



Thermal-bonding machines, impregnation & resistive-heating systems

Universal systems for coil production



The best quality for your product.

Thermal-bonding machines, as well as impregnation and trickle-impregnation systems serve for a safe bonding of all components within an electrical winding and to the lamination stack.

This process is always based on heat, which is necessary for bonding self-bonding enameled magnet wire or to bond insulating resin to the winding. For heating, current is applied to the windings. This creates electrical losses in the winding resistances, which heats up the winding. We call this principle “resistive-heating method”. An accurate measurement and regulation of the flowing current allows to control the heating process precisely and in a reproducible way.

Thermal-bonding machines

With current-generated heat, the windings made of self-bonding copper wire are heated to the melting point of the bonding varnish. After reaching the desired temperature level and after cooling down, the wires are bonded together. The complete winding now forms a solid unit. This is a reliable process controlled and monitored by a PC.

KEY FACTS

- Current-generated heat based on 30 years of experience
- Thermal-bonding machines for coils and windings of all kinds
- Impregnation systems with current/UV-curing method
- Heating with DC-current
- Heating with low-frequency AC-current
- Resistive-heating systems up to 100 kW, 1000 A, 1000 V
- Current densities up to 200 A/mm²
- Five different methods to regulate the current-generated heat
- Temperature-controlled heating
- Temperature curve during the heating process
- Integrated 4-wire-resistance measurement
- Evaluation of winding-temperature sensors
- Simultaneous resistance measurement during the heating process
- Online temperature monitoring
- Online connection monitoring
- Dynamic over-current sensor
- Monitoring of tools, grounding and short circuit, switch-off time ≤50 µs
- Can be combined with additional tests like:
 - Surge test
 - Partial-discharge (PD) test according to IEC 61934
 - High-voltage test AC/DC
 - Rotary-field test
 - Insulation-resistance test, ...
- Testing before and after the heating process
- Manual and automatic contacting units
- Forming tools and slot mandrels
- Heating cells, rotary-switching tables or production cells
- Integration into automatic production lines
- Integration into the IT of your company

The heating time may vary depending on the current density, the stator and the dimensions of the winding. Varying the current density allows to realize thermal-bonding processes between 1 to 300 s. The objective is to achieve an extremely even temperature distribution, which guarantees a good, homogeneous bonding in all parts of the winding.

In order to achieve optimum results for different types of applications at all times, various thermal-bonding processes for regulating current-generated heat are available.

Impregnation systems

The windings produced with conventional lacquer-coated wire are first electrically heated to a desired temperature and then dipped into a resin bath. The resin will start gelling the heated winding. After this process, the remaining resin is drained. The final curing process is accelerated by using UV-light.

During the individual, automated processes, the winding is continuously supplied with current. The computer-aided process ensures that the great variety of different temperatures and temperature-profiles required are reliably kept.

ATEX-testing for motors

ATEX-windings require a precise check of the temperature sensors. Ideally, this is done with the current-generated heat. The test determines, at which temperature and after which time the temperature sensors trigger.

Heating of coils

Damp windings of motors or transformers are dried with current-generated heat.

- › Up to 100 kW, 1000 A, 1000 V
- › Temperature-controlled heating
- › Can be combined with winding tests
- › Manual workstations
- › Fully-automatic production lines



Contents

Thermal-bonding machines	4
Impregnation systems	6
Basic unit	8
Heating windings with current-generated heat	10
Connection types & questionnaire	12
A deeper look into the winding	14
Contacting units, expanding mandrels & forming tools ...	16
Software	18
Result protocol	20
Integration into a computer network	22
Data exchange in automation	24
Data exchange with IT-systems	26
Traceability	28
Marking and labeling	29
Company	30

Thermal-bonding machines

Controlled heating with current-generated heat

With our thermal-bonding machines, coils produced with self-bonding magnet wire can be bonded directly after winding. If required, you can perform tests before and after the bonding process.

The thermal-bonding machines are suited for coils of all types. Provided the contacting of the winding allows a current flow significantly higher in comparison to normal operation, a reliable bonding of single coils as well as 1- phase and 3-phase stators and armatures is possible.

Manual thermal-bonding machines

At manual thermal-bonding machines, the winding ends are contacted by the operator. You can choose between a great number of different manual contacting variants, designed especially for high temperatures and high current levels.

The contacting units can be equipped with an automatic opening function. This saves time, because the operator doesn't have to disconnect every single winding end from the contacting unit after the bonding process.



KEY FACTS

- Heating with direct current
- Heating with low-frequency alternating current
- Thermal-bonding machines up to 100 kW, 1000 A, 1000 V
- Current densities up to 200 A/mm²
- Five different methods to regulate the current-generated heat
- Temperature-controlled heating
- Temperature curve during the heating process
- Integrated 4-wire-resistance measurement
- Evaluation of winding-temperature sensors
- Simultaneous resistance measurement during the heating process
- Online temperature monitoring
- Online connection monitoring
- Dynamic over-current sensor
- Monitoring of tools, grounding and short circuit, switch-off time $\leq 50 \mu s$
- Manual and automatic contacting units
- Single stations, rotary-switching tables or production cells
- Integration into automatic production lines

Automatic thermal-bonding machines

With automatic thermal-bonding machines designed as complete production line, the thermal-bonding process is executed fully automatically. The workpiece carriers with the windings to be bonded are automatically stopped and separated by the bonding machine or the line control. Now, they are lifted to the bonding position. The forming with the forming tools and the connection of the winding ends or a plug are also performed fully automatically.

Non-stripped winding ends can be connected, as well. Special contacting tools allow contacting the wire through the insulation.



Impregnation systems

Resistive-heating UV-dipping method

SCHLEICH impregnation systems are used to bond stators with insulating resin by means of the resistive-heating UV-dipping method, which is suitable for winding systems of all kinds. It basically consists of the PC-controlled heating up followed by applying and curing the insulating resin.

The impregnation process has four phases. While going through one phase after the other, the winding is continuously energized.

1. Heating phase

The specified temperature is reached by heating the winding in a controlled manner.

2. Impregnation phase

By means of the integrated pumping mechanism, the one-component impregnating resin is automatically filled into the winding. Filling quantities, filling time and impregnating time can be defined as desired. At the winding, the resin will start gelling.

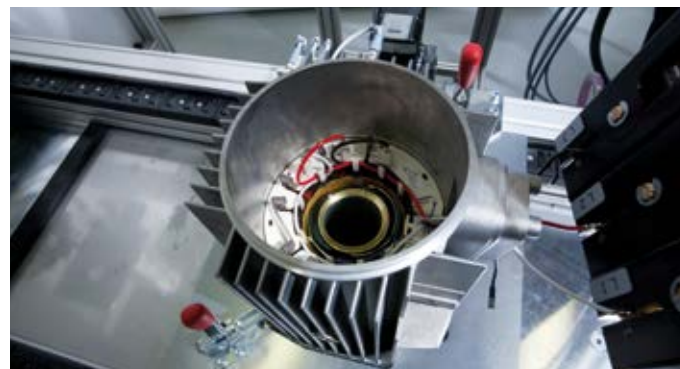
Especially in the impregnation phase, the constantly active temperature regulation is of particular importance. It is required to ensure that the cold resin doesn't cool down the heated winding too much. For this purpose, the control is operated with a special and very efficient control algorithm.

3. Draining phase

After the impregnating resin has been applied to the winding, it has to be drained. The draining time and the temperature required during this phase, can be selected as desired. During the draining phase, the impregnating resin gels at the winding. Excess impregnating resin flows back to the refrigerated collecting vessel and will be used for the next impregnating process.

4. UV-curing phase

After the draining process, the UV-lamp is activated in order to accelerate the curing process. The UV-curing time and the required temperature for this phase can be selected as desired.



The design of the impregnation systems allows to control several independent impregnation processes at the same time and display them on the monitor in a clear manner.

As a systems supplier, we supply you with the complete impregnation system. This includes the complete mechanics, the handling of the impregnating resin, the electrical heating and the UV-curing. The impregnation systems are tailor-made to your requirements. The combination of these perfectly matched components will guarantee you an optimum production outcome.

In addition to impregnating, it is possible to integrate tests into the process. In this context, high-voltage tests and surge tests are of particular importance. In principle, all tests of the winding-test system MTC3 can be combined with the impregnation process.

Our impregnation systems are ideal for both, single workstations or integration into fully-automatic rotary-switching tables or production lines. The control of workpiece carriers within a line or the data exchange with a PLC can easily be realized.

KEY FACTS

- Heating with direct current
- Heating with low-frequency alternating current
- Impregnation systems up to 100 kW, 1000 A, 1000 V
- Current densities up to 200 A/mm²
- Four different methods to regulate the current-generated heat
- Temperature-controlled heating
- Temperature curve during the heating process
- Integrated 4-wire-resistance measurement
- Evaluation of winding-temperature sensors
- Simultaneous resistance measurement during the heating process
- Online temperature monitoring
- Online connection monitoring
- Dynamic over-current sensor
- Manual and automatic contacting units
- Single stations, rotary-switching tables or production cells
- Integration into automatic production lines



Basic unit

The universal SCHLEICH-concept treats a thermal-bonding or an impregnating process like an operational step within a chain of test steps.

From an economic point of view, it doesn't make sense to bond or impregnate a defective winding. This is why, before heating the winding with current, the winding is often tested. After the heating process, it may be appropriate to perform a final test.

Depending on the desired tests, we recommend either the winding tester MTC3 or the function tester GLP3. For both device types, the software features are identical. Compared to the GLP3, the MTC3 has the advantage that it allows surge tests and partial-discharge (PD) tests. The configuration will be customized, so that the test methods and the required type of current heat perfectly match your application.

For testing, for process control of the current-generated heat and for storing heating/test plans and results, we rely on the integration of industrial PCs. A clear and well-structured user interface makes it easy for the operator to control the system. Your employees will learn the operation quickly and intuitively.

The screen layout during the tests and during the heating process is clearly structured; only key data and diagrams are indicated.

Quality assurance is supported by numerous statistical analyses. A great number of different print protocols serves your customers as proof for the delivered quality.



