HI-1501 Microwave Survey Meter User's Manual



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Revision Record

Manual #600010 HI–1501 Microwave Survey Meter

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Limited Warranty

Holaday Industries, Inc. warrants each model HI—1501 to be free from defects in material and workmanship for a period of one year from the date of shipment to the purchaser. This warranty extends to the original purchaser only, and does not apply to the batteries or to any products or parts subject to misuse, neglect, accident, unauthorized service or abnormal conditions of operation.

In the event an instrument covered by this warranty fails, Holaday Industries, Inc. will, without charge, repair and recalibrate the instrument if returned to their factory within one year of the original purchase—provided that Holaday Industries' examination discloses, to its satisfaction, that the product is defective. Holaday Industries, Inc. may, at its option, replace the product in lieu of repair. If the defect was caused by misuse, neglect, accident, unauthorized service or abnormal conditions of operation, repairs will be billed at a nominal cost. In such cases, an estimate will be provided before work is started, if requested by the purchaser.

For warranty service, contact Holaday Industries, Inc. Provide the serial number of the instrument and complete details regarding the failure mode. You will then be given either service information or shipping instructions. Return the instrument to the factory, transportation prepaid. Repairs will be made at the factory and the instrument will be returned to you, transportation prepaid. Holaday Industries, Inc., assumes no responsibility for loss of, or damage to, products in transit.

Warning!

EXTREME CAUTION IS ADVISED WHEN WORKING IN ENVIRONMENTS WHERE HIGH-INTENSITY ELECTROMAGNETIC FIELDS MAY EXIST AND WHERE CONTACT WITH HIGH VOLTAGE OR HIGH CURRENT CIRCUITS OR APPARATUS IS POSSIBLE. ACCIDENTAL CONTACT WITH OBJECTS OR CIRCUITS OPERATING AT HIGH VOLTAGES OR HIGH CURRENTS CAN BE LETHAL! HOLADAY INDUSTRIES, INC. ASSUMES NO LIABILITY FOR ANY DAMAGES OR PERSONAL INJURY WHICH MAY RESULT FROM

1.0 INTRODUCTION

The 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.

This easy to use meter, and the step-by-step instructions in this manual will enable you to easily and accurately measure leakage from your microwave oven.

This manual is divided into six sections:

- 1. About the HI-1501
- 2. Specifications
- 3. Acceptance
- 4. Getting Ready
- 5. Making the Measurement
- 6. What the Measurement Means





Figure 1 HI-1501 Microwave Survey Meter

2.0 ABOUT THE HI-1501

Description

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 a 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.

NOTE:

The HI-1501 must not be used without the spacer cone in place. Using the instrument without the cone will result in reading errors and may damage the unit.



Figure 2 HI-1501 Front Panel

Accuracy

The accuracy of this instrument is within \pm 1 db (+25%, -20%) when used according to these instructions:

- Always use a clean Holaday 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 range is between 60/ and 90/ F. If used outside this range, an additional error will be introduced. This error can be approximated as -0.14% per Fahrenheit 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.

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Parameter	Error (dB)	
	1 mW/cm ²	
Calibration - Precision - Accuracy	+0.42, -0.16 ±0.09	
Nonlinearity 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		

Calibration Method

Each meter is calibrated by placing the probe in a CW (continuous wave) 2450 MHZ electromagnetic field generated by a crystal controlled solid state source. 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 75/ F.

The calibration is also checked at 5 mW/cm^2 . 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

[formerly NBS]) through FDA/CDRH (Food and Drug Administration / Center for Devices and Radiological Health).

Maintenance

The only maintenance that is required is the replacement of the batteries or the spacer cone, should it become damaged or worn. Both items may be purchased from Holaday Industries, Inc.

NOTE:

Do not use the HI-1501 without the spacer in position. To maintain stated instrument accuracy, use only spacer cones provided by Holaday.

Battery Replacement

Turn the selector switch OFF. Unsnap the two clips that hold the cover in place. Always replace both batteries at the same time. Any nine (9) volt alkaline (or the optional, rechargeable NiCad) battery may be used. Replace batteries and reinsert the meter assembly into the cover being careful to not crimp the battery wires between the front panel and the cover. After replacement, turn the selector switch to BATT TEST. If the meter does not immediately indicate full scale, check the condition of each battery to assure that they are in good condition or fully charged.

Spacer Cone Replacement

The spacer cone must be replaced when worn or contaminated. Simply remove the old cone by pulling straight off the end of the probe. Slip a new cone on, being sure the cone is fully seated on the probe. A polystyrene cone shield is available which provides protection for the relatively soft material of the cone. The following spare parts and options are available from Holaday:

- 1. Spacer Cone Kit (Holaday part number 540013) (Includes two spacer cones and four cone shields)
- Nine Volt Batteries (Holaday p/n 30MN1604) (Duracell MN1604 or equivalent)
- 3. 600 mL Beaker (Holaday p/n 44600MLP)
- Nine Volt NiCad Batteries (Holaday p/n 30TR78) (SAFT CS9T or equivalent)
- NiCad Battery Charger (Holaday p/n 30AC22) (SAFT WC-4 or equivalent)

Recalibration Service

It is recommended that the HI-1501 be recalibrated every 12 months.

