SCHLEICH

Advanced Test Technologies

Dynamic MotorAnalyzer

Online Monitoring of electric motors

Made in Germany

〉Expect more.

The Dynamic MotorAnalyzer –
Motor monitoring without special know-how

The Dynamic MotorAnalyzer allows the testing of a running motor in its operational environment. Electric parameters are measured and other mechanical parameters are calculated. The aim is to receive an analysis of the electric motor, its mains supply, and its load conditions based on six electric measuring values.

The Dynamic MotorAnalyzer provides needed technology to facilitate the motor check without requesting special knowledge from the operator. It is a great extension to our winding testers, the MotorAnalyzer 2 and MTC2.

〉 Voltage
〉 Current
〉 Power
〉 Cos φ
〉 Performance factor
〉 Frequency
〉 Harmonics
〉 Total harmonic distortion
〉 Power supply analysis
〉 Torque

〉 Torque ripple
〉 Speed
〉 Efficiency
〉 Performance reduction factor
〉 Energy costs
〉 Utilization
〉 Overload
〉 Peak values
〉 Transients
〉 Long-term measurement
〉 …

KEY-FACTS

- All in one-motor monitoring
- Motor evaluation without special knowledge
- Mains supply analysis
- Monitoring of motor supply on VFD-operation
- Monitoring of the motor´s operation parameters
- Determination of mechanical performance characteristics and torque
- Analysis of load and efficiency
- Under and overload monitoring
- Spectral analysis to detect rotor problems
- Energy balance analysis
- Analyze energy costs with amortization calculations and payback time
- Historic trending with data recorder function and event logging
- All measuring signals and calculations are displayed (similar to an oscilloscope)
- Combine the Dynamic MotorAnalyzer with the EncoderAnalyzer
- Extensive protocol printing
- SQL-data base for motors, sorted by manufacturer and type
- SQL-data base for saving all settings and measured values
- Motor voltage measuring range up to 700 V_{trms}
- Motor current measuring range from 5-5000 A_{trms}
- Numerous current clamps and Rogowski current sensors can be connected
- Battery operated
- Multilingual, modern user interface
- Worldwide voltage supply 90-250 V/47-63 Hz

The dynamic motor monitoring in practice

Often motors become hot during operation. It may be due to the mains power supply, the motor itself, or its load. It may have an electrical or a mechanical cause.

It is often difficult to find the cause for the fault, as many motors are difficult to access. It is easier to access the motor´s input lead. The electric parameters can be measured here and then, among others, the mechanical parameters are calculated.
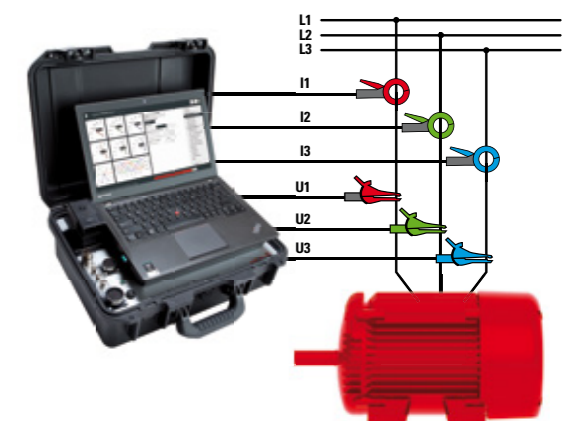
With the Dynamic MotorAnalyzer, the operator is able to find quickly and effectively the cause of the problem on the electric motor.

The Dynamic MotorAnalyzer –
Outstanding technology, robust packaging

The Dynamic MotorAnalyzer consists of a measuring module and the analysis software installed on the PC. Both components are installed as one unit in the rugged measuring case.

The measuring module detects millions of measuring values per second on the running electric motor and transfers them to the PC. The communication between the measuring module and the PC is done with a high-speed Gigabit-connection.

