Oklahoma City, Oklahoma

Master FM Broadband System Commissioning Report

Prepared For

KOMA 92.5, KMGL 104.1 & KRXO 107.7
Renda Broadcasting
&
KYIS 98.9 Citidel Broadcasting

Equipment

ERI COG-20P-12-240-2 Panel Antenna
with Dual Inputs and Reverse-fed IBOC
1660′ Dual ERI 6″- 50Ω Maxline & Dual 3″ Heliax Transmission Line
ERI 973-8 Four Channel Constant Impedance Combiner with Circulator Isolated IBOC

Measurement Data Taken on
3 - 12 August 2007

Submitted By

Todd R Loney
Senior RF Engineer

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Measurement setup

Measurements were taken with an Agilent 8753ES network analyzer, Agilent 4-port dual directional coupler. A three watt amplifier was used to overcome high RF level ingress. Richland Towers broadband, precision test adapters were used to make the measurements.
Data was extracted from the analyzer in complex pair values (real/imaginary) via the GPIB port to laptop computer. Data was then analyzed and presented using SoftPlot™ software and is imported into this document as an Object Linking Embedding (OLE). This data can be manipulated, (scale, format, markers, etc.) follow link to http://softplot.com/ and download demonstration version to utilize this feature.
Markers are placed at fc for each frequency utilized in the system; an additional marker is placed at the peak.

Measurement details

Analogue measurements were taken from the power divider input and on both 6" feeders, at the patch panel, on the output of the power divider. Both VSWR and polar impedance plots are presented. Time domain reflectometry plots are included to show line discontinuities vs. distance.
The IBOC upper and lower 3" Heliax lines were also swept from the 3" IBOC output ports of the patch panel. Polar impedance and VSWR plots are presented.
The antenna RHP (Analogue) – LHP (IBOC) isolation was measured between the upper, lower and combined inputs.
This report only includes data from the patch panel to the antenna. Individual station data is prepared under a separate report for each station

Findings

Overall results are satisfactory for this type of broadband system.
All three 9" inputs, on the analogue patch panel, exhibit a slight input mismatch. I slugged the lower line with a 0.5" slug to bump to locus over centre but it could use a bit more. This location is very difficult to disassemble and reassemble due to the amount of components and weights involved. The antenna inputs were optimized at tower top as well as from the patch panel. Overall, the antenna system readily meets the VSWR specification of <1.15 so additional attempts at optimization were not performed.
Antenna manufacturers favour the analogue match and RHP-LHP isolation over the digital match due to the lower power levels involved (-20dB for IBOC). The circulator provides the additional required isolation to the IBOC transmitters consequently; the match for the IBOC is determined by the circulator isolation. This equates to <≈1.2:1 match for the IBOC irrespective of the match
RHP – LHP antenna isolation is quite acceptable at ≈-25dB (combined resultant).

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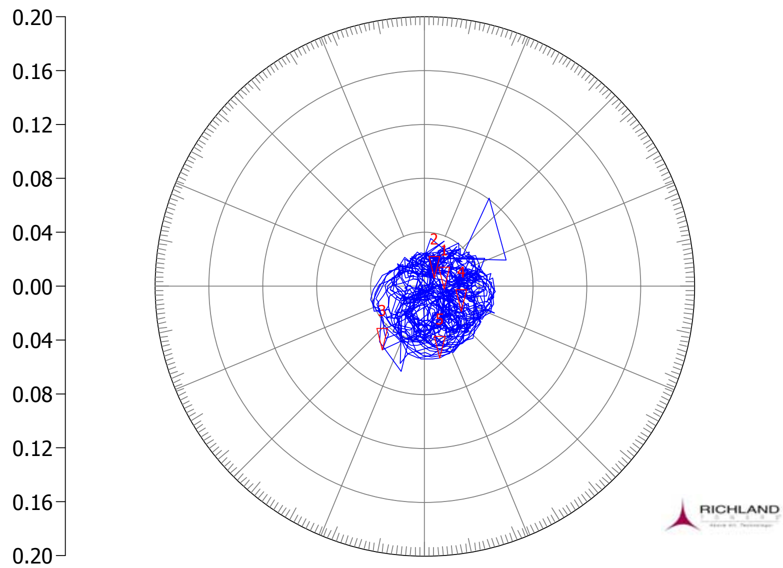
OKC Combined Polar Impedance 200mU

Combined



1 Combined
92.500000 MHz
0.0147, -8.9205°

2 Combined
98.900000 MHz
0.0091, 39.6457°

3 Combined
104.100000 MHz
0.0565, -123.5517°

4 Combined
107.700000 MHz
0.0330, -34.2465°

5 Combined
105.387500 MHz
0.0547, -78.2899°

Centre: 98.000000 MHz Span: 20.000000 MHz

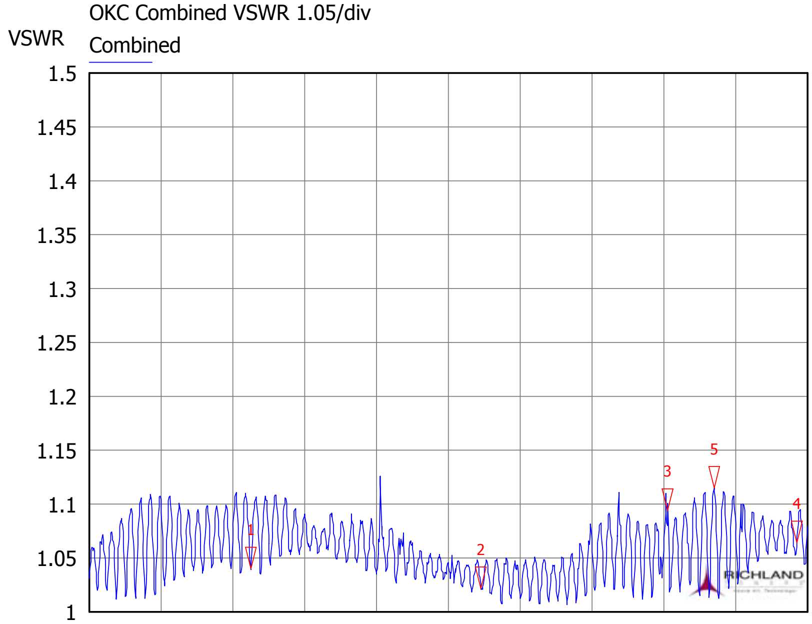
8/10/2007 10:09:51 AM 8753ES

Final Antenna Match.spt

Patch Panel to Antenna

OKC Combined VSWR 1.05/div

Combined



1 Combined
92.500000 MHz
1.0399 VSWR

2 Combined
98.900000 MHz
1.0221 VSWR

3 Combined
104.100000 MHz
1.0946 VSWR

4 Combined
107.700000 MHz
1.0639 VSWR

5 Combined
105.400000 MHz
1.1151 VSWR

Centre: 98.000000 MHz Span: 20.000000 MHz

8/10/2007 10:09:51 AM 8753ES

Final Antenna Match.spt

Patch Panel to Antenna

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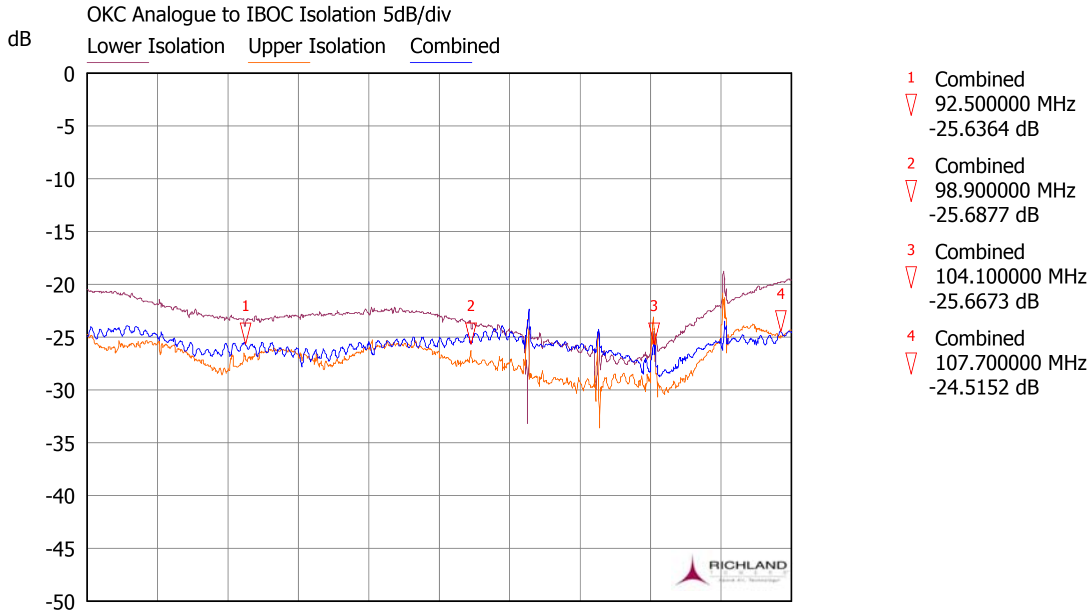
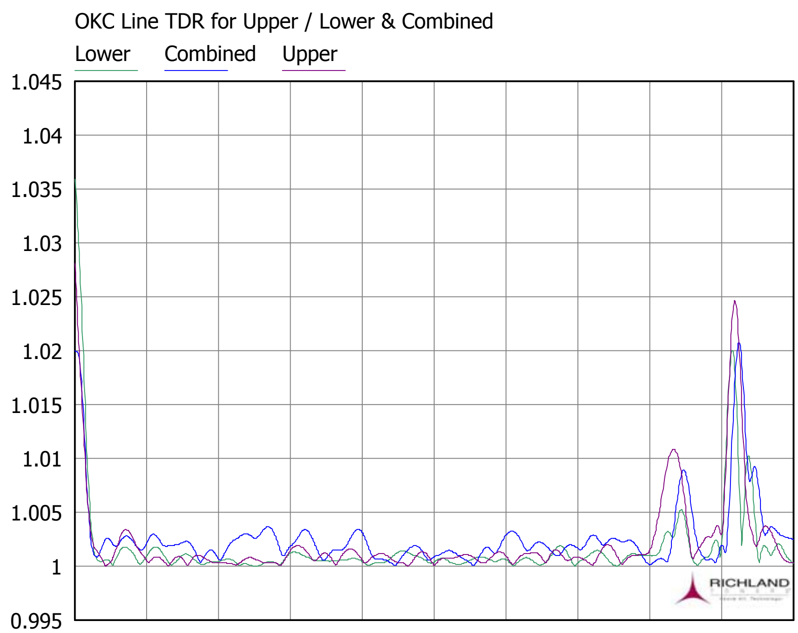


Start: 88.000000 MHz Stop: 108.000000 MHz

8/8/2007 8:30:19 AM 8753ES

Antenna Isolation.spt



Start: 0 s Stop: 4.000000 us

8/10/2007 10:10:02 AM 8753ES

Final TDR.spt

20MHz TDR @ 1601 points

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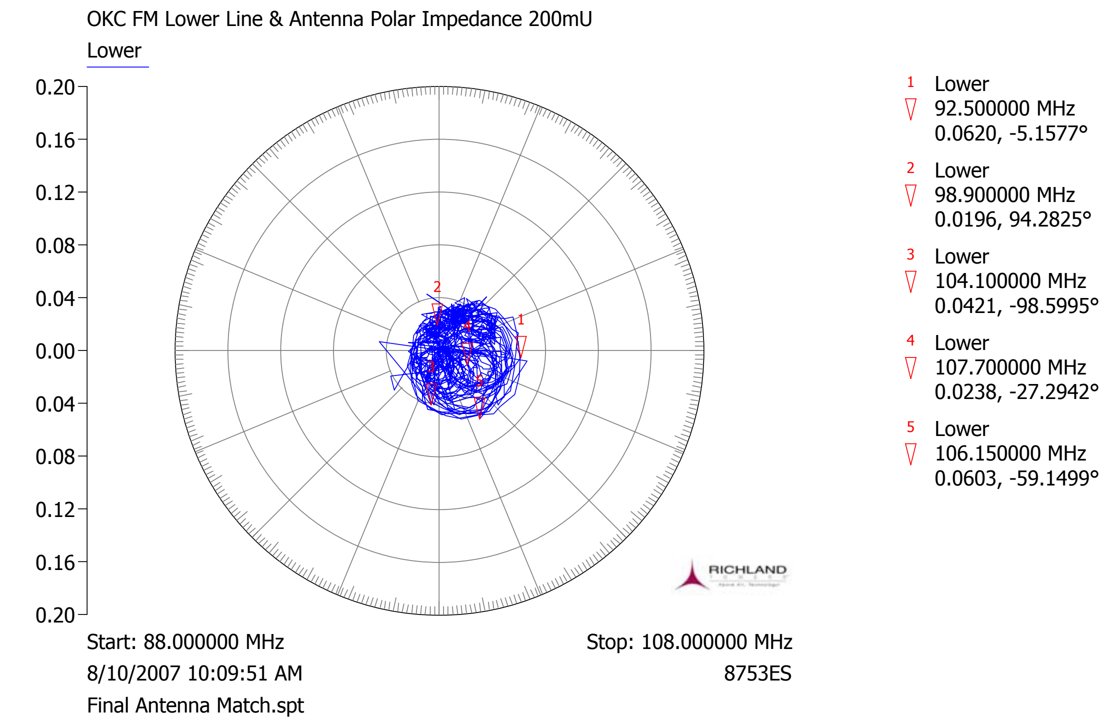
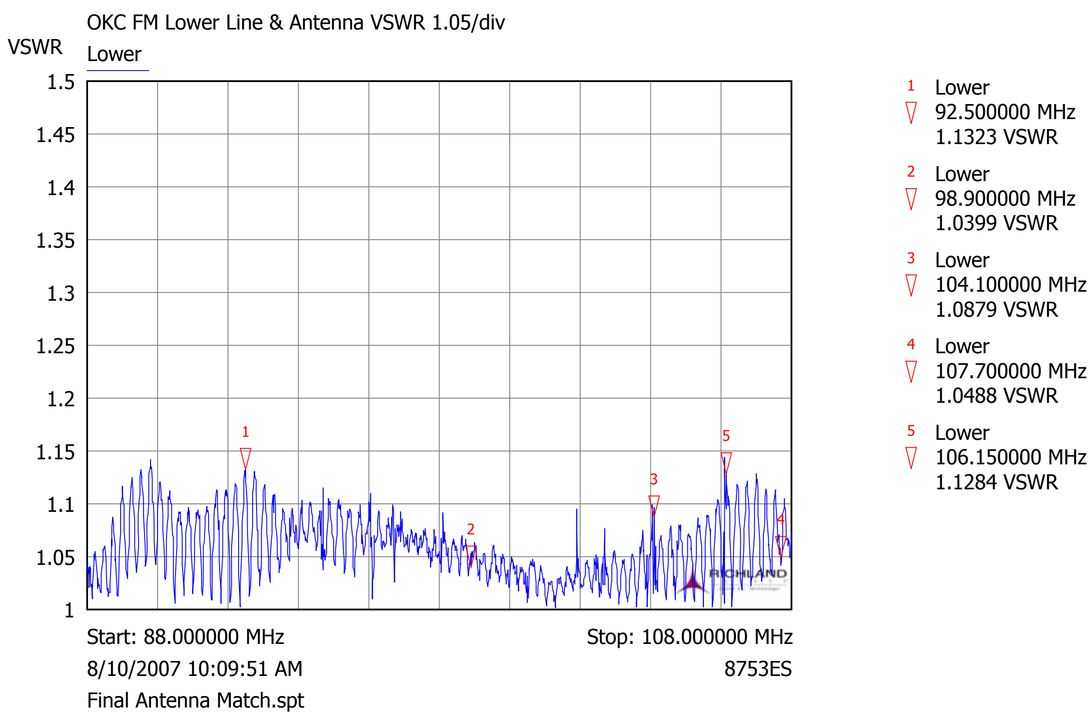


Patch Panel to Antenna (0.5" slug located 31.5" from top of vertical riser on patch panel)



Patch Panel to Antenna (0.5" slug located 31.5" from top of vertical riser on patch panel)

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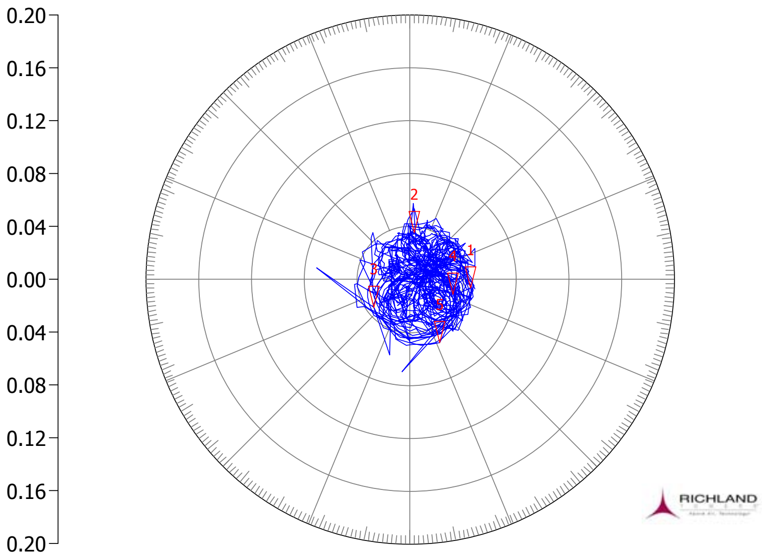
OKC FM Upper Line & Antenna Polar Impedance 200mU

Upper



1 Upper
92.500000 MHz
0.0463, -8.1748°

2 Upper
98.900000 MHz
0.0356, 84.3404°

3 Upper
104.100000 MHz
0.0349, -141.7032°

4 Upper
107.700000 MHz
0.0344, -19.2637°

5 Upper
88.700000 MHz
0.0529, -64.7454°

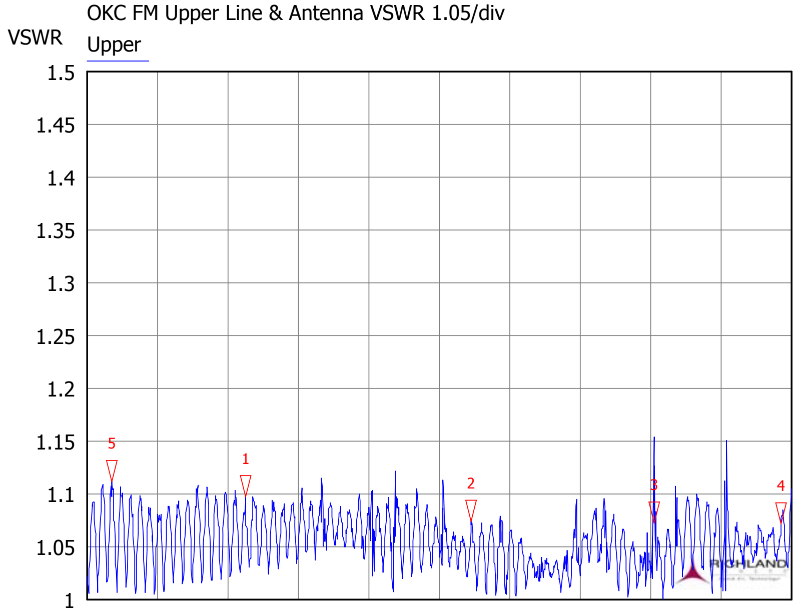
Start: 88.000000 MHz Stop: 108.000000 MHz

8/10/2007 10:09:51 AM 8753ES

Final Antenna Match.spt

OKC FM Upper Line & Antenna VSWR 1.05/div

Upper



1 Upper
92.500000 MHz
1.0971 VSWR

2 Upper
98.900000 MHz
1.0738 VSWR

3 Upper
104.100000 MHz
1.0723 VSWR

4 Upper
107.700000 MHz
1.0713 VSWR

5 Upper
88.700000 MHz
1.1117 VSWR

Start: 88.000000 MHz Stop: 108.000000 MHz

8/10/2007 10:09:51 AM 8753ES

Final Antenna Match.spt

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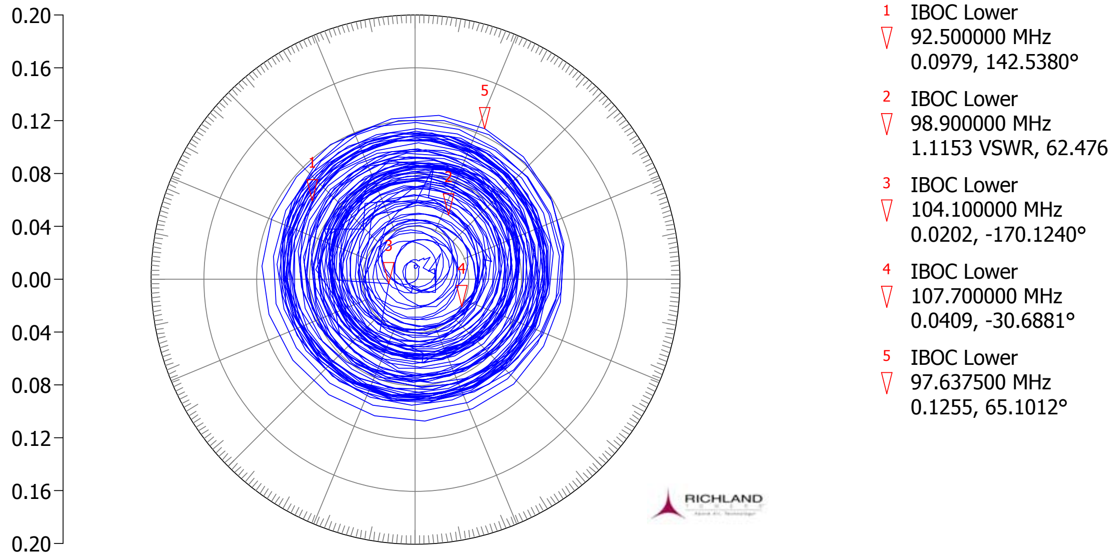
OKC FM IBOC Lower Line & Antenna Polar Impedance 200mU

IBOC Lower



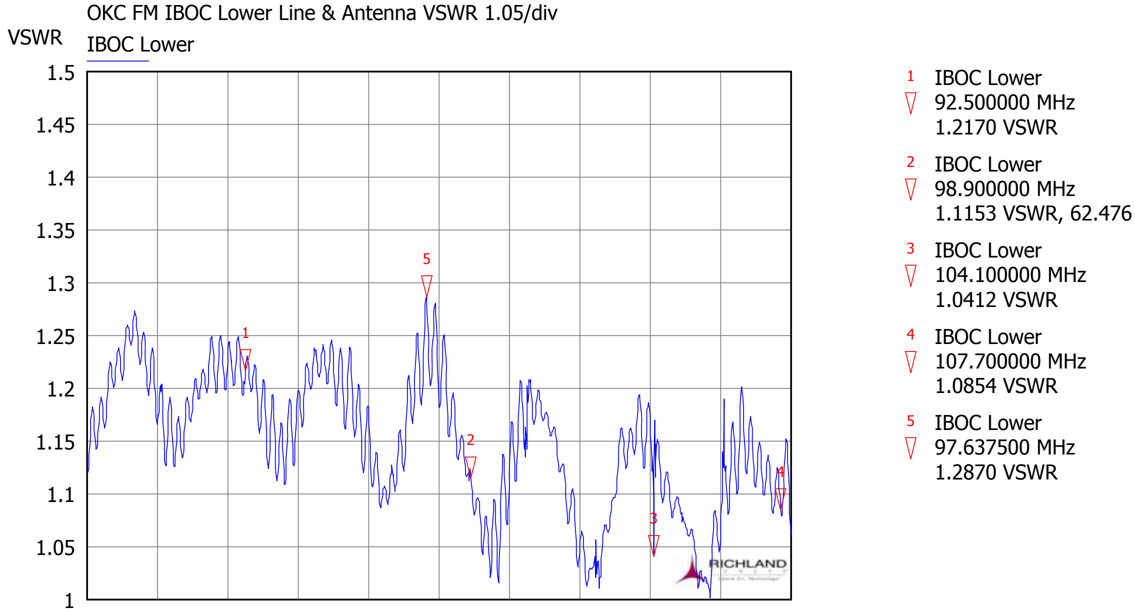
Centre: 98.000000 MHz | Span: 20.000000 MHz

8/2/2007 3:33:06 PM | 8753ES

IBOC S11.spt

OKC FM IBOC Lower Line & Antenna VSWR 1.05/div

IBOC Lower



Centre: 98.000000 MHz | Span: 20.000000 MHz

8/2/2007 3:33:06 PM | 8753ES

IBOC S11.spt

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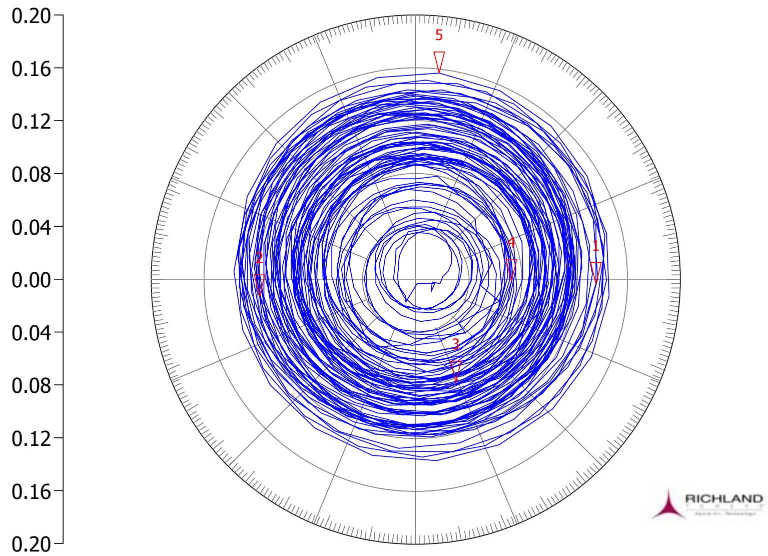
OKC FM Upper Line & Antenna Polar Impedance 200mU

IBOC Upper



Centre: 98.000000 MHz — Span: 20.000000 MHz

8/2/2007 3:33:06 PM — 8753ES

IBOC S11.spt

1 IBOC Upper
92.500000 MHz
0.1369, -1.3089°

2 IBOC Upper
98.900000 MHz
0.1189, -173.8273°

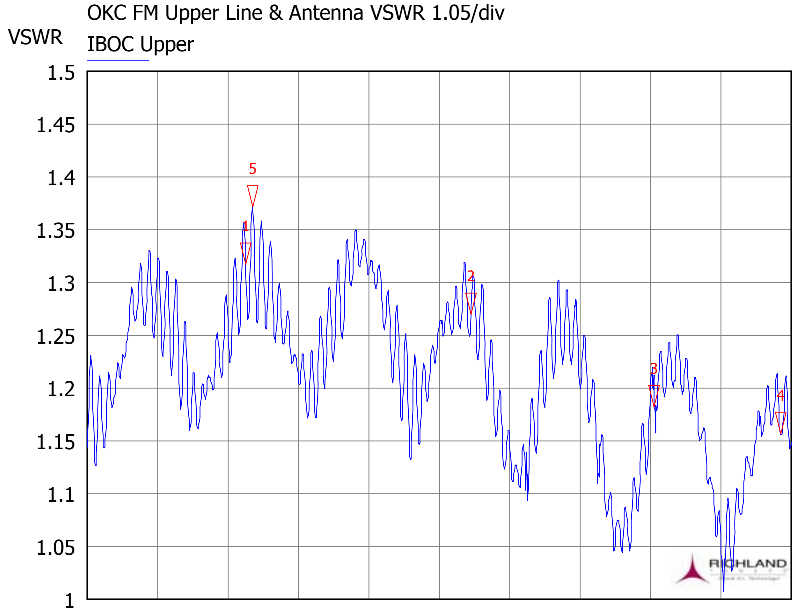
3 IBOC Upper
104.100000 MHz
0.0837, -68.4502°

4 IBOC Upper
107.700000 MHz
0.0725, -1.0790°

5 IBOC Upper
92.687500 MHz
0.1568, 83.3094°

OKC FM Upper Line & Antenna VSWR 1.05/div

IBOC Upper



Centre: 98.000000 MHz — Span: 20.000000 MHz

8/2/2007 3:33:06 PM — 8753ES

IBOC S11.spt

1 IBOC Upper
92.500000 MHz
1.3173 VSWR

2 IBOC Upper
98.900000 MHz
1.2699 VSWR

3 IBOC Upper
104.100000 MHz
1.1827 VSWR

4 IBOC Upper
107.700000 MHz
1.1564 VSWR

5 IBOC Upper
92.687500 MHz
1.3718 VSWR

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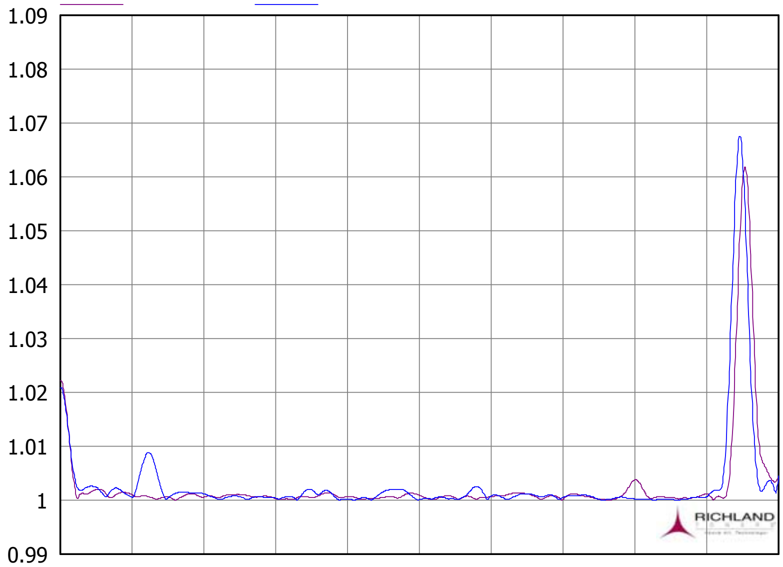
OKC FM IBOC Line & Antenna TDR

IBOC 1 TDR Initial   IBOC 2 TDR Initial



Start: 0 s   Stop: 4.000000 us

8/2/2007 3:32:06 PM   8753ES

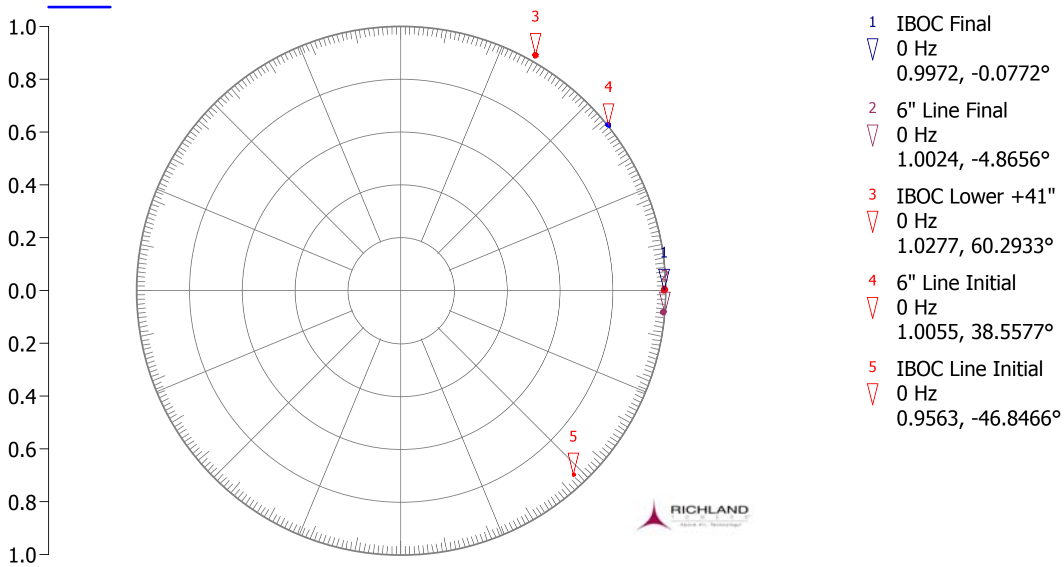
IBOC TDR.spt

20MHz TDR @ 1601 points

OKC FM Line Phasing @ 98MHz (Measured to Short / 2)

IBOC Line Initial   IBOC Lower +41"   IBOC Final   6" Line Final

6" Line Initial



Centre: 98.000000 mHz   Span: 1.000000 Hz

8/7/2007 1:34:18 PM   8753ES

Line Phase 98.spt

Analogue Line is +6.5" added to Upper & IBOC Line is +51.625" added to Lower)

6" Line Initial   6" Upper (Lower Ref)

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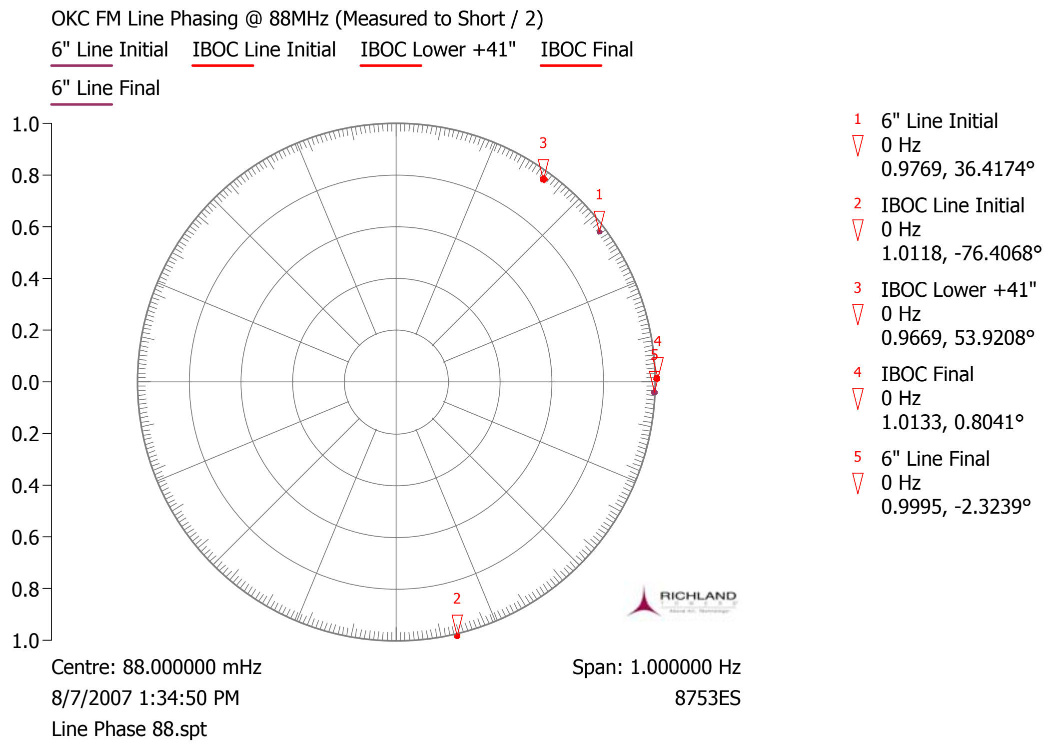
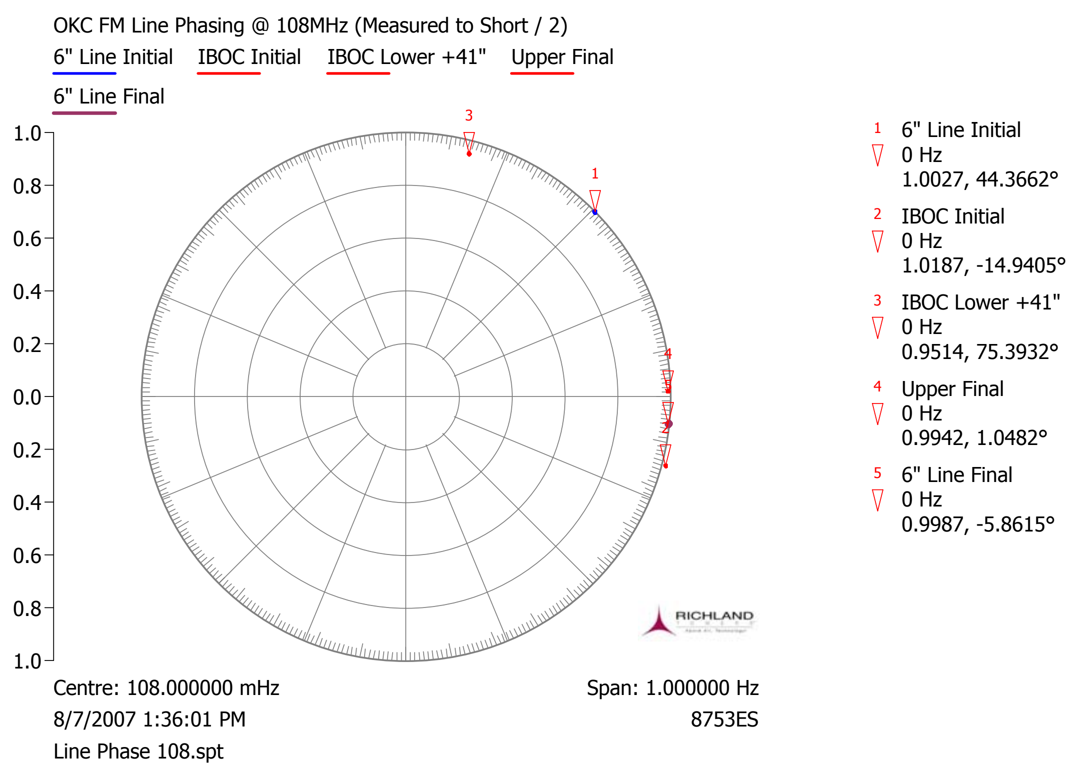


Analogue Line is +6.5" added to Upper & IBOC Line is +51.625" added to Lower)



Analogue Line is +6.5" added to Upper & IBOC Line is +51.625" added to Lower)

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Oklahoma City, Oklahoma

Master FM Broadband System

Intermodulation Study Report

Prepared For

KOMA 92.5, KMGL 104.1 & KRXO 107.7
Renda Broadcasting
&
KYIS 98.9 Citidel Broadcasting

Equipment

ERI COG-20P-12-240-2 Panel Antenna
with Dual Inputs and Reverse-fed IBOC
1660' Dual ERI 6"- 50Ω Maxline & Dual 3" Heliax Transmission Line
ERI 973-8 Four Channel Constant Impedance Combiner with Circulator
Isolated IBOC

Measurement Data Taken on
30 August – 1 September 2007

Submitted By

Todd R Loney
Senior RF Engineer

Introduction

This report is based on data collected at the KOMA, KYIS, KMGL & KRXO combined FM broadcast facility located in Okalahoma City, OK. The report includes measurements offered as proof that the combined operations of KOMA (92.5 MHz.), KYIS (98.7 MHz.), KMGL (104.1) and KRXO (107.7) 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).

TITLE 47--TELECOMMUNICATION

CHAPTER I--FEDERAL COMMUNICATIONS

COMMISSION (CONTINUED)

PART 73_RADIO BROADCAST SERVICES--Table of Contents

Subpart B_FM Broadcast Stations

Sec. 73.317 FM transmission system requirements.

(b) Any emission appearing on a frequency removed from the carrier by between 120 kHz and 240 kHz inclusive must be attenuated at least 25 dB below the level of the unmodulated carrier. Compliance with this requirement will be deemed to show the occupied bandwidth to be 240 kHz or less.

(c) Any emission appearing on a frequency removed from the carrier by more than 240 kHz and up to and including 600 kHz must be attenuated at least 35 dB below the level of the unmodulated carrier.

(d) Any emission appearing on a frequency removed from the carrier by more than 600 kHz must be attenuated at least 43 + 10 Log10 (Power, in watts) dB below the level of the unmodulated carrier, or 80 dB, whichever is the lesser attenuation.

In brief, the collection of measurements presented in this report demonstrate that all possible third order intermodulation (IM) products generated by this multiplex system are less than the maximum allowable level as required by section 73.317 (b) through (d).

Discussion of Intermodulation

When two or more transmitters are coupled to each other, new spectral components are produced by mixing of the fundamental and harmonic terms of each of the desired output frequencies. For example, if only two transmitters are involved, the third order intermodulation terms could be generated in the following way.
The output of the first transmitter (f1) is coupled into the non-linear output stage of the second transmitter (f2) because there is not complete isolation between the two output stages. (f2) will mix with the second harmonic of (f1) producing an in-band 3rd order term with a frequency of [2(f1)-(f2)]. In a similar fashion the other 3rd order term will be produced at a frequency of [2(f2)-(f1)]. This implies that the second harmonic content within each transmitter's output stage along with the specific nonlinear characteristics of the output stage will have an effect on the value of the mixing loss. It is possible however to generate these same 3rd order terms in another way. If the difference frequency between the two transmitters [(f2)-(fl)] which is an out-of-band frequency, re-mixes with either (fl) or (f2), the same 3rd order intermodulation frequencies are produced.
Experience has shown that to prevent spurious emissions, each transmitter must be isolated from all others in the system by a minimum of 40 dB, with 46 to 50 dB ensuring regulatory compliance. IM product attenuation is accomplished by a combination of transmitter turn-around loss and filtering. Turn-around losses are intrinsic to the way IM products are created in the transmitter. These losses typically run ≈6-13 dB for tube type transmitters. An off-frequency

signal is attenuated ≈40 dB, as it passes through the bandpass filters, of the combiner module, toward the transmitter with the IM product it creates exiting the transmitter an additional 6-13 dB below the level the signal entered. This product is then attenuated an additional 40 dB as it passes back through the combiner bandpass filters. The result is IM product attenuation of at least 80 dB, with 100 dB or more possible.

