

Report of Inter-Modulation Product Measurements

for

Three Station Constant Impedance Combiner
KAKQ 101.1 MHz / KIAK 102.5 MHz / KKED 104.7 MHz

Combined Broadcast Facility
Fairbanks, Alaska

JOB # 08087

July 15, 2001

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Introduction

This report of findings provides evidence to show that the three-station combined facility for the operation of KAKQ, KIAK and KKED is in compliance with the FCC Rules and Regulations as required by the Code of Federal Regulations (CFR) Title 47 Section 73.317 paragraph (d). In brief, the collection of measurements presented in this report shows that all possible second order inter-modulation (IM) products generated by this combined system are less than the maximum allowable level as required by section 73.317(d). Tom Silliman of Electronics Research, Inc. performed the measurements summarized herein on July 15, 2001.

IM products can potentially violate section 73.317 paragraph (d) requirements and are commonly generated from radio stations operating into multiplexed facilities and at congested antenna broadcast sites when inadequate transmitter to transmitter isolation is provided. The ERI installed filter/combiner system is designed to provide adequate isolation to ensure that interfering signals and any resulting intermodulation products are sufficiently attenuated to satisfy the section 73.317 paragraph (d) requirement. A Potomac Instruments FIM-71 with a bandpass filter is used to verify compliance with paragraph (d).

Measurements to verify compliance with section 73.317 (d) were made on the constant impedance combiner system installed by ERI at the KAKQ/KIAK/KKED primary transmission site. Schematic diagrams and specification sheets for the combiner system are included in Exhibit A of this report.

The combined system serves as the main transmitter site for KAKQ, KIAK and KKED.

Constant Impedance Combiner System

Stations KAKQ, KIAK and KKED were operating at licensed power for the duration of compliance measurements. Measurements were made to determine the level of second order IM products (of the type $2F_1 - F_2$) for the three-station constant impedance combiner system combining KAKQ (101.1 MHz), KIAK (102.5 MHz) and KKED (104.7 MHz). The combiner system is illustrated in the attached Exhibit A on page A-1.

The inter-modulation products were measured with the system transmitters operating at licensed TPO on the filter/combiner system. Directional couplers were placed at key locations throughout the combiner system to monitor and maintain the combiner performance. All couplers furnished with the system are factory calibrated and capable of delivering accurate and repeatable RF measurements. For the purposes of the measurements for these findings, the coupler located at the system output to the antenna was used. The RF directional coupler installed in the 3-1/8" line section to the antenna output allows forward and reflected readings of the antenna output signal levels. This type of directional coupler used for measurements is factory calibrated with a typical directivity of about 35 dB and a forward signal sample typically attenuated by around 55 dB.

The forward port of the output directional coupler was used for sampling all outgoing carrier levels and IM products. The sampled signal was fed by shielded cable through a band pass filter into a Potomac Instruments FIM-71 field strength meter. Various attenuation pads were used at connection locations to the band pass filter and/or the FIM-71 to ensure adequate signal levels for measurement without overloading the measurement equipment. The selective tuning of the FIM-71 and of the band pass filter was accomplished using a Wavetek Model 3000 signal generator. The measurement setup is illustrated in the attached Exhibit B.

The relative output signal levels for the system carriers are measured first to establish reference levels for other measurements. These levels will be used as a basis for comparing the IM product levels. The resulting signal levels for these measurements are listed in Table 1. The Adjusted Level shown in the last column of the table will be used as the reference level for possible IM products of each carrier.

Table 1. Carrier Reference Levels – Constant Impedance Combiner System

Carrier Frequency (MHz)	Pad One (dB)	Bandpass Filter Loss (dB)	Pad Two (dB)	Full Scale Range (dB μ)	Scale Reading (dB)	Adjusted Level (dB μ)
101.1	—	—	—	120	-1.1	118.9
102.5	—	—	—	140	-18.79	121.21
104.5	—	—	—	140	-18.42	121.58

Second-order products due to mixing of system second harmonics with system fundamentals are calculated and listed in Table 2.

**Table 2. Second Order Products for Fairbanks, Alaska
KAKQ/KIAK/KKED Constant Impedance Combiner System**

Carrier Frequency (MHz)	Interfering Frequency (MHz)		
	101.1	102.5	104.7
101.1	–	99.7	97.5
102.5	103.9	–	100.3
104.7	108.3	106.9	–

The IM product measurements using the measurement scheme as previously described were recorded and are listed in Table 3 with the signal level referenced to carrier calculated in the last column. Refer to the figure in Exhibit B for a layout of the measurement equipment. All product levels met requirements.

Table 3. IM Measurements for Constant Impedance Combiner System

Product Frequency (MHz)	Carrier Frequency (MHz)	Interfering Frequency (MHz)	Pad One (dB)	Bandpass Filter Loss (dB)	Pad Two (dB)	Full Scale Range (dBμ)	Scale Reading (dB)	Adjusted Level (dBμ)	Level Referenced to Carrier (dB)
97.5	101.1	104.7	-	9	-	20	<-20	<9	<-109.9
99.7	101.1	102.5	6	9	-	20	-16.48	18.52	-100.38
100.3	102.5	104.7	6	9	-	20	-10.46	24.54	-96.67
103.9	102.5	101.1	10	9	-	20	-13.98	25.02	-93.88 (Note 1)
106.9	104.7	102.5	-	9	-	20	<-20	<9	<-112.21
108.3	104.7	101.1	-	9	-	20	<-20	<9	<-109.9

Note 1 – This is an external signal from a local station.

Conclusions

Based upon the observations and measurements recorded in this document, I, Thomas B. Silliman, find the Constant Impedance Combiner system for the operation of the KAKQ main transmitter, the KIAK main transmitter and the KKED main transmitter to be in proper working order. Furthermore, based on the measured data, it is my opinion there are no inter-modulation products being generated in excess of 80 dB below station carrier levels by the stations operating on the installed system. Based on this recorded data, I conclude that KAKQ, KIAK and KKED are in compliance with the requirements of Sections 73.317 paragraph (d) of the FCC Rules and Regulations.

