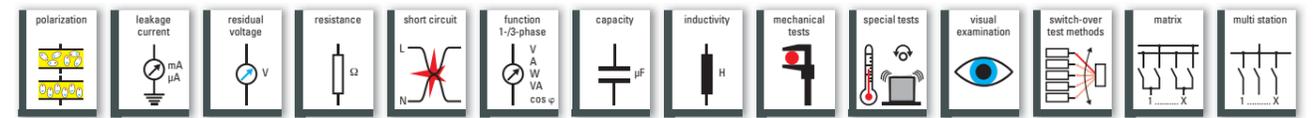
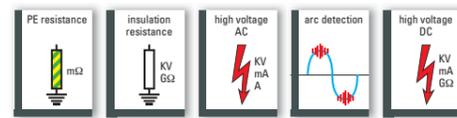


**Innovative Testing and
Measurement Technology**
for electrical safety and functional tests





Universal Windows®-operated safety and functional tester

- RS232
- USB
- CAN
- GPIB
- Ethernet
- DeviceNet
- Profibus
- I/O
- SPS
- Print



GLP3 in 19"-cabinet as system solution



GLP3 in rolling container for testing electro-medical products



GLP3 in 19"-cabinet with deposit table



GLP3 in 19"-cabinet with printer compartment

Highlights

- fast, high-precision measurements and evaluations via DSP (digital signal processor)
- single-phase and three-phase functional tests up to 500A
- ideal for complex test stations
- extendable by automatically switchable PE and high-voltage matrix points for building complex testers with 2...150 and more connections
- integrated PC with Windows XP® or Windows 7®
- database for millions of test programs and test results
- extensive statistical evaluations
- print-out of test protocols and labels on thermal-transfer printers
- bar-code reader and automatic generation of labels
- the GLP3 can be operated in complex PC networks
- data exchange with ERP systems
- optimum pre-conditions for OEM applications for an easy integration into automatic lines
- remote maintenance and remote calibration

Our premium-class Windows®-operated GLP3 testers for testing a variety of complex products are preferably used for testing electric motors, electronic components, run-in testers, power-supply testers, transformer testers, cable testers, household appliance, etc.

After connecting all connections of the test object, the tests are performed automatically via an internal switch-over of the connections and of the test methods. There is an automatic evaluation test step by test step. After the test process has been completed, you will receive a reproducible GO or NO GO result.

As one of the first manufacturers of testing devices, SCHLEICH incorporated PCs for measurement, control and storage into the testers of the GLP3 family. The extensive experience of our technicians and engineers provides the user with a sophisticated test system with extensive software. Both, hardware and software are made by SCHLEICH. Owing to the continuous enhancements of our products, we are leading in the area of measurement technology. Software and database are designed with the latest Microsoft® technology. The user has a clear and structured overview of the test – whereas the operator can avail himself of extensive input and configuration features.

For a perfect quality assurance, the tester is equipped with an extensive statistical analysis. With a great number of different protocols, you can document the tested quality of your products.

The testers are designed and manufactured according to your requirements. The necessary test methods are selected from a large pool of possible test methods. The design can vary: manual or automatic testing – single, dual or multiple test stations – with or without test covers or test tables or testing in automatic production lines. The extraordinary flexibility of our hardware and software puts us in a position to supply you with a tester perfectly matching your requirements at a reasonable price.



GLP3 in rolling container with complex system solution



GLP3 transformer-heating tester in 19"-cabinet with power meters and connection panels



GLP3 in 19"-cabinet as system solution with rotary table and handling



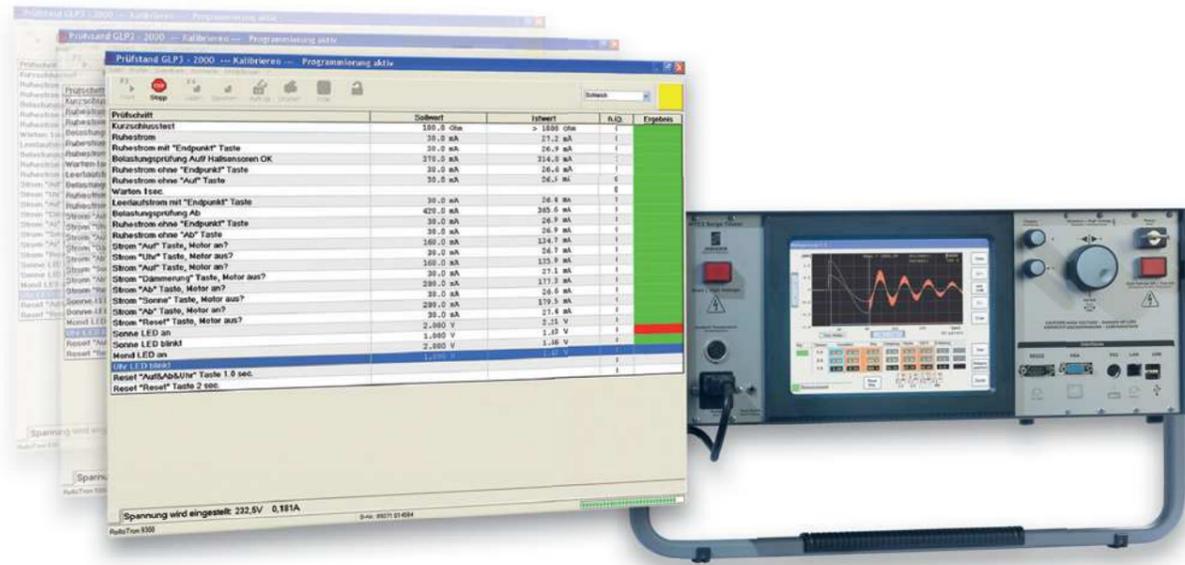
GLP3 as module tester

Refer to:

Windows® software	62
Windows® networks	64
Windows® data exchange	66
HV pistols and warning lamps	68
Mains-connection adapters	70
Contacting devices for leads	72
Special contacting devices	74
Test covers	76
Rolling tables	78
Calibration and black boxes	82
System solutions	86
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Test software for Windows® testers



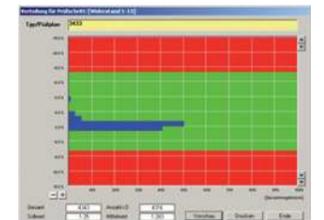
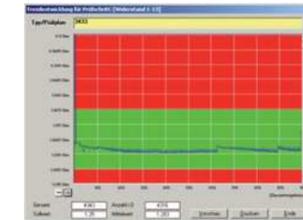
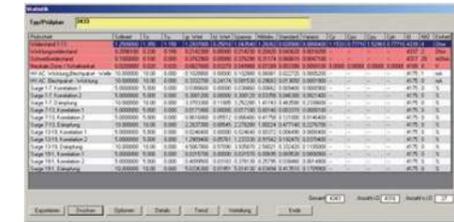
Input

For editing test steps, it is not necessary to open a separate test-program editor. For editing individual test steps, it is sufficient to click on the test step in order to be able to change parameters and adapt the tests. An integrated user-profile management makes sure that only authorised personnel can edit the data.

Data

Test programs and test results can be stored in Access®-database format either locally on the tester or on a central server on the network.

A standard feature of our Windows®-based testing devices is the operation of any number of testers in a network. The individual testers store their results on a central database. Always using the



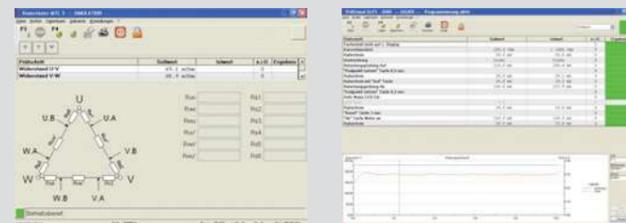
Database

Informative statistics can only be generated from a large basis of test results. For the design of our Windows®-based testing devices, we have, therefore, put great emphasis on a comfortable storage

Highlights

- intuitive operation
- clearly structured test sequence/logic GUI
- testing without special knowledge
- integrated information for users and operators
- input of test parameters without extra editor
- clearly structured input of test parameters
- based on Windows XP® or Windows 7®
- ideal for network operation
- high data security and long-term data storage
- connection to CAQ systems and/or ERP (Enterprise Resource Planning) systems
- extensive configuration options

Our test software is operated under Windows®. The easy-to-operate user interface facilitates controlling the test process, generating test programs, printing protocols, evaluating statistics and collecting data for the result documentation. Every Windows®-based tester we make offers the full functionality of our software.



The test process

The test process is indicated clearly structured. The status line at the bottom of the window instantly shows information about tested go / no go statements and allows to evaluate the quality of the product already during the test process.

In order to enable fast and fault-free testing, we have added pictures to all test steps with operator activities. Owing to the integrated operating instructions, the tester conforms to ISO9001.

same test programs for your products, you are thus able to assure the quality of your products worldwide and access the test results, no matter in which part of the world the branches of your company are located.

