電線電纜導電率測試系統

系統企劃書

製作：營業二處 李政達
電話：02-87973606 #605

佳準科技股份有限公司
PRO-PII TECHNOLOGY CORP.

在鉸線機裡電線電纜的電阻量測

為什麼要使用自動測量設備在電纜生產？

- 降低原料的需要量

在節省加工的原料和能源，這是不容易的評價尺度導體截面。鑑於原材料的消耗量在這些情況下更高，能量損失是更低的。如果橫斷面沒被完全監控，承辦夥伴必須根據重量計算每公里電纜為所有夥伴阻止缺點。然而，隨著標準的斷面依據這些合同，製造商需要進行檢查，以降低成本。必須在個別導線的生產時儘早開始這樣的檢查。

當一個電子高電壓電線的購買者發現被提供的橫截面電纜超過被指定的尺寸時，他有充分高興的理由。在這種情況下，他收到了小獎金，隨著電壓下降計劃在他的指揮系統將低於預期。然而，供應商，製造商分別獲得電纜短期的堅持在這裡。用常規測量儀器，很難準確地保持容忍限度，因此必須做安全係數最多 5%以防止任何低於將引起這種產品被拒絕的規定極限。隨著 5%的安全系數，浪費每噸銅處理大約 400 美元。考慮到大量銅處理的電纜廠，這個損失很容易積累到每月 10000 美元 。

到目前為止，它一直是標準程序，是切斷一完成米長的電纜樣品並且測量它分別在重新啟動一台機器之前。在此之後，機器調整和一系列測量，直到完成所要求的值得到。5%的安全系數在這個過程裡製作，當各自導線的張力穩定的增加損傷線圈的直徑減少，因而降低各自的導線的橫斷面。尺寸檢查的可能性，在機器被重新了開始之後是非常限制。一個干擾的因素是成品電纜的溫度，因為它使密實頭不僅增加，而且分佈不均的電纜截面。在這個變化引起相應的溫度變化的實測值。

為了理想的監測生產單絲的高壓電纜，質量控制必須直接履行在絞線機。Burster 電阻允許將測量精度為 0.1 %內生產的電纜長度。該機器操作員能夠調整密實頭根據測量結果，從而優化了電纜的截面。

它怎麼解決

所以，如所描述，單一導線的最佳質量管理生產和電纜做一個測試直接地在絞線機內。這些組件 RESISTOMAT ® 2304，該夾緊裝置 2382A 和一張工作檯進行測量樣品長度可能在生產過程中，但只需一個雇員停止絞線機。該機器指南的選項來調整壓縮機根據測量結果，以優化電纜的直徑。

生產過程的監督，因此，由於一體化的連續測量系統中的絞線機符合 ISO 9002 要求的國際品質管理。單一測量值可以紀錄在個人電腦上或直接由印表機列印輸出。

在 ISO 9002 –驗證標準生產是先進的，當然，在有關 ISO 9003- 驗證標準最後產品-在實際測試儀上的探針後，生產批次(用 RESISTOMAT® 2304 和安裝夾具 2382L)。

- 技術細節

在測量可以完成之前，撚線機必須停止和取消的平台進行測量盆地上升到接觸樣本。限位開關達到精確高的位置。把潛在的閥門安裝在一段 1000 毫米的距離，對這接觸電攬發生扭曲。在整體測量期間纜繩是在溫度控制的熱水鍋裡面。循環泵保證溫度的均勻發生在熱水鍋並且重新分發的水流通過艙壁。

熱水鍋加熱並保持恆溫在設定溫度盡可能接近，在試驗對象。這樣，您就能以短期溫度平衡的時間，所以，快速和非常精確的測量值。水溫的測定發生在準確的 Pt 100 傳感器。這水溫是必要的溫度補償的 RESISTOMAT ®的計算值在 20 攝氏度。

- **測量系統的必要校準**

Burster 的一系列 1240 的校準電阻專為校準和測試儀表設計的。每台電阻器與製造商一起交付測試證明書。依據需求，電阻器可以提供 DKD 校準證明書。此證書文件符合國家標準的顯示物理單位同意國際司系統。

隨著溫度的電纜進行直接影響測量結果，RESISTOMAT®2304 測量和顯示的熱水鍋的溫度也必需被檢查。校準溫度計與 DKD 證書可用於這目的。

彙編前提

當今的測量沒有特別的終端需要鋪設透過處理的電纜進行。電流在一個末端被直接透過這條電纜透過緊密結合的頭安排，在另一處用絞車拉動。上昇平台與測量的平台是組裝這兩個機器元件。當然，一個必要條件必須為尺寸完成正確地進行：拉絞盤以及跟隨它的電纜指南和彎曲的單位不可在緊密結合頭的邊上被用電力與剩下的機器零部件連結，，或抵抗電器之間必須有足夠高，使其作為一個微不足道的測量的電纜部分的一個分流器一樣無意義。換句話說，這抵抗應該大約是大產品抵抗在個 1000 倍緊密結合的頭並且開出之間用絞車拉動。

電線導電率測試系統

佳準科技股份有限公司
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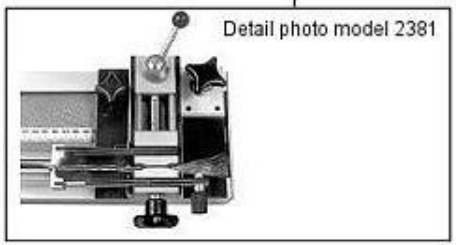
電線導電率測試系統組成

2316 微歐姆計

接線

RS232傳輸線

PC

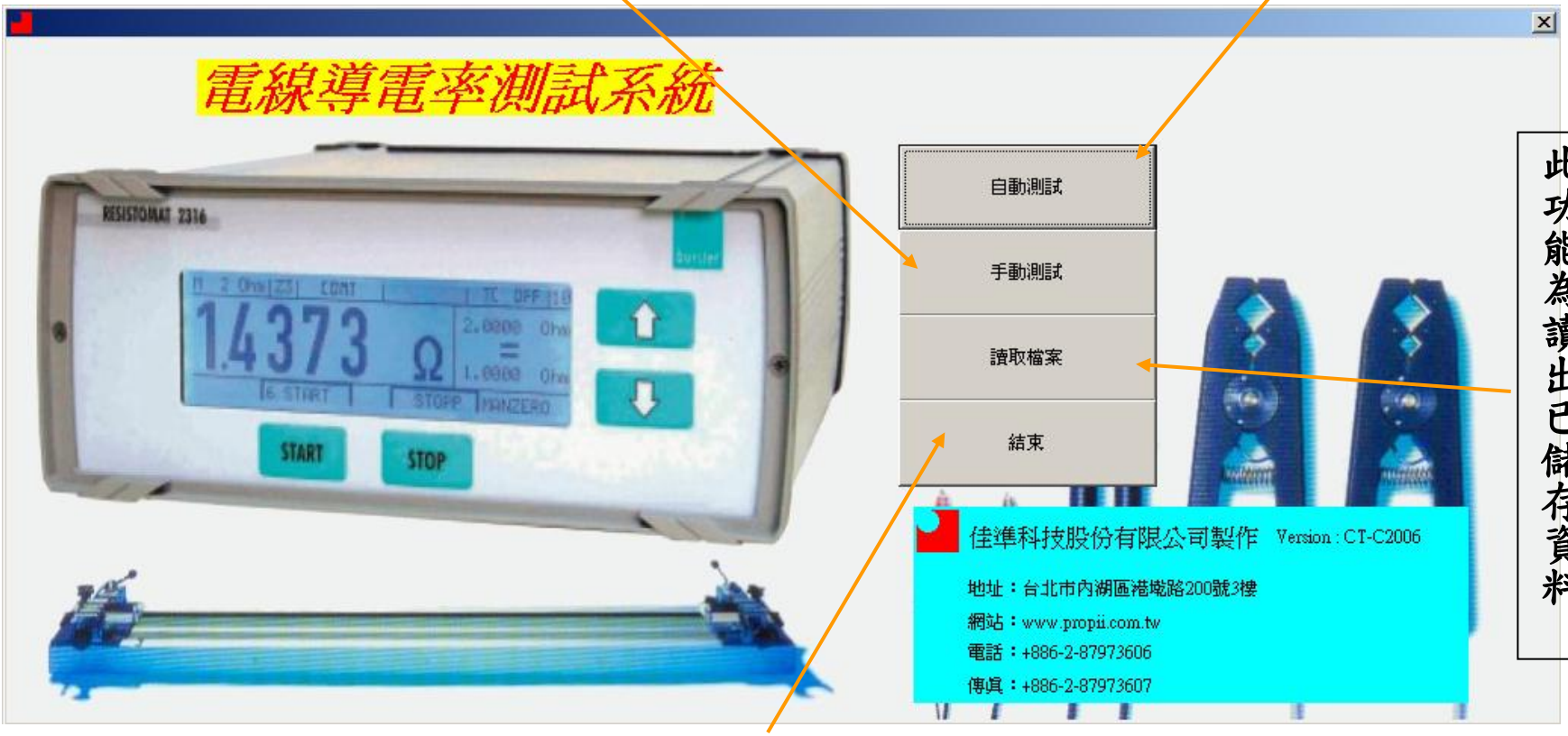


2381 Clamping

主畫面

此功能為量測到電阻值後，需將測導線剪下秤重量並輸入，然後軟體自動算出被測電線的導電率

此功能為量測到電阻值後，軟體利用設定好的參數，計算出被測導線的重量，然後算出被測電線的導電率



此功能為讀出已儲存資料

結束並離開軟體

設定參數畫面

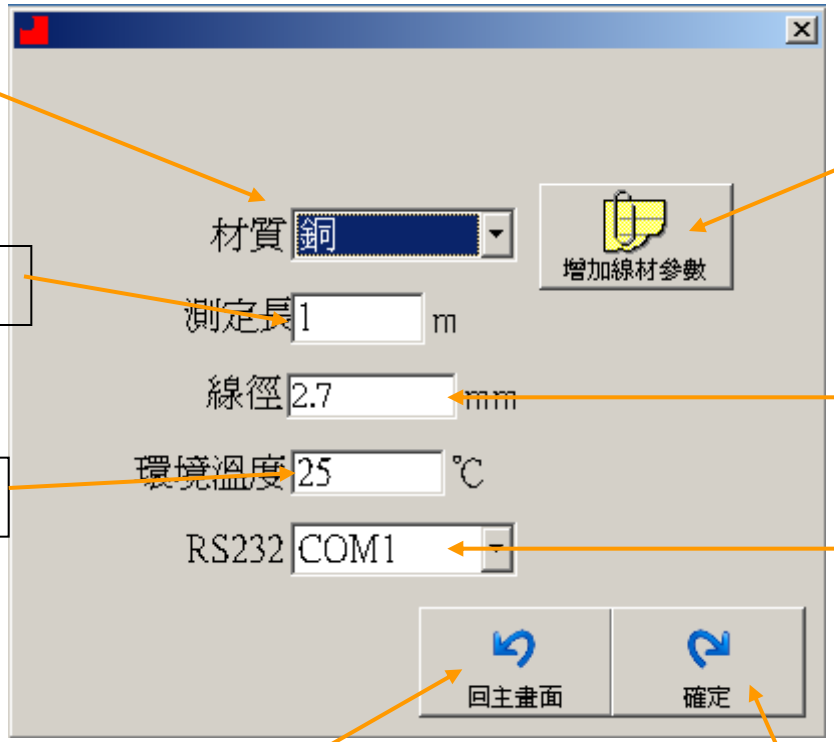
當執行“自動”或“手動”測試時會先進入“設定畫面”

