ELECTRONICS RESEARCH, INC.
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Report Of Intermodulation Product Findings

WLQT, WTUE, WMMX BROADCAST FACILITY
DAYTON, OHIO

August 2002

Electronics Research Inc.
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TABLE OF CONTENTS

Dayton, Ohio

Report of Findings for Intermodulation Product Measurements

Page 1 . . . . . Introduction
Page 3 . . . . . Carrier Reference Levels
Page 3 . . . . . Table of Second order Products Expected
Page 4 . . . . . Intermodulation Product Measurements
Page 5 . . . . . Conclusion
Page 6 . . . . . Affidavit

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
FM BROADCAST FACILITY
DAYTON, OHIO
August 20, 2002

Introduction : This report of findings is based on data collected at the combined FM broadcast facility located in Dayton, OH. The report includes measurements offered as proof that the operations of WLQT (99.9 MHz.), WTUE (104.7 MHz.) and WMMX (107.7 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 second 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). WXEG (103.9 MHz.) operate into a separate antenna located lower on the same tower. Their effects on the stations operating from the multiplexed system has been considered in this report. Jeffrey Taylor of Electronics Research, Inc. located in Chandler, Indiana performed the measurements summarized herein on August 20, 2002.

The following exhibits are provided:

Exhibit A:
- A-1 Drawing Depicting Antenna.
- A-2 1083-3CP Antenna Specification Sheet.
- A-3 Drawing Depicting Multiplexing Scheme.
- A-4 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 Second 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 second 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 second 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 WLQT, WTUE and WMMX multiplexed system is fundamentally comprised of antenna, feed line and multiplexer unit. The 1083-3CP antenna and Three 963-6 constant Impedance combiner modules are products of Electronics Research, Inc, whereas the feed line is manufactured by Myat, Refer to Exhibit B-2, 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 Combiner modules is used. Specifically, Three ERI 963-6 combiner modules were installed. The combiner is illustrated in the attached Exhibit A-3. The multiplexer, fully assembled, exhibited transmitter port-to-port isolation in excess of -68 dB. Other performance measurements, such as match, loss, group-delay, etc, revealed that the multiplexer units are 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 couplers located at the antenna output of both 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 -44 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 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.

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.

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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
WLQT (99.9)	3	---	140	-8.4	**134.6**	
WTUE (104.7)	3	---	140	-8.0	**135.0**	
WMMX (107.7)	3	---	140	-7.9	**135.1**	

Predictable second-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 - Second order Products.

	Carrier Frequency (MHz)		
Interfering Frequency (MHz)	**WLQT 99.9**	**WTUE 104.7**	**WMMX 107.7**
WLQT 99.9	---	109.5	115.5
WTUE 104.7	95.1	---	110.7
WMMX 107.7	92.1	101.7	---
WXEG 103.9	95.9	105.5	111.5

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 Frequency (MHz)	Interfering Frequency (MHz)	Pad (dB)	Bandpass Filter Loss (dB)	Full Scale Range (dBμ)	Scale reading (dB)	Adjusted Level (dBμ)	Carrier Reference Level (dBμ) (See Table 1)	**Level Referenced to Carrier (dB)**	Notes *
92.1	99.9	107.7	3	6.3	20	-3.9	25.4	134.6	**109.2**	
95.1	99.9	104.7	3	6.1	20	-6.8	22.3	134.6	**112.3**	
95.9	99.9	103.9	3	6.0	20	<-20	9.0	134.6	**125.6**	
101.7	104.7	107.7	3	5.8	20	-3.5	25.3	135.0	**109.7**	
105.5	104.7	103.9	3	5.7	40	-16.5	32.2	135.0	**102.8**	
109.5	104.7	99.9	3	5.8	20	<-20.0	8.8	135.0	**126.2**	
110.7	107.7	104.7	3	5.8	20	<-20.0	8.8	135.1	**126.3**	
111.5	107.7	103.9	3	5.7	20	<-20.0	8.7	135.1	**126.4**	
115.5	107.7	99.9	3	5.2	20	<-20.0	8.2	135.1	**126.9**	

NOTES

The Spectrum Analyzer was used to check the close- in spectral attenuation of each transmitter operating into the combined antenna system. At the time of my measurements, all system transmitters were 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 spectrum analyzer and resulted in no additional investigations.

Conclusion : Based upon my observations and measurements taken August 20th., 2002 as summarized in this document, I, Mark Steapleton, find the subject multiplexed system- specifically the transmitters and combiner system for the operation of the WLQT, WTUE and WMMX into the 1083-3CP 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 WLQT, WTUE and WMMX 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

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 20 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 WLQT, WTUE and WMMX in Dayton, OH. to prepare this Report Of Findings.

