



ERI *ELECTRONICS RESEARCH, INC.*

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Report Of Intermodulation Product Findings

*KTEX, KBFM BROADCAST FACILITY
MCALLEN, TEXAS*

April 2003

**Electronics Research Inc.
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REPORT OF FINDINGS
KTEX, KBFM COMBINED BROADCAST FACILITY
MCALLEN, TEXAS

Introduction: This report of findings is based on data collected at the KTEX and KBFM combined FM broadcast facility located in McAllen, TX. The report includes measurements offered as proof that the combined operations of KTEX (100.3 MHz.) and KBFM (104.1 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). Jeff Taylor of Electronics Research, Inc. located in Chandler, Indiana performed the measurements summarized herein on April 2, 2003.

The following exhibits are provided:

Exhibit A:

- A-1 Drawing Depicting Antenna.
- A-2 SHPX-12AC6-SP Antenna Specification Sheet.
- A-3 Drawing Depicting Multiplexing Scheme.
- A-4 963 - 6 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 : These measurements were taken with two FM stations operating from the combined antenna system. The KTEX, and KBFM multiplexed system is fundamentally comprised of antenna, feed line and multiplexer unit. The SHPX-12AC6-SP antenna and 963 TEE multiplexer unit are products of Electronics Research, Inc, whereas the feed line is manufactured by Andrew and Dielectric, Refer to Exhibit B-2, 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 was installed. Specifically, the Multiplexer utilizes three ERI Model 963 Bandpass filters for each transmitter. An interconnecting TEE is required to complete the multiplexer which is illustrated in the attached Exhibit A-3. The multiplexer, fully assembled, exhibited transmitter port-to-port isolation in excess of -60 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 40 dB directivity and a forward signal sample of -60 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. A Tektronix Model 2710 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-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.

Table 1 - Carrier Reference Levels.

Carrier Frequency (MHz)	Pad One (dB)	Bandpass Filter Loss (dB)	Full Scale Range (dB:)	Scale Reading (dB)	Adjusted Level (dB:)	Notes
KTEX (100.3)	3	-	120	- 4.0	119.0	
KBFM (104.1)	3	-	120	- 4.5	118.5	

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.

Interfering Frequency (MHz)	Carrier Frequency (MHz)	
	KTEX 100.3	KBFM 104.1
KTEX 100.3	---	107.9
KBFM 104.1	96.5	—

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*
96.5	100.3	104.1	+3	+9.1	20	<-20	<12.1	119.0	<-106.0	
107.9	104.1	100.3	+3	+8.6	20	-.5	31.1	118.5	-87.4	

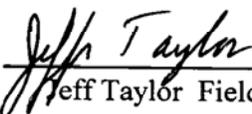
* NOTES

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 April 2nd, 2003 as summarized in this document, I, Jeff Taylor, find the subject multiplexed system- specifically the transmitters and combiner system for the operation of the KTEX and KBFM into the SHPX-12AC6-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 KTEX and KBFM 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  _____
Jeff Taylor Field Technician

State of Indiana)
) SS:
County of Warrick)

AFFIDAVIT

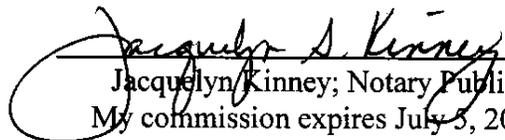
I, Jeff Taylor, hereby declare that the following statements are true and correct to the best of my knowledge and belief :

- 1.) I am a Field Technician for Electronics Research, Inc (“ERI “) and have been employed by ERI for 7 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 on behalf of radio Stations KTEX and KBFM in McAllen, TX. to prepare this Report Of Findings.



