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Report of Inter-Modulation Product Measurements

for

Two Station T-Type Combiner
KEAN 105.1 MHz / KEYJ 107.9 MHz

Combined Broadcast Facility
Abilene, TX

July 8, 2001

55 Years 1943 - 1998

Contents

Introduction

This report of findings provides evidence to show that the two-station combined facility for the operation of KEAN and KEYJ 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). Eric Wandel and Jeff Taylor of Electronics Research, Inc. performed the measurements summarized herein on July 8, 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 T-type combiner system installed by ERI at the KEAN/KEYJ 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 both KEAN and KEYJ.

T-Type Combiner System

Both stations (KEAN and KEYJ) 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 two-station T-combiner system combining KEAN (105.1 MHz) and KEYJ (107.9 MHz). The combiner system is illustrated in the attached Exhibit A on page A-1.

The inter-modulation products were measured with both 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 6-1/8" 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 60 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 – T-Combiner System

Carrier Frequency (MHz)	Pad One (dB)	Bandpass Filter Loss (dB)	Pad Two (dB)	Full Scale Range (dBμ)	Scale Reading (dB)	Adjusted Level (dBμ)
105.1	10	—	—	120	-9.2	120.8
107.9	10	—	—	120	-8.8	121.2

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 Abilene, TX
KEAN/KEYJ T-Combiner System

	Interfering Frequency (MHz)	
Carrier Frequency (MHz)	**105.1**	**107.9**
105.1	–	102.3
107.9	110.7	–

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 T-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)
102.3	105.1	107.9	10	-9.83	3	20	<-20	<22.83	<97.97
110.7	107.9	105.1	10	-9.24	3	20	<-20	<22.24	<98.96

Conclusions

Based upon the observations and measurements recorded in this document, I, Eric Wandel, find the T-Combiner system for the operation of the KEAN main transmitter and the KEYJ 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 KEAN and KEYJ are in compliance with the requirements of Sections 73.317 paragraph (d) of the FCC Rules and Regulations.

Respectfully submitted by Electronics Research, Inc.

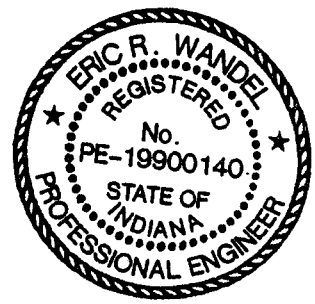
AFFIDAVIT

I, Eric R. Wandel, under the employ of Electronics Research, Inc. of Chandler, Indiana, have performed the preparation of all technical information contained in this document and to my knowledge have made no misrepresentations or false claims.

My qualifications to perform this work are supported as follows:

1. Education includes:
   a) The degree of Bachelor of Science in Electrical Engineering from Rose-Hulman Institute of Technology
   b) The degree of Bachelor of Science in Applied Optics from Rose-Hulman Institute of Technology
   c) The degree of Master of Science in Electrical Engineering from Rensselaer Polytechnic Institute
2. Experience includes:
   a) Recent experience includes laboratory work, engineering analysis projects, and field installation experience with Electronics Research, Inc. in the Antenna and Filter product areas
   b) Previous experience includes six years of engineering work in the military aerospace industry, including tasks involving RF signal processing, antenna measurements, microwave system testing, and various related areas in electromagnetics
3. Registered Professional Engineer in the State of Indiana, License No. PE19900140

Eric R. Wandel, P.E.

