Model HI-3624A

ELF Magnetic Field Meter

User Manual

ETS·LINDGREN™
HOLADAY EMF MEASUREMENT

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Revision Record | HI-3624A ELF Magnetic Field Meter, MANUAL
Part #H-600044, Rev. B

Revision	Description	Date
	Initial Release	April, 1991
A	Added CE, updated	January, 2000
B	Updated branding: Revised to meet Style Guide specifications; reformatted to half-size; PIB included with release; Remove HI-3624 reference. Remove VDT reference.	July, 2009

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Notes, Cautions, and Warnings

	Note: Denotes helpful information intended to provide tips for better use of the product.
CAUTION	**Caution**: Denotes a hazard. Failure to follow instructions could result in minor personal injury and/or property damage. Included text gives proper procedures.
WARNING	**Warning**: Denotes a hazard. Failure to follow instructions could result in SEVERE personal injury and/or property damage. Included text gives proper procedures.

See the ETS-Lindgren *Product Information Bulletin* for safety, regulatory, and other product marking information.

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1.0 Introduction

The HI-3624A ELF Magnetic Field Meter is designed to measure the flux density of magnetic fields in the frequency range of 30 Hz to 2 kHz. The Model HI-3624A provides for a switch selectable measurement range from 5 Hz to 2 kHz. It finds application in the measurement of magnetic fields associated with electric power lines and electrically operated appliances.

The HI-3624A is a single axis flux density meter designed to be responsive to either sinusoidal or complex magnetic fields. It directly displays the root-mean-square (rms) value of magnetic flux density on an analog meter. The sensor consists of a multi-turn loop connected to the instrumentation readout package via a one meter long cable.

The separate loop sensor provides for orientation of the sensor relative to the various magnetic field polarization components. This allows quick assessment of the greatest flux density value while conveniently holding the instrument for easy meter reading. This feature makes the HI-3624A especially useful for rapid, large area surveys of magnetic fields.

The field sensor loop is electrically shielded; consequently the response of the HI-3624A is solely due to magnetic fields. No interference is caused by ambient strong electric fields like those found beneath high voltage, overhead electric power lines or nearby radio or television stations.

The HI-3624A has a wide dynamic measurement range. The range provides for full scale ranges of as small as 2 milligauss to as great as 20 gauss. This large dynamic range makes the HI 3624A convenient for measurement of ambient residential magnetic fields as well as high level fields found near high current carrying conductors or electrical machinery.

Standard Configuration

- Meter
- Probe
- Manual

ETS-Lindgren Product Information Bulletin

See the ETS-Lindgren *Product Information Bulletin* included with your shipment for the following:

- Warranty information
- Safety, regulatory, and other product marking information
- Steps to receive your shipment
- Steps to return a component for service
- ETS-Lindgren calibration service
- ETS-Lindgren contact information

2.0 Maintenance

CAUTION

Before performing any maintenance, follow the safety information in the ETS-Lindgren *Product Information Bulletin* included with your shipment.

Maintenance of the HI-3624A is limited to external components such as cables or connectors.

If you have any questions concerning maintenance, contact ETS-Lindgren Customer Service.

Battery Replacement

Two 9 volt alkaline batteries power the HI-3624A ELF Magnetic Field Meter. To replace the batteries, remove the eight screws located on the back of the meter, pull the panel away from the chassis and unplug the battery connectors. Install the new batteries and reverse the proceeding steps to reassemble the meter.

Annual Calibration

See the *Product Information Bulletin* included with your shipment for information on ETS-Lindgren calibration services.

Service Procedures

For the steps to return a system or system component to ETS-Lindgren for service, see the *Product Information Bulletin* included with your shipment.

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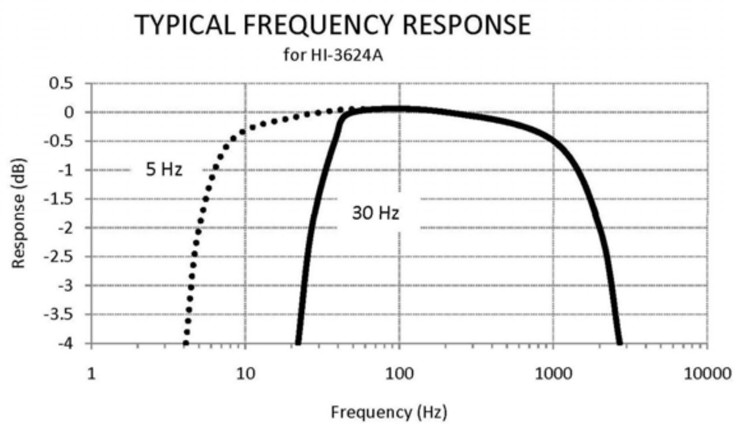
3.0 Specifications