The software analyzes the measured values in real-time and indicates the results. The results are displayed in two ways: the numerical values are listed and secondly through a graphical display that is quick and easy to understand. The test results are then stored in a safe, modern SQL- data base and detailed reports can be generated if required.
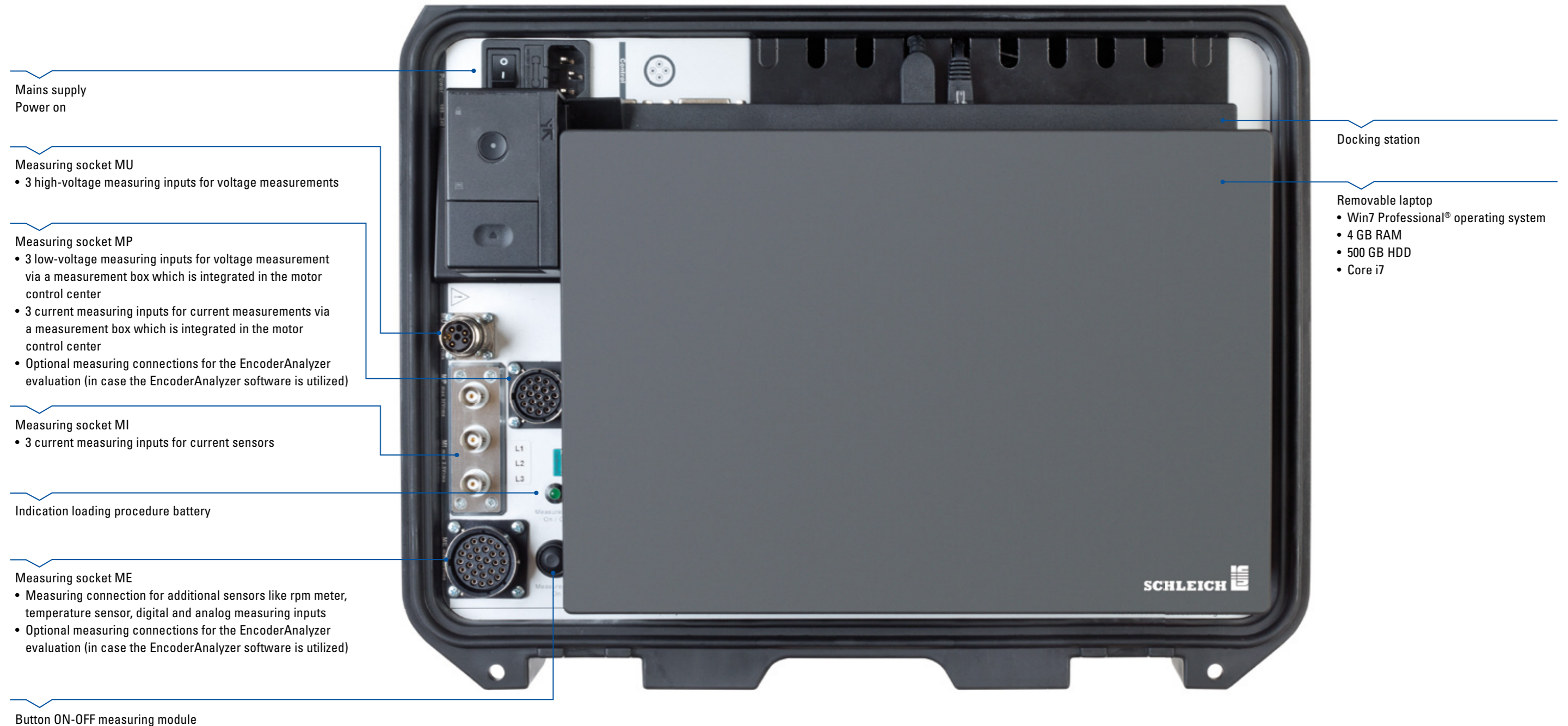
ROBUST INDUSTRIAL STANDARD

Made in Germany

Mains supply
Power on

Measuring socket MU
• 3 high-voltage measuring inputs for voltage measurements

Measuring socket MP
• 3 low-voltage measuring inputs for voltage measurement via a measurement box which is integrated in the motor control center
• 3 current measuring inputs for current measurements via a measurement box which is integrated in the motor control center
• Optional measuring connections for the EncoderAnalyzer evaluation (in case the EncoderAnalyzer software is utilized)

Measuring socket MI
• 3 current measuring inputs for current sensors

Indication loading procedure battery

Measuring socket ME
• Measuring connection for additional sensors like rpm meter, temperature sensor, digital and analog measuring inputs
• Optional measuring connections for the EncoderAnalyzer evaluation (in case the EncoderAnalyzer software is utilized)

Button ON-OFF measuring module

Docking station

Removable laptop
• Win7 Professional® operating system
• 4 GB RAM
• 500 GB HDD
• Core i7

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Discovering energy-saving potentials

Due to its variety of application fields, the Dynamic MotorAnalyzer completely covers all analyzing tasks, no matter if short or long term measurement, mains analysis, motor analysis, load analysis or annual energy costs calculation.

All these characteristics allow the detection of potentials for energy saving and for cost savings decisions.

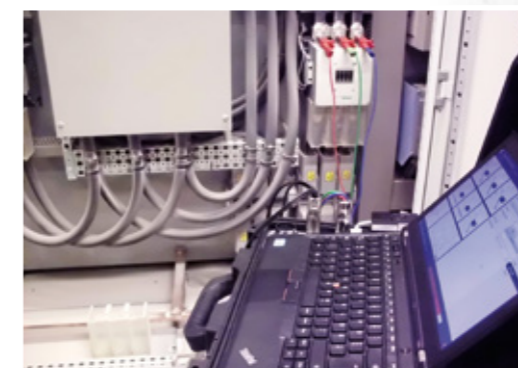The energy efficiency of large systems is the sum of many individual components. The electric motor is one of the components which make up a large share of the total consumption. In industrial plants, energy consumption of electric motors can be more than 60% of total plant consumption. Generating heat or lightning rather plays a minor role.

Thus the effective use of the electric motor offers significant potential for saving energy. Therefore, it makes sense to find efficient solutions in this range first.