Measurement Technique

A precision incident coupler, at the combiner output, was utilized for all measurements presented in this report. The coupling valve value is -53dB with >30 directivity. Double screened cables were utilized. A 16dB attenuator pad was inserted for all measurements. To achieve adequate dynamic measurement range, a high Q, tunable, bandpass filter was inserted for all F1 reference levels as well as most IM product frequencies. For frequencies out of the tunable range of the filter, an FM bandstop filter was inserted. The filter(s) loss was measured at each frequency and used as an offset for the measured levels. Figure 1 shows the typical match and response of the tunable bandpass filter. Figure 2 shows the response of the FM bandstop filter. Figure 3 is a drawing of the test configuration.
An Agilent 8753ES network analyzer was used to tune the bandpass filter and measure the insertion loss. Reference and product levels were measured on an Agilent ESA 4402B spectrum analyzer. Wideband measurements were also performed to identify any other anomalous energy. To obtain baseline data, a wideband sweep was taken prior to the transmitters be energized. The data was again taken with the transmitters operating. The FM bandstop filter was inserted to prevent analyzer overload and allow measurement level to -100dBc.

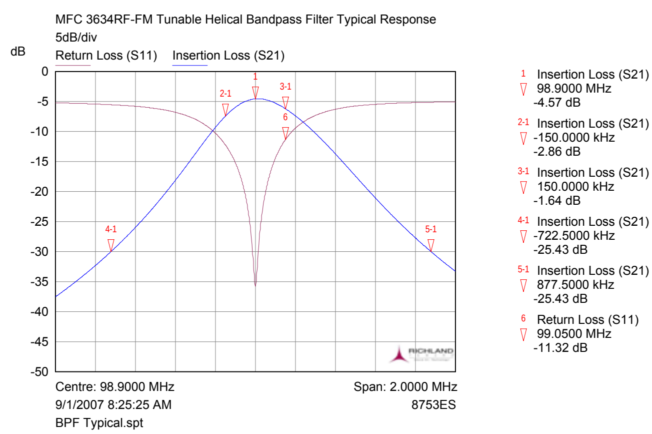


Figure 1

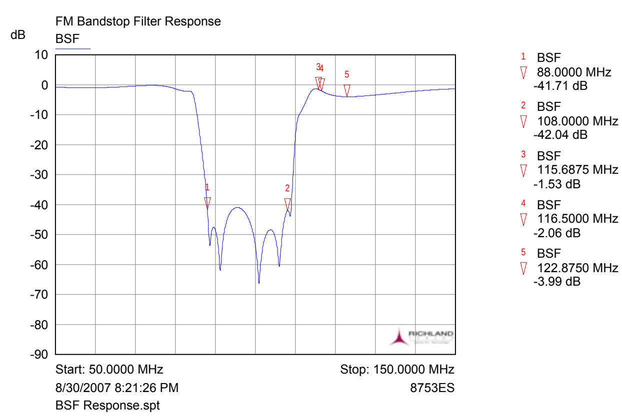


Figure 2

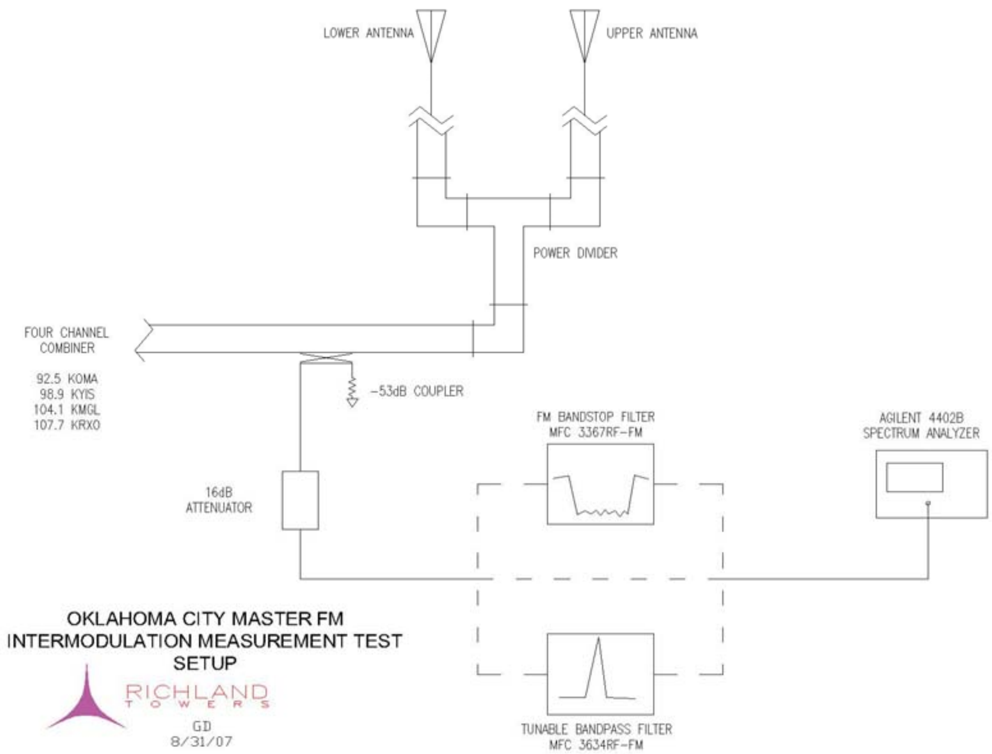


Figure 3

Measurement Results

Most products measured into the noise floor of the spectrum analyzer. Due to ingress from nearby stations on or near three of the product frequencies (77.25MHz, 90.1MHz & 100.5MHz), some results are erroneous. However, based on the results of the remaining frequencies and the documented input to input isolations of >75dB I am confident that all spurious emissions are in compliance.

Product Frequencies

IM Product Frequency (MHz) = [2(f1) – (f2)]

	f2 (MHz)			
f1 (MHz)	92.5	98.9	104.1	107.7
92.5	-	86.1	80.9	77.3
98.9	105.3	-	93.7	90.1
104.1	115.7	109.3	-	100.5
107.7	122.9	116.5	111.3	-

Note: Yellow highlight indicates an IM product in the FM band

Table of Measurements

Where:

$$\text{IM Level} = (f1_{ref} + f1_{filter\ loss}) - (IM_{product} + IM_{filter\ loss})$$

f1	f2	IM	f1 Ref Level	f1 Filter Loss	Offset Ref	Measured	IM Filter Loss	Measured Offset	Calculated IM Level	
92.5	107.7	**77.3**	-1.00	4.5	3.50	-85.00	5.15	-79.85	**83.35**	†
92.5	104.1	**80.9**	-1.00	4.5	3.50	-101.00	5.40	-95.60	**99.10**	
92.5	98.9	**86.1**	-1.00	4.5	3.50	-102.00	6.68	-95.32	**98.82**	
98.9	107.7	**90.1**	-0.07	4.3	4.23	-89.00	5.70	-83.30	**87.53**	†
98.9	104.1	**93.7**	-0.07	4.3	4.23	-101.00	4.36	-96.64	**100.87**	
104.1	107.7	**100.5**	0.08	4.8	4.88	-72.00	5.20	-66.80	**71.68**	†
98.9	92.5	**105.3**	-0.07	4.3	4.23	-104.00	4.16	-99.84	**104.07**	
104.1	98.9	**109.3**	0.08	4.8	4.88	-104.00	4.66	-99.34	**104.22**	
107.7	104.1	**111.3**	0.52	4.5	5.02	-103.00	4.30	-98.70	**103.72**	
104.1	92.5	**115.7**	0.08	4.8	4.88	-103.00	1.50	-101.50	**106.38**	
107.7	98.9	**116.5**	0.52	4.5	5.02	-103.00	2.00	-101.00	**106.02**	
107.7	92.5	**122.9**	0.52	4.5	5.02	-103.00	4.00	-99.00	**104.02**	

†Notes:

1. IM measurement frequency at 77.3 is contaminated by ingress from KOCO-TV channel 5 vision carrier located <1 mile from transmitter site. Both 92.5 & 107.7 transmitters were switched off and product remained unchanged.
2. IM measurement frequency at 90.1 is contaminated by ingress from KCSC located <1 mile from transmitter site. Both 98.9 & 107.7 transmitters were switched off and product remained unchanged.
3. IM measurement frequency at 100.5 is contaminated by ingress from KATT located <1 mile from transmitter site. Both 104.1 & 107.7 transmitters were switched off and product remained unchanged.

Wideband sweep data indicated no out of band emissions above the noise floor of the analyzer. Figure 4 shows baseline data with no stations operating into the combined system. For the 'Transmitter ON' trace, an FM bandstop filter was inserted to remove the fundamental tones and increase dynamic range for the measurement.

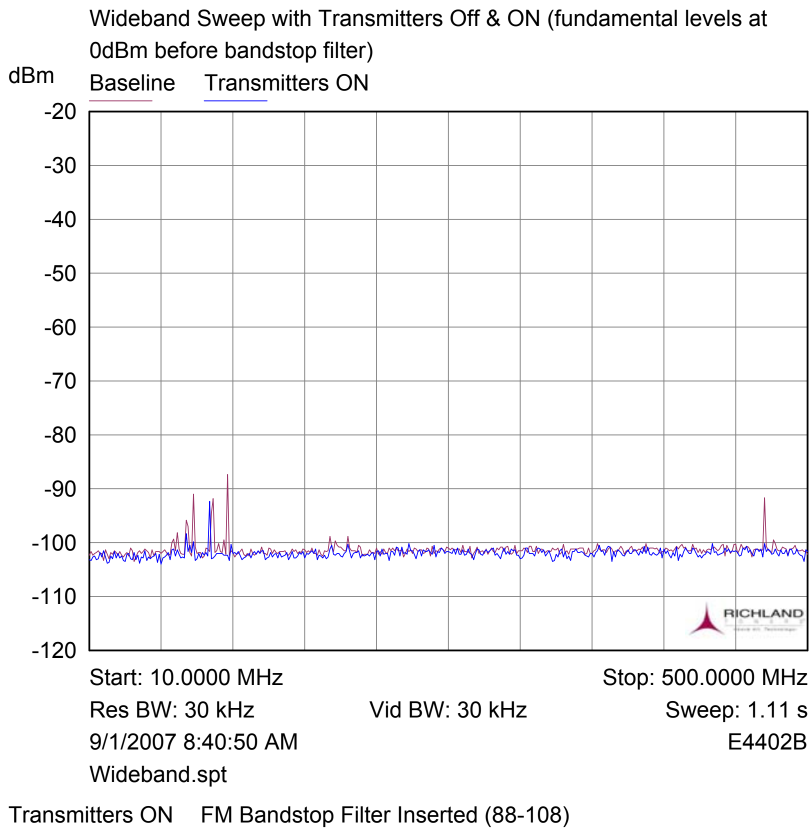


Figure 4

To demonstrate compliance with sections 73.317 (b) & (c) of FCC rules, the spectra of each station were analyzed by selecting a narrow span and resolution bandwidth and utilizing the max hold function. Since the stations were modulated with programming, the spectrum analyzer was allowed to 'build' before data was taken. This system operates with the IBOC signals (-20dB relative to analogue) excited left hand circular polarized (LHCP) while the analogue signals are excited right hand circular polarized (RHCP). The antenna / combiner system yield 25dB isolation, consequently there is some IBOC energy seen on the analogue output spectra (-45dB). Figures 5 – 8 are the plots of KOMA, KYIS, KMGL and KRXO spectra.

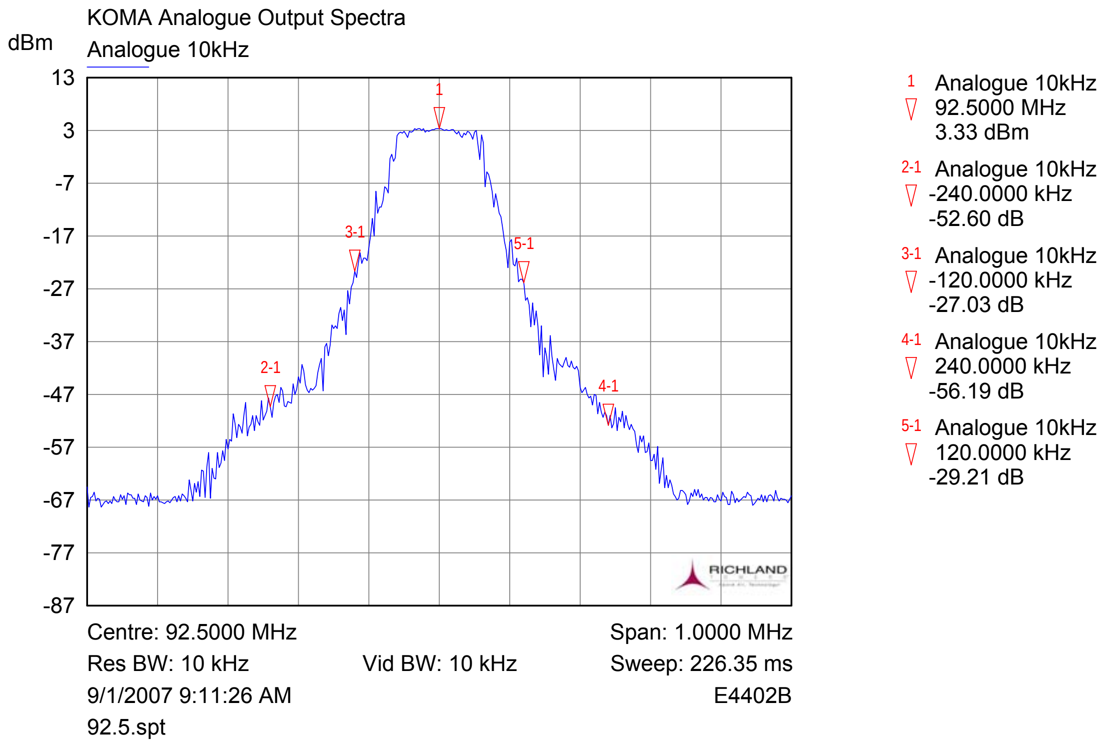


Figure 5

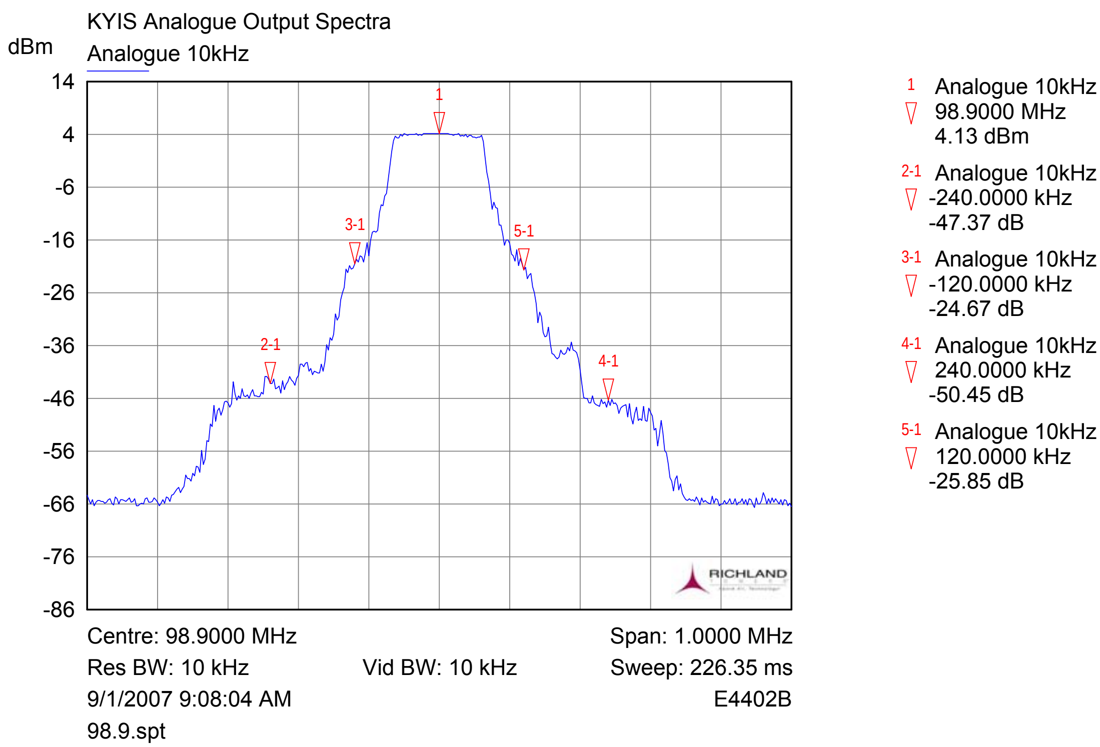


Figure 6

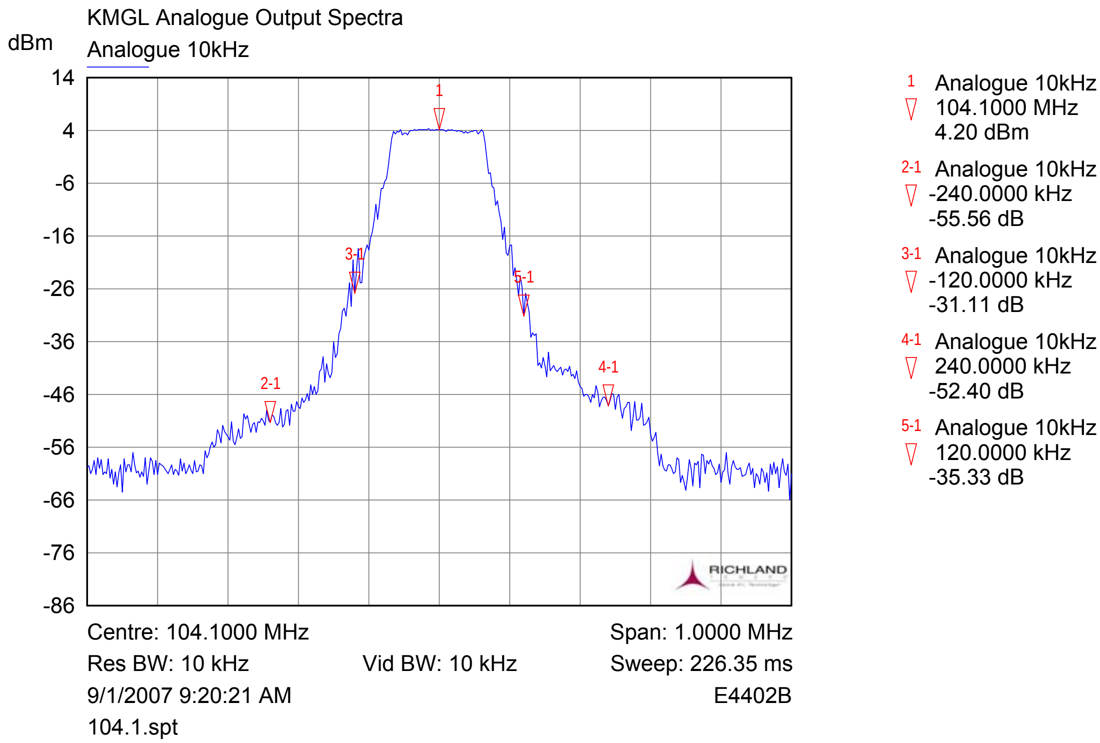


Figure 7

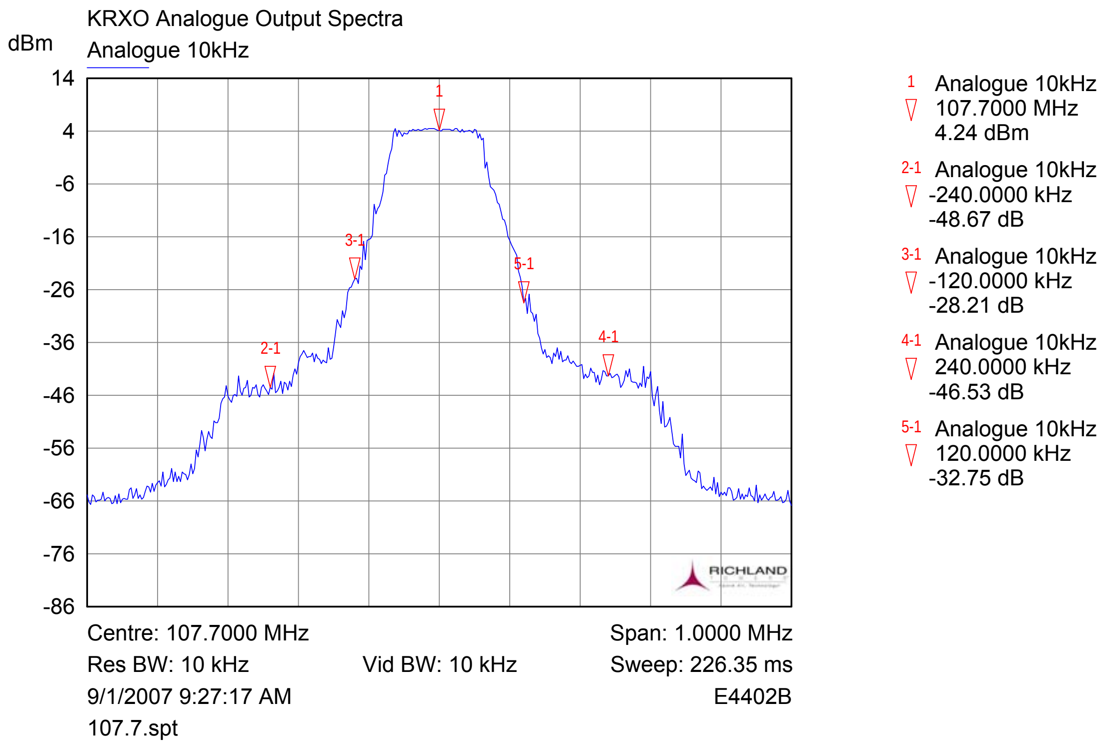


Figure 8

Conclusions

Based upon my observations and measurement data collected on 30 August 2007, I Todd Loney, find the subject combined system operating with stations KOMA, KYIS, KMGL and KRXO to be compliant with the requirements of Section 73.317 paragraph (b) through (d) of the FCC Rules and Regulations. All measurement data was collected under the observation of Citidel (KYIS) Chief Engineer Mike Fields.

Todd R Loney
1 September 2007

Preliminary FM Antenna System Calculations

Model COG20P-12-240-2 Master FM Antenna
System Losses without Group Delay Compensation

	ANALOG				*DIGITAL*			
Call Letters:	KYIS-FM							
Frequency:	98.9	MHz						
ERP:	100.000	kW	20.000	dBk	1.000	kW	0.000	dBk
Polarization:	Circular				Circular			
Antenna Gain:	6.127		7.872	dB	6.127		7.872	dB
Element Input Power:	16.321	kW	12.128	dBk	0.163	kW	-7.872	dBk
Element Hybrid Losses:	-0.165	kW	20.000	dB	-0.002	kW	20.000	dB
Antenna Input Power:	16.486	kW	12.171	dBk	0.165	kW	12.171	dBk
Transmission Line Type - Vertical Run:	6-1/8-inch rigid line (dual runs)				3-inch air HELIAX (dual runs)			
Vertical Run Length:	1627.000	feet			1627.000	feet		
Vertical Run Attenuation:	0.048	dB/100-feet			0.140	dB/100-feet		
Transmission Line Type - Horizontal: Run:	6-1/8-inch rigid line (dual runs)				3-inch air HELIAX (dual runs)			
Horizontal: Run Length:	100.000	feet			100.000	feet		
Horizontal: Run Attenuation:	0.048	dB/100-feet			0.140	dB/100-feet		
Line Loss:	3.467	kW	0.829	dB	0.123	kW	2.418	dB
Line Efficiency:	82.624%				57.309%			
Power Output from Hybrid Splitter:	19.953	kW	13.000	dBk	0.288	kW	-5.411	dBk
Combiner System Losses:	-1.925	kW	0.400	dB	-0.054	kW	0.750	dB
Transmitter Power Output:	21.878	kW	13.400	dBk	0.342	kW	-4.661	dBk

Additional loss from optional group delay compensation module, increases combiner loss by 0.25 dB.

Prepared by: Bill Harland

RICHLAND TOWERS
Above All, Technology

February 9, 2007

Mike Fields
Citadel Broadcasting WKY-AM
Oklahoma City, OK

Mike,

This letter is to notify you that Richland Towers is proposing construction of a broadcast tower located approximately 2.04km from the WKY-AM tower, at a bearing of 95.41 degrees. The Richland Towers proposed site coordinates (NAD27) and overall height are:

Latitude	35-33-36.76 N
Longitude	97-29-06.47 W
Overall height	2749ft AMSL
	1605ft AGL

Richland Towers has conducted a pre-construction partial proof of performance for the WKY-AM directional array, pursuant to FCC Title 47 Section 73.1692(d). Pre-construction measurements were taken along the four radials that include the reference monitoring points, per FCC Title 47 Section 73.154. Preliminary results are attached. The engineering consultant contracted by Richland who performed the measurements is Munn-Reese.

Upon completion of the tower construction, Richland Towers will perform the post-construction partial proof of performance. This is anticipated in Spring 2007. At that time, a complete report will be provided.

Sincererly,

John Figura
RF Engineering Manager
Richland Towers

Cc: Niel Atkinson, Richland Towers
Dave Denton, Richland Towers

Enclosure

RICHLAND TOWERS

Above All, Technology

WKY AM Proof-of-Performance (Pre-construction)				
Directional (night pattern)				
Radial (deg)	Level (mV/m)	Distance (km)	Distance (mi)	
44	150.00	2.79	1.73	
44	76.00	3.91	2.43	Monitoring Point
44	76.00	5.02	3.12	
44	53.00	6.17	3.83	
44	47.50	7.33	4.55	
44	22.50	8.44	5.24	
44	19.50	9.53	5.92	
44	17.50	10.80	6.71	
44	15.20	11.80	7.33	
44	15.00	14.00	8.70	
44	12.80	15.40	9.57	
44	10.80	16.30	10.13	
106	120.00	2.81	1.75	Monitoring Point
106	26.5	4.41	2.74	
106	52	6.20	3.85	
106	20.2	7.40	4.60	
106	12.1	8.67	5.39	
106	16.5	9.53	5.92	
106	6.7	10.20	6.34	
106	13.2	11.20	6.96	
106	10.6	12.90	8.02	
106	11.9	14.50	9.01	
106	7.9	15.90	9.88	
106	7.7	16.20	10.07	
271	23.90	18.20	11.31	
271	27.50	16.60	10.31	
271	41.50	15.00	9.32	
271	44.00	13.40	8.33	
271	53.00	11.80	7.33	
271	45.00	10.10	6.28	
271	100.00	5.33	3.31	
271	92.00	6.00	3.73	
271	138.00	3.72	2.31	
271	148.00	3.23	2.01	
271	210.00	2.52	1.57	Monitoring Point
307	148.00	2.65	1.65	Monitoring Point
307	150.00	3.47	2.16	
307	132.00	5.02	3.12	
307	111.00	6.09	3.78	
307	91.00	7.02	4.36	
307	74.00	8.11	5.04	
307	47.50	10.30	6.40	
307	31.50	11.40	7.08	
307	33.50	12.80	7.95	
307	28.50	14.20	8.82	
307	27.00	16.80	10.44	
307	29.50	14.80	9.20	

400 N. Ashley Drive, Suite 3010, Tampa, FL 33602
813.286.4140 ● Fax 813.286.4130
www.richlandtowers.com

DAY

Station WKY Frequency 930 kHz Radial Bearing 0 °T

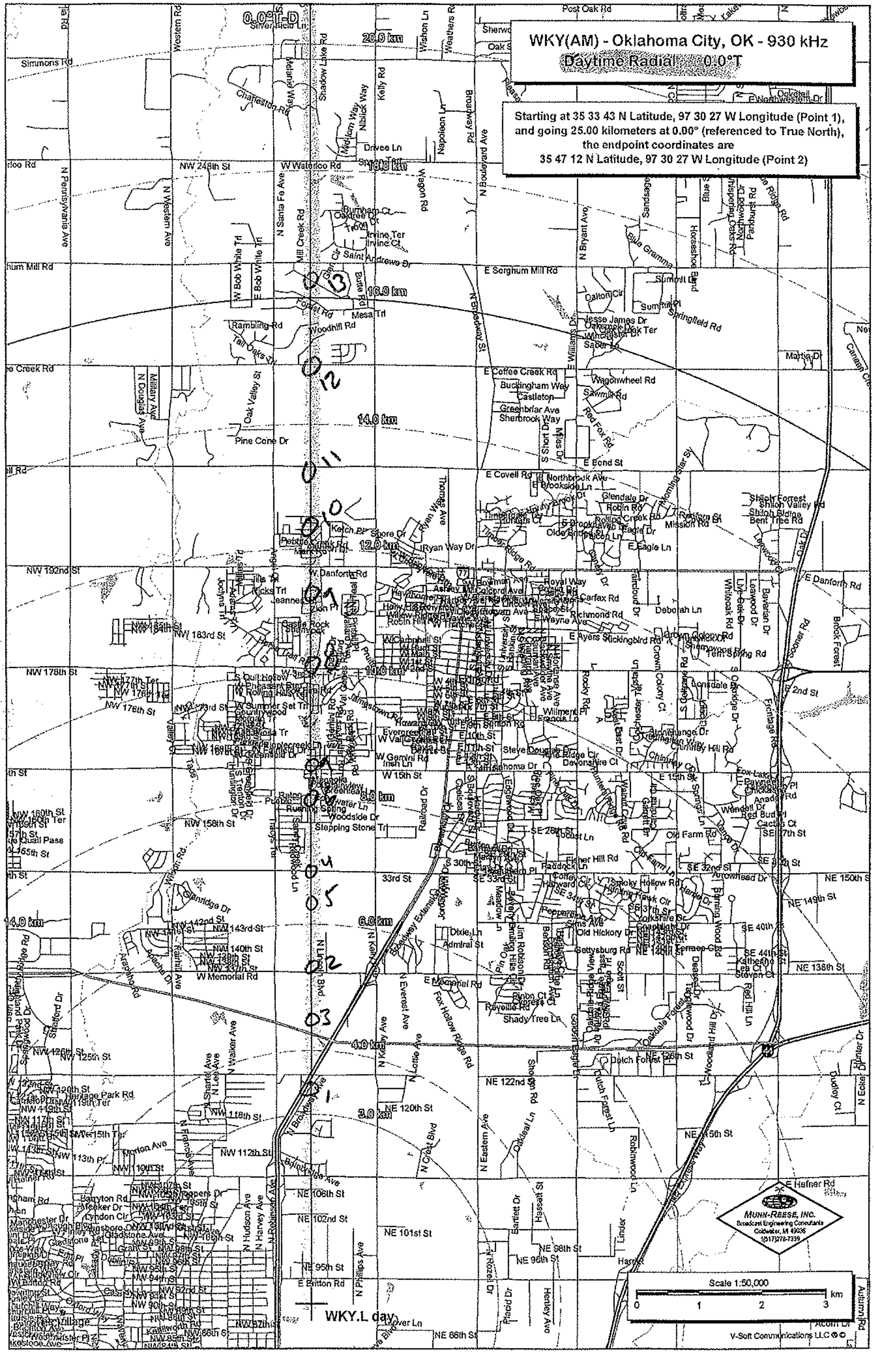
Center of Array Coordinates ____NL; ____WL

Meter NDA Type ____ S/N ____ Cal Date ____ Engineer ____

Meter DA Type ____ S/N ____ Cal Date ____ Engineer ____

Endpoint Coordinates ____NL; ____WL

Point Number	Revised	Non-Directional Power mV/m	Time	Date	Directional Power mV/m	Time	Date	Distance km	Remarks
1		270	950	10-26				3.35	S of R Sign
2		180	1001					5.26	Napa Lot
3		185	1032					4.41	By white Tank
4		133	1038					6.88	West of Bristol Park Sign
5		145	1042					6.49	Fence to Back lot
6		110	1050					8.06	E of 1813
7		110	1056					8.94	Batting Cage
8		95	1108					10.2	Dumpster @ Spencer Grill
9		84	1115					11.7	W of 1801
10		74	1122					12.5	Box 1801
11		69.0	1127					13.3	opp orange phone Box
12		62.0	1133					15.0	where Tree line Starts
13		42.5	1138					16.3	Box 1716


WKY(AM) - Oklahoma City, OK - 930 kHz
Daytime Radial 0.0°T
Starting at 35 33 43 N Latitude, 97 30 27 W Longitude (Point 1),
and going 25.00 kilometers at 0.00° (referenced to True North),
the endpoint coordinates are
35 47 12 N Latitude, 97 30 27 W Longitude (Point 2)
WKY.L day
Scale 1:50,000
MUNN-REESE, INC.
Broadcast Engineering Consultants
Coldwater, MI 49036
V-Soft Communications LLC

Station WKY Frequency 930 kHz Radial Bearing 60 °T

DAY

Center of Array Coordinates

________NL;________WL

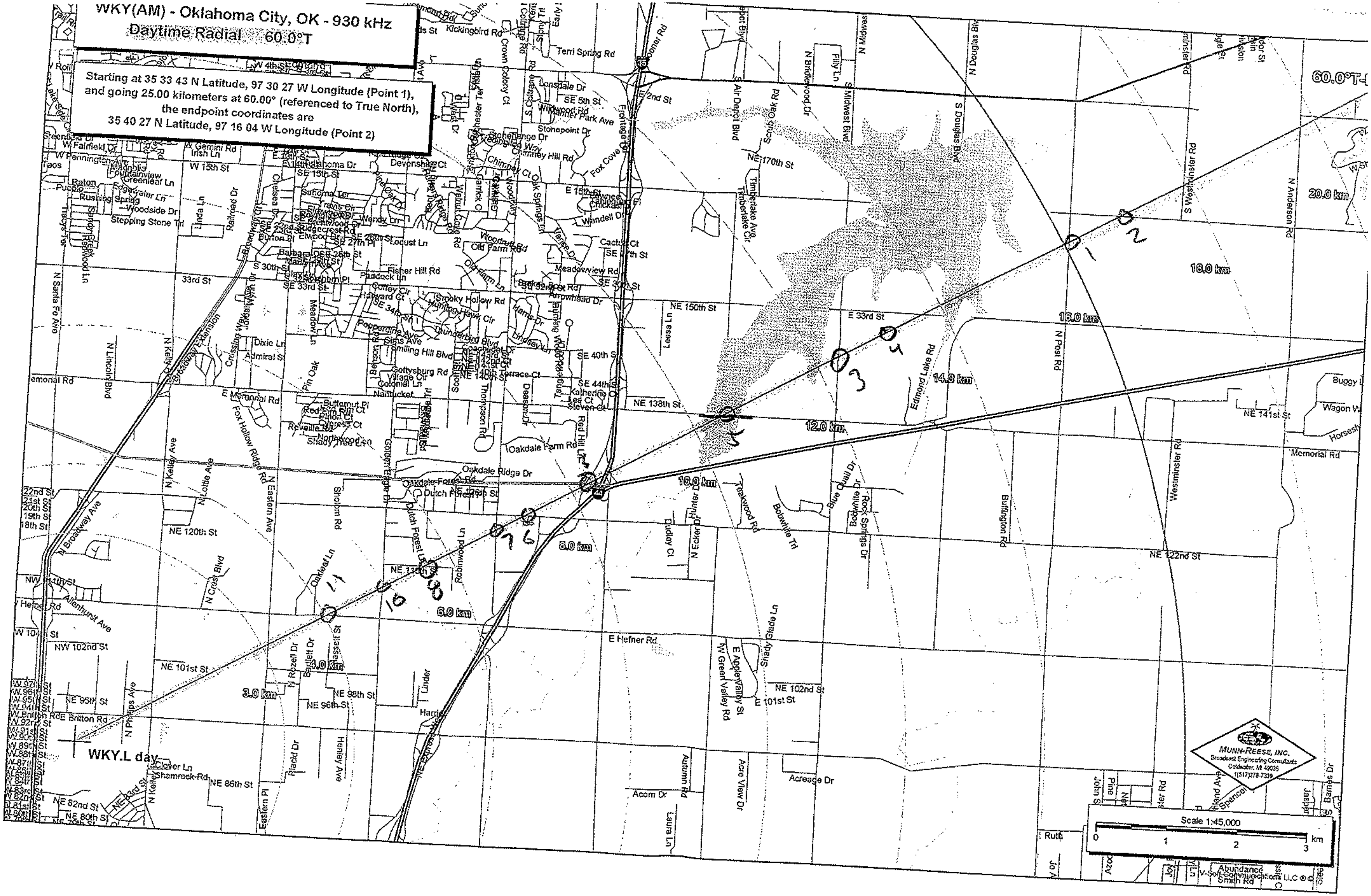
Meter NDA Type ________ S/N ________ Cal Date ________ Engineer ________

Meter DA Type ________ S/N ________ Cal Date ________ Engineer ________

Endpoint Coordinates

________NL;________WL

Point Number	Revised	Non-Directional Power mV/m	Time	Date	Directional Power mV/m	Time	Date	Distance km	Remarks
1		22.9	1223	10-25				16.1	N of Housing Development
2		15.5	1226					17.0	Stone Drive S side
3		39.5	1236					12.4	N of Stone wall Entrance
4		33.5	1239					13.2	South of Fountain
5		47.0	1247					10.5	on Land Bridge
6		61.0	1254					7.23	W of Holland
7		63	1302					6.78	Field
8		94.0	1307					5.60	E side of Hill
9		80.0	1310					4.94	Box 11403
10		63.0	1313					4.02	Speller oil sign
11		150.0	1317					3.11	Drain on curb
12									


WKY(AM) - Oklahoma City, OK - 930 kHz
Daytime Radial 60.0°T
Starting at 35 33 43 N Latitude, 97 30 27 W Longitude (Point 1), and going 25.00 kilometers at 60.00° (referenced to True North), the endpoint coordinates are
35 40 27 N Latitude, 97 16 04 W Longitude (Point 2)
WKY.L day
60.0°T
3.0 km
4.0 km
6.0 km
8.0 km
10.0 km
12.0 km
14.0 km
16.0 km
18.0 km
20.0 km
MUNN-REESE, INC.
Broadcast Engineering Consultants
Scale 1:45,000
0
1
2
3
km
V-Soft Communications LLC ©
N Santa Fe Ave
N Lincoln Blvd
N Broadway Ave
Broadway Extension
N Kelley Ave
N Eastern Ave
NE 122nd St
NE 138th St
NE 150th St
E Hefner Rd
Memorial Rd
N Post Rd
N Anderson Rd
N Douglas Blvd
S Douglas Blvd
S Midwest Blvd
S Air Depot Blvd
Frontage Rd
Edmond Lake Rd
Westminster Rd
S Westminster Rd
Buffington Rd
NE 141st St

Station WWY Frequency 920 kHz Radial Bearing 120 °T DAY

Meter NDA Type ______ S/N ______ Cal Date ______ Engineer ______

Meter DA Type ______ S/N ______ Cal Date ______ Engineer ______

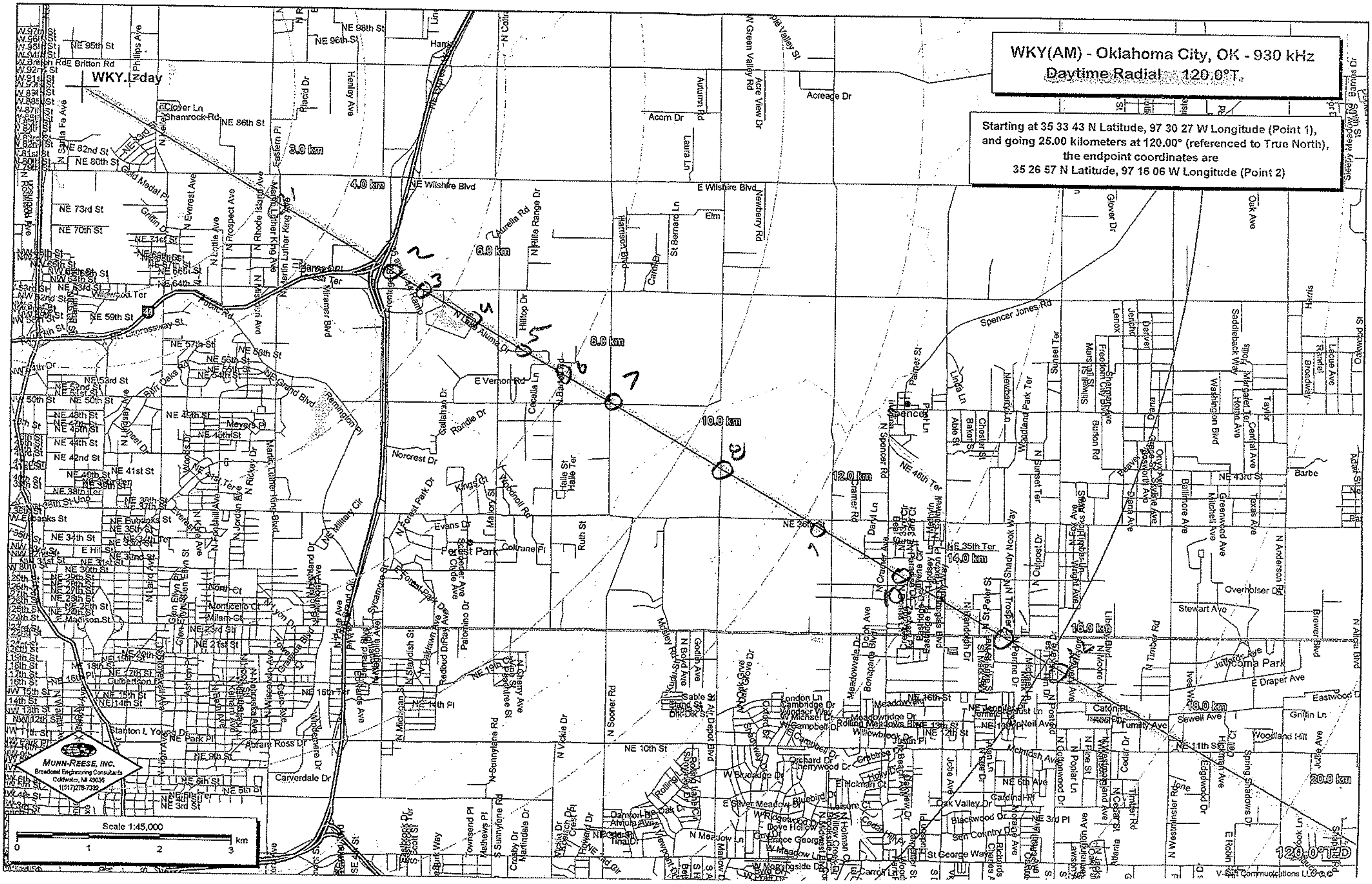
Center of Array Coordinates

______NL; ______WL

Endpoint Coordinates

______NL; ______WL

Point Number	Revised	Non-Directional Power mV/m	Time	Date	Directional Power mV/m	Time	Date	Distance km	Remarks
1		225	1036	10-25				3.27	MLK Dr field
2		125	1043					5.10	◇ church sign
3		115.0	1047					5.60	63th + Aluna Valley
4		121.0	1051					6.48	N of white posts
5		91.0	1106					7.42	white mail Box
6		89.0	1110					7.94	Tan / Blue house
7		83.0	1114					8.74	in Triangle of Land
8		69.0	1119					10.6	Sherrif training facility
9		55.0	1125					12.2	N of Flag Pole
10		52.0	1121					13.5	Back lot of Football Field
11		25.3	1125					15.3	Box 9512
12		36.5	1128					16.2	Box 1916
13									


