Model 3142C

BiConiLog™ Antenna

User Manual

ETS·LINDGREN™
An ESCO Technologies Company

Revision Record | MANUAL MODEL 3142, Part # 399229, Rev. E

Revision	Description	Date
A	Initial Release	November, 2000
B	Update to new format, add Model 3141 information	January, 2001
C	Edit/update	February, 2003
D	Edit/update	June, 2003
E	Update bowtie/antenna knob information	November, 2006

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Safety Symbol Definitions

This product and related documentation must be reviewed for familiarization with safety markings and instructions prior to operation of the product.

Safety Symbol	Definition
	**REFER TO MANUAL—**When the product is marked with this symbol refer to the instruction manual for additional information. If the instruction manual has been misplaced, go to www.ets-lindgren.com for downloadable files or contact ETS-Lindgren customer service.

General Safety Considerations

Safety Symbol	Definition
	**BEFORE SERVICING: CONTACT ETS-LINDGREN (+1.512.531.6400)—**Servicing or modifying the unit without ETS-Lindgren authorization may void your warranty. If an attempt to service the unit must be made, disconnect all electrical power prior to beginning. Voltages exist at many points within the instrument that could, if contacted, cause personal injury. Only trained service personnel should perform adjustments and/or service procedures upon this instrument. *Capacitors inside this instrument may still be charged even when the instrument is disconnected from the power source.*
	**ONLY QUALIFIED PERSONNEL** should operate or service this equipment.

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1.0 Introduction

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

A simple wire outline bow-tie antenna is narrowband compared to a sheet bow-tie or biconical, so struts are added to the Model 3142C 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, and above 150 MHz the radiation in the plane of the elements is directional.

To prevent cable pickup below 100 MHz, the Model 3142C contains a balun that acts as a common-mode choke to keep unbalanced current off the coaxial feed cable outer shield. Though the Model 3142C 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 one meter before any vertical drop.

The antenna has a mounting bracket and ¼-20 UNC thread knob to attach to an ETS-Lindgren tripod or tower adapter. Individual antenna factors and gain calibration data is included with each antenna.

The Model 3142C optional end plates (part #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 3142C make it appear like an antenna twice as long as its 1.4 meter length. The result is approximately 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 3142C bow-tie elements, the equivalent dipole electrical length is increased, which decreases resonant frequency and increases efficiency in the 20 to 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 1.4-meter long end plate option behaves as if a 2.8 meter tuned dipole. Cross-polar radiation is minimized because current flow on one of the T end frames is almost completely cancelled by the opposite-phased current on the other T end.

2.0 Receiving Your Order

2.1 Unpacking and Acceptance

Step 1. Upon delivery of your order, inspect the shipping container(s) for evidence of damage. Record any damage on the delivery receipt before signing it. In case of concealed damage or loss, retain the packing materials for inspection by the carrier.

Step 2. Remove the product from its shipping container(s). Save the container(s) and any protective packing materials for future use.

Step 3. Check all materials against the packing list to verify that the equipment you received matches what was ordered. If you find any discrepancies, note them and call ETS-Lindgren Customer Service for further instructions.

Ensure that you are satisfied with the contents and condition of your order prior to placing the product into service.

2.2 Return Procedures

To return a system or system component:

Step 1. Contact ETS-Lindgren Customer Service to obtain an SRO, Service Request Order.

Step 2. Briefly describe the problem in writing. Give details regarding the observed symptom(s) or error codes, and whether the problem is constant or intermittent in nature. Please include the date(s), the service representative you spoke with, and the nature of the conversation. Include the serial number of the item being returned.

Step 3. Package the system or component carefully. If possible, use the original packing materials to return a system or system component to ETS-Lindgren at the following address:

ETS-Lindgren
Attn. Service Department
301 Arrow Point Drive
Cedar Park, TX, USA 78613
Phone: +1.512.531.6400

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3.0 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, visit our website at http://www.ETS-Lindgren.com.

