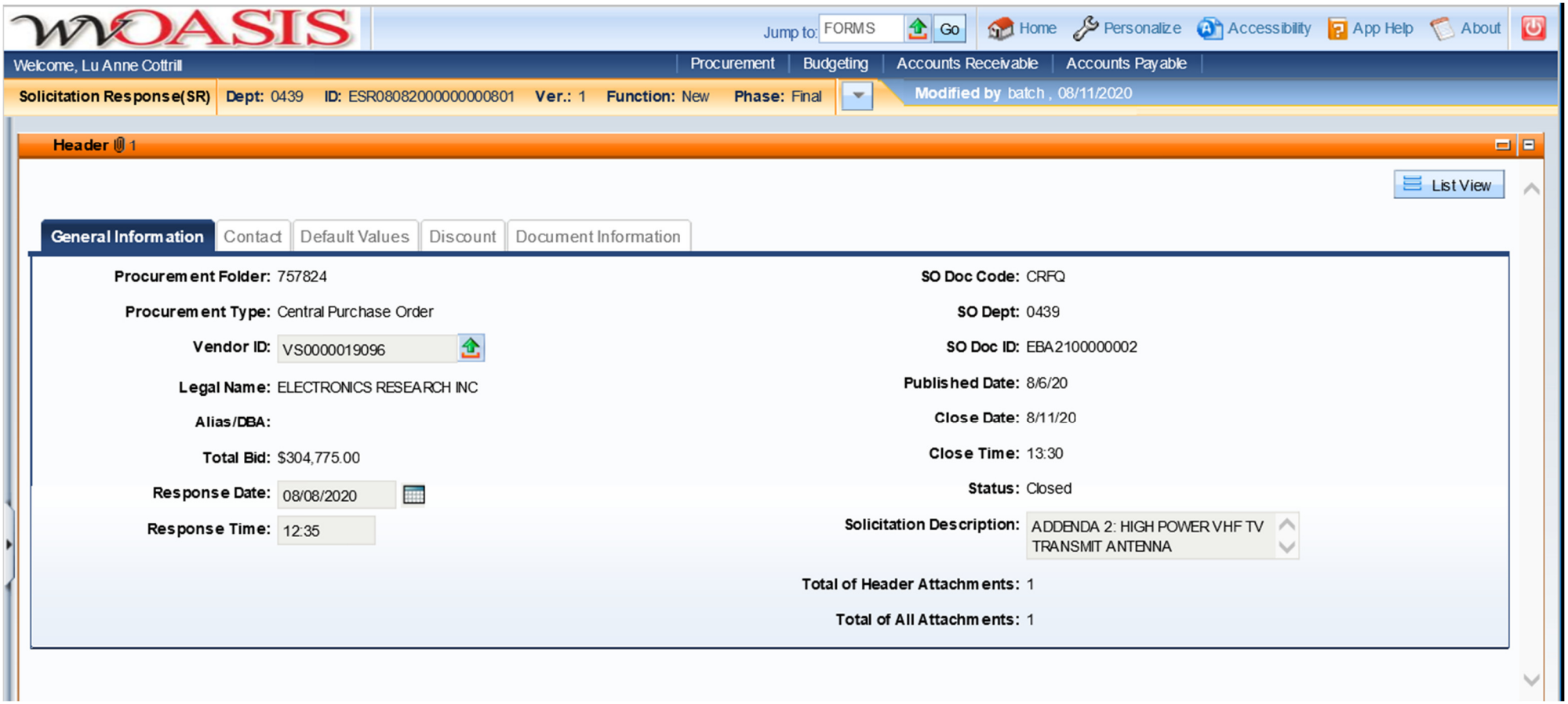
The following documentation is an electronically-submitted vendor response to an advertised solicitation from the *West Virginia Purchasing Bulletin* within the Vendor Self-Service portal at ***wvOASIS.gov***. As part of the State of West Virginia's procurement process, and to maintain the transparency of the bid-opening process, this documentation submitted online is publicly posted by the West Virginia Purchasing Division at ***WVPurchasing.gov*** with any other vendor responses to this solicitation submitted to the Purchasing Division in hard copy format.


wvOASIS
Jump to: FORMS Go
Home
Personalize
Accessibility
App Help
About
Welcome, Lu Anne Cottrill
Procurement
Budgeting
Accounts Receivable
Accounts Payable
Solicitation Response(SR) Dept: 0439 ID: ESR08082000000000801 Ver.: 1 Function: New Phase: Final
Modified by batch , 08/11/2020
Header 1
List View
General Information
Contact
Default Values
Discount
Document Information
Procurement Folder: 757824
Procurement Type: Central Purchase Order
Vendor ID: VS0000019096
Legal Name: ELECTRONICS RESEARCH INC
Alias/DBA:
Total Bid: $304,775.00
Response Date: 08/08/2020
Response Time: 12:35
SO Doc Code: CRFQ
SO Dept: 0439
SO Doc ID: EBA2100000002
Published Date: 8/6/20
Close Date: 8/11/20
Close Time: 13:30
Status: Closed
Solicitation Description: ADDENDA 2: HIGH POWER VHF TV TRANSMIT ANTENNA
Total of Header Attachments: 1
Total of All Attachments: 1

Purchasing Division
2019 Washington Street East
Post Office Box 50130
Charleston, WV 25305-0130

State of West Virginia
Solicitation Response

Proc Folder : 757824

Solicitation Description : ADDENDA 2: HIGH POWER VHF TV TRANSMIT ANTENNA

Proc Type : Central Purchase Order

Date issued	Solicitation Closes	Solicitation Response	Version
	2020-08-11 13:30:00	SR 0439 ESR08082000000000801	1

VENDOR

VS0000019096

ELECTRONICS RESEARCH INC

Solicitation Number: CRFQ 0439 EBA2100000002

Total Bid : $304,775.00 **Response Date:** 2020-08-08 **Response Time:** 12:35:32

Comments:

FOR INFORMATION CONTACT THE BUYER

Dusty J Smith

(304) 558-2063
dusty.j.smith@wv.gov

Signature on File **FEIN #** **DATE**

All offers subject to all terms and conditions contained in this solicitation

Line	Comm Ln Desc	Qty	Unit Issue	Unit Price	Ln Total Or Contract Amount
1	HIGH POWER VHF TV TRANSMIT ANTENNA	1.00000	EA	$304,775.000000	$304,775.00

Comm Code	Manufacturer	Specification	Model #
43221703			

Extended Description : HIGH POWER VHF TV TRANSMIT ANTENNA

Comments: Delivery is for the interim antenna and transmission line. The new main antenna proposed will ship 150 days ARO.

Electronics Research, Inc.
Response to
State of West Virginia
West Virginia Educational Broadcasting Authority
WVPB-TV, Huntington, West Virginia
Solicitation Number: CRFQ 0439 EBA2100000002
High Power VHF Television Transmit Antenna

ERI Proposal Number: 20200723-068
CRFQ Response Due: August 11, 2020 by 1:30 pm EDT

Submitted To:

Ms. Dusty Jo Smith
Department of Administration
Purchasing Division
State of West Virginia
2019 Washington Street East
Charleston, WV 25305-0130

ERI Contact:

Bill Harland
Vice President of Marketing
ELECTRONICS RESEARCH, INC.
Telephone: +1 (812) 925-6000, Ext. 214
Facsimile: +1 (812) 925-4030
Mobile: +1 (812) 455-1823
E- mail: bharland@eriinc.com

Table of Contents

Executive Summary:

Electronics Research, Inc. submits this bid response to provide a new top mounted high band VHF TRASAR® television antenna with a 1181-foot run of 3-1/8-inch MACXLine® rigid coaxial transmission line. Along with the equipment proposed ERI will also provide an ERI Field Service Technician to sweep the transmission line and antenna, after installation by a customer supplied tower crew, and optimize the system match, using the high band VHF fine matchers included in the transmission line components proposed. This response includes the executed forms required with the bid response, a detailed proposal outlining the items to be supplied, a comprehensive preliminary specification for the TRASAR® high band VHF television antenna proposed, product information on the individual components included in the ERI proposal, and information on ERI's background, facilities and experience in furnishing broadcast transmission equipment.

The top-mounted antenna proposed, which we believe meets the major requirements for the main WVPB-TV RF Channel 9 television antenna cannot be delivered in the 60-day specified in Section 6.1 of the Solicitation-Specifications. To accommodate this requirement ERI has proposed to supply an interim antenna and 493-feet of 3-inch Air HELIAX® which will be delivered within 35 days of being awarded a contract and receiving a purchase order or notice to proceed. This will provide a means to operate the facility until the main antenna and transmission line are delivered at 150-days after receiving a contract and purchase order or notice to proceed.

ERI has also included in the bid response a clear explanation of any other the exceptions taken the items listed in the Instructions to Vendors Submitting Bids and to the High-Power VHF Television Antenna Specifications included in the solicitation. Those exceptions can be found on page 46 of this document.

Respectfully submitted,

ELECTRONICS RESEARCH, INC.

Bill Harland
Vice President of Marketing
+1 (812) 925-6000, Ext. 214
+1 (812) 455-1823 (cell)
bharland@eriinc.com

Purchasing Divison
2019 Washington Street East
Post Office Box 50130
Charleston, WV 25305-0130

State of West Virginia
Request for Quotation
13 — Equipment

Proc Folder: 757824

Doc Description: ADDENDA 2: HIGH POWER VHF TV TRANSMIT ANTENNA

Proc Type: Central Purchase Order

Date Issued	Solicitation Closes	Solicitation No	Version
2020-08-06	2020-08-11 13:30:00	CRFQ 0439 EBA2100000002	3

BID RECEIVING LOCATION

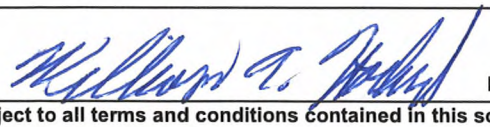
BID CLERK
DEPARTMENT OF ADMINISTRATION
PURCHASING DIVISION
2019 WASHINGTON ST E
CHARLESTON WV 25305
US

VENDOR

Vendor Name, Address and Telephone Number:
Electronics Research, Inc.
7777 Gardner Road
Chandler, IN 47610
Bill Harland, Vice President of Marketing
+1 (812) 925-6000, Ext. 214 (office)
bharland@eriinc.com

FOR INFORMATION CONTACT THE BUYER

Dusty J Smith
(304) 558-2063
dusty.j.smith@wv.gov

Signature X  **FEIN #** 35-1083384 **DATE** August 7, 2020

All offers subject to all terms and conditions contained in this solicitation

ADDITIONAL INFORMATION:

ADDENDUM 2 IS ISSUED FOR THE FOLLOWING REASONS:

1. AGENCY RESPONSES TO VENDORS QUESTIONS

BILL OPENING AND TIME WILL REMAIN THE SAME.

NO OTHER CHANGES

INVOICE TO	SHIP TO
CHIEF FINANCIAL OFFICER	PURCHASING ADMINISTRATOR
EDUCATIONAL BROADCASTING	EDUCATIONAL BROADCASTING
124 INDUSTRIAL PARK RD	600 CAPITOL ST
BEAVER WV 25813	CHARLESTON WV 25301-1223
US	US

Line	Comm Ln Desc	Qty	Unit Issue	Unit Price	Total Price
1	HIGH POWER VHF TV TRANSMIT ANTENNA	1.00000	EA	$304,775.00	$304,775.00

Comm Code	Manufacturer	Specification	Model #
43221703	Electronics Research, Inc. (ERI)	20200723-068-1	ATW6V5-ETP-9H TRASAR®

Extended Description :

HIGH POWER VHF TV TRANSMIT ANTENNA

SCHEDULE OF EVENTS

Line	Event	Event Date
1	TECHNICAL QUESTIONS DUE AT 10AM	2020-07-30

ADDITIONAL TERMS AND CONDITIONS

See attached document(s) for additional Terms and Conditions

INSTRUCTIONS TO VENDORS SUBMITTING BIDS

1. REVIEW DOCUMENTS THOROUGHLY: The attached documents contain a solicitation for bids. Please read these instructions and all documents attached in their entirety. These instructions provide critical information about requirements that if overlooked could lead to disqualification of a Vendor's bid. All bids must be submitted in accordance with the provisions contained in these instructions and the Solicitation. Failure to do so may result in disqualification of Vendor's bid.

2. MANDATORY TERMS: The Solicitation may contain mandatory provisions identified by the use of the words "must," "will," and "shall." Failure to comply with a mandatory term in the Solicitation will result in bid disqualification.

3. PREBID MEETING: The item identified below shall apply to this Solicitation.

☑ A pre-bid meeting will not be held prior to bid opening

☐ A **MANDATORY PRE-BID** meeting will be held at the following place and time:

All Vendors submitting a bid must attend the mandatory pre-bid meeting. Failure to attend the mandatory pre-bid meeting shall result in disqualification of the Vendor's bid. No one individual is permitted to represent more than one vendor at the pre-bid meeting. Any individual that does attempt to represent two or more vendors will be required to select one vendor to which the individual's attendance will be attributed. The vendors not selected will be deemed to have not attended the pre-bid meeting unless another individual attended on their behalf.

An attendance sheet provided at the pre-bid meeting shall serve as the official document verifying attendance. Any person attending the pre-bid meeting on behalf of a Vendor must list on the attendance sheet his or her name and the name of the Vendor he or she is representing.

Additionally, the person attending the pre-bid meeting should include the Vendor's E-Mail address, phone number, and Fax number on the attendance sheet. It is the Vendor's responsibility to locate the attendance sheet and provide the required information. Failure to complete the attendance sheet as required may result in disqualification of Vendor's bid.

All Vendors should arrive prior to the starting time for the pre-bid. Vendors who arrive after the starting time but prior to the end of the pre-bid will be permitted to sign in but are charged with knowing all matters discussed at the pre-bid.

Questions submitted at least five business days prior to a scheduled pre-bid will be discussed at the pre-bid meeting if possible. Any discussions or answers to questions at the pre-bid meeting

are preliminary in nature and are non-binding. Official and binding answers to questions will be published in a written addendum to the Solicitation prior to bid opening.

4. VENDOR QUESTION DEADLINE: Vendors may submit questions relating to this Solicitation to the Purchasing Division. Questions must be submitted in writing. All questions must be submitted on or before the date listed below and to the address listed below in order to be considered. A written response will be published in a Solicitation addendum if a response is possible and appropriate. Non-written discussions, conversations, or questions and answers regarding this Solicitation are preliminary in nature and are nonbinding.

Submitted e-mails should have solicitation number in the subject line.

Question Submission Deadline: 07/30/2020 10:00am

Submit Questions to: DUSTY SMITH
2019 Washington Street, East
Charleston, WV 25305
Fax: (304) 558-4115 (Vendors should not use this fax number for bid submission)
Email: DUSTY.J.SMITH@WV.GOV

5. VERBAL COMMUNICATION: Any verbal communication between the Vendor and any State personnel is not binding, including verbal communication at the mandatory pre-bid conference. Only information issued in writing and added to the Solicitation by an official written addendum by the Purchasing Division is binding.

6. BID SUBMISSION: All bids must be submitted electronically through wvOASIS or signed and delivered by the Vendor to the Purchasing Division at the address listed below on or before the date and time of the bid opening. Any bid received by the Purchasing Division staff is considered to be in the possession of the Purchasing Division and will not be returned for any reason. The Purchasing Division will not accept bids, modification of bids, or addendum acknowledgment forms via e-mail. Acceptable delivery methods include electronic submission via wvOASIS, hand delivery, delivery by courier, or facsimile.

The bid delivery address is:
Department of Administration, Purchasing Division
2019 Washington Street East
Charleston, WV 25305-0130

A bid that is not submitted electronically through wvOASIS should contain the information listed below on the face of the envelope or the bid may be rejected by the Purchasing Division.:

SEALED BID: HIGH POWER VHF TV TRANSMIT ANTENNA
BUYER: DUSTY SMITH
SOLICITATION NO.: CRFQ EBA2100000002
BID OPENING DATE: 08/06/2020
BID OPENING TIME: 1:30PM
FAX NUMBER: 304-558-3970

The Purchasing Division may prohibit the submission of bids electronically through wvOASIS at its sole discretion. Such a prohibition will be contained and communicated in the wvOASIS system resulting in the Vendor's inability to submit bids through wvOASIS. Submission of a response to an Expression or Interest or Request for Proposal is not permitted in wvOASIS.

For Request For Proposal ("RFP") Responses Only: In the event that Vendor is responding to a request for proposal, the Vendor shall submit one original technical and one original cost proposal plus n/a convenience copies of each to the Purchasing Division at the address shown above. Additionally, the Vendor should identify the bid type as either a technical or cost proposal on the face of each bid envelope submitted in response to a request for proposal as follows:

BID TYPE: (This only applies to CRFP)
☐ Technical
☐ Cost

7. BID OPENING: Bids submitted in response to this Solicitation will be opened at the location identified below on the date and time listed below. Delivery of a bid after the bid opening date and time will result in bid disqualification. For purposes of this Solicitation, a bid is considered delivered when confirmation of delivery is provided by wvOASIS (in the case of electronic submission) or when the bid is time stamped by the official Purchasing Division time clock (in the case of hand delivery).

Bid Opening Date and Time: AUGUST 6TH 2020 1:30PM

Bid Opening Location: Department of Administration, Purchasing Division
2019 Washington Street East
Charleston, WV 25305-0130

8. ADDENDUM ACKNOWLEDGEMENT: Changes or revisions to this Solicitation will be made by an official written addendum issued by the Purchasing Division. Vendor should acknowledge receipt of all addenda issued with this Solicitation by completing an Addendum Acknowledgment Form, a copy of which is included herewith. Failure to acknowledge addenda may result in bid disqualification. The addendum acknowledgement should be submitted with the bid to expedite document processing.

9. BID FORMATTING: Vendor should type or electronically enter the information onto its bid to prevent errors in the evaluation. Failure to type or electronically enter the information may result in bid disqualification.

10. ALTERNATE MODEL OR BRAND: Unless the box below is checked, any model, brand, or specification listed in this Solicitation establishes the acceptable level of quality only and is not intended to reflect a preference for, or in any way favor, a particular brand or vendor. Vendors may bid alternates to a listed model or brand provided that the alternate is at least equal to the model or brand and complies with the required specifications. The equality of any alternate being bid shall be determined by the State at its sole discretion. Any Vendor bidding an alternate model or brand should clearly identify the alternate items in its bid and should include manufacturer's specifications, industry literature, and/or any other relevant documentation demonstrating the

equality of the alternate items. Failure to provide information for alternate items may be grounds for rejection of a Vendor's bid.

☐ This Solicitation is based upon a standardized commodity established under W. Va. Code § 5A-3-61. Vendors are expected to bid the standardized commodity identified. Failure to bid the standardized commodity will result in your firm's bid being rejected.

11. EXCEPTIONS AND CLARIFICATIONS: The Solicitation contains the specifications that shall form the basis of a contractual agreement. Vendor shall clearly mark any exceptions, clarifications, or other proposed modifications in its bid. Exceptions to, clarifications of, or modifications of a requirement or term and condition of the Solicitation may result in bid disqualification.

12. COMMUNICATION LIMITATIONS: In accordance with West Virginia Code of State Rules §148-1-6.6, communication with the State of West Virginia or any of its employees regarding this Solicitation during the solicitation, bid, evaluation or award periods, except through the Purchasing Division, is strictly prohibited without prior Purchasing Division approval. Purchasing Division approval for such communication is implied for all agency delegated and exempt purchases.

13. REGISTRATION: Prior to Contract award, the apparent successful Vendor must be properly registered with the West Virginia Purchasing Division and must have paid the $125 fee, if applicable.

14. UNIT PRICE: Unit prices shall prevail in cases of a discrepancy in the Vendor's bid.

15. PREFERENCE: Vendor Preference may be requested in purchases of motor vehicles or construction and maintenance equipment and machinery used in highway and other infrastructure projects. Any request for preference must be submitted in writing with the bid, must specifically identify the preference requested with reference to the applicable subsection of West Virginia Code § 5A-3-37, and must include with the bid any information necessary to evaluate and confirm the applicability of the requested preference. A request form to help facilitate the request can be found at:
http://www.state.wv.us/admin/purchase/vrc/Venpref.pdf.

15A. RECIPROCAL PREFERENCE: The State of West Virginia applies a reciprocal preference to all solicitations for commodities and printing in accordance with W. Va. Code § 5A-3-37(b). In effect, non-resident vendors receiving a preference in their home states, will see that same preference granted to West Virginia resident vendors bidding against them in West Virginia. Any request for reciprocal preference must include with the bid any information necessary to evaluate and confirm the applicability of the preference. A request form to help facilitate the request can be found at: http://www.state.wv.us/admin/purchase/vrc/Venpref.pdf.

16. SMALL, WOMEN-OWNED, OR MINORITY-OWNED BUSINESSES: For any solicitations publicly advertised for bid, in accordance with West Virginia Code §5A-3-37(a)(7) and W. Va. CSR § 148-22-9, any non-resident vendor certified as a small, women-owned, or minority-owned business under W. Va. CSR § 148-22-9 shall be provided the same preference made available to any resident vendor. Any non-resident small, women-owned, or

minority-owned business must identify itself as such in writing, must submit that writing to the Purchasing Division with its bid, and must be properly certified under W. Va. CSR § 148-22-9 prior to contract award to receive the preferences made available to resident vendors. Preference for a non-resident small, women-owned, or minority owned business shall be applied in accordance with W. Va. CSR § 148-22-9.

17. WAIVER OF MINOR IRREGULARITIES: The Director reserves the right to waive minor irregularities in bids or specifications in accordance with West Virginia Code of State Rules § 148-1-4.6.

18. ELECTRONIC FILE ACCESS RESTRICTIONS: Vendor must ensure that its submission in wvOASIS can be accessed and viewed by the Purchasing Division staff immediately upon bid opening. The Purchasing Division will consider any file that cannot be immediately accessed and viewed at the time of the bid opening (such as, encrypted files, password protected files, or incompatible files) to be blank or incomplete as context requires, and are therefore unacceptable. A vendor will not be permitted to unencrypt files, remove password protections, or resubmit documents after bid opening to make a file viewable if those documents are required with the bid. A Vendor may be required to provide document passwords or remove access restrictions to allow the Purchasing Division to print or electronically save documents provided that those documents are viewable by the Purchasing Division prior to obtaining the password or removing the access restriction.

19. NON-RESPONSIBLE: The Purchasing Division Director reserves the right to reject the bid of any vendor as Non-Responsible in accordance with W. Va. Code of State Rules § 148-1-5.3, when the Director determines that the vendor submitting the bid does not have the capability to fully perform, or lacks the integrity and reliability to assure good-faith performance."

20. ACCEPTANCE/REJECTION: The State may accept or reject any bid in whole, or in part in accordance with W. Va. Code of State Rules § 148-1-4.5. and § 148-1-6.4.b."

21. YOUR SUBMISSION IS A PUBLIC DOCUMENT: Vendor's entire response to the Solicitation and the resulting Contract are public documents. As public documents, they will be disclosed to the public following the bid/proposal opening or award of the contract, as required by the competitive bidding laws of West Virginia Code §§ 5A-3-1 et seq., 5-22-1 et seq., and 5G-1-1 et seq. and the Freedom of Information Act West Virginia Code §§ 29B-1-1 et seq.

DO NOT SUBMIT MATERIAL YOU CONSIDER TO BE CONFIDENTIAL, A TRADE SECRET, OR OTHERWISE NOT SUBJECT TO PUBLIC DISCLOSURE.

Submission of any bid, proposal, or other document to the Purchasing Division constitutes your explicit consent to the subsequent public disclosure of the bid, proposal, or document. The Purchasing Division will disclose any document labeled "confidential," "proprietary," "trade secret," "private," or labeled with any other claim against public disclosure of the documents, to include any "trade secrets" as defined by West Virginia Code § 47-22-1 et seq. All submissions are subject to public disclosure without notice.

22. INTERESTED PARTY DISCLOSURE: West Virginia Code § 6D-1-2 requires that the vendor submit to the Purchasing Division a disclosure of interested parties to the contract for all contracts with an actual or estimated value of at least $1 Million. That disclosure must occur on the form prescribed and approved by the WV Ethics Commission prior to contract award. A copy of that form is included with this solicitation or can be obtained from the WV Ethics Commission. This requirement does not apply to publicly traded companies listed on a national or international stock exchange. A more detailed definition of interested parties can be obtained from the form referenced above.

23. WITH THE BID REQUIREMENTS: In instances where these specifications require documentation or other information with the bid, and a vendor fails to provide it with the bid, the Director of the Purchasing Division reserves the right to request those items after bid opening and prior to contract award pursuant to the authority to waive minor irregularities in bids or specifications under W. Va. CSR § 148-1-4.6. This authority does not apply to instances where state law mandates receipt with the bid.

GENERAL TERMS AND CONDITIONS:

1. CONTRACTUAL AGREEMENT: Issuance of a Award Document signed by the Purchasing Division Director, or his designee, and approved as to form by the Attorney General's office constitutes acceptance of this Contract made by and between the State of West Virginia and the Vendor. Vendor's signature on its bid signifies Vendor's agreement to be bound by and accept the terms and conditions contained in this Contract.

2. DEFINITIONS: As used in this Solicitation/Contract, the following terms shall have the meanings attributed to them below. Additional definitions may be found in the specifications included with this Solicitation/Contract.

2.1. "Agency" or **"Agencies"** means the agency, board, commission, or other entity of the State of West Virginia that is identified on the first page of the Solicitation or any other public entity seeking to procure goods or services under this Contract.

2.2. "Bid" or **"Proposal"** means the vendors submitted response to this solicitation.

2.3. "Contract" means the binding agreement that is entered into between the State and the Vendor to provide the goods or services requested in the Solicitation.

2.4. "Director" means the Director of the West Virginia Department of Administration, Purchasing Division.

2.5. "Purchasing Division" means the West Virginia Department of Administration, Purchasing Division.

2.6. "Award Document" means the document signed by the Agency and the Purchasing Division, and approved as to form by the Attorney General, that identifies the Vendor as the contract holder.

2.7. "Solicitation" means the official notice of an opportunity to supply the State with goods or services that is published by the Purchasing Division.

2.8. "State" means the State of West Virginia and/or any of its agencies, commissions, boards, etc. as context requires.

2.9. "Vendor" or **"Vendors"** means any entity submitting a bid in response to the Solicitation, the entity that has been selected as the lowest responsible bidder, or the entity that has been awarded the Contract as context requires.

3. CONTRACT TERM; RENEWAL; EXTENSION: The term of this Contract shall be determined in accordance with the category that has been identified as applicable to this Contract below:

☐ **Term Contract**

Initial Contract Term: Initial Contract Term: This Contract becomes effective on _____ and extends for a period of _____year(s).

Renewal Term: This Contract may be renewed upon the mutual written consent of the Agency, and the Vendor, with approval of the Purchasing Division and the Attorney General's office (Attorney General approval is as to form only). Any request for renewal should be delivered to the Agency and then submitted to the Purchasing Division thirty (30) days prior to the expiration date of the initial contract term or appropriate renewal term. A Contract renewal shall be in accordance with the terms and conditions of the original contract. Unless otherwise specified below, renewal of this Contract is limited to _____ successive one (1) year periods or multiple renewal periods of less than one year, provided that the multiple renewal periods do not exceed the total number of months available in all renewal years combined. Automatic renewal of this Contract is prohibited. Renewals must be approved by the Vendor, Agency, Purchasing Division and Attorney General's office (Attorney General approval is as to form only)

☐ **Alternate Renewal Term** – This contract may be renewed for _____ successive _____ year periods or shorter periods provided that they do not exceed the total number of months contained in all available renewals. Automatic renewal of this Contract is prohibited. Renewals must be approved by the Vendor, Agency, Purchasing Division and Attorney General's office (Attorney General approval is as to form only)

Delivery Order Limitations: In the event that this contract permits delivery orders, a delivery order may only be issued during the time this Contract is in effect. Any delivery order issued within one year of the expiration of this Contract shall be effective for one year from the date the delivery order is issued. No delivery order may be extended beyond one year after this Contract has expired.

☐ **Fixed Period Contract:** This Contract becomes effective upon Vendor's receipt of the notice to proceed and must be completed within _____days.

☐ **Fixed Period Contract with Renewals:** This Contract becomes effective upon Vendor's receipt of the notice to proceed and part of the Contract more fully described in the attached specifications must be completed within _____ days. Upon completion of the work covered by the preceding sentence, the vendor agrees that maintenance, monitoring, or warranty services will be provided for _____ year(s) thereafter.

☑ **One Time Purchase:** The term of this Contract shall run from the issuance of the Award Document until all of the goods contracted for have been delivered, but in no event will this Contract extend for more than one fiscal year.

☐ **Other:** See attached.

4. NOTICE TO PROCEED: Vendor shall begin performance of this Contract immediately upon receiving notice to proceed unless otherwise instructed by the Agency. Unless otherwise specified, the fully executed Award Document will be considered notice to proceed.

5. QUANTITIES: The quantities required under this Contract shall be determined in accordance with the category that has been identified as applicable to this Contract below.

☐ **Open End Contract:** Quantities listed in this Solicitation are approximations only, based on estimates supplied by the Agency. It is understood and agreed that the Contract shall cover the quantities actually ordered for delivery during the term of the Contract, whether more or less than the quantities shown.

☐ **Service:** The scope of the service to be provided will be more clearly defined in the specifications included herewith.

☐ **Combined Service and Goods:** The scope of the service and deliverable goods to be provided will be more clearly defined in the specifications included herewith.

☑ **One Time Purchase:** This Contract is for the purchase of a set quantity of goods that are identified in the specifications included herewith. Once those items have been delivered, no additional goods may be procured under this Contract without an appropriate change order approved by the Vendor, Agency, Purchasing Division, and Attorney General's office.

6. EMERGENCY PURCHASES: The Purchasing Division Director may authorize the Agency to purchase goods or services in the open market that Vendor would otherwise provide under this Contract if those goods or services are for immediate or expedited delivery in an emergency. Emergencies shall include, but are not limited to, delays in transportation or an unanticipated increase in the volume of work. An emergency purchase in the open market, approved by the Purchasing Division Director, shall not constitute of breach of this Contract and shall not entitle the Vendor to any form of compensation or damages. This provision does not excuse the State from fulfilling its obligations under a One Time Purchase contract.

7. REQUIRED DOCUMENTS: All of the items checked below must be provided to the Purchasing Division by the Vendor as specified below.

☐ **BID BOND (Construction Only):** Pursuant to the requirements contained in W. Va. Code § 5-22-1(c), All Vendors submitting a bid on a construction project shall furnish a valid bid bond in the amount of five percent (5%) of the total amount of the bid protecting the State of West Virginia. The bid bond must be submitted with the bid.

☐ **PERFORMANCE BOND:** The apparent successful Vendor shall provide a performance bond in the amount of 100% of the contract. The performance bond must be received by the Purchasing Division prior to Contract award.

☐ **LABOR/MATERIAL PAYMENT BOND:** The apparent successful Vendor shall provide a labor/material payment bond in the amount of 100% of the Contract value. The labor/material payment bond must be delivered to the Purchasing Division prior to Contract award.

In lieu of the Bid Bond, Performance Bond, and Labor/Material Payment Bond, the Vendor may provide certified checks, cashier's checks, or irrevocable letters of credit. Any certified check, cashier's check, or irrevocable letter of credit provided in lieu of a bond must be of the same amount and delivered on the same schedule as the bond it replaces. A letter of credit submitted in lieu of a performance and labor/material payment bond will only be allowed for projects under $100,000. Personal or business checks are not acceptable. Notwithstanding the foregoing, West Virginia Code § 5-22-1 (d) mandates that a vendor provide a performance and labor/material payment bond for construction projects. Accordingly, substitutions for the performance and labor/material payment bonds for construction projects is not permitted.

☐ **MAINTENANCE BOND:** The apparent successful Vendor shall provide a two (2) year maintenance bond covering the roofing system. The maintenance bond must be issued and delivered to the Purchasing Division prior to Contract award.

☐ **LICENSE(S) / CERTIFICATIONS / PERMITS:** In addition to anything required under the Section of the General Terms and Conditions entitled Licensing, the apparent successful Vendor shall furnish proof of the following licenses, certifications, and/or permits upon request and in a form acceptable to the State. The request may be prior to or after contract award at the State's sole discretion.

☐

☐

☐

☐

The apparent successful Vendor shall also furnish proof of any additional licenses or certifications contained in the specifications regardless of whether or not that requirement is listed above.

8. INSURANCE: The apparent successful Vendor shall furnish proof of the insurance identified by a checkmark below and must include the State as an additional insured on each policy prior to Contract award. The insurance coverages identified below must be maintained throughout the life of this contract. Thirty (30) days prior to the expiration of the insurance policies, Vendor shall provide the Agency with proof that the insurance mandated herein has been continued. Vendor must also provide Agency with immediate notice of any changes in its insurance policies, including but not limited to, policy cancelation, policy reduction, or change in insurers. The apparent successful Vendor shall also furnish proof of any additional insurance requirements contained in the specifications prior to Contract award regardless of whether or not that insurance requirement is listed in this section.

Vendor must maintain:

☑ **Commercial General Liability Insurance** in at least an amount of: $1,000,000.00 per occurrence.

☐ **Automobile Liability Insurance** in at least an amount of: _____per occurrence.

☐ **Professional/Malpractice/Errors and Omission Insurance** in at least an amount of: _____per occurrence. Notwithstanding the forgoing, Vendor's are not required to list the State as an additional insured for this type of policy.

☐ **Commercial Crime and Third Party Fidelity Insurance** in an amount of: _____ per occurrence.

☐ **Cyber Liability Insurance** in an amount of: _____ per occurrence.

☐ **Builders Risk Insurance** in an amount equal to 100% of the amount of the Contract.

☐ **Pollution Insurance** in an amount of: _____ per occurrence.

☐ **Aircraft Liability** in an amount of: _____ per occurrence.

☐

☐

☐

☐

Notwithstanding anything contained in this section to the contrary, the Director of the Purchasing Division reserves the right to waive the requirement that the State be named as an additional insured on one or more of the Vendor's insurance policies if the Director finds that doing so is in the State's best interest.

9. WORKERS' COMPENSATION INSURANCE: The apparent successful Vendor shall comply with laws relating to workers compensation, shall maintain workers' compensation insurance when required, and shall furnish proof of workers' compensation insurance upon request.

10. [Reserved]

11. LIQUIDATED DAMAGES: This clause shall in no way be considered exclusive and shall not limit the State or Agency's right to pursue any other available remedy. Vendor shall pay liquidated damages in the amount specified below or as described in the specifications:

☐ n/a for n/a

☐ Liquidated Damages Contained in the Specifications

12. ACCEPTANCE: Vendor's signature on its bid, or on the certification and signature page, constitutes an offer to the State that cannot be unilaterally withdrawn, signifies that the product or service proposed by vendor meets the mandatory requirements contained in the Solicitation for that product or service, unless otherwise indicated, and signifies acceptance of the terms and conditions contained in the Solicitation unless otherwise indicated.

13. PRICING: The pricing set forth herein is firm for the life of the Contract, unless specified elsewhere within this Solicitation/Contract by the State. A Vendor's inclusion of price adjustment provisions in its bid, without an express authorization from the State in the Solicitation to do so, may result in bid disqualification. Notwithstanding the foregoing, Vendor must extend any publicly advertised sale price to the State and invoice at the lower of the contract price or the publicly advertised sale price.

14. PAYMENT IN ARREARS: Payment in advance is prohibited under this Contract. Payment may only be made after the delivery and acceptance of goods or services. The Vendor shall submit invoices, in arrears.

15. PAYMENT METHODS: Vendor must accept payment by electronic funds transfer and P-Card. (The State of West Virginia's Purchasing Card program, administered under contract by a banking institution, processes payment for goods and services through state designated credit cards.)

16. TAXES: The Vendor shall pay any applicable sales, use, personal property or any other taxes arising out of this Contract and the transactions contemplated thereby. The State of West Virginia is exempt from federal and state taxes and will not pay or reimburse such taxes.

17. ADDITIONAL FEES: Vendor is not permitted to charge additional fees or assess additional charges that were not either expressly provided for in the solicitation published by the State of West Virginia or included in the unit price or lump sum bid amount that Vendor is required by the solicitation to provide. Including such fees or charges as notes to the solicitation may result in rejection of vendor's bid. Requesting such fees or charges be paid after the contract has been awarded may result in cancellation of the contract.

18. FUNDING: This Contract shall continue for the term stated herein, contingent upon funds being appropriated by the Legislature or otherwise being made available. In the event funds are not appropriated or otherwise made available, this Contract becomes void and of no effect beginning on July 1 of the fiscal year for which funding has not been appropriated or otherwise made available.

19. CANCELLATION: The Purchasing Division Director reserves the right to cancel this Contract immediately upon written notice to the vendor if the materials or workmanship supplied do not conform to the specifications contained in the Contract. The Purchasing Division Director may also cancel any purchase or Contract upon 30 days written notice to the Vendor in accordance with West Virginia Code of State Rules § 148-1-5.2.b.

20. TIME: Time is of the essence with regard to all matters of time and performance in this Contract.

21. APPLICABLE LAW: This Contract is governed by and interpreted under West Virginia law without giving effect to its choice of law principles. Any information provided in specification manuals, or any other source, verbal or written, which contradicts or violates the West Virginia Constitution, West Virginia Code or West Virginia Code of State Rules is void and of no effect.

22. COMPLIANCE WITH LAWS: Vendor shall comply with all applicable federal, state, and local laws, regulations and ordinances. By submitting a bid, Vendor acknowledges that it has reviewed, understands, and will comply with all applicable laws, regulations, and ordinances.

> **SUBCONTRACTOR COMPLIANCE:** Vendor shall notify all subcontractors providing commodities or services related to this Contract that as subcontractors, they too are required to comply with all applicable laws, regulations, and ordinances. Notification under this provision must occur prior to the performance of any work under the contract by the subcontractor.

23. ARBITRATION: Any references made to arbitration contained in this Contract, Vendor's bid, or in any American Institute of Architects documents pertaining to this Contract are hereby deleted, void, and of no effect.

24. MODIFICATIONS: This writing is the parties' final expression of intent. Notwithstanding anything contained in this Contract to the contrary no modification of this Contract shall be binding without mutual written consent of the Agency, and the Vendor, with approval of the Purchasing Division and the Attorney General's office (Attorney General approval is as to form only). Any change to existing contracts that adds work or changes contract cost, and were not included in the original contract, must be approved by the Purchasing Division and the Attorney General's Office (as to form) prior to the implementation of the change or commencement of work affected by the change.

25. WAIVER: The failure of either party to insist upon a strict performance of any of the terms or provision of this Contract, or to exercise any option, right, or remedy herein contained, shall not be construed as a waiver or a relinquishment for the future of such term, provision, option, right, or remedy, but the same shall continue in full force and effect. Any waiver must be expressly stated in writing and signed by the waiving party.

26. SUBSEQUENT FORMS: The terms and conditions contained in this Contract shall supersede any and all subsequent terms and conditions which may appear on any form documents submitted by Vendor to the Agency or Purchasing Division such as price lists, order forms, invoices, sales agreements, or maintenance agreements, and includes internet websites or other electronic documents. Acceptance or use of Vendor's forms does not constitute acceptance of the terms and conditions contained thereon.

27. ASSIGNMENT: Neither this Contract nor any monies due, or to become due hereunder, may be assigned by the Vendor without the express written consent of the Agency, the Purchasing Division, the Attorney General's office (as to form only), and any other government agency or office that may be required to approve such assignments.

28. WARRANTY: The Vendor expressly warrants that the goods and/or services covered by this Contract will: (a) conform to the specifications, drawings, samples, or other description furnished or specified by the Agency; (b) be merchantable and fit for the purpose intended; and (c) be free from defect in material and workmanship.

29. STATE EMPLOYEES: State employees are not permitted to utilize this Contract for personal use and the Vendor is prohibited from permitting or facilitating the same.

30. PRIVACY, SECURITY, AND CONFIDENTIALITY: The Vendor agrees that it will not disclose to anyone, directly or indirectly, any such personally identifiable information or other confidential information gained from the Agency, unless the individual who is the subject of the information consents to the disclosure in writing or the disclosure is made pursuant to the Agency's policies, procedures, and rules. Vendor further agrees to comply with the Confidentiality Policies and Information Security Accountability Requirements, set forth in http://www.state.wv.us/admin/purchase/privacy/default.html.

31. YOUR SUBMISSION IS A PUBLIC DOCUMENT: Vendor's entire response to the Solicitation and the resulting Contract are public documents. As public documents, they will be disclosed to the public following the bid/proposal opening or award of the contract, as required by the competitive bidding laws of West Virginia Code §§ 5A-3-1 et seq., 5-22-1 et seq., and 5G-1-1 et seq. and the Freedom of Information Act West Virginia Code §§ 29B-1-1 et seq.

DO NOT SUBMIT MATERIAL YOU CONSIDER TO BE CONFIDENTIAL, A TRADE SECRET, OR OTHERWISE NOT SUBJECT TO PUBLIC DISCLOSURE.

Submission of any bid, proposal, or other document to the Purchasing Division constitutes your explicit consent to the subsequent public disclosure of the bid, proposal, or document. The Purchasing Division will disclose any document labeled "confidential," "proprietary," "trade secret," "private," or labeled with any other claim against public disclosure of the documents, to include any "trade secrets" as defined by West Virginia Code § 47-22-1 et seq. All submissions are subject to public disclosure without notice.

32. LICENSING: In accordance with West Virginia Code of State Rules § 148-1-6.1.e, Vendor must be licensed and in good standing in accordance with any and all state and local laws and requirements by any state or local agency of West Virginia, including, but not limited to, the West Virginia Secretary of State's Office, the West Virginia Tax Department, West Virginia Insurance Commission, or any other state agency or political subdivision. Obligations related to political subdivisions may include, but are not limited to, business licensing, business and occupation taxes, inspection compliance, permitting, etc. Upon request, the Vendor must provide all necessary releases to obtain information to enable the Purchasing Division Director or the Agency to verify that the Vendor is licensed and in good standing with the above entities.

SUBCONTRACTOR COMPLIANCE: Vendor shall notify all subcontractors providing commodities or services related to this Contract that as subcontractors, they too are required to be licensed, in good standing, and up-to-date on all state and local obligations as described in this section. Obligations related to political subdivisions may include, but are not limited to, business licensing, business and occupation taxes, inspection compliance, permitting, etc. Notification under this provision must occur prior to the performance of any work under the contract by the subcontractor.

33. ANTITRUST: In submitting a bid to, signing a contract with, or accepting a Award Document from any agency of the State of West Virginia, the Vendor agrees to convey, sell, assign, or transfer to the State of West Virginia all rights, title, and interest in and to all causes of action it may now or hereafter acquire under the antitrust laws of the United States and the State of West Virginia for price fixing and/or unreasonable restraints of trade relating to the particular commodities or services purchased or acquired by the State of West Virginia. Such assignment shall be made and become effective at the time the purchasing agency tenders the initial payment to Vendor.

34. VENDOR CERTIFICATIONS: By signing its bid or entering into this Contract, Vendor certifies (1) that its bid or offer was made without prior understanding, agreement, or connection with any corporation, firm, limited liability company, partnership, person or entity submitting a bid or offer for the same material, supplies, equipment or services; (2) that its bid or offer is in all respects fair and without collusion or fraud; (3) that this Contract is accepted or entered into without any prior understanding, agreement, or connection to any other entity that could be considered a violation of law; and (4) that it has reviewed this Solicitation in its entirety; understands the requirements, terms and conditions, and other information contained herein.

Vendor's signature on its bid or offer also affirms that neither it nor its representatives have any interest, nor shall acquire any interest, direct or indirect, which would compromise the performance of its services hereunder. Any such interests shall be promptly presented in detail to the Agency. The individual signing this bid or offer on behalf of Vendor certifies that he or she is authorized by the Vendor to execute this bid or offer or any documents related thereto on Vendor's behalf; that he or she is authorized to bind the Vendor in a contractual relationship; and that, to the best of his or her knowledge, the Vendor has properly registered with any State agency that may require registration.

35. VENDOR RELATIONSHIP: The relationship of the Vendor to the State shall be that of an independent contractor and no principal-agent relationship or employer-employee relationship is contemplated or created by this Contract. The Vendor as an independent contractor is solely liable for the acts and omissions of its employees and agents. Vendor shall be responsible for selecting, supervising, and compensating any and all individuals employed pursuant to the terms of this Solicitation and resulting contract. Neither the Vendor, nor any employees or subcontractors of the Vendor, shall be deemed to be employees of the State for any purpose whatsoever. Vendor shall be exclusively responsible for payment of employees and contractors for all wages and salaries, taxes, withholding payments, penalties, fees, fringe benefits, professional liability insurance premiums, contributions to insurance and pension, or other deferred compensation plans, including but not limited to, Workers' Compensation and Social Security obligations, licensing fees, etc. and the filing of all necessary documents, forms, and returns pertinent to all of the foregoing.

Vendor shall hold harmless the State, and shall provide the State and Agency with a defense against any and all claims including, but not limited to, the foregoing payments, withholdings, contributions, taxes, Social Security taxes, and employer income tax returns.

36. INDEMNIFICATION: The Vendor agrees to indemnify, defend, and hold harmless the State and the Agency, their officers, and employees from and against: (1) Any claims or losses for services rendered by any subcontractor, person, or firm performing or supplying services, materials, or supplies in connection with the performance of the Contract; (2) Any claims or losses resulting to any person or entity injured or damaged by the Vendor, its officers, employees, or subcontractors by the publication, translation, reproduction, delivery, performance, use, or disposition of any data used under the Contract in a manner not authorized by the Contract, or by Federal or State statutes or regulations; and (3) Any failure of the Vendor, its officers, employees, or subcontractors to observe State and Federal laws including, but not limited to, labor and wage and hour laws.

37. PURCHASING AFFIDAVIT: In accordance with West Virginia Code §§ 5A-3-10a and 5-22-1(i), the State is prohibited from awarding a contract to any bidder that owes a debt to the State or a political subdivision of the State, Vendors are required to sign, notarize, and submit the Purchasing Affidavit to the Purchasing Division affirming under oath that it is not in default on any monetary obligation owed to the state or a political subdivision of the state.

38. ADDITIONAL AGENCY AND LOCAL GOVERNMENT USE: This Contract may be utilized by other agencies, spending units, and political subdivisions of the State of West Virginia; county, municipal, and other local government bodies; and school districts ("Other Government Entities"), provided that both the Other Government Entity and the Vendor agree. Any extension of this Contract to the aforementioned Other Government Entities must be on the same prices, terms, and conditions as those offered and agreed to in this Contract, provided that such extension is in compliance with the applicable laws, rules, and ordinances of the Other Government Entity. A refusal to extend this Contract to the Other Government Entities shall not impact or influence the award of this Contract in any manner.

39. CONFLICT OF INTEREST: Vendor, its officers or members or employees, shall not presently have or acquire an interest, direct or indirect, which would conflict with or compromise the performance of its obligations hereunder. Vendor shall periodically inquire of its officers, members and employees to ensure that a conflict of interest does not arise. Any conflict of interest discovered shall be promptly presented in detail to the Agency.

40. REPORTS: Vendor shall provide the Agency and/or the Purchasing Division with the following reports identified by a checked box below:

☐ Such reports as the Agency and/or the Purchasing Division may request. Requested reports may include, but are not limited to, quantities purchased, agencies utilizing the contract, total contract expenditures by agency, etc.

☐ Quarterly reports detailing the total quantity of purchases in units and dollars, along with a listing of purchases by agency. Quarterly reports should be delivered to the Purchasing Division via email at purchasing.requisitions@wv.gov.

41. BACKGROUND CHECK: In accordance with W. Va. Code § 15-2D-3, the Director of the Division of Protective Services shall require any service provider whose employees are regularly employed on the grounds or in the buildings of the Capitol complex or who have access to sensitive or critical information to submit to a fingerprint-based state and federal background inquiry through the state repository. The service provider is responsible for any costs associated with the fingerprint-based state and federal background inquiry.

