INSTRUCTION MANUAL

LOOP ANTENNA

MODEL ALR-30M

9 kHz – 30 MHz

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LO0P ANTENNA

9 kHz – 30 MHz

ELECTRO-METRICS

MODEL ALR-30M

SERIAL NO: N/A

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WARRANTY

This Model ALP-30M Loop Antenna is warranted for a period of 12 months (USA only) from date of shipment against defective materials and workmanship. This warranty is limited to the repair of or replacement of defective parts and is void if unauthorized repair or modification is attempted. Repairs for damage due to misuse or abnormal operating conditions will be performed at the factory and will be billed at our commercial hourly rates. Our estimate will be provided before the work is started.

DESCRIPTION AND USE ELECTO-METRICS MODEL ALR-30M LOOP ANTENNA

1.0 Introduction

The Model ALR-30M Loop Antenna is designed to obtain magnetic field measurements from 9 kHz to 30 MHz. A ten position rotary switch is used to switch in the appropriate matching network for the frequency selected. The antenna can be used with any 50-ohm receiver/analyzer being designed and calibrated for use in a 50-ohm system.

The bottom of the base has a 5/8-20 threaded receptacle for mounting to the Model TRI-136 Tripod.

2.0 Specifications

2.1 Electrical

Frequency Range (Calibrated):	9 kHz to 30 MHz.
	(Antenna Factor Chart furnished with each antenna.)
Input Impedance:	Matched to 50Ω.
Connector:	Type TNC.

2.2 Mechanical

Outside diameter:	432 mm (17").
Height:	508 mm (20").
Weight:	3.5 kg (7.5 lbs).

3.0 ALR-30M Description

The ALR-30M comprises an approximate 0.4 meter (17-inch) diameter electrostatically shielded loop mounted on a rectangular base containing the matching networks.

3.1 Frequency Range Switch

Ten position rotary switch, located on the right side of the antenna base, which selects one of ten RF Frequency Ranges.

3.2 Signal Out Connector

Type: TNC.

Connects the signal received by the antenna to the RF Input Connector of the 50-ohm receiver/analyzer (Electro-Metrics EMC-30 or equivalent).

3.3 Injection In Connector

Type: TNC.

Allows an external calibration signal to be applied to the antenna. This is required by certain test standards before testing can occur. Check the test standard being used for requirements, methods, and techniques.

4.0 Theory Of Operation

The Model ALR-30M Loop Antenna, is basically a single-turn balanced loop approximately 0.13 square meter in area. The loop is electrostatically shielded and is therefore sensitive only to the magnetic component (H-Field) of the electro-magnetic field.

For optimum energy transfer from the loop to the 50-ohm output cable and thus to the 50-ohm input of the receiver/analyzer, matching transformers, located between the loop and the output terminals of the antenna, are used to accomplish this task.

Since the loop source impedance varies with frequency, an optimum impedance match is feasible only over approximately octave segments of the frequency range. Thus, it is necessary to switch matching networks in order to cover the more-than-ten-octave range of the antenna (9 kHz-30 MHz).

The matching networks are mounted in the base of the antenna and a manual ten-position rotary switch is used to switch in the appropriate impedance tranformation network.

Although, as noted previously, the ALR-30M is sensitive only to the H-Field, the antenna factor chart at the rear of this manual converts the measurement from a two-terminal voltage at the input of the receiver/analyzer, to the far-field equivalent of the accompanying Electric field (E-Field). This conversion is valid because E and H far fields are related by the wave impedance, 377 ohms, as follows:

$$E = 377H$$

where:

E = Electric Field Intensity (µV/meter)

H = Magnetic Field Intensity (µA/meter)

In the near field, however, where the relationship between the E and H fields cannot be so easily defined, the E-Field measurement obtained through the use of the antenna factor charts should be understood to designate only a relative H-Field measurement.

In either the near or far field, a true H-Field measurement can be obtained by the relationship:

$$H = E/377$$

where:

H = Magnetic Field Intensity (µA/meter)

E = Electric Field Intensity measurement obtained through use of the Antenna-factor Curves (µV/meter).

