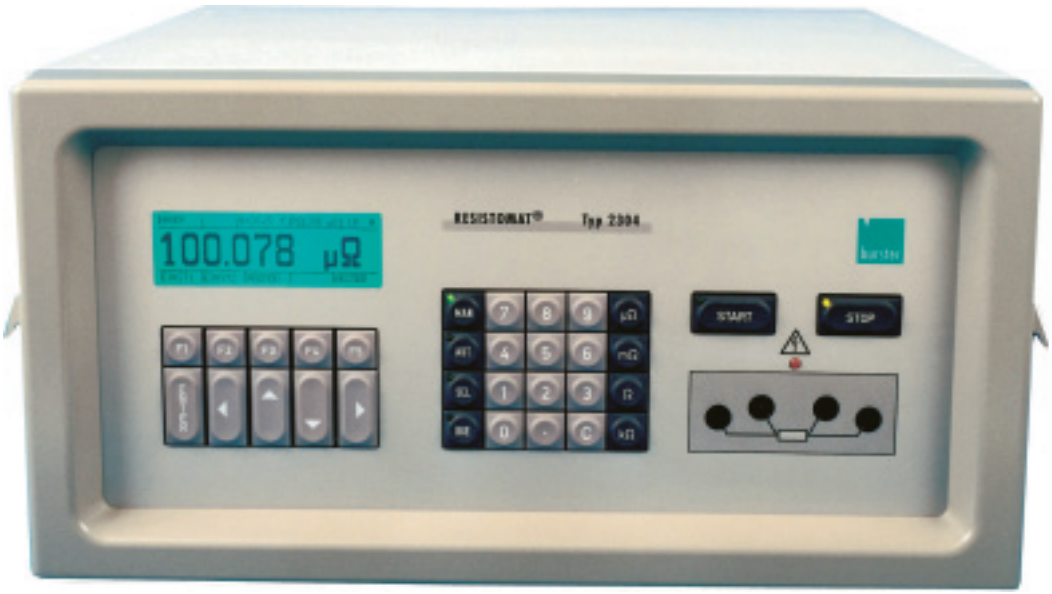
High-Precision Automatic Inspection and Test Unit for Electrical Resistance Testing RESISTOMAT®

Model 2304, 2305

Code:	2304 E
Manufacturer:	burster
Delivery:	ex stock
Warranty:	24 months
Issue:	1.8.2004

2304-E



Automatic inspection and test unit

Automatic choice of measuring ranges from 200 µΩ to 20 kΩ (2304) resp. 2 mΩ to 20 kΩ (2305)
Resolution up to 1 nΩ (2304) resp. up to 0,1 µΩ (2305)
Interfaces in series (IEEE488, RS232, RS485),
Checking of tolerances, classification with statistics.

Highest measuring accuracy

Measuring error ≤ 0.01 % (2304) resp. ≤ 0,05 % (2305)
Future-orientated measuring method with thermal e.m.f. compensation.
High level of stability due to constant comparisons with internal reference values.
2 models depending on the requirements (2304, 2305)

Inductive probes

Current regulation results in voltage-free disconnection, calculation of cooling curves of coils.

Menu control

Setting for measuring current entry for absolute or relative limits, classification with statistics, bar display for calibration of measuring probes, determination of resistivity, and many other functions.

