Report Of

Intermodulation Product Findings

KQMV 92.5 MHz Seattle, WA
KNUC 98.9 MHz Seattle, WA

Project# 37041

July 30, 2019

Electronics Research Inc.
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Chandler, Indiana 47610
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TABLE OF CONTENTS

Report of Findings for Intermodulation Product Measurements

Exhibits Accompanying This Report

REPORT OF FINDINGS
KQMV / KNUC
92.5 MHz / 98.9 MHz

Introduction: This report of findings is based on data collected at the KQMV and KNUC broadcast facility located on Cougar Mountain, WA. The report includes measurements offered as proof that the combined operations of KQMV (92.5 MHz) and KNUC (98.9 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). Troy Knotts of Electronics Research, Inc. located in Chandler, Indiana performed the measurements summarized herein on July 25, 2019.

The following exhibits are provided:

Exhibit A:
- A-1 Drawing Depicting Antenna.
- A-2 SHPX-6AC-HW-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 F2 signifies the frequency causing the interference.

The Multiplexed System: These measurements were taken with both FM stations operating from the combined antenna system. The KQMV and KNUC multiplexed system is fundamentally comprised of antenna, feed line and multiplexer unit. The SHPX-6AC-HW-SP (antenna), combiner units, and the rigid feedline are products of Electronics Research, Inc. while the coaxial feedline is a product of Andrew. 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 multiplexing scheme consisting of a 783-4 series FM "TEE" Combiner. Specifically, the combiner uses two ERI Model 783-4 modules for each frequency (92.5 MHz and 98.9 MHz). An interconnecting "T" is required to complete the combiner which is illustrated in the attached Exhibit A-3. The multiplexer, fully assembled, exhibited transmitter port-to-port isolation in excess of -89 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 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 -40 dB directivity and a forward signal sample of -46 dB.

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. An IFR Spectrum Analyzer (Model #2399A; Serial #02113071) was employed to record the level of all signals investigated. A Copper Mountain VNA (Model #S5048; Serial #15077025) was used for selective tuning of the Band Pass Filter. The IFR 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 A-2 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 both transmitters were operating at maximum 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.

Carrier Frequency (MHz)	Pad One (dB)	Bandpass Filter Loss (dB)	Measured Level (dBm)	**Adjusted Level (dBm)**	Notes
92.5	**10**	**-**	**12.75**	**22.75**	
98.9	**10**	**-**	**13.03**	**23.03**	

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.

	Carrier Frequencies	
Interfering Frequencies	92.5	98.9
92.5 MHz	---	105.3
93.3 MHz	91.7	104.5
95.7 MHz	89.3	102.1
98.9 MHz	86.1	---
101.5 MHz	83.5	96.3
105.3 MHz	79.7	92.5
106.9 MHz	78.1	90.9

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 on Cougar Mountain, WA										
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***
Transmitter Mixes										
	92.5		10		10	12.75	22.75	**22.75**		
	98.9		10		10	13.03	23.03	**23.03**		
78.1	92.5	106.9	10	11.57	21.57	-92.52	-70.95	22.75	**-93.7**	
79.7	92.5	105.3	10	11.64	21.64	-90.94	-69.3	22.75	**-92.05**	
83.5	92.5	101.5	10	11.27	21.27	-92.63	-71.36	22.75	**-94.11**	
86.1	92.5	98.9	10	10.98	20.98	-91.83	-70.85	22.75	**-93.6**	
89.3	92.5	95.7	10	10.9	20.9	-77.67	-56.77	22.75	**-79.52**	***Local Carrier***
90.9	98.9	106.9	10	10.79	20.79	-91.58	-70.79	23.03	**-93.82**	
91.7	92.5	93.3	10	10.71	20.71	-91.05	-70.34	22.75	**-93.09**	
92.5	98.9	105.3	10	10.76	20.76	-13.84	6.92	23.03	**-16.11**	***Local Carrier***
96.3	98.9	101.5	10	10.56	20.56	-90.08	-69.52	23.03	**-92.55**	
102.1	98.9	95.7	10	10.31	20.31	-90.61	-70.3	23.03	**-93.33**	
104.5	98.9	93.3	10	10.28	20.28	-52.25	-31.97	23.03	**-55**	***Local Carrier***
105.3	98.9	92.5	10	10.36	20.36	-49.83	-29.47	23.03	**-52.5**	***Local Carrier***

