



# HL5500™

Hall System for Measurement of Resistivity, Carrier Concentration and Mobility

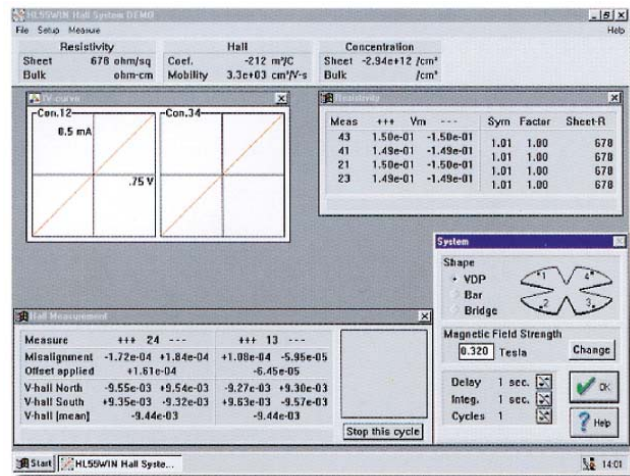
- AC/DC measurement modes. The use of AC currents and phase sensitive detection eliminates thermal effects, long term drifts and significantly enhances signal-to-noise ratios. DC mode is useful when rate dependent trapping, rectification due to non-ohmic contacts or stray capacitances may affect AC currents
- Van der Pauw, Hall Bar and Bridge measurements to ASTM F-76 standard
- Simple probe system for convenient, fast sample throughput
- Compact bench top design
- Wide current range including auto-current facility in order to minimize sample heating
- User defined electric field limitation to avoid impact ionization effects at low temperatures
- Optional high impedance buffer amplifier/current source to extend sheet resistivity measurements to  $10^{11} \Omega/\text{square}$
- Software control of all measurement functions, data reduction and storage, text and graphical output to printer
- Optional variable temperature capabilities:
  - a) Two-point, room temperature and 77 K
  - b) 90 K to 500 K liquid nitrogen cryostat
- Rare earth permanent magnet giving excellent stability
- Light-tight sample enclosure avoiding measurement errors due to photo generated effects
- Probe system allowing rapid sample set-up for room temperature and 77 K assessment of wafers up to 3-inch diameter<sup>1</sup>
- Extensive verification of measurement validity including contact checking algorithms
- Electro-forming circuitry for contact formation

The Nanometrics HL5500 is a turn-key, high performance Hall System for the measurement of resistivity, carrier concentration and mobility in semiconductors. Modular in concept, allowing easy upgrade paths, the system is suitable for a wide variety of materials, including silicon and compound semiconductors and metal oxide films

The system has both low and high resistivity measurement capabilities, with dual temperature capability and an optional cryostats extending the temperature range from below 90 K to 500 K. The computer is Microsoft® Windows™ based.

## Software

HL5500 features flexible, easy-to-use Windows software to enable easy export of data and information to other Windows packages.



- Support for van der Pauw, Hall Bar and Bridge samples
- Integration, delay & repeat measurement modes increases flexibility and accuracy on difficult to measure samples
- Easy export and storage of data and images for incorporation in other Windows applications.
- Contact verification including I-V curve tracer
- Electro-forming process for the formation of ohmic contacts<sup>2</sup>
- Correction algorithms for surface and interfacial depletion effects.
- Correction for Hall Scattering Factor





## Configurations

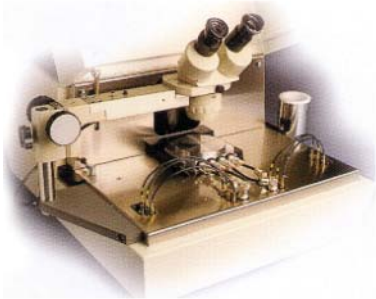
### Measurement Head

The standard system configuration is suitable for sheet resistivities of 0.1 m $\Omega$ /square to in excess of 1 M $\Omega$ /square. The measurement head is supplied with a two-temperature measurement stage complete with removable dewar and four micromanipulator probes.

### Buffer Amplifier

The HL5580 high impedance buffer amplifier/current source is available, extending sheet resistivity measurement capability to 100 G $\Omega$ /square and source currents to as low as 1 pA. Close proximity of the module to the sample, along with the use of driven guards, ensures minimization of cable capacitance effects. A special shielded sample holder is supplied (room temperature operation only).

A recommended optional extra is the HL5520 stereomicroscope.



