
Tettex INSTRUMENTS

# MIDAS

## Mobile Insulation Diagnosis & Analysing System


**Periodic maintenance** and inspection of high voltage insulation losses is performed on power transformers, bushings, motors, generators, etc. The MIDAS is a valuable tool for such measurements especially in the harsh electrical environments experienced in substations and other field locations.

Designed for testing at local power-line frequency (50 Hz or 60 Hz), MIDAS automatically measures and records dissipation factor (tan $\delta$), power factor (cos $\varphi$) and all other relevant values of impedances (capacitive, inductive and resistive). Damage or changes in the insulation material are detected rapidly and reliably.

Furthermore the optional build-in 3-phase Transformer Turns Ratio Meter and/or Frequency Response Analyser help to detect faulty transformer windings as well as defective tap positions.

The rugged construction and large pneumatic wheels make transportation and access to remote locations easy.

A large touch sensitive, sunlight readable colour display and the graphical user interface create a highly visual environment with clear illustration of the instrument's advanced measuring and analysing features.

Predefined test sequences linked with limiting values (e.g. previous measurements) guide the user automatically through the test sequence and allow obtaining a first assessment result on-site.

Built-in standard interfaces (USB, Ethernet) enable easy data exchange with a host computer for data collecting, reporting, printouts, statistics and advanced analysis.

## FEATURES

To analyze the condition and quality of high voltage insulation, the system performs automated measurement of:

- **Dissipation Factor** (tan $\delta$) and **Power Factor** (cos $\varphi$)
- **Short Circuit Impedance** and **Excitation Current**
- **Additional measuring capabilities** like Capacitance, Quality Factor, Frequency, Voltage, Current, Power, Losses, Impedance, Inductance, Reactance, Spectrum Analyzer, Digital Scope and Data Logger
- **Frequency Response Analysis** (optional; built-in or external remote controlled unit)
- **Turns ratio, voltage ratio, phase displacement** (optional; built-in or external remote controlled unit)
- **Trending Analysis** function – get a first graphical on-site assessment
- **Manual and Automatic** (Sequencer) test operation.
- Built-in high voltage supply up to **15 kV, 4 kVA**
- Built-in, long-term stable **standard capacitor**
- **Rugged, reliable and safe** construction
- **State-of-the-art** integrated PC running actual Windows platform with advanced user interface

## BENEFITS

### Shortest Measuring Time

Shortest equipment set-up and measuring time by an "all in one" unit. High output power allows testing of biggest class power transformers in shortest time.

### Easy to operate

Self-explanatory user interface with a large graphical colour TFT touch screen. Manual and Automatic test operation. Software assisted test planning, preparation, execution and first assessment.

### Highest Accuracy

Highest accuracy in field-testing using latest measuring techniques as well as highest long-term stability of system accuracy by using a gas-insulated standard capacitor as internal reference arm and self-calibrating measurement sensors.

### Advanced interference suppression

Advanced interference suppression (patented) allows measurement at local power-line frequency as recommended in the related standard IEEE/ANSI 57.12.90


Tettex INSTRUMENTS

## APPLICATIONS

- Power Transformers
- Distribution Transformers
- Instrument Transformers
- Rotating Machines
- Liquid Insulation
- Bushings
- Cables
- Capacitors
- Circuit Breakers
- Surge Arrestors

## HANDY MECHANICAL DESIGN

Rugged construction and large pneumatic wheels are an advantage for transportation in the back of a van and when measurements must be made in remote hard to access locations.

*Test system packed in the back of a station wagon*

Easy one-man transportation and loading with the integrated handles. Another great feature of this all-in-one-piece design is **the shortest measuring set-up time** you can get on the market.

## LATEST TECHNOLOGY

The development is based on the latest measurement and electronics technologies.

