

**LICENSE TO COVER**  
**Permit LMS- 0000193308**  
**K242DB (FX) Carlsbad NM FACID 202470**

**TECHNICAL STATEMENTS**

**TRANSMITTER POWER OUTPUT**

**TRANSMITTER POWER OUTPUT = 143 WATTS**  
**COMBINER – FILTER LOSS = -0.432 dB**  
**COAC LINE LOSS = -0.451 dB**  
**FOUR-BAY ANTENNA POWER GAIN = 2.137**  
**EFFECTIVE RADIATED POWER = 250 WATTS.**

**SPECIAL OPERATING CONDITIONS:**

- 1        The translator is rebroadcasting the authorized AM primary station.**
- 2        The AM station noted herein is commonly owned by the licensee. The antenna for this combined operation is the existing antenna for commonly owned KATK-FM and has been on the AM tower since the grant of BMLH-20000711AAB nearly 22 years ago. There has been no significant modification to the tower as a result of this combined operation; thus coordination with the AM station was deemed unnecessary. Out of the abundance of caution, careful notation was made of the operating parameters of KATK (AM) both before and after the installation of the combiner unit and there is no variation from licensed values of the AM station operation.**
- 3        This application is being filed prior to commencement of program operations.**
- 4        Attached is the proof of performance for the combiner and antenna system to which this translator is connected. It demonstrates full compliance with the spurious emissions requirements of 47 C.F.R. Sections 73.317(b) through 73.317(d). All measurements have been made with all stations simultaneously utilizing the shared antenna.**

# **Report Of Intermodulation Product Findings**

***Carlsbad, N.M.***

**KATK – 92.1 MHz.  
K230CI – 93.9 MHz.  
K242DB – 96.3 MHz.  
KCDY – 104.1 MHz.**

**Project# 39231**

***June 11, 2022***

**Electronics Research Inc.  
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## Exhibits Accompanying This Report

<b>EXHIBIT A</b> .....	Antenna and Combiner Specification Sheet and Drawing
A-1.....	Drawing Depicting Antenna
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B-2.....	Broadcasting Scheme of the Multiplexed System

## REPORT OF FINDINGS CARLSBAD, NEW MEXICO BROADCAST FACILITY

**Introduction:** This report of findings is based on data collected at the FM broadcast facility located in Carlsbad, N.M. The report includes measurements offered as proof that the combined operations of KATK (92.1 MHz.), K230CI (93.9 MHz.), K242DB (96.3 MHz.), and KCDY (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 multiplexed and single station systems 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 June 11, 2022.

**The following exhibits are provided:**

Exhibit A:

- A-1 Drawing Depicting Antenna.
- A-2 SHPX-4AC-SP Antenna Specification Sheet.
- A-3 Drawing Depicting Multiplexed Scheme.
- A-4 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 all FM stations operating from the antenna system. The KATK and KCDY, multiplexed system is fundamentally comprised of antenna, feed line and multiplexer unit. The SHPX-4AC-SP antenna, 955-3/935 Bandpass units, and rigid MACXLine 350 feedline, are products of Electronics Research, Inc. while the flex line is Cablewave. Refer to Exhibit B-1, for an illustration of the Broadcasting Scheme of these stations.

To accomplish the aggregation of four transmitter signals into a common feed and provide transmitter-to-transmitter isolation, a multiplexed scheme consisting of a 955-3 and 935-3 multiplexer Combiner” was installed. Specifically, the combiner uses two 955-3 modules for frequency (92.1 MHz. and 104.1 MHz.), and two 935-3 modules for frequency (93.9 MHz. and 96.3 MHz.). Interconnecting “T’s” are required to complete the combiner. The multiplexer combiner, fully assembled, exhibited transmitter port-to-port isolation in excess of -46 dB. Other performance measurements, such as match, loss, group-delay, etc, revealed that the multiplexer combiner 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 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 ensure 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 -34 dB directivity and a forward signal sample of -40 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 Spectrum Analyzer to ensure an adequate signal level for measurements without overloading the measurement equipment. A Rohde & Schwarz ZPH Spectrum Analyzer serial# 103069 was employed to record the level of all signals investigated. A Rohde & Schwarz ZVL3 Network Analyzer serial# 100396 was used for selective tuning of the Band Pass Filter. The Rohde & Schwarz Spectrum Analyzer was also 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 transmitters were operating at full licensed power. 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.**