The electric motor´s efficiency depends on several conditions. To achieve optimal energy consumption, all conditions should be met.
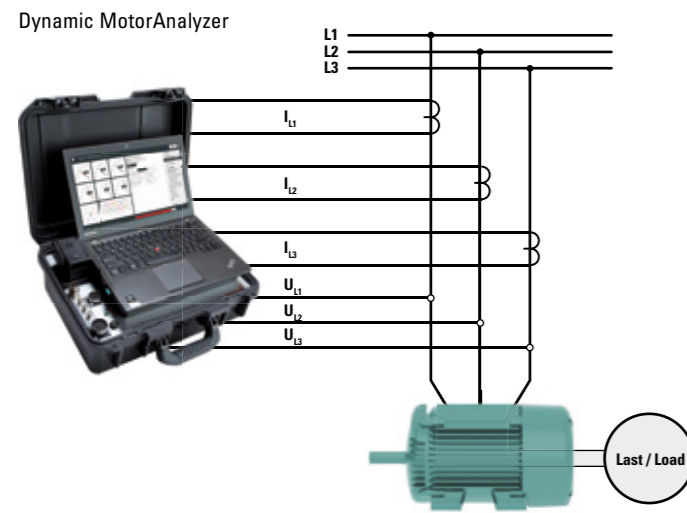
The optimization measures focus on the following points:

- **Performance factor as closely as possible to 1**
  Performance factors (cos φ) in the range of 0.97-0.98 are good.
- **Use motors with high efficiency**
  For motors with long operating times, the change to an IE3 or IE4 motor pays off within 1-5 years.
- **If possible, operate motors in the nominal range**
  Oversized motors operated with bad performance factors and the acquisition costs are quite high.
- **Even load profiles**
  If possible, avoid too high load peaks.
- **Use VFDs, if motor is operated with a lower than one nominal load**
  The use of a VFD makes sense if load peaks cannot be reduced in order to operate the motor at the maximum power point.
- **If possible, assure good mains quality**
  An asymmetric or fluctuating mains supply often influences the motor negatively.
- **Reduce losses in leads**
  Supply leads to large systems that are as short as possible and, for technical reasons, the next bigger lead cross-section should be considered. At longer operating times a pay off after 1-5 years can be expected.
- **Reduce motor leakage current against earth/ground bond**
  The motor insulation should be checked and maintained in regular intervals.
- **Maintenance- and life cycle management | LCC-Life Cycle Costs**
  To make optimum use of the plant, reasonable, preventive maintenance is important. Although this has no direct influence on the energy costs, the life cycle costs may be reduced. LCC consist of energy, acquisition, operating, and maintenance costs. In this context, maintenance should not mean repair. By reasonable preventive maintenance, high repair and breakdown costs can be avoided. Also in this case the Dynamic MotorAnalyzer, in combination with other SCHLEICH testers, offers valuable services.

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Measurements

Dynamic MotorAnalyzer

L1
L2
L3

I_{L1}
I_{L2}
I_{L3}
U_{L1}
U_{L2}
U_{L3}

Last / Load

The motor to be tested is connected to the motor lead by means of voltage measurement connections and current clamps.

The Dynamic MotorAnalyzer has an automatic phase balance. If the instrument has a phase connected accidentally wrong, the operator doesn't have to disconnect or re-clamp the measuring lead. The Dynamic MotorAnalyzer performs a connection control and adapts itself correspondingly.

Measurement at motors with current transformer

Dynamic MotorAnalyzer

L1
L2
L3

I_{L1}
5A
I_{L2}
5A
I_{L3}
5A
U_{L1}
U_{L2}
U_{L3}

Last / Load
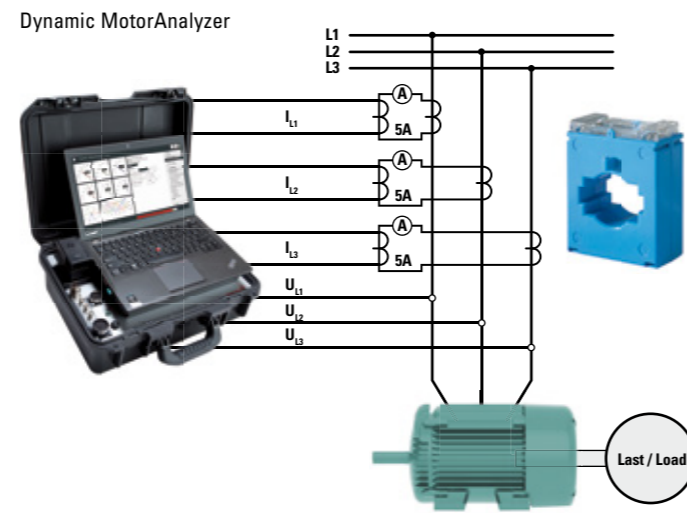
Due to the 5 A measuring range, the current can also be easily measured by current transformers on the secondary side. For this, only the transformation ratio has to be entered. Afterwards the software re-calculates the measured values accordingly.