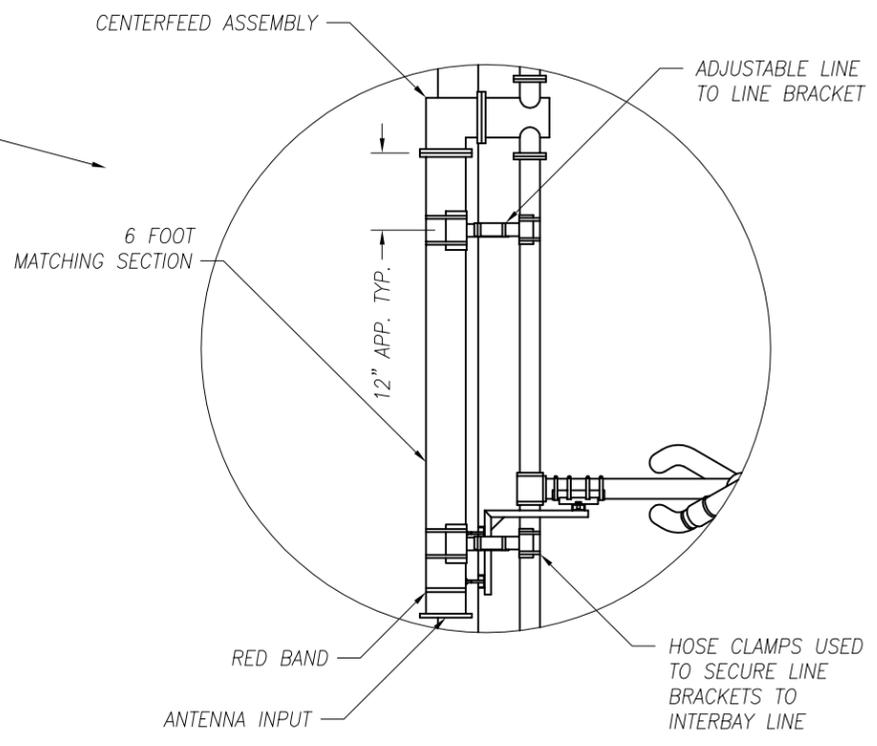
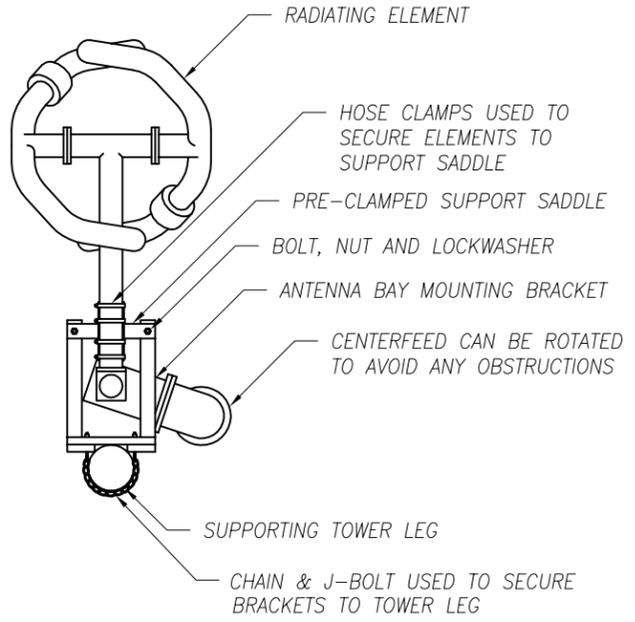
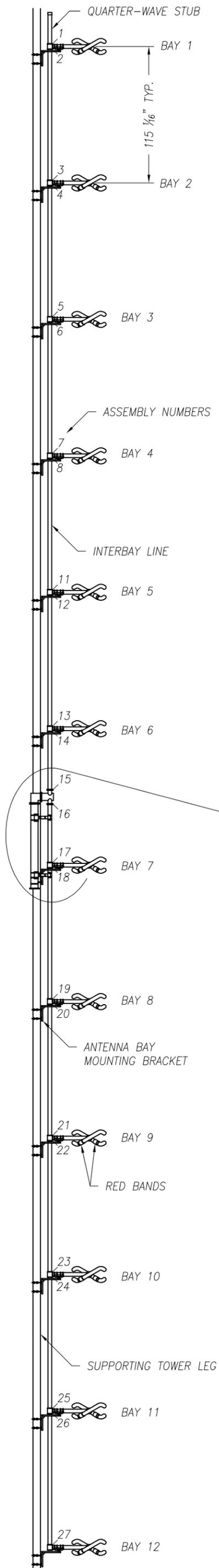
Jeff Taylor; Field Technician

Subscribed and sworn to before me on this 4th, day of April 2003!



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





- 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'-3" 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.