Holaday Industries, Inc. will recalibrate and repair any damaged instrument for a nominal charge. The calibration fee will be quoted on request.

Service Centers

Holaday Industries, Inc. has established factoryauthorized repair and recalibration centers in the US and the UK. If your microwave survey meter requires service or recalibration, contact Holaday for the nearest center.

Return Procedures

To return a product, use the following procedure:

Step 1. Briefly describe the problem in writing. Give details regarding observed symptom(s), and

whether the problem is constant or intermittent. If you have already talked to Holaday Customer Service about the problem, provide the date(s), the name of the service representative you spoke with, and the nature of the conversation. Include the serial number of the item.

Step 2. Package the probe carefully. Return the product, using the original boxes and packing materials, if possible to:

Holaday Industries Inc. Attn. Service Department 14825 Martin Drive Eden Prairie, MN USA 55344 Page — 10

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3.0 HI-1501 SPECIFICATIONS

Frequency:	2450 MHZ (± 50 MHZ)
Power Range:	0 -100 mW/cm ²
Accuracy:	± 1 dB
Response Time:	2 - 3 seconds (SLOW) < 1 second (FAST)
Overload Capacity:	Continuous 2000 mW/cm ²
Dimensions:	2.09 in. (5.3 cm) x 2.68 in. (6.8 cm) x 4.13 in. (10.5 cm)
Probe Length:	12.00 in. (30.5 cm)
Cable Length:	3.3 ft. (1.0 m)
Spacer:	1.97 in. (5 cm), EPS (Expanded Polystyrene - Styrofoam)

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4.0 ACCEPTANCE

Introduction

This section contains information on unpacking and acceptance of the HI-1501.

Unpacking and Acceptance

- Step 1. Upon delivery of your order, inspect the shipping container(s) for evidence of damage. Record any damage on the delivery receipt <u>before</u> signing. In case of concealed damage or loss, retain the packing materials for inspection by the carrier.
- Step 2. Remove the product from its shipping containers. Save the boxes and any protective packing materials for future use.
- Step 3. Check all materials against the packing list to verify that the equipment received matches that which was ordered. If you find any discrepancies, note them and call Holaday Customer Service for further instructions.

Be sure that you are satisfied with the contents of your order and the condition of your equipment <u>before</u> using the HI-1501.

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5.0 GETTING READY

Introduction

There are certain things that should be taken care of before testing your microwave oven. It is a good practice to follow these guidelines when using and testing any microwave oven:

DO NOT ATTEMPT TO OPERATE A MICROWAVE OVEN WITH:

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

Preparing the Oven

- 1. Make sure that the oven is clean and that there is no buildup of dirt around the door seal area.
- 2. Inspect the door and sealing surfaces, the hinge, and the latch for damage or a loose fit.
- 3. If the oven has a variable power control or a defrost setting, make sure it 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.
- Set your oven timer for approximately three (3) minutes. If your test takes longer than this, the water may boil. If it does, pour out the water and refill using 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. Replace if worn or contaminated.
- Move the SLOW/FAST switch to the "FAST" position. Turn the selector switch to "BATT TEST." The needle should indicate above the green "Batt OK" line. If not, replace both batteries (refer back to page 8).
- 3. Turn the selector switch to the "PROBE TEST" position. The needle should indicate between the green "OK", "PROBE TEST" lines. If not, the probe or meter circuits have been damaged and should not be used. A defective probe cannot be replaced in the field and the complete unit should be returned to the factory for repair.
- 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.

6.0 MAKING THE MEASUREMENT

Introduction

This section outlines the steps that should be taken while measurements are actually taken with the HI-1501.

- 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.
- If the needle goes beyond the end of the scale (2 mW/cm²), turn the selector switch to the 10 mW scale. Turn the oven off, rezero the meter, and repeat the measurement.
- 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 before.

- 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 your oven.
- 8. Check the zero after each measurement. If a shift in the zero is observed, the meter will be rezeroed and the measurement repeated.
- 9. Turn the selector switch to OFF when the meter is not in use.



Figure 3 Oven Scanning

7.0 WHAT THE MEASUREMENT MEANS

Introduction

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/cm^2 range, usually less than 0.6 when received from the manufacturer.

If the oven leakage exceeds 5 mW/cm², you should contact a service agency recommended by the oven manufacturer, or contact the manufacturer directly. This oven must be repaired to comply with the CDRH safety guidelines.

You may wish to write down for future reference the leakage level, and the model number and serial number of the meter used to make the measurement. Be sure to note the calibration due date of the instrument; for assurance of accurate readings, the microwave survey meter should have been calibrated within the last 12 months.

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-- NOTES --