WKY(AM) - Oklahoma City, OK - 930 kHz
Daytime Radial 120.0°T.
Starting at 35 33 43 N Latitude, 97 30 27 W Longitude (Point 1),
and going 25.00 kilometers at 120.00° (referenced to True North),
the endpoint coordinates are
35 26 57 N Latitude, 97 16 06 W Longitude (Point 2)
WKY.Lzday
3.0 km
4.0 km
6.0 km
8.0 km
10.0 km
12.0 km
14.0 km
16.0 km
18.0 km
20.0 km
120.0°T.D
Scale 1:45,000
0 1 2 3 km
MUNN-REESE, INC.
Broadcast Engineering Consultants
Coldwater, MI 49036
V-Soft Communications LLC

Station WKY Frequency 930 kHz Radial Bearing 180 °T

DAY

Meter NDA Type ________ S/N ________ Cal Date ________ Engineer ________

Meter DA Type ________ S/N ________ Cal Date ________ Engineer ________

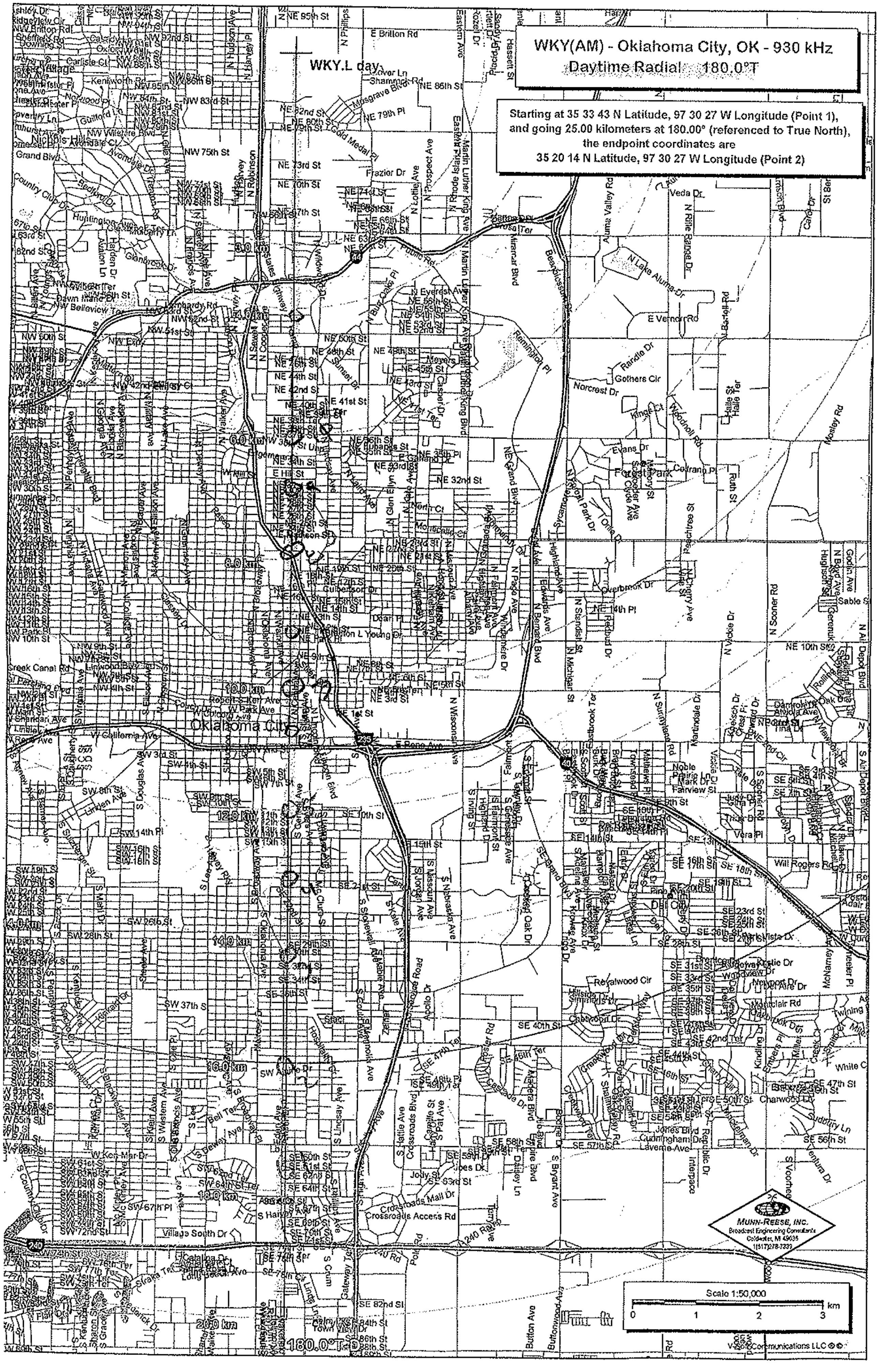
Center of Array Coordinates

________NL; ________WL

Endpoint Coordinates

________NL; ________WL

Point Number	Revised	Non-Directional Power mV/m	Time	Date	Directional Power mV/m	Time	Date	Distance km	Remarks
1		37.0	952	10-25				17.6	Universal Homes Sign
2		46.0	900					15.9	Greenhouse Mall
3		51.0	907					14.4	Opp. Browns
4		55.0	925					13.4	E of Andrews Pawn Shop
5		63.0	931					12.5	Kipplinger Sign
6		78.0	942					10.7	Ally between Park & Dall perk
7		73.0	949					10.1	Back lot of light Tan Brick Bldg project
8		80.0	955					9.83	Empty lot across from
9		115.0	959					7.91	Dept of Trans. DF
10		82.0	1005					7.06	Baker Dist Lot
11		115.0	1010					6.00	Plumber Bar lot
12		143.0	1014					5.02	Walnut + 44th St
13		203.0	1018					4.21	Family Junction Dr
14		285.0	1025					2.77	Box 6400


WKY(AM) - Oklahoma City, OK - 930 kHz
Daytime Radial 180.0°T
Starting at 35 33 43 N Latitude, 97 30 27 W Longitude (Point 1), and going 25.00 kilometers at 180.00° (referenced to True North), the endpoint coordinates are 35 20 14 N Latitude, 97 30 27 W Longitude (Point 2)
WKY.L day
Oklahoma City
Scale 1:50,000
0 1 2 3 km
MUNN-REESE, INC.
Broadcast Engineering Consultants
180.0°T
Vision Communications LLC

DAY

Station WKY Frequency 990 kHz Radial Bearing 240 °T

Meter NDA Type ______ S/N ______ Cal Date ______ Engineer ______

Meter DA Type ______ S/N ______ Cal Date ______ Engineer ______

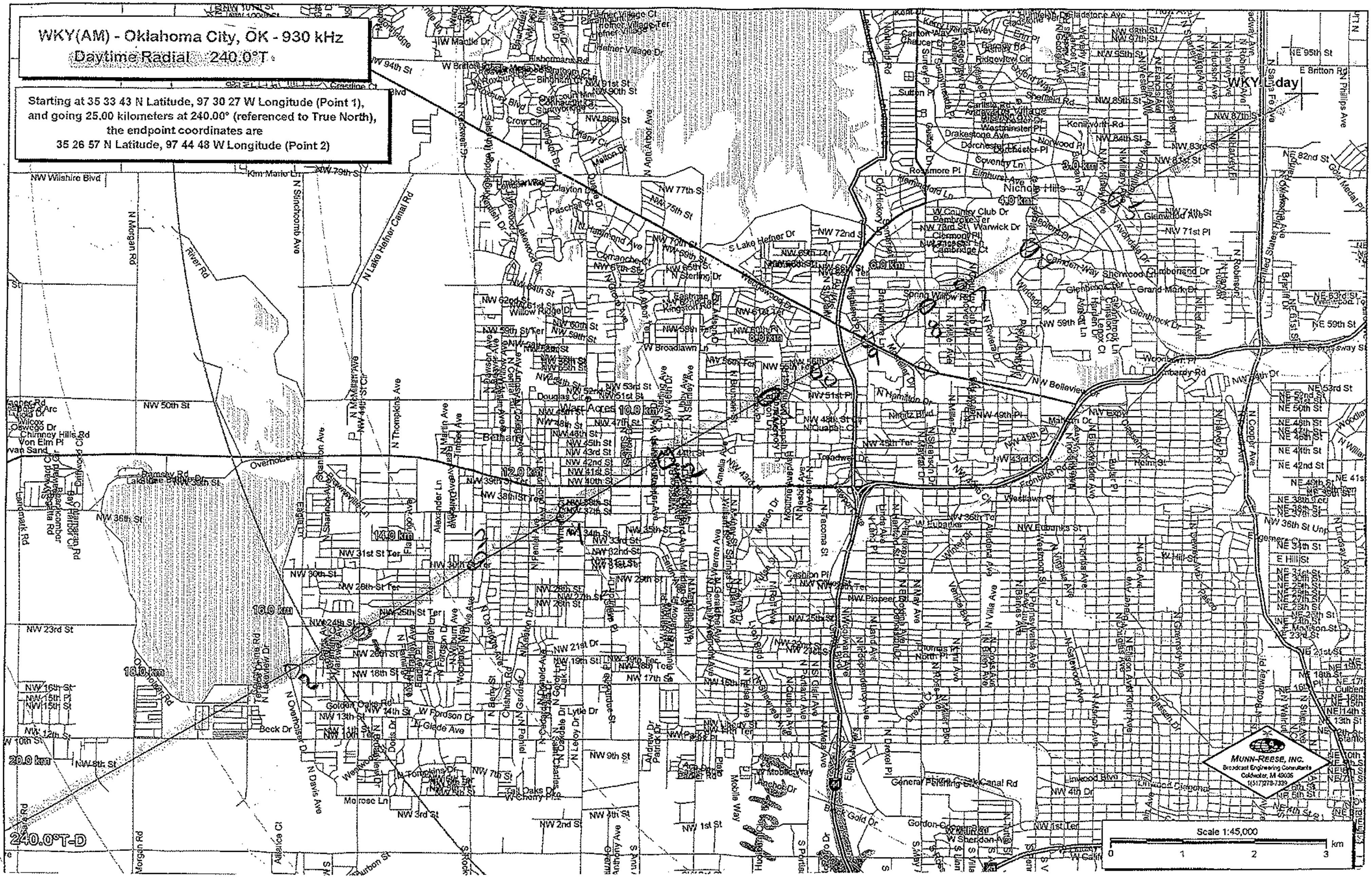
Center of Array Coordinates

______NL;______WL

Endpoint Coordinates

______NL;______WL

Point Number	Revised	Non-Directional Power mV/m	Time	Date	Directional Power mV/m	Time	Date	Distance km	Remarks
1		39.0	1618	10-25				15.3	Produce Stand
2		39.0	1623					16.4	Cedar Tree by Lake
3		47.5	1630					13.4	Stone Dr at church
4		64.0	1636					12.1	Hummond Manor
5		250	1212	10-26				2.99	W of Iron rails
6		165	1222					4.39	E of 6602
7		135	1226					5.29	Brick see through Garage
8		169	1230					6.17	Back Lot of Golden Corral
9		99	1236					7.01	Starbuck's lot
10		120	1243					7.84	By Blue Dumpster in Ally
11		101	1247					8.81	Brick Corner House
~~12~~			~~1253~~					~~9.7?~~	~~[illegible]~~
12		59	1253					10.4	42nd rd. white house



WKY(AM) - Oklahoma City, OK - 930 kHz
Daytime Radial 240.0°T
Starting at 35 33 43 N Latitude, 97 30 27 W Longitude (Point 1), and going 25.00 kilometers at 240.00° (referenced to True North), the endpoint coordinates are 35 26 57 N Latitude, 97 44 48 W Longitude (Point 2)
WKY day
3.0 km
4.0 km
6.0 km
8.0 km
10.0 km
12.0 km
14.0 km
16.0 km
18.0 km
20.0 km
240.0°T-D
Nichols Hills
Warr Acres
Bethany
MUNN-REESE, INC.
Broadcast Engineering Consultants
Coldwater, MI 49036
Scale 1:45,000
km
0
1
2
3

DAY

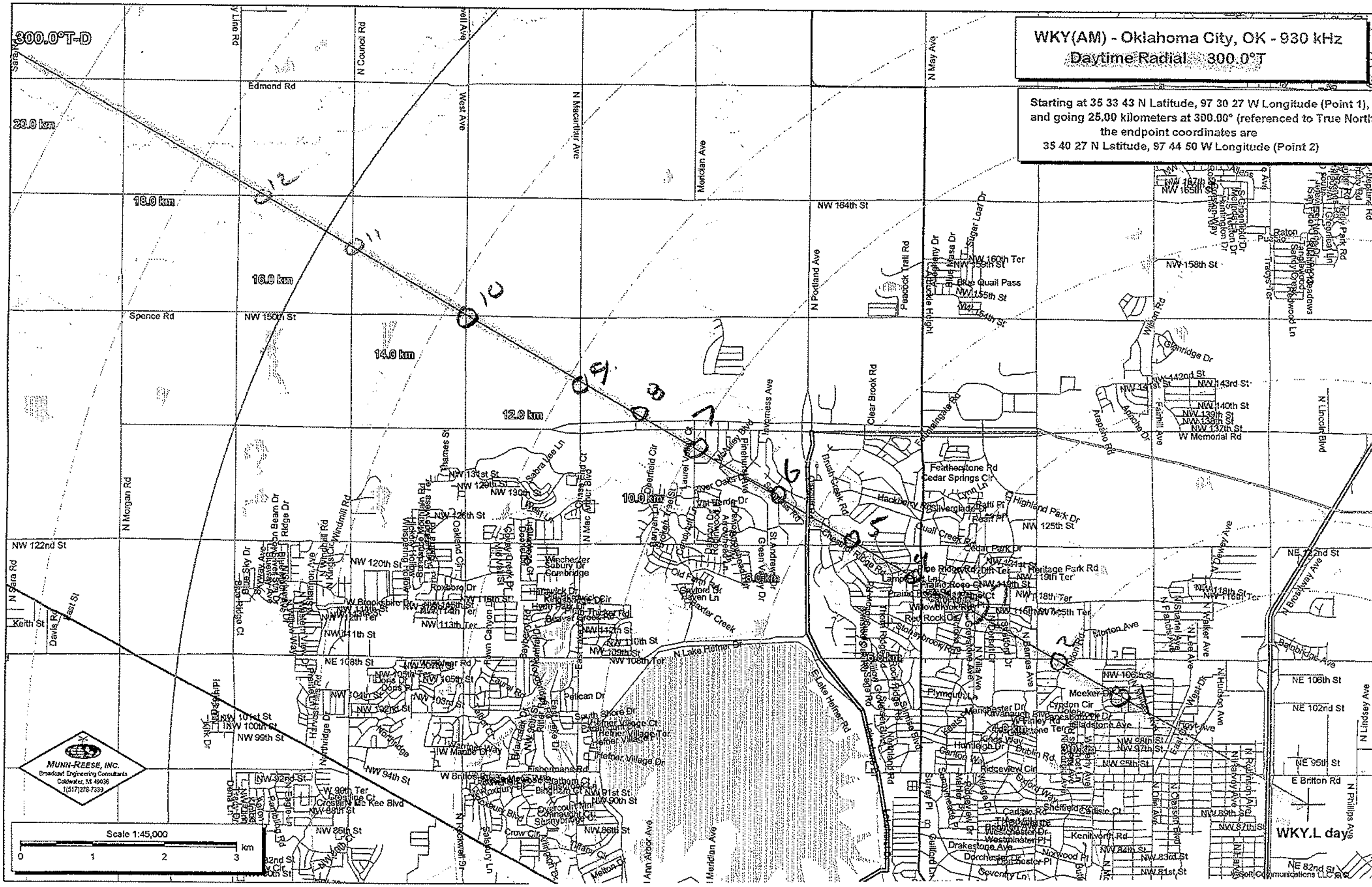
Station WKY Frequency 930 kHz Radial Bearing 300°T

Center of Array Coordinates
______NL;______WL

Meter NDA Type ______ S/N ______ Cal Date ______ Engineer ______
Meter DA Type ______ S/N ______ Cal Date ______ Engineer ______

Endpoint Coordinates
______NL;______WL

Point Number	Revised	Non-Directional Power mV/m	Time	Date	Directional Power mV/m	Time	Date	Distance km	Remarks
1		242	1509	10-25				3.03	Blue - Gray House
2		175	1514					4.01	Dr to oil well
3		150	1518					5.32	Box 11417
4		134	1524					6.45	Box 11909
5		106	1529					7.32	Box 3400
6		119	1534					8.46	Triangle island
7		90.0	1543					9.94	Lot opp hospital .03 [illegible]
8		105.0	1547					10.9	Beck "Drive" to office
9		90.0	1550					11.8	Gaillardia Dr
10		72.0	1553					13.7	50 MPH Sign
11		71.0	1556					15.5	Fenced Drive
12		42.5	1559					17.0	25 ft E of Bridge


WKY(AM) - Oklahoma City, OK - 930 kHz
Daytime Radial 300.0°T
Starting at 35 33 43 N Latitude, 97 30 27 W Longitude (Point 1), and going 25.00 kilometers at 300.00° (referenced to True North), the endpoint coordinates are 35 40 27 N Latitude, 97 44 50 W Longitude (Point 2)
300.0°T-D
WKY.L day
Scale 1:45,000
MUNN-REESE, INC.
Broadcast Engineering Consultants

Nile

Station WKY Frequency 930 kHz Radial Bearing 44 °T

Center of Array Coordinates

_____NL; _____WL

Meter NDA Type _____ S/N _____ Cal Date _____ Engineer _____

Meter DA Type _____ S/N _____ Cal Date _____ Engineer _____

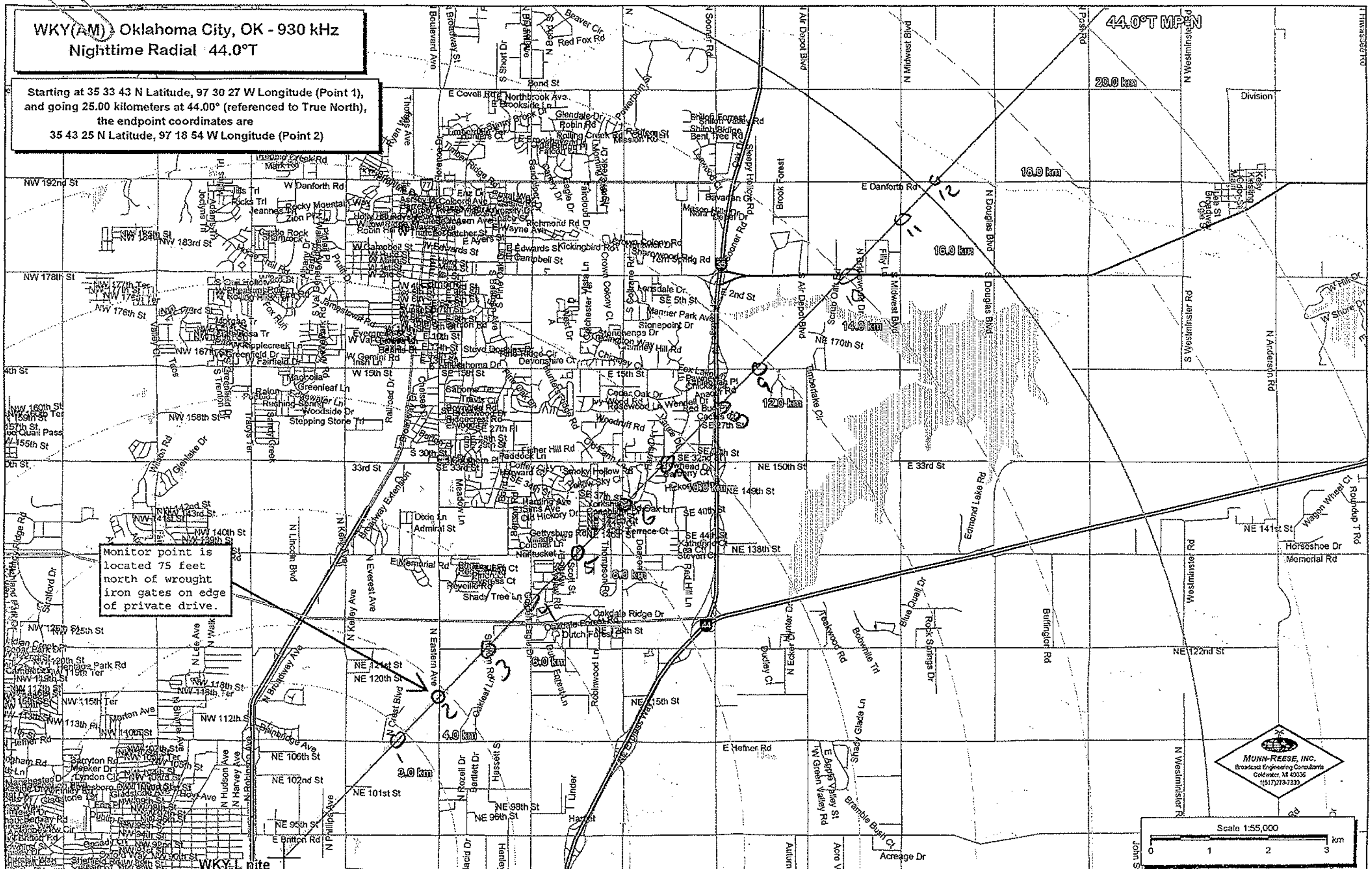
Endpoint Coordinates

_____NL; _____WL

Point Number	Revised	Non-Directional Power mV/m	Time	Date	Directional Power mV/m	Time	Date	Distance km	Remarks
1		150	1339	10-8-44				2.79	Just W of wire generator
2		76	1343					3.91	Box 2021 mp
3		76	1347					5.02	Duel Black mail Boxes
4		53.0	1350					6.17	North of Bridge
5		47.5	1354					7.33	7th Day Adv. Lot
6		22.5	1402					8.44	N of 40th + Coltrane
7		19.5	1406					9.53	W of Fenced Generator
8		17.5	1409					10.8	S of S.E. 15th St
9		15.2	1413					11.8	1/8 mi W of Fenced DF
10		15.0	1427					14.0	Even w/ Silver propane tank
11		12.8	1432					15.4	White meters Fence
12		10.8	1434					16.3	W of Private Dr

WKY(AM) Oklahoma City, OK - 930 kHz
Nighttime Radial 44.0°T

Starting at 35 33 43 N Latitude, 97 30 27 W Longitude (Point 1), and going 25.00 kilometers at 44.00° (referenced to True North), the endpoint coordinates are 35 43 25 N Latitude, 97 18 54 W Longitude (Point 2)



Nike

Station WKY Frequency 930 kHz Radial Bearing 106 °T

Meter NDA Type ______ S/N ______ Cal Date ______ Engineer ______

Meter DA Type ______ S/N ______ Cal Date ______ Engineer ______

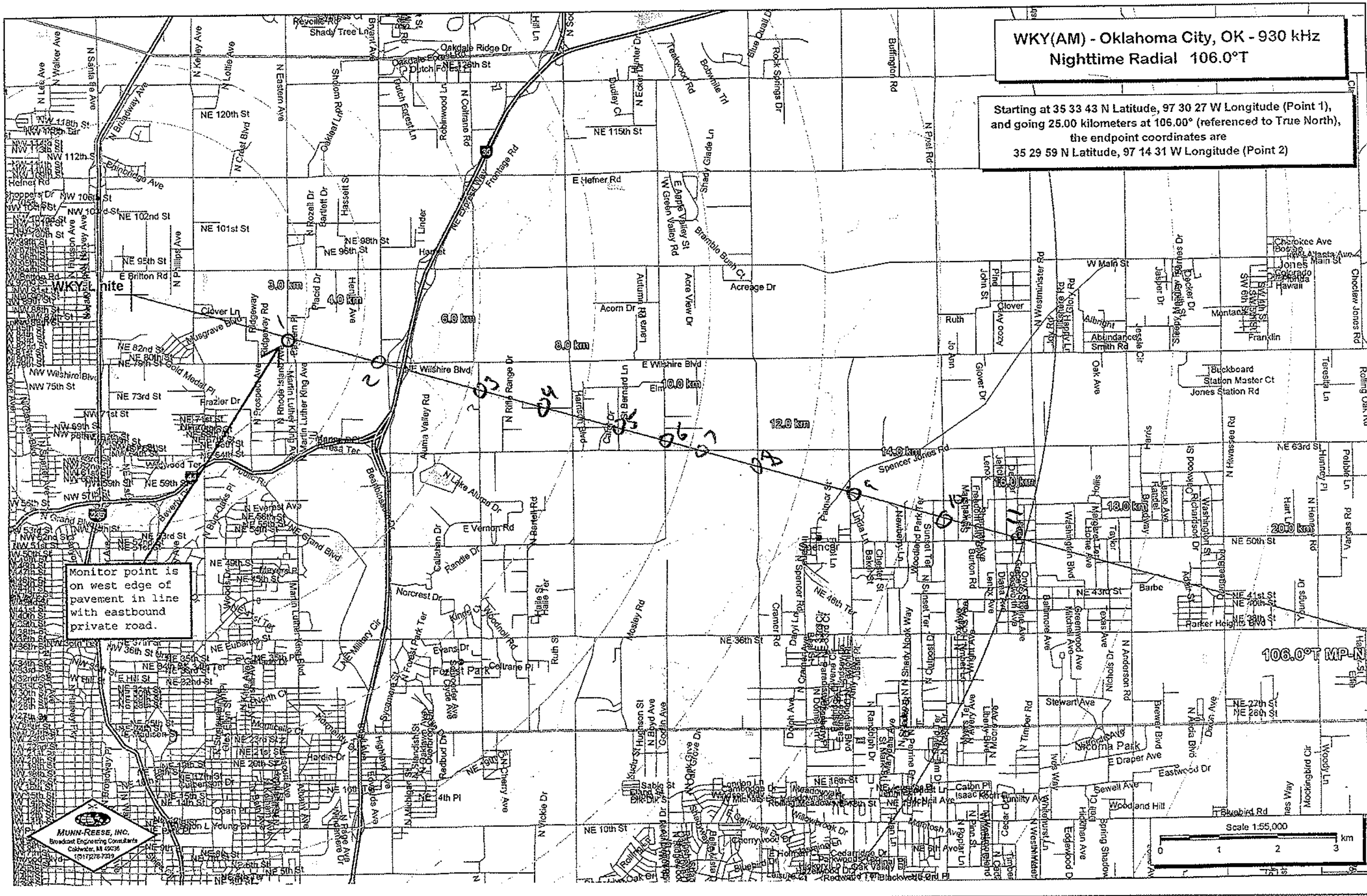
Center of Array Coordinates

______ NL; ______ WL

Endpoint Coordinates

______ NL; ______ WL

Point Number	Revised	Non-Directional Power mV/m	Time	Date	Directional Power mV/m	Time	Date	Distance km	Remarks
1		120	1551	10-24				2.81	on Curve [illegible] MT
2		26.5	1557					4.41	Stop ahead Sign
3		52.0	1601					6.20	N of stand of oak trees
4		20.2	1606					7.40	open mowed field
5		12.1	1611					8.67	opp white house black trim
6		16.5	1615					9.53	N of New house
7		6.7	1618					10.2	Top of hill wires
8		13.2	1620					11.2	10 ft N of yellow Gas sign
9		10.6	1627					12.9	N of "The Bradfords"
10		11.9	1632					14.5	opp Pentecost Church
11		7.9	1636					15.9	cement Drive to Church
12		7.7	1636					16.2	S of BBQ Shack


WKY(AM) - Oklahoma City, OK - 930 kHz
Nighttime Radial 106.0°T
Starting at 35 33 43 N Latitude, 97 30 27 W Longitude (Point 1), and going 25.00 kilometers at 106.00° (referenced to True North), the endpoint coordinates are
35 29 59 N Latitude, 97 14 31 W Longitude (Point 2)
Monitor point is on west edge of pavement in line with eastbound private road.
WKY Unite
3.0 km
4.0 km
6.0 km
8.0 km
10.0 km
12.0 km
14.0 km
16.0 km
18.0 km
20.0 km
106.0°T MP-N
Scale 1:55,000
0 1 2 3 km
MUNN-REESE, INC.
Broadcast Engineering Consultants
Coldwater, MI 49036

Ken Boyd (405) 694-3860

Nite

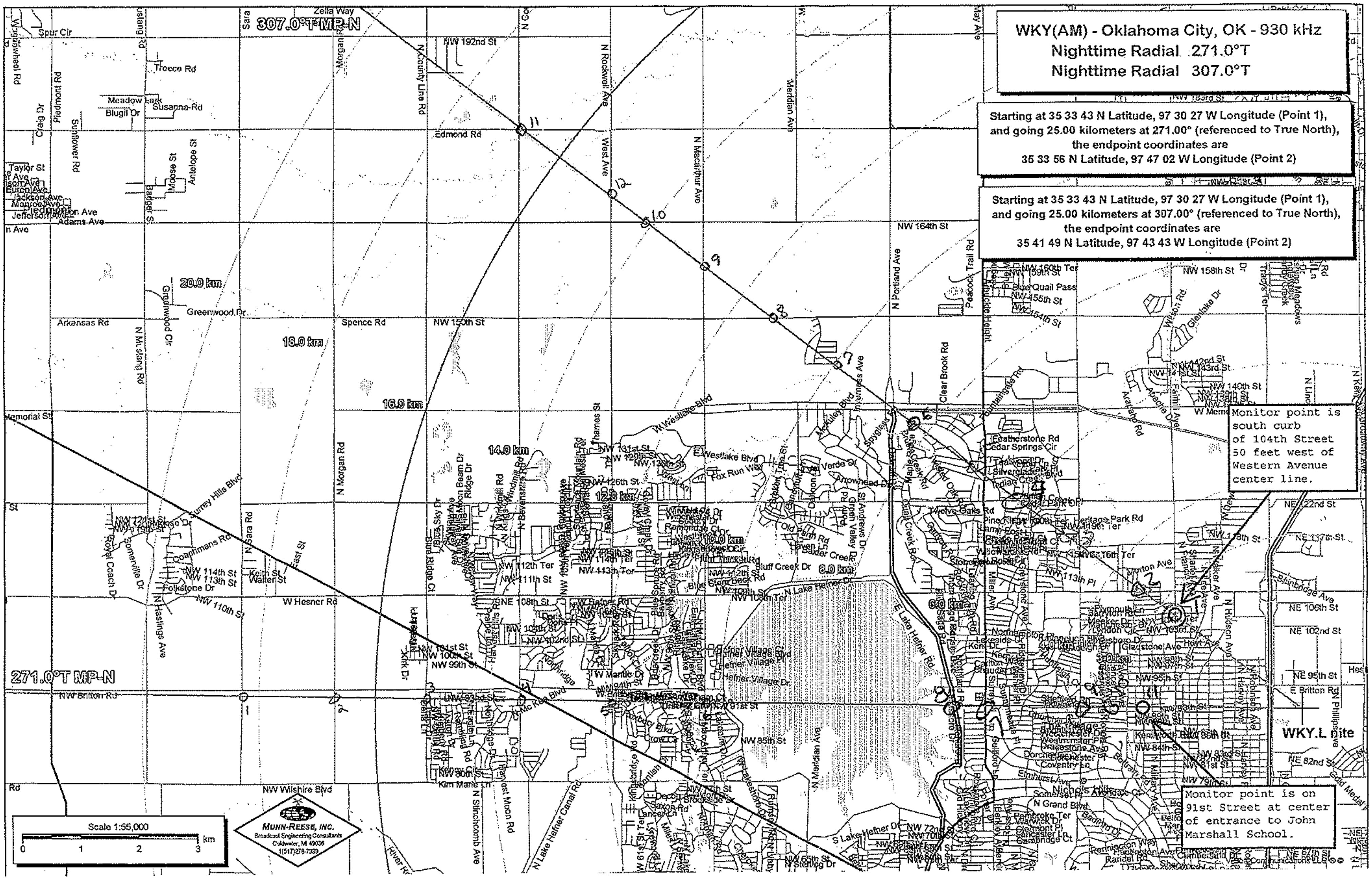
Station WKY Frequency 930 kHz Radial Bearing 271 °T

Center of Array Coordinates
_____ NL; _____ WL

Meter NDA Type _____ S/N _____ Cal Date _____ Engineer _____
Meter DA Type _____ S/N _____ Cal Date _____ Engineer _____

Endpoint Coordinates
_____ NL; _____ WL

Point Number	Revised	Non-Directional Power mV/m	Time	Date	Directional Power mV/m	Time	Date	Distance km	Remarks
1		23.9	1118	10-29				18.2	S of Britton 30ft
2		27.5	1123					16.6	End of tree line
3		41.5	1127					15.0	Trees N of 90th St
4		44.0	1132					13.4	N corner of carwash
5		53	1144					11.8	Childrens world
6		45	1150					10.1	S of Lola's
7		100	1231					5.33	St. Martins lot white sign
8		92	1239					6.00	S of Eastwarf sign
9		138	1323					3.72	Box 1633
10		148	1325					3.23	Box 1414
11		210	1329					2.52	Middle school Fly Pole


WKY(AM) - Oklahoma City, OK - 930 kHz
Nighttime Radial 271.0°T
Nighttime Radial 307.0°T
Starting at 35 33 43 N Latitude, 97 30 27 W Longitude (Point 1), and going 25.00 kilometers at 271.00° (referenced to True North), the endpoint coordinates are 35 33 56 N Latitude, 97 47 02 W Longitude (Point 2)
Starting at 35 33 43 N Latitude, 97 30 27 W Longitude (Point 1), and going 25.00 kilometers at 307.00° (referenced to True North), the endpoint coordinates are 35 41 49 N Latitude, 97 43 43 W Longitude (Point 2)
Monitor point is south curb of 104th Street 50 feet west of Western Avenue center line.
Monitor point is on 91st Street at center of entrance to John Marshall School.
307.0°T MP-N
271.0°T MP-N
WKY.L nite
20.0 km
18.0 km
16.0 km
14.0 km
12.0 km
10.0 km
8.0 km
6.0 km
3.0 km
Scale 1:55,000
km
0
1
2
3
MUNN-REESE, INC.
Broadcast Engineering Consultants
Coldwater, MI 49036
1(517)278-7339

Station WKY Frequency 930 kHz Nite Radial Bearing 307 °T

Center of Array Coordinates

_______NL; _______WL

Endpoint Coordinates

_______NL; _______WL

Meter NDA Type ______ S/N ______ Cal Date ______ Engineer ______

Meter DA Type ______ S/N ______ Cal Date ______ Engineer ______

Point Number	Revised	Non-Directional Power mV/m	Time	Date	Directional Power mV/m	Time	Date	Distance km	Remarks
1		148.0	1001	10-24				2.65	Box 1011 (MP)
2		150	1006					3.47	Box 10912
3		132	1012					5.02	Box 2219
4		111	1018					6.09	20ft S of Cedar Park Dr
5		91	1022					7.02	Box 2909
6		74	1030					8.11	25 E of 3909
7		47.5	1040					10.3	Box 14417
8		31.5	1044					11.4	3 Pine Trees, middle of Field
9		33.5	1048					12.8	South edge of yard
10		28.5	1052					14.2	100 N of Driveway
11		27.0	1057					16.8	S of intersection
12		29.5	1102					14.8	Box 16825

RICHLAND
TOWERS
Above All, Technology

Oklahoma City, Oklahoma

Analogue/IBOC FM Broadband System Commissioning Report

Prepared For

KYIS 98.9
Citidel Broadcasting

Equipment

ERI COG-20P-12-240-2 Panel Antenna
with Dual Inputs and Reverse-fed IBOC
1660' Dual ERI 6"- 50Ω Maxline & Dual 3" Heliax Transmission Line
ERI 973-8 Four Channel Constant Impedance Combiner with Circulator Isolated IBOC

Measurement Data Taken on
3 – 12 August 2007

Submitted By

Todd R Loney
Senior RF Engineer

400 North Ashley Dr., Suite 3010
Tampa, FL 33602
813.286.4140 ● Fax 813.286.4130
www.richlandtowers.com

Measurement setup

Measurements were taken with an Agilent 8753ES network analyzer, Agilent 4-port dual directional coupler. A three watt amplifier was used to overcome high RF level ingress. For combiner measurements, an HP S-Parameter test was used.
Richland Towers broadband, precision test adapters were used to make the measurements.
Data was extracted from the analyzer in complex pair values (real/imaginary) via the GPIB port to laptop computer. Data was then analyzed and presented using SoftPlot™ software and is imported into this document as an Object Linking Embedding (OLE). This data can be manipulated, (scale, format, markers, etc.) follow link to http://softplot.com/ and download demonstration version to utilize this feature.
Markers are placed at fc as well as +/- 150kHz.

Measurement details

Measurements were taken from the input to the combiner as well as from the transmitter output.
Antenna system data is included under a separate antenna system report.