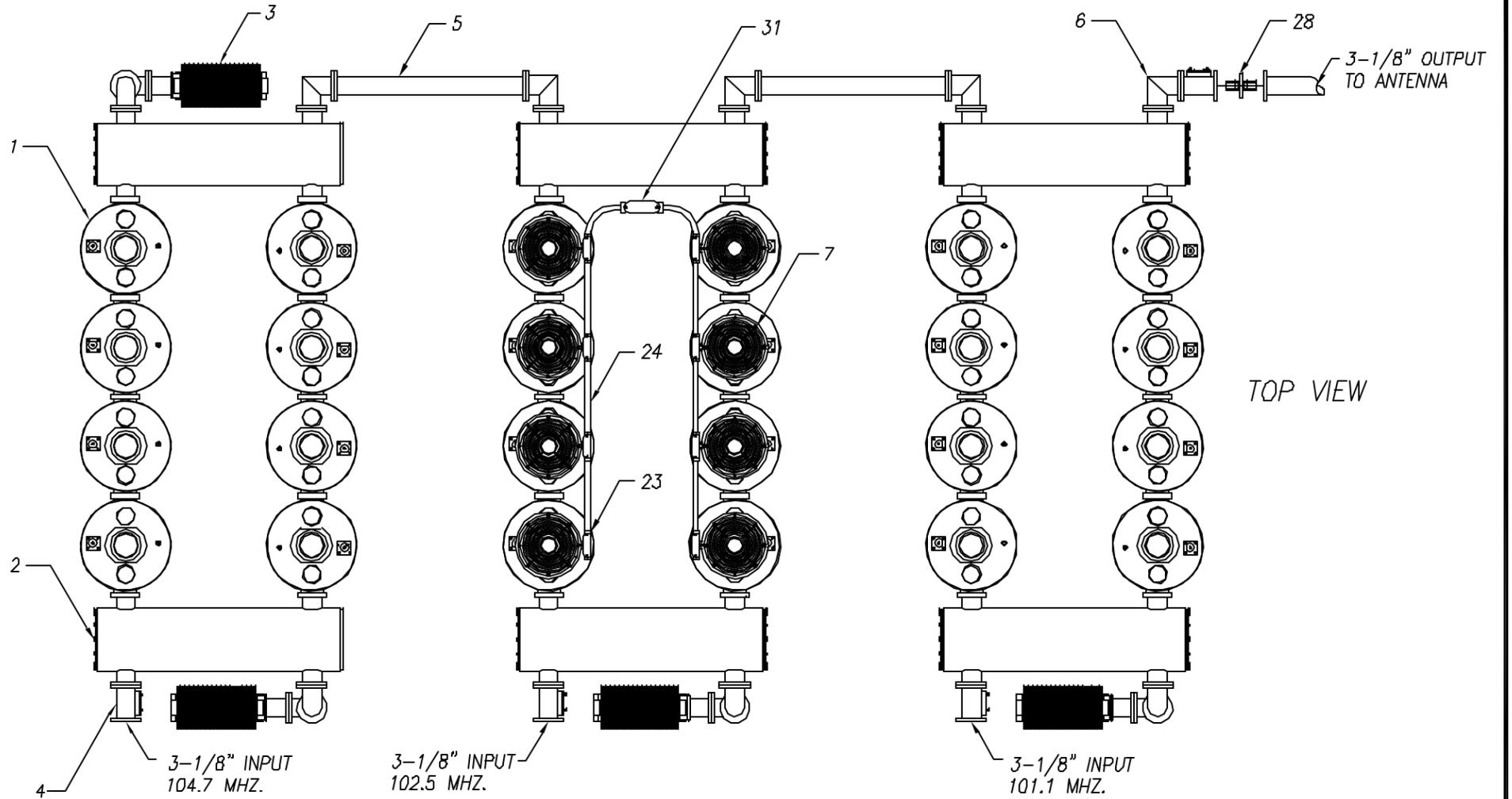
Respectfully submitted by Electronics Research, Inc.

Exhibit A

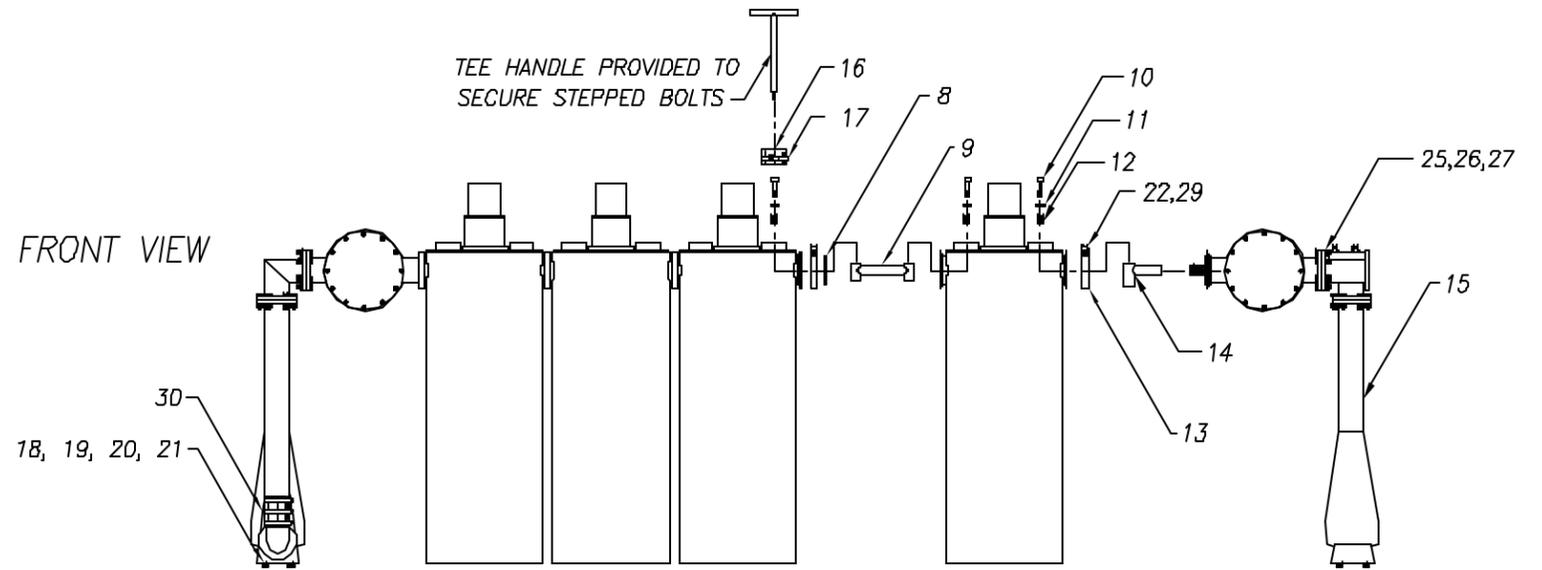
**Schematic Drawings and Specifications for
Filter/Combiner/Antenna Systems**

