# RESISTIVITY MEASURING SYSTEMS

Resistance & Resisitvity


NH Instruments.

The Resistivity Measuring Systems of Nittoseiko Analytech have been designed to ensure easy RCF calculation and thus resistivity is measured in a simple test procedure. The Systems are specialised in measuring the resistance, the surface resistivity (Ω/□) and volume resistivity (Ω·cm) of various substances and materials of all shapes and sizes in the high- and low-resistance measuring range.

The Powder Resistivity Measuring System contains a high precision pressure gauge for the measurement of conductive powders.

NH Instruments the exclusive representative of Nittoseiko Analytech in German speaking territories (DACH) and the Benelux Union and offer technical advice and support.

Nittoseiko Analytech

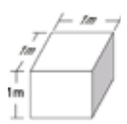
# RESISTANCE AND RESISTIVITY

As science and technology advance, demand has increased for simple, quick and precise classification of material properties in diverse fields such as research and development, production engineering and quality control.

According to the conventional method, resistance (Ω) was used for this purpose. However, resistance does vary depending on the type, shape and size of the material and also the measuring point. Therefore, the approved measuring method uses resistivity (Ω·cm) which expresses absolute and real material values.

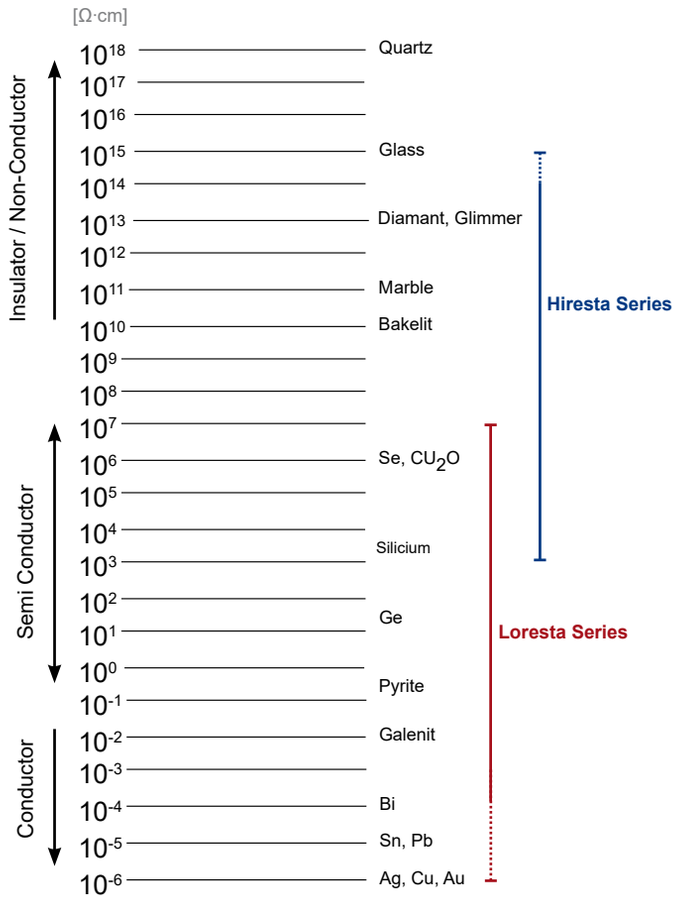
Resistivity is simply calculated by multiplying the measured resistance (Ω) with a Resistivity Correction Factor (RCF).
The resistivity measuring systems of Nittoseike Analytech have been designed to ensure easy RCF calculation and thus resistivity is measured in a simple test procedure.

**Resistivity is an absolute value**
A short test proves this:

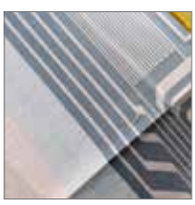
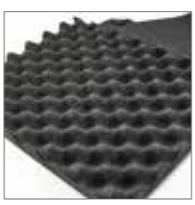
| Material | Au (Gold) | | |
|---|---|---|---|
| Dimensions |  |  |  |
| Resistance [Ω] | $2.4 \cdot 10^{-8}$ | $2.4 \cdot 10^{-6}$ | $2.4 \cdot 10^{-2}$ |
| Resistivity [Ω·cm] | $2.4 \cdot 10^{-6}$ | $2.4 \cdot 10^{-6}$ | $2.4 \cdot 10^{-6}$ |

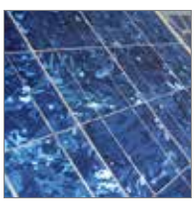
The results show obvious differences in resistance values, although the same test material has been used.
Therefore, resistivity is the best reliable index for material evaluation.