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 July 25, 2019 as summarized in this document, I, Troy Knotts, find the subject system, specifically the transmitter and filter system for the operation of KQMV and KNUC 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 KQMV and KNUC 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.

Troy Knotts, Field Technician

State of Indiana)
) SS:
County of Warrick)

AFFIDAVIT

I, Troy Knotts, 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 12 years. I am familiar with and have assisted in the installation of FM Antennas and FM Filters 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 Hubbard Broadcasting on behalf of radio Stations KQMV and KNUC in Seattle, WA to prepare this Report of Findings.

Troy Knotts; Field Technician

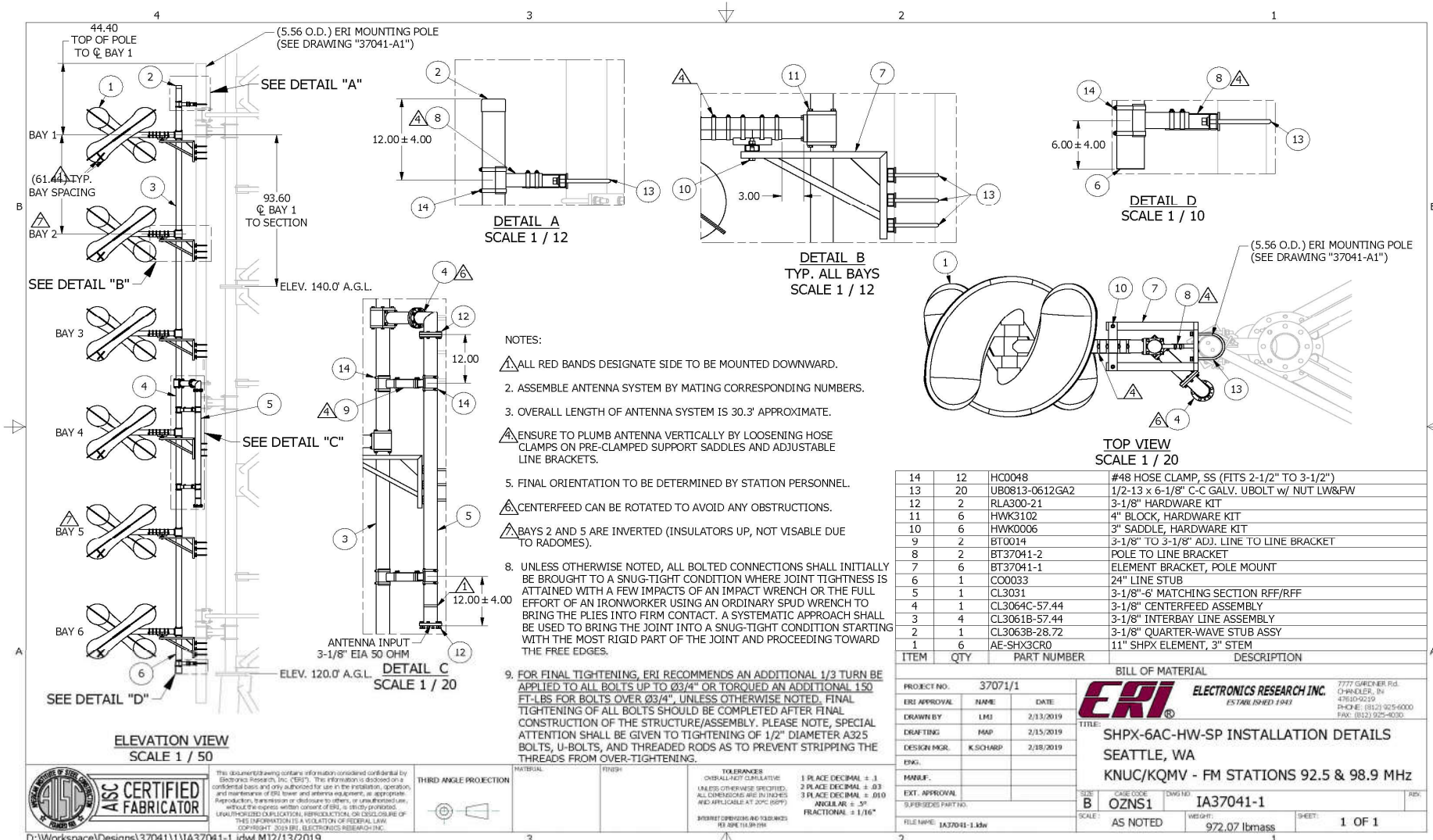
Subscribed and sworn to before me on this 30th, day of July, 2019.