Measurements at motors with voltage transformers

Dynamic MotorAnalyzer

L1
L2
L3

I_{L1}
I_{L2}
I_{L3}
U_{L1}
U_{L2}
U_{L3}

Last / Load
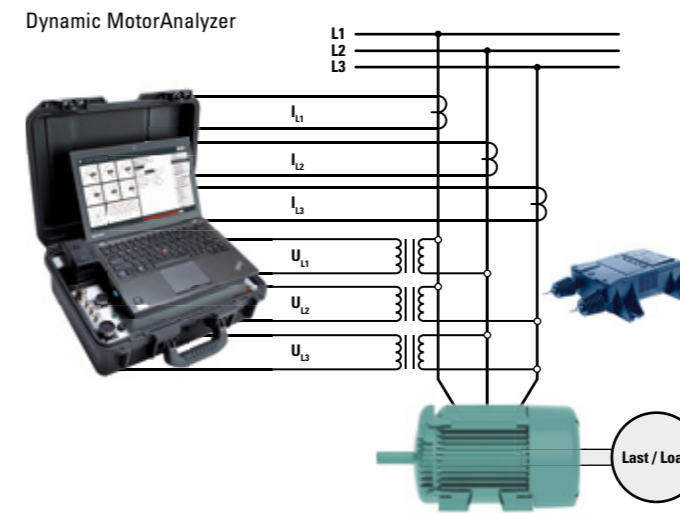
Voltage measurements in electric motors with high operational voltages are often performed with the help of voltage transformers. Here the Dynamic MotorAnalyzer is able to measure the voltage on the voltage transformer´s secondary side. For this, only the transformation ratio and the type of transformer have to be entered. Afterwards the software re-calculates the measured values accordingly.
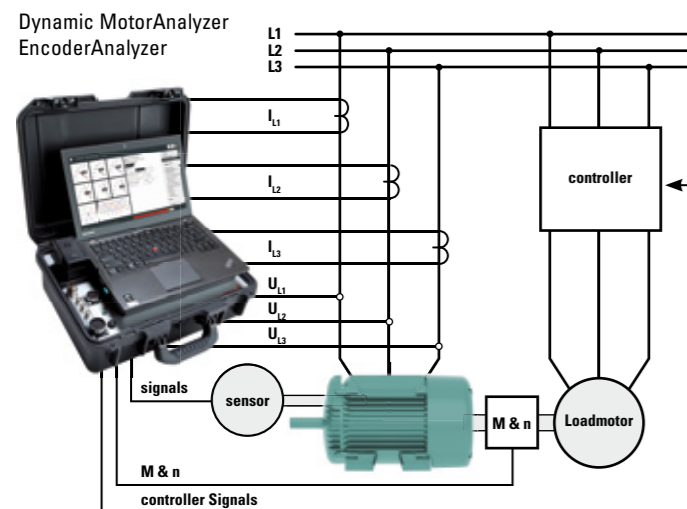
Other configurations of voltage transformer connections are also measurable.

Dynamic MotorAnalyzer in combination with EncoderAnalyzer

Dynamic MotorAnalyzer
EncoderAnalyzer

L1
L2
L3

I_{L1}
I_{L2}
I_{L3}
U_{L1}
U_{L2}
U_{L3}

signals   sensor   Last / Load
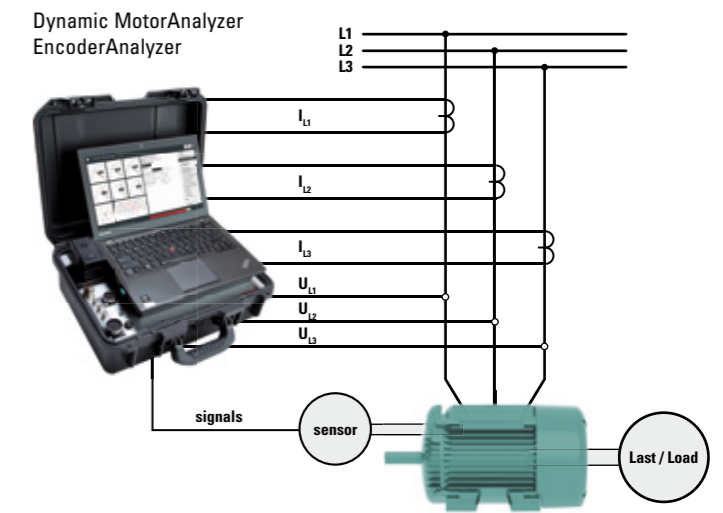
By combining the Dynamic MotorAnalyzer with the EncoderAnalyzer, SCHLEICH has developed a highly innovative instrument. This combination offers a great deal of value to the maintenance professional in performing dynamic monitoring and the comparison of various rotary encoder systems.

Test bench for electric motors

Dynamic MotorAnalyzer
EncoderAnalyzer

L1
L2
L3

I_{L1}
I_{L2}
I_{L3}
U_{L1}
U_{L2}
U_{L3}

controller

signals   sensor   M & n   Loadmotor

M & n

controller Signals

With the Dynamic MotorAnalyzer the user is also able to perform measurements at a load test rig. Torque-/speed characteristics can be determined with the Dynamic MotorAnalyzer, which is equipped with additional measuring inputs. Via these inputs, by using a torque measuring shaft, the torque and the speed signal as well as the temperature can be captured. In combination with the electrical input parameters, the system reliably delivers all information about the motor.

Depending on the configuration of the test bench, the Dynamic MotorAnalyzer is also able to control and monitor the test bench. Thus, the Dynamic MotorAnalyzer is also ideally suited for upgrading already existing test benches.

Additional measuring leads

The Dynamic MotorAnalyzer also offers additional analog and digital inputs. Via software, they can be easily and quickly configured for a variety of measuring signals. Thus, in combination with the electrical parameters, motor temperatures, oscillations, flow volumes or pump pressures can be measured and analyzed without any problems. The aim is, to provide the operator an overall picture of the system.

