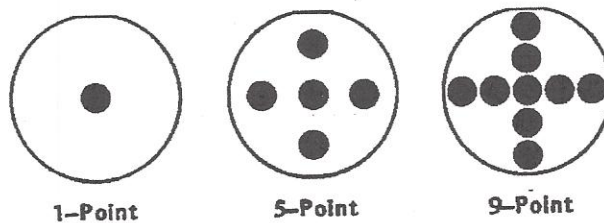# INTRODUCTION

The M-Gage™ 200 measures sheet resistance in ohms per square or milliohms per square. In addition, the Sonogage™ 200 measures substrate thickness and computes bulk resistivity. If specific resistivity is known, the thickness of the deposited film layer can be computed from the sheet resistance measured by either instrument. The Digital Data Converter will perform this computation automatically. On both instruments the choice of measurement data is easily switch selectable, as is the choice of units. The Sonogage's Doping Type Option indicates P or N doping of the wafer. When used with the Digital Data Converter and printer, all measurement information is printed automatically.

The M-Gage 300 and Sonogage 300 are similar to the models described above except for their maximum wafer size. The model 300s accommodate 150mm (6") wafers as well as the standard 2", 3", 100mm (4"), and 125mm (5") wafers. The differences in loading and unloading the wafers on the 300s, are noted in the section titled "Measurement."

Measurement Sequence

Wafers can be measured at a single point for greatest speed, or at multiple points for the most comprehensive analysis of wafer or film characteristics. In 1-point measurements, only the center point is examined. In 5- and 9-point measurements, data points are collected along two perpendicular axes, as shown below.
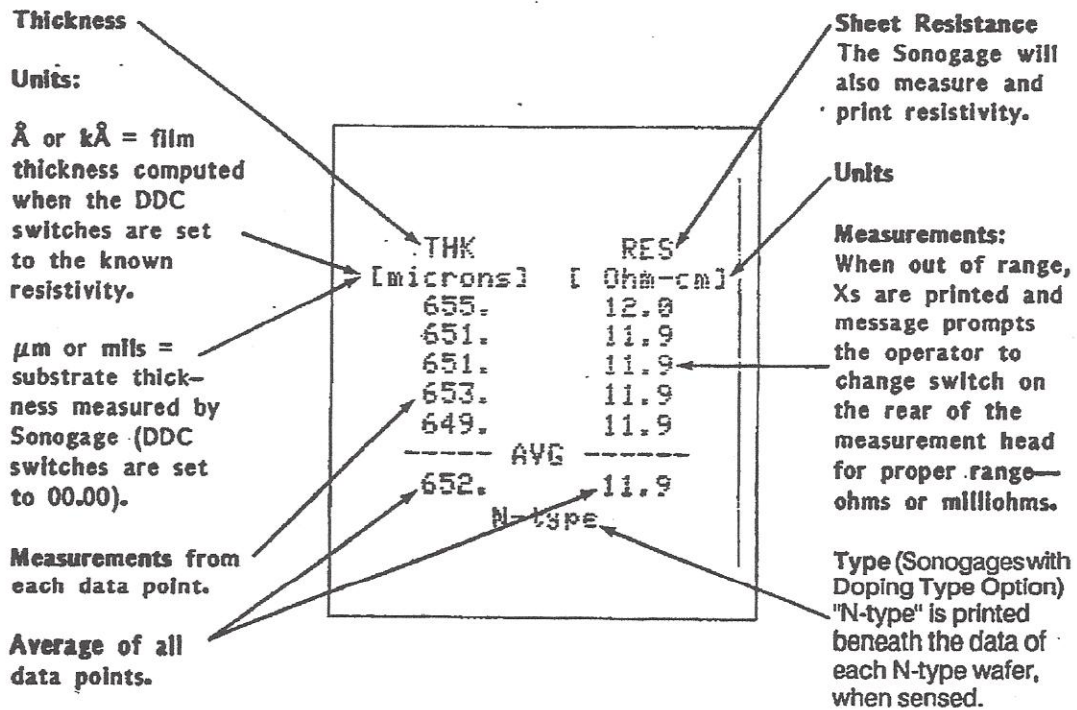

1-Point   5-Point   9-Point

Operating Modes

The M-Gage and Sonogage have two modes of operation—Manual and Automatic. In Manual Mode the operator steps the wafer through the measurement sequence one point at a time, by pressing a single button. The measurement is shown on the LED numeric display. The parameter to be displayed is chosen before measurement.