After the contract for such services has been approved, but before any such employees are permitted to be on the grounds or in the buildings of the Capitol complex or have access to sensitive or critical information, the service provider shall submit a list of all persons who will be physically present and working at the Capitol complex to the Director of the Division of Protective Services for purposes of verifying compliance with this provision. The State reserves the right to prohibit a service provider's employees from accessing sensitive or critical information or to be present at the Capitol complex based upon results addressed from a criminal background check.

Service providers should contact the West Virginia Division of Protective Services by phone at (304) 558-9911 for more information.

42. PREFERENCE FOR USE OF DOMESTIC STEEL PRODUCTS: Except when authorized by the Director of the Purchasing Division pursuant to W. Va. Code § 5A-3-56, no contractor may use or supply steel products for a State Contract Project other than those steel products made in the United States. A contractor who uses steel products in violation of this section may be subject to civil penalties pursuant to W. Va. Code § 5A-3-56. As used in this section:

a. "State Contract Project" means any erection or construction of, or any addition to, alteration of or other improvement to any building or structure, including, but not limited to, roads or highways, or the installation of any heating or cooling or ventilating plants or other equipment, or the supply of and materials for such projects, pursuant to a contract with the State of West Virginia for which bids were solicited on or after June 6, 2001.

b. "Steel Products" means products rolled, formed, shaped, drawn, extruded, forged, cast, fabricated or otherwise similarly processed, or processed by a combination of two or more or such operations, from steel made by the open heath, basic oxygen, electric furnace, Bessemer or other steel making process. The Purchasing Division Director may, in writing, authorize the use of foreign steel products if:

c. The cost for each contract item used does not exceed one tenth of one percent (.1%) of the total contract cost or two thousand five hundred dollars ($2,500.00), whichever is greater. For the purposes of this section, the cost is the value of the steel product as delivered to the project; or

d. The Director of the Purchasing Division determines that specified steel materials are not produced in the United States in sufficient quantity or otherwise are not reasonably available to meet contract requirements.

43. PREFERENCE FOR USE OF DOMESTIC ALUMINUM, GLASS, AND STEEL: In Accordance with W. Va. Code § 5-19-1 et seq., and W. Va. CSR § 148-10-1 et seq., for every contract or subcontract, subject to the limitations contained herein, for the construction, reconstruction, alteration, repair, improvement or maintenance of public works or for the purchase of any item of machinery or equipment to be used at sites of public works, only domestic aluminum, glass or steel products shall be supplied unless the spending officer determines, in writing, after the receipt of offers or bids, (1) that the cost of domestic aluminum, glass or steel products is unreasonable or inconsistent with the public interest of the State of West Virginia, (2) that domestic aluminum, glass or steel products are not produced in sufficient quantities to meet the contract requirements, or (3) the available domestic aluminum, glass, or steel do not meet the contract specifications. This provision only applies to public works contracts awarded in an amount more than fifty thousand dollars ($50,000) or public works contracts that require more than ten thousand pounds of steel products.

The cost of domestic aluminum, glass, or steel products may be unreasonable if the cost is more than twenty percent (20%) of the bid or offered price for foreign made aluminum, glass, or steel products. If the domestic aluminum, glass or steel products to be supplied or produced in a

"substantial labor surplus area", as defined by the United States Department of Labor, the cost of domestic aluminum, glass, or steel products may be unreasonable if the cost is more than thirty percent (30%) of the bid or offered price for foreign made aluminum, glass, or steel products. This preference shall be applied to an item of machinery or equipment, as indicated above, when the item is a single unit of equipment or machinery manufactured primarily of aluminum, glass or steel, is part of a public works contract and has the sole purpose or of being a permanent part of a single public works project. This provision does not apply to equipment or machinery purchased by a spending unit for use by that spending unit and not as part of a single public works project.

All bids and offers including domestic aluminum, glass or steel products that exceed bid or offer prices including foreign aluminum, glass or steel products after application of the preferences provided in this provision may be reduced to a price equal to or lower than the lowest bid or offer price for foreign aluminum, glass or steel products plus the applicable preference. If the reduced bid or offer prices are made in writing and supersede the prior bid or offer prices, all bids or offers, including the reduced bid or offer prices, will be reevaluated in accordance with this rule.

44. INTERESTED PARTY SUPPLEMENTAL DISCLOSURE: W. Va. Code § 6D-1-2 requires that for contracts with an actual or estimated value of at least $1 million, the vendor must submit to the Agency a supplemental disclosure of interested parties reflecting any new or differing interested parties to the contract, which were not included in the original pre-award interested party disclosure, within 30 days following the completion or termination of the contract. A copy of that form is included with this solicitation or can be obtained from the WV Ethics Commission. This requirement does not apply to publicly traded companies listed on a national or international stock exchange. A more detailed definition of interested parties can be obtained from the form referenced above.

45. PROHIBITION AGAINST USED OR REFURBISHED: Unless expressly permitted in the solicitation published by the State, Vendor must provide new, unused commodities, and is prohibited from supplying used or refurbished commodities, in fulfilling its responsibilities under this Contract.

DESIGNATED CONTACT: Vendor appoints the individual identified in this Section as the Contract Administrator and the initial point of contact for matters relating to this Contract.

Bill Harland, Vice President of Marketing

(Name, Title)

Electronics Research, Inc.

(Printed Name and Title)

7777 Gardner Road. Chandler, IN 47610

(Address)

+1 (812) 925-6000, Ext. 214 (Office)/+1 (812) 925-4030 (Fax)/_1 (812) 455-1823 (cell)

(Phone Number) / (Fax Number)

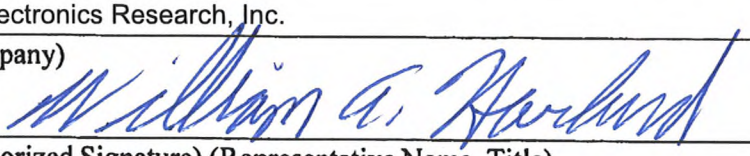
bharland@eriinc.com

(email address)

CERTIFICATION AND SIGNATURE: By signing below, or submitting documentation through wvOASIS, I certify that I have reviewed this Solicitation in its entirety; that I understand the requirements, terms and conditions, and other information contained herein; that this bid, offer or proposal constitutes an offer to the State that cannot be unilaterally withdrawn; that the product or service proposed meets the mandatory requirements contained in the Solicitation for that product or service, unless otherwise stated herein; that the Vendor accepts the terms and conditions contained in the Solicitation, unless otherwise stated herein; that I am submitting this bid, offer or proposal for review and consideration; that I am authorized by the vendor to execute and submit this bid, offer, or proposal, or any documents related thereto on vendor's behalf; that I am authorized to bind the vendor in a contractual relationship; and that to the best of my knowledge, the vendor has properly registered with any State agency that may require registration.

Electronics Research, Inc.

(Company)



(Authorized Signature) (Representative Name, Title)

William A. Harland, Vice President of Marketing

(Printed Name and Title of Authorized Representative)

August 7, 2020

(Date)

+1 (812) 925-6000, Ext. 214 (Office)/+1 (812) 925-4030 (Fax)/+1 (812) 455-1823 (cell)

(Phone Number) (Fax Number)

ADDENDUM ACKNOWLEDGEMENT FORM
SOLICITATION NO.:

Instructions: Please acknowledge receipt of all addenda issued with this solicitation by completing this addendum acknowledgment form. Check the box next to each addendum received and sign below. Failure to acknowledge addenda may result in bid disqualification.

Acknowledgment: I hereby acknowledge receipt of the following addenda and have made the necessary revisions to my proposal, plans and/or specification, etc.

Addendum Numbers Received:
(Check the box next to each addendum received)

- [x] Addendum No. 1
- [x] Addendum No. 2
- [ ] Addendum No. 3
- [ ] Addendum No. 4
- [ ] Addendum No. 5
- [ ] Addendum No. 6
- [ ] Addendum No. 7
- [ ] Addendum No. 8
- [ ] Addendum No. 9
- [ ] Addendum No. 10

I understand that failure to confirm the receipt of addenda may be cause for rejection of this bid. I further understand that any verbal representation made or assumed to be made during any oral discussion held between Vendor's representatives and any state personnel is not binding. Only the information issued in writing and added to the specifications by an official addendum is binding.

Electronics Research, Inc.
Company

William A. Harland, Vice President of Marketing
Authorized Signature

August 7, 2020
Date

NOTE: This addendum acknowledgement should be submitted with the bid to expedite document processing.

STATE OF WEST VIRGINIA
Purchasing Division

PURCHASING AFFIDAVIT

CONSTRUCTION CONTRACTS: Under W. Va. Code § 5-22-1(i), the contracting public entity shall not award a construction contract to any bidder that is known to be in default on any monetary obligation owed to the state or a political subdivision of the state, including, but not limited to, obligations related to payroll taxes, property taxes, sales and use taxes, fire service fees, or other fines or fees.

ALL CONTRACTS: Under W. Va. Code §5A-3-10a, no contract or renewal of any contract may be awarded by the state or any of its political subdivisions to any vendor or prospective vendor when the vendor or prospective vendor or a related party to the vendor or prospective vendor is a debtor and: (1) the debt owed is an amount greater than one thousand dollars in the aggregate; or (2) the debtor is in employer default.

EXCEPTION: The prohibition listed above does not apply where a vendor has contested any tax administered pursuant to chapter eleven of the W. Va. Code, workers' compensation premium, permit fee or environmental fee or assessment and the matter has not become final or where the vendor has entered into a payment plan or agreement and the vendor is not in default of any of the provisions of such plan or agreement.

DEFINITIONS:

"Debt" means any assessment, premium, penalty, fine, tax or other amount of money owed to the state or any of its political subdivisions because of a judgment, fine, permit violation, license assessment, defaulted workers' compensation premium, penalty or other assessment presently delinquent or due and required to be paid to the state or any of its political subdivisions, including any interest or additional penalties accrued thereon.

"Employer default" means having an outstanding balance or liability to the old fund or to the uninsured employers' fund or being in policy default, as defined in W. Va. Code § 23-2c-2, failure to maintain mandatory workers' compensation coverage, or failure to fully meet its obligations as a workers' compensation self-insured employer. An employer is not in employer default if it has entered into a repayment agreement with the Insurance Commissioner and remains in compliance with the obligations under the repayment agreement.

"Related party" means a party, whether an individual, corporation, partnership, association, limited liability company or any other form or business association or other entity whatsoever, related to any vendor by blood, marriage, ownership or contract through which the party has a relationship of ownership or other interest with the vendor so that the party will actually or by effect receive or control a portion of the benefit, profit or other consideration from performance of a vendor contract with the party receiving an amount that meets or exceed five percent of the total contract amount.

AFFIRMATION: By signing this form, the vendor's authorized signer affirms and acknowledges under penalty of law for false swearing (*W. Va. Code* §61-5-3) that: (1) for construction contracts, the vendor is not in default on any monetary obligation owed to the state or a political subdivision of the state, and (2) for all other contracts, that neither vendor nor any related party owe a debt as defined above and that neither vendor nor any related party are in employer default as defined above, unless the debt or employer default is permitted under the exception above.

WITNESS THE FOLLOWING SIGNATURE:

Vendor's Name: Electronics Research, Inc.

Authorized Signature: William A. Hartnett Date: August 7, 2020

State of Indiana

County of Warrick, to-wit:

Taken, subscribed, and sworn to before me this 7 day of August, 20 20.

My Commission expires September 17, 2020.

AFFIX SEAL HERE

CINDY D TOMES
Notary Public, State of Indiana
Warrick County
Commission # 658197
My Commission Expires
September 17, 2022

NOTARY PUBLIC Cindy D. Tomes

SPECIFICATIONS

1. **PURPOSE AND SCOPE:** The West Virginia Purchasing Division is soliciting bids on behalf of the West Virginia Educational Broadcasting Authority (Agency) to establish a contract for the one-time purchase of a High-Power VHF Television Transmit Antenna.

2. **DEFINITIONS:** The terms listed below shall have the meanings assigned to them below. Additional definitions can be found in section 2 of the General Terms and Conditions.

   2.1 Contract Item: means a High-Power VHF Television Transmit Antenna as more fully described by these specifications.

   2.2 Elliptical Polarization: An antenna is said to be vertically polarized (linear) when its electric field is perpendicular to the Earth's surface. If the axial ratio is near 0 dB (decibel), the antenna is said to be circular polarized. If the axial ratio is greater than 1-2 dB, the polarization is often referred to as elliptical.

   2.3 Horizontal Azimuth Pattern: horizontal angle radiation measured clockwise from any fixed reference plane or easily established base direction line.

   2.4 Moment Arm: the length between a joint axis and the line of force acting on that joint. Every joint that is involved in an exercise has a moment arm. The longer the moment arm is the more load will be applied to the joint axis through leverage.

   2.5 Pricing Page: the page(s), contained in wvOASIS or attached as Exhibit A, upon which Vendor should list its proposed price for the Contract Items.

   2.6 Radome: a dome or other structure protecting radar equipment and made from material transparent to radio waves, especially one on the outer surface of an aircraft.

   2.7 Solicitation: means the official notice of an opportunity to supply the State with goods or services that is published by the Purchasing Division.

3. **GENERAL REQUIREMENTS:**

   3.1 Mandatory Contract Item Requirements: Contract Item must meet or exceed the mandatory requirements listed below.

   3.1.1 High-Power VHF Television Transmit Antenna

   3.1.1.1 Mechanical Specifications

   3.1.1.1.1 All structural elements shall be designed and fabricated in accordance with TIA/EIA standard RS-222G, Structural Standards for Steel Antenna, Towers,

and Supporting structures. Download available here: Structural Standards for Antennae and Towers. A building markup (Exhibit D) is attached to facilitate this.

3.1.1.1.2 All hardware shall be constructed of non-ferrous material or be galvanized:

3.1.1.1.2.1 Steel elements shall be hot-dip galvanized in accordance with the ASTM A123 standard available here: ASTM A123 Standard

3.1.1.1.2.2 Zinc coating shall be applied with a minimum thickness of 0.002 inches (0.5mm)

3.1.1.1.3 Physical Antenna attributes:

3.1.1.1.3.1 Antenna shall be top mounted

3.1.1.1.3.2 Antenna shall have lifting points and directions for possible helicopter installation.

3.1.1.1.3.3 Antenna shall be designed for mounting as outlined in Exhibit B, WVPB Top of Steel Drawing.

3.1.1.1.3.4 Radiating elements shall be protected from ice by being enclosed in a Radome

3.1.1.1.3.5 Vendor shall provide mechanical interface between top of steel and antenna if required.

3.1.1.1.3.6 Weight without ice shall be less than 5000 pounds

3.1.1.1.3.7 Effective Projected Area (wind load) shall be less than 64.6 square feet (6 square meters)

3.1.1.1.3.8 Moment arm shall be less than 22 feet (6.7 Meters)

3.1.1.2 Electrical specifications:

3.1.1.2.1 Antenna shall operate on DTV Channel 9 (186-192MHz)

3.1.1.2.2 Polarization shall be elliptical

3.1.1.2.3 The Horizontal Azimuth Pattern shall meet the parameters defined in the Attachment provided (PDF of Construction permit on file with the FCC – Exhibit C)

3.1.1.2.4 The antenna shall have a vertical component of 25% compared to the horizontal radiation

3.1.1.2.5 Antenna and transmission line shall produce an Effective Radiated Power of 23 KW with a post mask filter TPO of less than 4KW.

3.1.1.2.6 Antenna and transmission line must be able to operate with a power level of 20 KW Transmitter Power Output.

3.1.1.3 Transmission Line and Accessories:

3.1.1.3.1 Vendor shall provide Transmission Line able to operate with 20 Kilowatts DTV (Digital Television) power

3.1.1.3.1.1 Current transmission line is 6 1/8" EIA, 75 Ohm with matching transformers at each end.

3.1.1.3.2 Vertical run is 1081 feet to top of steel

3.1.1.3.3 Horizontal run is 100 feet

3.1.1.3.4 Vendor shall provide all Transmission Line components for complete installation. Components shall include but not be limited to: Hangers, hoisting adapters, Elbows, Field terminated line sections, transformers, and pressure windows.

4. CONTRACT AWARD:

4.1 Contract Award: The Contract is intended to provide Agencies with a purchase price for the Contract Items. The Contract shall be awarded to the Vendor that provides the Contract Items meeting the required specifications for the lowest overall total cost as shown on the Pricing Pages (Commodity Line).

4.2 Pricing Page: Vendor should complete the Pricing Page (Commodity lines) by filling the line with the appropriate information. Vendor should complete the Pricing Page in full as failure to complete the Pricing Page in its entirety may result in Vendor's bid being disqualified.

4.2.1 If submitting a bid online, Vendors should enter the Unit Price into each commodity line and the system will sum the total amount automatically. If responding with a paper bid, Vendors should download and/or print the assembled Final Solicitation document (with the highest version number) from wvOASIS and insert their Unit Prices for each Commodity Line.

4.2.2 Shipping costs shall be included in the price of equipment.

4.2.3 Vendor must include additional documentation for all equipment and components to sufficiently demonstrate that all equipment and components meet specifications. Vendor should include this documentation with their bid. It will be required prior to award.

4.2.4 The total cost of the bid shall be the "Total Bid Cost" as described in section 4.2.1

4.2.5 If no vendor submits a bid within the budget limitations of the Agency, the Agency may, at its own discretion, cancel this RFQ and purchase nothing.

5. PAYMENT:

5.1 Payment: Vendor shall accept payment in accordance with the payment procedures of the State of West Virginia.

6. DELIVERY AND RETURN:

6.1 Shipment and Delivery: Vendor shall deliver the Contract Items within 60 calendar days of being awarded this Contract and receiving a purchase order or notice to proceed. Contract Items must be delivered to Agency at the following address:

WV Educational Broadcasting Authority
Attn: Dave McClanahan
9248 Barker Ridge Church Road
Milton, WV

Vendor must give the Agency a minimum notice of 10 business days prior to the arrival of the Contract Items on site to permit preparation for off-loading.

6.2 Late Delivery: The Agency placing the order under this Contract must be notified in writing if the shipment of the Contract Items will be delayed for any reason. Any delay in delivery that could cause harm to an Agency will be grounds for cancellation of the Contract, and/or obtaining the Contract Items from a third party.

Any Agency seeking to obtain the Contract Items from a third party under this provision must first obtain approval of the Purchasing Division.

6.3 Delivery Payment/Risk of Loss: Vendor shall deliver the Contract Items F.O.B. destination to the Agency's location.

6.4 Return of Unacceptable Items: If the Agency deems the Contract Items to be unacceptable, the Contract Items shall be returned to Vendor at Vendor's expense and with no restocking charge. Vendor shall either make arrangements for the return within five (5) days of being notified that items are unacceptable or permit the Agency to arrange for the return and reimburse Agency for delivery expenses. If the original packaging cannot be utilized for the return, Vendor will supply the Agency with appropriate return packaging upon request. All returns of unacceptable items shall be F.O.B. the Agency's location. The returned product shall either be replaced, or the Agency shall receive a full credit or refund for the purchase price, at the Agency's discretion.

6.5 Return Due to Agency Error: Items ordered in error by the Agency will be returned for credit within 30 days of receipt, F.O.B. Vendor's location. Vendor shall not charge a restocking fee if returned products are in a resalable condition. Items shall be deemed to be in a resalable condition if they are unused and in the original packaging. Any restocking fee for items not in a resalable condition shall be the lower of the Vendor's customary restocking fee or 5% of the total invoiced value of the returned items.

7 VENDOR DEFAULT:

7.1 The following shall be considered a vendor default under this Contract.

7.1.1 Failure to provide Contract Items in accordance with the requirements contained herein.

7.1.2 Failure to comply with other specifications and requirements contained herein.

7.1.3 Failure to comply with any laws, rules, and ordinances applicable to the Contract Services provided under this Contract.

7.1.4 Failure to remedy deficient performance upon request.

7.2 The following remedies shall be available to Agency upon default.

7.2.1 Immediate cancellation of the Contract.

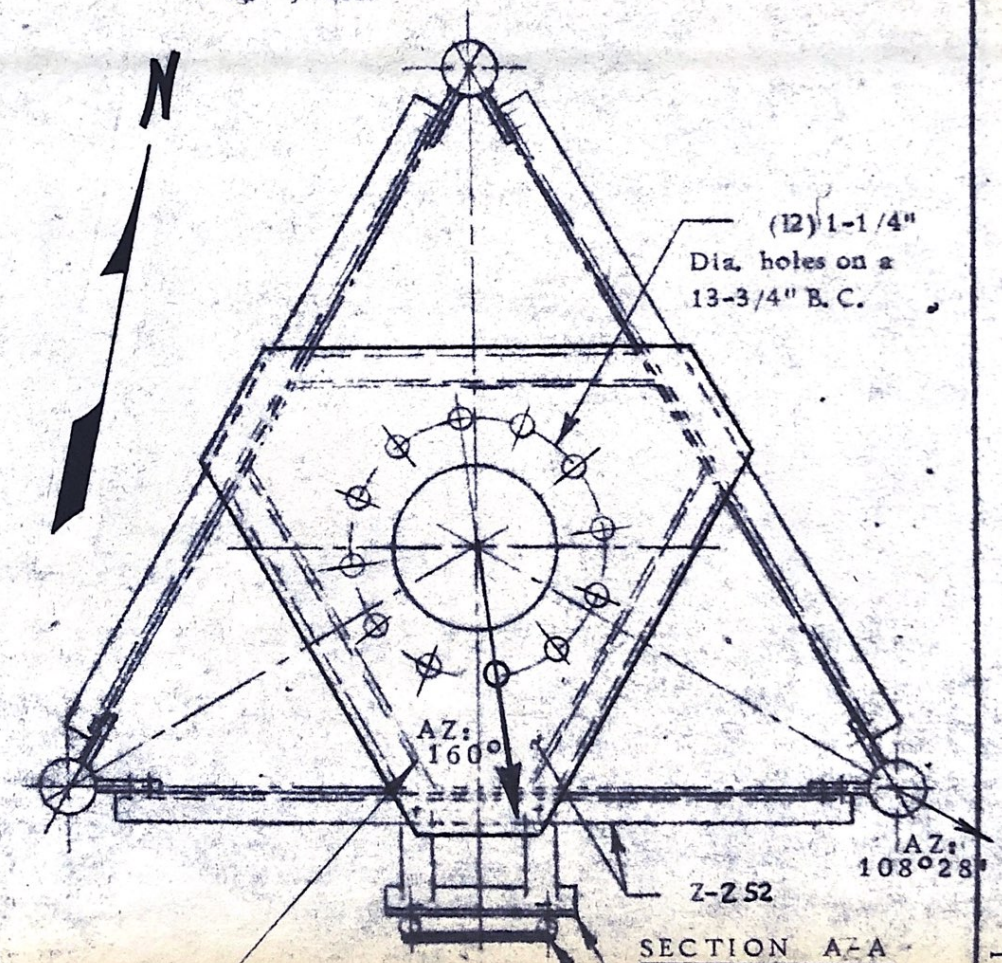
7.2.2 Immediate cancellation of one or more release orders issued under this Contract.

7.2.3 Any other remedies available in law or equity.

Exhibit B, Top of Steel Drawing

NOTES:

1. All bolts are 5/8 x 2 (Req'd this page = 183)
2. Use 2 stitch washers per each location #0722 (Req'd this page = 60)
3. Grating bolts with (2) 1/2 x 4-1/2 "J" bolts ((1) 1/2 washer ((4) 3/8 x 2 "J" bolts
4. Fasten ladder with 3/8 x 1-1/2 "U" bolts
5. Bolt ladder supports to horizontal members with 1/2 x 1-1/4 bolts
6. Bolt ladder support clip angle to grating with 3/8 dia. x 2 lg. "J" bolt



The antenna mounting flange has a bolt hole at zero degree (marked by metal arrow on side of base flange) with the single row of antenna slots and whichis is zero degree or maximum of the horizontal pattern. This zero degree or maximum of the horizontal pattern should be oriented N 160° E. as shown.

PREPARED BY: JWS DATE: 1/17/69

STAINLESS INC.

TOP OF TOWER DETAI

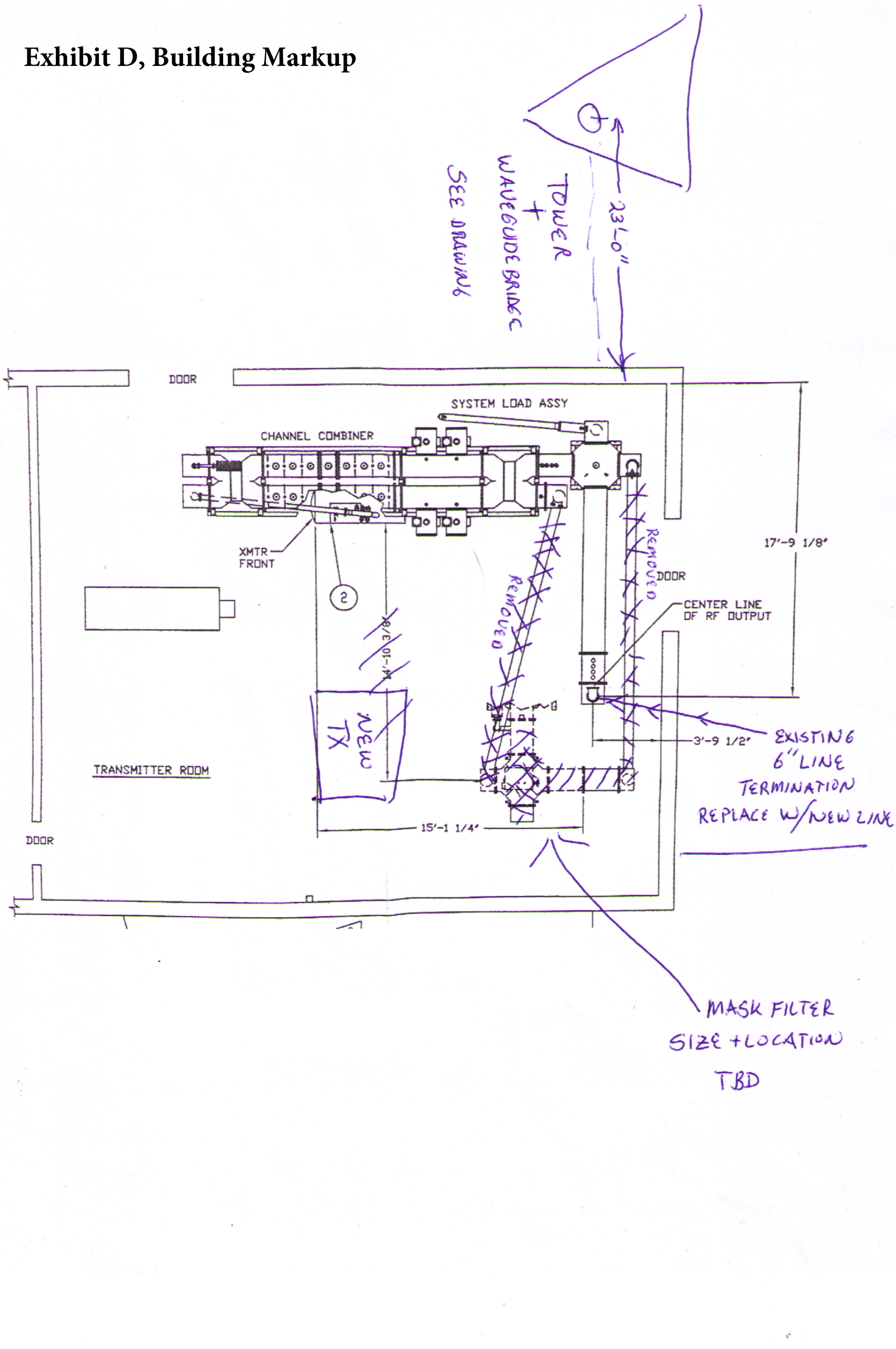
Directional Antenna Relative Field Values (Pre-rotated Pattern)

Degree	Value	Degree	Value	Degree	Value	Degree	Value
0	1.000	**90**	0.471	**180**	1.000	**270**	0.471
10	0.959	**100**	0.424	**190**	0.959	**280**	0.424
20	0.872	**110**	0.386	**200**	0.872	**290**	0.386
30	0.800	**120**	0.470	**210**	0.800	**300**	0.470
40	0.739	**130**	0.625	**220**	0.739	**310**	0.625
50	0.625	**140**	0.739	**230**	0.625	**320**	0.739
60	0.470	**150**	0.800	**240**	0.470	**330**	0.800
70	0.386	**160**	0.872	**250**	0.386	**340**	0.872
80	0.424	**170**	0.959	**260**	0.424	**350**	0.959

Additional Azimuths

Degree	V_A
71	0.384
289	0.384
251	0.384
109	0.384

Exhibit D, Building Markup



SOLICITATION NUMBER: EBA2100000002
Addendum Number: 1

The purpose of this addendum is to modify the solicitation identified as ("Solicitation") to reflect the change(s) identified and described below.

Applicable Addendum Category:

[✓] Modify bid opening date and time

[ ] Modify specifications of product or service being sought

[✓] Attachment of vendor questions and responses

[ ] Attachment of pre-bid sign-in sheet

[ ] Correction of error

[ ] Other

Description of Modification to Solicitation:

ADDENDUM 1 IS ISSUED FOR THE FOLLOWING REASONS:

1. AGENCY RESPONSES TO VENDORS QUESTIONS

2. BILL OPENING WILL BE CHANGED FROM AUGUST 6, 2020 TO AUGUST 11, 2020

TIME WILL REMAIN THE SAME.

NO OTHER CHANGES

Additional Documentation: Documentation related to this Addendum (if any) has been included herewith as Attachment A and is specifically incorporated herein by reference.

Terms and Conditions:

1. All provisions of the Solicitation and other addenda not modified herein shall remain in full force and effect.

2. Vendor should acknowledge receipt of all addenda issued for this Solicitation by completing an Addendum Acknowledgment, a copy of which is included herewith. Failure to acknowledge addenda may result in bid disqualification. The addendum acknowledgement should be submitted with the bid to expedite document processing.

ATTACHMENT A

Questions for CRFQ: EBA2100000002

Question

1. 3.0 General Are there any requirements as to supplier experience and qualifications with respect to the type of antenna proposed, and quantity of similar antennas already shipped and successfully in service?

Answer

1. Vendor must have been manufacturing broadcast antennas for a minimum of 10 years.

Question

2 What type of lighting/beacon is used? Will West Virginia Educational Broadcasting provide the beacon?

Answer

2. The beacon is a Dialight LED beacon. We will re-use it on the new antenna

Question

3. 3.1.1.1.3.3 Top of Steel Drawing - It was our understanding that the existing top mount antenna was a Model TCI 881-24. The Exhibit B drawing appears to be for an older RCA antenna. Please clarify.

Answer

3. The drawing is the original tower erection drawing. The original antenna was replaced by a TCI/Dielectric 881-24. The drawing is to define top of steel- the 881-24 will be removed to top of steel.

Question

4. 3.1.1.1.3.6 (.7, and .8) These specifications appear to be exactly the same as the recent RFQ for WSWP. Please clarify.

Answer

4. These parameters are based on available weight and wind loading information on a generic antenna. The antenna must fall within these parameters

Question

5. Is there a height/length limitation for the Ch. 9 antenna above top of steel?

Answer

5. Maximum height shall be less than 40 feet

Question

6. 3.1.1.3.1 Is 3" flexible line acceptable if all other requirements are met?

Answer

6. No, flexible line may not be substituted for sectional hard line.

Question

7. 3.1.1.3.1.1 3" rigid vertical spring hangers have a different hole spacing than existing 6-1/8" 75 OHM. Will the installer supply needed adapter plates to hang the line?

Answer

7. 3.1.1.3.4 Vendor shall provide all Transmission Line components for complete installation. Components shall include but not be limited to: Hangers, hoisting adapters, Elbows, Field terminated line sections, transformers, and pressure windows
Vendor shall provide the necessary components for complete installation.

Question

8 What is the diameter of the hole in the center of the mounting plate at the top of the WVPB-TV tower?

Answer

8.I don't have a verified measurement of the hole. Previously a six inch transmission line was run through it so there shouldn't be any issues with the new line.

Question

9. Is there a limit to the maximum length for the RF Channel 9 top-mounted antenna?

Answer

9.Antenna and beacon shall not exceed 50 feet above steel

SOLICITATION NUMBER: EBA2100000002
Addendum Number: 2

The purpose of this addendum is to modify the solicitation identified as ("Solicitation") to reflect the change(s) identified and described below.

Applicable Addendum Category:

[ ] Modify bid opening date and time

[ ] Modify specifications of product or service being sought

[✓] Attachment of vendor questions and responses

[ ] Attachment of pre-bid sign-in sheet

[ ] Correction of error

[ ] Other

Description of Modification to Solicitation:

ADDENDUM 2 IS ISSUED FOR THE FOLLOWING REASONS:

1. AGENCY RESPONSES TO VENDORS QUESTIONS

BILL OPENING AND TIME WILL REMAIN THE SAME.

NO OTHER CHANGES

Additional Documentation: Documentation related to this Addendum (if any) has been included herewith as Attachment A and is specifically incorporated herein by reference.

Terms and Conditions:

1. All provisions of the Solicitation and other addenda not modified herein shall remain in full force and effect.

2. Vendor should acknowledge receipt of all addenda issued for this Solicitation by completing an Addendum Acknowledgment, a copy of which is included herewith. Failure to acknowledge addenda may result in bid disqualification. The addendum acknowledgement should be submitted with the bid to expedite document processing.

ATTACHMENT A

Questions for CRFQ:

Question 1.

Question 3 - Does the 881-24 antenna that will be removed have the same exact base flange hole pattern as the previous old RCA antenna? Was the tower top modified or replaced when the 881-24 antenna was installed, hence it would have a different flange pattern than the CRFQ shows?

Answer

1. **There are no as-build drawings of the 881-24 installation. We had the same antenna at our WNPB facility, on a stainless G4 tower, and in that case, they utilized an adapter referred to as a "wedding cake". I have no indication the tower top of steel was modified to accommodate the new antenna**

Question 2.

Answer 5 (40 ft), conflicts with Answer 9 (50 ft). Please clarify.

Answer

2. **There are lighting and lightning arrestor appurtenances mounted above the antenna, usually 8-10 feet. The physical antenna shall be under 40', with a total height under 50' with beacon and lightning rods.**

ADDENDUM ACKNOWLEDGEMENT FORM
SOLICITATION NO.: EBA2100000002

Instructions: Please acknowledge receipt of all addenda issued with this solicitation by completing this addendum acknowledgment form. Check the box next to each addendum received and sign below. Failure to acknowledge addenda may result in bid disqualification.

Acknowledgment: I hereby acknowledge receipt of the following addenda and have made the necessary revisions to my proposal, plans and/or specification, etc.

Addendum Numbers Received:
(Check the box next to each addendum received)

[X]	Addendum No. 1	[ ]	Addendum No. 6
[X]	Addendum No. 2	[ ]	Addendum No. 7
[ ]	Addendum No. 3	[ ]	Addendum No. 8
[ ]	Addendum No. 4	[ ]	Addendum No. 9
[ ]	Addendum No. 5	[ ]	Addendum No. 10

I understand that failure to confirm the receipt of addenda may be cause for rejection of this bid. I further understand that any verbal representation made or assumed to be made during any oral discussion held between Vendor's representatives and any state personnel is not binding. Only the information issued in writing and added to the specifications by an official addendum is binding.

Electronics Research, Inc.
Company

William A. Harland, Vice President of Marketing
Authorized Signature

August 7, 2020
Date

NOTE: This addendum acknowledgement should be submitted with the bid to expedite document processing.
Revised 6/8/2012

ERI Exceptions and General Terms and Conditions

Electronics Research, Inc, carefully reviewed the requirements outlined in items 1 through 45 included in the General Terms and Conditions that were included in the solicitation for a new High-Power VHF Television Antenna. The offer ERI has provided in in compliance with or accepts all of the clauses included in this section of the solicitation with exception of the following:

42. Preference for Use of Domestic Steel Products

This solicitation requires that the equipment proposed be delivered within 60-days of receiving a firm order. As noted below, ERI cannot meet that requirement and is proposing providing an interim antenna as an alternative. The antenna required and ERI has proposed is a custom design and requires a specialty steel pipe for antenna outer conductor. We have the material available from inventory held by our steel distributor but this steel pipe is fabricated at and purchased from a steel mill in the Czech Republic. To accept a contract for this order, with a requirement to deliver the antenna and transmission line with 150-days after receipt of firm order will require the authorization of the Director of Purchasing to use this material of non-US origin.

6.1 Shipment and Delivery: Vendor shall deliver the Contract Items within 60 calendar days of being awarded this Contract and receiving a purchase order or notice to proceed. Contract

The top-mounted antenna proposed, which we believe meets the major requirements for the main WVPB-TV RF Channel 9 television antenna cannot be delivered in the 60-day specified in Section 6.1 of the Solicitation-Specifications. To accommodate this requirement ERI has proposed to supply an interim antenna and 493-feet of 3-inch Air HELIAX® which will be delivered within 35 days of being awarded a contract and receiving a purchase order or notice to proceed. This will provide a means to operate the facility until the main antenna and transmission line are delivered at 150-days after receiving a contract and purchase order or notice to proceed.

Respectfully submitted,

ELECTRONICS RESEARCH, INC.

Bill Harland
Vice President of Marketing
+1 (812) 925-6000, Ext. 214
+1 (812) 455-1823 (cell)
bharland@eriinc.com

ERI Response to High Power VHF Television Antenna Specifications

1. **PURPOSE AND SCOPE:** The West Virginia Purchasing Division is soliciting bids on behalf of the West Virginia Educational Broadcasting Authority (Agency) to establish a contract for the one-time purchase of a High-Power VHF Television Transmit Antenna.

2. **DEFINITIONS:** The terms listed below shall have the meanings assigned to them below. Additional definitions can be found in section 2 of the General Terms and Conditions.

   2.1 Contract Item: means a High-Power VHF Television Transmit Antenna as more fully described by these specifications.

   2.2 Elliptical Polarization: An antenna is said to be vertically polarized (linear) when its electric field is perpendicular to the Earth's surface. If the axial ratio is near 0 dB (decibel), the antenna is said to be circular polarized. If the axial ratio is greater than 1-2 dB, the polarization is often referred to as elliptical.

   2.3 Horizontal Azimuth Pattern: horizontal angle radiation measured clockwise from any fixed reference plane or easily established base direction line.

   2.4 Moment Arm: the length between a joint axis and the line of force acting on that joint. Every joint that is involved in an exercise has a moment arm. The longer the moment arm is the more load will be applied to the joint axis through leverage.

   2.5 Pricing Page: the page(s), contained in wvOASIS or attached as Exhibit A, upon which Vendor should list its proposed price for the Contract Items.

   2.6 Radome: a dome or other structure protecting radar equipment and made from material transparent to radio waves, especially one on the outer surface of an aircraft.

   2.7 Solicitation: means the official notice of an opportunity to supply the State with goods or services that is published by the Purchasing Division.

3. **GENERAL REQUIREMENTS:**

   3.1 Mandatory Contract Item Requirements: Contract Item must meet or exceed the mandatory requirements listed below.

   3.1.1 High-Power VHF Television Transmit Antenna

   3.1.1.1 Mechanical Specifications

   3.1.1.1.1 All structural elements shall be designed and fabricated in accordance with TIA/EIA standard RS-222G, Structural Standards for Steel Antenna, Towers, and Supporting structures. Download available here: Structural Standards for Antennae and Towers. A building markup (Exhibit D) is attached to facilitate this.

   ERI Reply: The product proposed by ERI is compliant with this requirement.

3.1.1.1.2 All hardware shall be constructed of non-ferrous material or be galvanized

3.1.1.1.2.1 Steel elements shall be hot-dip galvanized in accordance with the ASTM A123 standard available here:
ASTM A123 Standard

3.1.1.1.2.2 Zinc coating shall be applied with a minimum thickness of 0.002 inches (0.5mm)

ERI Reply: The product proposed by ERI is compliant with this requirement.

3.1.1.1.3 Physical Antenna attributes:

3.1.1.1.3.1 Antenna shall be top mounted

ERI Reply: The product proposed by ERI is compliant with this requirement.

3.1.1.1.3.2 Antenna shall have lifting points and directions for possible helicopter installation.

ERI Reply: The product proposed by ERI is compliant with this requirement.

3.1.1.1.3.3 Antenna shall be designed for mounting as outlined in Exhibit B, WVPB Top of Steel Drawing.

ERI Reply: The product proposed by ERI is compliant with this requirement.

3.1.1.1.3.4 Radiating elements shall be protected from ice by being enclosed in a Radome

ERI Reply: The product proposed by ERI is compliant with this requirement.

3.1.1.1.3.5 Vendor shall provide mechanical interface between top of steel and antenna if required.

ERI Reply: The product proposed by ERI is compliant with this requirement.

3.1.1.1.3.6 Weight without ice shall be less than 5000 pounds

ERI Reply: The product proposed by ERI has a preliminary weight of 8860 pounds.

3.1.1.1.3.7 Effective Projected Area (wind load) shall be less than 64.6 square feet (6 square meters)

ERI Reply: The product proposed by ERI has a preliminary EPA of 87.6 square feet.

3.1.1.1.3.8 Moment arm shall be less than 22 feet (6.7 Meters)

ERI Reply: The product proposed by ERI has a preliminary moment arm of 19.50 feet.

3.1.1.2 Electrical specifications:

3.1.1.2.1 Antenna shall operate on DTV Channel 9 (186-192MHz)

ERI Reply: The product proposed by ERI is compliant with this requirement.

3.1.1.2.2 Polarization shall be elliptical

ERI Reply: The product proposed by ERI is compliant with this requirement.

3.1.1.2.3 The Horizontal Azimuth Pattern shall meet the parameters defined in the Attachment provided (PDF of Construction permit on file with the FCC – Exhibit C)

ERI Reply: The antenna proposed deviates from the pattern specified very slightly. At no azimuth angle does the horizontal plane pattern exceed that of the pattern specified by the WVPB-TV construction permit by more than 0.042 dB or less -0.097 dB of the relative field value of the pattern authorized. A comparison of the patterns can be found, in both relative field and in dB beginning on page 74 of this document.

3.1.1.2.4 The antenna shall have a vertical component of 25% compared to the horizontal radiation

ERI Reply: The product proposed by ERI is compliant with this requirement.

3.1.1.2.5 Antenna and transmission line shall produce an Effective Radiated Power of 23 KW with a post mask filter TPO of less than 4KW.

ERI Reply: The product proposed by ERI is compliant with this requirement.

3.1.1.2.6 Antenna and transmission line must be able to operate with a power level of 20 KW Transmitter Power Output.

ERI Reply: The product proposed by ERI is compliant with this requirement.

3.1.1.3 Transmission Line and Accessories:

3.1.1.3.1 Vendor shall provide Transmission Line able to operate with 20 Kilowatts DTV (Digital Television) power

ERI Reply: The product proposed by ERI is compliant with this requirement.

3.1.1.3.1.1 Current transmission line is 6 1/8” EIA, 75 Ohm with matching transformers at each end.

3.1.1.3.2 Vertical run is 1081 feet to top of steel

ERI Reply: The product proposed by ERI is compliant with this requirement.

3.1.1.3.3 Horizontal run is 100 feet

ERI Reply: The product proposed by ERI is compliant with this requirement.

3.1.1.3.4 Vendor shall provide all Transmission Line components for complete installation. Components shall include but not be limited to: Hangers, hoisting adapters, Elbows, Field terminated line sections, transformers, and pressure windows.

ERI Reply: The product proposed by ERI is compliant with this requirement.

4. CONTRACT AWARD:

4.1 Contract Award: The Contract is intended to provide Agencies with a purchase price for the Contract Items. The Contract shall be awarded to the Vendor that provides the Contract Items meeting the required specifications for the lowest overall total cost as shown on the Pricing Pages (Commodity Line).

ERI Reply: ERI understands and accepts this condition.

4.2 Pricing Page: Vendor should complete the Pricing Page (Commodity lines) by filling the line with the appropriate information. Vendor should complete the Pricing Page in full as failure to complete the Pricing Page in its entirety may result in Vendor's bid being disqualified.

ERI Reply: ERI is submitting its response online at wvOASIS.

4.2.1 If submitting a bid online, Vendors should enter the Unit Price into each commodity line and the system will sum the total amount automatically. If responding with a paper bid, Vendors should download and/or print the assembled Final Solicitation document (with the highest version number) from wvOASIS and insert their Unit Prices for each Commodity Line.

ERI Reply: ERI understands these directions and has complied with them in its online submission at wvOASIS.

4.2.2 Shipping costs shall be included in the price of equipment.

ERI Reply: The shipping cost of the product is included in the ERI bid amount.

4.2.3 Vendor must include additional documentation for all equipment and components to sufficiently demonstrate that all equipment and components meet specifications. Vendor should include this documentation with their bid. It will be required prior to award.

ERI Reply: We believe this document provides the information required to evaluate whether the items proposed by ERI meet the requirements of this solicitation.

4.2.4 The total cost of the bid shall be the "Total Bid Cost" as described in section 4.2.1

ERI Reply: The single price submitted is the Total Bid Cost for the equipment and services proposed.

4.2.5 If no vendor submits a bid within the budget limitations of the Agency, the Agency may, at its own discretion, cancel this RFQ and purchase nothing.

ERI Reply: ERI understands this limitation.

5. PAYMENT:

5.1 Payment: Vendor shall accept payment in accordance with the payment procedures of the State of West Virginia.

ERI Reply: ERI's offer is based on receiving payment according to the payment procedures of the State of West Virginia.

6. DELIVERY AND RETURN:

6.1 Shipment and Delivery: Vendor shall deliver the Contract Items within 60 calendar days of being awarded this Contract and receiving a purchase order or notice to proceed. Contract Items must be delivered to Agency at the following address:

WV Educational Broadcasting Authority
Attn: Dave McClanahan
9248 Barker Ridge Church Road
Milton, WV

Vendor must give the Agency a minimum notice of 10 business days prior to the arrival of the Contract Items on site to permit preparation for off-loading.

ERI Reply: The ERI offer includes shipment to this location and we will provide the notification required in advance of shipment.

6.2 Late Delivery: The Agency placing the order under this Contract must be notified in writing if the shipment of the Contract Items will be delayed for any reason. Any delay in delivery that could cause harm to an Agency will be grounds for cancellation of the Contract, and/or obtaining the Contract Items from a third party.

ERI Reply: In the unlikely event late delivery will occur, based on the offer of an interim antenna and transmission line followed by delivery of a new main antenna and transmission line, ERI will provide the notification required by this section.

Any Agency seeking to obtain the Contract Items from a third party under this provision must first obtain approval of the Purchasing Division.

ERI Reply: ERI understands and will not aid any agency in circumventing this requirement.

6.3 Delivery Payment/Risk of Loss: Vendor shall deliver the Contract Items F.O.B. destination to the Agency's location.

ERI Reply: The ERI offer is FOB Destination and includes material transportation charges.

6.4 Return of Unacceptable Items: If the Agency deems the Contract Items to be unacceptable, the Contract Items shall be returned to Vendor at Vendor's expense and with no restocking charge. Vendor shall either make arrangements for the return within five (5) days of being notified that items are unacceptable or permit the Agency to

arrange for the return and reimburse Agency for delivery expenses. If the original packaging cannot be utilized for the return, Vendor will supply the Agency with appropriate return packaging upon request. All returns of unacceptable items shall be F.O.B. the Agency's location. The returned product shall either be replaced, or the Agency shall receive a full credit or refund for the purchase price, at the Agency's discretion.

ERI Reply: ERI accepts this clause and will accept an order with these deviations from its standard terms of sale.

6.5 Return Due to Agency Error: Items ordered in error by the Agency will be returned for credit within 30 days of receipt, F.O.B. Vendor's location. Vendor shall not charge a restocking fee if returned products are in a resalable condition. Items shall be deemed to be in a resalable condition if they are unused and in the original packaging. Any restocking fee for items not in a resalable condition shall be the lower of the Vendor's customary restocking fee or 5% of the total invoiced value of the returned items.

ERI Reply: ERI accepts this clause and will accept an order with these deviations from its standard terms of sale.

7. VENDOR DEFAULT:

7.1 The following shall be considered a vendor default under this Contract.

7.1.1 Failure to provide Contract Items in accordance with the requirements contained herein.

7.1.2 Failure to comply with other specifications and requirements contained herein.

7.1.3 Failure to comply with any laws, rules, and ordinances applicable to the Contract Services provided under this Contract.

