

Directional Antenna System for WYQS, Mars Hill, North Carolina

March 27, 2008

Electronics Research Inc. is providing a custom fabricated antenna system that is specially designed to meet the FCC requirements and the general needs of radio station WYQS.

The antenna is the ERI model 1092-1CP-DA configuration. The circular polarized system consists of one bay using two driven circular polarized radiating elements attached to two flat panels and one horizontal parasitic element placed one-quarter wave above and below the elements. The antenna was mounted on the North 61 degrees East tower leg with bracketry to provide an antenna orientation of North 54 degrees East. The antenna was tested on a tapered tower, which is the structure the station plans to use to support the array. All tests were performed on a frequency of 90.5 megahertz, which is the center of the FM broadcast channel assigned to WYQS.

Pattern measurements were made on a sixty-acre antenna pattern range that is owned and operated by Electronics Research, Inc. The tests were performed under the direction of Thomas B. Silliman, president of Electronics Research, Inc. Mr. Silliman has the Bachelor of Electrical Engineering and the Master of Electrical Engineering degrees from Cornell University and is a registered professional engineer in the states of Indiana, Maryland and Minnesota.



Directional Antenna System Proposed For WYQS, Mars Hill, North Carolina

(Continued)

DESCRIPTION OF THE TEST PROCEDURE

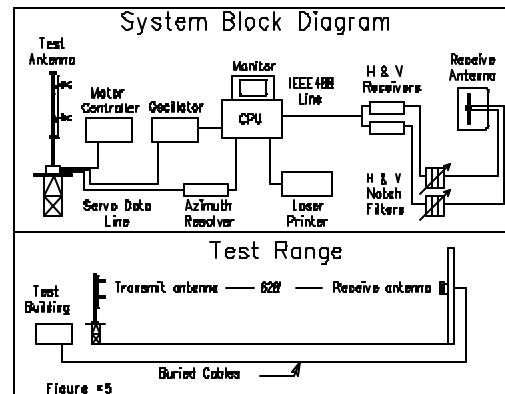
The test antenna consisted of a full-scale model of the complete circular polarized system with the associated horizontal parasitic element. The elements and brackets that were used in this test are electrically equivalent to those that will be supplied with the antenna.

The power distribution and phase relationship to the antenna elements was adjusted in order to achieve the directional radiation patterns for both horizontal and vertical polarization components.

The proof-of-performance was accomplished using a tapered tower with identical dimension and configuration including all braces, ladders, conduits, coaxial lines and other appurtenances that are included in the actual aperture at which the antenna will be installed. The structure was erected vertically on a turntable mounted on a non-metallic building with the antenna centered vertically on the structure, making the center of radiation of the test approximately 30 feet above ground. The turntable is equipped with a motor drive and a US Digital angle position indicator. The resolution of this angle position indicator is one-hundredth of a degree.

The antenna under test was operated in the transmitting mode and fed from a HP8657D signal generator. The frequency of the signal source was set at 90.5 MHz and was constantly monitored by a Rohde & Schwarz ESVD measuring receiver.

A broadband horizontal and vertical dipole system, located approximately 628 feet from the test antenna, was used to receive the emitted test signals. The dipole system was mounted at the same height above terrain as the center of the antenna under test. The signals received by the dipole system were fed to the test building by way of two buried Heliac cables to a Rohde & Schwarz measuring receiver.



Directional Antenna System
Proposed For
WYQS, Mars Hill, North Carolina

(Continued)

This data was interfaced to a Hewlett-Packard Laser Jet 4P printer by means of a computer system. Relative field strength was plotted as a function of azimuth.

The measurements were performed by rotating the test antenna in a counter-clockwise direction and plotting the received signal on polar coordinated graph paper in a clockwise direction. Both horizontal and vertical components were recorded separately.

CONCLUSIONS

The circular polarized system consists of one bay using one driven circular polarized radiating element and one horizontal parasitic element placed one-quarter wave above and below the bay. The power distribution and phase relationship will be fixed when antenna is manufactured. Proper maintenance of the elements should be all that is required to maintain the pattern in adjustment.

The 1092-1CP-DA array is to be mounted on the North 61 degrees East tower leg of the Tapered tower at a bearing of North 54 degrees East. Blue prints provided with the antenna will show the proper antenna orientation alignment. The antenna alignment procedure should be directed by a licensed surveyor as prescribed by the FCC.

Figure #1 represents the maximum value of either the horizontal or vertical component at any azimuth. The measured horizontal plane relative field pattern, for both the horizontal and vertical polarization components, is shown on Figure #2 attached. The actual measured pattern does not exceed the authorized FCC composite pattern at any azimuth. A calculated vertical plane relative field pattern is shown on Figure #3 attached. The power in the maximum will reach 0.250 kilowatts (-6.021 dBk).

The power at North 210-220 degrees East does not exceed 0.0135 kilowatts (-18.697 dBk).

The RMS of the vertically polarized horizontal plane component does not exceed the RMS of the horizontally polarized horizontal plane component.

The composite horizontal and vertical maximum relative field pattern obtained from the measured data as shown on Figure #1 has an RMS that is greater than 85% of the filed composite pattern.

Directional Antenna System
Proposed For
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(Continued)

The clear vertical length of the structure required to support the antenna is 20 feet.

The directional antenna should not be mounted on the top of an antenna tower that includes a top-mounted platform larger than the cross-sectional area of the tower in the horizontal plane. No obstructions other than those that are specified by the blue prints supplied with the antenna are to be mounted within 75 ft. horizontally of the system. The vertical distance to the nearest obstruction should be a minimum of 10 ft. from the directional antenna. Metallic guy wires should be a minimum distance of forty feet horizontally from the antenna.

ELECTRONICS RESEARCH, INC.

A handwritten signature in black ink, appearing to read "Tom Schaefer". The signature is fluid and cursive, with a large initial "T" and a long, sweeping underline.