Through an easy connection to ERP systems, PPS systems or CAQ systems, our Windows®-based testers can perfectly be integrated into your factory planning and your production control.



Labels and test protocols

Labels and test protocols are normally needed directly after the test. Comfortable print programs enable an optimum configuration. With the programs cablabel®, BarOne®, BarTender®, Codesoft® or Easylab®, labels can be designed beforehand. With the test software it is possible to add pre-defined, test-related information automatically. The labels can be printed via one or more thermal-transfer printers.

At a later point, it is possible to generate further print-outs or test protocols out of the database – either at the testers or within a network at a workstation. If desired, the print-outs or test protocols can be adapted to the customer's layout.

of the test results over a long period of time. Freely configurable search filters allow every user to find the relevant data in the database quickly and easily. After that, you can either have an individual evaluation or a summary of the results over a certain period of time followed by a statistical evaluation. Trend indicators and Gaussian distributions give detailed information about the quality status of the production. Our testers can store your data on a daily, weekly or monthly basis. In addition, they allow to evaluate your data related to orders or lots.

The integrated export function allows the user to extract data from the database easily. This data can be entered into other databases or processed in Excel®. This enables you to create your own, separate evaluation.

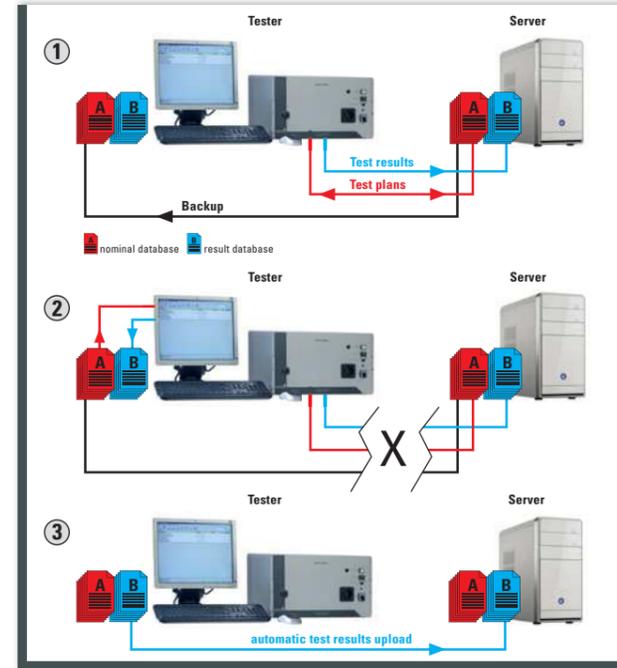
The database can be based on Access® or SQL. In case of large amounts of data or the application in a network, we recommend using Microsoft® SQL.

Refer to:

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MTC3 stator testers	50
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Windows® data exchange	66

Windows® networks

Networks with Windows® testers



- ① Every tester automatically stores local copies of the current test-program database of the server.
- ② Therefore, the tester can continue to operate in case of a possible network failure. The test results are stored locally.
- ③ After the network connection has been re-established, the tester transmits the test results automatically to the server, so that the server database is up-to-date.

Highlights

- central storage of test programs
- decentralized editing of test programs
- central storage of test results
- decentralized evaluation of test results
- working in global networks
- storage in Access®, Microsoft SQL®, Oracle®, etc.
- automatic local storage in case of a network failure
- automatic data synchronization after a network failure
- fast statistical calculations on the server
- ideal remote-maintenance features

Networking + IT

SCHLEICH's Windows® testers are instantly ready to be used in networks. Test programs and test results can either be stored locally on the tester or on a central server, granting high data security and optimum data exchange between different systems. Windows® testers made by SCHLEICH can ideally be integrated into the infrastructure of your server and are the ideal platform for collecting, managing and analyzing your data.

For your database, we are using common and well-proven technologies from Microsoft® and other manufacturers.

Our testers can easily communicate with ERP systems, PPS systems and CAQ systems. For all requirements, we offer customer-oriented standard solutions.



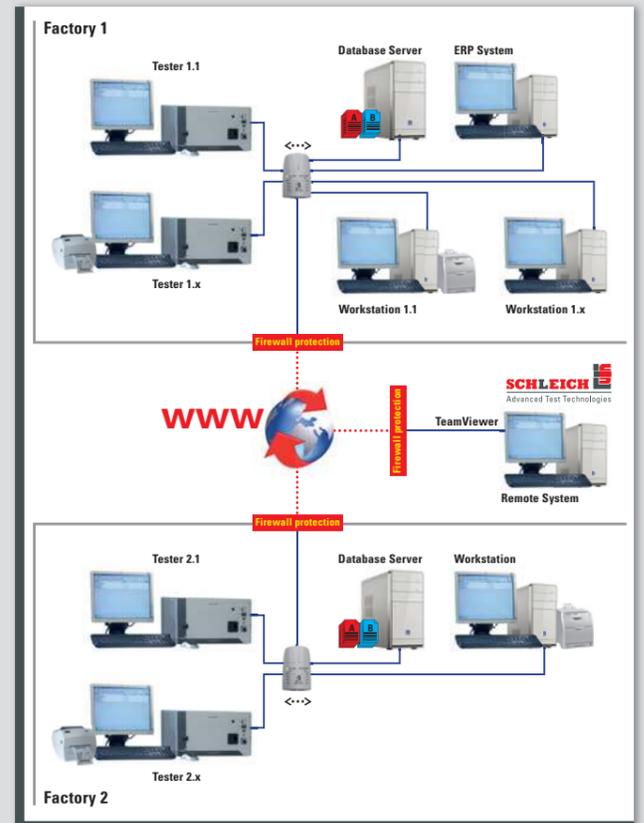
Global and complex network structures

Our Windows®-based testing devices can be operated in the most complex network topologies. You can install any desired number of testers at different locations all over the world. All testers will access a central server database for test programs and test results. Our extensive experience with the global networking of our testing devices provides you with the certainty that you can always offer the same product quality, no matter which production site the product comes from.

It goes without saying that all work related to test programs, printing, labels and statistics can also be performed at the individual testers. In order not to interfere with the production process, however, it is recommended to use separate workstations. The workstations operate with the same software as the testers, which guarantees an extremely comfortable operation.

Label data can also be stored centrally on a server. After testing, the tester loads the label data matching the respective test program and transfers the data to a thermal-transfer printer. You can design the labels as desired.

If necessary, we can access your network temporarily for remote maintenance. We can establish a connection to a certain tester and view the screen from our location. If you allow access, we can also control the mouse and the keyboard of your tester. It goes without saying that any such work will only be carried out with your agreement. In addition, it will always require a separate release from your side.



Refer to:

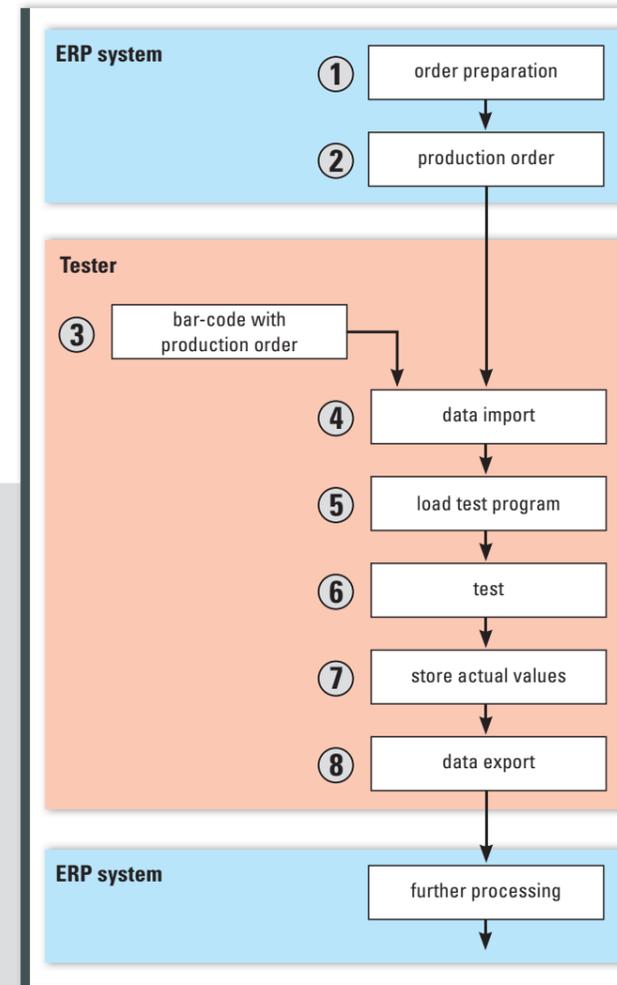
GLP3	36
MTC2	48
MTC3 stator testers	50
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Windows® data exchange	66

Windows® data exchange

Data exchange at Windows® testers



The picture shows the example of a typical application controlled by an ERP system.