測試導線“材質”可透過下拉視窗選擇

測試導線“測試長度”

測試時“環境溫度”

回 軟體 ” 主畫面”



增加測試導線基本參數

測試導線“線徑”

測試時與儀器連接的“RS232埠口”

與儀器建立連結並進入測試畫面

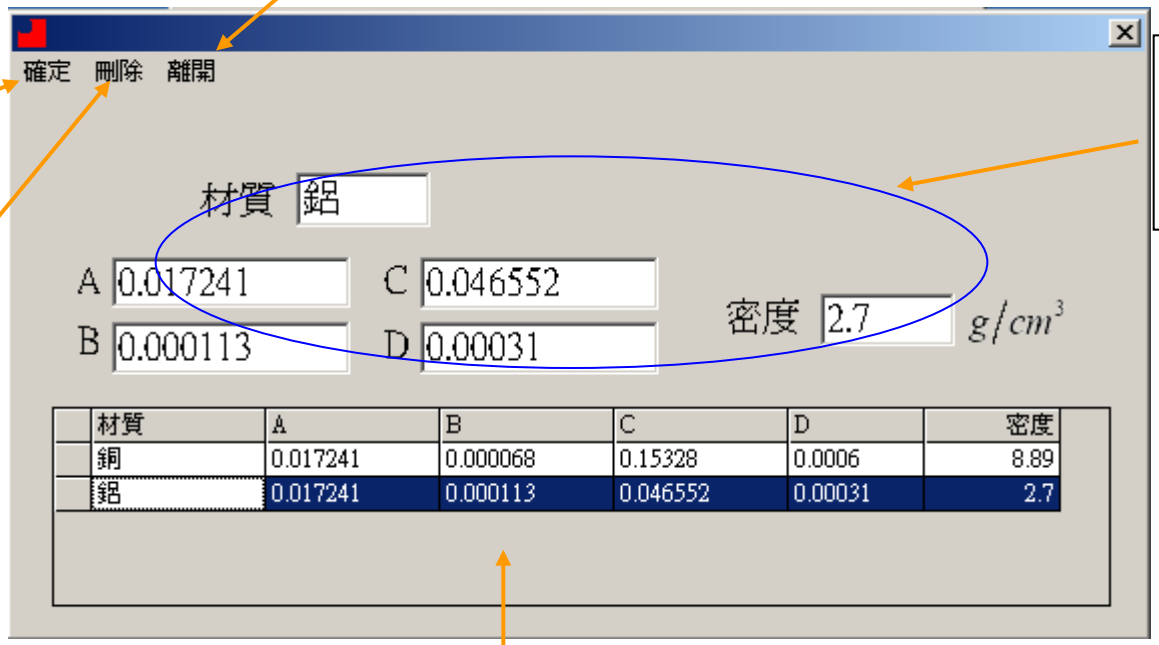
加入新材質畫面

回到設定參數畫面

將輸入的導線基本材質加入到下表

要加入的導線基本資料輸入區

將下表中顯示為藍色的材質基本資料刪除



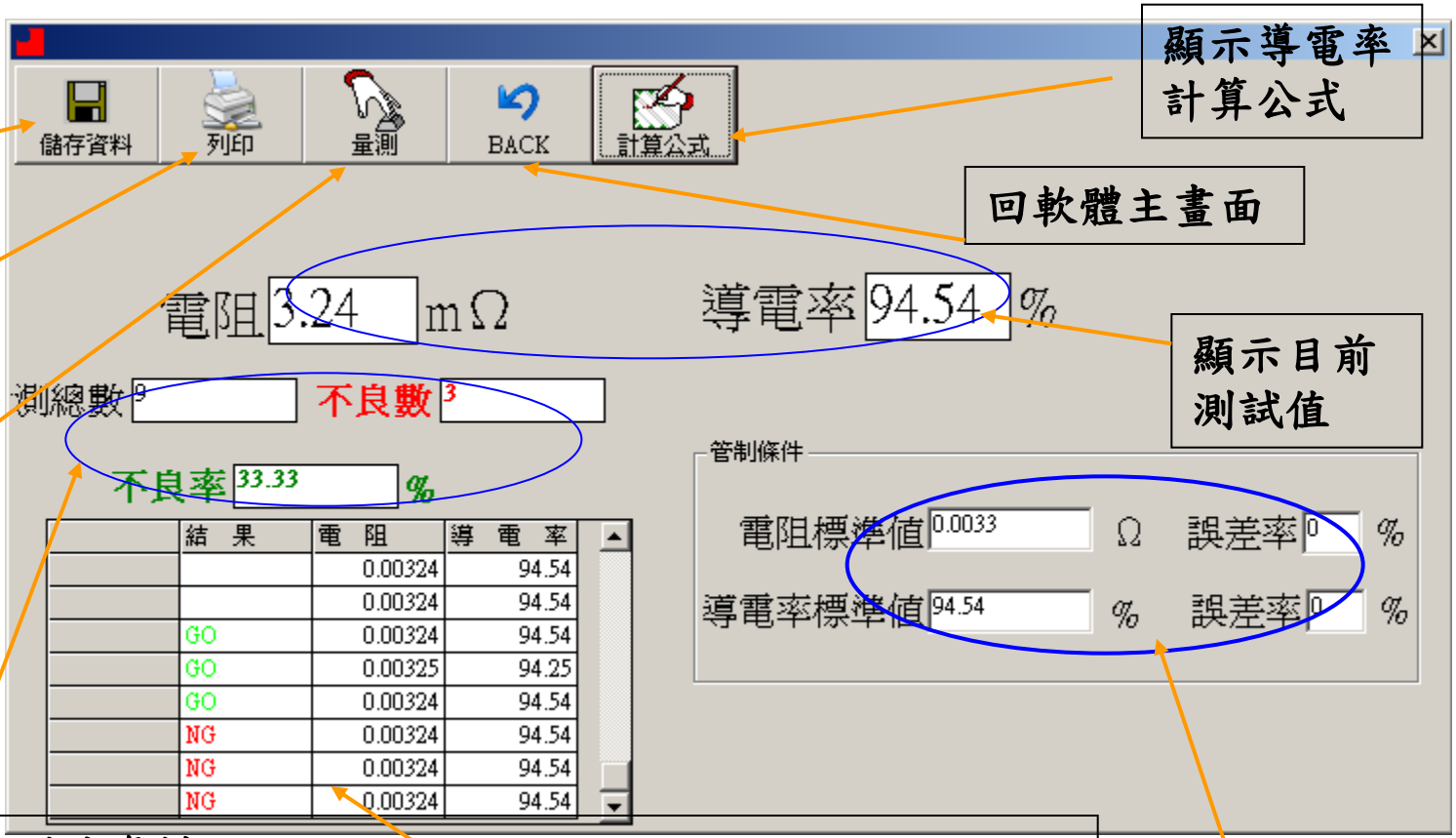
顯示所有加入的導線基本資料

連線畫面

執行“確定”進入測試畫面

表示RS232選擇錯誤

測試畫面



儲存測試資料

列印測試資料

進行測試

顯示導電率計算公式

回軟體主畫面

顯示目前測試值

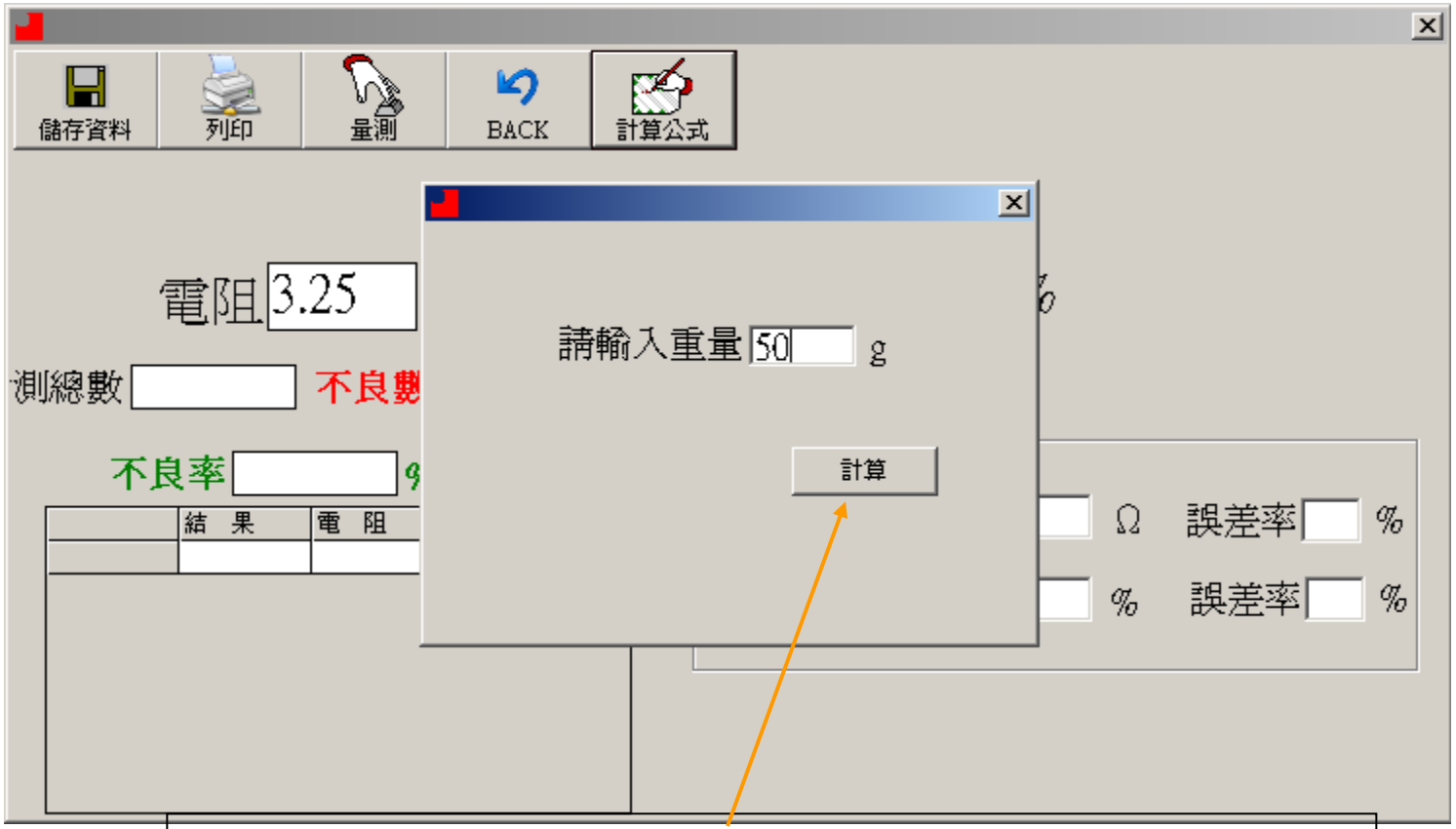
顯示總測試數量、不良數及不良率

測試資料：

1. 若沒輸入上下限則“結果”欄位為空白
2. 若在輸入上下限則內則“結果”欄位為“GO”
3. 若在輸入上下限則外則“結果”欄位為“NG”