- Conventional techniques like mechanical driven compensation is replaced by **real-time electronic compensation**. This is realized by using advanced high-speed data bus technology and powerful software algorithms.
- **Predefined test sequences** for transformer, bushings, generators, cables, etc. together with two measuring inputs reduce set-up and test time and minimize wiring and re-wiring errors.
- An integrated PC running under embedded **Windows XP™** gives you the most powerful tool in the field to make sure you get your maintenance job done fast and accurate.
- The large **colour TFT sunlight readable display with touch screen interface, designed for outdoor use** allows having a clear and easy presentation of all values, settings and operations.
- A **powerful data management** allows for an easy and fast trending and comparison analysis. Condition Based Maintenance gets a new quality.
- The **automatic report generator** minimises the time to complete the test procedure.
- The **integrated online help** supports the user during the test procedure.

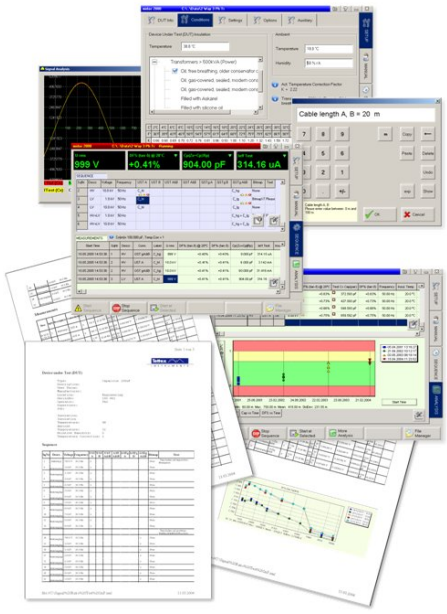
## EASY TO OPERATE

MIDAS software incorporates much of our and our customers' experiences in the test business. We designed a **very easy to operate and understand**, self-explanatory graphical user interface. Together with the large colour display and the touch screen you can handle test planning, preparation, execution and first assessment with just a fingertip. It also means the test equipment is sealed against environmental influences.


*Large TFT display with touch-screen interface*

## MANUAL AND AUTOMATIC

The manual test mode provides quick measurements without lots of definitions or pre-settings while the automatic tests in "Sequence mode" provide complete automated test sequences. This powerful software efficiently performs for field-testing from set-up to sequence definition to automatic operation to a first on-site assessment to the final report.



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High Voltage Test Business


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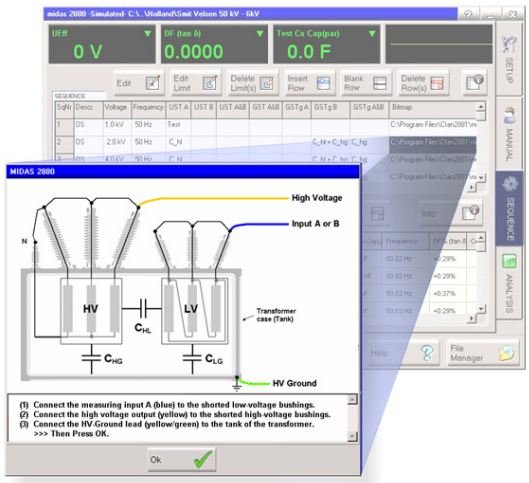
## SEQUENCE MODE

Executable test sequences (step macros) can be defined with

- **Set-ups:** Set all configuration values, type of DUT, insulation type, temperature correction function, limits, work order, serial numbers, test personal, location, etc.
- **Test levels:** Set the desired different test levels (voltage and frequency).
- **Connections:** Set the different connections (DUT wiring) e.g. GSTg A+B.
- **Measuring values:** Define the different values to be recorded. E.g. Voltage, Frequency, PF, Current, Insulation Temperature, PF@20°C, etc.
- **Test instructions:** In every step that requires a rewiring of the test object an instruction box with text and pictures can be defined to provide the test personal with a step by step guide of how to perform the connection, wiring and the test.
- **Pass/fail levels:** Limits can be set absolute or relative (based on reference measurements) that will be compared with the measured values and shown in the analysis diagram.

All this can be done on the MIDAS itself or with the office software package on a separate PC or laptop.

A predefined test sequence then can be performed by lower skilled or educated personal. It reduces the set up time in the field and also reduces failures due to lack of knowledge, wrong connections or misinterpretation of measuring values.