Each material has a unique resistivity value.





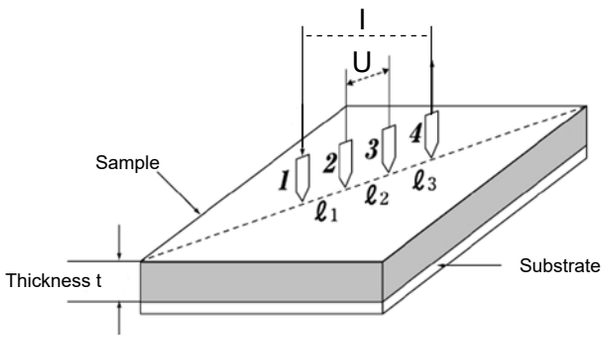




## Resistance (R)

Ohm's law states that the current (I) through a conductor between two points is proportional to the potential difference (V) across the two points and inversely proportional to the resistance (R) between them.

Resistance R [Ω] = $\frac{U}{I}\ \frac{[V]}{[A]}$




## Volume Resistivity ( $\rho_v$ )

Volume Resistivity ( $\rho_v$ ) expresses the resistance per unit volume of a sample and is also called specific resistance. It is the term mostly used for material classification (Ω·cm). Each material has a unique characteristic value for volume resistivity.

Volume Resistivity $\rho_v$ [Ω·cm] = R [Ω] · RCF · t [cm]

## Surface Resistivity( $\rho_s$ )

Surface Resistivity ( $\rho_s$ ) is the resistance per unit surface of a sample and is also called sheet resistance. In order to distinguish this from resistance, it is written Ω/□ or Ω/sq.. Since surface resistivity varies with the sample thickness, it is often used to evaluate paint and thin films.

Surface Resistivity $\rho_s$ [Ω/sq.] = R [Ω] · RCF = $\rho_v \cdot \frac{1}{t}$

t : Materialdicke

## Conductivity (σ)

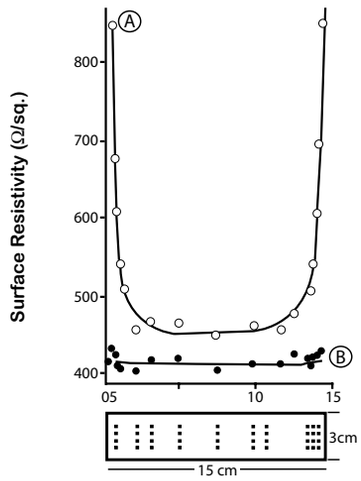
Conductivity (σ) is inversely related to volume resistivity. It is also called specific conductivity. The unit is S/cm.

Conductivity σ [S/cm] = $\frac{1}{\rho_v}$

## Factors

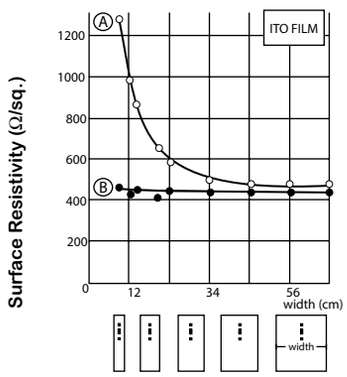
Influence of Measuring Position, Sample Size and Thickness on Resistivity

### Measuring Position

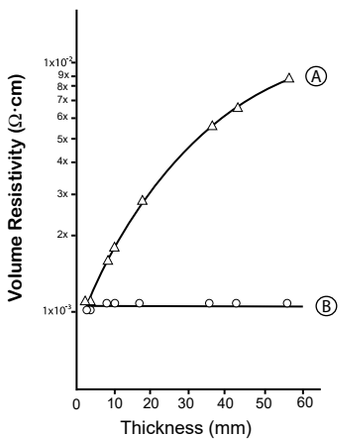



(A) shows graph with constant RCF (4.532)
(B) shows graph with variable RCF

### Sample Size




### Sample Thickness




Sample: isotropic graphite, Size: 7cm x 7cm
Measured with 4-pin probe at center of the sample

## 2- AND 4-TERMINAL METHOD

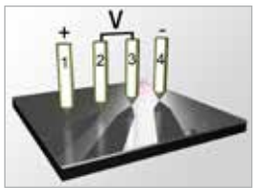
The multimeter, equipped with 2 terminals, is a cheap and simple instrument for measuring voltage, current and resistance. However, the conventional 2-terminal method is not suitable for material evaluation. The 4-terminal probe of the MCCAT Measuring Systems eliminates lead-wire connector and contact resistance. More precise measuring of resistance is achieved.