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ERI

NAME: INSTALLATION DRAWING
 STATION: KTEX - BROWNSVILLE, TX.
 FREQUENCY: 100.3 & 104.1 MHz PROJECT NO.: 08644/1
 PATH G: \DRAFTING\ALL\PROJECTS\08644
 FILE: 1 - 1 DRAWN: BAM FACTOR: NTS
 DATE: 7/17/01 APP'D: [Signature]
 MODEL: SHPX-12AC6-SP1/A-1

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

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.
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A-2 ERI Antenna Specification Sheet

McAllen, Texas

General Specifications

Antenna Type High Power FM-Broadcast, Suitable For Diplexing
 Model Number SHPX-12AC6-SP
 Number Of Bay Levels Twelve
 Polarization Right Hand Circular

Electrical Specifications

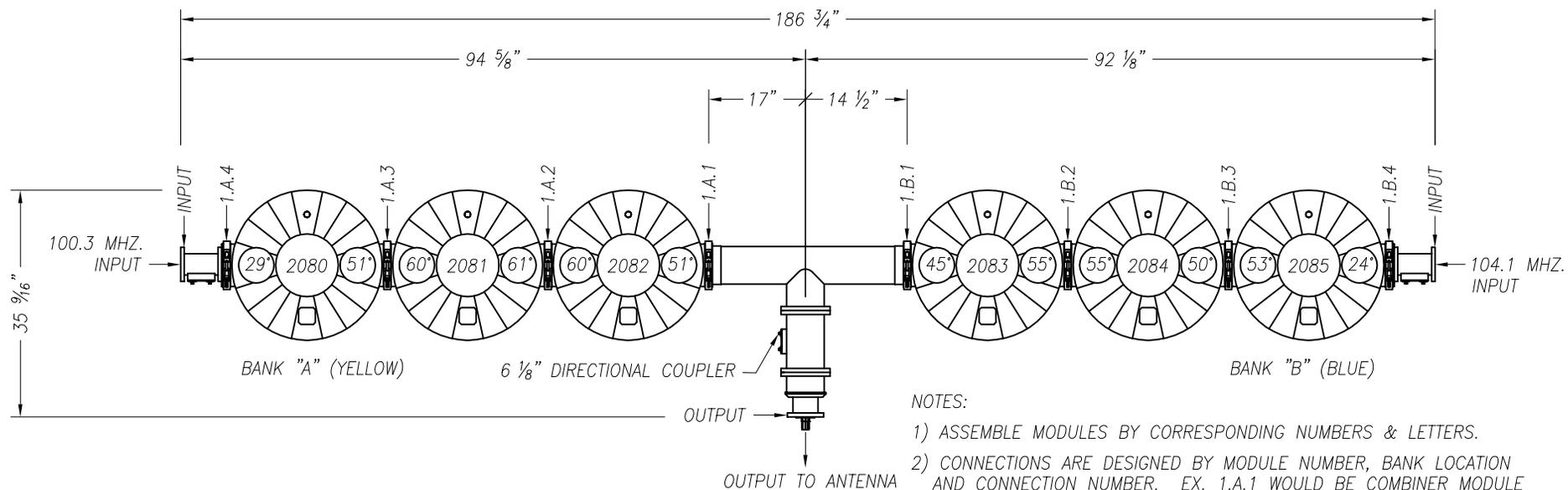
Antenna Input Power Capability (Single Feed) 64 KW Max ⁽¹⁾
 Operating Frequency Band 100.3 And 104.1 Megahertz.
 VSWR 1.1:1 @ Operating Frequencies⁽²⁾
 Azimuthal Pattern Circularity Less Than +/- 1.5 dB From RMS (Free Space)
 Power Split 50/50 (Horizontal & Vertical)
 Quarter Wave Shorting Stub Yes
 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> ⁽³⁾	<u>Filter Loss</u> ⁽⁴⁾	<u>Computed TPO</u>
100.3	100 (KW)	0.0°	14 %	0%	6.606	.828 dB	.188 dB	19.1 (KW)
104.1	100 (KW)	0.0°	14 %	0%	6.483	.831 dB	.169 dB	19.4 (KW)

