Report Of Intermodulation Product Findings

BOZEMAN, MONTANA

KMMSFM 95.1 MHz.
KISN 96.7 MHz.
KXLB 100.7 MHz.

August 17, 2006

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Bozeman, Montana

Report of Findings for Intermodulation Product Measurements

Exhibits Accompanying This Report

REPORT OF FINDINGS
CLEAR CHANNEL RADIO BOZEMAN

Introduction: This report of findings is based on data collected at the Clear Channel broadcast facility. The report includes measurements offered as proof that the combined operations of KMMSFM (95.1 MHz.) , KISN (96.7 MHz.), and KXLB (100.7 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 August 17, 2006.

The following exhibits are provided:

Exhibit A:
- A-1 Drawing Depicting Antenna.
- A-2 SHPX-8AC6-SP Antenna Specification Sheet.
- A-3 Drawing Depicting Multiplexing Scheme.
- A-4 973 Series Branch Combiner Specification Sheet.

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 F2 signifies the frequency causing the interference.

The Multiplexed System: These measurements were taken with all three FM stations operating from the combined antenna system. The multiplexed system is fundamentally comprised of antenna, feed line and multiplexer unit. The SHPX-8AC6-SP (antenna) and Branch combiner units are products of Electronics Research, Inc, while the 4 1/16" feedline components are products of Myat. Refer to Exhibit B-1, for an illustration of the Broadcasting Scheme of these stations.

To accomplish the aggregation of multiple transmitter signals into a common antenna feed and provide transmitter-to-transmitter isolation, a multiplexing scheme consisting of a "Branch Combiner" was installed. Specifically, the combiner utilizes ERI Model 973 series filter modules for each transmitter. The multiplexer, fully assembled, exhibited transmitter port-to-port isolation in excess of -56 dB. Other performance measurements, such as match, loss, group-delay, etc, revealed that the multiplexer unit was in proper working condition. Refer to page 12 for the Combiner Specification Sheet.

The IM Investigation: Directional Couplers were placed at key locations throughout the combiner to monitor and maintain the multiplexer'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 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 -30 dB directivity and a forward signal sample of -45 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 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 IFR Model 2399A Spectrum Analyzer Serial # 02113071 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 (dBµ)	Scale Reading (dB)	**Adjusted Level (dBµ)**	Notes
95.1	-	-	120	0.8	**119.2**	
96.7	-	-	120	7.7	**112.3**	
100.7	-	-	120	0.3	**119.7**	

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.

```
         95.1   96.7  100.7
       ---------------------
 95.1 |  ---    98.3  106.3
 96.7 |  93.5   ---   104.7
100.7 |  89.5   92.7   ---
```

Product Number	Product Frequency (MHz)	Transmitter Frequency (MHz)	Interfering Frequency (MHz)
1	89.5	95.1	100.7
2	92.7	96.7	100.7
3	93.5	95.1	96.7
4	98.3	96.7	95.1
5	104.7	100.7	96.7
6	106.3	100.7	95.1

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

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)	Notes*
	Transmitter Mixes										
	95.1	**Ref.**	**0**		**0**	**120**	**0.8**		**119.2**		
	96.7	**Ref.**	**0**		**0**	**120**	**7.7**		**112.3**		
	100.7	**Ref.**	**0**		**0**	**120**	**0.3**		**119.7**		
89.5	95.1	100.7	6	6.8	12.8	20	19	13.8	119.2	-105.4	
92.7	96.7	100.7	6	6.8	12.8	20	20	12.8	112.3	-99.5	
93.5	95.1	96.7	6	6.9	12.9	20	20	12.9	119.2	-106.3	
98.3	96.7	95.1	6	7	13	20	17.7	15.3	112.3	-97	
104.7	100.7	96.7	6	6.4	12.4	20	20	12.4	119.7	-107.3	
106.3	100.7	95.1	6	6.4	12.4	20	20	12.4	119.7	-107.3	

The 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 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 August 15, 2006 as summarized in this document, I, Jeff Taylor, find the subject system- specifically the transmitter and filter system for the operation of KMMSFM, KISN and KXLB 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 KMMSFM, KISN, and KXLB is in compliance with the requirements of Section 73.317 paragraph (b) through (d) of the FCC Rules and Regulations.

Respectfully submitted,
Electronics Research, Inc.

Jeff Taylor, Field Technician

ELECTRONICS RESEARCH, INC. ERI

State of Nevada)
) SS:
County of Washoe)

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 8 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.