BILL OF MATERIAL

ITEM NO.	ERI PART NO.	DESCRIPTION	QUANTITY
1	FI0074	960 BAND PASS, W/2 DBL LOOPS	24
2	HY0040	918 TYPE HYBRID	6
3	LD0002	2.5 KW DUMP LOAD	4
4	DC3003	3-1/8" SINGLE DIRECTIONAL COUPLER	4
5	CL3182-50A	3-1/8" LINE SECTION X 31-3/8" LONG	2
6	CE3022	3-1/8" FLG TO FLG ELBOW	9
7	FI0100	FILTER BLOWER SYSTEM ASSEMBLY	8
8	FI0003	CONTACT RING	18
9	FI0132	INNER CONDUCTOR CONNECTING ASSEMBLY	18
10	FI0220	1/2"-13 X 2" LONG BOLT	48
11	WF08SSA	1/2" FLATWASHER	48
12	SG0001	SPRING	48
13	CM0037	3" MARMAN CLAMP	30
14	FI0131	3" PORT ADAPTER	12
15	CL3034	3-1/8" FLG TO UNFLG LINE SECTION	4
16	CO0073	LINE CAP	48
17	HC004B	HOSE CLAMP	48
18	FI0223	DUMPLoad LEGS	16
19	WF05SS	5/16" FLATWASHER	32
20	WL05SS	5/16" LOCKWASHER SPLIT TYPE	16
21	NU0518	5/16"- 18 HEX NUT	32
22	SC0524T0450	5/16"-24 X 4-1/2" LONG T-BOLT	30
23	EFO036	CONDUIT ADAPTER	16
24	ED0050F-PVC	FLEXIBLE CONDUIT	13'
25	NU0616	3/8" HEX NUT	96
26	WL06SS	3/8" LOCKWASHER SPLIT TYPE	96
27	SC0616H0150	3/8"-16 X 1-1/2" LONG HEX HEAD BOLT	96
28	CC0012	3-1/8" INLINE BULLET W/WAFER	1
29	NU0524BR	5/16"- 24 HEX NUT BRASS FOR T-BOLT	30
30	CE3021	3-1/8" FLG TO UNFLG ELBOW	4
31	CE3021	1/2" PVC TEE ASSEMBLY	1



TOP VIEW



FRONT VIEW

 <p>ELECTRONICS RESEARCH, INC. Established 1943 7777 GARDNER RD. CHANDLER, IN. 47610-9637 PHONE: (812) 925-6000 FAX: (812) 925-4028</p>	This document/drawing contains information considered confidential by Electronics Research, Inc. ("ERI"). This information is disclosed on a confidential basis and only authorized for use in the installation, operation, and maintenance of ERI tower and antenna equipment, as appropriate. Reproduction, transmission or disclosure to others, or unauthorized use, without the express written consent of ERI, is strictly prohibited. UNAUTHORIZED DUPLICATION, REPRODUCTION, OR DISCLOSURE OF THIS INFORMATION IS A VIOLATION OF FEDERAL LAW. © COPYRIGHT 2000 ERI, ELECTRONICS RESEARCH INC.			6				<p>NAME COMBINER SYSTEM ASSEMBLY</p> <p>STATION: FAIRBANKS, ALASKA</p> <p>FREQUENCY: 101.1, 102.5, 104.7 MHZ PROJECT NO.: 08087</p> <p>PATH G: \DRAFTING\ALL\PROJECTS\08087\9</p> <p>FILE IM - 1 DRAWN BAM FACTOR NTS</p> <p>DATE 9/22/00 APP'D DWG. NO. IM - 1</p> <p>MODEL 963F08-C-033</p>
	5							
	4							
	3							
	2							
	1							
NO	REVISION	APP'D	DATE					

Constant Impedance Combiner System Specification Sheet
KAKQ/KIAK/KKED
Fairbanks, Alaska

General Specifications

Multiplexer Type.....Constant Impedance Combiner
 Number Of Combining Modules Used Three, Type 960
 Injected Port to Injected Port Isolation (typical).....55 dB
 Output Connector 3-1/8" 50Ω EIA (Flanged)
 Output Power..... 60 kW

Combiner Modules, Size and Weight (approx):

 Type 960 Tuned to 101.1 MHz 5' ht. X 3' wd. X 8' lng. & 1,000 lbs.
 Type 960 Tuned to 102.5 MHz 5' ht. X 3' wd. X 8' lng. & 1,000 lbs.
 Type 960 Tuned to 104.7 MHz 5' ht. X 3' wd. X 8' lng. & 1,000 lbs.

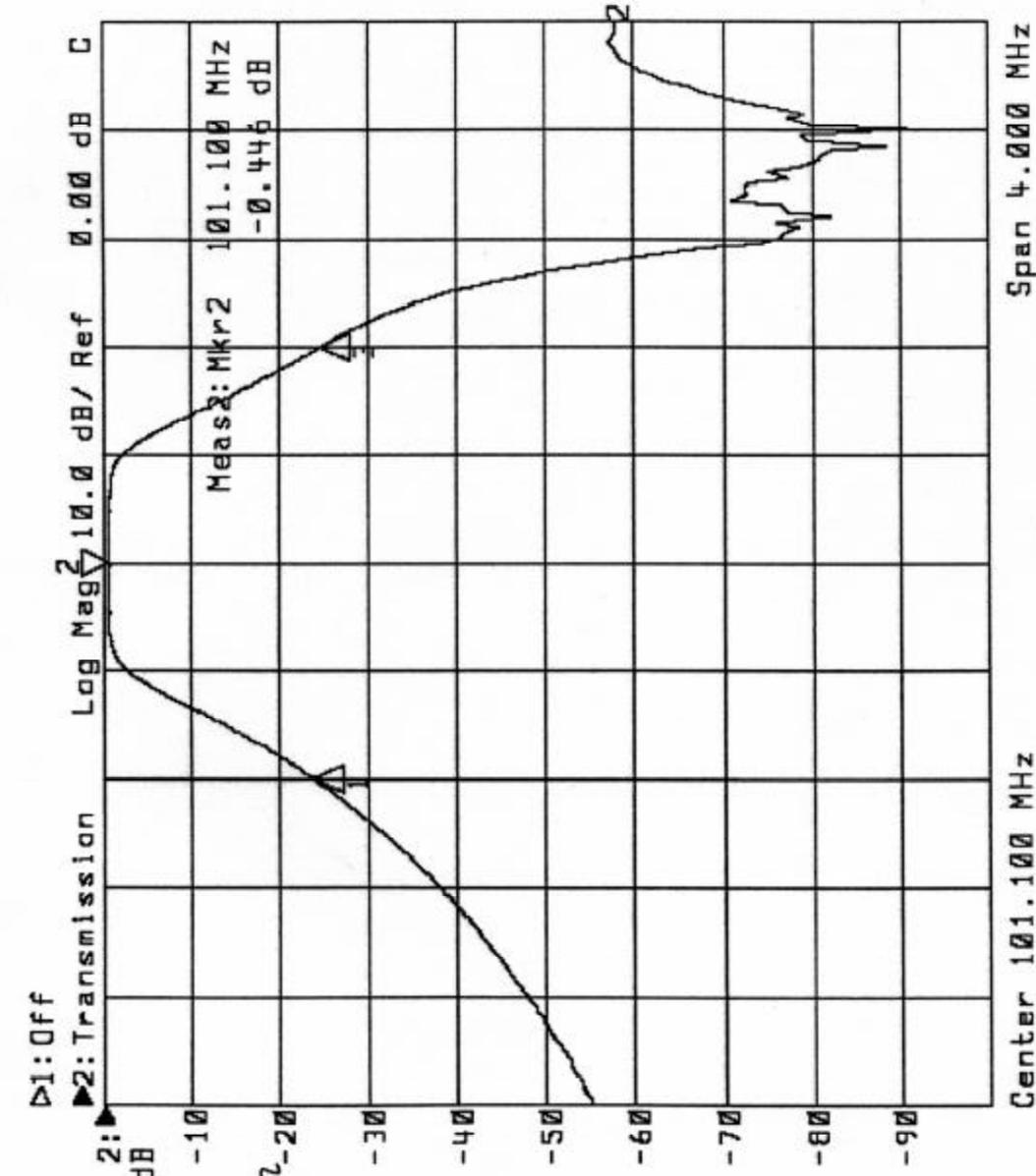
Heat Removal (All Multiplexer Components).....Natural Convection with blowers on KIAK Module
 Physical Arrangement All Components Floor Standing