Where measurements are made in dB(µV/m), this conversion from E-to H-Field values can be readily calculated by subtracting 51.5 dB (ohm) (20 Log_{10}377 ohms) from the E-Field measurement.

Thus:

$$H\ [(dB(\mu A/m)] = E\ [dB(\mu V/m)] - 51.5\ dB$$

The loop antenna is directional, having a maximum sensitivity when the loop is oriented perpendicular to the H-Field. The antenna curves are valid only when the antenna is oriented in both azimuth and elevation for maximum sensitivity to the received signal.

5.0 Operating Procedure

5.1 Antenna Set-Up Procedure

a. Mount the antenna base to the Model TRI-136 Tripod, by screwing it in a clockwise direction, as viewed from above.

5.2 Electrical Connections

a. Connect the 7.6 m (25-foot) coaxial cable from the "Signal Out" TNC Connector on the antenna base to the "RF Input" Connector on the 50-ohm receiver/analyzer.

NOTE: The other TNC connector marked "INJECTION IN" is used for injecting a calibration signal into the antenna. This feature is used for antenna calibration and required for measurement in accordance with some standards.

5.3 Operational Use

To use the antenna, simiply set the FREQUENCY RANGE Switch to one of ten frequency ranges arranged as follows:

0.009-0.035 MHz

0.035-0.075 MHz

0.070-0.150 MHz

0.120-0.250 MHz

0.250-0.500 MHz

0.5-1.1 MHz

1.1-2.4 MHz

2.4-5.5 MHz

5.5-12.5 MHz

12.5-30.0 MHz

6.0 Magnetic Field Measurements

6.1 Narrowband Radiated Signals

With the Model ALR-30M Loop Antenna, connected to the 50-ohm receiver/analyzer as described above, tune the receiver/analyzer to the frequency range of interest. Orient the loop for maximum sensitivity. This will normally be with the plane of the loop directed towards the source of radiation. However, in the extreme induction field, this may not be so.

Read the two-terminal voltage indicated by the receiver/analyzer for the particular signal of interest.

To convert the resulting two-terminal reading to the appropriate E-Field strength reading when using the ALR-30M, add the "antenna factor in dB" at the frequency of interest from the Antenna Factor Chart for the antenna being used.

To convert the E-Field strength reading in dB(µV/m) to the the H-Field reading in dB(µA/m), subtract 51.5 dB.

Example:

SIGNAL AMPLITUDE INDICATION.....+20 dB(µV)

Two-terminal voltage indication.....+20 dB(µV)

Antenna Factor from graph (typical).....+40 dB(m^{-1})

E-Field strength (apparent).....+60 dB(µV/m)

E to H field conversion factor.....-51.5 dB (ohms)

H-Field Strength..... 8.5 dB(µA/m)

The above procedure is similar for most 50-ohm receivers.

6.2 Broadband Radiated Signals

After determining that the signal is truly a broadband signal (refer to Section II Para. 2.4.7 EMC-30 Manual for a method of Broadband/Narrowband signal determination), proceed to determine the correct two-terminal broadband level using the calibration and operating procedures for the receiver/analyzer being used.

To convert the resulting two-terminal reading to the appropriate broadband field strength when using the ALR-30M, add the "antenna factor in dB" at the frequency of interest from the Antenna Factor Chart for the antenna being used.

Example:

SIGNAL AMPLITUDE INDICATION.....+20 dB(µV)

Broadband Conversion Factor.....+60 dB(µV/MHz)

Two-terminal broadband signal level.....+80 dB(µV/MHz)

Antenna Factor from graph (typical).....+40 dB(m^{-1})

E-Field strength (apparent).....+120 dB(µV/m/MHz)

E to H field conversion factor.....-51.5 dB (ohms)

H-Field Strength.....+68.5 dB(µA/m/MHz)

The procedure is similar for most 50-ohm receivers.

ANTENNA FACTOR CHART

ALR-30M LOOP ANTENNA

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