TDX 5000

Tan Delta & Capacitance Test System

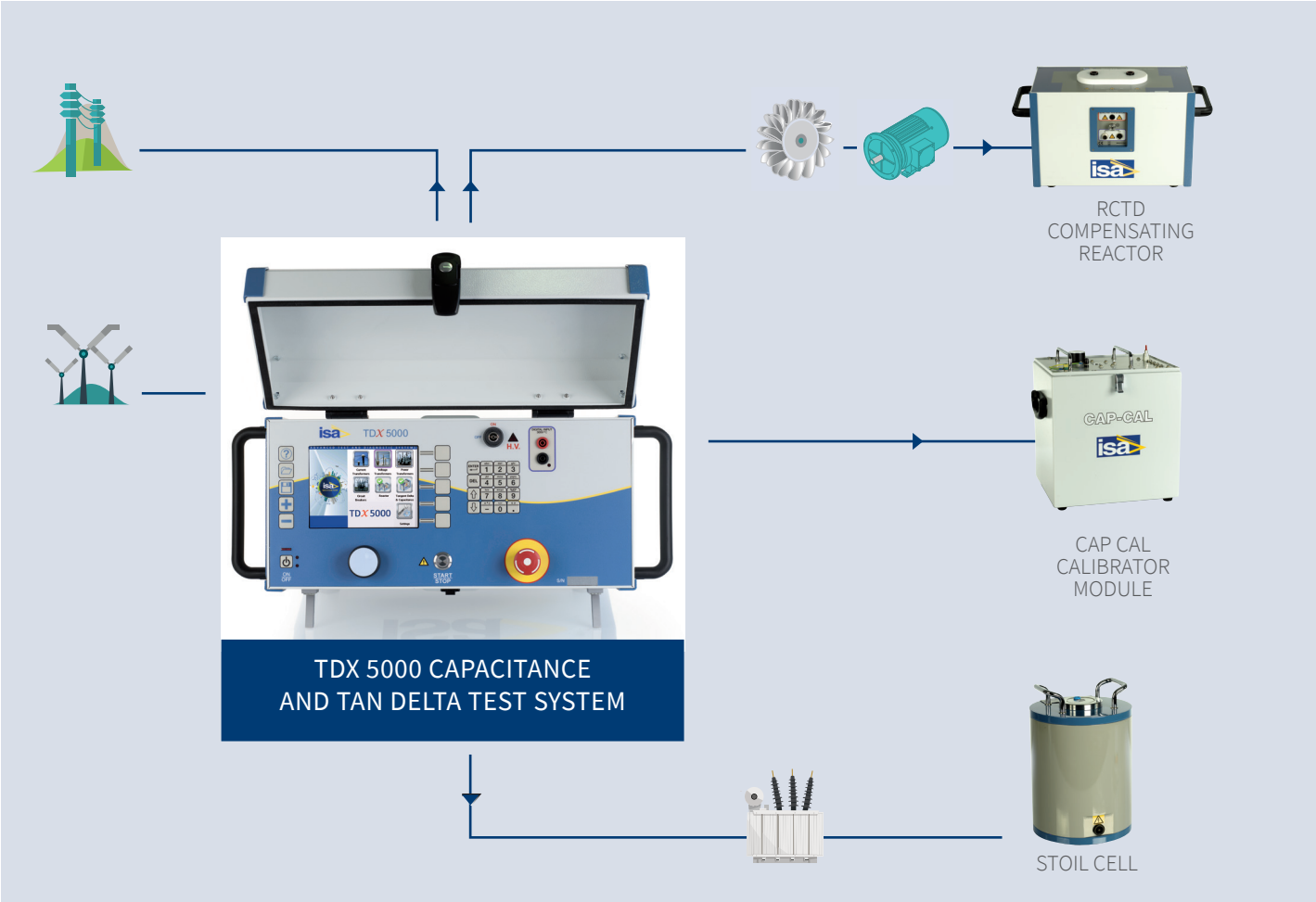
ALTANOVA GROUP

ALTANOVA GROUP

Advanced testing and monitoring solutions

Power Factor, Dissipation factor (Tan Delta) and Capacitance Diagnostic System for Power Apparatus

- Fully automatic
- Tan Delta, capacitance, dissipation factor measurements and excitation current test
- Variable output frequency: 1 ÷ 500 Hz
- Output voltage: from 0 V up to 12 kV
- Voltage sweep and frequency sweep (tip up or down tests)
- Local control with a large graphic display
- PADS - Power Apparatus Diagnostic Software for automatic testing, assessment and report
- Tan Delta test for rotating machines (generators and motors)
- USB interface and Ethernet interface for PC connection
- Compact and lightweight
- Patented technology for capacitance and Tan Delta measurement



Application

The following table lists the tests that can be performed on CTs, VTs and PTs.