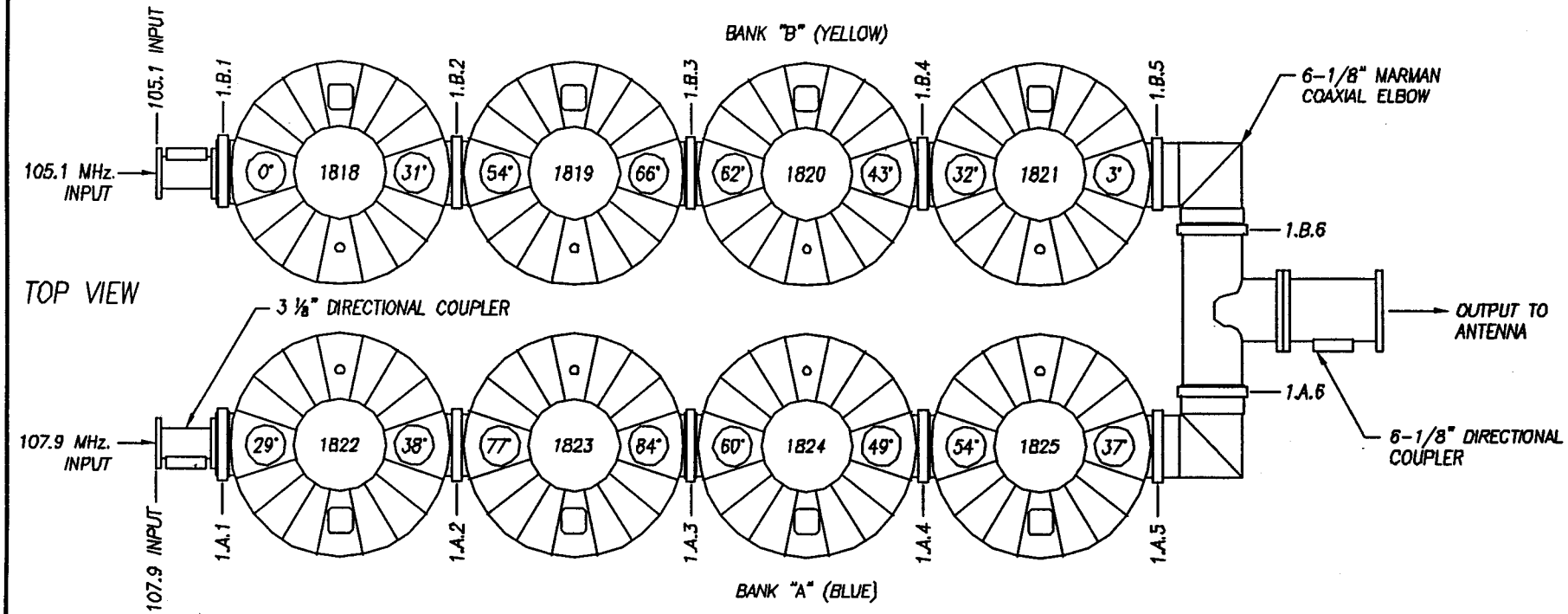


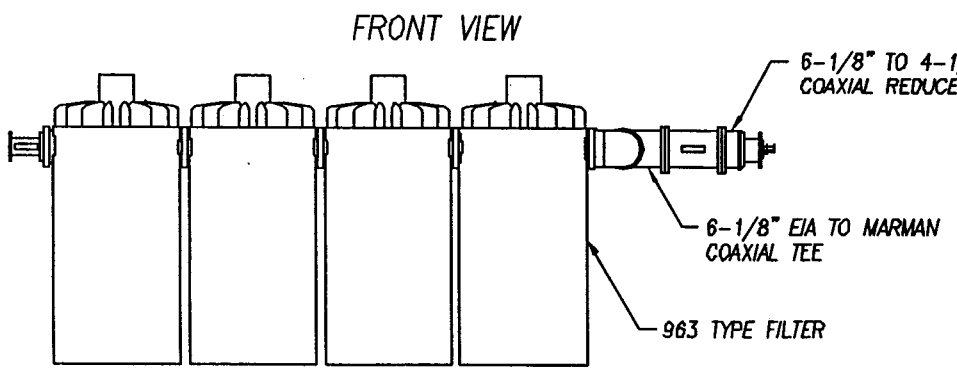
Subscribed and sworn to before me on this 16th day of July 2001.

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

Exhibit A

Schematic Drawings and Specifications for Filter/Combiner/Antenna Systems





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.

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NO	REVISION	APP'D	DATE
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NAME TUNING DETAIL
STATION: KEAN, KEYJ — ABILENE, TEXAS
FREQUENCY: AS LISTED PROJECT NO.: 08405/2
PATH: G:\DRAFTING\ALL\PROJECTS\08405\2
FILE: IM — 2 DRAWN: R.R.H. FACTOR: AS LISTED
DATE: 2/13/01 APP'D
MODEL: 963F08-U34 DWG. NO. IM — 2