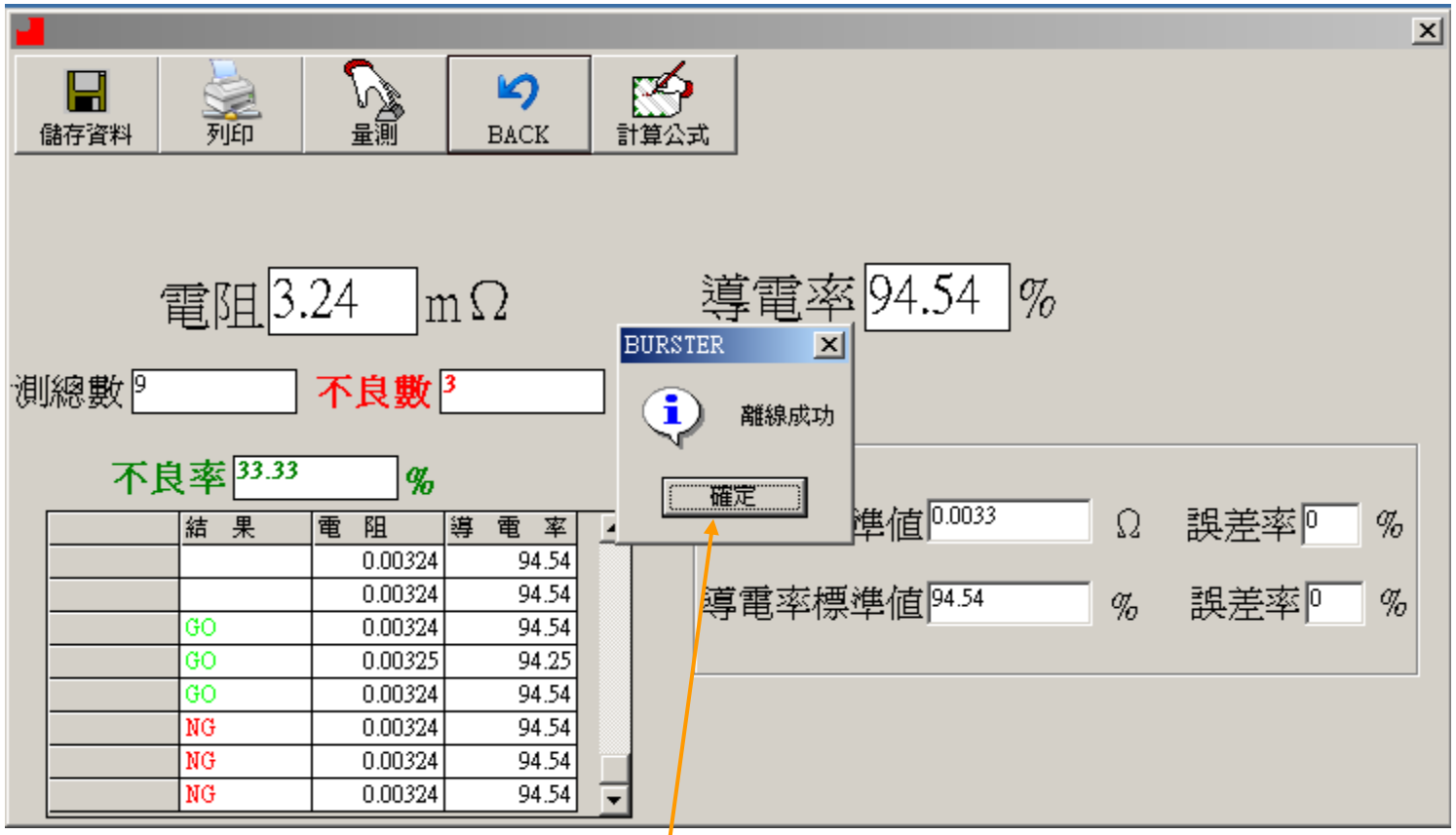
品管上下限及誤差率設定

手動測試



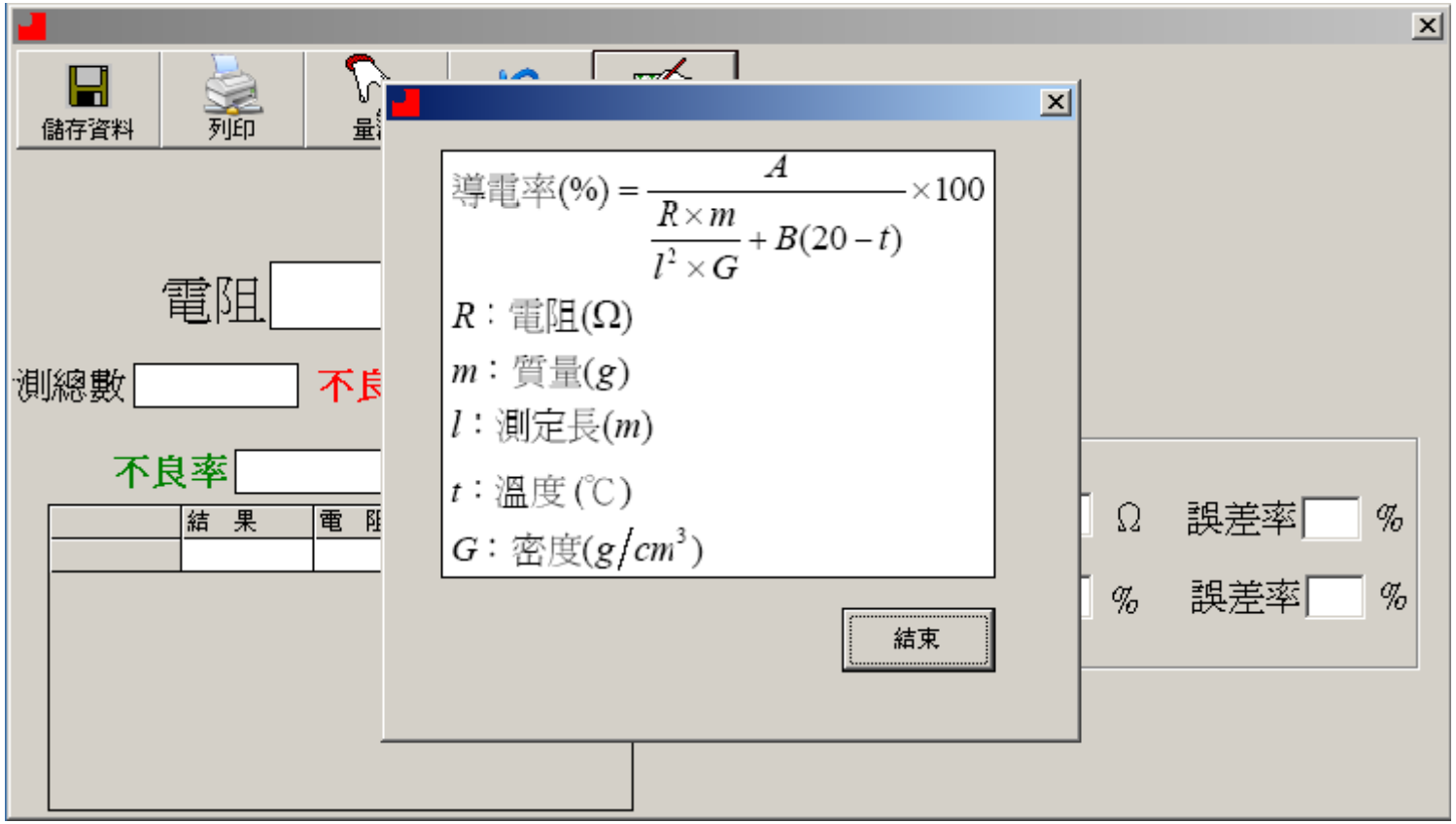
手動測試時，當被測電阻量測完畢則出現“輸入重量”畫面，此時將被測導線剪下秤重量後輸入重量值， 執行“計算”則會計算出導電率並顯示結果。

離開測試畫面



當測試結束，要離開測試畫面，軟體會先將PC與儀器間的連線結束，此時執行“確定”則會回到軟體“主畫面”。

顯示導電率計算公式畫面



佳準科技股份有限公司

銅線檢驗報告表

報驗單號碼：　　進料廠商：

品　　名：**SCR軟銅**　　進料數量：**10042kg/7架**

規　　格：**2.6mm**　　溫　　度：**21℃**

檢驗數量：**5**　　日　　期：**2006/11/23**

項目 / 規格值 / 樣號	直徑 mm	重量 g/50cm	導體電阻 Ω/km20℃	導電率 %	抗張力 kg	抗張強度 kg/mm^2	伸長 mm	伸長率 %	扭轉數
	2.6±0.03		3.248↓	100%↑		27↓	(銅線伸長)	30-35%	
2207	2.604	23.809	3.172	101.49	138.2	25.95	33.2	32.8	
2062	2.599	23.798	3.162	101.87	137.9	25.99	33.4	33.6	
2204	2.602	23.784	3.166	101.79	137.7	25.90	33.4	33.6	
2201	2.601	23.765	3.176	101.55	138.4	26.05	33.2	32.8	
2203	2.6	23.787	3.171	101.62	137.5	25.90	33.1	32.4	

備　　註：外觀檢查：銅線表面應圓滑且不得有變色或銅氯、刮傷、裂痕或其他缺點。整架銅線不得有接頭並做防鏽處理。

（合格允收）

AQ004/210×297/1.0

廠　　長：　　品保課長：　　檢驗員：林岱蔚

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

Model 2304

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

2304-E

Automatic inspection and test unit

Automatic choice of measuring ranges from 200 µΩ to 20 kΩ
Resolution up to 1 nΩ
Standard interfaces IEEE488, RS232, RS485, USB (option)
Checking of tolerances, classification with statistics.

Highest measuring accuracy

Measuring error ≤ 0.01 %
Future-orientated measuring method with thermal e.m.f. compensation.
High level of stability due to constant comparisons with internal reference values.