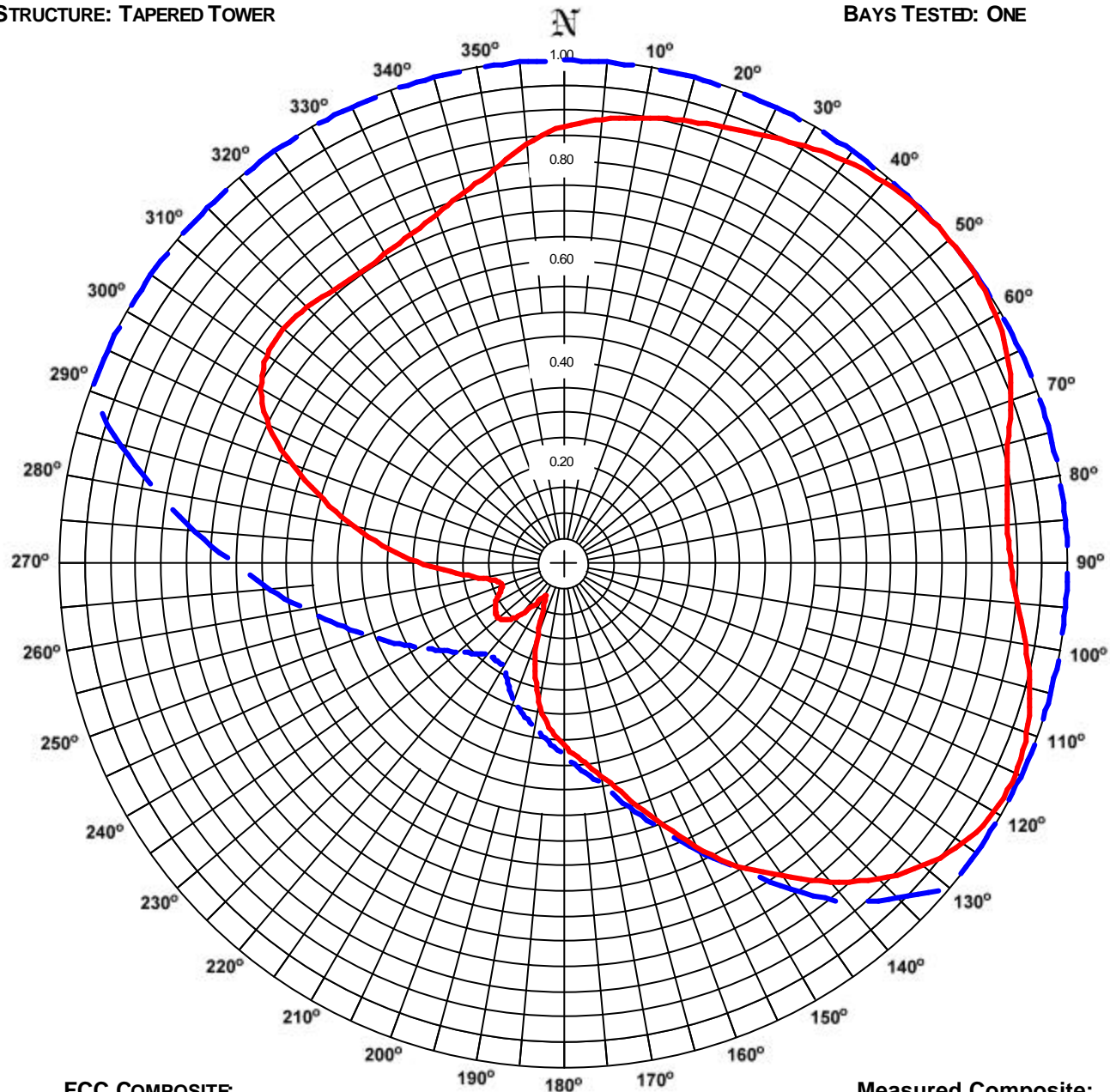
The Microsoft Word document on file electronically at Electronic Research, Inc. governs the specifications, scope, and configuration of the product described. All other representations whether verbal, printed, or electronic are subordinate to the master copy of this document on file at ERI.

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: 1
STATION: WYQS
LOCATION: MARS HILLS, NC
ANTENNA: 1092-1CP-DA
STRUCTURE: TAPERED TOWER

DATE: 3/26/2008
FREQUENCY: 90.5 MHz
ORIENTATION: 54° TRUE
MOUNTING: CUSTOM
BAYS TESTED: ONE



FCC COMPOSITE
RMS: 0.831
MAXIMUM: 1.000 @ 0° TRUE
MINIMUM: 0.233 @ 210° TRUE

Measured Composite:
RMS: 0.711
Maximum: 1.000 @ 49° True
Minimum: 0.071 @ 210° True

COMMENTS: COMPOSITE PATTERN: THIS PATTERN SHOWS THE MAXIMUM OF EITHER THE H OR V AZIMUTH VALUES. THIS PATTERN IS GREATER THAN 85% OF THE FCC FILED COMPOSITE PATTERN BMPED-20070905ADL