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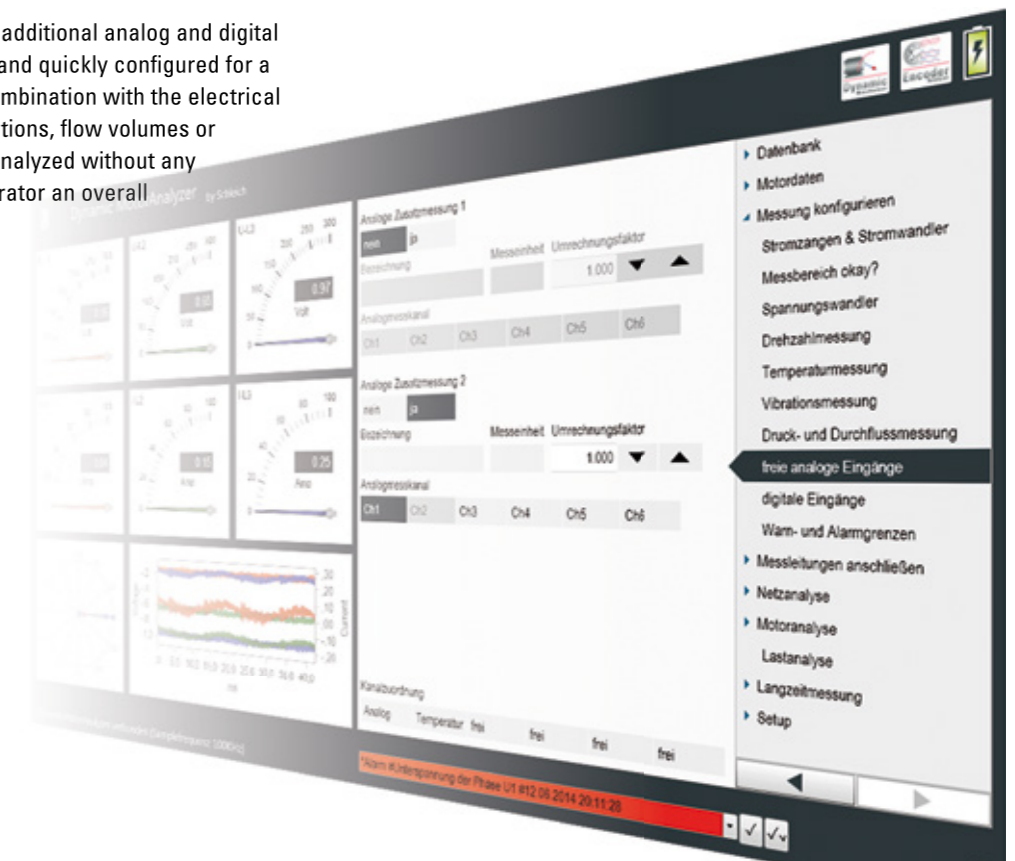
The analysis software

The quick, intuitive measuring technology and the user-friendly analysis software are effectively combined. Only a few setting clicks and selections are required for configuring the test for the connected motor.

The input of name plate details and other parameters is only required if the results are being printed after the measurements, as these are necessary for searching in the data base.

The comprehensive evaluations lead to clear, understandable results. Specialized knowledge is not necessary when using the analysis software. The software calculates all electrical and mechanical findings that are data based on six electrical values.

No other comparable tester offers, in combination with the EncoderAnalyzer´s functionality, such a variety of analyses. The variety of evaluations is impressive but still easy to understand. The modern user interface is clearly arranged and not overwhelmed with Microsoft® windows elements.

SCHLEICH sets new standards for innovative test technology.

Analyzing the mains supply

The mains quality from energy supplier or VFD decisively influences the motor´s operational performance. No matter whether over or under voltage, if asymmetry between phases or a too high harmonic content - all these facts negatively influence the electric motor and lead to reduced performance. That is why the following measurements and analyses regarding mains supply are performed at phases L1, L2 and L3:

- Minimum, maximum and average values of the voltage rms (root mean square)
- Minimum and maximum voltage peak value
- Minimum, maximum and average value of mains frequency
- Minimum, maximum and average value of phase angles between phases
- Minimum, maximum and average value of voltage asymmetry between phases
- Harmonics analysis up to the 50th harmonic incl. graphical display
- Distortion factor, Total harmonic distortion (THD) and performance reduction factor
- NEMA reduction factors
- Symmetric components
- Graphical voltage display at mains- and VFD operation
- Graphical voltage display of fundamental and the 3rd harmonic during VFD operation

Dynamic motor analysis and its opportunities

The electric motor is supplied with 3-phase current either from the energy supplier or from a VFD (variable frequency drive). The three phase voltages have to meet certain requirements to assure that the electric motor is properly working and according to specifications. If bigger deviations exist, this leads to a wrong operating condition, which regularly results in overheating.

The electric motor consumes current, depending on the mains, along with its qualitative condition and load conditions. The current contains an enormous variety of information, which is evaluated by the Dynamic MotorAnalyzer. Thus it is possible to determine the motor speed and to evaluate rotor problems.

The precise multiplication of voltage and current is the instantaneous power which is consumed by the motor. This might sound trivial; however, this measurement leads to correct results, even though a VFD is used. To meet these requirements, the Dynamic MotorAnalyzer is able to increase its sampling rate to up to 2.5 million measurements per second.
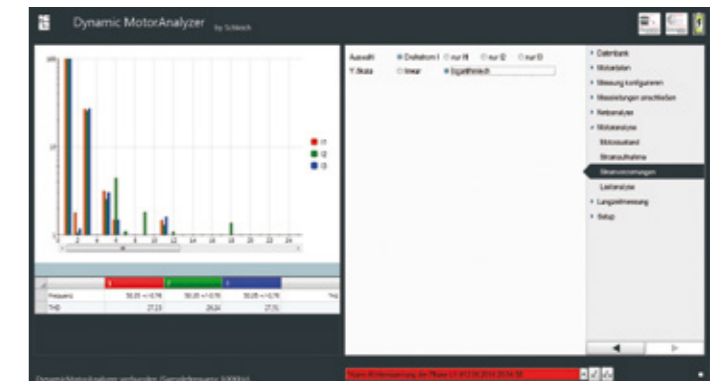
Analyzing the motor´s current consumption