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.

burster praezisionsmesstechnik gmbh & co kg · Tel. +49-7224-6450 · Fax 64588
Talstr. 1-5 · D-76593 Gernsbach · **www.burster.com** · **info@burster.com**

Functional Description

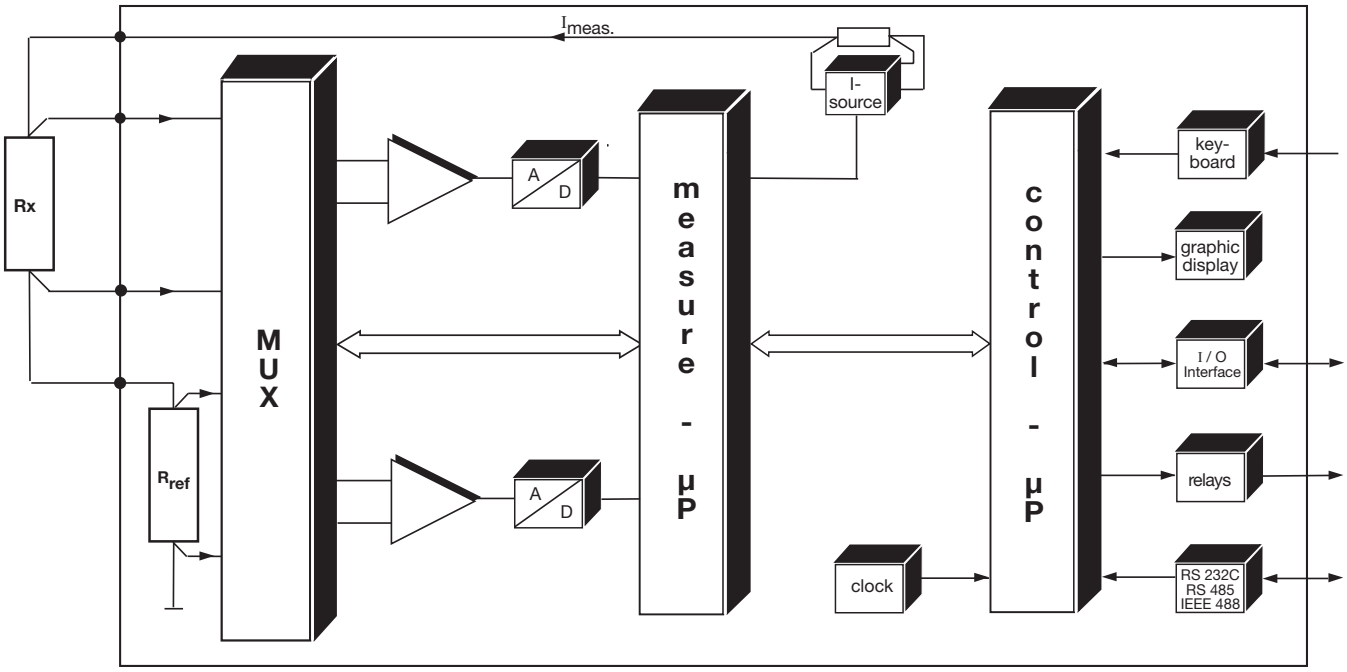
The operation of the measuring section of the RESISTOMAT® model 2304, 2305 high-precision inspection and test unit is based on an upgraded 4-wire design. It measures not only the voltage drops with injected current across the test object but also across an internal reference resistor. The quotient is 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 resistors alone. The deviations in these reference resistances 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 equipped 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 an optimum measuring accuracy is guaranteed.

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.

For PC user the device software 2304-P001 is available.

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, test field and production.

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.

Measurements on **coil, motor and 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, volume resistance on fuses.

Technical Data

Design

The device is designed in a modular system and embedded in a stable housing of sheet steel. Therefore every structural component is easily accessible and thus an optimal service is secured.
All operational knobs, the LCD graphic 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 tem-

Measuring Data

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 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

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. load voltage: 10V at $I_{meas.}$ = 100µA to 1A
6V at $I_{meas.}$ = 10A

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: manually, automatically or via interface

Zero balance: µP-controlled

General Data

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

Overload indication: >>>

Outline 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 %; 115 V as option

Power frequency: 45 - 65 Hz

Power requirement: max. 260 VA

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 internally grounded, reversible to external grounding

Watch: buffered by internal battery

Parameter input: by entry keys or interfaces

Weight: 28 kg

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

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

Interface Connections

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

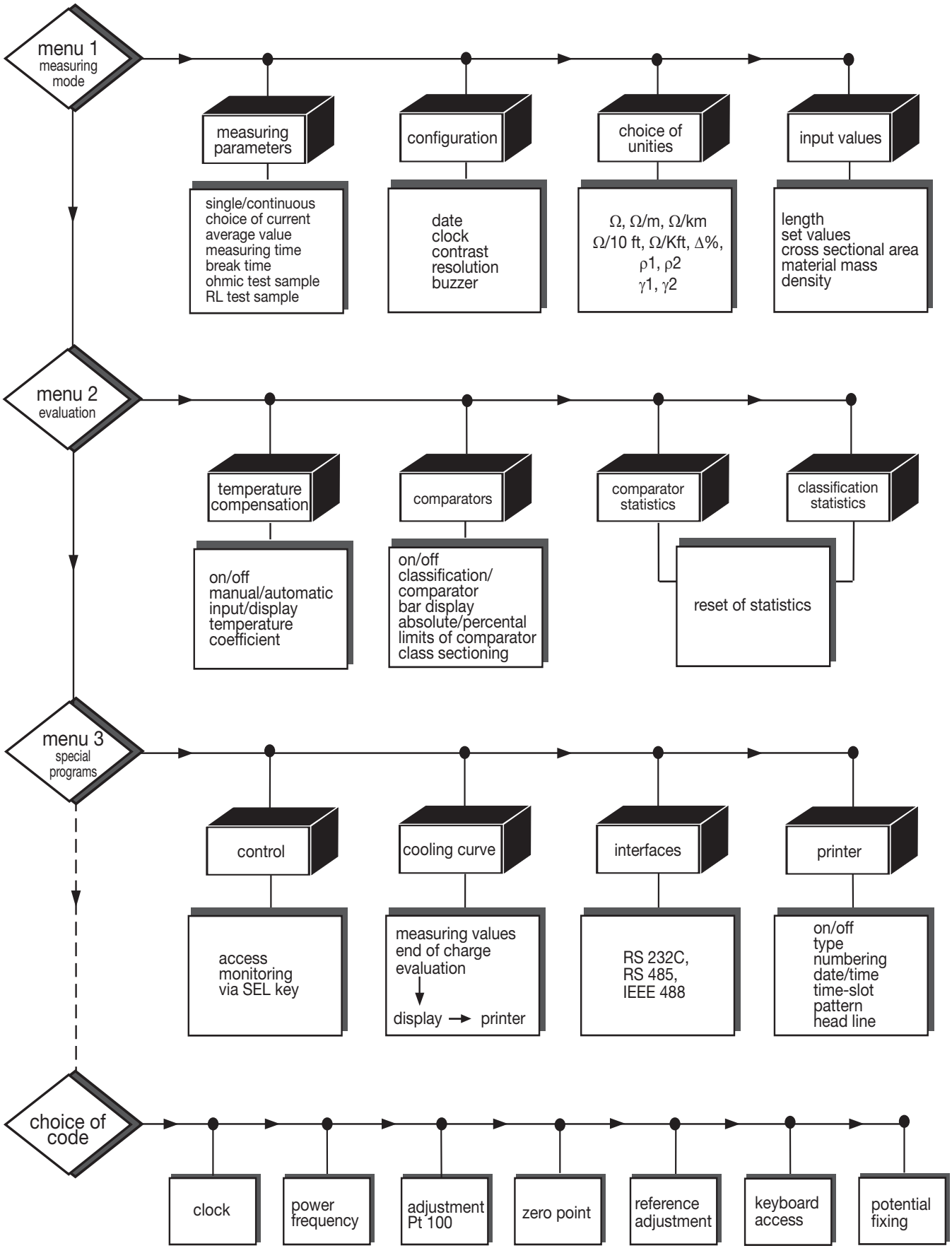
RS232C interface:
fullduplex with RTS, CTS
25-pin submin D-bush
baud rate 600 - 9600
protocol ANSI X 3.28 subcategory 2.5, A3/A4
instruction language SCPI, version 1990.0

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

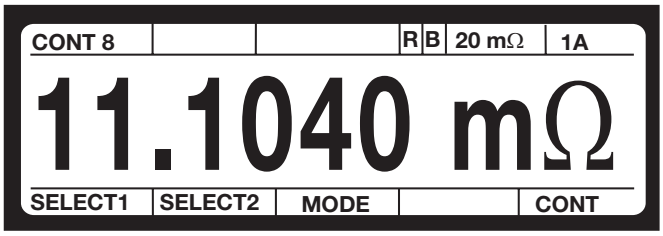
Overview Adjustments and Configuration

The many application orientated adjustments of the inspection and test unit are accompanied by a compact operator manual. The following diagram provides an overview for the existing menus and measuring programs.



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

Display of measured values, adapted to your working conditions:



Example: main menu 1 with 5 1/2 reading of absolute value, additionally display of the measurement unit

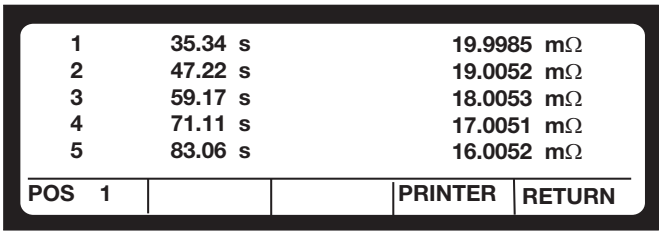
In absolute values, digital, 3 1/2- up to 5 1/2 digit, that means resolution, adapts to the application requirements i.e. 1,234 Ω or 1,23432 Ω;

in relative values as percential difference to a given set value. Display i.e: - 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 unit Ω, Ω/m, Ω/km, ρ (specific resistance) or κ (specific conductance). In the sub menu of the unit choice the RESISTOMAT® requires the data for calculating the specific values, 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



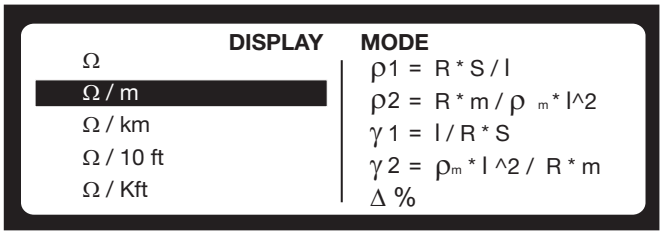
Example: presentation of automatically stored values with indication of recording time

short measuring times due to single polarity measurement;

determination of cooling-down curves: the device stores up to 256 measuring points. Start-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.

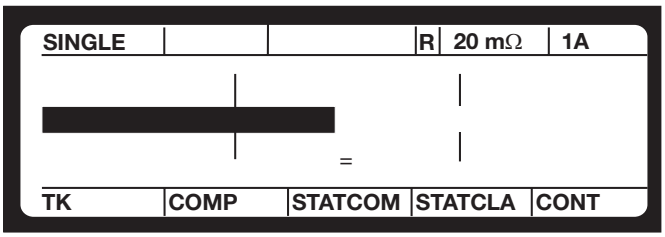
On **cable standing and wire twisting** the RESISTOMAT® saves raw material and money:



Example: choice of unit on display menu

Along with wire holding devices models 2381/82 - or as stand-alone device - RESISTOMAT® model 2304 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 either measured with a sensor or put-in manually. 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 following easements:



Example: bar indication with flashing-in of limits and comparator results

Bar or percentage indication: for adjustment processes

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

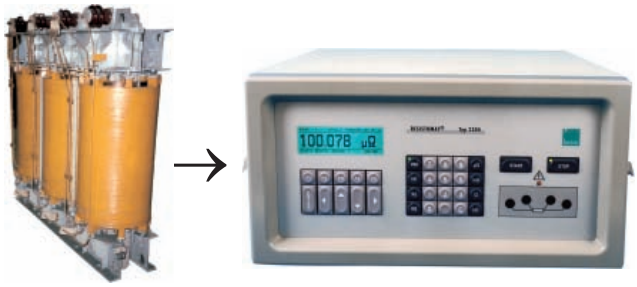
2 limits with switch outputs select the probe in the ranges "too small", "good", "too high".

