Report Of Intermodulation Product Findings

Lahoma, OK.

KXLS 95.7 MHz.
KZLS 107.1 MHz.

Job # 22051

July 15, 2008

Electronics Research Inc.
7777 Gardner Road
Chandler, Indiana 47610
Phone (812) 925-6000 Fax (812) 925- 4030

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Report of Findings for Intermodulation Product Measurements

Exhibits Accompanying This Report

REPORT OF FINDINGS
KXLS 95.7 MHz.
KZLS 107.1 MHz.

Introduction: This report of findings is based on data collected at the KXLS, and KZLS broadcast facility located in Lahoma, OK. The report includes measurements offered as proof that the combined operations of KXLS (95.7 MHz) and KZLS (107.1 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 diplex system are less than the maximum allowable level as required by section 73.317 (b) through (d). Mark Garrison of Electronics Research, Inc. located in Chandler, Indiana performed the measurements summarized herein on July 16, 2008…....

The following exhibits are provided:

Exhibit A:
- A-1 Drawing Depicting Antenna.
- A-2 SHPX-6AC3-SP Antenna Specification Sheet.
- A-3 Drawing Depicting Diplexing Scheme.
- A-4 973-3/970-3 Series "TEE" Combiner Diplexer 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 Diplexed 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 diplexed 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 diplexed 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 F2 signifies the frequency causing the interference.

The Diplexed System: These measurements were taken with two FM stations operating from the combined antenna system. The KXLS and KZLS diplexed system is fundamentally comprised of antenna, feed line and diplexer unit. The SHPX-6AC3-SP (antenna) and 973-3 / 970-3 Series "TEE" combiner units are products of ERI. App. 320 feet of 3 1/8"Heliax are products of Andrew, whereas app. 60 feet of the feed line is 3 1/8" Dielectric Rigid manufactured by Dielectric. 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 diplexing scheme consisting of a 973-3 /970-3 series "TEE" Combiner was installed. Specifically, the Diplexer utilizes ERI Model 973-3 /970-3 "TEE" combiner. An interconnecting "TEE" is required to complete the diplexer, which is illustrated in the attached Exhibit A-3. The diplexer, fully assembled, exhibited transmitter port-to-port isolation in excess of -79dB. 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 diplexer's 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 diplexed 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 -54 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 FIM-71 to ensure an adequate signal level for measurements without overloading the measurement equipment. A Potomac Instruments FIM-71 Field Strength Receiver Serial # 242 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 Serial # 7512028 signal generator was used. An Anritsu Sitemaster S114B with Spectrum Analyzer option Serial # 33089 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, Diplexer, Feed Line and Antenna were adjusted to optimal performance. In addition, 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 diplexed system.

Table 1 - Carrier Reference Levels.

Product Frequency (MHz)	Transmitter Frequency (MHz)	Interfering Frequency (MHz)	Pad (dB)	Bandpass Filter Loss (dB)	Total Loss	Full Scale Range (dBµ)	Scale Reading (dBµ)	Adjusted Level (dBµ)	Carrier Reference Level (dBµ)
	95.7	Ref.	6		6	120	7		119
	107.1	Ref.	6		6	120	5.7		120.3

Predictable third-order products due to system harmonics mixed with all on-site interfering frequencies that could be generated from the diplexed system are calculated and listed in Table 2.

Table 2 - Third order Products.

Product Number	Product Frequency (MHz)	Transmitter Frequency (MHz)	Interfering Frequency (MHz)
1	84.3	95.7	107.1
2	118.5	107.1	95.7

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-2 for a layout of the measurement equipment.

IM Measurements Taken in Lahoma, OK.