In the case of the 4-pin probe method, 4 needle-type electrodes are placed linearly on a sample, a certain current flows between 2 external pin probes (1 and 4), and a potential difference formed between 2 inner pin probes (2 and 3) is measured to determine the resistance.

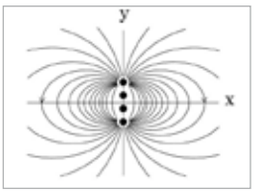
Then, multiplying the measured resistance (R in the unit of Q) with the sample thickness (t) and the Resistivity Correction Factor (RCF) derives the volume resistivity. In this way, the 4-pin probe method and 4-terminal method have a common measurement system, but the electrode sections in contact with the sample is different. Only the placement of a probe on a sample is required for measurement in this 4-pin probe method, but electrode formation over the sample is not required unlike the 4-terminal method and thus the procedure is remarkably more efficient.

Mulitmeter with 2 Pins

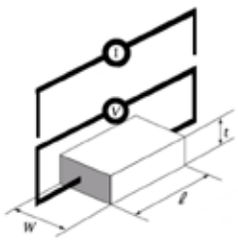
4-Pin Probe



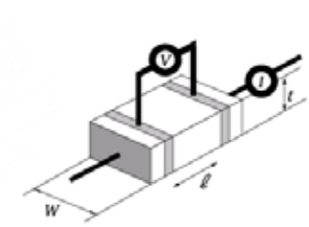

Placement on the measurement object




Electric Field Strength (4-Pin Probe)




2-Pol-Method




4-Pol-Method

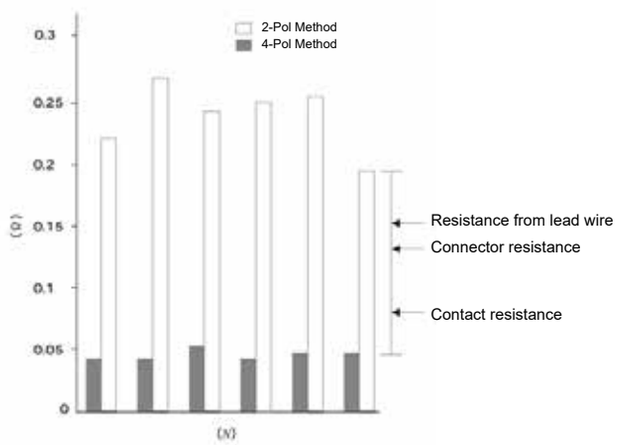
## RESISTIVITY CORRECTION FACTOR (RCF) - 4-PIN PROBE

The Resistivity Correction Factor (RCF) is changed with the sample shapes and sizes as well as measuring positions. In the 4-pin probe method, since the sample size or measuring position are not fixed, the electric energy distributed in the sample is changed with the sample size and the measuring positions. If the sample size is small or the measuring position is near the sample edge, the peak of the electric field becomes higher to yield a high resistance. This is caused by the electric energy being contained in the sample. The Resistivity Correction Factor is used to obtain correct values for the volume or surface resistivity by forecasting such difference in the peak of the electric energy. The electric potential Φ(r) in an optional point in a sample and is calculated by solving a Poisson's equation under a specific condition.

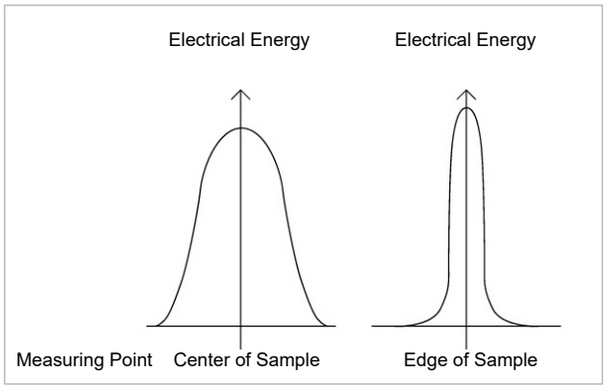
Poisson'sche Equation

$$^{2}\,\Phi(r) = 2\,\rho_v\, I\,[\,\delta\,(r\text{-}rD) - \delta(r\text{-}rA)]$$

The Loresta-GX has a built-in software for calculating this factor and is able to derive the factor by simple input of the sample shapes (rectangular or disk) and size as well as the measuring position. The Loresta-AX uses a fixed RCF which allows a sufficient precise measuring.
The 4-pin probe method was included to the JIS K7194 (Japanese Industrial Standard) in 1994.