Jayton L. Grubb Notary Public.

My commission expires Oct. 04. 2020

JAYTON L. GRUBB NOTARY PUBLIC MY COMM. EXPIRES OCTOBER 04, 2020 STATE OF ALASKA

EXHIBIT A-1



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 30.3' 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. CENTERFEED CAN BE ROTATED TO AVOID ANY OBSTRUCTIONS.
7. BAYS 2 AND 5 ARE INVERTED (INSULATORS UP, NOT VISABLE DUE TO RADOMES).
8. UNLESS OTHERWISE NOTED, ALL BOLTED CONNECTIONS SHALL INITIALLY BE BROUGHT TO A SNUG-TIGHT CONDITION WHERE JOINT TIGHTNESS IS ATTAINED WITH A FEW IMPACTS OF AN IMPACT WRENCH OR THE FULL EFFORT OF AN IRONWORKER USING AN ORDINARY SPUD WRENCH TO BRING THE PLIES INTO FIRM CONTACT. A SYSTEMATIC APPROACH SHALL BE USED TO BRING THE JOINT INTO A SNUG-TIGHT CONDITION STARTING WITH THE MOST RIGID PART OF THE JOINT AND PROCEEDING TOWARD THE FREE EDGES.
9. FOR FINAL TIGHTENING, ERI RECOMMENDS AN ADDITIONAL 1/3 TURN BE APPLIED TO ALL BOLTS UP TO Ø3/4" OR TORQUED AN ADDITIONAL 150 FT-LBS FOR BOLTS OVER Ø3/4", UNLESS OTHERWISE NOTED. FINAL TIGHTENING OF ALL BOLTS SHOULD BE COMPLETED AFTER FINAL CONSTRUCTION OF THE STRUCTURE/ASSEMBLY. PLEASE NOTE, SPECIAL ATTENTION SHALL BE GIVEN TO TIGHTENING OF 1/2" DIAMETER A325 BOLTS, U-BOLTS, AND THREADED RODS AS TO PREVENT STRIPPING THE THREADS FROM OVER-TIGHTENING.

ITEM	QTY	PART NUMBER	DESCRIPTION
14	12	HC0048	#48 HOSE CLAMP, SS (FITS 2-1/2" TO 3-1/2")
13	20	UB0813-0612GA2	1/2-13 x 6-1/8" C-C GALV. UBOLT w/ NUT LW&FW
12	2	RLA300-21	3-1/8" HARDWARE KIT
11	6	HWK3102	4" BLOCK, HARDWARE KIT
10	6	HWK0006	3" SADDLE, HARDWARE KIT
9	2	BT0014	3-1/8" TO 3-1/8" ADJ. LINE TO LINE BRACKET
8	2	BT37041-2	POLE TO LINE BRACKET
7	6	BT37041-1	ELEMENT BRACKET, POLE MOUNT
6	1	CO0033	24" LINE STUB
5	1	CL3031	3-1/8"-6' MATCHING SECTION RFF/RFF
4	1	CL3064C-57.44	3-1/8" CENTERFEED ASSEMBLY
3	4	CL3061B-57.44	3-1/8" INTERBAY LINE ASSEMBLY
2	1	CL3063B-28.72	3-1/8" QUARTER-WAVE STUB ASSY
1	6	AE-SHX3CR0	11" SHPX ELEMENT, 3" STEM