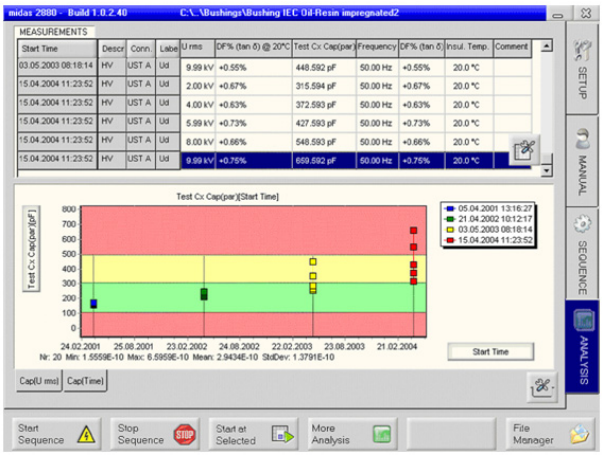


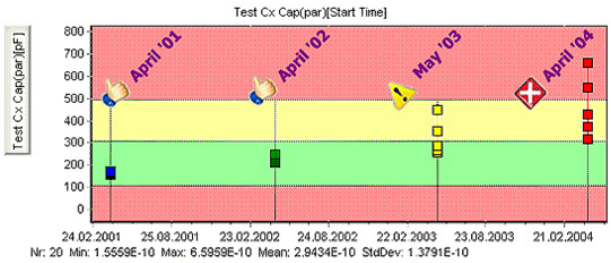

*The pop-up test instruction window with a connection diagram picture and below the corresponding instruction text*

The Sequence mode is the perfect tool to repeat maintenance measurements. If you have already done one complete measurement you can reload it, perform an identical test, collect the additional measurements and display the new trending. As easy as that!

## ANALYSIS FUNCTION

As an immediate on-site assessment you can compare the latest measurements with stored data sets and see how the insulation values have changed (trending), using the analysis diagram. Also comparison of measurements captured at different voltages and different frequencies can be observed.




*The ANALYSIS window with the list of stored measurements (top) and the corresponding diagram window (bottom)*

Both axis of the analysis diagram are free definable and the collected sets of different measuring data can be sorted as selected. So almost any dependency can be shown and displayed.
If the Pass/Fail criteria are set they are shown in the diagram as a green “Pass” band, a yellow “Attention” band and a red “Failed” section. So you can immediately identify a possible problem in your insulation.

*The ANALYSIS diagram shows the trending and the limits.*

## HIGHEST ACCURACY

Due to the technology used for this advanced test equipment we reached the highest accuracy in the market. The **built-in reference is a standard gas capacitor**, developed in-house, proven over 60 years, used as a calibration standard for high voltage laboratories and metrology national institutes. This guarantees the highest long-term stability unbeaten by any other reference standard. Because of the design of our standard capacitor, the stability and the accuracy is independent of the temperature, air pressure and humidity of the environment so there is no need for additional verification. It’s all built-in already and all calibrations are done automatically as part of the self-test at boot-up. That’s our interpretation of “accuracy by design”.


Tettex INSTRUMENTS

## ADVANCED INTERFERENCE SUPPRESSION

The built-in **A**daptive **D**ynamic **N**oise **S**uppression (ADNS) eliminates the external interferences from the measuring signal.
With ADNS we have successfully developed an advanced interference suppression method (patented) that allows **measurements at the real power-line frequency!**
For environments polluted with highest noise the system switches into a Extended Noise-Suppression mode to measure stable and accurate values even in most difficult locations.