T-Combiner System Specification Sheet
KEAN/KEYJ
Abilene, Texas

General Specifications

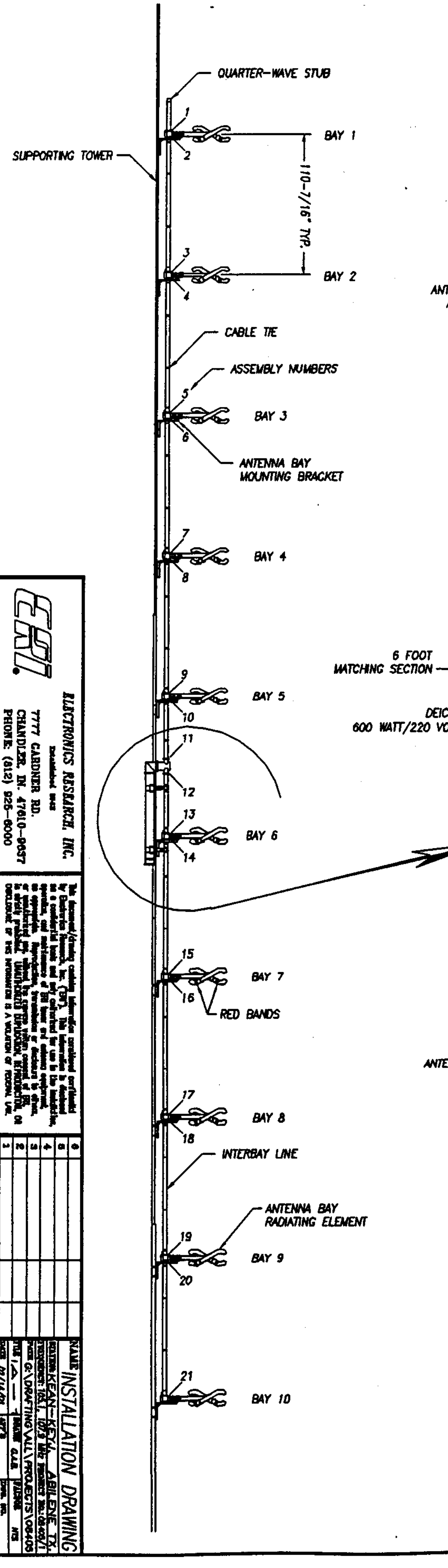
Multiplexer Type ..... Band Pass T-Type Combiner
Number Of Combining Modules Used ..... Two, Type 963
Injected Port to Injected Port Isolation (typical) ..... 60 dB
Output Connector ..... 6-1/8" 50Ω EIA (Flanged)
Output Power ..... 50 kW

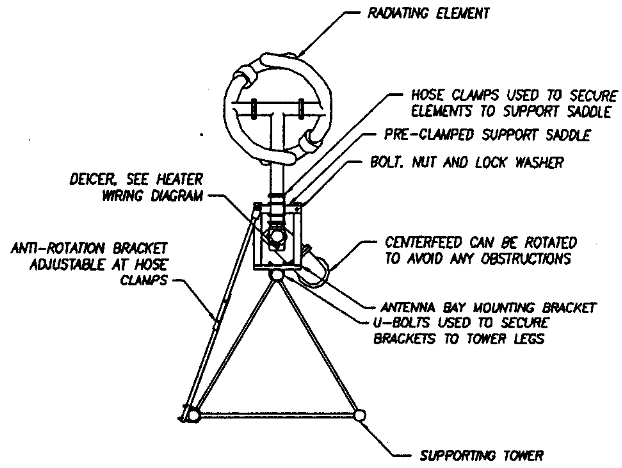
Combiner Modules, Size and Weight (approx):
Type 963-4 Tuned to 105.1 MHz ..... 4.5' ht. X 2' wd. X 8' lng. & 1,200 lbs.
Type 963-4 Tuned to 107.9 MHz ..... 4.5' ht. X 2' wd. X 8' lng. & 1,200 lbs.
Heat Removal (All Multiplexer Components) ..... Natural Convection
Physical Arrangement ..... All Components Floor Standing