BILL OF MATERIAL

PROJECT NO.	37071/1	
ERI APPROVAL	NAME	DATE
DRAWN BY	LMJ	2/13/2019
DRAFTING	MAP	2/15/2019
DESIGN MGR.	K.SCHARP	2/18/2019
ENG.		
MANUF.		
EXT. APPROVAL		
SUPERSEDES PART NO.		
FILE NAME: IA37041-1.idw		

ELECTRONICS RESEARCH INC.
ESTABLISHED 1949
7777 GARDNER Rd.
CHANDLER, IN
47610-9219
PHONE: (812) 925-6000
FAX: (812) 925-4030

TITLE:
SHPX-6AC-HW-SP INSTALLATION DETAILS
SEATTLE, WA
KNUC/KQMV - FM STATIONS 92.5 & 98.9 MHz

SIZE	CAGE CODE	DWG NO	REV.
B	OZNS1	IA37041-1	
SCALE: AS NOTED	WEIGHT: 972.07 lbmass	SHEET: 1 OF 1	

ASC CERTIFIED FABRICATOR

THIRD ANGLE PROJECTION | MATERIAL | FINISH

TOLERANCES
OVERALL-NOT CUMULATIVE
UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN INCHES AND APPLICABLE AT 20°C (68°F)
INTERNET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994
1 PLACE DECIMAL ± .1
2 PLACE DECIMAL ± .03
3 PLACE DECIMAL ± .010
ANGULAR ± .5°
FRACTIONAL ± 1/16"

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A-2 ERI Antenna Specification Sheet

MULTIPLEXED TRANSMISSION SITE
Seattle, Washington

General Specifications

Antenna Type . . . . . .High Power FM-Broadcast, Suitable For Multiplexing
Model Number SHPX-6AC-HW-SP
Number of Bay Levels ..... Six
Polarization ..... Right Hand Circular

Electrical Specifications

Antenna Input Power Capability . . . . . 39 kW Max (1)
Operating Frequency Band..... 92.5 ~ 98.9 Megahertz.
VSWR. . . . . .Better than 1.03:1 @ Operating Frequencies(2)
Azimuthal Pattern Circularity ..... Better Than +/- 1dB 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
92.5	**16.173 KW**	**0.0°**	**5.7 %**	**0.0 %**	**1.844**	**-0.241 dB**	**-.251 dB**	**10 kW**
98.9	**17.142 KW**	**0.0°**	**5.7 %**	**0.0 %**	**1.958**	**-0.249 dB**	**-.281 dB**	**10 kW**