The motor´s current and the relation between voltage and motor current provide information on the motor´s load conditions. From the measured values, the software filters and analyzes this information and presents it in an easy and understandable way. The following measurements and analyses regarding motor current in phases L1, L2 and L3 are performed:
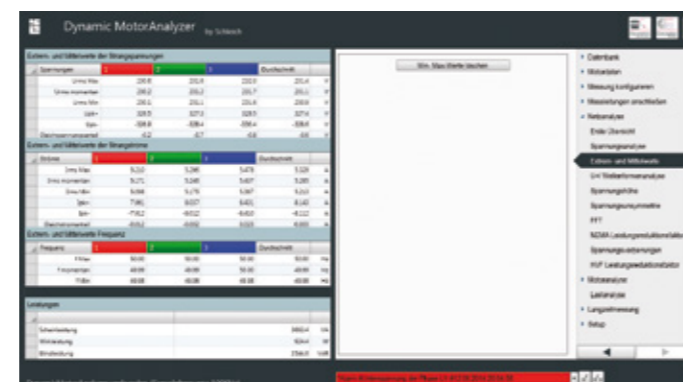
- Minimum, maximum and average values of the current rms (root mean square)
- Minimum and maximum voltage peak value
- Minimum, maximum and average value of current asymmetry between phases
- Harmonics analysis up to the 50th harmonic incl. graphical display
- Distortion factor, Total harmonic distortion (THD) and performance reduction factor
- Symmetry of impedances
- Vectorial total current
- Eccentricity in air gap
- Determination of speed from current
- Speed course at motors with VFD operation
- Inspection of squirrel cage motors regarding broken bars
- Graphical current display at mains- and VFD operation

Analyzing the load and running conditions

Based on voltage supply and the motor current further operational parameters are determined. These are:

- Minimum, maximum and average values of Cos φ in the phases
- Minimum, maximum and average values of the performance factor in the phases
- Electrical power, active power and reactive power
- Torque estimation and torque ripple
- Torque spectrum
- Overload peak detection
- Torque measurement with measuring shaft
- Utilization or %over- %under load
- Efficiency
- Motor temperature
- Various types of mechanical motor problems
- Vibration measurement in X-, Y- and Z direction
- Motor start-up measurement
- Determination of energy costs
- Determination of profitability costs at improved efficiency
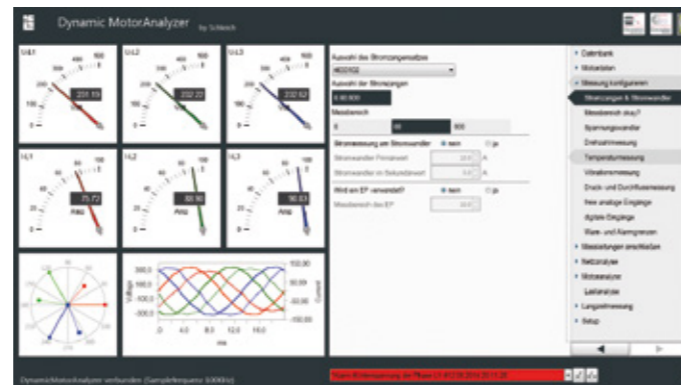
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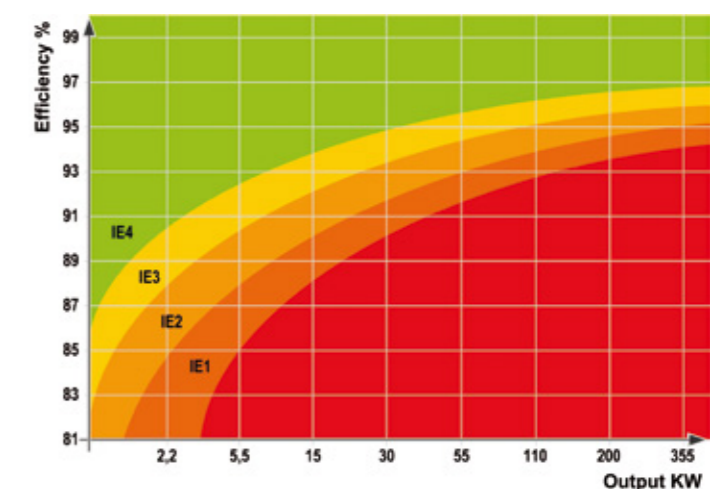
The analysis software

The measurement is performed similar to the use of a multimeter and is often only in short duration. The measuring period can last from a few minutes to hours.

On request the measurements can be directly saved in the data base with all performed analyses. Also an comprehensive printout is possible.

Transient analysis

Transients are measured values as e.g. voltage-, current- or torque peaks. Transients may be the reason for motor problems or may help to detect them. The Dynamic MotorAnalyzer is configured in a way that measures continuously and inspects the values for transients at the same time. As soon as a transient has been detected, the Dynamic MotorAnalyzer starts to record the measured values and displays them on the screen. A typical transient measurement is during the motor start-up.