Mark Steapleton

Mark Steapleton; Field Technician

Subscribed and sworn to before me on this 20th. day of August 2002.
in the County of: Warrick State of: Indiana

Cindy D. Tomes

Cindy D. Tomes; Notary Public
My commission expires November 6, 2006

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7777 GARDNER RD. CHANDLER, IN. 47610-9837
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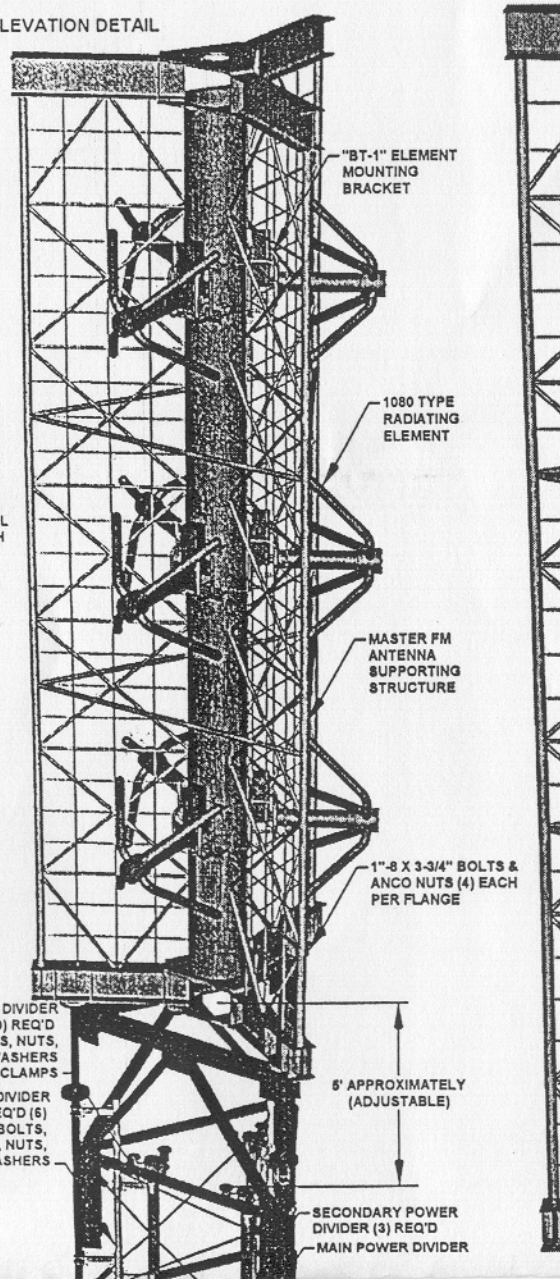
INSTALLATION DETAILS FOR DAYTON, OHIO

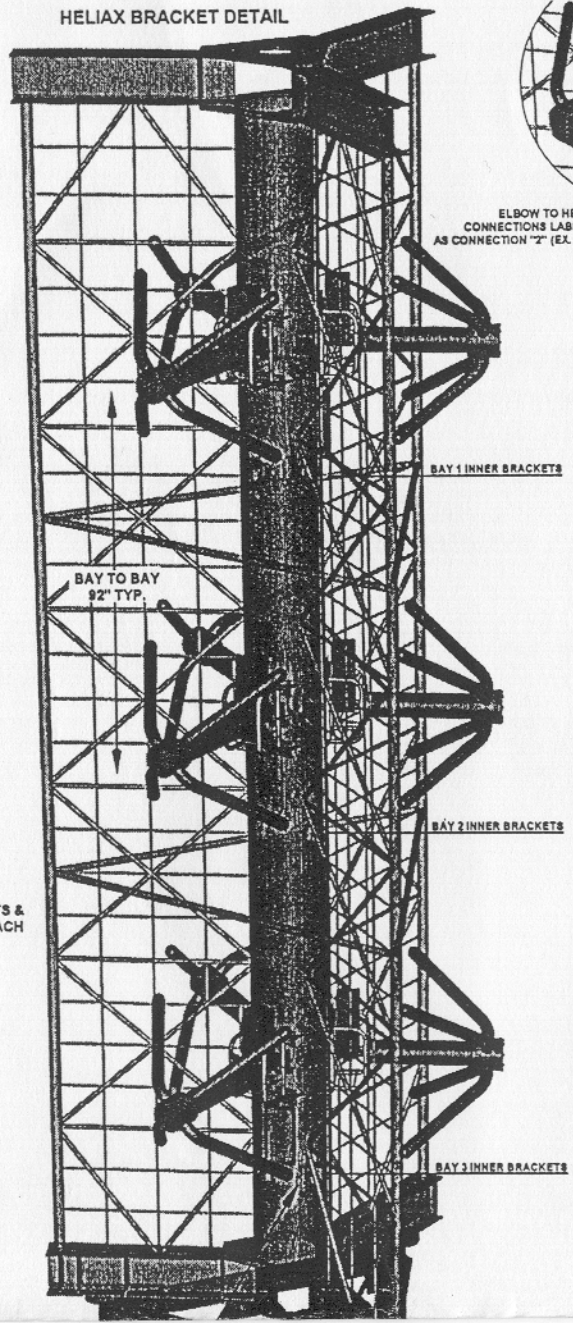
PROJECT NO. 08232\5
DRAWING NO. IC-1

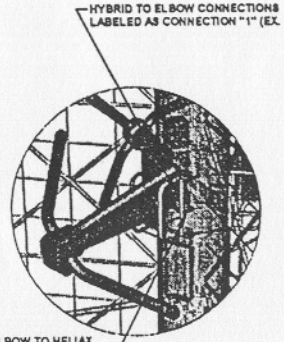
NOTE:
SUPPORTING STRUCTURE SHOWN TRANSPARENT FOR CLARITY OF INNER HELIAX BRACKETS.