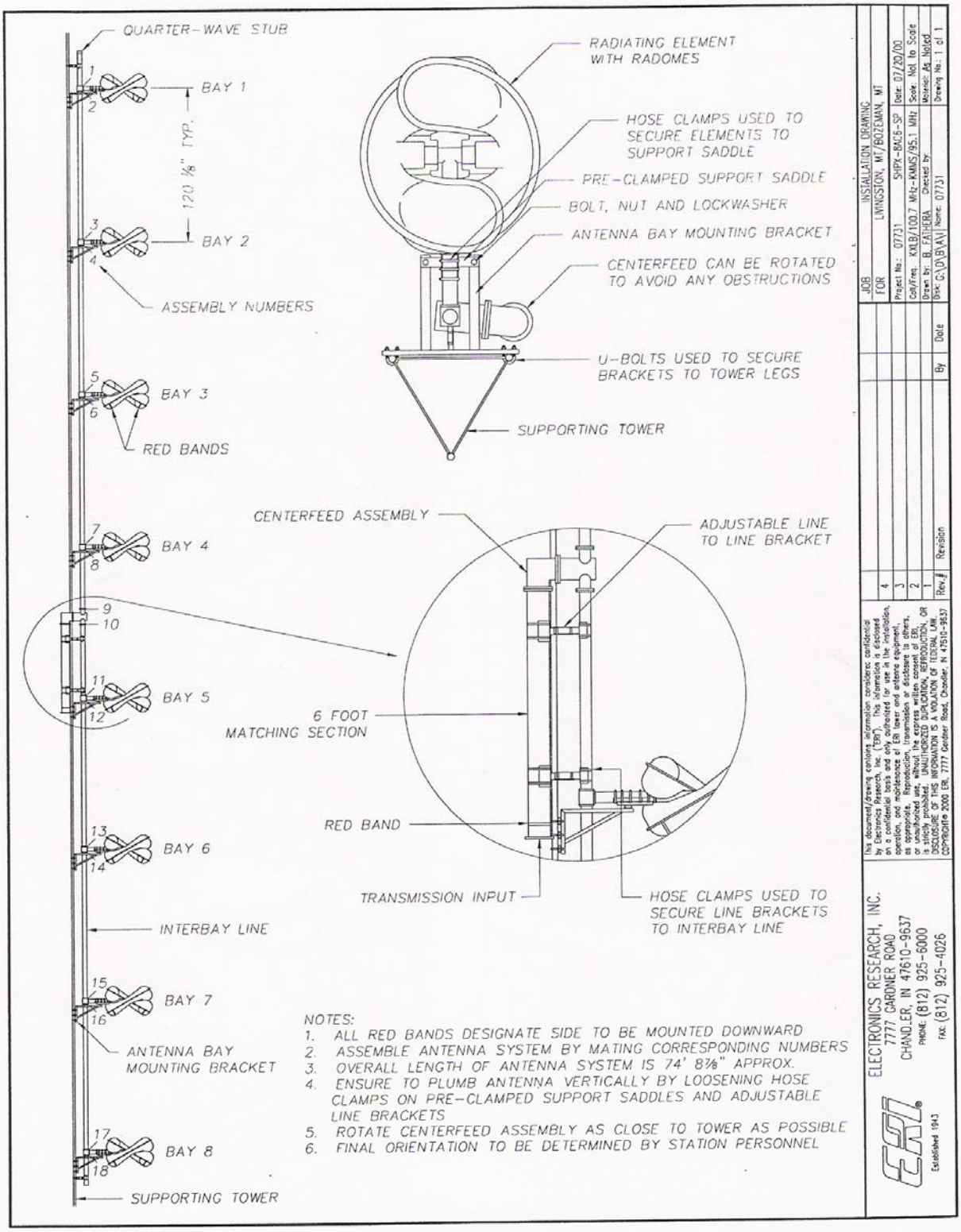
3.) ERI has been requested by Clear Channel Communications, Inc. on behalf of radio Stations KMMSFM, KISN, and KXLB in Bozeman, MT. to prepare this Report Of Findings.

Jeff Taylor; Field Technician

Jeff Taylor

Subscribed and sworn to before me on this 17th, day of August, 2006.