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

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

Application Example

Recording of cooling curve on motors or transformers



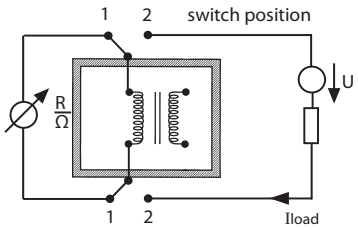
Transformer

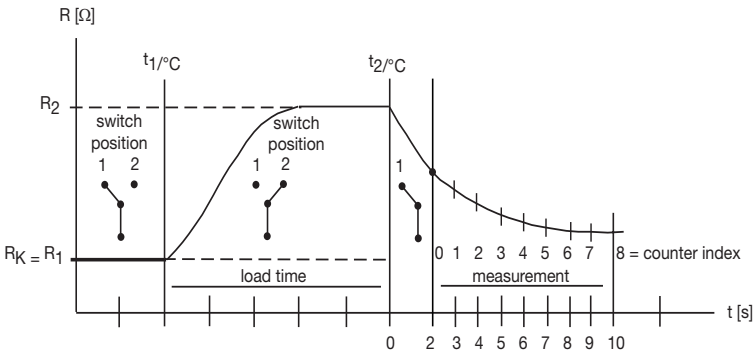
Rc:	4.387	Ω
T1:	+ 23.0	°C
Δ t:	1	s
R(t):	5.264	Ω
T2:	+ 28.0	°C

	+/-	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 resistance of a transformer winding in relation to the time factor.

Order Information

RESISTOMAT® **Model 2304**

Accessories

Temperature sensor with 2.5 m cable and connector	**Model 2392-V001**
37-pin connector suitable to optocoupler in- and outputs and relay contacts	**Model 9900-V165**
25-pin connector suitable to RS232C (interface)	**Model 9900-V160**
RS232 data transmission lead	**Model 9900-K336**
USB Converter	**Model 9900-K351**
5-pin connector for connecting the test probe on the rear panel	**Model 2304-Z003**
19"-rack mounting kit	**Model 2304-Z004**

PC Software **Model 2304-P001**

With this program measuring values from 2304 can be stored in an ASCII data file and can be reprocessed in Excel. In addition value and unit, time and date are stored. Upon start of the measurement a text with 80 characters can be entered which is written into the first line of the file.

Kelvin measuring pliers and probes	see data sheet 2385 E
Wire holding device for wires up to 100 mm²	see data sheet 2381 E
Wire holding device for wires up to 2500 mm²	see data sheet 2381 E
Calibration resistors	see data sheet 1240 E

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 customer is able to effect an easy, software supported recalibration.

Calibration set (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 model 2394 **Model 2304-Z010**

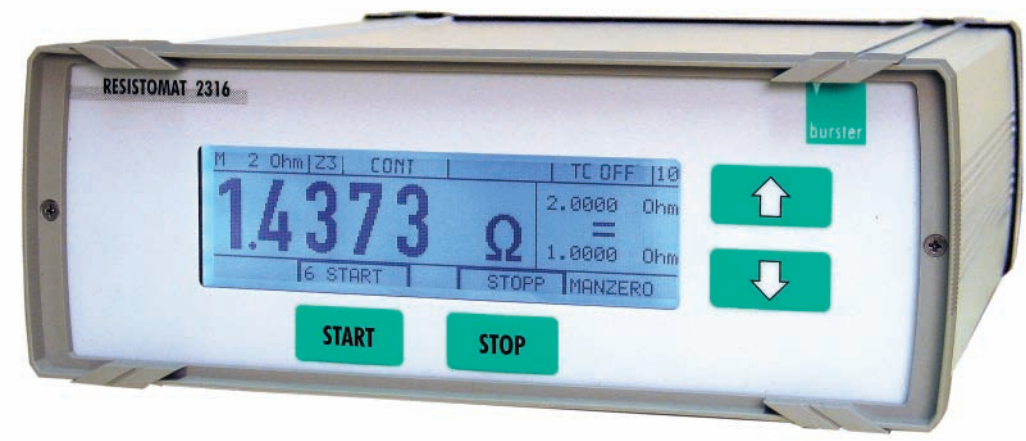
DKD/WKS Certificate **Model 23DKD-2304**
Model 23WKS-2304

Milliohmmeter RESISTOMAT® for Production and Laboratory

Model 2316

Code:	2316 E
Manufacturer:	burster
Delivery:	ex stock/6 weeks
Warranty:	24 months

2316-E



- **Measuring ranges from 2 mΩ to 200 kΩ**
- **Resolution up to 0.1 µΩ**
- **Accuracy 0.03 % Rdg.**
- **Autorange**
- **Temperature compensation for all materials**
- **Thermal e.m.f. compensation**
- **Input voltage protection up to 400 V_{eff}**
- **RS232 and PLC interface standard (USB option)**

Application

Fast and accurate measurements of the smallest resistance values are possible with the milliohmmeter RESISTOMAT® model 2316. Due to the rugged aluminium injection moulding desktop housing with membrane keypad it is suitable for use in laboratory and industrial environment likewise.
Wires and coils can be measured with temperature compensation. The temperature of the sample is measured with a Pt 100 or pyrometer and the resistance is then corrected to the equivalent at e.g. 20 °C (adjustable) in the instrument.

The application range is very wide such as the measurement of:

- ► transformer motor coil windings
- ► coils of all kind
- ► cables and wires on the drum or as meter samples
- ► switch and relay contacts
- ► heating elements
- ► fuses
- ► connections and transitions at power rails and many more

For a cooling curve recording with freely selectable time interval a data logger for up to 1000 values is available.
The complete control via RS232 interface enables the setup of fully automatic test stations. The instrument features a PLC interface for integration into production process control classification and makes selection of the samples an easy task.

Description

The device works according to the proven 4-wire measurement method which eliminates errors caused by test lead and contact resistances. Thermo voltages that might be in the measurement circle would be compensated automatically by this measurement method. The control of the measurement leads is done with an integrated cable fraction detection.
A temperature compensation for any given sample material such as copper, aluminium, tungsten, etc. is self-evident. The temperature measurement is done by an external Pt 100 sensor or by an external infrared measurement device (ref. to accessories). A special measurement voltage input protection was developed for testing large inductive samples so that voltage peaks do not cause permanent damage while pinching off the sample.
16 device settings such as the measurement range, limit values, temperature coefficient, etc. can be saved in order to test samples with different parameters in an automatic measurement system. All device specific settings are shown to the user via display. Calling up the settings is done via keypad or via PLC interface with a bit pattern (4-bits). It goes without saying that all device settings may also be effected via the RS232 interface.
The high-contrast LCD display with backlight assures very good reading of the measurement value in dark as well as bright spaces.

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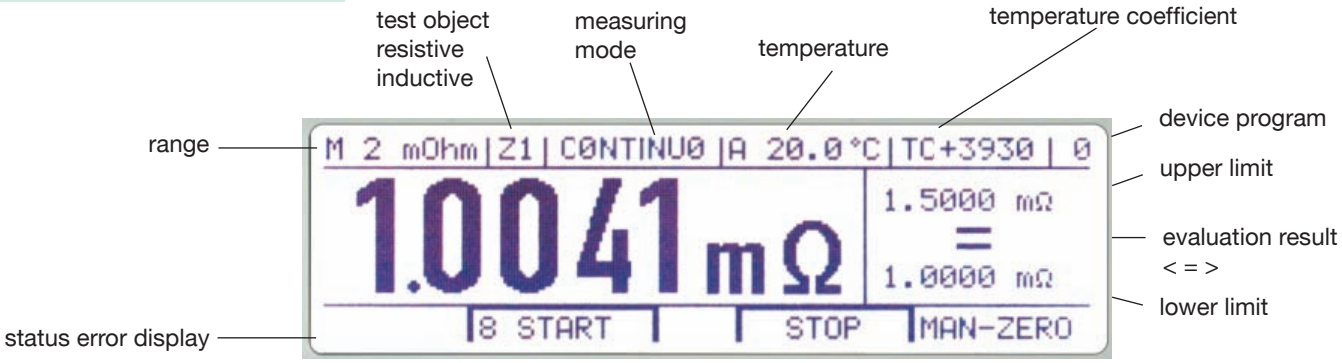
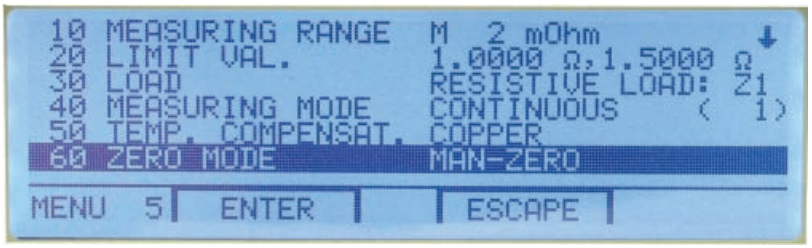
Talstr. 1-5 · D-76593 Gernsbach · **www.burster.com** · **info@burster.com**

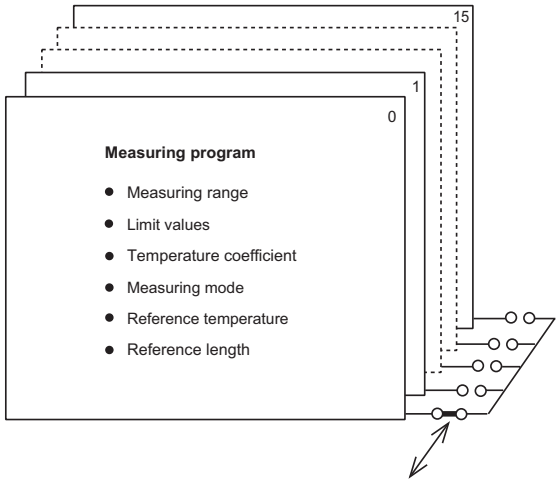
Measurement Display



Menu

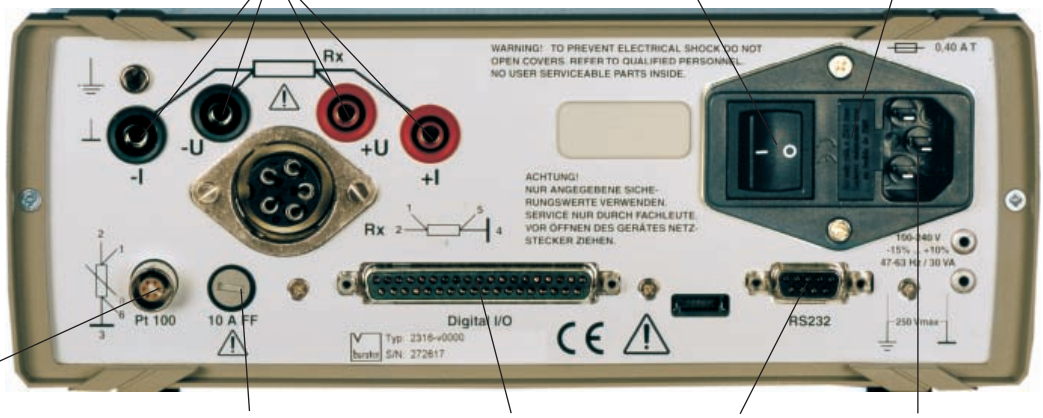


Measurement Program



For fast object changes, RESISTOMAT® 2316 can store up to 16 measurement programs, which can executed either by PLC, by hand or RS232 (USB)

Rear Side



Device and Documentation Software

The software model 2316-P001 is especially developed for the device setting, measurement value evaluation as well as measurement report printout.
A demo version is available at **www.burster.com/software.html**.