Injected Port Specifications

Frequency Assignments..... 101.1, 102.5 and 104.7 MHz
 Power Rating, Each Injected Port (Maximum) 20 kW
 Connector 3-1/8" 50 Ohm EIA (Flanged)
 VSWR Less than 1.06:1 @ +/-150 kHz⁽¹⁾
 Group Delay (typical).....Less than 50 nsec Overall Variation, Carrier @ +/-150 kHz
 Insertion Loss (Measured):
 101.1 MHz -0.464 dB @ +/- 100 kHz
 102.5 MHz -0.373 dB @ +/- 100 kHz
 104.7 MHz -0.551 dB @ +/- 100 kHz

(1) When Terminated in 50 Ohm Resistive Load.

KAKQ 101.1



1: Mkr (MHz)	dB	2: Mkr (MHz)	dB
1:	100.30	-23.748	
2:	101.10	-0.446	
3:	101.90	-24.413	

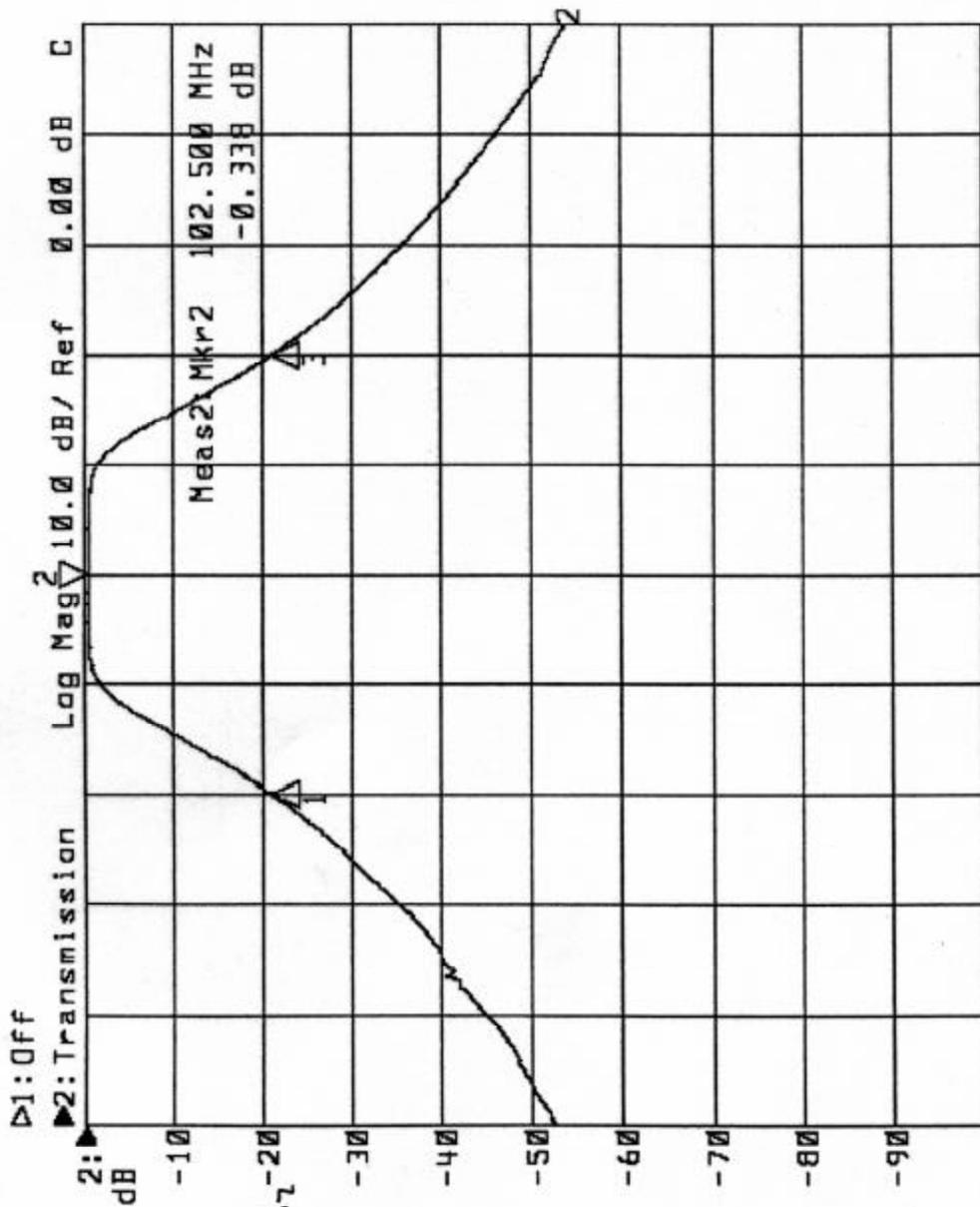
3/13/01

Fairbanks, AK
 W04TT
 101.1 Mkr₂

Isolation +/- 800 kHz

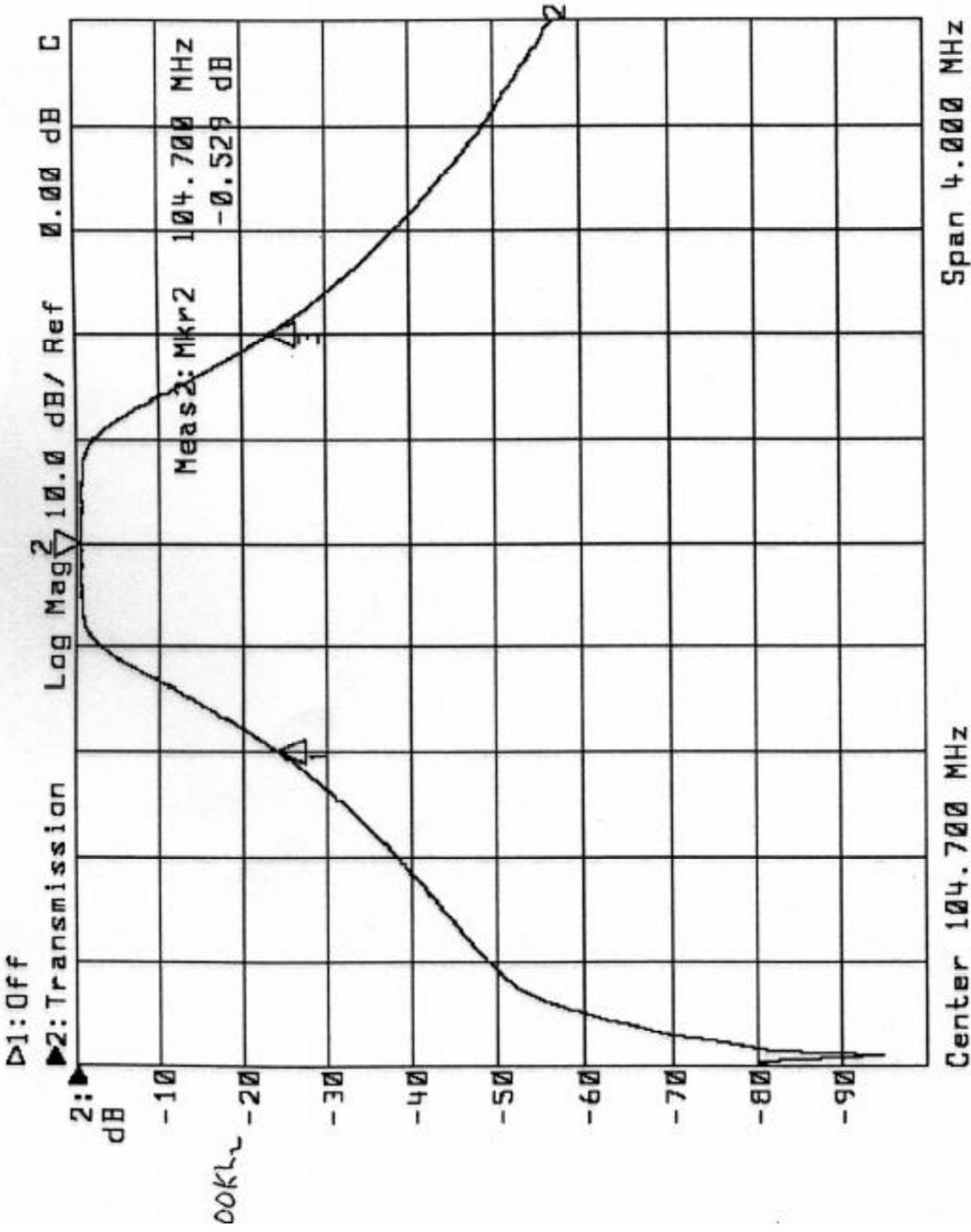
KIAK 102.5

3/13/01
Fairbanks, AK
JD&TS
102.5 MHz
Isolation +/- 800kHz - 20

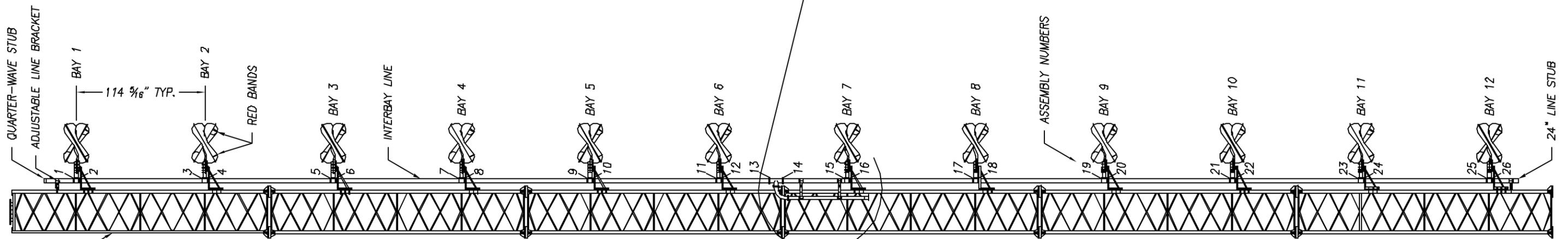
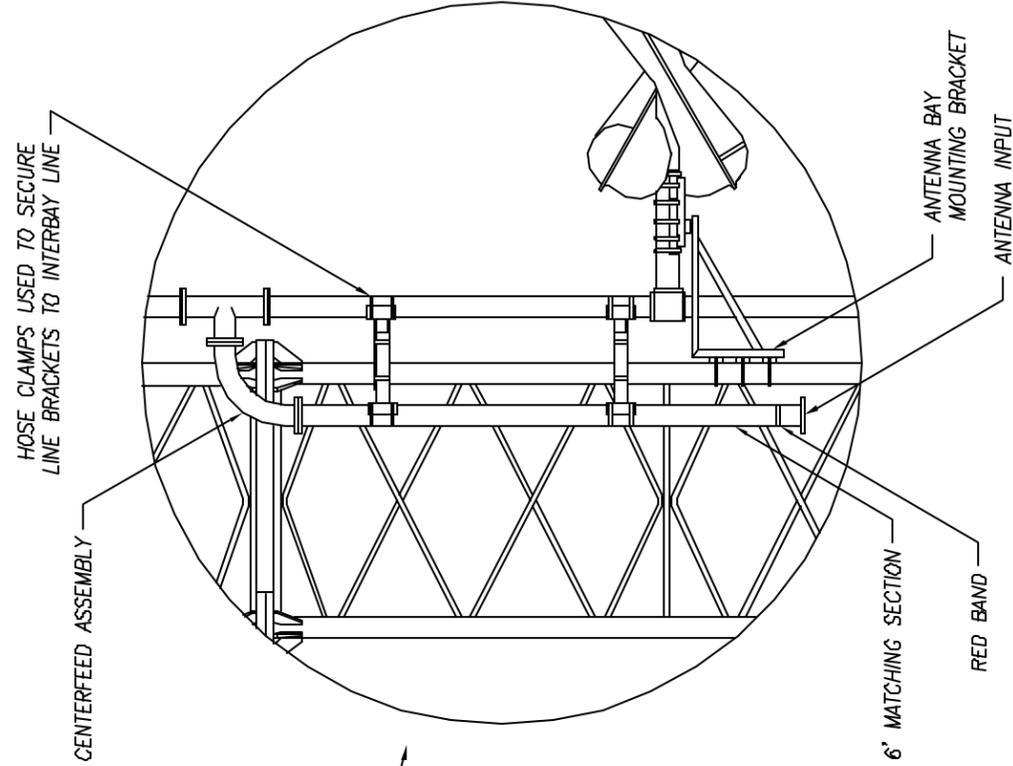
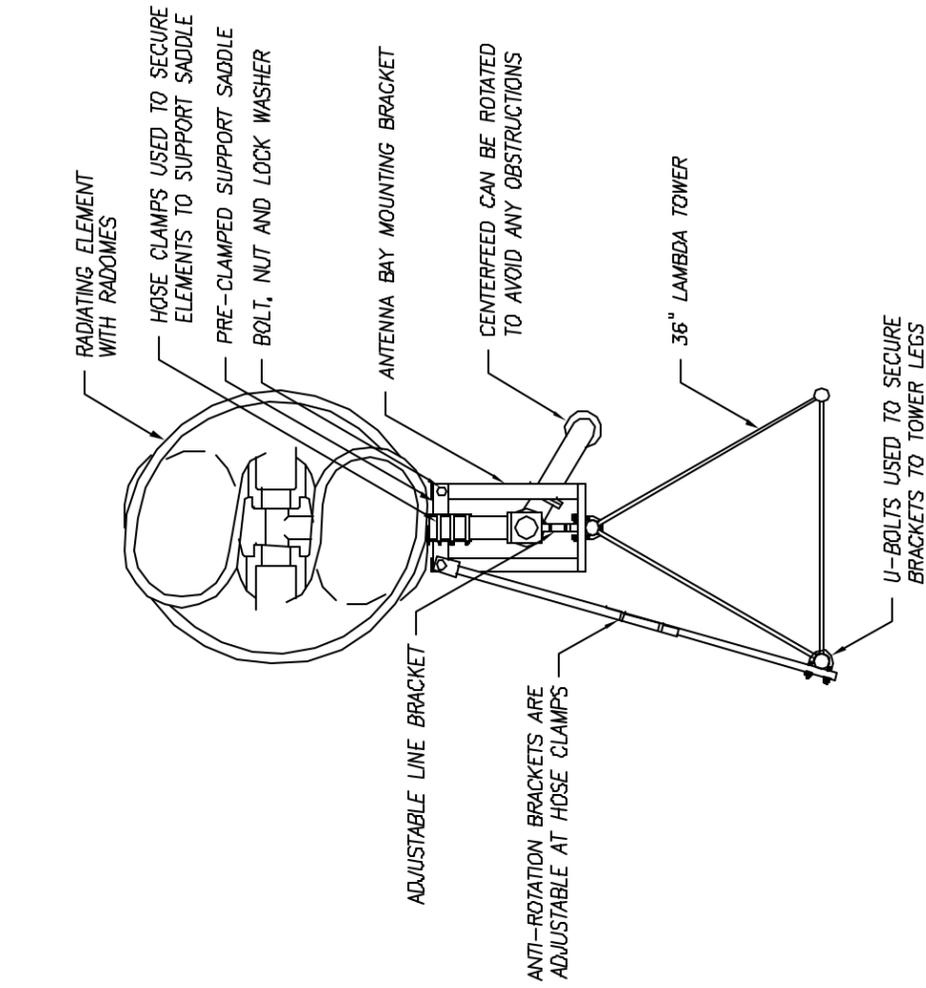


