

**HOLIDAY**

HI-1801

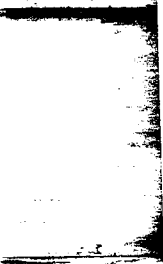


# INSTRUCTION MANUAL - HI-1801

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The HI-1801 Microwave Survey Meter is a rugged, compact, portable instrument and 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) 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 booklet will enable you to easily and accurately measure the leakage from your microwave oven.

This manual is divided into five sections:

1. Description of the HI-1801
2. Getting the oven ready
3. Getting the meter ready
4. Making the measurement
5. What the measurement means

If you have any questions on the use of this meter or on any information in this instruction manual, you may write directly to Holaday Industries, Inc., 14825 Martin Drive, Eden Prairie, MN, 55344, USA; or call (612) 934-4920 during regular business hours. For your convenience our FAX number is (612) 934-3604.

## 1.0 ABOUT THE METER

### 1.1 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



**HI-1801 MICROWAVE SURVEY METER**

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.

The instrument has a single calibrated range of zero to ten  $\text{mW}/\text{cm}^2$  (0 - 10). The scale is divided into three zones, with a calibration point at midscale ( $5 \text{ mW}/\text{cm}^2$ ). If the reading is in the green zone, it is definitely less than  $5 \text{ mW}/\text{cm}^2$ . If it is in the red zone, it is definitely greater than  $5 \text{ mW}/\text{cm}^2$ .

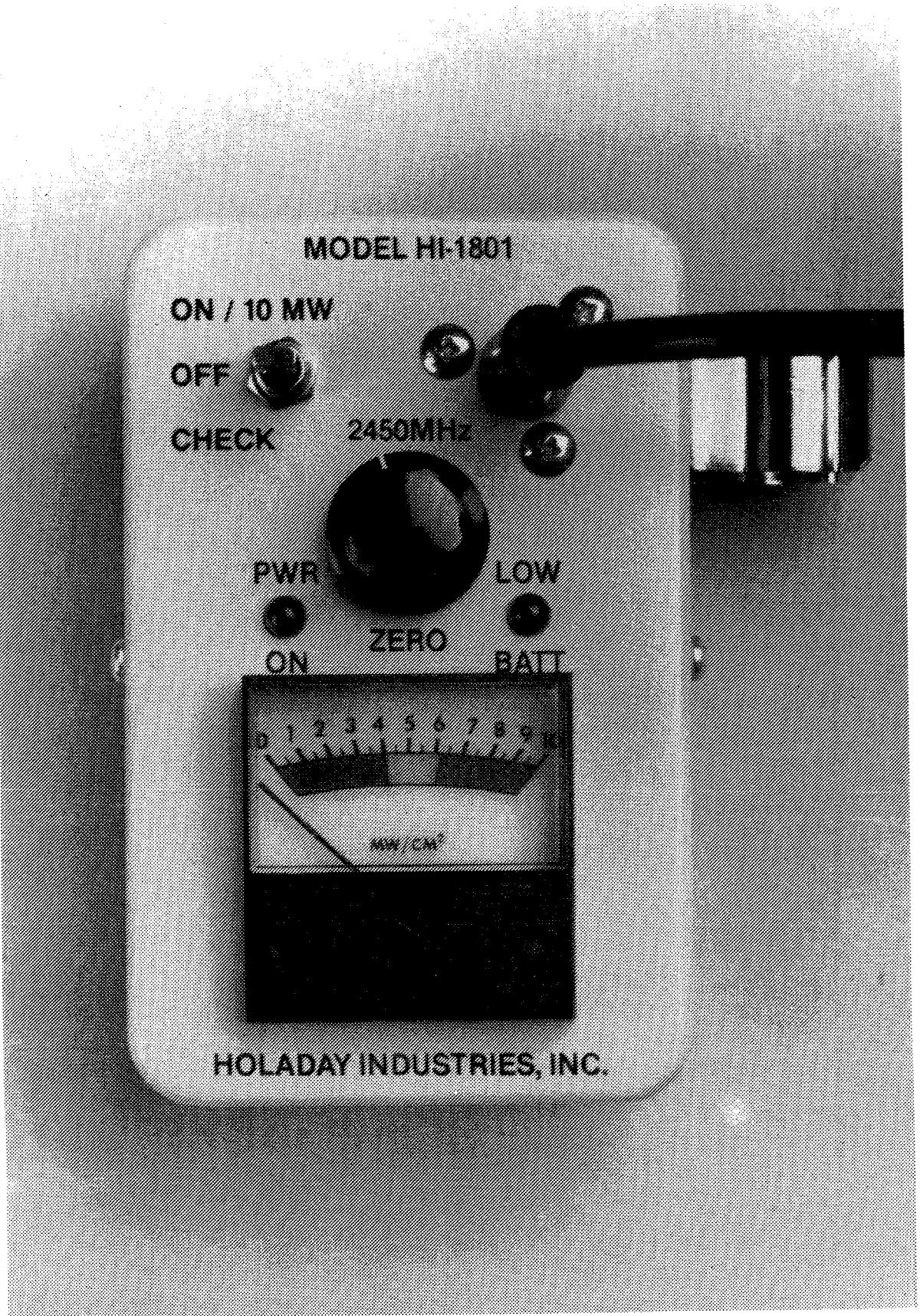
NOTE: The HI-1800 must not be used without the spacer cone in place. Using the instrument without the cone will result in reading errors and may damage the unit.