Comparsion 2- and 4-Pol Method



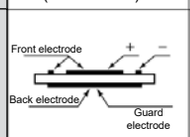
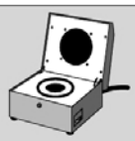
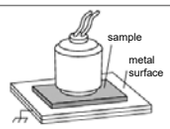
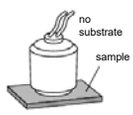
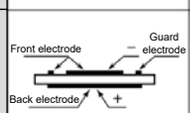
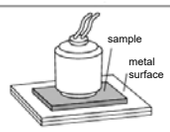

Verteilung der elektrischen Energie in einem Messobjekt

## MEASURING METHOD FOR HIGH RESISTIVITY

When measuring high-resistivity material (standard value Rx > 20MΩ), small current can not be applied stably. Therefore, the constant-voltage process of applying constant voltage and measuring leak current is used. The material condition of the surface is different from the one of the inside. It's necessary for material control that indicating condition by each index. The surface resistivity is results of surface condition and the volume resistivity is one of inside condition. They're defined according to JIS K 6911or ASTM D257 standard.

The Measurement Systems of the Hiresta Series works with ring electrode probes. The probes have a concentric ring electrode.

Due to the small size of flowing current, a higher measuring voltage up to 1000V is needed. Low currents can be falsified very easy by external influences and leak currents, so a special guard technic is used. For that technic a third connection between measuring equipment and measuring object is required. This additional connection has ground potential and ensures a common reference potential for shielding, without falsify the current measurement. The outer electrode works as the guard electrode and the current passed through the exterior of the detection electrode (the inner electrode) flows to the ground. Hiresta-UX can display the RCF by selecting the surface and volume directions and a probe type.

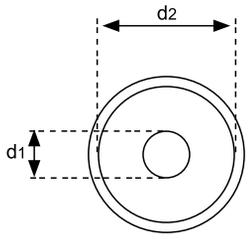
| Item | ASTM-Method (ASTM D257) | Hiresta UX Method | | |
|---|---|---|---|---|
| | | JBox X Type | Method 1 | Method 2 |
| Surface resistivity |  |  |  |  |
| Volume resistivity |  |  |  | — |

JBox X Type

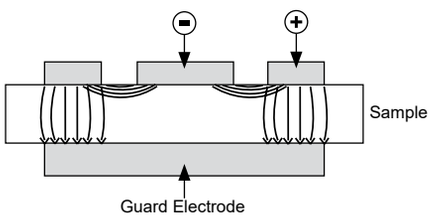
## RESISTIVITY CORRECTION FACTOR (RCF) - RING ELECTRODE

The correction factors RCF (S) and RCF (V) of the ring electrode probe are determined by the electrode diameters. Correction factors of probes is registered previously in Hiresta-UX.
Therefore the value can be called up automatically by selecting a probe type.

| Probe | d2 (cm) | d1 (cm) | $RCF_S$ | $RCF_V$ |
|---|---|---|---|---|
| UR-SS | 0.6 | 0.3 | **9.065** | **0.071** |
| URS | 1.1 | 0.59 | **10.09** | **0.273** |
| UR | 3.0 | 1.6 | **10.00** | **2.011** |
| UR-100 | 5.32 | 5.0 | **100** | **19.63** |
| UA | -- | -- | **1.050** | **--** |
| U-Type JBox | 7.0 | 5.0 | **18.85** | **19.63** |



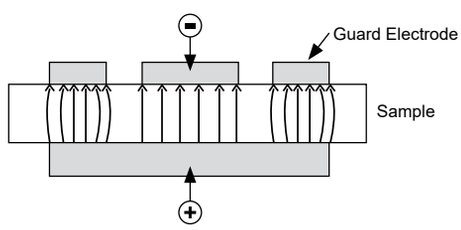

### Measurement of Surface Resistivity




Surface Resistivity

$\rho_s$ [Ω/sq.] = R [Ω] · **$RCF_S$**

### Measurement of Volume Resistivity




Volume Resistivity

$\rho_v$ [Ω·cm] = R [Ω] · **$RCF_V$** · $\frac{1}{t}$

t: sample thickness

High Resistivity

# HIRESTA-UX

## USE

R&D, Production Engineering, Quality Control
Related to ASTM D257 / ISO 2951 / JIS K 6911

## APPLICATIONS

- antistatic materials
- Flooring materials
- Paper, packaging materials
- Paints, pastes, paints
- Fibers, clothes, fabrics
- Adhesives, greases
- Glass, concrete, ceramics
- Plastics, film materials, foils
- etc.