7.1.4 Failure to remedy deficient performance upon request.

7.2 The following remedies shall be available to Agency upon default.

7.2.1 Immediate cancellation of the Contract.

7.2.2 Immediate cancellation of one or more release orders issued under this Contract.

7.2.3 Any other remedies available in law or equity.

ERI Reply: ERI accepts these clauses and allows this deviation from its standard terms of sale.

Main Antenna and Transmission Line Product Information

TRASAR® Television Antenna

The high band VHF television antenna proposed is top mounted, end fed, coaxial slotted array design which is an elliptically polarized antenna.

ERI TRASAR® High Band VHF Television Antenna. The antenna pictured is a circularly polarized. The antenna includes a fiberglass ladder for beacon access which has minimal impact on its omnidirectional azimuth pattern.

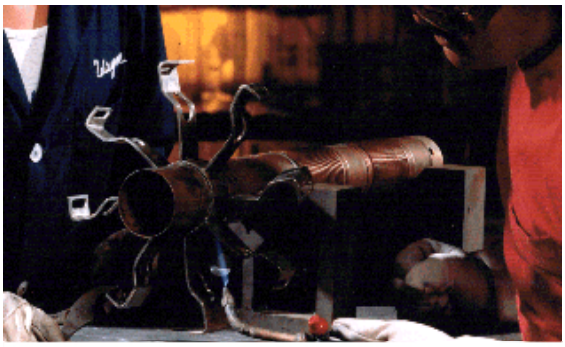
Major features, benefits and construction characteristics that are common to all of the TRASAR antenna proposed include:

- All the antennas proposed are end fed deigns which are capable of achieving electrical beam tilts of more than 0.5 degrees, without any loss of power gain as beam tilt is introduced.
- There are no internal feed lines and therefore input power is limited only by size of antenna cross section. These are excellent designs for handling very high-power levels
- End fed antennas produce a naturally null free elevation pattern and can easily be designed to produce null free, smooth elevation patterns.
- The pressurized radome enclosures protect the antennas from harsh environments and provides adequate clearance, so the ice formation does not affect operation.
- To further enhance reliability TRASAR antennas incorporate a fixed short and a patented bellows section in the inner conductor to compensate for the differential expansion between the inner and outer conductor.
- The fixed DC short across the internal feed line also protects the antenna against lightning damage.
- The methods and computer design tools developed and used by ERI Broadcast Products to design TRASAR antennas eliminate “beam wobble”.
- Beam wobble or beam steering is a change of the angular location of the antenna’s elevation beam.
- This is because the electrical spacing between slots is a function of frequency.
- ERI counters this by careful selection of the slot impedance and using non-uniform slot spacing.
- The net result is that the signal from the antenna arrives at a receiving location is essentially constant over the 6 MHz band.

ERI top mounted antenna configurations are constructed with a galvanized steel outer conductor. These antennas are also enclosed in a pressurized radome. If the antenna is elliptically polarized and omnidirectional then access to the beacon is provided by a fiberglass ladder which has a minimal effect on the azimuth pattern. The horizontally polarized omnidirectional antennas and directional antennas that

are either horizontally of elliptically polarized include a galvanized steel climbing pole for beacon access. All top mounted TRASAR antennas include four (4) lightning spurs at the top of the antenna.
All the antennas proposed are enclosed in aviation orange pressurized radome enclosures, other colors are optionally available. The radomes are pressurized and this prevents any ingress of moisture, dirt, or other debris into the radome were it could have an impact on antenna performance and reduce the antenna's useful life. There is no periodic maintenance required for the coloring of the radome of the antenna proposed. The radome clearance for each antenna is sufficient to ensure that the impact of any ice formation on the outside of the radome with have negligible impact on the antenna's azimuth and elevation patterns. The recommended pressurization level of the antenna and transmission line system is 2.0 to 5.0 psi the antenna is rated to a maximum of 10 psi. If the antenna and transmission line pressurization is maintained there should be no need to break open the radome and access the antenna inner or outer conductor.

The bellows assembly and fixed DC short between the inner and outer conductor has no finger stock or sliding contacts and so there is no periodic inspection or maintenance associated with these elements. In the highly unlikely event access is required to the fixed short top mounted TRASAR antennas include a top radome section (see photo left) that is a special 12-inch length, and the climbing pole, or climbing ladder in the case of an omnidirectional elliptically polarized antenna, is attached in a manner that allows its removal without removing the antenna from the tower.



ERI TRASAR Differential Expansion Compensation Assembly

The antennas proposed are elliptically polarized models. ERI uses an independent dipole, separated from the slot, which emits the horizontally polarized component, and this allows the pattern to be optimized to the coverage requirements of the facility it is designed for. In the case of side mounted antennas this eliminates destructive reflections that result from undesirable reflections from the supporting structure and allows for significantly better performance in side mounted applications.

Climbing Facilities

Top mounted TRASAR with fiberglass ladder climbing facility used with omnidirectional circularly and elliptically polarized antennas to eliminate pattern distortion.

Top mounted TRASAR with galvanized steel climbing pole used with horizontally polarized and directional circularly and elliptically polarized antennas.

All ERI top mounted television antennas are provided with dedicated climbing facilities that do not penetrate the radome. This prevents potential contamination or moisture intrusion into the antenna radome which can cause corrosion, impact electrical performance, and shorten the antenna useful lie. This also provides climbers superior access to the beacon and improves safety.

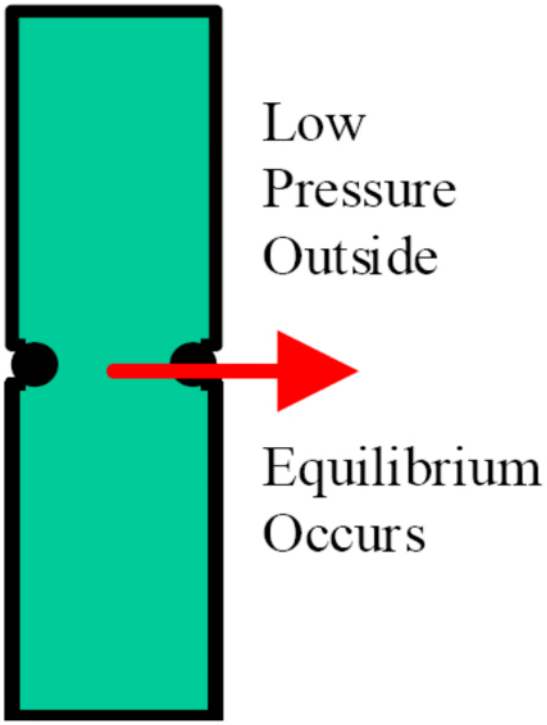
ERI elliptically polarized side mounted UHF television antenna under construction. The slots shown provide the horizontally polarized signal and the vertical dipoles between the slots emit the vertical signal component. This allows the horizontal plane patterns of the two polarizations to be optimized for the best over the air coverage for any given location and application.

Lifting & Handling Considerations

All ERI top mounted television antennas are provided with dedicated rigging lug attachments at the base of the antenna. This provides superior load control during lifting and installation. It also allows for reduced gin pole headroom (aka cantilever) which ultimately reduces the size of gin pole required. This also provides climbers superior access and safety.

Analysis of Pressurized Radome Enclosures

Pressurized radome enclosures eliminate the effects of the environment on the internal components of the antenna. This reduces the maintenance involved on a pressurized antenna to external damage to the radome, such as a lightning strike -- a very unlikely occurrence. In contrast, the likelihood of damage to the internal components of a non-pressurized antenna is great, as well as the probability that it will go unnoticed until catastrophic failure occurs.

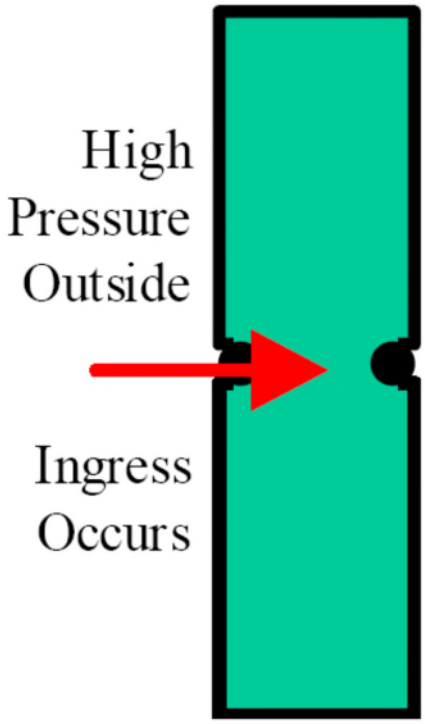


Pressure Equilibrium in Low-Pressure Storm

Creating Enclosures

Waveguide and coaxial transmission lines contain many joints sealed with O-rings around the flanges. Terrestrial and satellite microwave transmission lines are similarly sealed and pressurized[1]. All such transmission lines contain critical junctions that would corrode or otherwise degrade in the presence of contaminants, and for this reason that almost all high-power broadcast transmission facilities have pressurization equipment supplying dry gas to transmission lines. These systems contain O-rings and high-pressure flanges providing a seal, and they are pressurized as well. With a sealed volume of air, or any other gas, a pressure vessel exists. Such volumes are created in an effort to eliminate ingress of water or other contaminants. A small amount of gas is leaked in every seal, and over time a pressure differential will not exist between the sealed volume of gas and the environment surrounding it.

Efforts to create volumes sealed from environments that include the passage of weather systems are often thwarted by the pressure changes. A situation where the outside pressure rises above the pressure of the sealed environment is inevitable and accompanied by moisture (**Error! Reference source not found.**). The moisture and other contaminants are ultimately pumped into the sealed volume. Without equipment to constantly provide greater pressure in the enclosure, water and other contaminants would be pumped into the sealed line every time a front passes.



High Pressure System Moves In

[1] Whitaker, Jerry, ed., *NAB Engineering Handbook, 9th Edition,* Washington, DC, 1999

Ingress Protection Ratings

		1st Digit	2nd Digit
Levels of Protection	0	No special protection	
	1	Objects greater than 50mm in diameter.	Protection from dripping water.
	2	Object not greater than 80mm in length and 12mm in diameter.	Protection from vertically dripping water.
	3	Tools, wire, etc., of thickness greater than 1.0mm.	Protection from sprayed water.
	4	Any object with a diameter or thickness greater than 1.0mm	Protection from splashed water.
	5	Volume of dust that would interfere with operation	Protection from water projected from a nozzle
	6	Dust tight.	Protection against heavy seas, or powerful jets of water.
	7	NA	Protection against immersion.
	8	NA	Protection against complete, continuous submersion in water.

Ingress Protection (IP) Ratings

The IEC Test Standard EN 60529[2] outlines an international classification system for the sealing effectiveness of enclosures of electrical equipment against the intrusion into the equipment of foreign objects (i.e. tools, dust, fingers) and moisture. This classification system uses the letters "IP" (“Ingress Protection”) followed by two digits.

The first digit of the IP code indicates the degree that persons are protected against contact with moving parts (other than smooth rotating shafts, etc.) and the degree that equipment is protected against solid foreign bodies intruding into an enclosure. The second digit indicates the degree of protection of the equipment inside the enclosure against the harmful entry of various forms of moisture (e.g. dripping, spraying, submersion, etc.).

Pressurized Antennas

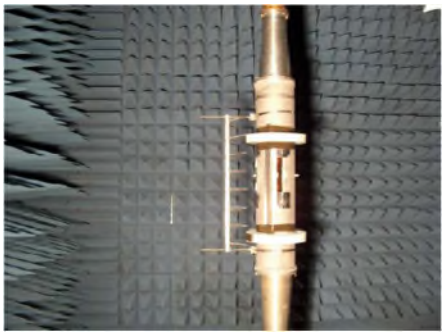
Broadcast television antennas have critical components that would be impaired greatly in the presence of water or other contaminants. Many antennas have flange junctions nearly identical to those critical junctions found in the transmission lines mentioned above. In addition, the performance of radiating elements, coupling devices, and power dividing components suffers if subjected to corrosive or contaminated environments. Without the use of pressurization equipment to eliminate the ingress of contaminants, periodic maintenance is required to clean and repair the damaged surfaces.

Ingress protected antenna equipment, with IP67 or better ratings, requires no periodic maintenance. No dust or debris from the harsh external environment will contaminate critical conducting surfaces and points of conductor contact. No water will be pumped into the antenna by passing storms and pressure changes. After 30 years of service, critical components will still be shiny and undamaged.

Pressure Protected Antenna After 30 Years of Service in Chicago

[2] IEC 60529, Edition 2.1, Degrees of protection provided by enclosures (IP Code), Geneva, Switzerland, 2001.

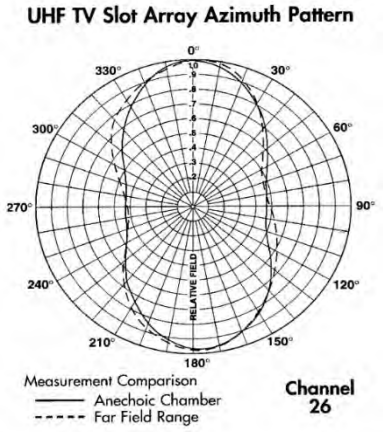
Array Antenna Pattern Measurement Techniques



ERI's Anechoic Chamber

Measurement of antenna patterns on a far-field test range, in a near-field environment, or in an anechoic chamber has been studied and standardized. The correlation between measurements made in the far-field and those made in an anechoic chamber is also an active field of study. Independent radiation pattern measurements of two UHF broadcast antenna arrays are compared and discussed.

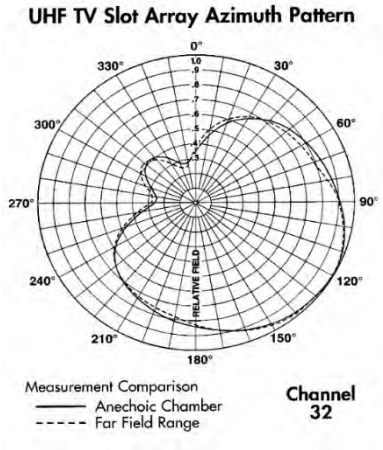
Two major areas of interest when specifying performance parameters for television transmitting antennas are elevation pattern and azimuth pattern. For proper coverage, a great deal of time, money and effort are usually expended to determine not only the ideal azimuth and elevation patterns but also their relationship to available transmitter power configurations and limitations. The final radiation pattern of any antenna is determined by the amplitude and phase distribution over the antenna aperture. The aperture effects can be divided into two separate and independent radiation characteristics: the azimuth pattern and the elevation pattern. The product of these two patterns gives the total radiation pattern for the antenna.



Azimuth Pattern Measurement

For UHF antennas, directional azimuth patterns are often chosen to optimize the coverage of the viewing area and to maximize the Effective Radiated Power (ERP) of the antenna by using the higher azimuth gains [5]. It is very important to eliminate all extraneous signals from the measurements or significant error can be introduced.

The appropriate conditions are accomplished by using an anechoic chamber for azimuth pattern testing. The anechoic chamber is designed with absorbing material that covers the walls, ceiling, and floor to prevent any unwanted reflections during the measurement procedure. The anechoic chamber is a controlled measurement environment. It aims to represent the free space condition of the design criteria because it minimizes reflections and, at the same time, allows direct measurement of the azimuth pattern. It is not subject to the dynamic environmental influences that affect measurements on a far-field test range, reflections from buildings, vegetation, seasonal changes, rain, snow, or ice. This assures both very accurate measurement results and repeatability of the results at any time.

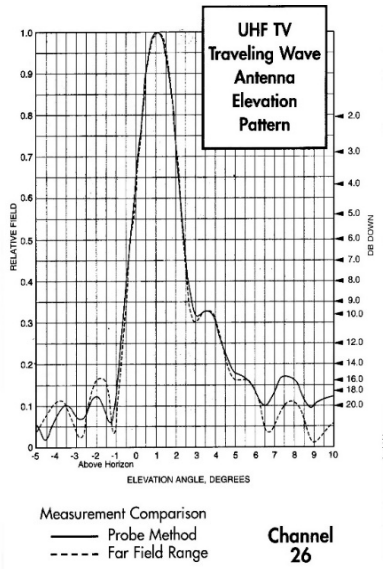


If the geometry of the antenna array is the same at any cross section, it is only necessary to measure a full-scale segment of the array to determine the azimuth pattern of the full antenna. The factorization of the antenna pattern into an element pattern and array factor allows model studies and if the geometry of the antenna array is the same at any cross section, it is only necessary to measure a full-scale segment of the array to determine the azimuth pattern of the full antenna. The factorization of the antenna pattern into an element pattern and array factor allows model studies and other investigations to be carried out where only the azimuth pattern is of interest. In order to provide the most accurate measurements possible and to ensure that the antenna is in strict conformance with the design requirements, an anechoic chamber is employed for antenna model measurements and production testing of broadcast antenna azimuth patterns. A full-scale, one-bay model for two antenna

arrays was measured in an anechoic chamber and compared with patterns measured on the full array on a far field test range.

Elevation Pattern Measurement

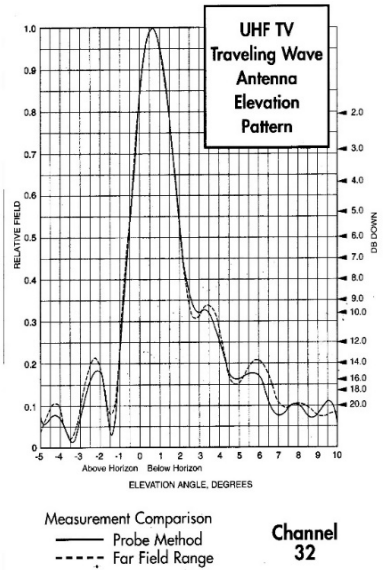
To determine the elevation pattern of the antenna requires that the entire array be assembled and that the phase and amplitude distribution across the aperture be measured. Because reflections and extraneous signals can cause significant error in this measurement, ideally the antenna should be placed inside an anechoic chamber and the elevation pattern measured in the same manner as the azimuth pattern. However, the physical size and cost of such a structure prohibits this in the UHF band.
An alternate method of measurement was developed to simulate the "free space" condition of the anechoic chamber. This near-field method uses an isolated probe to measure the slot excitation (amplitude and phase) of each slot in the array.



With the measured data, α_i, β_i, and the known array geometry, d_i, the array factor may be computed by the following equation:

$$E(\theta) = \sum \alpha_1 e^{j(kd_i \cos\theta + \beta_i)}$$

where k is the propagation constant and θ is the elevation angle. The product of the array factor and the pattern of the one-bay element produce the elevation pattern. The measured data and pattern are compared with the design data for conformance to design specifications.



There are two major advantages of this measurement technique. Because the measurements are made in the near field, the effects of reflections and other unwanted signals are greatly reduced. Also, because the elevation pattern specifications are based on a particular phase and amplitude distribution across the aperture, a direct comparison between predicted and measured patterns and distributions is possible. This greatly accelerates the test program by eliminating the need to determine if any variances are caused by interference in the measurements. Any adjustments that are necessary are immediately visible as well as what corrective action is required. Again, this technique is a measurement of the radiation pattern near-field method for improving accuracy when comparing to the design criteria.

The elevation patterns of two UHF arrays were measured using the near-field sampling method and are compared with the direct far-field measurements.

Pattern Comparisons

To better understand the ability to accurately measure the radiation patterns of a broadcast transmitting antenna, a comparison with traditional far-field measurements is shown. Variations in the azimuth pattern are less than 1dB, and variations in the main beam region of the elevation pattern are also less than 1dB. The differences may be attributed to undesirable reflections in the far-field test environment. The pattern data from the near-field probe measurement (for the elevation pattern) and the anechoic chamber (for the azimuth pattern) show excellent correlation with far-field test range results.

Preliminary Specification for
TRASAR® Top Mounted
High Band VHF Elliptically Polarized
Coaxial Slotted Array Television Antenna

WVPB-TV, RF Channel 9
WV Educational Broadcasting Authority, Huntington, WV

August 04, 2020

Antenna Model:
ATW6V5-ETP-9H

Specification Number
20200723-068-1

Electronics Research, Inc. 7777 Gardner Road Chandler IN 47610-9219 USA
+1 812 925-6000 (tel) +1 812 925-4030 (fax)

Preliminary Specification for TRASAR® Top Mounted High Band VHF Elliptically Polarized Coaxial Slotted Array Television Antenna

Electrical Characteristics:

Channel:		9	
Frequency:		186 MHz to 192 MHz	
Service:		ATSC	
Azimuth Pattern Number:	Horizontal Polarization	ATW-P	
	Vertical Polarization	ATW-P-V	
Elevation Pattern Number:	Horizontal Polarization	ATW6V5H	
	Vertical Polarization	ATW4V5H	
Azimuth Directivity:	Horizontal Polarization	2.02	(3.05 dB)
	Vertical Polarization	2.09	(3.20 dB)
Elevation Directivity:	Horizontal Polarization	6.00	(7.78 dBd)
	Vertical Polarization	4.00	(6.02 dBd)
Peak Power Gain:	Horizontal Polarization	8.90	(9.49 dBd)
Peak Power Gain:	Vertical Polarization	2.22	(3.47 dBd)
Gain at Horizontal:	Horizontal Polarization	8.42	(9.25 dBd)
	Vertical Polarization	2.17	(3.37 dBd)
ERP Vertical/Horizontal Ratio:		0.250	
Power Ratio:		0.362	
Electrical Beam Tilt:		1.25 Degrees	
Input Power Required:		2.59 kW	(4.13 dBk)
RF Input:		3-1/8-inch EIA, 50 Ω, flanged male	
Input Power Rating (maximum):		20 kW Average Power, 8VSB	
Antenna VSWR (maximum):		1.10 Over 6 MHz Channel	

Preliminary Specification for TRASAR® Top Mounted

Coaxial Slotted Array Television Antenna

Antenna Mechanical Characteristics:

Mounting Configuration:		Top Mounted	
Height of Antenna (D):		37.5 feet	(11.4 meters)
"Height of Center of Radiation (B):		18.8 feet	(5.7 meters)
Overall Height (Includes four 3.5 ft lightning spurs) (A):		41.0 feet	(12.5 meters)
Deicing:		Fully enclosed pressurized radome	
Radome Diameter (C):		28.50 inches	(723.9 millimeters)
Radome Color:		Aviation Orange	
Climbing Device:		Galvanized Steel Climbing Pole	
Calculated Weight[1]:	No Ice	8860.0 lb	4018.8 kg
	1/2" (13 mm) ice	9960.0 lb	4517.8 kg
Effective Projected Area (EPA-ft^2)[1 2]:			
	No Ice	130.8 ft²	(12.2 m²)
	1/2" (13 mm) ice	145.2 ft²	(13.5 m²)
Effective Moment Arm[1 2]:	No Ice	19.50 feet	(5.95 meters)
	1/2" (13 mm) ice	19.80 feet	(6.04 meters)

MOUNTING FLANGE BOLT CIRCLE3: Quantity (20), 1.38 inch holes for 1.25 inch bolts, equally spaced on a 24.00 inch bolt circle.

This antenna is designed to be supported by a structure that can resist the antenna base reactions and which provides a support that is rigid in the three translational and three rotational degrees of freedom.

1) Please note, the listed weights and effective wind areas are based on the PRELIMINARY design of the antenna. Final As-Built values for the antenna are typically within +/-10% of the Preliminary design values, and will be provided in the technical manual that accompanies the antenna. Specified loads include the antenna, lightning spurs, and beacon only. Custom mounting brackets/adapters and/or antenna input section are NOT included.

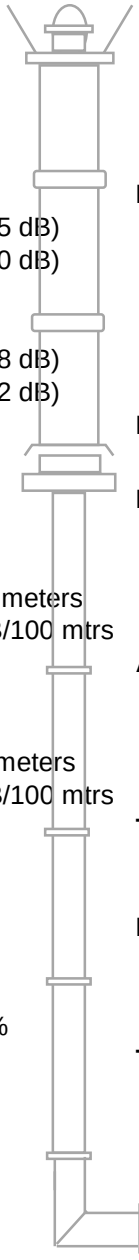
2) Preliminary antenna design based on a wind speed of 90 miles per hour (MPH) with no ice and 30 MPH with 0.75-inches of design radial ice (2.10-inches of factored ice at antenna, tiz) with a height above ground level (HAGL) of 1020 feet per ANSI/TIA-222-G. Structure Class II, Exposure Category C and Topographic Category III. Weight and wind area values include four lightning spurs and a standard beacon.

3) The mounting flange specified is the standard ERI mounting flange used for this antenna configuration. In those instances where an existing top mounted antenna is being replaced, the antenna supplied will be designed with a mounting flange to match that of the existing antenna bolt pattern unless electrical and/or mechanical requirements for the new antenna preclude the matching flange. Customer shall be responsible for supplying existing flange bolt pattern details when requesting a custom matching flange on the new antenna.

NOTE: The purchaser or their representative shall be required to contact the tower owner, state and/or local building officials for specific design requirements and suitable parameters for a particular structure. Any variation from the parameters shown above must be communicated to ERI for comprehensive assessment.

Broadcast Antenna System
Power Analysis

WVPB-TV **RF Channel: 9**
WV Educational Broadcasting Authority
Huntington, WV
ATW6V5-ETP-9H



Antenna Parameters

Azimuth Directivity:

Horizontal:	2.02	(3.05 dB)
Vertical:	2.09	(3.20 dB)

Elevation Directivity:

Horizontal:	6.00	(7.78 dB)
Vertical:	4.00	(6.02 dB)

Transmission Line

Vertical Run:

Type:	3-1/8-inch EIA, 50 Ω	
Length:	1,081 feet	329.5 meters
Attenuation:	0.132 dB/100 feet	0.433 dB/100 mtrs

Horizontal Run:

Type:	3-1/8-inch EIA, 50 Ω	
Length:	100 feet	30.5 meters
Attenuation:	0.132 dB/100 feet	0.433 dB/100 mtrs

Transmission Line Efficiency: 69.84%

RF System/Other Efficiency: 100.00%

Effective Radiated Power:

Horizontal:	23.00 kW	(13.62 dBk)
Vertical:	5.75 kW	(7.60 dBk)

Peak Power Gain:

Horizontal:	8.90 numeric	(9.49 dBd)

Peak Power Gain:

Vertical:	2.22 numeric	(3.47 dBd)

Antenna Input Power:
2.59 kW (4.13 dBk)

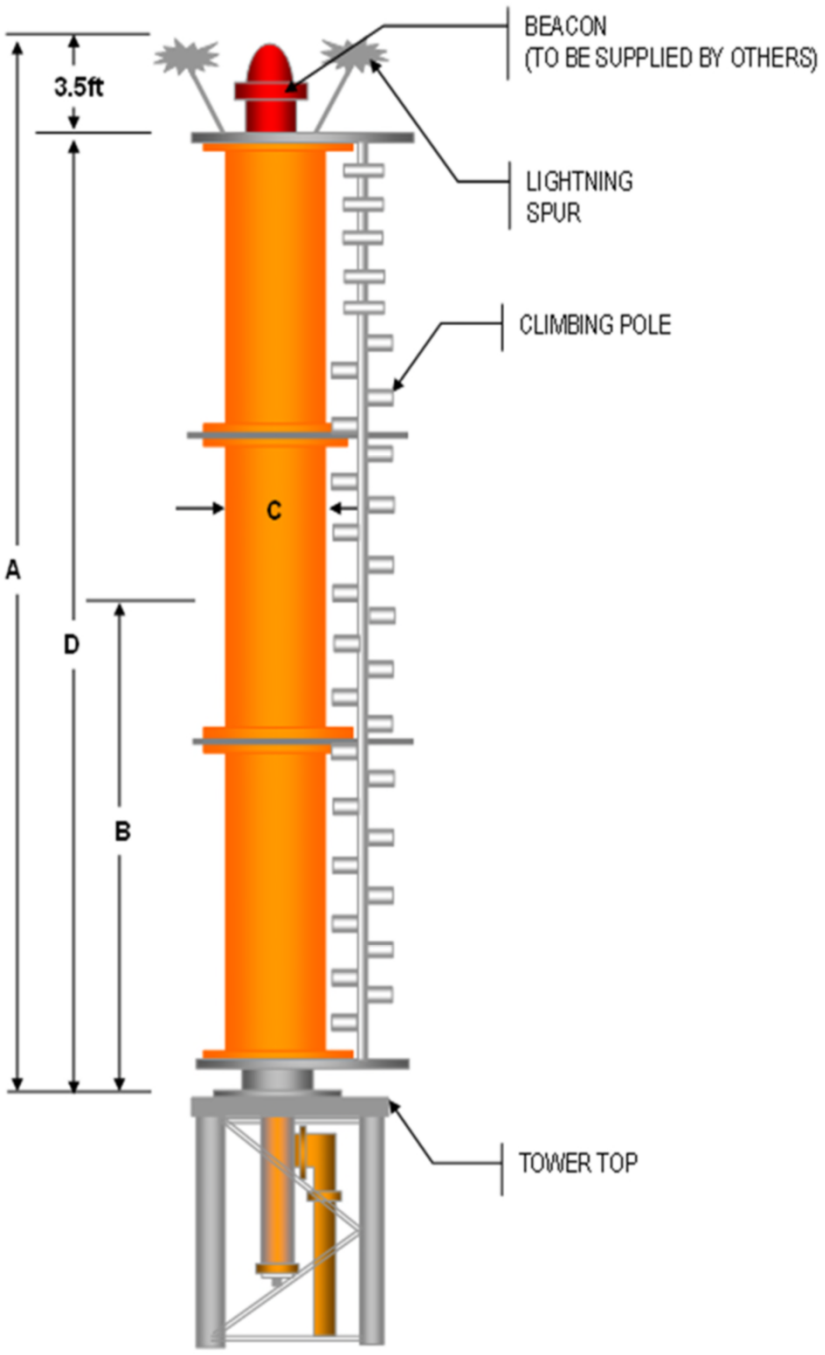
Transmission Line Losses:
-1.12 kW (1.559 dB)

RF System/Other Losses:
0.00 kW (0.000 dB)

Total Losses:
-1.12 kW (1.559 dB)

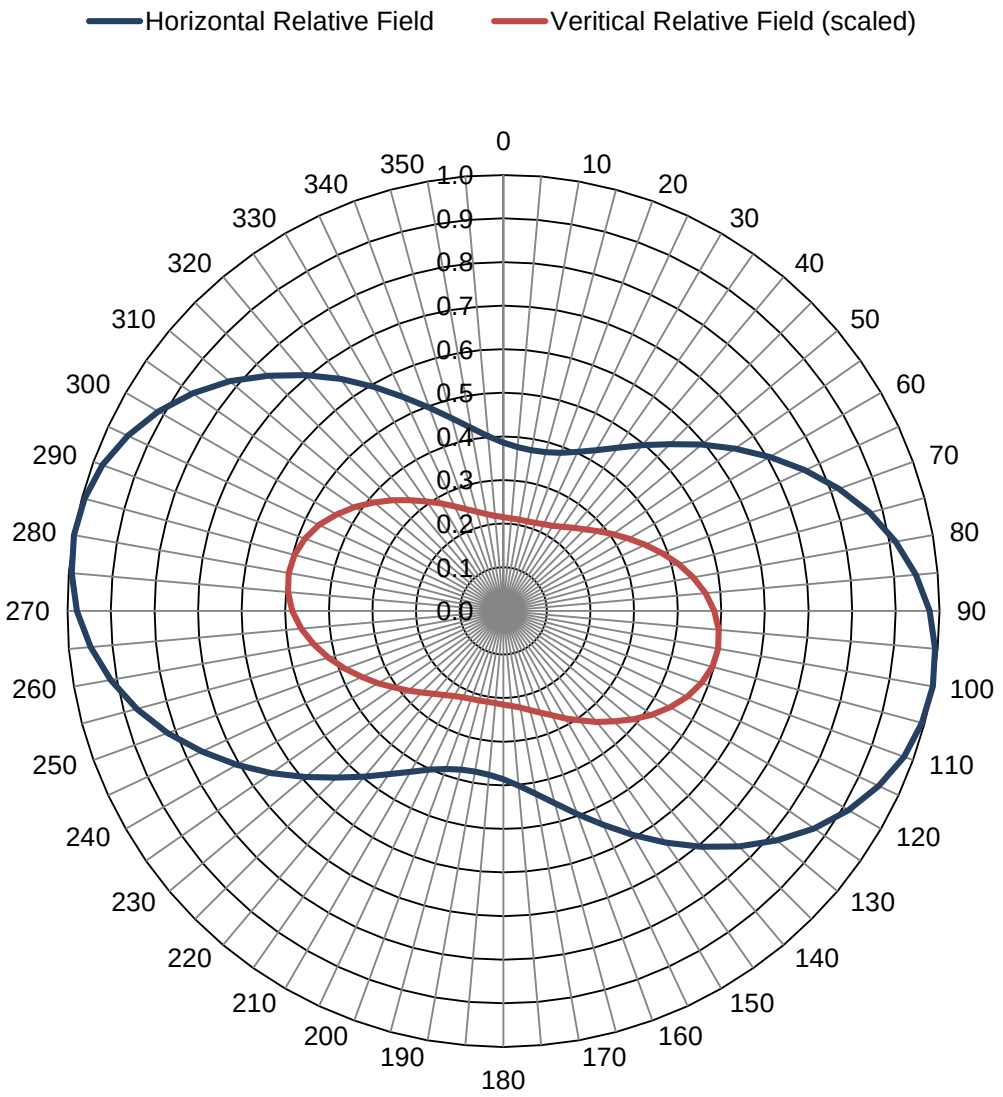
Transmitter Power Output:
3.70 kW
(5.68 dBk)

Typical Mounting Configuration Shown. Actual Configuration May Vary.



Composite Azimuth Patterns

Type:	ATW-P		**Polarization:**	Elliptical
Directivity (H-Pol):	2.02 numeric	(3.05 dB)	**Frequency:**	9 (ATSC)
Directivity (V-Pol):	2.09 numeric	(3.20 dB)	**Location:**	Huntington, WV
Percent Horizontal:	73.40%		NOTE: Pattern shape and directivity may vary with channel and mounting	
Percent Vertical:	26.60%			
Power Ratio:	36.24%			
ERP V/H Ratio::	25.00%			

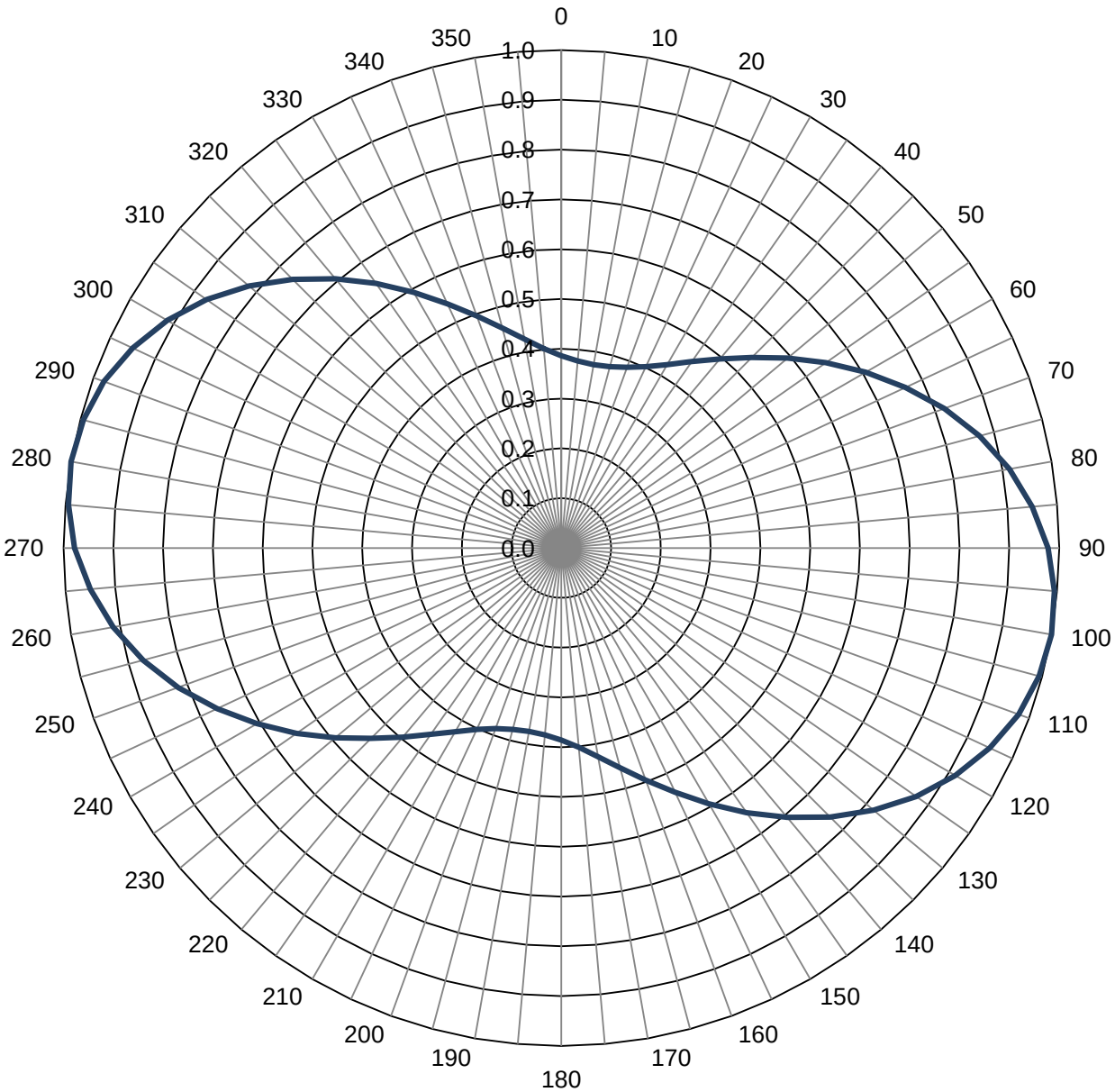


Azimuth Pattern

Type:	ATW-P		**Polarization:**	Horizontal
Directivity:	2.02 numeric	(3.05 dB)	**Frequency:**	9 (ATSC)
Peak(s) at:			**Location:**	Huntington, WV

NOTE: Pattern shape and directivity may vary with channel and mounting configuration.

Relative Field



Tabulated Data for Azimuth Pattern

Type: ATW-P

Angle	Field	dB
0	0.386	-8.27
2	0.382	-8.36
4	0.378	-8.45
6	0.376	-8.50
8	0.375	-8.52
10	0.374	-8.54
12	0.375	-8.52
14	0.376	-8.50
16	0.378	-8.45
18	0.382	-8.36
20	0.386	-8.27
22	0.392	-8.13
24	0.398	-8.00
26	0.406	-7.83
28	0.415	-7.64
30	0.425	-7.43
32	0.437	-7.19
34	0.450	-6.94
36	0.464	-6.67
38	0.479	-6.39
40	0.496	-6.09
42	0.513	-5.80
44	0.532	-5.48
46	0.551	-5.18
48	0.572	-4.85
50	0.593	-4.54
52	0.615	-4.22
54	0.637	-3.92
56	0.660	-3.61
58	0.683	-3.31
60	0.706	-3.02
62	0.729	-2.75
64	0.752	-2.48
66	0.775	-2.21
68	0.797	-1.97
70	0.819	-1.73
72	0.840	-1.51
74	0.860	-1.31
76	0.879	-1.12
78	0.897	-0.94
80	0.914	-0.78
82	0.930	-0.63
84	0.944	-0.50
86	0.957	-0.38
88	0.968	-0.28
90	0.978	-0.19
92	0.986	-0.12
94	0.992	-0.07
96	0.996	-0.03
98	0.999	-0.01

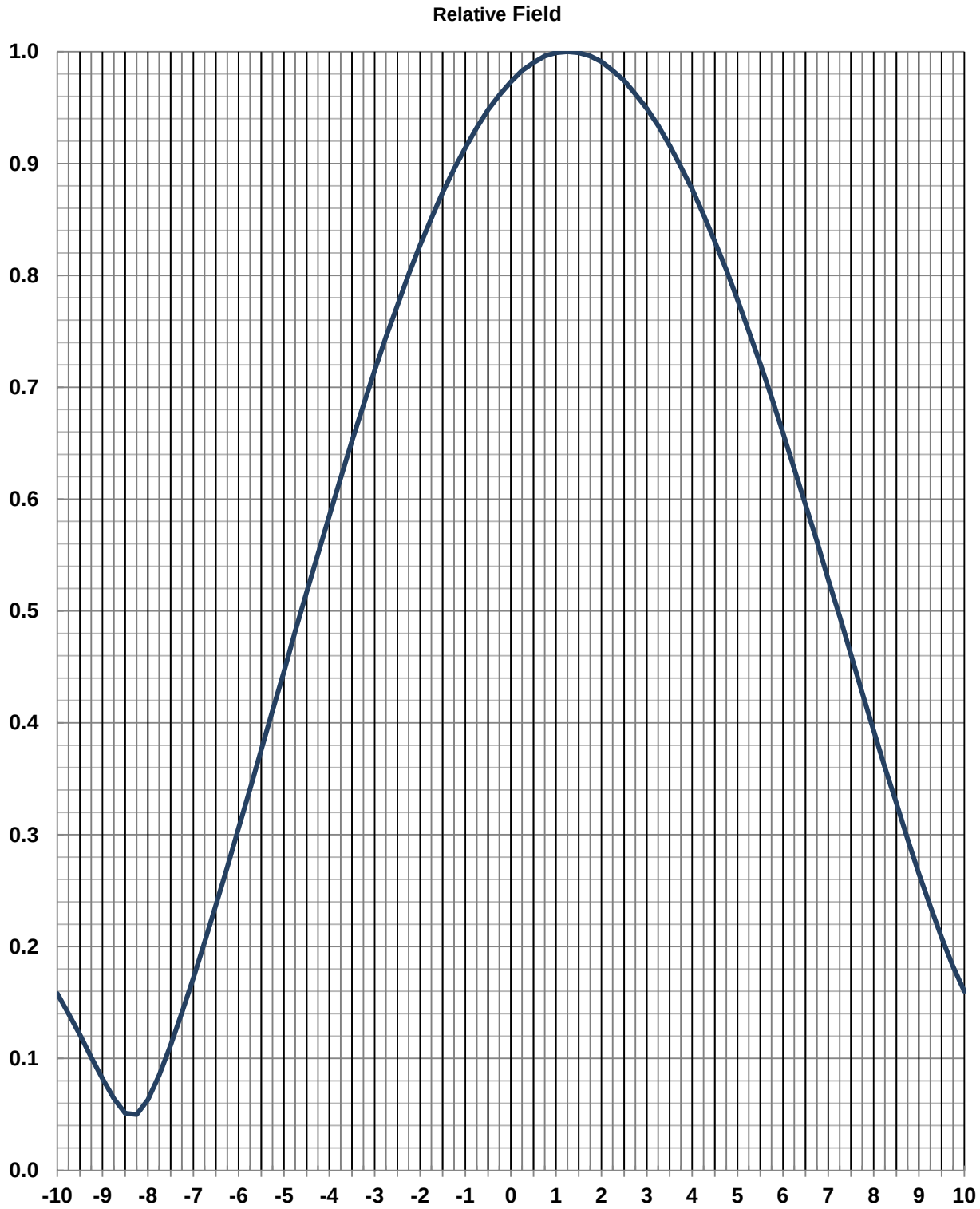
Angle	Field	dB
100	1.000	0.00
102	0.999	-0.01
104	0.996	-0.03
106	0.992	-0.07
108	0.986	-0.12
110	0.978	-0.19
112	0.968	-0.28
114	0.957	-0.38
116	0.944	-0.50
118	0.930	-0.63
120	0.914	-0.78
122	0.897	-0.94
124	0.879	-1.12
126	0.860	-1.31
128	0.840	-1.51
130	0.819	-1.73
132	0.797	-1.97
134	0.775	-2.21
136	0.752	-2.48
138	0.729	-2.75
140	0.706	-3.02
142	0.683	-3.31
144	0.660	-3.61
146	0.637	-3.92
148	0.615	-4.22
150	0.593	-4.54
152	0.572	-4.85
154	0.551	-5.18
156	0.532	-5.48
158	0.513	-5.80
160	0.496	-6.09
162	0.479	-6.39
164	0.464	-6.67
166	0.450	-6.94
168	0.437	-7.19
170	0.426	-7.41
172	0.415	-7.64
174	0.406	-7.83
176	0.398	-8.00
178	0.392	-8.13
180	0.386	-8.27
182	0.382	-8.36
184	0.378	-8.45
186	0.376	-8.50
188	0.375	-8.52
190	0.374	-8.54
192	0.375	-8.52
194	0.376	-8.50
196	0.378	-8.45
198	0.382	-8.36

Angle	Field	dB
200	0.386	-8.27
202	0.392	-8.13
204	0.398	-8.00
206	0.406	-7.83
208	0.415	-7.64
210	0.426	-7.41
212	0.437	-7.19
214	0.450	-6.94
216	0.464	-6.67
218	0.479	-6.39
220	0.496	-6.09
222	0.513	-5.80
224	0.532	-5.48
226	0.551	-5.18
228	0.572	-4.85
230	0.593	-4.54
232	0.615	-4.22
234	0.637	-3.92
236	0.660	-3.61
238	0.683	-3.31
240	0.706	-3.02
242	0.729	-2.75
244	0.752	-2.48
246	0.775	-2.21
248	0.797	-1.97
250	0.819	-1.73
252	0.840	-1.51
254	0.860	-1.31
256	0.879	-1.12
258	0.897	-0.94
260	0.914	-0.78
262	0.930	-0.63
264	0.944	-0.50
266	0.957	-0.38
268	0.968	-0.28
270	0.978	-0.19
272	0.986	-0.12
274	0.992	-0.07
276	0.996	-0.03
278	0.999	-0.01
280	1.000	0.00
282	0.999	-0.01
284	0.996	-0.03
286	0.992	-0.07
288	0.986	-0.12
290	0.978	-0.19
292	0.968	-0.28
294	0.957	-0.38
296	0.944	-0.50
298	0.930	-0.63

Angle	Field	dB
300	0.914	-0.78
302	0.897	-0.94
304	0.879	-1.12
306	0.860	-1.31
308	0.840	-1.51
310	0.819	-1.73
312	0.797	-1.97
314	0.775	-2.21
316	0.752	-2.48
318	0.729	-2.75
320	0.706	-3.02
322	0.683	-3.31
324	0.660	-3.61
326	0.637	-3.92
328	0.615	-4.22
330	0.593	-4.54
332	0.572	-4.85
334	0.551	-5.18
336	0.532	-5.48
338	0.513	-5.80
340	0.496	-6.09
342	0.479	-6.39
344	0.464	-6.67
346	0.450	-6.94
348	0.437	-7.19
350	0.426	-7.41
352	0.415	-7.64
354	0.406	-7.83
356	0.398	-8.00
358	0.392	-8.13
360	0.386	-8.27

Elevation Pattern

Type:	ATW6V5H		**Polarization:**	Horizontal
Directivity:			**Frequency:**	9 (ATSC)
Main Lobe:	6.00 numeric	(7.78 dB)	**Location:**	Huntington, WV
Horizontal:	5.68 numeric	(7.54 dB)	**Beam Tilt:**	1.25 degrees



Tabulated Data for Elevation Pattern

Type: ATW6V5H

-10 to 10 degrees in 0.25 degree increments.
10 to 90 degrees in 0.50 degree increments.