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4.0 Mounting Instructions

4.1 Model 3142C Components

The Model 3142C BiConiLog™ Antenna consists of the following:

- (1) Antenna
- (2) Bow-tie elements
- (2) 10-32 thread knobs to attach bow-tie elements
- (2) Protective end caps for bow-tie elements
- (8) Screws to attach protective end caps to bow-tie elements

The optional end plate package consists of:

- (2) T bow-tie endplates
- (8) Thumbscrew knobs to attach endplates to bow-tie elements

4.2 Mount the Bow-tie Elements

1. Without the bow-tie elements attached, mount the Model 3142C on a tripod or tower adapter.

2. Slide the narrow end of one of the bow-tie elements into the receptacle hole on the boom, and then align the bow-tie with the receptacle on the boom.

Figure 1: Bow-tie element mounted to boom

3. Insert one of the 10-32 thread knobs into the opposite side of the boom from where you inserted the bow-tie. Slowly tighten the knob, taking care not to cross-thread the connection. Cross-threading the connection could cause permanent damage to the bow-tie element.

4. Repeat steps 2 and 3 for the second bow-tie element.

4.3 Connect the Optional End Plates to Create the T Bow-ties

1. For protection, there is a black end cap on each of the bow-tie elements. Use a Phillips head screwdriver to carefully remove the four screws in each of the bow-tie end caps.

   The end caps should be reinstalled when you are done using the optional end plates, so store the end caps and the screws in a safe place.

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

Figure 2: Bow-tie element receptacle hole and optional end plate with screw knob

3. Repeat step 2 for the remaining end plate.

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 one meter or more back from the Model 3142C before dropping vertically.

Both horizontal and vertical polarization is easily accomplished when the Model 3142C with the optional end plates is mounted on a tower, but vertical polarization on a tripod requires special consideration. Because 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.

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5.0 Application

5.1 Without Optional End Plates

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

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

V = the receiver or spectrum analyzer voltage reading
AF = antenna factor
α = cable loss, if cable losses are non-negligible

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

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

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 *Model 3142C Typical 1 V/m Power Required* on page **Error! Bookmark not defined.Error! Bookmark not defined.Error! Bookmark not defined.**, 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 an equivalent. An estimate of the power required, taking VSWR into account, is obtained from:

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

P_f = forward (amplifier output) power
P_n = new power as discussed

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

5.2 With Optional End Plates

For emissions testing it is recommended that the Model 3142C 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 “Understanding the Measurement Uncertainties of the Bicon/log Hybrid Antennas” by Zhong Chen in the 1999 issue of the International Journal of EMC.

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

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

d = distance, in meters
g = numeric gain ($10^{G[dB]/10}$)
P = antenna net input power, in watts

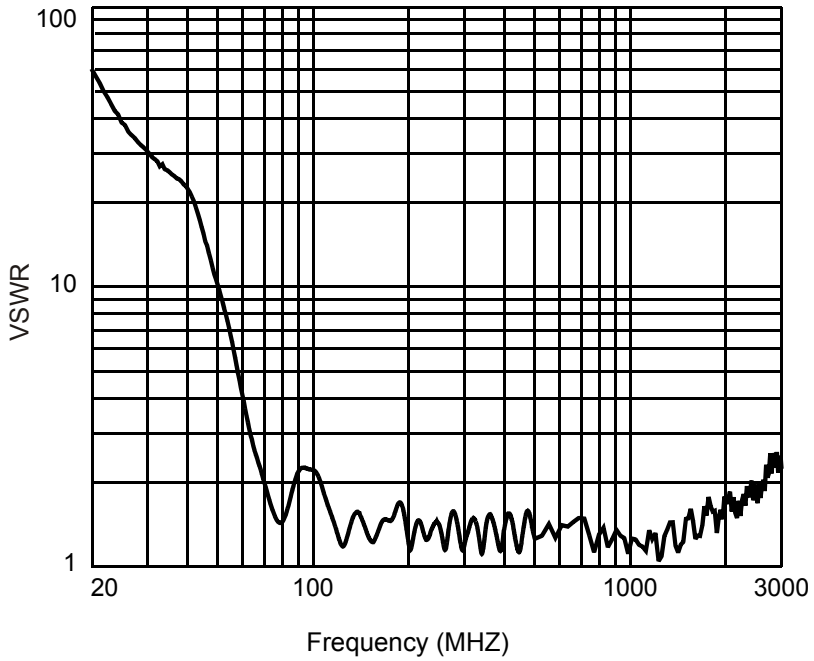
An estimate of the power required for any field strength *E* can be obtained from *Model 3142C Typical 26-3000 MHz 1M Forward Power* on page 23 or *Model 3142C Typical 26-3000 MHz 3M Forward Power* on page 24, which shows power required in watts to generate 1 V/m. For any other field strength not shown, 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 an equivalent. For IEC 1000-4-3 type testing, the antenna tip can be placed at any distance between one and three meters from the EUT as long as the front face plane is illuminated according to the –0,+6 dB specification. In general, closer distances require less power to create a given field strength.

