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ETS·LINDGREN®
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Microwave Survey Meter

Model HI-1501

User Manual



November, 2020

H-600010 Rev C

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Revision Record
MANUAL, HI-1501 Microwave Survey Meter | Part # H-600010 Rev C

Revision	Description	Date
	Initial Release	February, 1990
A	Revised, Reformatted	March, 1999
B	Update to current style standards, updated product photos; corrected PNs of optional parts, calibration method, and specifications	May, 2016
C	Updated Polarization, RFI, and Drift parameters. Warranty information specifics removed and general updates to format.	November, 2020

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Notes, Cautions, and Warnings



Note: Denotes helpful information intended to provide tips for better use of the product.



Caution: Denotes a hazard. Failure to follow instructions could result in minor personal injury and/or property damage. Included text gives proper procedures.



Warning: Denotes a hazard. Failure to follow instructions could result in **SEVERE** personal injury and/or property damage. Included text gives proper procedures.

Safety Information

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



Refer to Manual: When product is marked with this symbol, see the instruction manual for additional information. Manuals are available for download at ETS-Lindgren.com, or contact ETS-Lindgren Customer Service.



High Voltage: Indicates presence of hazardous voltage. Unsafe practice could result in severe personal injury or death.



Protective Earth Ground (Safety Ground): Indicates protective earth terminal. You should provide uninterruptible safety earth ground from the main power source to the product input wiring terminals, power cord, or supplied power cord set.

Before power is applied to this instrument, ground it properly through the protective conductor of the AC power cable to a power source provided with the protective earth contact. Any interruption of the protective (grounding) conductor, inside or outside the instrument, or disconnection of the protective earth terminal could result in personal injury.



LASER HAZARD: Laser power up to 150 mW at 830 nm may be accessible at the fiber connector of the laser. However, the laser beam itself is not hazardous as the interlock ensures that the exposure time will be less than 30 ms.



WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT (WEEE) DIRECTIVE: (European Union) At end of useful life, this product should be deposited at an appropriate waste disposal facility for recycling and disposal. Do not dispose of with household waste.



RECYCLABLE PRODUCTS: This product includes rechargeable batteries. At end of useful life, please recycle the used batteries, or dispose of them safely and properly. Many cities collect used batteries for recycling or disposal. You may contact your local waste disposal agency for information on battery recycling and disposal.



Before servicing: contact ETS-Lindgren – servicing (or modifying) the unit by yourself may void your warranty. If you attempt to service the unit by yourself, disconnect all electrical power before starting. There are voltages at many points in the instrument which 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 instrument is disconnected from its power source



Only qualified personnel should operate (or service) this equipment.

Introduction

The **ETS-Lindgren Model HI-1501 Microwave Survey Meter** is a rugged, compact, portable instrument that is virtually immune to failure caused by excessive fields or physical abuse. This instrument is acceptable to the US Government Center for Devices and Radiological Health (FDA/CDRH) for compliance testing of microwave ovens and to all major microwave oven manufacturers for testing ovens in use and after repair.

Microwave leakage (electromagnetic fields) is detected by an array of eight hot carrier diodes housed in the large end of the plastic probe. This antenna array has the unique feature of being able to sum microwave electric fields of any polarization in a plane perpendicular to the axis of the probe. The antenna lobe (effective measuring area) is also very broad, making the instrument easy to use when measuring leakage around an oven door. The spacer cone is designed to provide 5 cm spacing from the tip of the probe to the center of the array.

Each detection probe and meter amplifier is calibrated as a unit and serves all three ranges: 2, 10 and 100 mW/cm². Only the 2 and 10 mW/cm² ranges are considered compliance ranges in terms of compliance with the DHHs/CDRH standard for microwave survey instruments contained in CFR 1030.10.



The HI-1501 must be used with the spacer cone in place. Using the instrument without the cone will result in reading errors and may damage the unit.

Calibration Method

Each meter is calibrated by placing the probe in a CW (continuous wave) 2450 MHz electromagnetic field. The source feeds an anechoic chamber through a section of waveguide terminating in a slot radiator. Calibration is performed at a level of 1 mW/cm² and a standard temperature of 75º F.

The calibration is performed at 1 and 5 mW/cm². The accuracy of the field is determined by comparing with an LCR (local calibration reference) which is traceable to NIST (National Institute of Standards and Technology) through FDA/CDRH (Food and Drug Administration / Center for Devices and Radiological Health).

Standard Configuration

The Model HI-1501 Microwave Survey Meter includes:

- Survey meter including probe with spacer cone
- Two 9 Volt Alkaline Batteries
- Fitted carrying case

Optional Items

Additional items that may be included with the Model HI-1501 Microwave Survey Meter include:

- Plastic 600 ml beaker (pn H-44600MLP)
- Spacer Cone Kit (pn H-540013) – Includes two spacer cones and four cone shields
- Nine Volt Batteries (pn H-30MN1604) (Duracell MN1604 or equivalent)

ETS-Lindgren Product Information Bulletin

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

- 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

Maintenance

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

Maintenance of the Model HI-1501 is limited to battery and spacer cone replacement.