## FEATURES

The Hiresta UX is specialised in measuring the resistance, the surface and volume resistivity of various substances and materials of all shapes and sizes in the high-resistance measuring range.

- 29 steps of applied voltage with Auto Sweep Function enables measuring voltage dependence of resistance value
- With the new Built-in Switch Box, volume resistivity can be measured just by connecting a „Resitable UFL“ (optional) to Hiresta UX
- Up to 2000 measurement results can be exported to USB memory stick
- The probe is designed to read fast and accurately with one touch

## SPECIFICATIONS

| | | |
|---|---|---|
| Measuring method | | Constant-voltage apply / Leak-current |
| Range Switching | | Automatic, Manual |
| Display | | 7.5" TFT LC-Touch Display, 640 x 480 pixel |
| Power Supply | | AC 85-264V / 47-63Hz / 92VA |
| Comparator | | Maximum and Minimum values can be set manually |
| Data Output | | USB |
| Dimensions | | 330mm x 270mm x 113mm (W x D x H) /<br>Lid opened: 330mm x 270mm x 215mm (W x D x H) |
| Weight | | 2,4 kg |
| Standard Accessories | | URS Probe RMH214, Probe Checker RMH327 (500 MΩ), Portection gloves |
| Maesurement Range and Trueness | 1 ~ 10V | $10^3$ ~ $10^9$ [Ω]: ±2% $10^{10}$ [Ω]: ±3% |
| | 20 ~ 400V | $10^6$ ~ $10^{10}$ [Ω]: ±2% $10^{11}$ [Ω]: ±3% |
| | 500 ~ 900V | $10^7$ ~ $10^{10}$ [Ω]: ±2% $10^{11}$ [Ω]: ±3% $10^{12}$ [Ω]: ±4% |
| | 1000V | $10^8$ ~ $10^{10}$ [Ω]: ±2% $10^{11}$ [Ω]: ±3% $10^{12}$ [Ω]: ±4% $10^{13}$ [Ω]: ±5% $10^{14}$[Ω]: ±12% |

## ACCESSORIES





RMJ360 - Fixer for URS-Probe (RMH214)

| Probe | UR-SS | URS | UR | UR-100 | UA |
|---|---|---|---|---|---|
| Application | smallest samples | standard | larger surfaces | Measurment Range $10^{15}$ Ω/sq. | thin samples |
| d2 (cm) | 0.6 | 1.1 | 3.0 | 5.32 | 20mm pin distance |
| d1 (cm) | 0.3 | 0.59 | 1.6 | 5.0 | Ø2mm |
| Order No. | RMH215 | RMH214 | RMH212 | RMH216 | RMH211 |
| Probe Checker | RMH328 | RMH327 | RMH326 | RMH321 | RMH325 |

Resitable UFL (RMJ354) für Hiresta & Loresta

Low Resistivity

# LORESTA-GX

## USE

R&D, Production Engineering, Quality Control
Related to ASTM D 991 / ISO 2878 / ISO 1853 / JIS K 7194 / JIS R 1637

## APPLICATION

- Paints, pastes, paints, printing ink
- Plastics, rubber
- metallic thin films, metallised films
- amorphous silicon / silicon wafer
- antistatic materials
- EMC shielding materials
- ITO glass, coated glass
- passivated metals
- magnesium alloys
- Coated sheet metal, steel, aluminum
- etc.

## FRATURES

LORESTA-GX has a expanded measuring range of $10^{-4}$~$10^{7}$ Ω. The probe enables one-touch direct reading of [Ω], [Ω/sq.], and [Ω·cm]. It has a special silicon mode for silicon wafer measurement and one-touch automatic measurement by new functions like Auto-Hold and Timer Mode. The accurate low resistivity meter based on 4 Terminal 4 Pin method. It ensures a high accuracy by MCP probes' spring contact method which keeps pin pitch, pressure and contact area on samples constant.