- > Fully-automatic process
 - > Additional tests of all kinds
 - > Modular design
 - > Self-test and maintenance concept
- ## Industry 4.0

Standard features

Current-generated heat

- Voltage, current and power matching your requirements
- Integrated power module DC or AC
- Five different methods to regulate the current-generated heat
- Temperature-controlled heating
- Continuous temperature detection during the heating process
- Graphic presentation of temperature and current
- Integrated over-current protection and fast switch-off
- Tool-temperature monitoring
- Super-fast measurement technology, 100 kSample ideal for connection monitoring
- Highest measurement accuracy
- kWh energy meter per heating process

Test methods

Standard test methods:

- 4-wire resistance test from $\mu\Omega$ to 500 k Ω
- Simultaneous resistance measurement during the heating process
- Compensation of starting temperature
 - Ambient-temperature sensor
 - Infrared pyrometer
 - Thermographic camera
- Visual examination
- Surge test up to 6 kV (only MTC3)
- High-voltage test DC (only MTC3)
- Insulation-resistance test (only MTC3)

Optional test methods:

- Partial-discharge (PD) test with surge voltage (only MTC3)
- High-voltage test AC up to 6 kV
- Partial-discharge test (PD) with high voltage AC
- Sense-of-rotation test of the rotary field

Features and technology

- High-performance industrial PC
- Integrated plausibility checks of all parameters
- SQL or ACCESS-database without limits
- Automatic log
- Management of setting-parameter changelog
- Numerous languages

Communication

- USB-interfaces at front and rear panel of the PC
- RS232- and LAN/Ethernet-automation interface
- Digital I/O-interfaces

Optional automation interfaces:

- ProfiBus/ProfiNet
- EtherCAT
- and more...

Safety

- Start input
- Two-circuit safety inputs according to EN 50191/VDE 0104
- Integrated Emergency Stop and connection for external Emergency Stop
- Outputs for warning and result lamps
- Safety and warning messages
- Result outputs for Pass and Fail
- Status outputs
- Counter for operating hours and switching cycles with maintenance instructions
- Cycle counter for tools with maintenance instructions

Heating windings with current-generated heat

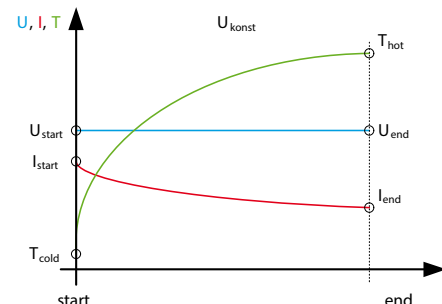
For heating, direct current or alternating current flows through the winding. The power dissipation created at the winding resistance is converted into heat.

To achieve short heating times, a high current density is required. It is limited by the cross section of the wire and perhaps by the contacting type. In order to avoid damage, both the wire and the contacting unit must not be overloaded.

A power module in the heating system, controlled by the software of the system, serves for generating the current.

The super fast, high-accuracy measurement technology delivers hundreds of thousands of current and voltage measurement values per second. With these values, the software continuously calculates, for example, the winding temperature. Based on the detected process values, the software controls the power module with varying heating methods.

Constant-voltage method

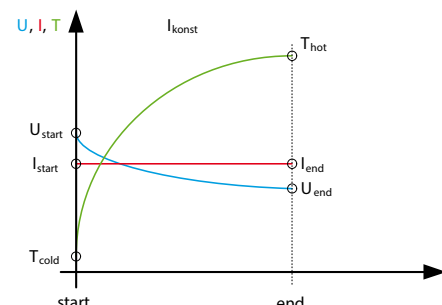
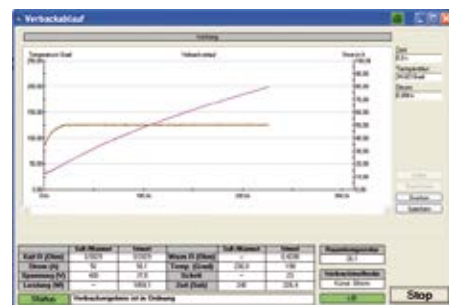


This is the easiest method. During the complete heating process, the voltage is kept at a constant level. As the copper resistance of the winding increases with rising temperature, the current flowing at the beginning will keep getting lower. The thermal energy, applied to the winding, decreases.

The advantage of this method is that the temperature increases relatively slow, which results in a good and even heating of the

winding. Therefore, when reaching the bonding temperature, the temperature difference between the winding in the winding head and the winding in the slot is normally quite small. Due to the fact that the maximum current density is only reached at the beginning of the heating process, it takes a relatively long time to reach the desired final temperature.

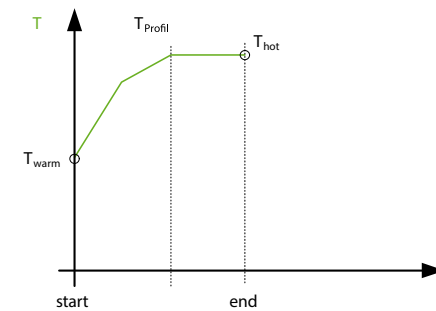
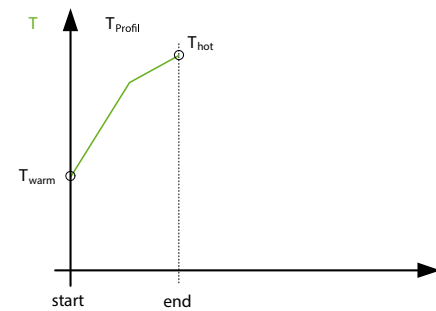
Constant-current method



With this method, the current is kept at a constant level for the duration of the complete heating process. As the copper resistance of the winding increases with rising temperature, this is only possible if the voltage is increased regulated by the controller.

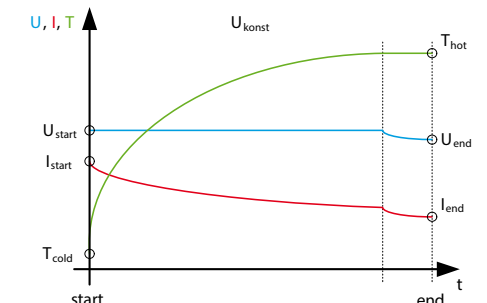
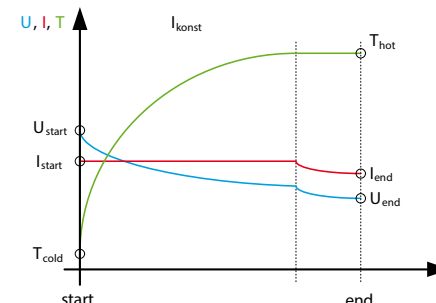
Compared to constant voltage, you can reach the desired final temperature with this method a lot faster.

Method for increased starting temperatures



This method is, for example, suited for repair work, because here the winding is often still very hot. The heating system will detect the increased winding temperature and start the heating process based on this initial value.

Additional function: constant final temperature

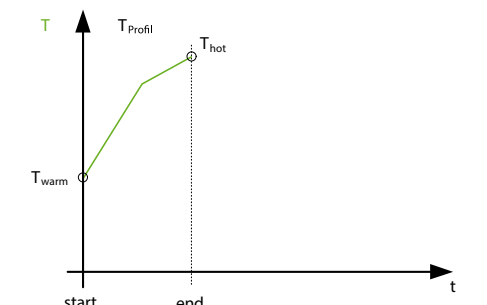
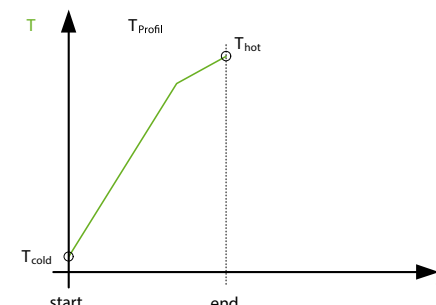


If you switch off directly after reaching the melting temperature, the time for the bonding coat to gel and connect to the adjacent wires might be too short. The result could be that, because of the lamination stack, the wires in the slot stay a little cooler than in the winding head. This could result in poor quality.

The method with constant voltage or constant current can be configured in a way, that, when the desired melting temperature

is reached, it will not be switched off right away, but the temperature will be kept at a constant level for a certain period of time. This will increase the time during which the bonding coat of the wire can melt evenly and safely connect to the adjacent wires.

Method with temperature profile



The operator determines the desired heating profile in different time zones. In the event that the integrated power module is not able to deliver the current or the voltage, this is verified and, if necessary, corrected during a plausibility check taking place in advance.

This is the standard procedure for an impregnation system. It is also used for thermal bonding.

Connection types & questionnaire

Our thermal-bonding systems are available as single or multiple workstations. In addition, they are ideally suited to be integrated into fully-automatic production lines.

Our impregnation systems are designed as single stations, rotary-switching tables or conveyor systems. In order to meet your requirements, resistive-heating systems are available with varying configurations.

If you could answer the following questions as completely as possible, we would be happy to configure a matching system and send you the respective quotation.

In case you find no match for your specific application or if you have questions, please feel free to contact us any time. In addition to the products shown in this brochure, we will be happy to offer you a tailor-made solution.

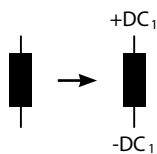
Everything you need!

System type

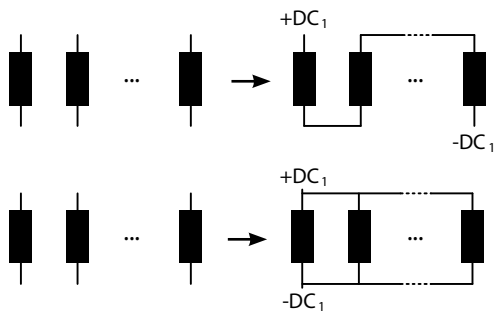
- ☐ Thermal-bonding machine
 - ☐ Resistive-heating UV-dipping system
 - ☐ Standard resistive-heating system
- What type of application is the system needed for?

Winding types | more than one answer is possible

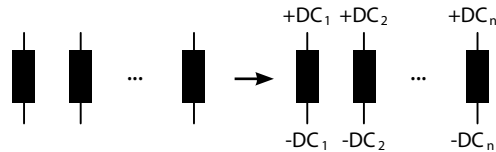
Single coil
The coil is heated with DC. This requires one voltage.



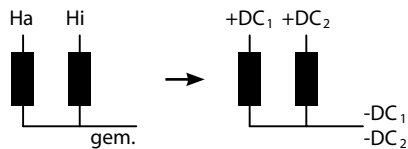
Several coils of the same type
The coils are heated with DC. This requires one voltage. Depending on the required current and the voltage resulting from resistance and current, the coils can be heated in series or in parallel.



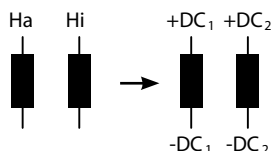
Several coils of different types
The coils are heated with DC. If the bonding procedures are to take place simultaneously, you require several voltages. Otherwise, you can process one coil after the other. However, this requires a certain period of time.