Mechanical Specifications

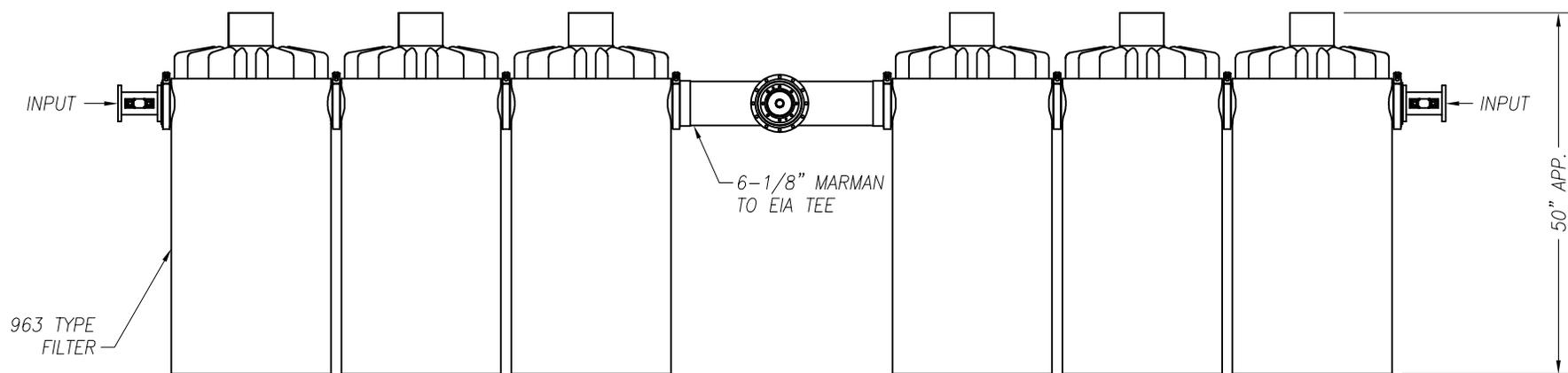
Antenna Feed System Fed With Single Line
 Input Connector 6 1/8" 50- Ohm EIA Flanged
 Element Deicing None Ordered
 Interbay Spacing 115.065" Center to Center
 Array Length Approximately 109' 3"
 Construction Material (Antenna) All Noncorrosive
 Construction Material (Mounting) All Stainless Steel

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 121 Feet, 4" Andrew Flex HJ11-50 and 1,355 Feet, Dielectric Type 70 Series Rigid 6 1/8" Coax.
 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.

Established 1943

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6					NAME	TUNING DETAIL	
5					STATION:	MCALLEN, TX.	
4					FREQUENCY:	100.3 & 104.1 MHz. PROJECT NO.: 09720	
3					PATH:	G:\DRAFTING\ALL\PROJECTS\09720	
2					FILE:	IM-2	DRAWN BAM FACTOR NTS
1					DATE:	9/9/02	APP'D _____ DWG. NO.
NO	REVISION	APP'D	DATE		MODEL:	963F06-000-T34	IM-2

A-4 ERI Combiner Specification Sheet

MCALLEN, TEXAS

General Specifications:

Multiplexer Type 963-6 TEE Combiner
 Number Of Combining Units Two
 Injected Port to Injected Port Isolation - 64 dB
 Output Connector 6 1/8 " 50 Ohm EIA (Flanged)
 Output Power (Designed) 40 KW⁽¹⁾
 Combiner Units, Size and Weight :

Type 963-3 Tuned To 100.3 MHz. 5' ht. X 2' wd. X 6' lg. & 555 Lbs.
 Type 963-3 Tuned To 104.1 MHz. 5' ht. X 2' wd. X 6' lg. & 555 Lbs.

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

Injected Port Specifications:

Frequency Assignment 100.3 MHz. And 104.1 MHz.
 Power Rating, Each Injected Port (Designed) 20 KW
 Input Connector 3-1/8" 50 Ohm EIA (Flanged)
 VSWR Less than 1.08:1 @ +/-150 KHz²
 Group Delay Less than 50 ns Overall Variation, Carrier @ +/- 150 KHz
 Insertion Loss (Measured):

100.3 MHz. - 0.188 dB
 104.1 MHz. - 0.169 dB

1) Power Rating Listed is as Designed Only. Actual Power Capabilities May Vary.
 2) When Terminated in 50 Ohm Resistive Load.