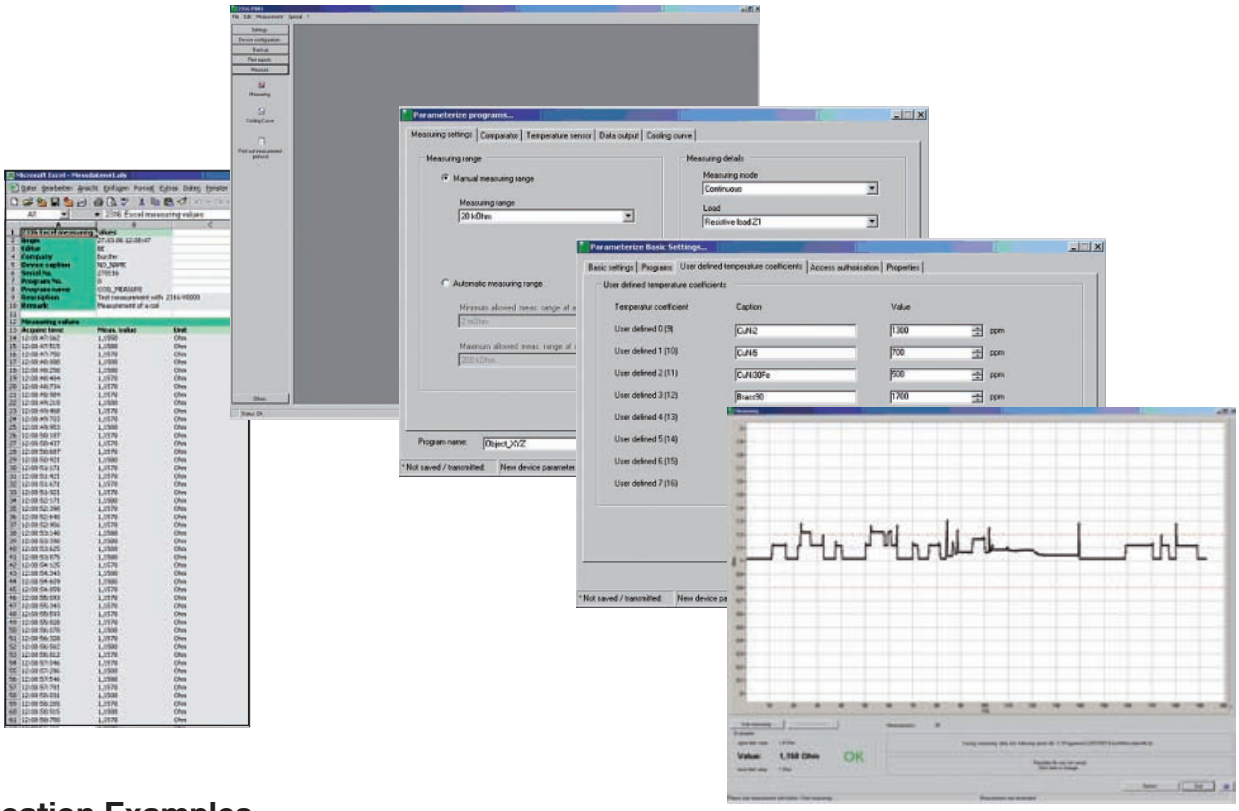
Following features are available:

- Full control of RESISTOMAT® model 2316
- On-line display of the measuring values including limits in graphic or tabular mode
- Direct storage of the measuring values with time stamp in ASCII files
- Export of all data in ASCII format to MS-EXCEL
- Printout of a test certifcate with your own logo
- Complete cooling curve record and printout of motor and transformer windings with extrapolation in Excel
- Backup of device settings

System requirements:

Processor:	Pentium 500 MHz (at least)
Graphic:	VAG 800 x 600 (at least) 256 colours (at least)
Memory:	64 MB RAM (at least) WIN 98SE and WIN NT 4.0) 128 MB RAM (at least) (WIN ME, WIN2000, WIN XP)
Hard Disk:	approx. 200 MB free memory
Interface:	RS232 or USB (with option USB adapter)

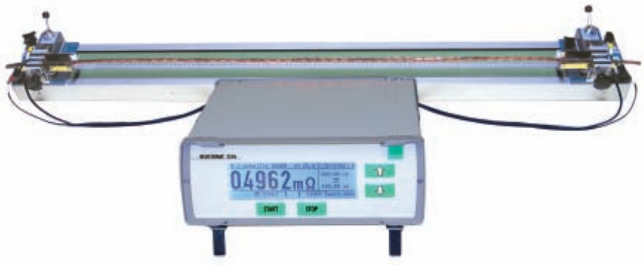
2316-E



Application Examples

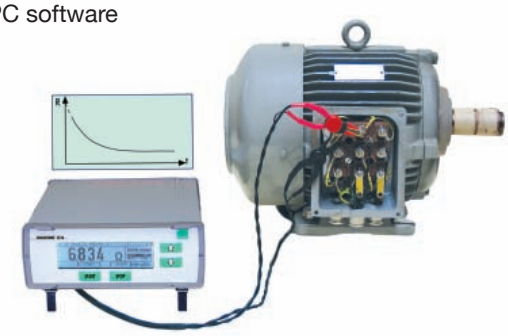
Quality control on wires and cable

- Testing of variable wire lengths from 100 mm ... 1000 mm measurement length
- The integrated temperature compensation allows a standardized resistance value in correspondence to the reference temperature (Germany e.g. 20 °C)
- Individual selection of material specific temperature coefficient



Cooling curve measurement on electric motors

- Selectable sample rate
- Data logger for up to 1000 measurement values
- External control of load stop
- Tranfer of measurement data to EXCEL via PC software



Technical Data

Construction

The device has a service-friendly construction in a sturdy aluminium die casting housing which enables good access to the various components. The operation is done via the membrane keypad. The connections for the sample, the in- and outputs of the RS232/PLC interface as well as the Pt 100-sensors are located at the backside of the device.
The device features a diagnosis function for current source, amplifier, display, internal operation voltage and PLC I/O.

Measuring range	Resolution	Measuring current small**	Measuring current big**
* 2 mΩ	0.0001 mΩ	3 A	3 A
20 mΩ	0.001 mΩ	1 A	1 A
200 mΩ	0.01 mΩ	100 mA	1 A
2 Ω	0.0001 Ω	10 mA	1 A
20 Ω	0.001 Ω	10 mA	100 mA
200 Ω	0.01 Ω	1 mA	10 mA
2 kΩ	0.1 Ω	1 mA	1 mA
20 kΩ	1 Ω	100 µA	100 µA
200 kΩ	10 Ω	10 µA	10 µA

*RESISTOMAT model 2316-V0001 only **adjustable at the device

Accuracy (with temp. comp. off):	≤ ± 0.03 % Rdg. ± 3 Digit
Burden voltage:	approx. 5 V max.
Measuring time (for ohmic probes):	approx. 500 ms
Warm-up time to attain the error tolerance range:	< 15 min
Measurement connection:	4-wire technology for current and voltage measurement (KELVIN), ground-free circuit design
	FE-PE max. 250 V
Input protected:	against induction voltages and external voltages up to 400 V_{eff}
Measurement mode:	continuous and single measurement, cooling curve measurements on motor or transformer windings alternated measurement 250 ms fast measurement
Data logger:	up to 1000 values (only in "cooling curve" mode)
Limit values:	Hi/Lo limits programmable via keypad or interface
Range selection:	manually or automatically
Automatic temperature compensation:	7 different temperature coefficients can be chosen and additional 8 TCs are adjustable
Temperature measurement:	0 ... 100 °C, resolution 0.1 °C, accuracy 0.1 °C with ext. Pt100 sensor or temperature transmitter (pyrometer) with a voltage output of 0 ... 10 V
Display:	high-contrast graphic LCD with adjustable contrast and LED background illumination 264*64 Dots, 127 x 34 mm
Measurement display:	max. 21 000 counts
Device setting memory:	for 16 different device settings
Operator language:	German, English, French, Italian, Spanish
Mains supply:	85 ... 264 V AC 50/60 Hz
Power consumption:	approx. 30 VA
Temperature drift:	50 ppm/K
Operation temperature:	0 ... ± 23 ... + 50 °C
Humidity non-condensing:	80 % rel. hum. (up to 31 °C), thereover linearity decreasing to 50 % at 50 °C
Storage temperature:	0 ... + 70 °C
Weight:	3.5 kg
Dimensions (W x H x D):	247 x 106 x 275 [mm]
	19"-3HU rack mount set optionally
Device protection:	EN 61010-1 protection class1
Type of protection:	IP 40

Connections

Measuring input:	alternatively via 4 terminals (ø 4 mm) or 5-pin socket with bayonet lock
Pt 100 sensor:	6-pin, LEMO socket EGG.1B.306
Digital I/O:	37-pin subminiature D-socket PLC interface with positive logic (negative logic optionally) additional comparator output with relay (disconnectible) 24 V / 1A
RS232 interface:	9-pin subminiature D-socket Baud rate: 300 ... 57 600 Protocol: ANSI X3.28 1976 Subc.2.1,A3 SCPI commands: Vers. 1995.0 direct data recording to a printer with RS232 interface is possible
USB interface:	possible with an RS232/USB adapter cable model 9900-K351

Calibrations Sets:

1. The **calibration set model 2316 -Z010** consists of 4 calibration resistors series 1240 with the values 1 mΩ, 10 mΩ, 100 mΩ and 1 Ω, including one DKD certificate for each resistor. The added adapter model 2394 allows a direct contacting with the RESISTOMAT®. This calibration certificate documents the traceability to national standards. Full description see data sheet 1240-E
2. The **calibration set model 2316-Z011** consists of 3 calibration resistors 10 mΩ, 100 mΩ and 1 Ω as well as adapter 2394. Otherwise as before mentioned.

Order Information

RESISTOMAT®

Range 20 mΩ ... 200 kΩ	**Model 2316-V0000**
Range 2 mΩ ... 200 kΩ	**Model 2316-V0001**

Accessories

Measurement leads, 4-pin, 1.5 m long shielded cable with banana plugs and bayonet socket	**Model 2329-K001**
Temperature sensor with 2.5 m shielded connection line and 6-pin connection plug	**Model 2392-V001**
Infrared temperature sensor (pyrometer) temperature range 0 ... 100 °C	**Model 2328-Z001**
RS232 data transmission lead	**Model 9900-K333**
USB data transmission lead	**Model 9900-K351**
37-pin plug for digital I/O interface	**Model 9900-V165**
5-pin bayonet plug for measuring input	**Model 9900-V172**
19"rack mount kit (3 HU)	**Model 2316-Z001**
External device program selecting switch with cable 2 m length and power supply	**Model 2316-Z002**
External foot switch for measuring start/stop with cable 2 m length	**Model 2316-Z003**
Device and documentation software	**Model 2316-P001**
Calibration set	**Model 2316-Z010**
Calibration set	**Model 2316-Z011**

DKD Calibration

Model 2316-V0000	**Model 23DKD-2316-V0000**
Model 2316-V0001	**Model 23DKD-2316-V0001**

WKS Calibration

Model 2316-V0000	**Model 23WKS-2316-V0000**
Model 2316-V0001	**Model 23WKS-2316-V0001**

For DKD (Deutscher Kalibrierdienst) calibrations we use PTB-calibrated standards (national institute).

For WKS (manufacturer calibration) calibrations we use DKD-calibrated resistors.