ELEVATION DETAIL

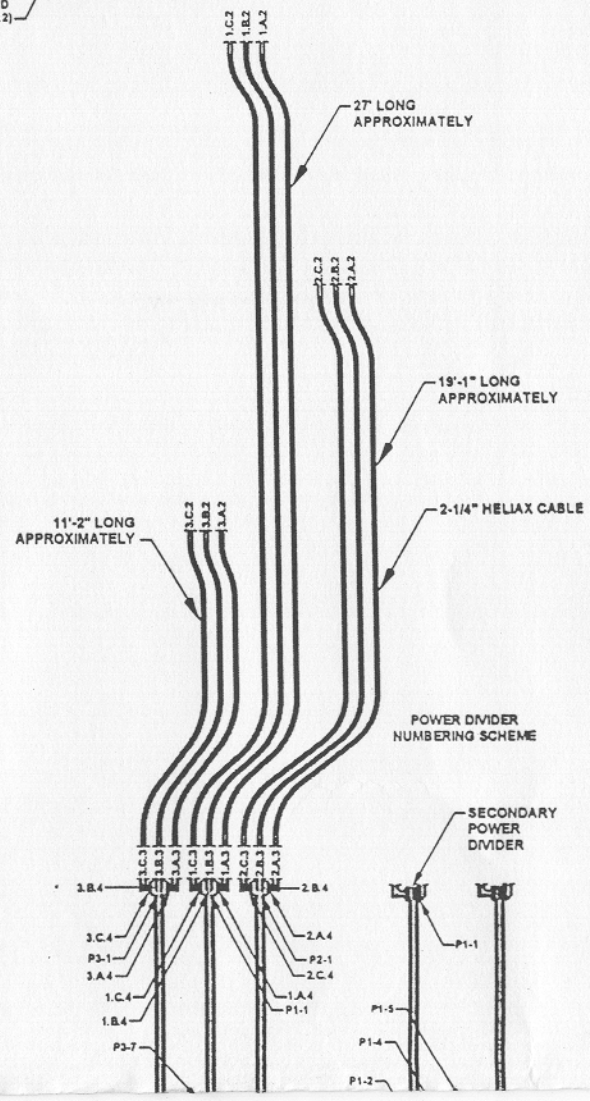


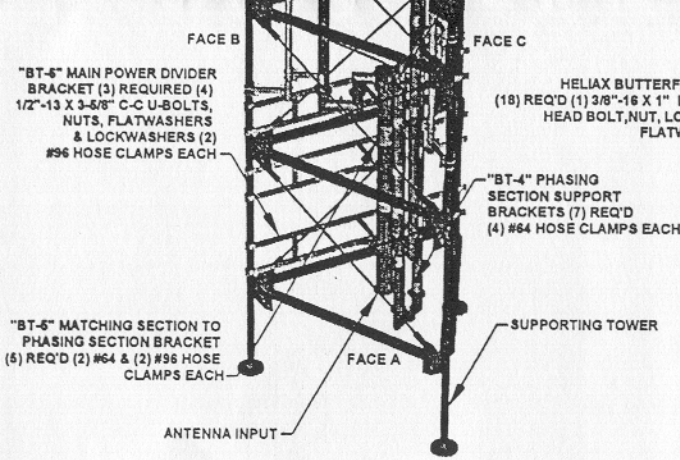
HELIAX BRACKET DETAIL

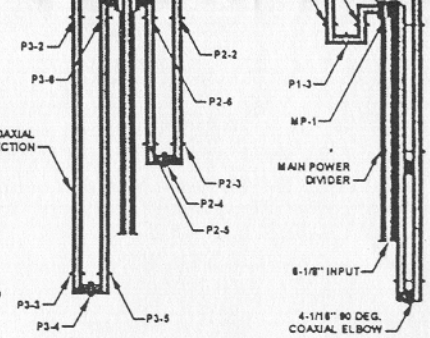




ELEMENT NUMBERING SCHEME DETAIL







NOTES:

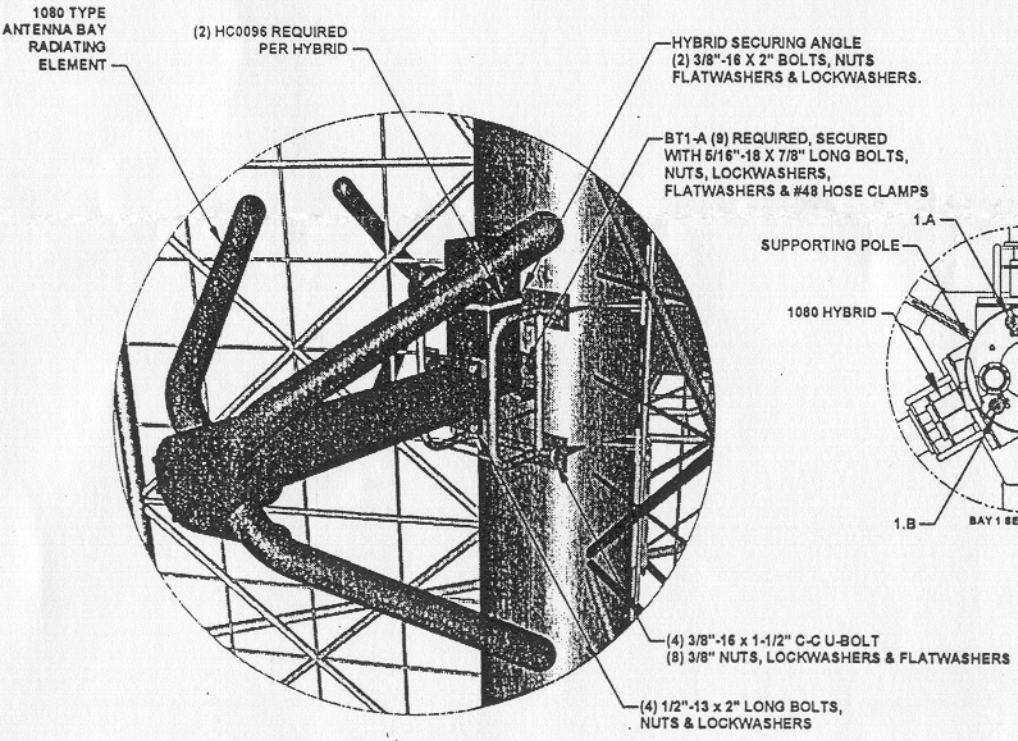
1) 3-1/8" LINE CONNECTIONS REQUIRE (6) 3/8"-16 X 1-1/2" LONG BOLTS, NUTS & LOCKWASHERS EACH.