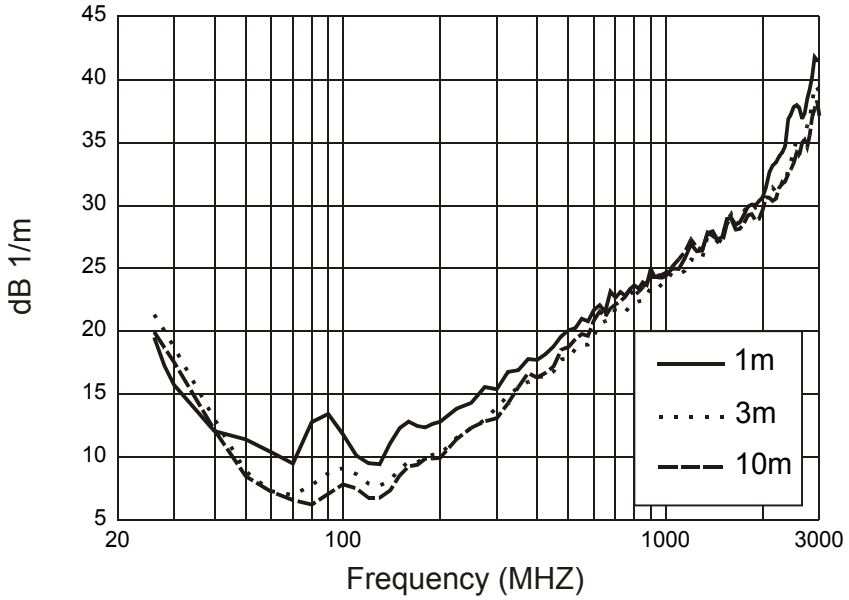
6.0 Typical Data Without Optional End Plates

6.1 Model 3142C Typical 26-3000 MHz VSWR



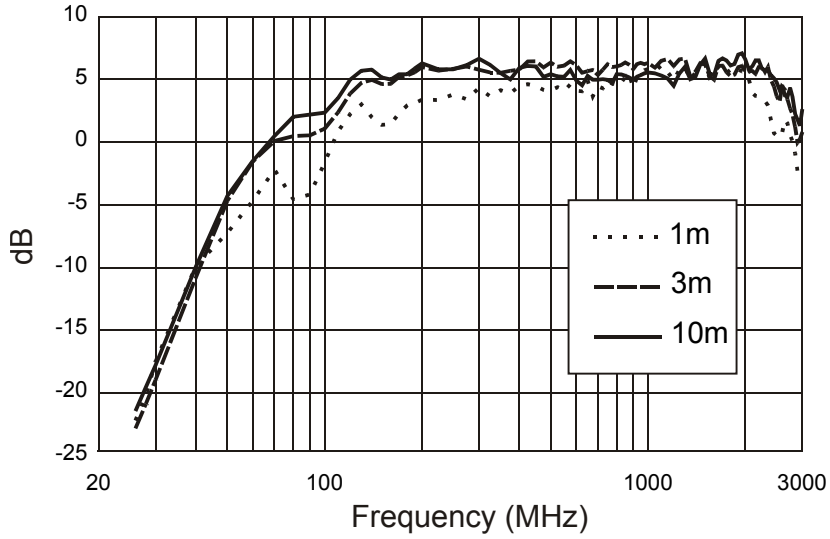
6.2 Model 3142C Typical 26-3000 MHz Antenna Factor

Distance for the ANSI 3 and 10 meter calibrations is measured from the antenna midpoint, and 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.