## SPECIFICATIONS

| | |
|---|---|
| Measuring Method | 4-pin probe, constant-current method |
| Measuring mode | Auto-Function: Auto-Hold / Timer Mode - Special Silicon measuring mode |
| Display | 7.5" TFT LC-Touch Display, 640 x 480 Pixel |
| Power Supply | AC 85-264V / 47-63Hz / 40VA |
| Interface of data output | USB |
| Dimensions | 320mm x 285mm x 110mm (B x T x H) / bei geöffneter Abdeckung: Höhe 220mm |
| Weight | 2,4 kg |
| Standard accessories | ASP probe RMH110 (4-pin probe, inter-pin distance 5mm, pin-head radius 0.37mm)<br>Probe checker RMH304 (1.0Ω) |

| | | Power Supply | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1A | 100mA | 10mA | 1mA | 100µA | 10µA | 1µA | 0.1µA |
| Range | $10^{-4}$ | ±(2.0% + 30dgt) | | | | | | | |
| | $10^{-3}$ | ±(2.0% + 20dgt) | ±(2.0% + 20dgt) | | | | | | |
| | $10^{-2}$ | ±(1.0% + 5dgt) | ±(1.0% + 5dgt) | ±(2.0% + 20dgt) | | | | | |
| | $10^{-1}$ | ±(1.0% + 3dgt) | ±(1.0% + 3dgt) | ±(1.0% + 5dgt) | ±(2.0% + 20dgt) | | | | |
| | $10^{0}$ | | ±(0.5% + 3dgt) | ±(0.5% + 3dgt) | ±(1.0% + 5dgt) | ±(2.0% + 20dgt) | | | |
| | $10^{1}$ | | | ±(0.5% + 3dgt) | ±(0.5% + 3dgt) | ±(1.0% + 5dgt) | ±(2.0% + 20dgt) | | |
| | $10^{2}$ | | | | ±(0.5% + 3dgt) | ±(0.5% + 3dgt) | ±(1.0% + 5dgt) | ±(2.0% + 20dgt) | |
| | $10^{3}$ | | | | | ±(0.5% + 3dgt) | ±(0.5% + 3dgt) | ±(1.0% + 5dgt) | ±(2.0% + 20dgt) |
| | $10^{4}$ | | | | | | ±(0.5% + 3dgt) | ±(0.5% + 3dgt) | ±(1.0% + 5dgt) |
| | $10^{5}$ | | | | | | | ±(0.5% + 3dgt) | ±(1.0% + 3dgt) |
| | $10^{6}$ | | | | | | | | ±(1.0% + 3dgt) |
| | $10^{7}$ | | | | | | | | ±(2.0% + 5dgt) |

Low Resistivity

# LORESTA-AX

## USE

R&D, Production Engineering, Quality Control

## APPLICATION

- Paints, pastes, paints, printing ink
- Plastics, rubber
- metallic thin films, metallised films
- amorphous silicon / silicon wafer
- Coated sheet metal, steel, aluminun
- EMC shielding materials
- ITO glass, coated glass
- passivated metals
- magnesium alloys
- antistatic materials
- etc.

## FEATURES

Loresta AX is a simplified resistivity meter and uses a manually adjustable RCF. When measuring various shapes and measuring points of samples, it is recommended to use the high-grade type of resistivity meter Model Loresta GX.
The Loresta-AX has a wide measuring range from 10mΩ to 10MΩ. The 4-pin probe ensures quick and precise resistivity measurements. A LC Dispaly is for easy reading of data. Data saved can be transmitted via USB-memorystick. The probe enables one-touch direct reading of [Ω], [Ω/sq.] and [Ω·cm].

## SPECIFICATIONS

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Measuring method | 4-pin probe, constant-current method | | | | | | | | |
| Measurement range [Ω] | $10^{-2}$ | $10^{-1}$ | $10^{0}$ | $10^{1}$ | $10^{2}$ | $10^{3}$ | $10^{4}$ | $10^{5}$ | $10^{6}$ |
| Supplied voltage | 100mA | | 10mA | | 1mA | | 100µA | 10µA | 1µA |
| Measuring accuracy | ± 1.0% ± 20dgt. | ± 1.0% ± 5dgt. | ± 0.5% ± 5dgt. | ± 0.5% ± 3dgt. | | | | | ± 2.0% ± 5dgt. |
| Display | LCD | | | | | | | | |
| Power supply | AC 90-264V / 47-63Hz / Nickel-Hydrogen Battery | | | | | | | | |
| Data output | USB-Memorystick | | | | | | | | |
| Dimensions | 85mm x 228mm x 65mm (W x D x H) | | | | | | | | |
| Weight | 420 g | | | | | | | | |
| Standard accessories | ASP Probe, Probe checker (1.0Ω) | | | | | | | | |