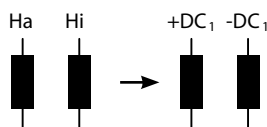
Single-phase motor with different main and auxiliary winding – 3 leads
The coils are heated with DC. This requires two different voltages. The two voltages are automatically regulated in a way that the temperature rise in the main winding and in the auxiliary winding is very similar. It has to be taken into consideration that the total current flows at the joint connection of the two windings.



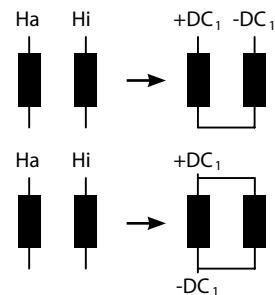
Single-phase motor with different main and auxiliary winding – 4 leads
The coils are heated with DC. This requires two different voltages. The two voltages are automatically regulated in a way that the temperature rise in the main winding and in the auxiliary winding is very similar.



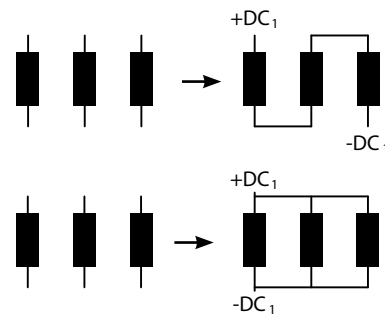
Single-phase motor with identical wire diameter in main and auxiliary winding
The coils are heated with DC. The two coils are connected in series. Therefore, only one voltage is required.



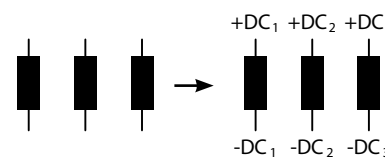
Single-phase motor with fully identical main and auxiliary winding
The coils are heated with DC. The two coils are connected in series or in parallel. Therefore, only one voltage is required.



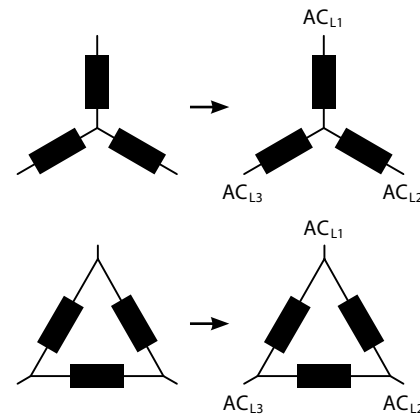
Three-phase motor with beginning and end per phase and equal windings
The coils are heated with DC. This requires one voltage. Depending on the required current and the voltage resulting from resistance and current, the coils can be heated in series or in parallel.



Three-phase motor with beginning and end per phase and unequal windings
The coils are heated with DC. Since all phases are different, 3 individual voltages are required.



Three-phase motor with internal star or delta connection
The coils are heated with three-phase current. When heating with AC, the simultaneous resistance test for accurate temperature detection is performed, as well!



Resistance and wire cross-section

smallest resistance _____ Ω

min. wire cross-section _____ mm^2

max. wire cross-section _____ mm^2

largest resistance _____ Ω

min. wire cross-section _____ mm^2

max. wire cross-section _____ mm^2

Heating time

min. duration _____ s

max. duration _____ s

min. weight _____ kg/lbs

max. weight _____ kg/lbs

Additional tests

- Surge voltage**
Checking the winding for turn-to-turn and phase-to-phase faults.
- Partial discharge in connection with surge voltage**
Checking the winding according to IEC 61934 and DIN 60034-18-41
- High voltage AC**
Checking the winding for phase-to-frame and phase-to-phase faults.
- Partial discharge in connection with high voltage**
Checking the winding for quality defects and critical, overloaded insulation
- Insulation resistance**
Checking the insulation resistance with DC. The resistance must reach or exceed a minimum value. Therefore, the test according to standards will take several seconds! This could make the complete process time a lot longer.
- Rotary field**
Checking the correct sense of rotation and the correct connection of the individual coils. This is done with a static rotary-field probe.

A deeper look into the winding

Your gain – integration of efficient test methods

Based on our test systems MTC3 or GLP3, the SCHLEICH-MODULAR-CONCEPT offers you many different options to add various winding and safety tests to your thermal-bonding or impregnation system.

You can choose the test methods required for your testing task from a large pool of test options. This allows you to check windings for all types of faults.

The combination of the test methods with our patented and award-winning innovations guarantees the quality of your products. In every single device you will find the experience of thousands of installations. The SCHLEICH team uses this experience consistently, with passion and without compromise.



This is “customer-based technology”.

1 Surge test

The unique surge test serves for testing the insulation within a winding. It is ideally suited for detecting turn-to-turn and phase-to-phase faults and testing many other winding characteristics. In addition, it can be used to check insulation problems with the lamination stack.

2 Partial-discharge test (PD) at surge voltage

The partial-discharge test serves to test and evaluate the insulation system between phases and/or to the lamination stack. For VFD-operated motors, the partial-discharge test is of particular importance.

3 Insulation-resistance test (IR)

The insulation resistance between the phases and/or the lamination stack must be equal to or larger than the indicated minimum value.

4 Resistance test

When checking the winding resistance with 4-wire method, the winding resistance must remain within a certain tolerance window. An influence on the test result through the temperature is compensated by the measuring equipment with effective methods.

5 High-voltage test AC

The high voltage ensures the dielectric strength between the phases and/or the lamination stack according to standards.

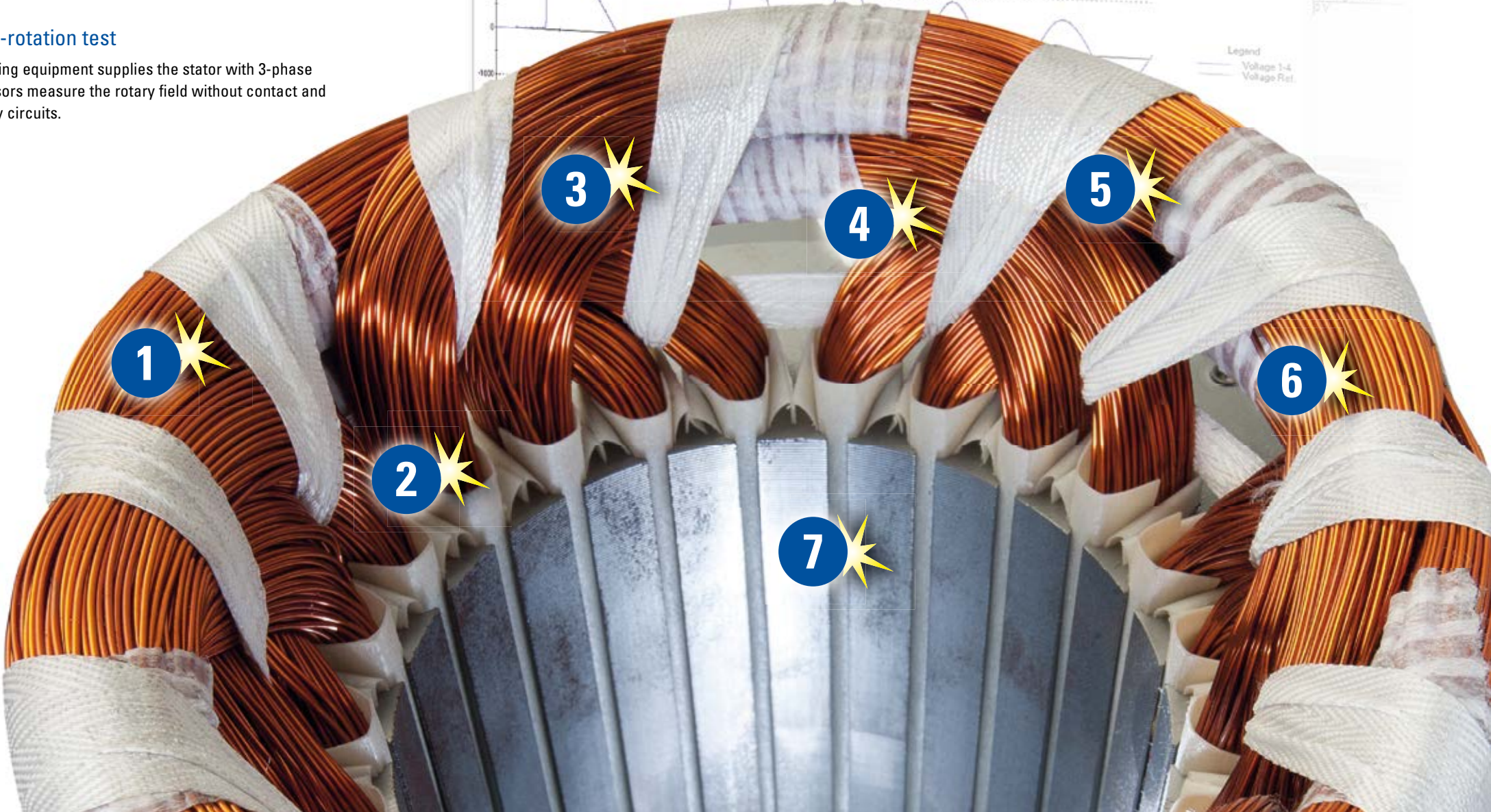
6 Partial-discharge test (PD) at high voltage AC

The partial-discharge test serves to evaluate the insulation system between the phases and/or to the lamination stack. Defects, like a wire that touches the lamination stack, can be detected with the partial-discharge test method.

7 Sense-of-rotation test

The measuring equipment supplies the stator with 3-phase power. Sensors measure the rotary field without contact and detect faulty circuits.