2) 4-1/16" LINE CONNECTIONS REQUIRE (8) 3/8"-16 X 1-1/2" BOLTS, NUTS & LOCKWASHERS EACH.

3) 6-1/8" LINE CONNECTIONS REQUIRE (12) 3/8"-16 X 1-3/4" LONG BOLTS, NUTS & LOCKWASHERS EACH.

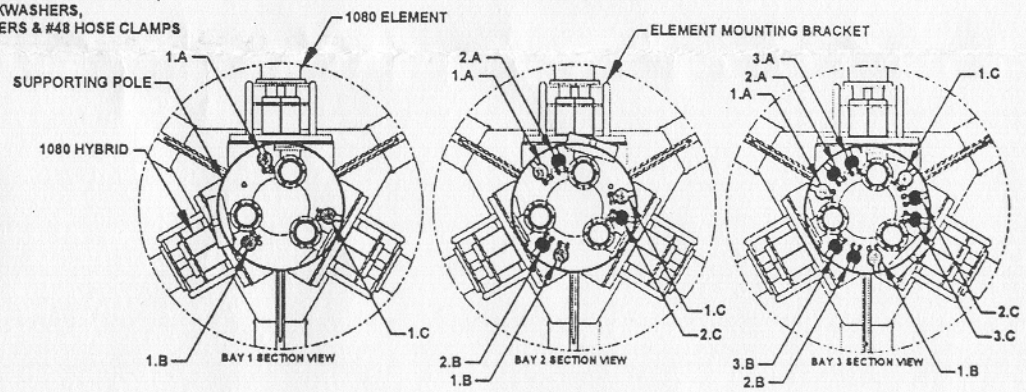
4) 4-1/16" LINE BRACKETS REQUIRE (2) #64 HOSE CLAMPS PER LINE SECTION ATTACHED.

5) 6-1/8" LINE BRACKETS REQUIRE (2) #96 HOSE CLAMPS PER LINE SECTION ATTACHED.



ELEMENT MOUNTING DETAIL

HELIAX LOCATIONS DETAIL
(SHOWN FROM BAY 3 LOOKING TO BAY 1)



NOTE:
1) HELIAX LOCATIONS ARE LABELED BY BAY LEVEL & FACE (EX. 1.A IS BAY "1" FACE "A" FEED .

2) FEED HARNESS IS COLOR CODED BY BAY LEVEL (YELLOW = BAY1) (BLUE = BAY2) (GREEN = BAY3).

3) HELIAX SPIRALS DOWN THE POLE MOVING ONE LOCATION AT EACH BAY LEVEL, SEE HELIAX LOCATION DETAIL FOR SPECIFIC LOCATIONS AT EACH BRACKETING LOCATION.

4) ASSEMBLE ANTENNA SYSTEM BY MATING CORRESPONDING NUMBERS.

COG 1083-3CP ERI Antenna Specification Sheet

WLQT /WTUE / WMMX Dayton, Ohio

General Specifications

Antenna Type ..... High Power FM-Broadcast, Suitable For Diplexing
Model Number ..... COG 1083-3CP
Number Of Bay Levels ..... Three
Polarization ..... Right Hand Circular

Electrical Specifications

Antenna Input Power Capability ..... 120 KW. Maximum (1)
Operating Frequency Band ..... 99.9, 104.7 and 107.7 Megahertz.
VSWR ..... 1.10 : 1 @ Operating Frequencies.(2)
Azimuthal Pattern Circularity ..... +/- 2dB From RMS (Free Space)
Power Split ..... 50/50 (Horizontal & Vertical)
Quarter Wave Shorting Stub ..... No
Frequency Specific Information:

Frequency	Station ERP	Beam Tilt	First Null Fill	Second Null Fill	Power Gain Horizontal	Power Gain Maximum	Line Loss (3)	Filter Loss (4)	Computed TPO
99.9	28 KW	-0.0°	0 %	0 %	1.367	1.367	0.474 dB	0.149 dB	23.64 KW
104.7	28 KW	-0.0°	0 %	0 %	1.415	1.415	0.475 dB	0.204 dB	23.13 KW
107.7	28 KW	-0.0°	0 %	0 %	1.441	1.441	0.490 dB	0.131 dB	22.42 KW.