6.3 Model 3142C Typical 26-3000 MHz Gain

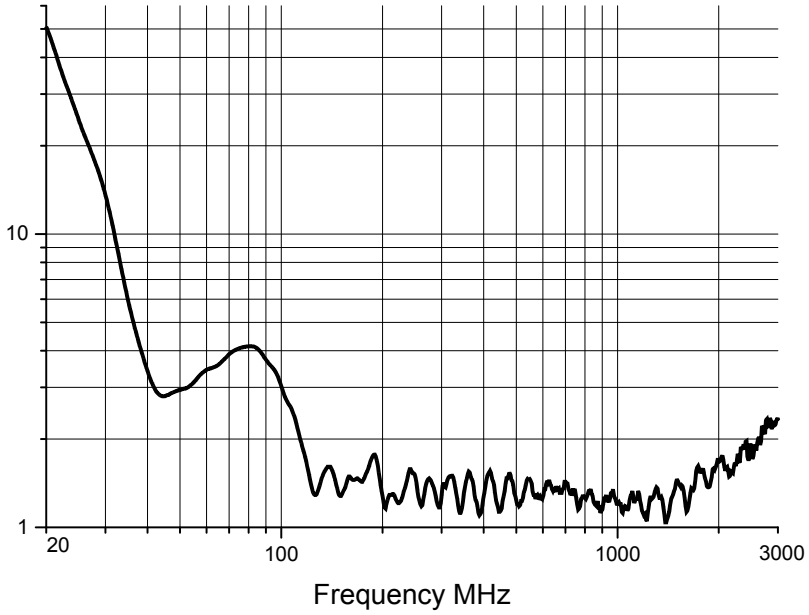
This data is derived from the 3 antenna method antenna factors.



7.0 Typical Data with Optional End Plates

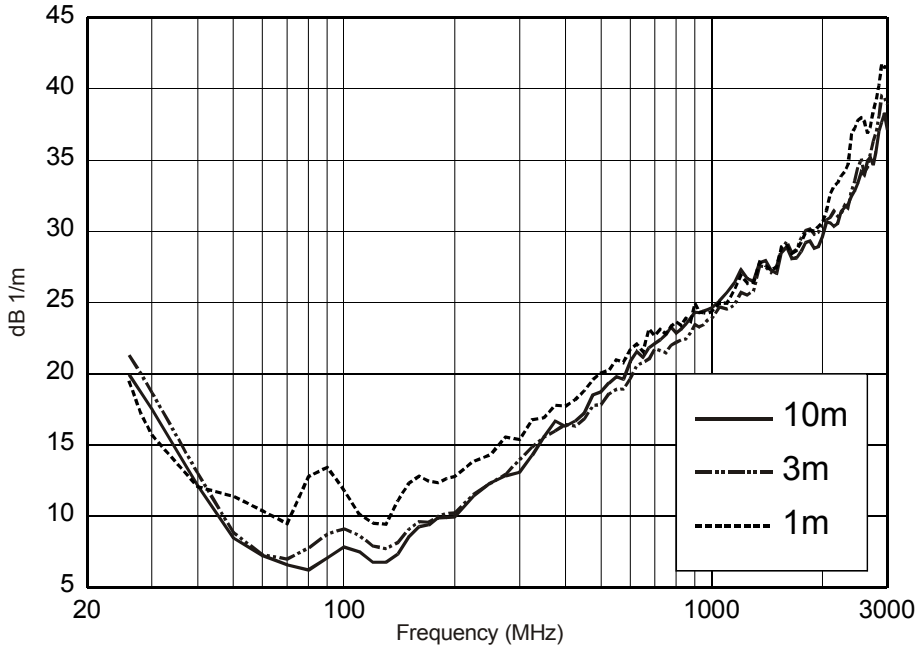
The power shown was measured over a ground plane with 1.5 meters transmit antenna and probe height, horizontal polarization. Horizontal polarization is the worst-case power required; typically less power is required for vertical polarization. In practice, many users place ferrite tiles on the ground 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.

