Model 3142B

BiConiLog™ Antenna

MANUAL

ETS·LINDGREN™
An ESCO Technologies Company

 REV C – PN 399229

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INTRODUCTION

The ETS-Lindgren EMCO brand Model 3142B BiConiLog™ Antenna is designed as a dual-purpose antenna that can be used for both emissions and immunity applications. The Model 3142B is a hybrid linearly polarized EMC antenna consisting of a log–periodic dipole array (LPDA) and a single bow-tie antenna. Although bow-ties have been used for all elements on log-periodic antennas in the past, in EMC applications the advantage gained is an extension of the useful low frequency range of the typical LPDA's from 100 down to 30 MHz. At 30 MHz, an efficient single dipole type antenna must be 5 meters long, whereas suitable performance is obtained here with a 1.7 meter long bow-tie.

A simple wire outline bow-tie antenna is narrowband compared to a sheet bow-tie or biconical, thus struts are added to the Model 3142B bow-ties to better simulate the broadband sheet bow-tie. The standard "self-balun" feed of the log-periodic also provides a matched, balanced feed to the bow-tie elements. 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.

To prevent cable pickup below 100 MHz, the Model 3142B contains a "balun" which acts as a common-mode choke to keep unbalanced current off the coaxial feed cable outer shield. Even though the Model 3142B is highly balanced, 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 1 meter before any vertical drop.

The antenna has a mounting bracket and 1/4X20 UNC knob for attaching to an ETS-Lindgren tripod or tower adapter. Individual antenna factors and gain calibration data is included with each antenna.

The Model 3142B optional end plates (Part Number 106572) are available to improve gain for immunity testing. This option consists of two end plates that are easily attached and detached by hand using captive screw knobs. When the end plates are attached it creates a T shaped bow-tie element.

For any dipole–type antenna to transmit or receive energy most efficiently, its length must be nearly a half wavelength, which is about 4.6 meters long at 30 MHz, and 2.8 meters long at 50 MHz. Unfortunately, this is too unwieldy for many anechoic chambers and test sites. The optional end plates of the Model 3142B make it look like an antenna twice as long as its 1.4 meter length. The result is about a 10 dB improvement in low-frequency transmit gain and receive antenna factor compared to a same-length regular bow-tie.

With the end plates attached to the Model 3142B bow-tie elements the equivalent dipole electrical length is increased, thereby decreasing resonant frequency and increasing efficiency in the 20-60 MHz range. Similarly, the regular bow-tie has a lower resonant frequency than an

equal length single-wire dipole. The T end plate option has its first resonance at a frequency where its length is about 0.22 λ, a regular bow-tie at a length of 0.3 λ, and a tuned dipole at about a length of 0.48 λ. Thus at 50 MHz the 1.4m long end plate option of the Model 3142B behaves like at 2.8 m 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.

ASSEMBLY & MOUNTING INSTRUCTIONS

The Model 3142B consists of the following:

1 ea. Antenna
2 ea. Bow-Tie Elements
2 ea. 1/4x20 Knobs for attaching Bow-Tie elements.
2 ea. Protective End Caps on the Bow-Tie elements.
8 ea. Screws to attach the Protective End Caps to the Bow-Tie elements.

The Optional End Plate package consists of:

2 ea. T Bow-Tie Endplates
8 ea. Thumbscrew Knobs for attaching the endplates to the bow-tie elements.

Step 1. Mount the Model 3142B on a tripod or tower adapter, without the bow-tie elements attached.

Step 2. Slide the narrow end of one of the bow-tie elements into the receptacle hole on the boom and align the bow-tie with the receptacle on the boom as shown in the picture. Insert one of the 1/4x20 knobs into the opposite side of the boom where the bow-tie was just inserted.

Slowly tighten the knob taking care not to cross thread the connection. Cross threading this connection could cause permanent damage to the bow-tie element. Repeat Step 2 for the other bow-tie element.

Bow-tie element connection to antenna boom.

Bow-tie element receptacle hole and optional end plate with screw knob.