## 1.2 UNIQUE FEATURES

When testing today's microwave ovens, the observed leakage levels are often well below one milliwatt/square centimeter. Many of these values are below the sensitivity threshold of the HI-1801.

Observers are often concerned that the instrument may not be operating properly when no leakage indication is noted.

When used on the same oven, low cost microwave leakage indicators may show a significant or even dangerous leakage level. This is due to the lack of damping and to the detection characteristics of the low cost meter. The HI-1801 is designed to comply with the requirements of the US Government criteria for testing microwave ovens.



HI-1801 FRONT PANEL

The HI-1801 provides a new "CHECK" feature that allows you to check the operation of the instrument at any time when testing a microwave oven. The control switch has two positions, an "ON/10 MW" position and a "CHECK" position.

The "ON/10 MW" position is used for testing microwave ovens in the normal manner.

The "CHECK" position provides an additional uncalibrated, highly sensitive mode for checking meter operation. In the "CHECK" position mode the meter will respond to very low levels of leakage and will assure you that the instrument is responding to microwave energy. With this increased sensitivity, most ovens will cause some deflection of the meter, verifying proper operation of both the oven and the meter.

After using the "CHECK" mode, return to the "TEST" mode and perform the oven test in the normal manner. Note that meter readings in the "CHECK" mode have no significance; the only purpose of this mode is to verify proper meter function.

### 1.3 SPECIFICATIONS

|       |                   |   |   |
|-------|-------------------|---|---|
| 1.3.1 | Frequency         | - | 2450 MHz ( $\pm$ 50 MHz)                        |
| 1.3.2 | Power Range       | - | 0-10 mW/cm <sup>2</sup>                         |
| 1.3.3 | Accuracy          | - | $\pm$ 1 dB                                      |
| 1.3.4 | Response Time     | - | 2-3 seconds                                     |
| 1.3.5 | Overload Capacity | - | Continuous 2000 mW/cm <sup>2</sup>              |
| 1.3.6 | Dimensions        | - | 5.3 cm x 6.8 cm x<br>10.5 cm                    |
| 1.3.7 | Probe length      | - | 30.5 cm   |
| 1.3.8 | Cable length      | - | 1 meter   |
| 1.3.9 | Spacer            | - | 5 cm, EPS (Expanded<br>Polystyrene - Styrofoam) |

## 1.4 ACCURACY

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

- 1.4.1 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 foam - Styrofoam).
- 1.4.2 Hold the instrument case at approximately 45°. The balance of the meter movement causes the needle to move slightly when held horizontally (flat) or vertically (upright). The meter is calibrated while at an angle of 45° and if used at that angle, no additional error will be introduced.
- 1.4.3 The normal operating temperature range is between 60 and 90 degrees F. If used outside this range, an additional error will be introduced. This additional error can be approximated as -0.1% per Fahrenheit degree. The negative temperature coefficient means that the instrument reads high at lower temperatures and low at higher temperatures.