## WIDE RANGE OF APPLICATIONS

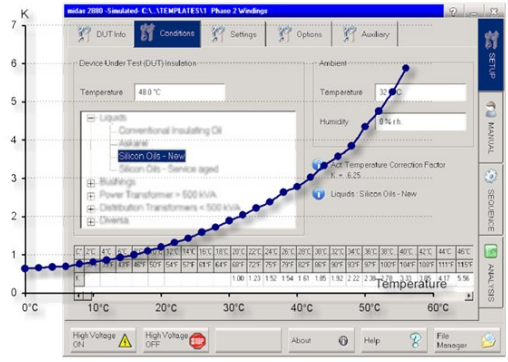
The built-in 15 kV and 4 kVA high voltage high power source is unique. The 15 kV output voltage (MIDAS 288xG) together with the mobile resonating inductor 5289 allows the testing of generators with 25 kV nominal voltage according to IEC 60034.
The powerful supply and measuring capabilities make sure that you can test even the biggest class of power transformers in shortest time.

The optional add-ons " Transformer Turns Ratio Meter" and "Frequency Response Analyser" are important additional diagnostic tools for power transformer diagnosis.
They can help to detect faulty transformer windings, defective tap changer positions and mechanical failures and displacements in the winding structure. For related technical data see flyers TTR 2795 and FRA 5310.

Furthermore measurements can be carried out on solid insulation such as cables, distribution-, voltage & current-transformers, motors, bushings, capacitors, etc.

With the optional test cell 6835 all kinds of liquid insulation samples can be tested as well.

## TEMPERATURE CORRECTION



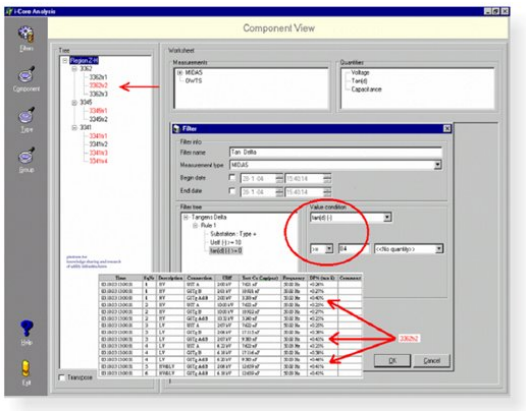

Built-in temperature correction curves for different insulation materials are used to recalculate the measured results to reference conditions (20°C, 68°F). The method of correction is depending on the type of insulation and the relevant standard, and the predefined set of curves can be easily expanded or changed by the user.

## REPORTING AND DATA HANDLING

All measurement results and test object data are saved in XML and CSV, which allow an easy transfer to database applications, MS WordTM, MS ExcelTM, MS AccessTM, MS PowerPointTM or even a simple text editor. Printing of the test reports can be done directly or after transferring the data to a PC using the Ethernet interface or a USB memory stick.


## CONDITION BASED MAINTENANCE

Gaining knowledge about asset (medium- and high voltage equipment) performance from condition measurements (e.g. tanδ values) with the help of a database and experienced personal are essential for the implementation of a risk strategy. Large-scale development of knowledge rules to support decisions about asset endurance, is possible with knowledge based platforms e.g. "ksandr", a mutually applied expert database, designed for the collection of local condition measurements, generates decision rules based upon a lager population than just the local user. Membership to this non-profit, independent organisation is open to all willing to share data and experience regarding asset performance.




Component view screen for tanδ values in the iCore© database of the "ksandr" platform which is supported by Delft University of Technology. See also www.ksandr.org