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CHANDLER, IN. 47610

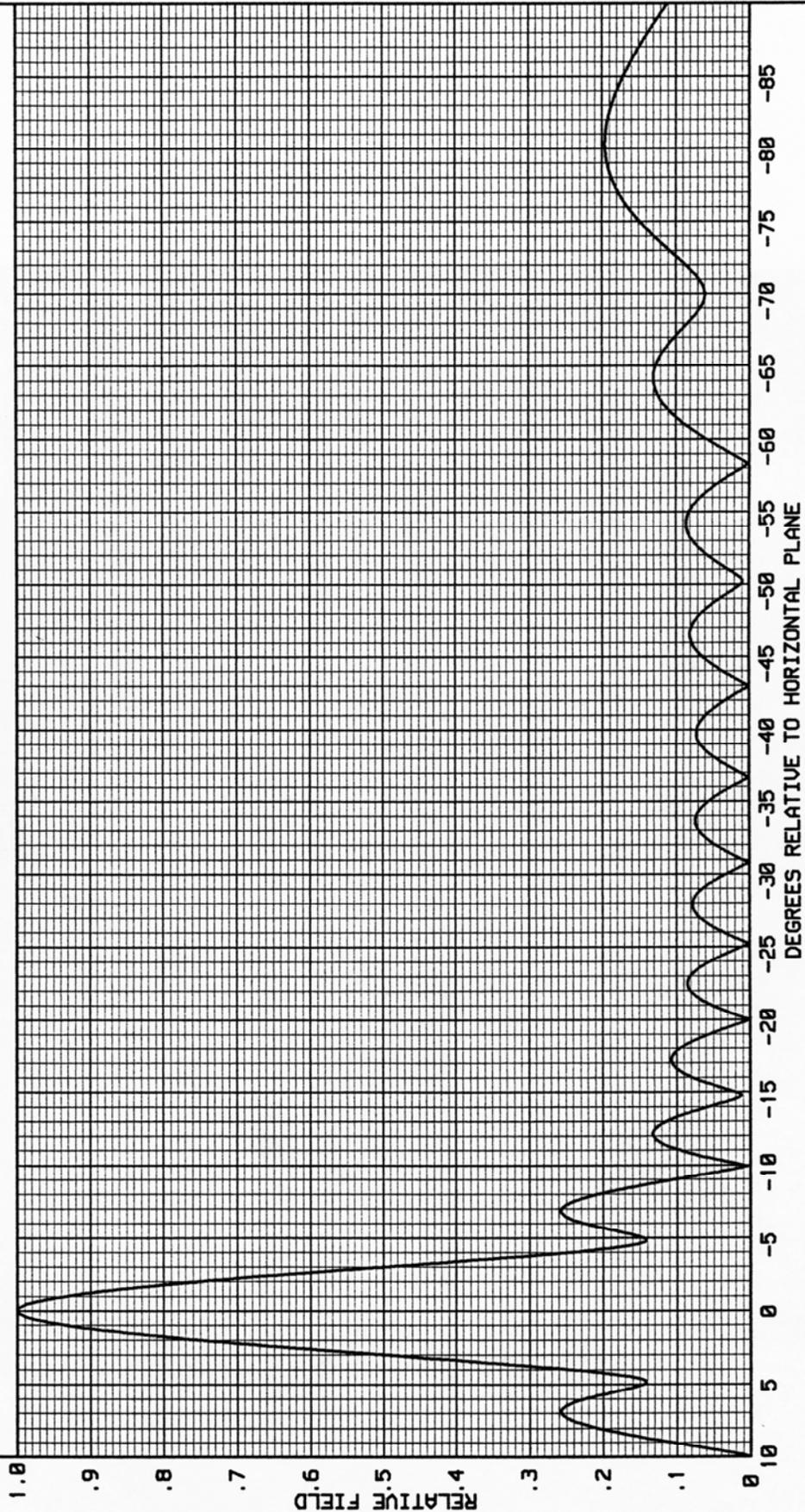
-----THEORETICAL-----
VERTICAL PLANE RELATIVE FIELD

JUNE 24, 2002
100.3 MHz
ELEMENT SPACING
115.0625 INCHES

12 ERI TYPE SHP, SHPX, LP, OR LPX ELEMENTS
+0.00 DEGREE(S) ELECTRICAL BEAM TILT
14 PERCENT FIRST NULL FILL
8 PERCENT SECOND NULL FILL

POWER GAIN IS 6.606 IN THE HORIZONTAL PLANE(6.606 IN THE MAX.)