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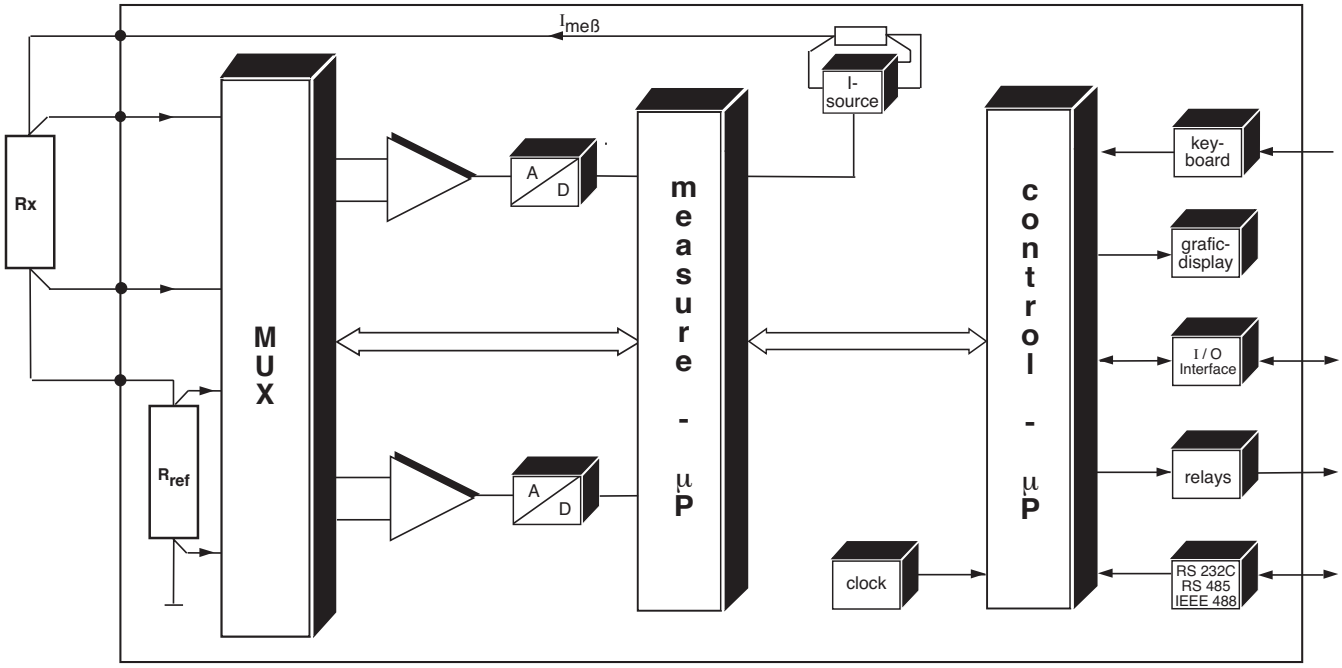
Functional Description

The operation of the measuring section of the RESISTOMAT® model 2304, 2305 high-precision inspection and test unit is based on an upgraded 4-wire design. It measures not only the voltage drops with injected current across the test object but also across an internal reference resistor. The quotient is calculated from both voltage drops. The resistance of the test object is calculated by multiplying this with the characteristic value of the reference resistor. Apart from eliminating the error of contact layer and contact resistance, this method has the advantage that errors reduce to the quality of the internal reference resistor alone. The deviations in these reference resistance are well known and accounted for the multiplication. The result is that the resistance of the test object can be determined very quickly and accurately irrespective of the resistances present in the current circuit.

In order to meet high standards in measuring and testing requirements the device was also fitted with an integrated high-resolution A/D converter with particularly low linearity deviations. The test objects are measured at both poles, thus eliminating parasitic thermal e.m.f. voltages. The quotient measuring method used, with constant comparison function automatically ensures zero point calibration, thus is garanteed an optimum measuring accuracy.

The unit features an extensive standard software for storing measured cooling curve values, temperature compensation, classification, statistical functions, printer and interface drivers, clock, line frequency adaption ... Two microprocessors ensure optimum and exact measuring and testing.

Block Diagram



Applications

The automatic inspection and test unit combines a high degree of measuring accuracy, variable resolution and long-term stability with versatile, user-friendly operation. A number of permanently installed programs allow the user to display and evaluate measured values easily. The unit can therefore be used for a wide range of applications:

High-precision measuring of ohmic resistances in the laboratory, in the test bay, in production - resolution 1nΩ, up to ± 0.01 % measuring accuracy, automatic range selection;

Series tests - programmable frequency distribution with switch output per class (histogram), specification of tolerance in absolute or relative values;

Calibration in production - particularly easy, due to the analog bar display for limit values;

Measurement on **coil, motor, transformer windings -** special limiting of the measuring current before disconnecting the measuring lines;

Recording of cooling curves on windings - adjustable time intervals, measured values stored in memories;

Meter probes on cables and wires with temperature compensation and output of measured values in Ω or %;

Determining **resistivity values** with material-related temperature compensation;

Measurements of **contact resistances** on switches, relays, pushbutton contacts with low measuring current.

Technical Data

Design

The device is designed in a modular system and built in a stable housing of steel sheet. Therefore every structural component is easily accessible and thus an optimal service is secured.
All operational knobs, the LCD grafic display and the connector box are situated clearly and easy to survey on the front panel. On the rear panel the in- and outputs of the interfaces are placed as well as the comparators, the Pt 100 sensor for temperature compensation and for controlling the instrument.

