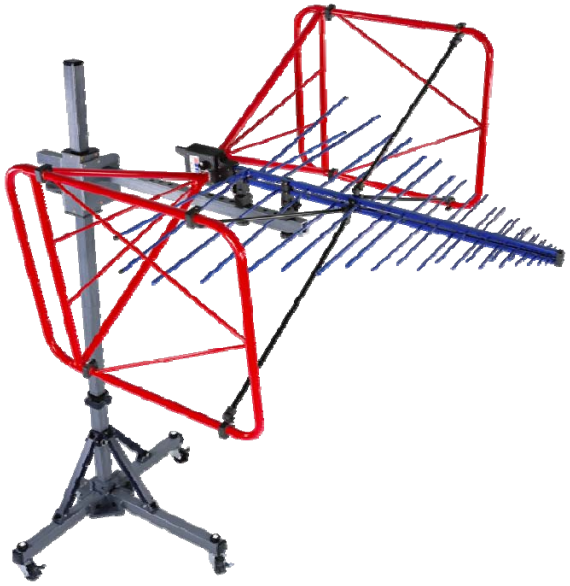
Model 3140B

BiConiLog™ Antenna

User Manual



Model 3140B mounted onto a 7-TR tripod (not included)

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Revision	Description	Date
A	Initial Release	November, 2000
B	Edits/updates	January, 2002
C	Edits/updates	January, 2003
D	Edits/updates	May, 2003
E	Rebrand	May, 2010

Table of Contents

Notes, Cautions, and Warnings

	**Note:** Denotes helpful information intended to provide tips for better use of the product.
CAUTION	**Caution**: Denotes a hazard. Failure to follow instructions could result in minor personal injury and/or property damage. Included text gives proper procedures.
WARNING	**Warning**: Denotes a hazard. Failure to follow instructions could result in SEVERE personal injury and/or property damage. Included text gives proper procedures.

 See the ETS-Lindgren *Product Information Bulletin* for safety, regulatory, and other product marking information.

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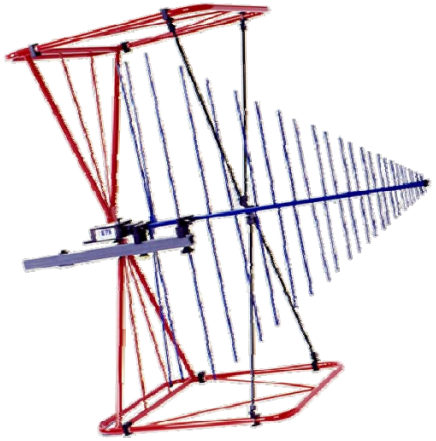
1.0 Introduction

The **ETS-Lindgren Model 3140B BiConiLog™** is a high-field antenna in the bow tie/log periodic family, providing the highest field-to-power ratio at low frequencies of any of the BiConiLog antennas. The Model 3140B is designed specifically to generate the field levels required for immunity/susceptibility tests required by standards such as IEC/EN 61000-4-3 using the lowest amount of input power possible.



A BiConiLog antenna combines a broadband biconical-like bow tie antenna with a standard log periodic dipole array (LPDA) to replace the traditional use of two antennas in the 26 MHz to 3000 MHz electromagnetic compatibility (EMC) test frequency range. Many EMC antennas are variations of a standard tuned dipole, which must be nearly half a wavelength long to transmit or receive energy most efficiently; at 26 MHz, a tuned dipole would have to be approximately 5.3 meters long, 4.6 meters long at 30 MHz, and 2.8 meters long at 50 MHz. This is unwieldy for many anechoic chambers and test sites. The end plates of the Model 3140B T bow ties make the bow tie antenna segment look like an antenna twice as long as the actual 1.6 meter length. The result is about a 10 dB improvement in low frequency transmit gain compared to a regular bow tie of the same length.

Although bow ties have been used for all of the elements on some log periodic antenna designs in the past, in EMC applications the advantage gained is an extension of the useful low frequency range of the typical LPDA from 100 MHz down to 26 MHz. At 26 MHz, an efficient single dipole type antenna must be over five meters long, whereas suitable performance is obtained here with a 1.6 meter bow tie. A simple wire outline bow tie antenna is narrowband compared to a sheet bow tie or biconical, so struts are added to the Model 3140B bow ties to better simulate the broadband sheet bow tie.

The unique feature of the Model 3140B is the T bow tie elements. A T bow tie increases the equivalent dipole electrical length, thereby decreasing resonant frequency and increasing efficiency in the 20 MHz to 60 MHz range. Similarly, a regular bow tie has a lower resonant frequency than an equal length single-wire dipole. The T bow tie has the first resonance at a frequency where the length is about 0.22λ, a regular bow tie at a length of 0.3λ, and a tuned dipole at about 0.48λ. Thus at 50 MHz the 1.4 meter long T bow tie of the Model 3140B behaves like a 2.8 meter tuned dipole. Cross-polar radiation is minimized because current flow on one of the T end frames is almost exactly cancelled by the oppositely-phased current on the other T end.

The standard self-balun feed of the log periodic also provides a matched balanced feed to the bow tie elements. To prevent cable pickup below 100 MHz and to improve matching to the bow tie elements, the Model 3140B contains a balun transformer which acts as a common-mode choke to keep unbalanced current off the coaxial feed cable outer shield, as well as adding some additional inductance to improve impedance matching to the bow ties. Even though the Model 3140B is highly balanced (symmetry +/- 0.5 dB), in vertically polarized measurements cable position can effect results, so it is recommended that the cable be suspended horizontally back from the antenna at least one meter before any vertical drop. Below 150 MHz bow tie radiation dominates with a dipole-like pattern, while above 150 MHz the radiation in the plane of the elements is directional.

The Model 3140B is designed only for immunity testing. The large size of the antenna makes it impractical for emissions testing where height scanning is required, and the bow tie end plates increase the measurement uncertainty when the antenna is polarized vertically. For that reason, individual calibrations are not provided for the Model 3140B.

About Mounting the Model 3140B

The Model 3140B can be mounted on the 2-in square booms of these ETS-Lindgren products:

- Model 7-TR Tripod Positioner
- Model 2075 MiniMast™
- Model 2070/2071 Antenna Positioning Mast

See *Mounting Illustrations* on page 26 for diagrams showing the Model 3140B mounted to these ETS-Lindgren products.

For the variety of mounting options available for the Model 3140B, see *Mounting Instructions* on page 23.

7-TR Tripod Positioner

ETS-Lindgren offers the non-metallic, non-reflective Model 7-TR for use at both indoor and outdoor EMC test sites.

Constructed of PVC and fiberglass components, providing increased stability for physically large antennas. The unique design allows for quick assembly, disassembly, and convenient storage. Allows several different configurations, including options for manual or pneumatic polarization. Quick height adjustment and locking wheels provide ease of use during testing. Maximum height is 2.17 m (85.8 in), with a minimum height of 0.8 m (31.8 in). This tripod can support a 13.5 kg (30 lb) load.

ETS-Lindgren Product Information Bulletin

See the ETS-Lindgren *Product Information Bulletin* included with your shipment for the following:

- Warranty information
- Safety, regulatory, and other product marking information
- Steps to receive your shipment
- Steps to return a component for service
- ETS-Lindgren calibration service
- ETS-Lindgren contact information

2.0 Maintenance

CAUTION

Before performing any maintenance, follow the safety information in the ETS-Lindgren *Product Information Bulletin* included with your shipment.

Maintenance of the Model 3140B is limited to external components such as cables or connectors.

If you have any questions concerning maintenance, contact ETS-Lindgren Customer Service.