The software is not only able to display the oscillation´s measured single values, but also the rms-values.
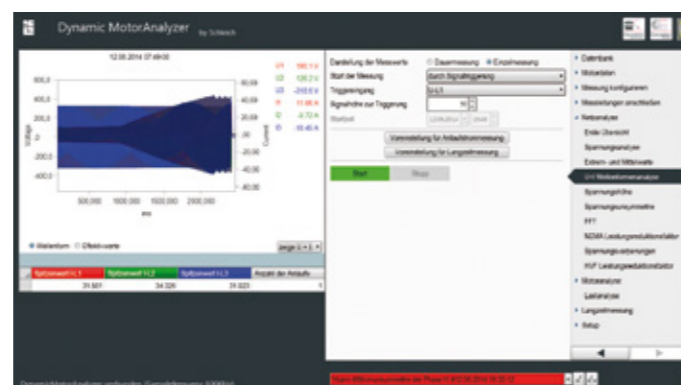

Long-term measurement

For longer observations, measurements may also be carried out for several days. Long-term measurements can either be performed continuously or triggered, based on certain, adjustable events. Extraordinary events are called transients and can be voltage, current or torque peaks. When such an event occurs, the long-term measurement is started and automatically stopped after a predefined time period. By this method, the measured results are reduced only to the extraordinary events.

The saved long-term measurements can be loaded again and analyzed, as if the measurement is still currently running.
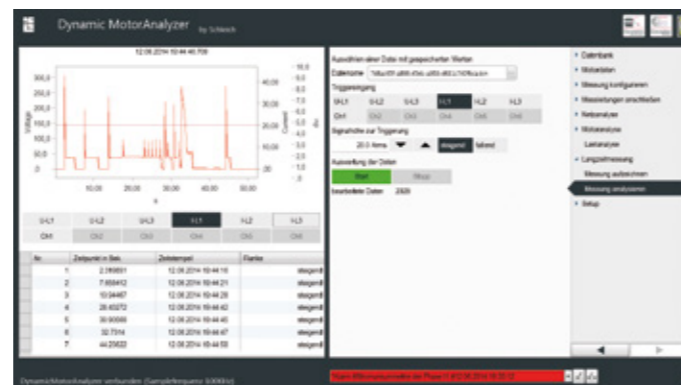

The data base – everything at a glance

All test results, not only the measured values of single oscillations but also the values calculated from them, like the rms, are stored in the data base. To be able to search for the motors quickly and efficiently, many additional search criteria can be entered. The modern data base is based on Microsoft® SQL. Not only the motor test data but also the test results can be arbitrarily exchanged between several Dynamic MotorAnalyzers.
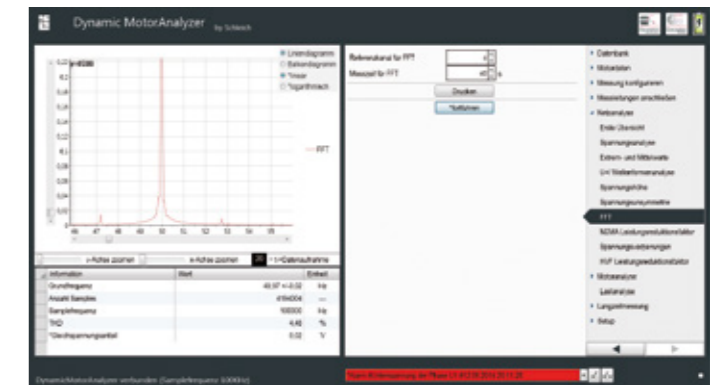
MotorData-Analyzer – special software for centralized storage and analysis
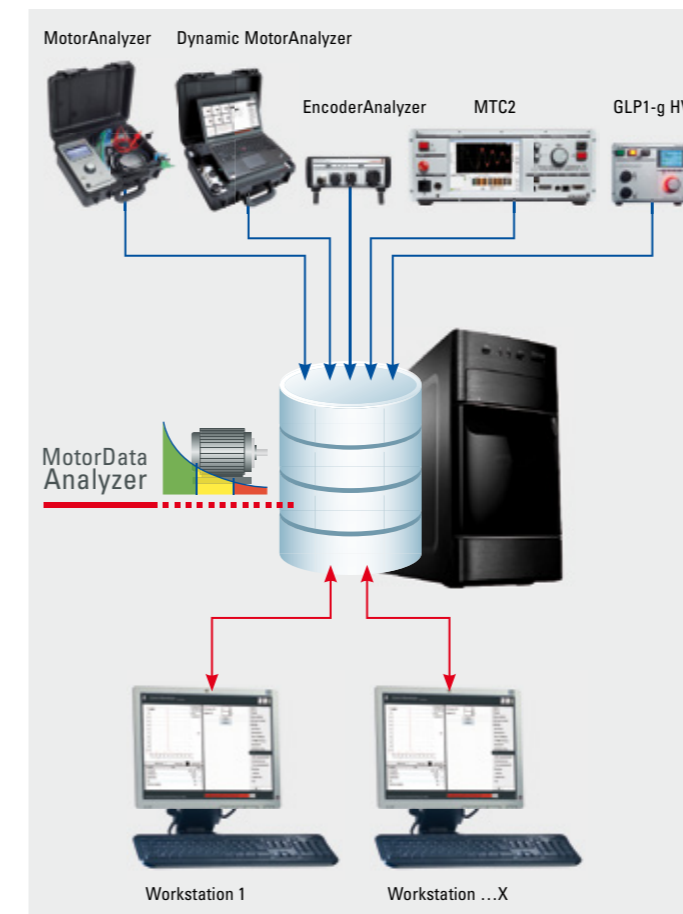
If further SCHLEICH testers are used, the EncoderAnalyzer, MotorAnalyzer 2, the surge voltage tester MTC2 or the high-voltage tester GLP1-g, the user can store all test results together in one central data base. The centralized data storage and evaluation happens by the MotorData-Analyzer software. Based on the measured values from all testers, the MotorData-Analyzer provides the user with detailed information about the electric motor´s condition and its attachments.