Automatic Mode requires the Digital Data Converter (DDC) or the HP-85 computer to control the measurement sequence and to send data to a remote printer or other device. In this mode the entire multi-point measurement sequence is initiated with the press of a button. The data output is recorded on a printer. With the Parallel-to-Serial Converter, any serial printer having 20 or more columns can be used. In this mode data will not be displayed on the instrument's numeric displays. Automatic Mode provides the following comprehensive data print-out:

M-Gage 200 print-out shown.

Thickness

Units:

Å or kÅ = film thickness computed when the DDC switches are set to the known resistivity.

μm or mils = substrate thickness measured by Sonogage (DDC switches are set to 00.00).

Measurements from each data point.

Average of all data points.

```
   THK            RES
[microns]    [ Ohm-cm]
  655.         12.0
  651.         11.9
  651.         11.9
  653.         11.9
  649.         11.9
  ----- AVG -----
  652.         11.9
       N-type
```

Sheet Resistance
The Sonogage will also measure and print resistivity.

Units

Measurements:
When out of range, Xs are printed and message prompts the operator to change switch on the rear of the measurement head for proper range— ohms or milliohms.

Type (Sonogages with Doping Type Option) "N-type" is printed beneath the data of each N-type wafer, when sensed.

During multi-point measurement the wafer is carried beneath the measurement head in two passes. In a 5-point measurement sequence, three points are measured during the first pass. (In 9-point measurements, five points are measured on the first pass.) The wafer is then returned to the starting point, rotated 90°, and the process is repeated. Notice that in Manual Mode the center point is actually measured twice, once on each pass. The DDC is programmed to skip the center point on the second pass.
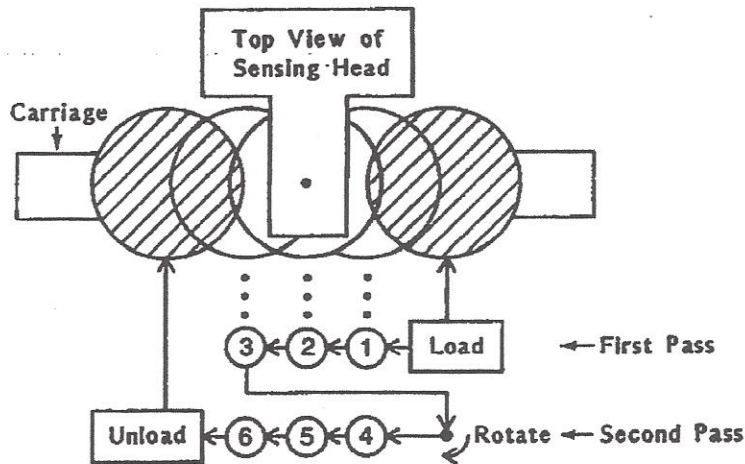
The measurement sequence is programmed by an optical encoder disk housed within the instrument. To change the measurement sequence, simply change the disk, as described in a later section. Disks are available for 1-, 5-, and 9-point sequences. Other measurement sequences are available on special order. Consult the appendix for ordering information.

> NOTE: Different 5- and 9-point disks are required for each size wafer to be tested. The disk must be changed when the wafer size is changed. Be sure to specify wafer size when ordering.

M-Gage and Sonogage Functions

	M-Gage 200 & 300		Sonogage 200 & 300	
	Manual	Automatic requires DDC or HP–85	Manual	Automatic requires DDC or HP–85
Sheet Resistance	1 to 1999 mΩ/□ or 1 to 1999 Ω/□ Extended Range Option (Multiply Display by 10): 10 to 19990 Ω/□			
Film Thickness	May be calculated manually	Calculated and printed automatically when known resistivity is entered.	May be calculated manually	Calculated and printed automatically when known resistivity is entered.
Substrate Thickness	—	—	250 to 700 μm 10 to 28 mils	
Resistivity	—	—	See Graph	
Type	—	—	Doping Type Option: (In Resistivity Mode) + = P–type − = N–type N–type indicated on print-out	

Relation Between Thickness and Resistivity Ranges

Thickness

650 μm

| milliohm range | ohm range | extended range |

350 μm

.035 .065   35   65   70   130   700 1300
milliohm-centimeter   ohm-centimeter

Resistivity