Product Frequency (MHz)	Transmitter Frequency (MHz)	Interfering Frequency (MHz)	Pad (dB)	Bandpass Filter Loss (dB)	Total Loss	Full Scale Range (dBµ)	Scale Reading (dBµ)	Adjusted Level (dBµ)	Carrier Reference Level (dBµ)	Level Referenced to Carrier (dB)		
	95.7	**Ref.**	**6**		**6**	**120**	**7**		**119**			
	107.1	**Ref.**	**6**		**6**	**120**	**5.7**		**120.3**			
84.3	95.7	107.1	6	13.7	19.7	20	20	19.7	119	-99.3		
118.5	107.1	95.7	6	11.1	17.1	20	20	17.1	120.3	-103.2		

The Anritus Sitemaster with an option Spectrum Analyzer was used to check the close in spectral attenuation of the carrier to confirm the operation of the transmitter is 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 Anritus Sitemaster with an option 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 on July 16, 2008 as summarized in this document, I, Mark Garrison, find the subject system- specifically the transmitter and filter system for the operation of KXLS 95.7 MHz. and KZLS 107.1 MHz. into the 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 station operating on the installed system. Based on this recorded data, I conclude that KXLS and KZLS comply with the requirements of Section 73.317 paragraph (b) through (d) of the FCC Rules and Regulations.

Respectfully submitted,
Electronics Research, Inc.

Mark Garrison, Field Technician

State of Indiana

(County of Warrick) SS:

AFFIDAVIT

I, Mark Garrison, 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 6 years. I am familiar with and have assisted in the design, manufacturing and installation of FM Antennas and FM Multiplexers in my 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 BTA on behalf of radio Stations KXLS and KZLS in Lahoma, OK.. to prepare this Report Of Findings.

Mark Garrison; Field Technician

Mark Garrison

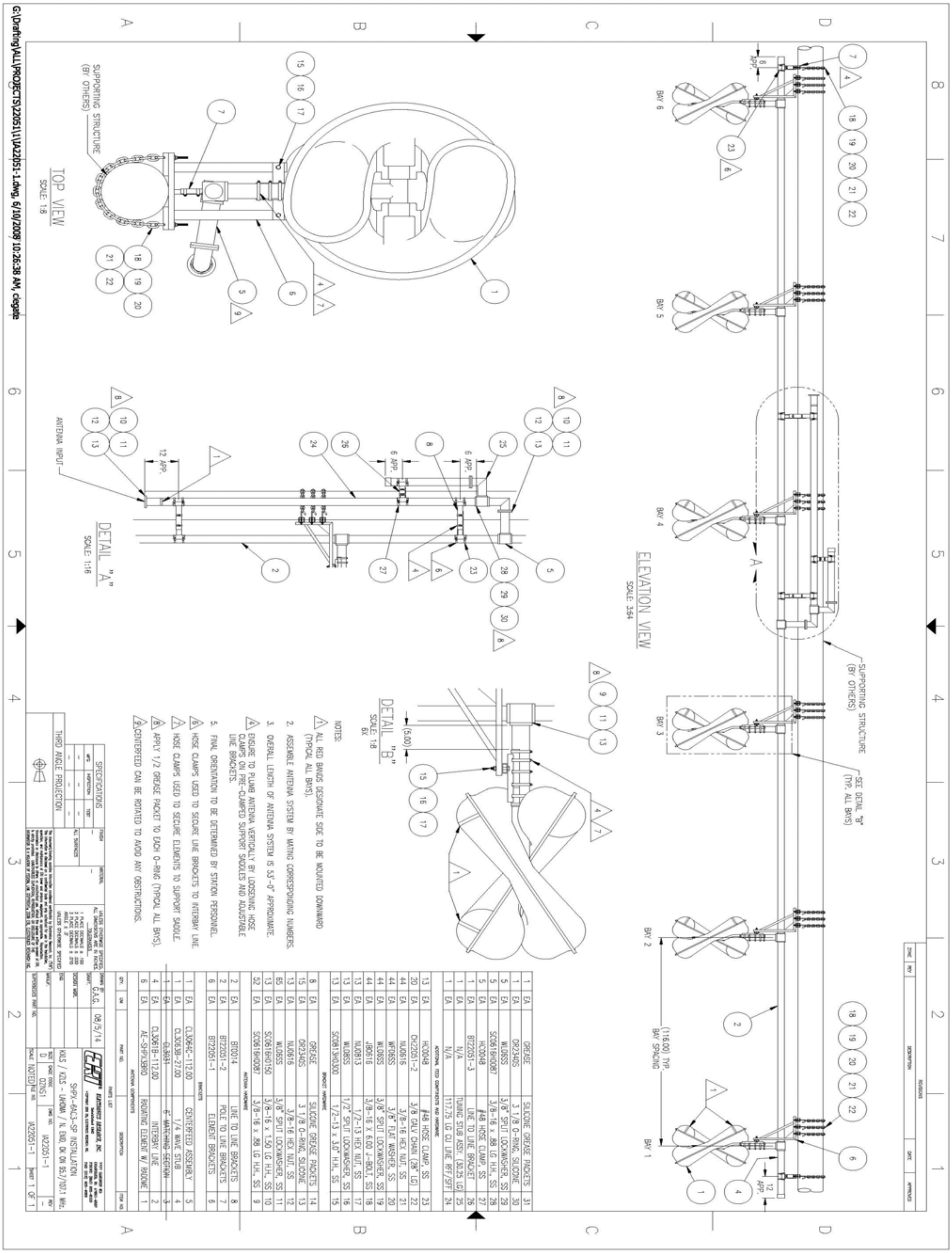
Subscribed and sworn to before me on this 17th. day of July, 2008.