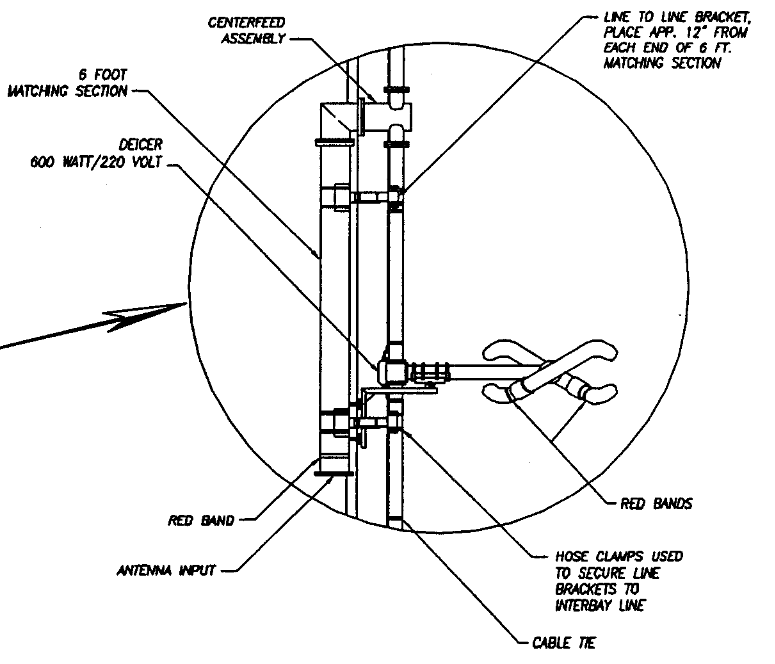
Injected Port Specifications

Frequency Assignments ..... 105.1 and 107.9 MHz
Power Rating, Each Injected Port (Maximum) ..... 25 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):
105.1 MHz -0.224 dB @ +/- 100 kHz
107.9 MHz -0.205 dB @ +/- 100 kHz

(1) When Terminated in 50 Ohm Resistive Load.




RADIATING ELEMENT
HOSE CLAMPS USED TO SECURE ELEMENTS TO SUPPORT SADDLE
PRE-CLAMPED SUPPORT SADDLE
BOLT, NUT AND LOCK WASHER
DEICER, SEE HEATER WIRING DIAGRAM
ANTI-ROTATION BRACKET ADJUSTABLE AT HOSE CLAMPS
CENTERFEED CAN BE ROTATED TO AVOID ANY OBSTRUCTIONS
ANTENNA BAY MOUNTING BRACKET
U-BOLTS USED TO SECURE BRACKETS TO TOWER LEGS
SUPPORTING TOWER



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 86'-6" 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. ANTI-ROTATION BRACKETS OMITTED FROM ELEVATION VIEW FOR CLARITY.
7. FINAL ORIENTATION TO BE DETERMINED BY STATION PERSONNEL.

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NAME: INSTALLATION DRAWING
KEAN-KEYJ ABILENE, TX.
MODEL: SHPX-10AC6-SP
DWG. NO. A-1

ERI Antenna Specification Summary
KEAN/KEYJ
Abilene, Texas

General Specifications

Antenna Type ..... High Power FM-Broadcast, Suitable for Multiplexing
Model Number ..... SHPX-10AC6-SP with heaters
Number Of Bay Levels ..... Ten (one element per bay)
Polarization ..... Right Hand Circular

Electrical Specifications

Antenna Input Power Capability ..... 64 kW Maximum (1)
Diplexed Frequencies ..... 105.1 and 107.9 MHz
VSWR (typical) ..... 1.15 : 1 @ Operating Frequencies
Typical Horizontal Plane Pattern Circularity ..... Better than +/-2 dB from RMS (Free Space)
Power Split ..... 50/50 (Horizontal & Vertical)
Frequency Specific Information:

Frequency	Station ERP	Beam Tilt	First Null Fill	Power Gain	Line Loss (2)	Filter Loss (3)	Computed TPO
105.1 MHz.	100 kW	-0.0°	8 %	5.620	-0.7353 dB	-0.224 dB	22.2 kW
107.9 MHz.	100 kW	-0.0°	8 %	5.539	-0.7473 dB	-0.205 dB	22.5 kW

Mechanical Specifications

Antenna Feed System ..... Fed with approx. 500' Andrew 4" Heliax and
..... 212.5' Myat 4-1/16" Rigid Feed Line
Input Connector ..... 6-1/8" 50- Ohm EIA Flanged (6-1/8" diameter rigid matching section)
Element Deicing ..... Heaters
Interbay Spacing (approx) ..... 110-7/16 Inch Center-to-Center
Array Length (approx) ..... 86.5 Feet
Mounting ..... Customer furnished triangular 42" face tower
Construction Material (Antenna) ..... All Noncorrosive
Construction Material (Mounting) ..... Galvanized Plated Steel and Stainless Steel

1) Power Capability Has Been Rated Assuming an Operating Transmission VSWR Of 1.5:1
2) Line Loss Assumes A Feed Run of 500 feet of Andrew 4" heliax and 212.5 feet of Myat 4-1/16" Rigid Coax
Line losses in dB per 100 feet at each system frequency:

	105.1	107.9
Andrew 4"	-0.116	-0.118
Myat 4-1/16"	-0.0731	-0.074

3) Losses Taken From Actual Multiplexer Measurements

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FIGURE 1

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

10 ERI TYPE SHP, SHPX, LP, OR LPX ELEMENTS
+0.00 DEGREE(S) ELECTRICAL BEAM TILT
8 PERCENT FIRST NULL FILL
0 PERCENT SECOND NULL FILL
POWER GAIN IS 5.620 IN THE HORIZONTAL PLANE(5.620 IN THE MAX.)