Mechanical Specifications

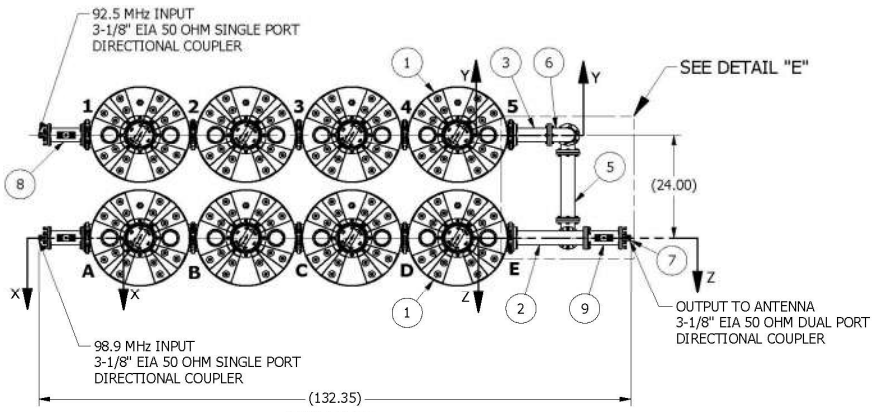
Antenna Feed System.....Fed with One 3 1/8" Line
Input Connector ..... . 3 1/8"-50 Ohm EIA Flanged
Element Deicing.....Radomes
Interbay Spacing..... 61.442" Center to Center
Array Length ..... 27.99 Feet
Construction Material (Antenna) ..... All Non-Corrosive
Construction Material (Mounting)..... All 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 120 Feet of HJ7-50A Flex and 85 Feet of ERI 3 1/8" Rigid. Section Lengths 17.5'.
4) Losses Taken from Actual Combiner.

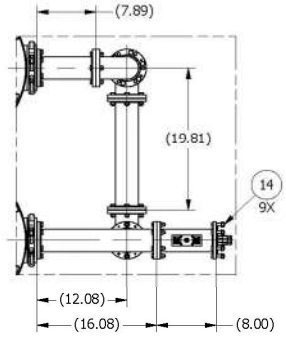
EXHIBIT A-3

NOTES:
1. REMOVE ALL BURRS & SHARP EDGES.
2. ASSEMBLE FILTER BY MATING CORRESPONDING LETTERS AND NUMBERS.

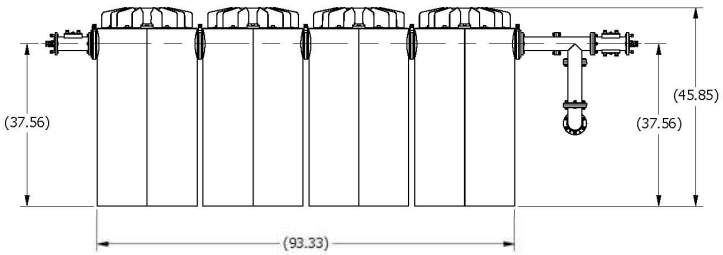
REVISION HISTORY			
REV	DESCRIPTION	DATE	APPROVED
A	ADDED ASSEMBLY CORRESPONDENCE NOTES	3/11/19	JTR



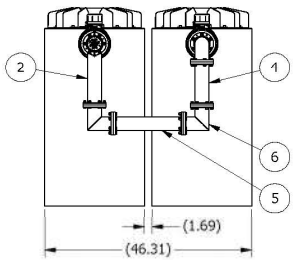
TOP VIEW
SCALE 1 / 25



DETAIL E
SCALE 1 / 15



FRONT VIEW
SCALE 1 / 25



RIGHT VIEW
SCALE 1 / 25

ITEM	QTY	PART NUMBER	DESCRIPTION
18	24	WL06SS	3/8 in, SS LOCK WASHER
17	24	SC0616H0100	3/8-16 UNC x 1 in, SST HEX BOLT
16	4	NU0518BZ	5/16 - 18 BRONZE HEX NUT
15	4	SC0518T0450	5/16-18 X 4.50" T-BOLT
14	4	RLA300-21	3-1/8" HARDWARE KIT
13	4	FI0284	INPUT ADAPTER
12	4	FI0001	6-1/4" O.D. X .128" WALL BRASS TUBE
11	4	CM0036	6" MARMAN CLAMP
10	4	CF0099	6" MARMAN TO 3-1/8" ADAPTER
9	1	DC3005-AL	3-1/8" DIRECTIONAL COUPLER (DUAL)
8	2	DC3003-AL	3-1/8" DIRECTIONAL COUPLER
7	5	CCA3101A-3	3-1/8" INNER CONNECTOR ASSEMBLY
6	3	1329350-10SE	90 DEG FLANGED ELBOW ASSEMBLY
5	1	1329350-5-15.622	3-1/8" EIA ALUM. LINE SECT., 15.622" LONG
4	1	1329350-5-10.160	3-1/8" EIA ALUM. LINE SECT., 10.160" LONG
3	1	1329350-5-7.891	3-1/8" EIA ALUM. LINE SECT., 7.891" LONG
2	1	CT37041-1	3-1/8" FLANGED TEE, ALUMINUM
1	2	783-4-00-66	FM BAND PASS FILTER (4) CAV., FLOOR MTD, CONVECTION COOLED