Jacquelyn Kinney; Notary Public
My commission expires July 5, 2015

JACQUELYN S. KINNEY
Notary Public, State of Indiana
Vanderburgh County
My Commission Expires
July 05, 2015

Jacquelyn D. Kinney

EXHIBIT A-1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ELEVATION VIEW
SCALE: 3:64
TOP VIEW
SCALE: 1:8
DETAIL "A"
SCALE: 1:16
DETAIL "B"
SCALE: 1:8
6X
SUPPORTING STRUCTURE (BY OTHERS)
SEE DETAIL "B" (TYP. ALL BAYS)
(116.00) TYP. BAY SPACING
ANTENNA INPUT
BAY 1
BAY 2
BAY 3
BAY 4
BAY 5
BAY 6
NOTES:
1. ALL RED BANDS DESIGNATE SIDE TO BE MOUNTED DOWNWARD (TYPICAL ALL BAYS).
2. ASSEMBLE ANTENNA SYSTEM BY MATING CORRESPONDING NUMBERS.
3. OVERALL LENGTH OF ANTENNA SYSTEM IS 53'-0" APPROXIMATE.
4. ENSURE TO PLUMB ANTENNA VERTICALLY BY LOOSENING HOSE CLAMPS ON PRE-CLAMPED SUPPORT SADDLES AND ADJUSTABLE LINE BRACKETS.
5. FINAL ORIENTATION TO BE DETERMINED BY STATION PERSONNEL.
6. HOSE CLAMPS USED TO SECURE LINE BRACKETS TO INTERBAY LINE.
7. HOSE CLAMPS USED TO SECURE ELEMENTS TO SUPPORT SADDLE.
8. APPLY 1/2 GREASE PACKET TO EACH O-RING (TYPICAL ALL BAYS).
9. CENTERFEED CAN BE ROTATED TO AVOID ANY OBSTRUCTIONS.
SPECIFICATIONS
THIRD ANGLE PROJECTION
SHPX-6AC3-SP INSTALLATION
IA22051-1

A-2 ERI Antenna Specification Sheet

Lahoma, OK

General Specifications

Antenna Type . . . . . .High Power FM-Broadcast, Suitable For Diplexing
Model Number SHPX-6AC3-SP
Number of Bay .....SIX
Polarization..... Right Hand Circular