dgt. = digits

## ACCESSORIES LORESTA-SERIE

| Probe | ASP | ESP | LSP | TFP | QPP | PSP | BSP | NSCP |
|---|---|---|---|---|---|---|---|---|
| **Application** | Standardprobe | non-uniform samples | soft surfaces | thin films, glass substrate | small samples, thin films | small samples, thin films | large samples | hard surfaces |
| **Inter-pin distance** | 5 mm | 5 mm | 5 mm | 1.0 mm | 1.5 mm | 1.5 mm | 2.2 mm | 1.0 mm |
| **Pin-head radius** | 0.37 mm | Pin Ø2 mm | Pin Ø2 mm | 0.15 mm | 0.26 mm | 0.26 mm | 0.37 mm | 0.04 mm |
| **Spring pressure** | 210 g/pin | 240 g/pin | 130 g/pin | 50 g/pin | 70 g/pin | 70 g/pin | 210 g/pin | 250 g/pin |
| **Order No.** | RMH110 | RMH114 | RMH116 | RMJ217 | RMH115 | RMH112 | RMH111 | RMJ202 |
| **Probe** | RMH304 | RMH304 | RMH304 | RMH312 | RMH313 | RMH311 | | RMH312 |

# POWDER RESISTIVITY MEASURING SYSTEM PD-600

## USE

Research & Development, Quality Control, etc.

## APPLICATIONS

**Powder materials of carbon products:**

Materials used for rechargeable battery electrodes, condensers and resistance material and insulating electronics / cokes / graphite / carbon black / carbon fiber / nano carbon, etc.

**Metal powder:**

Materials used for battery electrodes, thin film materials such as copper powder or ITO powder, for circuit board materials,
for example conductive paste and electro conductive paint.

**Others:**

Printer toner, magnetic material such as ferrite, food material, pharmaceutical related and automobile parts

## SPECIFICATIONS

| | |
|---|---|
| Measuring method | Constant-current / -voltage methods |
| Measuring Units | Low resistance ( $10^{-4}$-$10^{7}$ Ω) Loresta-GX<br>High resistance ( $10^{3}$-$10^{14}$ Ω) Hiresta-UX |
| Power supply | AC 90 - 240V / 50 - 60Hz |
| Max. Load | 0,01kN - 20kN (~60Mpa) |
| Hydraulic unit | automatic |
| Probe unit | 20mm (Ø) x 40mm (L) |
| Probe types | 4-Pin Electrode (inner-pin distance 3mm)<br>Ring Electrode (Ø 20mm) |
| Necessary accessories | Window PC with Excel |
| Dimensions (W x D x H in cm) | |
| Main Unit | 43 x 23 x 49 (42kg) |
| Hydraulic Pump | 57 x 37 x 32 (29kg) |

## FEATURES

The Powder Measuring System MCP-PD600 contains a high precision pressure gauge for the measurement of conductive powders for maximum pressure of 20kN and is quickly attached to either the Loresta-GX or Hiresta-UX unit.

- Fully automatic, just input the load value and press START
- Newly developed cylinder pump allows measuring from low load (0.01kN)
- 4-pin probe for precise measurement of low range resistivity / Ring probe for high range resistivity
- Improved powder filling performance with a new vacuum-pump.

## DETAILS


## PROBES

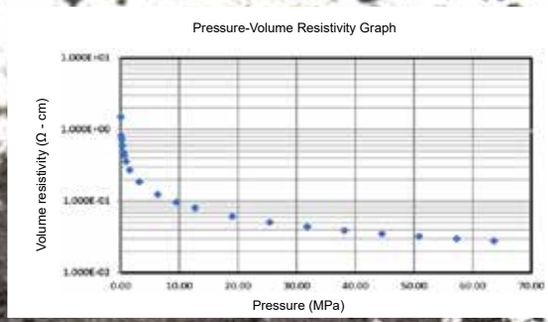
For Low Resistivity Measurement in addition with LORESTA-GX (4 Terminal Method)

Probe Unit

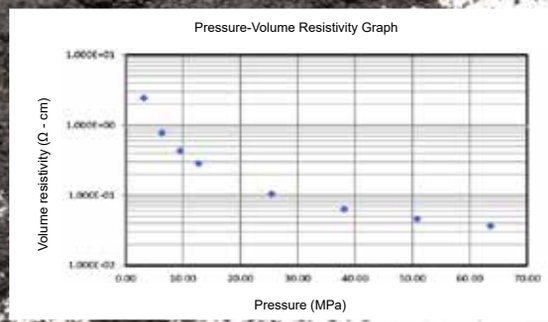
For High Resistivity Measurement in addition with HIRESTA-UX. (Ring Electrode)