<b>Carrier Frequency (MHz)</b>	<b>Pad One (dB)</b>	<b>Full Scale Range (dB)</b>	<b>Scale Reading (dBm)</b>	<b>Carrier Level (dBm)</b>	<b>Notes</b>
<b>KATK 92.1</b>	<b>0</b>	<b>---</b>	<b>22.4</b>	<b>22.4</b>	
<b>K230CI 93.9</b>	<b>0</b>	<b>---</b>	<b>10.4</b>	<b>10.4</b>	
<b>K242DB 96.3</b>	<b>0</b>	<b>---</b>	<b>10.9</b>	<b>10.9</b>	
<b>KCDY 104.1</b>	<b>0</b>	<b>---</b>	<b>20.5</b>	<b>20.5</b>	

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.**

<b>Carrier Frequencies</b>					
<b>Interfering Frequencies</b>	<b>92.1</b>	<b>93.9</b>	<b>96.3</b>	<b>104.1</b>	
KATK 92.1 MHz.	----	95.7	100.5	116.1	
K230CI 93.9 MHz.	90.3	----	98.7	114.3	
K242DB 96.3 MHz.	87.9	91.5	----	111.9	
KCDY 104.1 MHz.	80.1	83.7	88.5	----	

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-2 for a layout of the measurement equipment.

**Table 3 – Intermodulation Measurements**

IM Measurements Taken in Carlsbad, New Mexico										
Product Frequency (MHz)	Transmitter Frequency (MHz)	Interfering Frequency (MHz)	Pad (dB)	Bandpass Filter Loss (dB)	Total Loss	Measured Level (dBm)	Adjusted Level (dBm)	Carrier Reference Level (dBm)	Level Referenced to Carrier (dBm)	Notes*
<b>Transmitter Mixes</b>										
	<b>92.1</b>	<b>Ref.</b>	0		0	22.4	22.4	<b>22.4</b>		
	<b>93.9</b>	<b>Ref.</b>	0		0	10.4	10.4	<b>10.4</b>		
	<b>96.3</b>	<b>Ref.</b>	0		0	10.9	10.9	<b>10.9</b>		
	<b>104.1</b>	<b>Ref.</b>	0		0	20.5	20.5	<b>20.5</b>		
80.1	92.1	104.1	6	12.8	18.8	-115.9	-97.1	22.4	<b>-119.5</b>	
83.7	93.9	104.1	6	12.9	18.9	-115.3	-96.4	10.4	<b>-106.8</b>	
87.9	92.1	96.3	6	12.7	18.7	-115.4	-96.7	22.4	<b>-119.1</b>	
88.5	96.3	104.1	6	12.6	18.6	-115.2	-96.6	10.9	<b>-107.5</b>	
90.3	92.1	93.9	6	12.7	18.7	-84.2	-65.5	22.4	<b>-87.9</b>	
91.5	93.9	96.3	6	12.5	18.5	-113.3	-94.8	10.4	<b>-105.2</b>	
95.7	93.9	92.1	6	12.2	18.2	-112.3	-94.1	10.4	<b>-104.5</b>	
98.7	96.3	93.9	6	12.1	18.1	-104.1	-86	10.9	<b>-96.9</b>	
100.5	96.3	92.1	6	12.2	18.2	-115.4	-97.2	10.9	<b>-108.1</b>	
111.9	104.1	96.3	6	11.7	17.7	-115.1	-97.4	20.5	<b>-117.9</b>	
114.3	104.1	93.9	6	11.7	17.7	-115.6	-97.9	20.5	<b>-118.4</b>	
116.1	104.1	92.1	6	11.7	17.7	-114.1	-96.4	20.5	<b>-116.9</b>	

The Spectrum Analyzer was used to check the close in spectral attenuation of the carrier to confirm the operation of the transmitter, 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 on June 11, 2022 as summarized in this document, I, Jeff Taylor, find the subject system, specifically the transmitters and filter systems for the operation of KATK, K230CI, K242DB, and KCDY 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 KATK, K230CI, K242DB, and KCDY, 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.

Jeff Taylor, Field Technician



State of Indiana)  
 ) SS:  
County of Warrick)

**AFFIDAVIT**

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

- 1.) I am the Field Service Manager for Electronics Research, Inc ("ERI ") and have been employed by ERI for 41 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 Carlsbad Radio, Inc., on behalf of radio Stations KATK, K230CI, K242DB, and KCDY in Carlsbad, N.M. to prepare this Report Of Findings.