7.1 Model 3142C Typical 26-3000 VSWR



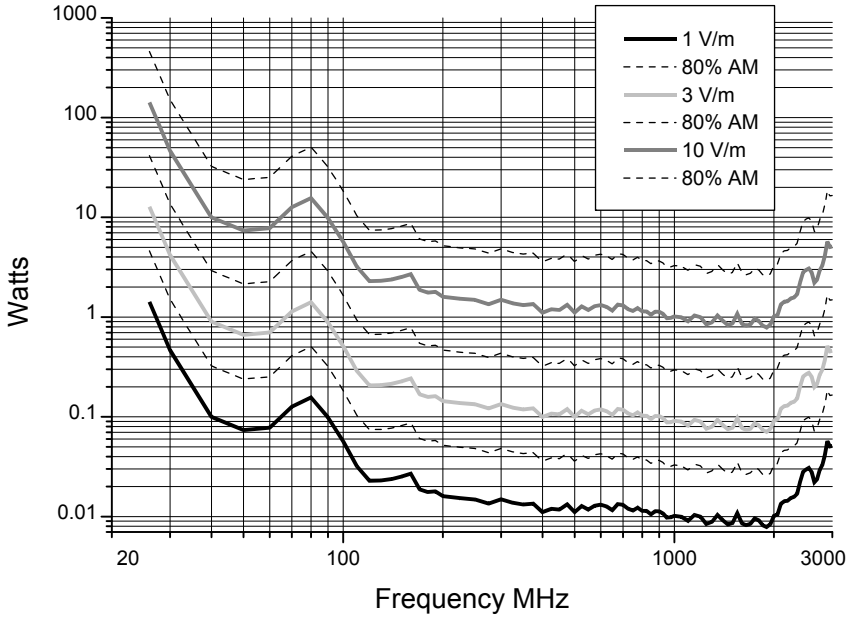
7.2 Model 3142C Typical 26-3000 MHz Antenna Factor

Distance for the ANSI 3 meter and 10 meter calibrations is measured from the antenna midpoint, and 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.



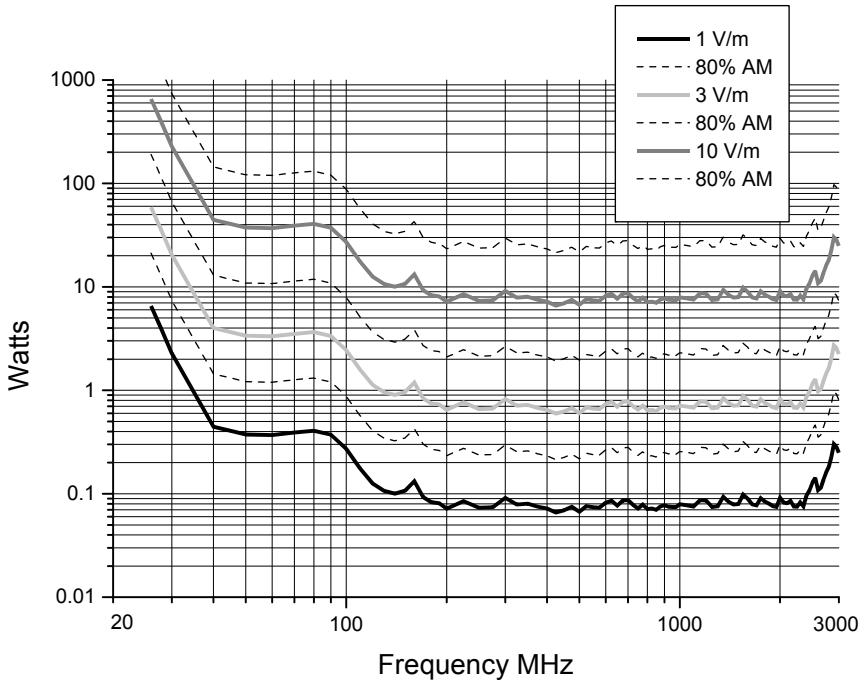
7.3 Model 3142C Typical 26-3000 MHz 1M Forward Power

The following illustrates the typical 26-3000 MHz forward power required for 1, 3, and 10 V/m at 1 meter from the tip of the antenna.