ERI[®] *Horizontal Plane Relative Field List*

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

Station: WYQS
Location: Mars Hills, NC
Frequency: 90.5 MHz

Antenna: 1092-1CP-DA
Orientation: 54° True
Tower: Tapered Tower

Figure: 1
Date: 3/26/2008
Reference: wyqs1m.fig

Angle	Envelope			Polarization	Angle	Envelope			Polarization
	Field	kW	dBk			Field	kW	dBk	
0°	0.868	0.19	-7.25	Horizontal	180°	0.360	0.03	-14.90	Vertical
5°	0.886	0.20	-7.07	Horizontal	185°	0.326	0.03	-15.77	Vertical
10°	0.901	0.20	-6.93	Horizontal	190°	0.279	0.02	-17.12	Vertical
15°	0.912	0.21	-6.82	Horizontal	195°	0.219	0.01	-19.20	Vertical
20°	0.924	0.21	-6.71	Horizontal	200°	0.151	0.01	-22.44	Vertical
25°	0.939	0.22	-6.56	Horizontal	205°	0.093	0.00	-26.66	Horizontal
30°	0.958	0.23	-6.39	Horizontal	210°	0.071	0.00	-28.97	Vertical
35°	0.976	0.24	-6.23	Horizontal	215°	0.096	0.00	-26.39	Vertical
40°	0.990	0.24	-6.11	Horizontal	220°	0.131	0.00	-23.68	Vertical
45°	0.998	0.25	-6.04	Horizontal	225°	0.156	0.01	-22.14	Vertical
50°	1.000	0.25	-6.02	Horizontal	230°	0.167	0.01	-21.55	Vertical
55°	0.999	0.25	-6.03	Vertical	235°	0.166	0.01	-21.62	Vertical
60°	0.991	0.25	-6.10	Vertical	240°	0.156	0.01	-22.17	Vertical
65°	0.974	0.24	-6.25	Vertical	245°	0.141	0.00	-23.02	Vertical
70°	0.946	0.22	-6.50	Vertical	250°	0.131	0.00	-23.68	Vertical
75°	0.913	0.21	-6.81	Horizontal	255°	0.135	0.00	-23.42	Vertical
80°	0.894	0.20	-7.00	Horizontal	260°	0.163	0.01	-21.79	Vertical
85°	0.885	0.20	-7.08	Horizontal	265°	0.213	0.01	-19.44	Vertical
90°	0.888	0.20	-7.05	Horizontal	270°	0.277	0.02	-17.17	Vertical
95°	0.904	0.20	-6.89	Horizontal	275°	0.348	0.03	-15.19	Vertical
100°	0.931	0.22	-6.64	Horizontal	280°	0.422	0.04	-13.51	Vertical
105°	0.958	0.23	-6.39	Horizontal	285°	0.493	0.06	-12.16	Vertical
110°	0.979	0.24	-6.21	Horizontal	290°	0.571	0.08	-10.88	Vertical
115°	0.989	0.24	-6.11	Horizontal	295°	0.645	0.10	-9.83	Vertical
120°	0.986	0.24	-6.14	Horizontal	300°	0.694	0.12	-9.20	Vertical
125°	0.967	0.23	-6.31	Horizontal	305°	0.720	0.13	-8.88	Vertical
130°	0.932	0.22	-6.63	Horizontal	310°	0.727	0.13	-8.79	Vertical
135°	0.883	0.19	-7.10	Horizontal	315°	0.720	0.13	-8.87	Vertical
140°	0.823	0.17	-7.71	Horizontal	320°	0.711	0.13	-8.98	Vertical
145°	0.755	0.14	-8.46	Horizontal	325°	0.706	0.12	-9.04	Vertical
150°	0.692	0.12	-9.21	Vertical	330°	0.710	0.13	-8.99	Vertical
155°	0.619	0.10	-10.19	Vertical	335°	0.720	0.13	-8.87	Vertical
160°	0.543	0.07	-11.32	Vertical	340°	0.739	0.14	-8.65	Vertical
165°	0.477	0.06	-12.45	Vertical	345°	0.765	0.15	-8.35	Vertical
170°	0.426	0.05	-13.44	Vertical	350°	0.796	0.16	-8.00	Horizontal
175°	0.390	0.04	-14.20	Vertical	355°	0.836	0.17	-7.57	Horizontal

Polarization:
Maximum Field:
Minimum Field:
RMS:
Maximum ERP:
Maximum Power Gain:

Envelope
1.000 @ 49° True
0.071 @ 210° True
0.711
0.250 kW
0.955 (-0.201 dB)

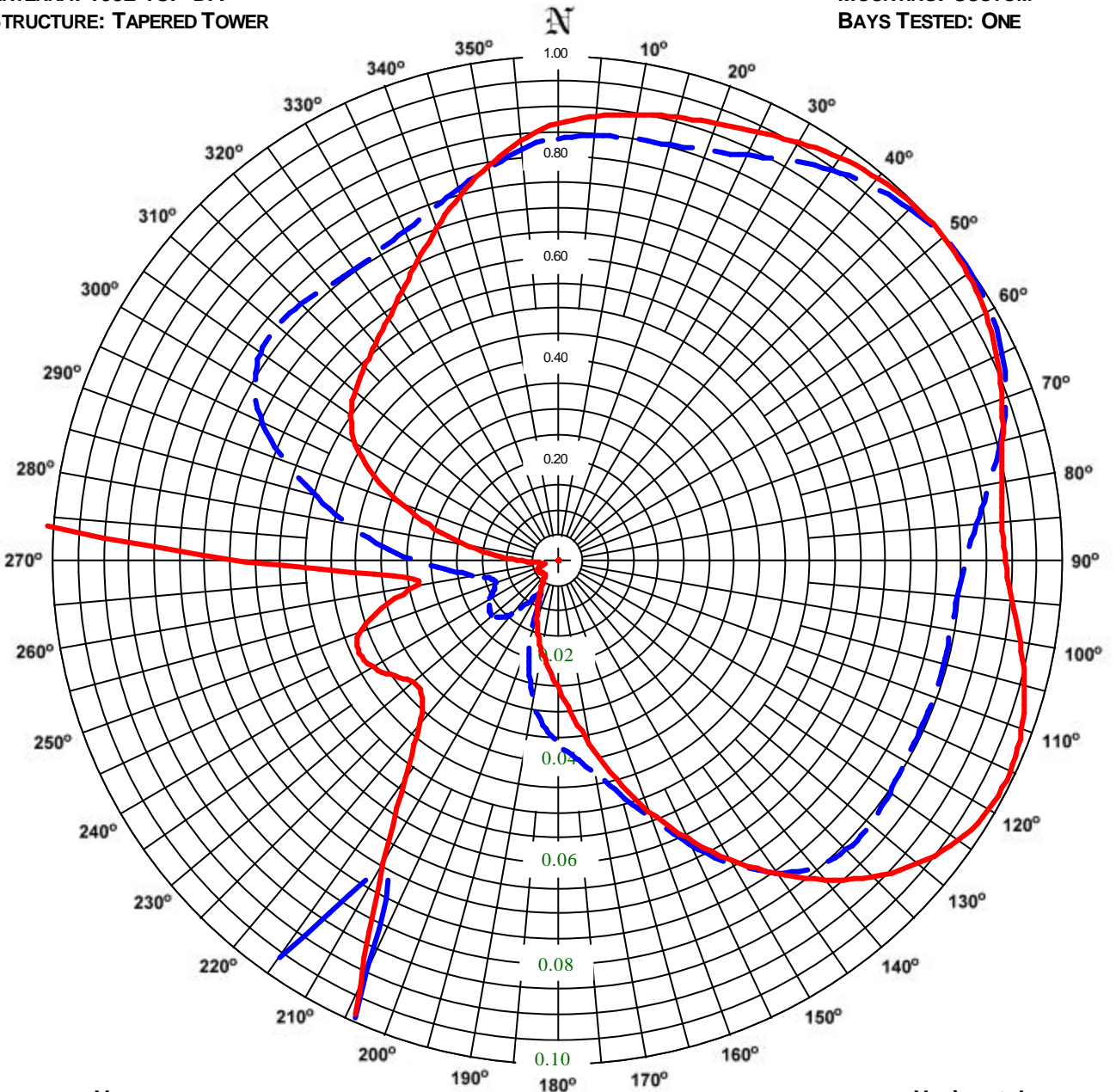
Total Input Power: 0.262 kW

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: 2
STATION: WYQS
LOCATION: MARS HILLS, NC
ANTENNA: 1092-1CP-DA
STRUCTURE: TAPERED TOWER