Step 3. Connecting the optional end plates to create the T bow-ties. The Model 3142B has a black end cap on each of the bow-tie elements to protect them. In order to utilize the optional end plates that create the T bow-ties, the black end caps must first be removed. Using a Phillips head screwdriver carefully remove the four screws in each of the bow-tie end caps. Store the end caps and the screws in a safe place, as they should be reinstalled when you are done using the optional end plates.

Align the four holes on the wide end of the bow-tie element with the four holes on the end plate. Insert and slowly tighten each of the 4 small knobs in the receptacle holes. Be careful not to cross-thread this connection or permanent damage to bow-tie could occur. Repeat Step 3 for the other optional end plate.

Contact with any metal or non-metallic structure can capacitively load the antenna, which may cause unrepeatable results. Therefore, care must be taken to ensure that no part of the dipole elements or bow-ties are in contact with the tripod or tower, particularly in vertically-polarized tests. Where possible, run the feed cable straight at least 1 meter or more back from the Model 3142B before dropping vertically.

Both horizontal and vertical polarization is easily accomplished when the Model 3142B with the optional end

plates is mounted on a tower. Vertical polarization on a tripod requires special consideration. Since immunity power requirements are many dB lower for vertical polarization, the T end frames can be removed when mounting vertically on a standard tripod. A special tripod is available from ETS-Lindgren for vertical polarization with T bow-ties intact. Please contact ETS-Lindgren for the recommended mounting scheme.

APPLICATION WITHOUT THE OPTIONAL END PLATES

For emissions measurements, electric fields strength in dB[V/m] is obtained from

$$E(dB[V/m]) = V(dB[V] + AF(dB[1/m]) + \alpha(dB)$$

where V is the receiver or spectrum analyzer voltage reading, AF is antenna factor (see attached calibration data), and α is cable loss, if cable losses are non-negligible.

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

$$E(V/m) = \sqrt{(30\ P\ g) / d}$$

where d is in meters, g is the numeric gain ($10^{G[dB]/10}$, see attached calibration data), and P is antenna net input power in watts. An estimate of the power required for any field strength E can be obtained from Figure 4 in the Typical Data section below, which shows power required in watts to generate 1 V/m. Power shown is calculated from the measured gain and corrected for VSWR. For any other field strength, multiply the power in watts by desired E-field squared, or

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

Actual transmitted field strength should be verified using an ETS-Lindgren electric field probe or equivalent. An estimate of the power required taking VSWR into account is obtained from

$$P_f = P_n / \{1-[(VSWR-1)/(VSWR+1)]^2\}$$

where P_f is the forward (amplifier output) power and P_n is the new power as discussed above.

For IEC 1000-4-3 type testing, the antenna tip can be placed at any distance between 1 and 3 m from the EUT as long as the front face plane is illuminated according to the –0,+6 dB specification.

APPLICATION WITH THE OPTIONAL T BOW-TIE END PLATES

For emissions testing it is recommended that the Model 3142B be used without the optional end plates. The coupling of the endplates to ground will create higher uncertainty values, particularly in the vertical polarization. *For more information about this issue see the article "Understanding the measurement uncertainties of the bicon/log hybrid antenna" by Zhong Chen in the 1999 issue of Item The International Journal of EMC.*

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

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

where d is in meters, g is the numeric gain ($10^{G[\mathrm{dB}]/10}$, see attached calibration data) and P is antenna net input in watts. An estimate of the power required for any field strength E can be obtained from Figure 3 or 4 in the Typical Data section below, which shows power required in watts to generate 1 V/m. For any other field strength not show, multiply the power in watts by the desired E-field squared, or

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

Actual transmitted field strength should be verified using an ETS-Lindgren electric field probe or equivalent. For IEC 1000-4-3 type testing, the antenna tip cam be placed at any distance between 1 and 3 m from the 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.

TYPICAL DATA WITHOUT THE END PLATES

Figure 1 shows typical 26-200 MHz VWSR for the Model 3142B.

Figure 2 shows typical Model 3142B 26-2000 MHz antenna factors. Distance for the ANSI 3 and 10 meter calibrations is measured from the antenna midpoint, while for SAE 1 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 45 cm from the small end tip.

