INSTRUCTION MANUAL

REMOTE LOOP ANTENNA

MODEL ALR-30

9 kHz – 30 MHz

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REMOTE LO0P ANTENNA

9 kHz – 30 MHz

ELECTRO-METRICS

MODEL ALR-30

SERIAL NO: N/A

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WARRANTY

This Model ALP-30 Remote 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-30 REMOTE LOOP ANTENNA

1.0 Introduction

The Model ALR-30 Remote Loop Antenna is designed specifically for use with the Electro-Metrics Model EMC-30 Interference Analyzer and is used to obtain magnetic field measurements from 9 kHz to 30 MHz. This frequency range covers the first ten RF Frequency Ranges for the EMC-30 and is automatically switched for optimum operation at the particular EMC-30 RF Frequency Range selected.

The Model ALR-30 is designed for use in conjunction with the Model TRI-136 Tripod, Model CAC-30 Coaxial Cable, and is furnished with a 7.6 meter (25-foot) length of control cable for connection to the EMC-30.

The Model ALR-30 antenna is also designed to be a replacement for the ALR-25 for use with the R-2168/URM-200 and various versions of the EMC-25 Interference Analyzer. When used in this manner, a special cable is used to connect it to the antenna control connector in place of the ALR-25.

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 Description

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

3.1 LED Indicators

Type: LED.

Color: Amber.

Number: 10.

Location: Front of the antenna base, numbered 1 thru 10.

Function: Indicate which of the ten lower frequency RF Frequency Ranges is being used. Since the ALR-30 only covers from 9 kHz to 30 MHz, there are no indicators for the five upper RF Frequency Ranges (e.g. 20 MHz to 1 GHz). Whenever the EMC-30 is set to any one of these upper RF ranges, no indicators will be lit on the ALR-30.

3.2 Signal Out Connector

Type: TNC, receptacle.

Function: Connects the signal received by the antenna to the RF Input Connector of the EMC-30.

3.3 Injection In Connector

Type: TNC, receptacle.

Function: 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.

3.4 Power/Control Line Connector

Type: Nine-pin PT Pygmy Connector (PT02A-9-19S).

Function: To supply power and control from the EMC-30.

4.0 Theory Of Operation

The Model ALR-30 Remote 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 EMC-30 Receiver, 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 seg•ments of the frequency range. It is therefore necessary to switch matching networks in order to cover the more-than-ten-octave range of the antenna (9 kHz-30 MHz).

As is the case in conventional remote antennas, the matching networks are mounted in the base of the antenna. However, rather than a manual ten-position switch as would be used with a conventional remote antenna, the Model ALR-30 utilizes relays which switch in the appropriate impedance tranformation network.

Digital logic voltage from the EMC-30, indicating the RF Frequency Range to which the receiver is set, is applied to A2-U1 on the Switching Logic Board. A2-U1 is a 4-16 line decoder with outputs to A2-U2, U3, and U4, which are a two-input NAND GATE, four-input AND GATE, and a HEX BUFFER respectively. The gates control pull-down transistors A2Q1-A2Q14 which in turn control the switching of Relays A1K1-A1K10 (Relay Switching Board) and the LED indicators, CR1-CR10 on the front of the antenna housing. A +8 VDC regulator (integrated circuit, A2U5), operating from the + RAW supplied through the control cable from the EMC-30, provides the supply voltage to the two internal PC boards. Although, as noted previously, Loop Antenna ALR-30 is sensitive only to the H-Field, the antenna factor charts at the rear of this manual convert the measurement from a two-terminal voltage at the input of the EMC-30, 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:

$$E = 377\ H$$

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. The antenna base is secured to the tripod by screwing it in a clockwise direction, as viewed from above.

5.2 Electrical Connections

a. Connect the 7.6 m (25') multiple-conductor cable furnished with the antenna between the 9-pin connector on the antenna base and the 14-pin Antenna Connector on the rear panel of the EMC-30.

b. Connect the 7.6 m (25-foot) coaxial cable from the "Signal Out" TNC Connector on the antenna base (nearest the 9-pin connector) to the "RF Input" TNC Connector on the EMC-30 front panel.

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 Checkout

a. Turn "ON" the EMC-30.

b. Set the EMC-30 front panel controls as follows:

DETECTOR.....PEAK
BANDWIDTH.....WIDE BAND position of the frequency range selected.
ATTENUATION Setting.....20 dB
FREQUENCY RANGE.....0.009-0.035 MHz. (FREQUENCY RANGE 1)
FREQUENCY INIDICATION.....0.022 MHz.
Mid-range frequency point of Frequency Range 1.

c. With the EMC-30 set to RF Frequency Range 1 (0.009-0.035 MHz), the front panel LED marked "1" should be on.

d. Step through each RF Frequency Range and check for the appropriate LED to be lit (RF Frequency Ranges 1-10 only).

No LEDS should be lit for RF Frequency Ranges 11-15, this would indicate a fault within the antenna circuitry. If this occurs contact the ELECTRO-METRICS CUSTOMER SERVICE DEPARTMENT (518) 843-2600 or your nearest ELECTRO-METRICS representative.

6.0 Magnetic Field Measurements

6.1 Narrowband Radiated Signals

With the Model ALR-30 Remote Loop Antenna, connected to the EMC-30 as described above, tune the EMC-30 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 EMC-30 for the particular signal of interest, following the calibration and operating procedures in Section II (OPERATING INSTRUCTIONS) Paragraph 2.3 of the EMC-30 Instruction Manual.

To convert a two-terminal reading on the EMC-30 to the appropriate E-Field strength reading when using the ALR-30, simply 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)
(Digital Meter)
Two-terminal voltage indication is thus.....+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)

6.2 Broadband Radiated Signals

After determining that the signal is truly a broadband signal (refer to Section II Paragraph 2.4.4 EMC-30 Manual), proceed to determine the correct two-terminal broadband level using the calibration and operating procedures in Section II (OPERATING INSTRUCTIONS) Paragraph 2.3 of the EMC-30 Instruction Manual.

To convert the resulting two-terminal reading to the appropriate broadband field strength when using the ALR-30, simply 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)
(Digital Meter)
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)

ANTENNA FACTOR CHART

ALR-30 REMOTE LOOP ANTENNA

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