- ① The customer order is included in the production planning by means of the ERP system.
- ② With this data, the ERP system generates a production order and adds the data, the testing device needs for the test, e.g. type name and/or the definition of the test program, serial numbers, quantities, label data or parts lists. This data is either stored in a database or in file format for the tester on the network.
- ③ At a manual test station, before the test can be started, the operator reads off the number of the production order (e.g. in the form of a bar-code) from the production documents. At automatic test stations within a production line, this information can also come from the line control or from mobile data carriers on the pallets.
- ④ After this, the data-import software of the tester evaluates the data received. The software imports necessary information for the test process from the data generated by the ERP system.
- ⑤ The test program matching the production order is loaded from the database of the tester. Under the pre-condition that the ERP system has also transmitted parts-list information regarding the partial tests, the test program can also consist of several partial tests. In addition, the ERP system can transmit set values and tolerances, which are added to the test program at the respective points. This way, you will have a test program that matches your production order precisely, without the operator having to enter or select any values.
- ⑥ The test is performed according to the generated test program.
- ⑦ The tester stores the detected actual values either locally or in a database on the network. With the data you can generate a protocol and/or print them on a label. The label can contain both, test results and additional data from the ERP system.
- ⑧ Finally, it is possible to transfer finish messages, results, date/time, operator name and quantities back to the ERP system. On top of that, it is possible to send test results to CAQ systems in order to create further evaluations and analyses.

Highlights

- data exchange with various ERP (Enterprise Resource Planning) systems
- configurable tools for data import
- configurable tools for data export
- exporting data to CAQ (Computer Aided Quality) systems
- exporting data to PPS (Production Planning & Controlling) systems
- exporting data into CSV files
- exporting data in Excel®
- exporting data in databases of your choice

Testers often need interfaces to other systems. We offer solutions for a great variety of applications.

Typical applications:

- reading-in production orders from ERP systems
- automatic generation of test programs from the data of the production orders
- automatic generation of serial numbers from the data of the production orders
- transmission of results and counter values to ERP systems
- receiving label data for printing labels
- filtering and transmission of data to statistical evaluation systems
- transmission of the results of safety tests to long-term archiving systems for product liability
- communication with other test systems, line controls, etc.
- communication with special systems in the automotive industry

In order to meet the requirements, we developed configurable standard-software modules. This reduces the work for integrating the tester into your IT system to a minimum.

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HV pistols and warning lamps

HV test pistols | safety equipment | test probes



Warning lamps and result lamps

Warning lamps serve to indicate, whether the test object is connected to voltage or not.

Result lamps indicate the overall test result of the test process. Customer-specific special displays, which can be controlled by the tester, also belong to our extent of delivery.

Resistance test probe

With the probes for the resistance test, the resistance to be measured is detected in 4-wire configuration.



Resistance test probe in 4-wire configuration



Test probes for the armature test



Warning or result lamp



High Voltage

For a secure manual high-voltage test, safety test pistols are required. There are various designs depending on the level of the test voltage. For convenient handling, we offer test pistols with integrated start function. The high-voltage test does not start before activating the switch.



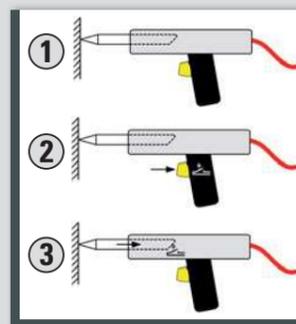
High-voltage test probe up to 1500V safety-current limited



High-voltage connection lead



Test pistol up to 8KV AC/10KV DC



High-voltage test pistol without start function ①, with start function ②, with start via mechanical pressure switch ③



Test pistol up to 12KV AC/15KV DC



Adapter between test object and test pistol

PE test probes

PE test probes serve for contacting the PE connections manually. Test probes with integrated start function and colored LED can be used not only for starting the PE test, but also for starting the complete test process, for confirming test steps for visual examination and for confirming other messages.



Large PE test probe with integrated start function



Test probe with switch-over for limit values and test methods



Two-hand start



Small PE test probe



Test probe with start function



Safety chain with warning sign

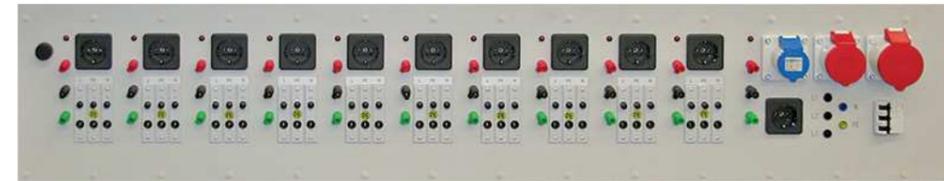


Barrier posts with warning lamps and emergency stop

Refer to:

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Mains-connection adapters



Mains-connection adapters for 13 test objects



3-phase connection box



1-phase connection box with quick-fastening clamps



Connection box for earthed plug

Highlights

- various standard contactings
- durable mechanical design
- universal sockets for different standards
- line-terminal adapters of all kinds
- lamp adapters
- quick exchange of wearing parts

Many test objects can be contacted via a Mains-connection adapters.

The operator inserts the mains plugs into the test socket of the Mains-connection adapters. The sockets can be either national and international standard sockets for single-phase or three-phase operation or standardized special sockets.

Mains-connection adapters can be equipped with more than one standard socket, so that the adapter can be used for various mains plugs.

For contacting free cable ends, the Mains-connection adapters can be equipped only or additionally with quick-fastening clamps.

We manufacture the Mains-connection adapters according to your requirements following a modular concept.

Of course, we also have the right solution for contacting terminal blocks or luster terminals.

In addition to mains terminals, the lighting industry also needs lamp-holder terminals. It goes without saying that we also offer suitable adapters.



Universal socket



Adapter between test object and high-voltage test pistol



Lamp adapter



Lamp adapter

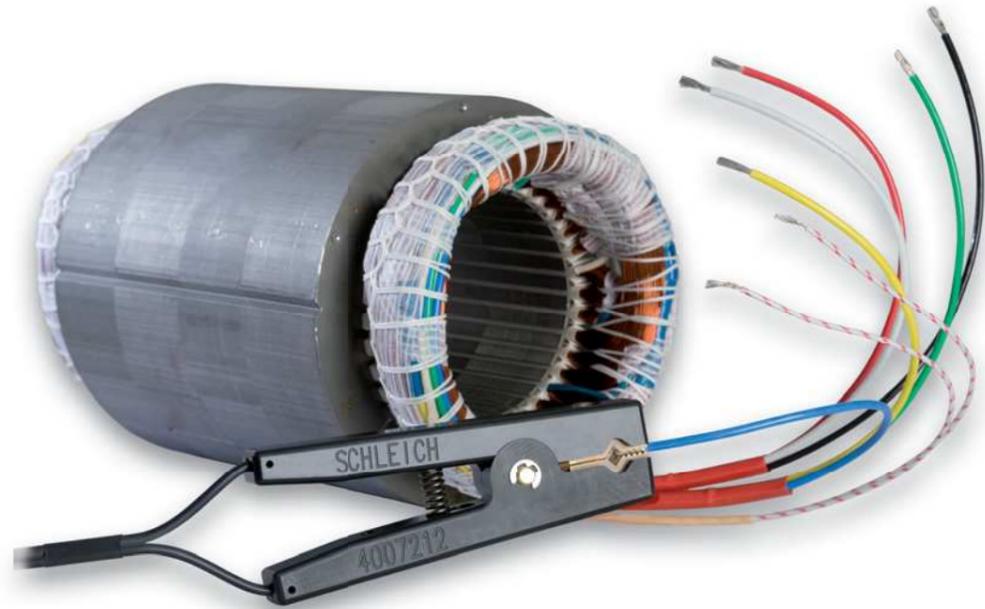


Clamp adapter/
luster terminal adapter

Refer to:

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Contacting devices for leads



Test objects often only have cable ends without any plug connections. Therefore, a typical task is the contacting of free cable ends.

For contacting free cable ends, we offer an extensive range of contacting units. They can be used, for example, for contacting the windings of stators, which can be designed in both, 2-wire and 4-wire configuration.

For the 4-wire resistance or voltage measurement, Kelvin clamps are used. Kelvin clamps are perfect to measure low resistance values with high accuracy. The 4-wire measurement compensates the contact resistances at the contact point.

The special design of our Kelvin clamps guarantees highest contact reliability, a solid grip and low wear-and-tear. For less demanding contactings, we use our multifunctional spring-terminal clamps.