About Calibration

The Model 3140B BiConiLog™ Antenna was designed for immunity testing, so the generated field is measured with a calibrated field probe, not the Model 3140B. For that reason, it is not required that the Model 3140B be recalibrated regularly. If you would like to have your Model 3140B antenna verified or serviced please contact ETS-Lindgren Calibration.

See the *Product Information Bulletin* included with your shipment for information on ETS-Lindgren calibration services.

Service Procedures

For the steps to return a system or system component to ETS-Lindgren for service, see the *Product Information Bulletin* included with your shipment.

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3.0 Specifications

Electrical Specifications

Frequency Range:	26 MHz–3000 MHz
Input Impedance:	50 Ω
VSWR (Average):	2:1
CW Power (Average):	• 26 MHz to 150 MHz = 750 W • 150 MHz to 600 MHz = 500 W • 600 MHz to 1 GHz = 365 W • 1 GHz to 3 GHz = 200 W
Symmetry:	+/- 0.5 dB
Connector:	Type N female

Physical Specifications

Height (T Bow Tie):	76.65 cm (30.18 in)
Width (T Bow Tie):	161.5 cm (63.60 in)
Depth (Length):	151.3 cm (59.6 in)
Weight:	10 kg (22 lb)

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4.0 Assembly Instructions

CAUTION

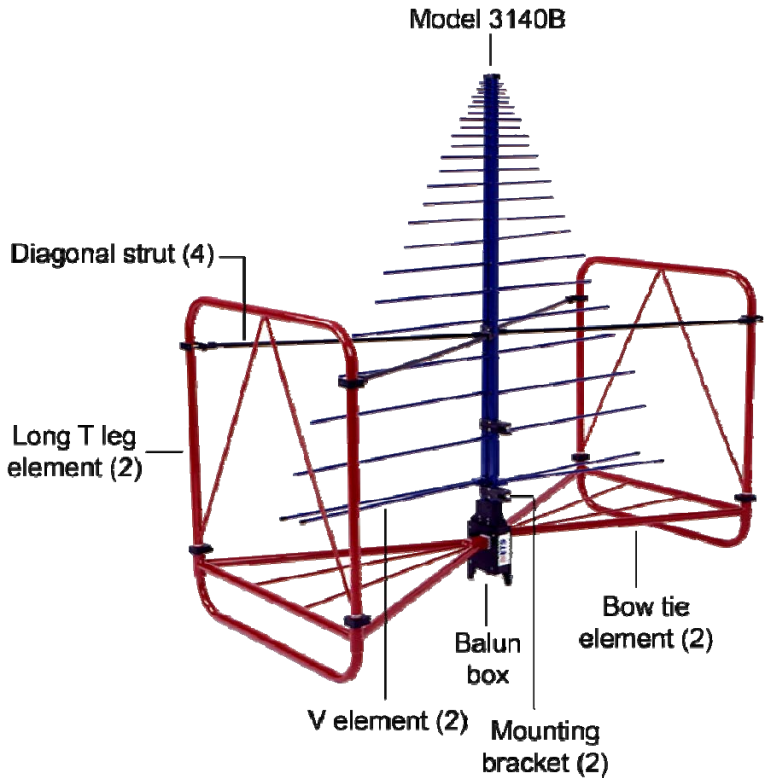
Before connecting any components, follow the safety information in the ETS-Lindgren *Product Information Bulletin* included with your shipment.

Model 3140B Components

The Model 3140B BiConiLog™ Antenna consists of the following:

- Antenna
- Bow tie elements (2)
- Long T leg elements (2)
- Diagonal struts (4)
- V elements (2)
- Boom assembly
- Mount knobs (2): one 7/8-in (104169) and one 1/4-in (104136)
- Polarizing adapters (100989) for booms with 7/8-in mount holes (2)
- Thread inserts (105861B) 7/8 in-to-1/4 in (2)

Model 3140B Assembled

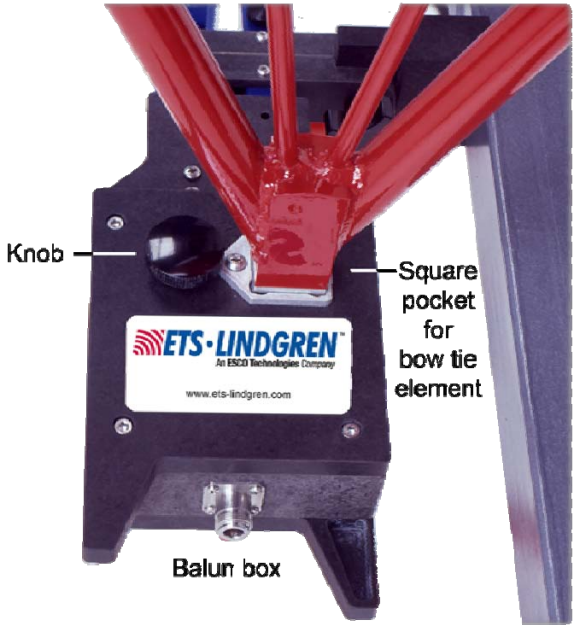


Steps to Assemble the Model 3140B

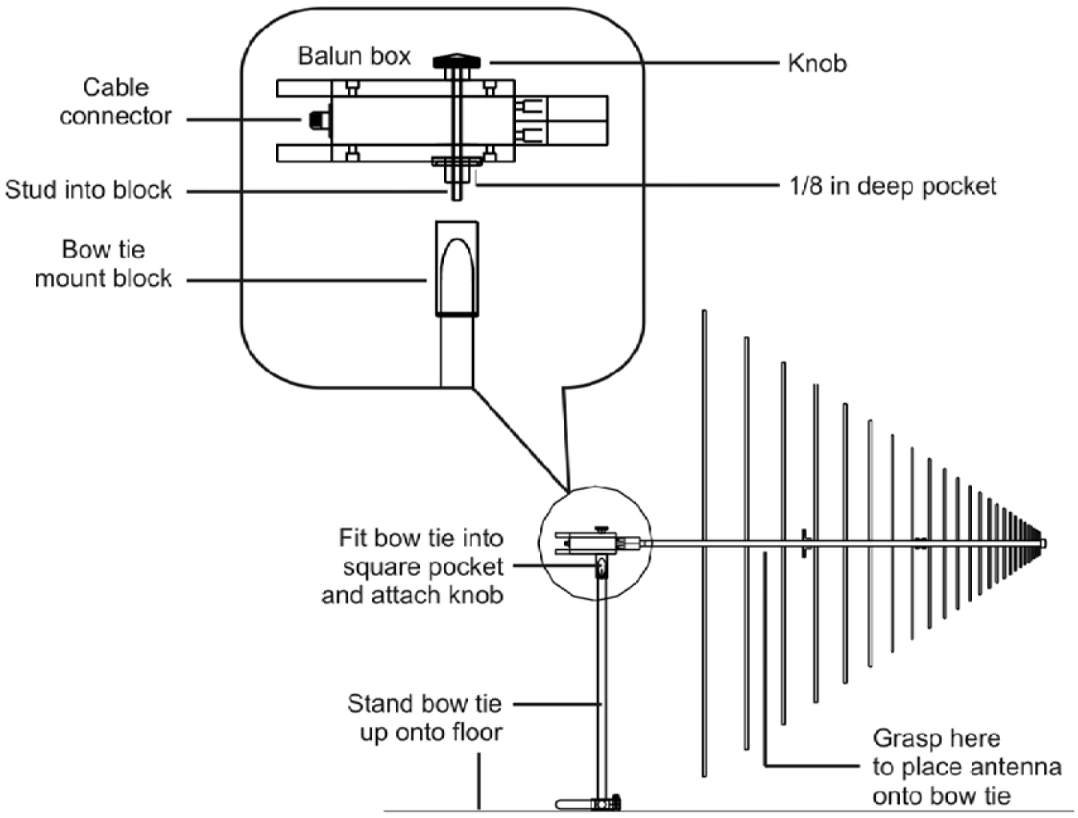
CAUTION

To eliminate stress and prevent damage to the balun box connection, you must support the antenna while attaching the bow tie elements.