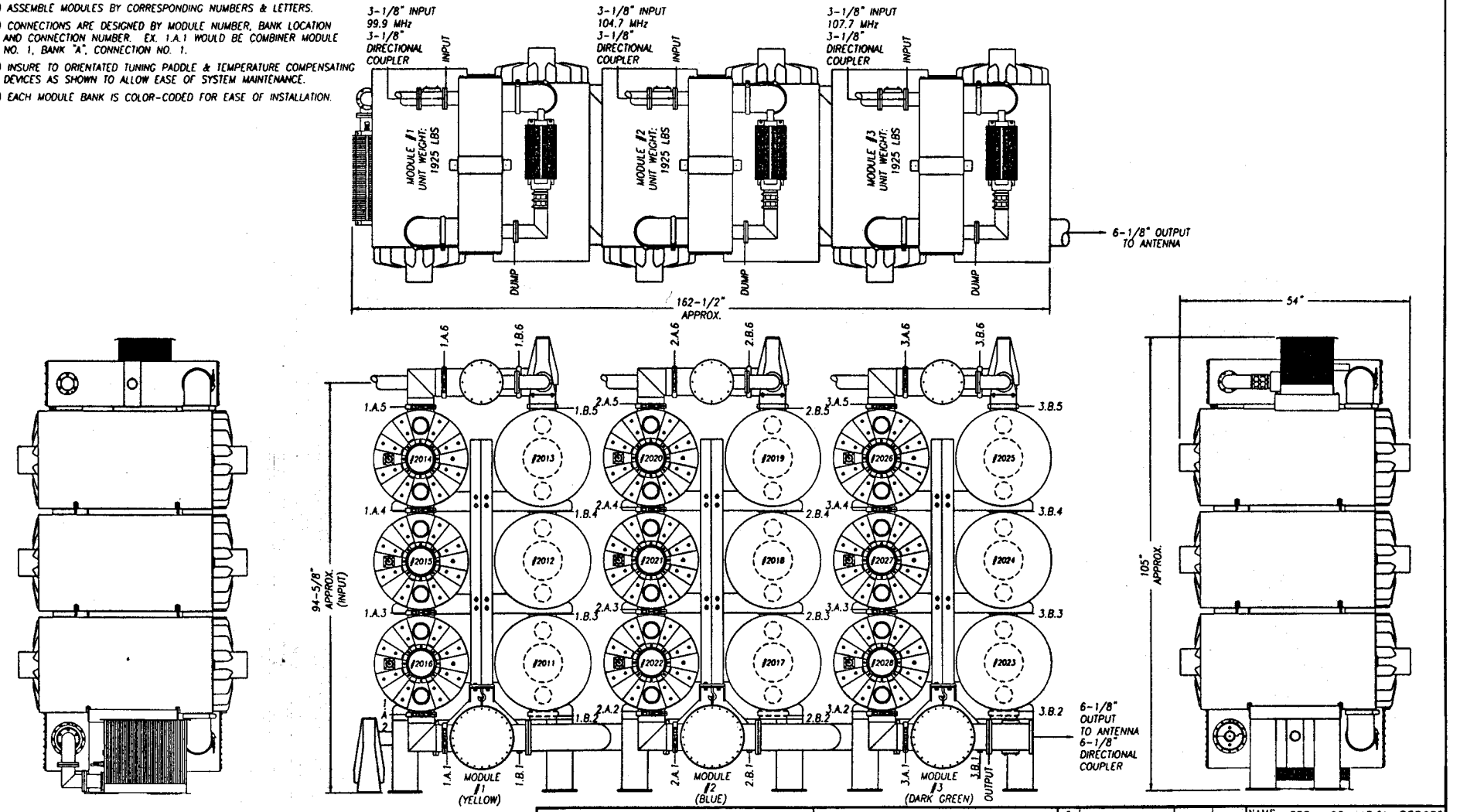
Mechanical Specifications

Antenna Feed System ..... Fed With Single Feed Line
Input Connector ..... 6 1/8" 50- Ohm EIA Flanged
Element Deicing ..... None
Interbay Spacing ..... 92.00 Inch Center to Center
Array Length ..... 27 Feet
Construction Material (Antenna) ..... All Noncorrosive
Construction Material (Mounting) ..... Galvanized steal Plate and Stainless Steel
Mounting ..... Integral Arrangement (Antenna Preassembled To Mast)

NOTES:
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 780 Feet, of Myat Type 601 Rigid 6 1/8" Coax. Each Transmitter Incorporates a Dielectric 3" Motorized Coax Switch and Myat Type 301 Rigid Coax Between The Filter And Multiplexer, 50 Feet for 99.9 MHz., 40Feet for 104.7 Mhz., and 50 Feet for 107.7 MHz.
4) Losses Taken From Actual Multiplexer Measurements.

NOTES:

1) ASSEMBLE MODULES BY CORRESPONDING NUMBERS & LETTERS.
2) CONNECTIONS ARE DESIGNED BY MODULE NUMBER, BANK LOCATION AND CONNECTION NUMBER. EX. 1.A.1 WOULD BE COMBINER MODULE NO. 1, BANK "A", CONNECTION NO. 1.
3) INSURE TO ORIENTATED TUNING PADDLE & TEMPERATURE COMPENSATING DEVICES AS SHOWN TO ALLOW EASE OF SYSTEM MAINTENANCE.
4) EACH MODULE BANK IS COLOR-CODED FOR EASE OF INSTALLATION.