NOTARY PUBLIC
STATE OF NEVADA
County of Washoe
PAMELA L. PENFIELD
No: 99-30841-2
My Appointment Expires Feb. 15, 2007



A-2 ERI Antenna Specification Sheet

Clear Channel Radio
Bozeman, Montana

General Specifications

Antenna Type . . . . . .High Power FM-Broadcast, Suitable For Triplexing
Model Number SHPX-8AC6-SP
Number of Bay Levels .....Eight
Polarization ..... Right Hand Circular

Electrical Specifications

Antenna Input Power Capability . . . . . 59 KW Max (1)
Operating Frequency Band ..... 95.1 ~ 96.7 ~ 100.7 Megahertz.
VSWR. . . . . <1.15:1 @ Operating Frequencies(2)
Azimuthal Pattern Circularity ..... Less Than +/- 1.5 dB 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
95.1	**100 KW**	**-1°**	**15 %**	**3%**	**4.199**	**.205 db**	**.2185 db**	**26.2 KW**
96.7	**18.5 KW**	**-1°**	**7 %**	**1%**	**4.348**	**.209 db**	**.2480 db**	**4.70 KW**
100.7	**100 KW**	**-1°**	**15 %**	**3%**	**4.074**	**.2119 db**	**.2045 db**	**27.0 KW**

Mechanical Specifications

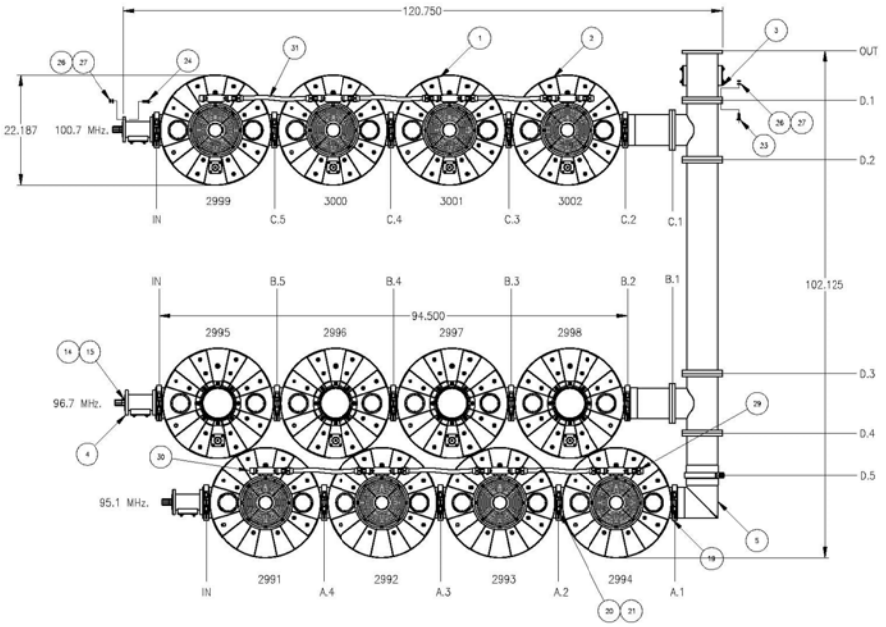
Antenna Feed System .....Fed With One 6 1/8" Lines
Input Connector …….. 6 1/8"-50 Ohm EIA Flanged
Element Deicing.....Radomes
Interbay Spacing ..... 120 1/8" Center to Center
Array Length..... 74.75'
Construction Material (Antenna) ..... All Noncorrosive
Construction Material (Mounting) ..... All Stainless Steel

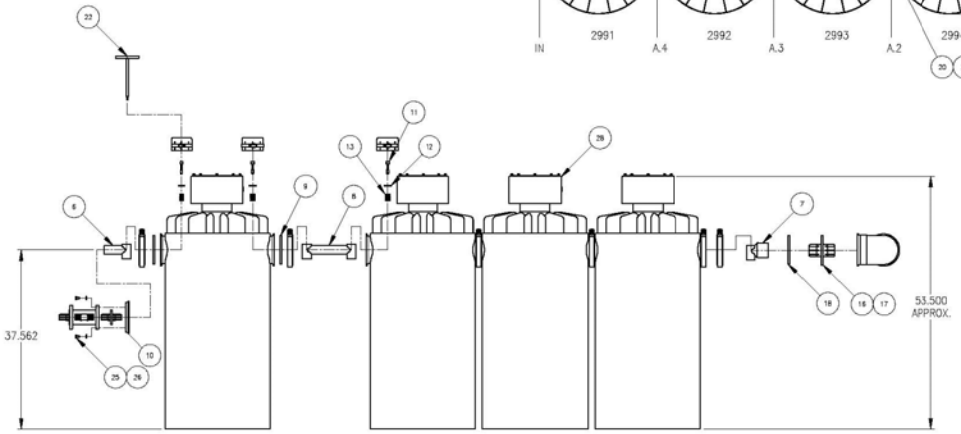
.