ATTACH BOW TIE ELEMENTS



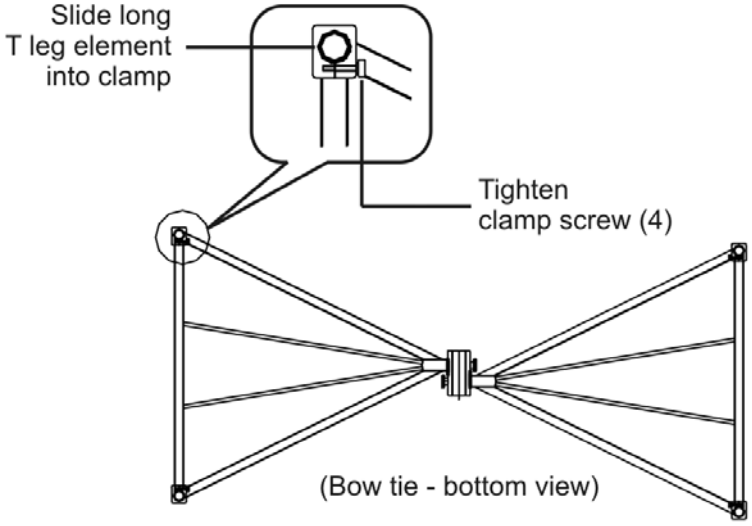
1. Place the bow tie vertically on the floor and hold the antenna horizontally. See illustration on next page.
2. Fit the bow tie into one side of the balun.
3. Insert and tighten the knob.
4. Carefully place the antenna in a vertical position with the feet of the balun box level and on a flat surface.
5. Repeat steps 2 and 3 to attach the second bow tie element to the balun box.

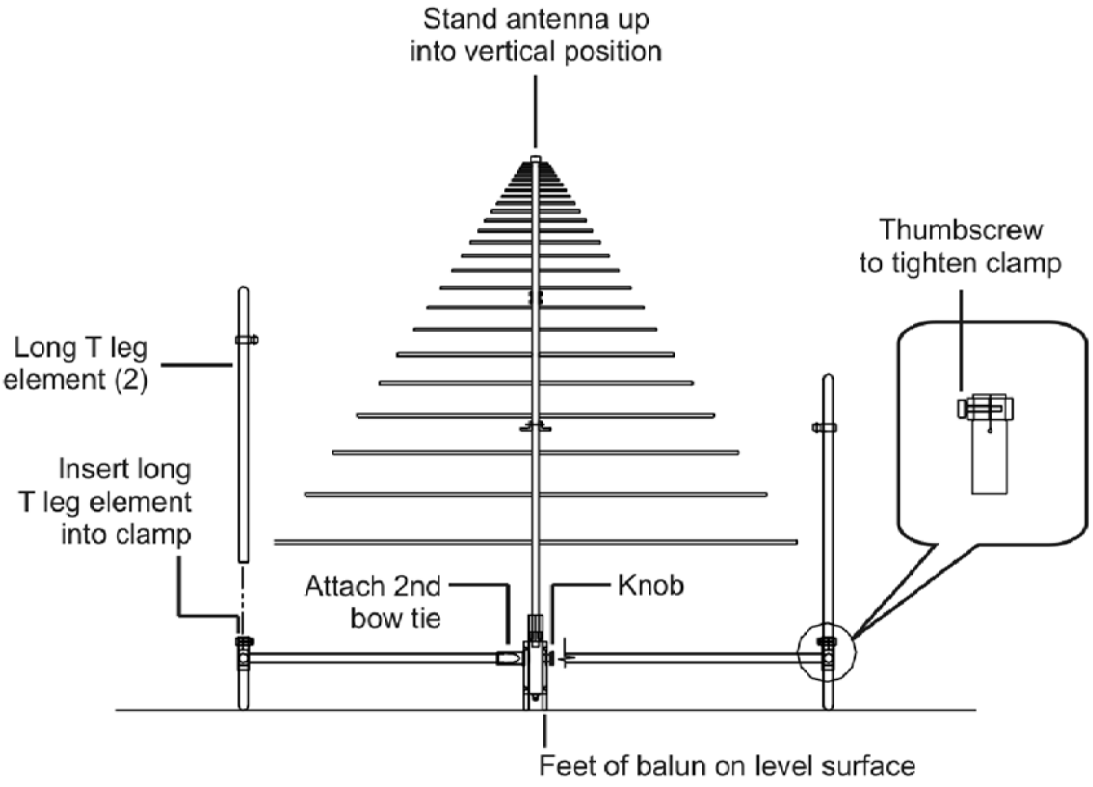

Balun box
Knob
Cable connector
Stud into block
1/8 in deep pocket
Bow tie mount block
Fit bow tie into square pocket and attach knob
Stand bow tie up onto floor
Grasp here to place antenna onto bow tie

ATTACH T LEG ELEMENTS

6. Insert one long T leg element into the clamp and tighten the clamp screws. See illustration on next page.

7. Repeat for second T leg element.

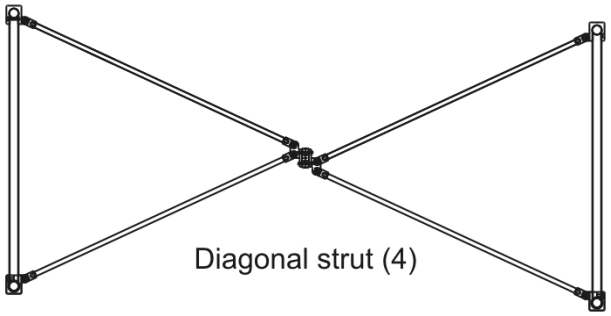


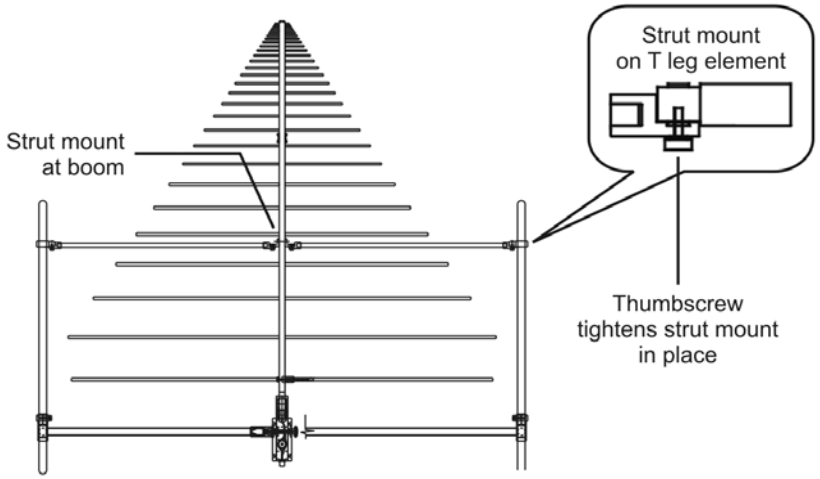

Stand antenna up
into vertical position
Thumbscrew
to tighten clamp
Long T leg
element (2)
Insert long
T leg element
into clamp
Attach 2nd
bow tie
Knob
Feet of balun on level surface