Electrical Specifications

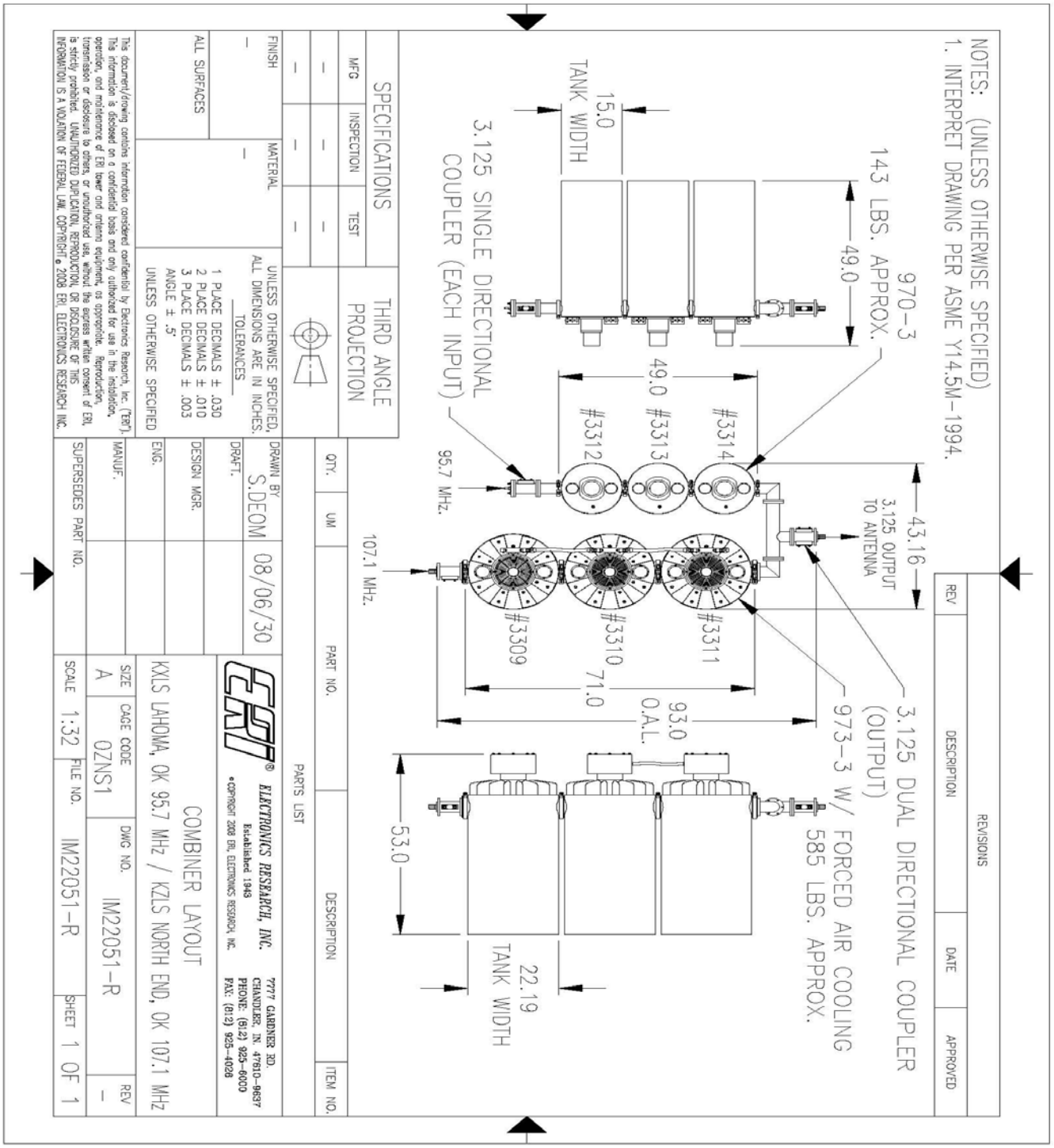
Antenna Input Power Capability . . . . . 7 KW Max (1)
Operating Frequency Band..... 88 ~ 108 Megahertz.
VSWR. . . . . <1.038:1 @ Operating Frequencies(2)
Azimuthal Pattern Circularity ..... Better Then +/- 2dB from RMS (Free Space)
Power Split ..... 50/50 (Horizontal & Vertical)
Frequency Specific Information:

Frequency	Station ERP	Beam Tilt	First Null Fill	Second Null Fill	Power Gain	Line Loss (3)	Filter Loss (4)	Computed TPO
95.7	**14 KW**	**0°**	**20%**	**1%**	**3.005**	**-.5203 db**	**-.206db**	**5.5 KW**
107.1	**14 KW**	**0°**	**20 %**	**1%**	**2.869**	**-.5504db**	**-.0994 db**	**5.6 KW**

Mechanical Specifications

Antenna Feed System... App. 327` of Andrew Heliax 3 1/8" Line & 60` of3 1/8" Dielectric Rigid
Input Connector ……. . 3 1/8"-50 Ohm EIA Flanged
Element Deicing..... Radomes
Interbay Spacing..... 116" Center to Center
Array Length ..... 53'
Construction Material (Antenna) ..... All Noncorrosive
Construction Material (Mounting) ..... 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 377of 3 1/8" Andrew Heliax
4) Losses Taken From Actual Combiner.