Kelvin measuring pliers and probes	**see data sheet 2385-E**
Wire holding devices for wires up to 2500 mm²	**see data sheet 2381-E**
Calibration resistors	**see data sheet 1240-E**

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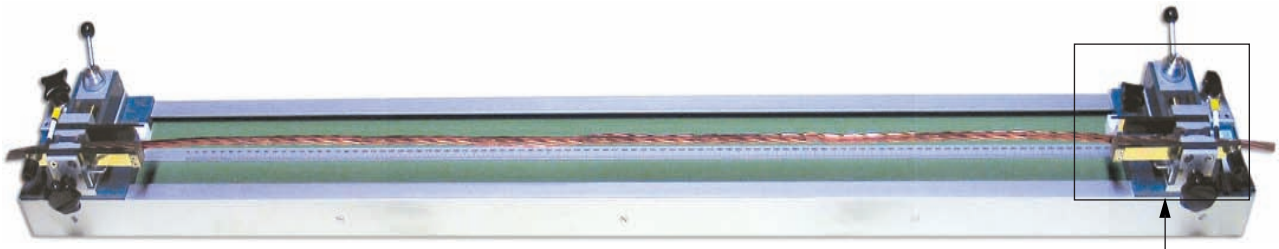
117-002316EN-5072-031511

Clamping Device

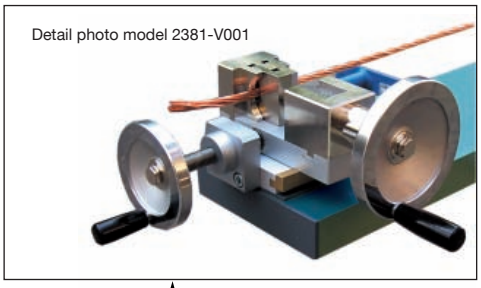
Model 2381
Model 2381-V001
Model 2382 L

Code:	2381 E
Manufacturer:	burster
Delivery:	ex stock/8 weeks
Warranty:	24 months

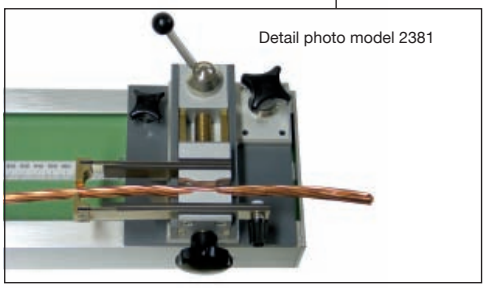
2381-E



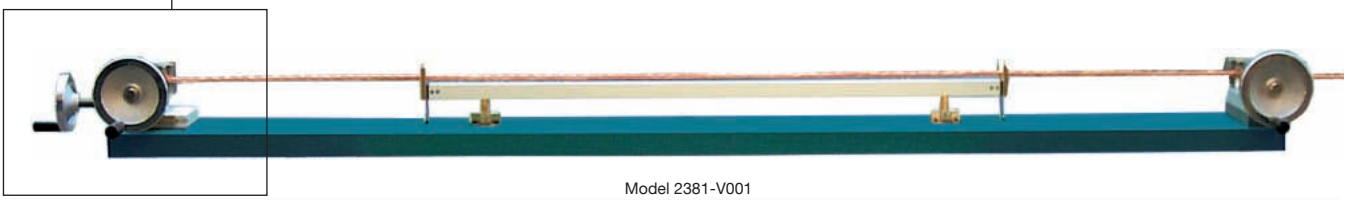
Model 2381



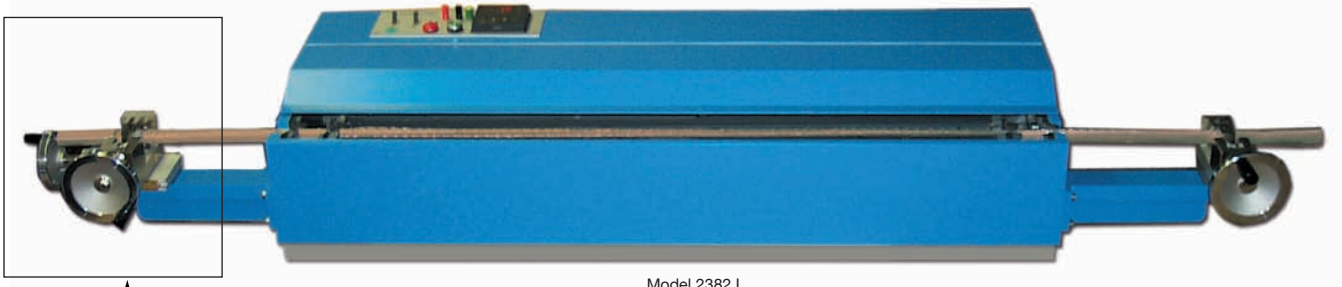
Detail photo model 2381-V001



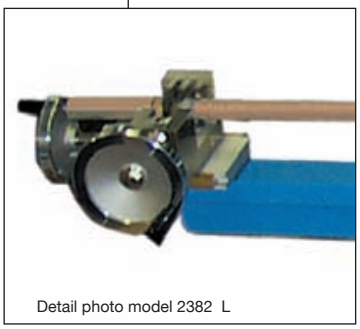
Detail photo model 2381



Model 2381-V001



Model 2382 L



Detail photo model 2382 L

During the manufacture of wires, rails, cables and sector conductors, the electrical conductivity respectively the resistance must be checked for compliance with specified values.
In conjunction with a digital ohmmeter of the RESISTOMAT® series, the clamping devices are used in the cable industry for production monitoring and quality assurance.
As most of the materials used have a very high temperature coefficient, e.g. copper 3,93 ‰/$_K$ brass 1,5 ‰/$_K$, a precise recording of the test unit´s temperature during measurement is of particular importance.
Needless to say, the clamping devices described are equipped with 4-conductor technology, thus eliminating lead and contact resistances.

Clamping Device Model 2381

With the help of clamping device model 2381 and a milliohm- or microohmmeter of the RESISTOMAT® series, the ohmic resistances of test cables and material samples in the shape of cords or strips can be measured. Fields of application include production monitoring, quali-ty assurance and general test measurements.

Model 2381 consists of a robust, warp-resistant, light-metal rail with one movable and one rigid clamping device. It allows the measurement of samples 50 to 1000 mm long. The clamping device is designed to accomodate cable cross-sections of 0.1 mm² to approx. 100 mm². For larger cross-sections, the distances between current feed and potential tap must be increased in order to ensure a uniform current distribution.

Adaptation to the diameter of the test unit is carried out through a coarse adjustment of the clamping jaws. The quick-action clamping device allows the test unit to be clamped rapidly and securely in one single movement.

Optional Features

The clamping device can always be supplemented with the guide rail model 2388 shown in the illustration. This rail offers major advantages. It serves as a support and guidance for the test samples. In addition, it offers protection against draughts, thus preventing rapid changes in the temperature of the test objects. These advantages are particularly noticeable in the case of small cross-sections which, due to their low heat capacity, react to the slightest draught. Although thin test units sag only minimally even without a guide rail, the increase in length due to this sag is often significant enough to cause errors in the measurement results.

A sensor block is integrated into the guide rail. With the help of the temperature sensors model 2392 resp. 2391, the temperature of the guide rail resp. the sample material can be recorded and compensated appropriately by the measurement device.

Technical Data

Adjustable clamp support:	measurement length of up to 1000 mm
Test unit cross-sections:	ranging from 0.1 mm² to approx. 100 mm²
Current connections:	designed for 100 A
Potential tap: routed to 4 mm standard device terminals via material with low thermoelectric power.	
Dimensions (height x width x depth):	1300 x 120 x 150 [mm]
Weight:	approx. 8.5 kg

Order Information

Clamping device	**Model 2381**
Guide rail	**Model 2388**
1 set interchangeable contacts for the potential tap	**Model 2390**
Connection cable for RESISTOMAT® models 2304, 2320, 2323, 2316-V000X with 4 banana plug, 2 m length	**Model 2381-K003**
Connection cable for RESISTOMAT® models 2329, 2316-V000X with 5 pin bayonet plug, 2 m length	**Model 2381-K006**

Clamping Device Model 2381-V001

The clamping device model 2381-V001 is designed for cross-sections of 1 ...1500 mm².The measurement length is 1000 mm. A uniform current distribution is ensured by the distance between current and voltage tap. The clamp support is laterally adjustable by means of a spindle so that the immersed test unit can be stretched. This is particulary advantageous in the case of large cross-sections.

Technical Data

Measurement length:	1000 mm
Clamping device:	designed for cross-sections of 1 ... *1500 mm²
Distance between voltage tap and current feed:	420 mm
Connection cable:	2 m length with 4 banana plugs
Dimensions (height x width x depth):	approx. 170 x 2100 x 250 [mm]
Weight:	approx. 25 kg

Order Information

Clamping device	**Model 2381-V001**

Clamping Device Mode 2382 L

The clamping device model 2382 L can be used to check during production or in the test bay the electrical conductivity respectively resistance of wires, rails cables or sector conductors for power cables. The measurement length is 1000 mm. The clamping device is designed for cross-sections of 1 ... 1500 mm².

Detailed investigations and long experience have shown that particulary in the case of larger cross-sections, precise temperature measurement is only possible in a liquid medium.

Model 2382 L is equipped with a water bath which temperature is controlled with an integrated thermostat.

The integrated circulation pump ensures a uniform temperature distribution in the water bath. The specimen´s measurement length of 1000 mm is immersed entirely in a liquid medium (water). The digital ohmmeters of our RESISTOMAT® series correct the measurement value display automatically to the VDE value at 20 °C.

A uniform current distribution has been ensured by fitting quick-action vices outside the bath. The clamp support is laterally adjustable by means of a spindle so that the immersed test unit can be stretched. This is particularly advantageous in the case of large cross-sections.

Technical Data

Measurement length:	1000 mm in a temperature-controlled water bath
Clamping device:	designed for cross-sections of 1 ... *1500 mm² Constant water temperature ensured by a two-position controller and an integrated circulation pump. Precise temperature measurement with an integrated sensor.
Operating range:	25 °C ... 60 °C, tolerance ± 0.5 °C The distance between the potential tap and the current feed can be adjusted between 400 and 800 mm in relation to the cross-section.This ensures an adequate current distribution even in the case of large cross-sections.
Current connections:	designed for 100 A
Output of the integrated heating filaments:	2 kW
Voltage supply:	230 V, + 6 % -10%
Mains frequency:	50/60 Hz
Power consumption:	approx. 2.2 kVA
Device protection:	EN 61010
Weight (without water):	approx. 80 kg
Dimensions (height x width x depth):	0.3 x 2.10 x 0.75 [m]
without wire holder	0.3 x 1.33 x 0.5 [m]

Order Information

Clamping device	**Model 2382 L**

Clamping Device Model 2382 A

The clamping device can be integrated in the stranding machine. A good fixation of the wire is therefore assured. So the clamp jaws, as included in the 2382 L, are not necessary.

Technical Data

See model 2382 L, but without clamp jaws. The measurement current connection happens directly by the stranding equipment.

Order Information

Clamping device	**Model 2382 A**

* Option 2500 mm²

Application

Control and Quality Inspection of Power Cables or Singular Wires during Production by means of a RESISTOMAT® 2304 and Clamping Device 2382 A

Application

The optimal quality control for production of singular wires and power cables is done with a test directly in the stranding machine. The components RESISTOMAT® 2304, clamping device 2382 A and a lifting table make a measurement of a sample length possible during production, however only with a temporary stop of the stranding machine.
The machine guide has the option to adjust the compressor according to the measurement result in order to optimize the cable diameter.