ATTACH DIAGONAL STRUTS

8. Attach the four diagonal struts.

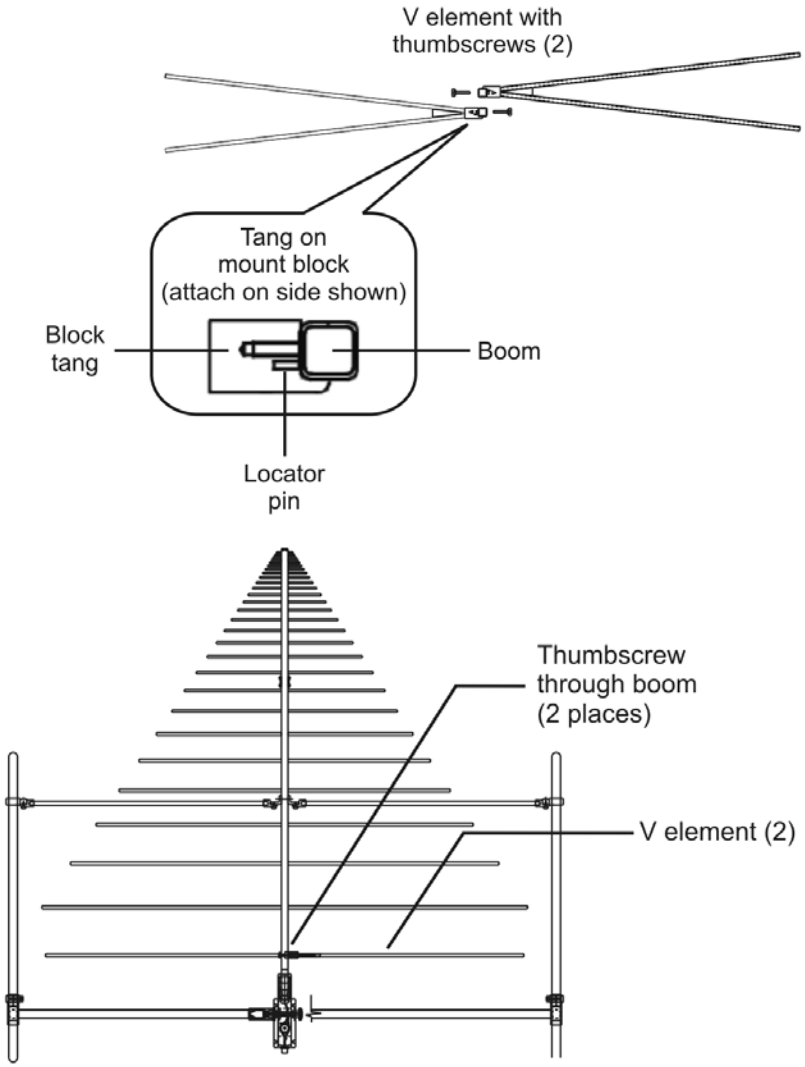
- Loosen the thumbscrew at each strut mount on the T leg element and at the boom.
- Place the pocket of the straight end facing the raised face of each mount.
- Tighten the thumbscrew.





ATTACH V ELEMENTS

9. Attach the V elements and tighten the thumbscrews through the boom



The Model 3140B is now ready for mounting to a tripod or mast. See *Mounting Instructions* on page 23.

5.0 Mounting Instructions

CAUTION **Before connecting any components, follow the safety information in the ETS-Lindgren *Product Information Bulletin* included with your shipment.**

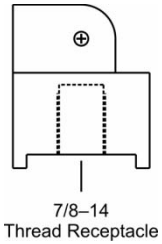
CAUTION **The Model 3140B is a precision measurement device. Handle with care.**

Do not mount the Model 3140B onto an ETS-Lindgren 4-TR Tripod.

Included Mounting Adapters

The Model 3140B BiConiLog™ ships with these mounting adapters:

- **100989 Polarizing Mounting Adapter with 7/8–14 thread receptacle (2)**



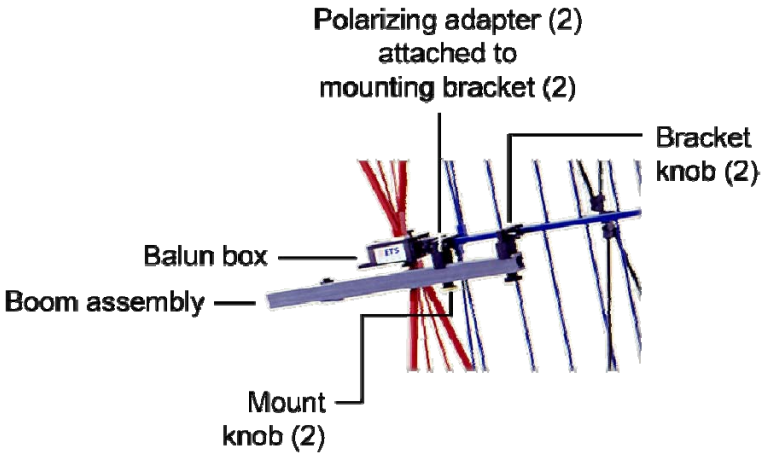
If you need to convert the polarizing adapter to a 1/4–20 receptacle, insert the 1/4–20 thread insert into the polarizing adapter

- **105861B 1/4–20 Thread Insert (2)**

Using Included Adapters to Mount to an Offset Boom

ATTACH INCLUDED MOUNTING ADAPTERS TO MODEL 3140B

To allow manual polarization of the Model 3140B, install the 100989 polarizing adapters with the curve at the top of each adapter facing the same direction. To prohibit manual polarization, install one adapter with the curve facing the opposite direction from the other.



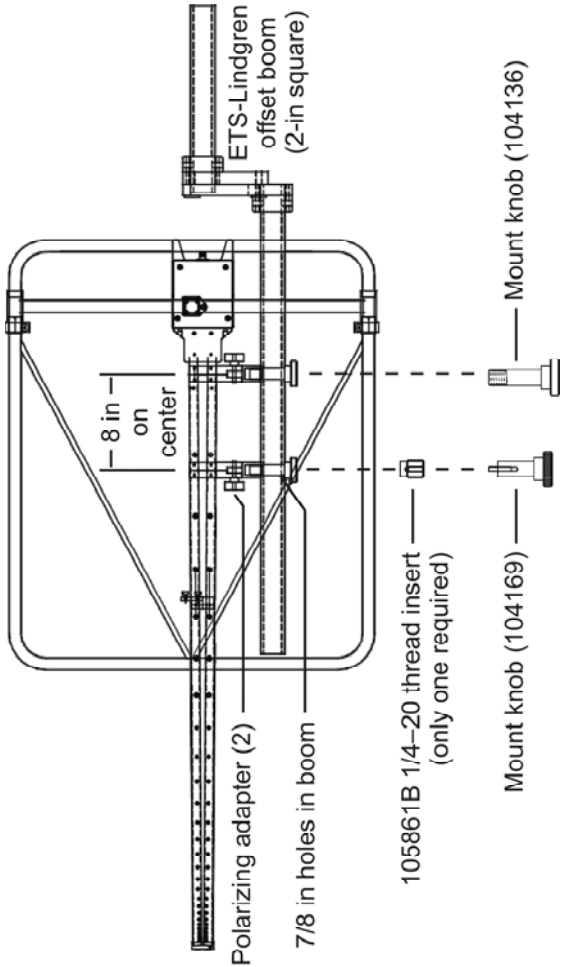
1. Place one 100989 polarizing adapter between the shoulders of one of the mounting brackets on the antenna.