N.	TEST	TEST DESCRIPTION
10	CT	Tan Delta measurements
16	VT	Tan Delta measurements
20	PT	No-load / excitation current
22	PT	Tan Delta measurements
23	PT	Ratio with RTD
25	CB	Tan Delta measurements
30		Capacitor Measurement of the capacitance Banks

Tests are performed in accordance with the following IEC standards: IEC61869-2; IEC61869-3; EN 60044-1; EN 60044-2; EN 60044-5; EN 60076-1, and also in accordance with C57,12-90.

General Characteristic

TDX 5000 equipment performs the measurement of the Tan Delta, of the dissipation factor and of the capacitance of a transformer or of any MV and EHV device (13.8 kV up to more than 500 kV), at the frequency of the mains or in a wide frequency range. With the RTD option is possible to measure the transformer ratio with high voltage. The measurement is performed by patented technology.

TDX 5000 measurement circuitry incorporates a reference high voltage capacitor, rated 200 pF, with a Tan Delta better than 0.005%, and a reference resistor bridge, with accuracy better than 0.01%, and thermal drift less than 1 ppM/°C. The patented circuitry and the variable frequency output make test results immune from external noise.
Before each test, the TDX5000 automatic check and calibrate itself with the internal reference capacitor.

Available test selections:

- Ungrounded: UST-A; UST-B; UST A+B
- Grounded: GST; GSTg-A; GSTg-B; GSTg-A+B.

TDX 5000 is powered by an internal voltage generator with electronic control. The instrument must be grounded during the operation, in case the ground is disconnected during the test, the generation stops automatically.
TDX5000 can be supplied with a portable generator without loss of performances.

System Description

The STS family includes three models : STS 5000, STS 4000 and TDX 5000. TDX 5000 is developed as a compact solution for high voltage Capacitance and Tan Delta (Dissipation Factor) measurements on CT, VT, PT, bushings. Using the reactor option, TDX 5000 can also perform tests on rotating machines (motors and generators).
In the local control mode, the selected output is adjustable and metered on the large, graphic LCD display. With the control knob and the LCD display, it is possible to enter the MENU mode, that allows to set many functions and that make TDX 5000 a very powerful testing device, with manual and automatic testing capabilities and with the possibility to transfer test results to a PC via ETHERNET or Pen Drive. The TDMS software suite, which comes with the test set, allows to download, display and analyse test results obtained in local mode. Remote maintenance and diagnostic of the instrument is available via Ethernet. TDMS operates with all Windows® versions.

The ease of operation has been the first goal of TDX 5000 unit. This is why the LCD display is so large and the dialogue in MENU mode is made easy.
TDX 5000 includes the detection of the digital signal coming from the RTCD- Compensating Reactor option.

The instrument is housed in a transportable aluminium box, which is provided with cover and handles for ease of transportation. A transport trolley can be optionally supplied.

LEGENDA:


POWER TRANSFORMER TESTING


CIRCUIT BREAKER TESTING


CURRENT AND VOLTAGE TRANSFORMER TESTING


ELECTRIC MOTOR TESTING


POWER GENERATOR TESTING

TDMS - Test & Data Management Software

TDMS, Test & Data Management Software, is a powerful software package providing data management for acceptance and maintenance testing activities. Electrical apparatus data and test results are shown in the local frontal interface and are automatically saved in the TDMS database for historical results analysis.
The TDMS database organizes test data and results for the majority of electrical apparatus tested with ISA test sets and related software. All the results include the information about the apparatus under test, location, references, operator, data, time, ambiental conditions and graphs. With TDMS software is possible to export the data to electronic formats like XLSX (EXCEL), CSV, DOC, RPT, PDF, JPEG y XML.