NOTES: (UNLESS OTHERWISE SPECIFIED)
1. INTERPRET DRAWING PER ASME Y14.5M-1994.
970-3
143 LBS. APPROX.
49.0
43.16
3.125 OUTPUT TO ANTENNA
3.125 DUAL DIRECTIONAL COUPLER (OUTPUT)
973-3 W/ FORCED AIR COOLING
585 LBS. APPROX.
15.0
TANK WIDTH
3.125 SINGLE DIRECTIONAL COUPLER (EACH INPUT)
#3314
#3313
#3312
#3311
#3310
#3309
95.7 MHz.
107.1 MHz.
49.0
71.0
93.0
O.A.L.
53.0
22.19
TANK WIDTH
REVISIONS
REV
DESCRIPTION
DATE
APPROVED
SPECIFICATIONS
MFG
INSPECTION
TEST
THIRD ANGLE PROJECTION
FINISH
MATERIAL
UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN INCHES.
TOLERANCES
1 PLACE DECIMALS ± .030
2 PLACE DECIMALS ± .010
3 PLACE DECIMALS ± .003
ANGLE ± .5'
UNLESS OTHERWISE SPECIFIED
ALL SURFACES
DRAWN BY
S.DEOM
08/06/30
DRAFT.
DESIGN MGR.
ENG.
MANUF.
SUPERSEDES PART NO.
QTY.
UM
PART NO.
DESCRIPTION
ITEM NO.
PARTS LIST
ELECTRONICS RESEARCH, INC.
Established 1948
7777 GARDNER RD.
CHANDLER, IN. 47610-9637
PHONE: (812) 925-6000
FAX: (812) 925-4028
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COMBINER LAYOUT
KXLS LAHOMA, OK 95.7 MHz / KZLS NORTH END, OK 107.1 MHz
SIZE
A
CAGE CODE
0ZNS1
DWG NO.
IM22051-R
REV
-
SCALE
1:32
FILE NO.
IM22051-R
SHEET 1 OF 1
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A-4 ERI Combiner Specification Sheet

Lahoma, OK.

General Specifications:

Diplexer Type ..... "TEE" Combiner 973-3 & 970-3 Series
Number of Combining Units .....Two
Injected Port to Injected Port Isolation..... < -79 dB
Output Connector .....3 1/8 "50 Ohm EIA (Flanged)
Output Power (Designed) ..... 12 KW (1)

