EMC TEST SYSTEMS – An ESCO Company

USER MANUAL
EMCO MODEL 3141 BICONILOG™
LOG-PERIODIC / T BOW-TIE ANTENNA

399236 Rev A
01/97

P.O. Box 80589, Austin, Texas 78708-0589 2205 Kramer Lane, Austin, Texas 78758-4047 Tel 800.253.3761 512.835.4684 Fax 512.835.4729

GENERAL DESCRIPTION

The EMCO Model 3141 is the latest evolution in the popular bow-tie/log periodic combination BiConiLog™ family. A biconilog antenna combines a broadband biconical-like bow-tie antenna with a standard log periodic to replace the traditional use of two antennas in the 30-1000 MHz EMC test frequencies. Many EMC antennas are variations of a standard tuned dipole. 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 end plates of the Model 3141 T bow-ties 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.

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 MHz 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 less than a 1.4 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 3141 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. To prevent cable pickup below 100 MHz, the Model 3141 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 3141 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 1 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 antenna has a mounting bracket and 1/4x20 UNC knob for attaching to EMCO tripod and tower adaptors. Individual antenna factor calibration data is included with each antenna. The Model 3141 can be used with or without the end frames of the T bow-ties. However, calibration data is valid ONLY with the T bow-ties intact.

The unique feature of the Model 3141 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 20-60 MHz range. Similarly, a regular bow-tie has a lower resonant frequency than an equal length single-wire dipole. The T bow-tie has its first resonance at a frequency where its length is about 0.22λ, a regular bow-tie at a length of 0.3λ, and a tuned dipole at about a length of 0.48λ. Thus at 50 MHz the 1.4 m long T bow-tie of the Model 3141 behaves like a 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.

APPLICATION

Install the Model 3141 without the T bow-ties on an EMCO tripod or tower adaptor. Insert the bow-ties one at a time and tighten the base knobs. Attach each T end frame with four knobs. Connect an N-type coaxial cable from the antenna connector to a generator or receiver. 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 3141 before dropping vertically.

Both horizontal and vertical polarization is easily accomplished when the Model 3141 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 EMCO for vertical polarization with T bow-ties intact. Please contact EMCO for the recommended mounting scheme.

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

$$E(\mathrm{dBV/m}) = V(\mathrm{dBV}) + AF(\mathrm{dB1/m}) + \alpha(\mathrm{dB}),$$

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 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 power 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 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 EMCO Model 7100 series electric field probe or equivalent. 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 uniform field specification. In general, closer distances require less power to create a given field strength.

TYPICAL DATA

Figure 1 shows typical 26-2000 MHz VSWR for the EMCO Model 3141. Figure 2 shows typical 3141 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 3141 26-2000 MHz forward power 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 1.5 m 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.

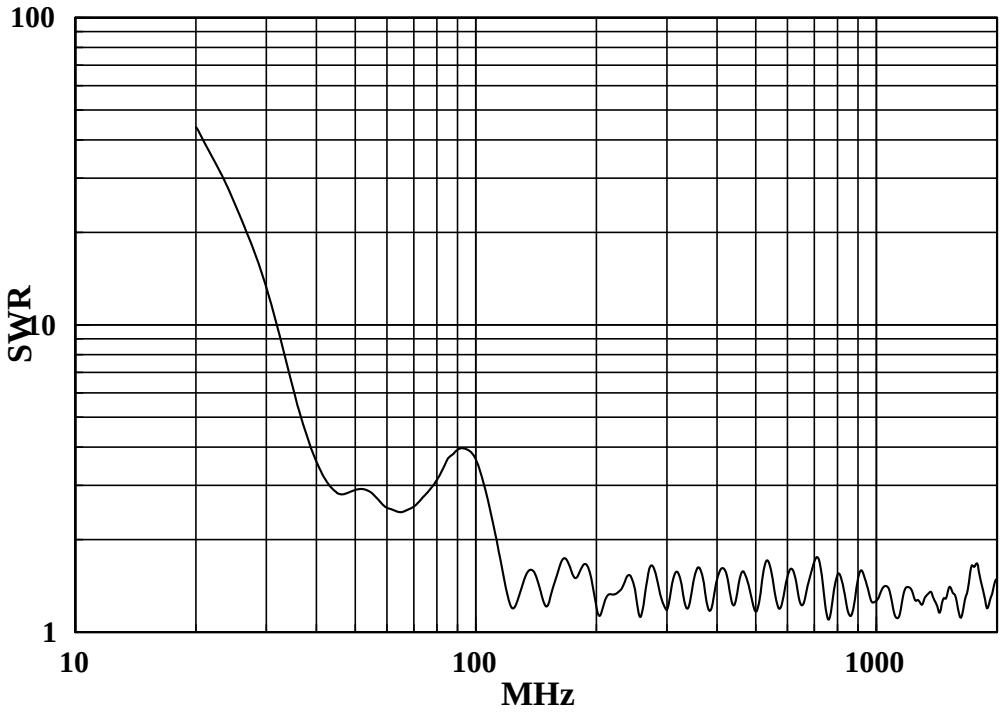

Figure 1. EMCO Model 3141 typical SWR.