Figure 3 shows typical Model 3142B 26-2000 MHz gain, derived from the 3 antenna method antenna factors.

Figure 4 gives approximate input power required to generate 1 V/m at 1 and 3 meters. For any other field strength E, multiply power in watts by E2.

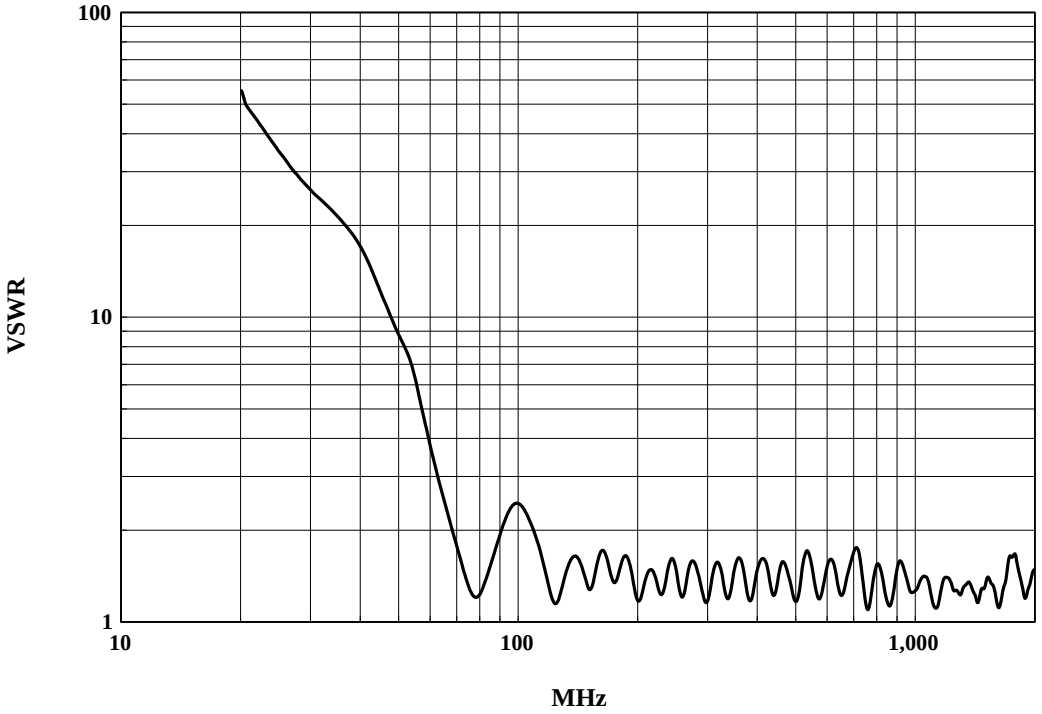

Figure 1. Model 3142B Typical VSWR

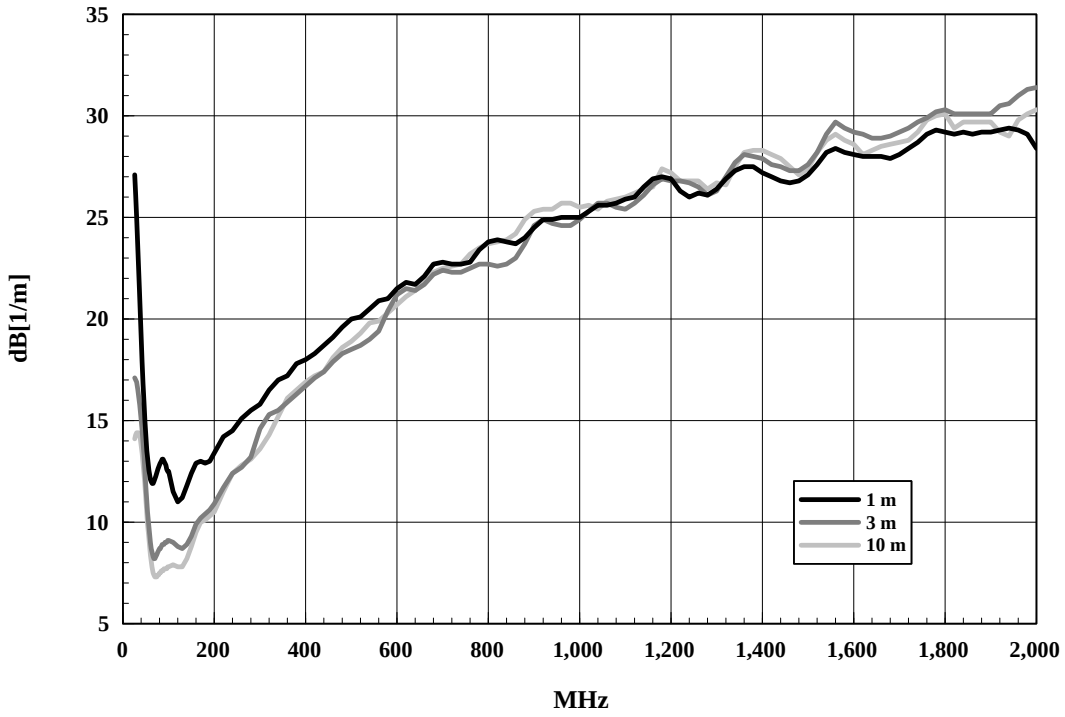

Figure 2. Model 3142B Typical Antenna Factor

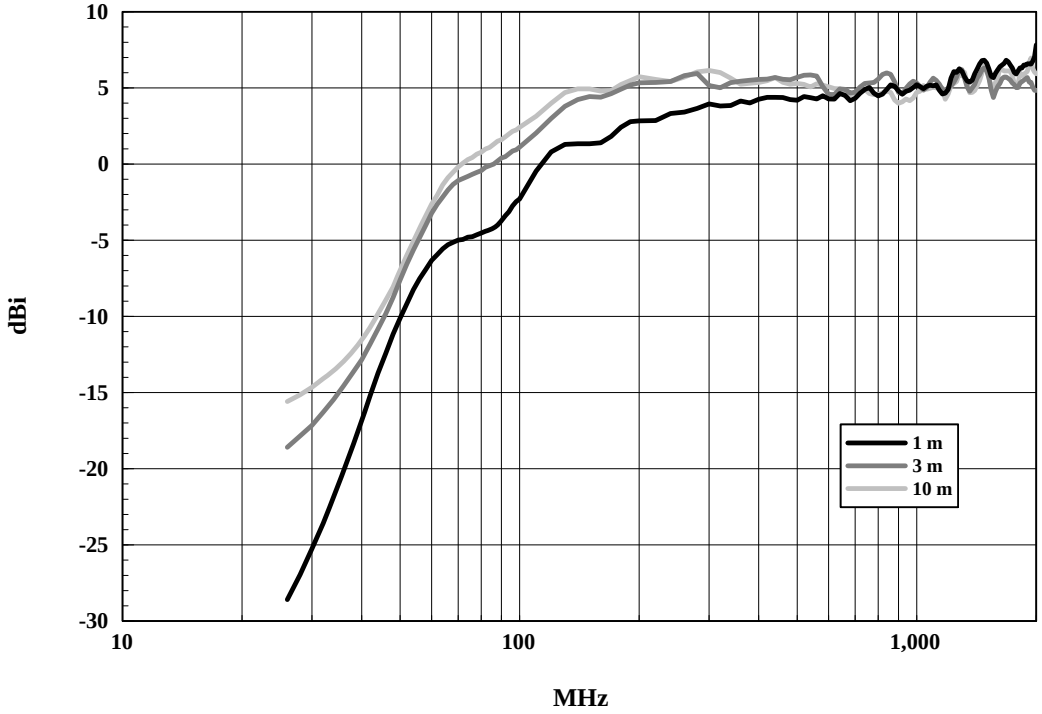