Measuring Data (type 2304)

Resistance measuring range	Resolution	Measuring current
200.000 µΩ	0.001 µΩ	10 A
2.00000 mΩ	0.01 µΩ	10 A, 1A
20.0000 mΩ	0.1 µΩ	10 A, 1 A, 100 mA
200.000 mΩ	1 µΩ	1 A, 100 mA, 10 mA
2.00000 Ω	10 µΩ	1 A, 100 mA, 10 mA, 1mA
20.0000 Ω	0.1 mΩ	100 mA, 10 mA, 1mA,100 µA
200.000 Ω	1 mΩ	10 mA, 1 mA, 100 µA
2.00000 kΩ	10 mΩ	1 mA, 100 µA
20.0000 kΩ	0.1 Ω	100 µA

Measuring Data (type 2305)

Resistance measuring range	Resolution	Measuring current
2.0000 mΩ	0.1 µΩ	1A
20.0000 mΩ	0.1 µΩ	1 A, 100 mA
200.000 mΩ	1 µΩ	1 A, 100 mA, 10 mA
2.00000 Ω	10 µΩ	1 A, 100 mA, 10 mA, 1mA
20.0000 Ω	0.1 mΩ	100 mA, 10 mA, 1mA,100 µA
200.000 Ω	1 mΩ	10 mA, 1 mA, 100 µA
2.00000 kΩ	10 mΩ	1 mA, 100 µA
20.0000 kΩ	0.1 Ω	100 µA

Measuring method:
Quotient method with Kelvin-4-terminal measurement

Error of measurement (switched off temp. comp.):
down to ± 0.01 % of reading, ± 2 Digit, depending on range (2304)
down to ± 0.05 % of reading, ± 2 Digit, depending on range (2305)

Max. input voltage (no load operation) < ± 16 V

Measuring connection:
4-terminal principle for current-voltage measurement (Kelvin), potentialfree circuit design, potential binding either at the test object or at the RESISTOMAT®.

Max. burden voltage: 10V at $I_{meß}$ = 100µA to 1A (2304, 2305)
6V at $I_{meß}$ = 10A (2304)

Max. over voltage on measuring input: 100 V DC

Measuring time:
adjustable, calculation of mean value (up to 255 values) possible

Display	measuring time with pure ohmic sample
3 1/2-digit	≤ 300 ms
4 1/2-digit	≤ 500 ms
5 1/2-digit	≤ 5 s

Measuring method: continuous, single, unipolar or bipolar

Range selection: manuel, self-acting or interface

Zero balance: µP-controlled

General Data

Display:
240 x 64 dots transflective LCD grafic display with adjustable contrast and background lighting.

Overload indication: >>>

Representation of measuring value:
alternatively 3 1/2, 4 1/2, or 5 1/2 -digit, LCD 15 mm height, reading absolute or in Δ %.

Power supply: 230 V + 6 % - 10 %;
45 - 65 Hz, 115 V as option

Power requirement: approx. 260 VA (model 2304)
approx. 60 VA (model 2305)

Environmental conditions:
operating temperature range +5 ... **23** ... 40 °C,
max. 90 % rel. humidity, not condensing
storage temperature range 0 ... **23** ... 60 °C

Potential binding:
measuring part internal grounded reversible to external grounding

Watch: buffered by internal battery

Parameter input: by entry keys or interface

Weight: 28 kg (model 2304)
24 kg (model 2305)

Dimensions (width by height by depth): 520 x 255 x 480 [mm]

Safety: according to VDE 0411

Connections

Probe connections:
front panel via 4 safety bushers, 4 mm ø, immerged.
Rear panel: 5 pin LEMO-bush EGG. 2B. 305

Over a 37 pin submin D-bush it is possible to pass through the following signals:

Optocoupler-output: "operate"
"trouble"

Optocoupler-input: "stop/go"

9 change-over contacts for sorting:
max. voltage 42 V
max. current 0,5 A

Pt 100 sensor for temperature compensation:
6-pin LEMO-bush EGG. 1B. 306

Output and connections on the rear panel:

IEEE488 interface:
24-pin plug type standard connector open collector output
SH1, AH1, T6, TEØ, L4, LEØ, SR1, RL1, PPØ, DC1, DT1, CØ instruction language SCPI, version 1990.0

RS232C interface:
fullduplex with RTS, CTS
25-pin submin D-bush
baud rate 600 - 9600
protocol ANSI X 3.28 subcategory 2.5, A3/A4
instruction language SCPI, version 1990.0