OCTOBER 12, 2000

105.1 MHz

ELEMENT SPACING
110.4375 INCHES

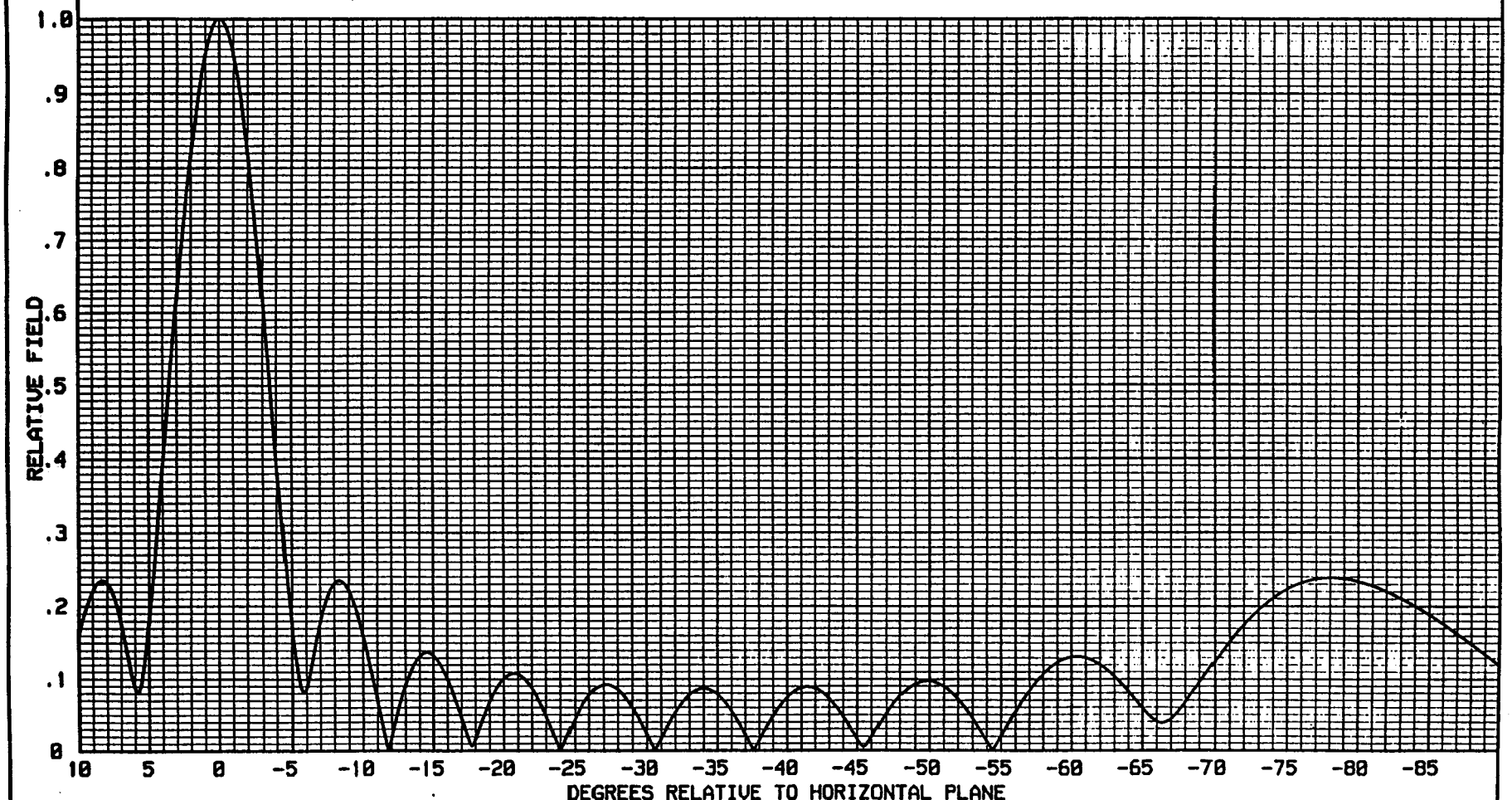

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FIGURE 2

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

10 ERI TYPE SHP, SHPX, LP, OR LPX ELEMENTS
+0.00 DEGREE(S) ELECTRICAL BEAM TILT
8 PERCENT FIRST NULL FILL
0 PERCENT SECOND NULL FILL
POWER GAIN IS 5.539 IN THE HORIZONTAL PLANE(5.539 IN THE MAX.)