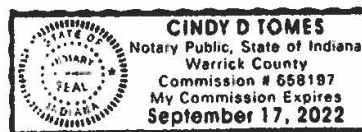
Mark Steapleton; Field Service Manager

Mark Steapleton

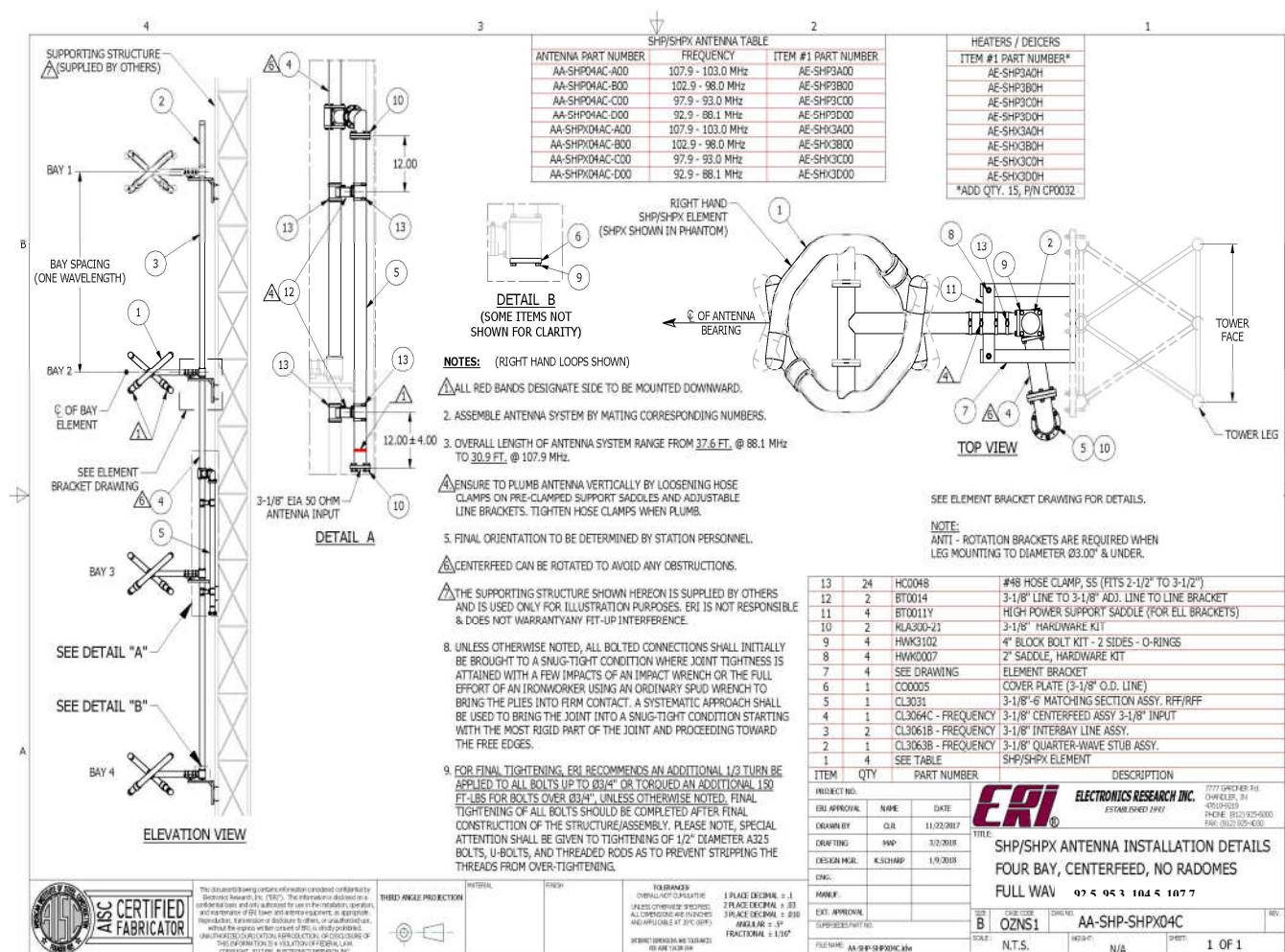
*Subscribed and sworn to before me on this 14th, day of June, 2022.*

Cindy D Tomes; Notary Public  
My commission expires September 17, 2022

Cindy D. Tomes



**EXHIBIT, A-1**



**A-2 ERI Antenna Specification Sheet**

TRANSMISSION SITE

CARLSBAD, N.M.