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 286.33 Feet, 4 1/16" Rigid.
4) Losses Taken From Actual Combiner.

NOTES: (UNLESS OTHERWISE SPECIFIED)
1. REMOVE ALL BURRS AND SHARP EDGES FROM PART.
2. INTERPRET DRAWING PER ASME Y14.5M-1994.
3. USE TOLERANCES SPECIFIED IN TOLERANCE BLOCK UNLESS OTHERWISE NOTED.

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED





QTY	UM	PART NO.	DESCRIPTION	ITEM NO
108	IN	ED0050F-PVC	1/2" FLEXIBLE CONDUIT (6) 18" LG	31
2	EA	C00111	1/2" PVC CAP	30
4	EA	EF0036	1/2" FLEXIBLE CONDUIT ADAPTER	29
8	EA	FI0100	FILTER COOLING UNIT ASSEMBLY	28
42	EA	NU0616	3/8-16 SST HEX NUT	27
60	EA	WL06SS	3/8" SST LOCKWASHER	26
18	EA	SC0616H0100	3/8-16 X 1.00 SST HHCS	25
18	EA	SC0616H0150	3/8-16 X 1.50 SST HHCS	24
24	EA	SC0616H0175	3/8-16 X 1.75 SST HHCS	23
1	EA	FI0004	"T" HANDLE TOOL, 1/2" SOCKETHEAD	22
17	EA	NU0518BZ	5/16"-18 BRONZE HEX NUT	21
17	EA	SC0518T0450	5/16"-18 X 4-1/2" LONG "T" BOLT	20
17	EA	CM0036	6" MARMAN CLAMP	19
3	EA	FI0005	CONTACT RING	18
3	EA	IN0074	6" "S" SPLIT WAFER INSULATOR	17
3	EA	CC0033	6-1/8" IN-LINE BULLET	16
6	EA	IN0028	3" "S" SPLIT WAFER INSULATOR	15
6	EA	CC0021	3-1/8" IN-LINE BULLET	14
24	EA	SG0001	SPRING	13
24	EA	WF08SSA	1/2" FLATWASHER	12
24	EA	FI0220	1/2"-13 X 2" LONG STEPPED BOLT	11
3	EA	CF0099	6" MARMAN TO 3-1/8" EIA PORT ADAPTER	10
12	EA	FI0001	6" CONTACT RING	9
9	EA	FI0147	INNER CONNECTING ASSEMBLY	8
3	EA	FI0148	6" INNER PORT CONNECTOR	7
3	EA	FI0145	3" INNER PORT CONNECTOR	6
1	EA	CE6024	6-1/8" MARMAN TO MARMAN ELBOW	5
3	EA	DC3003	3-1/8" SINGLE DIRECTIONAL COUPLER	4
1	EA	DC6005	6-1/8" DUAL DIRECTIONAL COUPLER	3
6	EA	FI0251	973 BAND PASS FILTER W/TRIPLE LOOP	2
6	EA	FI0250	913 BAND PASS FILTER 2 DOUBLE LOOPS	1

PARTS LIST

MFG PROCESSES	INSPECTION PROCEDURES	TEST PROCEDURES
—	—	—
—	—	—

FINISH: —
MATERIAL: —
ALL SURFACES

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN INCHES.
TOLERANCES
1 PLACE DECIMALS ± .030
2 PLACE DECIMALS ± .010
3 PLACE DECIMALS ± .003
ANGLE ± 0°
UNLESS OTHERWISE SPECIFIED

THIRD ANGLE PROJECTION

DRAWN BY:
DRAFT:
DESIGN MGR.
ENG.
QA/VLP.
SUPERCEDES DWG.

ELECTRONICS RESEARCH, INC.
Established 1945

7777 GARDNER RD.
CHANDLER, IN. 47610-9287
PHONE: (812) 925-6000
FAX: (812) 925-6060

COMBINER DETAIL
BOZEMAN/BELGRADE/LIVINGSTON, MT.