Findings

- Performance of the system, from transmitter outputs, through the combiner to the antenna is satisfactory
- Station to station isolations measured >-80dB except 98.9 into 104.1 which measured -75dB. Specification is -55dB

400 North Ashley Dr., Suite 3010
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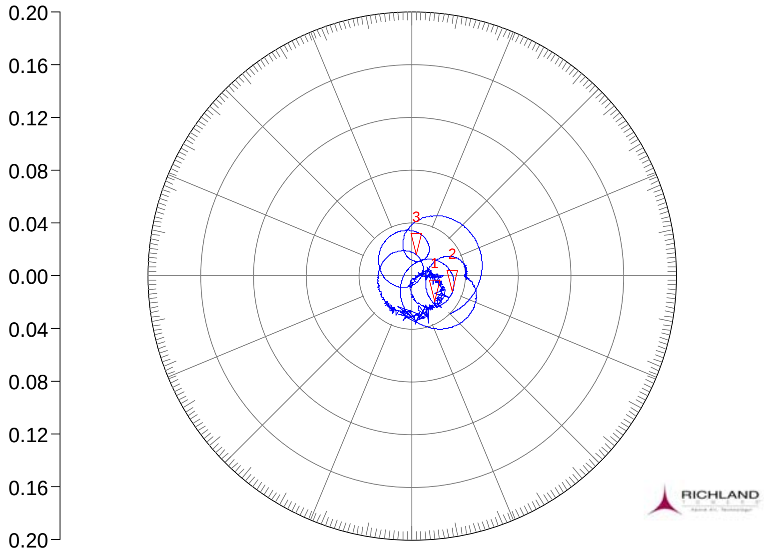
813.286.4140 ● Fax 813.286.4130
www.richlandtowers.com

KYIS 98.9 Transmitter to Antenna Polar Impedance 200mU

TX to ANT



1 TX to ANT
98.900000 MHz
0.0260, -48.0351°

2 TX to ANT
98.750000 MHz
0.0331, -20.8204°

3 TX to ANT
99.050000 MHz
0.0161, 77.6244°

Centre: 98.900000 MHz | Span: 1.000000 MHz

8/12/2007 3:33:29 PM | 8753ES

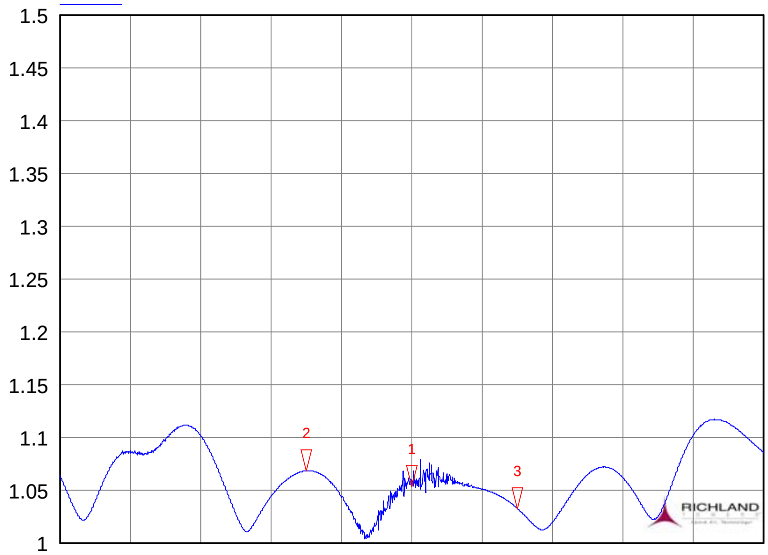
98.9.spt

98.9 Module

KYIS 98.9 Transmitter to Antenna VSWR 1.05/div

VSWR

TX to ANT



1 TX to ANT
98.900000 MHz
1.0535 VSWR

2 TX to ANT
98.750000 MHz
1.0684 VSWR

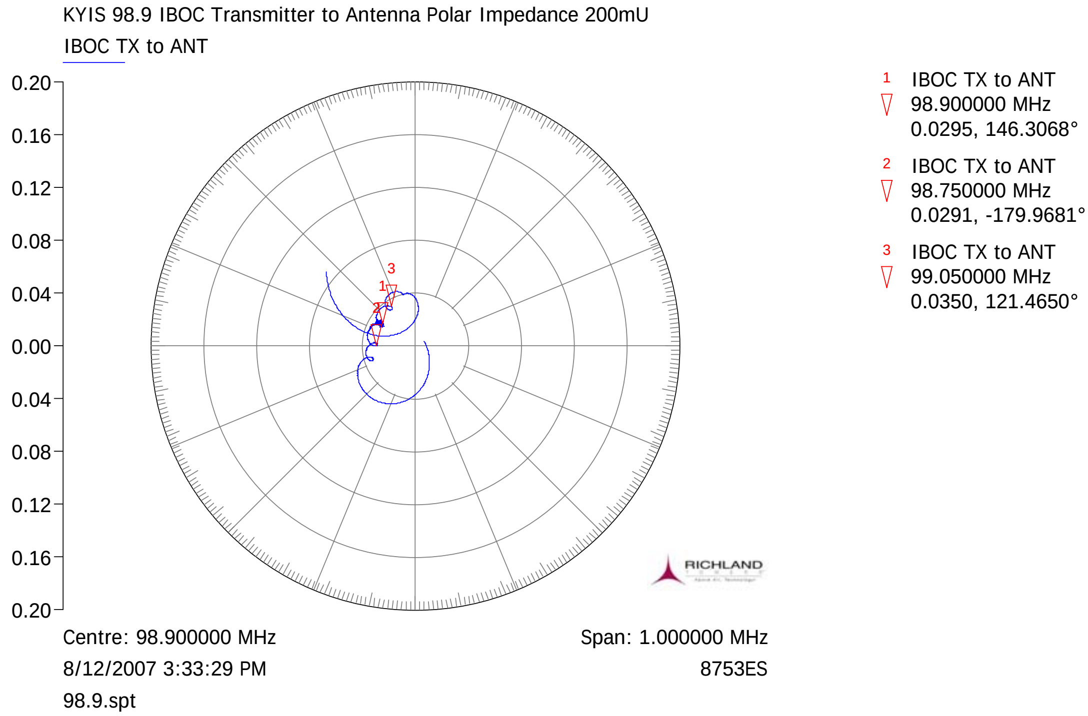
3 TX to ANT
99.050000 MHz
1.0328 VSWR

Centre: 98.900000 MHz | Span: 1.000000 MHz

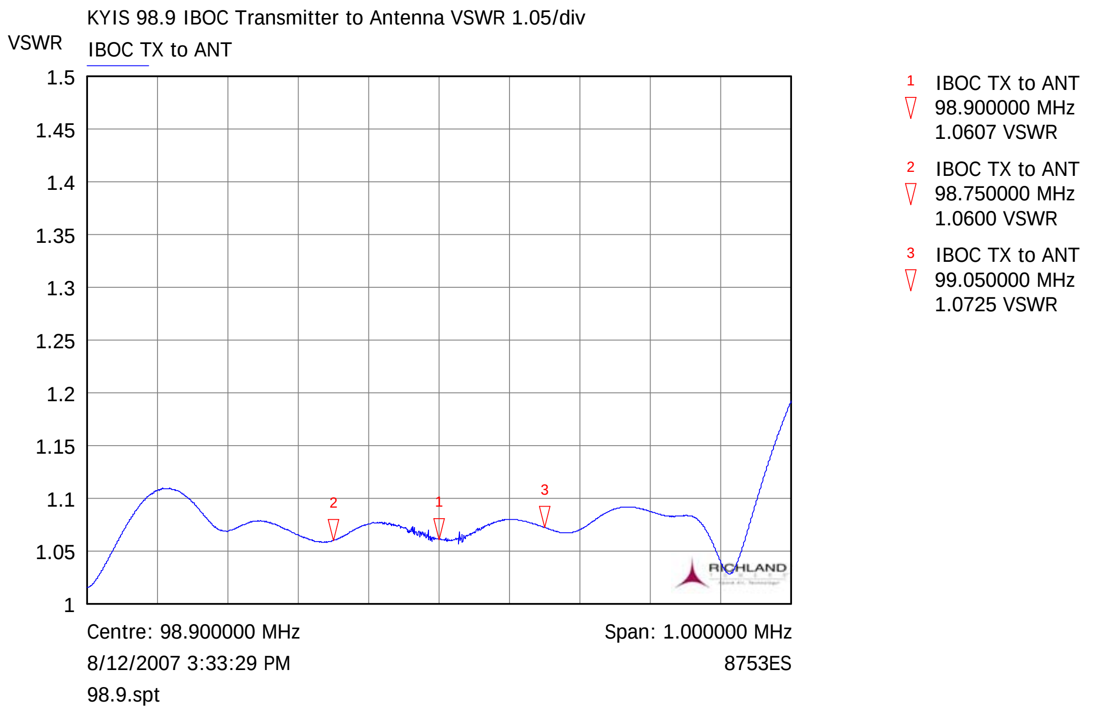
8/12/2007 3:33:29 PM | 8753ES

98.9.spt

98.9 Module



Through Circulator



98.9 Module

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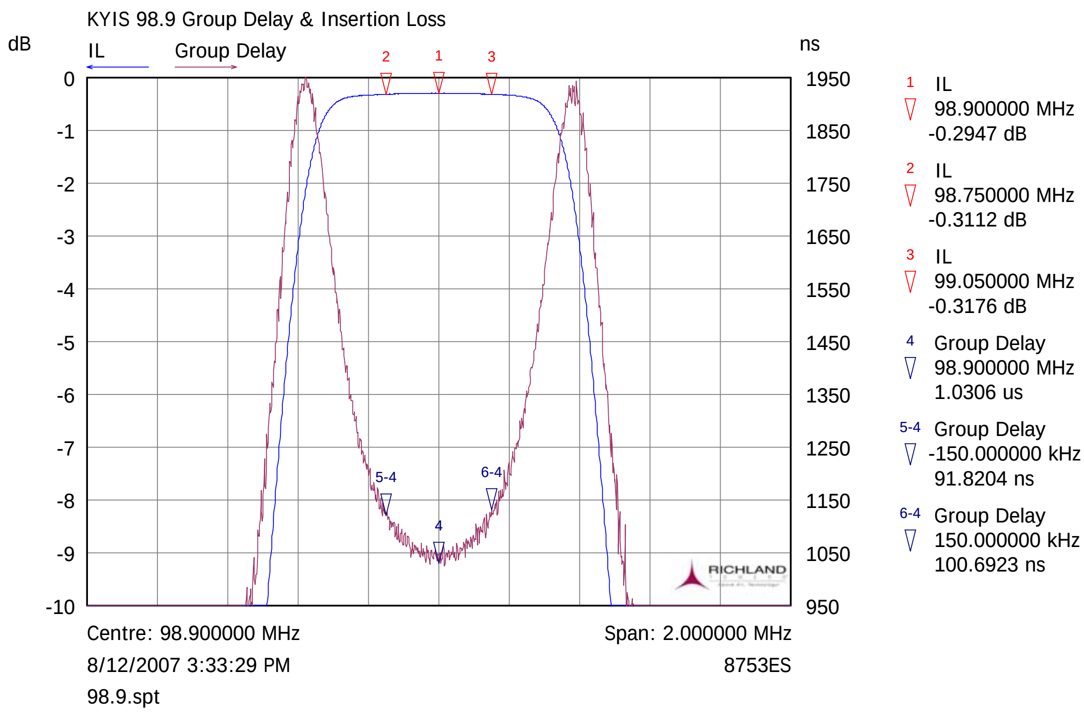
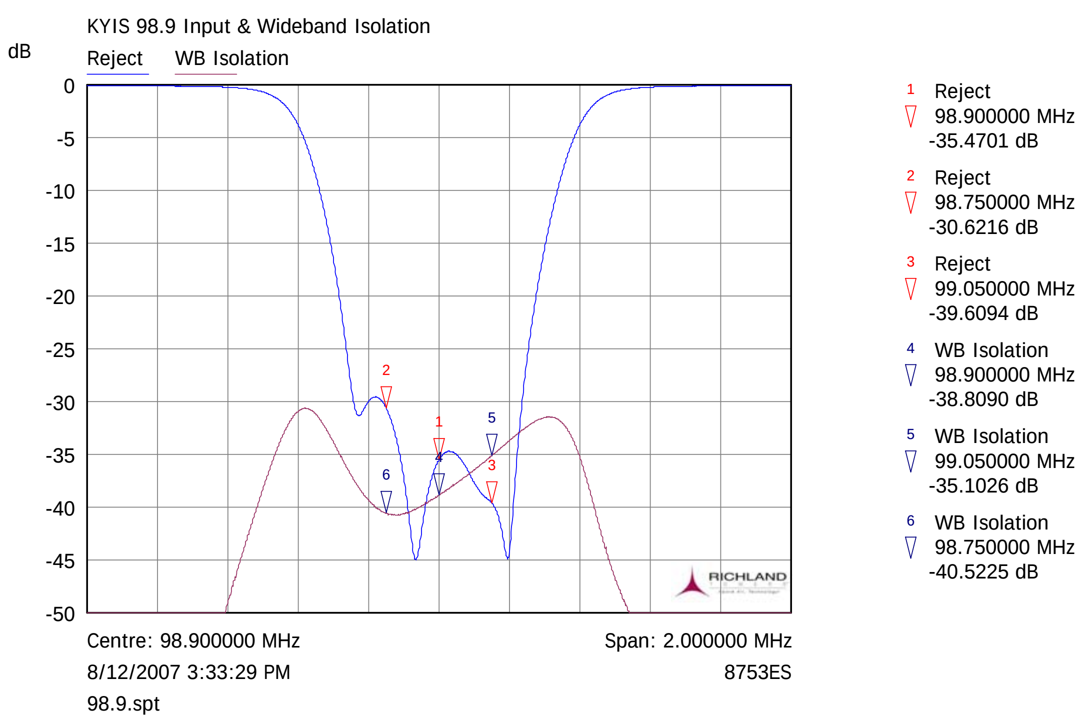
813.286.4140 ● Fax 813.286.4130
www.richlandtowers.com





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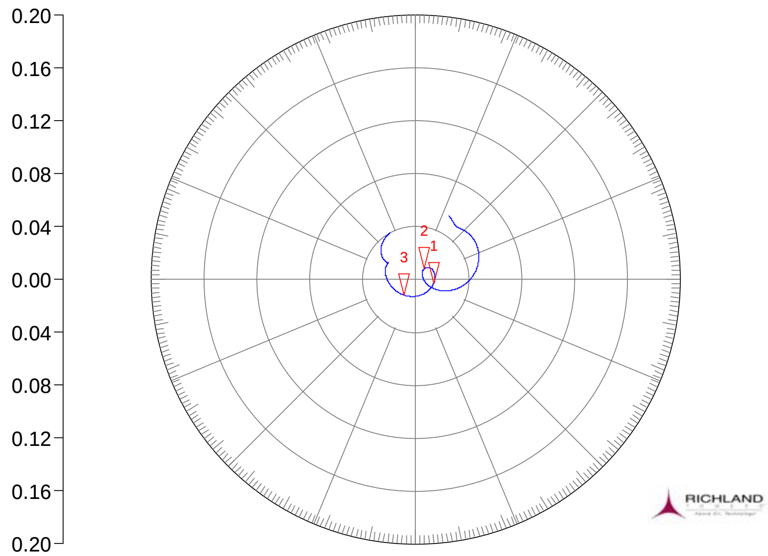
KYIS 98.9 Combiner System Polar Impedance 200mU

S11



1 S11
98.900000 MHz
0.0142, -12.9652°

2 S11
98.750000 MHz
0.0104, 49.7270°

3 S11
99.050000 MHz
0.0147, -124.8285°

Centre: 98.900000 MHz | Span: 1.000000 MHz

8/12/2007 3:33:29 PM | 8753ES

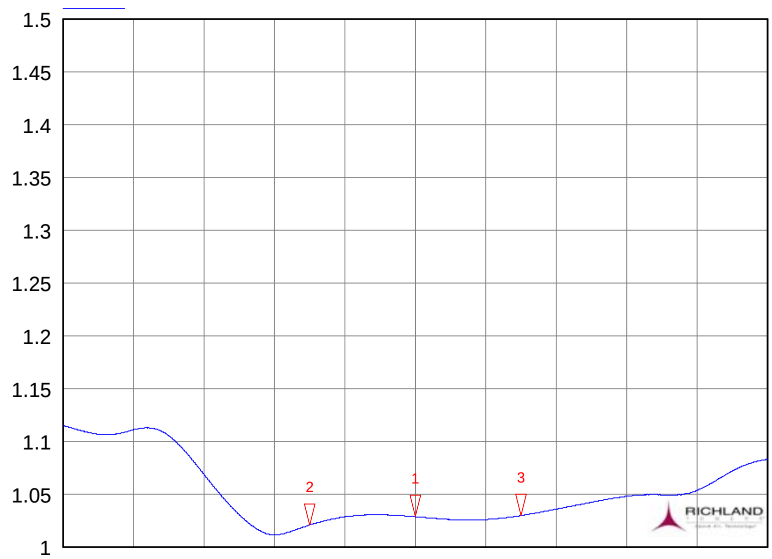
98.9.spt

98.9 Module

KYIS 98.9 Combiner System VSWR 1.05/div

VSWR

S11



1 S11
98.900000 MHz
1.0288 VSWR

2 S11
98.750000 MHz
1.0210 VSWR

3 S11
99.050000 MHz
1.0299 VSWR

Centre: 98.900000 MHz | Span: 1.000000 MHz

8/12/2007 3:33:29 PM | 8753ES

98.9.spt

98.9 Module

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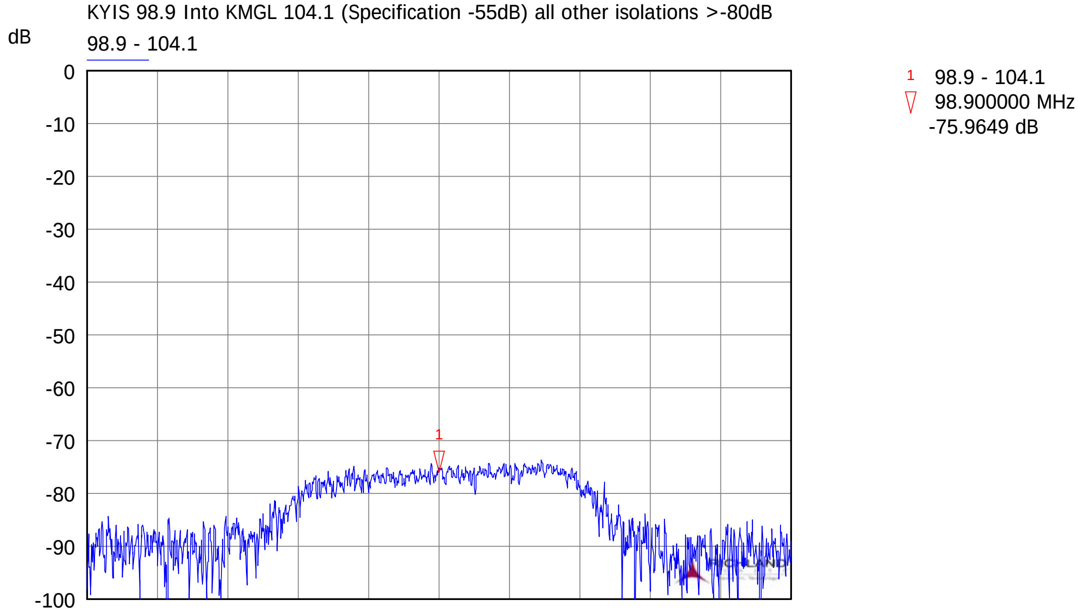
www.richlandtowers.com

KYIS 98.9 Into KMGL 104.1 (Specification -55dB) all other isolations >-80dB



Centre: 98.900000 MHz Span: 2.000000 MHz

8/12/2007 3:33:29 PM 8753ES

98.9.spt

400 North Ashley Dr., Suite 3010
Tampa, FL 33602
813.286.4140 ● Fax 813.286.4130
www.richlandtowers.com

Oklahoma City, Oklahoma

Analogue/IBOC FM Broadband System Commissioning Report

Prepared For

KRXO 107.7
Renda Broadcasting

Equipment

ERI COG-20P-12-240-2 Panel Antenna
with Dual Inputs and Reverse-fed IBOC
1660′ Dual ERI 6″- 50Ω Maxline & Dual 3″ Heliax Transmission Line
ERI 973-8 Four Channel Constant Impedance Combiner with Circulator Isolated IBOC

Measurement Data Taken on
3 – 12 August 2007

Submitted By

Todd R Loney
Senior RF Engineer

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Tampa, FL 33602
813.286.4140 ● Fax 813.286.4130
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Measurement setup

Measurements were taken with an Agilent 8753ES network analyzer, Agilent 4-port dual directional coupler. A three watt amplifier was used to overcome high RF level ingress. For combiner measurements, an HP S-Parameter test was used.
Richland Towers broadband, precision test adapters were used to make the measurements.
Data was extracted from the analyzer in complex pair values (real/imaginary) via the GPIB port to laptop computer. Data was then analyzed and presented using SoftPlot™ software and is imported into this document as an Object Linking Embedding (OLE). This data can be manipulated, (scale, format, markers, etc.) follow link to http://softplot.com/ and download demonstration version to utilize this feature. Markers are placed at fc as well as +/- 150kHz.

Measurement details

Measurements were taken from the inputs to the combiner as well as from the transmitter output.
Antenna system data is included under a separate antenna system report.

Findings

- Performance of the system, from transmitter outputs, through the combiner to the antenna is satisfactory
- Station to station isolations measured >-80dB except 98.9 into 104.1 which measured -75dB. Specification is -55dB

400 North Ashley Dr., Suite 3010
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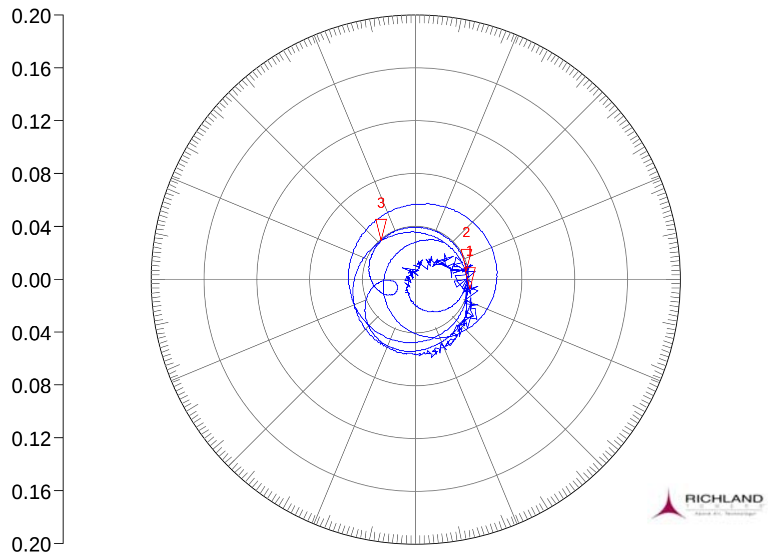
813.286.4140 ● Fax 813.286.4130
www.richlandtowers.com

KRXO 107.7 Transmitter to Antenna Polar Impedance 200mU

TX to ANT



Centre: 107.700000 MHz | Span: 1.000000 MHz

8/12/2007 3:20:56 PM | 8753ES

107.7.spt

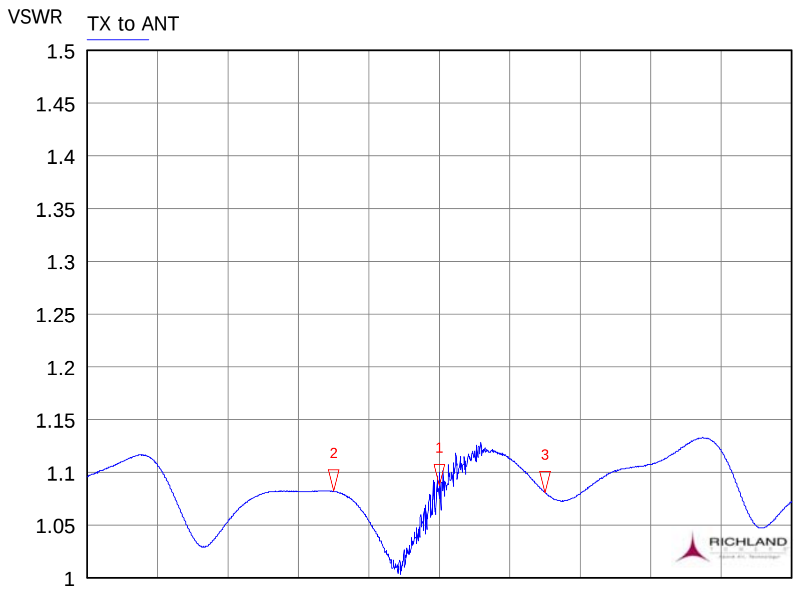
1 TX to ANT
107.700000 MHz
0.0421, -10.0456°

2 TX to ANT
107.550000 MHz
0.0395, 9.4660°

3 TX to ANT
107.850000 MHz
0.0389, 131.5496°

KRXO 107.7 Transmitter to Antenna VSWR 1.05/div

TX to ANT



Centre: 107.700000 MHz | Span: 1.000000 MHz

8/12/2007 3:20:56 PM | 8753ES

107.7.spt

1 TX to ANT
107.700000 MHz
1.0878 VSWR

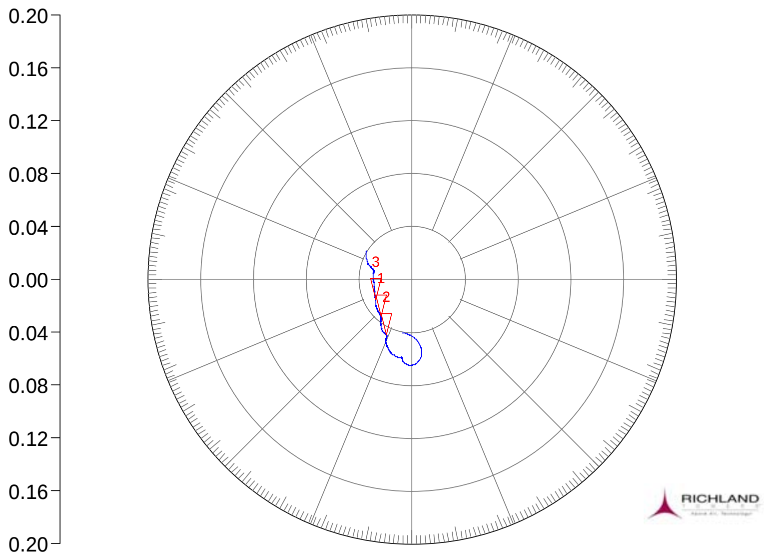
2 TX to ANT
107.550000 MHz
1.0823 VSWR

3 TX to ANT
107.850000 MHz
1.0810 VSWR

400 North Ashley Dr., Suite 3010
Tampa, FL 33602
813.286.4140 ● Fax 813.286.4130
www.richlandtowers.com

KRXO 107.7 IBOC Transmitter to Antenna Polar Impedance 200mU

IBOC TX to ANT



1 IBOC TX to ANT
107.700000 MHz
0.0369, -129.7955°

2 IBOC TX to ANT
107.550000 MHz
0.0463, -114.7526°

3 IBOC TX to ANT
107.850000 MHz
0.0316, -150.5100°

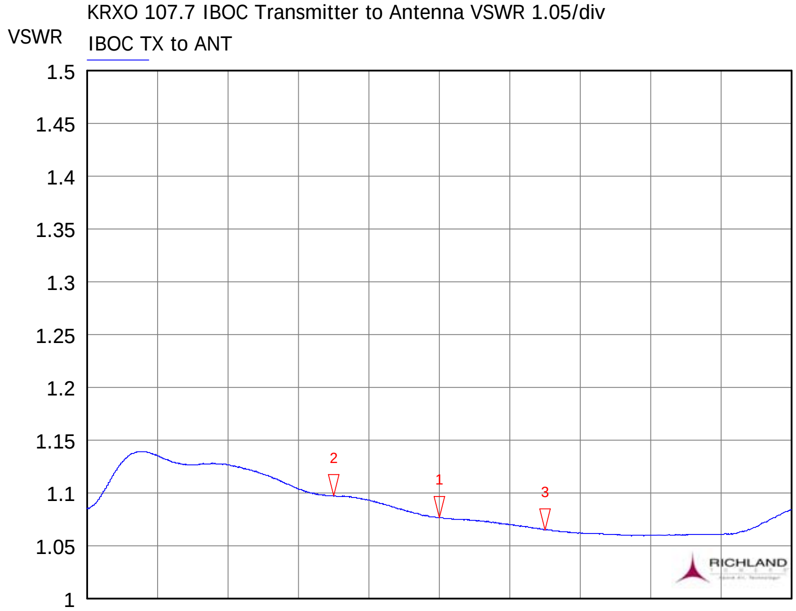
Centre: 107.700000 MHz Span: 1.000000 MHz

8/12/2007 3:20:56 PM 8753ES

107.7.spt

KRXO 107.7 IBOC Transmitter to Antenna VSWR 1.05/div

IBOC TX to ANT



1 IBOC TX to ANT
107.700000 MHz
1.0765 VSWR

2 IBOC TX to ANT
107.550000 MHz
1.0971 VSWR

3 IBOC TX to ANT
107.850000 MHz
1.0653 VSWR

Centre: 107.700000 MHz Span: 1.000000 MHz

8/12/2007 3:20:56 PM 8753ES

107.7.spt

Through Circulator

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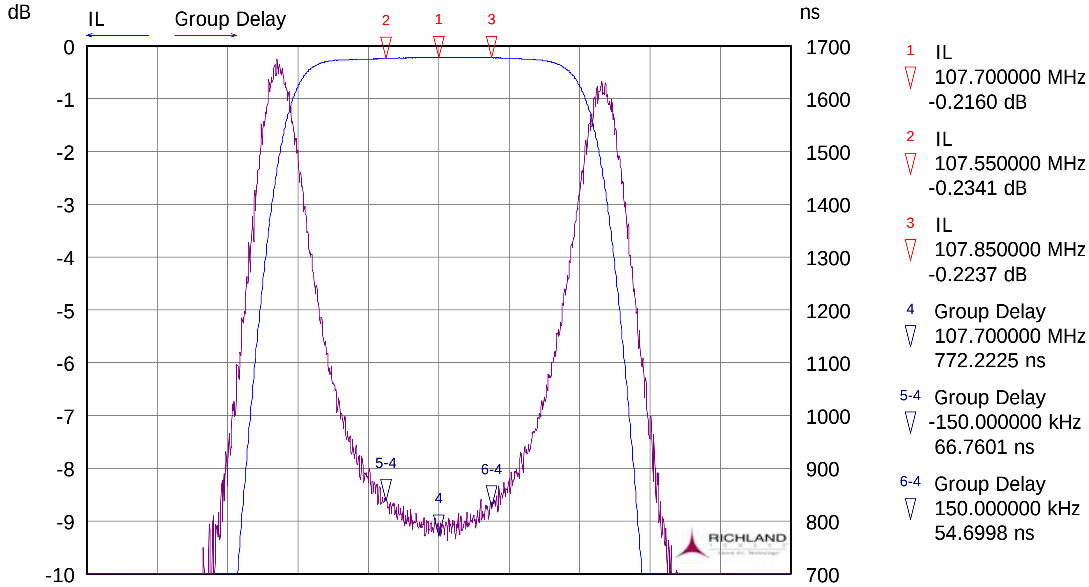
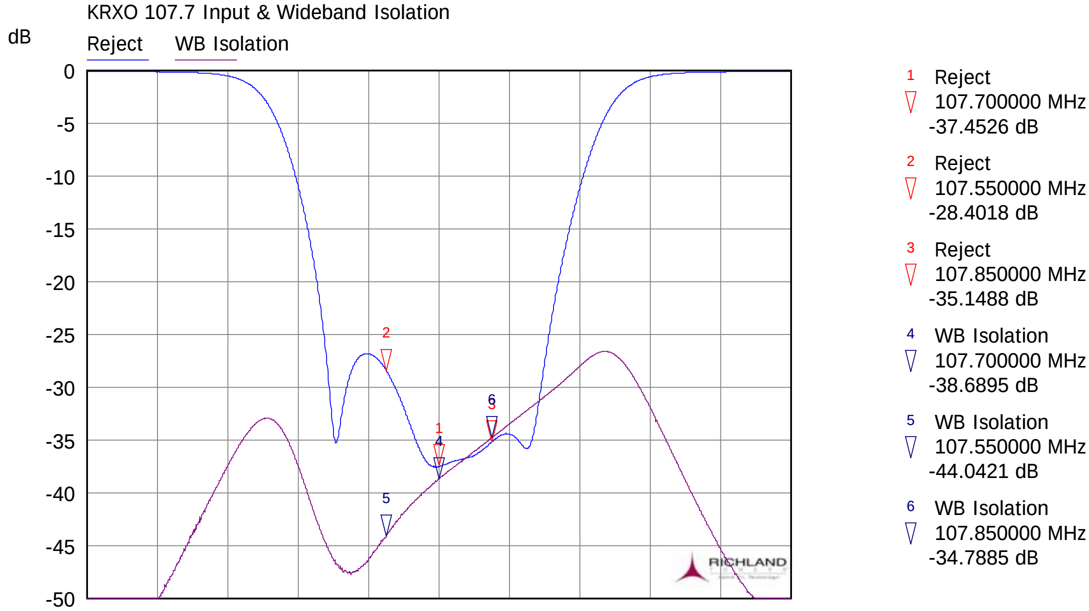
Tampa, FL 33602
813.286.4140 ● Fax 813.286.4130
www.richlandtowers.com

KRXO 107.7 IBOC Group Delay & Insertion Loss



Centre: 107.700000 MHz Span: 2.000000 MHz
8/12/2007 3:20:56 PM 8753ES
107.7.spt

KRXO 107.7 Input & Wideband Isolation



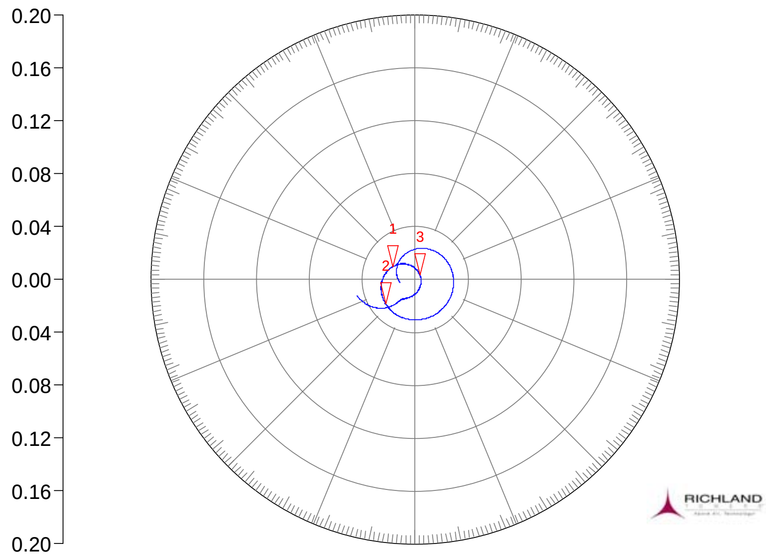
Centre: 107.700000 MHz Span: 2.000000 MHz
8/12/2007 3:20:56 PM 8753ES
107.7.spt

Reject Analogue to IBOC

400 North Ashley Dr., Suite 3010
Tampa, FL 33602
813.286.4140 ● Fax 813.286.4130
www.richlandtowers.com

KRXO 107.7 Combiner System Polar Impedance 200mU

S11



1 S11
107.700000 MHz
0.0193, 151.0055°

2 S11
107.550000 MHz
0.0291, -139.3488°

3 S11
107.850000 MHz
0.0052, 43.2076°

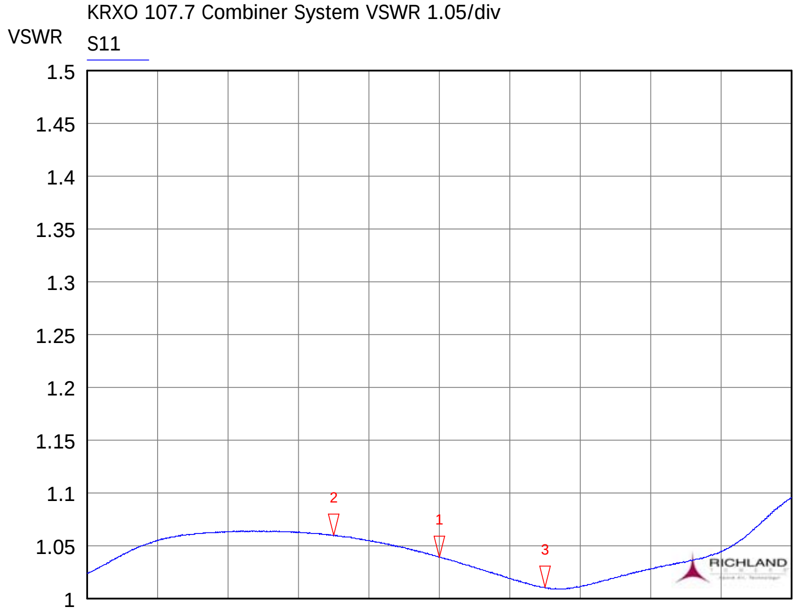
Centre: 107.700000 MHz Span: 1.000000 MHz

8/12/2007 3:20:56 PM 8753ES

107.7.spt

KRXO 107.7 Combiner System VSWR 1.05/div

S11



1 S11
107.700000 MHz
1.0394 VSWR

2 S11
107.550000 MHz
1.0599 VSWR

3 S11
107.850000 MHz
1.0105 VSWR

Centre: 107.700000 MHz Span: 1.000000 MHz

8/12/2007 3:20:56 PM 8753ES

107.7.spt

400 North Ashley Dr., Suite 3010
Tampa, FL 33602
813.286.4140 ● Fax 813.286.4130
www.richlandtowers.com

Oklahoma City, Oklahoma

Analogue/IBOC FM Broadband System Commissioning Report

<u>Prepared For</u>

KOMA 92.5
Renda Broadcasting

<u>Equipment</u>

ERI COG-20P-12-240-2 Panel Antenna
with Dual Inputs and Reverse-fed IBOC
1660′ Dual ERI 6″- 50Ω Maxline & Dual 3″ Heliax Transmission Line
ERI 973-8 Four Channel Constant Impedance Combiner with Circulator Isolated IBOC

Measurement Data Taken on
3 – 12 August 2007

<u>Submitted By</u>

Todd R Loney
Senior RF Engineer

400 North Ashley Dr., Suite 3010
Tampa, FL 33602
813.286.4140 ● Fax 813.286.4130
www.richlandtowers.com

Measurement setup

Measurements were taken with an Agilent 8753ES network analyzer, Agilent 4-port dual directional coupler. A three watt amplifier was used to overcome high RF level ingress. For combiner measurements, an HP S-Parameter test was used.
Richland Towers broadband, precision test adapters were used to make the measurements. Data was extracted from the analyzer in complex pair values (real/imaginary) via the GPIB port to laptop computer. Data was then analyzed and presented using SoftPlot™ software and is imported into this document as an Object Linking Embedding (OLE). This data can be manipulated, (scale, format, markers, etc.) follow link to http://softplot.com/ and download demonstration version to utilize this feature. Markers are placed at fc as well as +/- 150kHz.

Measurement details

Measurements were taken from the input to the combiner as well as from the transmitter output.
Antenna system data is included under a separate antenna system report.