**General Specifications**

Antenna Type .....High Power FM-Broadcast, Suitable For Multiplexing  
 Model Number .....SHPX-4AC-SP  
 Number of Bay Levels ..... Four  
 Polarization..... Right Hand Circular Polarized

**Electrical Specifications**

Antenna Input Power Capability ..... 7.5 kW Max <sup>(1)</sup>  
 Operating Frequency Band ..... 92.1 ~ 93.9 ~ 96.3 ~ 104.1 Megahertz.  
 VSWR. .... <1.04:1 @ Operating Frequencies<sup>(2)</sup>  
 Azimuthal Pattern Circularity ..... Better Than +/- 2dB From RMS (Free Space)  
 Power Split ..... 50/50 (Horizontal & Vertical)  
 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> <sup>(3)</sup>	<u>Filter Loss</u> <sup>(4)</sup>	<u>Computed TPO</u>
92.1	6.00 KW	0.0°	13.2 %	0.0 %	2.053	-0.441 dB	-0.322 dB	3.484 kW
93.9	250 Watts	0.0°	9.2 %	0.0 %	2.105	-0.445 dB	-0.522 dB	0.148 kW
96.3	250 Watts	0.0°	3.9 %	0.0 %	2.137	-0.451 dB	-0.432 dB	0.143 kW
104.1	6.00 KW	0.0°	13.3 %	0.0 %	1.968	-0.469 dB	-0.324 dB	3.660 kW

**Mechanical Specifications**

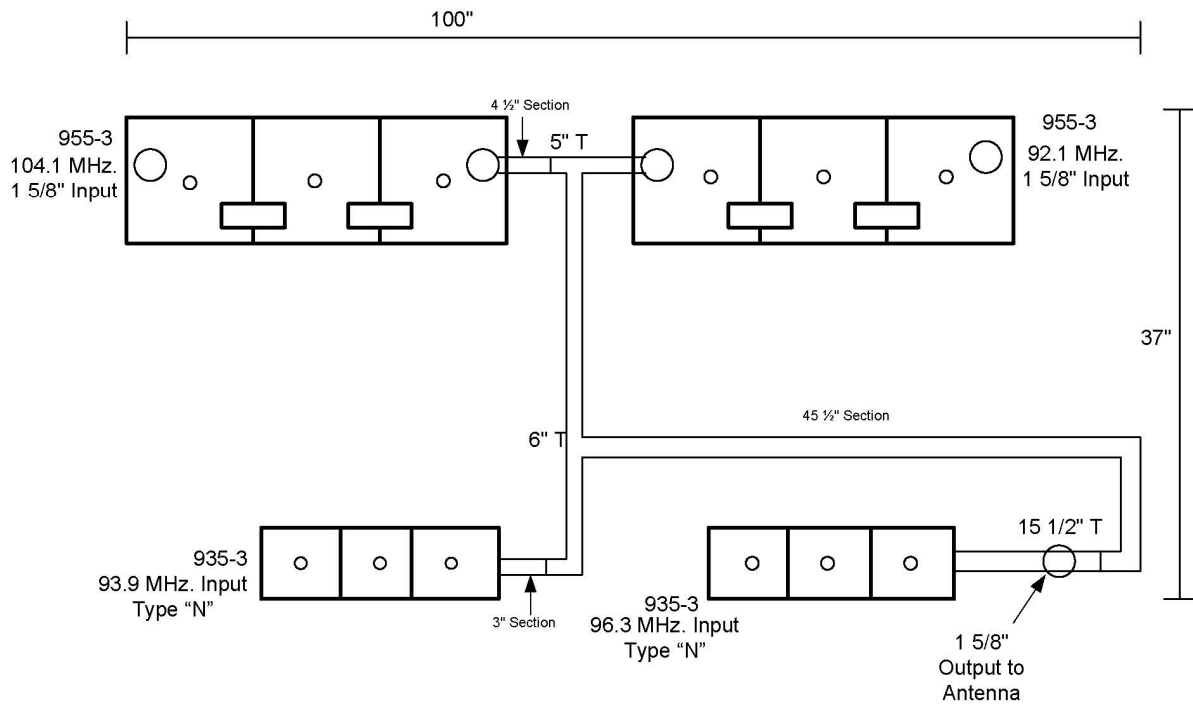
Antenna Feed System.....Single Input  
 Input Connector .....3 1/8"50-Ohm EIA Flanged  
 Element Deicing.....None  
 Interbay Spacing..... 119.88" Center to Center  
 Array Length ..... 32.5 Feet  
 Construction Material (Antenna)..... Brass and Stainless Steel

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 215 Feet of ERI MACXLine 3 1/8" Rigid 17.5 Foot Sticks & 181 Feet of Cablewave 1 5/8" Flex.