Figure 3. Model 3142B Typical Gain

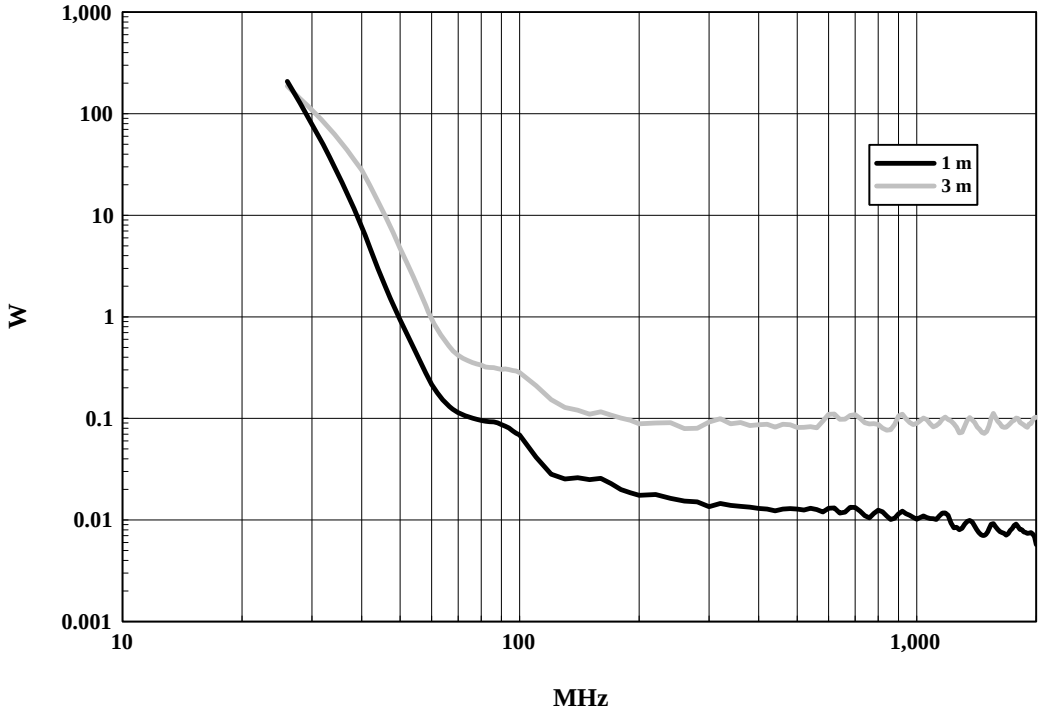

Figure 4. Model 3142B Typical 1 V/m Power Required

TYPICAL DATA WITH THE END PLATES

Figure 1 shows typical 26-2000 MHz VSWR for the Model 3142B with optional end plates.

Figure 2 shows typical Model 3142B with optional end plates antenna factors from 26-2000 MHz. Distance for the ANSI 3 and 10 meter calibrations is measured from the antenna midpoint, while for SAE 1 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 45 cm from the small end tip.

Figure 3 shows typical Model 3142B 26-2000 MHz forward power with optional end plates required for 1, 3, and 10 V/m at 1 m from the tip of the antenna, while Figure 4 is for 3 m from the antenna tip.

The power shown was measured over a ground plane with 1.5m transmit antenna and probe height, horizontal polarization. Horizontal polarization is the worst-case power required; 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.