ID	Test step	Set value	Actual value	No go	Result
R 1	Resistance 1-4	1.500 Ohm	1.457 Ohm	0	
R 2	Resistance 2-5	1.500 Ohm	1.455 Ohm	0	
R 3	Resistance 3-6	1.500 Ohm	1.462 Ohm	0	
R 4	Resistance Deviation	8.000 %	0.481 %	0	
HV 1	High voltage Partial Discharge	800.0V, Tp=70.0, Ts=15000.0	Tp=12, Ts=2, N=3	0	
HV 2	High voltage Phase's - Ground	1200V, <10.000 mA	1.640 mA	0	
SSp 1	Surgetest U 2000V	2000.0V, <5.0%, <10.0%	1931.1V, 0.0%, 0.9%	0	
SSp 2	Surgetest V 2000V	2000.0V, <5.0%, <10.0%		0	
SSp 3	Surgetest W 2000V	2000.0V, <5.0%, <10.0%		0	
SSp 4	Surgetest U Partial Discharge	1000V, 1000V, 1000V, 1000V		0	
SSp 5	Surgetest V Partial Discharge	1000V, 1000V, 1000V, 1000V		0	
SSp 6	Surgetest W Partial Discharge	1000V, 1000V, 1000V, 1000V		0	
ISO 1	Insulation Resistance 1000V	>1.000 MOhm		0	
DRF 1	Rotation Direction CCW	CCW (left)		0	



For detailed information on our test systems, please refer to our brochure:
“MTC3 – Multi-purpose winding testers for motor production”

Contacting units, expanding mandrels, forming tools, ...

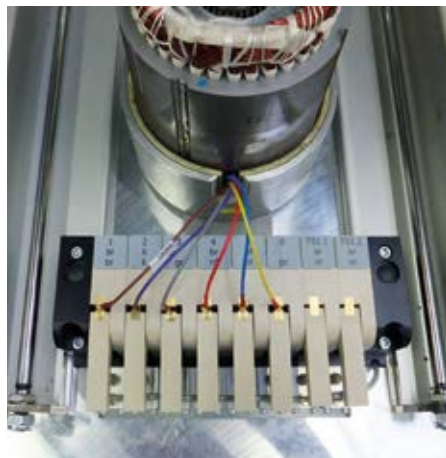
The mechanical adaptation of stators and their special contacting units is one of SCHLEICH's key strengths. Heating system and mechanics are manufactured to match your task. For this purpose, we use manual or pneumatically controlled 4-wire clamps. It is important that they transfer the high currents and the measurement signals perfectly.

The design is done at our own 3D-CAD work stations. With state-of-the-art CNC machines, our mechanics department guarantees the production of high-quality components at low prices.

KEY FACTS

- Solid and durable design
- 2-wire or 4-wire contacting
- High-current contacting
- Special solutions for manual contacting
- Special solutions for automatic production lines
- Contacting units for handling systems
- Quick exchange of wearing parts

Contacting units

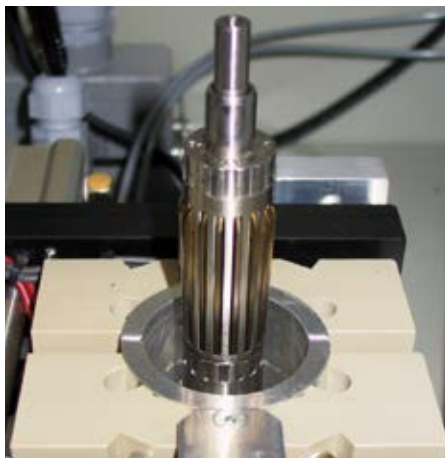


Manual contacting unit with high-temperature 4-wire contacts and automatic opening



Automatic contacting unit with forming tool

Expanding mandrels



Expanding mandrel with forming tool



Dual station with expanding mandrel and forming tool

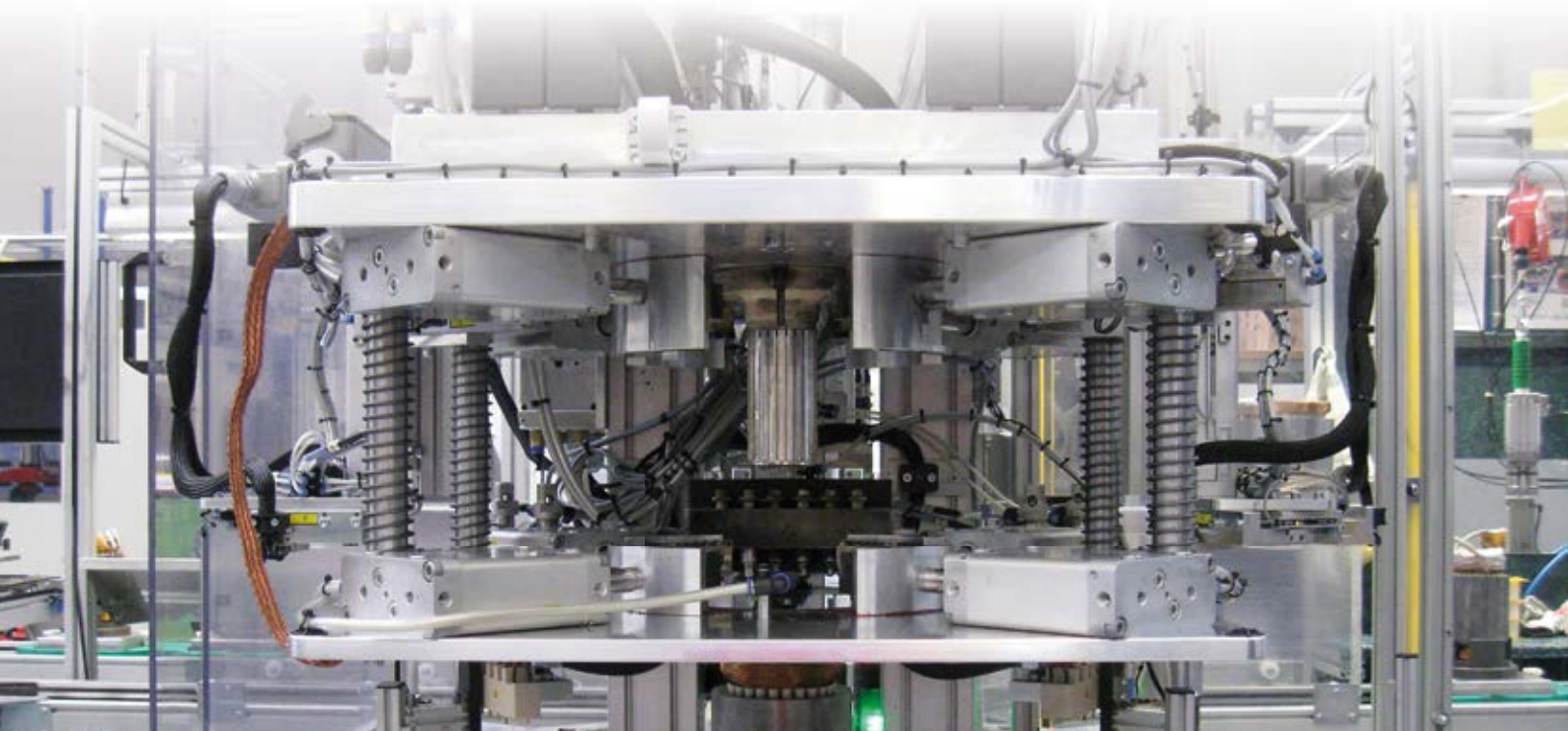
Forming tools



Forming tool in the bonding station



Forming tools with contacting unit



Forming tool consisting of four segments and contacting unit



Forming tool consisting of four segments for forming the winding head



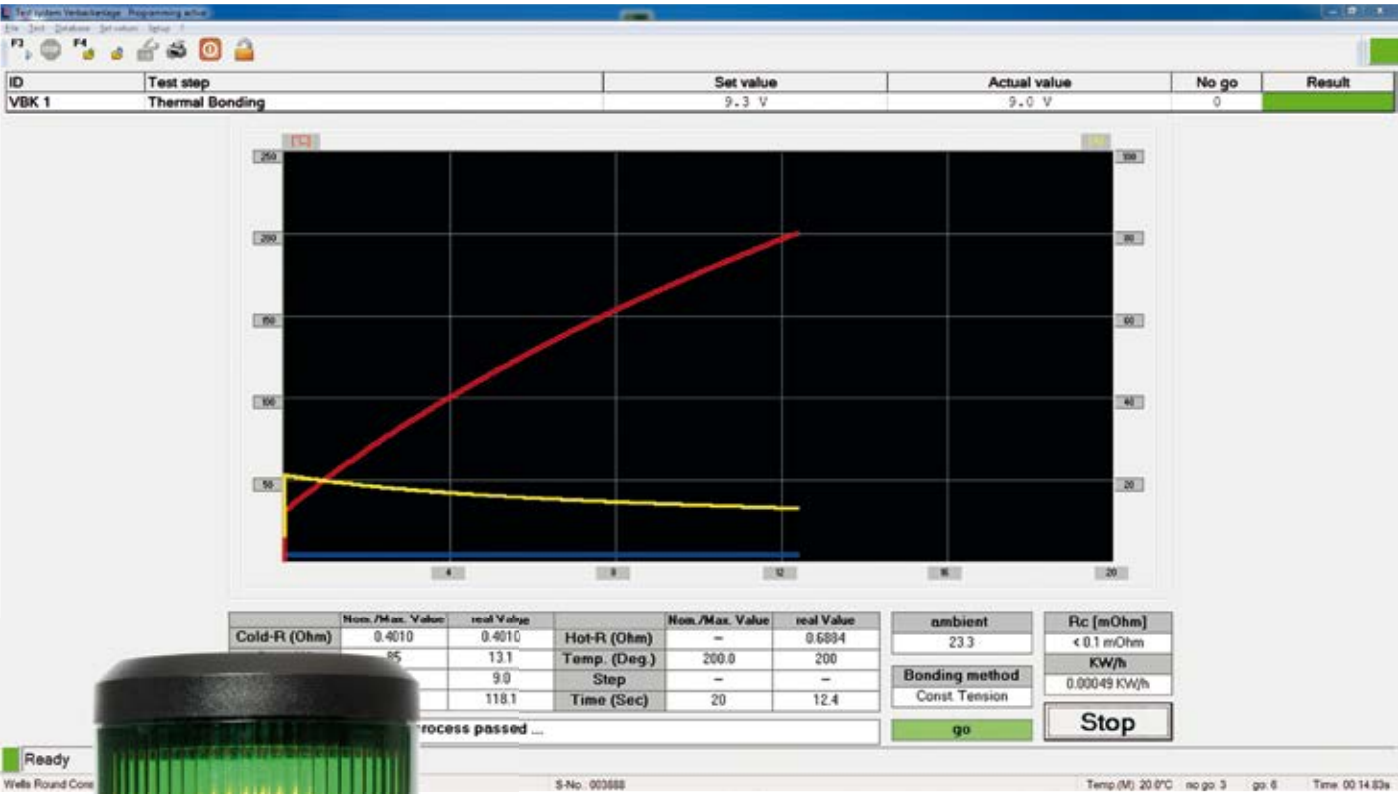
Forming tool consisting of four segments, closed condition

Software

Our software is based on the operating system Microsoft Windows®. The optimized user interface allows to carry out:

- Heating with current
- Testing
- Generation of heating/test plans
- Printing of test protocols
- Statistical evaluation of the results

Heating | test process

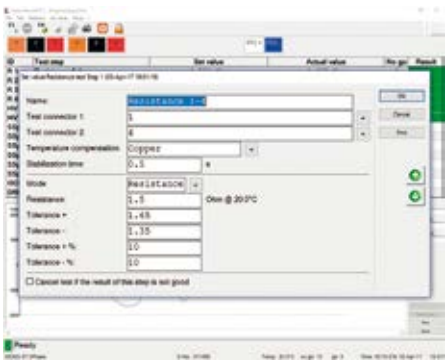


All heating processes and, if applicable, tests are performed fully-automatically. During the processes, the test results are continuously indicated and evaluated. A clear GO/NO GO display visualizes the automatic evaluation.