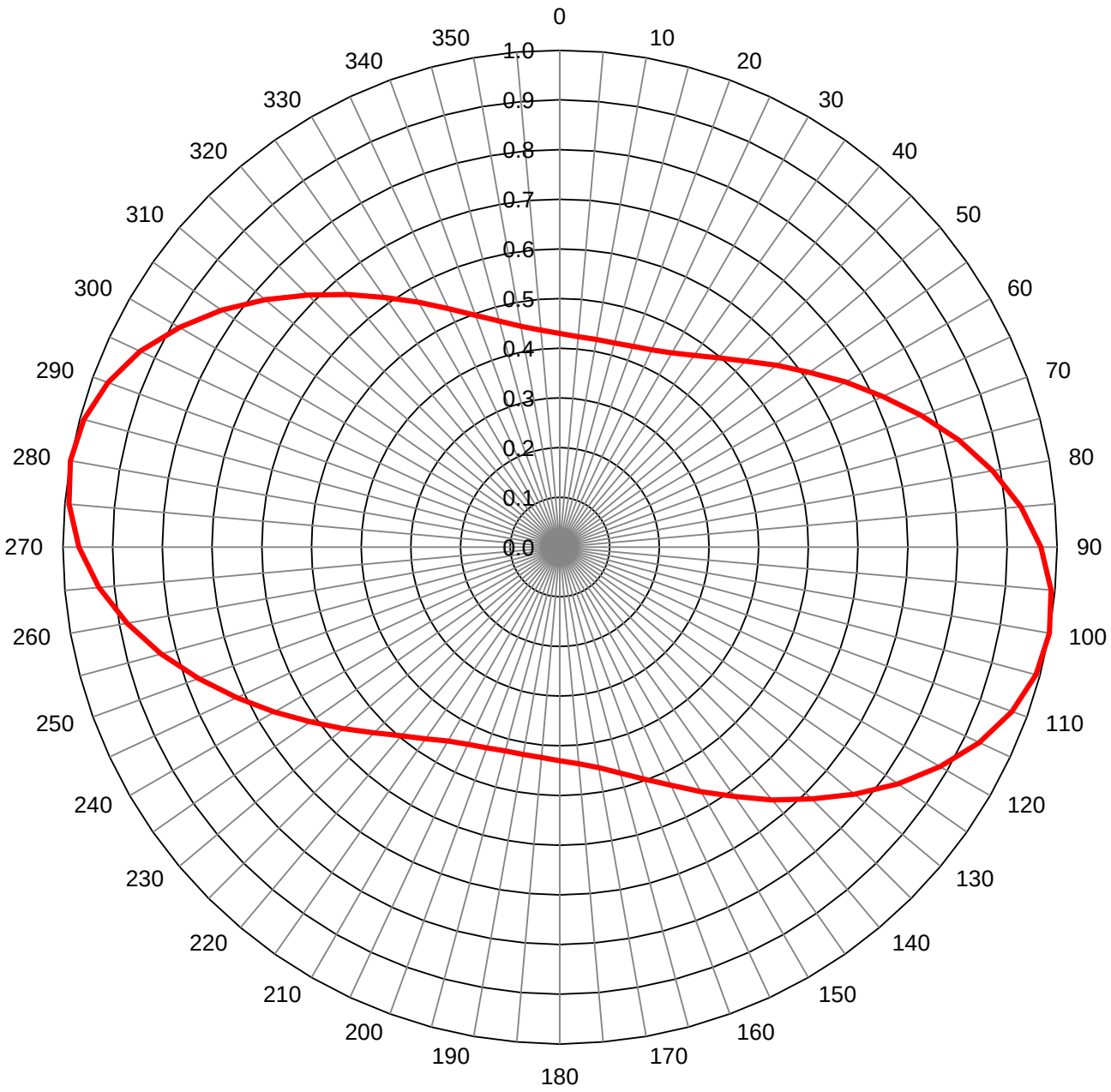
Angle	Field	dB	Angle	Field	dB	Angle	Field	dB	Angle	Field	dB	Angle	Field	dB
-10.00	0.158	-16.03	2.25	0.983	-0.15	19.00	0.141	-17.02	43.50	0.050	-26.02	68.00	0.110	-19.17
-9.75	0.140	-17.08	2.50	0.974	-0.23	19.50	0.115	-18.79	44.00	0.038	-28.40	68.50	0.116	-18.71
-9.50	0.121	-18.34	2.75	0.962	-0.34	20.00	0.090	-20.92	44.50	0.028	-31.06	69.00	0.121	-18.34
-9.25	0.101	-19.91	3.00	0.949	-0.45	20.50	0.069	-23.22	45.00	0.024	-32.40	69.50	0.125	-18.06
-9.00	0.082	-21.72	3.25	0.934	-0.59	21.00	0.054	-25.35	45.50	0.029	-30.75	70.00	0.129	-17.79
-8.75	0.064	-23.88	3.50	0.916	-0.76	21.50	0.054	-25.35	46.00	0.039	-28.18	70.50	0.132	-17.59
-8.50	0.051	-25.85	3.75	0.897	-0.94	22.00	0.065	-23.74	46.50	0.050	-26.02	71.00	0.135	-17.39
-8.25	0.050	-26.02	4.00	0.877	-1.14	22.50	0.082	-21.72	47.00	0.062	-24.15	71.50	0.138	-17.20
-8.00	0.063	-24.01	4.25	0.854	-1.37	23.00	0.100	-20.00	47.50	0.074	-22.62	72.00	0.139	-17.14
-7.75	0.085	-21.41	4.50	0.830	-1.62	23.50	0.118	-18.56	48.00	0.085	-21.41	72.50	0.141	-17.02
-7.50	0.112	-19.02	4.75	0.805	-1.88	24.00	0.133	-17.52	48.50	0.096	-20.35	73.00	0.142	-16.95
-7.25	0.141	-17.02	5.00	0.778	-2.18	24.50	0.146	-16.71	49.00	0.105	-19.58	73.50	0.142	-16.95
-7.00	0.172	-15.29	5.25	0.750	-2.50	25.00	0.155	-16.19	49.50	0.113	-18.94	74.00	0.142	-16.95
-6.75	0.204	-13.81	5.50	0.721	-2.84	25.50	0.162	-15.81	50.00	0.121	-18.34	74.50	0.141	-17.02
-6.50	0.237	-12.51	5.75	0.691	-3.21	26.00	0.165	-15.65	50.50	0.126	-17.99	75.00	0.140	-17.08
-6.25	0.271	-11.34	6.00	0.659	-3.62	26.50	0.166	-15.60	51.00	0.131	-17.65	75.50	0.139	-17.14
-6.00	0.306	-10.29	6.25	0.627	-4.05	27.00	0.163	-15.76	51.50	0.135	-17.39	76.00	0.137	-17.27
-5.75	0.341	-9.34	6.50	0.595	-4.51	27.50	0.157	-16.08	52.00	0.137	-17.27	76.50	0.135	-17.39
-5.50	0.376	-8.50	6.75	0.562	-5.01	28.00	0.149	-16.54	52.50	0.138	-17.20	77.00	0.133	-17.52
-5.25	0.411	-7.72	7.00	0.528	-5.55	28.50	0.138	-17.20	53.00	0.137	-17.27	77.50	0.130	-17.72
-5.00	0.446	-7.01	7.25	0.495	-6.11	29.00	0.126	-17.99	53.50	0.136	-17.33	78.00	0.127	-17.92
-4.75	0.482	-6.34	7.50	0.461	-6.73	29.50	0.111	-19.09	54.00	0.133	-17.52	78.50	0.124	-18.13
-4.50	0.517	-5.73	7.75	0.427	-7.39	30.00	0.095	-20.45	54.50	0.129	-17.79	79.00	0.120	-18.42
-4.25	0.551	-5.18	8.00	0.393	-8.11	30.50	0.079	-22.05	55.00	0.124	-18.13	79.50	0.116	-18.71
-4.00	0.585	-4.66	8.25	0.360	-8.87	31.00	0.062	-24.15	55.50	0.119	-18.49	80.00	0.112	-19.02
-3.75	0.619	-4.17	8.50	0.328	-9.68	31.50	0.047	-26.56	56.00	0.112	-19.02	80.50	0.108	-19.33
-3.50	0.652	-3.72	8.75	0.296	-10.57	32.00	0.036	-28.87	56.50	0.105	-19.58	81.00	0.104	-19.66
-3.25	0.684	-3.30	9.00	0.265	-11.54	32.50	0.034	-29.37	57.00	0.097	-20.26	81.50	0.099	-20.09
-3.00	0.715	-2.91	9.25	0.236	-12.54	33.00	0.042	-27.54	57.50	0.088	-21.11	82.00	0.094	-20.54
-2.75	0.745	-2.56	9.50	0.208	-13.64	33.50	0.055	-25.19	58.00	0.079	-22.05	82.50	0.089	-21.01
-2.50	0.773	-2.24	9.75	0.182	-14.80	34.00	0.069	-23.22	58.50	0.069	-23.22	83.00	0.084	-21.51
-2.25	0.801	-1.93	10.00	0.160	-15.92	34.50	0.083	-21.62	59.00	0.059	-24.58	83.50	0.079	-22.05
-2.00	0.827	-1.65	10.50	0.127	-17.92	35.00	0.096	-20.35	59.50	0.048	-26.38	84.00	0.073	-22.73
-1.75	0.851	-1.40	11.00	0.116	-18.71	35.50	0.107	-19.41	60.00	0.038	-28.40	84.50	0.068	-23.35
-1.50	0.874	-1.17	11.50	0.128	-17.86	36.00	0.117	-18.64	60.50	0.028	-31.06	85.00	0.062	-24.15
-1.25	0.895	-0.96	12.00	0.151	-16.42	36.50	0.125	-18.06	61.00	0.018	-34.89	85.50	0.057	-24.88
-1.00	0.914	-0.78	12.50	0.178	-14.99	37.00	0.132	-17.59	61.50	0.010	-40.00	86.00	0.051	-25.85
-0.75	0.932	-0.61	13.00	0.203	-13.85	37.50	0.136	-17.33	62.00	0.011	-39.17	86.50	0.045	-26.94
-0.50	0.948	-0.46	13.50	0.224	-13.00	38.00	0.138	-17.20	62.50	0.019	-34.42	87.00	0.039	-28.18
-0.25	0.961	-0.35	14.00	0.240	-12.40	38.50	0.137	-17.27	63.00	0.029	-30.75	87.50	0.033	-29.63
0.00	0.973	-0.24	14.50	0.251	-12.01	39.00	0.135	-17.39	63.50	0.038	-28.40	88.00	0.027	-31.37
0.25	0.983	-0.15	15.00	0.257	-11.80	39.50	0.131	-17.65	64.00	0.048	-26.38	88.50	0.021	-33.56
0.50	0.990	-0.09	15.50	0.257	-11.80	40.00	0.126	-17.99	64.50	0.057	-24.88	89.00	0.015	-36.48
0.75	0.996	-0.03	16.00	0.252	-11.97	40.50	0.118	-18.56	65.00	0.066	-23.61	89.50	0.009	-40.92
1.00	0.999	-0.01	16.50	0.242	-12.32	41.00	0.109	-19.25	65.50	0.075	-22.50	90.00	0.003	-50.46
1.25	1.000	0.00	17.00	0.228	-12.84	41.50	0.099	-20.09	66.00	0.083	-21.62			
1.50	0.999	-0.01	17.50	0.210	-13.56	42.00	0.088	-21.11	66.50	0.090	-20.92			
1.75	0.996	-0.03	18.00	0.189	-14.47	42.50	0.075	-22.50	67.00	0.097	-20.26			
2.00	0.991	-0.08	18.50	0.166	-15.60	43.00	0.063	-24.01	67.50	0.104	-19.66			

Azimuth Pattern

Type:	ATW-P-V		**Polarization:**	Vertical
Directivity:	2.09 numeric	(3.20 dB)	**Frequency:**	9 (ATSC)
Peak(s) at:			**Location:**	Huntington, WV

NOTE: Pattern shape and directivity may vary with channel and mounting configuration.

Relative Field



Tabulated Data for Azimuth Pattern

Type: ATW-P-V

Angle	Field	dB
0	0.430	-7.33
2	0.428	-7.37
4	0.426	-7.41
6	0.425	-7.43
8	0.424	-7.45
10	0.424	-7.45
12	0.424	-7.45
14	0.425	-7.43
16	0.426	-7.41
18	0.428	-7.37
20	0.430	-7.33
22	0.433	-7.27
24	0.436	-7.21
26	0.441	-7.11
28	0.446	-7.01
30	0.451	-6.92
32	0.458	-6.78
34	0.466	-6.63
36	0.475	-6.47
38	0.485	-6.29
40	0.497	-6.07
42	0.509	-5.87
44	0.522	-5.65
46	0.536	-5.42
48	0.552	-5.16
50	0.569	-4.90
52	0.585	-4.66
54	0.604	-4.38
56	0.623	-4.11
58	0.643	-3.84
60	0.664	-3.56
62	0.684	-3.30
64	0.706	-3.02
66	0.729	-2.75
68	0.751	-2.49
70	0.774	-2.23
72	0.797	-1.97
74	0.820	-1.72
76	0.842	-1.49
78	0.864	-1.27
80	0.884	-1.07
82	0.904	-0.88
84	0.923	-0.70
86	0.940	-0.54
88	0.955	-0.40
90	0.968	-0.28
92	0.980	-0.18
94	0.988	-0.10
96	0.995	-0.04
98	0.999	-0.01

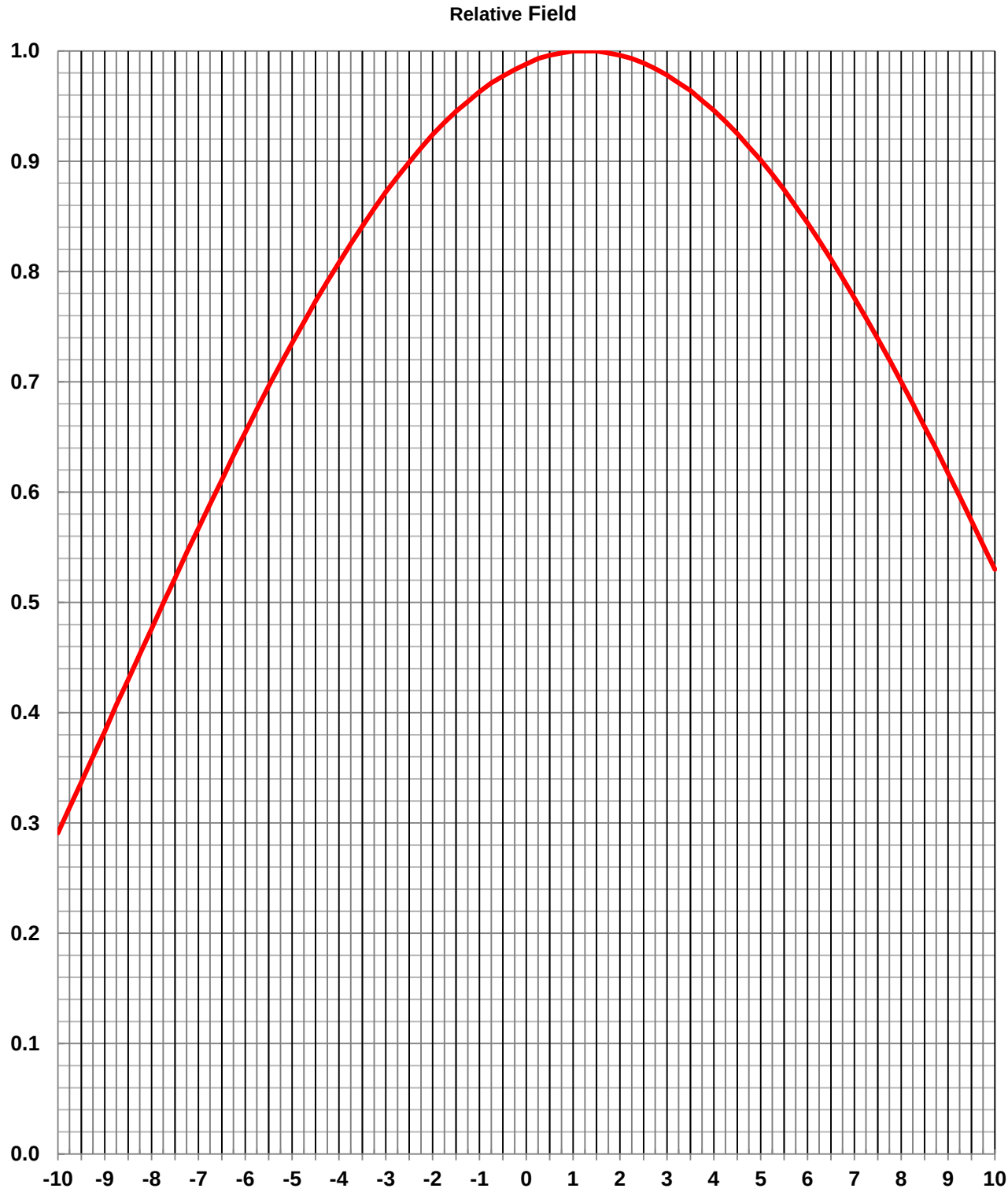
Angle	Field	dB
100	1.000	0.00
102	0.999	-0.01
104	0.995	-0.04
106	0.988	-0.10
108	0.980	-0.18
110	0.968	-0.28
112	0.955	-0.40
114	0.940	-0.54
116	0.923	-0.70
118	0.904	-0.88
120	0.884	-1.07
122	0.864	-1.27
124	0.842	-1.49
126	0.820	-1.72
128	0.797	-1.97
130	0.774	-2.23
132	0.751	-2.49
134	0.729	-2.75
136	0.706	-3.02
138	0.685	-3.29
140	0.664	-3.56
142	0.643	-3.84
144	0.623	-4.11
146	0.604	-4.38
148	0.585	-4.66
150	0.569	-4.90
152	0.552	-5.16
154	0.536	-5.42
156	0.522	-5.65
158	0.509	-5.87
160	0.497	-6.07
162	0.485	-6.29
164	0.475	-6.47
166	0.466	-6.63
168	0.458	-6.78
170	0.451	-6.92
172	0.446	-7.01
174	0.441	-7.11
176	0.436	-7.21
178	0.433	-7.27
180	0.430	-7.33
182	0.428	-7.37
184	0.426	-7.41
186	0.425	-7.43
188	0.424	-7.45
190	0.424	-7.45
192	0.424	-7.45
194	0.425	-7.43
196	0.426	-7.41
198	0.428	-7.37

Angle	Field	dB
200	0.430	-7.33
202	0.433	-7.27
204	0.436	-7.21
206	0.440	-7.13
208	0.446	-7.01
210	0.451	-6.92
212	0.458	-6.78
214	0.466	-6.63
216	0.475	-6.47
218	0.485	-6.29
220	0.496	-6.09
222	0.509	-5.87
224	0.522	-5.65
226	0.536	-5.42
228	0.552	-5.16
230	0.569	-4.90
232	0.585	-4.66
234	0.604	-4.38
236	0.623	-4.11
238	0.643	-3.84
240	0.664	-3.56
242	0.684	-3.30
244	0.706	-3.02
246	0.729	-2.75
248	0.751	-2.49
250	0.774	-2.23
252	0.797	-1.97
254	0.820	-1.72
256	0.842	-1.49
258	0.864	-1.27
260	0.884	-1.07
262	0.904	-0.88
264	0.923	-0.70
266	0.940	-0.54
268	0.955	-0.40
270	0.968	-0.28
272	0.980	-0.18
274	0.988	-0.10
276	0.995	-0.04
278	0.999	-0.01
280	1.000	0.00
282	0.999	-0.01
284	0.995	-0.04
286	0.988	-0.10
288	0.980	-0.18
290	0.968	-0.28
292	0.955	-0.40
294	0.940	-0.54
296	0.923	-0.70
298	0.904	-0.88

Angle	Field	dB
300	0.884	-1.07
302	0.864	-1.27
304	0.842	-1.49
306	0.820	-1.72
308	0.797	-1.97
310	0.774	-2.23
312	0.751	-2.49
314	0.729	-2.75
316	0.706	-3.02
318	0.685	-3.29
320	0.664	-3.56
322	0.643	-3.84
324	0.623	-4.11
326	0.604	-4.38
328	0.585	-4.66
330	0.569	-4.90
332	0.552	-5.16
334	0.536	-5.42
336	0.522	-5.65
338	0.509	-5.87
340	0.496	-6.09
342	0.485	-6.29
344	0.475	-6.47
346	0.466	-6.63
348	0.458	-6.78
350	0.451	-6.92
352	0.446	-7.01
354	0.441	-7.11
356	0.436	-7.21
358	0.433	-7.27
360	0.430	-7.33

Elevation Pattern

Type:	ATW4V5H		**Polarization:**	Vertical
Directivity:			**Frequency:**	9 (ATSC)
Main Lobe:	4.00 numeric	(6.02 dB)	**Location:**	Huntington, WV
Horizontal:	3.90 numeric	(5.92 dB)	**Beam Tilt:**	1.25 degrees



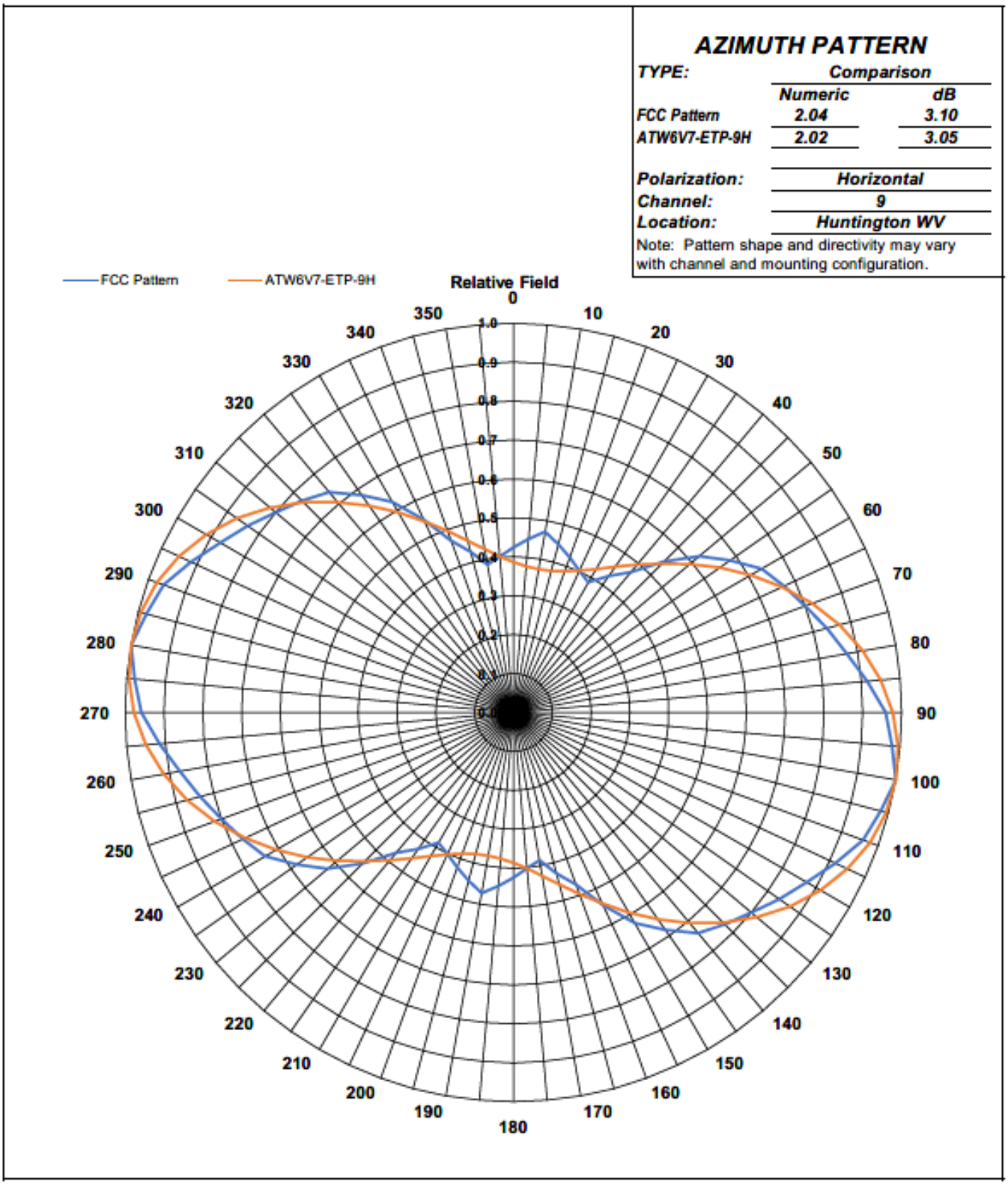
Tabulated Data for Elevation Pattern

Type: ATW4V5H

-10 to 10 degrees in 0.25 degree increments.
10 to 90 degrees in 0.50 degree increments.

Angle	Field	dB	Angle	Field	dB	Angle	Field	dB	Angle	Field	dB	Angle	Field	dB
-10.00	0.291	-10.72	2.25	0.993	-0.06	19.00	0.182	-14.80	43.50	0.188	-14.52	68.00	0.201	-13.94
-9.75	0.314	-10.06	2.50	0.989	-0.10	19.50	0.200	-13.98	44.00	0.184	-14.70	68.50	0.201	-13.94
-9.50	0.337	-9.45	2.75	0.984	-0.14	20.00	0.216	-13.31	44.50	0.179	-14.94	69.00	0.201	-13.94
-9.25	0.360	-8.87	3.00	0.978	-0.19	20.50	0.230	-12.77	45.00	0.173	-15.24	69.50	0.200	-13.98
-9.00	0.383	-8.34	3.25	0.971	-0.26	21.00	0.241	-12.36	45.50	0.166	-15.60	70.00	0.199	-14.02
-8.75	0.407	-7.81	3.50	0.964	-0.32	21.50	0.250	-12.04	46.00	0.159	-15.97	70.50	0.198	-14.07
-8.50	0.430	-7.33	3.75	0.955	-0.40	22.00	0.256	-11.84	46.50	0.151	-16.42	71.00	0.196	-14.15
-8.25	0.453	-6.88	4.00	0.946	-0.48	22.50	0.260	-11.70	47.00	0.142	-16.95	71.50	0.194	-14.24
-8.00	0.476	-6.45	4.25	0.936	-0.57	23.00	0.262	-11.63	47.50	0.132	-17.59	72.00	0.192	-14.33
-7.75	0.499	-6.04	4.50	0.925	-0.68	23.50	0.261	-11.67	48.00	0.122	-18.27	72.50	0.189	-14.47
-7.50	0.522	-5.65	4.75	0.913	-0.79	24.00	0.259	-11.73	48.50	0.112	-19.02	73.00	0.187	-14.56
-7.25	0.545	-5.27	5.00	0.901	-0.91	24.50	0.254	-11.90	49.00	0.101	-19.91	73.50	0.184	-14.70
-7.00	0.567	-4.93	5.25	0.888	-1.03	25.00	0.247	-12.15	49.50	0.090	-20.92	74.00	0.180	-14.89
-6.75	0.589	-4.60	5.50	0.874	-1.17	25.50	0.239	-12.43	50.00	0.078	-22.16	74.50	0.177	-15.04
-6.50	0.611	-4.28	5.75	0.859	-1.32	26.00	0.229	-12.80	50.50	0.067	-23.48	75.00	0.173	-15.24
-6.25	0.633	-3.97	6.00	0.844	-1.47	26.50	0.217	-13.27	51.00	0.055	-25.19	75.50	0.169	-15.44
-6.00	0.654	-3.69	6.25	0.828	-1.64	27.00	0.204	-13.81	51.50	0.043	-27.33	76.00	0.165	-15.65
-5.75	0.675	-3.41	6.50	0.811	-1.82	27.50	0.189	-14.47	52.00	0.031	-30.17	76.50	0.160	-15.92
-5.50	0.696	-3.15	6.75	0.794	-2.00	28.00	0.174	-15.19	52.50	0.019	-34.42	77.00	0.156	-16.14
-5.25	0.716	-2.90	7.00	0.776	-2.20	28.50	0.157	-16.08	53.00	0.008	-41.94	77.50	0.151	-16.42
-5.00	0.735	-2.67	7.25	0.758	-2.41	29.00	0.140	-17.08	53.50	0.009	-40.92	78.00	0.146	-16.71
-4.75	0.754	-2.45	7.50	0.739	-2.63	29.50	0.123	-18.20	54.00	0.019	-34.42	78.50	0.141	-17.02
-4.50	0.773	-2.24	7.75	0.720	-2.85	30.00	0.105	-19.58	54.50	0.031	-30.17	79.00	0.136	-17.33
-4.25	0.791	-2.04	8.00	0.700	-3.10	30.50	0.087	-21.21	55.00	0.042	-27.54	79.50	0.130	-17.72
-4.00	0.808	-1.85	8.25	0.680	-3.35	31.00	0.069	-23.22	55.50	0.053	-25.51	80.00	0.125	-18.06
-3.75	0.825	-1.67	8.50	0.659	-3.62	31.50	0.052	-25.68	56.00	0.064	-23.88	80.50	0.120	-18.42
-3.50	0.841	-1.50	8.75	0.639	-3.89	32.00	0.037	-28.64	56.50	0.075	-22.50	81.00	0.114	-18.86
-3.25	0.857	-1.34	9.00	0.617	-4.19	32.50	0.028	-31.06	57.00	0.085	-21.41	81.50	0.108	-19.33
-3.00	0.872	-1.19	9.25	0.596	-4.50	33.00	0.030	-30.46	57.50	0.095	-20.45	82.00	0.102	-19.83
-2.75	0.886	-1.05	9.50	0.574	-4.82	33.50	0.041	-27.74	58.00	0.105	-19.58	82.50	0.097	-20.26
-2.50	0.899	-0.92	9.75	0.552	-5.16	34.00	0.055	-25.19	58.50	0.114	-18.86	83.00	0.091	-20.82
-2.25	0.912	-0.80	10.00	0.530	-5.51	34.50	0.070	-23.10	59.00	0.123	-18.20	83.50	0.085	-21.41
-2.00	0.924	-0.69	10.50	0.485	-6.29	35.00	0.085	-21.41	59.50	0.131	-17.65	84.00	0.079	-22.05
-1.75	0.935	-0.58	11.00	0.440	-7.13	35.50	0.099	-20.09	60.00	0.139	-17.14	84.50	0.072	-22.85
-1.50	0.945	-0.49	11.50	0.395	-8.07	36.00	0.113	-18.94	60.50	0.146	-16.71	85.00	0.066	-23.61
-1.25	0.954	-0.41	12.00	0.351	-9.09	36.50	0.126	-17.99	61.00	0.153	-16.31	85.50	0.060	-24.44
-1.00	0.963	-0.33	12.50	0.307	-10.26	37.00	0.138	-17.20	61.50	0.160	-15.92	86.00	0.054	-25.35
-0.75	0.971	-0.26	13.00	0.264	-11.57	37.50	0.148	-16.59	62.00	0.166	-15.60	86.50	0.048	-26.38
-0.50	0.977	-0.20	13.50	0.223	-13.03	38.00	0.158	-16.03	62.50	0.171	-15.34	87.00	0.041	-27.74
-0.25	0.983	-0.15	14.00	0.184	-14.70	38.50	0.167	-15.55	63.00	0.176	-15.09	87.50	0.035	-29.12
0.00	0.988	-0.10	14.50	0.148	-16.59	39.00	0.174	-15.19	63.50	0.181	-14.85	88.00	0.029	-30.75
0.25	0.993	-0.06	15.00	0.117	-18.64	39.50	0.180	-14.89	64.00	0.185	-14.66	88.50	0.022	-33.15
0.50	0.996	-0.03	15.50	0.094	-20.54	40.00	0.185	-14.66	64.50	0.189	-14.47	89.00	0.016	-35.92
0.75	0.998	-0.02	16.00	0.083	-21.62	40.50	0.189	-14.47	65.00	0.192	-14.33	89.50	0.010	-40.00
1.00	1.000	0.00	16.50	0.086	-21.31	41.00	0.191	-14.38	65.50	0.194	-14.24	90.00	0.003	-50.46
1.25	1.000	0.00	17.00	0.101	-19.91	41.50	0.193	-14.29	66.00	0.197	-14.11			
1.50	1.000	0.00	17.50	0.120	-18.42	42.00	0.193	-14.29	66.50	0.198	-14.07			
1.75	0.998	-0.02	18.00	0.142	-16.95	42.50	0.192	-14.33	67.00	0.200	-13.98			
2.00	0.996	-0.03	18.50	0.163	-15.76	43.00	0.190	-14.42	67.50	0.201	-13.94			

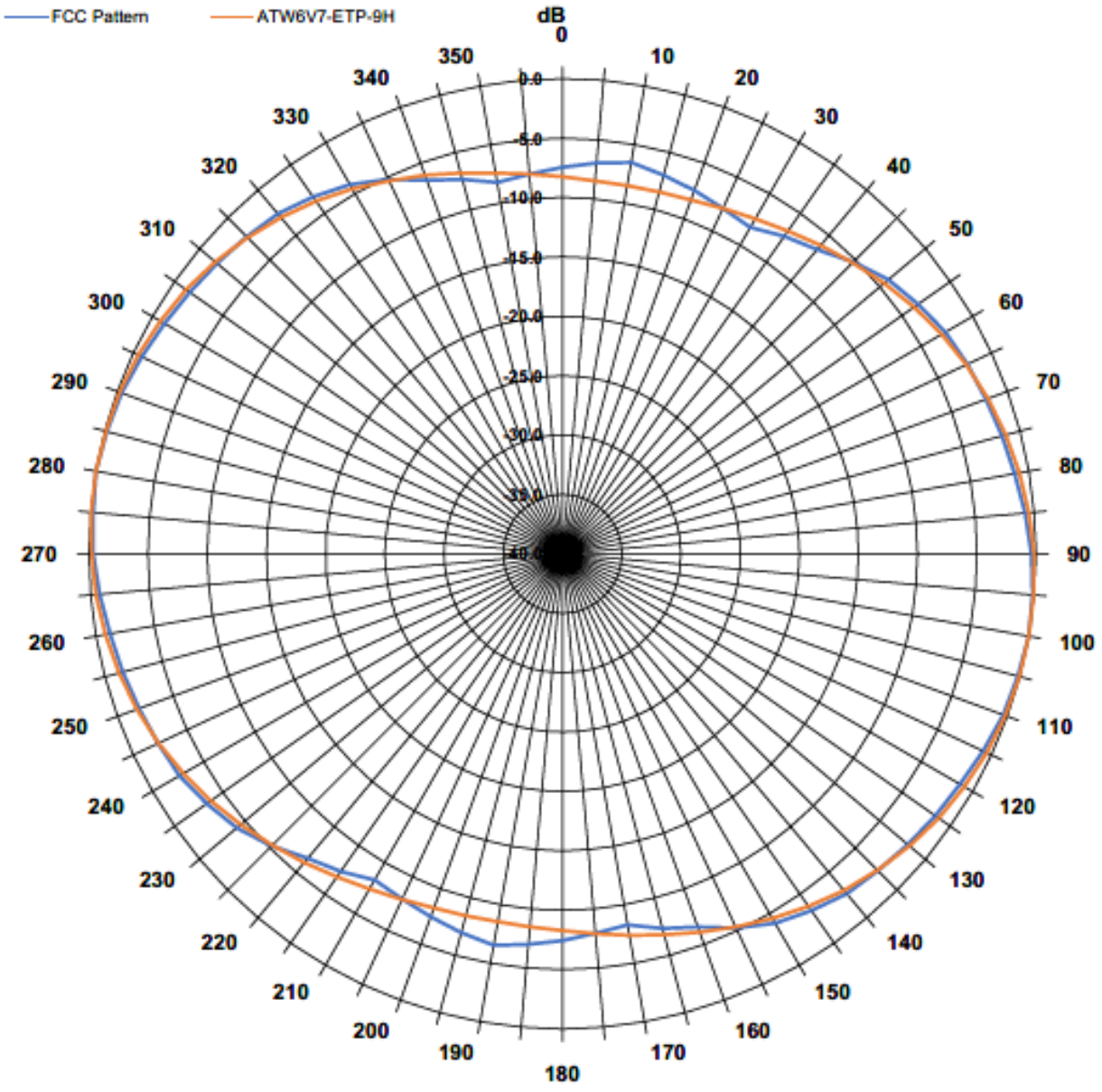
Azimuth Pattern Comparison between WVPB Filed Pattern and ERI ATW6V5-ETP-9H



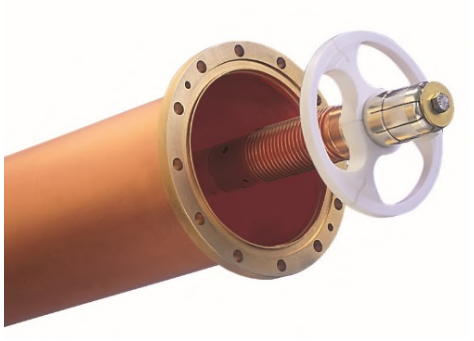
AZIMUTH PATTERN

TYPE:	Comparison	
	Numeric	dB
FCC Pattern	2.04	3.10
ATW6V7-ETP-9H	2.02	3.05
Polarization:	Horizontal	
Channel:	9	
Location:	Huntington WV	

Note: Pattern shape and directivity may vary with channel and mounting configuration.



3-1/8-inch MACXLine® Rigid Transmission Line



Made with heavy wall extruded copper inner and outer conductors, MACXLine® Rigid Line with Bellows Inner Connector is designed for exceptional reliability and long life. Six sizes, ranging from 3-1/8-inch through 8-3/16-inch, are available in original MACXLine®. ERI offers solutions optimized to meet your needs. ERI's field proven bellows expansion compensator accommodates the differential expansion between the inner and outer conductor and vertical and horizontal spring hangers are designed to support the system and compensate for differential expansion between the tower and vertical and horizontal runs. All the required system components and installation accessories can also be purchased from ERI.

MACX350A **MACX450** **MACX675B** **MACX775** **MACX875**

MACX650 not shown

During broadcasting, RF heating of the inner and outer connectors causes differential expansion between them. With original design rigid transmission line, this expansion is compensated for with sliding metal bullets. Eventually this produces wear, hot spots—and burnout. Experienced broadcast consultants recommend replacing these bullets every seven years to avoid sudden failure.

The solution to eliminating sliding-contact wear is to eliminate the sliding. All expansion of the ERI, patented, MACXLine® inner connector is taken up with a flexible, built-in bellows, once put into service. Burnout and bullet replacement are eliminated. This advantage comes with no VSWR penalty or significant cost premium.

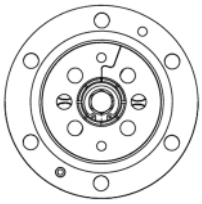
MACXLine® is manufactured by ERI from high conductivity copper tubing, outer conductors. Extra strength, custom PTFE dielectric disk insulators maintain precise mechanical alignment. Each section comes complete with a bullet/bellows assembly, stainless steel flange hardware and pressure sealing O ring gasket.

3-1/8-inch Rigid Line Common Specifications

Size, Impedance	Outer Material	Velocity	Cutoff Frequency	Peak Power Rating	Production Test Voltage
3-1/8-inch, 50-ohm	CU and AL	99.8%	1600 MHz	440 kW	19 kV D.C.

		Outer Conductor				Inner Conductor			
Size, Impedance	Outer Material	Outer Diameter		Inner Diameter		Outer Diameter		Inner Diameter	
3-1/8-inch, 50-ohm	CU and AL	3.125-in	(79-mm)	3.027-in	(77-mm)	1.315-in	(33-mm)	1.231-in	(31-mm)

	Flange Information					
Size	Overall Diameter		Bolt Circle		Number of Bolts	Bolt Size
3-1/8-inch	5.188-in	(132-mm)	4.375-in	(111-mm)	6	3/8 in



3-1/8-inch, 50-ohm

Recommended Transmission Line Section Lengths

Rigid transmission line is manufactured in flanged sections of a fixed length. At each flange section all, rigid coaxial inner connectors exhibit a minor deviation from the characteristic impedance of the transmission line. This deviation causes a small amount of power to be reflected back to the RF source (VSWR). By using the correct fixed line length, the VSWR buildup occurs outside the system's designed operating frequency. This needs to be considered for both digital television and FM service.

US Television Channels

20.00-foot (6.096 m) Section Length
Channels: 2, 3, 5, 6, 7, 8, 9, 11, 12, 14, 15, 18, 19, 22, 23, 27, 31, 32, 35, 36
19.75-foot (6.020 m) Section Length
Channels: 16, 20, 24, 28, 33
19.5-foot (5.944 m) Section Length
Channels: 4, 10, 13, 17, 21, 25, 26, 29, 30, 34

FM Radio Frequencies

Foot (Meter)	MHz
20.00 (6.096) Sections	88.1 - 95.9
	100.3 - 107.9
19.50 (5.944) Sections	96.1 - 98.3
19.00 (5.791) Sections	98.5 - 100.1
17.50 (5.342) Sections	88.1 – 107.9

Television channels listed are preferred, others may also be acceptable. Contact ERI for more information.

3-1/8-inch Rigid Line Attenuation and Power Handling

ERI 3-1/8-Inch Rigid Transmission Lines

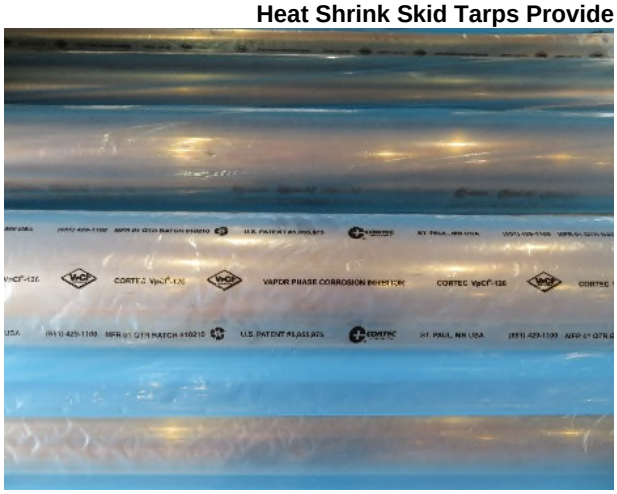
Channel	Freq. (MHz)	Attn. (dB/100 feet)	Attn. (dB/100 meters)	Average Power (kW)	Channel	Freq. (MHz)	Attn. (dB/100 feet)	Attn. (dB/100 meters)	Average Power (kW)
FM Frequencies									
201	88.1	0.090	0.295	53.2	251	98.1	0.095	0.311	50.4
202	88.3	0.090	0.295	53.1	252	98.3	0.095	0.312	50.3
203	88.5	0.090	0.296	53.0	253	98.5	0.095	0.312	50.3
204	88.7	0.090	0.296	53.0	254	98.7	0.095	0.312	50.2
205	88.9	0.090	0.296	52.9	255	98.9	0.095	0.313	50.2
206	89.1	0.090	0.297	52.9	256	99.1	0.095	0.313	50.1
207	89.3	0.090	0.297	52.8	257	99.3	0.095	0.313	50.1
208	89.5	0.091	0.297	52.7	258	99.5	0.096	0.314	50.0
209	89.7	0.091	0.298	52.7	259	99.7	0.096	0.314	49.9
210	89.9	0.091	0.298	52.6	260	99.9	0.096	0.314	49.9
211	90.1	0.091	0.298	52.6	261	100.1	0.096	0.315	49.8
212	90.3	0.091	0.299	52.5	262	100.3	0.096	0.315	49.8
213	90.5	0.091	0.299	52.5	263	100.5	0.096	0.315	49.7
214	90.7	0.091	0.299	52.4	264	100.7	0.096	0.315	49.7
215	90.9	0.091	0.300	52.3	265	100.9	0.096	0.316	49.6
216	91.1	0.091	0.300	52.3	266	101.1	0.096	0.316	49.6
217	91.3	0.092	0.300	52.2	267	101.3	0.096	0.316	49.5
218	91.5	0.092	0.301	52.2	268	101.5	0.097	0.317	49.5
219	91.7	0.092	0.301	52.1	269	101.7	0.097	0.317	49.5
220	91.9	0.092	0.301	52.0	270	101.9	0.097	0.317	49.4
221	92.1	0.092	0.302	52.0	271	102.1	0.097	0.318	49.4
222	92.3	0.092	0.302	51.9	272	102.3	0.097	0.318	49.3
223	92.5	0.092	0.302	51.9	273	102.5	0.097	0.318	49.3
224	92.7	0.092	0.303	51.8	274	102.7	0.097	0.319	49.2
225	92.9	0.092	0.303	51.8	275	102.9	0.097	0.319	49.2
226	93.1	0.092	0.303	51.7	276	103.1	0.097	0.319	49.1
227	93.3	0.093	0.304	51.7	277	103.3	0.097	0.320	49.1
228	93.5	0.093	0.304	51.6	278	103.5	0.097	0.320	49.0
229	93.7	0.093	0.304	51.5	279	103.7	0.098	0.320	49.0
230	93.9	0.093	0.305	51.5	280	103.9	0.098	0.320	48.9
231	94.1	0.093	0.305	51.4	281	104.1	0.098	0.321	48.9
232	94.3	0.093	0.305	51.4	282	104.3	0.098	0.321	48.8
233	94.5	0.093	0.305	51.3	283	104.5	0.098	0.321	48.8
234	94.7	0.093	0.306	51.3	284	104.7	0.098	0.322	48.7
235	94.9	0.093	0.306	51.2	285	104.9	0.098	0.322	48.7
236	95.1	0.093	0.306	51.2	286	105.1	0.098	0.322	48.6
237	95.3	0.094	0.307	51.1	287	105.3	0.098	0.323	48.6
238	95.5	0.094	0.307	51.0	288	105.5	0.098	0.323	48.5
239	95.7	0.094	0.307	51.0	289	105.7	0.099	0.323	48.5
240	95.9	0.094	0.308	50.9	290	105.9	0.099	0.324	48.4
241	96.1	0.094	0.308	50.9	291	106.1	0.099	0.324	48.4
242	96.3	0.094	0.308	50.8	292	106.3	0.099	0.324	48.4
243	96.5	0.094	0.309	50.8	293	106.5	0.099	0.325	48.3
244	96.7	0.094	0.309	50.7	294	106.7	0.099	0.325	48.3
245	96.9	0.094	0.309	50.7	295	106.9	0.099	0.325	48.2
246	97.1	0.094	0.310	50.6	296	107.1	0.099	0.325	48.2
247	97.3	0.094	0.310	50.6	297	107.3	0.099	0.326	48.1
248	97.5	0.095	0.310	50.5	298	107.5	0.099	0.326	48.1
249	97.7	0.095	0.311	50.5	299	107.7	0.099	0.326	48.0
250	97.9	0.095	0.311	50.4	300	107.9	0.100	0.327	48.0

ERI 3-1/8-Inch Rigid Transmission Lines

Channel	Freq. (MHz)	Attn. (dB/100 feet)	Attn. (dB/100 meters)	Average Power (kW)	Channel	Freq. (MHz)	Attn. (dB/100 feet)	Attn. (dB/100 meters)	Average Power (kW)
TV Frequencies									
2	57	0.072	0.237	66.2	20	509	0.219	0.719	21.8
3	63	0.076	0.249	63.0	21	515	0.220	0.723	21.7
4	69	0.079	0.261	60.1	22	521	0.222	0.727	21.6
5	79	0.085	0.279	56.2	23	527	0.223	0.731	21.4
6	85	0.088	0.290	54.1	24	533	0.224	0.736	21.3
7	177	0.128	0.420	37.4	25	539	0.226	0.740	21.2
8	183	0.130	0.427	36.7	26	545	0.227	0.744	21.1
9	189	0.132	0.434	36.1	27	551	0.228	0.748	21.0
10	195	0.134	0.441	35.6	28	557	0.229	0.752	20.8
11	201	0.136	0.448	35.0	29	563	0.231	0.757	20.7
12	207	0.138	0.454	34.5	30	569	0.232	0.761	20.6
13	213	0.141	0.461	34.0	31	575	0.233	0.765	20.5
14	473	0.211	0.692	22.7	32	581	0.234	0.769	20.4
15	479	0.212	0.697	22.5	33	587	0.236	0.773	20.3
16	485	0.214	0.701	22.4	34	593	0.237	0.777	20.2
17	491	0.215	0.705	22.2	35	599	0.238	0.781	20.1
18	497	0.216	0.710	22.1	36	605	0.239	0.785	20.0
19	503	0.218	0.714	22.0					
TV Frequencies (Europe)									
2	48.25	0.066	0.218	72.0	40E	626	0.243	0.799	19.6
2A	49.75	0.067	0.221	70.9	41E	634	0.245	0.804	19.5
3	55.25	0.071	0.233	67.3	42E	642	0.247	0.809	19.4
4	66.25	0.078	0.255	61.4	43E	650	0.248	0.814	19.3
5	175.25	0.127	0.418	37.5	44E	658	0.250	0.820	19.1
6	182.25	0.130	0.426	36.8	45E	666	0.251	0.825	19.0
7	189.25	0.132	0.434	36.1	46E	674	0.253	0.830	18.9
8	196.25	0.135	0.442	35.5	47E	682	0.254	0.835	18.8
9	203.25	0.137	0.450	34.8	48E	690	0.256	0.840	18.7
10	210.25	0.140	0.458	34.2	49E	698	0.257	0.845	18.6
11	217.25	0.142	0.466	33.7	50E	706	0.259	0.850	18.5
12	224.25	0.144	0.473	33.1	51E	714	0.260	0.855	18.3
21E	474	0.211	0.693	22.6	52E	722	0.262	0.860	18.2
22E	482	0.213	0.699	22.4	53E	730	0.263	0.864	18.1
23E	490	0.215	0.705	22.2	54E	738	0.265	0.869	18.0
24E	498	0.217	0.711	22.1	55E	746	0.266	0.874	17.9
25E	506	0.218	0.716	21.9	56E	754	0.268	0.879	17.8
26E	514	0.220	0.722	21.7	57E	762	0.269	0.884	17.7
27E	522	0.222	0.728	21.5	58E	770	0.271	0.888	17.6
28E	530	0.224	0.734	21.4	59E	778	0.272	0.893	17.6
29E	538	0.225	0.739	21.2	60E	786	0.274	0.898	17.5
30E	546	0.227	0.745	21.1	61E	794	0.275	0.903	17.4
31E	554	0.229	0.750	20.9	62E	802	0.277	0.907	17.3
32E	562	0.230	0.756	20.7	63E	810	0.278	0.912	17.2
33E	570	0.232	0.761	20.6	64E	818	0.279	0.917	17.1
34E	578	0.234	0.767	20.4	65E	826	0.281	0.921	17.0
35E	586	0.235	0.772	20.3	66E	834	0.282	0.926	16.9
36E	594	0.237	0.778	20.2	67E	842	0.284	0.930	16.9
37E	602	0.239	0.783	20.0	68E	850	0.285	0.935	16.8
38E	610	0.240	0.788	19.9	69E	858	0.286	0.939	16.7
39E	618	0.242	0.794	19.8					
40E	626	0.243	0.799	19.6					
41E	634	0.245	0.804	19.5					
42E	642	0.247	0.809	19.4					

Transmission Line Shipment Packaging

Heat Shrink Skid Tarps Provide Long Term Weather Protection



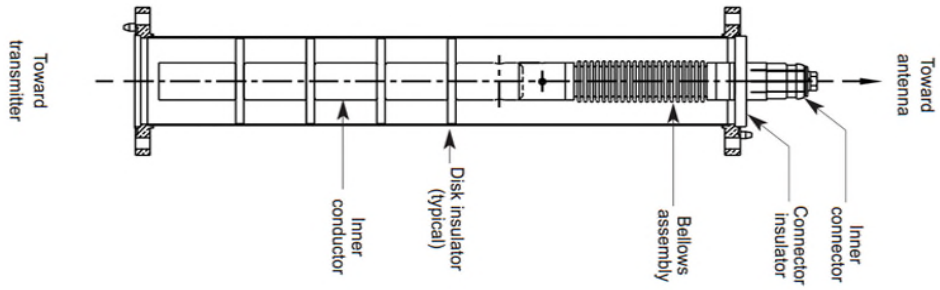
CORTEC Corrosion Inhibitor Impregnated Packing Sleeves

Styrofoam Stacking Cradles for Shipment and Storage

Rigid transmission line components are usually shipped to site and outdoor storage is often required. All transmission line systems shipped from ERI are suitably packaged for outdoor storage. This includes bagging the individual line sections in CORTEC bags that are impregnated with a corrosion inhibitor and stacking the line sections in Styrofoam cradles that are strapped to a shipping skid and then fully enclosed in a weatherproof heat shrink cover. This process has been used by ERI for several years and it has been demonstrated to be an excellent way to store rigid line components outdoors, for long periods, without tarnishing.