BILL OF MATERIAL

PROJECT NO.	37041/12	
ERI APPROVAL	NAME	DATE
DRAWN BY	HRH	2/14/2019
DRAFTING		
DESIGN MGR.		
ENG.	JTR	2/28/2019
MANUF.		
EXT. APPROVAL		
SUPERSEDES PART NO.		
FILE NAME: IM37041-1.idw		

ELECTRONICS RESEARCH INC.
ESTABLISHED 1943
7777 GARDNER Rd.
CHANDLER, IN
47610-9219
PHONE: (812) 925-6000
FAX: (812) 925-4030

TITLE:
MULTIPLEXER INSTALLATION LAYOUT
783-4 SERIES FM TEE/BRANCH COMBINER
SEATTLE, WA - KQMV 92.5 MHz/ KNUC 98.9MHz

SIZE	CAGE CODE	DWG NO.	REV
B	OZNS1	IM37041-1	A
SCALE: NOTED	WEIGHT: 859.47 lbmass	SHEET: 1 OF 2	

AISC CERTIFIED FABRICATOR

THIRD ANGLE PROJECTION | MATERIAL | FINISH

TOLERANCES
OVERALL-NOT CUMULATIVE
UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN INCHES AND APPLICABLE AT 20°C (68°F)
INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994

1 PLACE DECIMAL ± .1
2 PLACE DECIMAL ± .03
3 PLACE DECIMAL ± .010
ANGULAR ± .5°
FRACTIONAL ± 1/16"

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A-4 ERI Combiner Specification Sheet

MULTIPLEXED TRANSMISSION SITE
Seattle, Washington

General Specifications:

Multiplexer Type ..... "TEE" Combiner
Number of Combining Units ..... Two
Injected Port to Injected Port Isolation ..... < -89 dB
Output Connector ..... 3 1/8 "50 Ohm EIA (Flanged)
Output Power (Designed) ..... 20 kW(1)