The process can be edited by simply adding or deleting heating steps and test steps. This way, the process can be perfectly adapted to different tasks. By double-clicking the respective step, it can be edited easily.

The comprehensive integrated user management ensures that changes can only be done by authorized personnel. Together with additional operating instructions, the heating system is the perfect production system according to ISO 9001.

Input



By simply clicking the respective step with the mouse, you can edit the heating and test parameters. You don't have to work with an extra heating-plan editor. Every operator can view the settings. Changes, however, can only be done by authorized personnel. All changes are stored in the history management and in the log.

Data

Heating plans and results are stored by the system either locally on the hard disk or in a central SQL-database on the network. We would always recommend to network your testing devices. Advantages:

- All testing devices connected to the network access the same database for heating plans and results.
- All testing devices perform the tests according to the same specifications.

Statistics

With a large amount of results, it is possible to generate informative statistics. Therefore, we have put great emphasis on useful and well-structured storage of the results over a long period of time. Via search filters, which the user can configure as needed, all relevant data can be found in the database quickly and easily. Individual evaluations or summaries of the test results over a long period of time followed by a statistical evaluation are possible.

Trend displays and Gaussian distributions give clear information about the quality of production. The heating system can store and display the results order- or lot-based. By means of the integrated

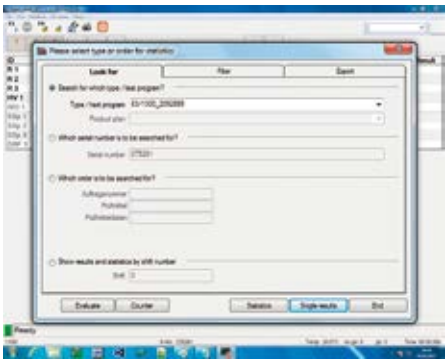
KEY FACTS

- Intuitive operation
- Clear and simple user interface
- Input of parameters without editor
- Clearly structured inputs
- Integrated operator and setup messages
- Plausibility check of all inputs
- Based on the latest version of Windows®
- Ideal for integration into company networks
- High data security and long-term storage of data
- Connection to CAQ- and/or ERP-systems
- Highly configurable
- Integrated user and rights management
- Lifetime free updates

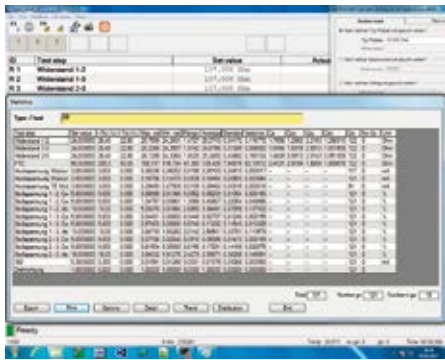
- A central database for all heating systems in a global network helps you to ensure the quality of your products worldwide, regardless of the location.
- From one or several locations, you can access the test results from all sites around the world.
- Through simple connection to ERP-, PPS- or CAQ-systems, the heating systems can ideally be integrated into your factory planning and production control.

extensive export functions, the user can extract data from the database and export them to other databases or process them in Excel®. This allows you to create your own evaluations.

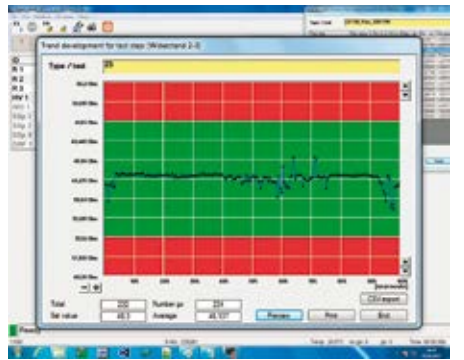
The database can be based on SQL or ACCESS®. For large amounts of data or for operation in networks, we recommend to use Microsoft® SQL.



Filter function



Result overview



Diagram

Result protocol

All results can be printed on the modern standard protocol either directly after the heating process or later.

Before printing, you can select the language of the protocol.
Standard languages: German, English, French, Dutch, Spanish, Italian and Russian.

You can print the protocol in different ways as required:

- Creating PDF-files
If requested, the heating system creates a PDF-file that is either directly printed or stored on a USB flash drive, the internal hard disc or in a network directory.

- Creating CSV-files
The heating system can also create a CSV-file with the results and store it in a network directory. The data exported to the CSV-file can be configured as desired and adapted to your requirements.

Editable field with your company logo and address

General motor data, date and time, etc.

Overview of all test results

Test protocol

Sample Inc.
Any Street 89
12345 Any City

Your logo

Test system	Testsystem Entwicklung SCHLEICH MTC2-12kV 4590
Test program	Triangle test complete
Result	PASS
Serial number	35601
Test date	28.02.2014 13:51:46
Job no.	1010
Customer	Hermes
Manufacturer	Schleich

Summary		
Resistance 1-2	76.52 mOhm (25.2°C)	PASS
Resistance 2-3	76.41 mOhm (25.2°C)	PASS
Resistance 3-1	76.48 mOhm (25.2°C)	PASS
Deviation	0.148 %	PASS
Surge PD	PDIV: 1394V, RPDIV: 1583V, RPDEV: 1509V, PDEV: 1509V, Background noise signal: 31.25mV, Detection system noise signal: 31.25mV	PASS
Surge 1-2	1033V, EAR=0.0%, Cor.=0.1%, Attenuate=0.0%, Inductance=1.65mH	PASS
Surge 2-3	1056V, EAR=8.1%, Cor.=0.3%, Attenuate=4.9%, Inductance=1.67mH	PASS
Surge 3-1	1062V, EAR=5.7%, Cor.=0.1%, Attenuate=5.1%, Inductance=1.63mH	PASS
Compare	1014V, EAR=6.0%, Cor.=0.2%, Attenuate=0.7%	PASS
Insulation test	2214V, 6.503 GOhm (40.0°C), 18.139GOhm (25.2°C), Imax1=35.953µA, Imax2=0.122µA	PASS

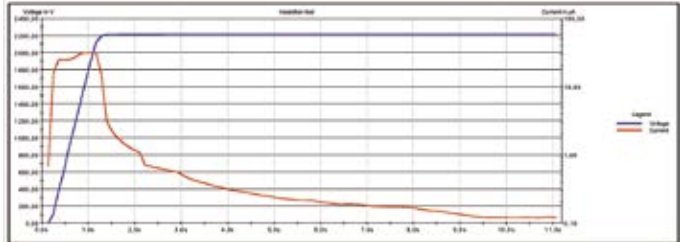
Details: resistance

Resistance test			
Test step	Set value(s)	Real value(s)	
Resistance 1-2	76.00, (68.40 - 83.60) mOhm	76.52 mOhm (25.2°C)	PASS
Resistance 2-3	76.00, (68.40 - 83.60) mOhm	76.41 mOhm (25.2°C)	PASS
Resistance 3-1	76.00, (68.40 - 83.60) mOhm	76.48 mOhm (25.2°C)	PASS
Deviation	5.000 %	0.148 %	PASS

- Phase resistances compensated to 20° C | 68° F
- Winding temperature
- Deviation
- Set values

Details: insulation resistance

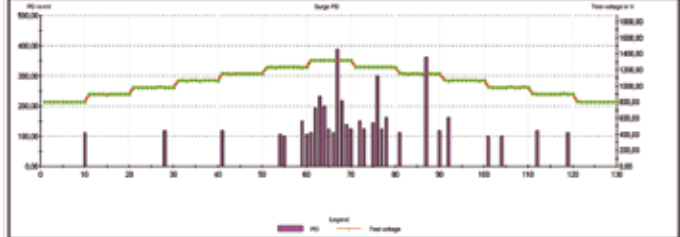
Insulation test DC			
Test step	Set value(s)	Real value(s)	
Insulation test	2000V, 1.000 MOhm	2214V, 6.503 GOhm (40.0°C), 18.139GOhm (25.2°C), Imax1=35.953µA, Imax2=0.122µA	PASS



- Signal characteristics:
Voltage-current | resistance-current | resistance-voltage
- Insulation resistance at measured temperature
- Insulation resistance compensated to 40° C | 104° F
- Set values

Details: partial-discharge test

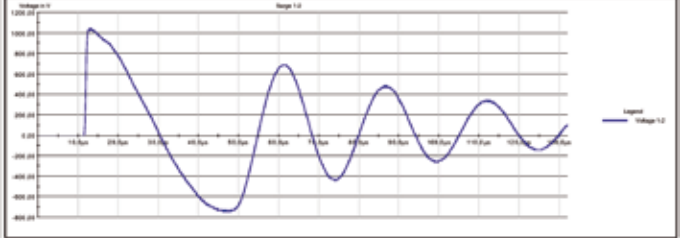
Surge test			
Test step	Set value(s)	Real value(s)	
Surge PD	PDIV: 800V, RPDIV: 1500V, RPDEV: 1400V, PDEV: 1000V, Detection threshold: 300 mV	PDIV: 1394V, RPDIV: 1583V, RPDEV: 1509V, PDEV: 1509V, Background noise signal: 31.25mV, Detection system noise signal: 31.25mV	PASS



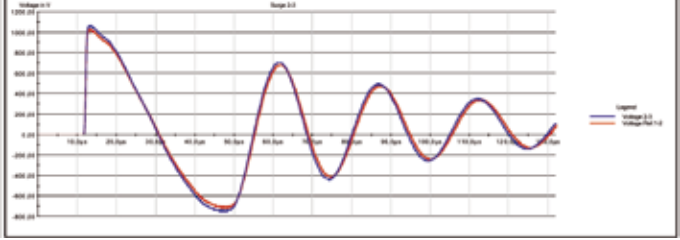
- Logging according to IEC 61934
- Measured values:
PDIV | RPDIV | RPDEV | PDEV
- Background interference level
- Detection-system interference level
- Set values