MACXLine® Standard Length Rigid Line Sections

MACXLine® standard length rigid line section come in standard section lengths of 20.00-foot (6.096-meter) detail “-1”, 19.75-foot (6.020 meter) detail “-2”, 19.50-foot (5.944 meter) detail “-3”, 19.00-foot (5.791 meter) detail “-6”and 17.50-foot (5.342 meter) detail “-11”. The detail “-D” line sections are for DUALine™ systems which use a specially engineered section length, that is the same for the entire system, to accommodate two (2) or three (3) television RF channels which are not able to use a standard line section length. The detail “W” line section are variable length line sections which are designed to provide a system which has a maximum VSWR of 1.1:1 or less for the entire UHF television band. Each line section includes the copper inner and outer conductor. The inner conductor includes the MACXLine fixed bullet/bellows expansion compensator. One flange hardware kit, with O ring is also included with each rigid line section.



MACXLine® Standard Rigid Line Sections Specifications

Part No.	Line Size	Impedance	Length		Section Weight	
MACX350A-1	3-1/8-inch	50 ohm	20.00-ft	(6.10-m)	56-lbm	(25.4-kg)

MACXLine® Variable Length Rigid Line Sections

Special length MACXLine rigid line sections are available in any length and are a fixed price offering with detail numbers for variable length line sections up to 60.00-inches (1524-mm), 60.00-inches to 120.00-inches (1524-mm to 3048-mm) and 120.00-inches to 240.00-inches (3048-mm to 6096-mm). Each line section includes the copper inner and outer conductor. The inner conductor includes the MACXLine fixed bullet/bellows expansion compensator in variable length line sections greater than 60.00-inches (1524 mm). Variable length rigid line sections less than 60-inches (1524 mm), where the bellows compensator is not required, include a standard copper inner conductor with a captivated inner connector. One flange hardware kit, with O ring, is also included with each variable length rigid line section.

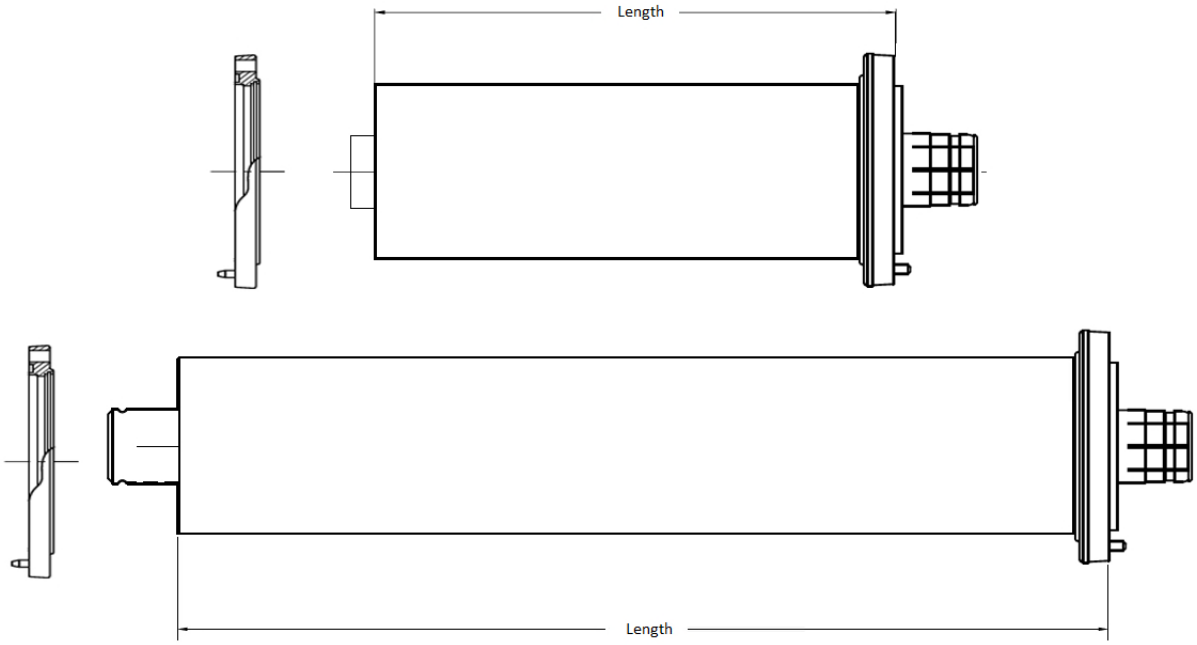
MACXLine® Variable Length Rigid Line Section Specifications

Part No.	Line Size	Impedance	Length			
MACX350A-5	3-1/8-inch	50 ohm	5.00-in to	60.00-in	(127-mm to	1524-mm)
MACX350A-10	3-1/8-inch	50 ohm	60.00-in to	120.00-in	(1524-mm to	3048-mm)
MACX350A-20	3-1/8-inch	50 ohm	120.00-in to	240.00-in	(3048-mm to	6096-mm)

MACXLine® Field Cut Rigid Line Sections

MACXLine Field Cut rigid line sections are available as an alternative to factory fabricated variable length line section. The detail -39 field cut MACXLine sections are for any length from 60.00-inches (1524-mm) to 240.00-inches (6096-mm). Each line section includes the copper inner and outer conductor. The inner conductor includes the MACXLine fixed bullet/bellows expansion compensator. Includes bellows attachment bushing (stub adapter) at both ends of the inner conductor. This accommodates any cut length required while maintaining sufficient separation from the inner conductor support insulators.

The detail -41 field cut line section is for section lengths less than 60-inches (1524 mm), where the bellows compensator is not required, include a standard copper inner conductor with a captivated inner connector. Both kits include a silver solder fixed field flange kit and one flange hardware kit, with O ring, is also included with each rigid line section.



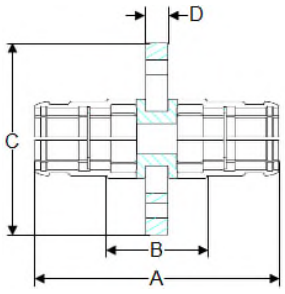
MACXLine® Field Cut Rigid Line Sections Specifications

Part No.	Line Size	Impedance	Length			
MACX350A-39	3-1/8-inch	50-ohm	60.00-in to	120.00-in	(1524-mm to	3048-mm)
MACX350A-41	3-1/8-inch	50-ohm	0.00-in to	60.00-in	(0-mm to	1524-mm)

Inner Connectors

Standard Inner Connectors

Standard inner connectors are used in most field applications they should not be used if the inner connector is to support a line section inner conductor when being hoisted during installation.



ACX050-20, ACX150-20, and ACX350-20

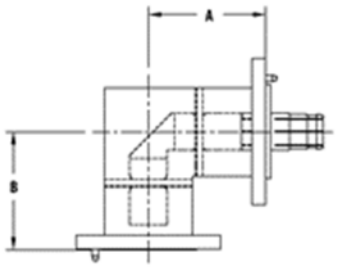
Standard Inner Connectors Specifications

Part Number	Size	Impedance	Dim A		Dim B	
ACX350-20	3-1/8-inch	50-ohm	4.133-in	(105-mm)	1.697-in	(43-mm)

Part Number	Size	Impedance	Dim C		Dim D	
ACX350-20	3-1/8-inch	50-ohm	3.187-in	(81-mm)	0.375-in	(10-mm)

Miter Elbows

90-Degree Flanged Elbows



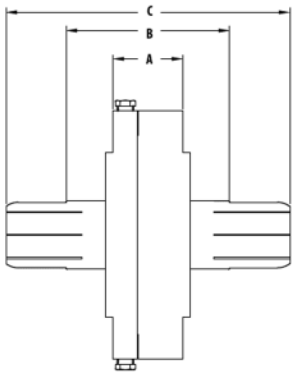
90-degree flanged miter elbows have supported inner conductors and swivel flanges. Each elbow includes one inner connector, O-ring, silicone grease and one flange hardware kit. They are pressure tight and suitable for indoor and outdoor applications. “-2” detail elbows include an outer conductor reinforcement gusset. “*” indicates an elbow that must be tuned to channel. “-W” detail 7-3/16-inch and 8-3/16-inch elbows are double mitered broadband designs. All other elbow sizes are broadband and do not require tuning to channel.

90-Degree Flanged Elbow Specifications

Part Number	Line Size	Impedance	Outer	Leg A	
ACX350-10SE	3-1/8-inch	50-ohm	Copper	4.189-in	(106-mm)

Part Number	Line Size	Leg B		Weight	
ACX350-10SE	3-1/8-inch	4.189-in	(106-mm)	4.2-lbm	(1.9-kg)

Gas Barriers



Gas barrier, both sides have at least one pressure port, except the RLA150-16 which has a single pressure port. The assembly has fixed male inner connectors both ends. Includes flange hardware kit.

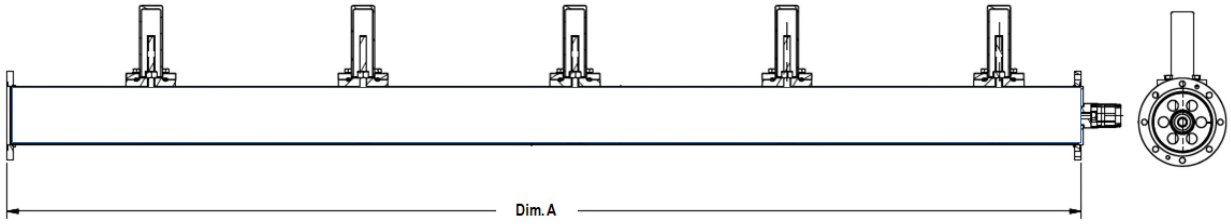
Gas Barrier Specifications

Part Number	Line Size	Impedance	Outer	Dim A		Dim B	
RLA350-16	3-1/8-inch	50-ohm	Copper/Brass	1.000-in	(25-mm)	5.187-in	(132-mm)

Part Number	Line Size	No of Ports	Weight	
RLA350-16	3-1/8-inch	2	4.8-lbm	(2.2-kg)

High Band VHF Fine Matchers

Coaxial fine matcher flanged both ends for the high band VHF television broadcast band (174 to 216 MHz). Includes one captive inner connector, O ring and one flange hardware kit. Five (5) tuners. Can be pressurized for outside use. 48-inches flange to flange. Tuners including locking nuts and pressure tight caps. Does not include mounting brackets or hardware. These are available from ERI at additional cost.



High Band VHF Fine Matcher Specifications

Part Number	Line Size	Impedance	Outer	Tuners	Dim A		Weight	
STD350-FTV	3-1/8-inch	50-ohm	Copper/Brass	Five (5)	48.000-in	(1219-mm)	34-lbm	(15.3-kg)

Hangers and Support Accessories

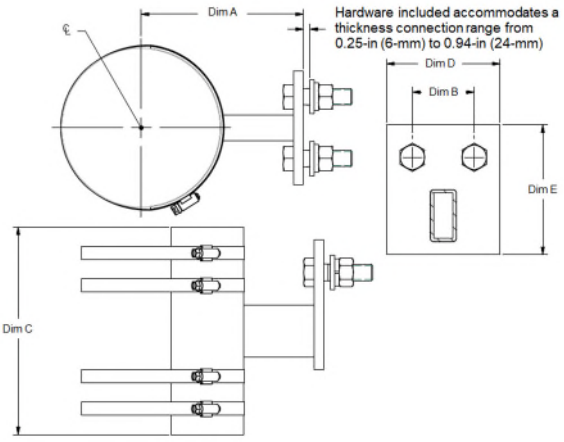
Rigid Line Vertical Hangers

Vertical Fixed Hangers

Rigid Line Fixed Hangers support the weight of the transmission line vertical run. Use two (2) at the tower top for up to 500-feet of vertical line. Add one additional fixed hanger at the tower top for each additional 500-feet of vertical run length.

All ERI rigid transmission line vertical fixed hangers are made with stainless steel.

Mounting hardware included: 1/2-inch diameter hardware requires mounting to 9/16-inch diameter holes. 5/8-inch diameter hardware requires 11/16-inch diameter mounting holes.



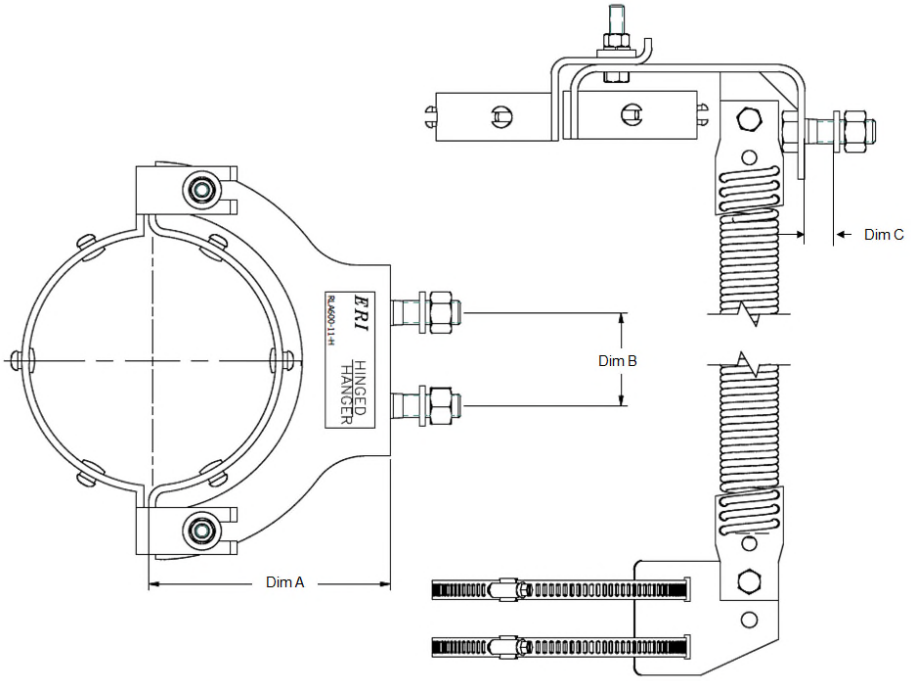
RLA300-13-2

Vertical Fixed Hanger Specifications

Part Number	Line Size	Dim A	Dim B	Dim C	Dim D	Dim E	Weight	Attachment Hardware
RLA300-13-2	3-1/8-inch	4.125-in (105-mm) (203-mm)	2.250-in (57-mm) (76-mm)	8.000-in (203-mm) (203-mm)	4.250-in (108-mm) (127-mm)	5.000-in (127-mm) (127-mm)	4.8-lbm (2.2-kg) (3.5-kg)	1/2-inch

Vertical Spring Hangers

For all other rigid coaxial line sizes ERI's offers its unique Hinged Vertical Spring Hanger, they support the transmission line vertical run while preventing lateral motion and accommodating differential expansion and contraction. For 3-1/8-inch and 4-1/16-inch rigid line one hanger and one vertical sliding ring is used on each line section. Transmission line systems of 6-1/8-inch, 7-3/16-inch and 8-3/16-inch rigid use two vertical spring hangers per line section for support. All vertical spring hangers and vertical sliding ring hangers are hinged to open from left or right side to save installation labor. Each hanger includes mounting hardware shown in the table below.



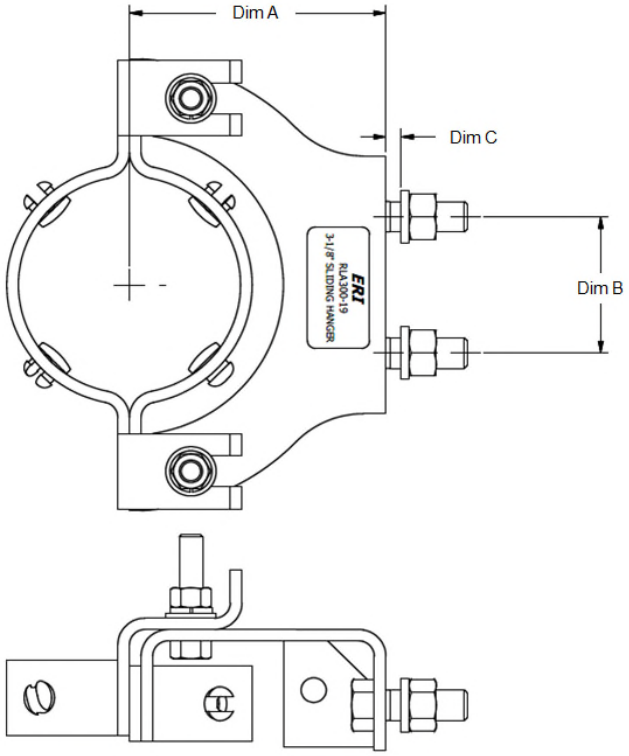
RLA300-11-H, RAL400-11-H, RLA600-11-H, RLA700-11-H

Vertical Spring Hanger Specifications

Part Number	Line Size	Dim A	Dim B	Dim C	Weight	Attachment Hardware
RLA300A-11-H	3-1/8-inch	4.125-in (105-mm) (203-mm)	2.250-in (57-mm) (76-mm)	0.130 - 0.690-in (3 - 18-mm) (6 - 25-mm)	6.4-lbm (2.9-kg) (6.2-kg)	1/2-inch

Vertical Sliding Hangers

Smaller sizes of ERI rigid transmission line. 1-5/8-inch, 3-1/18-inch and 4-1/16-inch use a combination of vertical spring hangers and vertical sliding rings. These vertical sliding hangers should be used at 10-foot intervals along the vertical run if there is more than approximately 10-feet between vertical spring hangers. These sliding hangers prevents lateral motion and accommodate differential expansion and contraction. Each hanger includes mounting hardware shown in the table below. ERI's vertical sliding hangers use the same hinged closure used in ERI's vertical spring hangers. These hangers are hinged to open from the left or right side to save installation labor and time.



RLA300-19 and RLA400-19 Vertical Sliding Hanger

Vertical Sliding Hanger Specifications

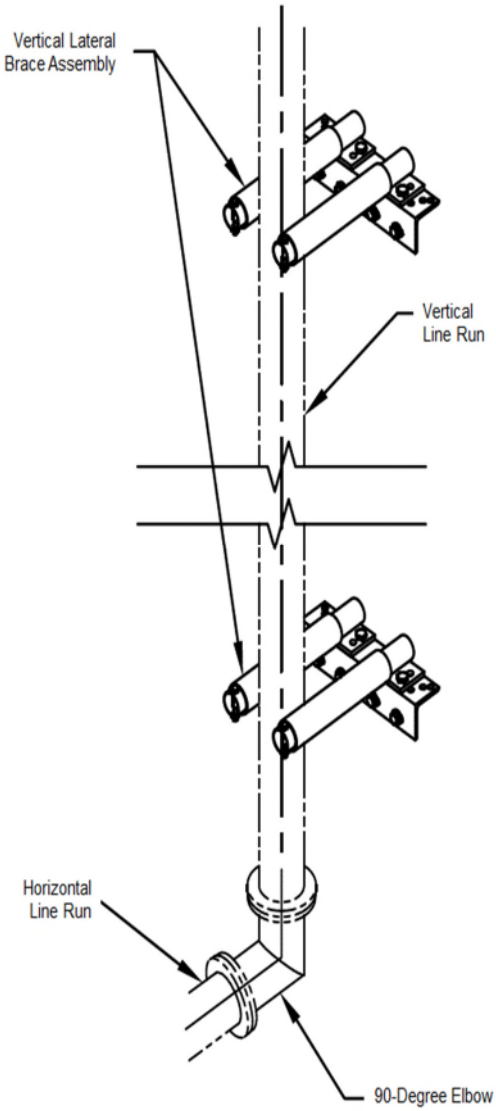
Part Number	Line Size	Dim A	Dim B	Dim C	Weight	Attachment Hardware
RLA300-19	3-1/8-inch	(78-mm) 4.125-in (105-mm) (135-mm)	-- 2.250-in (57-mm) (60-mm)	(3 - 18-mm) (6 - 25-mm)	(0.6-kg) 2.7-lbm (1.2-kg) (1.5-kg)	1/2-inch

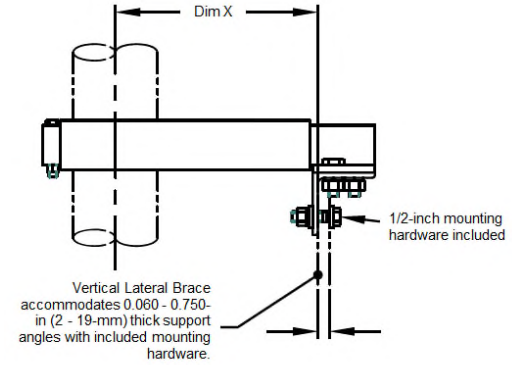
Minimum Distance to the Lowest Vertical Spring Hanger or Vertical Sliding Hanger

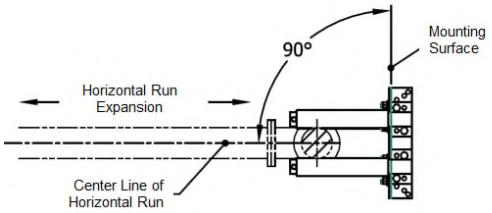
Horizontal Run Length	Copper Outer Conductor Rigid Line		Aluminum Outer Conductor Rigid Line	
Up to 100-feet (30.5-meters)	16.0-feet	(4.9-meters)	24.0-feet	(7.3-meters)
101-feet to 200-feet (30.6-meters to 61.0-meters)	32.0-feet	(9.8-meters)	48.0-feet	(14.6-meters)

Vertical Lateral Braces

The Vertical Lateral Brace is an innovative unique product manufactured by ERI. These braces are used at the base of vertical run to prevent lateral motion and are universal with adjustments to accommodate all rigid transmission line sizes from 3-1/8-inch through 8-3/16-inch. Use two (2) vertical lateral guides equally spaced between the lowest vertical spring or sliding hanger and elbow at the base of the vertical run. Includes 1/2-inch mounting hardware.

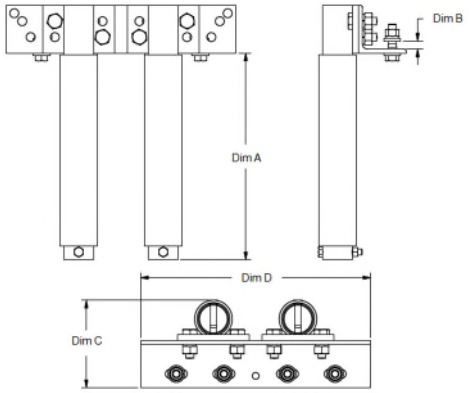






Line Size	Dim X	
3-1/8-inch	4.130-in	(105-mm)
4-1/16-inch	5.310-in	(135-mm)
6-1/8-inch	6.250-in	(159-mm)
7-3/16-inch	8.000-in	(203-mm)
8-3/16-inch	8.000-in	(203-mm)

The line settings above are for horizontal transmission line runs up to 200-feet (61-meters).



Vertical Lateral Brace Specifications

Part Number	Dim A	Dim B	Dim C	Dim D	Weight	Attachment Hardware
RLA000-01VLB	13.000-in (330-mm)	0.060 - 0.750-in (2 - 19-mm)	5.510-in (140-mm)	14.500-in (368-mm)	11.2-lbm (5.1-kg)	1/2-inch

Rigid Line Horizontal Hangers

ERI provides a unique Horizontal Hanger System which uses components that are compatible with all rigid transmission line sizes from 3-1/8-inch through 8-3/16-inch. The system uses a Universal Horizontal Hanger Bracket and interchangeable Hanger Springs, Fixed Hanger Rods, and a Universal Horizontal Lateral Brace. The system is engineered to allow many different support configurations and is particularly useful when adding new transmission lines to towers with multiple existing transmission line already installed under the transmission line bridge.

Minimum Horizontal Run Length

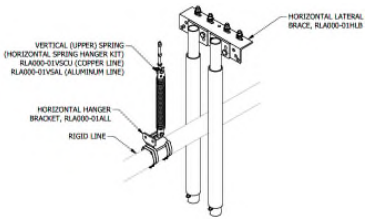
The entire length of the Minimum Horizontal Run length should be supported be horizontal spring hanger to accommodate differential expansion, beyond that length fixed hangers may be used. The Minimum Horizontal Run length should be the greater of 20-feet (6.1-meters) or:

Line Size	Copper Outer Conductor Rigid Line	Aluminum Outer Conductor Rigid Line
3-1/8-inch and 4-1/16-inch	4% of Vertical Run Height	7% of Vertical Run Height

Universal Horizontal Hanger System

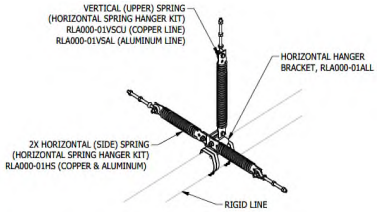
The ERI horizontal transmission line support system is made up of four (4) components that can be used to accommodate many different installation configurations. This system is particularly useful when adding new transmission line to an already crowded structure and in systems that use more than one transmission line to feed dual input FM and television master antennas. The components include the Universal Horizontal Hanger Bracket is compatible with all rigid transmission line sizes from 3-1/8-inch through 8-3/16-inch. It includes a stainless-steel bracket and stainless-steel hose clamps for all these transmission line sizes. The brackets accept a variety of accessory supports including Horizontal Vertical Support Springs, Horizontal Side Springs, Horizontal Fixed Supports. The separate Horizontal Lateral Brace assembly provides support to prevent lateral motion of the transmission line when the Universal Horizontal Hanger Bracket is used in single point mounting configurations.

Single Point Horizontal Spring Hanger



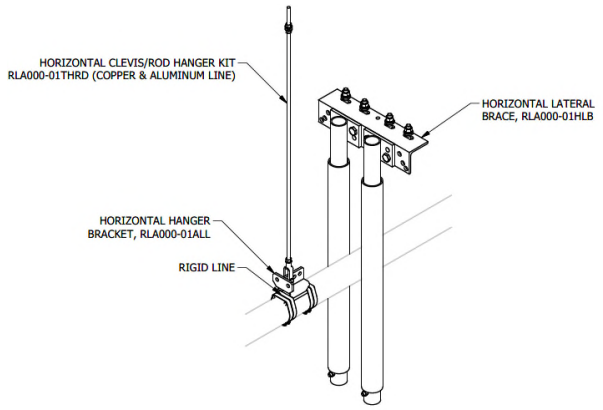
This configuration requires one (1) RLA000-01ALL Universal Horizontal Hanger Bracket and one (1) RLA000-01VSxx (xx="CU" for Copper Outer Conductor Line or xx="AL" for Aluminum Outer Conductor Line) Horizontal Vertical Spring. The horizontal hanger spacing should be an average of 480-inches (12,192-mm) for 3-1/8 and 4-1/16-inch Aluminum Outer Conductor Rigid Line, 240-inches (6,096-mm) for 3-1/8 and 4-1/16-inch Copper Outer Conductor or 6-1/8-inch Aluminum Outer Conductor Rigid Line and 120-inches (3,048-mm) 6-1/8, 7-3/16 and 8-3/17-inch Copper outer Conductor Rigid Line. In addition, an RLA000-01HLB Horizontal Lateral Brace to prevent lateral motion should be installed every 240-inches (6,096-mm) for the entire length of the horizontal run.

Three Point Horizontal Spring Hanger



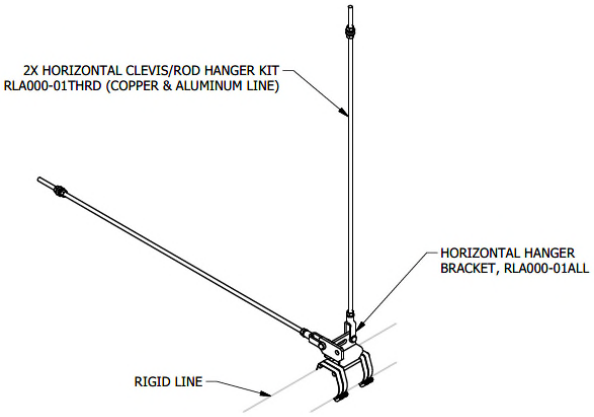
This configuration requires one (1) RLA000-01ALL Universal Horizontal Hanger Bracket, one (1) RLA000-01VSxx (xx="CU" for Copper Outer Conductor Line or xx="AL" for Aluminum Outer Conductor Line) Horizontal Vertical Spring and two (2) RLA000-1HS Horizontal Side Springs. The horizontal hanger spacing should be an average of 480-inches (12,192-mm) for 3-1/8 and 4-1/16-inch Aluminum Outer Conductor Rigid Line, 240-inches (6,096-mm) for 3-1/8 and 4-1/16-inch Copper Outer Conductor or 6-1/8-inch Aluminum Outer Conductor Rigid Line and 120-inches (3,048-mm) 6-1/8, 7-3/16 and 8-3/17-inch Copper outer Conductor Rigid Line. When this configuration is used the RLA000-01HLB Horizontal Lateral Brace to prevent lateral motion is not required.

Single Point Horizontal Fixed Hanger



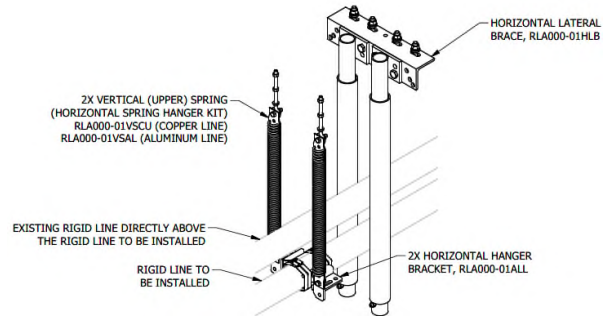
This configuration requires one (1) RLA000-01ALL Universal Horizontal Hanger Bracket and one (1) RLA000-01THRD Horizontal Clevis/Rod Hanger Kit. The horizontal hanger spacing should be an average of every 120-inches (3,048-mm) for all rigid line sizes and types. In addition, an RLA000-01HLB Horizontal Lateral Brace to prevent lateral motion should be installed every 240-inches (6,096-mm) for the entire length of the horizontal run. NOTE: Horizontal fixed hangers should only be installed beyond the minimum horizontal run length (see table page 88).

Two Point Horizontal Fixed Hanger



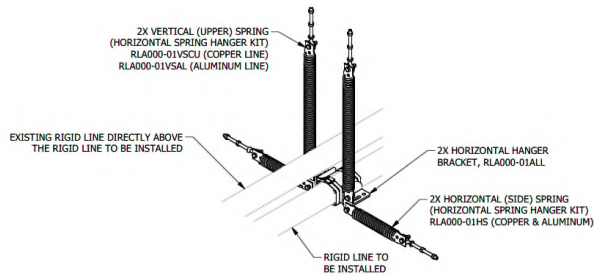
This configuration requires one (1) RLA000-01ALL Universal Horizontal Hanger Bracket and two (2) RLA000-01THRD Horizontal Clevis/Rod Hanger Kit. The horizontal hanger spacing should be an average of every 120-inches (3,048-mm) for all rigid line sizes and types. When this configuration is used the RLA000-01HLB Horizontal Lateral Brace to prevent lateral motion is not required. NOTE: Horizontal fixed hangers should only be installed beyond the minimum horizontal run length (see table page 88).

Two Point Horizontal Spring Hanger



This configuration requires two (2) RLA000-01ALL Universal Horizontal Hanger Bracket and two (2) RLA000-01VSxx (xx="CU" for Copper Outer Conductor Rigid Line or xx="AL" for Aluminum Outer Conductor Rigid Line) Horizontal Vertical Spring. The horizontal hanger spacing should be an average of 480-inches (12,192-mm) for 3-1/8 and 4-1/16-inch Aluminum Outer Conductor Rigid Line, 240-inches (6,096-mm) for 3-1/8 and 4-1/16-inch Copper Outer Conductor or 6-1/8-inch Aluminum Outer Conductor Rigid Line and 120-inches (3,048-mm) 6-1/8, 7-3/16 and 8-3/17-inch Copper outer Conductor Rigid Line. In addition, an RLA000-01HLB Horizontal Lateral Brace to prevent lateral motion should be

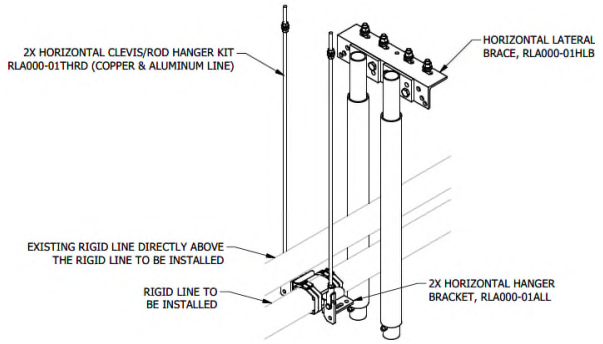
Two Point Horizontal Spring Hanger



This configuration requires two (2) RLA000-01ALL Universal Horizontal Hanger Bracket, two (2) RLA000-01VSxx (xx="CU" for Copper Outer Conductor Rigid Line or xx="AL" for Aluminum Outer Conductor Rigid Line) Horizontal Vertical Spring and two (2) RLA000-1HS Horizontal Side Springs. The horizontal hanger spacing should be an average of 480-inches (12,192-mm) for 3-1/8 and 4-1/16-inch Aluminum Outer Conductor Rigid Line, 240-inches (6,096-mm) for 3-1/8 and 4-1/16-inch Copper Outer Conductor or 6-1/8-inch Aluminum Outer Conductor Rigid Line and 120-inches (3,048-mm) 6-1/8, 7-3/16 and 8-3/17-inch Copper outer Conductor Rigid Line.

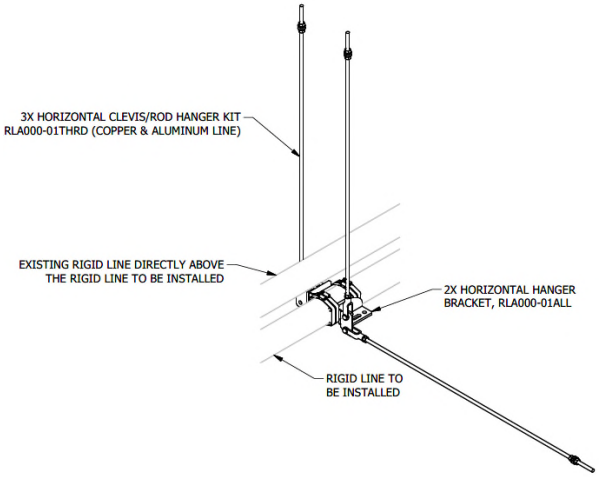
installed every 240-inches (6,096-mm) for the entire length of the horizontal run.	

Two Point Horizontal Fixed Hanger

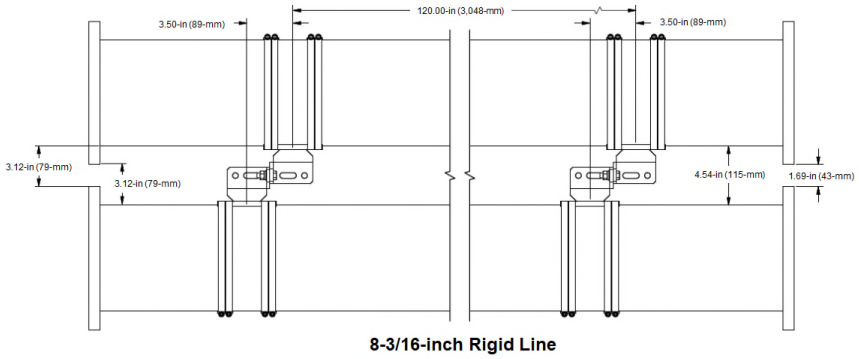


This configuration requires two (2) RLA000-01ALL Universal Horizontal Hanger Bracket and two (2) RLA000-01THRD Horizontal Clevis/Rod Hanger Kit. The horizontal hanger spacing should be an average of every 120-inches (3,048-mm) for all rigid line sizes and types. In addition, an RLA000-01HLB Horizontal Lateral Brace to prevent lateral motion should be installed every 240-inches (6,096-mm) for the entire length of the horizontal run. NOTE: Horizontal fixed hangers should only be installed beyond the minimum horizontal run length (see table page 88).

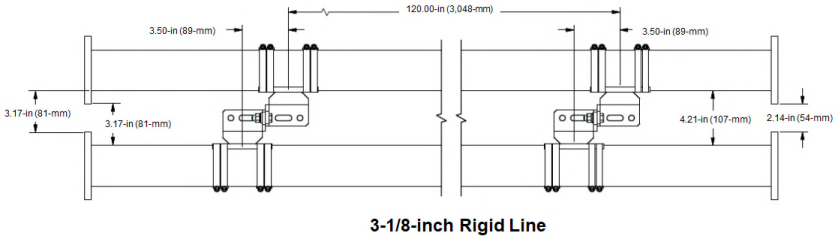
Three Point Horizontal Fixed Hanger



This configuration requires two (2) RLA000-01ALL Universal Horizontal Hanger Bracket and three (3) RLA000-01THRD Horizontal Clevis/Rod Hanger Kit. The horizontal hanger spacing should be an average of every 120-inches (3,048-mm) for all rigid line sizes and types. When this configuration is used the RLA000-01HLB Horizontal Lateral Brace to prevent lateral motion is not required. NOTE: Horizontal fixed hangers should only be installed beyond the minimum horizontal run length (see table page 88).



8-3/16-inch Rigid Line

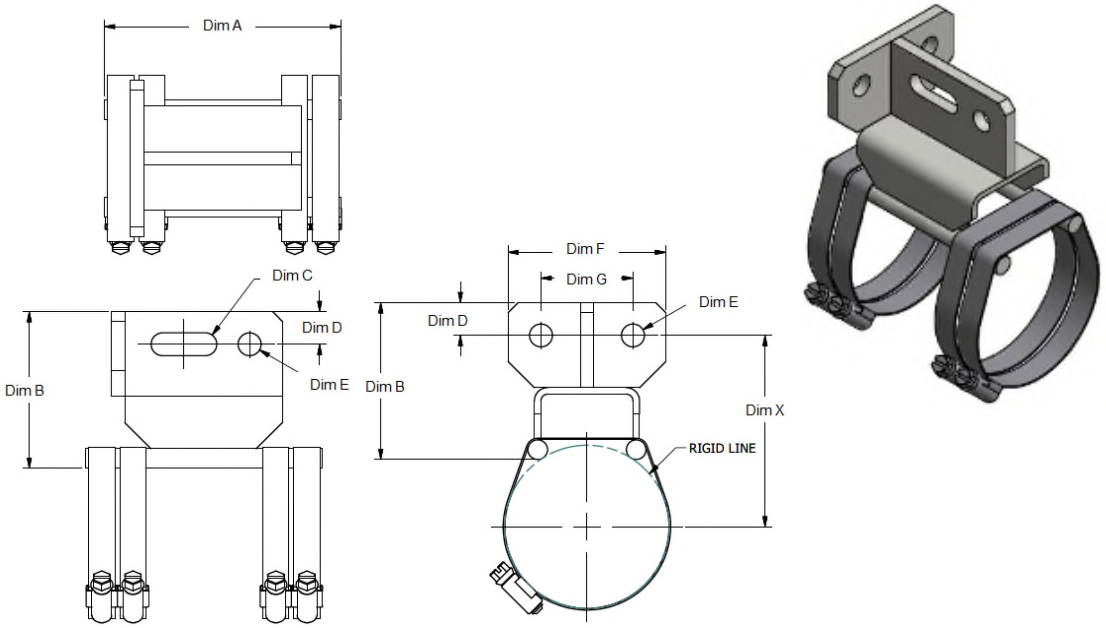


3-1/8-inch Rigid Line

RLA000-01ALL Horizontal Hanger Brackets configured to support two transmission lines side by side.

Universal Horizontal Hanger Brackets

The Universal Horizontal Hanger Bracket includes the bracket assembly and a quantity of four (4) HC0062 Stainless Steel Hose Clamps (2.500-in (64-mm) to 4.500-in (114-mm)) for 3-1/8-inch and 4-1/16 rigid transmission lines and four (4) HC0128 Stainless Steel Hose Clamps (2.500-in (64-mm) to 8.500-in (216-mm)) for 6-1/8-inch, 7-3/16-inch and 8-3/16-inch rigid lines. This bracket is used in combination with the RLA000-01VSCU Horizontal Vertical Spring for Copper Outer Conductor Rigid Line or the RLA000-01VSAL Horizontal Vertical Spring for Aluminum Outer Conductor Rigid Line to provide vertical support for the weight of the horizontal run while allowing the differential expansion of the vertical transmission line run. lateral support is provided by adding two (2) RLA000-1HS Horizontal Side Springs or using the RLA000-01HLB Horizontal Lateral Brace. The horizontal hanger spacing should be an average of 480-inches (12,192-mm) for 3-1/8 and 4-1/16-inch Aluminum Outer Conductor Rigid Line, 240-inches (6,096-mm) for 3-1/8 and 4-1/16-inch Copper Outer Conductor or 6-1/8-inch Aluminum Outer Conductor Rigid Line and 120-inches (3,048-mm) 6-1/8, 7-3/16 and 8-3/17-inch Copper outer Conductor Rigid Line. In addition, an RLA000-01HLB Horizontal Lateral Brace to prevent lateral motion should be installed every 240-inches (6,096-mm) for the entire length of the horizontal run. Beyond the length of Minimum Horizontal Run (see Table on Page 88) the Universal Horizontal Hanger Bracket can be used with the RLA000-01THRD Horizontal Clevis/Rod Hanger Kit. The horizontal hanger spacing should average of every 120-inches (3,048-mm) for all rigid line sizes and types. In addition, an RLA000-01HLB Horizontal Lateral Brace to prevent lateral motion should be installed every 240-inches (6,096-mm) for the entire length of the horizontal run if no other lateral support is provided by Horizontal Side Springs or Horizontal Clevis/Rod Kits.

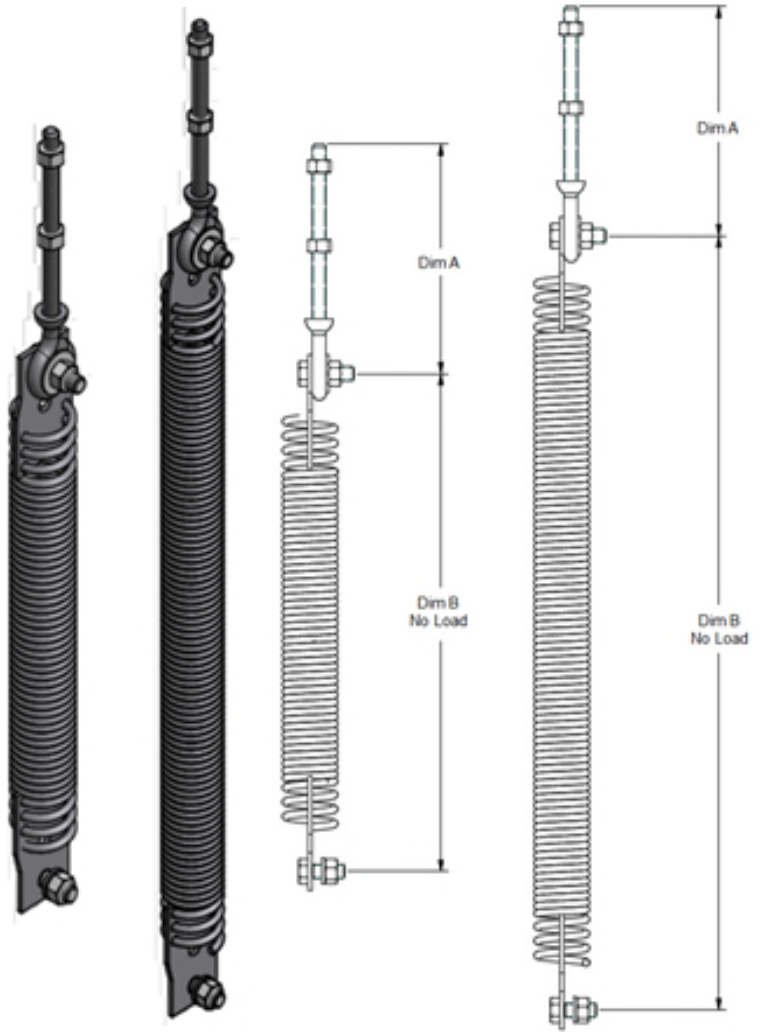


Universal Horizontal Hanger Bracket Specifications

Part Number		RLA000-01ALL			
Dim A	4.500-in	(114-mm)	**Line Size**	**Dim X**	
Dim B	3.000-in	(76-mm)	3-1/8-inch	3.670-in	(93-mm)
Dim C	0.44 x 1.25-in	11 x 32-mm	4-1/16-inch	4.200-in	(107-mm)
Dim D	0.625-in	(16-mm)	6-1/8-inch	5.300-in	(135-mm)
Dim E	0.440-in	(11-mm)	7-3/16-inch	5.830-in	(148-mm)
Dim F	3.000-in	(76-mm)	8-3/16-inch	6.350-in	(161-mm)
Dim G	1.750-in	(44-mm)			
Weight	1.6-lbm	(0.7-kg)			

Horizontal Vertical Springs

The Horizontal Vertical Spring comes in two (2) versions the RLA000-01VSCU for Copper Outer Conductor Rigid Line and the RLA000-01VSAL for Aluminum Outer Conductor Rigid Line. These are used in combination with the RLA000-01ALL Universal Horizontal Hanger Bracket to provide vertical support for the weight of the horizontal run while allowing the differential expansion of the vertical transmission line run, lateral support is provided by adding two (2) RLA000-1HS Horizontal Side Springs or using the RLA000-01HLB Horizontal Lateral Brace. The horizontal hanger spacing should be an average of 480-inches (12,192-mm) for 3-1/8 and 4-1/16-inch Aluminum Outer Conductor Rigid Line, 240-inches (6,096-mm) for 3-1/8 and 4-1/16-inch Copper Outer Conductor or 6-1/8-inch Aluminum Outer Conductor Rigid Line and 120-inches (3,048-mm) 6-1/8, 7-3/16 and 8-3/16-inch Copper outer Conductor Rigid Line. In addition, an RLA000-01HLB Horizontal Lateral Brace to prevent lateral motion should be installed every 240-inches (6,096-mm) for the entire length of the horizontal run.