Findings

- Performance of the system, from transmitter outputs, through the combiner to the antenna is satisfactory
- Station to station isolations measured >-80dB except 98.9 into 104.1 which measured -75dB. Specification is -55dB

400 North Ashley Dr., Suite 3010
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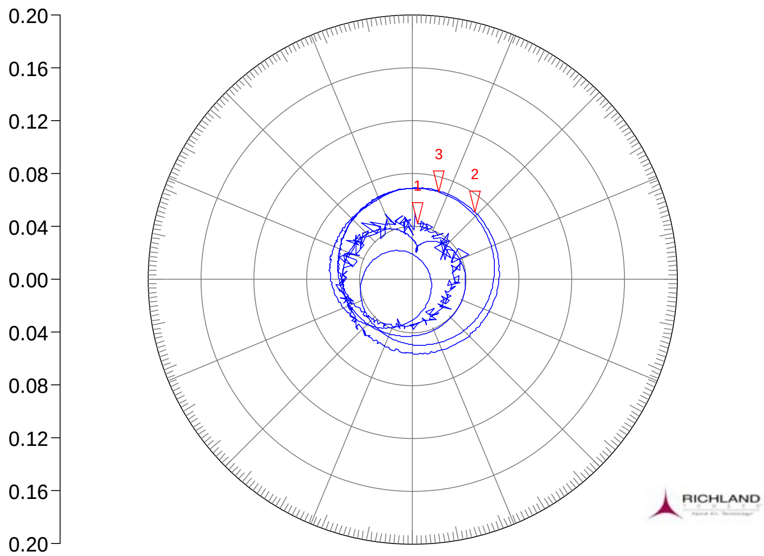
813.286.4140 ● Fax 813.286.4130
www.richlandtowers.com

KOMA 92.5 Transmitter to Antenna Polar Impedance 200mU

TX to ANT



1 TX to ANT
92.500000 MHz
0.0422, 84.5245°

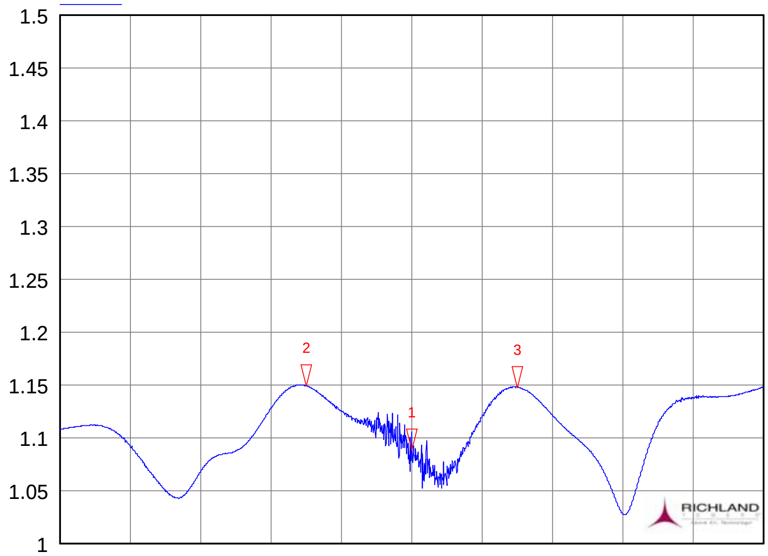
2 TX to ANT
92.350000 MHz
0.0694, 46.8610°

3 TX to ANT
92.650000 MHz
0.0688, 73.0173°

Centre: 92.500000 MHz Span: 1.000000 MHz
8/12/2007 3:25:26 PM 8753ES
92.5.spt

KOMA 92.5 Transmitter to Antenna VSWR 1.05/div

VSWR TX to ANT



1 TX to ANT
92.500000 MHz
1.0882 VSWR

2 TX to ANT
92.350000 MHz
1.1492 VSWR

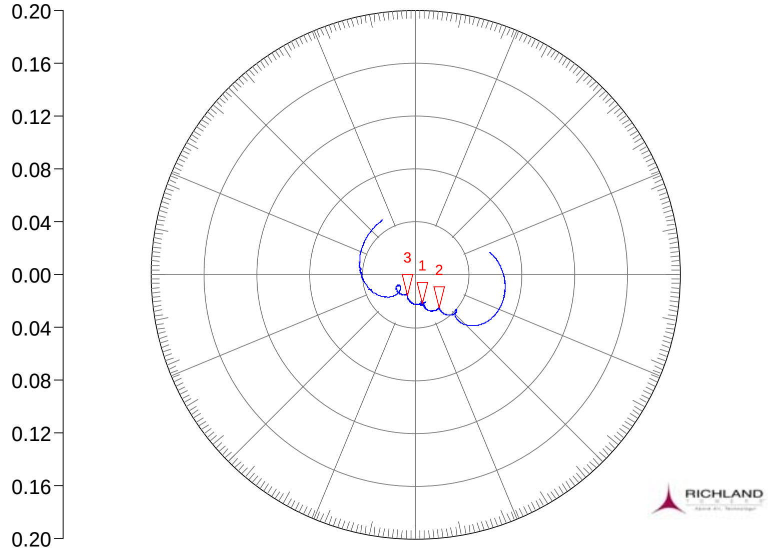
3 TX to ANT
92.650000 MHz
1.1478 VSWR

Centre: 92.500000 MHz Span: 1.000000 MHz
8/12/2007 3:25:26 PM 8753ES
92.5.spt

400 North Ashley Dr., Suite 3010
Tampa, FL 33602
813.286.4140 ● Fax 813.286.4130
www.richlandtowers.com

KOMA 92.5 IBOC Transmitter to Antenna Polar Impedance 200mU

IBOC TX to ANT



1 IBOC TX to ANT
92.500000 MHz
0.0226, -75.6112°

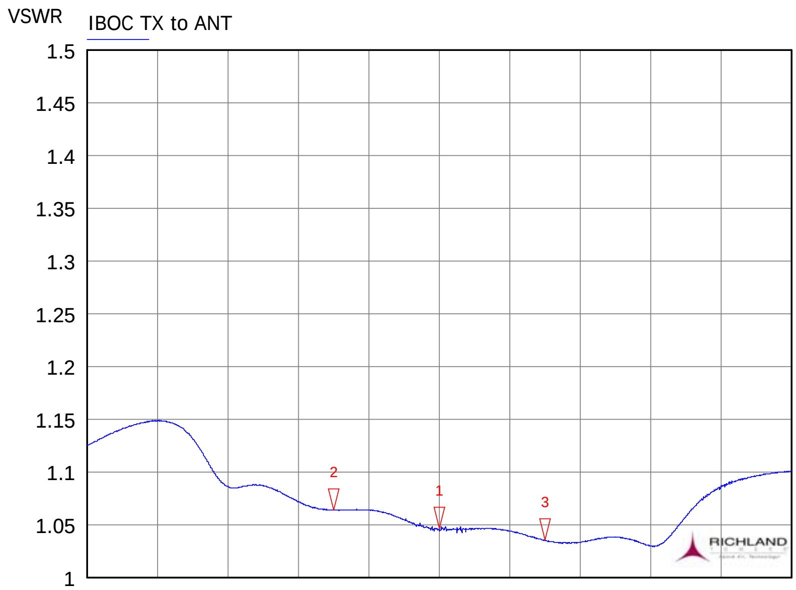
2 IBOC TX to ANT
92.350000 MHz
0.0310, -54.8298°

3 IBOC TX to ANT
92.650000 MHz
0.0174, -110.8140°

Centre: 92.500000 MHz | Span: 1.000000 MHz
8/12/2007 3:25:26 PM | 8753ES
92.5.spt

KOMA 92.5 IBOC Transmitter to Antenna VSWR 1.05/div

IBOC TX to ANT



1 IBOC TX to ANT
92.500000 MHz
1.0463 VSWR

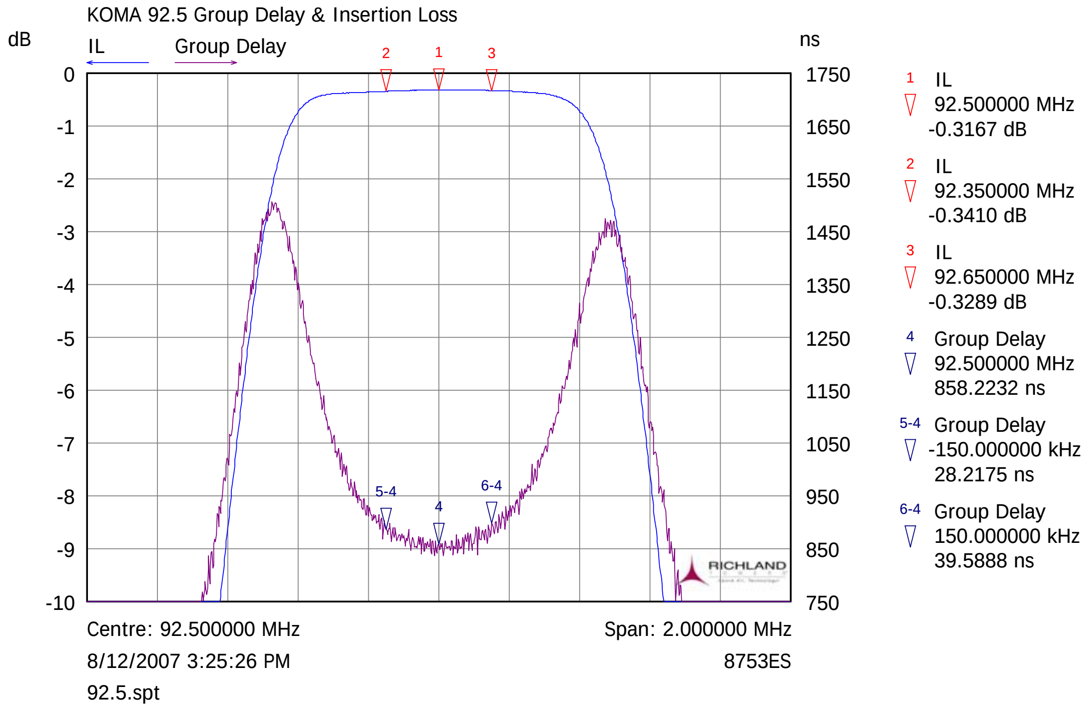
2 IBOC TX to ANT
92.350000 MHz
1.0641 VSWR

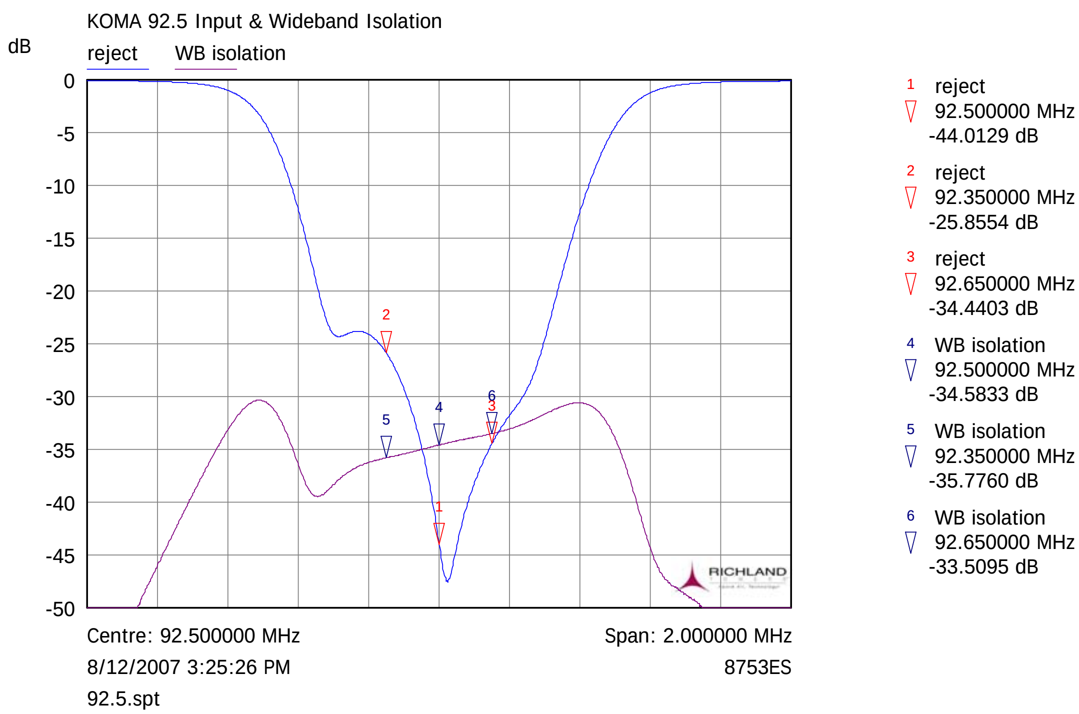
3 IBOC TX to ANT
92.650000 MHz
1.0355 VSWR

Centre: 92.500000 MHz | Span: 1.000000 MHz
8/12/2007 3:25:26 PM | 8753ES
92.5.spt

IBOC TX to ANT Through circulator

400 North Ashley Dr., Suite 3010
Tampa, FL 33602
813.286.4140 ● Fax 813.286.4130
www.richlandtowers.com





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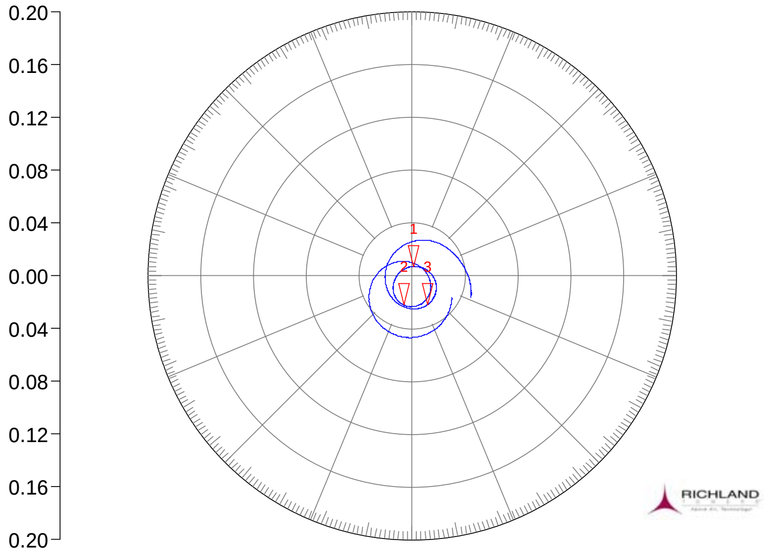
KOMA 92.5 Combiner System Polar Impedance 200mU

S11



1 S11
92.500000 MHz
0.0070, 77.4290°

2 S11
92.350000 MHz
0.0231, -105.6459°

3 S11
92.650000 MHz
0.0251, -62.1593°

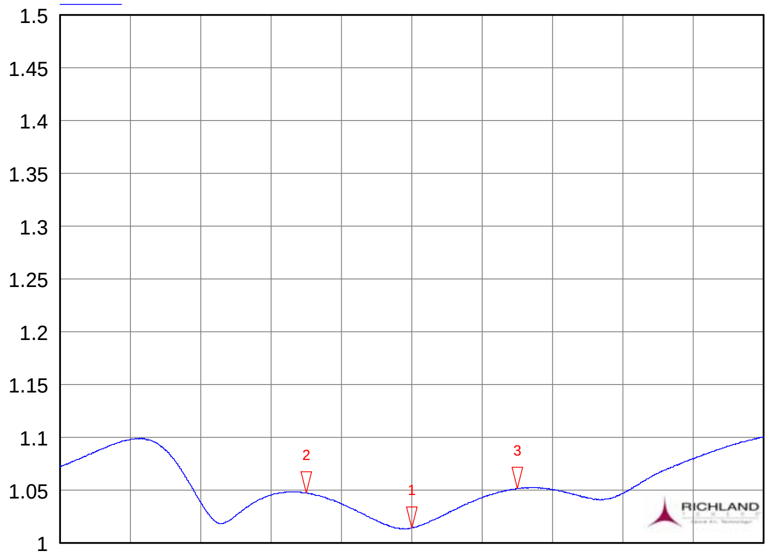
Centre: 92.500000 MHz — Span: 1.000000 MHz

8/12/2007 3:25:26 PM — 8753ES

92.5.spt

KOMA 92.5 Combiner System VSWR 1.05/div

VSWR S11



1 S11
92.500000 MHz
1.0142 VSWR

2 S11
92.350000 MHz
1.0474 VSWR

3 S11
92.650000 MHz
1.0514 VSWR

Centre: 92.500000 MHz — Span: 1.000000 MHz

8/12/2007 3:25:26 PM — 8753ES

92.5.spt

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Tampa, FL 33602
813.286.4140 ● Fax 813.286.4130
www.richlandtowers.com

Oklahoma City, Oklahoma

Analogue/IBOC FM Broadband System Commissioning Report

Prepared For

KMGL 104.1
Renda Broadcasting

Equipment

ERI COG-20P-12-240-2 Panel Antenna
with Dual Inputs and Reverse-fed IBOC
1660′ Dual ERI 6″- 50Ω Maxline & Dual 3″ Heliax Transmission Line
ERI 973-8 Four Channel Constant Impedance Combiner with Circulator Isolated IBOC

Measurement Data Taken on
3 – 12 August 2007

Submitted By

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Richland Towers broadband, precision test adapters were used to make the measurements.
Data was extracted from the analyzer in complex pair values (real/imaginary) via the GPIB port to laptop computer. Data was then analyzed and presented using SoftPlot™ software and is imported into this document as an Object Linking Embedding (OLE). This data can be manipulated, (scale, format, markers, etc.) follow link to http://softplot.com/ and download demonstration version to utilize this feature.
Markers are placed at fc as well as +/- 150kHz.

Measurement details

Measurements were taken from the input to the combiner as well as from the transmitter output.
Antenna system data is included under a separate antenna system report.

Findings

- Performance of the system, from transmitter outputs, through the combiner to the antenna is satisfactory
- Station to station isolations measured >-80dB except 98.9 into 104.1 which measured -75dB. Specification is -55dB
- When taking the KMGL data, the operating site was being received very well as can be seen by the “noise” on the analogue polar and VSWR plots. This was by far the hottest ingress of any station. For all “system” measurements, the amplifier was not used due the need to be calibrated for VSWR, isolation and loss measurements.

400 North Ashley Dr., Suite 3010
Tampa, FL 33602
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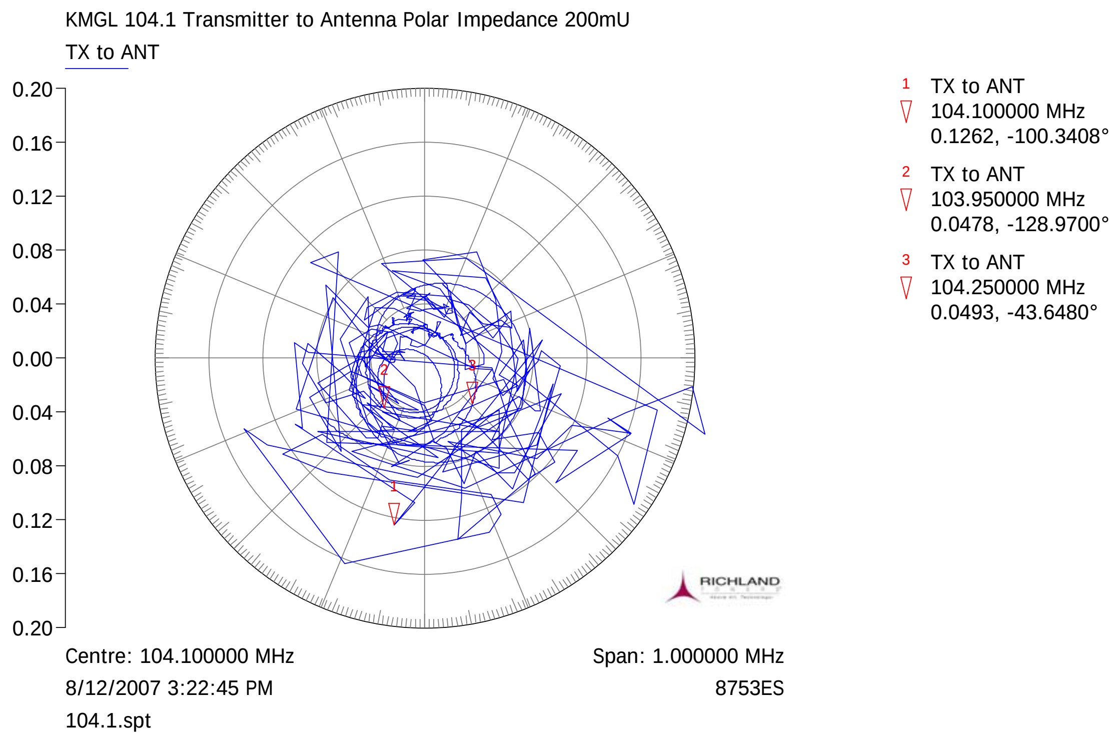
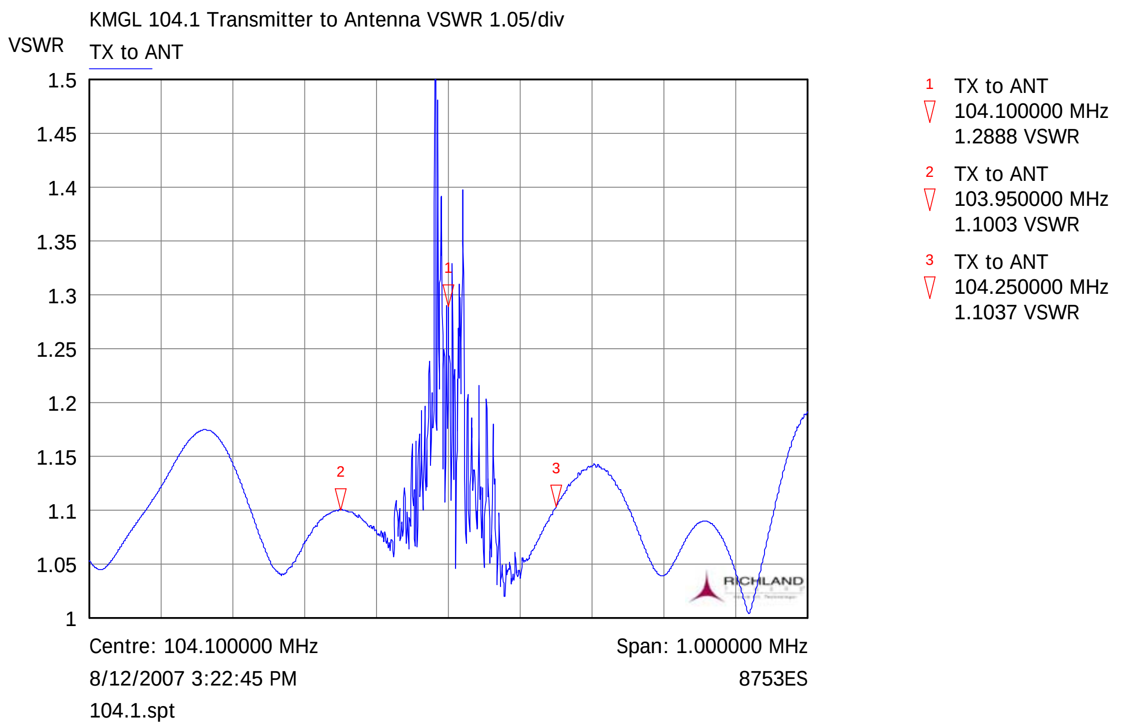


High Level Ingress from Operating Station



High Level Ingress from Operating Station

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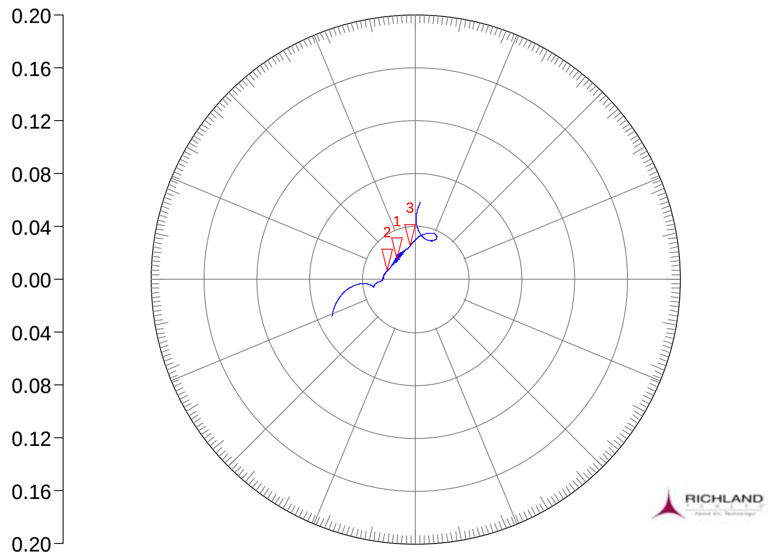
KMGL 104.1 IBOC Transmitter to Antenna Polar Impedance 200mU

IBOC TX to ANT



1 IBOC TX to ANT
104.100000 MHz
0.0210, 133.0018°

2 IBOC TX to ANT
103.950000 MHz
0.0221, 162.3533°

3 IBOC TX to ANT
104.250000 MHz
0.0255, 98.8290°

Start: 103.600000 MHz | Stop: 104.600000 MHz

8/12/2007 3:22:45 PM | 8753ES

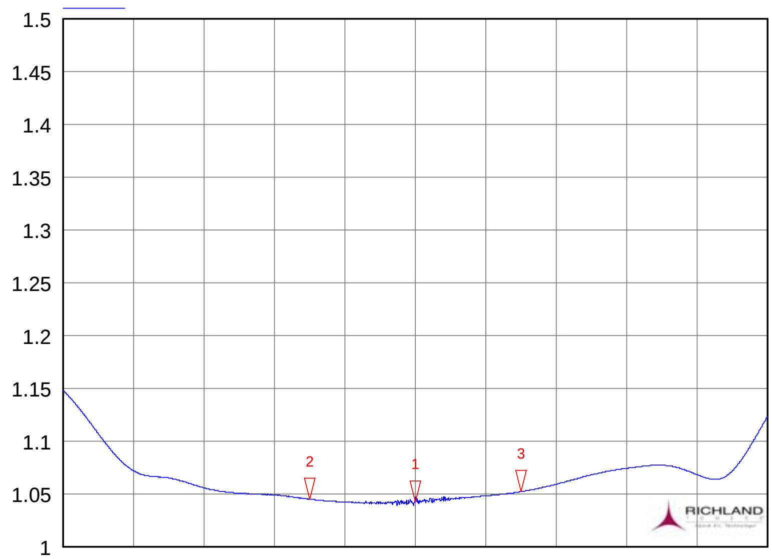
104.1.spt

Through Circulator

KMGL 104.1 IBOC Transmitter to Antenna VSWR 1.05/div

VSWR

IBOC TX to ANT



1 IBOC TX to ANT
104.100000 MHz
1.0429 VSWR

2 IBOC TX to ANT
103.950000 MHz
1.0451 VSWR

3 IBOC TX to ANT
104.250000 MHz
1.0523 VSWR

Start: 103.600000 MHz | Stop: 104.600000 MHz

8/12/2007 3:22:45 PM | 8753ES

104.1.spt

Through Circulator

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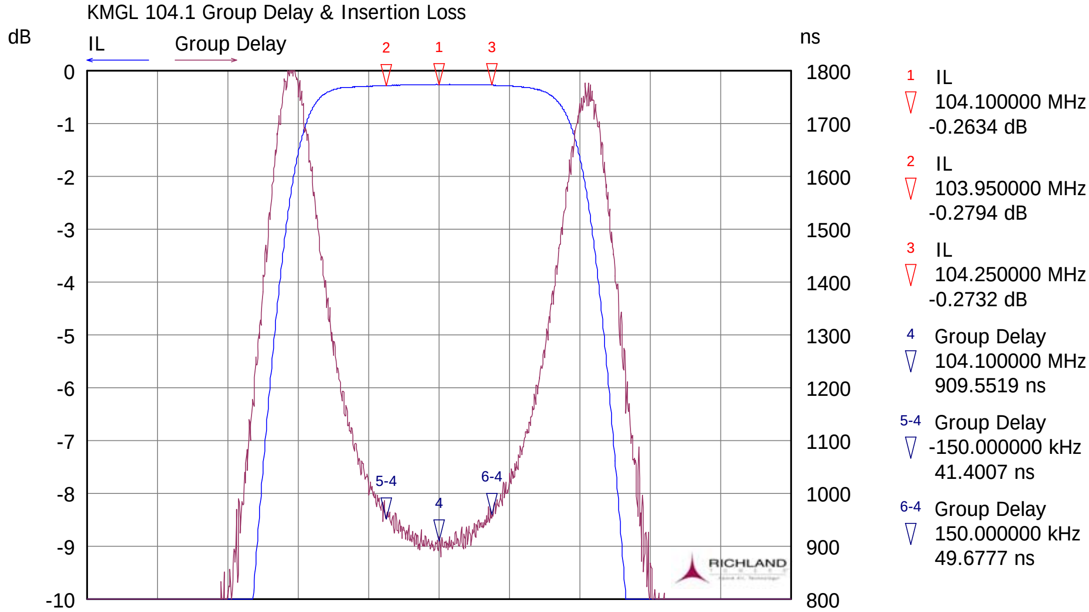
KMGL 104.1 Group Delay & Insertion Loss



Centre: 104.100000 MHz Span: 2.000000 MHz

8/12/2007 3:22:45 PM 8753ES

104.1.spt

KMGL 104.1 Input & Wideband Isolation

Centre: 104.100000 MHz Span: 2.000000 MHz

8/12/2007 3:22:45 PM 8753ES

104.1.spt

Reject Analogue to IBOC Isolation

WB Isolation Isolation to IBOC Patch

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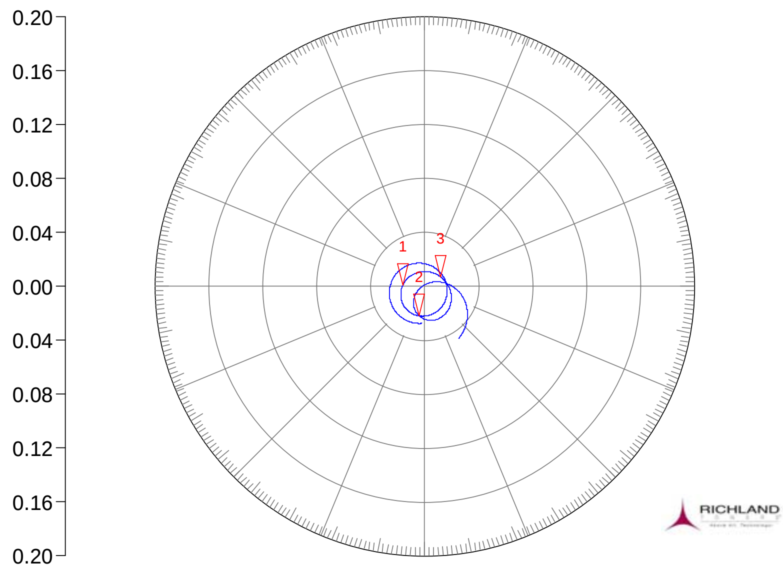
KMGL 104.1 Combiner System Polar Impedance 200mU

S11



1 S11
104.100000 MHz
0.0162, 178.1618°

2 S11
103.950000 MHz
0.0225, -99.5314°

3 S11
104.250000 MHz
0.0140, 28.5498°

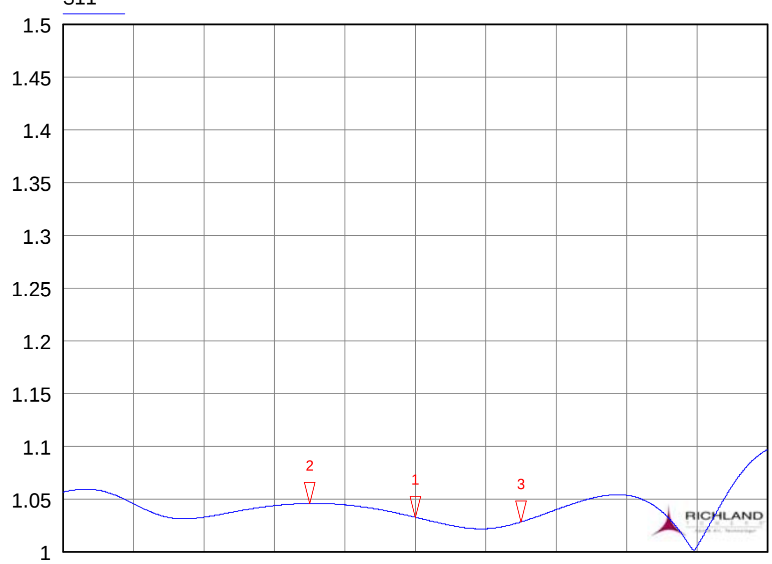
Centre: 104.100000 MHz | Span: 1.000000 MHz
8/12/2007 3:22:45 PM | 8753ES
104.1.spt

S11 Analogue Match

KMGL 104.1 Combiner System VSWR 1.05/div

VSWR

S11



1 S11
104.100000 MHz
1.0329 VSWR

2 S11
103.950000 MHz
1.0460 VSWR

3 S11
104.250000 MHz
1.0284 VSWR

Centre: 104.100000 MHz | Span: 1.000000 MHz
8/12/2007 3:22:45 PM | 8753ES
104.1.spt

S11 Analogue Match

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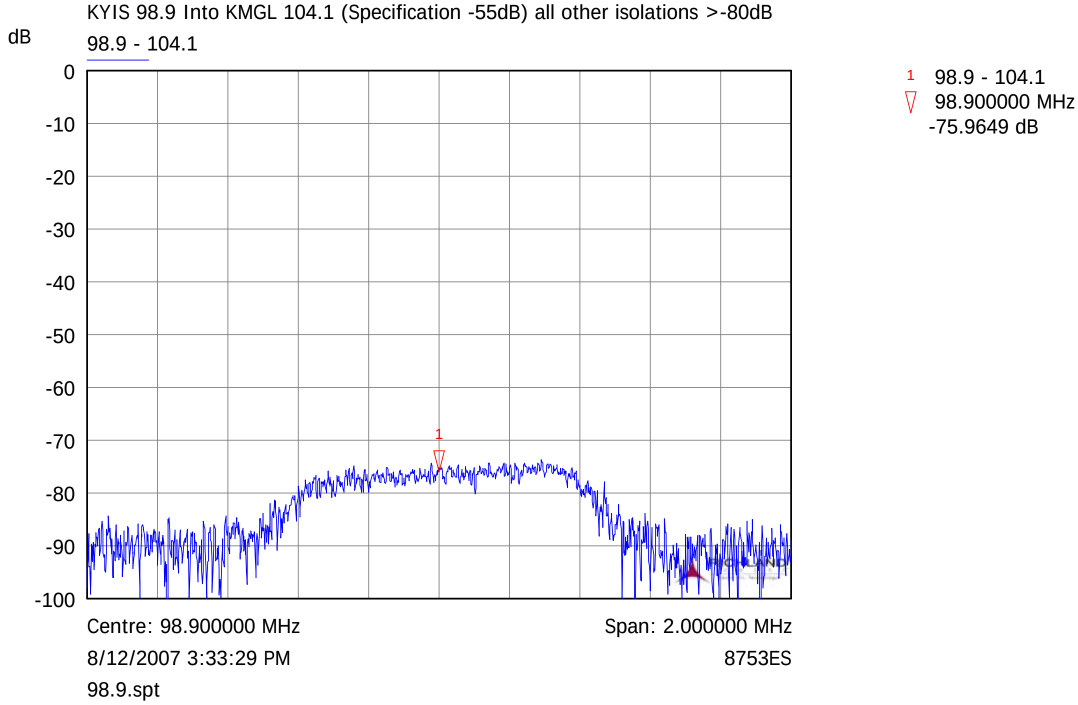
KYIS 98.9 Into KMGL 104.1 (Specification -55dB) all other isolations >-80dB



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ERI Model COG3-20P-12-240-2 Master FM Antenna

Richland Towers COGWHEEL Atlanta Master FM Antenna.

The Oklahoma City, Richland Towers Master FM Antenna and Combiner system description, a simplified schematic diagram, titled Combiner Plan, and a detailed sketch titled COGWHEEL™ Antenna showing the modular arrangement of the COGWHEEL antenna are provided.

The standard COG-20P-12-240-2 antenna is built on its own supporting spine and only a transition section is all that is required to interface with a triangular support tower; however, due to the tower candelabra mounting requirement of the Richland Towers project, a support tower for this project will be offered and fabricated to a specific height of 25-feet and made up of two bolt-together sections. The support tower will interface to the tower candelabra arm and elevate the antenna, topping out at a height above ground level of 1,605-feet[1]. The support tower would appear conventional in design; however, it would be factory equipped with brackets and the necessary intermediary power dividers and phased rigid line sections in order for the antenna installation to be completed in a minimum amount of time. Once the support tower is placed on top of the broadcast tower, the COGWHEEL can then be installed.

The COG-20P-12-240-2 Master FM Antenna is an eight-section antenna developed specifically for the simultaneous radiation of analog and digital signals. Each COGWHEEL section consists of three radiators, mounted at 120-degree intervals around the cogwheel pole. The COGWHEEL Master FM Antenna features broadband operating characteristics, a simplified feed system and durable modular construction. Each factory assembled module is furnished complete with two levels of elements including integral pole and structural wing sections, plus RF feed harness (bay level power dividers) ready for operation with FM stations with a combined analog power input of 240 kW (with both halves of the array in use). This provides adequate power handling for up to 12 Class C FM radio stations, given the average numeric power gain for the antenna of approximate 5.0. Each module is provided with interconnecting transmission lines contained within each flanged pole section. This feature allows for quick and easy module stacking. For example, ERI testing will consist of setting up half of the antenna (two modules at a time) on a stationary stand. Once proofed and inspected each two-module assembly can be transferred via crane onto a flatbed tractor trailer and shipped as semi-assembled sections. The antenna's two module assemblies

[1] Overall height above top of tower does not include any necessary obstruction lighting and doesn't include the new "Lightning / Beacon Shield" for the protection of the beacon from lightning and RF power.

(4 bays each) can be installed in three lifts and the antenna installation is complete by interconnecting the internal feed lines.

Electrical feed to both the analog and digital components of each antenna module is by means of rigid coaxial transmission lines brought down through the bottom of each module. A single analog and digital line is required for each module; therefore, four 4-1/16-inch analog and four 3-1/8-inch digital feeds are used to feed the individual modules. Two intermediate analog and two intermediate digital power dividers placed below the COGWHEEL in the COGWHEEL support structure permit the feeding of the upper and lower sections of the antenna system. The power dividers are fed from two 6-1/8-inch and two 3-1/8-inch transmission lines, hence the power handling capacity is correspondingly high due to this power distribution method and the use of appropriately sized material.

To complete the antenna's installation, interconnections to the four transmission line sections are made. Two 6-1/8-inch rigid lines carry analog signals and two 3-inch air HELIAX lines are used for digital IBOC. These feed lines create the dual feed system planned for the project. The dual line concept provides a means of changing the feed arrangement to the antenna (within the combiner room) to permit emergency operation to either half of the antenna, should an unlikely failure ever occur in either half of the system.

Contained within this proposal packet is a set of azimuth patterns to exhibit the Cogwheel's ability to radiate well in all directions. Also included is a set of elevation patterns illustrating the vertical cut pattern of the 12-bay antenna. The 114-inch spacing between element levels provides an average antenna gain value of five. This gain roughly allows twelve stations to achieve 100-kilowatts of Effective Radiated Power (ERP) with 25 kW transmitters. Special vertical pattern shaping is desired for this project: with first and second null fill[2] the antenna provides good uniform close-in coverage and, together with -0.75-degrees of electrical beam tilt[2], the antenna will yield a strong broadcast signal in the desired coverage locations. With the system in operation, the antenna/combiner provides concurrent operation of twelve or more analog channels along with their companion digital IBOC carriers.

The combiner is designed to handle combined RF power up to 290 kW from twelve stations and is designed with the ability to simultaneously operate with Analog and Digital signals, hence two inputs are provided on each combiner module. With non-adjacent filter coupling and Circulators placed on Digital IBOC input ports, the combining is achieved without transmitter interaction. In a system such as this (using individualized combiner modules) it is possible to initially operate with a small group of stations and expand the group up to the full capability of the antenna and combiner system.

---

[2] Vertical plane pattern shaping provided at the request of the customer.

Senior Road Tower Group COGWHEEL Master FM Antenna installation of two sections in January 2006.

In the arrangement shown in the drawing titled "Combiner Plan" all stations are injected into the 9-3/16-inch main combiner trunk and, due to the combiner's behavior, the Analog and Digital IBOC output signals appear at opposite ends of the combiner string. The two output terminals lead to independent 90-degree hybrid power splitters where the signals are converted into two feeds for the antenna. This scheme provides the ability to use the combined or either the upper or lower halves of the Cogwheel independently in an emergency. Therefore, by either rerouting the combiner with (optional) bypass coax components, patching equipment, or electronic switching, the hybrids can be bypassed. Note: electronic sensing equipment can be provided as an option to provide rapid switching between operating modes if a fault is detected within the system.

The versatility and flexibility of the combining network makes possible a number of desirable features. For instance, if there is additional capacity in the Digital IBOC power distribution system, then (after final review of system ratings) additional Combiner modules can be placed and arranged to inject high power Analog signals into the Digital IBOC branch of the system.

On-site assembly and the erection of the antenna are not included as part of the services supplied by ERI; however, assembly supervision and electrical checkout by a qualified ERI service engineer is provided. This will include comprehensive final tests to insure a correct installation.

1.1. Power Considerations (Overview)

Average Power and Peak Voltage coax ratings must be evaluated when combining stations into a common coax line (or lines). The following provides a critical analysis of the tower transmission feeds, for it is these feeds that predominantly regulate the power supplied to the antenna; therefore, the antenna will be built with ratings equal to or exceeding those of its transmission feeds.

1.2. ERI Recommended Rigid Line Ratings and Specifications

The investigations show that under the operating condition imposed by the Antenna and Combiner in Figures A & B, there are four distinct areas that the transmission lines carry large levels of RF within the system:

3-1/8-inch 50 ohm air HELIAX; Used as dual Digital IBOC antenna feeds.

6-1/8-inch 50 ohm rigid coaxial line; Feed to Digital power divider and this coax is used as the dual Analog antenna feeds and carries the majority of power to the antenna.
9-3/16-inch 50 ohm rigid coaxial line; Main trunk used to interconnect Combiner Modules

Rigid Line Size	Derated Average Power[3,4]	Maximum Peak Voltage[3,4]
3-1/8-inch	39 kW	6.32 kV
6-1/8-inch, 50 ohm	147.5 kW	12.25 kV
9-3/16-inch, 50 ohm	289.7 kW	17.32 kV

It is understood that the antenna and transmission line ratings are recommended by ERI and are low enough to prevent catastrophic failure should a 1.5:1 VSWR be incurred from a failure of an antenna component or if a sudden loss of pressure is experienced from a mechanical breach in the outer conductor of the system.

NOTE: If the 9-3/16-inch rigid line in the interconnecting transmission line for the combiner system or the 6-1/8-inch transmission line used for the analog antenna feeds would be exceeded, there is adequate power handling remaining in the dual 3-inch air HELIAX digital transmission lines to accommodate two additional Class C FM radio stations, including their companion IBOC carriers.

1.3. Theoretical Evaluations

We hope that this summary will clarify the number of stations that may occupy the system, their operating criteria, and offer reviewed definitions to determine and compute the power handling boundaries of a new station to the system. The primary finding in Myron Fanton's worksheet (See Attached Sheet "Power Computations – 10 Stations") is that there does not appear to be any major concerns regarding the selection of Antenna feeds by Richland Tower for the operation of 10 FM stations.

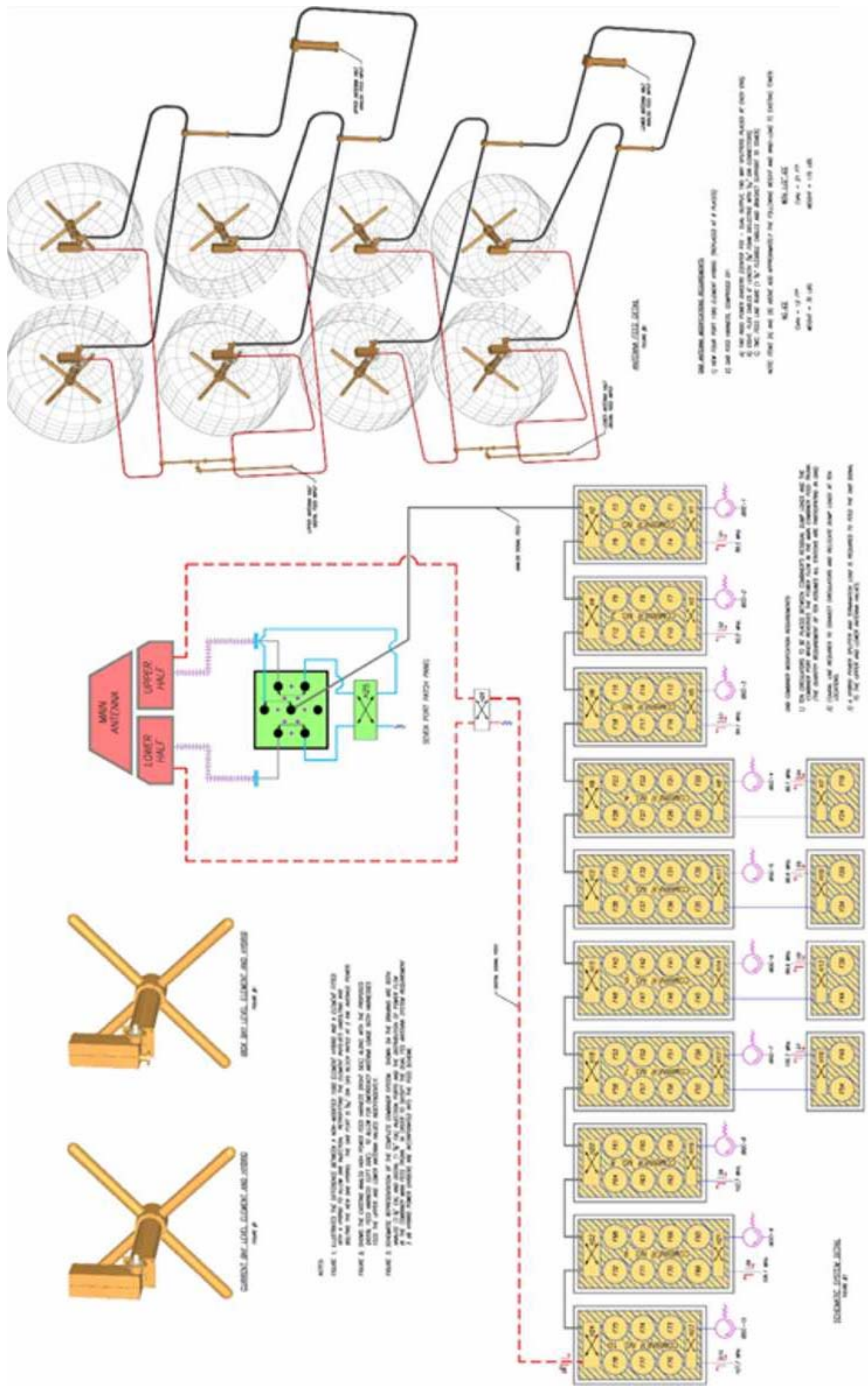
1.4. Power Handling Considerations

Operating with a VSWR less than 1.5 will increase the maximum power of the system. Additionally, pressurizing the transmission lines would allow for a greater Average Power rating.