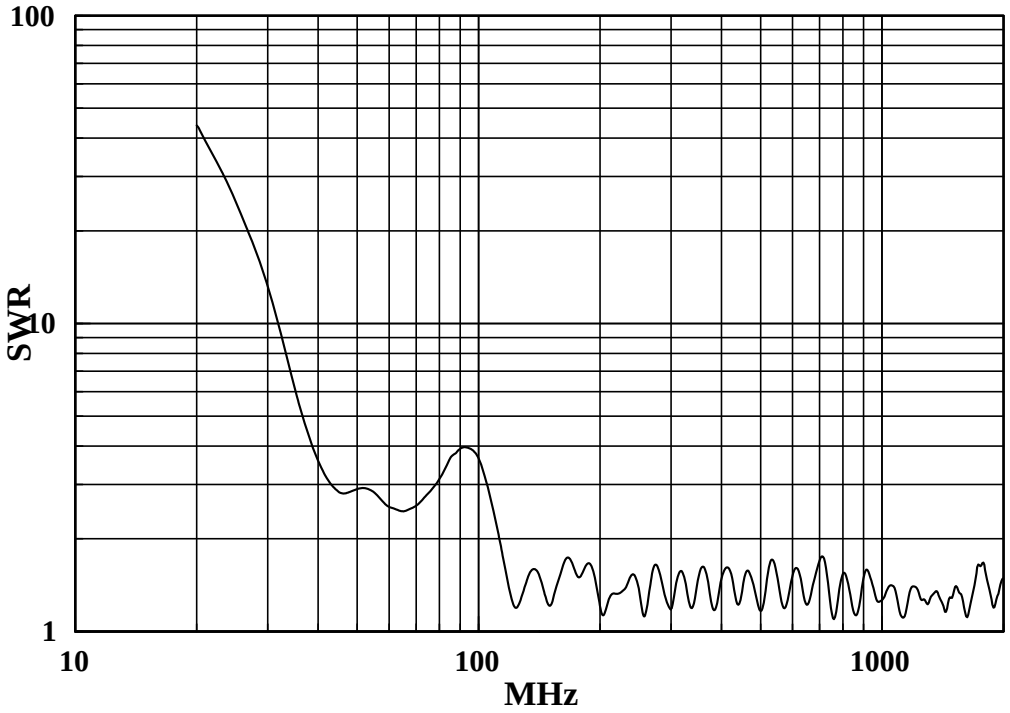

Figure 1. Model 3142B typical VSWR.

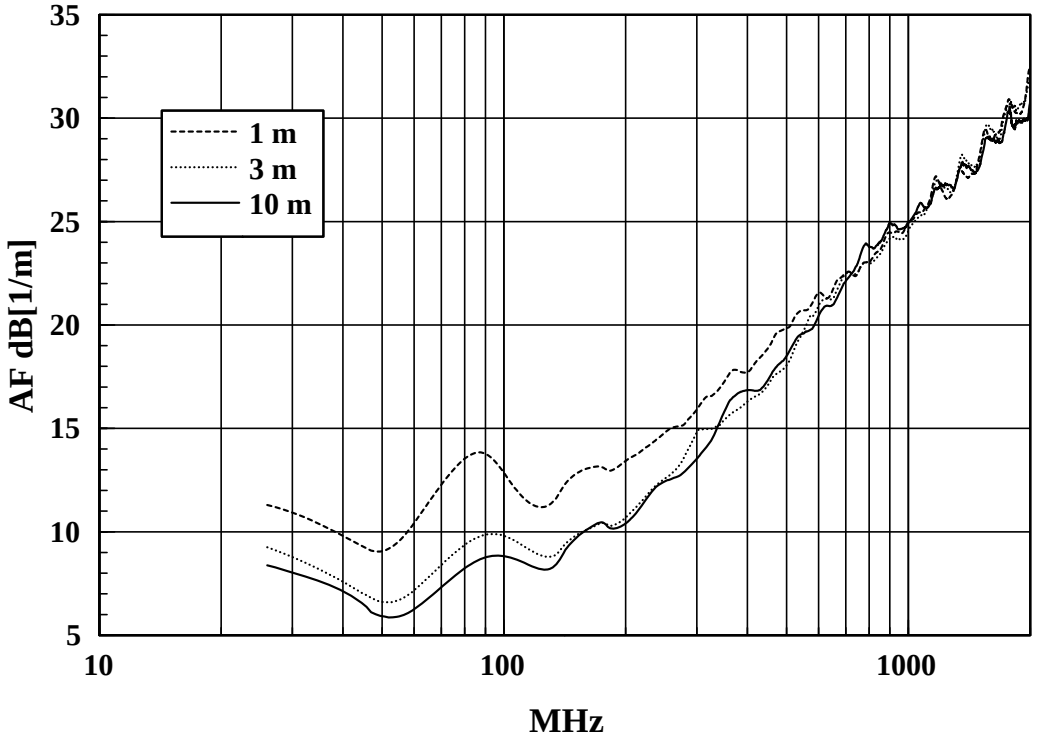

Figure 2. Model 3142B typical antenna factor.