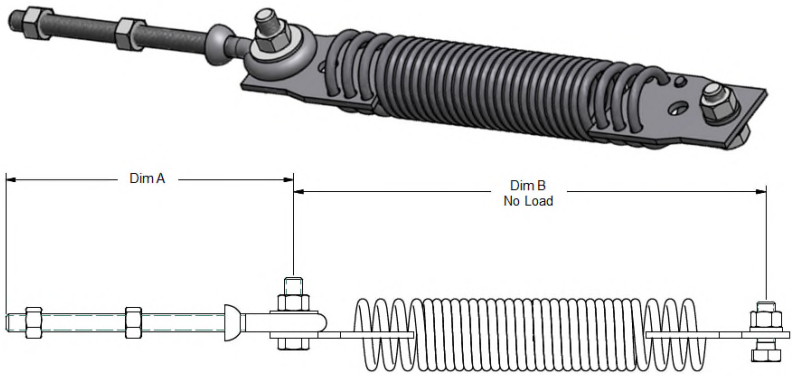
Horizontal Vertical Spring Specifications

Part Number	**RLA000-01VSCU**
Line Type	Copper Outer
Dim A	6.000-in (152-mm)
Dim B	13.400-in (340-mm)
Weight	2.4-lbm (1.1-kg)
Attachment Hardware	3/8-inch
Part Number	**RLA000-01VSAL**
Line Type	Aluminum Outer
Dim A	6.000-in (152-mm)
Dim B	20.500-in (521-mm)
Weight	3.6-lbm (1.6-kg)
Attachment Hardware	3/8-inch

Horizontal Side Springs

The Horizontal Side Spring, Part Number RLA000-01HS are used in pairs (two (2)) in combination with the RLA000-01ALL Universal Horizontal Hanger Bracket and the RLA000-01VSCU Horizontal Vertical Spring for Copper Outer Conductor Rigid Line or the RLA000-01VSAL Horizontal Vertical Spring for Aluminum Outer Conductor Rigid Line to provide lateral support to the horizontal transmission line run while allowing the differential expansion of the vertical transmission line run. The horizontal hanger spacing should be an average of 480-inches (12,192-mm) for 3-1/8 and 4-1/16-inch Aluminum Outer

Conductor Rigid Line, 240-inches (6,096-mm) for 3-1/8 and 4-1/16-inch Copper Outer Conductor or 6-1/8-inch Aluminum Outer Conductor Rigid Line and 120-inches (3,048-mm) 6-1/8, 7-3/16 and 8-3/17-inch Copper outer Conductor Rigid Line. When this configuration is used the RLA000-01HLB Horizontal Lateral Brace to prevent lateral motion is not required.

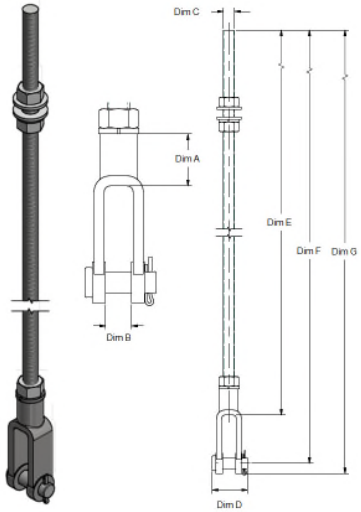


Horizontal Side Spring Specifications

Part Number	RLA000-01HS
Dim A	6.000-in (152-mm)
Dim B	9.600-in (244-mm)
Weight	1.8-lbm (0.8-kg)
Attachment Hardware	3/8-inch

Horizontal Clevis Rod Kits

The Horizontal Clevis Rod Kit, Part Number RLA000-01THRD are used in combination with the RLA000-01ALL Universal Horizontal Hanger Bracket to provide vertical support for the weight of the horizontal run while allowing expansion and contraction of the horizontal run. They are to be used beyond the length of Minimum Horizontal Run (see Table on Page 88). A second Horizontal Clevis Rod Kit can be installed horizontally to provide the required lateral support to the horizontal transmission line run while allowing the differential expansion of the horizontal transmission line run. When this configuration is used the RLA000-01HLB Horizontal Lateral Brace to prevent lateral motion is not required. The horizontal hanger spacing should be an average of every 120-inches (3,048-mm) for all copper outer conductor rigid line sizes and 240-inches (6,096-mm) for all aluminum outer conductor rigid line. In cases were a horizontal rod cannot be installed an RLA000-01HLB Horizontal Lateral Brace can be used to prevent lateral motion and should be installed every 240-inches (6,096-mm) for the entire length of the horizontal run if no other lateral support is provided by Horizontal Side Springs or Horizontal Clevis Rod Kits.

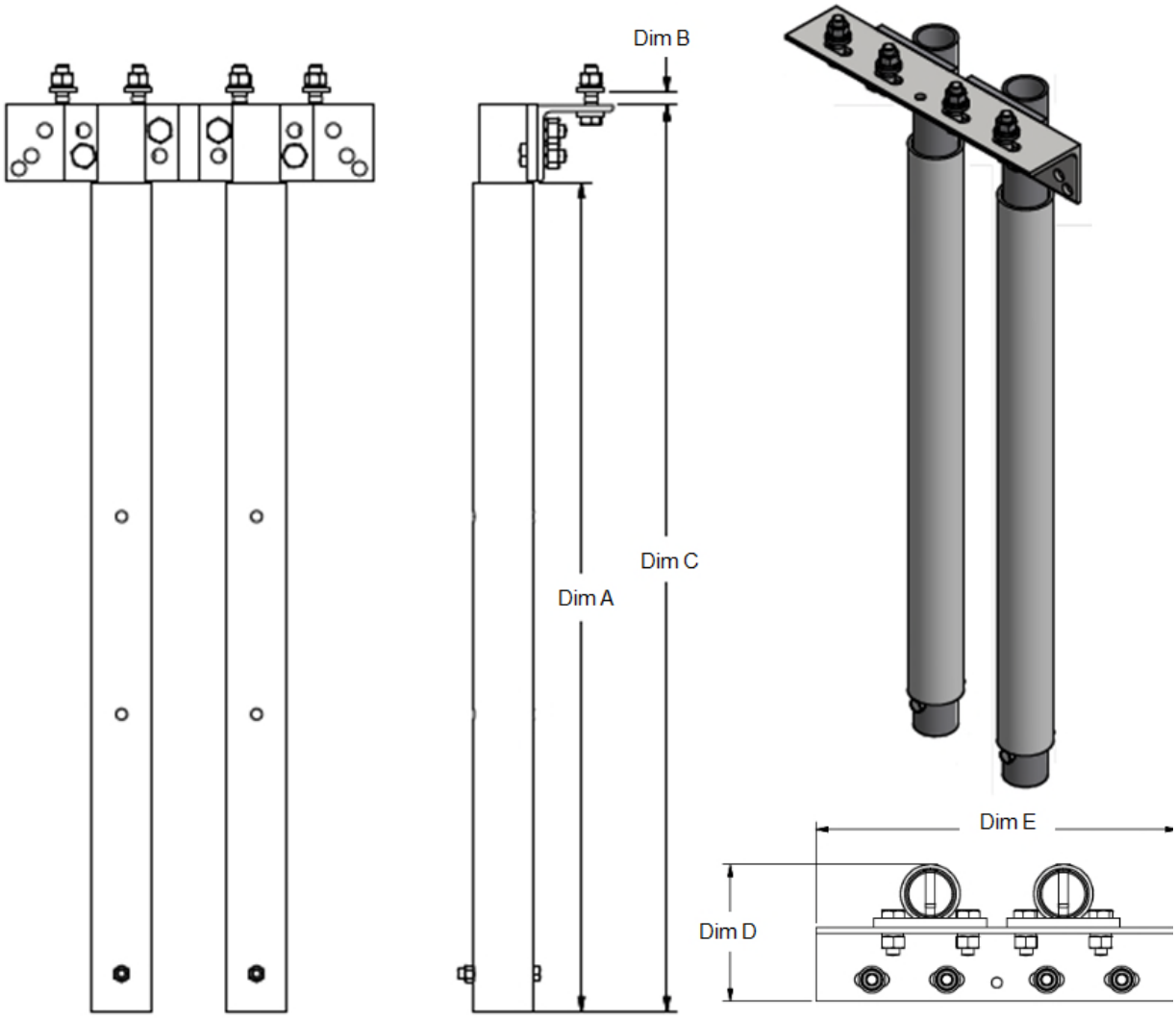


Horizontal Clevis/Rod Kit Specifications

Part Number	RLA000-01THRD	
Dim A	0.880-in	(22-mm)
Dim B	0.440-in	(11-mm)
Dim C	0.380-in	(10-mm)
Dim D	1.190-in	(30-mm)
Dim E	36.000-in	(914-mm)
Dim F	37.630-in	(956-mm)
Dim G	37.970-in	(964-mm)
Weight	1.4-lbm	(0.6-kg)
Attachment Hardware	3/8-inch	

Horizontal Lateral Braces

The Horizontal Lateral Brace, Part Number RLA000-01HLB are used in combination with the RLA000-01ALL Universal Horizontal Hanger Bracket to provide lateral support to the horizontal run of transmission line run while allowing expansion and contraction of both the vertical and horizontal run. They can be used with both Horizontal Vertical Spring Hanger and Horizontal Fixed Hangers and provide lateral support for the single point attachment configurations of both types. The Horizontal Lateral Brace spacing should be an average of every 240-inches (6,096-mm) for all rigid line sizes and types. If other lateral support is provided in the horizontal run by Horizontal Side Springs or Horizontal Clevis/Rod Kits, then a Horizontal Lateral Brace is not required.

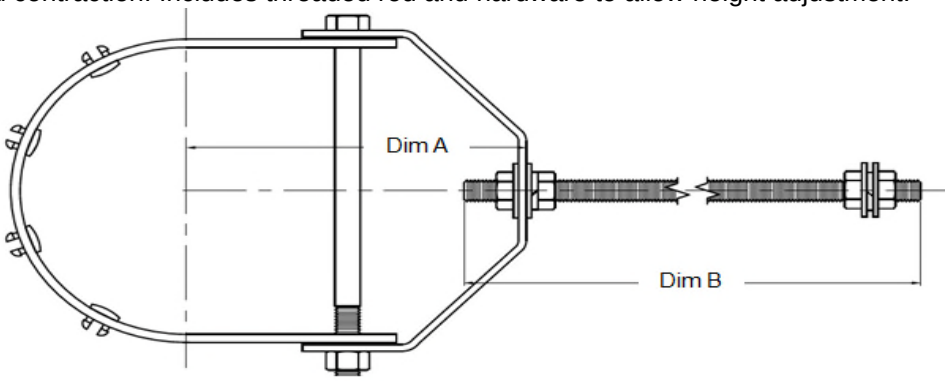


Horizontal Lateral Brace Specifications

Part Number	Dim A	Dim B	Dim C	Dim D	Dim E	Weight	Attachment Hardware
RLA000-01HLB	32.750-in (832-mm)	0.060 - 0.750-in (2 - 19-mm)	35.810-in (910-mm)	5.510-in (140-mm)	14.500-in (368-mm)	17.8-lbm (8.1-kg)	1/2-inch

Horizontal Slip Hangers

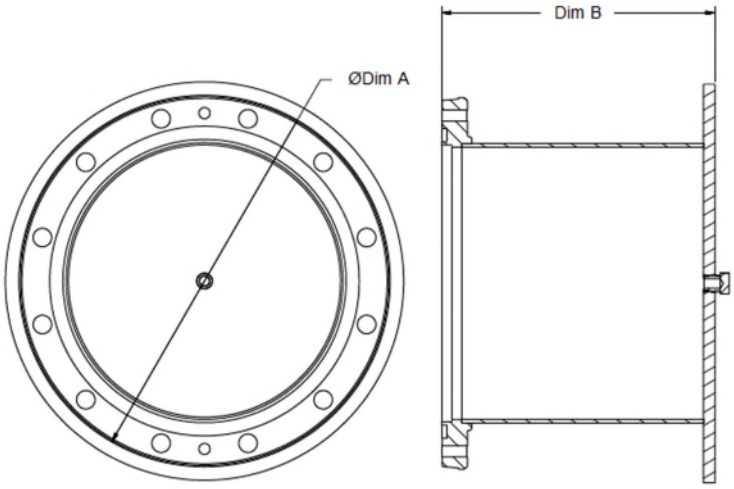
For indoor use only. Supports horizontal transmission line runs accommodates lateral motion due to expansion and contraction. Includes threaded rod and hardware to allow height adjustment.



RLAx00-22A Horizontal Sliding Hanger

Horizontal Sliding Hanger Specifications

Part Number	Line Size	Dim A		Dim B		Weight		Attachment Hardware
RLA300-22A	3-1/8-inch	4.880-in	(124-mm)	36.000-in	(914-mm)	2.0-lbm	(0.9-kg)	1/2-inch



End Caps

End caps are used during installation to allow pressurizing transmission line runs during installation, when installation is interrupted by weather or to allow pressurization of rigid line runs that are temporarily not in use. End caps include a 1/8-inch NPFT pipe plug which can be replaced with a gas inlet valve to allow connection to a dry air or nitrogen source.

End Cap Specifications

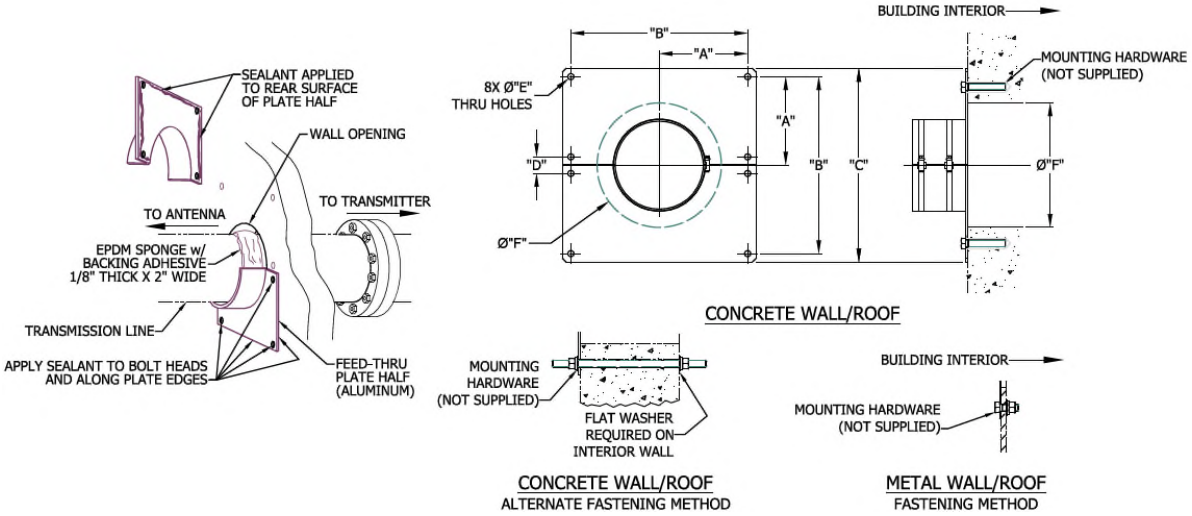
Part Number	Line Size	Dim A		Dim B		Weight	
RLA300A-50	3-1/8-inch	5.180-in	(132-mm)	3.750-in	(95-mm)	4.0-lbm	(1.8-kg)

Wall Roof Feed Thru Plates

Wall/Roof Feed Thru Plates are split aluminum plates that accommodate passage of a section of copper or aluminum rigid transmission line through the metal or concrete wall or roof of the transmitter equipment building. The two-piece plate is supplied with EPDM weatherproofing sponge with backing and provides

for proper weather sealing of the line to the building. Eight (8) (Four (4) in the RLA100-15) mounting holes are sized, refer to dimension "E" in table, for 3/8-inch or ½-inch mounting hardware (customer supplied).

Accurately determine the entry point where the rigid line penetrates the structure. Cut out the designated area at the point of entry, refer to dimension “F” in table. Insert a single rigid line section through the entry opening. Complete both the exterior and interior installation of horizontal rigid line run. Ensure that the rigid line is suspended at the point of entry and not resting on either the top or bottom of the entry opening.



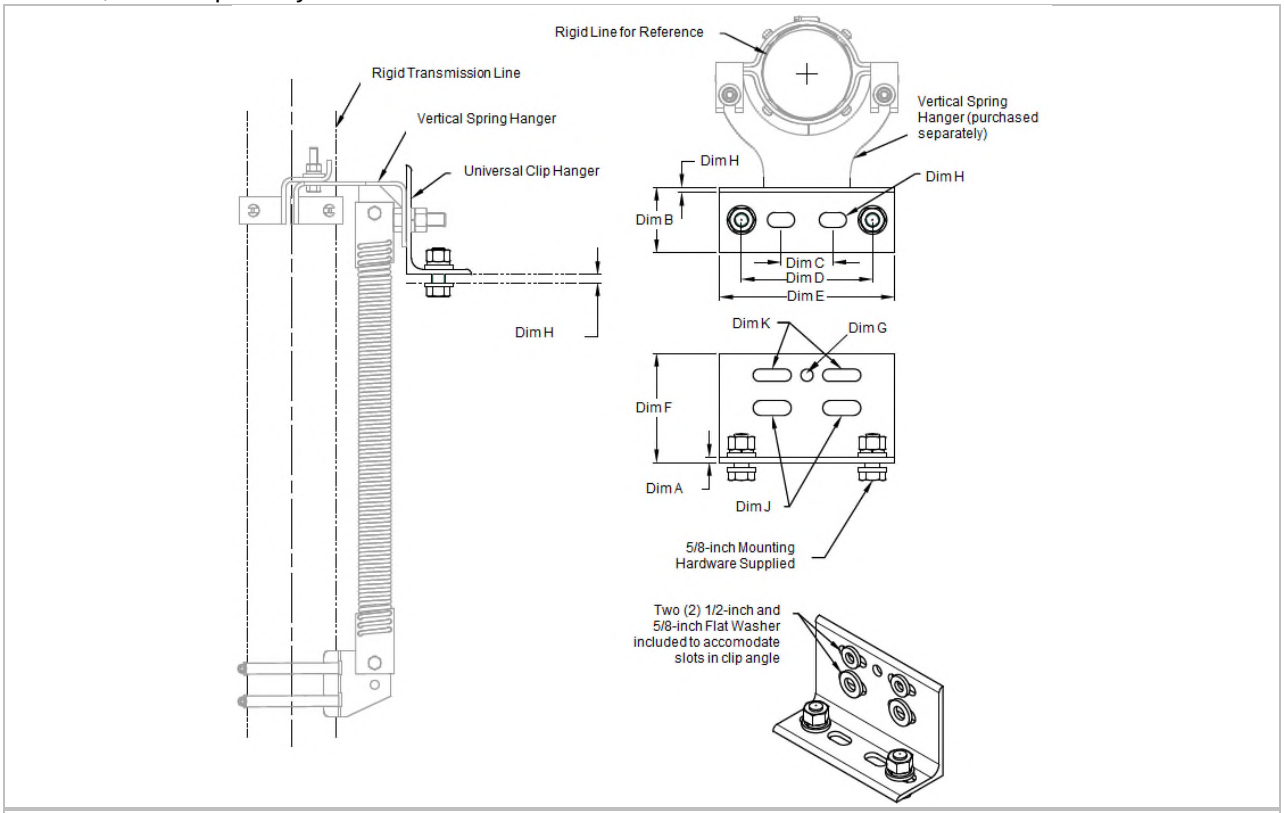
Wall/Roof Feed Thru Plate Specifications

Part Number	Line Size	Dim A	Dim B	Dim C	Dim D	Dim E	Dim F	Weight
RLA300-15A	3-1/8-inch	3.400-in (86-mm)	6.800-in (173-mm)	8.000-in (203-mm)	1.200-in (30-mm)	0.438-in (11-mm)	6.000-in (152-mm)	1.1-lbm (0.5-kg)

Rigid Transmission Line Attachment Brackets

Horizontal Angle Member Rigid Line Hanger Attachment Bracket

Universal Rigid Line Hanger Attachment Bracket for 3-1/8-inch, 4-1/16-inch, 6-1/8-inch, 7-3/16-inch, 8-3/16-inch and 9-3/16-inch rigid transmission lines. Includes 5/8-inch hardware to attach to drilled or punched horizontal angle members. The mounting hardware supplied can accommodate thickness connection range from 0.06-inches to 0.50-inches. Spring hanger shown for reference only and is not included, order separately.



Universal Clip Angle Kit Specifications

Part Number	**RLA001-00KIT**	
Dim A	0.250-in	(6-mm)
Dim B	3.000-in	(76-mm)
Dim C	2.380-in	(60-mm)
Dim D	6.000-in	(152-mm)
Dim E	8.000-in	(203-mm)
Dim F	5.000-in	(127-mm)
Weight	5.0-lbm	(2.3-kg)
Attachment Hardware	5/8-inch	

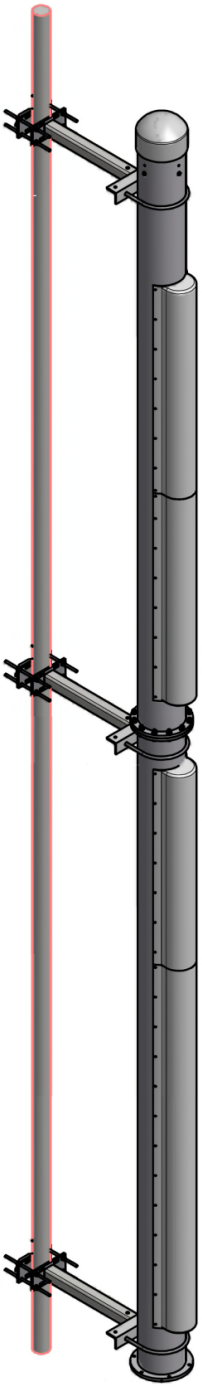
Dim G	0.563-in	(14-mm)
	1/2-inch mounting hardware	
Dim H	0.06 x 0.5-in	2 x 10-mm
	With Two (2) Flat Washer	
	0.06 x 0.31-in	2 x 10-mm
	With Two (2) Flat Washers	
Dim J	0.69 x 1.75-in	18 x 40-mm
	slots for 5/8-inch mounting hardware	
	5/8-inch Hardware Spacing	
	2.125 x 4.25-in	54 x 110-mm
Dim K	0.56 x 1.75-in	14 x 40-mm
	slots for 1/2-inch mounting hardware	
	1/2-inch Hardware Spacing	
	2 x 4.38-in	51 x 110-mm

Interim Antenna and Transmission Line Product Information

ERI ALV Series High Band VHF Television Antenna

Features

- Light weight side mounted television antenna
- 2, 4, and 8 bay models standard
- Unpressurized slot covers
- Includes brackets for leg or pole mounting



ERI's ALV Series high band VHF television antenna is a new lightweight, side mounted, family of high band VHF television antennas available in 2, 4, and 8 bay configurations with omnidirectional and Omnioid (Skull) standard azimuth patterns. The antenna is available for any single Band III RF Channel from 7 through 13. ALV Series antennas are rated for up to 32 kW average input power. The ALV series is ruggedly constructed and is suitable for use as a main or auxiliary antenna.

The ALV Series is an end fed antenna which provides benefits in terms of simplicity and reliability and eliminates any external power dividers or feed cables. The RF input is 3-1/8-inch EIA flanged, male. The antenna includes standard brackets for side mounting on a tower leg or pole from 1.5 inches (38 mm) to 7.5 inches (190 mm) OD.

Type Number Definition

ALV a V b - HS c - d f

ALV	ERI ALV Series
a =	Elevation Directivity (2, 4, or 8 standard)
V	VHF Band: V=VHF High Band
b =	Beam Tilt: 0=0.00 degrees (ALV2) 7=1.75 degrees (ALV4 and ALV8)
HS	Horizontally Polarized Side Mount
c =	Azimuth Pattern O = Omnidirectional (±2.0 dB) OC = Omnioid
d =	RF Channel (7 - 13)
f =	Ice Protection: Blank = Unpressurized slot covers only

Antenna shown is an RF Channel 7 (174 MHz to 180 MHz) Model ALV4V7-HSOC-7. Four (4) Bay, Omnioid, High Band VHF Television Antenna. It is shown using the standard mounting brackets supplied with the antenna.

Product Specifications

Frequency Range:	Any single high band VHF television channel (174 MHz to 216 MHz)	
RF Input:	3-1/8-inch EIA flange, male	
Power Handling:	ALV2	20 kW average power, ATSC or COFDM
	ALV4	20 kW average power, ATSC or COFDM
	ALV8	32 kW average power, ATSC or COFDM
VSWR:	ALV2 and 4	1.20:1.00, maximum
	ALV8	1.12:1.00, maximum

Power Gain:	**Omnidirectional**		**Omnioid (Channel 10)**	
2-Bay	2.30	(3.62 dBd)	4.03	(6.05 dBd)
4-Bay	4.32	(6.35 dBd)	7.56	(8.79 dBd)
8-Bay	8.51	(9.30 dBd)	14.89	(11.73 dBd)

Mechanical Specifications

Height

	ALV2		**ALV4**		**ALV8**	
Channel 7 (174 to 180 MHz)			27.8 ft	(8.49 m)	49.4 ft	(15.05 m)
Channel 8 (180 to 186 MHz)			27.0 ft	(8.22 m)	47.8 ft	(14.56 m)
Channel 9 (186 to 192 MHz)			26.1 ft	(7.96 m)	46.4 ft	(14.13 m)
Channel 10 (192 to 198 MHz)	14.1 ft	(4.30 m)	25.4 ft	(7.73 m)	44.9 ft	(13.69 m)
Channel 11 (198 to 204 MHz)			24.6 ft	(7.51 m)	43.6 ft	(13.29 m)
Channel 12 (204 to 210 MHz)			24.0 ft	(7.30 m)	42.4 ft	(12.92 m)
Channel 13 (210 to 216 MHz)			23.3 ft	(7.11 m)	41.2 ft	(12.57 m)
Input Section	3.5 ft	(1.07 m)	N/A		N/A	

Weight (No Ice)

	ALV2		**ALV4**		**ALV8**	
Channel 7 (174 to 180 MHz)			480 lbm	(217.7 kg)	860 lbm	(390.1 kg)
Channel 8 (180 to 186 MHz)			470 lbm	(213.2 kg)	830 lbm	(376.5 kg)
Channel 9 (186 to 192 MHz)			450 lbm	(204.1 kg)	805 lbm	(365.1 kg)
Channel 10 (192 to 198 MHz)	260 lbm	(117.9 kg)	440 lbm	(199.6 kg)	780 lbm	(353.8 kg)
Channel 11 (198 to 204 MHz)			430 lbm	(195.0 kg)	760 lbm	(344.7 kg)
Channel 12 (204 to 210 MHz)			415 lbm	(188.2 kg)	740 lbm	(335.7 kg)
Channel 13 (210 to 216 MHz)			405 lbm	(183.7 kg)	720 lbm	(326.6 kg)

Weight (1/2 inch / 13 mm Ice)

	ALV2		**ALV4**		**ALV8**	
Channel 7 (174 to 180 MHz)			725 lbm	(328.9 kg)	1300 lbm	(589.7 kg)
Channel 8 (180 to 186 MHz)			705 lbm	(319.8 kg)	1260 lbm	(571.5 kg)
Channel 9 (186 to 192 MHz)			685 lbm	(310.7 kg)	1225 lbm	(555.7 kg)
Channel 10 (192 to 198 MHz)	365 lbm	(165.6 kg)	665 lbm	(301.6 kg)	1185 lbm	(537.5 kg)
Channel 11 (198 to 204 MHz)			645 lbm	(292.6 kg)	1150 lbm	(521.6 kg)
Channel 12 (204 to 210 MHz)			625 lbm	(283.5 kg)	1120 lbm	(508.0 kg)
Channel 13 (210 to 216 MHz)			610 lbm	(276.7 kg)	1090 lbm	(494.4 kg)

EPA (No Ice)

	ALV2		**ALV4**		**ALV8**	
Channel 7 (174 to 180 MHz)			30 sq ft	(2.8 sq m)	53.1 sq ft	(4.9 sq m)
Channel 8 (180 to 186 MHz)			29 sq ft	(2.7 sq m)	51.4 sq ft	(4.8 sq m)
Channel 9 (186 to 192 MHz)			28 sq ft	(2.6 sq m)	49.9 sq ft	(4.6 sq m)
Channel 10 (192 to 198 MHz)	16 sq ft	(1.5 sq m)	27 sq ft	(2.5 sq m)	48.3 sq ft	(4.5 sq m)
Channel 11 (198 to 204 MHz)			27 sq ft	(2.5 sq m)	46.9 sq ft	(4.4 sq m)
Channel 12 (204 to 210 MHz)			26 sq ft	(2.4 sq m)	45.6 sq ft	(4.2 sq m)
Channel 13 (210 to 216 MHz)			25 sq ft	(2.3 sq m)	44.4 sq ft	(4.1 sq m)

EPA (1/2 inch / 13 mm Ice)

	ALV2		**ALV4**		**ALV8**	
Channel 7 (174 to 180 MHz)			33 sq ft	(3.0 sq m)	58.1 sq ft	(5.4 sq m)
Channel 8 (180 to 186 MHz)	18 sq ft	(1.7 sq m)	32 sq ft	(2.9 sq m)	56.2 sq ft	(5.2 sq m)
Channel 9 (186 to 192 MHz)			31 sq ft	(2.9 sq m)	54.5 sq ft	(5.1 sq m)

Channel 10 (192 to 198 MHz)	30 sq ft	(2.8 sq m)	52.8 sq ft	(4.9 sq m)
Channel 11 (198 to 204 MHz)	29 sq ft	(2.7 sq m)	51.3 sq ft	(4.8 sq m)
Channel 12 (204 to 210 MHz)	28 sq ft	(2.6 sq m)	49.9 sq ft	(4.6 sq m)
Channel 13 (210 to 216 MHz)	28 sq ft	(2.6 sq m)	48.5 sq ft	(4.5 sq m)

Mounting Brackets

ALV Series VHF television antennas are shipped with 36-inch (914 mm) standoff brackets for mounting on poles or tower legs from 1.5-inches (35 mm) to 7.5-inches (191 mm) OD. Standoff support pipes, face mount brackets, and mounts for larger diameter poles are available from ERI as optional items. Please contact ERI for a proposal for these requirements.

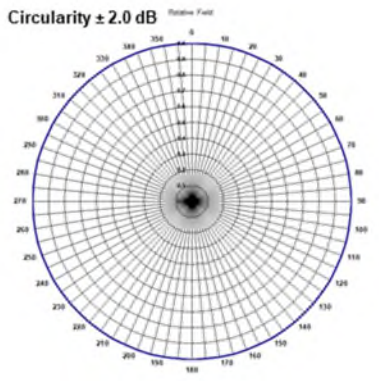
	ALV2	ALV4	ALV8
Number of Brackets:	Three (3)	Three (3)	Five (5)

Bracket Mechanical Specifications

	No Ice		1/2 inch / 13 mm Ice	
Bracket Weight (each):	56 lbm	(25.4 kg)	76 lbm	(34.5 kg)
EPA (each):	1.1 sq ft	(0.1 sq m)	1.3 sq ft	(0.1 sq m)

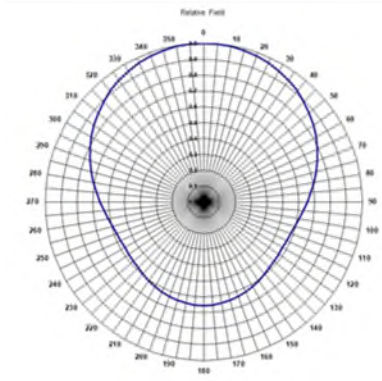
Note: All loads calculated per TIA-222-G

ALV Series Horizontally Polarized Antenna Patterns



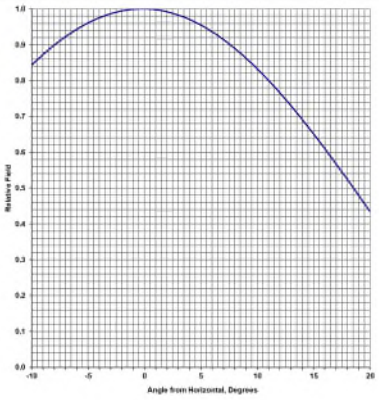
ALV-O Azimuth Pattern

	Numeric	dB
Directivity:	1.00	0.00



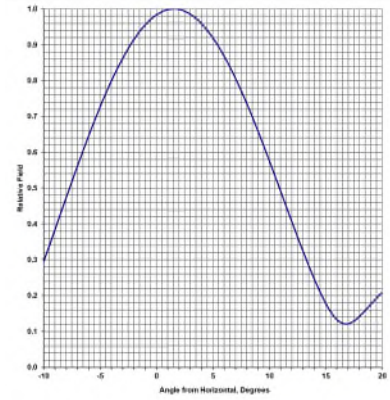
ALV-OC Azimuth Pattern

	Numeric	dB
Directivity:	1.75	(2.43)



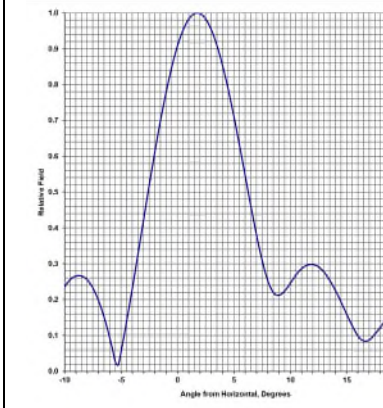
ALV2V0 Elevation Pattern

Directivity:	Numeric	dBd
Main Lobe:	2.30	(3.62)
Horizontal:	2.30	(3.62)
Beam Tilt:	0.00 Degrees	
Polarization:	Horizontal	



ALV4V7 Elevation Pattern

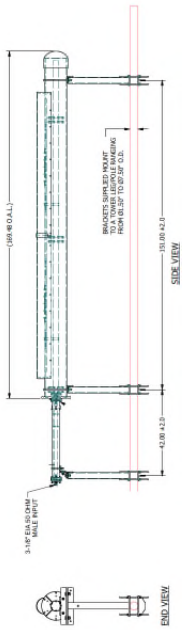
Directivity:	Numeric	dBd
Main Lobe:	4.32	(6.35)
Horizontal:	4.18	(6.21)
Beam Tilt:	1.75 Degrees	
Polarization:	Horizontal	



ALV8V7 Elevation Pattern

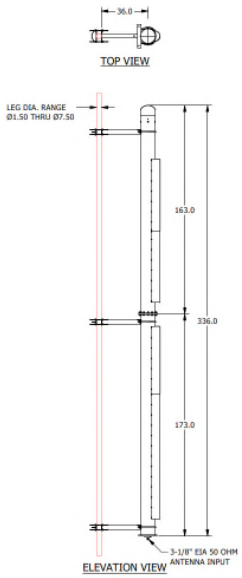
Directivity:	Numeric	dBd
Main Lobe:	8.51	(9.30)
Horizontal:	7.02	(8.46)
Beam Tilt:	1.75 Degrees	
Polarization:	Horizontal	

ALV2 Top Level View



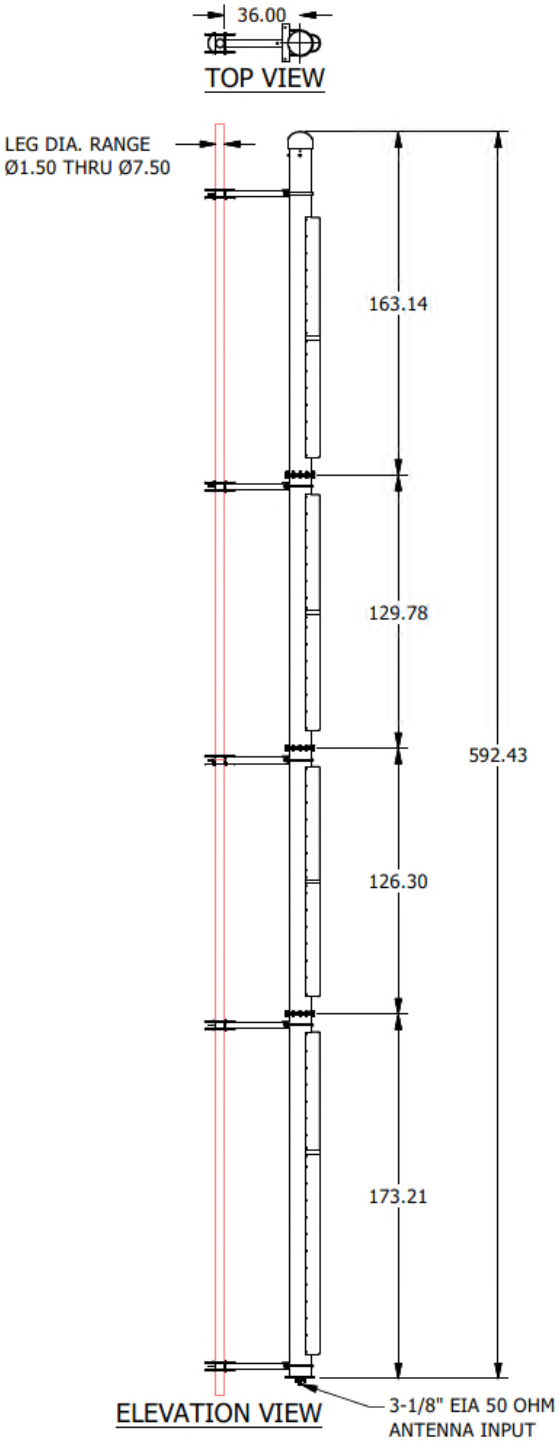
Antenna shown is an RF Channel 7 (174 MHz to 180 MHz) Model ALV2V2-HSOC-7. Two (2) Bay, Omnioid, High Band VHF Television Antenna. It is shown using the standard mounting brackets supplied with the antenna. Dimensions shown are inches.

ALV4 Top Level View



Antenna shown is an RF Channel 7 (174 MHz to 180 MHz) Model ALV4V7-HSOC-7. Four (4) Bay, Omnioid, High Band VHF Television Antenna. It is shown using the standard mounting brackets supplied with the antenna. Dimensions shown are inches.

ALV8 Top Level View



Antenna shown is an RF Channel 7 (174 MHz to 180 MHz) Model ALV8V7-HSOC-7. Eight (8) Bay, Omnioid, High Band VHF Television Antenna. It is shown using the standard mounting brackets supplied with the antenna. Dimensions shown are inches.

Preliminary Specification for
ALV Series Side Mounted
High Band VHF Horizontally Polarized
Coaxial Slotted Array Television Antenna

WVPB, RF Channel 9
WV Educational Broadcasting Authority, Huntington, WV

August 04, 2020

Antenna Model:
ALV4V7-HSOC-9

Specification Number
20200723-068-23

Electronics Research, Inc. 7777 Gardner Road Chandler IN 47610-9219 USA
+1 812 925-6000 (tel) +1 812 925-4030 (fax)

Preliminary Specification for ALV Series Side Mounted High Band VHF Horizontally Polarized Coaxial Slotted Array Television Antenna

Electrical Characteristics:

Channel:		9	
Frequency:		186 MHz to 192 MHz	
Service:		ATSC	
Azimuth Pattern Number:	Horizontal Polarization	ALV-9-OC	
Elevation Pattern Number:	Horizontal Polarization	ALV4V7	
Azimuth Directivity:	Horizontal Polarization	1.72	(2.36 dB)
Elevation Directivity:	Horizontal Polarization	4.32	(6.35 dBd)
Peak Power Gain:	Horizontal Polarization	7.43	(8.71 dBd)
Gain at Horizontal:	Horizontal Polarization	7.19	(8.57 dBd)

Electrical Beam Tilt:	1.75 Degrees	
Input Power Required:	2.94 kW	(4.69 dBk)
RF Input:	3-1/8-inch EIA, 50 Ω, flanged male	
Input Power Rating (maximum):	20 kW Average Power, 8VSB	
Antenna VSWR (maximum):	1.20 Over 6 MHz Channel	

Preliminary Specification for ALV Series Side Mounted High Band VHF Horizontally Polarized Coaxial Slotted Array Television Antenna

Antenna Mechanical Characteristics:

Mounting Configuration:		Side Mounted	
Height of Antenna		26.1 feet	(8.0 meters)
Height of Center of Radiation (above RF input)		13.1 feet	(4.0 meters)
Deicing:		Unpressurized radome slot covers	
Radome Height:		1.50 inches	(38.1 millimeters)
Radome Color:		Gray	
Climbing Device:		Not Applicable	
Calculated Weight[1]:	No Ice	450.0 lb	204.1 kg
	0.5inch (13 mm) ice	685.0 lb	310.7 kg
Windload Data[1,2]	EPA No Ice	28.1 ft²	(2.6 m²)
	0.5inch (13 mm) ice	30.8 ft²	(2.9 m²)

1) Please note, the listed weights and effective wind areas are based on the PRELIMINARY design of the antenna. Final As-Built values for the antenna are typically within +/-10% of the Preliminary design values, and will be provided in the technical manual that accompanies the antenna. Specified loads include the antenna, standard mounts, and power divider and jumper feed harnessing where applicable. Custom mounting brackets/adapters are NOT included.

2) Loads calculated in accordance with the ANSI/TIA-222-G standard.

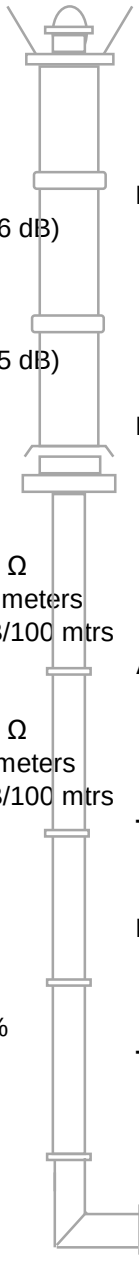
3) Low Power UHF television antennas are shipped with 15-inch (381 mm) stand off brackets for mounting on poles or tower legs (non- tapered) from 1.5-inches (35 mm) to 7.5-inches (191 mm) OD. Stand off support pipes, face mount brackets, and mounts for larger diameter poles are available from ERI as optional items.
3) Mounting Brackets (each) 76 Lbs. with 1.30 Sq.Ft. EPA, 1/2" Ice
4) Area per TIA-222-G

ALV Series VHF television antennas are shipped with 36-inch (914 mm) stand off brackets for mounting on poles or tower legs from 1.5-inches (35 mm) to 7.5-inches (191 mm) OD. Stand off support pipes, face mount brackets, and mounts for larger diameter poles are available from ERI as optional items. Please contact ERI for a proposal for these requirements.

NOTE: The purchaser or their representative shall be required to contact the tower owner, state and/or local building officials for specific design requirements and suitable parameters for a particular structure. Any variation from the parameters shown above must be communicated to ERI for comprehensive assessment.

Broadcast Antenna System
Power Analysis

WVPB RF Channel: 9
WV Educational Broadcasting Authority
Huntington, WV
ALV4V7-HSOC-9



Antenna Parameters

Azimuth Directivity:
Horizontal: 1.72 (2.36 dB)

Elevation Directivity:
Horizontal: 4.32 (6.35 dB)

Transmission Line

Vertical Run:
Type: 3-inch HJ8-50B Air HELIAX, 50 Ω
Length: 393 feet 119.8 meters
Attenuation: 0.202 dB/100 feet 0.663 dB/100 mtrs

Horizontal Run:
Type: 3-inch HJ8-50B Air HELIAX, 50 Ω
Length: 100 feet 30.5 meters
Attenuation: 0.202 dB/100 feet 0.663 dB/100 mtrs

Transmission Line Efficiency: 79.51%

RF System/Other Efficiency: 100.00%

Effective Radiated Power:
Horizontal: 21.86 kW (13.40 dBk)

Power Gain:
Horizontal: 7.43 numeric (8.71 dBd)

Antenna Input Power:
2.94 kW (4.69 dBk)

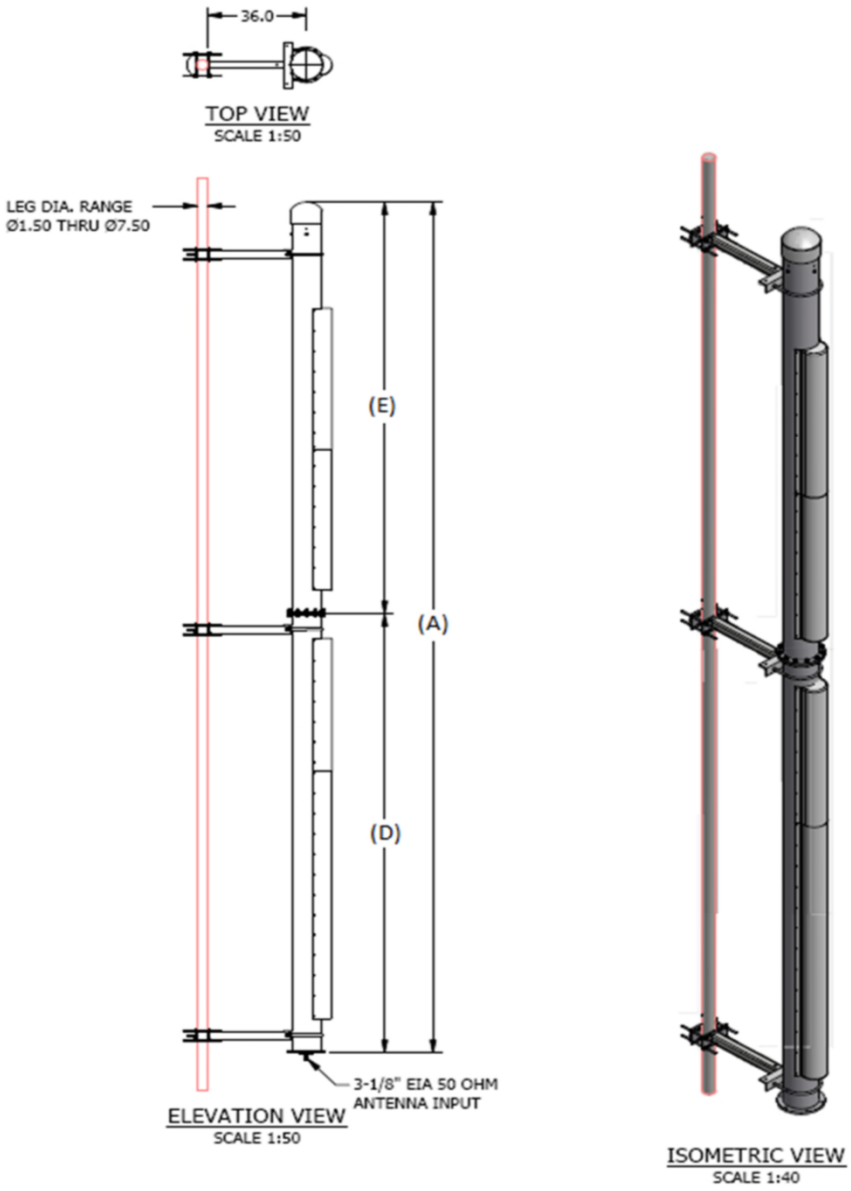
Transmission Line Losses:
-0.76 kW (0.996 dB)

RF System/Other Losses:
0.00 kW (0.000 dB)

Total Losses:
-0.76 kW (0.996 dB)

Transmitter Power Output:
3.70 kW
(5.68 dBk)

Typical Mounting Configuration Shown. Actual Configuration May Vary.