Note:
1) Average Power and Peak Voltage assume: Operating VSWR of 1.5:1; atmospheric pressure, dry air, no solar loading, and multiple carriers; maximum (non-objectionable) transformer conductor temperature of 100ºC (212ºF).
2) For a margin of safety (Average Power and Peak Voltage), it is suggested that the antenna operate below its rated power. Determination of level is as the consumer's discretion.

---

[3] The Digital IBOC power rating is derated to 1/6 the normal average peak.
[4] It is assumed the Digital IBOC will operate at 1% (-20dB) of the Analog ERP otherwise the transmission line ratings will be exceeded if Analog stations are added to this supplement.


MAIN ANTENNA
UPPER HALF
LOWER HALF

The antenna system is designed with all elements at DC ground and the screens, transmission lines, and power dividers will be all firmly bonded to the support structure. This eliminates any potential for the static build up and helps protect the system from damage from lightning. ERI has also included full scale range testing on our far field range to optimize the horizontal plane pattern during the design phase and will range test one section of the complete antenna prior to shipment.

The preliminary electrical and mechanical specifications for this antenna are as follows:

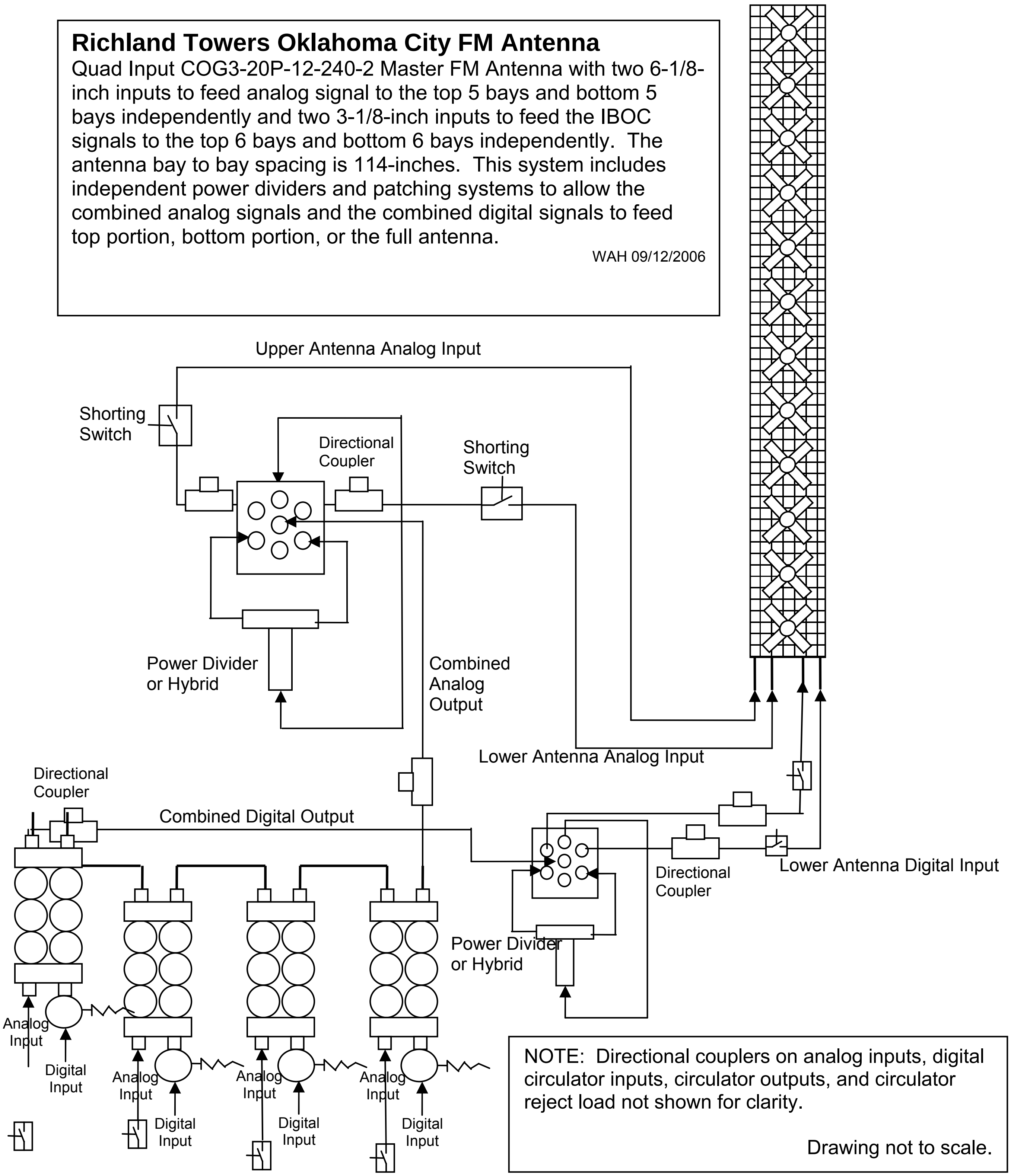
Model:	COG3-20P-12-240-2
Frequency Range:	88 to 108 MHz
Input Power Handling:	240 kW average power, 120 kW, each half
RF Input:	Analog Inputs: Dual 6-1/8-inch EIA female
	Digital Inputs: Dual 3-1/8-inch EIA female
Configuration:	Twelve (12) layers of three elements per layer
VSWR:	1.15:1, maximum 1.25:1, maximum with 1/2-inch of radial ice
Element Type:	1180 Series
Panel Dimensions:	92-inches wide x 114-inches high
Panel to Panel Spacing	114-inches
Antenna Height:	120-feet, including 4-foot A-3 Lightning Spurs
Antenna Aperture:	114-feet
Support Spine:	118-feet high, including lightning rods and transition section x 22-inch pipe
Broadcast Mode:	Analog: Right hand circular polarization Digital: Left hand circular polarization
Isolation between antenna inputs (analog to digital and digital to analog):	23 dB or better at band edges and an average of better than 30 dB over the primary FM pass band.
EPA (No Ice):	665 ft^2
Weight (No Ice):	56,500 lbs.
EPA $^{\text{with 2.1-inches ice}}$:	1,800 ft^2
Weight $^{\text{with 2.1-inches ice}}$:	118,750 lbs.

Notes: (1) All mechanical data per TIA-227-G standard for 90 mph (40 mph with ¾-inch radial ice thickness) (3 second gust).
(2) Loading includes "typical" inner transmission feed harness.

Simplified Block Diagram

Richland Towers Oklahoma City FM Antenna
Quad Input COG3-20P-12-240-2 Master FM Antenna with two 6-1/8-inch inputs to feed analog signal to the top 5 bays and bottom 5 bays independently and two 3-1/8-inch inputs to feed the IBOC signals to the top 6 bays and bottom 6 bays independently. The antenna bay to bay spacing is 114-inches. This system includes independent power dividers and patching systems to allow the combined analog signals and the combined digital signals to feed top portion, bottom portion, or the full antenna.

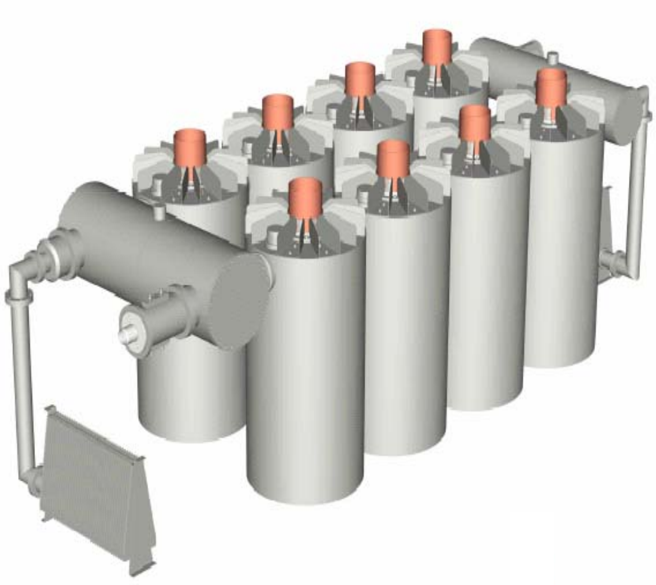
WAH 09/12/2006



NOTE: Directional couplers on analog inputs, digital circulator inputs, circulator outputs, and circulator reject load not shown for clarity.

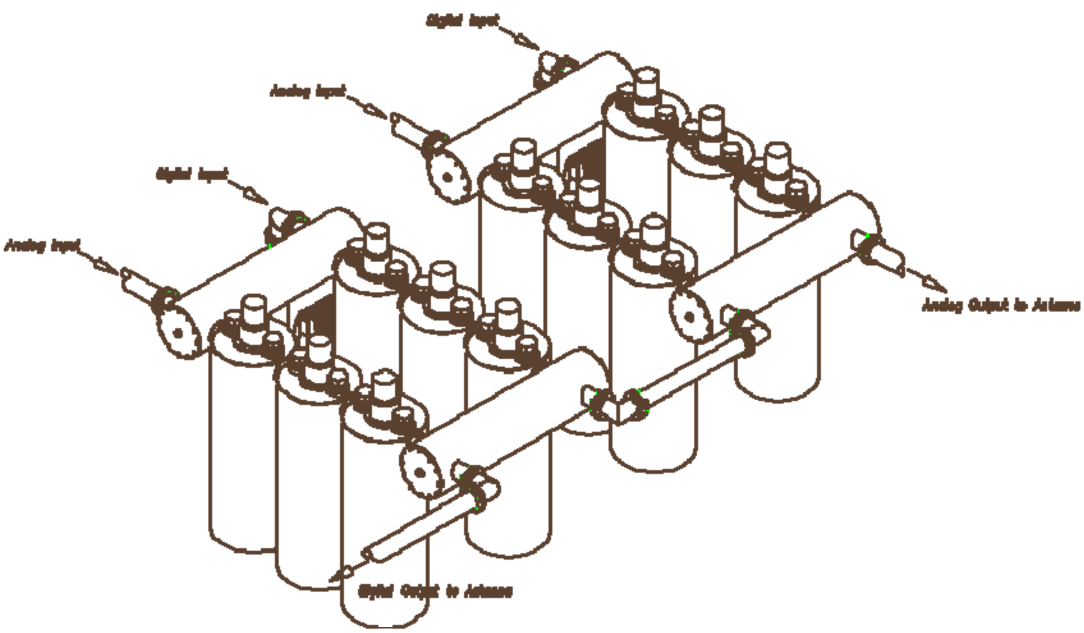
Drawing not to scale.

ERI Model 973-8 Series Constant Impedance Combiner



The system proposed includes a four (4) station constant impedance combiner system, that can be expanded (with a minimum of 0.8 MHz of frequency spacing) until the power limit of the combined transmission line is reached.. Each of the modules includes eight band pass cavities, hybrids on the input and output of each module, and a dump load. Each of the combiner modules is configured for floor mounting allow for easy placement and connection. Each module includes non-adjacent coupling loops to improve pass band performance on modules that are closely spaced in terms of frequency. The combiner system also can be optionally equipped with circulators to allow the digital FM IBOC signals to be "reverse fed" and combined using the same modules.

The ERI Model 973-8 Series Constant Impedance Combiner is an improved design that includes an exclusive bellows temperature compensation system, temperature indicator, and unique cylindrical tank construction. The use of cylindrical tanks provides the benefit of a mechanically rigid tank design. The effect of thermal expansion and contraction on electrical performance is minimized. The use of an Invar/Bellows



temperature compensator eliminates any residual impact of mechanical expansion and contraction on electrical performance. The filters operate and meet specifications at any operating temperature.

The filter system offered is configured in a floor mounted configuration to maximize heat transfer, power handling capability, and simplify system modification in the future. The individual modules are forced air cooled. There are optional configurations that include ceiling hung frames and floor stands to accommodate a wide variety of physical space requirements. The combiner includes circulators for the dump load ports of the system to enable the capability or “reverse feeding” the combiner with the digital FM signals.

973-8 Series Constant Impedance Combiner Specifications:

Model:	973-8
Combiner Type:	Band Pass Constant Impedance
VSWR:	1.1:1 ±200kHz, maximum
Injected Port to Broad Port Isolation:	≥-30 dB
Injected Port to Injected Port Isolation:	≥-55 dB, with two or more modules
Output Connector:	Appropriate for size for power rating
Output Power Capability:	289 kW capability (limited by line size)
Combiner Module Size and Weight:	50-inches H x 53-inches W x 146-inches L, 1900 lbs.
Group Delay Compensation Module Size and Weight:	50-inches H x 53-inches W x 62-inches L, 475 lbs.
Multiple Station Broad Port:	
Frequency[4]:	All FM Broadcast Channels (88 to 108MHz)
Connector:	6-1/8" 50-Ohm EIA (flanged)
VSWR[1]:	<1.06:1
Insertion Loss[2]:	-0.05dB Typical
Group Delay[3]:	<75ns Overall Variation, Carrier ± 150kHz
Injected Station Port Performance:	
Frequency[4]:	All FM Broadcast Channels (88 to 108MHz)
Power Rating:	60 kW
Connector:	6-1/8" 50-Ohm EIA (flanged)
VSWR[1]:	<1.06:1 at ±150 kHz
Isolation Analog Input to Digital Input (no circulator)[1]:	<-25.0 dB or better
Isolation Analog Input to Digital Input (with circulator)[1]:	<-45.0 dB or better
Isolation Digital Input to Analog Input[1]:	<-25.0 dB or better
Insertion Loss[2]:	<0.40 dB without GDC Module <0.65 dB with GDC Module
Group Delay[3]:	<75 nsec overall variation ±150 kHz <25 nsec overall variation ±150 KHz with optional Group Delay Compensation

1) When terminated in 50-Ohm resistive load.

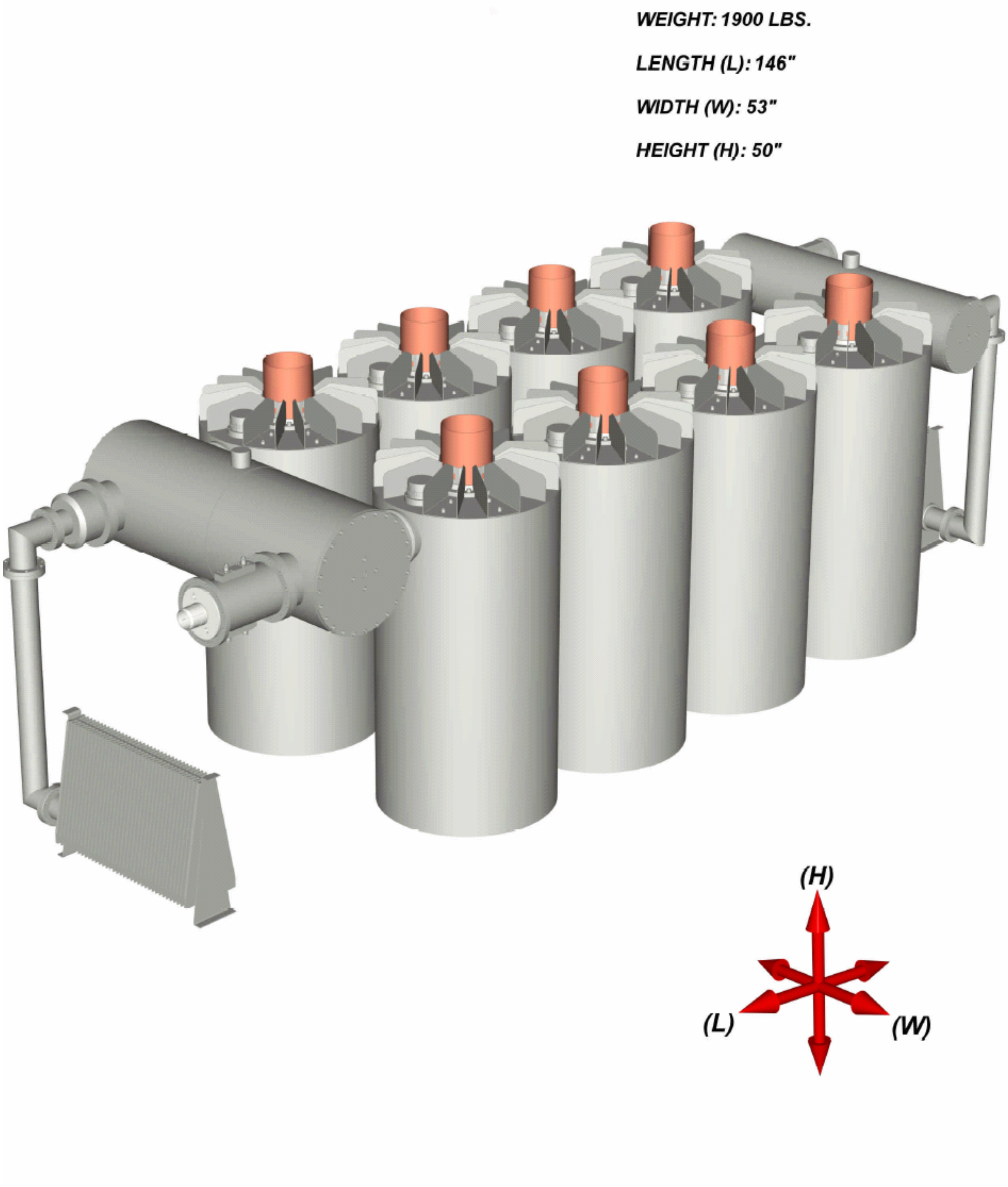
2) Loss values will be somewhat greater for frequency separations 2.0 MHz or less.

3) Group delay correction required for frequency separations 0.8 MHz or less and recommended for frequency separations of 2.0 MHz or less.

4) 800kHz or more removed from any signal appearing at the broad port.

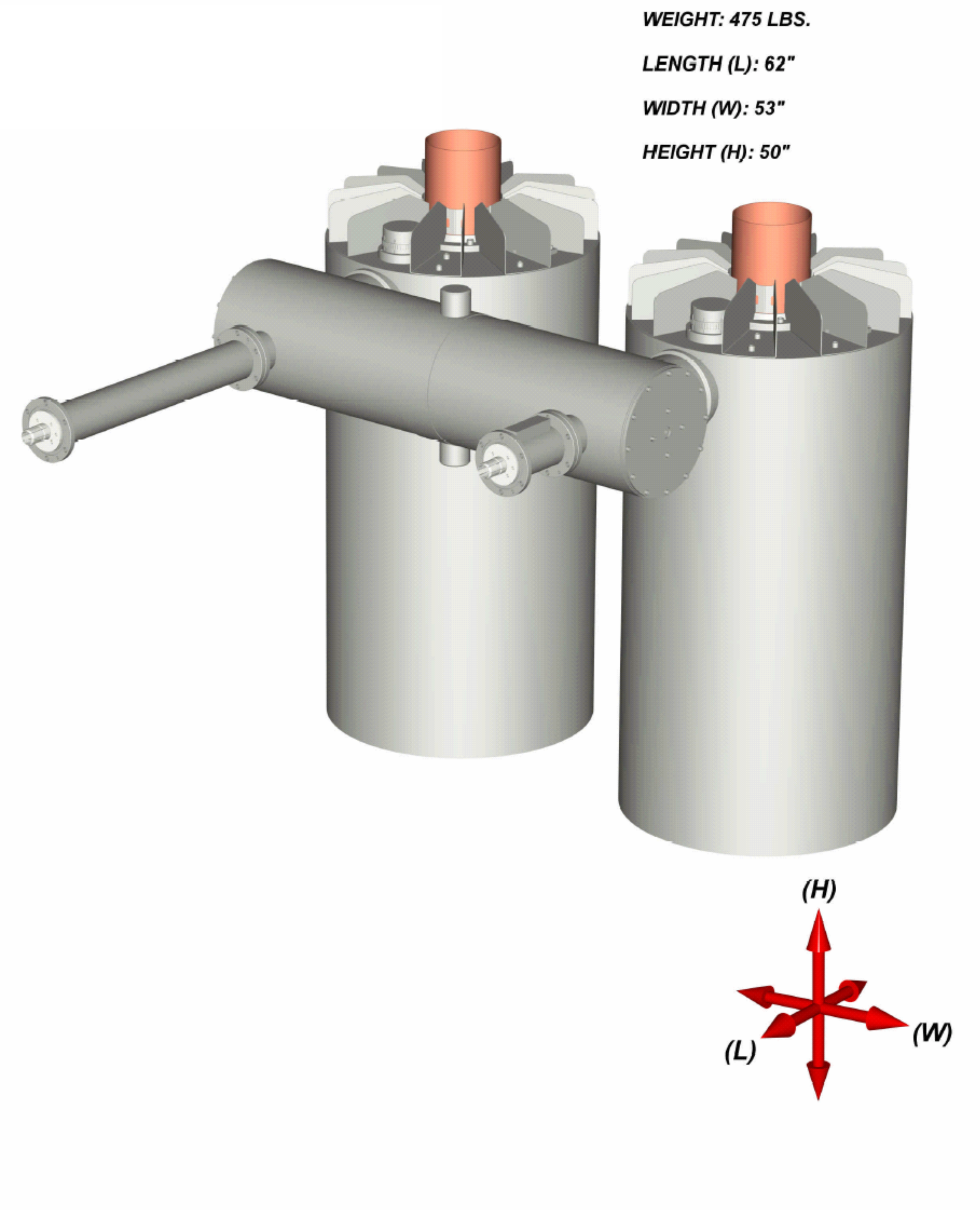
Specifications presented are typical, total system performance may vary. In a continuing effort to improve products, ERI reserves the right to change specifications and features.

The system will be completely assembled at ERI's factory in Chandler and the system fully tuned and documented prior to shipment. The individual modules will be shipped as completely assembled as possible to the tower site and then reassembled as designated. The package of services offered includes combiner placement, assembly, set up, and test. When the combiner is totally assembled and the installation complete an ERI technician will take measurements and complete a cross modulation products report for the system.



NOTE: DIMENSIONS & WEIGHTS ARE APPROXIMATE AND SUBJECT TO CHANGE PER TUNING.

ERI Model 973-8 Constant Impedance Combiner Module



NOTE: DIMENSIONS & WEIGHTS ARE APPROXIMATE AND SUBJECT TO CHANGE PER TUNING.

ERI High Level Group Delay Compensation Module

Combiner Summary:

Model 973 Series Constant Impedance Combiner:
Factory tuned to multiplex any or all of the following: 92.5 MHz, 100.5 MHz, 102.7 MHz, and 107.7 MHz. Floor mounted with convection cooling. Includes circulators for reverse fed IBOC combining.
Module types:[5]

92.5 MHz	973-8 Band Pass Filter Module, floor mounted, forced air cooled. Equipped with circulator and optimized for reverse feed IBOC combining.
100.5 MHz	973-8 Band Pass Filter Module, floor mounted, forced air cooled. Equipped with circulator and optimized for reverse feed IBOC combining.
104.1 MHz	973-8 Band Pass Filter Module, floor mounted, forced air cooled. Equipped with circulator and optimized for reverse feed IBOC combining.
107.7 MHz	973-8 Band Pass Filter Module, floor mounted, forced air cooled. Equipped with circulator and optimized for reverse feed IBOC combining.

3-1/8-inch Analog Inputs
1-5/8-inch Digital Inputs
9-3/16-inch Analog Output
6-1/8-inch Digital Output
Typical Input VSWR: Less than 1.06:1[6]

[5] The combiner room ambient temperature should be maintained between 60 and 80 degrees.
[6] With combiner terminated with a 50 ohm RF load.

Patch Panels and Switching System

Patch Panel System

The proposal includes two 7-port patch panels, one for the analog transmission system and one for the digital transmission system. The patch panels are mounted in free standing rack frames which include the typically required interconnecting transmission line, to the combiner outputs, and the power dividers to split the combined output power to feed the top half and bottom half of the antenna system. This portion of the proposal also includes lock out/tag out switches on all four outputs of the splitter system, feeding the Master FM Antenna.

The patch panel/power divider stands include appropriately sized reject loads for hybrid power divider, including a directional coupler at the reject load input. The directional couplers furnished with the combiner for measuring the combined analog and combined digital output provides input power sensing for the hybrid. The system proposed also includes dual port directional couplers for each of the digital transmission lines and each of analog transmission lines. Each patch panel includes one test adapter that provide a Type N female to the patch panel interface ports.

Preliminary FM Antenna System Calculations

Model COG20P-12-240-2 Master FM Antenna
System Losses without Group Delay Compensation

	ANALOG				DIGITAL			
Call Letters:	KOMA-FM							
Frequency:	92.5	MHz						
ERP:	100.000	kW	20.000	dBk	1.000	kW	0.000	dBk
Polarization:	Circular				Circular			
Antenna Gain:	5.861		7.680	dB	5.861		7.680	dB
Element Input Power:	17.062	kW	12.320	dBk	0.171	kW	-7.680	dBk
Element Hybrid Losses:	-0.172	kW	20.000	dB	-0.002	kW	20.000	dB
Antenna Input Power:	17.234	kW	12.364	dBk	0.172	kW	12.364	dBk
Transmission Line Type - Vertical Run:	6-1/8-inch rigid line (dual runs)				3-inch air HELIAX (dual runs)			
Vertical Run Length:	1627.000	feet			1627.000	feet		
Vertical Run Attenuation:	0.047	dB/100-feet			0.135	dB/100-feet		
Transmission Line Type - Horizontal: Run:	6-1/8-inch rigid line (dual runs)				3-inch air HELIAX (dual runs)			
Horizontal: Run Length:	100.000	feet			100.000	feet		
Horizontal: Run Attenuation:	0.047	dB/100-feet			0.135	dB/100-feet		
Line Loss:	3.542	kW	0.812	dB	0.122	kW	2.331	dB
Line Efficiency:	82.953%				58.459%			
Power Output from Hybrid Splitter:	20.776	kW	13.176	dBk	0.295	kW	-5.305	dBk
Combiner System Losses:	-2.004	kW	0.400	dB	-0.056	kW	0.750	dB
Transmitter Power Output:	22.780	kW	13.576	dBk	0.350	kW	-4.555	dBk

Preliminary FM Antenna System Calculations

Model COG20P-12-240-2 Master FM Antenna
System Losses without Group Delay Compensation

	ANALOG				DIGITAL			
Call Letters:	KATT-FM							
Frequency:	100.5	MHz						
ERP:	100.000	kW	20.000	dBk	1.000	kW	0.000	dBk
Polarization:	Circular				Circular			
Antenna Gain:	6.157		7.894	dB	6.157		7.894	dB
Element Input Power:	16.242	kW	12.106	dBk	0.162	kW	-7.894	dBk
Element Hybrid Losses:	-0.164	kW	20.000	dB	-0.002	kW	20.000	dB
Antenna Input Power:	16.406	kW	12.150	dBk	0.164	kW	12.150	dBk
Transmission Line Type - Vertical Run:	6-1/8-inch rigid line (dual runs)				3-inch air HELIAX (dual runs)			
Vertical Run Length:	1627.000	feet			1627.000	feet		
Vertical Run Attenuation:	0.049	dB/100-feet			0.142	dB/100-feet		
Transmission Line Type - Horizontal: Run:	6-1/8-inch rigid line (dual runs)				3-inch air HELIAX (dual runs)			
Horizontal: Run Length:	100.000	feet			100.000	feet		
Horizontal: Run Attenuation:	0.049	dB/100-feet			0.142	dB/100-feet		
Line Loss:	3.529	kW	0.846	dB	0.124	kW	2.452	dB
Line Efficiency:	82.296%				56.855%			
Power Output from Hybrid Splitter:	19.935	kW	12.996	dBk	0.289	kW	-5.398	dBk
Combiner System Losses:	-1.923	kW	0.400	dB	-0.054	kW	0.750	dB
Transmitter Power Output:	21.858	kW	13.396	dBk	0.343	kW	-4.648	dBk

Preliminary FM Antenna System Calculations

Model COG20P-12-240-2 Master FM Antenna
System Losses without Group Delay Compensation

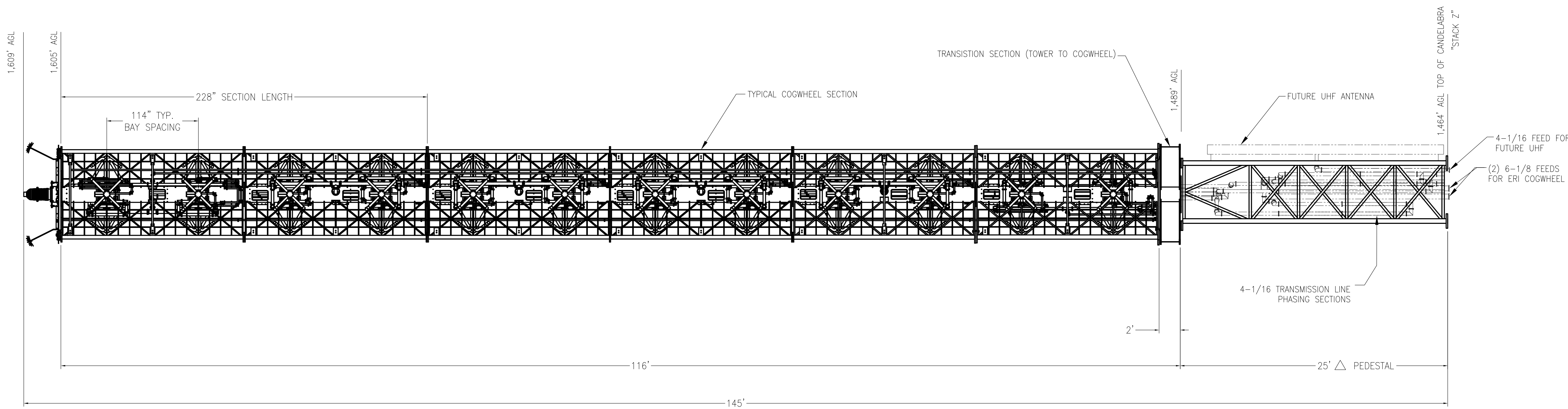
	ANALOG				DIGITAL			
Call Letters:	KMGL-FM							
Frequency:	104.1	MHz						
ERP:	100.000	kW	20.000	dBk	1.000	kW	0.000	dBk
Polarization:	Circular				Circular			
Antenna Gain:	6.073		7.834	dB	6.073		7.834	dB
Element Input Power:	16.466	kW	12.166	dBk	0.165	kW	-7.834	dBk
Element Hybrid Losses:	-0.166	kW	20.000	dB	-0.002	kW	20.000	dB
Antenna Input Power:	16.633	kW	12.210	dBk	0.166	kW	12.210	dBk
Transmission Line Type - Vertical Run:	6-1/8-inch rigid line (dual runs)				3-inch air HELIAX (dual runs)			
Vertical Run Length:	1627.000	feet			1627.000	feet		
Vertical Run Attenuation:	0.050	dB/100-feet			0.145	dB/100-feet		
Transmission Line Type - Horizontal: Run:	6-1/8-inch rigid line (dual runs)				3-inch air HELIAX (dual runs)			
Horizontal: Run Length:	100.000	feet			100.000	feet		
Horizontal: Run Attenuation:	0.050	dB/100-feet			0.145	dB/100-feet		
Line Loss:	3.659	kW	0.864	dB	0.130	kW	2.504	dB
Line Efficiency:	81.969%				56.180%			
Power Output from Hybrid Splitter:	20.291	kW	13.073	dBk	0.296	kW	-5.286	dBk
Combiner System Losses:	-1.958	kW	0.400	dB	-0.056	kW	0.750	dB
Transmitter Power Output:	22.249	kW	13.473	dBk	0.352	kW	-4.536	dBk

Preliminary FM Antenna System Calculations

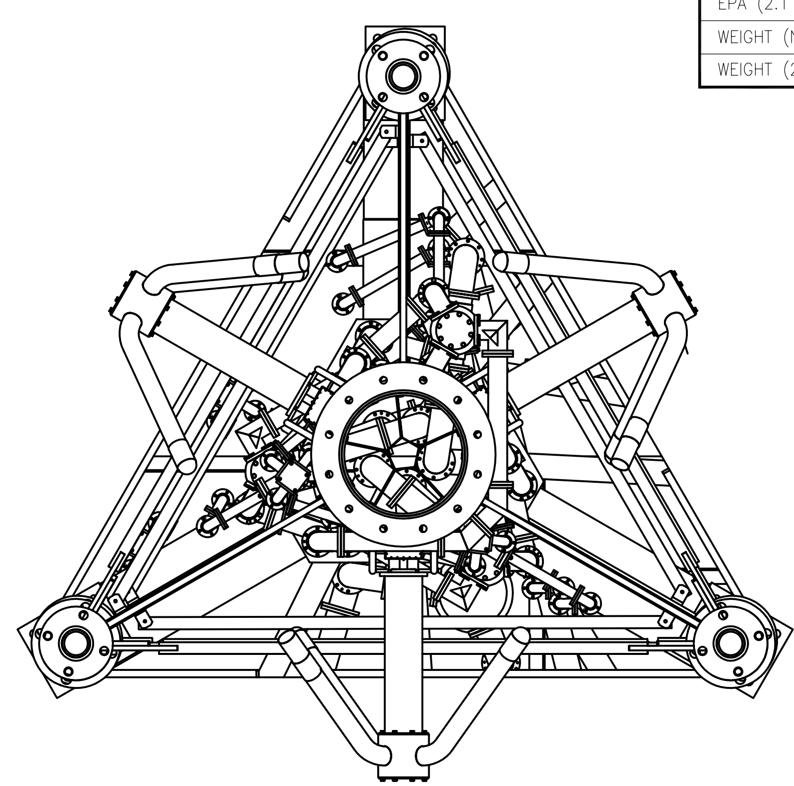
Model COG20P-12-240-2 Master FM Antenna
System Losses without Group Delay Compensation

	ANALOG				DIGITAL			
Call Letters:	KRXO-FM							
Frequency:	107.7	MHz						
ERP:	98.500	kW	19.934	dBk	0.985	kW	-0.066	dBk
Polarization:	Circular				Circular			
Antenna Gain:	5.803		7.637	dB	5.803		7.637	dB
Element Input Power:	16.974	kW	12.298	dBk	0.170	kW	-7.702	dBk
Element Hybrid Losses:	-0.171	kW	20.000	dB	-0.002	kW	20.000	dB
Antenna Input Power:	17.145	kW	12.341	dBk	0.171	kW	12.341	dBk
Transmission Line Type - Vertical Run:	6-1/8-inch rigid line (dual runs)				3-inch air HELIAX (dual runs)			
Vertical Run Length:	1627.000	feet			1627.000	feet		
Vertical Run Attenuation:	0.050	dB/100-feet			0.147	dB/100-feet		
Transmission Line Type - Horizontal: Run:	6-1/8-inch rigid line (dual runs)				3-inch air HELIAX (dual runs)			
Horizontal: Run Length:	100.000	feet			100.000	feet		
Horizontal: Run Attenuation:	0.050	dB/100-feet			0.147	dB/100-feet		
Line Loss:	3.772	kW	0.864	dB	0.136	kW	2.539	dB
Line Efficiency:	81.969%				55.735%			
Power Output from Hybrid Splitter:	20.917	kW	13.205	dBk	0.308	kW	-5.120	dBk
Combiner System Losses:	-2.018	kW	0.400	dB	-0.058	kW	0.750	dB
Transmitter Power Output:	22.935	kW	13.605	dBk	0.366	kW	-4.370	dBk

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
	A	CHANGED FROM 8 BAY TO 10 BAY	8/8/06	________
	B	ADDED DIMENSIONS TO TOP VIEW	8/18/06	________
	C	CHANGED FROM 10 BAY TO 12 BAY	9/12/06	________



ERI (12) LEVEL MASTER FM COG
EPA (NO ICE) = 665 FT^2
EPA (2.1" ICE) = 1800 FT^2
WEIGHT (NO ICE) = 56,500 LBS
WEIGHT (2.1" ICE) = 118,750 LBS

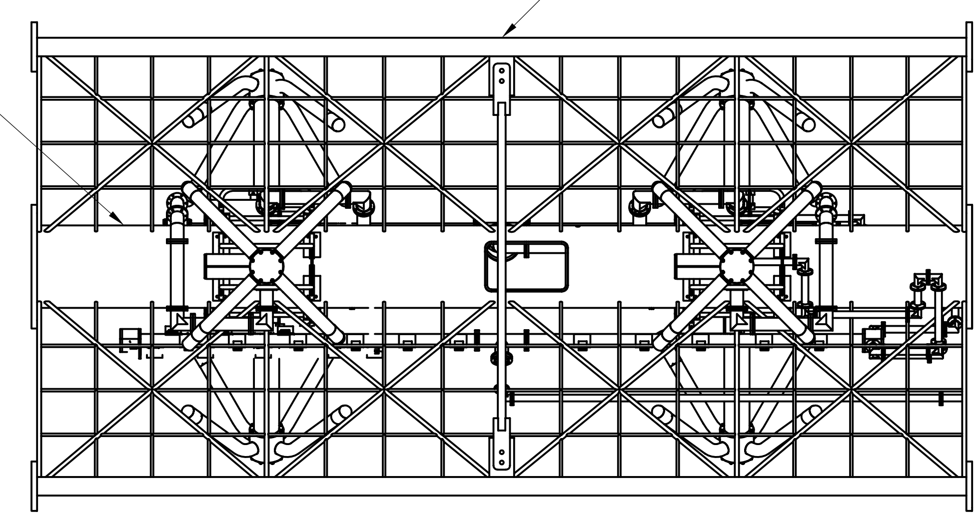


TOP VIEW ANTENNA SYSTEM

STACK MECHANICAL DATA	
90 MPH/0" ICE	40 MPH/2.1" ICE
M_{ARM} = 66.2 FT	M_{ARM} = 67.9 FT
EPA = 884.5 FT^2	EPA = 2240.3 FT^2
WEIGHT = 69,900 LBS	WEIGHT = 147,500 LBS

△ ALL MECHANICAL DATA PER TIA-222-G STANDARD FOR 90 MPH (40 MPH / 3/4" BASE RADIAL ICE THICKNESS) [3 SECOND GUST]

△ STACK MECHANICAL DATA INCLUDES PEDESTAL, FEEDLINES, AND FUTURE UHF SIDE MOUNT TV ANTENNA.



TYPICAL COGWHEEL SECTION

QTY.	UM	PART NO.	DESCRIPTION	ITEM NO.
PARTS LIST				

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

THIRD ANGLE PROJECTION

FINISH: — ALL SURFACES
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

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DRAWN BY: BAM 9/12/06
DRAFT.
DESIGN MGR.
ENG.: J. ROBINSON 9/12/06
MANUF.
SUPERSEDES DWG.