Details: surge voltage

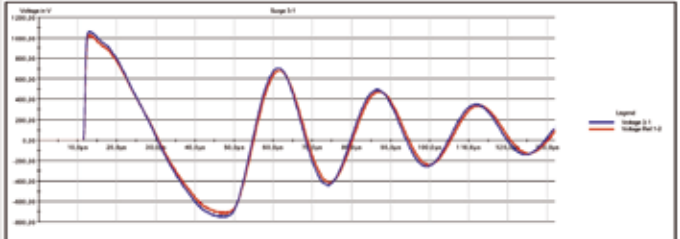
Test step	Set value(s)	Real value(s)	
Surge 1-2	1000V, EAR=15.0%, Cor.=10.0%, Att.=15.0%, Inductance=1.00mH	1033V, EAR=0.0%, Cor.=0.1%, Attenuate=0.0%, Inductance=1.65mH	PASS



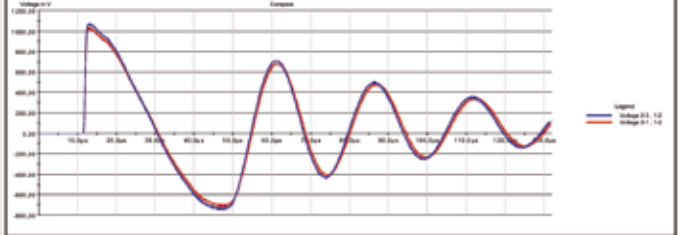
Surge 2-3	1000V, EAR=15.0%, Cor.=10.0%, Att.=15.0%, Inductance=1.00mH	1056V, EAR=8.1%, Cor.=0.3%, Attenuate=4.9%, Inductance=1.67mH	PASS
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Surge 3-1	1000V, EAR=15.0%, Cor.=10.0%, Att.=15.0%, Inductance=1.00mH	1062V, EAR=5.7%, Cor.=0.1%, Attenuate=5.1%, Inductance=1.63mH	PASS
-----------	---	---	------



Compare	1000V, EAR=15.0%, Cor.=10.0%, Att.=15.0%	1014V, EAR=6.0%, Cor.=0.2%, Attenuate=0.7%	PASS
---------	--	--	------



- Signal characteristics of all three phases in one diagram
- Display of the symmetry of all 3 phases one below the other
- Deviation to the reference coil in percent
- Set values

KEY FACTS

- Editable protocol with your company data and your logo
- Printing on Windows®-compatible printers
- Creating PDF-files
- Test protocols in various languages

Integration into a computer network

Heating and test plans as well as results can be stored locally or alternatively on a central server. This guarantees high data security and an optimum data exchange between different heating systems.

Even with only the standard features, the heating system can operate in all network infrastructures. This gives you the ideal platform to collect, manage, analyze and distribute information.

Proven and widely-used Microsoft®-technologies are the foundation for the database.

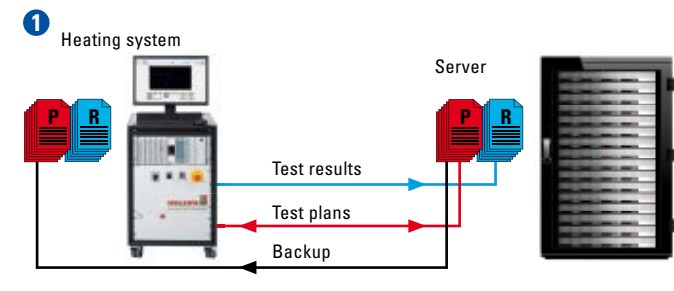


The heating systems can ideally be networked with ERP-, PPS- and CAQ-systems. For every application, we offer reliable and user-oriented standard solutions.

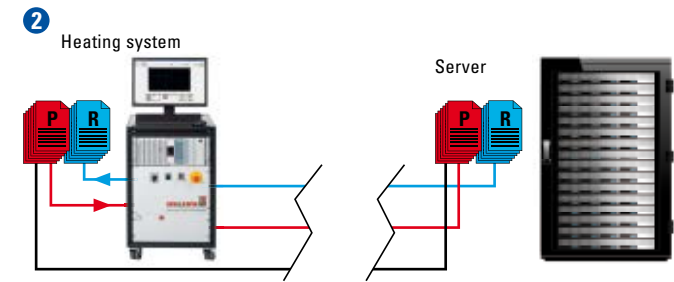


KEY FACTS

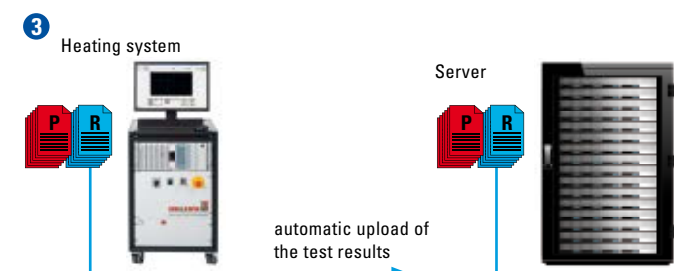
- Central storage of heating & test plans
- Editing of the plans directly at the system or at workstations
- Central storage of the results
- Local evaluation of the results at the system or at workstations
- Working in global networks
- Storage in Microsoft SQL®, Access®, ...
- Automatic local storage in case of network failures
- Automatic data exchange after the failure
- Fast statistical calculations on the server
- Ideal options for remote maintenance



1 In order to be able to keep operating in the event of a network failure, every system automatically creates local copies of the latest heating & test-plan database of the server.



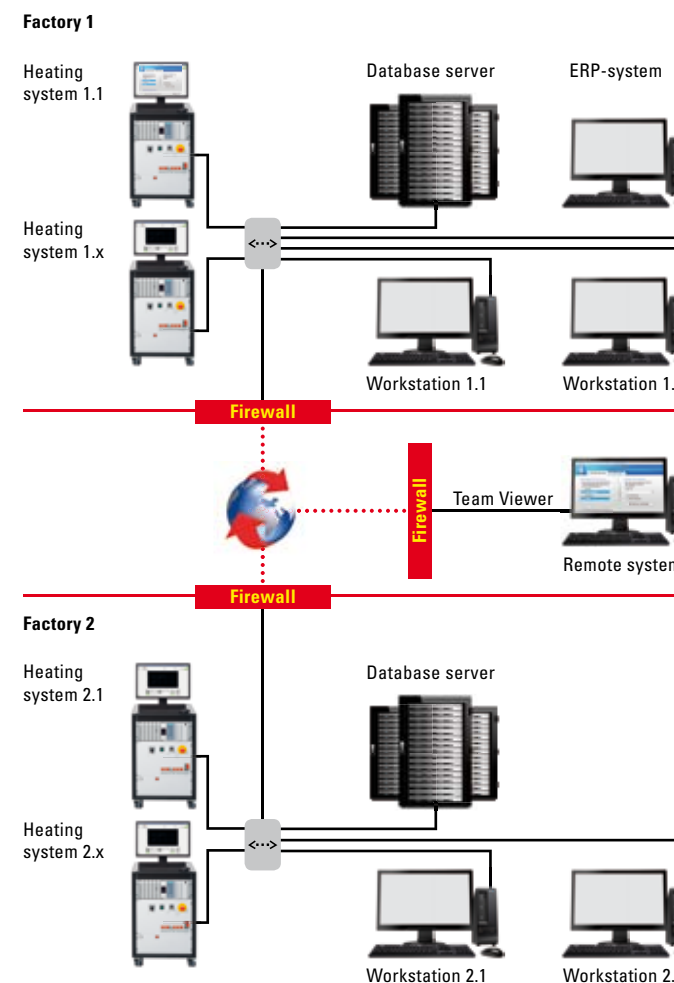
2 In the event of a network failure, the tester uses the local backups and stores the results locally in the system.



3 After the network connection has been reestablished, the system automatically uploads the test results to the server to update the server database.

Test plans Test results

Complex global network



Our Windows®-based resistive-heating systems can be operated in complex network topologies. You can install any number of systems at various sites all over the world and have them work in a central server database for heating and test plans as well as results. With our extensive experience in networking our systems globally, we guarantee that you can offer the same quality of your product no matter where it has been produced.

It goes without saying that any work connected with editing plans, printing labels and working with statistics can also be carried out at the individual resistive-heating systems. In order not to interfere with the production process, networks allow to do this kind of work at separate workstations. These workstations use the same software as the resistive-heating systems allowing the most convenient operation.

You can also store labels centrally on a server. The system loads the label matching the respective plan and, after heating/testing, sends the data to a thermal transfer printer. The labels can be designed as required.

In the event of remote maintenance, we can temporarily log on to your network and directly access the respective system. If you grant us access, we can use mouse and keyboard and view the screen contents of your system. Of course, this kind of work will only be done together with you and requires a separate access from your part.

Data exchange in automation

The resistive-heating system is ideally suited to be integrated into automatic systems. It offers a huge variety of different interfaces for communicating with the higher-level automation systems.

Typical requirements:

- Controlling complete processes and components
 - Processing inputs, signal transmitters, scanners, RFID-readers, ...
 - Setting outputs, e.g. for cylinders, ...
 - Controlling motors and drives, ...
- Exchanging start-, stop- and result signals
- Direct communication with a PLC
- Bidirectional communication
 - Receiving heating and test plans or parameters
 - Sending results
 - Transfer of raw data
- Communication with robots, cameras, ...

This is done by our configurable standard software modules, which reduce the effort for an integration of the system into automation systems to a minimum.

KEY FACTS

- Digital input/output interfaces
- Various interfaces directly to a PC
- Interfaces based on field busses
- Interfaces based on industrial Ethernet systems



The indicated logos are registered trademarks of the respective companies.