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

Maintenance Recommendations

Spacer Cone Replacement

WARNING Do not use the HI-1501 without the space cone in position.

To maintain stated instrument accuracy, only use spacer cones provided by ETS-Lindgren.

The spacer cone must be replaced when worn or contaminated. A polystyrene cone shield provides protection for the relatively soft material of the cone.

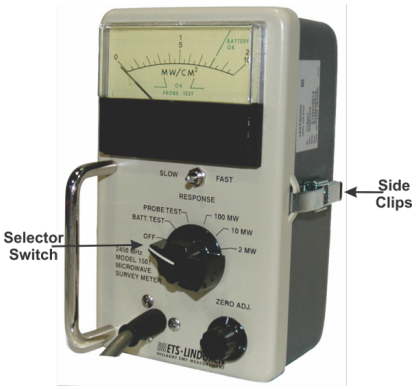


1. Remove the old cone by pulling straight up and off the end of the probe.
2. Slip a new cone on, being sure the cone is fully seated on the probe.

Battery Replacement

Always replace both batteries when batteries are in need of replacement.

1. Turn the selector switch to the OFF position.
2. Unsnap the two side clips that hold the cover in place.
3. Replace the batteries and re-insert the meter assembly into the cover being careful to not crimp the battery wires between the front panel and cover.
4. Turn the selector switch to BATT TEST. If the meter does not immediately indicate full scale, check the condition of each battery to make sure they are in good condition or fully charged



Annual Calibration

It is recommended that the Model HI-1501 Microwave Survey Meter be recalibrated every 12 months. See the Product Information Bulletin included with your shipment for information on ETS Lindgren calibration services.

Replacement and Optional Parts



ETS Lindgren may substitute a similar part or new part number with the same functionality for another part/part number. Contact ETS Lindgren for questions about part numbers and ordering parts.

Following are the part numbers for ordering replacement or optional parts for the Model HI-1501 Microwave Survey Meter:

Part Description	Part Number
Spacer Cone and Shield Replacement Kit (10 Cones and 20 Shields)	H-540013
600 mL Plastic Beaker	H-44600MLP
Carrying Case	H-51FPC6506B

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.

Specifications

Electrical Specifications

Frequency	2450 MHz (±50 MHz)
Power Range	0.2-100 mW/cm²
Accuracy	±1 dB
Response Time	**Fast Mode:** <1 second **Slow Mode:** 2 – 3 seconds (to 90% of Impulse Level)
Overload Capacity	Continuous 2.0 W/cm²

Physical Specifications

Dimensions	5.3 x 6.8 x 4.13 cm (2.09 x 2.68 x 4.13 in)
Probe Length	30.0 cm (11.81 in)
Cable Length	1.2 m (3.94 ft)
Shipping Weight	2.3 kg (5 lbs)

Operation

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

Do not attempt to operate a microwave oven with:

- Any object caught in the door
- A door that does not close properly
- A damaged door hinge, latch or sealing surface

WARNING Do not use the HI-1501 without the spacer cone in position.

The areas where leakage is likely to occur are around the door seal, the window, and at ventilation louvers or vents. A damaged or improperly installed magnetron mounting gasket may cause leakage in the control panel area of the oven.

Accuracy

The accuracy of the ETS-Lindgren Model HI-1501 Microwave Survey Meter is within ± 1 dB (+25%, -20%) when used according to these instructions:

1. Always use a clean spacer cone. Accuracy will be affected by wear of the cone and by dirt and metallic particles which may become imbedded in the EPS (Expanded Polystyrene-Styrofoam).

2. If the instrument is to be used continuously for an extended period of time, the condition of the batteries must be checked by rotating the selector switch to the BATT Test position at least once every 15 minutes.

3. The normal operating temperature ranges is between 60º and 90º F (15.5º and 32.2º C). If used outside this range, an additional error will be introduced. This error can be approximated as -0.14% per Fahrenheit (F) degree. The negative temperature coefficient means that the instrument reads high at lower temperatures and low at higher temperatures.

4. The parameters which affect the accuracy of this instrument are listed along with the error contribution of each in the following table:

Parameter	Error (dB) 1 mW / cm²
Calibration-Precision-Accuracy	+0.42, -0.16, ±0.09
Non-linearity and AM response	±0.09
Near Field vs. Far Field	±0.29
Receiving Pattern	-0.11
Temperature Response	±0.17
Frequency Response*	±0.04
Polarization*	±0.21
RFI*	±0.04
Drift	±0.02
Total	**+1.27 / -1.12**