ERI® ELECTRONICS RESEARCH, INC. Established 1943
7777 GARDNER RD. CHANDLER, IN. 47610-9637
PHONE: (812) 925-6000
FAX: (812) 925-4026
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OKLAHOMA CITY
PROPOSED MASTER ANTENNA SYSTEM "STACK Z"

SIZE D | CAGE CODE 0ZNS1 | DWG NO. COGOKLA-3 | REV C
SCALE NONE | FILE NO. COGOKLA-3B | SHEET 1 OF 1

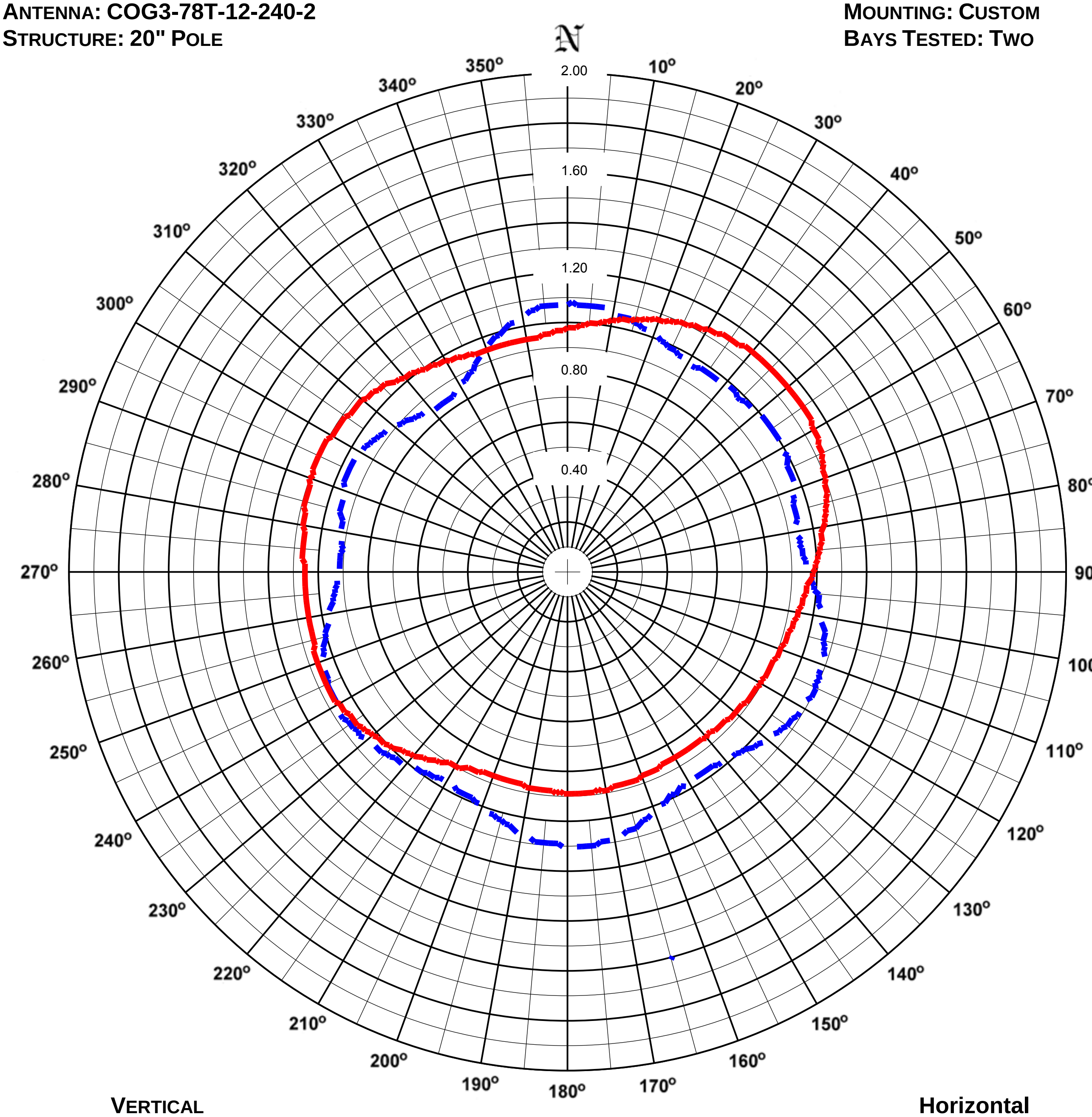
G:\Drafting\ALL\PROJECTS\18120A\COGOKLA-3C.dwg, 9/12/2006 9:12:11 AM, bmeunier

ERI® Horizontal Plane Relative Field Pattern

Electronics Research, Inc. 7777 Gardner Rd. Chandler, In 47610 Phone (812) 925-6000 Fax (812) 925-4030 http://www.eriinc.com/

Figure No: 1B
Station:
Location: Reference Plot
Antenna: COG3-78T-12-240-2
Structure: 20" Pole

Date: 8/3/2005
Frequency: 92.9 MHz
Orientation: 0° True
Mounting: Custom
Bays Tested: Two



Vertical

RMS: 1.000
Maximum: 1.099 @ 113° True
Minimum: 0.843 @ 321° True

Horizontal

RMS: 1.000
Maximum: 1.155 @ 38° True
Minimum: 0.856 @ 138° True

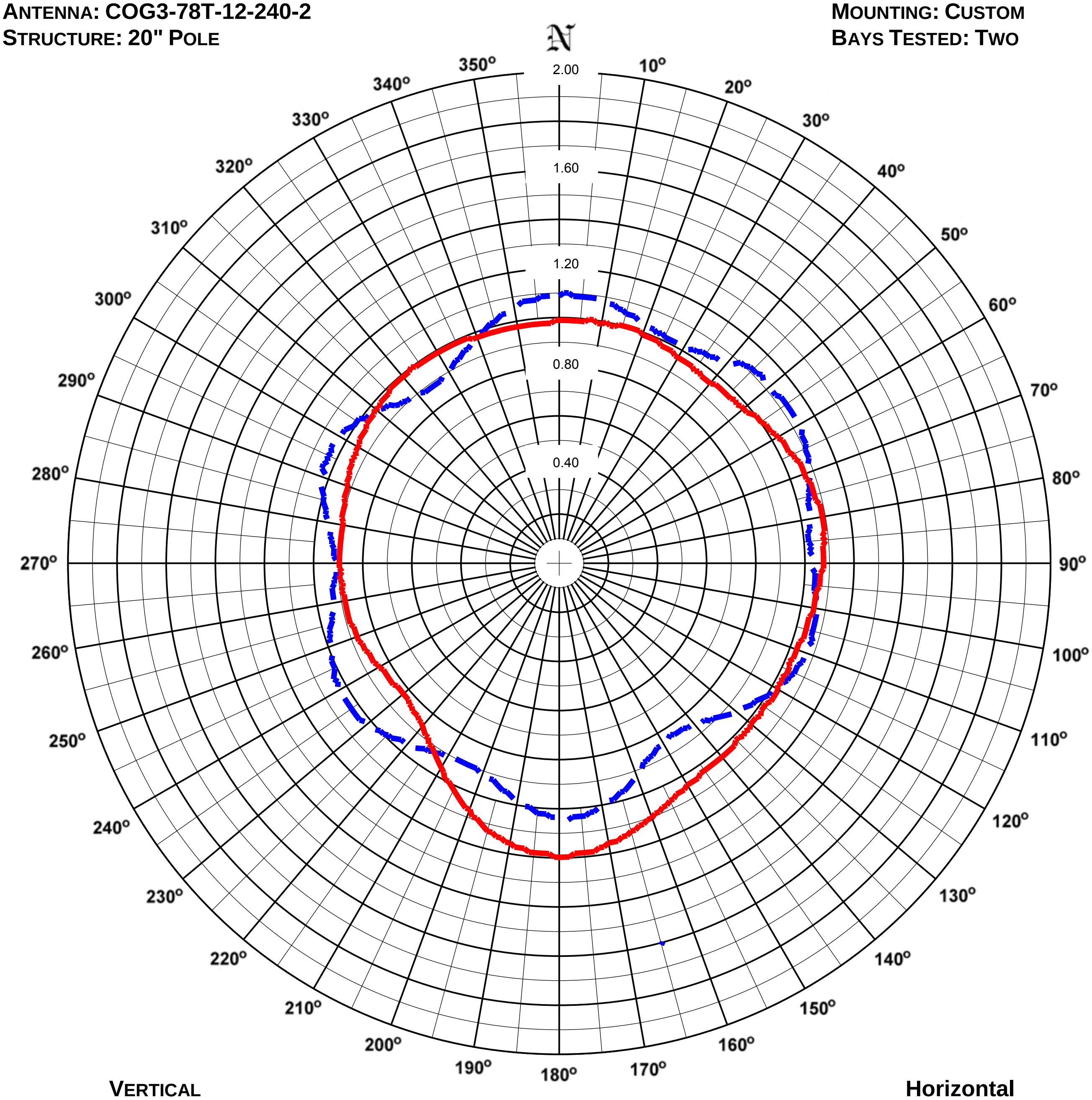
Comments: Two bay test. Analog input. #6 MODULE. "C" leg down range.

ERI® Horizontal Plane Relative Field Pattern

Electronics Research, Inc. 7777 Gardner Rd. Chandler, In 47610 Phone (812) 925-6000 Fax (812) 925-4030 http://www.eriinc.com/

FIGURE NO: 1B
STATION:
LOCATION: REFERENCE PLOT
ANTENNA: COG3-78T-12-240-2
STRUCTURE: 20" POLE

DATE: 8/3/2005
FREQUENCY: 100.3 MHZ
ORIENTATION: 0° TRUE
MOUNTING: CUSTOM
BAYS TESTED: TWO



VERTICAL

RMS: 1.000
MAXIMUM: 1.130 @ 47° TRUE
MINIMUM: 0.828 @ 147° TRUE

Horizontal

RMS: 1.000
Maximum: 1.193 @ 178° True
Minimum: 0.826 @ 228° True

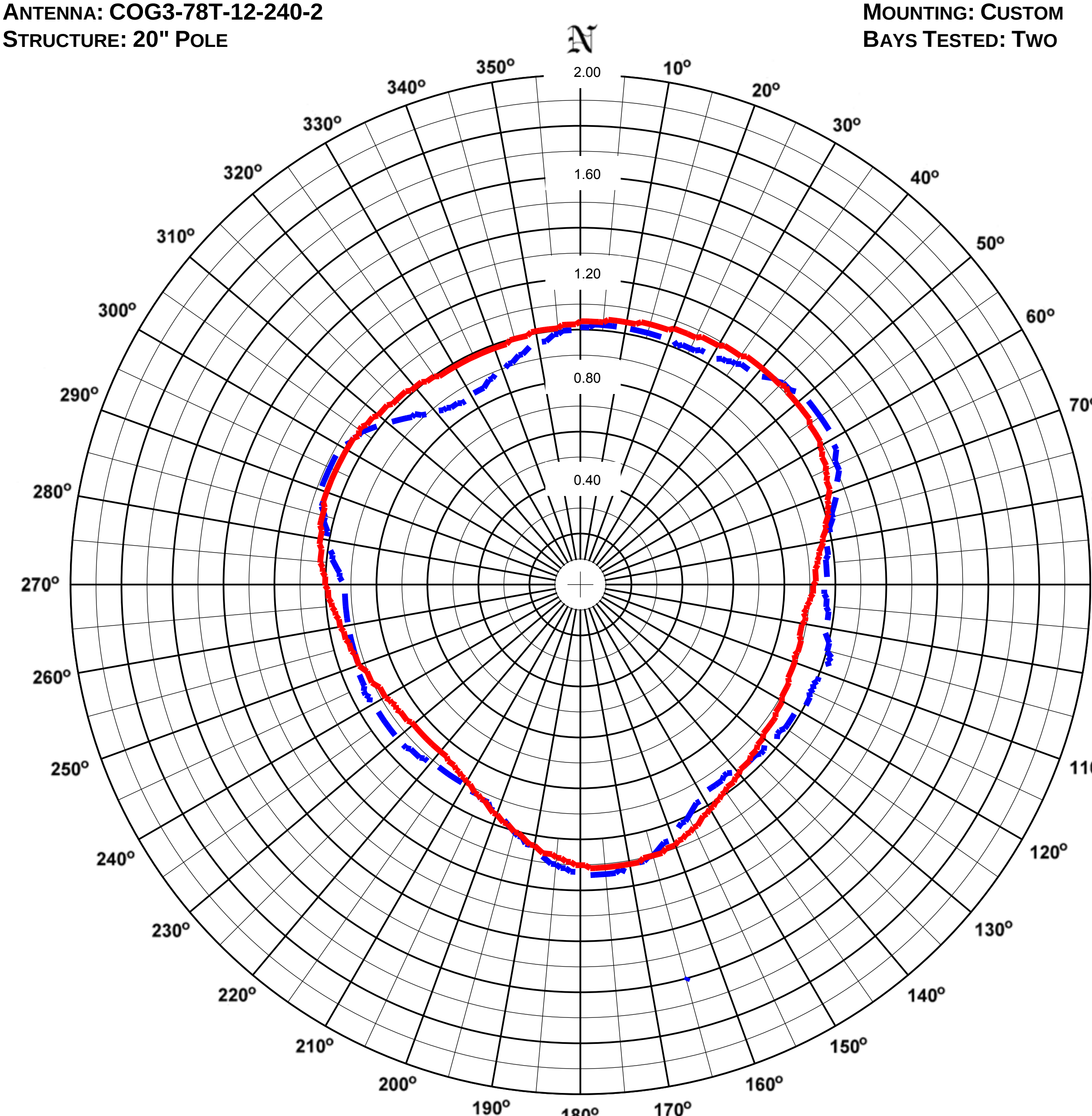
COMMENTS: TWO BAY TEST. ANALOG INPUT. #6 MODULE. "C" LEG DOWN RANGE.

Horizontal Plane Relative Field Pattern

Electronics Research, Inc. 7777 Gardner Rd. Chandler, In 47610 Phone (812) 925-6000 Fax (812) 925-4030 http://www.eriinc.com/

Figure No: 1B
Station:
Location: Reference Plot
Antenna: COG3-78T-12-240-2
Structure: 20" Pole

Date: 8/3/2005
Frequency: 104.1 MHz
Orientation: 0° True
Mounting: Custom
Bays Tested: Two



Vertical

RMS: 1.000
Maximum: 1.150 @ 50° True
Minimum: 0.853 @ 327° True

Horizontal

RMS: 1.000
Maximum: 1.123 @ 46° True
Minimum: 0.852 @ 218° True

Comments: Two bay test. Analog input. #6 MODULE. "C" leg down range.

ELECTRONICS RESEARCH, INC.
7777 GARDNER ROAD
CHANDLER, IN. 47610

FIGURE 1

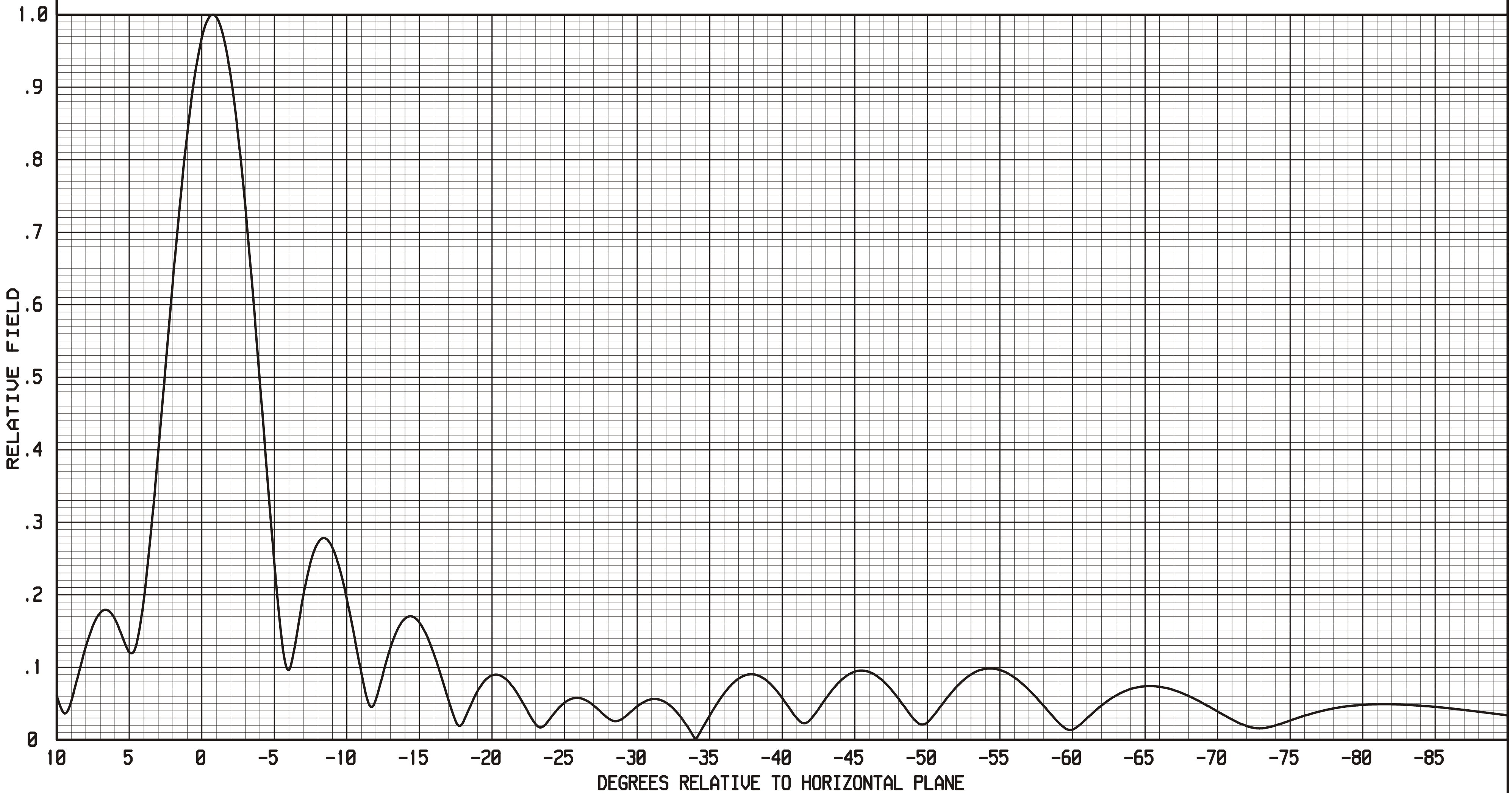
----THEORETICAL----
VERTICAL PLANE RELATIVE FIELD

ERI 12 LEVEL OMNI-DIRECTIONAL MASTER ANTENNA
-.75 DEGREE(S) BEAM TILT
10 PERCENT FIRST NULL FILL
5 PERCENT SECOND NULL FILL
POWER GAIN IS 5.495 IN THE HORIZONTAL PLANE(5.861 IN THE MAX.)
[POWER GAINS AT 95% ANTENNA EFFICIENCY]

AUGUST 16, 2006

92.5 MHz.

BAY SPACING:
114.00 INCHES



ELECTRONICS RESEARCH, INC.
7777 GARDNER ROAD
CHANDLER, IN. 47610

FIGURE 2

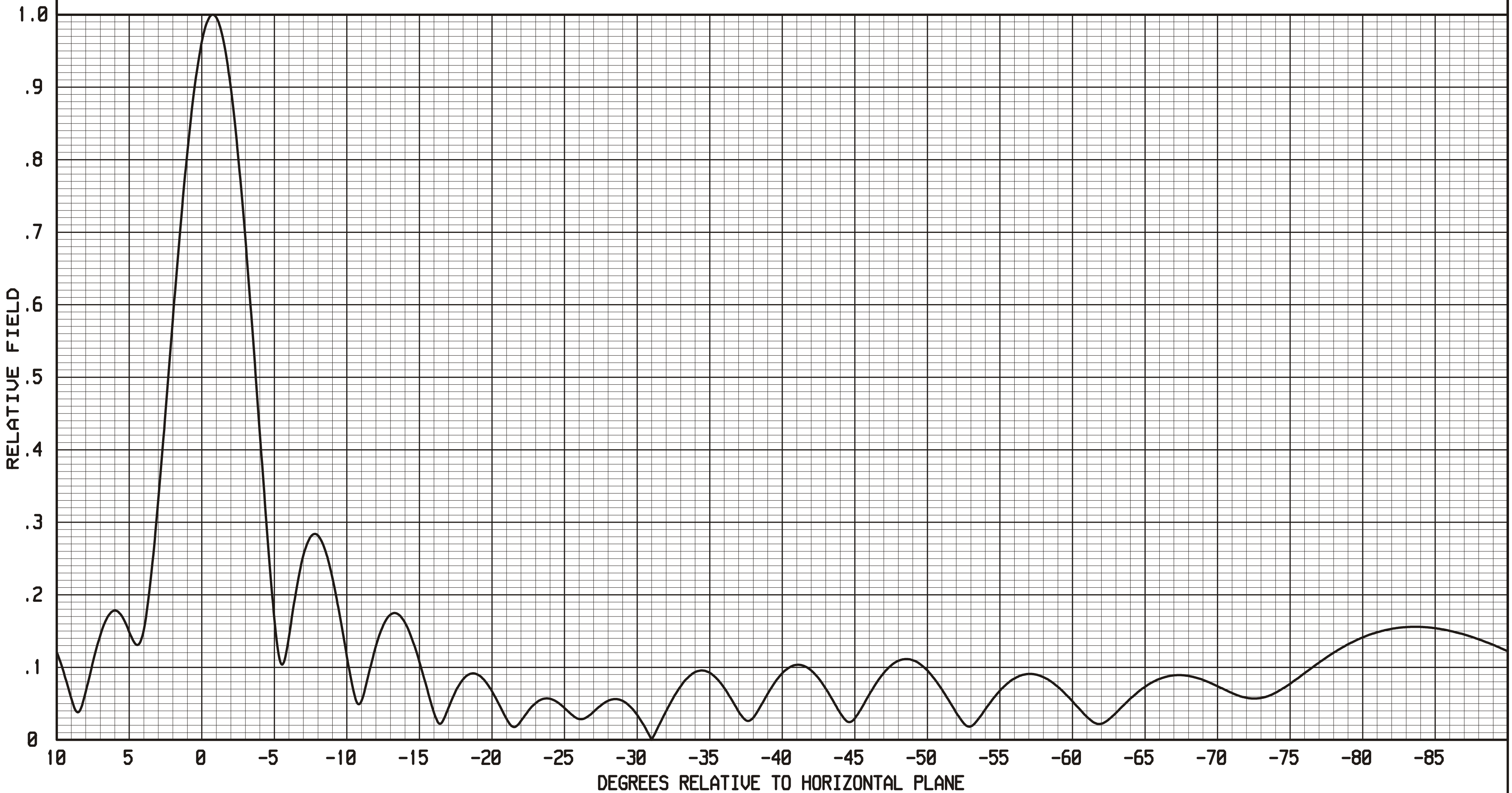
----THEORETICAL----
VERTICAL PLANE RELATIVE FIELD

ERI 12 LEVEL OMNI-DIRECTIONAL MASTER ANTENNA
-.75 DEGREE(S) BEAM TILT
10 PERCENT FIRST NULL FILL
5 PERCENT SECOND NULL FILL
POWER GAIN IS 5.706 IN THE HORIZONTAL PLANE(6.157 IN THE MAX.)
[POWER GAINS AT 95% ANTENNA EFFICIENCY]

AUGUST 16, 2006

100.5 MHz.

BAY SPACING:
114.00 INCHES



ELECTRONICS RESEARCH, INC.
7777 GARDNER ROAD
CHANDLER, IN. 47610

FIGURE 3

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

ERI 12 LEVEL OMNI-DIRECTIONAL MASTER ANTENNA
-.75 DEGREE(S) BEAM TILT
11 PERCENT FIRST NULL FILL
5 PERCENT SECOND NULL FILL
POWER GAIN IS 5.598 IN THE HORIZONTAL PLANE(6.073 IN THE MAX.)
[POWER GAINS AT 95% ANTENNA EFFICIENCY]

AUGUST 16, 2006

104.1 MHz.

BAY SPACING:
114.00 INCHES

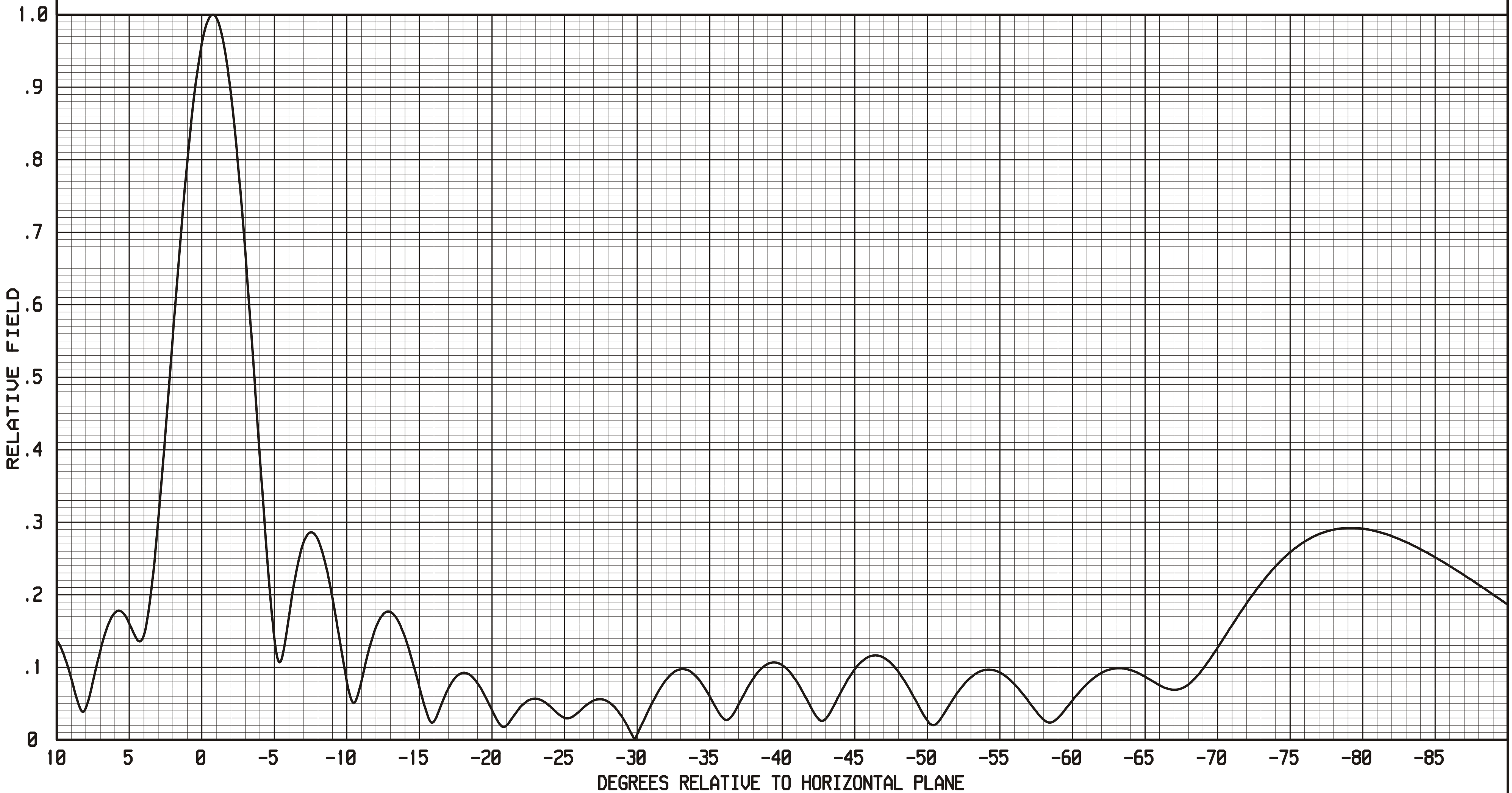


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FIGURE 4

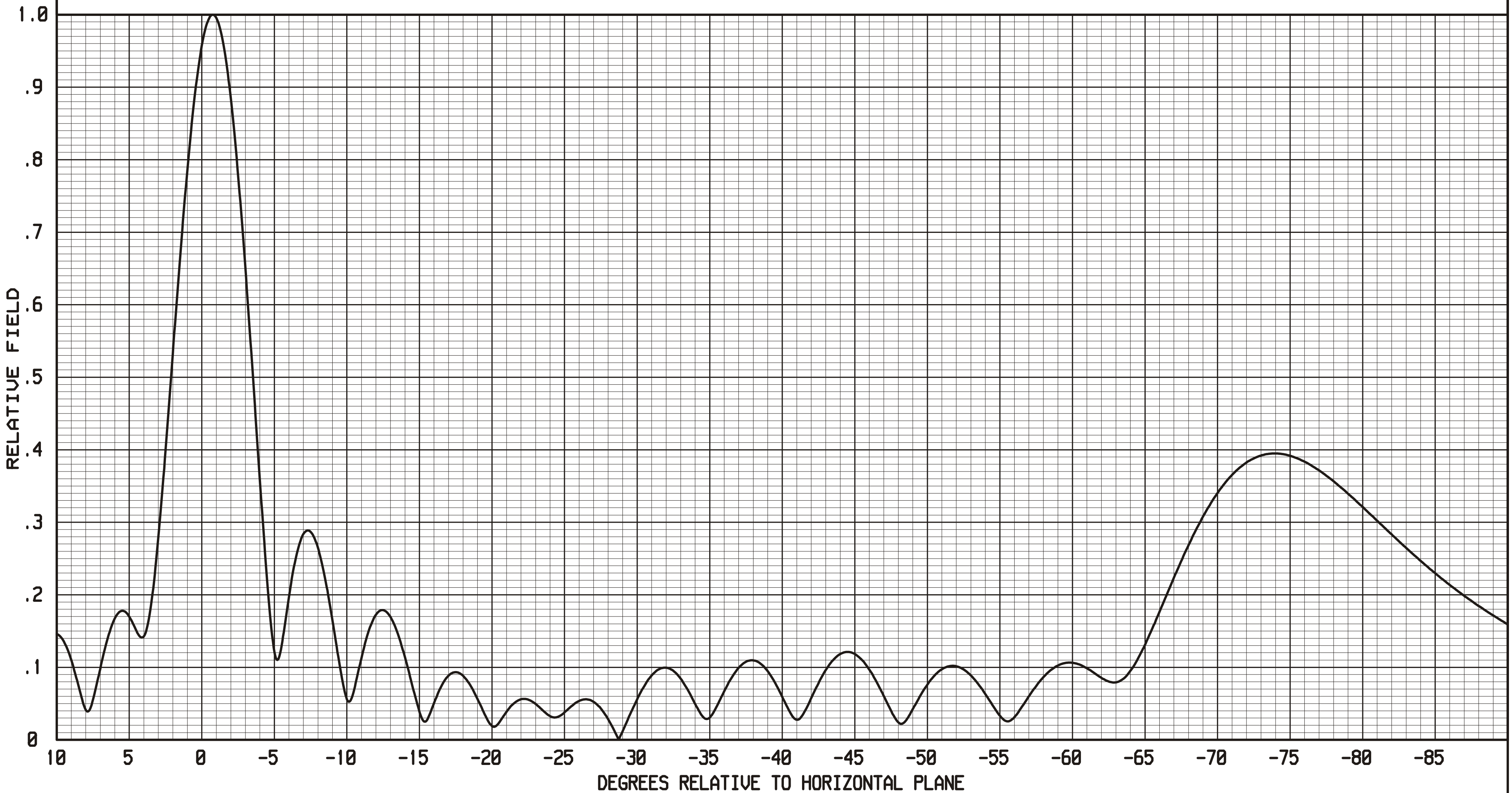
----THEORETICAL----
VERTICAL PLANE RELATIVE FIELD

AUGUST 16, 2006

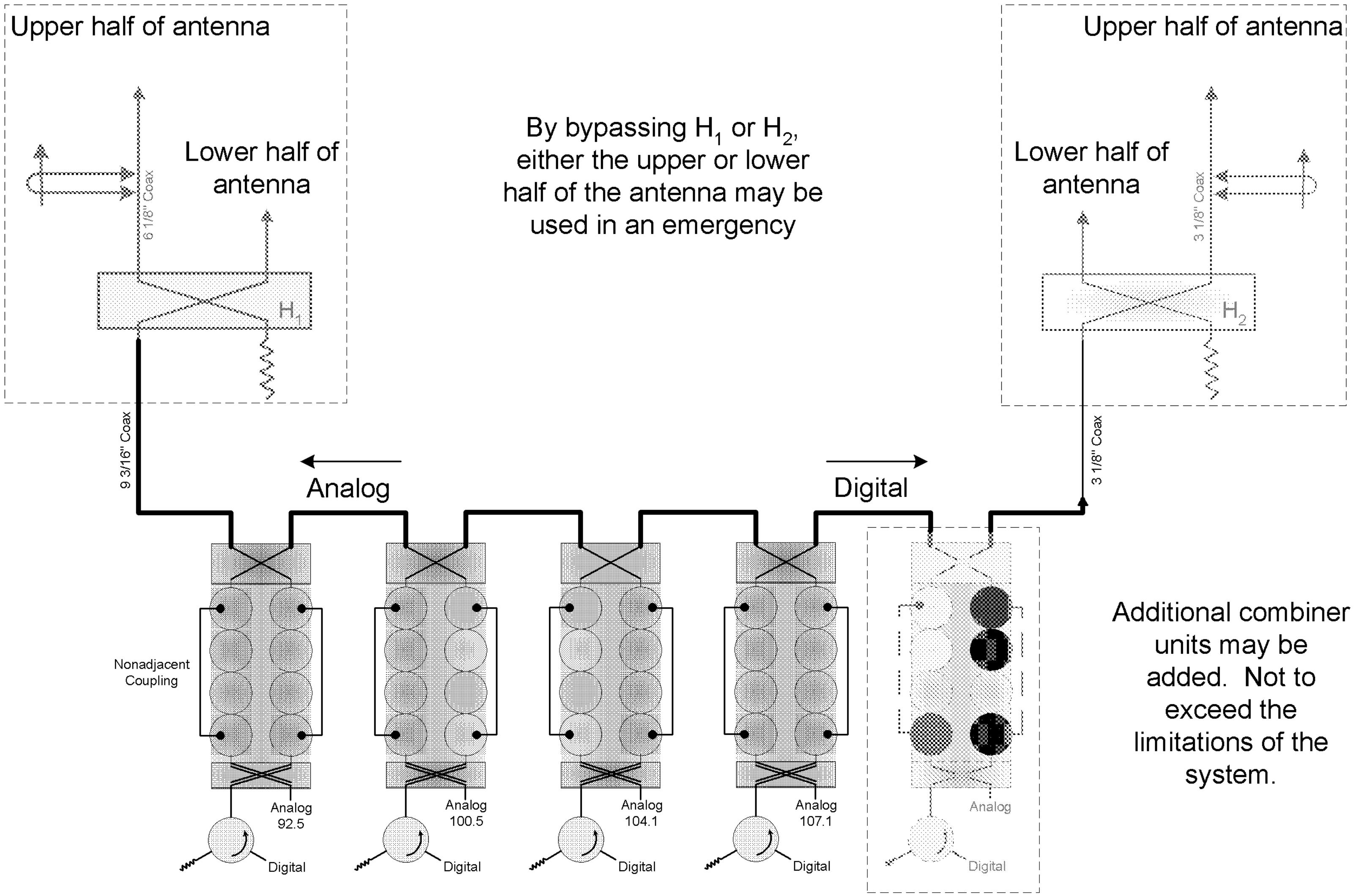
107.7 MHz.

ERI 12 LEVEL OMNI-DIRECTIONAL MASTER ANTENNA
-.75 DEGREE(S) BEAM TILT
11 PERCENT FIRST NULL FILL
5 PERCENT SECOND NULL FILL
POWER GAIN IS 5.319 IN THE HORIZONTAL PLANE(5.803 IN THE MAX.)
[POWER GAINS AT 95% ANTENNA EFFICIENCY]

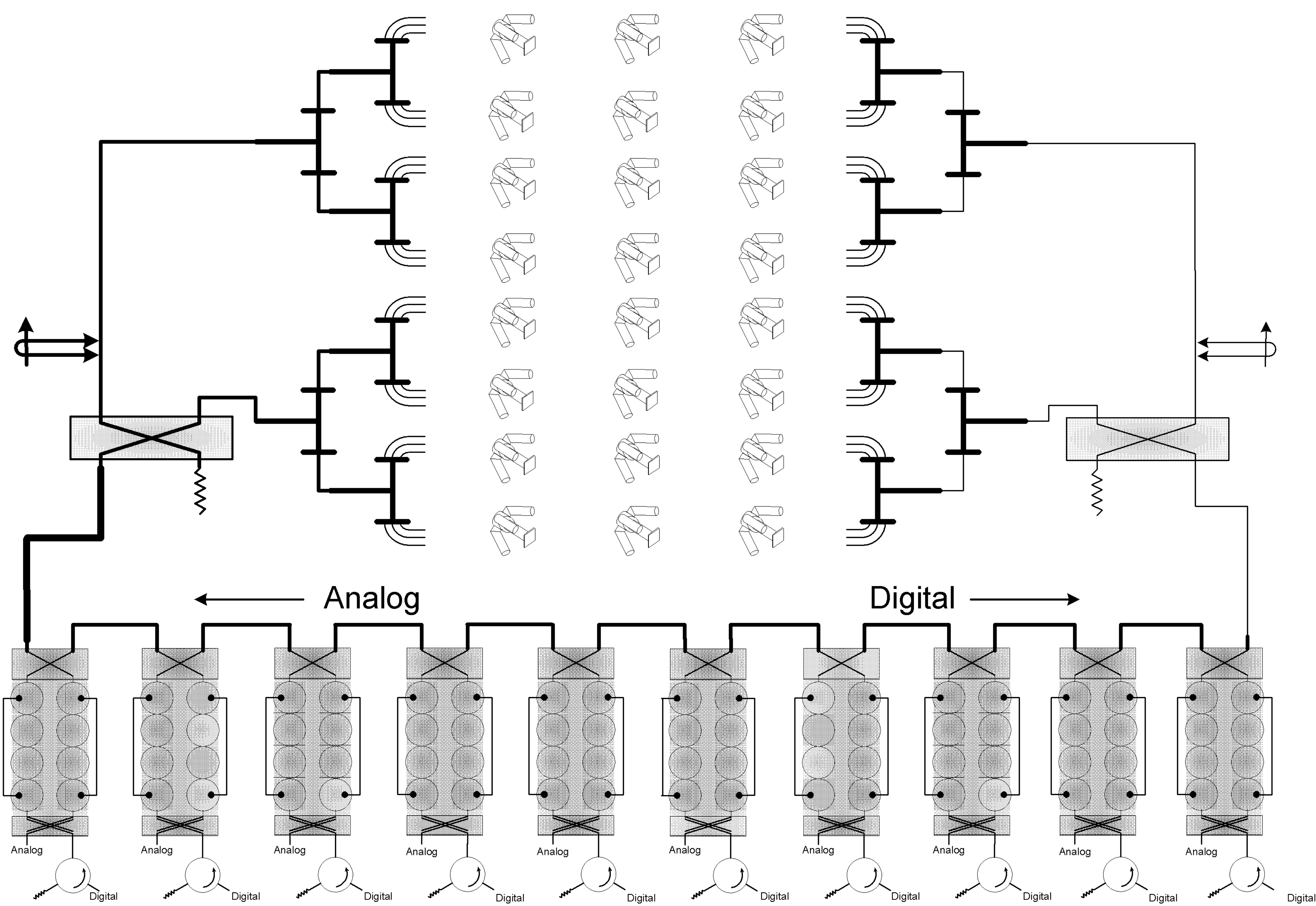
BAY SPACING:
114.00 INCHES



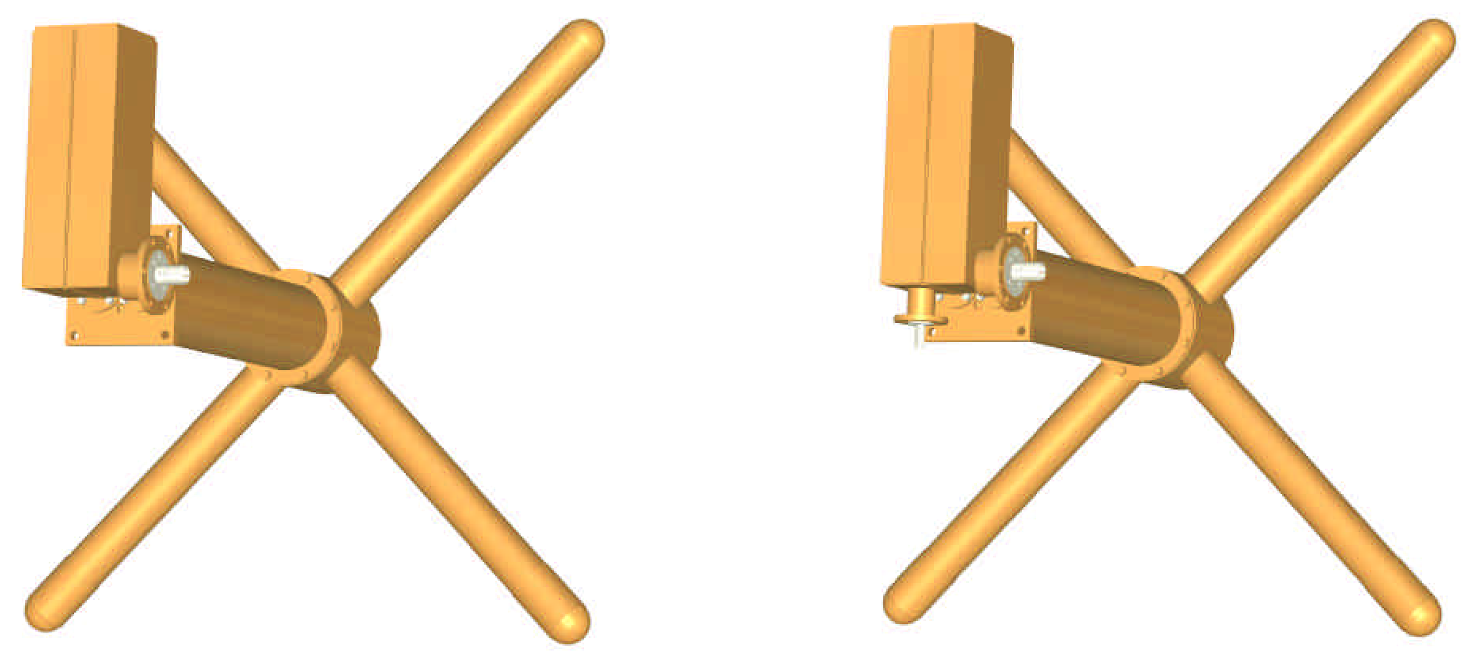
Oklahoma City
Combiner Plan
(Preliminary Drawing)