Fast and easy contacting can also be realized via pneumatic terminal blocks. The cable ends are inserted into the hole of the pneumatic terminal block. An automatic clamping mechanism



Single pneumatic clamp in 2-wire configuration



Attachable pneumatic clamps in 4-wire configuration for a modular design



Connection box with pneumatic clamps in 2-wire configuration

Highlights

- large selection of standard contactings
- modular concept
- durable, long-life mechanical design
- 4-wire contacting units – Kelvin clamps
- 2-wire and 4-wire pneumatic clamps
- customer-specific solutions on the basis of our standard products
- quick and easy exchange of wearing parts



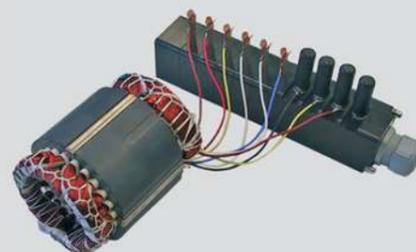
Terminal block, modular design



8 x Kelvin terminal block



11 x spring-terminal block



6 x 4-wire contact blades and 4 x spring-terminal block



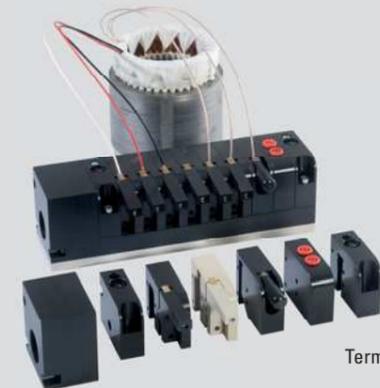
contacts the cable end. After the test, if the results are OK, all terminal blocks can be released automatically by the tester, so that all leads are instantly free. If the results are "not OK", this needs to be confirmed by the operator, before the clamps open.

The contacting units are available as single contacting units or integrated into a terminal block.

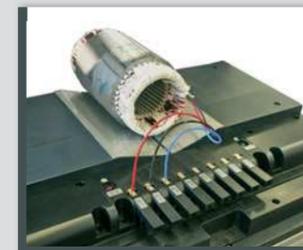
The terminal blocks can either be firmly installed within a test cover or they are moveable within the test area, which has the advantage that they can always be brought into an optimum position for connecting the leads.



Block with Kelvin clamps with automatic release



Terminal block, modular design



Kelvin contacting device in a test cover with prism



Small, medium and large Kelvin clamps

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Special contacting devices

Special contacting devices | contacting of motor terminal plates

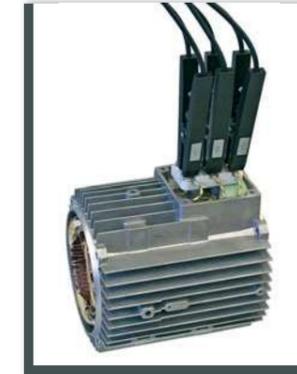


Plugs for motor-terminal plates

Every manufacturer of electric motors is familiar with the time-consuming contacting of motor-terminal plates. Without the respective contacting device, however, the motor cannot be tested. SCHLEICH offers a variety of contacting methods, saving you a lot of time.

We have designed special plugs for motor-terminal plates that are very easy to handle. They are equipped with collets that grip every stud of the motor-terminal plate individually granting a stable contact. After the plug has been attached, the collets are locked with a lever. The contacting of the frame has also been integrated into our plugs for motor-terminal plates.

We make plugs for motor-terminal plates for any number of connection studs and for various dimensions. Our plugs for motor-terminal plates are also available in 4-wire configuration, worldwide unique, allowing you to measure extremely low resistances with the highest accuracy.



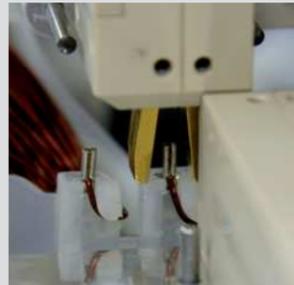
Individual Kelvin clamps for motor-terminal plates



Plug for motor-terminal plates

Highlights

- durable mechanical design
- 2-wire or 4-wire contacting devices
- high-current contacting devices
- special solutions for manual contacting
- special solutions for automatic production lines
- contacting devices for handling systems
- Kelvin clamps suspended movably, allowing automatic contacting in various positions
- spring-loaded testprobes in 2-wire and 4-wire configuration
- plug for motor-terminal plate in 2-wire and 4-wire configuration
- quick and easy exchange of wearing parts



Contacting of contact pins with Kelvin clamps



Contacting of contact pins with Kelvin clamps

Special contacting devices

SCHLEICH's strength lies particularly in the adaptation of test objects and their special contacting devices. Tester and mechanical components are manufactured to match your testing task precisely. We often use pneumatically controlled, extremely small Kelvin clamps or resilient contactings from our product range that follows a modular principle.

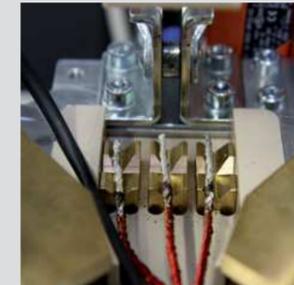
The design is performed at in-house 3D-CAD workplaces. State-of-the-art CNC machines guarantee the production of professional long-life components at low prices.



Basic contacting on a pallet



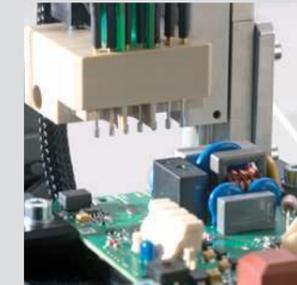
Special solution / contacting unit for leads



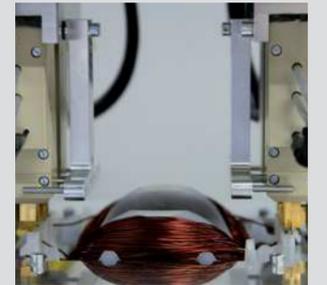
Contacting of motor-connecting wires



Contacting a test object from the top



Contacting of a PCB



Contacting of contact pins with Kelvin clamps



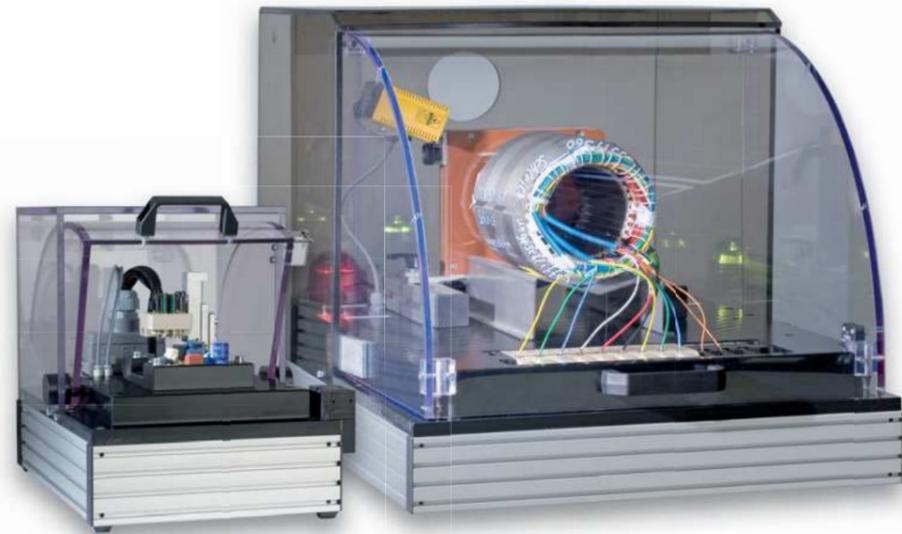
Contacting of clamps and plugs of all kinds

Refer to:

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Test covers

Test covers and test tables



Highlights

- many different types of standard test covers
- durable mechanical design
- sufficient room for clamps and contacting devices
- automatic start after closing the test cover
- immediate interruption when opening the test cover during the test
- CAT IV-compatible safety limit switches
- optional locking of the cover or automatic opening and closing
- transparent test cover for visual control during the test
- test tables for a wide variety of applications
- special solutions for automatic production lines

The main task of our test covers is to guarantee the safety of the operator. According to standards, the operator is protected either via forced touch-guard or via a light barrier. An additional warning lamp indicates, whether the test object is under test voltage or not.

Depending on your testing task, we will either use test covers from our standard range of products or, if necessary, we will design and manufacture special test covers exactly meeting your requirements.