*Errors combined in RMS manner

Preparing the Oven

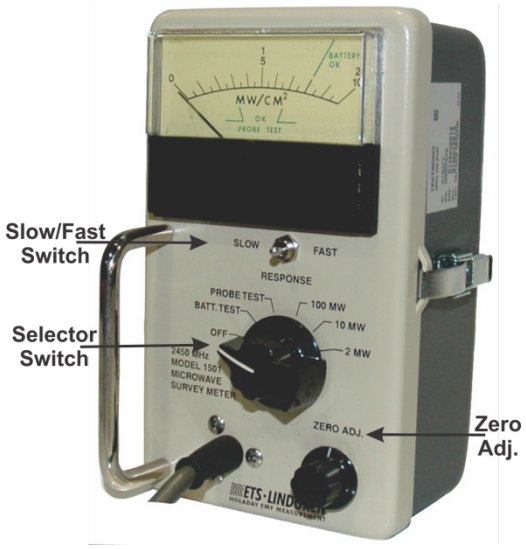
CAUTION Do not attempt to operate a microwave oven with:

- Any object caught in the door
- A door that does not close properly
- A damaged door hinge, latch or sealing surface

1. Make sure the oven is clean and there is no buildup of dirt around the door seal area.
2. Inspect the door and sealing surfaces, the hinge and latch for damage or a loose fit.
3. Make sure the oven is set for full power.
4. In order to make an accurate leakage measurement you must use the specified water load. Fill the beaker to a level of 275 mL with cool tap water and place it in the center of the oven.
5. Set the oven timer for three minutes.

WARNING If the timer is set longer than three minutes, the water may boil. If the water does boil, carefully remove the beaker and pour out the water. Once the beaker has cooled, refill with 275 mL of cool tap water.

Preparing the Meter



1. Remove the meter from the carrying case. Make sure the EPS (Styrofoam) spacer cone is intact and firmly seated on the probe. Check the cone for signs of wear or contamination. If the cone is contaminated or worn, contact ETS-Lindgren Customer Service Department for replacement.
2. Move the SLOW / FAST switch to the FAST position. Turn the selector switch to the BATT TEST position. If the needle does not indicate above the green BATT OK line, replace both batteries. See Maintenance Section for more information.
3. Turn the selector switch to the PROBE TEST position. The needle should indicate between the green OK and PROBE TEST lines.
4. Turn the selector switch to the desired scale (usually the 2 mW scale) and let the meter stabilize for two minutes.
5. Adjust the indicator needle on the meter to read zero by turning the ZERO ADJ knob. The probe must be shielded or removed from the vicinity of any RF fields when the meter is being zeroed.

The probe must be in a zero microwave field with no RF energy present for accurate zeroing.

Making a Measurement



1. Turn the oven on and proceed with the leakage measurement.
2. Hold the probe by the red handle in one hand and hold the meter in the other hand. Place the tip of the spacer cone against the oven surface, with the probe handle perpendicular to the surface. While testing, hold the meter away from the oven to minimize the possible RF pickup directly from the oven to the meter case.
3. Move the probe slowly, about one inch per second, keeping the cone tip in contact with the oven and the probe handle straight.
4. The areas where leakage is likely to occur are around the door seal, the window and at ventilation louvers or vents. A damaged or improperly installed magnetron mounting gasket may cause leakage in the control panel area of the oven.
5. If the needle goes beyond the end of the scale (2 mW/cm^2), turn the selector switch to the 10 mW scale. Turn the oven off, re-zero the meter and repeat the measurement.
6. Once you have checked all around the door edges, around and across the window and at any louvers or vents, move the SLOW / FAST switch to the SLOW position. Return to the spot where you noticed the highest reading.
7. Hold the probe in place over the spot for at least five seconds and watch for the highest needle indication. The needle will move slower and not go quite as high as it did in the FAST position. The reading you obtain is the maximum leakage of the oven.
8. Check the zero after each measurement. If a shift in the zero is observed, the meter will be re-zeroed and the measurement repeated.
9. Turn the selector switch to OFF when the meter is not in use.

What the Measurement Means

The FDA / CDRH (Food and Drug Administration / Center for Devices and Radiological Health) has established the following requirements concerning microwave oven leakage:

> *The power density (leakage) emitted by a microwave oven shall not exceed one milliwatt per square centimeter (1 mW/cm²) measured prior to acquisition by a purchaser, and thereafter, five milliwatts per square centimeter (5 mW/cm²).*

Ovens in use today often have leakage values in the 0.1 to 0.4 mW/cm² range, usually less than 0.6 when received from the manufacturer.

Appendix A: Warranty



See the Product Information Bulletin included with your shipment for the complete ETS Lindgren warranty for your ETS-Lindgren Model HI-1501 Microwave Survey Meter.

Appendix B: EC Declaration of Conformity

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CE 96

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-1501

Model/Part Name: MICROWAVE SURVEY METER

Date of Declaration: 17 January, 1996

Affirmation Date: 04 June, 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):

CISPR 11 (EN 55011): Electromagnetic emissions requirements for Industrial, Scientific and Medical (ISM) Equipment (Class B)

EN 50082-1:1992 Electromagnetic compatibility - Generic immunity 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, a 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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