8-1-2006
Drawn by Aaron Schuetter

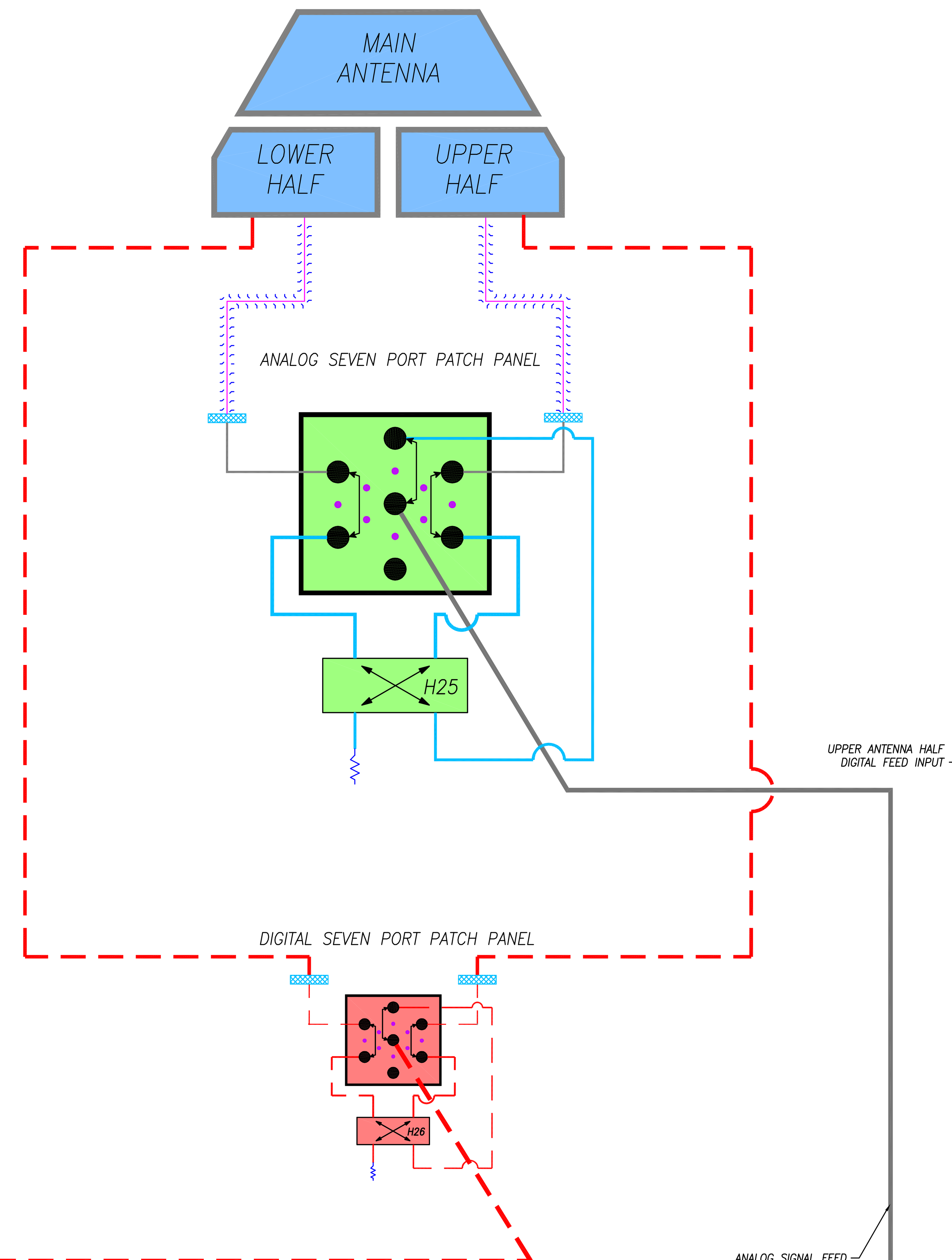


10 Station Analog/Digital



CURRENT BAY LEVEL ELEMENT AND HYBRID
FIGURE #1

IBOX BAY LEVEL ELEMENT AND HYBRID
FIGURE #1



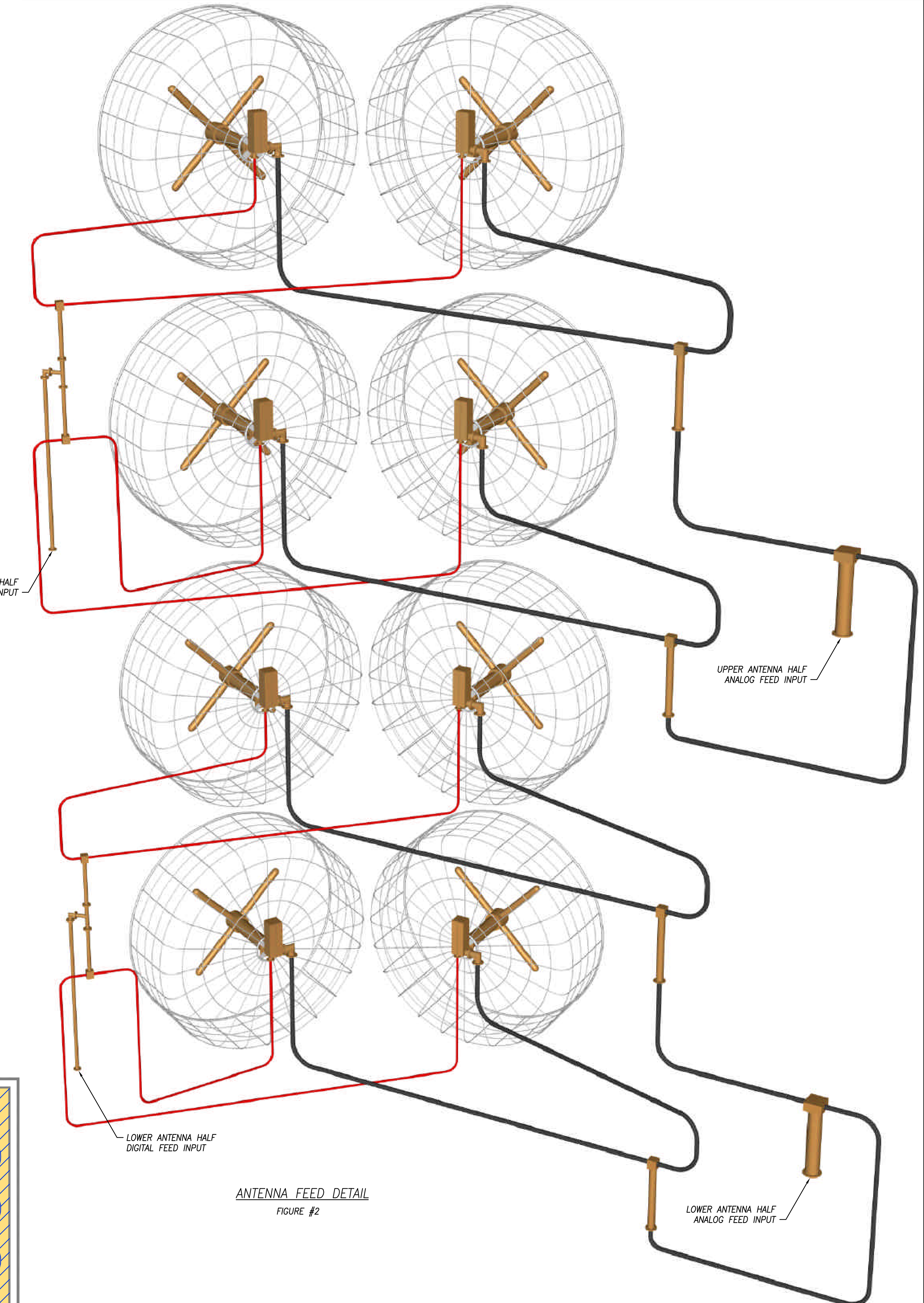
NOTES:

FIGURE 1; ILLUSTRATES THE DIFFERENCE BETWEEN A NON-MODIFIED 1080 ELEMENT HYBRID AND A ELEMENT FITTED WITH A HYBRID TO ALLOW DAB INJECTION. RETROFITTING THE ELEMENT INVOLVES UNBOLTING AND BOLTING THE NEW DAB HYBRID. THE DAB PORT IS 1 ⅝" EIA GAS PASS RATED AT 2 KW. AVERAGE POWER.

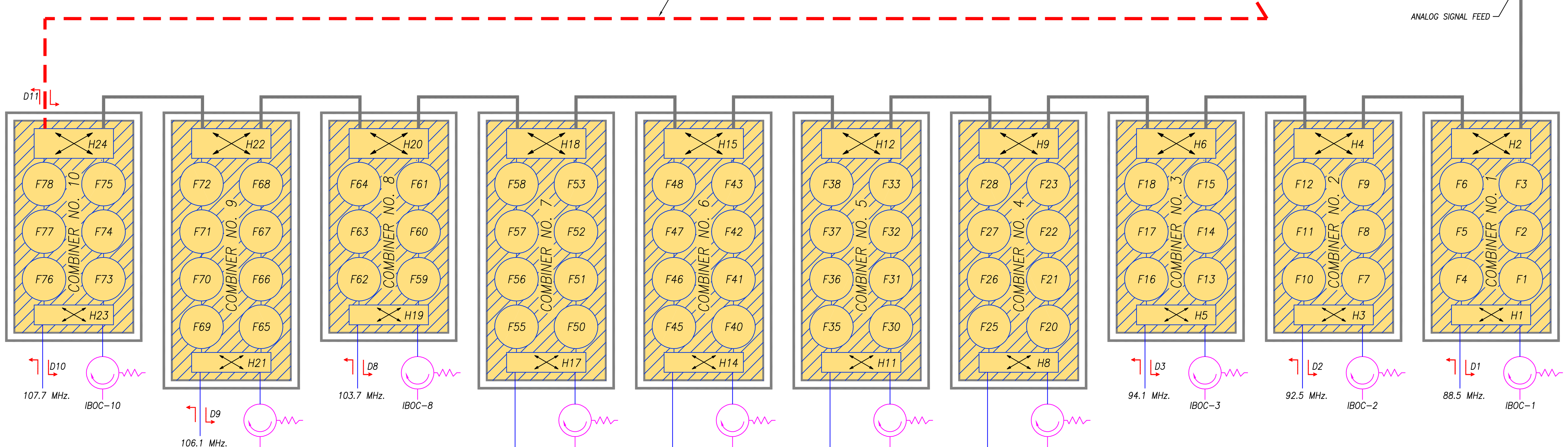
FIGURE 2; SHOWS THE EXISTING ANALOG HIGH POWER FEED HARNESS (RIGHT SIDE) ALONG WITH THE PROPOSED DIGITAL FEED HARNESS (LEFT SIDE). TO ALLOW FOR EMERGENCY ANTENNA USAGE BOTH HARNESSES FEED THE UPPER AND LOWER ANTENNA HALVES INDEPENDENTLY.

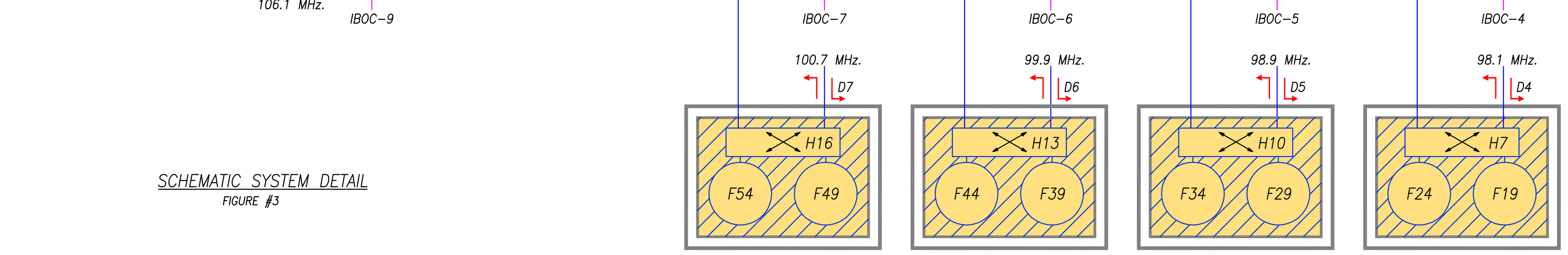
FIGURE 3; SCHEMATIC REPRESENTATION OF THE COMPLETE COMBINER SYSTEM. SHOWN ON THE DRAWING ARE BOTH ANALOG (3 ⅛" EIA) AND DIGITAL (500 WATT CIRCULATOR WITH TYPE "N" FEMALE INPUT CONNECTORS) INJECTION PORTS AND THE DISTRIBUTION OF POWER FLOW IN THE COMBINER MAIN FEED TRUNK. IN ORDER TO SATISFY THE DUAL FED ANTENNA SYSTEM REQUIREMENT 3 dB HYBRID POWER DIVIDERS ARE INCORPORATED INTO THE FEED SCHEME.

LEGEND			
●	DATA COLLECTION SENSOR	(symbol)	REJECT LOAD
(symbol)	GAS BARRIER	(symbol)	DAB CIRCULATOR
(symbol)	DIRECTIONAL COUPLER	(symbol)	CONNECTION ASSEMBLY FOR PATCHING COMPLEX & SWITCHING CONTROLLER



ANTENNA FEED DETAIL
FIGURE #2





SCHEMATIC SYSTEM DETAIL
FIGURE #3

DAB COMBINER MODIFICATION REQUIREMENTS:

1) TEN 500 WATT DIGITAL CIRCULATORS TO BE PLACED BETWEEN COMBINER'S RESIDUAL DUMP LOADS AND THE COMBINER PORT WHICH REVERSES THE POWER FLOW IN THE MAIN COMBINER FEED TRUNK. (THE QUANTITY REQUIREMENT OF TEN ASSUMES ALL STATIONS ARE PARTICIPATING IN DAB)

2) COAXIAL LINE AND COAXIAL ADAPTERS REQUIRED TO CONNECT CIRCULATORS AND RELOCATE DUMP LOADS AT TEN LOCATIONS.

3) ONE RUN OF APPROXIMATELY 40 FEET OF 1 ⅝" FLEX CABLE TO FEED THE DIGITAL PATCH PANEL FROM THE DIGITAL OUTPUT OF THE COMBINER.

4) A HYBRID POWER SPLITTER AND TERMINATION LOAD IS REQUIRED TO FEED THE DAB SIGNAL TO THE UPPER AND LOWER ANTENNA HALVES, AND A 7 PORT 1 ⅝" MANUAL PATCH PANEL IS PROVIDED IN ORDER TO FEED EITHER HALF OF THE ANTENNA SYSTEM IN AN EMERGENCY.

DAB ANTENNA MODIFICATIONS REQUIREMENTS:

1) NEW FOUR PORT 1080 ELEMENT HYBRID. (REPLACED AT 8 PLACES)

2) DAB FEED HARNESS, COMPRISED OF:

A) TWO RIGID POWER DIVIDERS (CENTER FED – DUAL OUTPUT, TWO WAY SPLITTERS PLACED AT EACH END)
B) EIGHT, FLEX CABLES 8' LENGTH (⅞" AIR DIELECTRIC WITH 1 ⅝" EIA CONNECTORS)
C) TWO, FEED LINE RUNS (1 ⅝" FLEXIBLE CABLES AND BRACKET SUPPORT TO TOWER) APPROXIMATELY 200 FEET EACH

NOTE: ITEMS (A) AND (B) ABOVE ADD APPROXIMATELY THE FOLLOWING WEIGHT AND WIND-LOAD TO EXISTING TOWER:

NO ICE	WITH 1/2" ICE
CaAa = 12 FT²	CaAa = 21 FT²
WEIGHT = 75 LBS.	WEIGHT = 175 LBS.

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CHANDLER, IN. 47610-9637
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NO	REVISION	APP'D	DATE
6			
5			
4			
3			
2	UPDATED TEXT		3/4/03 BAM
1	UPDATED TEXT & ADDED DIGITAL PATCH		2/13/03 BAM

NAME IBOC ADDITION PROPOSAL
STATION: WEST TIGER MOUNTAIN
FREQUENCY: N/A QUOTE NO.: WEST TIGER 1
PATH G:\DRAFTING\ANTENNA\QUOTES\WEST TIGER 1
FILE QA—1 DRAWN BAM FACTOR NTS
DATE 12/2/02 APP'D DWG. NO.
MODEL NON-APPLICABLE QA—1

Station _***WKY***_ Frequency_***930***__ KHz Radial Bearing _______ Deg T.
Center of Array Coordinates: NAD 83 North Lat._***35 33 43***__ West Long _***97 30 28***_
Endpoint Coordinates : NAD 83 North Lat.___________ West Long ___________
F/S Meter Type_***FM - 41***__ S/N _***2050***__ Cal Date _***2/15/7***_ Cal By_***F Sandel***_
F/S Meter Type _***FM- 41***__ S/N ____***XX***___ Cal Date ___***XX***___ Engineer _______
Pattern Day _______ Ground Condition: Dry___ Damp ___Wet ___ Sky: Clear ___Cloudy __
Pattern Night ___***X***___ Ground Condition: Dry___ Damp _***X***_Wet ___ Sky: Clear _***X***_Cloudy __

Monitoring		By Munn Reese			By Ed Reid				
Point	Max	**Directional power**			Directional Power			Distance	Remarks
Number	mV/m	mV/m	Time	Date	mV/m	Time	Date	Km	GPS Approx. Locations
1	82	76	13:43	10.24.6	81	9:15am	7.26.7	3.91	Lat 35 35.252 Long 97 29.082
2	150	120	15:51	10.24.6	122	9:30am	7.26.7	2.81	Lat 35 32.875 Long 97 29.576
3	211	210	13:29	10.24.6	209	9:45am	7.26.7	2.52	Lat 35 33.741 Long 97 32.151
4	162	148	10:01	10.24.6	148	10:00am	7.26.7	2.65	Lat 35 34.458 Long 97 31.881
5	*				*	11:00am	7.26.7		Lat 35 33.345 Long 97 29.559
6									
7									

Comments:

Pt# 1 Intersection of N. Eastern Ave & NE 115 St 1st drive way on the N. side of 115 St. reading taken near the W. side of the drive way. Coordinates taken in the center of drive way.

Pt# 2 N. Eastern at junction of Eastern Place. Historical readings taken on north side of road st this junction. Munn Reese taken on the south side of the Eastern place road. Coordinates taken near the north side of the road.

Pt# 3 University Ave between NW 90th and NW 89 St.Reading taken in front of the Centenial H.S. school near flag pole (Historical Readings taken in the rear of the school due to traffic and accessibility. This reading was taken in front of the school. Coordinates taken in front of school, but in the street.

Pt#4 N Western Ave & NW 104th St.Readings taken on NW 104th st 2nd home on the right north side of curb. Coordinates taken along the north side of NW 104th St.

* Pt#5 An optional reading taken at the entrance of Richland Tower site at the end of pavement near east side of gate for a future reference (RT info Only) Meter aligned for a Max of 400 mV/m and a Min of 70 mV/m. Coordinates taken on east side of entrance gate of the RT site. New tower still under construction and old tower has not been removed.

Lat long reading taken inside of vehicle and due to MPT's on the side of street, the Lat & long readings is for reference locations only.

ENGINEERING REPORT

PARTIAL PROOF OF PERFORMANCE

on

WKY(AM) – Oklahoma City, OK

for

Richland Towers – Oklahoma City, LLC

August, 2007

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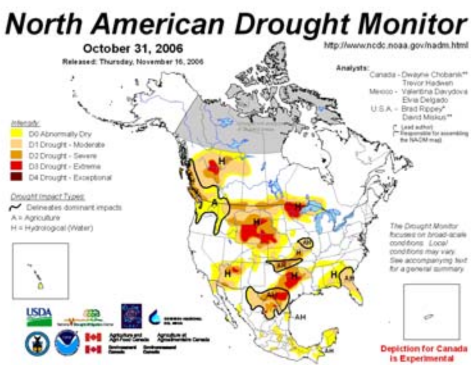
MUNN–REESE, INC.
Broadcast Engineering Consultants
Coldwater, MI 49036

TABLE OF CONTENTS

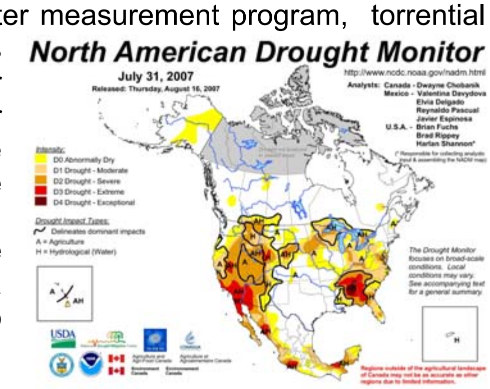
Discussion

The firm of Munn-Reese, Inc., was retained to prepare this report detailing a daytime non-directional partial proof of performance and nighttime directional partial proof of performance on AM Radio Station WKY(AM), Oklahoma City, OK. WKY(AM) operates on 930 kHz with 5.0 kW of daytime non-directional power and 5.0 kW of nighttime directional power using a three tower array. Construction of Antenna Structure Registration (ASR) tower 1253490 by Richland Towers – Oklahoma City, LLC, has taken place, in addition to the installation of multiple antennas and feedlines. ASR #1253490 resides within the §73.1692 3.2 km affected radius of the nighttime WKY(AM) array, but outside of the 0.8 km affected radius of the daytime WKY(AM) non-directional operation. However, out of an overabundance of caution, the data contained herein is being submitted to show the WKY(AM) daytime and nighttime operations remain essentially unchanged by the nearby tower construction.

Field strength measurements were conducted by Mr. Justin Asher, Engineer for Munn-Reese, Inc. Mr. Asher made his measurements using Potomac Instruments Field Intensity Meter, Model #FIM-41, S/N 844, calibrated March 28, 2006. Representatives of both WKY(AM) and ASR 1253490 were invited to ride along during the measurement project. Mr. Ken Boyd, staff engineer of WKY(AM) was witness to portions of the before measurement program while Mr. Ed Reid, contract engineer for Richland Towers was witness to portions of the after measurement program.



Measurements were taken on the six (6) cardinal radials spaced 60.0° apart for daytime non-directional operation and the four (4) nighttime monitor point radials, meeting the requirements of 47 C.F.R. §73.154 of the FCC Rules. Field strength measurements were taken on the dates and at the times indicated in the respective Tabulations of Field Strength Measurements and included in ***Exhibit(s) 1.1–2.2*** for nighttime operation***.*** The tabulation sheets show the distance from the transmitter site to each point in units of kilometers. The locations and point numbers were derived from topographical maps with the assistance of GPS computer software. Before and after measurements were taken approximately ten months apart due to delays in tower construction. Initial before measurements were conducted in late October, 2006 with very dry conditions. Temperatures ranged from 75°F to 83°F. After measurements were conducted in late August, 2007 with temperatures ranging from 71°F to 93°F. While no precipitation was observed during the after measurement program, torrential rains were noted in the weeks preceding. NOAA records indicate 5.38 inches of rain fell between August 18-19 for the area. In addition, Inspection of U.S. Drought Monitor charts[1] taken closest to the measurement dates indicate before measurements were taken in severe to extreme drought conditions with central Oklahoma being delineated as a Dominant Impact Area. After measurements were conducted in normal or non-drought conditions. As a result, higher after measurements were anticipated due to the ground conductivity-ground moisture relationship.



[1] The U.S. Drought Monitor is a joint effort between the USDA (United States Department of Agriculture), DOC (Department of Commerce), NOAA (National Oceanic and Atmospheric Administration) and the University of Nebraska – Lincoln.

Discussion

Exhibit 3.1 provides a summary of the field intensity measurements made on the daytime non-directional and nighttime directional array. As seen in the exhibit, all ratios indicate a uniform increase of approx 5% as expected due to the change in climate conditions was noted for both daytime and nighttime operations. No daytime radial varied by more than ±2.5% from the mean log average for daytime radials or ±1.5% from the mean log average for nighttime radials . These variances are well within the allowable 10% limits when taking into account climate factors.

In addition, all four MP values were noted to be with licensed maximum limits for both the before and after measurement programs as well as nighttime antenna monitor readings.

Therefore, through a combination of the uniform increase in field attributable to climatic changes and continued MP measurements within licensed values, the result obtained indicate the constructed tower has had a negligible effect on the WKY(AM) day and night operations.

CERTIFICATION OF ENGINEERS

The firm of Munn-Reese, Inc., Broadcast Engineering Consultants, with offices at 385 Airport Drive, Coldwater, Michigan, has been retained for the purpose of preparing the technical data forming this report.

The data utilized in this report is based on field measurements made by the undersigned, or others under the supervision of the undersigned, on the dates and times indicated in the report.

The report has been prepared by properly trained electronics specialists under the direction of the undersigned whose qualifications are a matter of record before the Federal Communications Commission.

I declare under penalty of perjury that the contents of this report are true and accurate to the best of my knowledge and belief.

August 31, 2007

MUNN-REESE, INC.

By Wayne S. Reese
Wayne S. Reese, President

By Justin W. Asher
Justin W. Asher, Project Engineer

385 Airport Drive, PO Box 220
Coldwater, Michigan 49036

Telephone: 517-278-7339

Exhibit 1.1
Tabulation of Daytime Radials 0.0°T, 60.0°T & 120.0°T

Call:	**WKY**			**Frequency (kHz):**		**930**	**Power (kW):**		**5.00**		Engineer: Justin Asher
				Bearing (°T):		**0.0°**					Meter Model: FIM-41 S/N: 844
											Calibration Date: March 28, 2006
Point	**Before Non-Directional**			**After Non-Directional**			**Distance**	**Direct**		**Log**	
#	**mV/m**	**Time**	**Date**	**mV/m**	**Time**	**Date**	**km**	**Ratio**	**Remarks**	**Ratio**	**Other Notes**
1	180.00	1001	10-26-06	193.00	1248	08-28-07	5.26	1.0722		0.0697	
2	133.00	1038	10-26-06	135.00	1310	08-28-07	6.88	1.0150		0.0149	
3	110.00	1050	10-26-06	117.00	1323	08-28-07	8.06	1.0636		0.0617	
4	110.00	1056	10-26-06	110.00	1329	08-28-07	8.94	1.0000		0.0000	
5	95.00	1108	10-26-06	99.00	1336	08-28-07	10.20	1.0421		0.0412	
6	84.00	1115	10-26-06	90.00	1349	08-28-07	11.70	1.0714		0.0690	
7	74.00	1122	10-26-06	72.00	1355	08-28-07	12.50	0.9730		-0.0274	
8	69.00	1127	10-26-06	68.00	1403	08-28-07	13.30	0.9855		-0.0146	
9	62.00	1133	10-26-06	65.00	1420	08-28-07	15.00	1.0484		0.0473	
							Arithmetic Ratio:	**1.0301**			
							Log Ratio:	**1.0295**			

Call:	**WKY**			**Frequency (kHz):**		**930**	**Power (kW):**		**5.00**		Engineer: Justin Asher
				Bearing (°T):		**60.0°**					Meter Model: FIM-41 S/N: 844
											Calibration Date: March 28, 2006
Point	**Before Non-Directional**			**After Non-Directional**			**Distance**	**Direct**		**Log**	
#	**mV/m**	**Time**	**Date**	**mV/m**	**Time**	**Date**	**km**	**Ratio**	**Remarks**	**Ratio**	**Other Notes**
1	80.00	1310	10-25-06	78.00	0919	08-28-07	4.84	0.9750		-0.0253	
2	94.00	1307	10-25-06	98.00	0923	08-28-07	5.60	1.0426		0.0417	
3	63.00	1302	10-25-06	70.00	0928	08-28-07	6.78	1.1111		0.1054	
4	61.00	1254	10-25-06	65.50	0933	08-28-07	7.23	1.0738		0.0712	
5	47.00	1247	10-25-06	56.00	0942	08-28-07	10.50	1.1915		0.1752	
6	39.50	1236	10-25-06	41.00	0947	08-28-07	12.40	1.0380		0.0373	
7	33.50	1239	10-25-06	34.50	0950	08-28-07	13.20	1.0299		0.0294	
8	22.90	1223	10-25-06	23.90	1000	08-28-07	16.10	1.0437		0.0427	
9	15.50	1226	10-25-06	16.20	1004	08-28-07	17.00	1.0452		0.0442	
							Arithmetic Ratio:	**1.0612**			
							Log Ratio:	**1.0597**			

Call:	**WKY**			**Frequency (kHz):**		**930**	**Power (kW):**		**5.00**		Engineer: Justin Asher
				Bearing (°T):		**120.0°**					Meter Model: FIM-41 S/N: 844
											Calibration Date: March 28, 2006
Point	**Before Non-Directional**			**After Non-Directional**			**Distance**	**Direct**		**Log**	
#	**mV/m**	**Time**	**Date**	**mV/m**	**Time**	**Date**	**km**	**Ratio**	**Remarks**	**Ratio**	**Other Notes**
1	125.00	1043	10-25-06	125.00	1120	08-28-07	5.10	1.0000		0.0000	
2	115.00	1047	10-25-06	125.00	1115	08-28-07	5.60	1.0870		0.0834	
3	121.00	1051	10-25-06	135.00	1111	08-28-07	6.48	1.1157		0.1095	
4	91.00	1106	10-25-06	101.00	1105	08-28-07	7.42	1.1099		0.1043	
5	89.00	1110	10-25-06	92.00	0158	08-28-07	7.94	1.0337		0.0332	
6	69.00	1119	10-25-06	73.00	1048	08-28-07	10.60	1.0580		0.0564	
7	65.00	1125	10-25-06	70.00	1043	08-28-07	12.20	1.0769		0.0741	
8	57.00	1131	10-25-06	61.00	1038	08-28-07	13.50	1.0702		0.0678	
9	36.50	1138	10-25-06	38.50	1022	08-28-07	16.20	1.0548		0.0533	
							Arithmetic Ratio:	**1.0673**			
							Log Ratio:	**1.0668**			

Exhibit 1.2
Tabulation of Daytime Radials 180.0°T, 240.0°T & 300.0°

Call:	WKY		Frequency (kHz):		930		Power (kW):	5.00			Engineer: Justin Asher
				Bearing (°T):	180.0°						Meter Model: FIM-41 S/N: 844
											Calibration Date: March 28, 2006
Point	Before Non-Directional			After Non-Directional			Distance	Direct		Log	
#	mV/m	Time	Date	mV/m	Time	Date	km	Ratio	Remarks	Ratio	Other Notes
1	285.00	1025	10-25-06	305.00	1539	08-29-07	2.77	1.0702		0.0678	
2	143.00	1014	10-25-06	150.00	1531	08-29-07	5.02	1.0490		0.0478	
3	115.00	1010	10-25-06	123.00	1553	08-29-07	6.00	1.0696		0.0673	
4	82.00	1005	10-25-06	87.00	1556	08-29-07	7.08	1.0610		0.0592	
5	78.00	0942	10-25-06	90.00	1618	08-29-07	10.70	1.1538		0.1431	
6	63.00	0931	10-25-06	67.00	1623	08-29-07	12.50	1.0635		0.0616	
7	51.00	0907	10-25-06	53.50	1635	08-29-07	14.40	1.0490		0.0479	
8	46.00	0900	10-25-06	47.00	1639	08-29-07	15.80	1.0217		0.0215	
9	37.00	0852	10-25-06	39.50	1648	08-29-07	17.60	1.0676		0.0654	
							Arithmetic Ratio:	1.0673			
							Log Ratio:	1.0667			

Call:	WKY		Frequency (kHz):		930		Power (kW):	5.00			Engineer: Justin Asher
				Bearing (°T):	240.0°						Meter Model: FIM-41 S/N: 844
											Calibration Date: March 28, 2006
Point	Before Non-Directional			After Non-Directional			Distance	Direct		Log	
#	mV/m	Time	Date	mV/m	Time	Date	km	Ratio	Remarks	Ratio	Other Notes
1	250.00	1212	10-26-06	255.00	1731	08-28-07	2.99	1.0200		0.0198	
2	135.00	1226	10-26-06	148.00	1716	08-28-07	5.29	1.0963		0.0919	
3	99.00	1236	10-26-06	105.00	1701	08-28-07	7.01	1.0606		0.0588	
4	120.00	1243	10-26-06	119.00	1657	08-28-07	7.84	0.9917		-0.0084	
5	59.00	1253	10-26-06	63.00	1647	08-28-07	10.40	1.0678		0.0656	
6	64.00	1636	10-25-06	63.00	1642	08-28-07	12.10	0.9844		-0.0157	
7	47.50	1630	10-25-06	52.50	1635	08-28-07	13.40	1.1053		0.1001	
8	39.00	1618	10-25-06	39.50	1618	08-28-07	15.30	1.0128		0.0127	
9	39.00	1623	10-25-06	43.00	1625	08-28-07	16.40	1.1026		0.0976	
							Arithmetic Ratio:	1.0490			
							Log Ratio:	1.0481			

Call:	WKY		Frequency (kHz):		930		Power (kW):	5.00			Engineer: Justin Asher
				Bearing (°T):	300.0°						Meter Model: FIM-41 S/N: 844
											Calibration Date: March 28, 2006
Point	Before Non-Directional			After Non-Directional			Distance	Direct		Log	
#	mV/m	Time	Date	mV/m	Time	Date	km	Ratio	Remarks	Ratio	Other Notes
1	242.00	1509	10-25-06	255.00	1455	08-28-07	3.03	1.0537		0.0523	
2	175.00	1514	10-25-06	180.00	1459	08-28-07	4.01	1.0286		0.0282	
3	134.00	1524	10-25-06	145.00	1514	08-28-07	6.45	1.0821		0.0789	
4	119.00	1534	10-25-06	129.00	1528	08-28-07	8.46	1.0840		0.0807	
5	105.00	1547	10-25-06	105.00	1539	08-28-07	10.90	1.0000		0.0000	
6	90.00	1550	10-25-06	90.00	1543	08-28-07	11.80	1.0000		0.0000	
7	72.00	1553	10-25-06	75.00	1549	08-28-07	13.70	1.0417		0.0408	
8	71.00	1556	10-25-06	76.00	1554	08-28-07	15.50	1.0704		0.0681	
9	42.50	1559	10-25-06	43.50	1557	08-28-07	17.00	1.0235		0.0233	
							Arithmetic Ratio:	1.0427			
							Log Ratio:	1.0422			

Exhibit 2.1
Tabulation of Nighttime Radials 44.0°T & 106.0°T

Call:	WKY			Frequency (kHz):		930	Power (kW):		5.00		Engineer: Justin Asher
				Bearing (°T):		44.0°					Meter Model: FIM-41 S/N: 844
											Calibration Date: March 28, 2006
Point	**Before**	**Directional**		**After**	**Directional**		**Distance**	**Direct**		**Log**	
#	**mV/m**	**Time**	**Date**	**mV/m**	**Time**	**Date**	**km**	**Ratio**	**Remarks**	**Ratio**	**Other Notes**
1	76.00	1343	10-24-06	85.00	0815	08-29-07	3.91	1.1184	MP	0.1119	
2	76.00	1347	10-24-06	80.00	0828	08-29-07	5.02	1.0526		0.0513	
3	53.00	1350	10-24-06	54.50	0832	08-29-07	6.17	1.0283		0.0279	
4	47.50	1354	10-24-06	48.50	0836	08-29-07	7.33	1.0211		0.0208	
5	22.50	1402	10-24-06	22.00	0840	08-29-07	8.44	0.9778		-0.0225	
6	19.50	1406	10-24-06	21.90	0845	08-29-07	9.53	1.1231		0.1161	
7	17.50	1409	10-24-06	18.80	0850	08-29-07	10.80	1.0743		0.0717	
8	12.80	1432	10-24-06	14.50	0906	08-29-07	15.40	1.1328		0.1247	
9	10.80	1434	10-24-06	10.50	0909	08-29-07	16.30	0.9722		-0.0282	
							Arithmetic Ratio:	**1.0556**			
							Log Ratio:	**1.0540**			

Call:	WKY			Frequency (kHz):		930	Power (kW):		5.00		Engineer: Justin Asher
				Bearing (°T):		106.0°					Meter Model: FIM-41 S/N: 844
											Calibration Date: March 28, 2006
Point	**Before**	**Directional**		**After**	**Directional**		**Distance**	**Direct**		**Log**	
#	**mV/m**	**Time**	**Date**	**mV/m**	**Time**	**Date**	**km**	**Ratio**	**Remarks**	**Ratio**	**Other Notes**
1	120.00	1551	10-24-06	130.00	0930	08-29-07	2.81	1.0833	MP	0.0800	
2	26.50	1557	10-24-06	27.50	0938	08-29-07	4.41	1.0377		0.0370	
3	52.00	1601	10-24-06	52.00	0943	08-29-07	6.20	1.0000		0.0000	
4	12.10	1611	10-24-06	12.80	0957	08-29-07	8.67	1.0579		0.0562	
5	16.50	1615	10-24-06	16.50	1001	08-29-07	9.53	1.0000		0.0000	
6	13.20	1620	10-24-06	14.30	1008	08-29-07	11.20	1.0833		0.0800	
7	10.60	1627	10-24-06	11.50	1013	08-29-07	12.90	1.0849		0.0815	
8	11.90	1632	10-24-06	13.10	1018	08-29-07	14.50	1.1008		0.0961	
9	7.90	1636	10-24-06	8.30	1025	08-29-07	15.90	1.0506		0.0494	
							Arithmetic Ratio:	**1.0554**			
							Log Ratio:	**1.0548**			

Exhibit 2.2
Tabulation of Nighttime Radials 271.0°T & 307.0°T

Call:	WKY		Frequency (kHz):		930		Power (kW):	5.00		Engineer: Justin Asher
				Bearing (°T):	271.0°					Meter Model: FIM-41 S/N: 844
										Calibration Date: March 28, 2006
Point	Before Directional			After Directional			Distance	Direct		Log	
#	mV/m	Time	Date	mV/m	Time	Date	km	Ratio	Remarks	Ratio	Other Notes
1	210.00	1329	10-24-06	210.00	1344	08-29-07	2.52	1.0000	MP	0.0000	
2	148.00	1325	10-24-06	159.00	1339	08-29-07	3.23	1.0743		0.0717	
3	138.00	1323	10-24-06	140.00	1336	08-29-07	3.72	1.0145		0.0144	
4	100.00	1231	10-24-06	108.00	1329	08-29-07	5.33	1.0800		0.0770	
5	92.00	1239	10-24-06	95.00	1323	08-29-07	6.00	1.0326		0.0321	
6	53.00	1144	10-24-06	56.00	1303	08-29-07	11.80	1.0566		0.0551	
7	44.00	1132	10-24-06	45.00	1233	08-29-07	13.40	1.0227		0.0225	
8	41.50	1127	10-24-06	42.50	1229	08-29-07	15.00	1.0241		0.0238	
9	27.50	1123	10-24-06	27.50	1225	08-29-07	16.60	1.0000		0.0000	
						Arithmetic Ratio:		1.0339			
						Log Ratio:		1.0335			

Call:	WKY		Frequency (kHz):		930		Power (kW):	5.00		Engineer: Justin Asher
				Bearing (°T):	307.0°					Meter Model: FIM-41 S/N: 844
										Calibration Date: March 28, 2006
Point	Before Directional			After Directional			Distance	Direct		Log	
#	mV/m	Time	Date	mV/m	Time	Date	km	Ratio	Remarks	Ratio	Other Notes
1	148.00	1001	10-24-06	160.00	1059	08-29-07	2.65	1.0811	MP	0.0780	
2	150.00	1006	10-24-06	154.00	1109	08-29-07	3.47	1.0267		0.0263	
3	132.00	1012	10-24-06	138.00	1115	08-29-07	5.02	1.0455		0.0445	
4	111.00	1018	10-24-06	119.00	1123	08-29-07	6.09	1.0721		0.0696	
5	91.00	1022	10-24-06	92.00	1127	08-29-07	7.02	1.0110		0.0109	
6	74.00	1030	10-24-06	76.00	1132	08-29-07	8.11	1.0270		0.0267	
8	31.50	1044	10-24-06	33.50	1146	08-29-07	11.40	1.0635		0.0616	
9	33.50	1048	10-24-06	36.00	1150	08-29-07	12.80	1.0746		0.0720	
11	29.50	1102	10-24-06	32.00	1157	08-29-07	14.80	1.0847		0.0813	
						Arithmetic Ratio:		1.0540			
						Log Ratio:		1.0537			

Exhibit 3.1
Tabulation of Ratios

Daytime Operation:

Radial	Arithmetic Ratio	Log Ratio
0.0°T	1.0301	1.0295
60.0°T	1.0612	1.0597
120.0°T	1.0673	1.0668
180.0°T	1.0673	1.0667
240.0°T	1.0490	1.0481
300.0°T	1.0427	1.0422
Average:	**1.0529**	**1.0522**

Nighttime Operation:

Radial	Arithmetic Ratio	Log Ratio
44.0°T	1.0556	1.0540
106.0°T	1.0554	1.0548
271.0°T	1.0339	1.0335
307.0°T	1.0540	1.0537
Average:	1.0497	1.0490

Radial	MP Limit (mV/m)	Before MP Value (mV/m)	After MP Value (mV/m)
44.0°T	86.6	76.0	85.0
106.0°T	151.1	120.0	130.0
271.0°T	211.0	210.0	210.0
307.0°T	162.1	148.0	160.0

Tower	Before Field	Before Phase	After Field	After Phase
1	1.000	0.0°	1.000	0.0°
2	0.604	+21.9°	0.612	+21.7°
3	0.617	-126.3°	0.623	-125.7°