Single test covers



Small test cover with a GLP1e-HV



Typical hinged test cover



Test cover with special contacting device



Single test cover installed on a rolling container



This test cover can be opened and closed easily and remain in any desired position

Dual test covers



Dual station with sliding cover



Dual station with 2 single covers

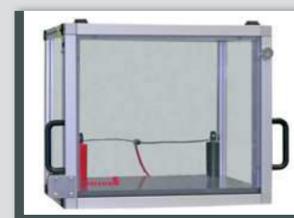


Dual station of a bonding machine installed on a rolling container



Dual station with MTC3 in 19"-cabinet

Test covers for extra-high voltage



Test cage 30KV



Test cage for material testing up to 40KV



High-voltage test station up to 20KV for electronic modules



High-voltage test station up to 40KV

Special solutions



Test table with light curtain



Single test cage and work table with deposit tables at the sides and GLP2



Large test cage with front door



Large test cage with conveyor belt, light curtain and side doors with pneumatic control

Test tables



Test table for stators with prism and a magazine for the test leads, which can be moved along the front side



Workstation for testing distribution boxes – protection through two-hand start

Refer to:

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Rolling tables



Rolling table with sloped table board and integrated HV test



Rolling table with sloped table board and drawer element



Rolling table with sloped table board, drawer element and cable holders

Highlights

- solid design / made of aluminum profiles
- steplessly adjustable table boards
- horizontal or sloped table boards
- sloped table board with horizontal front part, e.g. for a keyboard
- drawers with full extension, steplessly adjustable in height
- holders for test probes, steplessly adjustable in height
- holders for test leads, steplessly adjustable in height
- integrated LED warning lamps in the side bars – protected design
- the rolling tables are delivered completely mounted and ready-to-use

Rolling tables are ideally suited for transporting a tester or a combination of a tester and a test cover from one test object to the next. The large and stable rubber castors guarantee a good maneuverability. The optional handle at the front of the table is used for pushing and steering.

The rolling tables can be equipped with fully-extendable drawers, where you can store, for example, adapters, tools or documentation.



Rolling table with horizontal table board and handle



Rolling table with horizontal table board, handle and LED warning lamps integrated in the side bars



Rolling table with integrated test cover, handle, LED warning lamps in the side bars and holders for cables, test pistols and test probes



Rolling table with integrated test cover, drawer element and cable holders



Refer to:

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Black boxes

Black boxes are used for the daily check of your testing device. They are connected to the testing device and it is checked, whether the measured values match the values of the black box. If the values do not match, the tester is disabled. The tester will only be enabled after a black-box test with a "GO"-result. We only deliver testing devices with digital evaluation. Therefore, this test is not performed with a "GO / NO GO black box". We are using only one black box and evaluate the measured values within narrow tolerance limits.

Every black box consists of one connection for the tester and one or more resistances and/or inductivities. They can be designed either for one test method or for a combination of several test methods.

Every black box is delivered with the resistance values indicated and with a calibration certificate. This enables the operator to adjust the tests correctly.



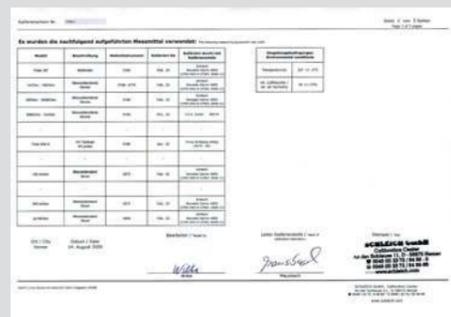
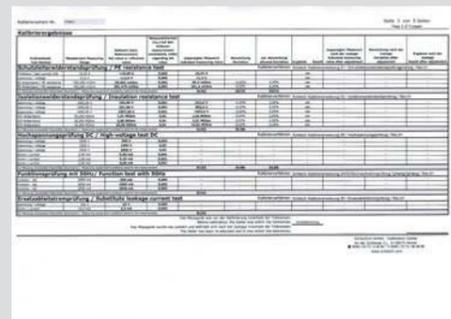
Black box for PE



Black box for PE/IR/HV



Black box HV for test-pistols



Calibration

For every company, the monitoring of the test equipment is very important. The regular calibration of your test equipment is an important pre-condition for assuring the quality of your products. Therefore, we calibrate the test equipment of our customers according to standards.

We offer three types of calibration:

- "In-House Calibration" means, we calibrate at the premises of the customer.
- "At-SCHLEICH Calibration" means, we calibrate in our factory.
- "Remote Calibration" means, we support the calibration in your factory via remote maintenance.

Calibrations are performed within the shortest possible time. If necessary, we can provide testing devices on loan for the duration of time we need for the calibration. If required, we can also calibrate devices from other manufacturers – this can save you costs.

If the calibration shows deviating measured values, the test equipment is adjusted. The adjustment is part of our service and is included in the delivery extent of a calibration. A calibration certificate documents the measured values before and after the adjustment.

Our calibrations are based on international standards. Of course, our ISO9001-certified Calibration Center also works with additional standards, like DIN EN ISO 10012 "Requirements for measurement processes and measuring equipment".

Calibration resistors

In addition to measuring instruments, precise calibration resistors are necessary for the calibration of testers. The calibration resistors enable the respective test currents for individual test methods and test voltages.

The high-precision resistors withstand high temperatures and have a long service life. In order to dissipate the heat resulting from high test currents or long-time measurements, all our calibration resistors are delivered in special heatsink enclosures. In addition, the resistors have a low-capacity and low-inductivity design.

All resistors for high test currents and low test voltages are designed in 4-wire configuration.

Every resistor is delivered with a calibration certificate indicating the resistance value, which can be used for calculations.



Calibration resistor in 4-wire configuration



Calibration resistor, high-voltage proof

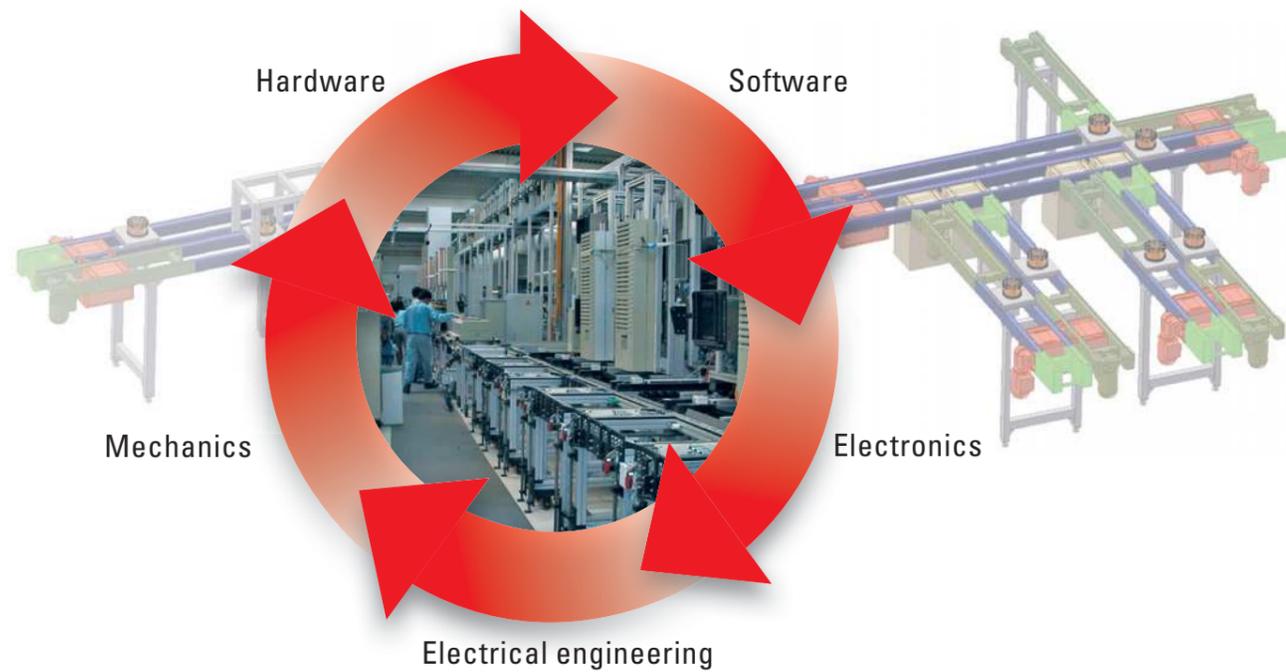


High-current resistor in 4-wire configuration

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System solutions



Combined with the respective mechanics, the testers of the GLP2, GLP3 and MTC3 family offer perfect conditions to be integrated into your production process as a system solution.

From testers to systems, from project planning right through to the commissioning – we offer full-scale service and adapt your system in all detail to your requirements.

A system solution can consist of a tester and test station with adaptation, of part of a production line or of a complete production line. For production lines we use customary standard automation components, which are equipped with the respective test stations and processing stations. Either the PC of the tester or a PLC is used as control unit for the line. The control software is generated by us. The part holders on the pallets for the production lines are also designed and manufactured by us.

Our concept for the storage of data is particularly suited for complex system solutions. Within an extensive production process with various test stations, individual testers can perform tests from production step to production step. Under the pre-condition that the product or the pallet is clearly marked with a serial number, the individual test results are stored together with this serial number in the central database. When the production has been completed, all individual results of this product are available for further processing.