## TEST REPORT (EXAMPLE)

| Sample | | | CARBON BLACK | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| No. | Load (kN) | Pressure (MPa) | Thickness (mm) | RCF | Resistance (Ω) | | Resistivity (Ω -cm) | Conductivity (S/cm) | Density (g/cm³) |
| 1 | 0.01 | 0.03 | 11.60 | 1.460 | OK | 8.804E-01 | 1.491E+00 | 6.706E-01 | 1.388E-01 |
| 2 | 0.03 | 0.10 | 10.94 | 1.539 | OK | 4.869E-01 | 8.199E-01 | 1.220E+00 | 1.472E-01 |
| 3 | 0.05 | 0.16 | 10.40 | 1.610 | OK | 4.378E-01 | 7.332E-01 | 1.364E+00 | 1.548E-01 |
| 4 | 0.10 | 0.32 | 9.58 | 1.730 | OK | 3.639E-01 | 6.032E-01 | 1.658E+00 | 1.681E-01 |
| 5 | 0.15 | 0.48 | 9.03 | 1.819 | OK | 2.969E-01 | 4.878E-01 | 2.050E+00 | 1.783E-01 |
| 6 | 0.20 | 0.64 | 8.72 | 1.874 | OK | 2.663E-01 | 4.354E-01 | 2.297E+00 | 1.846E-01 |
| 7 | 0.29 | 0.92 | 8.21 | 1.972 | OK | 2.206E-01 | 3.569E-01 | 2.802E+00 | 1.963E-01 |
| 8 | 0.49 | 1.56 | 7.50 | 2.121 | OK | 1.713E-01 | 2.724E-01 | 3.671E+00 | 2.148E-01 |
| 9 | 1.00 | 3.18 | 6.47 | 2.372 | OK | 1.213E-01 | 1.863E-01 | 5.368E+00 | 2.448E-01 |




| Sample | | | IRON POWDER | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| No. | Load (kN) | Pressure (MPa) | Thickness (mm) | RCF | Resistance (Ω) | | Resistivity (Ω -cm) | Conductivity (S/cm) | Density (g/cm³) |
| 1 | 0.09 | 3.15 | 4.19 | 3.096 | OK | 1.875E+00 | 2.433E+00 | 4.110E-01 | 3.039E+00 |
| 2 | 1.99 | 6.33 | 4.02 | 3.155 | OK | 6.127E-01 | 7.777E-01 | 1.286E+00 | 3.166E+00 |
| 3 | 2.99 | 9.52 | 3.90 | 3.200 | OK | 3.442E-01 | 4.291E-01 | 2.330E+00 | 3.269E+00 |
| 4 | 3.99 | 12.70 | 3.78 | 3.241 | OK | 2.309E-01 | 2.827E-01 | 3.537E+00 | 3.371E+00 |
| 5 | 7.99 | 25.43 | 3.46 | 3.349 | OK | 8.970E-02 | 1.039E-01 | 9.624E+00 | 3.682E+00 |
| 6 | 11.97 | 38.10 | 3.23 | 3.424 | OK | 5.725E-02 | 6.330E-02 | 1.580E+00 | 3.994E+00 |
| 7 | 15.97 | 50.83 | 3.05 | 3.479 | OK | 4.331E-02 | 4.594E-02 | 2.177E+00 | 4.177E+00 |
| 8 | 19.99 | 65.63 | 2.91 | 3.520 | OK | 3.560E-02 | 3.647E-02 | 2.742E+00 | 4.376E+00 |



NH Instruments deals with the import & export of industrial products and offers the appropriate technical advice and support. We exclusively represent the conductivity measuring devices from Nittoseiko Analytech in the DACH and BENELUX region.

## Service

- Presentation and demonstration at our laboratory at N&H in Willich, Germany or on site
- Individual and low-cost solutions provided on-site
- Installation of systems and machinery with On-Site Training
- Maintenance and Service contracts (optional)

## Sample Measurement

We also offer the analysis of your materials as a service in our laboratory. After the measurement, you will receive a detailed measurement protocol. Please contact us for an individual offer.

## Contact

Our engineers look forward to your inquiry and are always at your side with help and advice.

**NH Instruments**

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