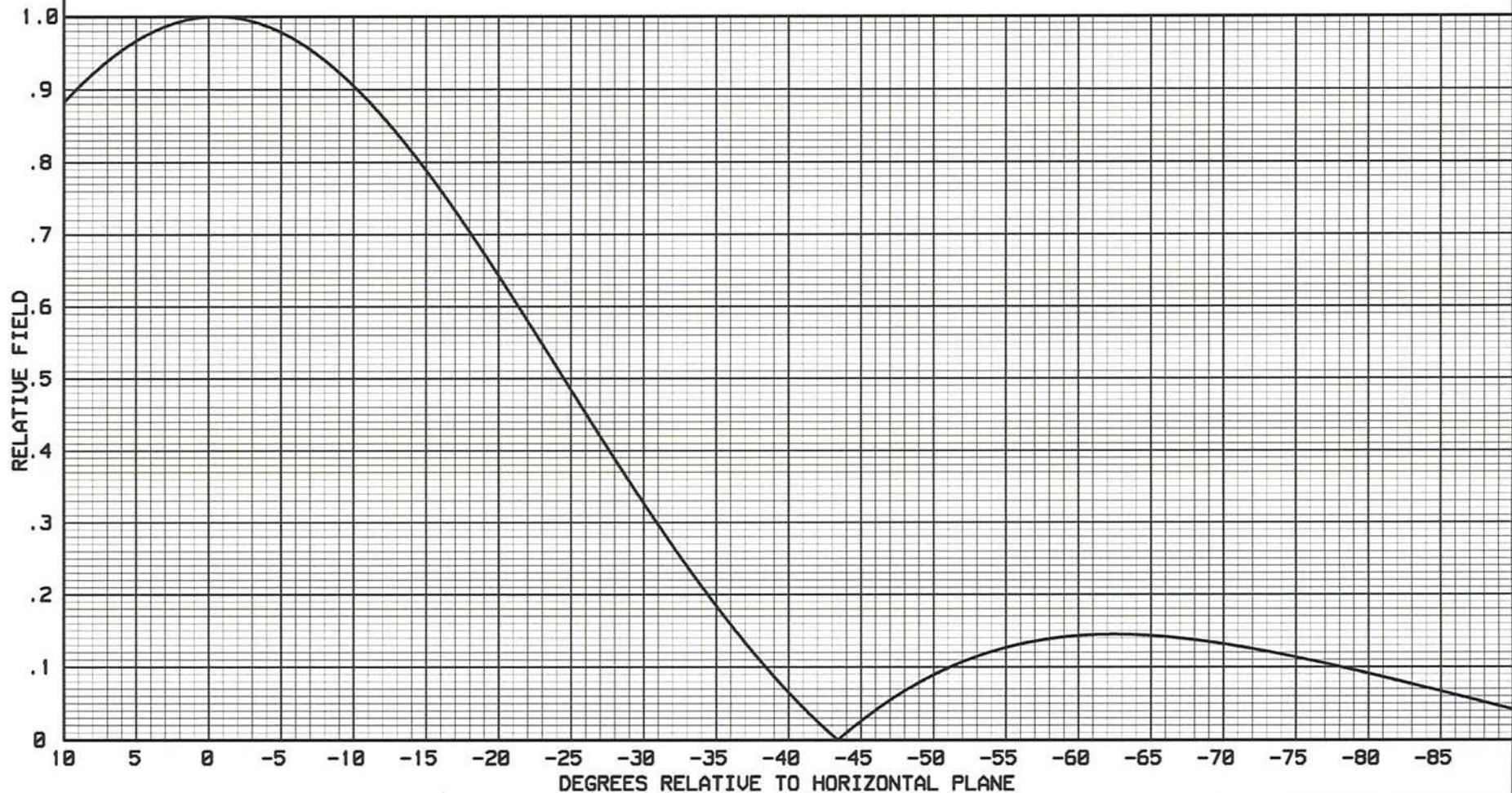
-----THEORETICAL-----  
VERTICAL PLANE RELATIVE FIELD

TYPE MP-3E-DA-HW-SP DIRECTIONAL ANTENNA  
-.53 DEGREE(S) ELECTRICAL BEAM TILT  
0 PERCENT FIRST NULL FILL  
0 PERCENT SECOND NULL FILL