Do not cross thread or permanent damage to the adapter and thread insert could occur.

2. Thread a bracket knob through the mounting bracket, then through the polarizing adapter, and finally through the hex nut.
3. Tighten the mounting knob to secure the antenna.
4. Repeat steps 1, 2, and 3 for the remaining polarizing adapter and mounting bracket.

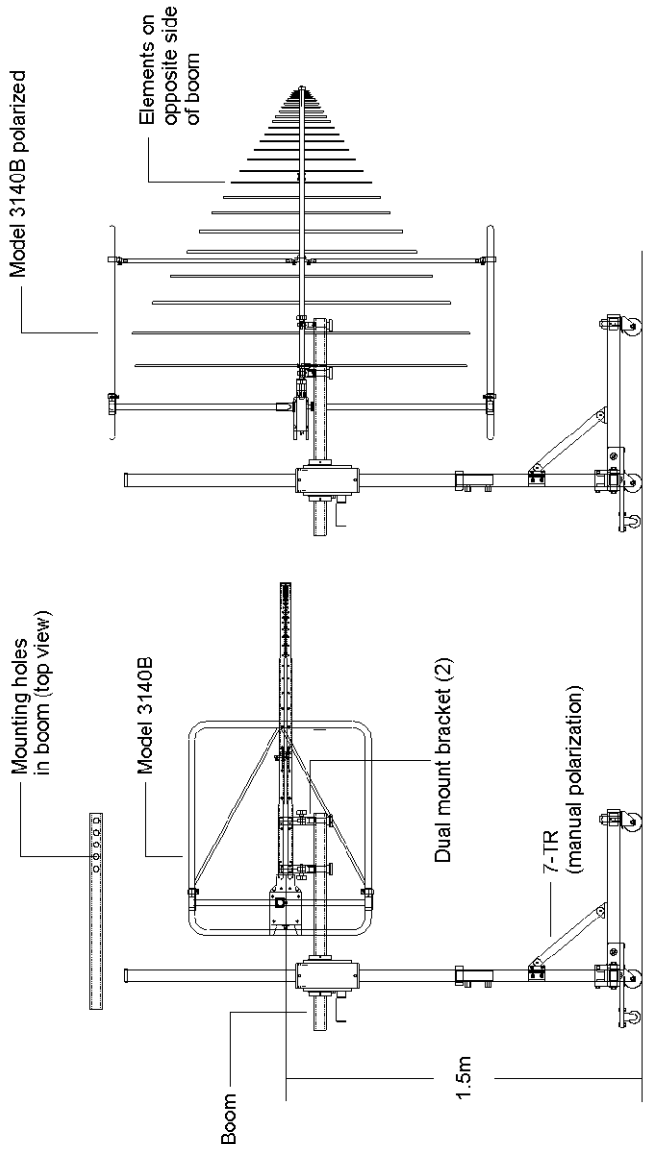
ATTACH MODEL 3140B TO AN ETS-LINDGREN OFFSET BOOM

1. Place the Model 3140B onto the offset boom with the attached polarizing adapters flat against the top surface of the boom.
2. Holding the Model 3140B securely, insert one 105861B 1/4–20 thread insert into the underside of the offset boom.
3. Attach the two mount knobs and tighten to secure the Model 3140B to the offset boom.