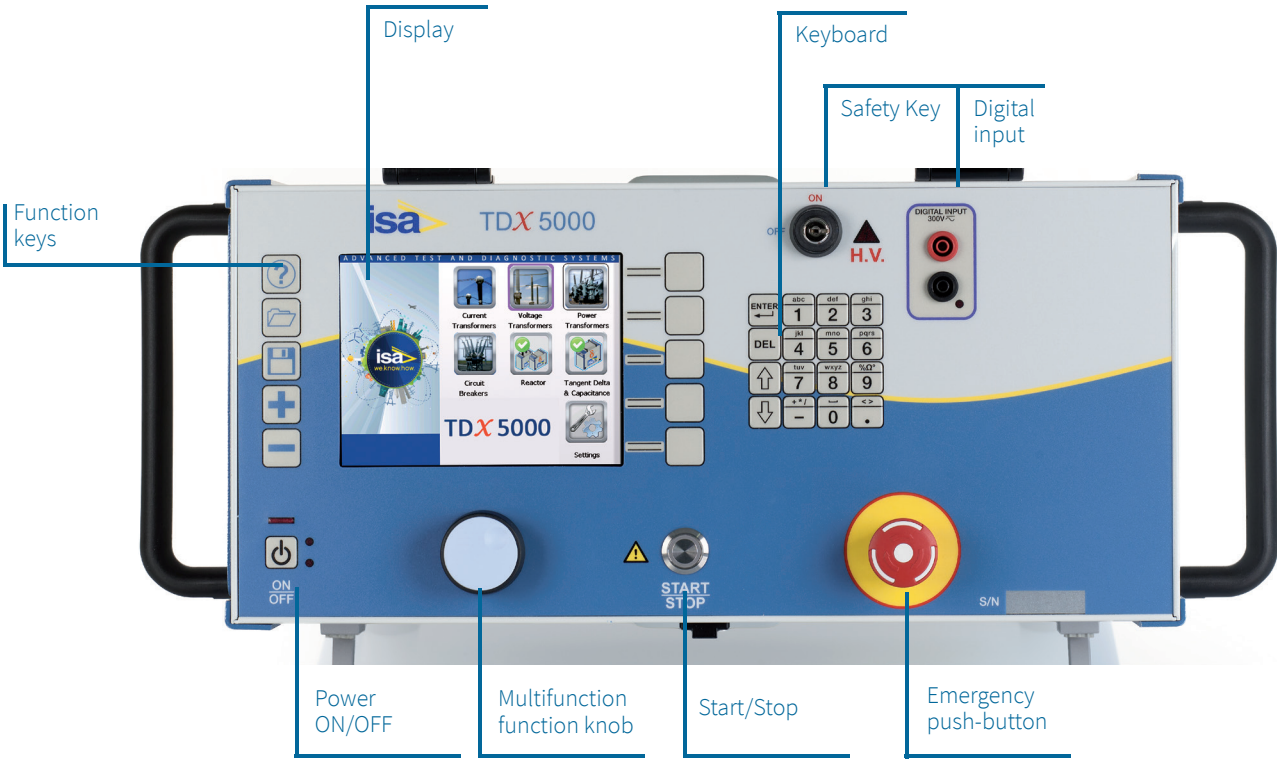
PADS - Power Apparatus Diagnostic Software

PADS - Power Apparatus Diagnostic Software is a powerful software application, included in TDMS software, that optionally allows the remote control of the STS family: STS 5000, STS 4000, TDX 5000. The software performs various tasks, such as:

- Control TDX 5000 remotely from PC
- Create test plan
- Download stored test results via Ethernet cable
- Create and customize test reports
- Print test results

This program runs under Windows© environment.
Note: Windows is trademark of Microsoft Corporation.