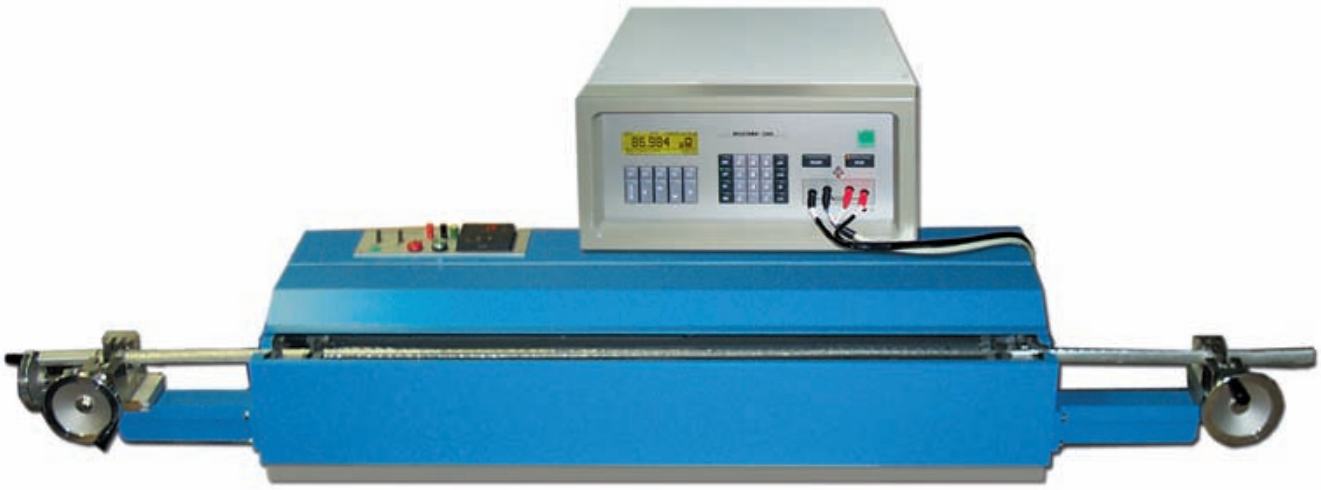
Due to the integration of the measurement system straight in the stranding machine the production process is supervised and therefore fulfils the requirements of ISO 9002. The single measurement values can be registered on a PC or by printout on a printer.

The ISO 9002 - verification level production - ranges of course on a considerably higher level in relation to the ISO 9003 - verification level end product - where the testing is effected on meter probes after the production of the batch (with RESISTOMAT® 2304 and clamping device 2382L).

Description

Before a measurement can be done, the twisting machine must stop and the lifting platform carrying the measurement basin rises to make contact with the specimen. The exact altitude positioning is effected by limit switches on the lifting platform. The contact to the cable happens with spring-mounted potential taps at a distance of 1000 mm. During the whole measurement the cable stays inside a temperature-controlled water bath.
A circulation pump ensures a uniform temperature distribution within the water bath and re-circulates the water flowing out through the bulkheads.

The water bath is heated and maintained by a thermostat at a temperature as close as possible to that of the test object. This cares for a very short temperature equalizing time of the test object and thus for a fast and very accurate measurement value. The determination of the water temperature is effected with an accurate Pt 100 sensor. The water temperature is necessary for the temperature compensation in the RESISTOMAT® which calculates the so-called VDE value at 20 °C.



Calibration of the Measuring System

Our series 1240 calibration resistors are designed for calibrating and testing the resistance measurement device. Each resistor is delivered with a works test certificate. Technical details are provided by data sheet 1240-E.

On request, the resistor can be delivered also with a DKD Calibration Certificate. This certificate documents compliance with national standards for displaying physical units in agreement with the international SI system.

As the temperature of the conducting cable directly influences the measurement result, the temperature of the water bath measured and displayed by the RESISTOMAT® 2304 must also be checked. A calibrated thermometer with DKD Certificate can be used for this purpose.

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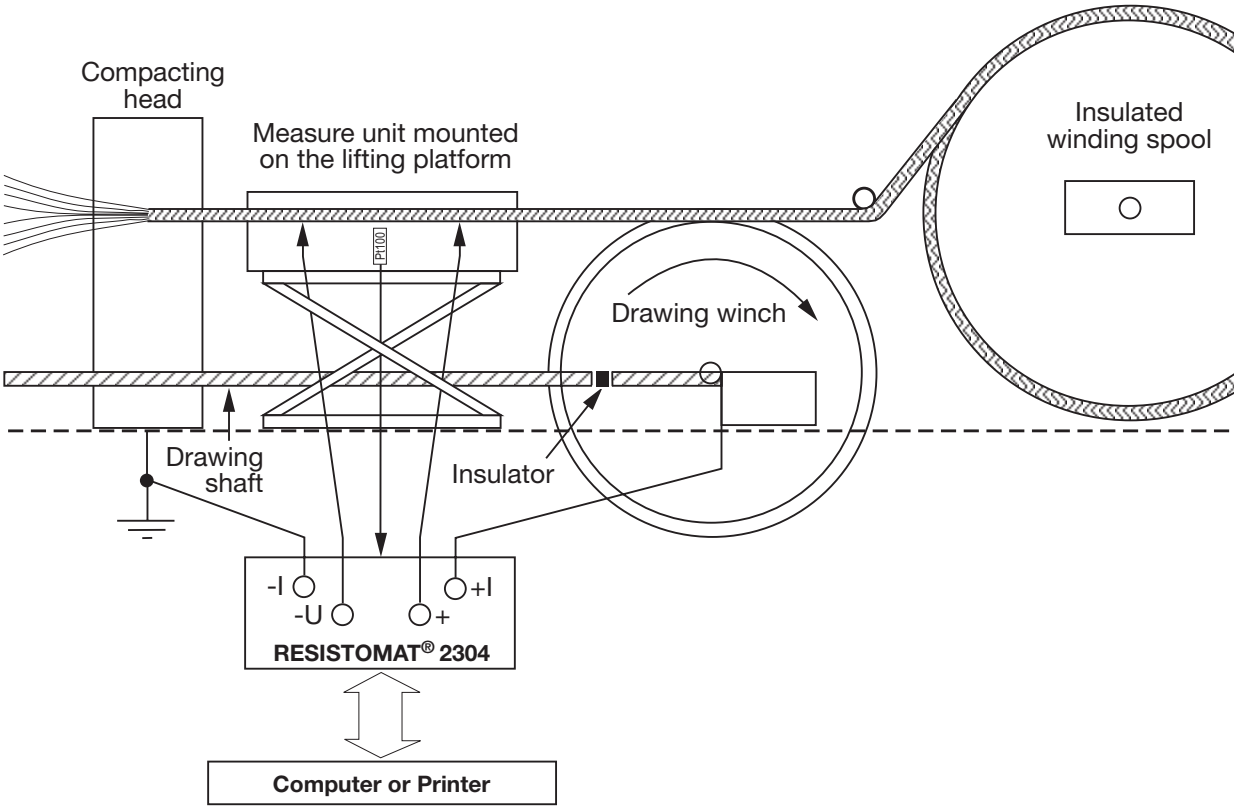
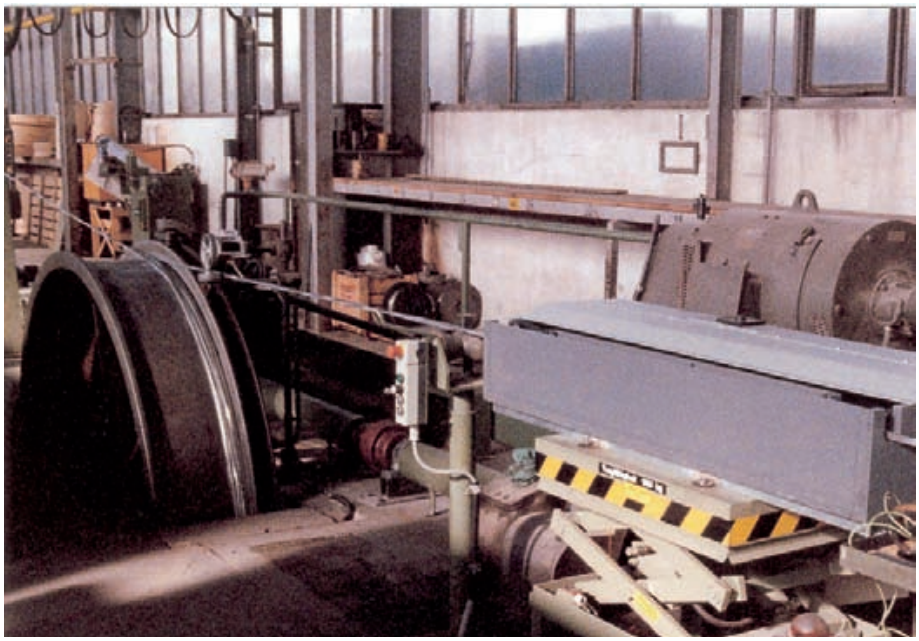
Structure

No special terminals are required for routing the measurement current through the conducting cable. The current is routed directly through the cable via the compacting head at one end and the drawing winch at the other. The lifting platform with the measurement basin is assembled between these two machine components. Of course, one prerequisite must be fulfilled for measurements to proceed correctly:
The drawing winch as well as the cable guides and winding units following it must not be electrically linked with the remaining machine components on the side of the compacting head, or the resistance of the electrical link must be high enough to render it insignificant as a shunt to the cable section which is to be measured. In other words, this resistance should be about 1000 times larger than the line resistance between the compacting head and drawing winch.



The RESISTOMAT® 2304 has not necessarily to be mounted directly at the clamping device 2382 A. The instrument can also be placed at the general control elements of the machine.

Clamping device model 2382 A with lifting platform and hand control unit



德國 RESISTOMAT®

精密電阻量測的專家

burster

桌上型高精度微阻計 Model 2304

- 量測範圍從200μΩ到20kΩ。
- 解析度為1nΩ(1X10^{-9}Ω)。
- 量測精確度≤0.01 %。
- 具自動量測範圍的功能。
- 溫度補償計可以適用所有材料。
- 熱電動勢補償。
- RS232及RS485使用介面標準。

桌上型微阻計 Model 2316 應用實驗室及生產線上電阻量測領域

- 量測範圍從2 mΩ到 200 kΩ。
- 解析度為0.1μΩ(0.1 X 10^{-6}Ω)。
- 量測精確度可達0.03 %。
- 具自動量測範圍的功能。
- 溫度補償計可以適用所有材料。
- 熱電動勢補償。
- 輸入電壓保護高達400Veff。

高速量測型微阻計 Model 2329 因應自動化產線需求 可以提供快速量測電阻服務

- 量測範圍從200 mΩ到200kΩ。
- 解析度為10μΩ(10 X 10^{-6}Ω)。
- 量測精確度為0.03%。
- 具有自動量測範圍功能。
- 高達50筆/sec的量測值。
- 具備所有材料的溫度補償功能。
- RS232及PLC使用介面標準。

微阻計專用測棒或夾具

可攜式微阻計 Model 2323

- 量測範圍從600μΩ到60Ω，共分6種檔位測值。
- 解析度為0.1μΩ(0.1 X 10^{-6}Ω)。
- 量測精確度為0.2%。
- 量測電流可達10A。
- 輸入電壓保護高達415Vrms。
- 四線式量測設計。
- RS232的數據輸出。
- 可以使用充電電池。

掌上型微阻計 Model 2320

- 測量範圍從40mΩ到4kΩ。
- 解析度為10μΩ(10 X 10^{-6}Ω)。
- 量測精確度為0.05%。
- 具溫度補償功能。
- 輸入電壓保護高達415Vrms。

導線測試用夾具 Model 2381

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PRO-PII TECHNOLOGY CORP.
The Best Testing & Measuring Solution Provider

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