Data exchange with IT-systems



KEY FACTS

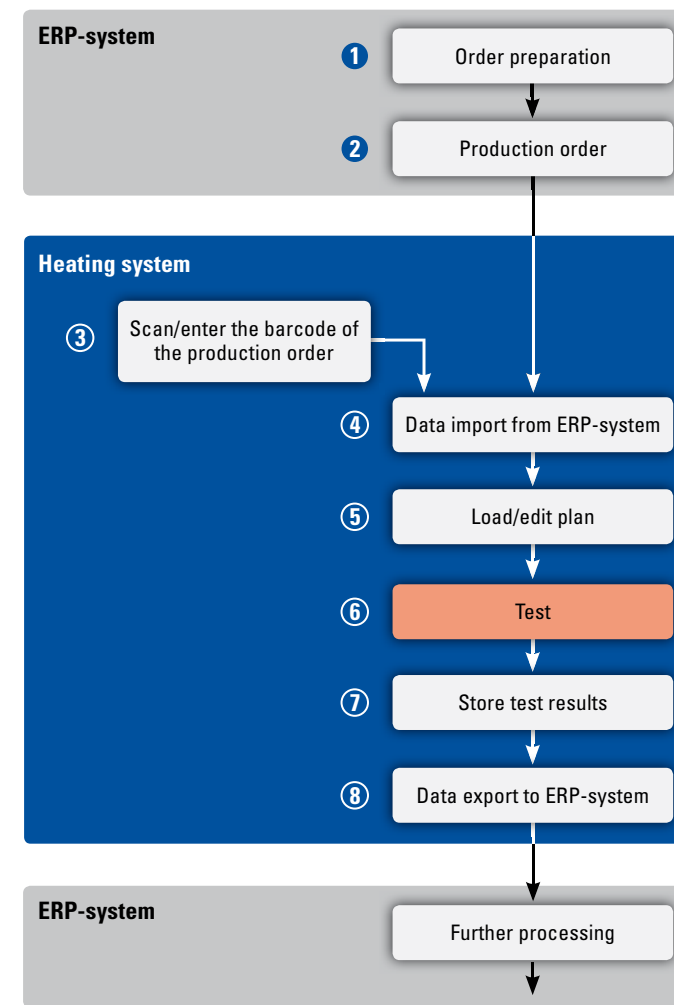
- Bidirectional communication with
 - ERP-systems
 - MES-systems
- Exporting data to
 - CAQ-systems
 - Databases of your choice
 - CSV-files
 - Excel®
- Data import and export via XML
- Configurable tools for
 - Data import
 - Data export
- ...

The data exchange between the heating system and other IT-systems is based on well-proven solutions.

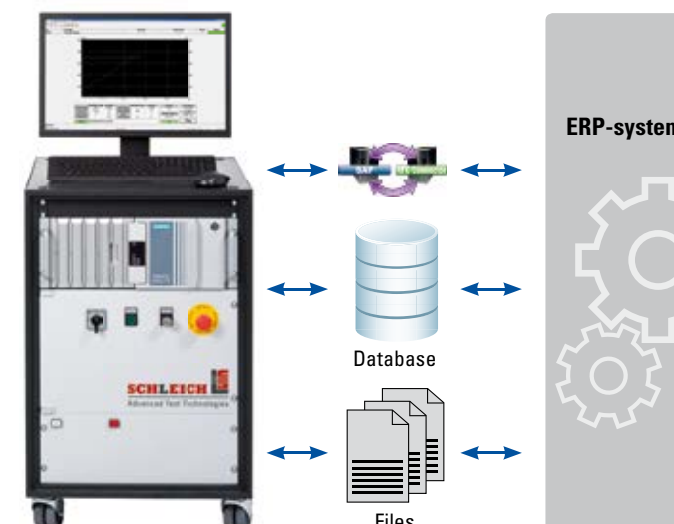
Typical requirements:

- Importing production orders from ERP-systems
- Automatic and dynamic creation of heating and test plans based on production orders and parts lists
- Automatic generation of serial numbers from the data of the production orders
- Communication of results to ERP-systems
- Traceability of the complete production chain
- Receiving data for printing labels
- Filtering and transmitting data to statistical evaluation systems / CAQ
- Transfer of the test results to long-term archiving systems / product liability
- Communication with special systems of automotive industry

By means of our standard software modules, the heating system can be integrated into an IT-system with minimum effort.



Typical ways of communication



- 1 The customer order is planned in the ERP-system.
- 2 The ERP-system creates a production order and adds data required by the testing device. For example:
 - heating plan / test plan definition
 - serial numbers
 - quantities
 - label information
 - parts lists
 - product characteristics

The heating system can access these data directly or indirectly. For example with SAP, indirect access takes place via an RFC.net connector. For indirect access, the ERP-system stores the data either in a separate database or in special files in the network.

- 3 At a manual test station, the operator scans the number of the production order (confirmation number) from the working documents – for example via a barcode. At an automatic test station, this information might also come from the line control, from mobile data carriers (RFID) or from other systems.
- 4 On the basis of the production order, the heating system now imports the information relevant for the test.
- 5 The respective heating/test plan is automatically loaded out of the heating/test-plan database of the heating system. Depending on the parts-list information of the ERP-system, the heating/test plan can consist of several sub test plans.

The ERP-system can transfer further test parameters and tolerances that are added to the respective test steps of the heating/test plan. This creates an automatically generated process exactly matching the production order, without the operator having to make any inputs.

- 6 The heating system starts the test based on the valid test plan.
- 7 The detected test results are stored either locally or in the network. The test results can either directly be printed as test protocol or automatically generated and stored as PDF file.

In addition, automatic label printing is possible. The label will contain the results and, if applicable, data from the ERP-system.

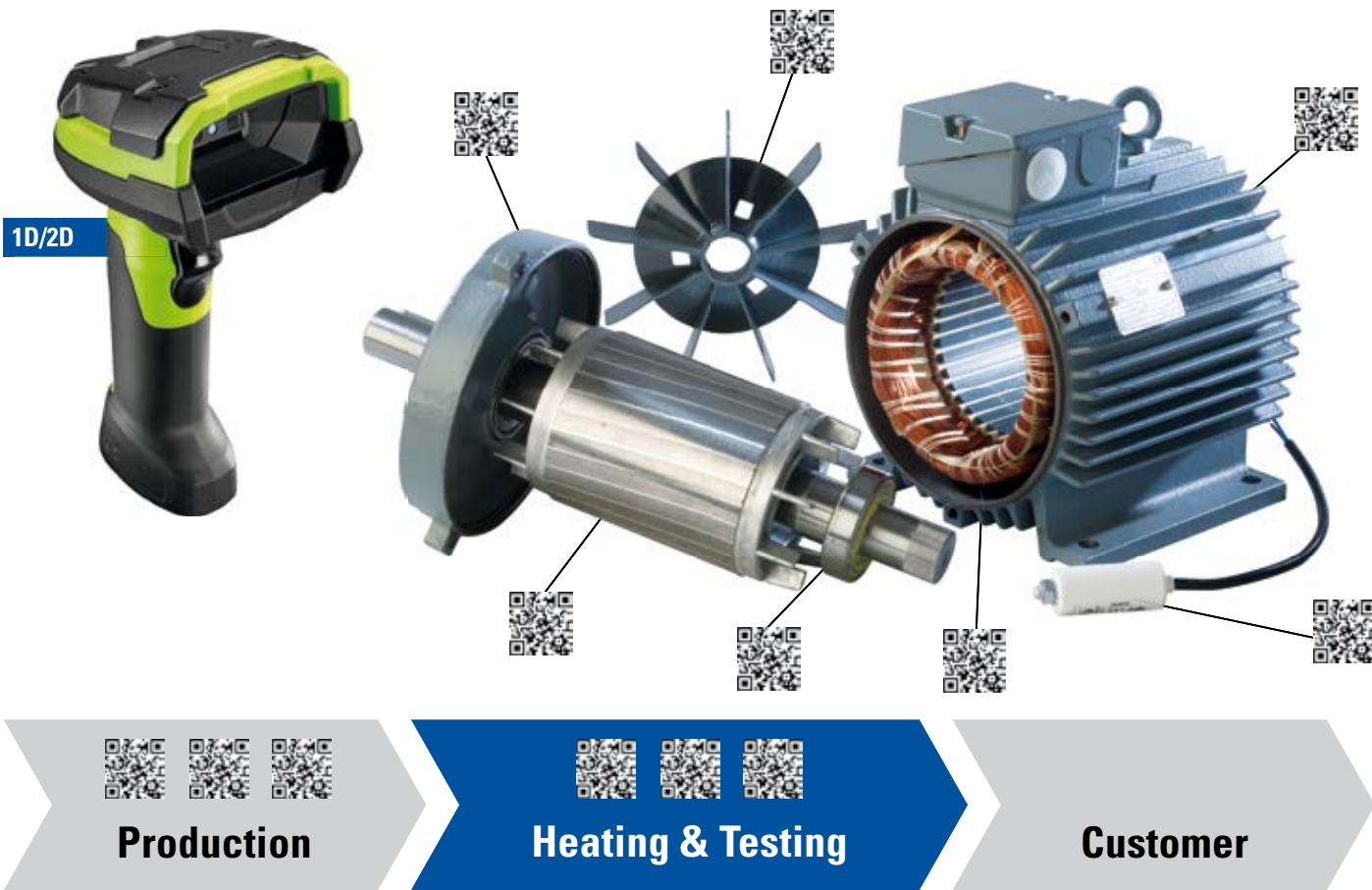
- 8 Finally, completion reports, results, date/time, operator name, quantities, etc. are sent to the ERP-, CAQ- or MES-system for further evaluations and analyses.

The indicated logos are registered trademarks of the respective companies.

Traceability

The heating system can store characteristics and further information of the DUT in the database.

In the event of variations in quality, marking components, modules and final products with a unique number gives you clear information about the complete manufacturing process. Traceability puts you in a position to react to production problems in a fast and targeted manner.



KEY FACTS

- Embedded in Industry 4.0
- Free configuration of the information to be scanned
- Free configuration of additionally stored order data
- Storage of traceability data
 - in the result database
 - in an ERP- or MES-system
- Traceability without additional IT-system
 - searching for stored information
 - detecting the products in question

Marking and labeling

After heating/testing, you might want to mark or label the DUT.

This is a process that takes place automatically after the test, requiring no manual intervention.

To control marking or labeling devices, the heating system is equipped with the following interfaces:

- Ethernet
- USB
- RS232

The system can also load and print various layout data. The layout can be provided by a higher-level ERP-system.

Possible marking and labeling:

- Marking of good or bad by means of an impact punch
- Marking of good or bad by means of a color-marking system
- Laser marking of the serial number after passing the test
- Printing of GO labels
- Printing of NO GO labels
- ...

Laser marking

Laser marking is extremely durable and allows to mark nearly all types of materials. The laser changes the color of the material without changing the surface condition.