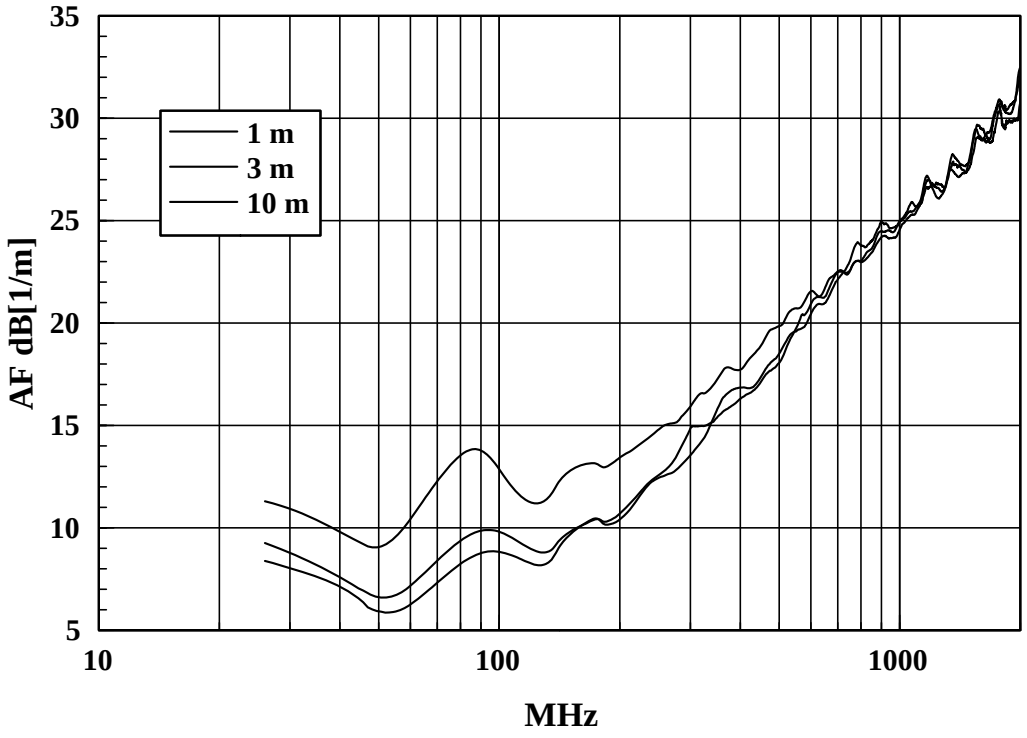

Figure 2. EMCO Model 3141 typical antenna factor.