GLP3 tester with large high-voltage matrix

Highlights

- development and production of hardware and software in our own factory
- software development with Microsoft® Visual Studio
- in-house development and production of controls and mechanics
- design with ePLAN P8 and Inventor 2010
- machining centers for special parts
- decades of experience gained through many large projects



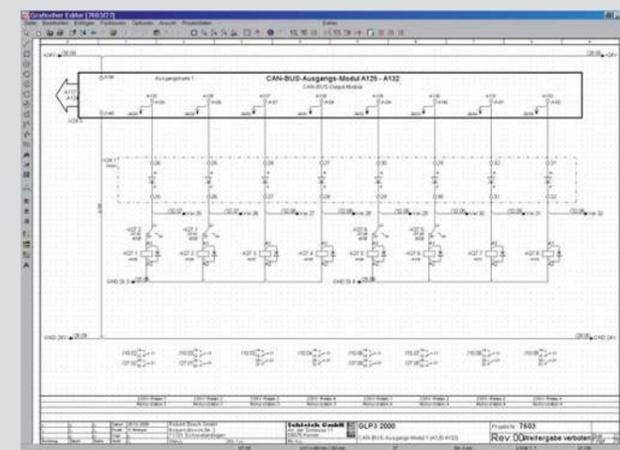
GLP3 tester for a motor test station, front and rear view



System solution for testing windings



Electrical setup of the tester



Designing electric diagrams with ePLAN

Refer to:

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System solutions

Examples for system solutions

Test system for testing air conditioning units for service cabinets

The production area is equipped with various testers at different production lines. The safety and functional tests are performed at various workstations within the production flow. All test programs and test results are stored on a central server.

All products are clearly identified via bar-code. Therefore, all results collected in the database can later be assigned to every single test object. This enables a perfect and complete documentation.

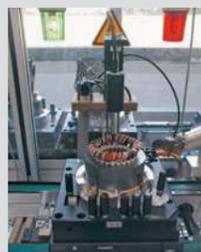


In addition to the safety tests, extensive functional tests are performed. Under live conditions, the complete operational area of every single air conditioning unit is checked and a great number of characteristics and operating points is detected and automatically evaluated. Owing to its optimized and extremely fast tester software, the functional tester is capable of managing and evaluating 4 test stations independently from each other at the same time.



Fully-automatic testing and bonding line for the production of vacuum-cleaner motors

The project consists of the complete line and the mechanics. Special work-piece carriers with stator-holding devices and contactings adapted to the test objects are made to customers' specification. At various test points, the pallets are automatically contacted via specially designed plugs.



Fully-automatic RunIn tester for frequency converters

The test system, consisting of a test table and testing electronics, is designed for testing electronic modules. For testing conditions as realistic as possible, the test table is set slightly vibrating.

A great number of testing fixtures can be controlled and monitored by one tester. In short time intervals, the tester collects, evaluates and stores various measured values for the duration of several hours.

We deliver RunIn testers for running in your products and for long-term analyses. For the duration of the test, all relevant features are monitored, analyzed and stored. If limit values are exceeded, the test process is interrupted automatically. All measured features are indicated graphically. After the test, it is possible to indicate all individual results. Special occurrences can be analyzed in detail via a the zoom function. The collected data can be stored in EXCEL® format. This enables you to do your own analyses.

Automatic functional test stations for electronic modules

Automatic functional-test stations serve to check your products thoroughly and find every single manufacturing error.

Our GLP3-Windows® testers offer a great variety of analyzing methods. When testing the products, electrical and other physical variables are measured and automatically evaluated.

Since the test systems delivered by SCHLEICH are mostly delivered ready-to-operate, our delivery extent, of course, also comprises mechanical holders for the test objects and the contacting devices adapted to the test objects.



Fully-automatic stator tester integrated in a production line

This project integrates a SCHLEICH tester into an automatic production line of a manufacturer of special machines.

The complete data exchange with the line control takes place via a PROFIBUS. The line control automatically selects test programs via the tester and sends back the results. Data carriers on the pallets serve to pass the information on to the next station.





Tester for avionics applications

These testers serve for testing electromechanical modules and electronic components from the aircraft industry. These test stations serve to perform extensive safety tests, electrical functional tests and complex water-hydraulic functional tests.

All systems are designed and manufactured by SCHLEICH. Especially in the aircraft industry, the requirements for testing, result documentation and the quality of the test equipment are extremely high.

With these projects, we were able to implement the interdisciplinary know-how of the SCHLEICH team impressively.



Fully-automatic production and test system for lamps

At up to 4 luminaires, the tester performs both safety tests and functional tests at the same time. For this purpose, the luminaires are contacted automatically at all relevant test points via special adapters. The contactings are controlled by the tester. Together with the controller of the robot, the tester is operated on one PC. On Windows® basis, the data is exchanged between the systems directly on the PC. For external communication with I/O components, CAN bus and DeviceNet are used.

Another special feature is the application of lamp simulators, which replace the functions of "real lamps" and, in addition, check the complete wiring for faults.

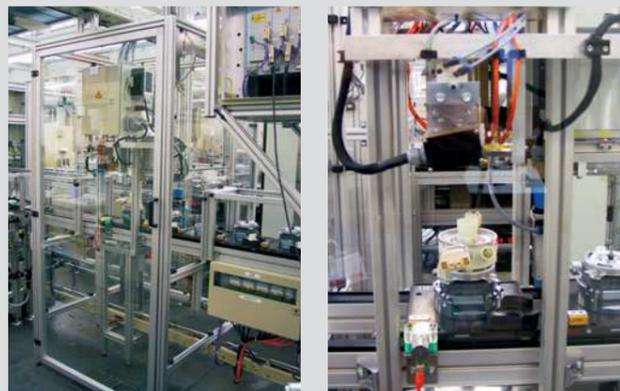
Safety and functional analyzer for 150 terminals

With this project, the complete wiring and function of a service cabinet (right side of the picture) is tested fully automatically:

- high-voltage test
- PE test
- insulation-resistance test
- ohmic-resistance test
- inductivity test
- capacity test
- medical leakage-current test
- three-phase functional test

For connecting the test object, the tester supplies 150 freely programmable, high-voltage clamps in 4-wire configuration. The test program consists of hundreds of test steps. Optimum operating instructions with many different instructions and repair messages allows to perform complex tests. In addition, many test steps are accompanied by digital pictures displayed by the tester. All test connections of the service cabinet are connected to the tester via approx. 15 adapters with greatly varying designs.

The touch screen, which can be adjusted in X, Y and Z direction, provides the operator with optimal operating features.



Fully-automatic production line for washing-machine pumps

All safety tests and many functional tests are performed at the washing-machine motors. The range of delivery comprises the complete test station and the automatic contacting at various points of the test object. The test system communicates with the line control. Once again, SCHLEICH has proven that not only single devices, but also complex system solutions can be realized.



Test station for small electric motors

This project consists of the tester and the complete testing and mounting unit for small electric motors – all “made by SCHLEICH”. The rotary table, where, for example, the tests are performed, is the heart of this system.



Automatic testing and bonding machine for electric motors with rotary table

This machine serves for bonding and testing motors. Before and after the bonding process, various tests are performed. The machine is loaded manually. Because of the required cycle times, a rotary table with three testing fixtures per station is used. At this machine, the tester serves not only for testing, but also for controlling all mechanical processes. For this purpose, our testers have a software module for PLC configuration, designed by us. The module enables a fast and cost-efficient integration of mechanical processes into the tester.

Testing and contacting unit for vacuum-cleaner handles

Various electrical safety and functional tests are performed at a vacuum cleaner handle with integrated operation. For testing the operating unit, pneumatic micro cylinders are used to simulate the fingers of the operator pushing the buttons of the handle.



Testers for the lightning industry with state-of-the-art pick-by-light adapter allocation

The main target of our customer was to reach an economic production quantity for lot size 1, which requires a suitable design of the work station. Owing to its flexible software, the SCHLEICH tester perfectly fits into the redesigned production process.

After the tester has clearly identified the luminaire via a scanner, the test program is loaded automatically. An optical signal shows the operator, which DUT (device under test) adapter to use for the test (pick-by-light method).

As soon as the adapters have been connected and the test area has been left, the test, which also includes high-voltage tests, is performed fully-automatically. Our lamp simulators allow testing without lamps. Light barriers ensure the safety of the operator.

After testing, the test station automatically prints labels containing all necessary data of the luminaires. Finally, all test programs and test results are stored centrally.



Water-hydraulic functional-test stations

Functional test stations for complex water technology combined with the measurement of various physical and electrical values also belong to our range of products.

On the basis of our successful Windows® testing software, it is possible to realize a great variety of test requirements. In addition to the test, the entire mechanical structure including water technology and the complex test-object adaptation are, of course, also part of the extent of delivery.



Tester for automatic roller shutter drives with video-camera evaluation

In addition to an extensive functional test with torque measurement, this application comes with an evaluation via video camera. The camera is used to check the LCD in connection with various functions. If, for example, the DCF77 time transmitter is active, it is checked, whether the LCD shows the antenna symbol.

At the front, the automatic roller shutter drive has up to 10 different small operating keys, which are operated by the tester via freely programmable micro cylinders. The tester simulates all activities, which will later be carried out at the roller shutter drive by the user.