DATE: 3/26/2008
FREQUENCY: 90.5 MHz
ORIENTATION: 54° TRUE
MOUNTING: CUSTOM
BAYS TESTED: ONE



VERTICAL

RMS: 0.677
MAXIMUM: 1.000 @ 53° TRUE
MINIMUM: 0.070 @ 209° TRUE

10X Scale

Horizontal

RMS: 0.678
Maximum: 1.000 @ 49° True
Minimum: 0.028 @ 262° True

COMMENTS: MEASURED PATTERNS OF THE HORIZONTAL AND VERTICAL COMPONENTS.

ERI[®] *Horizontal Plane Relative Field List*

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

Station: WYQS
Location: Mars Hills, NC
Frequency: 90.5 MHz

Antenna: 1092-1CP-DA
Orientation: 54° True
Tower: Tapered Tower

Figure: 2
Date: 3/26/2008
Reference: wyqs1m.fig

Angle	Horizontal			Vertical			Angle	Horizontal			Vertical		
	Field	kW	dBk	Field	kW	dBk		Field	kW	dBk	Field	kW	dBk
0°	0.868	0.19	-7.25	0.838	0.18	-7.55	180°	0.248	0.02	-18.12	0.360	0.03	-14.90
5°	0.886	0.20	-7.07	0.847	0.18	-7.46	185°	0.211	0.01	-19.55	0.326	0.03	-15.77
10°	0.901	0.20	-6.93	0.851	0.18	-7.42	190°	0.180	0.01	-20.91	0.279	0.02	-17.12
15°	0.912	0.21	-6.82	0.855	0.18	-7.38	195°	0.151	0.01	-22.45	0.219	0.01	-19.20
20°	0.924	0.21	-6.71	0.866	0.19	-7.27	200°	0.121	0.00	-24.33	0.151	0.01	-22.44
25°	0.939	0.22	-6.56	0.888	0.20	-7.05	205°	0.093	0.00	-26.66	0.089	0.00	-27.04
30°	0.958	0.23	-6.39	0.918	0.21	-6.77	210°	0.069	0.00	-29.24	0.071	0.00	-28.97
35°	0.976	0.24	-6.23	0.947	0.22	-6.49	215°	0.053	0.00	-31.58	0.096	0.00	-26.39
40°	0.990	0.24	-6.11	0.971	0.24	-6.28	220°	0.043	0.00	-33.39	0.131	0.00	-23.68
45°	0.998	0.25	-6.04	0.988	0.24	-6.13	225°	0.038	0.00	-34.42	0.156	0.01	-22.14
50°	1.000	0.25	-6.02	0.999	0.25	-6.03	230°	0.037	0.00	-34.58	0.167	0.01	-21.55
55°	0.993	0.25	-6.08	0.999	0.25	-6.03	235°	0.039	0.00	-34.09	0.166	0.01	-21.62
60°	0.980	0.24	-6.19	0.991	0.25	-6.10	240°	0.042	0.00	-33.54	0.156	0.01	-22.17
65°	0.961	0.23	-6.37	0.974	0.24	-6.25	245°	0.043	0.00	-33.28	0.141	0.00	-23.02
70°	0.937	0.22	-6.58	0.946	0.22	-6.50	250°	0.042	0.00	-33.59	0.131	0.00	-23.68
75°	0.913	0.21	-6.81	0.908	0.21	-6.85	255°	0.036	0.00	-34.87	0.135	0.00	-23.42
80°	0.894	0.20	-7.00	0.868	0.19	-7.25	260°	0.029	0.00	-36.85	0.163	0.01	-21.79
85°	0.885	0.20	-7.08	0.833	0.17	-7.60	265°	0.033	0.00	-35.69	0.213	0.01	-19.44
90°	0.888	0.20	-7.05	0.808	0.16	-7.87	270°	0.062	0.00	-30.19	0.277	0.02	-17.17
95°	0.904	0.20	-6.89	0.795	0.16	-8.01	275°	0.113	0.00	-24.97	0.348	0.03	-15.19
100°	0.931	0.22	-6.64	0.791	0.16	-8.05	280°	0.178	0.01	-21.00	0.422	0.04	-13.51
105°	0.958	0.23	-6.39	0.791	0.16	-8.06	285°	0.251	0.02	-18.01	0.493	0.06	-12.16
110°	0.979	0.24	-6.21	0.792	0.16	-8.05	290°	0.326	0.03	-15.76	0.571	0.08	-10.88
115°	0.989	0.24	-6.11	0.792	0.16	-8.04	295°	0.401	0.04	-13.95	0.645	0.10	-9.83
120°	0.986	0.24	-6.14	0.796	0.16	-8.01	300°	0.461	0.05	-12.74	0.694	0.12	-9.20
125°	0.967	0.23	-6.31	0.803	0.16	-7.93	305°	0.500	0.06	-12.03	0.720	0.13	-8.88
130°	0.932	0.22	-6.63	0.810	0.16	-7.85	310°	0.525	0.07	-11.62	0.727	0.13	-8.79
135°	0.883	0.19	-7.10	0.809	0.16	-7.86	315°	0.543	0.07	-11.32	0.720	0.13	-8.87
140°	0.823	0.17	-7.71	0.792	0.16	-8.05	320°	0.562	0.08	-11.02	0.711	0.13	-8.98
145°	0.755	0.14	-8.46	0.753	0.14	-8.49	325°	0.587	0.09	-10.65	0.706	0.12	-9.04
150°	0.682	0.12	-9.35	0.692	0.12	-9.21	330°	0.617	0.10	-10.21	0.710	0.13	-8.99
155°	0.605	0.09	-10.39	0.619	0.10	-10.19	335°	0.656	0.11	-9.68	0.720	0.13	-8.87
160°	0.526	0.07	-11.61	0.543	0.07	-11.32	340°	0.703	0.12	-9.08	0.739	0.14	-8.65
165°	0.446	0.05	-13.04	0.477	0.06	-12.45	345°	0.751	0.14	-8.50	0.765	0.15	-8.35
170°	0.368	0.03	-14.70	0.426	0.05	-13.44	350°	0.796	0.16	-8.00	0.792	0.16	-8.05
175°	0.300	0.02	-16.47	0.390	0.04	-14.20	355°	0.836	0.17	-7.57	0.819	0.17	-7.75