Electrical Specifications

Frequency Response	5 to 2000 Hz	Flat
	5 Hz	-3 dB
	2000 Hz	-3 dB
	<5 Hz	Falling 80 dB/decade
	>2000 Hz	Falling 80 dB/decade
Detector Response	True rms field indication for accurate measurement of non-sinusoidal waveforms.	
Sensitivity	Full scale ranges of: 2 mG, 20 mG, 200 mG, 2 G, 20 G ±5% at calibration frequencies of 50, 100, 500 and 1000 Hz	
Accuracy	Within ±5% at calibration frequencies of 50, 100, 500 and 1000Hz	
Linearity	2%	

Physical Specifications

Power	Two, 9 volt alkaline batteries
Battery Life	Up to 120 hours intermittent use
External Multi-Turn Loop Sensor	Inside diameter = 110 mm
	Outside diameter =116 mm
	Area = 0.010 m^2
Cable Length	1.2 m



Instrument accuracy is derived from a field calibration using a one meter diameter pair of Helmholtz coils for establishing an accurately known magnetic field flux density. A precisely controlled and measured sinusoidal current is driven through the Helmholtz coils and, based on the dimensions of the coils; the magnetic field flux density between the coils in milligauss (mG) is calculated.

While the HI-3624A indicates magnetic flux density (B) in units of milligauss, the flux density in microtesla or magnetic field strength (H) in milliamperes per meter may be obtained via the following relations:

1 microTesla = 10 mG

1 mG = 80 milliamperes per meter (mA/m)

4.0 Practical Application and Use

CAUTION

Before operating any components, follow the safety information in the ETS-Lindgren *Product Information Bulletin* included with your shipment.

Example Application

Power Lines

Magnetic fields near overhead power lines can be easily measured with the HI-3624A. An approach commonly used to characterize power line fields is to measure the flux density along a straight line which passes perpendicular to the power line. Generally, readings are first taken along the length of a span of the power line to identify the point at which the greatest flux density exists. Then at this point take the readings perpendicular to the power line. Take readings every five to ten feet and orient the sensor for maximum reading. A magnetic field flux density profile can then be developed. This method is outlined by the Institute of Electrical and Electronics Engineers (IEEE) in the American National Standards Institute (ANSI) standard 644 1987

A similar approach may be used for measuring the flux density produced by buried lines. In this case, the area must be explored by walking about with the meter, simultaneously moving the sensor in various orientations, until the region of maximum flux density is found.

Residential Measurements

Magnetic fields found in home environments are highly variable, depending on location within the home. This variability is strongly related to the distribution of the wiring in the home, the location of electrical appliances and occasionally, the location of plumbing lines or other metallic structures within the ground which may form low resistance paths for electrical ground return currents. Establishing what the ambient magnetic field environment is in a home usually requires numerous measurements throughout the home, with at least one measurement within each room. Normal practice would include at least one field measurement taken near the center of each room. A more thorough approach would include five measurements in each room, one at the center and one near each corner of the room. A reasonable technique is to position the sensor at a point approximately one meter from each room corner for the flux density measurement. This avoids, to an extent, placing the sensor immediately next to wiring which may be hidden within the walls of the room and which may yield unrealistically high values of flux density compared to what most individuals within the room might be exposed.

Surveys of the areas near electrical appliances will usually reveal higher values of flux density due to the currents flowing within motors or heating elements. Logical choices would include the location of beds, for example, since this is a location of extended occupancy. In characterizing the magnetic fields near obvious sources, such as appliances, it is often helpful to measure and record the flux density value at intervals of a few inches (or centimeters) beginning near the surface of the device. These data will help provide a perspective on the spatial extent of the elevated field levels and the significance of the levels relative to other values determined elsewhere within the home. Field measurements should take into account the likelihood that individuals may have access to areas where measurements are contemplated.

Because 60-Hz magnetic fields produced by the use of electricity within the home are dependent on the magnitude of current flowing within wires or the operation of appliances, flux densities will be seen to vary with time, being greater when more electrical power is being used. For example, when heating or air conditioning systems turn on or the compressor within a refrigerator cycles on, the flux density will increase. Measurements must take this condition into account and it is recommended that, when taking measurements in a room, the meter be watched for a period of time to observe for fluctuations in the indicated value of flux density. After some experience, it may be possible to relate the observed fluctuations to various uses of electricity within the home.

A phenomenon which has recently received some attention in regard to residential magnetic fields is the flow of earth currents via plumbing lines or telephone cables buried beneath the home. In some cases, it has been noted that 60-Hz magnetic fields exist within a home, even when the home is not using any electrical power (the circuit breakers have all been turned off at the main electrical service box of the home). This observation has, in some cases, been related to the flow of currents beneath the home on pipes or cables. It is not unusual for currents, related to other neighbors' use of electricity, to flow back to the electrical supply via low resistance paths formed by metal plumbing pipes or wires used for telephones as opposed to the electrical system neutral wire. In such cases, it is possible to measure magnetic flux densities within the home without any apparent reason if the power to the home has been shut off.