ELECTRONICS RESEARCH, INC.
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NO	REVISION	APP'D	DATE
6			
5			
4			
3			
2			
1			

NAME: INTER-MODULATION REPORT
STATION: DAYTON, OHIO
FREQUENCY: 107.7, 104.7 & 99.9 MHz PROJECT NO: 08232/8
PATH: G:\DRAFTING\ALL\PROJECTS\08232\8
FILE: IM — 4 | DRAWN: S.DEON | FACTOR: 3/64"=1'
DATE: 5/21/02 | APP'D:
MODEL: 963R06-000-036 | DWG NO: IM — 4

EXHIBIT A - 3

963 Type Constant Impedance Combiner Specification Sheet

WLQT /WTUE / WMMX Dayton, Ohio

General Specifications:

Multiplexer Type ..... 963R06-000-036 Constant Impedance
Number Of Combining Units ..... Three
Injected Port to Injected Port Isolation ..... < - 58 dB
Output Connector ..... 6 1/8 " 50 Ohm EIA (Flanged)
Output Power (Maximum) ..... 140 KW
Combiner Units, Approx. Size and Weight: (Including racks)

Type 963-6 Tuned To 99.9 MHz. ..... 105" ht. X 54" wd. X 54" lng. & 1,925 Lbs.
Type 963-6 Tuned To 104.7 MHz ..... 105" ht. X 54" wd. X 54" lng. & 1,925 Lbs.
Type 963-6 Tuned To 107.7 MHz ..... 105" ht. X 54" wd. X 54" lng. & 1,925 Lbs.

Heat Removal (All Multiplexer Components) ..... Natural Convection
Physical Arrangement ..... Rack Mounted

Injected Port Specifications:

Frequency Assignment (From Antenna Output) ..... 107.7, 104.7 And 99.9 Mhz.
Power Rating, Each Injected Port (Maximum) ..... 40 KW
Input Connector ..... 3-1/8" 50 Ohm EIA (Flanged)
VSWR ..... Less than 1.07:1 @ +/-150 KHz(1)
Group Delay ..... Less than 50 ns Overall Variation, Carrier @ +/- 150 KHz

Insertion Loss (Measured):

99.9 MHz. ..... - 0.149 dB
104.7 MHz. ..... - 0.204 dB
107.7 MHz. ..... 0.131 dB

Notes:
1) When Terminated in 50 Ohm Resistive Load.
2) The Combiner room ambient temperature should be maintained between 60 and 70 degrees Fahrenheit

ELECTRONICS RESEARCH,INC.
7777 GARDNER ROAD
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FIGURE 1

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

3 LEVELS OF TYPE 1080 ELEMENTS
+0.00 DEGREE(S) BEAM TILT
0 PERCENT FIRST NULL FILL
0 PERCENT SECOND NULL FILL
POWER GAIN IS 1.367 IN THE HORIZONTAL PLANE(1.367 IN THE MAX.)

JUNE 13, 2000

99.9 MHz

BAY SPACING
92.00 INCHES
(.7787 WAVELENGTH)