MAY 16, 2003

100.1 MHz.

ELEMENT SPACING:  
58.125 INCHES



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FIGURE 3A

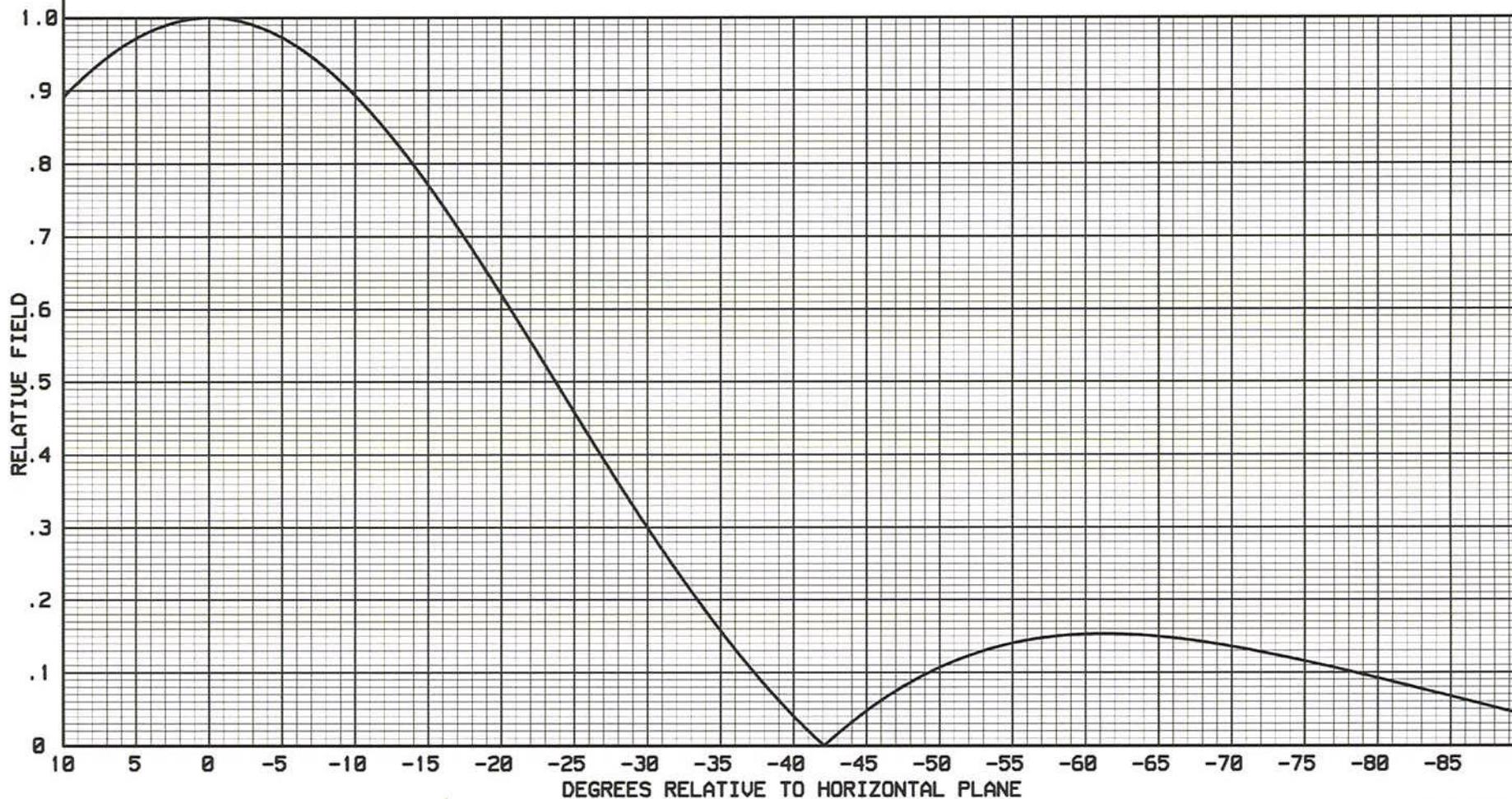
-----THEORETICAL-----  
VERTICAL PLANE RELATIVE FIELD

TYPE MP-3E-DA-HW-SP DIRECTIONAL ANTENNA  
-.03 DEGREE(S) ELECTRICAL BEAM TILT  
0 PERCENT FIRST NULL FILL  
0 PERCENT SECOND NULL FILL