RS485 interface:
fullduplex/halfduplex without internal closing resistor
25-pin submin D-bush
protocol ANSI X 3.28 subcategory 2.5, A3/A4
instruction language SCPI, version 1990.0

Printer: Connection to RS232 interface

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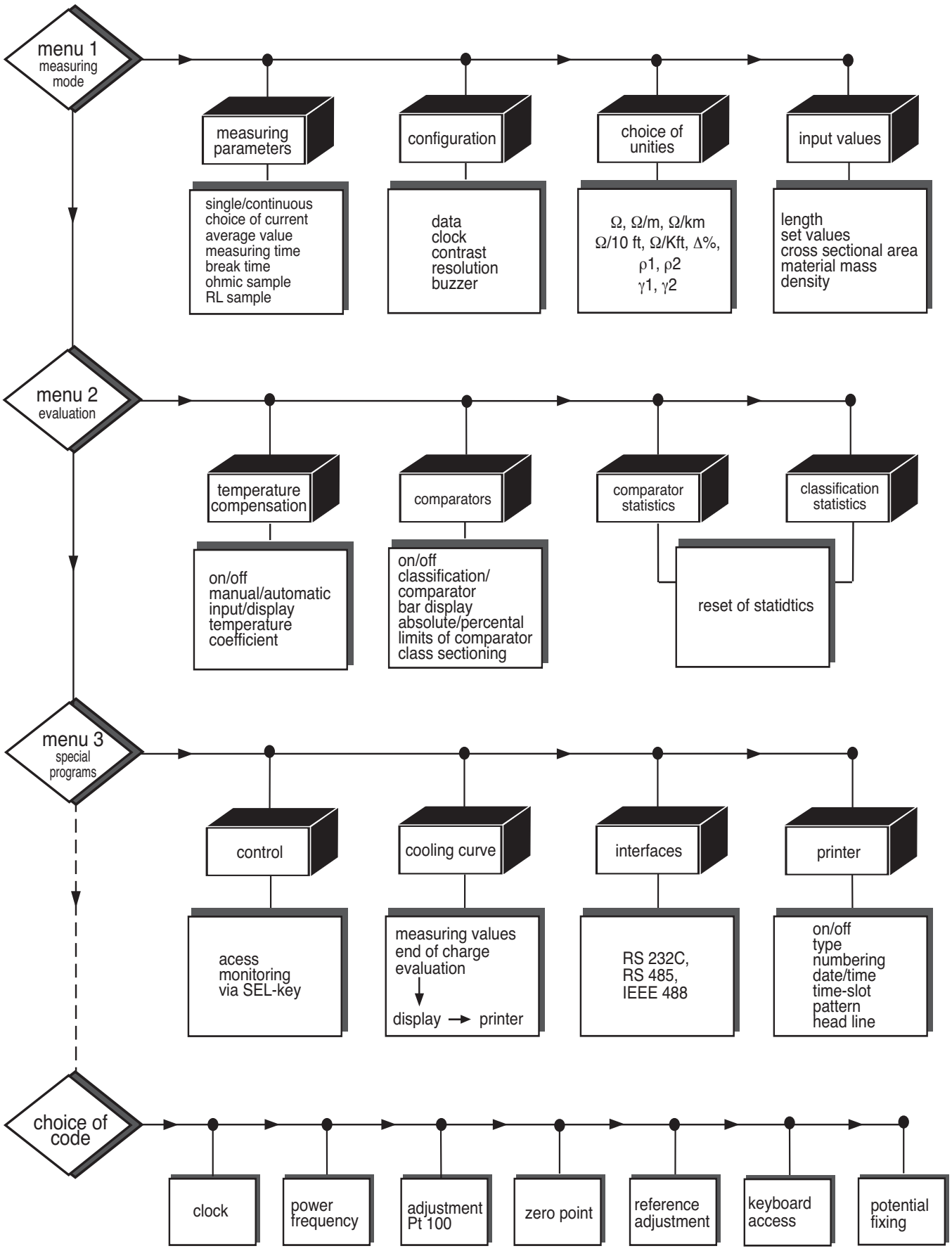
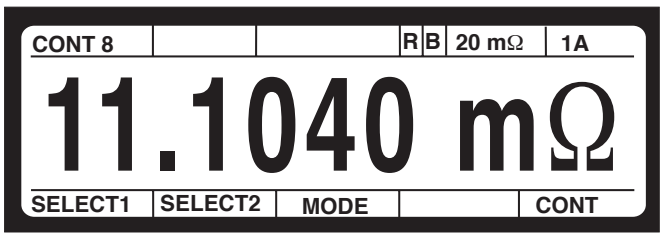
General Plan Adjustments and Configuration