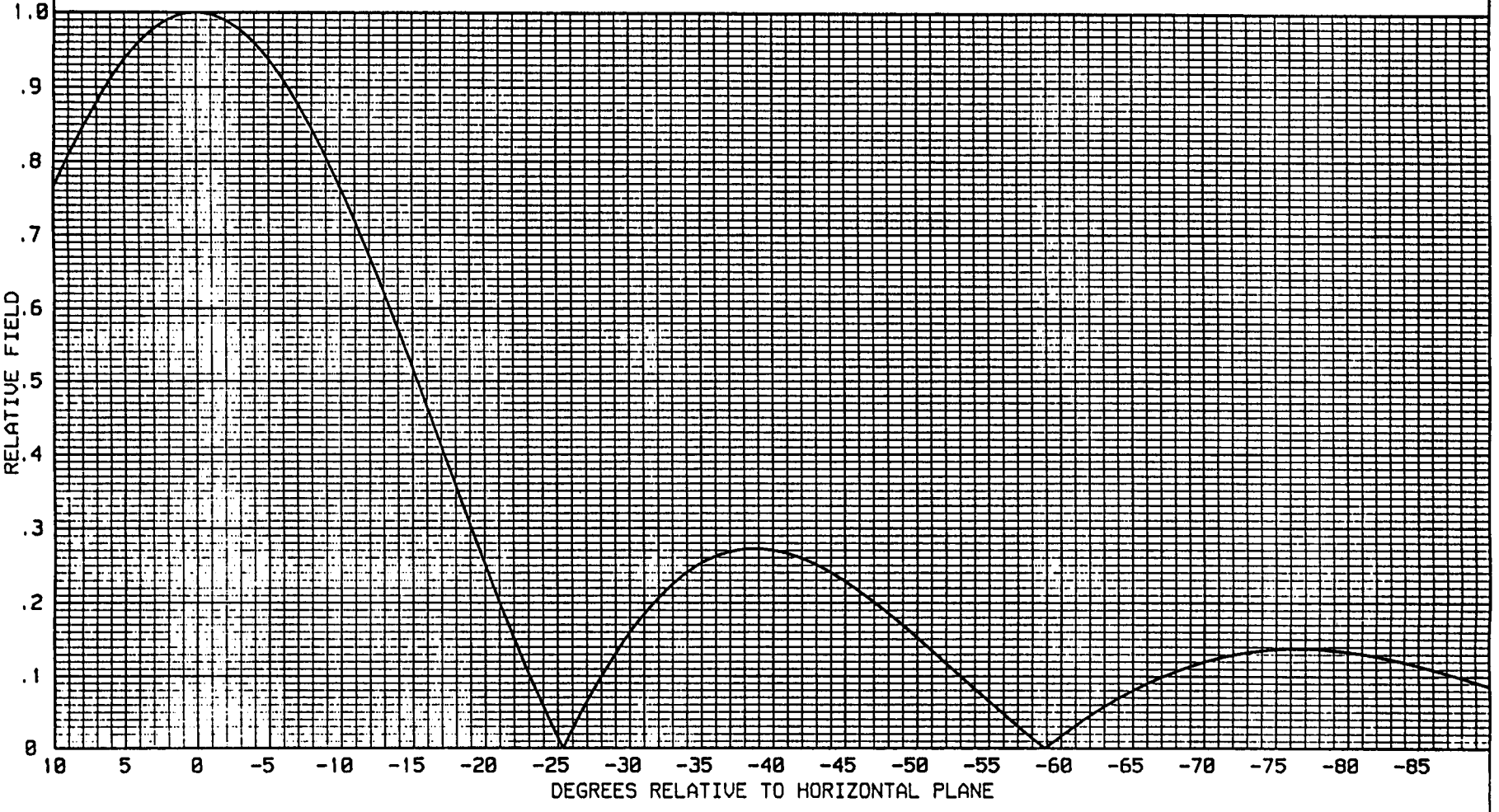


EXHIBIT A - 5

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

FIGURE 2

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

3 LEVELS OF TYPE 1080 ELEMENTS
+0.00 DEGREE(S) BEAM TILT
0 PERCENT FIRST NULL FILL
0 PERCENT SECOND NULL FILL
POWER GAIN IS 1.415 IN THE HORIZONTAL PLANE(1.415 IN THE MAX.)

JUNE 13, 2000

104.7 MHz

BAY SPACING
92.00 INCHES
(.8161 WAVELENGTH)

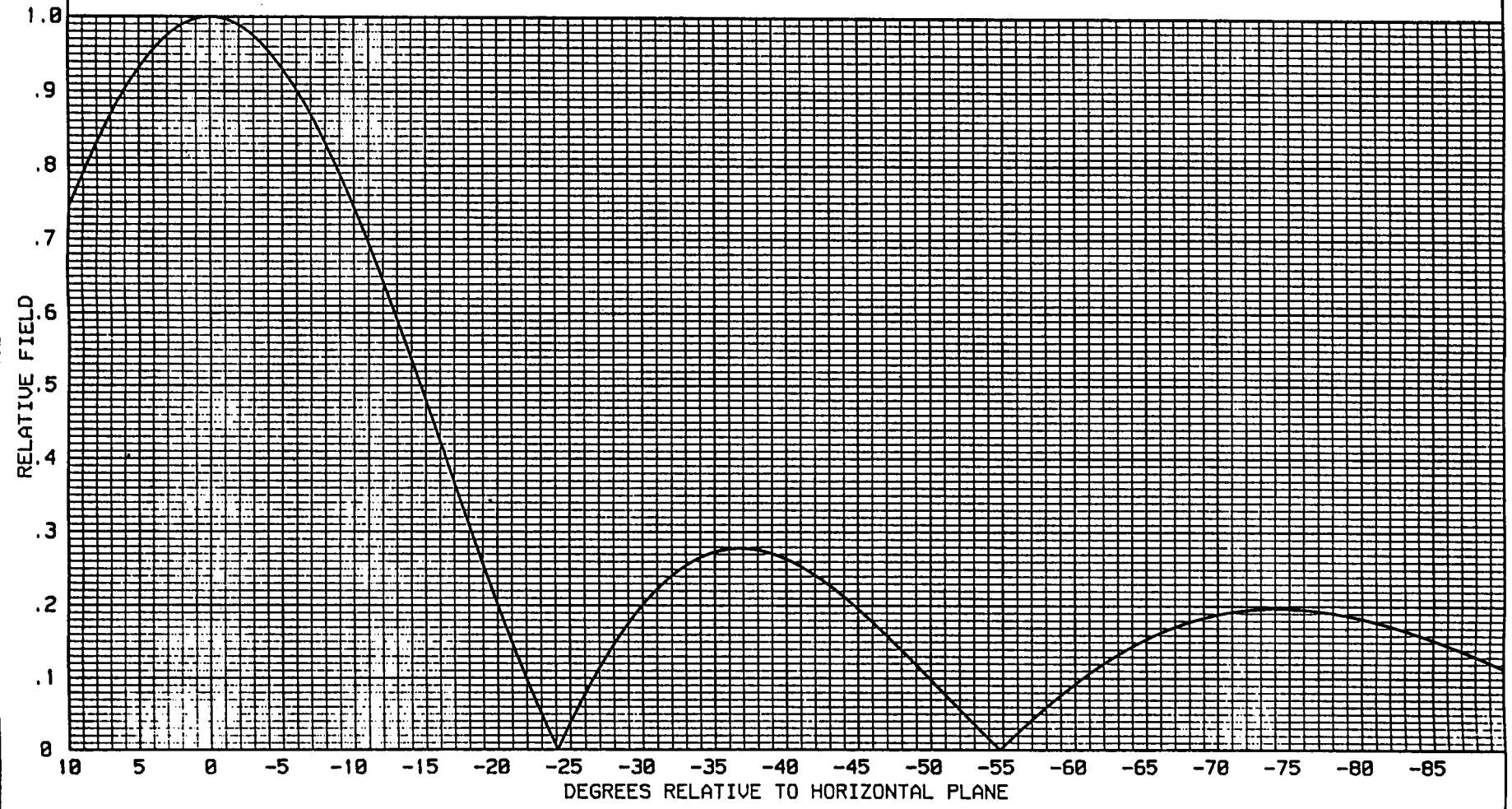
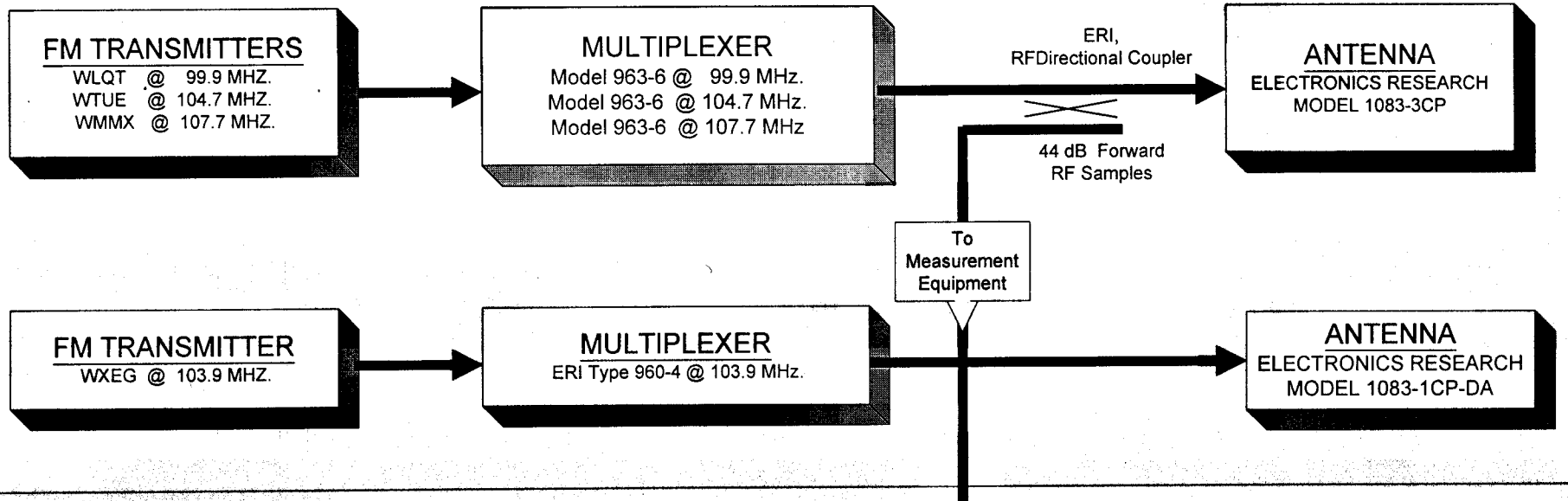