4) Losses Taken from Actual Combiner.



## Combiner Layout for Carlsbad, N.M.

KATK 92.1 MHz. ~ K230CI 93.9 MHz.  
K242DB 96.3 MHz. ~ KCDY 104.1 MHz.

**A-4 ERI "T" Combiner Specification Sheet**

TRANSMISSION SITE

CARLSBAD, N.M.

**General Specifications:**

Multiplexer Type ..... 955-3/935-3 "T" Combiner  
Number of Combining Units ..... Four  
Injected Port to Injected Port Isolation ..... < - 46 dB  
Output Connector ..... 1 5/8 "50 Ohm EIA (Flanged)  
Output Power (Designed) ..... 7.5 kW<sup>(1)</sup>

Heat Removal ..... Forced Air Cooling for 92.1 & 104.1 MHz.  
Physical Arrangement ..... Rack Mounted

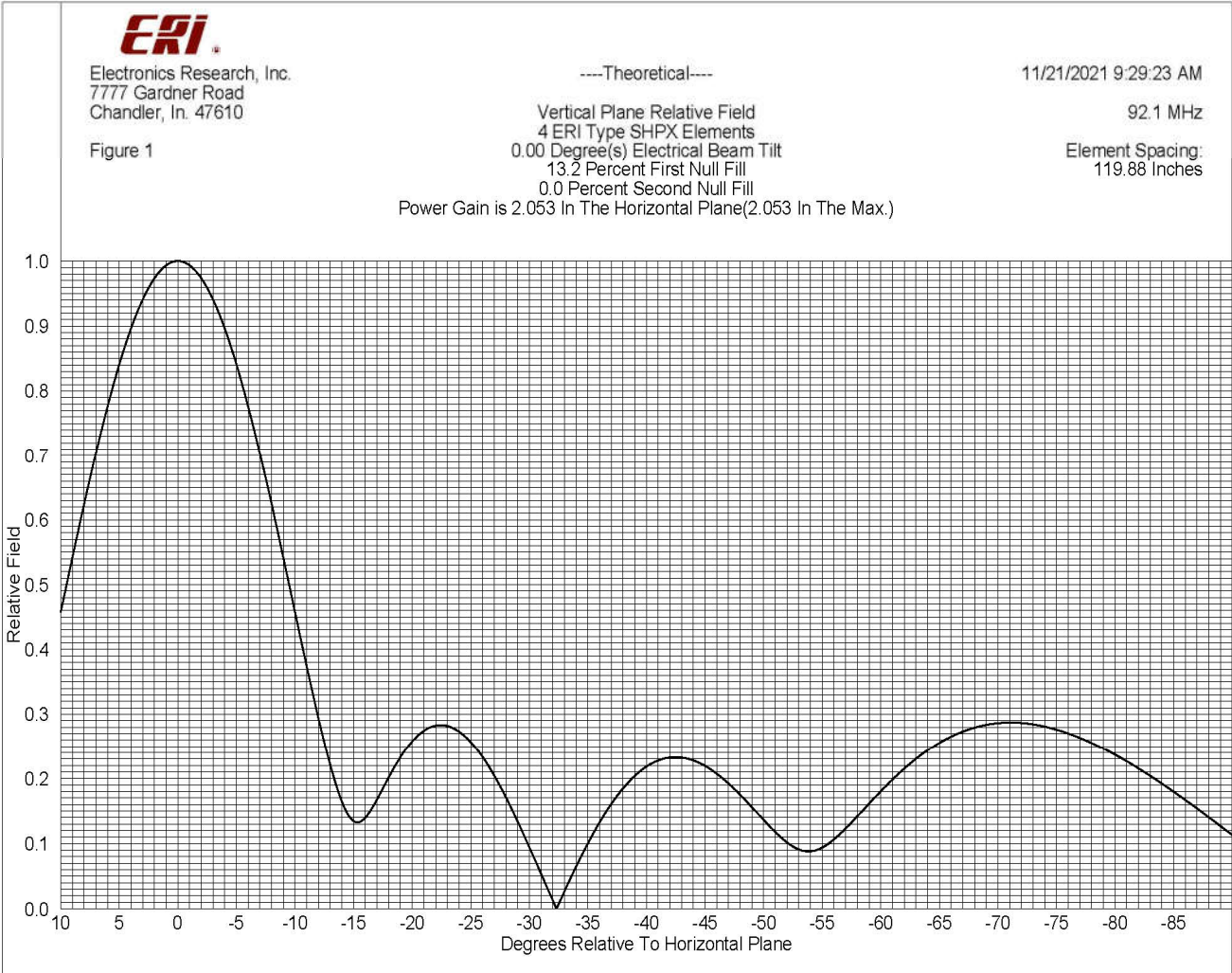
**Injected Port Specifications:**

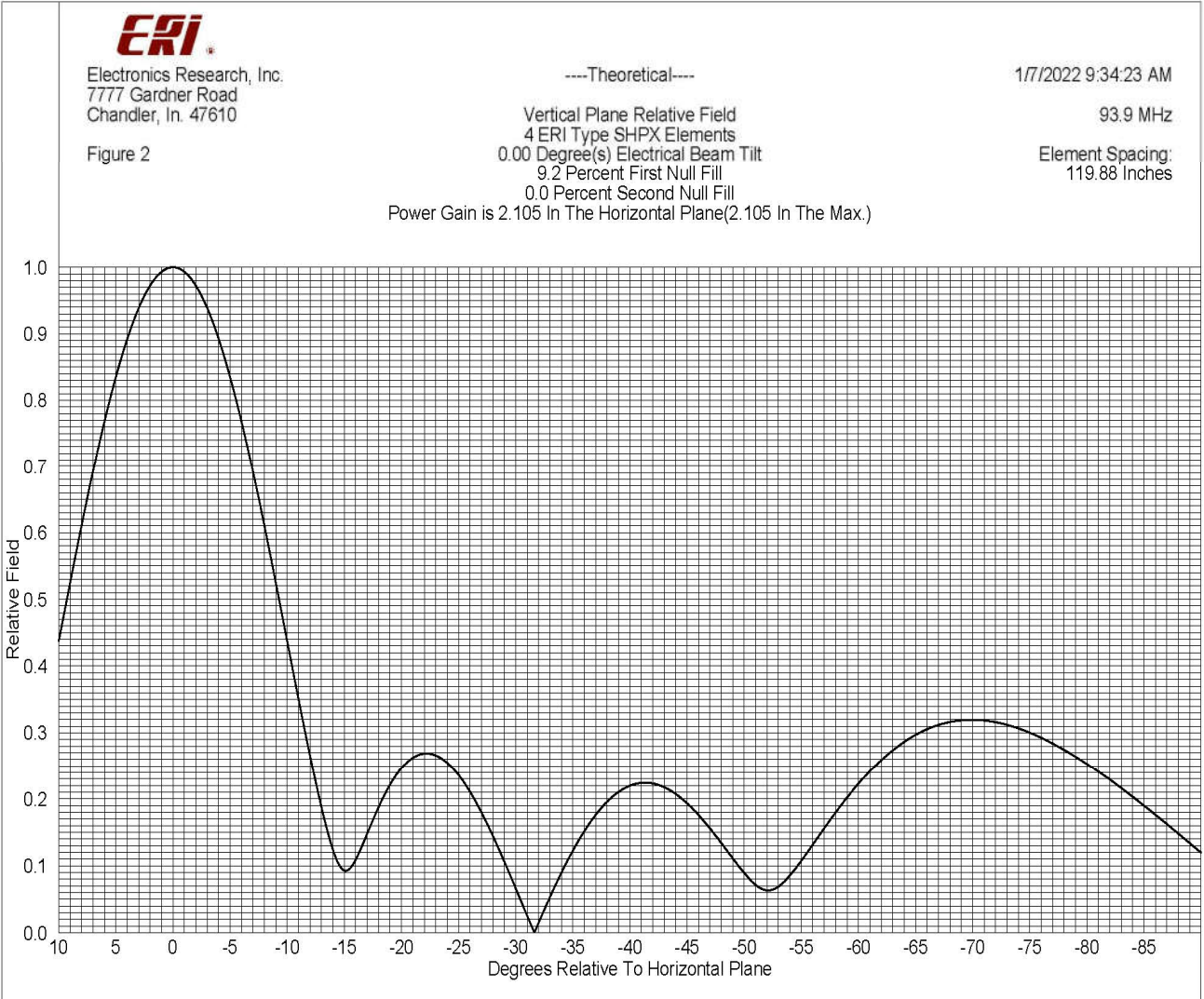
Frequency Assignment ..... 92.1 ~ 93.9 ~ 96.3 ~ 104.1 MHz.  
Power Rating, Each Injected Port (Designed)..... 3.484 kW 92.1 MHz, 148 Watts 93.9 MHz.  
Power Rating, Each Injected Port (Designed)..... 143 Watts 96.3 MHz, 3.660 kW 104.1 MHz.  
Input Connector ..... 1-5/8" 50 Ohm EIA (Flanged) 92.1 & 104.1 MHz.  
Input Connector ..... Type "N" 50 Ohm 93.9 & 96.3 MHz.  
VSWR..... < 1.07:1 @ +/-180 KHz.<sup>(2)</sup>  
Group Delay ..... Less than 60 ns Overall Variation, Carrier @ +/- 150 KHz.  
Insertion Loss (Measured):