FIGURE 1



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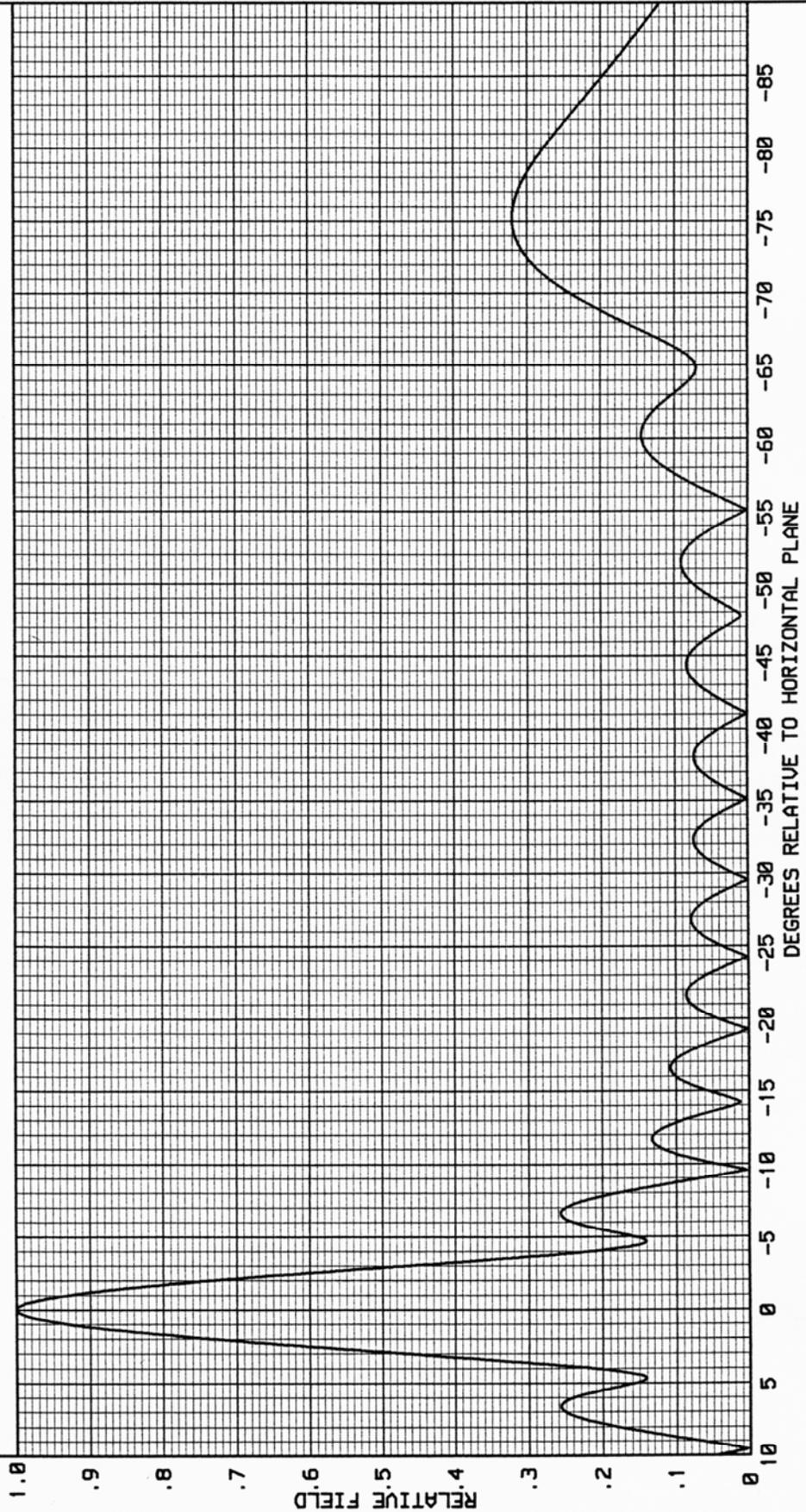
-----THEORETICAL-----
VERTICAL PLANE RELATIVE FIELD

12 ERI TYPE SHP, SHPX, LP, OR LPX ELEMENTS
+0.00 DEGREE(S) ELECTRICAL BEAM TILT
14 PERCENT FIRST NULL FILL
0 PERCENT SECOND NULL FILL