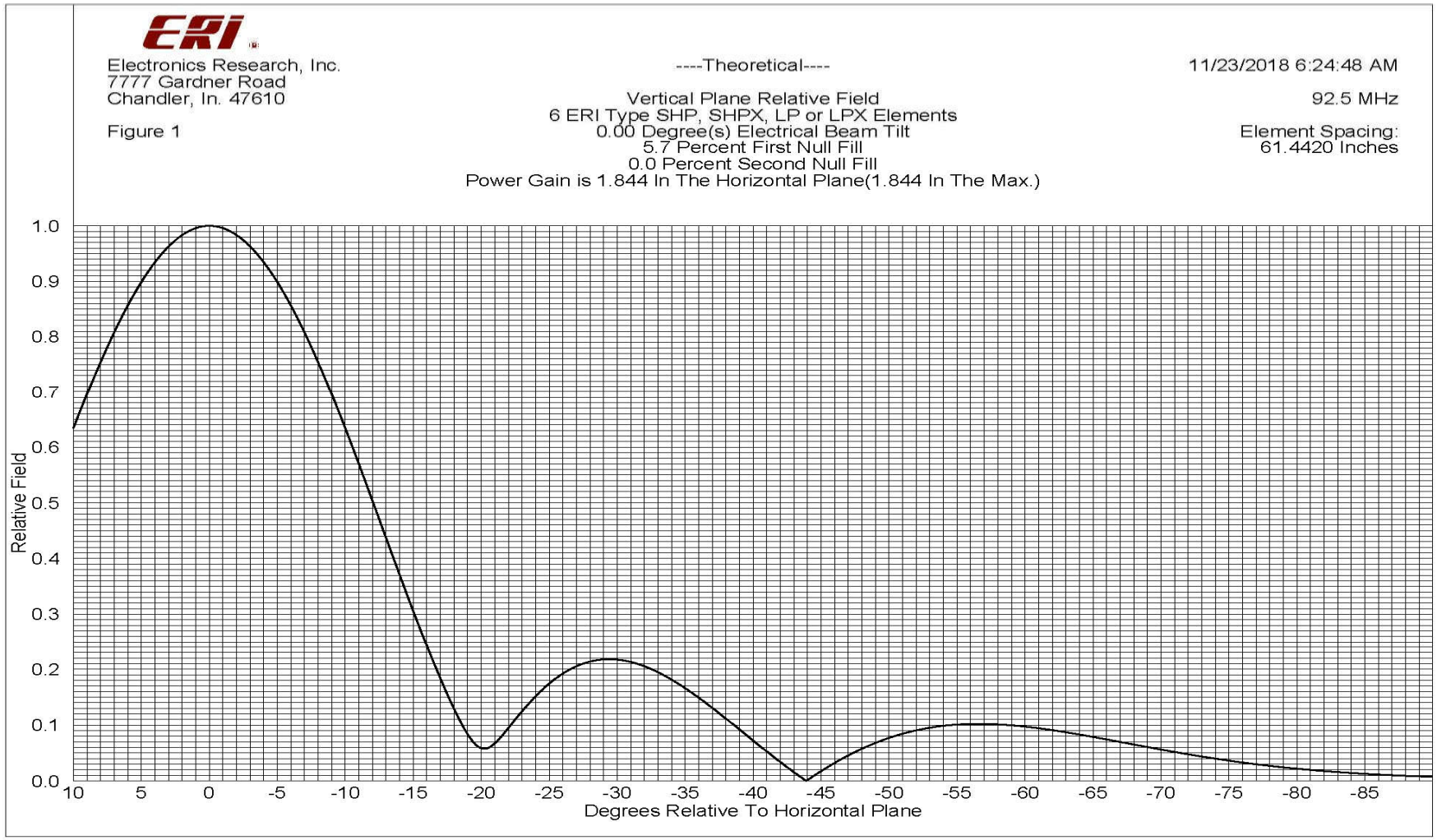
Heat Removal ..... Convection Cooling
Physical Arrangement ..... All Components Free Standing