Test methods



PE resistance

The PE test is performed at devices of protection class I. It is checked, whether the PE resistance is below the normative limit value.

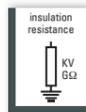
The test serves to detect, whether possible leakage currents inside the test object are grounded correctly. If the PE connection is not OK, this can result in too high a voltage at exposed metallic parts of the device.

In order to determinate the PE resistance, a very high AC test current (typically 10A or 25A/30A AC), conforming to standards, is led through the PE. Via the voltage-drop measurement at the PE resistance and the measurement of the test current, the tester calculates the PE resistance.

The PE test is performed with the precise 4-wire resistance measurement (Kelvin measurement). With this method, the resistance in the leads up to the test probe is compensated automatically.

PE tests are often performed by contacting the PE connection points manually with a PE test probe.

We supply testing devices with test currents up to 100A.



Insulation resistance

The insulation-resistance test is performed at devices of protection class I and protection class II. It is checked whether the ohmic insulation resistance exceeds the normative limit value.

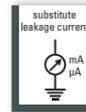
The test serves to detect, whether there is too high a leakage current in the test object. If the insulation resistance is too low or if there is a fault at the PE, this could cause too high a touch voltage at exposed metallic parts of the device.

In order to detect the insulation resistance, a test voltage (according to standards) as high as possible (typically 500V DC) is connected to the current-carrying leads (L+N) of the test object against PE. With the flowing current and the connected test voltage, the tester calculates the insulation resistance.

At devices of protection class II, the test is performed by means of a probe, which is held against the exposed metallic enclosure parts of the test object. In addition, the test can be performed between the current-carrying leads (L against N).

If required, the insulation-resistance test is performed with a security-current limitation to max. 3mA. This protects the operator if the test voltage is touched accidentally.

We supply testing devices with test voltages up to 40KV DC.

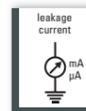


Substitute leakage current

Exactly like the insulation-resistance test, the substitute-leakage-current test is performed between the current-carrying leads L+N against PE. In contrast to the insulation-resistance test, the substitute leakage current test is, however, performed with AC voltage.

The test is called substitute-leakage-current test, because the test is not performed with the nominal voltage of the test object between L+N against PE, but with reduced test voltage. The test voltage and the leakage current are measured and afterwards the current is projected to the leakage current, that would be flowing with nominal voltage. It is checked, whether this leakage current is below the normative limit value.

I.e. it is checked with a low voltage, how the test object behaves under nominal voltage



Leakage current

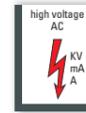
The leakage current test can be performed at devices of protection class I and protection class II. It is checked, whether, owing to the insulation, the leakage current is below the normative limit value.

For detecting the leakage current, the test object is usually operated with a test voltage "nominal voltage +10%". The tester selects the measuring circuit matching the required standard.

At devices of protection class I, the earth leakage current can be measured in the PE. At devices of protection class I and II, the enclosure leakage current can be measured with a test probe at many different exposed parts.

At electro-medical products, all necessary tests according to standard EN60601 and other international standards can be performed, as well.

An increasing number of electronic products is operated with electronic modules and switching power supplies. Through this, leakage currents with the frequency of the fundamental wave (50Hz / 60Hz) and, additionally, with the clock frequency and various harmonic waves of the electronic modules are flowing. For measuring these high-frequency leakage currents, we offer a leakage-current test up to 1MHz according to standards.



High voltage HV-AC

The high-voltage test with AC voltage serves to find insulation faults at electric products of all kinds.

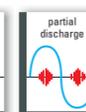
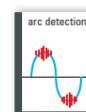
The level of the test voltage for the individual electronic products is determined in the respective standards.

Testing with AC voltage is the most common high-voltage test method. However, the HV-test with AC voltage has disadvantages, that have to be considered. If there is a parasitical capacity in the insulation of the test object, this will cause a capacitive current during the test. This capacitive charge-discharge current can be much higher than the leakage current through the ohmic insulation resistance R_{iso} , because R_{iso} is mostly highly resistive. The result is, that the charge-discharge current through the capacitor, strongly superimposes the fault current that normally should be measured. In addition, the charge-discharge current can affect the test object in a negative way.

The capacitive current is not a fault current caused by defective insulation, but inevitable based on physical facts. Because of the before mentioned points, it has to be kept in mind that the HV-test is more a breakdown test than an accurate measurement of the fault current via the insulation.

Touching currents over 3mA is for the operator potentially lethal. Testing devices with test currents over 3mA, therefore, must be operated with the respective safety measures. Suitable protection devices are safety test pistols or, ideally, test covers or test cages. High-voltage testers with currents below 3mA AC are referred to as "safety-current limited".

We supply testing devices with up to 100KV test voltage and high test currents.



Partial discharge / ARC detection with HV-AC

Partial discharge describes the discharges at insulations, which can not be identified right away through a disruptive breakdown when connecting the high voltage. Only part of the isolator is damaged. The field strength at this damaged spot becomes so large that there is a partial discharge (PD). The remaining, good insulation still withstands the connected test voltage. This type of fault is detected in the isolator via ARC detection or a special partial-discharge measuring technique. This test is of special importance for the production of electric motors in order to locate production errors, like damaged windings.

It is often tried to distinguish between "inner PD" and "outer PD". Outer PD occurs on surfaces – often between bare and damaged leads. Inner PD occurs within the insulating material, e.g. in the impregnating resin of the motor.



High voltage HV-DC

The DC high-voltage test serves to detect insulation faults at electric products of all kinds. The test with direct voltage can often be used as an alternative to the test with alternating voltage. In principle, this is the standard insulation-resistance test, often, however, with much higher test voltages. Therefore, a testing device evaluates either the current or the insulation resistance.

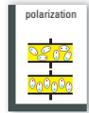
The capacitive current that is flowing during the test with alternating voltage, does not flow during the high-voltage test with DC. The capacities in the test object are charged only once. After this, only a leakage current is flowing through the ohmic resistance R_{iso} . The high-voltage test with DC thus allows more precise statements on the quality of the insulation than it would be possible with AC. Since no permanent capacitive charge reversal takes place, the test object is not affected too much.

It must, however, be noted that currents over 12mA are hazardous for the life of the operator. Testing devices, which can supply test currents over 12mA, must, therefore, be operated with the respective safety measures. Suitable protection devices are safety test pistols or, ideally, test covers or test cages. High-voltage testers with currents below 12mA DC are referred to as "safety-current limited".

The level of the test voltage for the individual electric products can be found in the respective standards. As a rule of thumb, however, the DC test voltage should be 1.5 times the AC test voltage.

We supply testing devices with test voltages up to 40KV.

Test methods



Polarization index

The polarization index is a very important value to determine the quality of the insulation, which deteriorates with increasing age of the motor.

Polarization is the ability of the charge carriers in the isolator to spin and align to the electric field – i.e. to polarize. The mobility of the charge carriers deteriorates with increasing age of the insulation. This results in deteriorated insulating properties and the motor is more likely to be damaged.

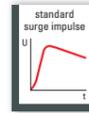
The force that is necessary to spin the charge carrier inside the isolator can be measured during the high-voltage test DC in the form of a small current.

The polarization of the charge carriers is not finished directly after connecting the test voltage – it can take up to 10 minutes. It is assumed that one minute after charging the capacity of the test object the polarization is still in process. The mobility of the charge carriers can thus be determined by the ratio between the strong spinning at the beginning and the reduced current after the spinning.

$$PI = \frac{\text{current}_{1\text{minute}}}{\text{current}_{10\text{minutes}}} \quad \text{or} \quad \frac{\text{insulation resistance}_{10\text{minutes}}}{\text{insulation resistance}_{1\text{minute}}}$$

In case of a good isolator, the current has, after 10 minutes, decreased by four or five times, because all charge carriers have polarized. The result is a good PI of, for example, 4 to 5. In case of a bad isolator, the current has hardly changed after 10 minutes, because the immobile charge carriers can no longer polarize correctly. This results in a bad PI of, for example, 1.5. In this case, the device needs urgent maintenance.

After the polarization, therefore, the real current is measured through the insulation resistance. If the insulation resistance of a motor is measured too fast, the resistance is indicated too low, because you are still measuring the charging of the capacity of the test object and the polarization.



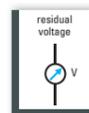
Standard surge impulse

The standard-surge-impulse test is another alternative to the high-voltage test AC and/or DC. The standard surge impulse is more like a lightning-impulse voltage.

The standard surge impulse has a temporal definition of the curve shape. Therefore, it is often defined as “1.2/50 impulse”. The two time values define the rise time and the falling time to half-value. The pulse shape during the test should differ from this definition only to a small extent.

The test impulse is created between the leads and between the lead and ground. During the test, the test impulse is applied between the leads and ground and/or successively between every lead and ground.

We supply testing devices with test voltages up to 6KV.