1: Mkr (MHz)	dB	2: Mkr (MHz)	dB
1:	101.70	-20.856	
2:	102.50	-0.338	
3:	103.30	-20.828	

KKED 104.7



1: Mkr (MHz)	dB	2: Mkr (MHz)	dB
1:	103.90	-23.982	
2:	104.70	-0.529	
3:	105.50	-23.114	



- NOTES:
1. ALL RED BANDS DESIGNATE SIDE TO BE MOUNTED DOWNWARD.
 2. ASSEMBLE ANTENNA SYSTEM BY MATING CORRESPONDING NUMBERS.
 3. OVERALL LENGTH OF ANTENNA SYSTEM IS 109'-4" APPROXIMATE.
 4. ENSURE TO PLUMB ANTENNA VERTICALLY BY LOOSENING HOSE CLAMPS ON PRE-CLAMPED SUPPORT SADDLES AND ADJUSTABLE LINE BRACKETS.
 5. ROTATE CENTERFEED ASSEMBLY AS CLOSE TO TOWER AS POSSIBLE.
 6. FINAL ORIENTATION TO BE DETERMINED BY STATION PERSONNEL.



ELECTRONICS RESEARCH, INC.

Established 1945

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8						NAME	INSTALLATION DRAWING
6						STATION:	FAIRBANKS, AK
4						FREQUENCY:	104.1/102.4/104.7 MHz PROJECT NO.: 08087/7
3						PATH:	G:\DRAFTING\ALL\PROJECTS\08087\7
2						FILE:	A-7
1						DRAWN:	J.B.F.
						DATE:	10/17/00
						APP'D:	
NO	REVISION	APP'D	DATE			FACTOR	NTS
						DWG. NO.	1 OF 2
						MODEL	SHPX-12AC-SP

ERI Antenna Specification Summary

KAKQ/KIAK/KKED

Fairbanks, Alaska

General Specifications

Antenna Type High Power FM-Broadcast
 Model Number SHPX-12AC-SP
 Number Of Bay Levels..... Twelve
 Polarization Right Hand Circular

Electrical Specifications

Antenna Input Power Capability 39 kW Maximum
 Diplexed Frequencies 101.1, 102.5 and 104.7 MHz
 VSWR (typical)..... 1.15 : 1 @ Operating Frequencies
 Typical Horizontal Plane Pattern Circularity Measured
 Power Split 50/50 (Horizontal & Vertical)

Frequency Specific Information:

<u>Frequency</u>	<u>Station ERP</u>	<u>Beam Tilt</u>	<u>1st/2nd Null Fill</u>	<u>Power Gain</u>	<u>Line Loss</u>	<u>Filter Loss</u>	<u>Computed TPO</u>
101.1 MHz.	32 kW	-0.75°	14% / 3%	6.428	-0.3233 dB	-0.464 dB	5.97 kW
102.5 MHz.	100 kW	-0.75°	3% / 1%	6.644	-0.3256 dB	-0.373 dB	17.68 kW
104.7 MHz.	50 kW	-0.75°	14% / 3 %	6.299	-0.3288 dB	-0.551 dB	9.72 kW

Mechanical Specifications

Antenna Feed System.....Fed with approx. 300' Myat 3-1/8" Rigid Coax
 Input Connector 3-1/8" 50- Ohm EIA Flanged (3-1/8" diameter rigid matching section)
 Element Deicing..... Radomes
 Interbay Spacing (approx) 114-5/16 Inch Center-to-Center
 Array Length (approx)..... 109' 4"
 Mounting..... Lambda mount
 Construction Material (Antenna) All Noncorrosive
 Construction Material (Mounting) Galvanized Plated Steel and Stainless Steel