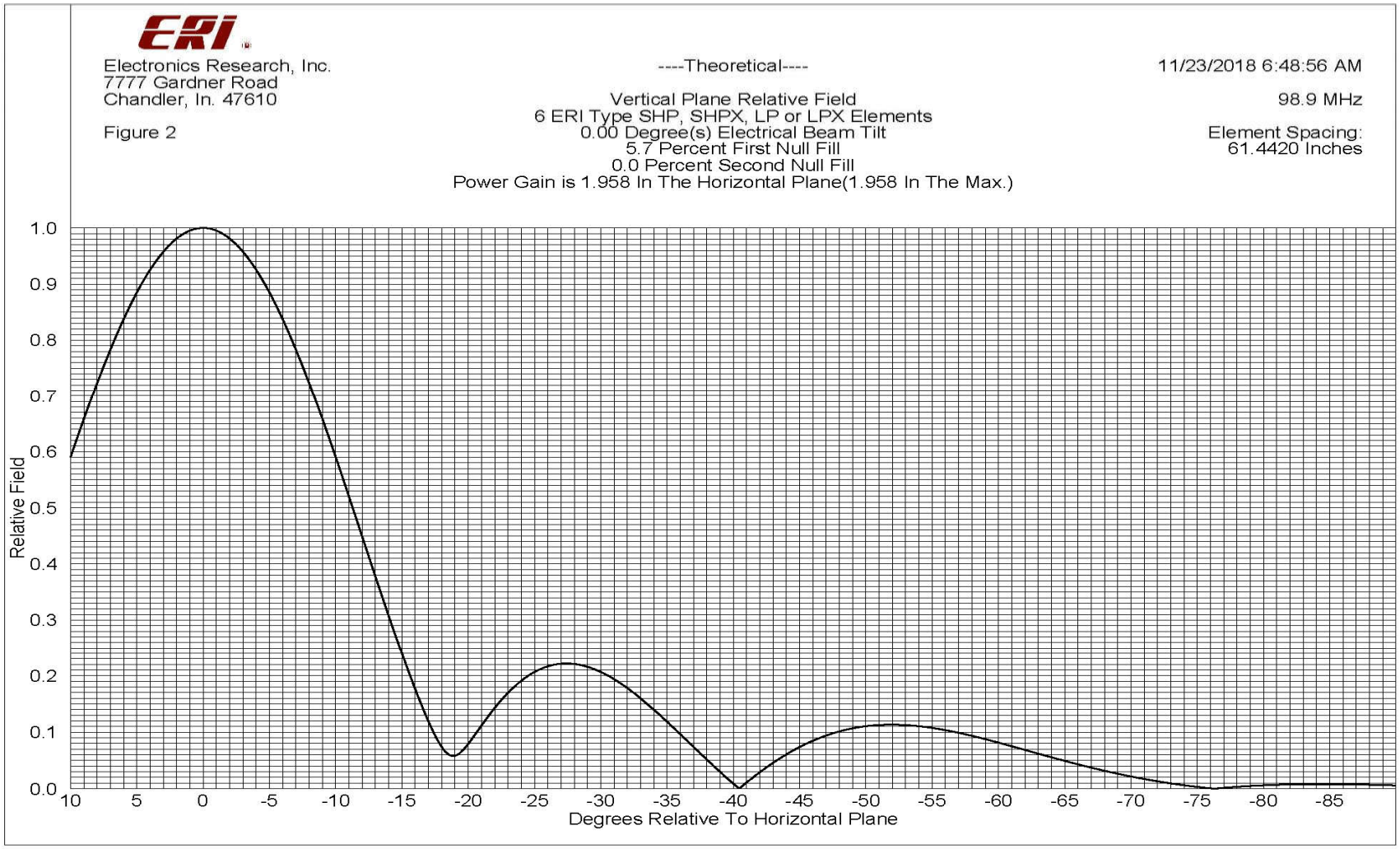
Injected Port Specifications:

Frequency Assignment ..... 92.5 ~ 98.9 MHz
Power Rating, Each Injected Port (Designed) ..... 10 kW for 92.5 MHz & 10 kW for 98.9 MHz
Input Connector ..... 3-1/8" 50 Ohm EIA (Flanged)
VSWR ..... Better than 1.07:1 @ +/-200 kHz(2)
Group Delay ..... Less than 67 ns Overall Variation, Carrier @ +/- 150 kHz
Insertion Loss (Measured):

92.5 MHz. ..... - 0.251 dB
98.9 MHz. ..... - 0.281 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
6 ERI Type SHP, SHPX, LP or LPX Elements
0.00 Degree(s) Electrical Beam Tilt
5.7 Percent First Null Fill
0.0 Percent Second Null Fill
Power Gain is 1.844 In The Horizontal Plane(1.844 In The Max.)
11/23/2018 6:24:48 AM
92.5 MHz
Element Spacing:
61.4420 Inches
Relative Field
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
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 SHP, SHPX, LP or LPX Elements
0.00 Degree(s) Electrical Beam Tilt
5.7 Percent First Null Fill
0.0 Percent Second Null Fill
Power Gain is 1.958 In The Horizontal Plane(1.958 In The Max.)
11/23/2018 6:48:56 AM
98.9 MHz
Element Spacing:
61.4420 Inches
Relative Field
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
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