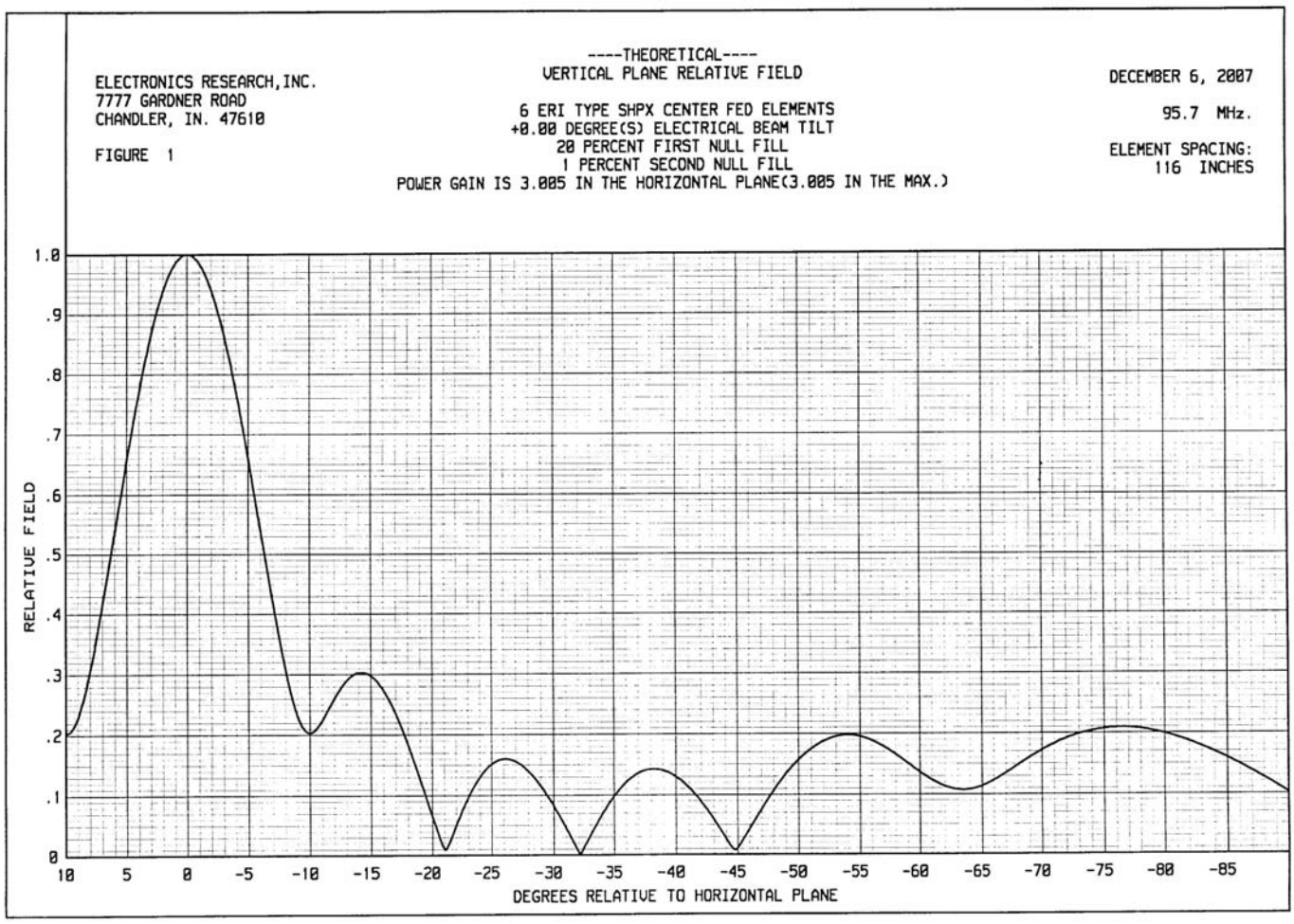
Heat Removal.....95.7 Natural Convection
107.1 Forced Air Cooling
Physical Arrangement.....All Components floor standing