OCTOBER 12, 2000

107.9 MHz

ELEMENT SPACING
110.4375 INCHES

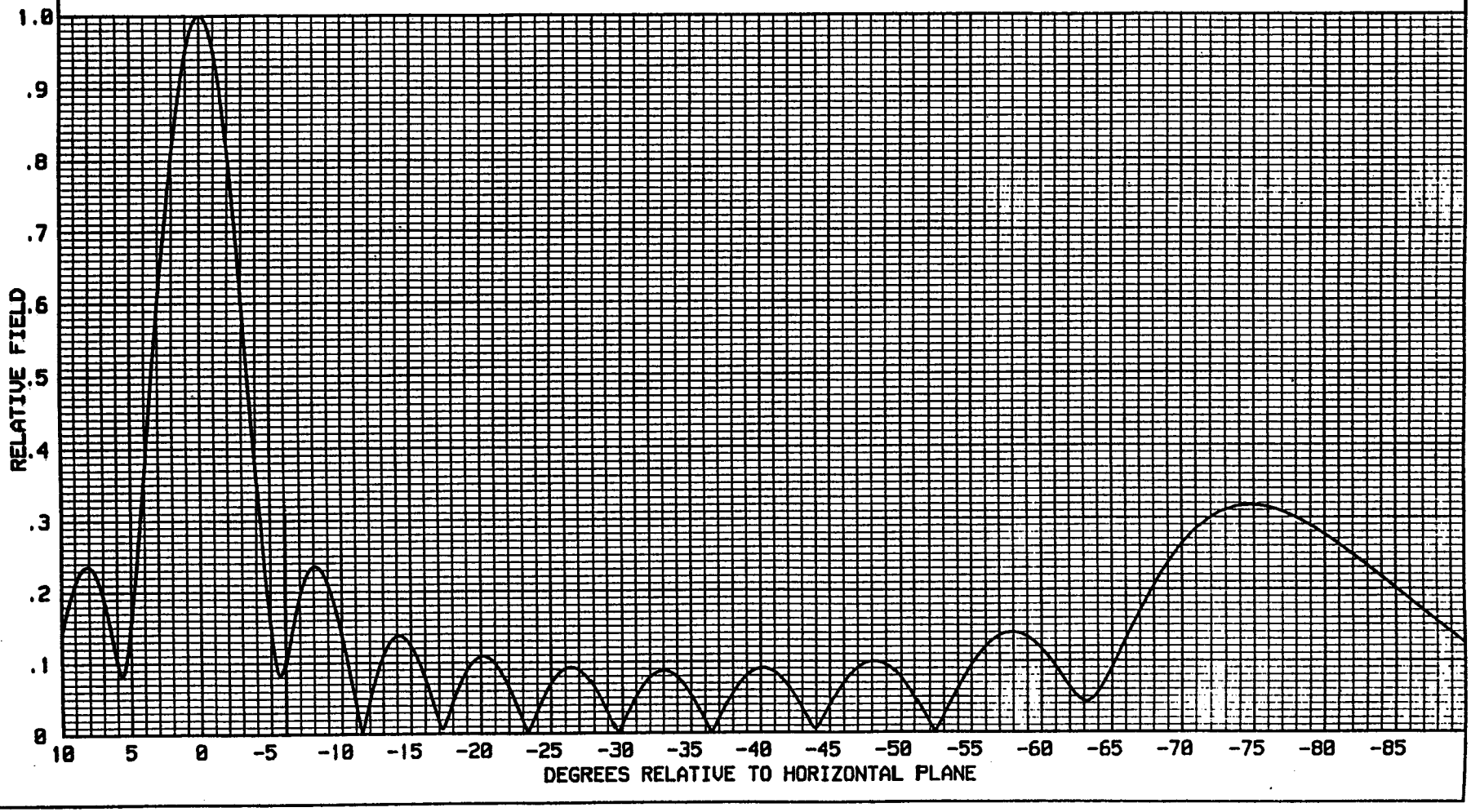

Exhibit B

Inter-Modulation Product Measurement Equipment Layout