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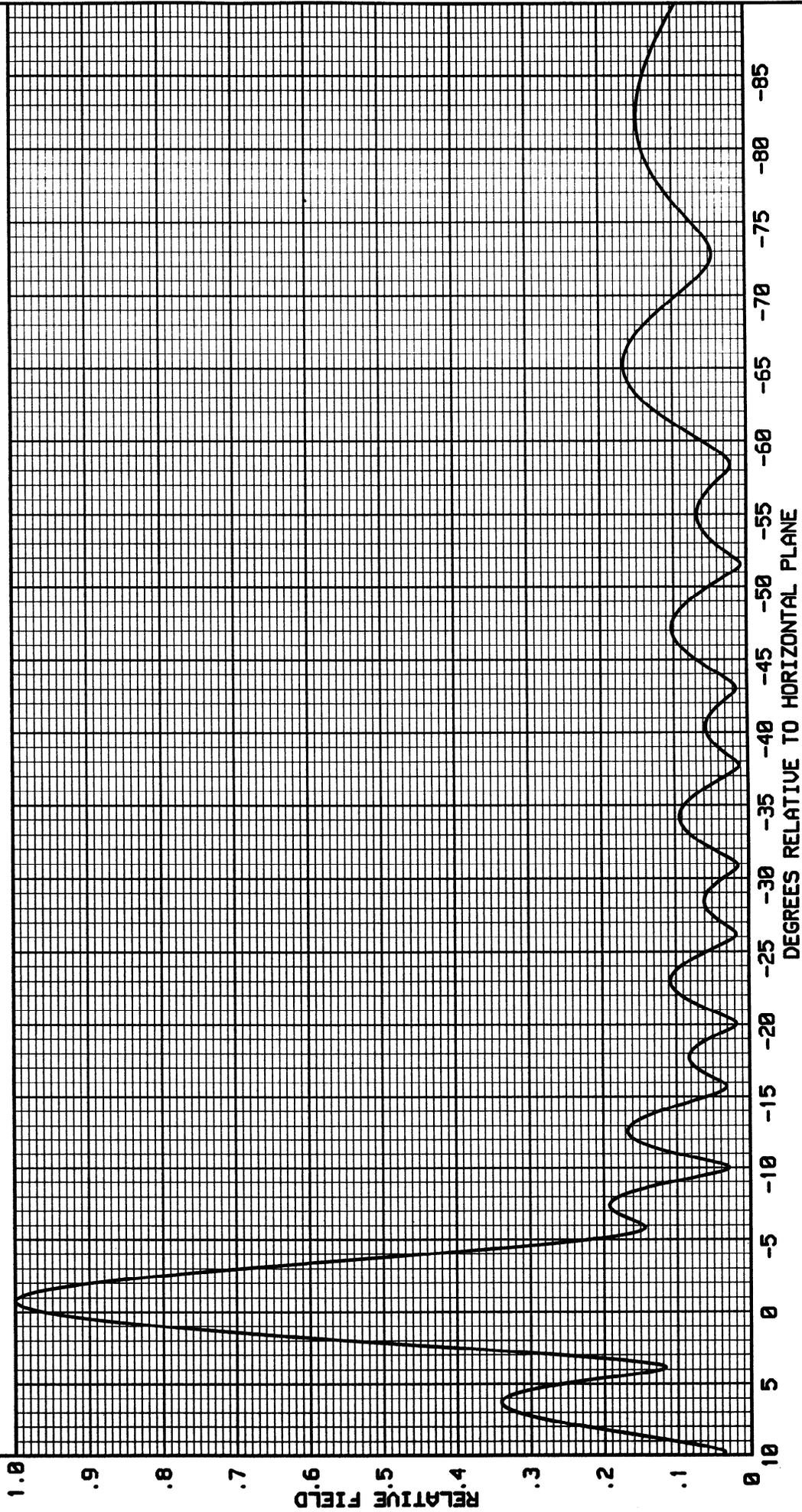
SEPTEMBER 25, 2000
101.1 MHz
ELEMENT SPACING
114.2857 INCHES

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

12 ERI TYPE SHP, SHPX, LP, OR LPX ELEMENTS
-.75 DEGREE(S) ELECTRICAL BEAM TILT
14 PERCENT FIRST NULL FILL
3 PERCENT SECOND NULL FILL

POWER GAIN IS 5.936 IN THE HORIZONTAL PLANE(6.428 IN THE MAX.)

FIGURE 1



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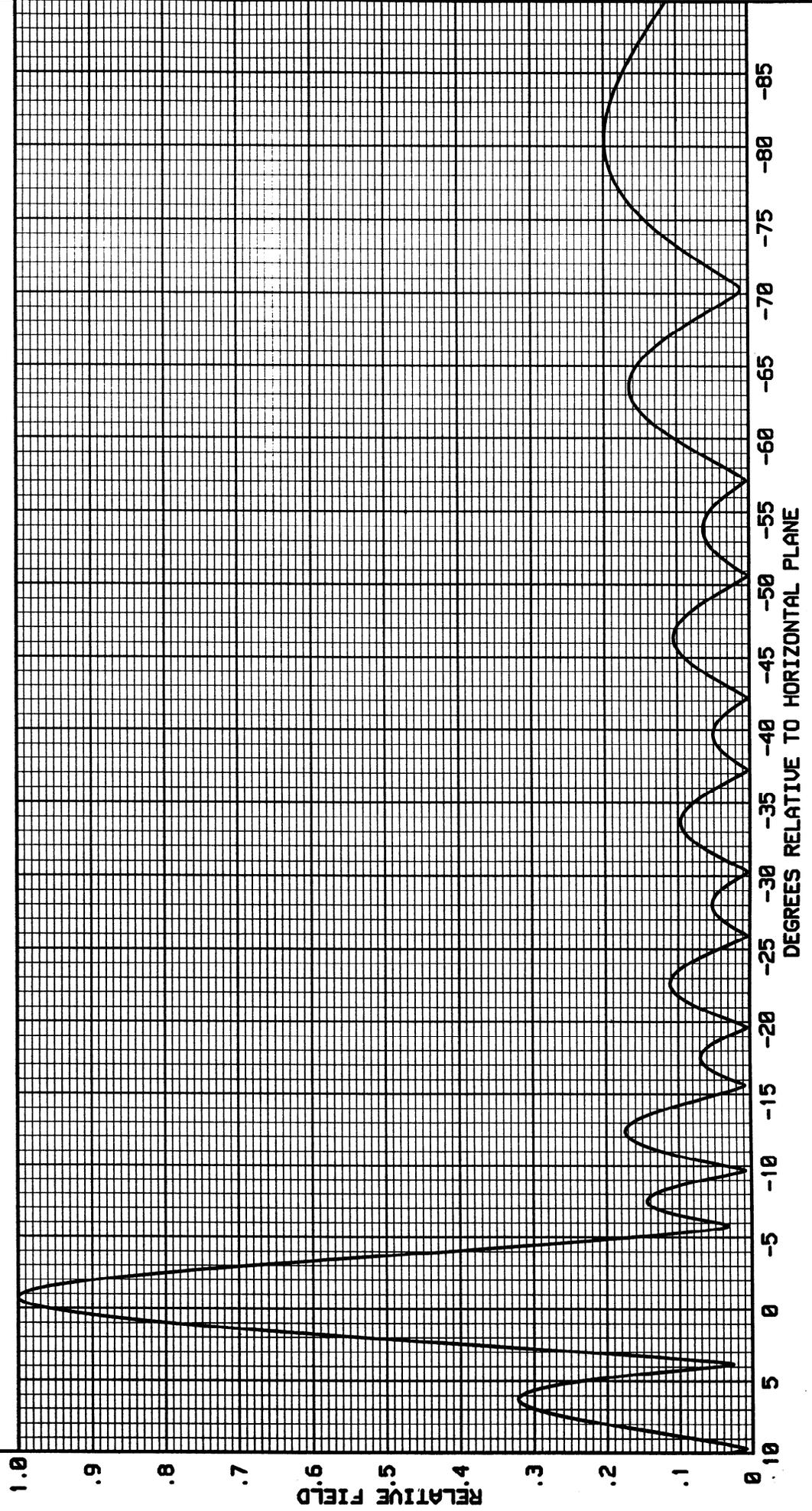
FIGURE 2