Polarization:	Horizontal	Vertical
Maximum Field:	1.000 @ 49° True	1.000 @ 53° True
Minimum Field:	0.028 @ 262° True	0.070 @ 209° True
RMS:	0.678	0.677
Maximum ERP:	0.250 kW	0.250 kW
Maximum Power Gain:	0.955 (-0.201 dB)	0.955 (-0.201 dB)

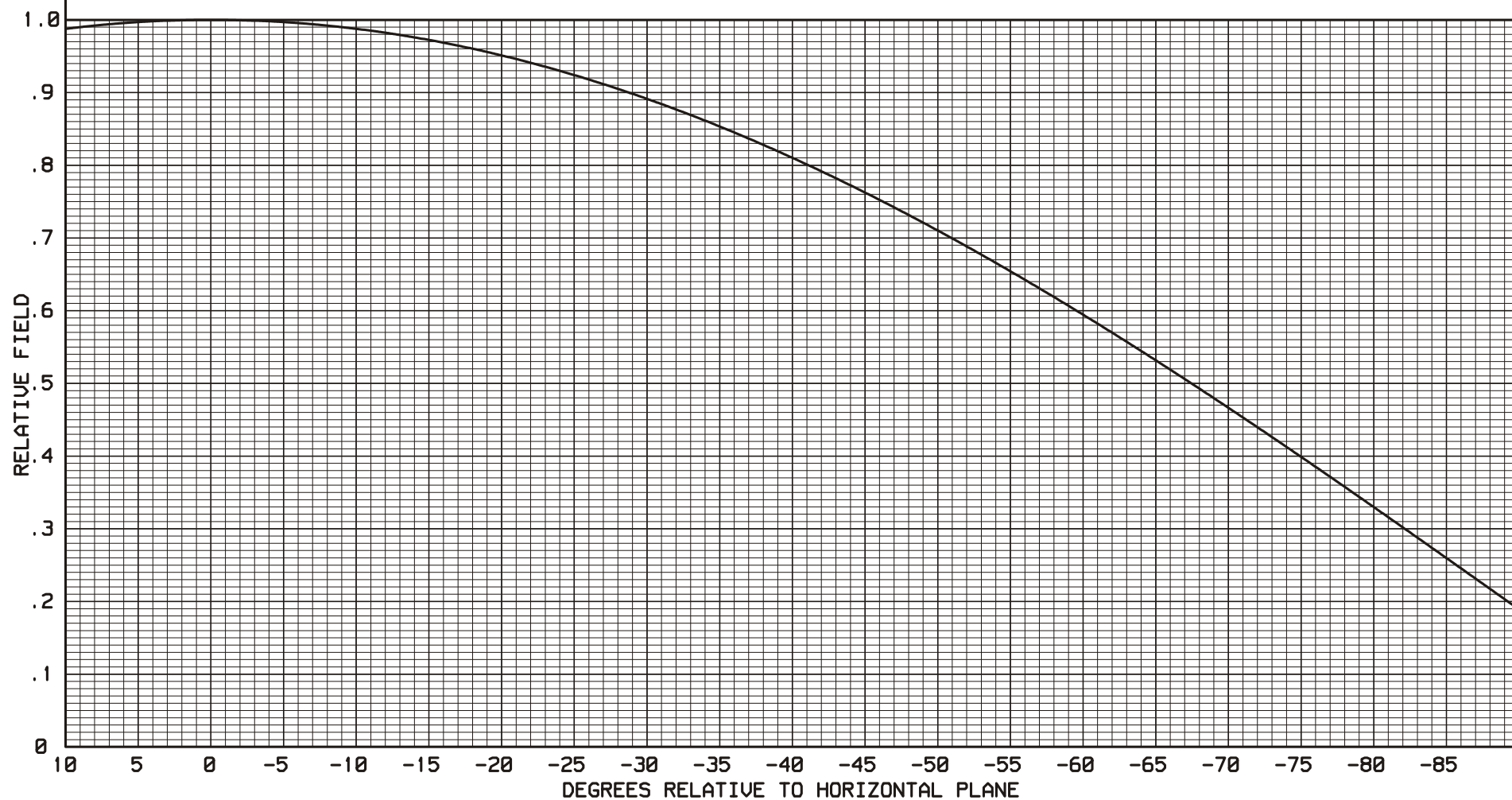
Total Input Power: 0.262 kW

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

FIGURE 3

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

ERI TYPE 1092-1CP-DA ANTENNA
0 DEGREE BEAM TILT
0 PERCENT NULL FILL



Directional Antenna System for WYQS, Mars Hill, North Carolina

(Continued)

ANTENNA SPECIFICATIONS

Antenna Type:	1092-1CP-DA
Frequency:	90.5 MHz
Number of Bays:	One

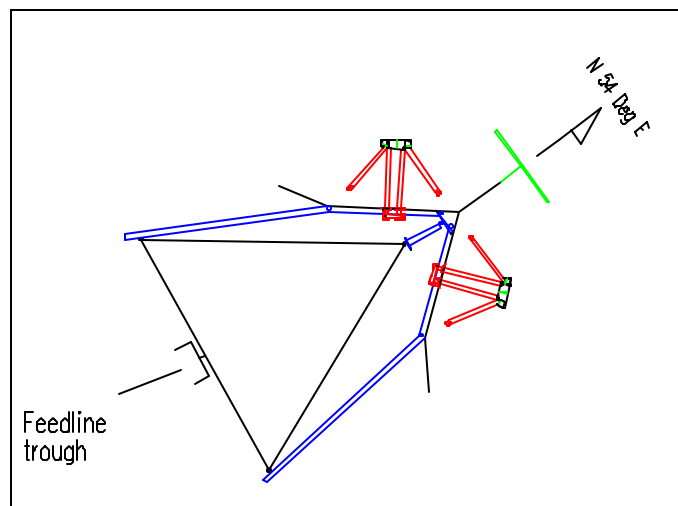
MECHANICAL SPECIFICATIONS

Mounting:	Custom
System length:	10 ft
Aperture length required:	20 ft.
Orientation:	54° true
Input flange to the antenna	1 5/8 inch female

ELECTRICAL SPECIFICATIONS

(For directional use)

Maximum horizontal ERP:	0.250 kW (-6.021 dBk)
Horizontal maximum power gain:	0.955 (-0.201 dB)
Maximum vertical ERP:	0.250 kW (-6.021 dBk)
Vertical maximum power gain:	0.955 (-0.201 dB)
Total input power:	0.262 kW (-5.82 dBk)



8

7

6

5

4

3

2

1

REVISIONS				DATE	APPROVED
ZONE	REV	DESCRIPTION			
A	UPDATE	FEED TROUGH		08/4/28	G.H.