7.4 Model 3142C Typical 26-3000 MHz 3M Forward Power

The following illustrates the typical 26-3000 MHz forward power required for 1, 3, and 10 V/m at 3 meters from the antenna tip.



8.0 Specifications

8.1 Electrical Specifications

	With Standard Bow-tie Elements	With Optional End Plates
Frequency Range:	26-3000 MHz	26-3000 MHz
Input Impedance	50 Ω	50 Ω
VSWR:	2:1 average	2:1 average
CW power:	26 MHz – 60 MHz500 W60 MHz – 600 MHz1kW600 MHz – 1GHz750W1 GHz – 3 GHz500 W	26 MHz – 60 MHz500 W60 MHz – 600 MHz1kW600 MHz – 1GHz750W1 GHz – 3 GHz500 W
Symmetry:	+/- 0.5 dB	+/- 0.5 dB
Connector:	N female	N female

8.2 Physical Specifications

	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

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9.0 Warranty Policy for Standard EMCO Brand Products

9.1 Scope and Duration of Warranties

Seller warrants to Buyer that the Standard EMCO Brand Products Excluding 5211 & 5220 be (1) free from defects in material, manufacturing workmanship, and title, and (2) conform to the Seller's applicable product descriptions and specifications, if any, contained in or attached to Seller's quotation. If no product descriptions or specifications are contained in or attached to the quotation, Seller's applicable product descriptions and specifications in effect on the date of shipment shall apply. The criteria for all testing shall be Seller's applicable product specifications utilizing factory-specified calibration and test procedures and instruments.

All product warranties, except the warranty of title, and all remedies for warranty failures are limited in time as shown in the following table.

Product Warranted	Duration of Warranty Period
Standard EMCO Brand Products Excluding 5211 & 5220	2 Years

Any product or part furnished to Buyer during the warranty period to correct a warranty failure shall be warranted to the extent of the unexpired term of the warranty applicable to the repaired or replaced product.

The warranty period shall commence on the date the product is delivered to Buyer; however, if Seller assembles the product, or provides technical direction of such assembly, the warranty period for such product shall commence on the date the assembly of the product is complete. Notwithstanding the foregoing, in the event that the assembly is delayed for a total of thirty (30) days or more from the date of delivery for any reason or reasons for which Seller is not responsible, the warranty period for such product may, at Seller's options, commence on the thirtieth (30th) day from the date such product is delivered to Buyer. Buyer shall promptly inspect all products upon delivery. No claims for shortages will be allowed unless shortages are reported to Seller in writing within ten (10) days after delivery. No other claims against Seller will be allowed unless asserted in writing within thirty (30) days after delivery (or assembly if the products are to be assembled by Seller) or, in the case of alleged breach of warranty, within the applicable warranty period.

9.2 Warranty Exclusions

Except as set forth in any applicable patent indemnity, the foregoing warranties are exclusive and in lieu of all other warranties, whether written, oral, express, implied, or statutory. EXCEPT AS EXPRESSLY STATED ABOVE, SELLER MAKES NO WARRANTY, EXPRESS OR IMPLIED, BY STATUTE OR

OTHERWISE, WHETHER OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE OR USE OR OTHERWISE ON THE PRODUCTS, OR ON ANY PARTS OR LABOR FURNISHED DURING THE SALE, DELIVERY OR SERVICING OF THE PRODUCTS. THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE DESCRIPTION ON THE FACE HEREOF.