TDX 5000 - Front Panel



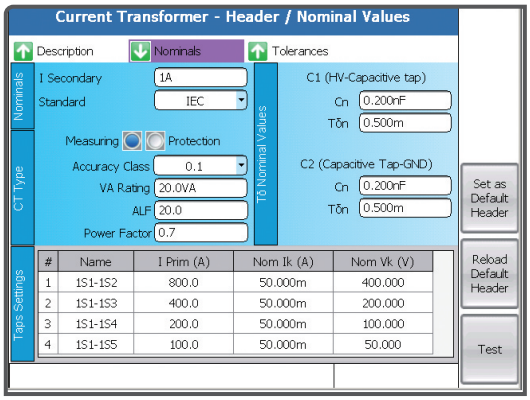
TDX 5000 - Side Panels

TDX 5000 - Side Panels

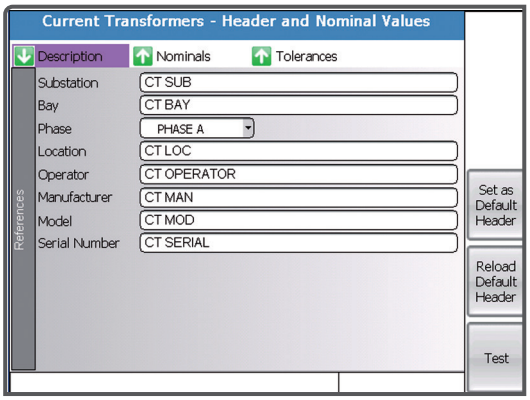
Test Header

Before starting a test, all relevant test object data are input into the header, which is made of four screens. These data are used by the device for the following test execution. If, during tests, some results do not conform and nominal data are to be modifi ed, the change is made in the Header, so that consistent nominal data and the corresponding test results are saved together.

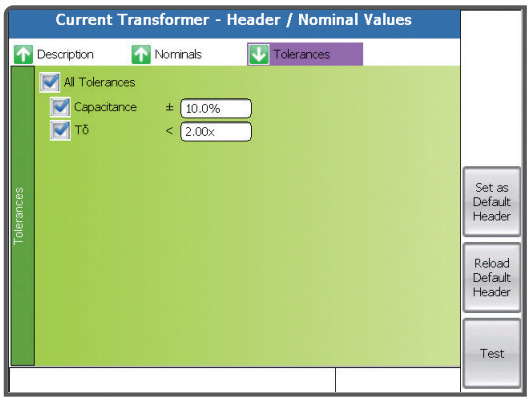
If the device is a PT, the Capacitance tests and the no-load / excitation current test can be pre-set together, to form a single Test Plan. The Test Plan can be saved and recalled; up to 64 different plans can be stored into memory.



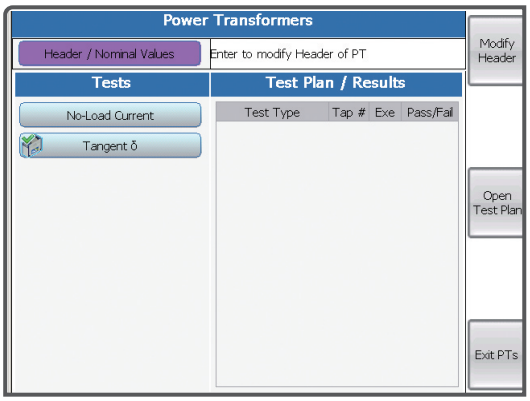
Nominal values window: from these nominal data, the program computes the nominal saturation knee



Tests header window: test reference data



Tolerances window allows setting the tolerances for each of the available tests



Test selection window: it allows selecting the test to be performed

At the end of the programming, starting the first test will execute the complete sequence. During the test, test results are stored in the internal memory. The test set minimizes the test duration, in order to avoid over-heating the components. The same feature is available when controlling the test set via PC by PADS.

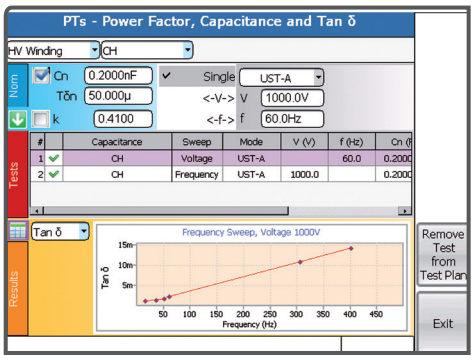
Power Factor, Capacitance, Dissipation Factor and Tan Delta for CT, VT, Power Transformer and CB