KEY FACTS

- Durable and long-lasting
- High contrast
- Wear-free
- No consumables



Label printing

Thermal transfer label printers are used for marking your product after heating/testing. The printer creates labels that are attached to the product, e.g. as a name plate.

The printer comes with a label-design software, which allows an individual design. After heating/testing, the desired variables are entered in the respective place holders by the heating system.

KEY FACTS

- Universal use owing to a great number of available label materials
- Simple integration into the testing process
- Easy operation

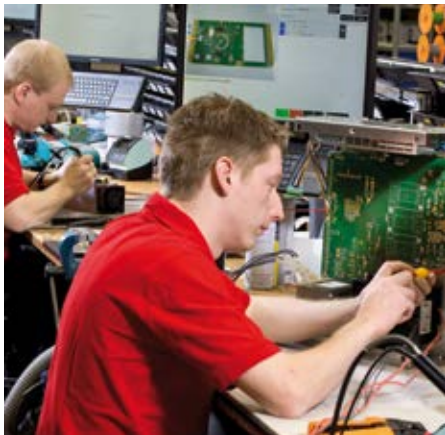


Another word for “Made in Germany”: SCHLEICH



Comprehensive production facilities allow designing and manufacturing almost all tester components at our site in Hemer.

For example, our measuring and electronic PCBs are produced with an ultra-modern in-line-SMD-placement system, which assures a stable quality of our products.



Modern high-end processors in our testers process the test tasks in a fast, precise and reliable manner. With our modern CNC-machines, we also design and manufacture a great number of accessory components such as test covers, contacting units, workpiece carriers with DUT-holders or robot gripping tools as well as complete automatic production lines.

Whatever you want to test... ...SCHLEICH has the solution!

SCHLEICH is a leading system provider in the area of testing motors and windings. Our extensive range of products allows us to provide you with testers, test systems and complete production lines for almost every test task.

Decades of experience, listening to our customers and satisfying their wishes – facing individual tasks with technical creativity and realize them in a team of highly skilled engineers and designers – this is what we do. This is SCHLEICH.

Every single one of our more than 120 employees works on guaranteeing and optimizing the high quality standard of our testing devices each and every day. Our customers, our sales department, our motivated engineers and manufacturing staff – with their ideas and suggestions for improvement they are all part of the innovation process.



Service without limits. We are there for you – wherever you are.

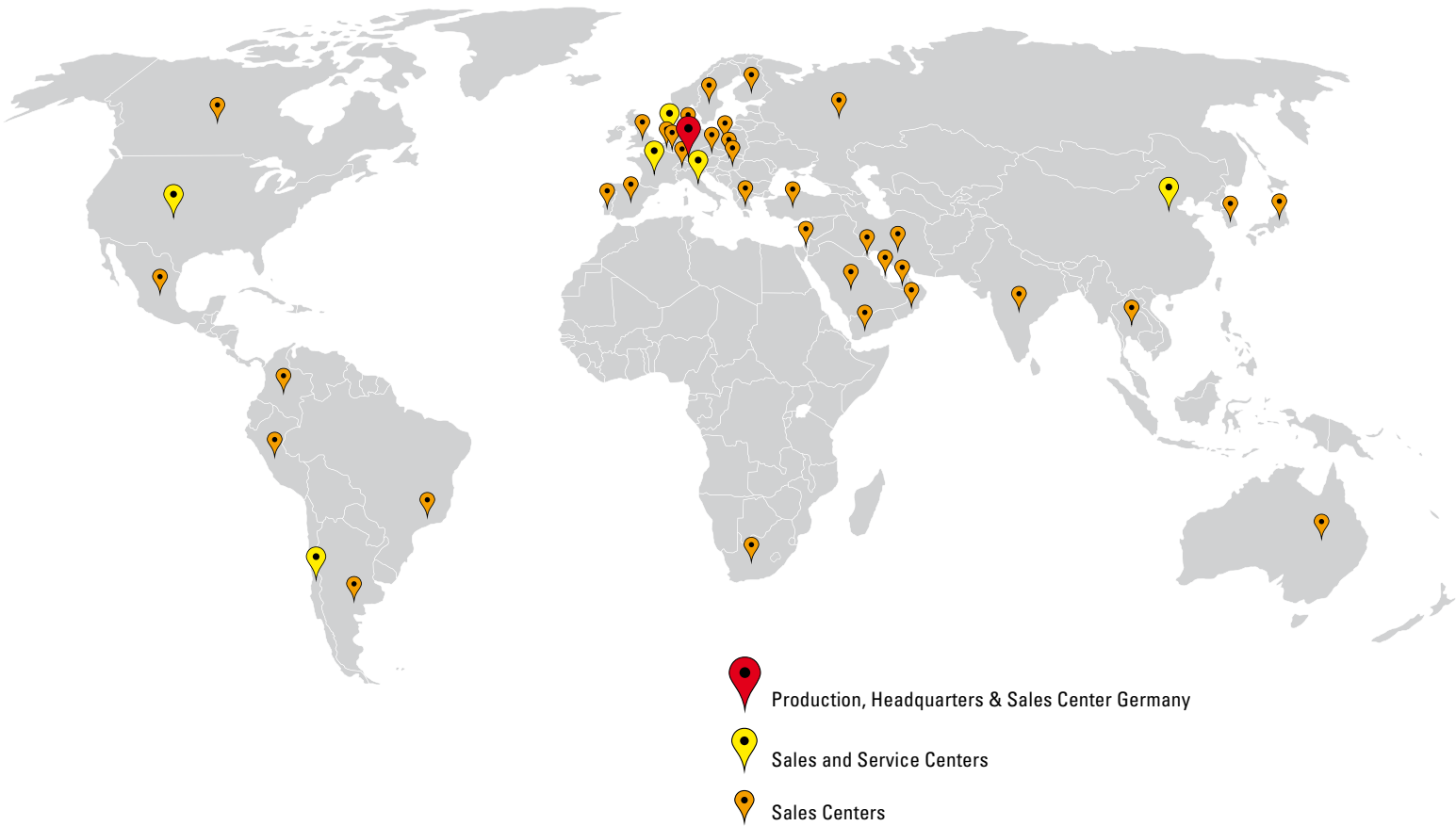


First-class customer service is our top priority. From detailed consulting during the planning phase to training and After-Sales-Service – we support you during the entire process.

In training sessions adapted to your requirements, our technicians will teach you the necessary know-how allowing you to avail yourself of the functional variety of our testing devices to the full extent. Should there be questions or technical problems, our technical support team will assist you by phone, on-line or on-site fast and reliably. Constant software updates and extensions make sure that you can always work with state-of-the-art test software. The periodic calibration of test equipment is an essential precondition for quality assurance. We calibrate your test equipment according to standards – on site or via remote maintenance.

It goes without saying that we calibrate in accordance with national and international standards. Our Service Centers support you around the world – with dedication, competence and reliability.

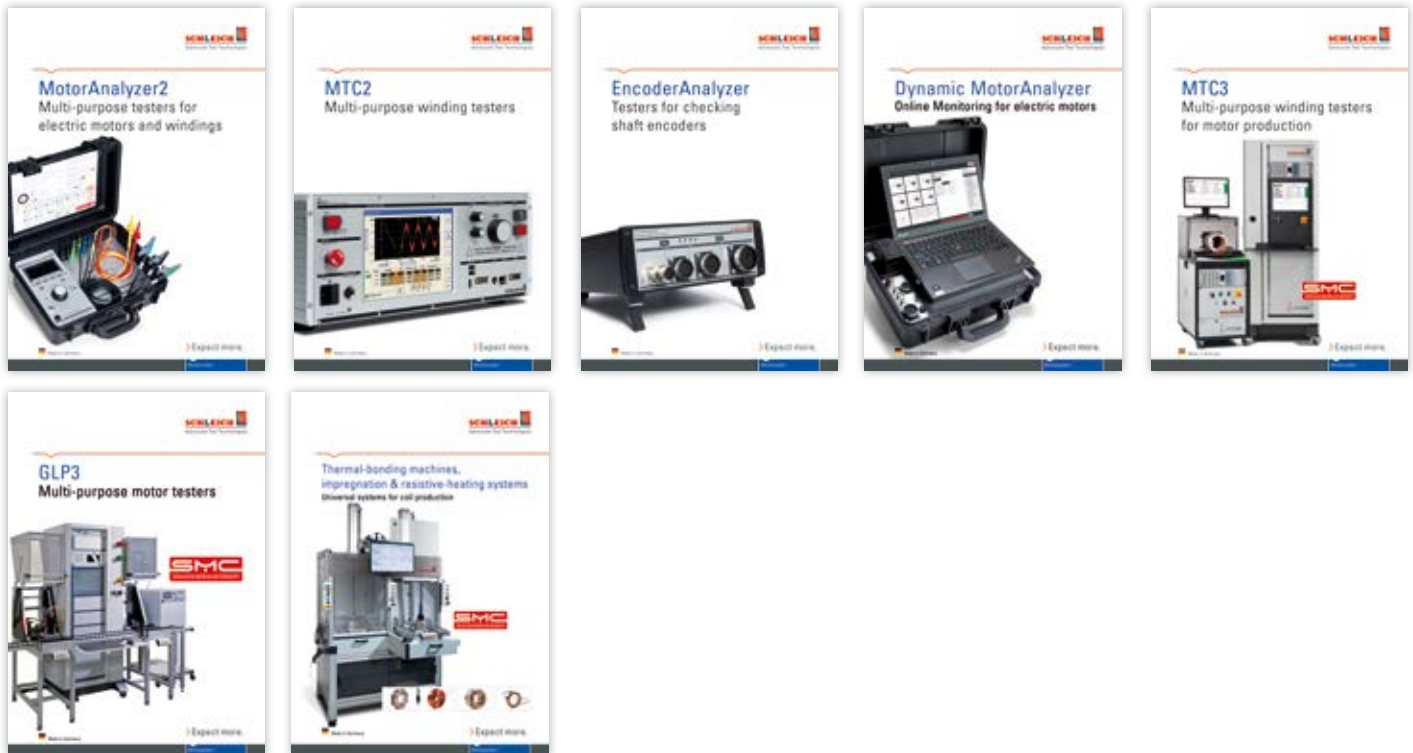
Sales and Service Centers



Experts in tests and measurements.

Whatever you want to test, SCHLEICH has the solution! As a leading supplier of electric safety and function test systems as well as motor and winding testers, we offer solutions for any task in this sector. Our owner-managed company, founded more than 50 years ago, is present in over 40 markets all around the globe.

Testers for electric motors and windings



Electrical safety- and function testers



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Advanced Test Technologies

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