The many application orientated adjustments of the inspection and test unit are accompanied by a compact operator control. A general plan of the existing menus and programs relays the following diagram:



The solution for your day by day measuring problems: the RESISTOMAT® 2304 resp. 2305

Reading of measured value, adapted to your accustomed manner:



e.g.: main menu 1 with 5 1/2 reading of absolute value, additional with unit of measurement

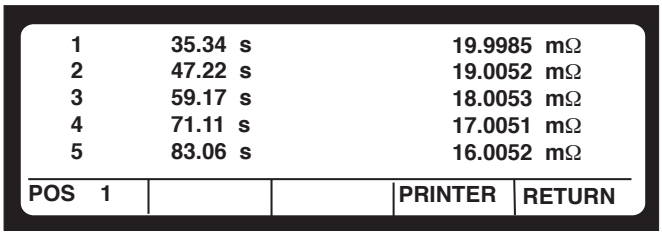
In absolute values, digital, 3 1/2- bis 5 1/2-digit, that means with the resolution the application requires, i.e. 1,234 Ω or 1,23432 Ω;

in relative values as percential difference to a given set value. Notation then: - 1.23 %

as quasi-analog bar. You immediately realize where the instantaneous value ranges within in the tolerance field.

Independent from the display you can choose as dimension Ω, Ω/m, Ω/km, r (specific resistance) or k (specific conductance). Ina sub menu of the unit choice the RESISTOMAT® requires the data for calculating the specific value, as i.e. length, cross section, mass, density, and so on.

On **resistance testing of windings** on transformers, motors, coils a.s.o. with inductive parts the RESISTOMAT® helps with



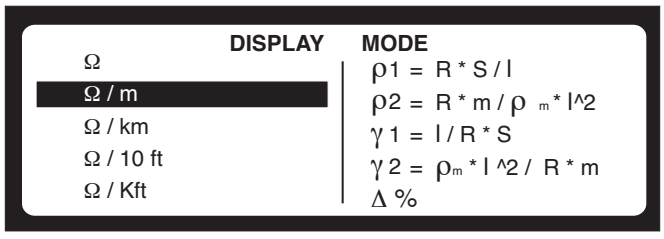
e.g.: presentation of automatically stored values with indication of recording time

Short measuring times due to single polarity measurement;

determination of cooling-down curves: the device stores up to 256 measuring points. Starting-up time, end of recording and time division are on your free disposal; output of measuring values directly to the printer;

voltage-free disconnection of test samples: a special circuit regulates the measuring current down to zero. The end of the regulation is pointed out by a LED.

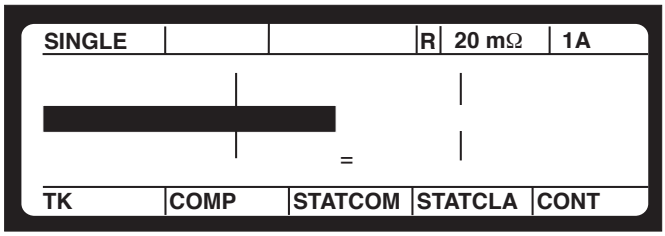
On **cable standing and wire twisting** the RESISTOMAT® saves raw material and money:



e.g.: choice of unit out from the display menu

Together with the wire holding devices of the types 2381/82 - or as stand-alone device - the model 2304 resp. 2305 measures on cable probes resistances or specific resistances and specific conductivities - just like the user is accustomed and always with the same accuracy and the same resolution.
You can work with or without temperature compensation. The temperature of the test sample is measured with a sensor or manually put in. You can store the temperature coefficient of max. 10 materials and choose one for working. Or you adjust the individual value of "your probe".

For **quality control** the RESISTOMAT® offers the following easements:



e.g.: bar indication with flashing-in of limits and the result of comprovision.

Bar or percentage indication: also for smoothing the service staff.

Perfect integration in test system by control possibilities via all common interfaces.

2 limits with switch outputs select the probe in the ranges "too small", "good", "too high".