Residual voltage

The residual-voltage test serves to detect dangerous residual voltages at connection leads or at the mains plug of a test object after the mains voltage has been switched off.

Residual voltages are created through internal capacities inside the test object. For safety reasons, these electric charges must disappear within a time period defined in the standards.

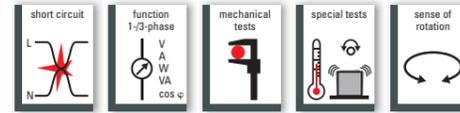


Visual examination

The operator checks and evaluates the test object visually. The result is entered manually at the tester.

In order to facilitate the testing procedure, it is, depending on the tester, possible to show digital photos on the monitor.

Visual examinations are performed as individual test steps or as combined test steps within a test process. Just like safety tests, the results of visual examinations are stored and documented in protocols.



Function

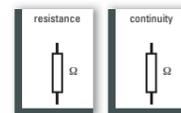
The safety tests are followed by the functional test. If the test object has no short circuit, the desired test voltage is connected to the test object.

The current consumption is the most commonly used criterion for the evaluation of the function. However, other electric variables, like power or phase shift can also be the basis of the evaluation. On top of that, it is possible to measure and evaluate other physical parameters like:

- RPM
- sense-of-rotation
- torque
- temperature
- pressure
- caliper measurement
- vibration
- noise
- flow rate
- optical measurements and more

Due to the modular design of our testing devices, we are in a position to offer both, simple functional tests and more complex and challenging functional tests, e.g. for vehicle drives.

We supply testing devices with functional tests up to 1000A.



Resistance

The ohmic resistance test is performed either in 2-wire configuration or in 4-wire configuration. With 2-wire configuration, the resistances of the test leads, the relay switch-overs and the contact points influence the test result. This variant is, therefore, only used for resistances over 1...10Ω – here, this fault is only a small percentage of the measured value.

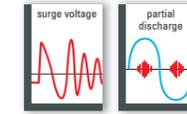
In order to compensate the contact resistances in the test leads and at the contact points, it is, for low-resistance test objects, always necessary to use the 4-wire measurement configuration.

For an optimum 4-wire contacting, we recommend Kelvin clamps and 4-wire test probes.

When measuring temperature-dependent resistances, e.g. at motor coils made of copper wire, it is necessary to consider the temperature. For this purpose, either the ambient temperature

or the temperature of the test object is measured. The measured resistances are converted to 20 degrees celsius temperature.

We supply testing devices with measuring ranges from 1μΩ to 1MΩ.



Surge voltage and partial discharge

For the surge test, the testing device connects a so-called surge capacitor to the desired test voltage. The testing device connects the charged capacitor abruptly to the winding to be tested. This takes only a few hundred nanoseconds. Subsequently, the surge capacitor and the winding to be tested form an RLC circuit. A surge oscillation, typical for the winding, appears in the RLC circuit.

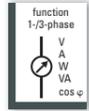
For fractions of seconds, there are high voltage differences from turn to turn inside the winding, which can cause local flashovers at possible damaged spots. This way, winding errors can be detected even visually.

Inside the tester, the surge curves are digitized and indicated on the screen.

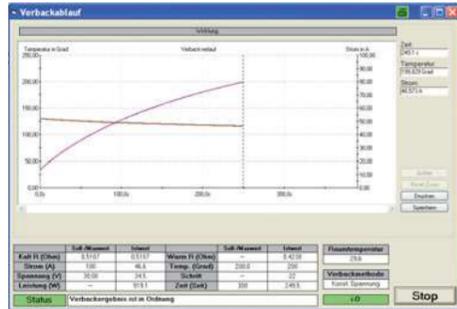
The evaluation takes place either through a visual examination by the operator or fully-automatically by the testing device. The automatic evaluation is based on the comparison between the windings of a stator or to a stored reference part.

Various automatic analyzing methods allow precise statements on the equality of windings. Short circuits in the windings or in the phases of the winding cause asymmetries of the surge curves. They are detected by the software and automatically evaluated GO or NO GO. The process is performed reliably and doesn't require any special knowledge from the operator.

We supply testing devices with test voltages up to 30KV.



Bonding

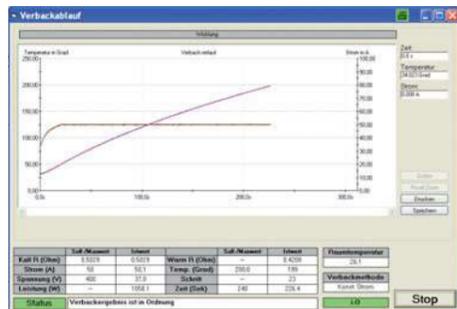


Bonding with constant voltage – constant-voltage method

A constant voltage is connected to the winding to be bonded. The growing heat causes the resistance of the winding to rise, which results in a decreasing current. An increase of the temperature thus has the effect that less power is released to the winding.

The advantage of this method is that the temperature rises relatively slow, allowing the stator to be heated up evenly. When reaching the bonding temperature, the temperature difference between winding head and slot is, therefore, optimally low.

Since the maximum current density in the wire is only reached at the beginning of the bonding process, it is possible to achieve very short bonding times.



Bonding with constant current – constant-current method

During the bonding process, this method keeps the current at a constant level. Owing to the increasing resistance, the current decreases. In order to stabilize the current, the bonding machine increases the voltage continuously during the bonding process. For this reason, the final temperature is reached much faster than with constant voltage. However, the temperature in the winding may be distributed unevenly.

The advantage of this method is that you can reach very short bonding times. In most cases, however, the temperature is distributed unevenly.

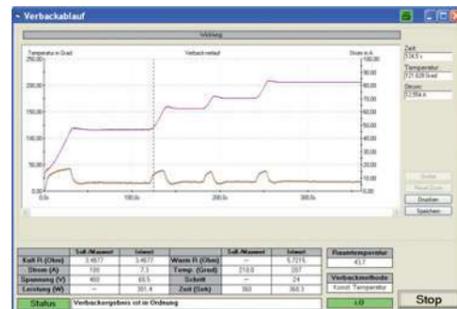


Bonding with constant temperature

If you use the constant-voltage method or the constant-current method, the bonding process stops as soon as the bonding temperature has been reached.

With these two methods, the time period, during which the coating of the enameled wire can melt and form a connection with the adjacent wires is relatively short. It is, therefore, possible that the wires are not bonded properly at those parts that go through the slot, because, owing to the winding head, at these points the wires are somewhat cooler.

When using the constant-temperature method, after reaching the target temperature, the temperature is kept at a constant level for a certain period of time. This prolongs the time during which the coating of the enameled wire can melt and form a connection with the adjacent wires.



Bonding with temperature profile

In principle, bonding with a temperature profile corresponds to bonding with constant temperature. With this method, however, the process has several temperature steps.

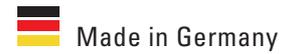
The temperature difference between winding head and slot can be balanced, even in case of low initial temperatures, before starting the bonding process.

This method is primarily used in case of very long stacks compared to very short winding heads and/or if the stack is very large.

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|-------------------|--------------------|---------------|
| ABB | Grundfos | Salmson |
| AEG | Hanning | Saeco |
| Arcelik | Heidelberger Druck | Salzgitter AG |
| Airbus Industries | HILTI | Sauer-Danfoss |
| Alcatel | Hirschmann | Schabmüller |
| AMK | IFM | Severin |
| Ansorg | Ihne + Tesch | SEW |
| ATB | Indramat-Rexroth | Siemens |
| Audi | Juno | Siteco |
| AUMA | Jungheinrich | Stahl |
| Aumann | KaVo | Staff |



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|------------------------|-----------------------|-----------------|
| Becker Antriebstechnik | Kärcher | Stöber |
| Bega | Kress | TCM |
| Bernal Tore | KSB | Tecumseh |
| BMW | Leica | TEE |
| Bosch | Lenze Antriebstechnik | Trilux |
| Braun | LEONI | TÜV |
| BSHG | Liebherr Aerospace | UPS |
| Continental | Lufthansa | USK |
| Daimler | Maiko | Vaillant |
| Danfoss | MDEXX | Vestas |
| DAL | Miele | VDE |
| Dematic Cranes | Murr Elektronik | Vossloh-Schwabe |
| DOM | Nettelhof | VW |
| Dometic | Nilfisk | WAP-ALTO |
| Durst | Novoferm Tore | WDR |
| E.G.O. | Oase Pumpen | Weidmüller |
| Electrolux | Ocean | WEG |
| Elmotec | Opel | WILO |
| ELNOR | Osram | XHL |
| Embraco | Papst | Zanussi |
| EMU | Philips | Zeiss |
| Enercon | Philips medical | ZF |
| Engel | Phoenix | Zumtobel |
| ERCO | Preh | |
| Fagor | Premiere | |
| Festool | Q.Cells | |
| Flygt | QS-Group | |
| Franklin Electric | Rexroth | |
| Gildemeister | Rittal | |
| Grohe | Rotomatika | |



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