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5.0 Operation

CAUTION

Before placing into operation, follow the safety information in the ETS-Lindgren *Product Information Bulletin* included with your shipment.

The ELF magnetic field sensor must be plugged into the HI-3624A meter case for proper operation; it makes no difference whether the sensor is plugged in before or after the meter is turned on.

The main switch turns on the instrument and selects one of five ranges for measurement. A second switch controls the desired low frequency cutoff. A "Low Battery" LED glows when the batteries are low. If the "low Battery" indicator remains on replace both of the batteries which are accessible from the back side of the meter case (instructions for replacing batteries may be found in the Maintenance section of this manual). It is normal for the LED battery indicator to briefly blink while turning the switch to various ranges and when turning the instrument off.

When beginning field measurements, successively turn the range switch to the right, increasing the instrument's sensitivity until an upscale reading on the meter is obtained. Most accuracy is achieved when the meter reads approximately midscale. At each range setting, while holding the meter in one hand, rotate the sensor with the other hand so as to obtain a maximum indication on the meter.

Because the sensor is capable of measuring only one polarization component of the magnetic field at any specific time, there are two methods that can be used for measurements. In the majority of cases, it is sufficient to orient the sensor so that a maximum indication on the meter is observed. In many instances this will be a measurement of the resultant magnetic flux density. The sensor must be rotated about three axes which are each perpendicular to one another. This can be quickly accomplished with a little practice.

In other cases, the root-sum-squared resultant value of flux density may be obtained by taking three orthogonal measurements of the field; in this case, the sensor is successively oriented in three mutually perpendicular directions around a fixed point and the individual readings recorded. The mutually perpendicular directions will be denoted as X, Y, and Z. The resultant flux density is then found by forming the root-sum-squared value from the individual readings as follows:

$$B = (Bx^2 + By^2 + Bz^2)^{1/2}$$

B = resultant flux density; B_x = Reading in the X direction;

B_y = Reading in the y direction; B_z = Reading in the Z direction.

It does not matter which orientation of the field sensor is used for the X orientation but the Y and Z orientations must be perpendicular to one another and the X orientation.

The user may select the lower frequency of the band pass for the instrument as either 30 Hz or 5 Hz. It should be noted that when the instrument is switched to the 5 Hz lower frequency cutoff, the unit will be very sensitive to motion of the sensor since movement within the earth's constant field will appear as a signal to the instrument. When the sensor is accelerated or rotated within a constant field, there will be an output from the sensor at a frequency corresponding to the movement and this will usually include frequency components greater than 5 Hz. Consequently, during such movement, the meter will typically show significant upscale indications. The 5 Hz frequency cutoff setting is primarily useful for measurements at fixed coil positions. For area surveys of ELF fields, the 30 Hz cutoff will be more useful.

Appendix A: Warranty

See the *Product Information Bulletin* included with your shipment for the complete ETS-Lindgren warranty for your HI-3624A ELF Magnetic Field Meter.

DURATION OF WARRANTIES FOR HI-3624A ELF MAGNETIC FIELD METER

All product warranties, except the warranty of title, and all remedies for warranty failures are limited to one year.

Product Warranted	**Duration of Warranty Period**
HI-3624A ELF Magnetic Field Meter	1 Year

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Appendix B: EC Declaration of Conformity

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An ESCO Technologies Company

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Declaration of Conformity

We, ETS-Lindgren, L.P., 1301 Arrow Point Drive, Cedar Park, TX, 78613, USA, declare under sole responsibility that the:

Model/Part Number: HI-3624A

Model/Part Name: ELF Magnetic Field Meter

Date of Declaration:

Affirmation Date: 07 April, 2009

to which this declaration relates, meets the requirements and is in conformity with the relevant EC Directives listed below using the relevant section(s) of the following EC harmonized standards and other normative documents;

Applicable Directive(s):

Electomagnetic Compatibility Directive (EMC), 89/336/EEC and its amending directives

Applicable harmonized standard(s) and/or normative document(s):

EN 50081-1:1992 Electromagnetic compatibility - Generic emission standard Part 1: Residential, commercial and light industry

EN 55011:1991- Group 1 Class B, Limits and methods of measurement of radio disturbance characteristics of industrial, scientific, and medical (ISM) radio-frequency equipment

Authorized Signatories:

ETS-Lindgren L.P.
Bryan Sayler, General Manager

ETS-Lindgren L.P.
James C. Psencik, Vice President of Engineering

The authorizing signatures on this Declaration of Conformity document authorizes ETS-Lindgren, L.P. to affix the CE mark to the indicated product. CE marks placed on these products will be distinct and visible. Other marks or inscriptions liable to be mistaken with the CE mark will not be affixed to these products.

ETS-Lindgren, L.P. has ensured that technical documentation shall remain available on premises for inspection and validation purposes for a period ending at least 10 years after the last product has been manufactured.

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