Warranty coverage does not include any defect or performance deficiency (including failure to conform to product descriptions or specifications) which results, in whole or in part, from (1) negligent storage or handling of the product by Buyer, its employees, agents, or contractors, (2) failure of Buyer to prepare the site or provide an operating environmental condition in compliance with any applicable instructions or recommendations of Seller, (3) absence of any product, component, or accessory recommended by Seller but omitted at Buyer's direction, (4) any design, specification, or instruction furnished by Buyer, its employees, agents or contractors, (5) any alteration of the product by persons other than Seller, (6) combining Seller's product with any product furnished by others, (7) combining incompatible products of Seller, (8) interference with the radio frequency fields due to conditions or causes outside the product as furnished by Seller, (9) improper or extraordinary use of the product, or failure to comply with any applicable instructions or recommendations of Seller, or (10) acts of God, acts of civil or military authority, fires, floods, strikes or other labor disturbances, war, riot, or any other causes beyond the reasonable control of Seller. This warranty does not cover (1) contact fingers or replacements unless loss is caused by a defect in material or manufacturing workmanship within the scope of this warranty (2) items designed to be consumable and (3) removal and reconstruction of walls, partitions, ceilings and other facility costs arising from repair or replacement of the product or parts thereof by Seller under the warranty. Seller does not warranty products of others which are not included in Seller's published price lists for shielding products and systems supplies and accessories.

9.3 Buyer's Remedies

If Seller determines that any product fails to meet any warranty during the applicable warranty period, Seller shall correct any such failure by either, at its option, repairing, adjusting, or replacing without charge to Buyer any defective or nonconforming product, or part or parts of the product. Seller shall have the option to furnish either new or exchange replacement parts or assemblies.

Warranty service during the applicable warranty period will be performed without charge to Buyer within the contiguous 48 United States during Seller's normal business hours. After the warranty period, service will be performed at Seller's prevailing service rates. Subject to the availability of personnel, after-hours service is available upon request at an additional charge. For service outside the contiguous 48 United States, travel and per diem expenses, when required, shall be the responsibility of the Buyer, or End User, whichever is applicable.

The remedies set forth herein are conditioned upon Buyer promptly notifying Seller within the applicable warranty period of any defect or nonconformance and making the product available for correction.

The preceding paragraphs set forth Buyer's exclusive remedies and Seller's sole liability for claims based on failure of the products to meet any warranty, whether the claim is in contract, warranty, tort (including negligence and strict liability) or otherwise, and however instituted, and, upon the expiration of the applicable warranty period, all such liability shall terminate. IN NO EVENT SHALL SELLER BE LIABLE TO BUYER FOR ANY SPECIAL INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES OF ANY KIND ARISING OUT OF, OR AS A RESULT OF, THE SALE, DELIVERY, NON-DELIVERY, SERVICING, ASSEMBLING, USE OR LOSS OF USE OF THE PRODUCTS OR ANY PART THEREOF, OR FOR ANY CHARGES OR EXPENSES OF ANY NATURE INCURRED WITHOUT SELLER'S WRITTEN CONSENT DESPITE ANY NEGLIGENCE ON BEHALF OF THE SELLER. IN NO EVENT SHALL SELLER'S LIABILITIES UNDER ANY CLAIM MADE BY BUYER EXCEED THE PURCHASE PRICE OF THE PRODUCT IN RESPECT OF WHICH DAMAGES ARE CLAIMED. This agreement shall be construed in accordance with laws of the State of Illinois. In the event that any provision hereof shall violate any applicable statute, ordinance, or rule of law, such provision shall be ineffective to the extent of such violation without invalidating any other provision hereof.

Any controversy or claim arising out of or relating to the sale, delivery, nondelivery, servicing, assembling, use or loss of use of the products or any part thereof or for any charges or expenses in connection therewith shall be settled in Austin, Texas by arbitration in accordance with the Rules of the American Arbitration Association, and judgment upon the award rendered by the Arbitrator may be entered in either the Federal District Court for the Western District of Texas or the State District Court in Austin, Texas, all of the parties hereto consenting to personal jurisdiction of the venue of such court and hereby waive the right to demand a jury trial under any of these actions.