1.4.4 The parameters which affect the accuracy of this instrument are listed along with the error contribution of each.

| Parameter                    | Error in dB   |
|------------------------------|---------------|
| Calibration                  |               |
| - Precision                  | $\pm 0.09$    |
| - Accuracy                   | $+ 0.13$      |
| Nonlinearity and AM Response | $\pm 0.17$    |
| Near Field vs Far Field      | $\pm 0.29$    |
| Receiving Pattern            | $- 0.11$      |
| Temperature Response         | $\pm 0.06$    |
| Frequency Response *         | $\pm 0.04$    |
| Polarization *               | $\pm 0.21$    |
| RFI *                        | $\pm 0.04$    |
| Drift *                      | $\pm 0.04$    |
| Total                        | $+0.96/-0.81$ |

\*Errors combined in RMS manner.

## 1.5 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 5 mW/cm<sup>2</sup> and a standard temperature of 75 degrees Fahrenheit.

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).

## 1.6 MAINTENANCE

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

NOTE: The HI-1801 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. Use only spacer cones provided by Holaday Industries, Inc. to maintain stated instrument accuracy.

1.6.1 Battery replacement: Remove the two screws that hold the instrument cover in place. Remove the foam block holding the batteries. Always replace both batteries. Any nine (9) volt alkaline battery may be used.

1.6.2 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 will provide protection for the relatively soft EPS material of the spacer cone.

1.6.3 The following spare parts and options are available from Holaday Industries, Inc.:

- a. Spacer Cone Kit, P/N 54413  
(includes two spacer cones and four cone shields)
- b. Nine Volt Batteries, P/N 30MN1604  
(Duracell MN1604 or equivalent)
- c. 600 mL Beaker, P/N 44600MLP

### 1.7 RECALIBRATION SERVICE

It is recommended that the instrument 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.

### 1.8 SERVICE CENTERS

Holaday Industries, Inc. has established factory-authorized repair and recalibration centers in the US, Canada, and the UK. If your microwave survey meter requires service or recalibration, contact Holaday Industries for the name of the nearest center.

## 1.9 WARRANTY

### LIMITED WARRANTY

Holiday Industries, Inc. warrants each model HI-1801 Microwave Survey meter to be free from defects in material and workmanship under normal use and service for a period of ONE YEAR from date of shipment. This warranty extends to the original purchaser only. This warranty does not apply to misuse, neglect, accident, or abnormal conditions of operation.

In the event of instrument failure covered by this warranty, Holiday Industries, Inc. will repair the instrument if returned to their factory within one year of original purchase, provided the warrantor's examination discloses to its satisfaction that the product was defective. The warrantor may, at its option, replace the product in lieu of repair. With regard to any instrument returned within the warranty period, said repairs or replacement will be made without charge. If the defect was caused by misuse, neglect, accident, or abnormal conditions of operation, repairs will be billed at nominal cost. In such a case, an estimate will be submitted before work is started, if requested.

### INSTRUCTIONS IN CASE OF DEFECT

A. Notify Holiday Industries, Inc. giving full details of the difficulty, and include the serial number of the instrument. On receipt of this information, service data or shipping instructions will be forwarded to you.

B. On receipt of the shipping instructions, forward the instrument, transportation prepaid, to:

Holiday Industries, Inc.  
14825 Martin Drive  
Eden Prairie, MN 55344, USA

Repairs will be made at the factory and the instrument returned to you, transportation paid.

## 2.0 GETTING THE OVEN READY

Most ovens in use carry the following common sense guidelines on the inner door surface:

PRECAUTIONS FOR SAFE USE TO AVOID POSSIBLE EXPOSURE TO EXCESSIVE MICROWAVE ENERGY.

DO NOT ATTEMPT TO OPERATE THIS OVEN WITH:

1. Object caught in door.
2. Door that does not close properly.
3. Damaged door, hinge, latch, or sealing surface.

It is a good practice to follow these guidelines when using and testing any microwave oven.

- 2.1 Make sure the oven is clean and that there is no buildup of dirt around the door seal area.
- 2.2 Inspect the door and sealing surfaces, the hinge, and the latch for damage or loose fit.
- 2.3 If your oven has a variable power control or a defrost setting, make sure it is set for full power.