Tettex INSTRUMENTS

## TECHNICAL SPECIFICATIONS

| Measuring Unit | Range | Resolution | Accuracy |
|---|---|---|---|
| Dissipation Factor<br>tan δ | 0 .. 100<br>(0 .. 10'000%) | 0.0001<br>(0.01%) | ± 0.5 % rdg ± 0.0001<br>(± 0.5 % rdg ±0.01%) [1] |
| Power Factor<br>cos φ | 0 .. 1<br>(0 .. 100%) | 0.0001<br>(0.01%) | ± 0.5 % rdg ± 0.0001<br>(± 0.5 % rdg ±0.01%) [1] |
| Quality Factor | 0.01 .. 10000 | 0.0001 | ± 0.5% rdg ± 0.0001 [1] |
| Capacitance Range [3]<br>@ 50Hz | 6.5 pF .. 56 nF @ 15 kV<br>8.1 pF .. 88 nF @ 12 kV<br>1.2 nF .. 13 uF @ 80 V | 0.01 pF | ± 0.3 % rdg ± 0.3 pF |
| Capacitance Range [3]<br>@ 60Hz | 5.4 pF .. 47 nF @ 15 kV<br>6.8 pF .. 73 nF @ 12 kV<br>1.0 nF .. 10.8uF @ 80 V | 0.01 pF | ± 0.3 % rdg ± 0.3 pF |
| Inductance Range [4]<br>@ 50Hz | 140 H .. 1600 kH @ 15 kV<br>112 H .. 1280 kH @ 12 kV<br>0.75 H .. 8.5 kH @ 80 V | 0.1 mH | ± 0.5 % rdg ± 0.5 mH |
| Inductance Range [4]<br>@ 60Hz | 117 H .. 1334 kH @ 15 kV<br>93 H .. 1067 kH @ 12 kV<br>0.62 H .. 7 kH @ 80 V | 0.1 mH | ± 0.5 % rdg ± 0.5 mH |
| Test Voltage | 80 V .. 15 kV (12 kV) | 1 V | ± 0.3 % rdg ± 1 V [2] |
| Test Current Input A & B | 30uA .. 15 A | 0,1 uA | ± 0.3 % rdg ± 1 uA |
| Ref Current Input Cn ext | 30uA .. 300 mA | 0,1 uA | ± 0.3 % rdg ± 1 uA |
| Test Frequency | 10 .. 1000 Hz | 0.01 Hz | ± 0.1 % rdg ± 0.1 Hz |
| Apparent Power S | ≤ 1 MVA | 0.1 mVA | ± 0.8 % rdg ± 1 mVA |
| Real Power P | ≤ 1 MW | 0.1 mW | ± 0.8 % rdg ± 1 mW |
| Reactive Power Q | ≤ 1 Mvar | 0.1 mvar | ± 0.8 % rdg ± 1 mvar |
| Output Voltage | 1 V .. 15 kV MIDAS 288x G  1 V .. 12 kV MIDAS 288x | | |
| Output Frequency | 10 .. 1000 Hz Output power derating (max 5 kV) beyond 40..70 Hz | | |
| Output Current | 150 mA continuous , 450 mA max 5min. | | |
| Output Power max | 4000 VA | | |
| | **≤ 1500VA** | **1501 .. 2000 VA** | **2001 .. 3000 VA** | **3001 .. 4000 VA** |
| Output Power duration | continuous | 30 min. ON / 1h OFF | 5 min. ON / 1h OFF | 1 min. ON / 1h OFF |
| Output PD level max | ≤ 500 pC | | | |
| Internal Cn (Reference) | 100 pF, tan δ 0.00002, Capacitance constancy < 0.01% / year<br>Temperature coefficient < 0.01% / K | | | |
| Input Power | 90 .. 264 VAC, 50 / 60 Hz, 1 kW, active PFC (IEC61000-3-2) | | | |
| Operating Temperature | -10 .. 50°C | | | |
| Storage Temperature | -20 .. 70°C | | | |
| Relative Humidity | 5 .. 95 % r.h. | | | |
| Protection classes | IP22, IEC 61010, CE mark, general IEC 61326-1,<br>IEC 61000-4-X, 61000-3-X, EN 55011, ANSI/IEEE C37.90 | | | |
| Weight & Dimensions | Instrument box 58 kg (128 lbs) 34 x 47 x 104 cm (13.5" x 18.5" x 41")<br>PC head 7.5 kg (17 lbs) 30 x 42 x 26 cm (12" x 16.5" x 10")<br>Trolley 11 kg (25 lbs) 33 x 68 x 112 cm (13" x 26.8" x 44") | | | |
| Recorded Values | DF(tan δ), DF(tan δ)@20°C, DF%(tan δ), DF%(tan δ)@20°C, PF(cos φ), PF(cos φ)@20°C, PF%(cos φ), PF%(cos φ)@20°C, QF (quality factor), QF (quality factor) @20°C<br>$C_P$ ($Z_X$= $C_P$ \|\| $R_P$), $R_P$ ($Z_X$= $C_P$ \|\| $R_P$), $C_S$ ($Z_X$= $C_S$ + $R_S$), $R_S$ ($Z_X$= $C_S$ + $R_S$),<br>$L_S$ ($Z_X$= $L_S$ + $R_S$), $R_S$ ($Z_X$= $L_S$ + $R_S$), $L_P$ ($Z_X$= $L_P$ \|\| $R_P$), $R_P$ ($Z_X$= $L_P$ \|\| $R_P$),<br>Standard capacitor Cn, $U_{RMS}$, $U_{RMS}$ √3, $I_{Test\ eff}$, $I_{Ref\ eff}$, $I_m$, $I_{Fe}$, Impedance Zx, Phase-angle φ (Zx),<br>Admittance Yx, $Frequency_{Test}$, $Frequency_{Line}$, App. Power S, Real Power P, Reactive Power Q,<br>Real Power @2.5 kV, Real Power @10 kV, $Temperature_{Ambient}$ [5], $Temperature_{Insulation}$ [5],<br>Rel.Humidity [5], Temp.Corr.Factor K,<br>Connection mode, Settings, all Notes and Comments, Time, Date | | | |
| Interfaces (PC head 2880) | USB, Ethernet, RS232, Mouse, Keyboard, Thermal printer | | | |
| Data format | XML, CSV | | | |
| Calibration Interval | 2 years recommended | | | |
| Safety Specification | VDE 0411/part 1a , IEC/EN 61010-1:2002 | | | |