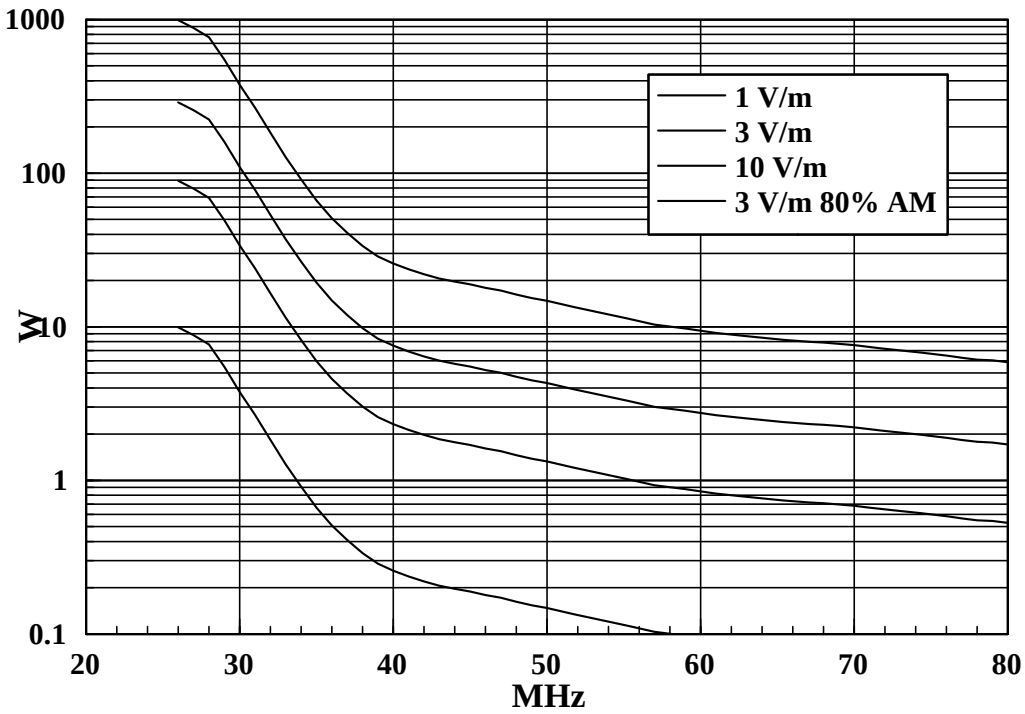

Figure 3. EMCO Model 3141 typical 1 m forward power.

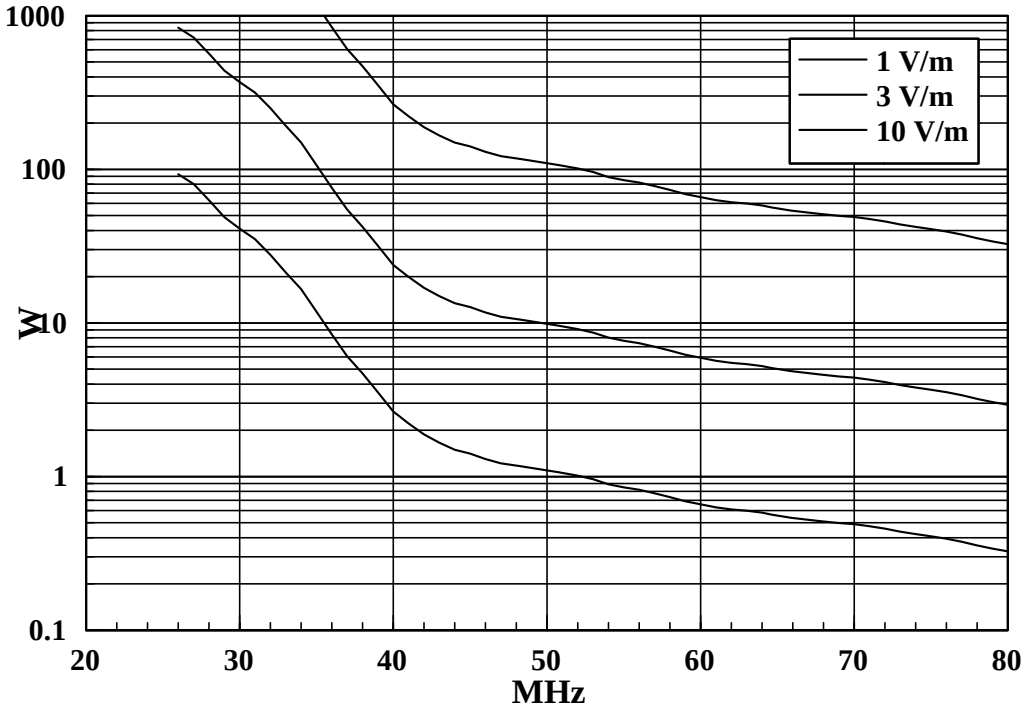

Figure 4. EMCO Model 3141 typical 3 m forward power.

SPECIFICATIONS

Electrical (nominal):

Frequency range	26 - 2000 MHz
Input impedance	50 Ω
VSWR	2:1 average
CW power	1 kW, above 60 MHz 500 W, below 60 MHz
Symmetry	+/- 0.5 dB
Connector	N female

Mechanical:

Height (T bow-tie)	75 cm
Width (T bow-tie)	136 cm
Depth (length)	132 cm
Weight	6.8 kg

WARRANTY

EMC Test Systems warrants that our products are free from defects in materials and workmanship for a period of two years from the date of shipment. If you notify us of a defect within the warranty period, we will, at our option, either repair or replace those products which prove to be defective. If applicable, we will also recalibrate the product.

There will be no charge for warranty services at the location we designate. However, you must prepay inbound shipping costs and any duties or taxes. We will pay outbound shipping costs with a carrier of our choice, exclusive of any duties or taxes. You may request warranty services to be performed at your location, but it is our option to do so. If we determine that warranty services can only be performed at your location, you will not be charged for our travel related costs.

This warranty does not apply to:

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

THIS WARRANTY IS EXCLUSIVE. NO OTHER WARRANTY, WRITTEN OR ORAL, IS EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR PARTICULAR PURPOSE.

THE REMEDIES PROVIDED BY THIS WARRANTY ARE YOUR SOLE AND EXCLUSIVE REMEDIES. IN NO EVENT ARE WE 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.

Please contact our sales department for a Return Material Authorization number before shipping equipment to us.

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