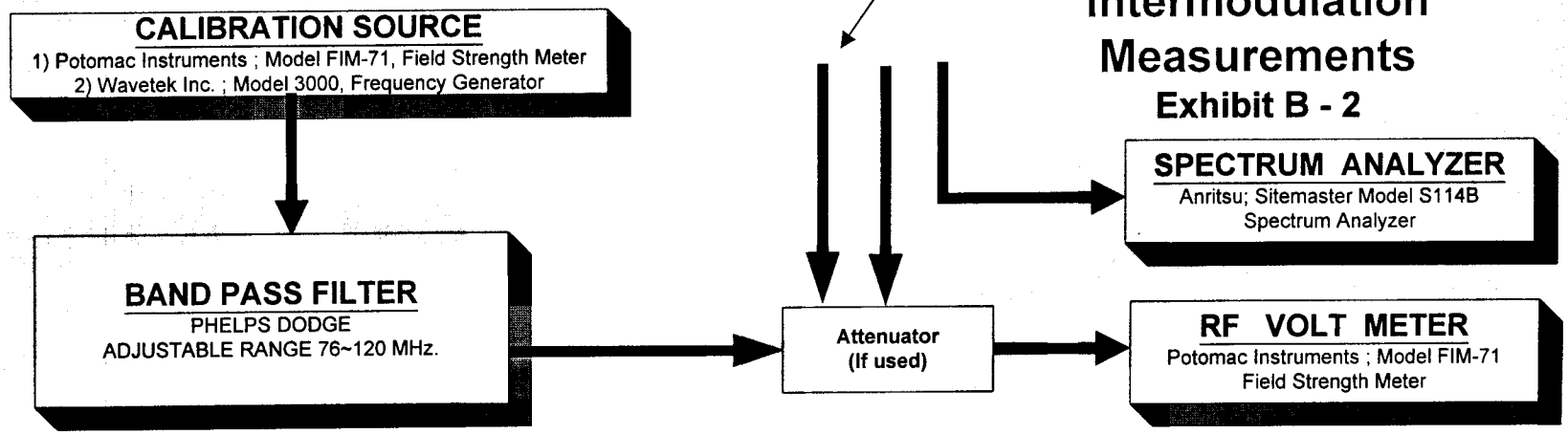
EXHIBIT A - 5

Broadcasting Scheme, WLQT~WTUE~WMMX Dayton, Ohio



Equipment Employed in Intermodulation Measurements

Exhibit B - 2



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

EXHIBIT B 1 & 2