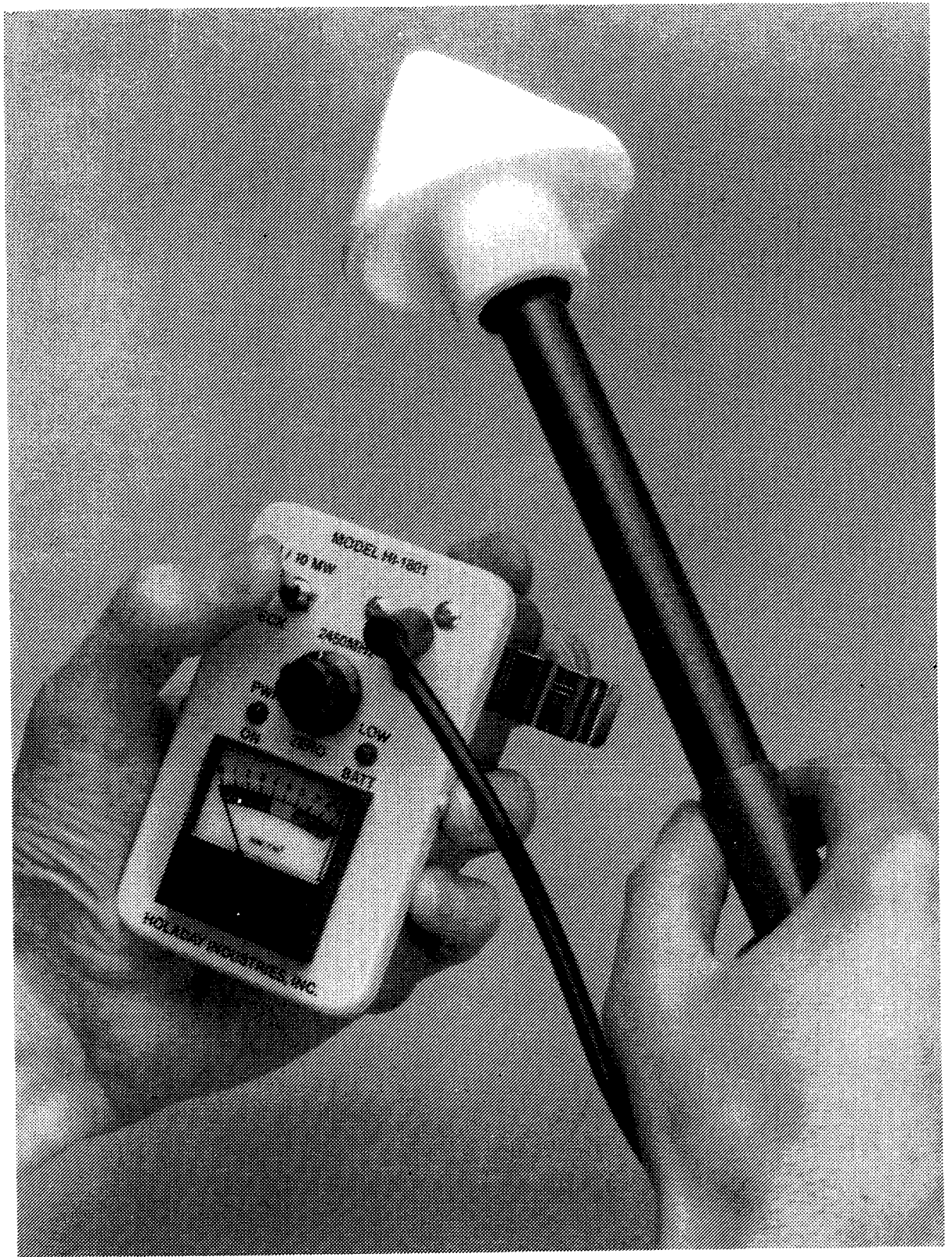
- 2.4 In order to make an accurate leakage measurement you must use the specified water load. Fill the beaker to a level of 275 milliliters with cool tap water and place it in the center of the oven.
- 2.5 Set your oven timer for approximately three (3) minutes. If your test takes longer than this the water may boil. If it does, pour out the water and refill using 275 mL of cool tap water.

### 3.0 GETTING THE METER READY

- 3.1 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.
- 3.2 Operate the ON/OFF switch in either the ON or the CHECK position. If the batteries are low, the "LOW BATT" light will come on. When this occurs, the batteries must be replaced before further testing.

NOTE: Replace both batteries at the same time.

- 3.3 The "ON/OFF" switch must be moved to the "ON" or "CHECK" position to operate the unit. The "PWR" light will come on when the "ON/OFF" button is held in either position and the instrument is operating.