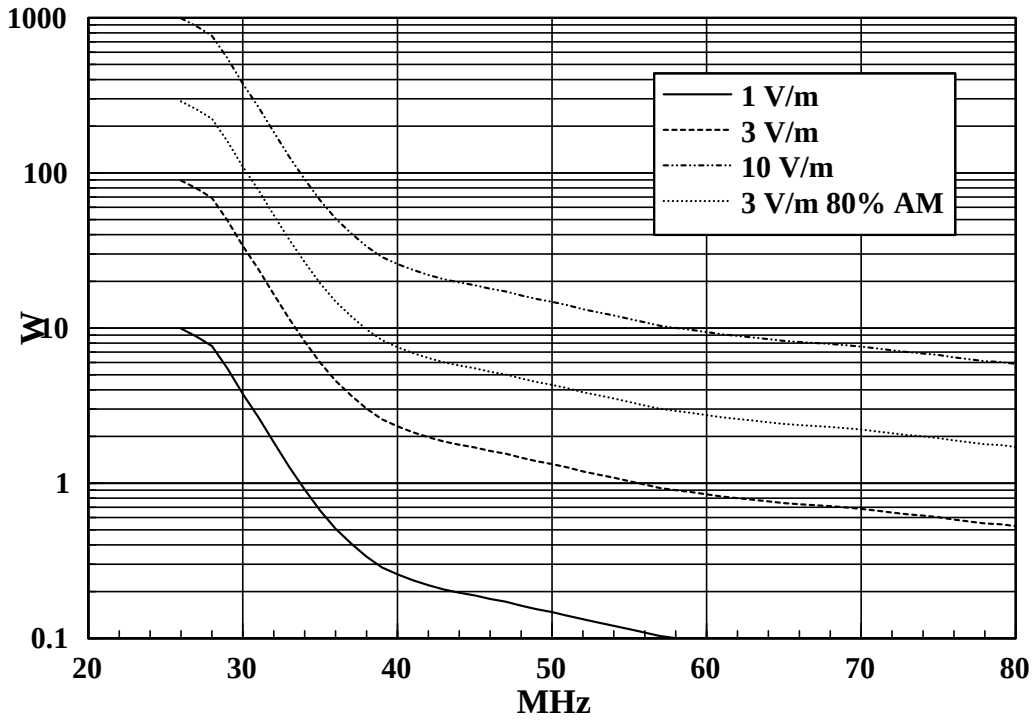

Figure 3. Model 3142B typical 1 m forward power.