SIZE	CAGE CODE	DWG NO.	REV
D	0ZNS1	IM17456-1	—
SCALE 1:1	FILE NO. IM17456-1	SHEET 1 OF 1	

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A-4 ERI Combiner Specification Sheet

Clear Channel Radio
Bozeman, Montana

General Specifications:

Multiplexer Type ..... Branch Combiner "Series 973"
Number of Combining Units ..... Three
Injected Port to Injected Port Isolation ..... < - 56 dB
Output Connector ..... 6 1/8 "50 Ohm EIA (Flanged)
Output Power (Designed) ..... 58 KW(1)

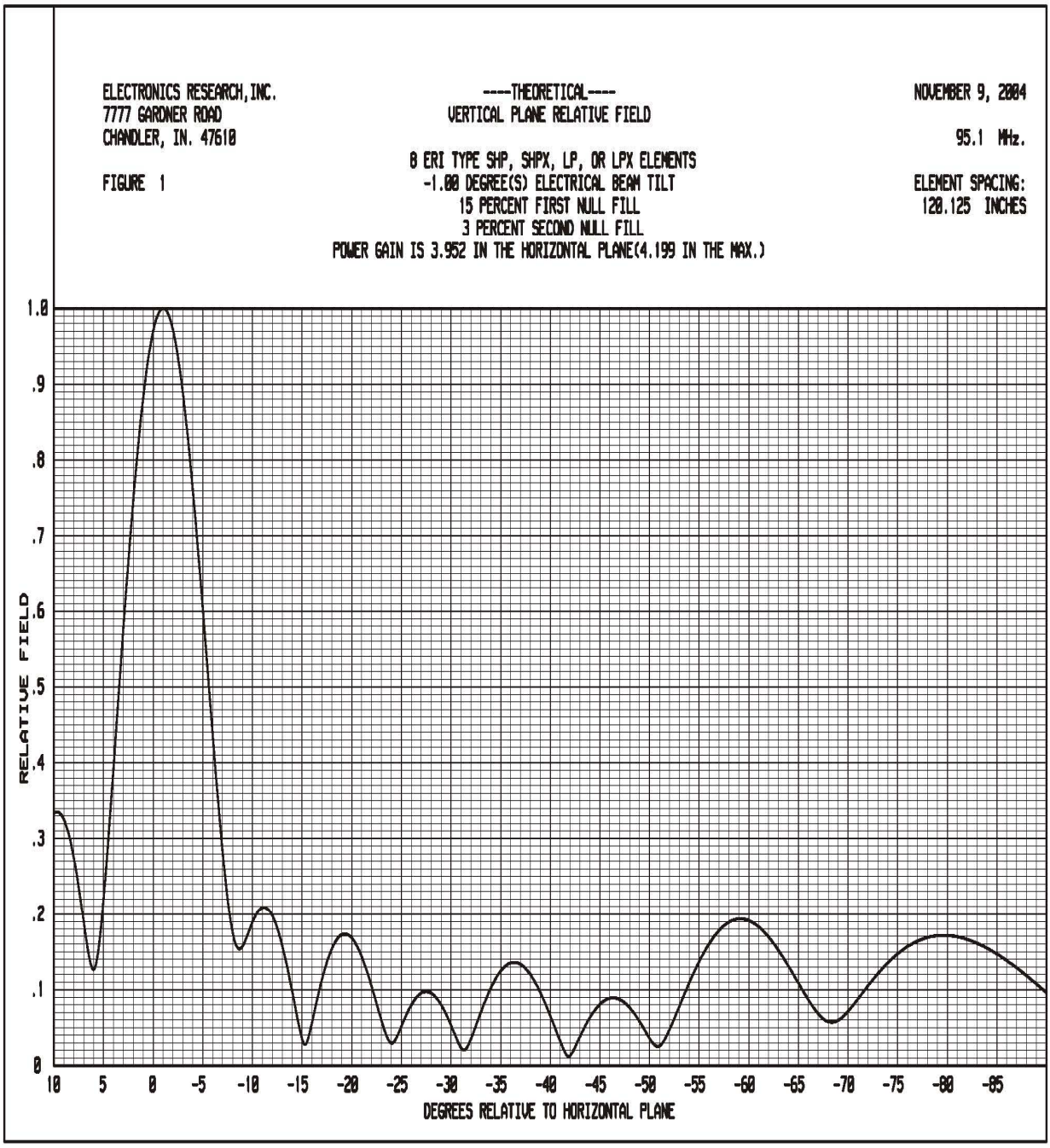
Heat Removal ..... Forced Air for 95.1 and 100.7 MHz. Natural Convection for 96.7 MHz.
Physical Arrangement ..... All Components floor standing