## ON / OFF SWITCH OPERATION

3.4 While operating the ON/OFF switch in the ON/10 MW position, use the large knob to adjust the meter to a ZERO indication. Note that the probe must be in a zero microwave field with no RF energy present for accurate zeroing.

#### 4.0 MAKING THE MEASUREMENT

4.1 Turn the oven on and proceed with the leakage measurement.

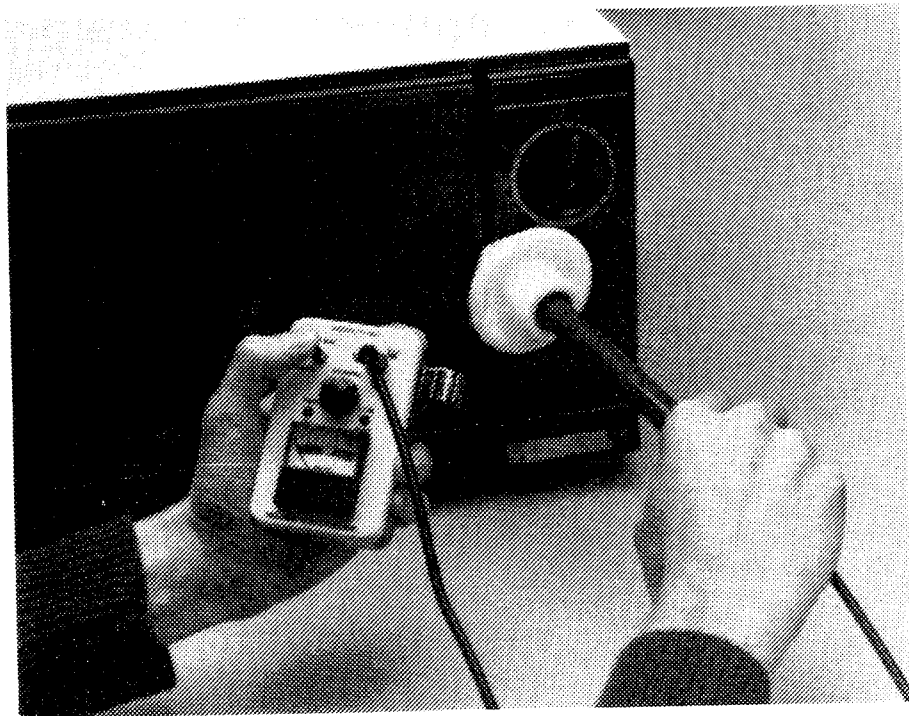
4.2 Hold the probe by the red handle with one hand and hold the meter with the other hand, holding the ON/OFF switch in the ON/10 MW position. Place the tip of the spacer cone against the oven surface, with the probe handle perpendicular to the surface as shown. While testing, hold the meter away from the oven to minimize possible RF pickup directly from the oven to the meter case.

4.3 Move the probe slowly, about one inch per second, keeping the cone tip in contact with the oven and the probe handle straight.

4.4 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.

4.6 Once you have checked all around the door edges, around and across the window, and at any louvers or vents, return to the spot where you noticed the highest reading before.





## OVEN SCANNING

4.7 Hold the probe in place over the spot for at least five seconds and watch for the highest needle indication. The reading you obtain is the maximum leakage of your oven.

#### 5.0 USING THE "CHECK" FEATURE

5.1 Hold the ON/OFF switch in the CHECK position and use the large knob to adjust the meter to an indication between 0 (zero) and 1. Note that the probe must be in zero microwave field with no RF energy present.

5.2 Holding the ON/OFF switch in the CHECK position and the oven operating, move the probe over the door and door gap surfaces of the oven. In the CHECK mode, the sensitivity of the HI-1801 is increased from five to ten fold. Note that it may be necessary to test the oven in a no-load condition momentarily to observe meter deflection.

#### 6.0 WHAT THE MEASUREMENT MEANS - IS YOUR OVEN SAFE?

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

The power density (leakage) emitted by a microwave oven shall not exceed one milliwatt per square centimeter ( $1 \text{ mW/cm}^2$ ) measured prior to acquisition by a purchaser, and thereafter, five (5) milliwatts per square centimeter ( $5 \text{ mW/cm}^2$ ).

Five  $\text{mW/cm}^2$  is mid-scale on the 10 MW range. However, many ovens leak so little that you may notice only a small indication. This actual value is sometimes as low as 0.1 or 0.2  $\text{mW/cm}^2$ .