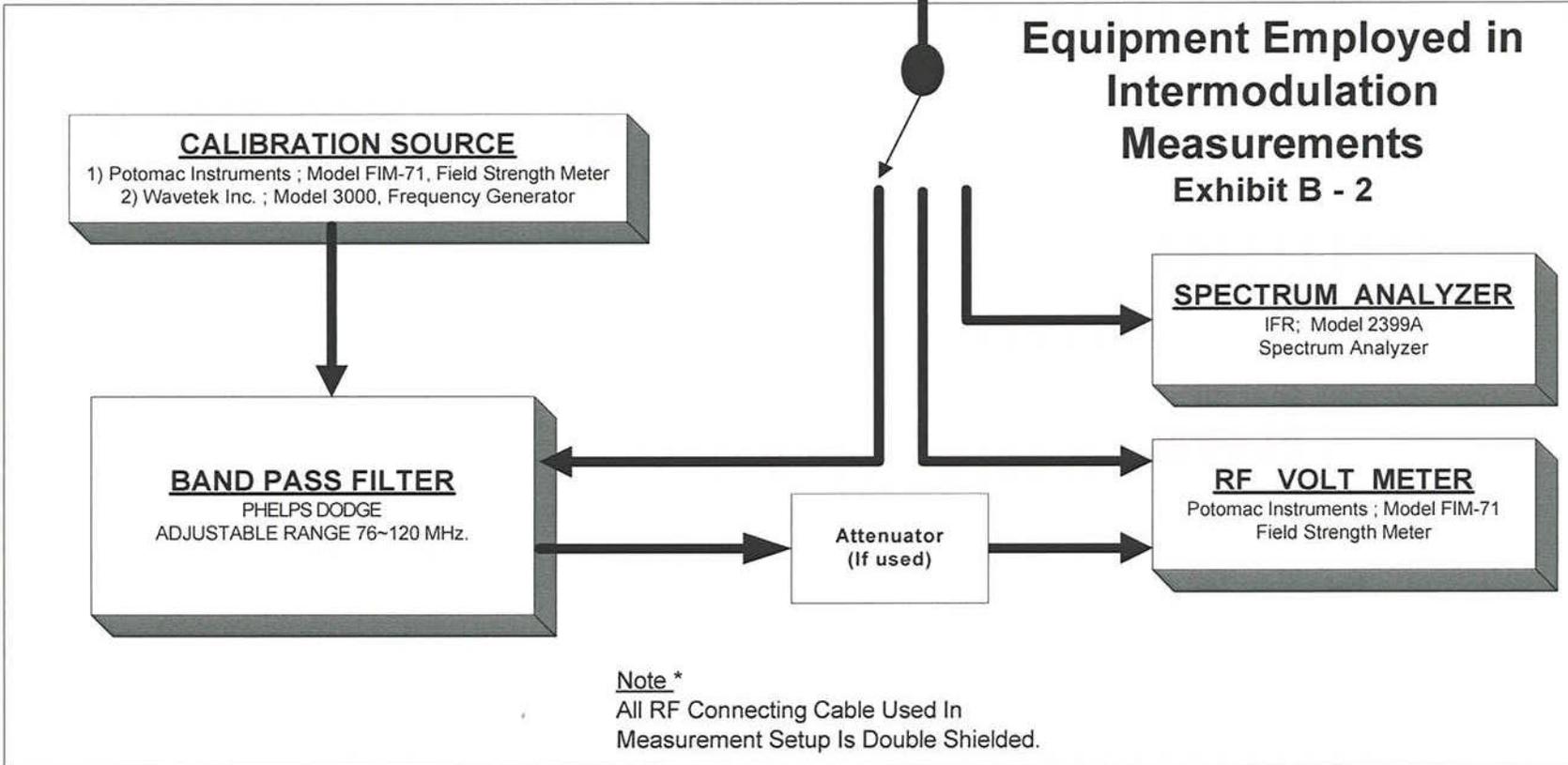
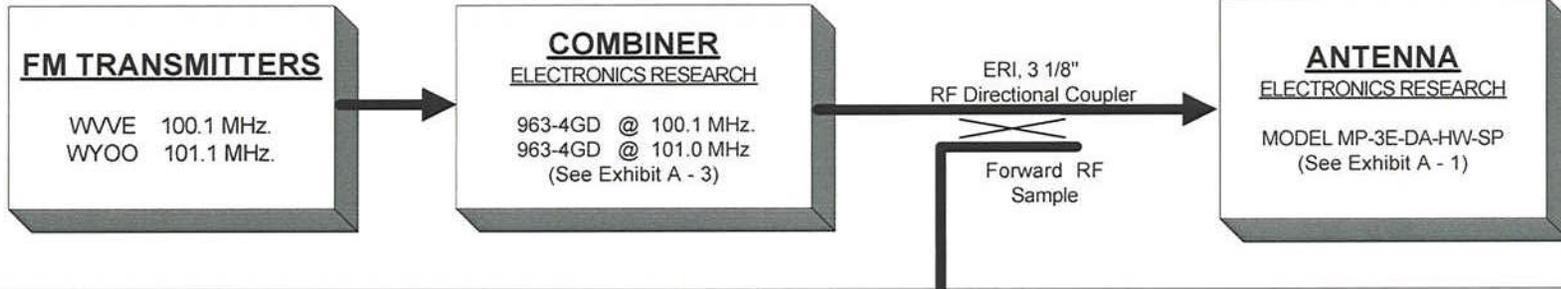
MAY 16, 2003

101.1 MHz.

ELEMENT SPACING:  
58.125 INCHES



# WVVE ~ WYOO Broadcasting Scheme EXHIBIT - B1



Broadcasting Scheme and Equipment Employed in Intermodulation Measurements