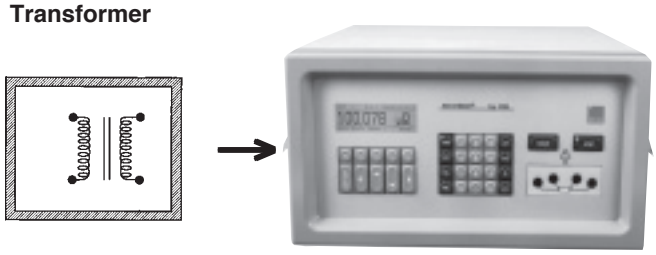
Statistic and classification function: counts and divides the sample in max. 8 classes.

Is there a new test sample on the line? The RESISTOMAT® is quickly reconfigurated via the interfaces or manually by the keyboard.

Example of Application

1. Recording of cooling curve on motors or transformers

Transformer

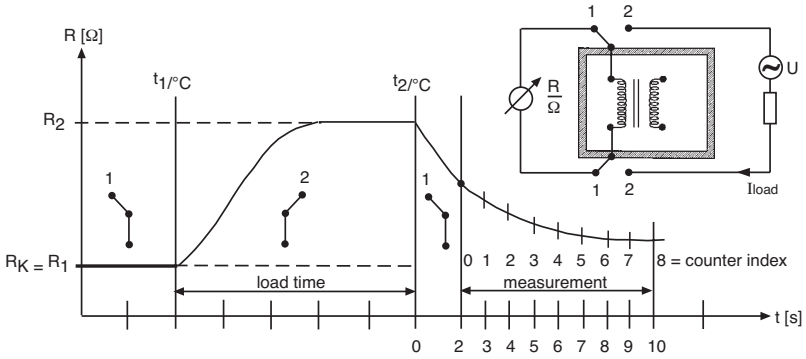


Depending on the transformer's size you can use model 2304 or model2305.
Our sales engineers will advise you.

Rc:	4.387	Ω	
T1:	+ 23.0	°C	
Δ t:	1	s	
R(t):	X.XXX	Ω	
T2:	+ 28.0	°C	
	+/-	L-REM	MEAS-t	EVAL

Cooling curve parameters and display

In a freely selectable time interval up to 255 measurement values can be stored.
After completion of the measurement the values are displayed in tabular form respectively can be transmitted to a PC.



Change of the resistance of a transformer winding in relation to the time factor.

Order Information

RESISTOMAT® model 2304 / model 2305

Accessories for model 2304 and model 2305

Temperature sensor with 2,5 m cable and connector
model 2392-V001

37-pin connector suitable to optocoupler in- and output and relay contacts **model 2304-Z001**

25-pin connector suitable to RS232C (interface)
model 2304-Z002

5-pin connector for connecting the test probe on the rear panel
model 2304-Z003

19"-rack mount kid **model 2304-Z004**

PC-Software **model 2304-P001**

With this program measure values from 2304/05 can be stored in an ASCII data file and can reprocess in Excel.
In addition to the value and unit the time and date will stored.It goes without saying that you can control the instrument.

Kelvin measuring pliers and probes see data sheet 2385 E

Wire holding device for wires up to 1000 mm² see data sheet 2381 E

Calibration resistors see data sheet 1240 E

Calibration Set

Consists of 5 calibration resistors with DKD Certificate with the following values 100 μΩ, 1 mΩ, 10 mΩ, 100 mΩ and 1 Ω.
This certificate documents the traceability to national standards, which realize the physical units of measurement according to the International Unit System of Unit (SI).
The added adaptor model 2394 allows a direct contacting with the RESISTOMAT®.

Device Calibration

On a standard calibration certificate the devices are calibrated in each range with one point in the middle range.

For DKD (Deutscher Kalibrierdienst) calibrations we use PTB-calibrated standards, for WKS (Werkskalibrierschein) calibrations we use DKD calibrated resistors.

With a calibration set the client can make an easy, software supported recalibration.

Calibration set for model 2304 (for customer recalibrations)
consists of 5 calibration resistors of series 1240 with DKD Certificate 100 μΩ, 1mΩ, 10 mΩ, 100 mΩ, 1 Ω and one adaptor type 2394
Model 2304-Z010

Calibration set for type 2305 (for customer recalibrations)
consists of 5 calibration resistors of series 1240 with DKD Certificate 1mΩ, 10 mΩ, 100 mΩ, 1 Ω and one adaptor type 2394

Model 2304-Z011

DKD/WKS Certificate for model 2304

Model 23 DKD-2304

Model 23 WKS-2304

DKD/WKS Certificate for model 2305

Model 23 DKD-2305

Model 23 WKS-2305