1 Accuracy valid @ 50..60Hz  2 Accuracy valid for voltage > 1000 V  3 Can be expanded with optional Resonating Inductor  4 Can be lowered with optional Current Booster
5 measured by external temperature/humidity probe


Tettex INSTRUMENTS

## SCOPE OF SUPPLY

**MIDAS 2880** System with touch screen operated PC head as system controller. Max. output voltage 12 kV

**MIDAS 2881** System with laptop as system controller. Max. output voltage 12 kV

**MIDAS 2880G, MIDAS 2881G** Systems as above but with a maximum output voltage of 15 kV. Optimised solution for power generator testing.


**MIDAS 2880** **MIDAS 2881**

Rugged cable case including:

HV supply cable double shielded 20m with clamp and hook, ground cable 20m with clamp, 3 shielded Measuring cables 20m with clamps, 2 Mini clamps, Safety switch with cable 10m, USB memory stick, Instruction manual and Test Certificate.

## ACCESSORIES AND OPTIONS

**MIDAS OFFICE** Software. Can be used for PC test preparation, data visualisation and staff education

**288x TEMP** Laser infrared, contact-less Thermo/Hygrometer. For determination of: tank (oil) temperature, air temperature and air humidity.

**288x SAFE** * Safety Strobe Light with magnetic base for mounting e.g. on a transformer tank, providing visual warning of high voltage presence.

**6835** Test cell for on-site measurements on liquid insulation samples.

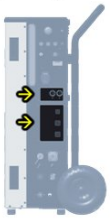
**5287** * Current Booster for inductance testing, especially for short circuit impedance testing of power transformers acc. IEC60076 to diagnose transformer winding deformation.

**5289** * 15kV, 100kVA Automated Resonating Inductor for testing high capacitance values up to 1.56uF. E.g. for testing of large power generator windings.

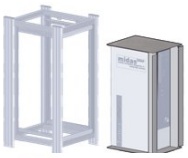
**5288A** 10kV, 33kVA Manual Resonating Inductor for testing high capacitance values up to 1uF.

**288x FRA *** Built-in fully automated frequency response analyser. Operated via MIDAS system controller.

**288x TTR *** Built-in fully automated three phase Turns Ratio Meter. Operated via MIDAS system controller.



**288x RACK** Mechanical kit for 19" rack mounting of MIDAS Instrument box.



**288x CASE** Additional rugged field case for safe transportation of MIDAS 2880 or 2881.

* For these options the MIDAS unit needs additional interfaces built-in the factory.

www.tettex.com

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