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

12 ERI TYPE SHP, SHFX, LP, OR LPX ELEMENTS
-.75 DEGREE(S) ELECTRICAL BEAM TILT
3 PERCENT FIRST NULL FILL
1 PERCENT SECOND NULL FILL

POWER GAIN IS 6.124 IN THE HORIZONTAL PLANE(6.644 IN THE MAX.)

SEPTEMBER 25, 2000
102.5 MHz
ELEMENT SPACING
114.2857 INCHES



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CHANDLER, IN. 47610

FIGURE 3

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

12 ERI TYPE SHP, SHPX, LP, OR LPX ELEMENTS
-.75 DEGREE(S) ELECTRICAL BEAM TILT
14 PERCENT FIRST NULL FILL
3 PERCENT SECOND NULL FILL

POWER GAIN IS 5.783 IN THE HORIZONTAL PLANE(6.299 IN THE MAX.)

SEPTEMBER 25, 2000
104.7 MHz
ELEMENT SPACING
114.2857 INCHES

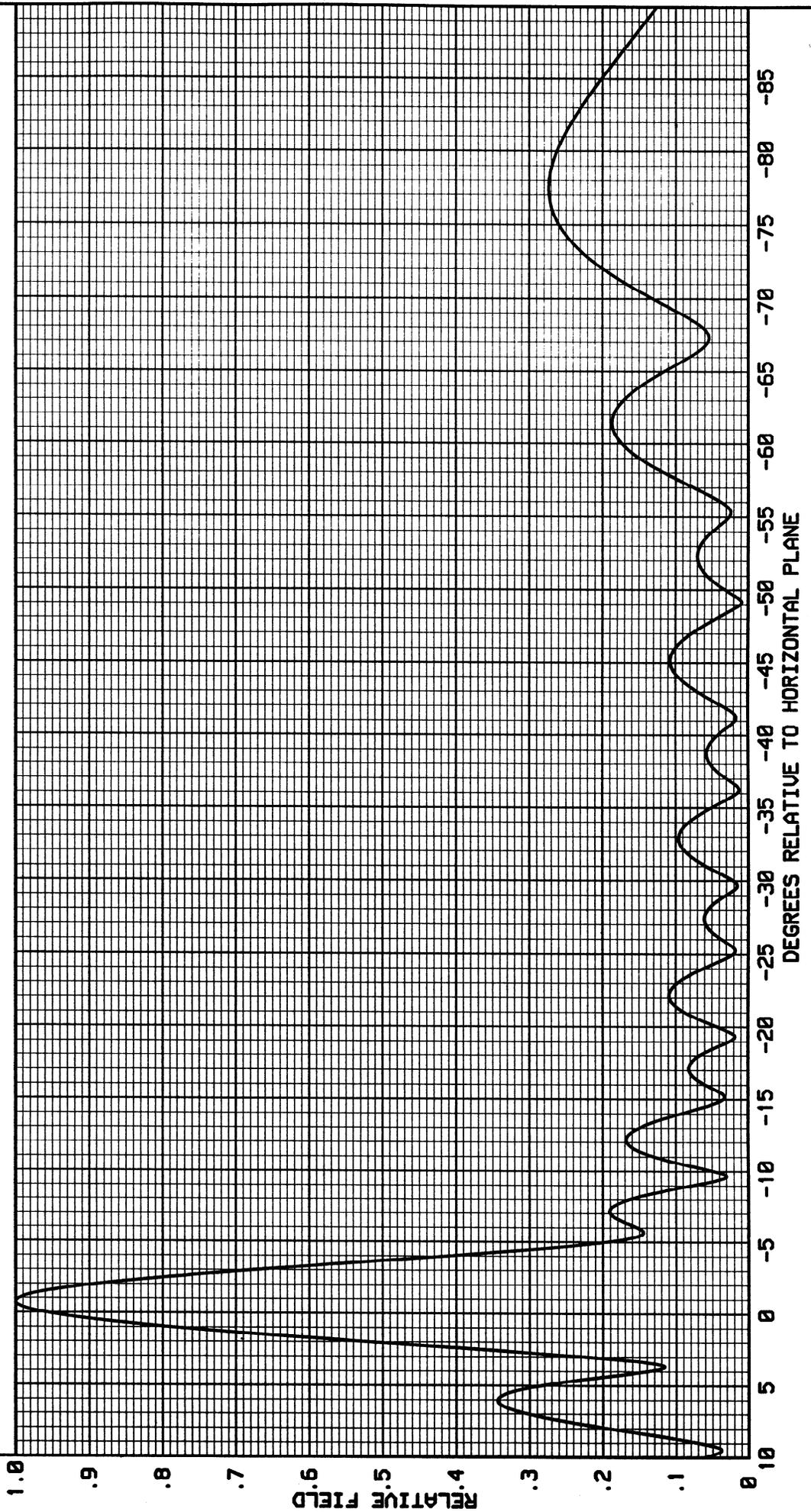


Exhibit B

Inter-Modulation Product Measurement Equipment Layout