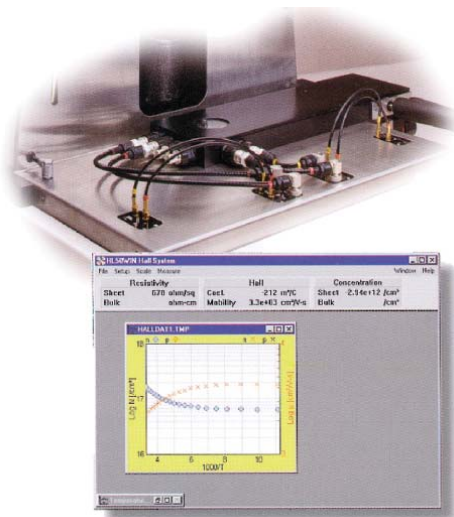
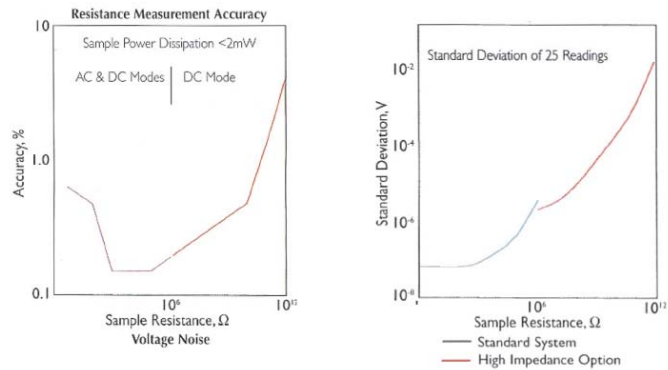
Optional Buffer Amplifier and Stereomicroscope

### Magnet

Type	Permanent with field reversal by magnet rotation
Field	Strength 0.32 T nominal $\pm 1\%$ of marked value Stability 0.1% over 10 years Uniformity $\pm\%$ over 25 mm diameter from center
Pole Gap	33.4 mm
Max Measurement Diameter	25 mm
Alternative Field Strengths	0.1, 0.2, 0.4, 0.5 T (nominal) [Available as Options]

### Typical Data HL5500

Includes cables and fixtures



Optional HL5550 Liquid Nitrogen Cryostat Stage

### HL5550

The HL5550 cryostat uses a horizontal, continuous flow, liquid nitrogen design. It is normally evacuated in order to remove moisture, which may affect measurements. The cryostat fits neatly between the pole-pieces of the magnet and has a viewing window through which the HL5520 stereo microscope option can be employed for easy probe location. It is designed to be fully compatible with the HL5580PC high impedance buffer amplifier/current source which, when fitted, is switched into the measurement circuit automatically if the sample current falls below 0.1  $\mu$ A.

Temperature:	Range Accuracy Stability	90 K - 500 K +0.5 K +0.1 K
Cool-down time (typical):		5 minutes
Maximum sample size:		15 x 15 mm

Note: Items not supplied by Nanometrics – Two stage rotary vacuum pump with pumping speed of 1 m<sup>3</sup>h<sup>-1</sup> or better.

## Specifications

Current Source	Standard System	With HL5580 High Resistivity Buffer Amplifier/Current Source Module
Range	100 nA - 19.9 mA	1 pA - 10 $\mu$ A
Compliance	20 V	20 V
Output Impedance	10 <sup>10</sup> $\Omega$	>10 <sup>13</sup> $\Omega$
Voltage Measure	Standard System	With HL5580 High Resistivity Buffer Amplifier/Current Source Module
Input Impedance	10 <sup>10</sup> $\Omega$	10 <sup>15</sup> $\Omega$ in parallel with 3 pF input
Input Voltage Operating Range	$\pm$ 6 V	$\pm$ 6 V
Input Leakage Current	20 nA per input (typical)	40 fA per input (typical)
Current Input Voltage Noise	0.8 $\mu$ V pk-pk at 0.1 - 10 Hz (typical) 15 nV/ $\sqrt{\text{Hz}}$ at 213 Hz	4.0 $\mu$ V pk-pk at 0.1 - 10 Hz (typical)
Measurement Modes	AC (213 Hz)/DC	DC
Sample Inputs	Coaxial	Two-lug female coaxial BNC with driven screen. Guard to input potential <100 $\mu$ V
Contact Switching	FET	Dry Reed

Dimensions (Not including computer)	
Measurement Head	535 mm (W) x 700 mm (D) x 295 mm (H)
Instrumentation Unit	280 mm (W) x 400 mm (D) x 150 mm (H)
Weight	
Measurement Head including Magnet	47.8 kg
Instrumentation Unit	90 kg

## Ordering Information

HL5500PC	Windows PC controlled Hall Effect Measurement System includes Measurement Head, Instrumentation Unit and HL55WIN Software Package which includes a GPIB card for the PC and User. Manual does not include magnet.
HL5500/M10	0.1 T Magnet (nominal)
HL5500/M20	0.20 T Magnet (nominal)
HL5500/M	0.32 T Magnet (nominal)
HL5500/M40	0.40 T Magnet (nominal)
HL5500/M50	0.50 T Magnet (nominal)
HL5501	Spare Two-Temperature Stage
HL5502	Spare Teflon Sample Dewar
HL5503	3-inch Teflon Sample Dewar
HL5504	Calibration Set
HL5510	Additional Two Probes
HL5520	Stereo Microscope
HL5550PC	Liquid Nitrogen Cryostat Stage (90 K - 500 K)
HL5580PC	High Impedance Buffer Amplifier/Current Source

System supplied with current specification Windows PC.

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<sup>1</sup> Using optional HL5503.

<sup>2</sup> Not available when HL5580 is fitted.

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