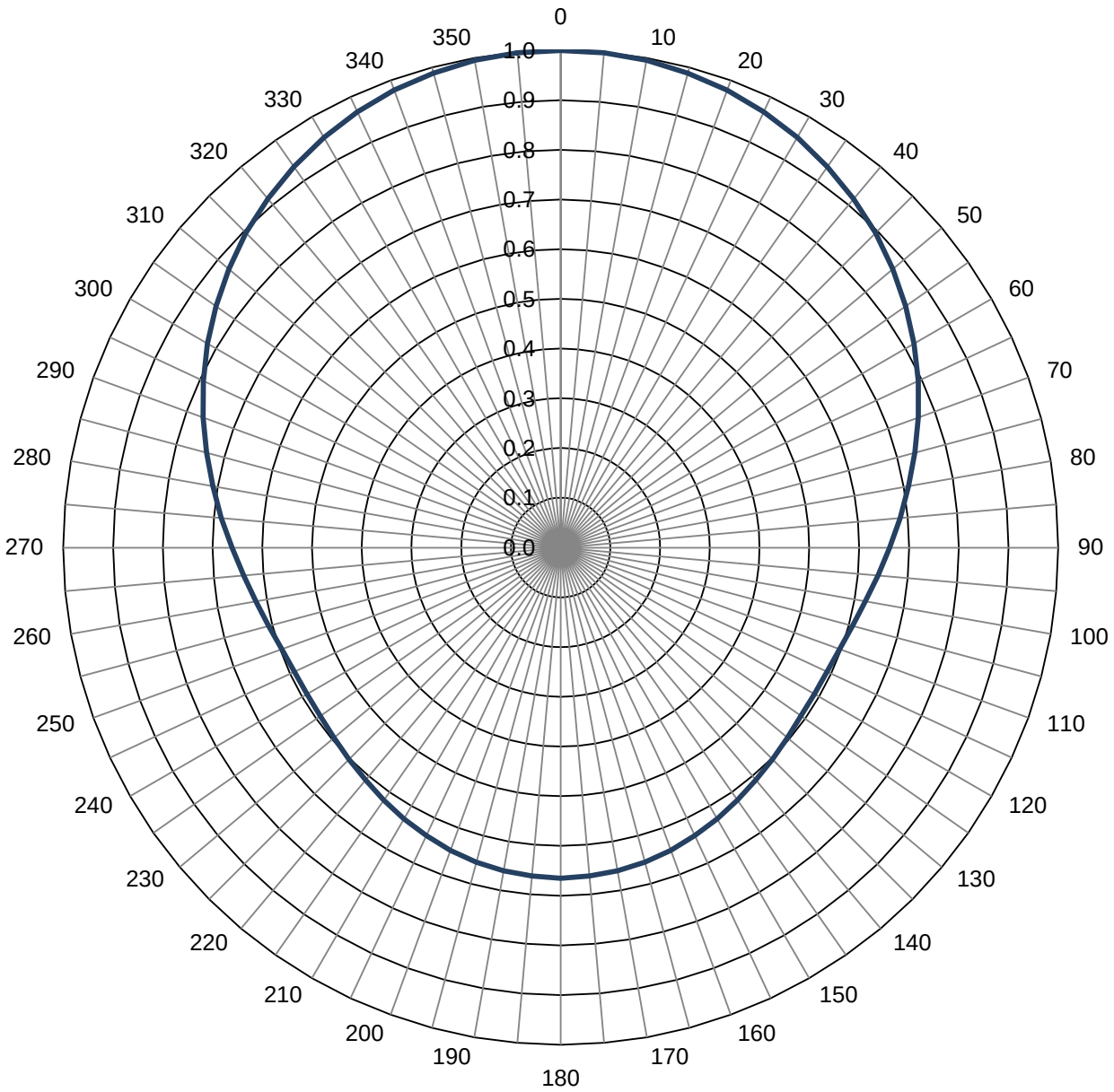
ALV Series VHF television antennas are shipped with 36-inch (914 mm) stand off brackets for mounting on poles or tower legs from 1.5-inches (35 mm) to 7.5-inches (191 mm) OD. Stand off support pipes, face mount brackets, and mounts for larger diameter poles are available from ERI as optional items. Please contact ERI for a proposal for these requirements.

Azimuth Pattern

Type:	ALV-9-OC		**Polarization:**	Horizontal
Directivity:	1.72 numeric	(2.36 dB)	**Channel:**	9 (ATSC)
Peak(s) at:			**Location:**	Huntington, WV

NOTE: Pattern shape and directivity may vary with channel and mounting configuration.

Relative Field



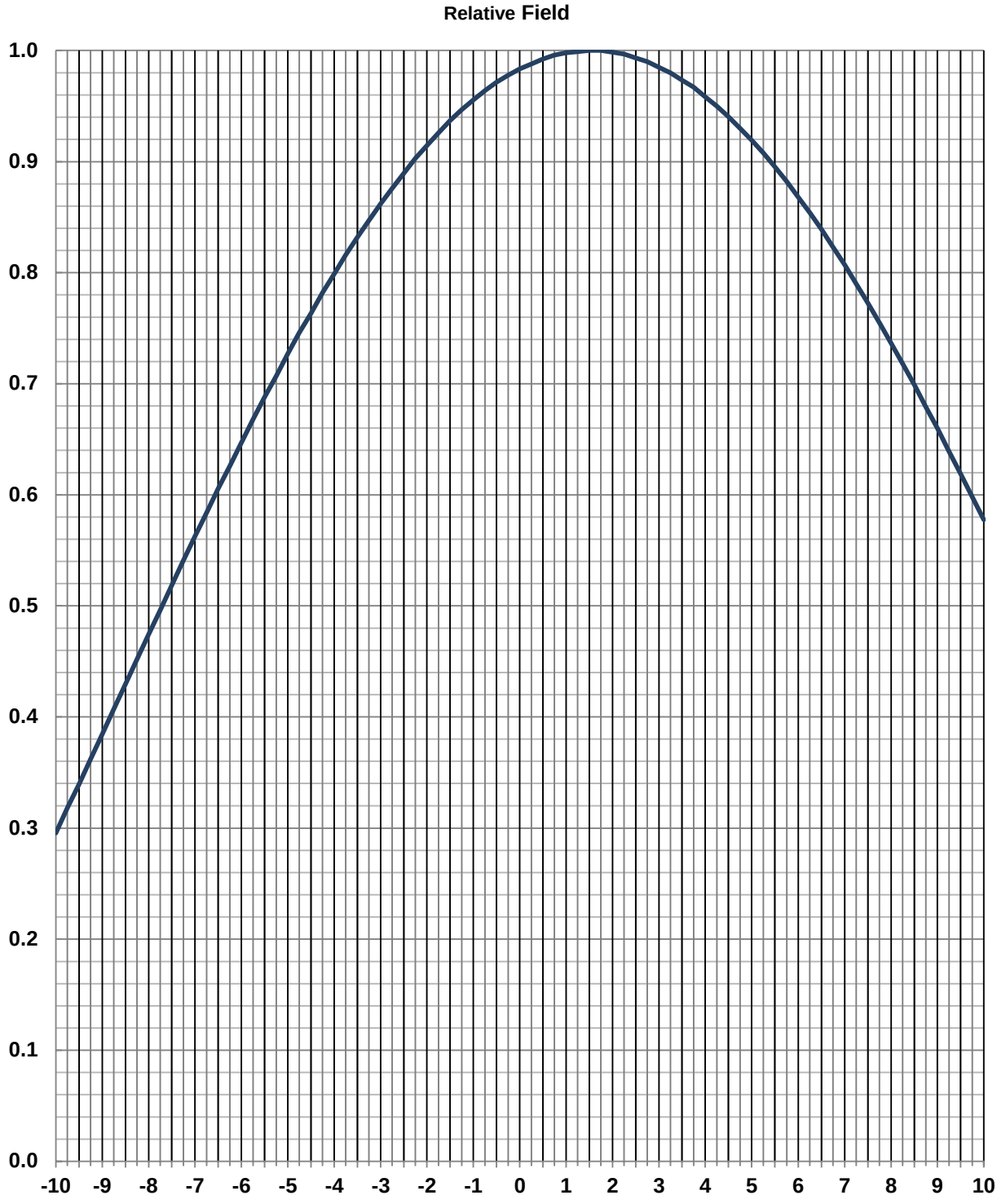
Tabulated Data for Azimuth Pattern

Type: ALV-9-OC

Angle	Field	dB
0	1.000	0.00
2	1.000	0.00
4	0.999	-0.01
6	0.998	-0.02
8	0.997	-0.03
10	0.995	-0.04
12	0.992	-0.07
14	0.989	-0.10
16	0.986	-0.12
18	0.983	-0.15
20	0.979	-0.18
22	0.974	-0.23
24	0.969	-0.27
26	0.964	-0.32
28	0.958	-0.37
30	0.952	-0.43
32	0.946	-0.48
34	0.939	-0.55
36	0.932	-0.61
38	0.924	-0.69
40	0.916	-0.76
42	0.908	-0.84
44	0.899	-0.92
46	0.890	-1.01
48	0.881	-1.10
50	0.871	-1.20
52	0.861	-1.30
54	0.851	-1.40
56	0.841	-1.50
58	0.831	-1.61
60	0.820	-1.72
62	0.809	-1.84
64	0.798	-1.96
66	0.787	-2.08
68	0.776	-2.20
70	0.765	-2.33
72	0.754	-2.45
74	0.743	-2.58
76	0.732	-2.71
78	0.721	-2.84
80	0.710	-2.97
82	0.700	-3.10
84	0.690	-3.22
86	0.680	-3.35
88	0.670	-3.48
90	0.661	-3.60
92	0.652	-3.72
94	0.644	-3.82
96	0.636	-3.93
98	0.629	-4.03
100	0.622	-4.12
102	0.616	-4.21
104	0.610	-4.29
106	0.605	-4.36
108	0.601	-4.42
110	0.597	-4.48
112	0.595	-4.51
114	0.592	-4.55
116	0.591	-4.57
118	0.589	-4.60
120	0.589	-4.60
122	0.589	-4.60
124	0.590	-4.58
126	0.591	-4.57
128	0.593	-4.54
130	0.595	-4.51
132	0.597	-4.48
134	0.600	-4.44
136	0.603	-4.39
138	0.607	-4.34
140	0.610	-4.29
142	0.614	-4.24
144	0.618	-4.18
146	0.622	-4.12
148	0.626	-4.07
150	0.630	-4.01
152	0.634	-3.96
154	0.637	-3.92
156	0.641	-3.86
158	0.644	-3.82
160	0.648	-3.77
162	0.651	-3.73
164	0.654	-3.69
166	0.656	-3.66
168	0.658	-3.64
170	0.660	-3.61
172	0.662	-3.58
174	0.663	-3.57
176	0.664	-3.56
178	0.664	-3.56
180	0.665	-3.54
182	0.664	-3.56
184	0.664	-3.56
186	0.663	-3.57
188	0.662	-3.58
190	0.660	-3.61
192	0.658	-3.64
194	0.656	-3.66
196	0.654	-3.69
198	0.651	-3.73
200	0.648	-3.77
202	0.644	-3.82
204	0.641	-3.86
206	0.637	-3.92
208	0.634	-3.96
210	0.630	-4.01
212	0.626	-4.07
214	0.622	-4.12
216	0.618	-4.18
218	0.614	-4.24
220	0.610	-4.29
222	0.607	-4.34
224	0.603	-4.39
226	0.600	-4.44
228	0.597	-4.48
230	0.595	-4.51
232	0.593	-4.54
234	0.591	-4.57
236	0.590	-4.58
238	0.589	-4.60
240	0.589	-4.60
242	0.589	-4.60
244	0.591	-4.57
246	0.592	-4.55
248	0.595	-4.51
250	0.597	-4.48
252	0.601	-4.42
254	0.605	-4.36
256	0.610	-4.29
258	0.616	-4.21
260	0.622	-4.12
262	0.629	-4.03
264	0.636	-3.93
266	0.644	-3.82
268	0.652	-3.72
270	0.661	-3.60
272	0.670	-3.48
274	0.680	-3.35
276	0.690	-3.22
278	0.700	-3.10
280	0.710	-2.97
282	0.721	-2.84
284	0.732	-2.71
286	0.743	-2.58
288	0.754	-2.45
290	0.765	-2.33
292	0.776	-2.20
294	0.787	-2.08
296	0.798	-1.96
298	0.809	-1.84
300	0.820	-1.72
302	0.831	-1.61
304	0.841	-1.50
306	0.851	-1.40
308	0.861	-1.30
310	0.871	-1.20
312	0.881	-1.10
314	0.890	-1.01
316	0.899	-0.92
318	0.908	-0.84
320	0.916	-0.76
322	0.924	-0.69
324	0.932	-0.61
326	0.939	-0.55
328	0.946	-0.48
330	0.952	-0.43
332	0.958	-0.37
334	0.964	-0.32
336	0.969	-0.27
338	0.974	-0.23
340	0.979	-0.18
342	0.983	-0.15
344	0.986	-0.12
346	0.989	-0.10
348	0.992	-0.07
350	0.995	-0.04
352	0.997	-0.03
354	0.998	-0.02
356	0.999	-0.01
358	1.000	0.00
360	1.000	0.00

Elevation Pattern

Type:	ALV4V7		**Polarization:**	Horizontal
Directivity:			**Channel:**	9 (ATSC)
Main Lobe:	4.32 numeric	(6.35 dB)	**Location:**	Huntington, WV
Horizontal:	4.18 numeric	(6.21 dB)	**Beam Tilt:**	1.75 degrees



Tabulated Data for Elevation Pattern

Type: ALV4V7

-10 to 10 degrees in 0.25 degree increments.
10 to 90 degrees in 0.50 degree increments.

Angle	Field	dB	Angle	Field	dB	Angle	Field	dB	Angle	Field	dB	Angle	Field	dB
-10.00	0.296	-10.59	2.25	0.997	-0.03	19.00	0.176	-15.11	43.50	0.185	-14.66	68.00	0.153	-16.31
-9.75	0.318	-9.95	2.50	0.994	-0.06	19.50	0.193	-14.31	44.00	0.185	-14.66	68.50	0.154	-16.25
-9.50	0.340	-9.38	2.75	0.990	-0.09	20.00	0.209	-13.62	44.50	0.185	-14.66	69.00	0.154	-16.25
-9.25	0.362	-8.83	3.00	0.985	-0.13	20.50	0.224	-13.01	45.00	0.184	-14.73	69.50	0.154	-16.25
-9.00	0.385	-8.30	3.25	0.980	-0.18	21.00	0.237	-12.52	45.50	0.182	-14.82	70.00	0.154	-16.25
-8.75	0.407	-7.81	3.50	0.974	-0.23	21.50	0.247	-12.15	46.00	0.179	-14.97	70.50	0.154	-16.25
-8.50	0.430	-7.34	3.75	0.967	-0.29	22.00	0.257	-11.82	46.50	0.175	-15.14	71.00	0.153	-16.31
-8.25	0.452	-6.90	4.00	0.959	-0.37	22.50	0.264	-11.58	47.00	0.171	-15.37	71.50	0.152	-16.36
-8.00	0.475	-6.48	4.25	0.950	-0.45	23.00	0.269	-11.42	47.50	0.166	-15.62	72.00	0.151	-16.42
-7.75	0.496	-6.09	4.50	0.941	-0.53	23.50	0.271	-11.34	48.00	0.161	-15.89	72.50	0.150	-16.51
-7.50	0.519	-5.71	4.75	0.930	-0.63	24.00	0.272	-11.31	48.50	0.155	-16.22	73.00	0.148	-16.59
-7.25	0.541	-5.34	5.00	0.920	-0.73	24.50	0.271	-11.36	49.00	0.149	-16.57	73.50	0.146	-16.71
-7.00	0.563	-5.00	5.25	0.908	-0.84	25.00	0.267	-11.47	49.50	0.142	-16.98	74.00	0.144	-16.86
-6.75	0.584	-4.67	5.50	0.896	-0.96	25.50	0.262	-11.65	50.00	0.135	-17.43	74.50	0.141	-17.02
-6.50	0.606	-4.36	5.75	0.882	-1.09	26.00	0.255	-11.87	50.50	0.128	-17.89	75.00	0.139	-17.17
-6.25	0.626	-4.07	6.00	0.868	-1.23	26.50	0.246	-12.18	51.00	0.121	-18.38	75.50	0.136	-17.36
-6.00	0.647	-3.78	6.25	0.854	-1.37	27.00	0.236	-12.54	51.50	0.114	-18.90	76.00	0.133	-17.56
-5.75	0.668	-3.50	6.50	0.839	-1.52	27.50	0.225	-12.96	52.00	0.107	-19.45	76.50	0.129	-17.79
-5.50	0.688	-3.25	6.75	0.823	-1.69	28.00	0.212	-13.47	52.50	0.100	-20.04	77.00	0.126	-18.03
-5.25	0.707	-3.01	7.00	0.807	-1.86	28.50	0.199	-14.04	53.00	0.094	-20.58	77.50	0.122	-18.31
-5.00	0.727	-2.77	7.25	0.790	-2.05	29.00	0.184	-14.73	53.50	0.088	-21.16	78.00	0.118	-18.56
-4.75	0.746	-2.55	7.50	0.773	-2.24	29.50	0.168	-15.52	54.00	0.083	-21.67	78.50	0.114	-18.86
-4.50	0.764	-2.34	7.75	0.755	-2.44	30.00	0.151	-16.45	54.50	0.079	-22.10	79.00	0.110	-19.21
-4.25	0.782	-2.14	8.00	0.737	-2.66	30.50	0.134	-17.49	55.00	0.075	-22.50	79.50	0.106	-19.53
-4.00	0.799	-1.95	8.25	0.718	-2.88	31.00	0.116	-18.71	55.50	0.073	-22.73	80.00	0.102	-19.87
-3.75	0.816	-1.77	8.50	0.699	-3.11	31.50	0.098	-20.18	56.00	0.072	-22.85	80.50	0.097	-20.31
-3.50	0.832	-1.60	8.75	0.679	-3.36	32.00	0.080	-21.94	56.50	0.073	-22.79	81.00	0.093	-20.68
-3.25	0.847	-1.44	9.00	0.660	-3.61	32.50	0.062	-24.15	57.00	0.074	-22.62	81.50	0.088	-21.16
-3.00	0.862	-1.29	9.25	0.639	-3.89	33.00	0.044	-27.13	57.50	0.077	-22.33	82.00	0.083	-21.67
-2.75	0.876	-1.15	9.50	0.619	-4.17	33.50	0.027	-31.54	58.00	0.080	-21.94	82.50	0.078	-22.21
-2.50	0.890	-1.02	9.75	0.598	-4.47	34.00	0.011	-39.58	58.50	0.084	-21.57	83.00	0.073	-22.79
-2.25	0.903	-0.89	10.00	0.578	-4.77	34.50	0.013	-38.06	59.00	0.089	-21.06	83.50	0.068	-23.41
-2.00	0.915	-0.78	10.50	0.535	-5.43	35.00	0.028	-31.21	59.50	0.094	-20.58	84.00	0.063	-24.08
-1.75	0.926	-0.67	11.00	0.493	-6.15	35.50	0.044	-27.23	60.00	0.098	-20.22	84.50	0.058	-24.81
-1.50	0.937	-0.57	11.50	0.450	-6.95	36.00	0.060	-24.51	60.50	0.103	-19.79	85.00	0.052	-25.76
-1.25	0.947	-0.47	12.00	0.407	-7.81	36.50	0.074	-22.62	61.00	0.108	-19.37	85.50	0.047	-26.65
-1.00	0.956	-0.40	12.50	0.365	-8.75	37.00	0.089	-21.06	61.50	0.113	-18.98	86.00	0.042	-27.64
-0.75	0.964	-0.32	13.00	0.324	-9.79	37.50	0.102	-19.87	62.00	0.118	-18.60	86.50	0.036	-29.00
-0.50	0.972	-0.25	13.50	0.284	-10.93	38.00	0.114	-18.86	62.50	0.122	-18.31	87.00	0.031	-30.31
-0.25	0.978	-0.19	14.00	0.246	-12.18	38.50	0.125	-18.06	63.00	0.127	-17.96	87.50	0.025	-32.22
0.00	0.984	-0.14	14.50	0.211	-13.51	39.00	0.136	-17.33	63.50	0.131	-17.69	88.00	0.020	-34.20
0.25	0.988	-0.10	15.00	0.179	-14.94	39.50	0.145	-16.77	64.00	0.134	-17.46	88.50	0.014	-37.39
0.50	0.993	-0.07	15.50	0.153	-16.33	40.00	0.154	-16.25	64.50	0.138	-17.23	89.00	0.009	-41.41
0.75	0.996	-0.03	16.00	0.134	-17.49	40.50	0.162	-15.84	65.00	0.141	-17.05	89.50	0.003	-52.04
1.00	0.998	-0.02	16.50	0.123	-18.24	41.00	0.168	-15.52	65.50	0.144	-16.86	90.00	0.116	-18.71
1.25	0.999	-0.01	17.00	0.122	-18.31	41.50	0.174	-15.21	66.00	0.146	-16.71			
1.50	1.000	0.00	17.50	0.129	-17.79	42.00	0.178	-15.02	66.50	0.148	-16.59			
1.75	1.000	0.00	18.00	0.143	-16.92	42.50	0.181	-14.85	67.00	0.150	-16.48			
2.00	0.999	-0.01	18.50	0.158	-16.03	43.00	0.184	-14.73	67.50	0.152	-16.39			

Product Information for Transmission, Transmission Line Accessories, and Other Items

HJ8-50B 3-inch Air HELIAX

HJ8-50B

HJ8-50B, HELIAX® Standard Air Dielectric Coaxial Cable, corrugated copper, 3 in, black PE jacket

Product Classification

Brand	HELIAX®
Product Series	HJ8-50B
Product Type	Air coaxial cable

Construction Materials

Jacket Material	PE
Dielectric Material	PP
Flexibility	Standard
Inner Conductor Material	Copper tube
Jacket Color	Black
Outer Conductor Material	Corrugated copper

Dimensions

Nominal Size	3 in
Cable Volume	36.7 ft^3/kft
Cable Weight	1.78 lb/ft
Diameter Over Jacket	76.454 mm | 3.010 in
Inner Conductor OD	28.9560 mm | 1.1400 in
Outer Conductor OD	72.390 mm | 2.850 in

Electrical Specifications

Cable Impedance	50 ohm ±0.5 ohm
Capacitance	71.2 pF/m | 21.7 pF/ft
dc Resistance, Inner Conductor	0.150 ohms/kft
dc Resistance, Outer Conductor	0.070 ohms/kft
dc Test Voltage	16000 V
Inductance	1.870 µH/m | 0.570 µH/ft
Insulation Resistance	100000 Mohms•km
Jacket Spark Test Voltage (rms)	10000 V
Operating Frequency Band	1 – 1640 MHz
Peak Power	640.0 kW
Power Attenuation	5.997
Velocity	93 %

HJ8-50B

Environmental Specifications

Installation Temperature	-40 °C to +60 °C (-40 °F to +140 °F)
Operating Temperature	-40 °C to +85 °C (-40 °F to +185 °F)
Storage Temperature	-70 °C to +85 °C (-94 °F to +185 °F)

Mechanical Specifications

Bending Moment	40.7 N-m | 30.0 ft lb
Flat Plate Crush Strength	175.0 lb/in
Minimum Bend Radius, Multiple Bends	762.00 mm | 30.00 in
Number of Bends, minimum	15
Number of Bends, typical	25
Pressurization, maximum	0 N/mm^2 | 30 psi
Tensile Strength	340 kg | 750 lb

Note

Performance Note	Values typical, unless otherwise stated

Standard Conditions

Attenuation, Ambient Temperature	20 °C | 68 °F
Average Power, Ambient Temperature	40 °C | 104 °F
Average Power, Inner Conductor Temperature	121 °C | 250 °F

HJ8-50B

Peak Power	640 kW
Power Attenuation	5.997
Velocity	93 %

Attenuation

Frequency (MHz)	Attenuation (dB/100 m)	Attenuation (dB/100 ft)	Average Power (kW)
1.0	0.041	0.013	475.58
1.5	0.051	0.015	387.14
2.0	0.059	0.018	334.42
10.0	0.135	0.041	146.13
20.0	0.194	0.059	101.59
30.0	0.24	0.073	81.89
50.0	0.316	0.096	62.17
85.0	0.424	0.129	46.44
88.0	0.432	0.132	45.55
100.0	0.464	0.141	42.41
108.0	0.484	0.148	40.62
150.0	0.584	0.178	33.72
174.0	0.635	0.194	30.97
200.0	0.689	0.21	28.57
204.0	0.697	0.212	28.24
300.0	0.874	0.266	22.51
400.0	1.039	0.317	18.93
450.0	1.117	0.34	17.62
460.0	1.132	0.345	17.38
500.0	1.191	0.363	16.52
512.0	1.209	0.368	16.28
600.0	1.334	0.407	14.75
700.0	1.47	0.448	13.38
800.0	1.6	0.488	12.29
824.0	1.631	0.497	12.06
894.0	1.719	0.524	11.45
960.0	1.8	0.549	10.93
1000.0	1.848	0.563	10.65
1218.0	2.103	0.641	9.35
1250.0	2.14	0.652	9.2

HJ8FB-302-S 3-1/8-inch Air HELIAX Connector

H8FB-302-S

3-1/8 in EIA Female Flange with gas barrier for 3 in HJ8-50B air dielectric cable. Coupling Element, O-Ring, screw-set sold separately. Click-on: Related Products, Device connectors and Adapters

Product Classification

Brand	HELIAX®
Product Type	Air coaxial connector

General Specifications

Interface	3-1/8 in EIA Female Flange
Body Style	Straight
Gas Barrier	Yes
Mounting Angle	Straight
Ordering Note	Gas pass version can be created by drilling out the PTFE dielectric | Male version can be created ordering an appropriate coupling element separately | When ordering factory assembled transmission lines gas pass/barrier option can be fitted

Electrical Specifications

Connector Impedance	50 ohm
Operating Frequency Band	0 – 1640 MHz
Average Power at Frequency	10.9 kW @ 960 MHz
Cable Impedance	50 ohm
RF Operating Voltage, maximum (vrms)	5656.00 V
dc Test Voltage	16 kV
Insulation Resistance, minimum	5000 MOhm
Peak Power, maximum	640.00 kW
Insertion Loss, typical	0.05 dB

Mechanical Specifications

Outer Contact Attachment Method	Tab-flare
Inner Contact Attachment Method	Thread-in stub
Outer Contact Plating	Silver
Inner Contact Plating	Silver

H8FB-302-S

Dimensions

Nominal Size	3 in
Diameter	135.38 mm | 5.33 in
Length	163.07 mm | 6.42 in
Weight	5.50 kg | 12.13 lb

Environmental Specifications

Operating Temperature	-40 °C to +85 °C (-40 °F to +185 °F)
Storage Temperature	-70 °C to +85 °C (-94 °F to +185 °F)

Return Loss/VSWR

Frequency Band	VSWR	Return Loss (dB)
0–960 MHz	1.02	40.09
960–1640 MHz	1.04	34.15

Regulatory Compliance/Certifications

Agency	Classification
ISO 9001:2015	Designed, manufactured and/or distributed under this quality management system

BN-918710 3-1/8-inch EIA Coupling Element and Hardware Kit

BN-918710

3-1/8 EIA Coupling Element, O-Ring, screw-set

Product Classification

Product Type	Coupling element

General Specifications

Interface	3-1/8 in EIA Flange
Includes	O-rings | Screw set

Electrical Specifications

Connector Impedance	50 ohm
Operating Frequency Band	1 – 5200 MHz

Mechanical Specifications

Inner Contact Plating	Silver

Dimensions

Height	81.30 mm | 3.20 in
Length	101.10 mm | 3.98 in
Weight	0.50 kg | 1.10 lb
Width	81.30 mm | 3.20 in

Standard Conditions

Attenuation, Ambient Temperature	20 °C | 68 °F
Average Power, Ambient Temperature	20 °C | 68 °F
Average Power, Inner Conductor Temperature	100 °C | 212 °F

Regulatory Compliance/Certifications

Agency	**Classification**
RoHS 2011/65/EU	
ISO 9001:2015	Designed, manufactured and/or distributed under this quality management system

26985A 3-1/8-inch Air HELIAX Hoisting Grip

Lace-up Hoisting Grip for 3 in coaxial cable and elliptical waveguide 28 and 34

Product Classification

Product Type	Hoisting grip

Dimensions

Nominal Size	3 in
Grip Length, minimum	762.00 mm | 30.00 in
Leader Length, minimum	457.20 mm | 18.00 in
Waveguide Size	WR229 | WG11 | R40

Electrical Specifications

DTF Effect	0.1 dB
Return Loss Effect	0.1 dB

General Specifications

Hoisting Grip Type	Lace-up hoisting grip
Attachment Spacing Intervals	61 m | 200 ft
Cable Type	Corrugated | Elliptical waveguide
Material Type	Tin-coated bronze
Ordering Note	CommScope® non-standard product
Package Quantity	1
Support Clamp	Not included
Tool Type	Hoisting grip

Mechanical Specifications

Pull Load Capacity	500 lb

Packed Dimensions

Shipping Weight	1.43 kg | 3.15 lb

Regulatory Compliance/Certifications

Agency	**Classification**
ISO 9001:2015	Designed, manufactured and/or distributed under this quality management system

HGK0001 Hoisting Grip Hoisting Grip Hanger Kit

Part Number	Description
HGK0001	Hoisting grip hanger kit to attach HELIAX hoisting grips to tower. Includes 18-inches of chain, 12-inch x 12-inch turnbuckle and two shackles. One required for each hoisting grip and one hoisting grip required for each 200-feet (60-meters) of vertical run.
II-HGK-0001	Installation Instructions

223700-724 Standard Grounding Kit for 3-inch Air HELIAX

Standard Grounding Kit for 2-1/4 in and 3 in corrugated coaxial cable and elliptical waveguide 28 and 37

Product Classification

Product Type	Grounding kit

Dimensions

Nominal Size	2-1/4 in | 3 in
Waveguide Size	WR229 | WG11 | R40 | WR284 | WG10 | R32
Bonding Conductor Length	1524.0 mm | 60 in
Cable Jacketing Removal Length, maximum	59.1 mm | 2.3 in
Cable Jacketing Removal Length, minimum	55.9 mm | 2.2 in
Compatible Diameter, maximum	78.740 mm | 3.100 in
Compatible Diameter, minimum	58.674 mm | 2.310 in

Electrical Specifications

Current Handling	Tested to withstand 100,000 amps peak current surge
Current Handling Test Method	MIL-STD-1757
Grounding, Bonding and Shielding Test Method	MIL-STD-188-124A
Lightning Protection Test Method	IEC 1024-1

Environmental Specifications

Operating Temperature	-40 °C to +85 °C (-40 °F to +185 °F)
Storage Temperature	-40 °C to +80 °C (-40 °F to +176 °F)
Weatherproofing Method	Butyl and electric tape

General Specifications

Grounding Kit Type	Standard Grounding Kits
Cable Type	Corrugated | Elliptical waveguide
Ordering Note	CommScope® non-standard product
Color	Black
Bonding Conductor Material	Copper
Bonding Conductor Wire Size	6 gauge
Bonding Conductor Jacketing Material	PVC
Grounding Strap Material	Copper

223700-724

Includes	Grounding kit | Hardware | Lug | One roll of 2 in PVC tape | One roll of 24 in butyl rubber tape
Lug Attachment	Field attached
Lug Type	Two-hole lug
Package Quantity	1
Rivet Material	Copper

Mechanical Specifications

Blowing Rain Test Method	MIL-STD-810, Method 506
Corrosion Test Method	MIL-STD-1344, Method 1001
Freezing Rain/Icing Test Method	MIL-STD-810, Method 521
Humidity Test Method	MIL-STD-1344, Method 1002
Immersion Test Method	IEC 60529:2001, IP68
Thread Size	3/8 in
UV Resistance Test Method	MIL-STD-810, Method 505
Vibration Test Method	MIL-STD-202, Method 214

Packed Dimensions

Height	269.7 mm | 10.6 in
Length	177.8 mm | 7.0 in
Shipping Weight	0.92 kg | 2.03 lb
Width	57.2 mm | 2.3 in

Regulatory Compliance/Certifications

Agency	Classification
ISO 9001:2015	Designed, manufactured and/or distributed under this quality management system

Included Products

9905-71 — Black 2 in PVC Tape, 20 ft

42615-10 — Butyl Rubber Tape, 24 in

* Footnotes

Grounding, Bonding and Shielding Test Method	Military Standard for Grounding, Bonding, and Shielding: Bond Resistance Requirement of a Maximum dc resistance of 0.001 ohm
Lightning Protection Test Method	Protection Against Lightning Electromagnetic Impulse, Table 1—Protection Level

31766A-11 3-inch Butterfly Hanger Kit

31766A-11

Butterfly Hanger for 3 in coaxial cable and elliptical waveguide 28

Product Classification

Product Type	Hanger kit

Dimensions

Nominal Size	3 in
Compatible Diameter, maximum	81.280 mm | 3.200 in
Compatible Diameter, minimum	76.200 mm | 3.000 in
Height	41.91 mm | 1.65 in
Length	63.50 mm | 2.50 in
Waveguide Size	WR284 | WG10 | R32
Width	38.10 mm | 1.50 in

Electrical Specifications

DTF Effect	0.1 dB
Return Loss Effect	0.1 dB

Environmental Specifications

Operating Temperature	-40 °C to +85 °C (-40 °F to +185 °F)

General Specifications

Hanger Type	Standard butterfly hanger
Cable Type	Corrugated | Elliptical waveguide
Cables per Hanger	1
Color	Silver
Material Type	Stainless steel
Ordering Note	CommScope® non-standard product
Package Quantity	10

Mechanical Specifications

Corrosion Resistance, minimum with no degredation	≥500 hours in salt spray chamber

31766A-11

Mounting	3/8 in (M10) drilled cable ladder
Vibration Survival	≥4 hours at resonant frequency
Environmental Strength Capability	Double cable weight

Packed Dimensions

Height	26.0 cm | 10.2 in
Length	9.0 cm | 3.5 in
Shipping Weight	1.67 kg | 3.68 lb
Width	9.0 cm | 3.5 in

Regulatory Compliance/Certifications

Agency	Classification
ISO 9001:2015	Designed, manufactured and/or distributed under this quality management system

40394-2 Single Entrance Panel for 3-inch Coaxial Cable

40394-2

Single Entrance Panel for 3 in coaxial cable

Product Classification

Product Type	Entrance panel

Dimensions

Height	177.80 mm | 7.00 in
Nominal Size	3 in
Width	76.20 mm | 3.00 in

General Specifications

Number of Ports	1
Panel Type	Single
Color	Gray
Entry Panel Port Size	162.6 mm | 6.4 in
Includes	Boot | Clamp | Plate
Material Type	Aluminum
Ordering Note	CommScope® non-standard product
Package Quantity	1

Mechanical Specifications

Weather Resistance Test Method	04AS00-03.9.0 | IEC 60529:2001, IP66

Packed Dimensions

Height	304.8 mm | 12.0 in
Length	304.8 mm | 12.0 in
Shipping Weight	2.53 kg | 5.58 lb
Width	76.2 mm | 3.0 in

Regulatory Compliance/Certifications

Agency	**Classification**
ISO 9001:2015	Designed, manufactured and/or distributed under this quality management system

31769-5 Hardware Kit for Standard Hangers

31769-5

Hardware Kit for Standard Hangers, includes 3/8 in hex head bolts and hardware

Product Classification

Product Type	Hardware kit
Ordering Note	CommScope® non-standard product

General Specifications

Thread Size	3/8 in

Dimensions

Maximum Stack Height	1
Length	19.05 mm | 0.75 in

Packaging and Weights

Height, packed	149.86 mm | 5.9 in
Width, packed	50.8 mm | 2 in
Length, packed	50.8 mm | 2 in
Included	Hex nuts | Hex screws | Lock washers
Packaging quantity	10
Weight, gross	0.29 kg | 0.64 lb

Regulatory Compliance/Certifications

Agency	**Classification**
CHINA-ROHS	Below maximum concentration value
ISO 9001:2015	Designed, manufactured and/or distributed under this quality management system
REACH-SVHC	Compliant as per SVHC revision on www.commscope.com/ProductCompliance
ROHS	Compliant

Electronics Research, Inc. Company Profile

Primary Business and Services

Electronics Research, Inc. is a company focused on serving the needs of the terrestrial radio and television broadcasters with antennas, transmission line, RF components, and structural products. The company is focused on providing high quality and sophisticated engineering solutions to customer problems. ERI Products and Services include:

- UHF and VHF Television Broadcast Antennas
- Single and Multi-Station FM Broadcast Antennas
- Television and FM Broadcast Filters and Combiners
- Rigid Coaxial Transmission Line
- Rectangular and Circular Waveguide
- Broadcast Master Distributor for CommScope HELIAX®[3] products and accessories
- Structural products:
    - Guyed towers
    - Self-supporting towers
    - Antenna support poles
    - Specialty structures
    - Lambda™ Antenna Mounting System
    - Grounding and lightning protection products
    - Gin Poles
- Structural services:
    - Site inspection services
    - Tower installation
    - Tower rescue services
    - Structural analysis services
    - Engineering field support
    - Antenna test range facilities
    - Tower field service
    - Tower reinforcement design and installation services

ERI's Headquarters and Manufacturing Facility.

[3] HELIAX® is registered trademark of CommScope.

History and Qualifications

Electronics Research, Inc. (ERI) is a company that has provided state-of-the-art telecommunications and broadcast products since 1943. ERI's products and services include television and FM antennas; RF filters and combiners; self-supporting and guyed towers; grounding and lightning protection products; installation, maintenance, structural analysis and inspection services; rigid coaxial transmission line and UHF waveguide transmission line systems. ERI is also the Broadcast Master Distributor for CommScope HELIAX®, HELIAX accessories, pressurization products, and terrestrial microwave products.

ERI is the originator of many of the commonly used technologies for FM transmission today, including internally fed circularly polarized FM antennas, and temperature compensated RF filters. The company produces a broad array of single station and broadband FM antenna designs provide superior reliability and performance for any reasonable application. ERI also manufactures a wide array of filter products that can be configured to eliminate undesirable intermodulation products and are used as combining systems for master FM antennas.

In November 2003, ERI completed the acquisition of selected assets that comprised Andrew Corporation's (now CommScope) television broadcast antenna business. The acquisition included Andrew's MACXLine and GUIDELine transmission line products and the company's complete line of television transmitting antennas and Andrew's television filter and RF components business which includes waveguide and coaxial switches, patch panels, directional couplers, and the other components required to produce a wide array of filter and combiner system for broadcast and scientific applications. In addition, to purchasing these assets ERI also entered into an agreement to serve as a CommScope Master Distributor of HELIAX products and accessories to the broadcast market.

ERI has 180 employees, including two (2) registered professional engineers. ERI's corporate headquarters and main manufacturing facility is located in Chandler, Indiana. Our Midwest location provides the benefit of the most convenient, cost effective, product transportation to any part of North America. The ERI facility is located on 100 acres and includes a total of more than 250,000 square feet of indoor manufacturing space. Near the main factory complex is ERI's 50-acre test range, capable of full-scale antenna/tower pattern measurements. The company has decades of research and experience at full scale testing and the company's unique blend of individual educated and trained in antenna and structural design result in systems that offer superior performance and reliability. The test range is equipped with the latest in computerized test equipment and also has the latest computer software to measure and predict antenna performance and coverage.

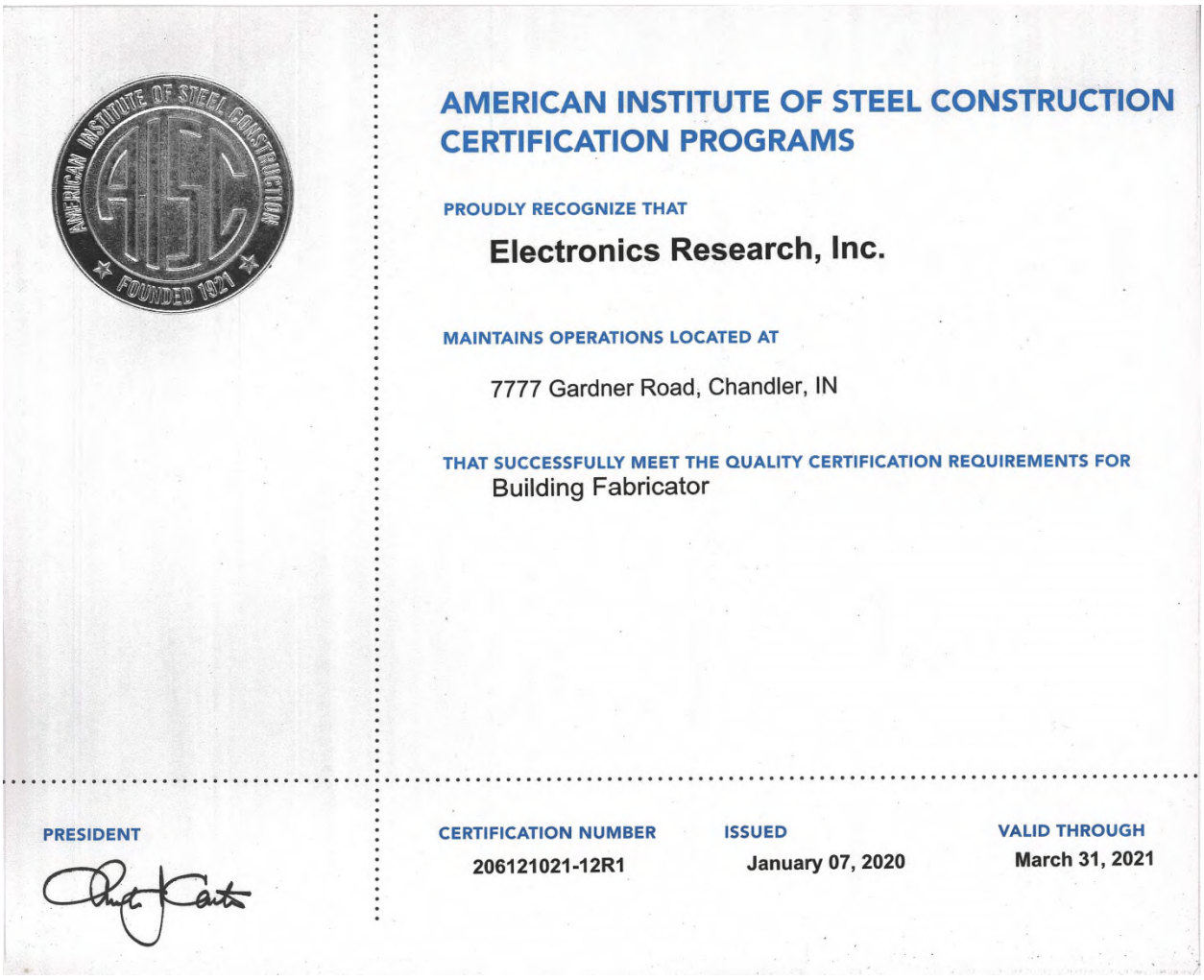
The company has decades of research and experience at full scale testing and the company's unique blend of individuals educated and trained in antenna and structural design result in systems that offer superior performance and reliability. The test range is equipped with the latest in computerized test equipment and also has the latest computer software to measure and predict antenna performance and coverage. The company takes full advantage of innovative technology, which includes the latest computer modeling, design, and drafting tools; as well as the latest computer-controlled machining and milling equipment. ERI's main manufacturing facility also includes an advanced acid cleaning facility and an in-house silver-plating operation. This high degree of vertical integration allows control of product quality at every step during fabrication and final assembly.

ERI began manufacturing towers and providing structural analysis services in 1990. We manufacture guyed and self-supporting towers. ERI also has registered structural engineers on staff to provide structural analysis and reinforcement design services to tower owners. ERI has manufactured and installed towers ranging in height from less than 100-feet to 2000-feet. The structural division of ERI also provides a complete line of grounding and lightning protection products.

Electronics Research, Inc. is officially certified under the Steel Building Standard of the American Institute of Steel Construction (AISC). This designation reaffirms ERI's dedication to the quality-control process and our on-going effort to ensure our customers receive the highest quality structural systems.

The company maintains two fulltime tower crews each with a full set of equipment, trucks, and winches. All tower crews undergo rigorous safety training and the company's training regime is considered one of the industry's best. The company also maintains a separate crew that focuses and tower inspections. The company is compliant with all current OSHA regulations, maintains liability and workmen's compensation insurance at or above minimum requirement levels and can provide performance and payment bonds, for specific projects if required.

ERI has continuously served the broadcast industry with a dedicated team of engineering professionals, supported by experienced and meticulous craftsman for product fabrication and dedicated project management to insure on time and on budget project delivery, installation, and commissioning.



ERI's current AISC certification

ERI Equipment Proposal

Submitted to:

Depart of Administration, Purchasing Division
State of West Virginia
2019 Washington Street East
Charleston, WV 25305-0130

Attn: Dusty Jo Smith

by:

Electronics Research, Inc.

Bill Harland
Vice President of Marketing

Phone: +1 (812) 925-6000, Ext. 214

bharland@eriinc.com

This document includes pages 127 of 142 and is governed by the terms and conditions contained on pages 135 through 142. Upon customer acceptance, order is subject to final review and written acceptance by ERI at our main business office. Unless otherwise stated in the body of this quotation, freight charges are not included and will be added to the final invoice. Also, unless listed separately in the body of this quotation, prices do not include any state, local, or other taxes or duties.

Proposal Number: 20200723-068

Date: August 11, 2020
Valid Through: October 1, 2020
FOB Destination
Reference: CRFQ 0439 EBA2100000002 WVPB-TV High Power VHF Antenna and Transmission Line

Payment Terms: Net 30 days, as invoiced.

Please **complete** the Purchaser's Acceptance block, **scan** this document along with your deposit check and **e-mail** to: ahand@eriinc.com or **FAX** to: 812-925-4030. Please **remit** down payment to the address below, attn: Accounts Receivable.

Purchaser's Acceptance:

Please accept our order for the products and services contained in this proposal.