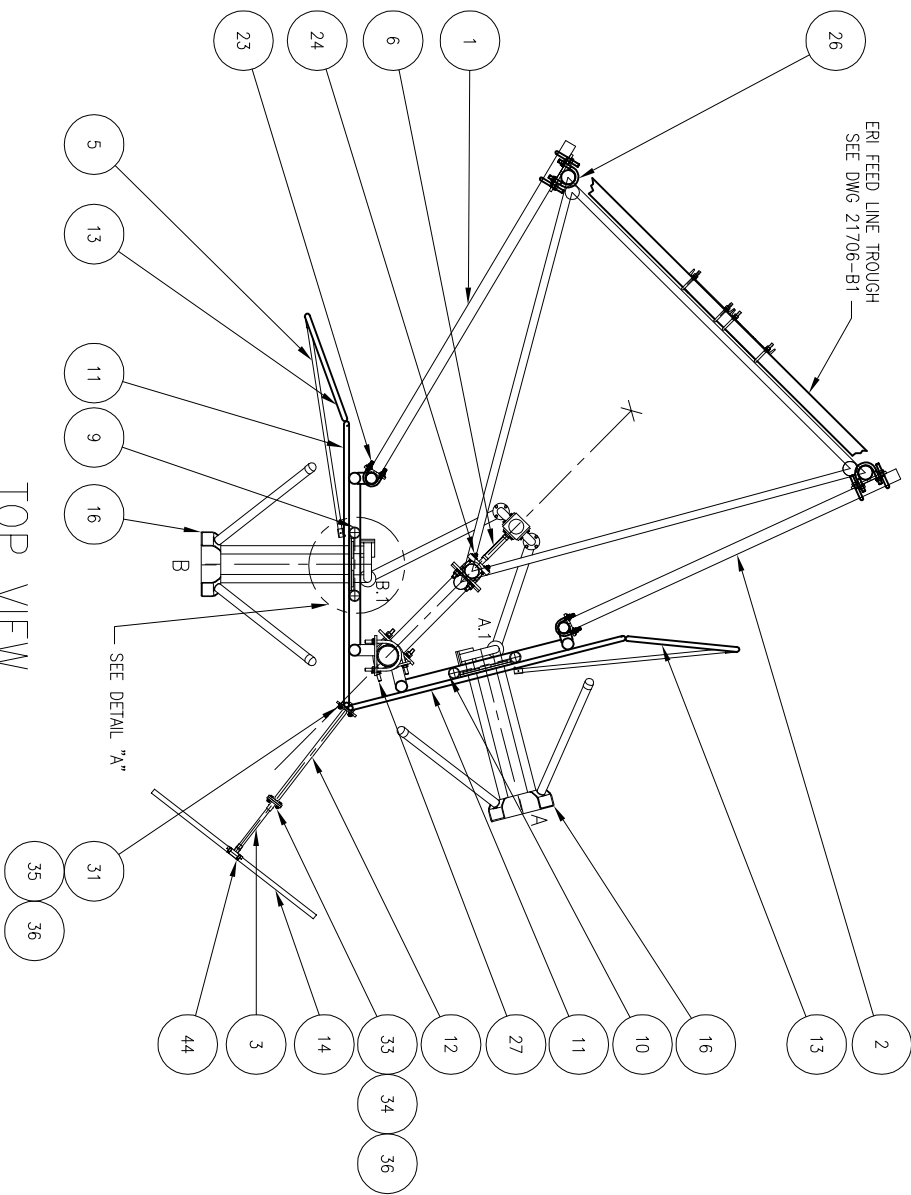
NOTES: (UNLESS OTHERWISE SPECIFIED)
1. ALL RED BANDS DESIGNATE SIDE TO BE MOUNTED DOWNWARD.
ALL FEED HARNESS CONNECTIONS ARE LABELED AND MUST BE
MATCHED WHEN ASSEMBLING.

2 A STAINLESS STEEL FLATWASHER MUST BE BETWEEN ELEMENT
MOUNT PLATE, WHICH IS BRASS, AND PLATE ON FRAME, WHICH
HAS BEEN GALVANIZED, DUE TO CORROSIVE REACTION BETWEEN
GALVANIZED STEEL AND BRASS.

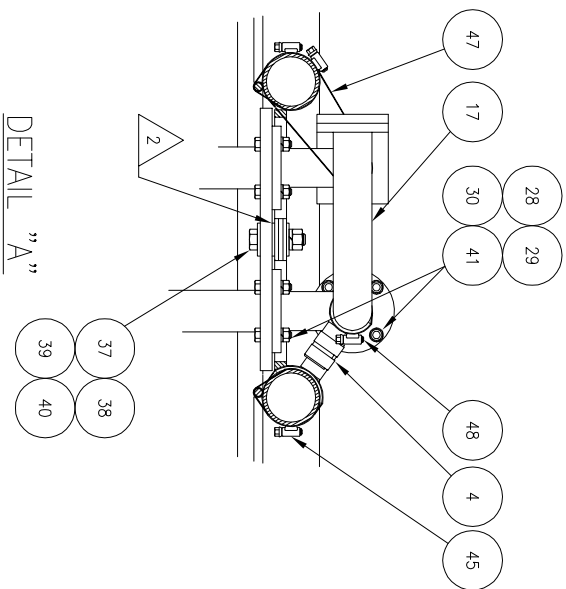
3 HORIZONTAL PARASITES ARE LOCATED 1/4 WAVE ABOVE AND BELOW
BAY LEVEL.