92.1 MHz. .... - 0.322 dB  
93.9 MHz. .... - 0.522 dB  
96.3 MHz. .... - 0.432 dB  
104.1 MHz. .... - 0.324 dB

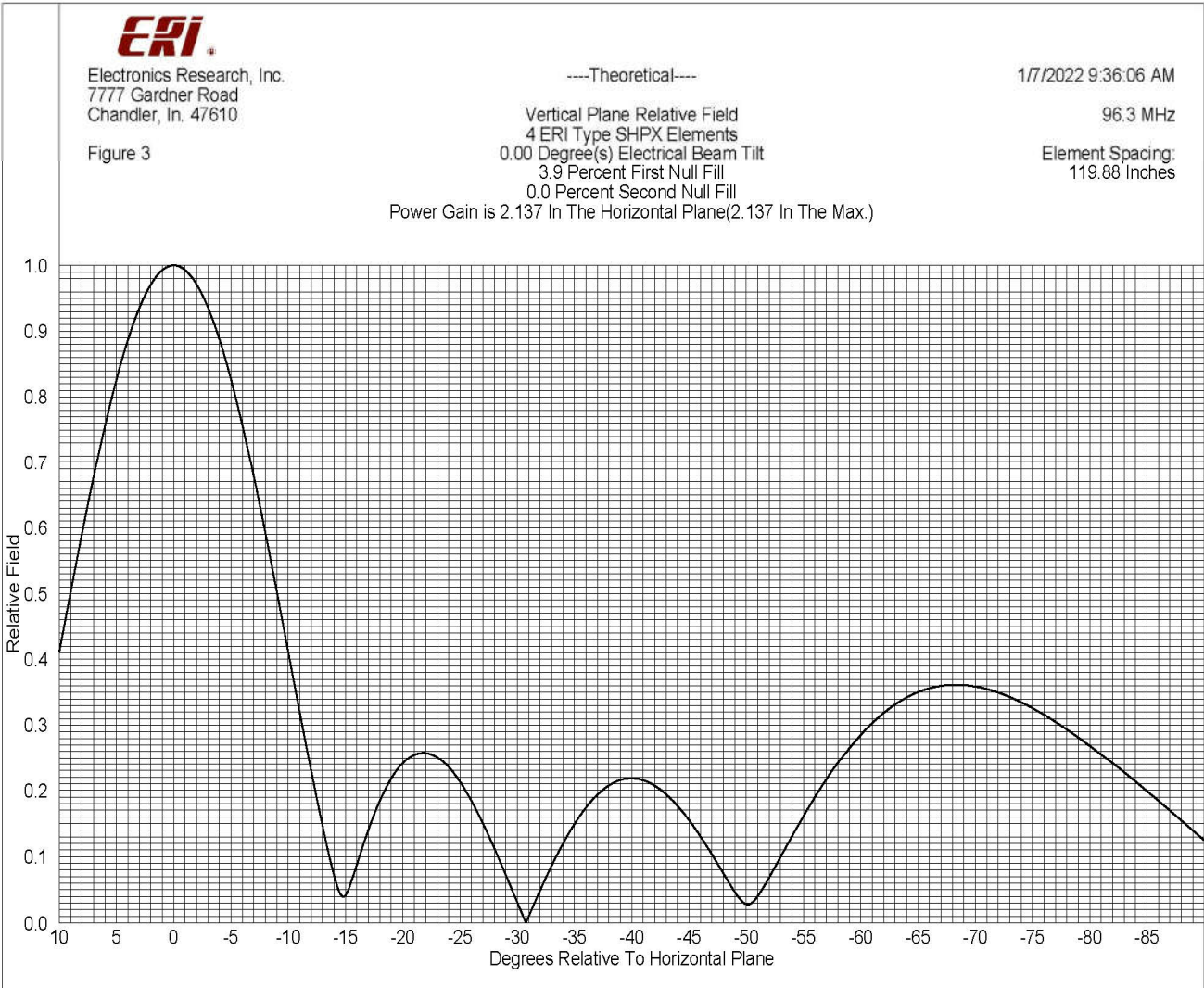
1) Power Rating Listed is as Designed Only. Actual Power Capabilities May Vary.