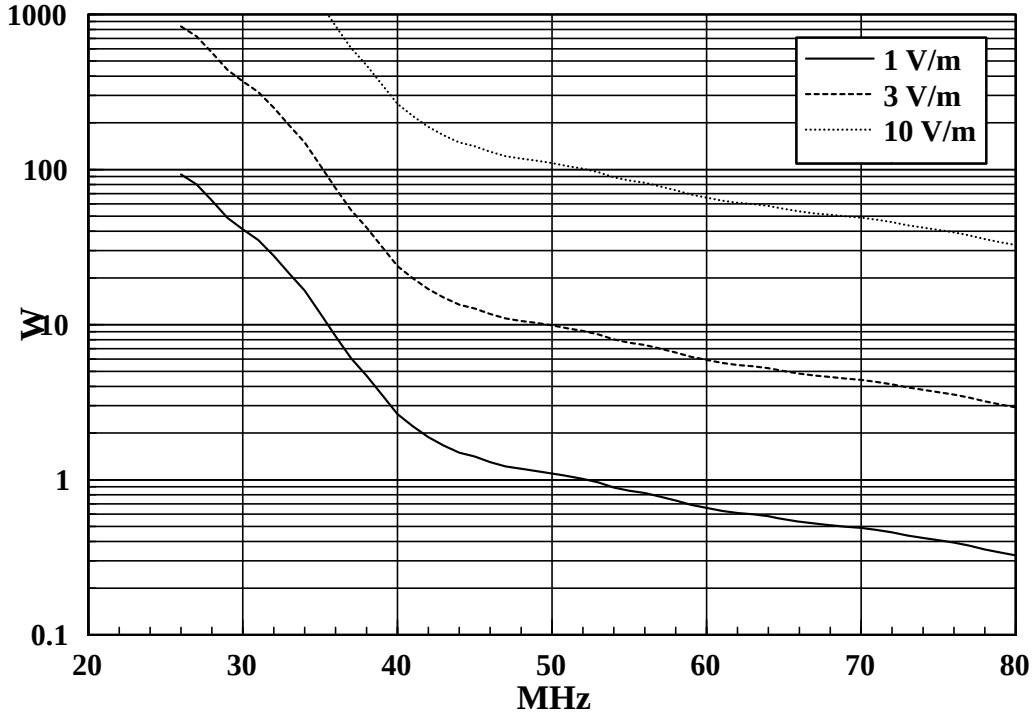

Figure 4. Model 3142B typical 3 m forward power.

SPECIFICATIONS

ELECTRICAL

3142B	With Standard Bow-tie Elements	With Optional End Plates
Frequency Range	26-2000 MHz	26-2000 MHz
Input Impedance	50 ς	50 ς
VSWR	2:1 average	2:1 average
CW power	1 kW, above 100 MHz 300 W, below 100 MHz	1 kW, above 60 MHz 500 W, below 60 MHz
Symmetry	+/- 0.5 dB	+/- 0.5 dB
Connector	N female	N female

PHYSICAL

3142B	With Standard Bow-tie Elements	With Optional End Plates
Height (bow-tie)	75 cm 29.5 in	75 cm 29.5 in
Width (bow-tie)	135 cm 53.1 in	136 cm 53.5 in
Depth (boom length)	90 cm 35.4 in	132 cm 51.9 in
Weight	4 kg 8.8 lb	6.8 kg 14.9 lb

MAINTENANCE

To ensure reliable and repeatable long-term performance, annual recalibration of your antenna by ETS-Lindgren's experienced technicians is recommended. Our staff can recalibrate almost any type or brand of antenna. Please call to receive a Service Order Number prior to sending an antenna to us for calibration.

For more information about our calibration services or to place an order for antenna calibration visit our calibration website at http://www.antennacalibration.com/.

WARRANTY STATEMENT

EMC Test Systems, L.P., hereinafter referred to as the Seller, warrants that standard EMCO products are free from defect in materials and workmanship for a period of two (2) years from date of shipment. Standard EMCO Products include the following:

- Antennas, Loops, Horns
- GTEM cells, TEM cells, Helmholtz Coils
- LISNs, PLISNs, Rejection cavities & Networks
- Towers, Turntables, Tripods, & Controllers
- Field Probes, Current Probes, Injection Probes

If the Buyer notifies the Seller of a defect within the warranty period, the Seller will, at the Seller's option, either repair and/or replace those products that prove to be defective.

There will be no charge for warranty services performed at the location the Seller designates. The Buyer must, however, prepay inbound shipping costs and any duties or taxes. The Seller will pay outbound shipping cost for a carrier of the Seller's choice, exclusive of any duties or taxes. If the Seller determines that warranty service can only be performed at the Buyer's location, the Buyer will not be charged for the Seller's travel related costs.

This warranty does not apply to:

- Normal wear and tear of materials
- Consumable items such as fuses, batteries, etc.
- Products that have been improperly installed, maintained or used
- Products which have been operated outside the specifications
- Products which have been modified without authorization
- Calibration of products, unless necessitated by defects

THIS WARRANTY IS EXCLUSIVE. NO OTHER WARRANTY, WRITTEN OR ORAL, IS EXPRESSED OR IMPLIED, INCLUDING BUT NOT LMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE REMEDIES PROVIDED BY THIS WARRANTY ARE THE BUYER'S SOLE AND EXCLUSIVE REMEDIES. IN NO EVENT IS THE SELLER LIABLE FOR ANY DAMAGES WHATSOEVER, INCLUDING BUT NOT LIMITED TO, DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

Note: Please contact the Seller's sales department for a Return Materials Authorization (RMA) number before shipping equipment to us.