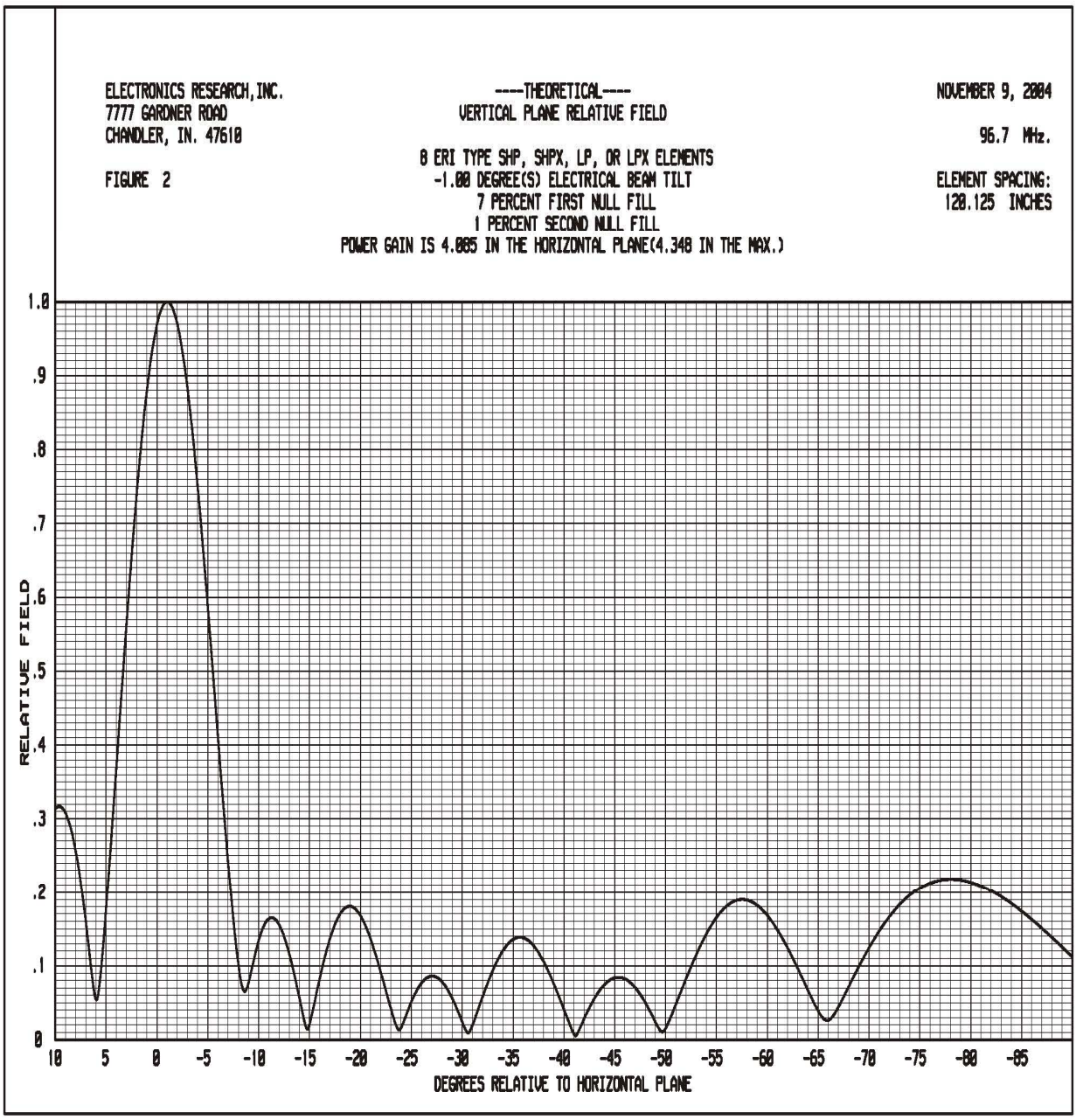
Injected Port Specifications:

Frequency Assignment ..... 95.1, 96.7, and 100.7 MHz.
Power Rating, Each Injected Port (Designed) .....27.1 KW
Input Connector .....3-1/8" 50 Ohm EIA (Flanged)
VSWR..... < 1.07:1 @ +/-200 KHz.(2
Group Delay .....Less than 150 ns Overall Variation, Carrier @ +/- 150 KHz.
Insertion Loss (Measured):