2) When Terminated in 50 Ohm Resistive Load.

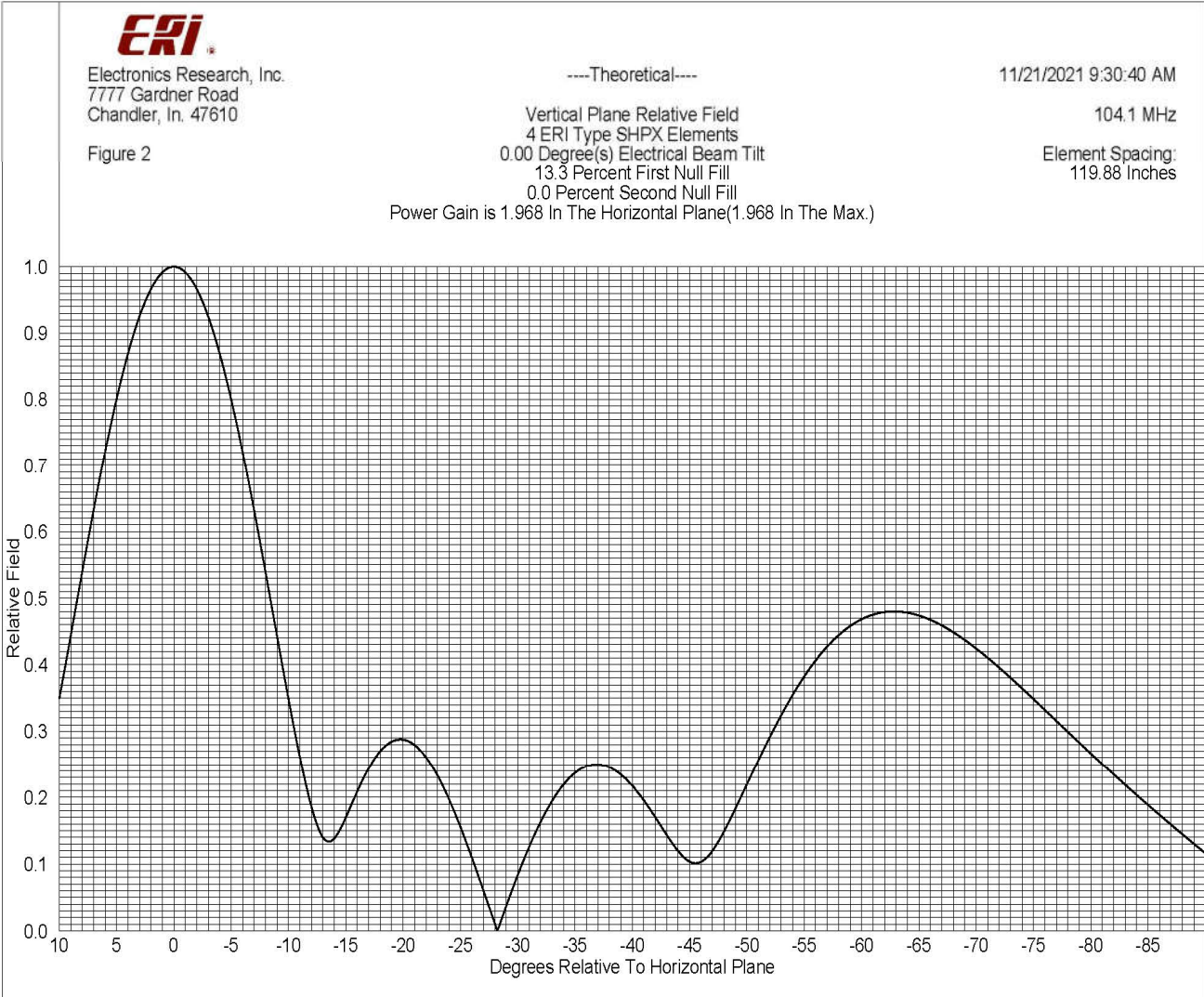












# **Broadcasting Scheme and Equipment Employed in Intermodulation Measurements**