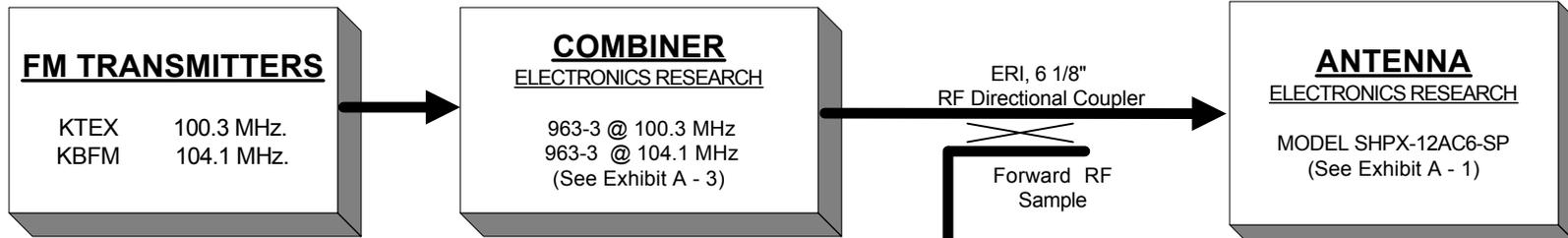
JUNE 24, 2002
104.1 MHz
ELEMENT SPACING
115.0625 INCHES

FIGURE 2

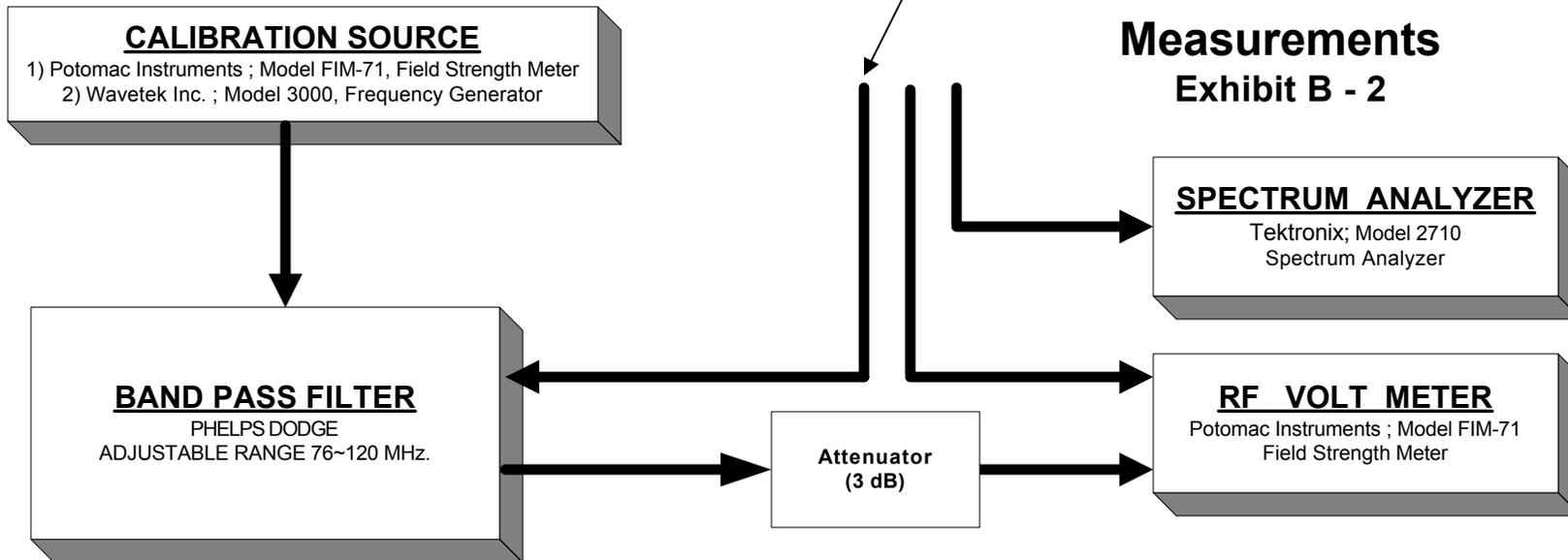
POWER GAIN IS 6.483 IN THE HORIZONTAL PLANE(6.483 IN THE MAX.)



KTEX ~ KBFM Broadcasting Scheme EXHIBIT - B1



Equipment Employed in Intermodulation Measurements Exhibit B - 2



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

Broadcasting Scheme and Equipment Employed in Intermodulation Measurements