95.1 MHz. ..... - 0.2185 dB
96.7 MHz. ..... - 0.2480 dB
100.7 MHz. ..... - 0.2045 dB

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
8 ERI TYPE SHP, SHPX, LP, OR LPX ELEMENTS
-1.00 DEGREE(S) ELECTRICAL BEAM TILT
15 PERCENT FIRST NULL FILL
3 PERCENT SECOND NULL FILL
POWER GAIN IS 3.952 IN THE HORIZONTAL PLANE(4.199 IN THE MAX.)
NOVEMBER 9, 2004
95.1 MHz.
ELEMENT SPACING:
120.125 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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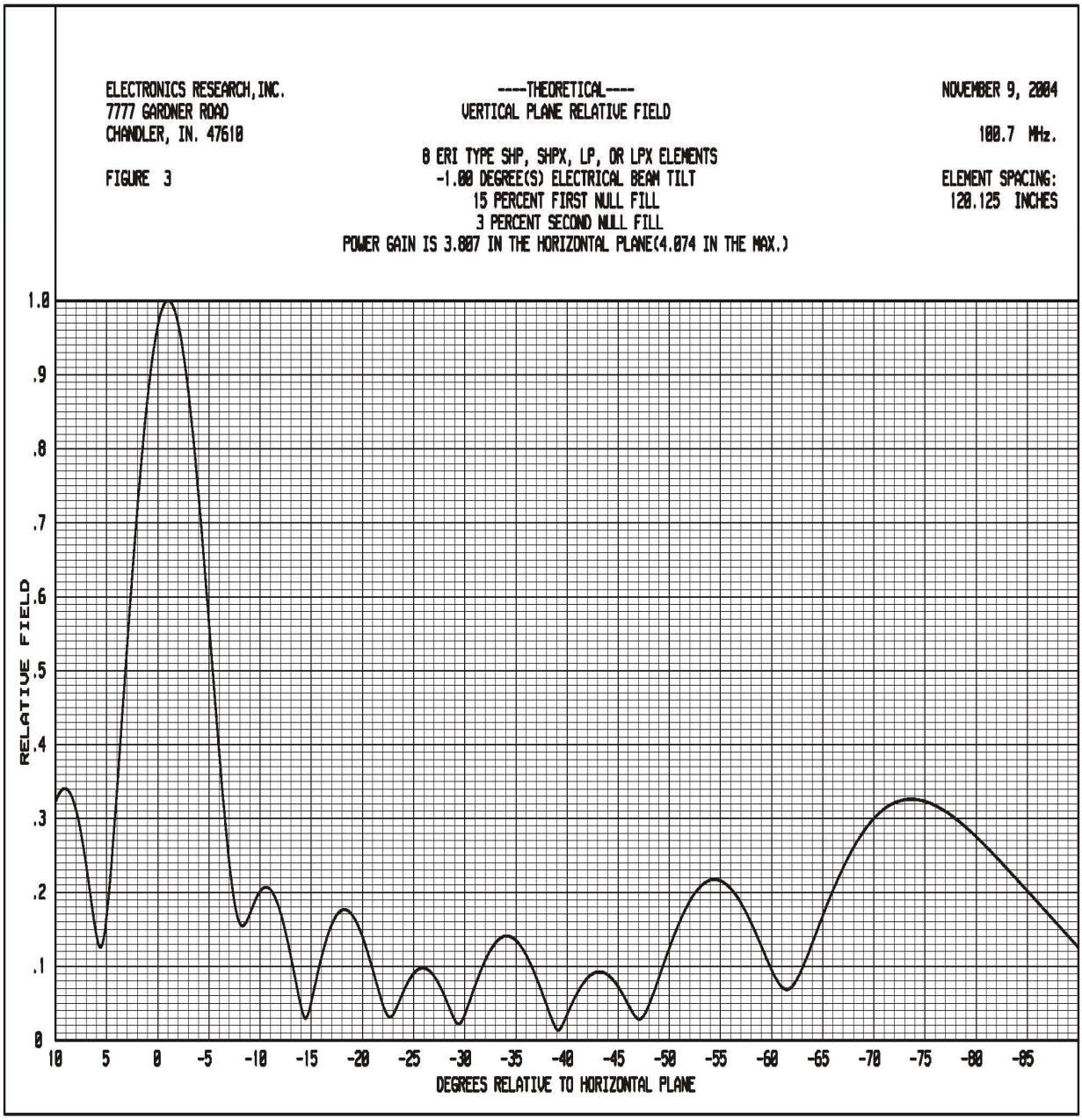
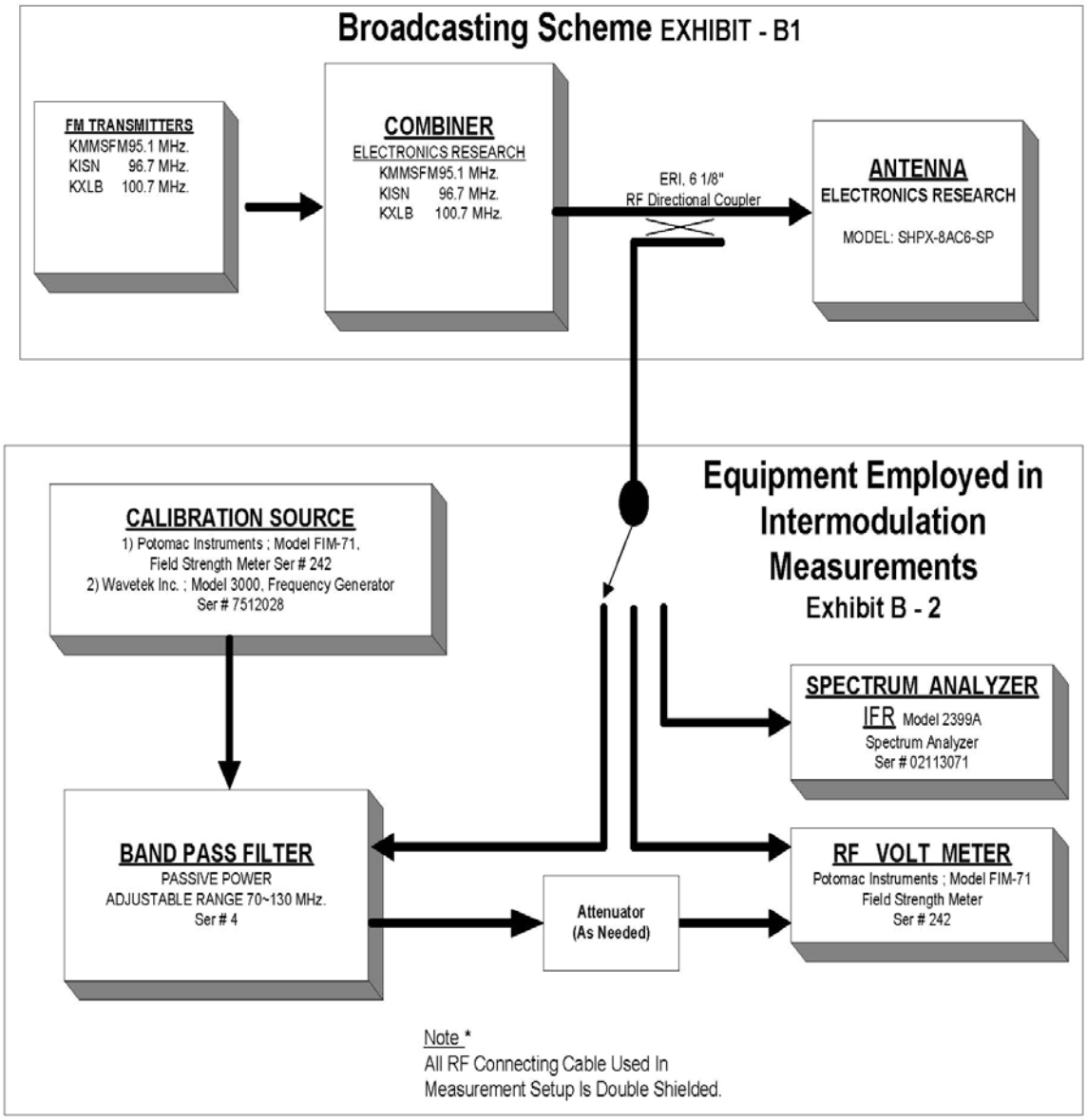
7777 GARDNER ROAD
CHANDLER, IN. 47610
FIGURE 2
----THEORETICAL----
VERTICAL PLANE RELATIVE FIELD
8 ERI TYPE SHP, SHPX, LP, OR LPX ELEMENTS
-1.00 DEGREE(S) ELECTRICAL BEAM TILT
7 PERCENT FIRST NULL FILL
1 PERCENT SECOND NULL FILL
POWER GAIN IS 4.085 IN THE HORIZONTAL PLANE(4.348 IN THE MAX.)
NOVEMBER 9, 2004
96.7 MHz.
ELEMENT SPACING:
120.125 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 3
----THEORETICAL----
VERTICAL PLANE RELATIVE FIELD
8 ERI TYPE SHP, SHPX, LP, OR LPX ELEMENTS
-1.00 DEGREE(S) ELECTRICAL BEAM TILT
15 PERCENT FIRST NULL FILL
3 PERCENT SECOND NULL FILL
POWER GAIN IS 3.807 IN THE HORIZONTAL PLANE(4.074 IN THE MAX.)
NOVEMBER 9, 2004
100.7 MHz.
ELEMENT SPACING:
120.125 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