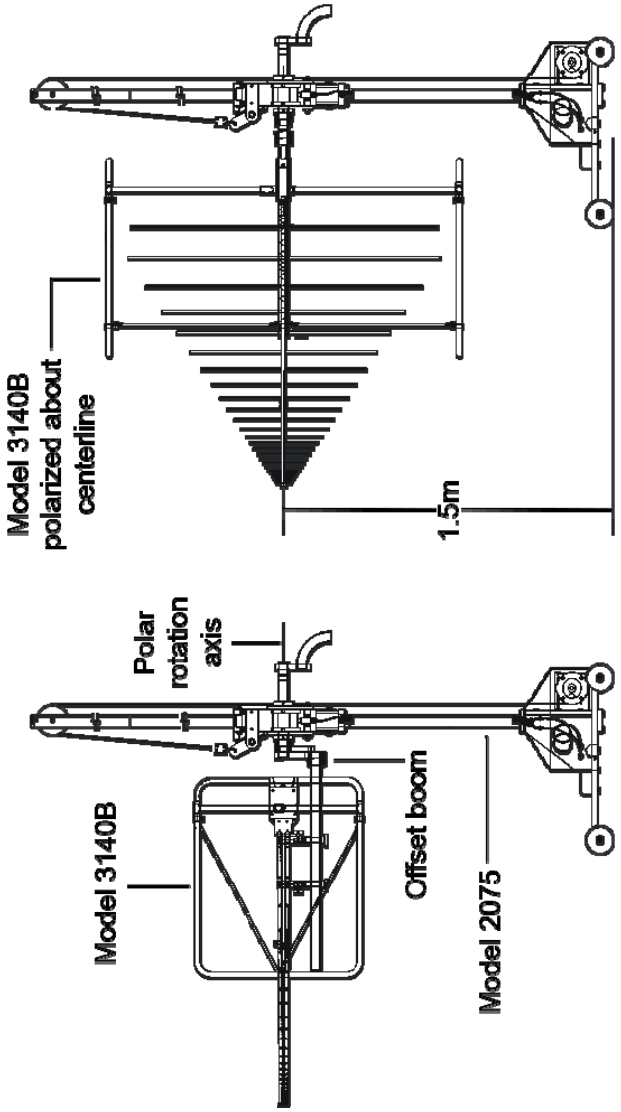


Mounting Illustrations

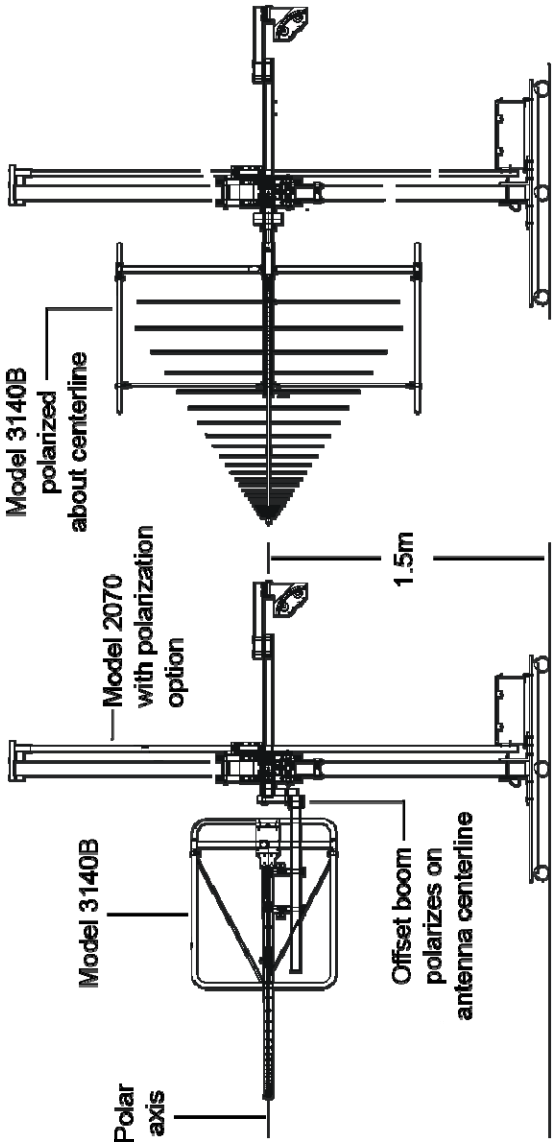
MODEL 3140B ON 7-TR TRIPOD POSITIONER



MODEL 3140B ON MODEL 2075 MINIMAST



MODEL 3140B ON MODEL 2070/2071 ANTENNA POSITIONING MAST

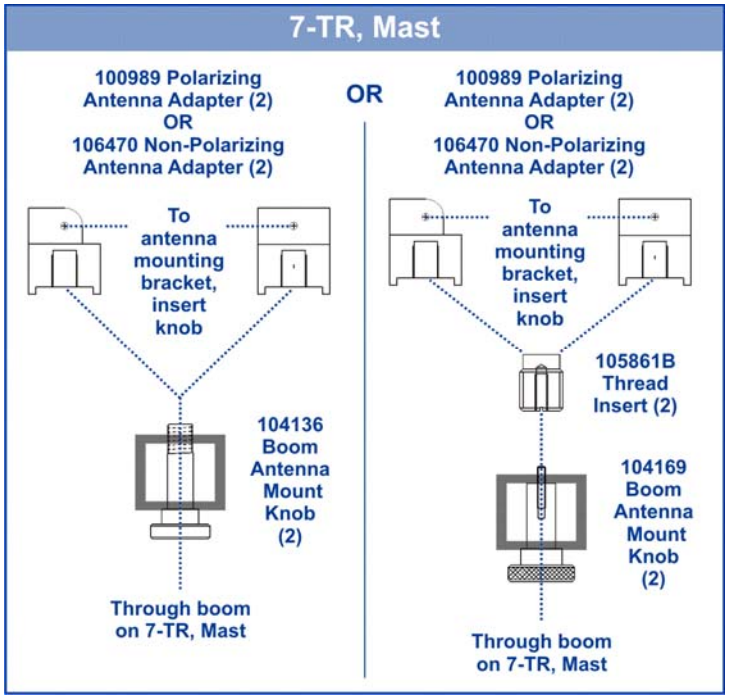


7-TR AND MAST MOUNTING OPTIONS

Following are options for mounting the Model 3140B onto an ETS-Lindgren 7-TR Tripod or mast. Contact the ETS-Lindgren Sales Department for information on ordering optional mounting hardware.

Mast refers to 2070 Series, 2075, and 2175 Antenna Towers.
7-TR refers to 109042, 106328, and 108197 booms:

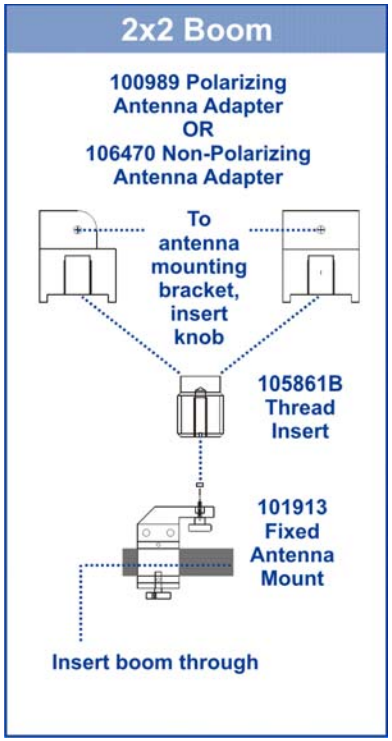
- *109042 boom*—Straight boom; for general antenna mounting on a 7-TR
- *106328 boom*—Offset boom; for general antenna mounting on a 7-TR with pneumatic or manual polarization
- *108197 boom*—Center rotate boom; for rear-mount stinger-type antennas only



2X2 BOOM MOUNTING OPTIONS

Following are options for mounting the Model 3140B onto a 2x2 boom. Contact the ETS-Lindgren Sales Department for information on ordering optional mounting hardware.

2x2 boom refers to a typical 2-inch by 2-inch boom



6.0 Application

After mounting the Model 3140B BiConiLog™, connect an N-type coaxial cable from the antenna connector to a signal generator or amplifier. Contact with any metal or non-metallic structure can capacitively load the antenna, which may cause unrepeatable results. Therefore, make sure that no part of the dipole elements or bow ties is in contact with the tripod or tower, particularly in vertically-polarized tests. Where possible, run the feed cable straight back at least one meter or more from the Model 3140B before dropping vertically.

Both horizontal and vertical polarizations are easily accomplished when the Model 3140B is mounted on an ETS-Lindgren tower. The Model 7-TR Tripod Positioner is designed specifically for T bow tie BiConiLog antennas for easy changes to polarization, and with the air polarization option can provide automated polarization using a Model 2090 Multi-Device Controller. See *Mounting Instructions* on page 23 for mounting schemes for ETS-Lindgren towers and the 7-TR Tripod.

For immunity testing, the electric field strength generated at a distance *d* can be approximated by:

$$E(\mathrm{V/m}) = \frac{\sqrt{30Pg}}{d}$$

d = distance, in meters

g = numeric gain ($10^{G[dB]/10}$)

P = antenna net input power, in watts

An estimate of the power required for any field strength *E* can be obtained from the forward power graphs in *Typical Data* on page 33, which shows forward power required in watts to generate 1 V/m. While the formula provided previously is based on the net power (forward minus reflected) transmitted by the antenna, the gain determined from the antenna factor already contains effects due to mismatch, so the formula then predicts the required forward power rather than net power. To determine the power (in watts) required for any other field strength not shown, multiply the power required for 1 V/m by the desired *E*-field squared, or

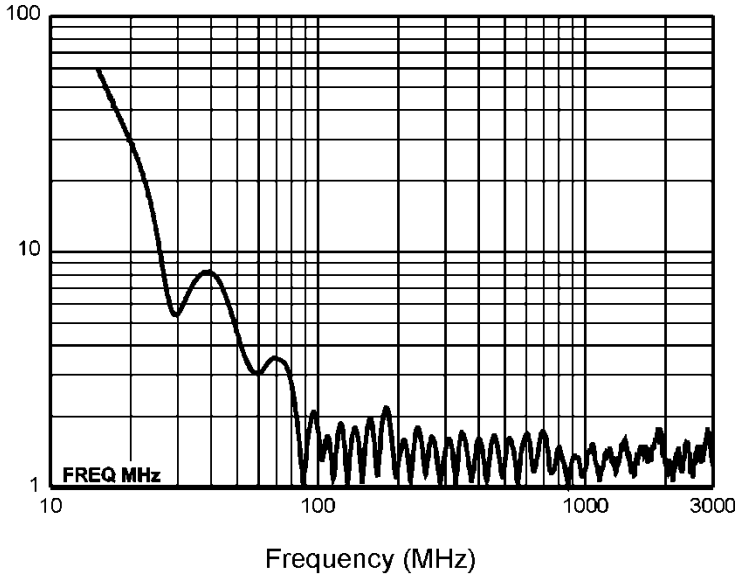
$$P(E\ \mathrm{V/m}) = E^2 P(1\ \mathrm{V/m})$$

To determine the additional amplifier overhead required to handle 80% amplitude modulation, multiply the result by 3.24 (1.8^2). Actual transmitted field strength should be verified using an ETS-Lindgren Model HI-6005 Field Probe, or equivalent. The forward power data graphs on page 39 and page 40 show power requirements for the lower frequencies at three meters based on measurements using a field probe on an Open Area Test Site (OATS) over both conducting ground and a $(2.4\mathrm{m})^2$ ferrite absorber field over conducting ground. For IEC 61000-4-3 type testing, the antenna tip can be placed at any distance between one and three meters from the Equipment Under Test (EUT) as long as the front face plane is illuminated according to the -0, +6 dB uniform field specification. In general, closer distances require less power to create a given field strength.