Signature:_____

Name:_____

Title:_____

P.O. Number:_____

Item	Qty	Part #	Description	Unit Price	Extended
			Main Antenna and Transmission Line		
001	1	ATW6V5-ETP-9H	Top Mounted Elliptically Polarized High Band VHF TRASAR® Television Transmitting Antenna ERI Model ATW6V5-ETP-9H top mounted, elliptically polarized High Band VHF TRASAR® television antenna for RF Channel 9 (186 to 192 MHz). Rated for 20 kW Average Power, 8VSB input power. 3-1/8-inch EIA, 50 Ω, flanged male RF input. Described in ERI Preliminary Specification _____ dated _____. Price does not include tower top plate interface or "wedding cake" pedestal. A "wedding cake" pedestal will be required to interface the antenna to the existing tower. Note(s): 1. Fill in final approved specification number and date. Submit specification selection with ERI's signed Proposal.	129,010.00	129,010.00
002	59	MACX350A-1	3-1/8-inch, 50 ohm, 20 foot MACXLine section, flanged both ends, supplied with bellows, captivated inner connector, and flange hardware kit, with O ring. Price shown is **per line section** Vertical Run: 1081 (feet) Horizontal Run: 100 (feet)	1,350.00	79,650.00
003	4	MACX350A-5	3-1/8-inch, 50 ohm, customer specified length, up to 60-inches, MACXLine section, flanged both ends, supplied with inner connector, and flange hardware kit. Specify flange to flange length of outer conductor in inches (two decimal places): _____ inches.	630.00	2,520.00
004	1	MACX350A-10	3-1/8-inch, 50 ohm, customer specified length, from 60-inches to 120-inches, MACXLine section, flanged both ends, supplied with bellows, captivated inner connector, and flange hardware kit. Specify flange to flange length of outer conductor in inches (two decimal places): _____ inches.	810.00	810.00
005	7	ACX350-10SE	3-1/8-inch, 50 ohm, 90 degree miter elbow, captivated inner conductor, includes inner connector, 'O' ring, silicone grease, and flange hardware kit. Not reinforced.	710.00	4,970.00
006	2	ACX350-20	3-1/8-inch, 50 ohm standard inner connector.	98.00	196.00
007	1	RLA350-16	3-1/8-inch, 50 ohm, heavy duty gas barrier, both sides have a pressure port, fixed male inner connectors both ends.	560.00	560.00

Item	Qty	Part #	Description	Unit Price	Extended
008	4	RLA300-13-2	3-1/8-inch Vertical Rigid Hanger. Use at tower top minimum of two required for up to 500 feet of vertical line. Mounting hardware included: 1/2-inch diameter hardware for mounting to 9/16 inch diameter hole. Two (2) hangers, mounted 10-feet (3.0 meters) apart will support a 500-foot vertical run of 3-1/8-inch rigid line. Add one (1) hanger for each additional 500-feet of vertical run length. Price shown is for one piece. Stainless steel.	130.00	520.00
009	52	RLA300A-11-H	3-1/8 inch hinged Vertical Spring Hanger, supports the transmission line, prevents lateral motion, and accommodates differential expansion and contraction. Use one Vertical Spring Hanger and one RLA300-19 Vertical Sliding Hanger per line section. Hinged to open from left or right side to save installation labor. Includes 1/2-inch mounting hardware.	170.00	8,840.00
010	52	RLA300-19	3-1/8 inch hinged Vertical Sliding Hanger, supports the transmission line, prevents lateral motion, and accommodates differential expansion and contraction. Use one per line section for each line section supported by a vertical spring hanger and for third, fourth, and fifth line sections at the base of the vertical run. Hinged to open from left or right side to save installation labor. Includes 5/8-inch mounting hardware.	100.00	5,200.00
011	2	RLA000-01VLB	Rigid transmission line vertical lateral brace for 3-1/8, 4-1/16, 6-1/8, 7-3/16 and 8-3/16-inch rigid transmission lines, restricts lateral motion while allowing vertical and horizontal line movement. Use two (2) braces at bottom of vertical run, equally spaced above the elbow at the base of the vertical run and the lowest vertical sliding hanger or vertical spring hanger. Includes 1/2-inch mounting hardware.	375.00	750.00
012	5	RLA000-01HLB	Rigid transmission line horizontal lateral brace for 3-1/8, 4-1/16, 6-1/8, 7-3/16 and 8-3/16-inch rigid transmission lines, restricts lateral motion while allowing vertical and horizontal line movement. Use at 240-inch intervals along the horizontal run. Includes 1/2-inch mounting hardware.	395.00	1,975.00
013	110	RLA001-00KIT	Universal Rigid Line Bracket for 3-1/8-inch, 4-1/16-inch, 6-1/8-inch, 7-3/16-inch, 8-3/16-inch, and 9-3/16-inch rigid transmission lines. Includes 5/8-inch hardware to attach to drilled or punched horizontal angle members.	41.00	4,510.00

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Item	Qty	Part #	Description	Unit Price	Extended
014	3	RLA000-01VSCU	Horizontal Spring Hanger for RLA000-01ALL creates a single point horizontal spring hanger for copper outer conductor 3-1/8, 4-1/16, 6-1/8, 7-3/16 and 8-3/16-inch rigid transmission lines. Use with RLA000-01HLB to restrict lateral motion or add two (2) RLA000-01HS Horizontal Side Springs.	92.00	276.00
015	7	RLA000-01THRD	Horizontal Rigid Hanger for RLA000-01ALL creates a single point horizontal rigid hanger for 3-1/8, 4-1/16, 6-1/8, 7-3/16 and 8-3/16-inch rigid transmission lines. Use with RLA000-01HLB to restrict lateral motion or add a second RLA000-01THRD to create a two-point horizontal rigid hanger.	65.00	455.00
016	9	RLA000-01ALL	Rigid transmission line horizontal hanger bracket assembly for 3-1/8, 4-1/16, 6-1/8, 7-3/16 and 8-3/16-inch rigid transmission lines.	95.00	855.00
017	1	RLA300-15A	3-1/8-inch Wall Feed Thru, includes split mounting plate. Aluminum with EPDM weatherproofing sponge with backing. Uses 3/8-inch mounting hardware (not supplied).	150.00	150.00
018	2	RLA300-21	3-1/8-inch hardware kit, includes 'O' ring, silicone lubricant, nuts, bolts, and lock washers for one flange joint.	22.00	44.00
019	2	RLA300A-50	3-1/8-inch end cap to seal line.	290.00	580.00
020	3	STD350-FTV	3-1/8-inch, 50 ohm, High Band VHF fine matcher, flanged both ends. Includes one captive inner connector, O ring, and flange hardware kit. 5 tuners. Can be pressurized for outside use. 48-inches flange to flange. Tuners including locking nuts and pressure tight caps. Does not include mounting brackets or hardware. These are available from ERI at additional cost.	3,490.00	10,470.00
021	1	TST-001	TV System Sweep (Tune and Test) One (1) ERI Technician to field match television antenna after installation. Price includes travel, local living expense, and daily field service rate for one (1) day on site. ERI field service price includes a single (per project) mobilization and indicated number of days on site, for one person. Additional days if required will be charged for at the rate of $2,150.00 per day. Price includes test equipment usage. Field service prices are net to ERI and not discountable. Customer to provide tower crew to assist antenna field matching.	6,250.00	6,250.00

Item	Qty	Part #	Description	Unit Price	Extended
			Price valid for the location within the contiguous forty-eight (48) United States only. Contact ERI for pricing in other locations.		
022	1	Interface	Tower Interface Stub to Interface ERI Model ATW6V5-ETP-9H TRASAR® VHF Antenna to WVPB-TV Tower top plate. Preliminary mounting stub height is 24-inches. This offer does not include replacing the tower top plate. If reinforcement is required that analysis, design, material, and installations will be performed by others.	8,700.00	8,700.00
			Interim Antenna and Transmission Line		
023	1	ALV4V7-HSOC-9	ALV Series Low Power High Band VHF (CH 7-13) Television Antenna. ERI 4 bay, Side Mounted, Horizontally Polarized, Channel 9 / 189 broadcast antenna with 1.75 degree(s) of electrical beam tilt and a 3-1/8-inch EIA male input. Omnioid azimuth pattern, 20kW average power rating, and a 0 % ERP vertical/horizontal ratio. Country of Operation: United States Operating Frequency: 186 - 192 NOTE: All ALV Series High Band VHF television antennas are shipped with 36-inch standoff brackets for mounting on poles or tower legs from 1.5-inches to 7.5-inches OD. Standoff support pipes, face mount brackets, and mounts for larger diameter poles are available from ERI as optional items. Please contact ERI for a proposal for these requirements.	35,000.00	35,000.00
024	493	HJ8-50B	HELIAX standard air dielectric coaxial cable, 3-inch, 50 ohm (wideband from 0.5-1640 MHz). Price shown is **per line section** Vertical Run: 393 (feet) Horizontal Run: 100 (feet)	47.23	23,284.39
025	1	H8FB-302-S-SP	3-1/8 inch EIA Female Flange with gas barrier for 3-inch air HELIAX (HJ8-series). Attached first off reel. Modified to gas pass. Gas pass version created by drilling out the PTFE dielectric per installation instructions. Male version can be created ordering BN-918710 coupling element separately. When ordering connector attached at factory order ATTACH-AC4 separately.	796.01	796.01
026	1	ATTACH-AC4	Factory attachment charge for HJ8-50B connectors.	90.00	90.00
027	1	BN-918710	3-1/8 inch EIA Coupling Element (inner connector), O-Ring, and screw-set. To modify 3-1/8-inch Air HELIAX connectors to male.	67.34	67.34

Item	Qty	Part #	Description	Unit Price	Extended
028	1	H8FB-302-S-LB	3-1/8 inch EIA Female Flange with gas barrier for 3-inch air HELIAX (HJ8-series). Shipped loose (not attached to cable). Gas pass version created by drilling out the PTFE dielectric per installation instructions. Male version can be created ordering BN-918710 coupling element separately.	796.01	796.01
029	1	BN-918710	3-1/8 inch EIA Coupling Element (inner connector), O-Ring, and screw-set. To modify 3-1/8-inch Air HELIAX connectors to male.	67.34	67.34
030	2	26985A	Hoisting Grip for 3-inch coaxial cable and EW28 and EW34 elliptical waveguides	103.21	206.42
031	2	HGK0001	Hoisting grip hanger kit to attach HELIAX hoisting grips to tower. Includes 18-inches of chain, 12-inch x 12-inch turnbuckle, and two shackles. One required for each hoisting grip and one hoisting grip required for each 200-feet of vertical run.	150.00	300.00
032	5	223700-724	Grounding kit, qty. 1, 60-inch cable with 2-hole field attachable crimp-on lug for 2-1/4-inch and 3-inch coaxial and EW28, EW34, and EW37	41.25	206.25
033	13	31766A-11	Standard hangers, qty. 10, 3-inch HELIAX® and EW28 waveguide. Hangers do not include hardware kit. For 1/2 to 4 inch hangers use 3/8 inch hardware 3/4 inch long Part Number 31769-5 or HWK0005 or 1 inch long Part Number 31769-1 or HWK0001.	108.90	1,415.70
034	2	31769-5	3/8-inch hardware, kit of 10, with 3/4-inch fillister-head bolts, lock washers and nuts.	12.06	24.12
035	1	40394-2	Wall/Roof Feed Thru, Single Entrance, for 3-inch cable	255.00	255.00
036	2	31768A	Angle adapter qty 10 for all waveguides and coaxial cables 1/2-inch to 4-inch	71.01	142.02
037	11	HR30848-1	1-inch standoff adapter kit for 3 to 6 inch legs. Kit of 10. Includes hardware to attach non-insulated butterfly hanger. Requires 31670-* round member adapter kit, one per kit.	155.00	1,705.00

Item	Qty	Part #	Description	Unit Price	Extended
038	22	31670-3E	Round member adapter for 3 to 4-inch round members. Kit of 10. Stainless steel clamps to mount 1/2 to 4-inch cable hangers to round support members. Two each are required for 3 and 4-inch cable hangers.	25.91	570.02

Total Price	$332,216.62
Net Package Price	$301,325.00
Estimated Freight	$3,450.00
Grand Total	$304,775.00

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CustomerSupport@eriinc.com
www.eriinc.com

Purchaser Information Page

Mail to Address:

Name:	Dusty Jo Smith
Company: Company 2:	Department of Administration, Purchasing Division State of West Virginia
Address:	2019 Washington Street East
City, ST, ZIP:	Charleston, WV, 25305-0130
Country:	
Phone:	+1 (304) 558-2063
FAX:	
E-Mail:	dusty.j.smith@wv.gov

Ship to Address:

Name:	Dave McClanahan
Company: Company 2:	WVPB-TV Transmitter Site WV Educational Broadcasting Authority
Address:	9248 Barker Ridge Church Road
City, ST, ZIP:	Milton, WV, 25545
Country:	
Phone:	
FAX:	
E-Mail:	

Submit to Address:

Name:	Dusty Jo Smith
Company: Company 2:	Department of Administration, Purchasing Division State of West Virginia
Address:	2019 Washington Street East
City, ST, ZIP:	Charleston, WV, 25305-0130
Country:	
Phone:	+1 (304) 558-2063
FAX:	
E-Mail:	dusty.j.smith@wv.gov

Consultant Address:

Name:	
Company:	
Address:	
City, ST, ZIP:	
Country:	
Phone:	
FAX:	
E-Mail:	

Ship Via:
ERI selected method, unless otherwise specified.

Special Shipping Method:
ERI designated truck. Fuel surcharge may apply.

Final CP Received? Yes

Comments:

1. Applicable to All Orders

1.1 Acceptance of Proposal: When the Proposal is signed by Buyer, returned to Electronics Research, Inc. (hereinafter called "ERI"), and accepted by ERI at its offices in Chandler, Indiana, USA, the Proposal shall become a binding agreement for the purchase by buyer from ERI of the Products and/or Services described therein, upon the terms specified, including these Terms and Conditions of Sale, attached to the Proposal. Refundable deposits are charged for some skids and large size cable reels. All orders are subject to a minimum charge of $50.00 net.

1.2 Acknowledgement of Terms: By signing the Proposal, Buyer represents and acknowledges that it has fully read, understands, and accepts the terms of the Proposal, including these "Terms and Conditions of Sale" included therein, that the Proposal contains the complete and final agreement of Buyer and ERI with respect to the Products and/or Services described therein; that all other agreements, representations, and warranties, whether oral or in writing, made prior to or at the time of the signing of the Proposal, are merged and replaced therein; and that no change or addition to the Proposal shall be valid and enforceable unless made in writing and signed by an authorized representative of ERI.

1.3 Buyer's Terms and Conditions: ERI desires to provide its customers with prompt and efficient service. However, to negotiate individually the terms and conditions of each sales contract would substantially impair ERI's ability to provide such service. Accordingly, Products and Services furnished by ERI are sold only on the terms and conditions stated herein, any terms or conditions on Buyer's order to the contrary notwithstanding. ERI's performance of any contract is expressly made conditional on Buyer's agreement to ERI's Terms and Conditions of Sale unless otherwise specifically agreed to, in writing, by ERI. In the absence of such agreement, commencement of performance and/or delivery shall be for Buyer's convenience only and shall not be deemed or construed to be acceptance of Buyer's terms and conditions. If a contract is not earlier formed by mutual agreement, in writing, acceptance of any Product or Service shall be deemed acceptance of the terms and conditions stated herein. In the case of a conflict between the terms and conditions stated herein and those appearing on the face of this Proposal, the latter shall control. All contracts for the sale of Products and/or Services shall be construed under and governed by the laws of the State of Indiana, the location of ERI's primary manufacturing facilities and its corporate headquarters.

1.4 Conditions of Proposal: ERI's Proposal is subject to the following:

1.4.1 The Buyer warrants that all information supplied by it to ERI for the preparation by ERI of the Proposal, including oral and written correspondence, reports, plans, and specifications are adequate, accurate, workable, and practicable of design, and, if the supplied information is followed, a sufficient and satisfactory result will be achieved. Buyer shall be responsible for all costs incurred by ERI by reason of any inaccurate or incomplete information supplied by Buyer.

1.4.2 Unless otherwise stated in the Proposal, the Buyer is responsible for obtaining any necessary permits and/or approvals (FCC, FAA, local, etc.) needed to install and use the Products included in the Proposal. If the Proposal includes Installation Services, the necessary permits must be obtained prior to mobilization.

1.4.3 UNLESS OTHERWISE SPECIFIED, IN WRITING, ALL PROPOSALS ARE FIRM FOR, AND EXPIRE, THIRTY (30) DAYS AFTER DATE THEREOF AND CONSTITUTE OFFERS, provided, however, that budgetary Proposals and estimates are for preliminary information only and shall neither constitute offers, nor impose any responsibility or liability upon ERI.

1.4.4 Unless otherwise stated in writing by ERI in the Proposal, all prices in a Proposal shall be exclusive of transportation, insurance, taxes (including, without limitation, any sales, use or similar tax, and any tax levied on or assessed to ERI after Product delivery by reason of ERI's security interest in Products), license fees, customs fees, duties and other charges related thereto, and Buyer shall report and pay any and all such shipping charges, premiums, taxes, fees, duties and other charges related thereto, and shall hold ERI harmless there from, provided, however, that if ERI, in its sole discretion, chooses to make any such payment, Buyer shall reimburse ERI in full upon demand.

1.4.5 Stenographical, typographical and clerical errors contained in the Proposal are subject to correction.

1.4.6 Prices set forth in a Proposal are for Products and/or Services only and do not include technical data, proprietary rights of any kind, patent rights, qualification, environmental or other than ERI's standard product performance tests, and other than ERI's normal domestic commercial packaging, unless expressly agreed to in writing by ERI.

1.4.7 Published weights and dimensions are approximate only. Certified dimension drawings can be obtained upon request. Manuals, programs, listings, drawings, or other documentation required hereunder must be referenced specifically.

1.5 Terms of Payment: Unless otherwise stated in the Proposal, payment is due upon delivery. All payments for Products released and shipped on approved credit accounts shall be due in upon receipt of invoice therefore. Past due balances shall be subject to a late charge of 1.8% per month. Partial shipments will be billed as made and payments therefore are subject to the above terms. Payment shall not be withheld for delay in delivery of required documentation unless a separate price is stated therefore, and then only to the extent of the price stated for such undelivered documentation. ERI may cancel or delay delivery of Products in the event Buyer fails to make prompt payment therefore or in the event of an arrearage in Buyer's account with ERI.

1.6 Performance: ERI will make all reasonable effort to observe its dates indicated for delivery or other performance. However, ERI shall not be liable in any way because of any delay in performance hereunder due to acceptance of prior orders; technical difficulties; strike; lockout; riot; war; fire; act of God; accident; failure or breakdown of components necessary to complete an order; subcontractor, supplier or Buyer caused delays; inability to obtain or constrain substantial rises in the price of labor, materials or manufacturing facilities; curtailment of or failure to obtain sufficient electrical or other energy supplies; or compliance with any law, or regulation or order, whether valid or invalid, of any cognizant governmental body or any instrumentality thereof now existing or hereafter created; or due to any unforeseen circumstances or causes beyond ERI's control, provided such delay is neither material nor indefinite. ERI's performance shall be deemed suspended during and extended for such time as it is so delayed, and thereafter Buyer shall accept performance hereunder. Delay in performance shall not be considered material or indefinite unless it exceeds or is reasonably estimated by ERI to exceed a period of six (6) months. ERI reserves the right, in its sole discretion, to allocate inventories and current production and substitute suitable materials when, in its opinion, such allocation or substitution is necessary due to such circumstances or causes in the interest of conservation of scarce materials and efficient utilization of high value parts and components. ERI's products may contain remanufactured parts and components. Such parts and components are covered by the same warranty and are subject to the same high standards of quality control applied to other parts and components. No penalty clause for delay in performance contained in any Buyer-originated documents of any kind shall be effective. As used herein, "performance" shall include, without limitation, fabrication, shipment, delivery, assembly, installation, testing and warranty repair or replacement, as applicable.

1.7 Change Orders: Buyer change orders must be in writing and no change shall be made pursuant to this clause unless agreed to in writing and signed by duly authorized representatives of ERI and Buyer. If any such change causes an increase or decrease in the cost or the time required for the performance of any part of the work, an equitable adjustment shall be made in the contract price and schedule. ERI shall have no obligation to commence any extra or changed work without written agreement as to adjustments to contract price and delivery schedules affected thereby.

1.8 Assignments and Terminations: Any assignment by Buyer of any contract created by the Proposal without the express written consent of ERI is void. No order may be terminated by Buyer except by mutual agreement in writing. Terminations by mutual agreement are subject to the following conditions: (a) Buyer will pay, at applicable contract prices, for all Products which are completely manufactured and allocable to Buyer at the time of ERI's receipt of a request for mutual termination; (b) Buyer will pay all costs, direct and indirect, which have been incurred by ERI with regard to Products which have not been completely manufactured at the time of ERI's receipt of a request for mutual termination, plus a pro rata portion of normal profit on the contract; (c) Buyer will pay a termination charge on all other Products affected by the termination. (d) Orders for standard catalog products may be canceled prior shipment, however any order that has been cut, filled or packaged prior to Seller's receipt of cancellation notice shall be subject to a 20% re-stocking charge. (e) Orders for non-standard products or specially manufactured products may be canceled prior to the start of manufacture provided Buyer reimburses ERI for any actual costs incurred on the order prior to the effective cancellation date. After manufacture commences, orders for non-standard products or specially manufactured products may not be canceled. In the event Buyer terminates such orders, Buyer shall be liable to ERI for termination charges, including, but not limited to, reasonable profits. ERI's normal accounting practices shall be used to determine costs and other charges. To reduce termination charges, ERI will divert completed parts, material or work in process from terminated contracts to other Buyers whenever, in ERI's sole discretion, it is practicable to do so.

1.9 Damage and Liability: ERI'S AGGREGATE LIABILITY IN DAMAGES OR OTHERWISE SHALL NOT EXCEED THE PAYMENT, IF ANY, RECEIVED BY ERI FOR THE UNIT OF PRODUCT OR SERVICE FURNISHED OR TO BE FURNISHED, AS THE CASE MAY BE, WHICH IS THE SUBJECT OF CLAIM OR DISPUTE. IN NO EVENT SHALL ERI BE LIABLE FOR INCIDENTAL, CONSEQUENTIAL, LIQUIDATED, OR SPECIAL DAMAGES, HOWSOEVER CAUSED. Liability to third parties for bodily injury, including death, resulting from ERI's performance shall be determined in accordance with applicable law and shall not be affected by the liability limitations stated above in this paragraph.

1.10 Disputes: All disputes under any contract concerning Products and/or Services not otherwise resolved between ERI and Buyer shall be resolved in a court of competent jurisdiction in the County of Warrick in the State of Indiana or the United States District Court for the Southern District of Indiana, Evansville Division, and in no other place. Provided, that in ERI's sole discretion, such action may be heard in some other place designated by ERI if necessary to acquire jurisdiction over third persons so that the dispute can be resolved in one action. Buyer hereby consents to the jurisdiction of such court or courts and agrees to appear in any such action upon written notice thereof. No action, regardless of form, arising out of, or in any way connected with, the Products or Services furnished by ERI, may be brought by Buyer more than one (1) year after the cause of action has occurred. If any part, provision or clause of these `Terms and Conditions of sale, or the application thereof to any person or circumstances, is held invalid, void or unenforceable, such holding shall not affect and shall leave valid all other parts, provisions, clauses or applications of these Terms and Conditions remaining, and to this end these Terms and Conditions shall be treated as severable.

1.11 General Conditions:

1.11.1 No delay or failure on the part of ERI in exercising any right or remedy under any contract resulting from, and/or partial or single exercise thereof, shall constitute a waiver of such right or any other remedy. ERI's rights and remedies under any contract resulting here from are cumulative and not alternative.

1.11.2 If any term of any contract resulting here from or the application thereof shall be illegal, such illegality shall not affect any other term or condition thereof, and such shall continue in full force and effect.

1.11.3 Any contract resulting here from shall be binding upon the heirs, personal representative, successors and permitted assigns of the parties.

2. Applicable to Orders for Products

2.1 Transportation and Risk of Loss: Transportation will normally follow Buyer's shipping instructions, but ERI reserves the right to ship Products freight collect and to select the means of transportation and routing when Buyers instructions are deemed unsuitable in ERI's judgment. Unless otherwise advised, ERI may, but shall be under no obligation to, insure to full value of the Products or declare full value thereof to the transportation company at the time of delivery, and all freight and insurance costs shall be for Buyer's account. Risk of loss and/or damage shall pass to Buyer upon delivery of the Products to the transportation company at the FOB point whether or not installation is provided by or under supervision of ERI. Confiscation or destruction of, or damage to Products shall not release, reduce or in any way affect the liability of Buyer therefore. Notwithstanding any defect or nonconformity, or any other matter, such risk of loss and/or damage shall remain in Buyer until the Products are returned at Buyer's expense to such place as ERI may designate, in writing. Buyer, at its expense, shall fully insure Products against all loss and/or damage until ERI has been paid in full or the Products have been returned for whatever reason to ERI. All Products must be inspected upon receipt and claims should be filed with the transportation company when there is evidence of shipping damage, either concealed or external. As used in the clauses appearing herein or attached hereto, "delivery" shall occur when the Product is delivered at the FOB point which shall be the point of manufacture or such other place as ERI shall specify, in writing, notwithstanding installation by or under supervision of ERI.

2.2 Acceptance: The shipment by ERI of a Product to the Buyer shall constitute acceptance of that Product by Buyer, unless notice of defect or nonconformity is received by ERI within thirty (30) days of receipt of the Product at Buyer's designated receiving address, provided, that for Products for which ERI agrees, in writing, to perform acceptance testing after installation, the completion of ERI's applicable acceptance test, or execution of ERI's acceptance form by Buyer, shall constitute acceptance of the Product by Buyer. Notwithstanding the foregoing, any use of a Product by Buyer, its agents, employees, contractors or licensees, for any purpose, after receipt thereof, shall constitute acceptance of that Product by Buyer. ERI may repair or, at its option, replace defective or nonconforming parts after receipt of notice of defect or nonconformity.

2.3 Shipment Delays/Billing in Place: Upon completion of Buyer's order, any delay in shipment attributable to Buyer, including, but not limited to, Buyer's request to defer the delivery date, shall cause the following to occur: Thirty (30) days after the original shipment date, a storage charge of 1½% of the invoice price per month will be billed to Buyer and title to the shipment will automatically pass to Buyer. ERI will invoice Buyer for completed goods and Buyer will pay in accordance with the terms of the original sale, as the goods will be deemed to have shipped in place. ERI will insure against risk of loss until physical shipment of the goods to a common carrier. A tower shipment date is contingent upon receipt by ERI of all necessary site specific information. This information must be included with the signed Proposal and tower order. Depending upon the nature of the project, site specific information may include, but is not limited to: a site survey showing plot dimensions, topography, and possible obstructions; a geotechnical report; the desired tower orientation; the desired antenna orientation; and a complete shipping address.

2.4 Returns: Standard catalog products may be returned for credit provided such products are returned within six (6) months after the original shipment date. The minimum value accepted for return from each purchase order is $50.00. The amount of credit issued for any returned product shall be determined solely by ERI based on the resalable condition of the product. Non-standard products, including products specially manufactured in accordance with Buyer's specifications or tuned to one or more specified operating frequencies may not be returned for credit. Buyer shall obtain ERI's written return goods authorization prior to returning any Product for credit.

2.5 Service Warning: The Products may be dangerous if improperly installed, handled, serviced, refurbished, or reinforced. In the event that repair, maintenance or servicing need to be performed on the Products, Buyer should contact ERI immediately. ERI shall not be liable for any damages or injuries occurring in connection with maintenance, servicing or repair work on the Products done by persons other than ERI or its duly authorized representatives.

2.6 Installation: Unless this Proposal includes installation services, Buyer is responsible for installation of the Products, including preparation and maintenance of all Products, materials, or services necessary for the operation of the Products not provided by ERI. All installations should be performed by qualified tower climbers and electricians. All OSHA, state and local safety regulations should be observed. Any photos or drawings in product literature, installation manuals, or drawings are used to illustrate a specific point and are not intended to supersede any OSHA, state or local safety regulations.

2.7 Patents and Other Intellectual Property Rights: ERI will, at its own expense and as set forth herein, defend any action brought against Buyer in respect to any claim that the design or manufacture of any Product in ERI's commercial line of Products or manufactured to specifications set by ERI and furnished hereunder, constitutes an infringement of any patents or other intellectual property rights of the United States. Subject to the provisions in the DAMAGES AND LIABILITY section hereof, ERI will pay all damages and costs either awarded in a suit or paid, in ERI's sole discretion, by way of settlement, which are based on such claim of infringement, provided, that Buyer promptly notifies ERI, in writing, of such claim or infringement and gives ERI full authority, information and assistance in settling or defending such claim, or ERI will, in its sole discretion and at its own expense, either procure a license which will protect Buyer against such claim without cost to Buyer, replace said Product with a non-infringing Product or remove said Product and refund an equitable portion of the price paid by the Buyer to ERI for said Product. ERI shall have no liability whatsoever hereunder with respect to any claims settled by Buyer without ERI's prior written consent. ERI EXPRESSLY EXCLUDES from any liability hereunder, and Buyer shall hold ERI harmless from and against, any expense, loss, costs, damages or liability resulting from claimed infringement of patents, trademarks, copyrights or other intellectual property rights: (a) arising from a use of or a combination of a Product with other equipment, processes, programming applications or materials not furnished under the Proposal; (b) based on items made with the Products furnished under the Proposal; (c) arising out of compliance by ERI with Buyer's designs, specifications or instructions; and/or (d) arising from use or manufacture by anyone of inventions in connection with Products or services sold, used or intended for sale or use in performing contracts with the United States or related subcontracts. The foregoing states ERI's entire liability for any claim based upon or related to any alleged Infringement of any patent or other intellectual property rights.

2.8 Standard Two (2) Year Product Limited Warranty: Electronics Research. Inc. (ERI) warrants to the original Buyer that its Product is free from defects in material or workmanship

2.8.1 existing at the time of shipment from the factory or

2.8.2 that develop under normal use in a properly installed and maintained system for a period of twenty-four (24) months following the date of shipment, ex-works.

2.8.3 ERI Exclusions: Expressly excluded from the terms of this limited warranty are defects caused by:

2.8.3.1 faulty installation;

2.8.3.2 all minor system leakage ("leakage" is defined in paragraph 2.8.15), below);

2.8.3.3 equipment leaks and detuning if caused by rough handling or installation;

2.8.3.4 lack of proper inspection and maintenance;

2.8.3.5 unusually severe weather, lightning, icing, acts of God; such events require inspection for, and correction of, such damage;

2.8.3.6 water intrusion, foreign materials in the system;

2.8.3.7 vandalism, physical abuse, tampering, or unauthorized disassembly, repair or modification without explicit written approval of ERI;

2.8.3.8 operation not in accordance with published ratings, specifications, or instructions.

2.8.4 ERI Products are delivered Ex-Works. Unless ERI supervises the transportation, delivery, and/or installation of the product, ERI is not responsible for damage that may result from incorrect or improper transportation, storage, handling or installation of Products.

2.8.5 Buyer shall regularly inspect and maintain all ERI manufactured parts and Resale parts in accordance with ERI's and/or manufacturer's inspection and maintenance guidelines and in accordance with all regulations and recommendations of any government agency or body and in accordance with generally accepted industry maintenance standards. An initial inspection shall be conducted promptly after installation to verify that the installation is properly performed in accordance with ERI's and/or the manufacturer's installation instructions and procedures. Such inspections shall be performed at Buyer's expense by qualified personnel, and inspection summary report(s) shall be prepared immediately upon inspection completion. Reports of initial inspections shall be submitted to ERI Customer Service. Buyer shall forever protect, defend, indemnify, and hold ERI free and harmless against all claims, demands, liabilities, cause of action (including, without limitation, legal costs and expenses and reasonable attorney's fees) arising out of, or relating to Buyer's failure to completely discharge its obligations hereunder.

2.8.6 Buyer shall follow promptly all recommendations from qualified inspectors and/or ERI regarding the maintenance of all ERI manufactured and Resale structural Products.

2.8.7 Upon making a warranty claim, make copies of all preceding inspection reports and dispositions available to ERI for review.

2.8.8 Any defective warranted component of an ERI product will be repaired or replaced at the place of manufacture, ex-works, without charge if all defective components are returned by the Buyer to ERI, and ERI inspection discloses that such defects are as reported and are not the result of ERI Exclusions.

2.8.9 Under some circumstances, continuity of service may necessitate immediate shipment of repair parts before ERI inspection of defective parts. Under these conditions, ERI requires that Buyer place an order for replacement parts and will require that all defective parts be packaged and returned for factory inspection and determination of warranty status. If failure is determined to be covered by this warranty, credit will be issued for parts ordered by Buyer to expedite replacement.

2.8.10 Other than the replacement of defective Products or components ex-works, ERI shall not be responsible for any costs or expenses incurred by the Buyer arising from the identification, removal, and replacement of defective products.

2.8.11 ERI, at its sole discretion, may choose to supply warranty parts for repairs on site. In such cases, materials shall be shipped free of additional charge to the site. Losses arising from repair or replacement activities, including those for delays, rigging, and additional installation or maintenance crew time, are not be covered under this warranty.

2.8.12 Warranty repairs/replacements, whether at factory or on site, will fulfill the term of the original warranty. No extension of the original warranty term will be allowed.

2.8.13 "Resale equipment/parts/components" are defined as equipment, parts, or components purchased from another manufacturer or supplier and resold by ERI, shall only carry such manufacturer's or supplier's standard warranty in effect at the time of Product shipment from the supplier.

2.8.14 Antenna warranties shall be void if Buyer does not (i) purge and pressurize the antenna system with dry nitrogen or dry air furnished by the Buyer immediately following the installation of the system to initially check for installation leaks and (ii) maintain the antenna under a positive pressure of approximately 2 to 5 pounds per square inch at all times, including prior to installation, using either dry nitrogen or dry air. This warranty is void in the event that the system is pressurized above ERI's published instructions.

2.8.15 Minor leakage in a large system can be difficult if not impossible to detect, especially since temperature variations can mask their extent. ERI recommends the installation of dehydration equipment in any significant pressurized system. Minor leakage is beneficial because it causes occasional cycling the dehydration equipment and provides a fresh purge to the system. ERI regards any leak resulting in a system pressure drop of 0.5 PSI per day or less, temperature compensated, as an acceptable leak rate not actionable under these warranty terms.

2.8.16 For the scope and purposes of this warranty with regard to ERI manufactured structural towers/parts and resale structural parts, the phrase "Current Standard" is defined as the most current revision of ANSI/TIA-222 Standard including, but not limited to, all relevant appendices and annexes thereof, and all relevant documents incorporated by reference there from. This warranty shall be void if the Buyer does not:

2.8.16.1 follow all relevant and applicable directives as set forth in the Current Standard;

2.8.16.2 consult and obtain explicit approval from ERI regarding the qualifications of the tower crew chosen to implement/install any structural repairs and/or modifications;

2.8.16.3 consult and obtain explicit approval from ERI prior to implementing changes to the structure serviceability requirements, structure classification, and/or tower appurtenance loading (such as antennas, transmission lines, mounts, ice shields, platforms, ladders, etc.) which varies significantly from the original design parameters as determined by ERI.

2.8.17 Adequate VSWR monitoring and protection equipment must be installed and properly maintained in the transmission system to prevent system damage from ice, lightning, and other natural phenomena. Failure to properly install, maintain, or observe the warnings of the VSWR protection equipment voids this warranty, and subsequent damage caused by such failure is not covered under this warranty. ERI recommends purchase of an ERI manufactured or approved VSWR protection unit at time of antenna purchase.

2.8.18 If warranty site service is requested, it will be provided pursuant to a Buyer issued purchase order. If defects are not found to be the result of a valid warranty claim an invoice for such service will be issued at prevailing rates.

2.8.19 Notification of warranty claim must be provided to ERI within 30 days of the triggering event or detection of the failure.

2.8.20 In no case may the value of the warranty claim exceed the purchase price of the Product.

2.8.21 Warranty services will be provided, and valid claims will be honored as long as Buyer is current on all accounts due and owing to ERI.

2.8.22 THE FOREGOING WARRANTY IS AND SHALL BE IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY AND ANY IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR APPLICATION OR PURPOSE. THERE ARE NO WARRANTIES, REPRESENTATIONS OF FACT, OR PROMISES WITH RESPECT TO SIGNAL COVERAGE OR STRENGTH.

2.8.23 UNDER NO CIRCUMSTANCES SHALL ERI BE OBLIGATED OR LIABLE FOR SPECIAL INCIDENTAL, INDIRECT, CONSEQUENTIAL OR OTHER DAMAGES, LOSSES, OR EXPENSES IN CONNECTION WITH OR BY REASON OF THE FOREGOING WARRANTY OR BY REASON OF SOME OTHER TYPE OF EXPRESS OR IMPLIED WARRANTY FOUND TO EXIST NOTWITHSTANDING THE FOREGOING DISCLAIMERS.

2.9 Warranty Replacement and Adjustment: All claims under warranty must be made promptly after occurrence of circumstances giving rise thereto and must be received within the applicable warranty period by ERI or its authorized representative. Such claims should include the Product type and serial numbers and a full description of the circumstances giving rise to the claim. Before any Products are returned for repair and/or adjustment, written authorization from ERI or its authorized representative for the return and instructions as to how and where such Products should be shipped must be

obtained. Any Product returned to ERI for examination shall be sent prepaid via the means of transportation indicated as acceptable by ERI. ERI reserves the right to reject any warranty claim not promptly reported and any warranty claim on any item that has been altered or has been shipped by non acceptable means of transportation. When any Product is returned for examination and inspection, or for any other reason Buyer shall be responsible for all damage resulting from improper packing or handling, and for loss in transit notwithstanding any defect or non conformity in the Product. In all cases ERI has sole responsibility for determining the cause and nature of failure, and ERI's determination with regard thereto shall be final. If it is found that ERI's Product has been returned without cause and is still serviceable, Buyer will be notified and the Product returned at its expense; in addition, a charge for testing and examination may, in ERI's sole discretion, be made on Products so returned.

2.10 General Conditions:

2.10.1 ERI reserves the right to change or modify its design and construction of the Products and/or to substitute materials equal to or superior to or functional equivalents to that originally specified herein provided, however, that any substitution, change or modification shall not materially and adversely affect Buyer's ability to use the Products.

2.10.2 ERI reserves the right to make changes in design and construction of the Products it manufactures for others and to make and/or add improvements in such Products at any time without incurring any obligation to install the same in the products sold herein.

2.10.3 The Buyer shall at its expense engage any qualified engineer necessary to approve ERI's design, obtain building permits, and insure structural integrity of existing structure considering any ERI addition or appurtenance unless otherwise specified in the Proposal. ERI shall furnish construction and installation drawings and engineering data for its Products upon request.

2.10.4 The Proposal is submitted in accordance with the ANSI/EIA/TIA-222 standard in effect as of the date of the Proposal, unless otherwise stated in the body of the Proposal. This standard is intended to set the minimum criteria for the structural design, fabrication and construction of antennas and antenna support structures. It is the responsibility of the Buyer to provide site specific data and design requirements and any requirements differing from those contained in this standard to ERI prior to accepting the Proposal. Please refer to the applicable edition of the ANSI/EIA/TIA-222 standard for further information.

2.10.5 Buyer is responsible for any and all disposal and recycling of Products, packaging, reels, shipping crates, and other items associated with the fulfillment of order, as well as for compliance with any mandated "green" initiatives.

2.10.6 If field services are provided Buyer may request to be named as an additional insured on ERI's Liability policy and be provided a Certificate of Insurance naming Buyer as a certificate holder.

3. Special Terms and Conditions Applied to Field and Installation Services

3.1 If ERI is not the current Engineer of Record (EOR) for the supporting structure, it shall be the Purchaser's responsibility to engage the current structure's EOR or a Qualified Engineer to review all Construction Class IV work activities to assess construction loads at rigging attachment points and/or work activities impacting the strength and stability of the supporting tower such as structural member replacements in direct accordance with the current ANSI/TIA-322, Loading, Analysis, and Design Criteria Related to the Installation, Alteration and Maintenance of Communication Structures. ERI shall retain the services of a Supervising Engineer to develop construction loads which will be provided to the Purchaser, or their named representative, along with specific rigging attachment points being made to the supporting structure no less than 2 weeks prior to planned Construction Class IV work activities to allow time for the EOR/Qualified Engineer review. Any work delays occurring from the Purchaser's engineering review may result in delayed mobilizations and/or change order fees for downtime. Please note, if the Purchaser is unable or unwilling to attain the required engineering services to facilitate the construction review in accordance with current industry standards, any and all fees incurred by ERI for performing additional engineering assessments including any potential field inspections shall be submitted to the Purchaser as part of a change order.

3.2 The Proposal is based on work carried out in one mobilization and continuous operation without interruption or delays due to Buyer supplied missing materials, such as, but not limited to antennas, transmission lines, transmission line hangers, installation drawings, tower components, or electrical power. All material necessary for completing installation to be furnished by Buyer, must be on the tower site prior to starting of installation or scheduled in such a manner as to avoid delaying crew. Proposal is also based upon the following conditions:

3.2.1 Painting of the tower components (i.e. antenna or line) is not included in Proposal unless specified in Proposal.

3.2.2 Antenna feed line system will end just inside the transmitter facility (max 20'). Purchaser to have existing port for the line to enter. ERI is not responsible for installation inside the transmitter facility, such as, but not limited to inside transmission line runs, hangers, wall feed through plates, etc. ERI can perform these tasks at our standard daily rate if so desired.

3.2.3 This Proposal is subject to mutually negotiated scheduling and availability of resources and personnel. In case of significant delays beyond the control of ERI that cause ERI increased costs due to the rescheduling of crews, additional charges may apply. For this purpose, a delay shall not be considered significant unless it exceeds a period of ninety (90) days.

3.2.4 All work is to be performed unrestricted during daylight hours. (Weekend, holiday, or evening/ night work, when requested by customer will be billed an additional charge of 1.5 times standard rate.)

3.2.5 No guy wires interlaced or overhead power lines in working areas.

3.2.6 No tower, antenna, feed line, and/or bracket modifications required unless specified in Proposal.

3.2.7 No onsite transmission line field cuts required. If necessary, additional charges will be billed.

3.2.8 Antennas are assumed to have no more than 2 parasitic directors per bay. Each additional will be billed as necessary.

3.2.9 Taxes, bond or permit costs/fees have been paid by buyer/customer.

3.2.10 All antennas to be non-radiating or reduced to a safe power level while ERI personnel are in the immediate RF zones.

3.3 Downtime resulting from situations beyond the control of ERI or its subsidiary ERI Installations, Inc. as described above, will be billed at normal labor rates.

3.4 The Proposal on labor to install tower and/or antenna and other related equipment is based upon weather and time of day suitable for outdoor construction. Installation, field services and hazardous operations shall not be performed under adverse weather conditions for the safety of ERI personnel. Adverse weather delays shall be charged to Buyer at normal day rates and will be added to the construction schedule as time extensions. Certain operations may be performed under adverse weather conditions by mutual agreement and shall be billed at special rates provided in the Proposal. The ERI representative is the sole determinant of suitable and safe conditions while ERI personnel are on site.

3.5 In the event adverse weather causes a delay, ERI will notify the Buyer of those conditions and additional charges as soon as it is practical to do so. The responsibility to determine this condition rests with the ERI supervisor on site.

3.6 The tower site shall be accessible to workman and installation equipment, using two-wheel drive vehicles (under their own power) and heavy construction equipment such as, but not limited to cranes, concrete trucks, semi-tractor trailers, forklifts, etc.

3.7 All labor is based upon non-union wages. Should any conditions exist such that the use of union trades for installation of the tower, accessories and/or foundations is necessary, the prices stated in the Proposal are subject to adjustment unless a union stipulation has been specifically noted in the Proposal. Unless provided by ERI, the foundations must be completed so as to permit continuous work from time ERI's crew reports on the job and must be finished in accordance with ERI's specifications.

3.8 The Buyer assumes all liability resulting from site conditions differing from those specified or agreed to by the Buyer.

3.9 Unless otherwise specified in the Proposal, it is also Buyer's responsibility to:

3.9.1 To provide one (1) tagline path (75 feet wide and equal in length to the height of the tower) at the work face, cleared of all obstructions in order to permit a truck to be driven thereon.

3.9.2 Clear a guy path alley and fire lane down each guy radial 25 feet wide on each side of the guy line; and extend this lane 50 feet beyond the outer guy anchor, a 10-foot width of this 50-foot lane must be cleared of all obstructions in order to permit a truck to be driven thereon.

3.9.3 So grade the area immediately surrounding the tower site so as to permit the movement of trucks, cranes and/or other equipment required to handle and install the tower or related appurtenances.

3.9.4 Clear an area a minimum of 200 feet x 200 feet adjacent to the center of the tower to permit unloading, sorting, assembling, working space, and shall provide a hoist and equipment area 20 feet x 50 feet with capabilities for anchoring.

3.9.5 Provide a free and clear radius of 100 feet at the tower base for construction equipment and to allow staging and landing during tower construction and for future service work. This area shall have a rock/gravel surface bedding to support heavy equipment.

3.9.6 Provide fittings and gas required in pressure checking all of the antennas and transmission lines, if required.

3.9.7 A safe and secure work site to prevent theft and vandalism of contractor provided equipment and materials and Buyer delivered materials.

3.9.8 Provide electric power to the base of the tower suitable for powering construction equipment and tools. This also includes permanent electric power for the tower lighting system, if required, in accordance with the current revision of FAA circular AC 70/7460-1.

3.9.9 Provide the police service to direct traffic, if in the event the guy lines should cross a public or private road and secure the site from theft or vandalism of ERI equipment.

3.9.10 Provide toilet facilities, water, and trash containers for waste disposal. If sufficient trash receptacles are not provided, all trash and removed steel, antennas, mounts, lines, etc. shall be neatly left on site.

3.9.11 Provide scaled site survey of proposed tower location specifying tower location and orientation, property boundaries, site topography, overhead or buried utility service lines, or any other construction hazards or obstructions. Also provide survey required for antenna location and/or directional proof.

3.9.12 Provide a cleared and level area suitable for and capable of anchoring a hoist with a minimum area of 30' x 25'.

3.9.13 Obtain a tower structural analysis from a licensed Professional Engineer appropriate to the scope of work being requested.

3.9.14 Obtain any necessary rights of way and/or easements to allow access to work sites.

3.9.15 Provide a local certified electrical worker to make final connections. ERI's responsibility for lighting conduit and electrical wiring ends at the base of the tower.

3.9.16 Coordinate any required RF reductions or off-air time to allow ERI to perform necessary work in a safe and acceptable RF environment without any work flow interruption. If this cannot be accomplished, standby charges will apply at standard rates. ERI is NOT responsible for any consequential damages or loss of revenue or audience as a result of having to reduce transmitter power or go off air in order to accomplish a safe working environment.

3.9.17 Provide surveyed and staked locations for utilities, foundations, and directional proof prior to arrival of tower installation and/or foundation installation crews. Surveys must be coordinated with ERI.

3.10 When foundations are specified as a part of the Proposal, the Proposal for such work is based upon such work being undertaken and completed under "assumed normal" soil conditions as described by the latest revision of the ANSI/EIA-222 code. It shall be the responsibility of the Buyer to supply specific soil descriptive parameters, and ERI shall have an absolute right to rely on written test reports furnished by Buyer in the preparation of foundation drawings and in the installation of foundations. Normal soil conditions do not include rock, saturated soil, frozen soil, peat, or other soil variations similar or dissimilar. If subsurface soil conditions differ from geotechnical report and delay foundation work, the project schedule will be increased accordingly, and additional charges will be billed.

3.11 The installation price does not include work such as clearing or grading of tower site; installing, re-locating or repairing utility services; obtaining profiles or surveys; installing grounding systems unless specified; blasting; rock removal; water evacuation; cribbing; installing fill; removal of obstructions; snow removal, installation of planking; road building; clearance for site access; clearing of guy anchor paths; or any other kind of site preparation or site maintenance work.

3.12 If necessity dictates non-included labor or materials to be expended resulting from but not limited to, compliance to OSHA or local safety standards, inadequate site accessibility, non-included specified soil conditions, non-included labor or material requirements, then ERI shall be allowed to increase the installation and materials price to include any additional cost incurred, plus a reasonable profit.

3.13 ERI has the right to complete installation work early and be compensated for delay damages if other segments of the project, not in ERI control, affect an early completion of any part of ERI's work if ERI submits a reasonable plan to place the Buyer on notice of the intent to finish early and submits documentation of delays.

3.14 If requested or approved by the Buyer, ERI may provide accelerated services including overtime and/or multiple crews, as required to maintain the schedule or provide other services, and Buyer agrees to compensate ERI for such services.

Revised July 23, 2020