The MotorData-Analyzer is a powerful tool, which allows an overview of all motors from plant or customer´s production. No matter whether insulation resistances, surge voltage strength, current consumption, load peaks, harmonic content of the mains supply, resolver evaluation and more, all measured values are available at a glance.

Historical trends and the course estimation of future measured values like the polarization index (PI), are provided by the software, and allow clear statements regarding preventive maintenance and repair. It is the aim, to integrate maintenance into production flow at an early stage prior to problems and not to wait until motor´s failure. That is why the software automatically reminds the user of the next maintenance round.

Furthermore it generates various kinds of reports for documentary purposes.

The accessory

The accessory EncoderAnalyzer

MotorData-Analyzer-Software

Software for central analyzing and storing of all motors, encoders and test results

Part no	403307

TeamViewer-software

- Tester´s remote-control by SCHLEICH in case of service/ support
- Fast support
- Safe and verified connection

Part no.	40031248

Manual rpm meter

For contact free speed measurement

Lead length	5 m/16.4 ft
Part no.	403309

〉Note: may only be used in combination with software 403308.

Software for external speed measurement

Part no.	403308

Temperature probe for measuring the motor temperature

Lead length	5 m/16.4 ft
Part no.	403311

〉Note: may only be used in combination with software 403310.

Software for motor temperature measurement

Part no.	403310

Current clamps

Quantity	3
Type of current	AC
Measuring range switchable	20 A/200 A, 40 KHz
Lead length	2 m/6.6 ft
Part no.	4033105

Quantity	3
Type of current	AC
Measuring range	500 A, 3 KHz
Lead length	2 m/6.6 ft
Part no.	4033106

Quantity	3
Type of current	AC
Measuring range switchable	10 A/100 A/1000 A, 100 KHz
Lead length	2 m/6.6 ft
Part no.	4033107

| Quantity	3
Type of current	AC
Measuring range switchable	30 A/300 A/300 A, 10 KHz
Lead length	2 m/6.6 ft
Part no.	4033108

Current clamps Rogowski

Quantity	3
Type of current	AC
Measuring range switchable	30 A/300 A, 1 MHz
Lead length	2 m/6.6 ft
Loop diameter	45 mm/1.8 inch
Part no.	4033109

Quantity	3
Type of current	AC
Measuring range switchable	30 A/300 A, 1 MHz
Lead length	2 m/6.6 ft
Loop diameter	70 mm/2.76 inch
Part no.	4033111

Quantity	3
Measuring range	3000 A, 1MHz
Type of current	AC
Lead length	2 m/6.6 ft
Loop diameter	100 mm/3.9 inch
Part no.	4033110

Measuring lead MU with alligator clamps incl. fuses
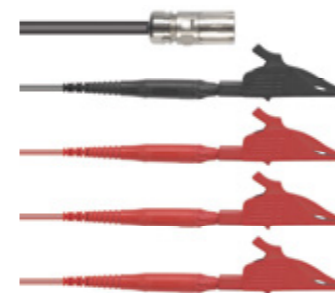
Lead length	3 m/9.8 ft
integrated fuses	4
Part no.	403291

Software for EncoderAnalyzer measuraments

Part no	403304

Software for data interface EncoderAnalyzer

〉 Hiperface and SSi are registered trademarks of the SICK AG
  Endat is a registered trademark of the Dr. Johannes Heidenhain GmbH

Part no.	403211

〉Note: may only be used in combination with EncoderAnalyzer software 403304.

Resolver measuring lead MP

Lead length	2 m/6.6 ft
Part no.	4032201

〉Note: measuring leads may only be used in combination with EncoderAnalyzer software 403304.

Encoder measuring lead MP 17-pole

Lead length	2 m/6.6 ft
Part no.	4032200

〉Note: measuring leads may only be used in combination with EncoderAnalyzer software 403304.

Encoder measuring lead ME 25-pole

Lead length	2 m/6.6 ft
Part no.	4032300

〉Note: measuring leads may only be used in combination with EncoderAnalyzer software 403304.

SCHLEICH
Advanced Test Technologies

Expect more!

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.

Electric motors- and winding testers

MotorAnalyzer 1+2
Multi-purpose testers for electric motors and windings

MTC2
Multi-purpose winding testers

EncoderAnalyzer
Testers for checking shaft encoders

Dynamic MotorAnalyzer
Online Monitoring for electric motors

MTC3
Multi-purpose winding testers

GLP3
Multi-purpose motor testers

Bonding machines

Electrical safety- and function testers

Handheld
Mobile multi-purpose testers

GLP1
Safety-, functional and high-voltage testers

GLP2-BASIC
Safety- and functional testers
15-in-1

GLP2 MODULAR
Safety-, functional and high-voltage testers

GLP3
Multi-purpose Windows®-testers

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Advanced Test Technologies

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❯ Expect more.