7.0 Typical Data

Model 3140B Typical VSWR

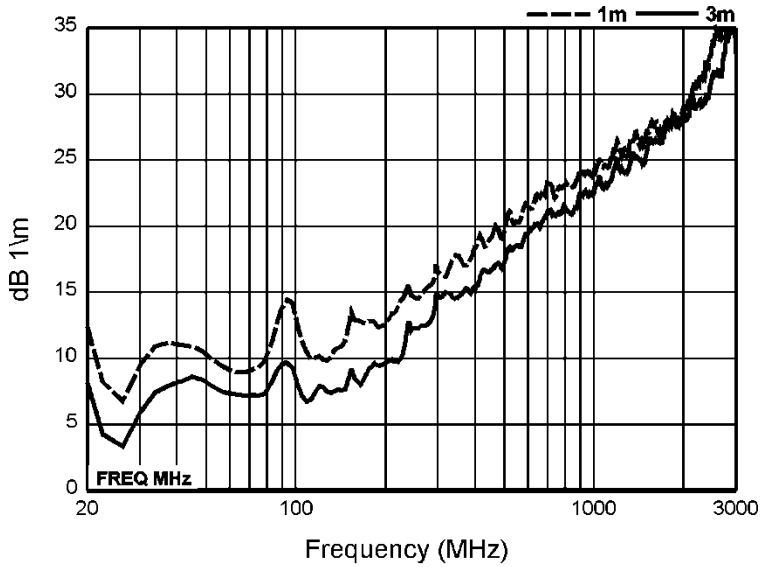
This graph illustrates the typical VSWR for Model 3140B in the frequency range 26 MHz to 3000 MHz.



Model 3140B Typical Antenna Factors

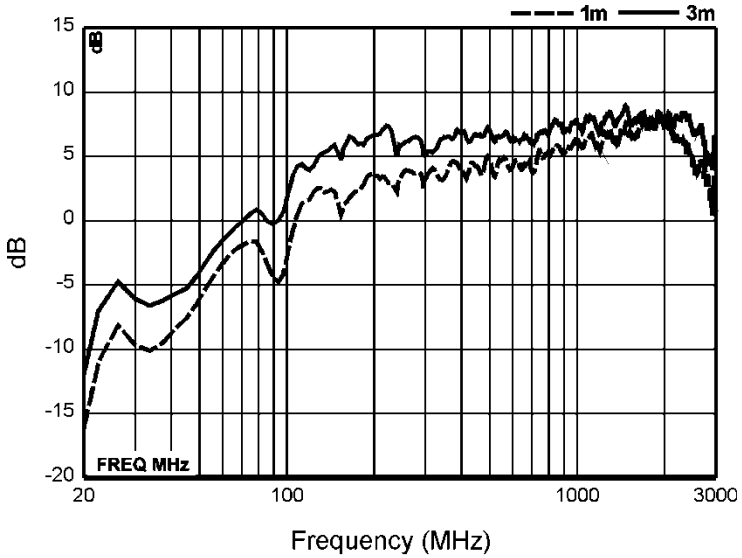
This graph illustrates the typical horizontal antenna factors for the Model 3140B in the frequency range 26 MHz to 3000 MHz.

The separation distance for the ANSI C63.5 three and 10 meter calibrations is measured from the antenna midpoint, while for SAE/ARP-958 one meter calibrations the distance is measured from the antenna tip. Midpoint is defined as half the distance between the small elements and the bow ties, which is about 65 cm from the small end tip.



Model 3140B Gain

This graph illustrates one and three meter gain.

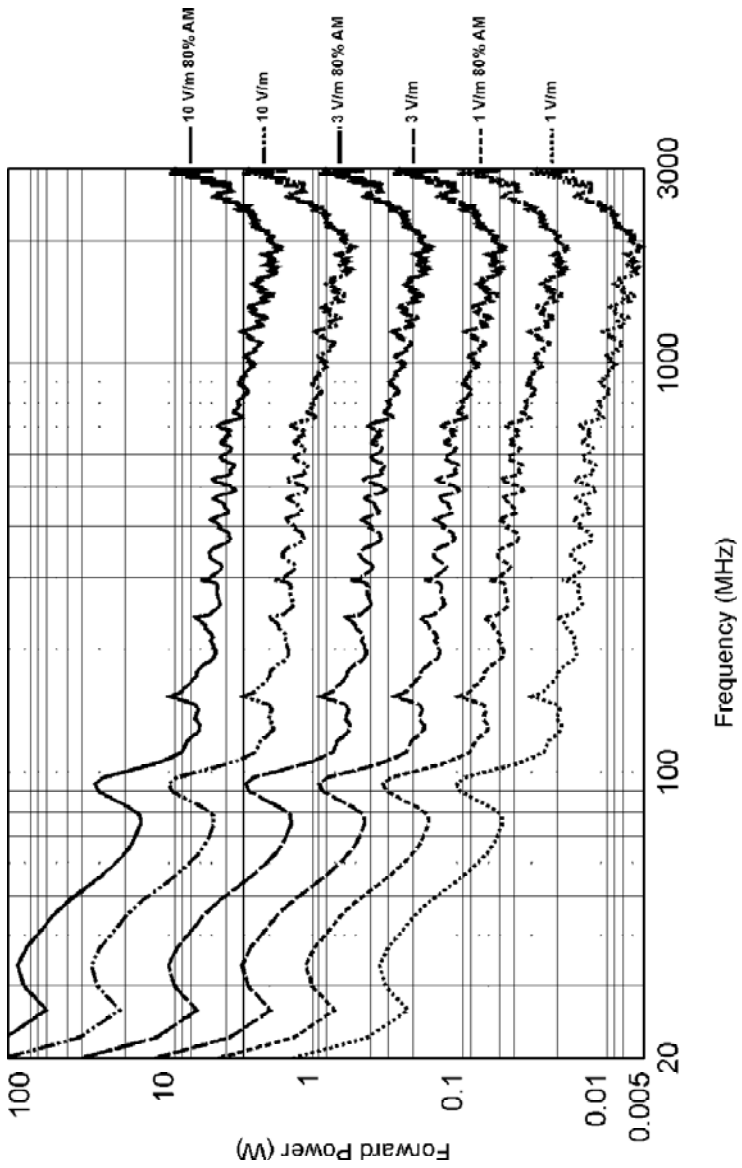


Model 3140B Typical Forward Power (FP)