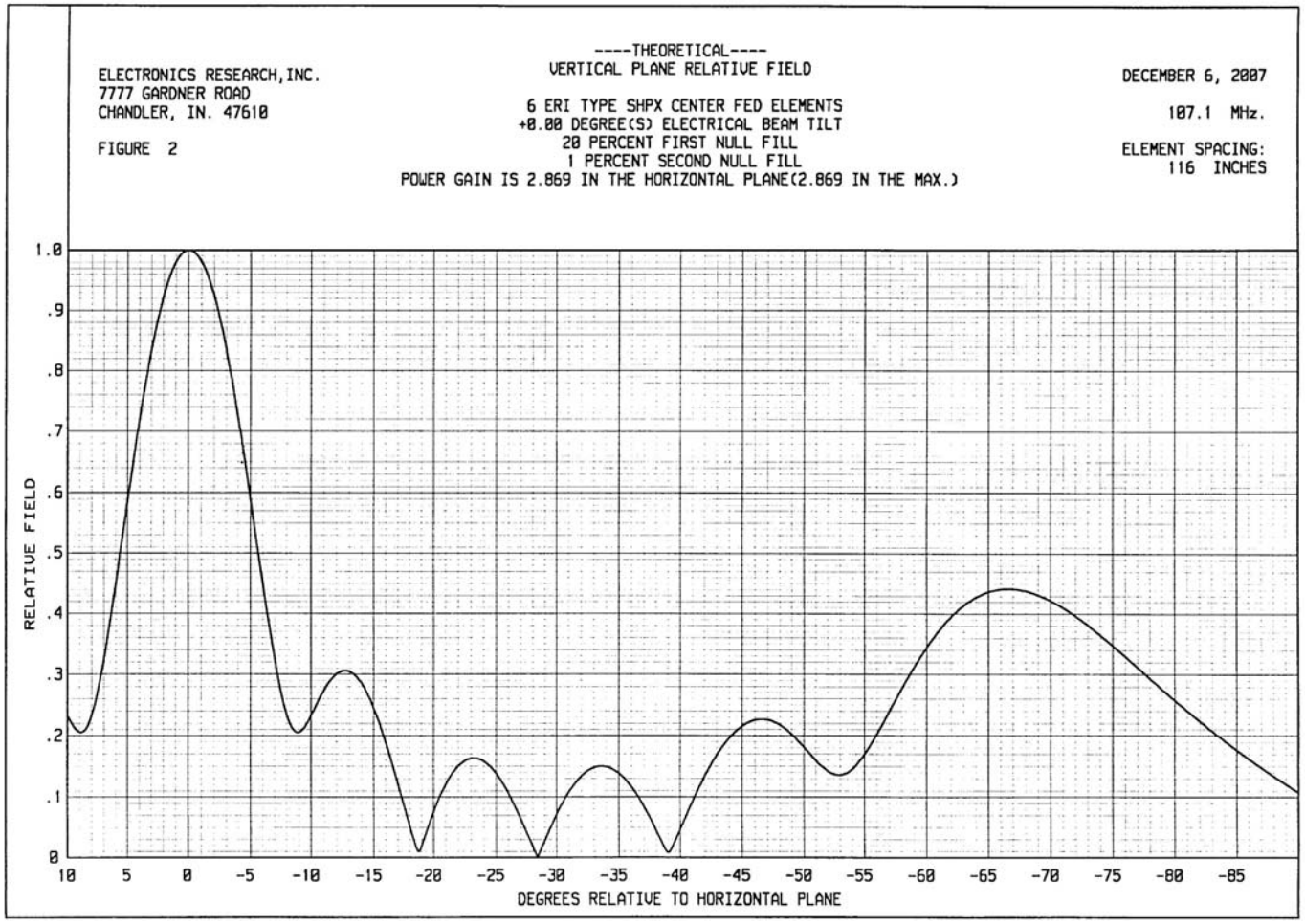
Injected Port Specifications:

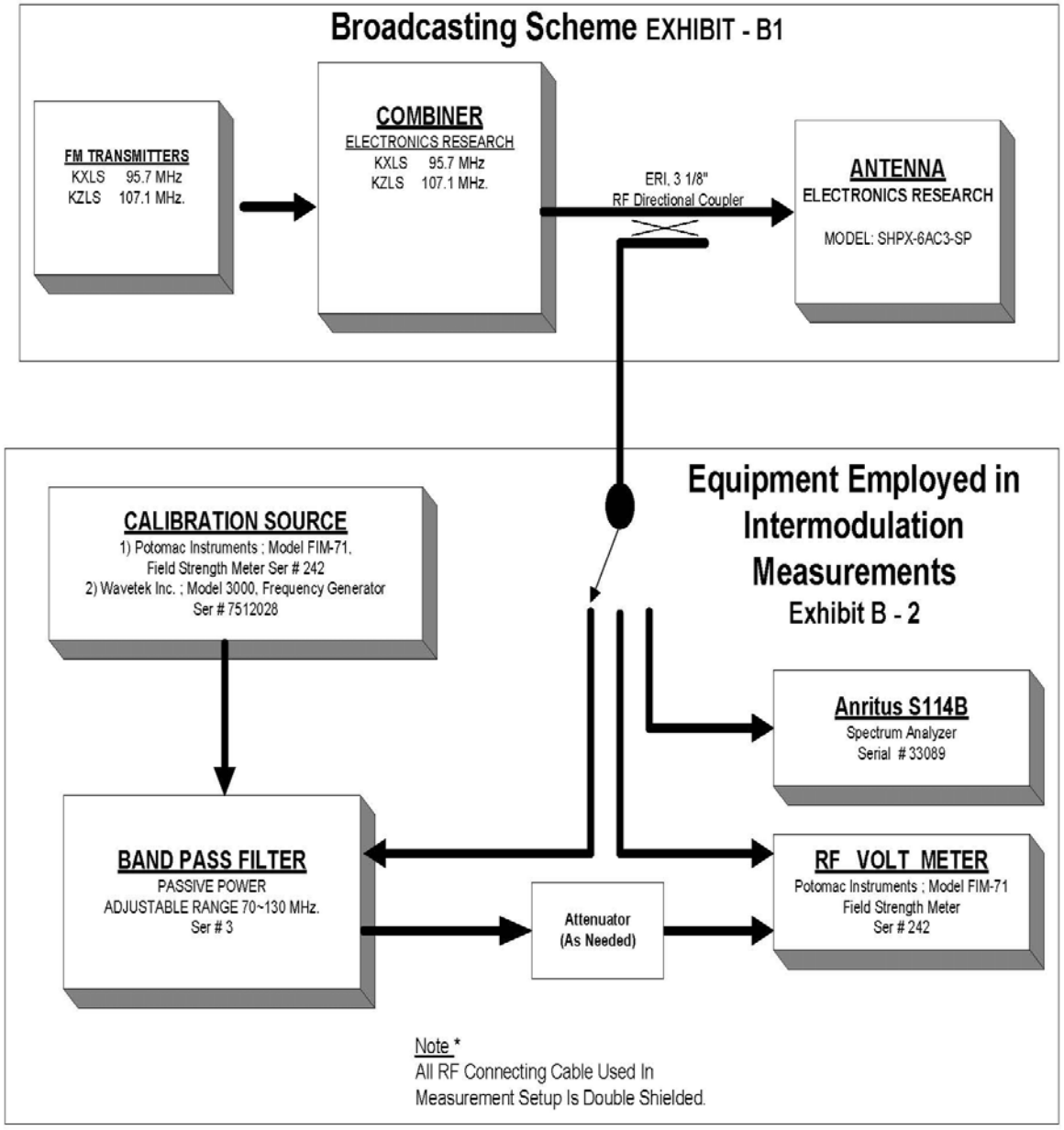
Frequency Assignment ..... 95.7 & 107.1 MHz.
Power Rating, Each Injected Port (Designed) .....5.7 KW
Input Connector ..... 3-1/8" 50 Ohm EIA (Flanged)
VSWR.....< 1.04:1 @ +/-150 KHz.(2
Group Delay..... Less than 30ns Overall Variation, Carrier @ +/- 150 KHz.
Insertion Loss (Measured):

89.1 MHz. ……. - 0.206 dB
91.1 MHz..... - 0.099dB

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


ELECTRONICS RESEARCH,INC.
7777 GARDNER ROAD
CHANDLER, IN. 47610
FIGURE 1
----THEORETICAL----
VERTICAL PLANE RELATIVE FIELD
6 ERI TYPE SHPX CENTER FED ELEMENTS
+0.00 DEGREE(S) ELECTRICAL BEAM TILT
20 PERCENT FIRST NULL FILL
1 PERCENT SECOND NULL FILL
POWER GAIN IS 3.005 IN THE HORIZONTAL PLANE(3.005 IN THE MAX.)
DECEMBER 6, 2007
95.7 MHz.
ELEMENT SPACING:
116 INCHES
RELATIVE FIELD
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
0
10 5 0 -5 -10 -15 -20 -25 -30 -35 -40 -45 -50 -55 -60 -65 -70 -75 -80 -85
DEGREES RELATIVE TO HORIZONTAL PLANE


ELECTRONICS RESEARCH,INC.
7777 GARDNER ROAD
CHANDLER, IN. 47610
FIGURE 2
----THEORETICAL----
VERTICAL PLANE RELATIVE FIELD
6 ERI TYPE SHPX CENTER FED ELEMENTS
+0.00 DEGREE(S) ELECTRICAL BEAM TILT
20 PERCENT FIRST NULL FILL
1 PERCENT SECOND NULL FILL
POWER GAIN IS 2.869 IN THE HORIZONTAL PLANE(2.869 IN THE MAX.)
DECEMBER 6, 2007
107.1 MHz.
ELEMENT SPACING:
116 INCHES
RELATIVE FIELD
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
0
10 5 0 -5 -10 -15 -20 -25 -30 -35 -40 -45 -50 -55 -60 -65 -70 -75 -80 -85
DEGREES RELATIVE TO HORIZONTAL PLANE



Broadcasting Scheme and Equipment Employed in Intermodulation Measurements

EXHIBIT B