4 HELIX MUST BE SECURED TO THE TOWER LEGS, HORIZONTALS,
DIAGONALS ETC. W/ BLACK CABLE TIES, BEAM CLAMPS AND/OR
BUTTERFLY HANGERS TO PREVENT MOVEMENT AND POSSIBLE DAMAGE.

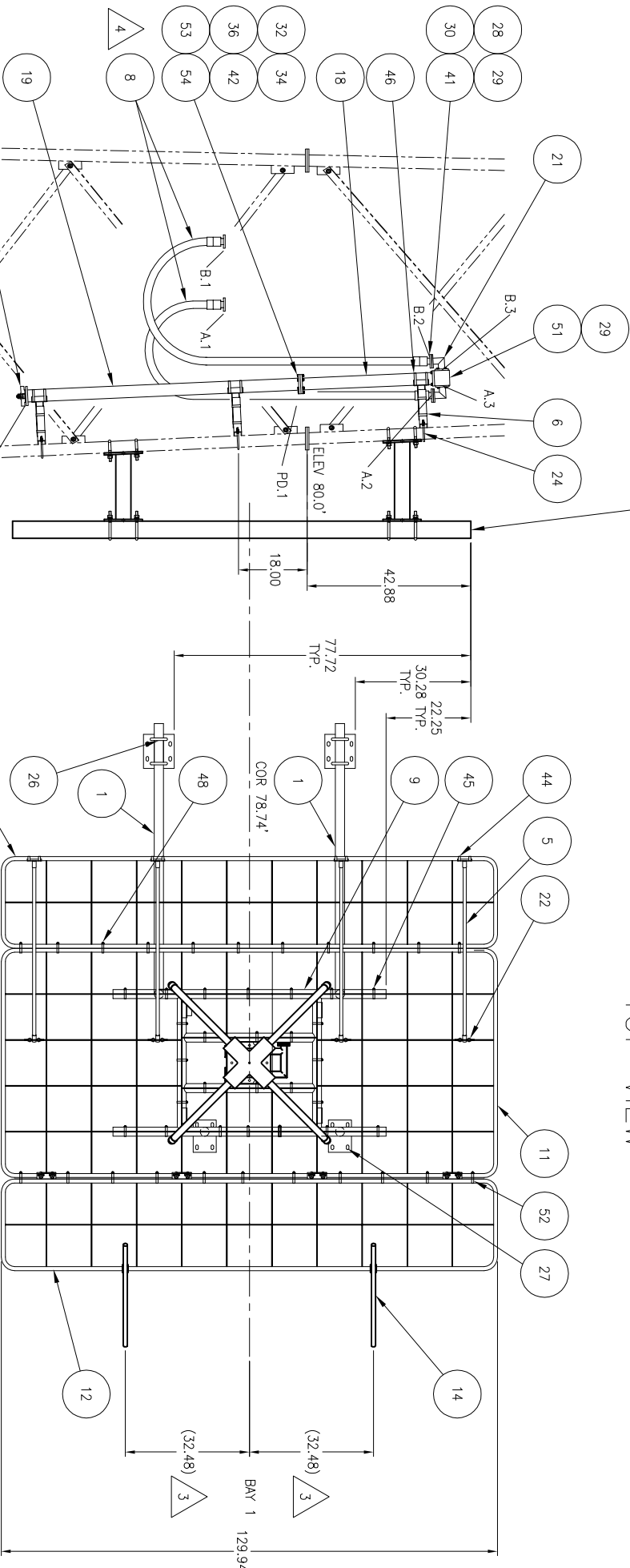
7. FINAL ORIENTATION TO BE DETERMINED BY LICENSED SURVEYOR.



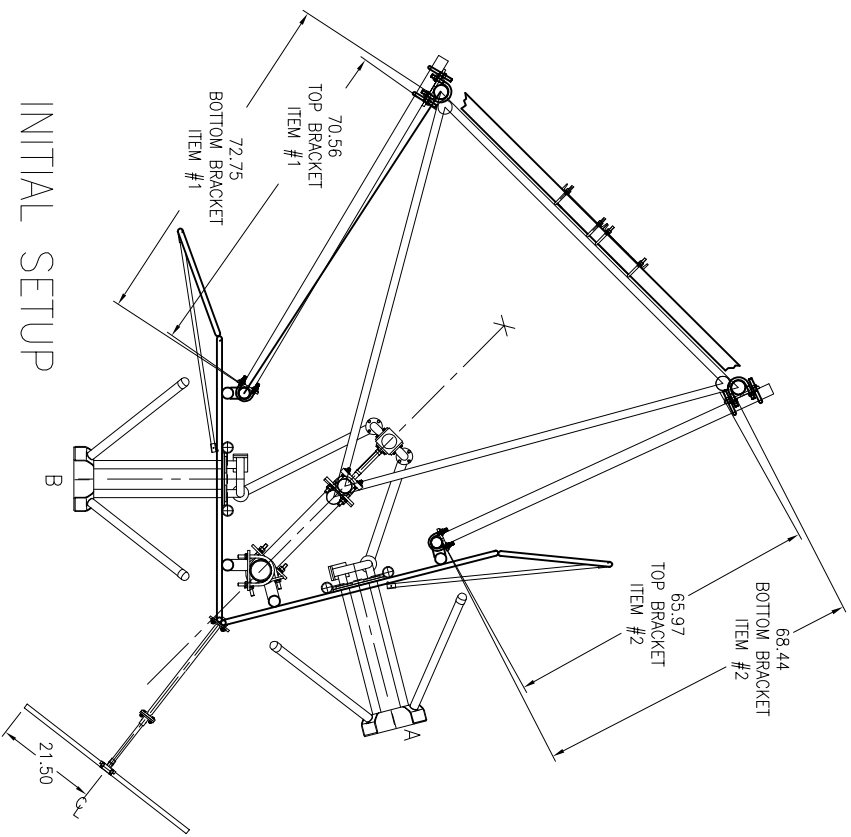
TOP VIEW



DETAIL "A"