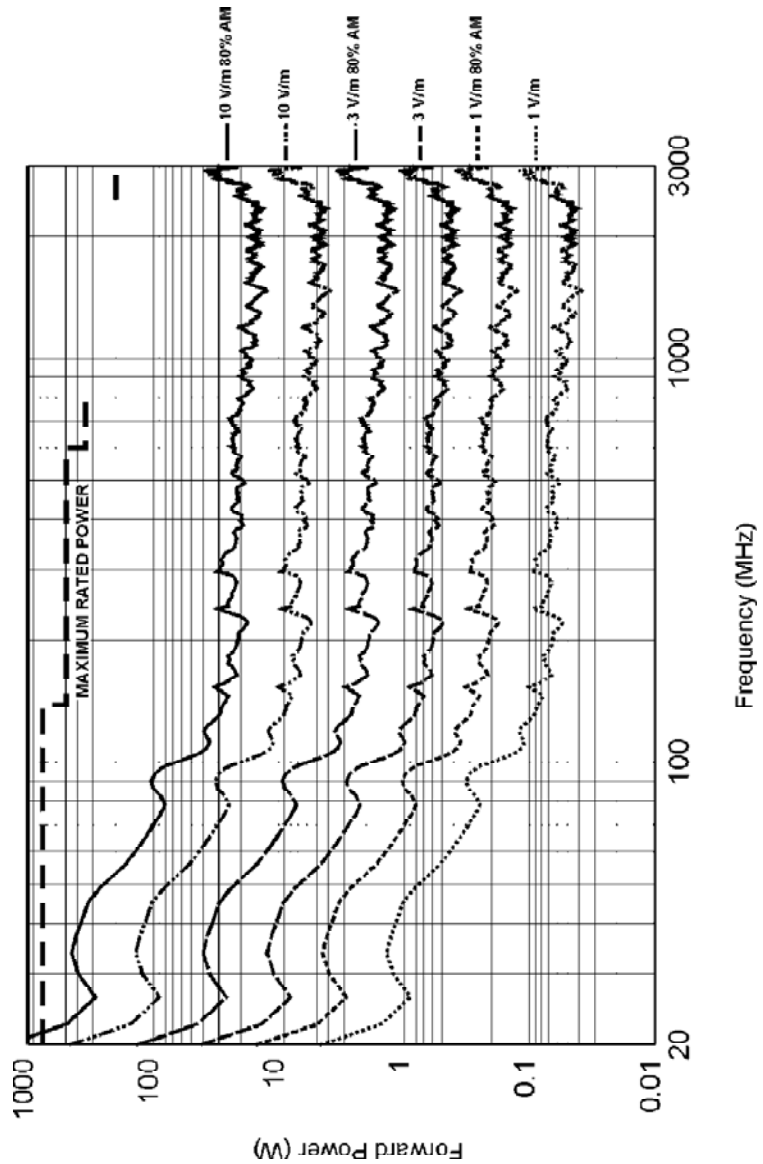
The forward power graphs illustrate the typical forward power required for one, three, and 10 V/m (with and without 80% amplitude modulation).

- The graph on page 37 illustrates one meter from the tip of the antenna, and the graph on page 38 illustrates three meters from the tip of the antenna.
- The graphs on page 39 and page 40 illustrate power requirements for the lower frequencies at three meters based on measurements using a field probe on an Open Area Test Site (OATS) over both conducting ground and a $(2.4m)^2$ ferrite absorber field over conducting ground. The power shown was measured with 1.5 meter transmit antenna and probe height and horizontal polarization. Horizontal polarization represents the worst-case power requirement; typically less power is required for vertical polarization. In practice, many users place ferrite tiles on the ground between the antenna and probe to reduce reflected-ray interference. For any other field strength *E*, multiply the power in watts for 1 V/m by E^2.

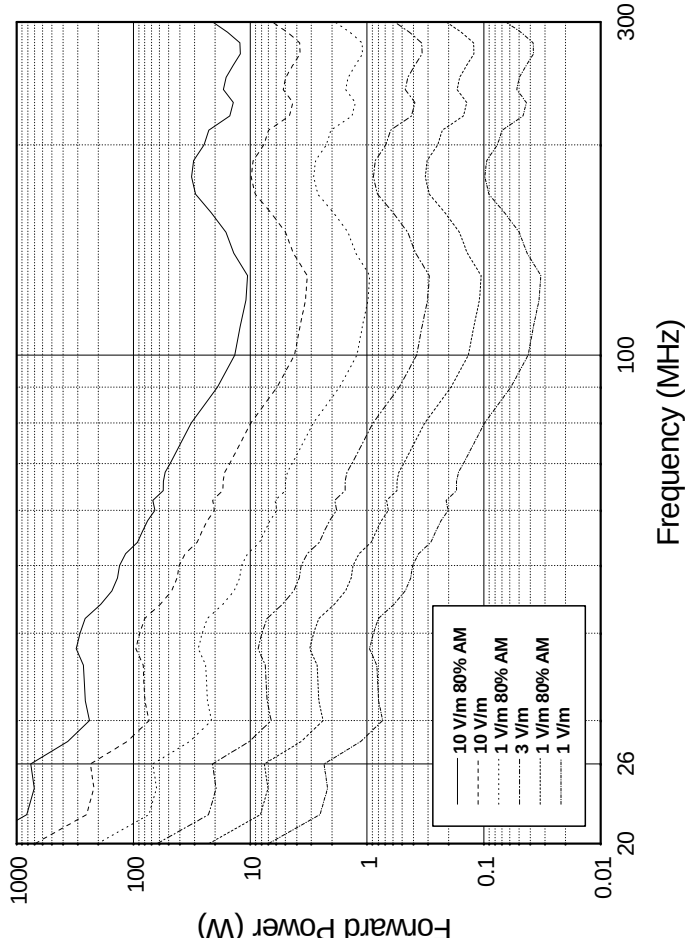
TYPICAL 1 METER FP BASED ON 1 METER ANTENNA FACTOR



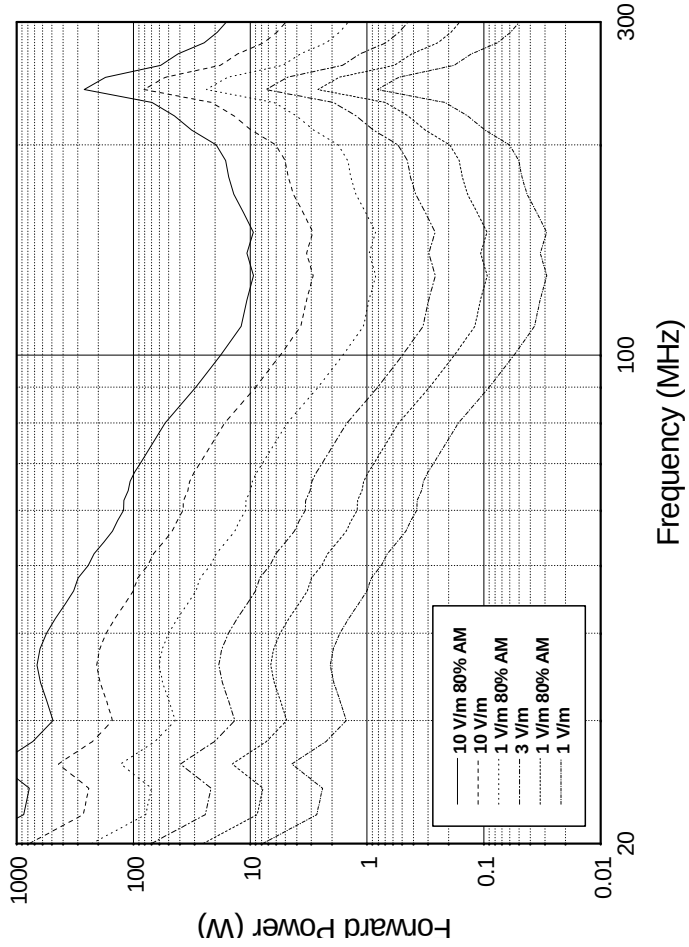
TYPICAL 3 METER FP BASED ON 3 METER ANTENNA FACTOR



TYPICAL 3 METER FP OVER FERRITE TILE



TYPICAL 3 METER FP MEASURED OVER CONDUCTING GROUND



Appendix A: Warranty

See the *Product Information Bulletin* included with your shipment for the complete ETS-Lindgren warranty for your Model 3140B.

DURATION OF WARRANTIES FOR MODEL 3140B

All product warranties, except the warranty of title, and all remedies for warranty failures are limited to two years.

Product Warranted	Duration of Warranty Period
Model 3140B BiConiLog™	2 Years