INITIAL SETUP



INITIAL SETUP

A

B

C

D

A

B

C

D


5

4

3

2

1

SPECIFICATIONS		FINISH	MATERIAL	UNLESS OTHERWISE SPECIFIED	DRAWN BY	DATE	PART NO.	DESCRIPTION	ITEM NO.	
WFG	INSPECTION	TEST	—	1. PLACE DECIMALS ± .030 2. PLACE DECIMALS ± .010 3. PLACE DECIMALS ± .003 ANGLE 1/2°	L. SEIBERT	08/4/18				
—	—	—	ALL SURFACES	UNLESS OTHERWISE SPECIFIED	S. DEOM	08/4/24				
—	—	—	—	—	G. HUMBERT	08/4/24				
THIRD ANGLE PROJECTION										
										
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<p>1092-10P-DA/ MARS HILL, NC/ WQ93-90.5 MHz</p>										
<p>SCALE 1:20 TITLE NO. I2A21706-2 SHEET 1 OF 1</p>										
<p>ELETTRONICS RESEARCH, INC. 47700 Glenview Road, Suite 400, Glenview, IL 60045-4000 Phone: (847) 892-4000 Fax: (847) 892-4000 Website: www.erinc.com</p>										

8

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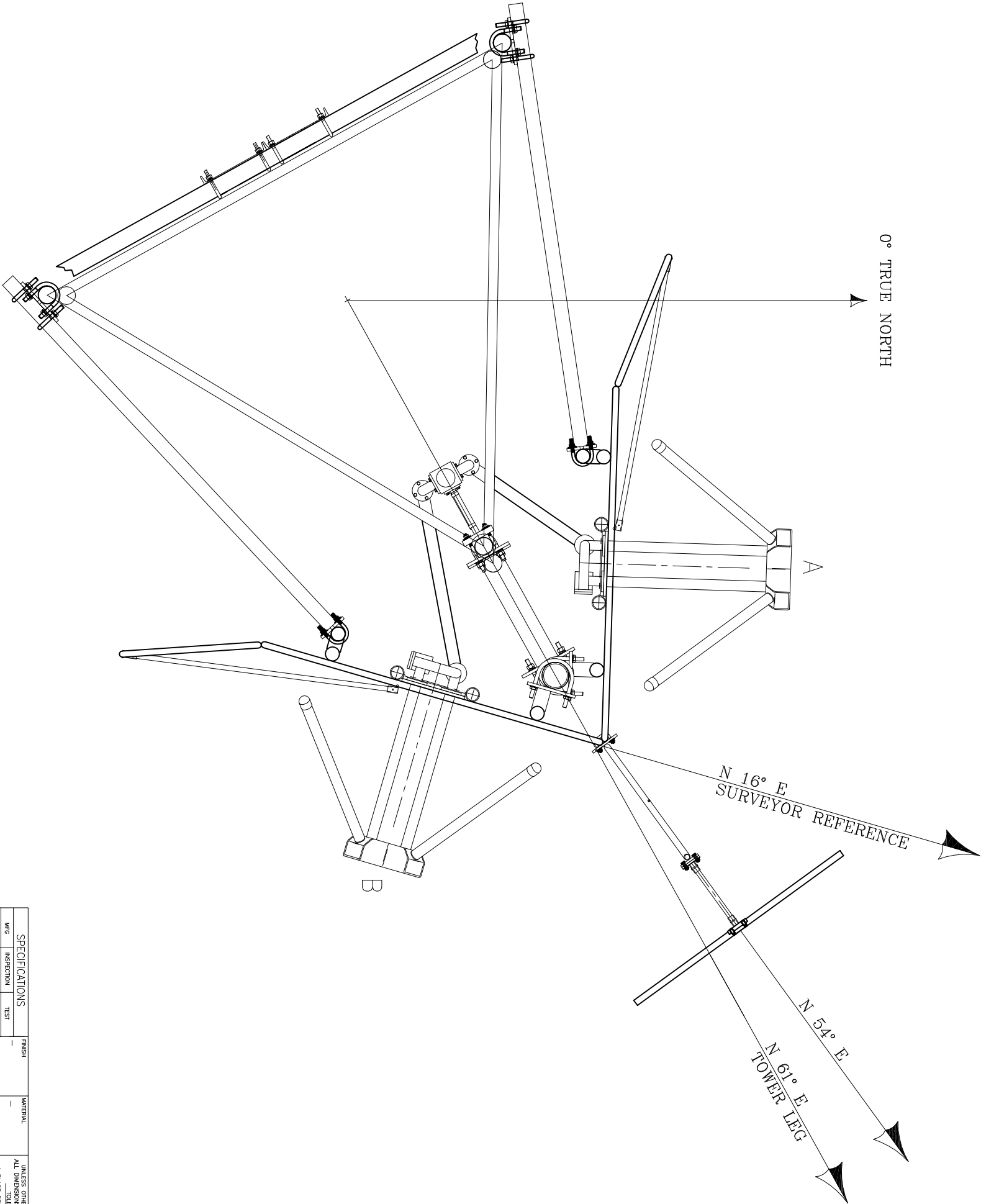
3


2

1

NOTES: (UNLESS OTHERWISE SPECIFIED)
1. INTERPRET DRAWING PER ASME Y14.5M-1994.

REVISIONS			
ZONE	REV	DESCRIPTION	DATE
	A	UPDATE FEED TROUGH	08/4/28
			G.H.



SPECIFICATIONS		FINISH		MATERIAL		UNLESS OTHERWISE SPECIFIED	
WFO	INSPECTION	TEST	—	—	—	ALL DIMENSIONS UNLESS IN INCHES	—
—	—	—	—	—	—	1 PLACE DECIMALS ± .020	—
—	—	—	—	—	—	2 PLACE DECIMALS ± .010	—
—	—	—	—	—	—	3 PLACE DECIMALS ± .005	—
THIRD ANGLE PROJECTION		ALL SURFACES		UNLESS OTHERWISE SPECIFIED		UNLESS OTHERWISE SPECIFIED	
							
<p>The quantities furnished are based on a standard of finish and are subject to change without notice. The quantities are based on a standard of finish and are subject to change without notice. The quantities are based on a standard of finish and are subject to change without notice. The quantities are based on a standard of finish and are subject to change without notice. The quantities are based on a standard of finish and are subject to change without notice. The quantities are based on a standard of finish and are subject to change without notice. The quantities are based on a standard of finish and are subject to change without notice. The quantities are based on a standard of finish and are subject to change without notice. The quantities are based on a standard of finish and are subject to change without notice. The quantities are based on a standard of finish and are subject to change without notice. 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