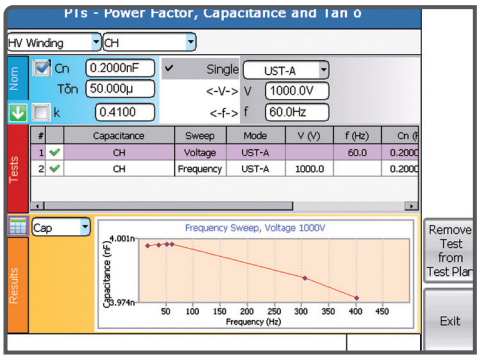
Power Factor, Capacitance and Tan Delta

The test is performed connecting TDX 5000 to the high AC voltage source to test target.
Input parameters are: Winding, test voltage and frequency, test mode, and the nominal capacitance, PF, DF.

The display shows the following data:

- Test voltage, current and frequency
- Capacitance
- Tan Delta and power factor
  (absolute 0-1 or percentage 0 -1,0000% values)
- Power data: active, reactive and apparent
- Impedance: module, argument and components





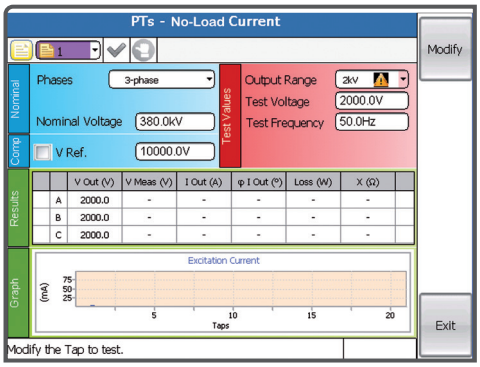
It is possible to apply automatic temperature compensation in the range 5 ÷60°C with reference temperature 20°C.

It is also possible to calculate some equivalent parameters at different voltages (for example watt loss and current at 10 kV).

No-Load / Excitation Current

The test is performed connecting TDX 5000 to the high AC voltage source to the test target.
Input parameters are: the tap number, the type of Tap changer, the test voltage and the frequency.
The test set applies the high voltage and measures the output current during the test.

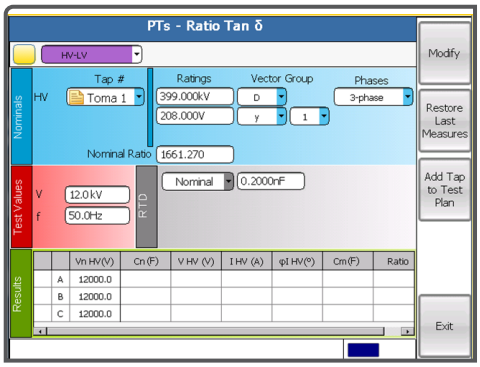
The display shows:
• The test voltage
• The current and the phase shift (inductive, resistive, capacitive)
• The power losses
• The reactance



Ratio with TD

The test is performed connecting TDX 5000 to the RTD option.
The Ratio test is performed by measuring the RTD sample capacitance two times.
Input parameters are: the tap number, voltages primary and secondary side, vector group, nominal ratio, test voltage and frequency, the nominal RTD capacitance.

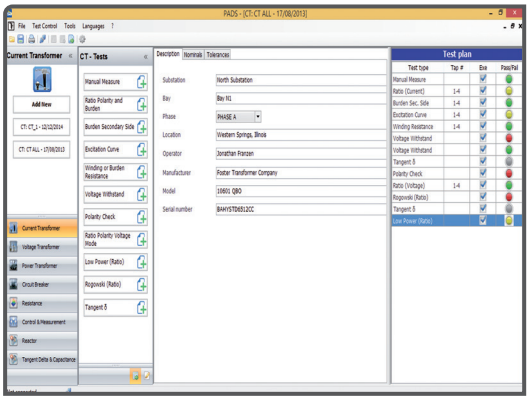
The display shows the following data:
• Test voltage, nominal capacitance
• Voltage, current, angle, high voltage side
• Measured capacitance
• Ratio



Other Functions
Pads Software

The PADS software is a powerful application, included in the TDMS software, which provides connectivity to the instruments of the STS family. The software performs various tasks, such as:

- Edit and upload to the instrument the test headers
- Create and modify plans containing one or more tests
- Optionally remote control of the execution of test plans (start, interruption, results assessment)
- Download and save results of tests previously performed by the instrument
- Open and save results on the PC
- Print test results
- Export test results (excel, CSV, DOC, RPT, PDF,JPEG, XMLformat)



TDX 5000 Specification
Generator Characteristics

MAX VOLTAGE OUTPUT V	CURRENT OUTPUT A	MAX OUTPUT DURATION T Max	FREQUENCY Hz
12000	300 mA	240 s	1 to 500
12000	125 mA	> 1 hour	1 to 500
12000	100 mA	steady	1 to 500

Note[1]: the maximum voltage output may decrease for frequency below 45Hz and above 400Hz.
Note[2]: at 10 kV the output (current value and duration) has the same characteristic.
Note[3]: output power is 3.6 kVA @12 kV @240 s

Voltage and current output metering accuracy and resolution

INTERNAL MEASURE	RESOLUTION	TYPICAL ACCURACY		GUARANTEED ACCURACY	
		± % (rdg)	± % (rg)	± % (rdg)	± % (rg)
12.000 V AC	1V	±0,2%	±0,5 V	<0,3%	+ 1 V
5 A AC (10A AC @10s model PII50185) (@ inputs A o B> 10 mA)	0,1 mA	±0,2%	±1 mA	< 0,5%	< 0,5%
<10 mA AC (@ inputs A o B)	0,1 µA	±0,2%	±0,1 µA	< 0,3%	+0,1 µA

- Frequency range: 1 ÷ 500 Hz

• Connections: by a double shielded HV connector, two Ground sockets (case and external shield of HV cable), and two measurement sockets (A and B)

• All measuring are indipendent by the power supply and for this they are repetible. The voltage generator is independent by the power supply.

Test Measurements

Capacitance

The TDX5000 can measure capacitance between 0 and 200 µF. There are 2 automatic ranges:

• Measurement range 1 The TDX5000 can measure capacitance between 0 and 200 µF. There are 2 automatic ranges: from 0 pF to 5 µF. Resolution: 6 digits (or 0.01 pF). Accuracy, typical: ± 0.03% of the value ± 0.1 pF; guaranteed: < 0.1% of the value +1 pF (from 45 to 70 Hz)

• Measurement range 2: from 5 µF to 200 µF. Resolution: 6 digits (or 0.01 nF). Accuracy, tipical: ±0.1% of the value ±0.1 nF, guaranteed: <0.5% of the value ±1 nF

Tan Delta or dissipation factor DF

The TDX5000 can measure Tan delta or Dissipation factor between 0 and more than 100%. There are 3 automatic ranges:

• Measurement range 1: from 0 to 10% (capacitive). Resolution: 6 digits (or 0.000001%); accuracy, typical: 0.05% of the value ± 0.005 %; guaranteed: 0.1% of the value ± 0.005 % (from 45 to 70 Hz, current < 10 mA)

• Measurement range 2: from 0 to 100%. Resolution: 6 digits (or 0.00001%); accuracy, typical: 0.3% of the value ± 0.01 %; guaranteed: 0.5% of the value ± 0.02 %

• Measurement range 3: over 100%. Resolution: 6 digits; accuracy, typical: 0.5% of the value ± 0.03 %; guaranteed: 0.8% of the value ± 0.05 %

Power factor PF (or cos(ϕ))

The TDX5000 can measure power factor between 0 and 100%. There are 2 automatic ranges:

• Measurement range 1: from 0 to 10% (capacitive). Resolution: 6 digits (or 0.000001); accuracy, typical: 0.05% of the value ± 0.005 %; guaranteed: 0.1% of the value ± 0.005 % (from 45 to 70 Hz, current < 10 mA)

• Measurement range 2: from 0 to 100%. Resolution: 6 digits (or 0.00001); accuracy, typical: 0.3% of the value ± 0.02 %; guaranteed: 0.5% of the value ± 0.02 %

Impedance

From 1kOhm to 1400 MOhm. Accuracy, typical 0.3% of the value ± 0.1%, guaranteed <0.5% of the value. Resolution: 6 digits.

Power dielectric losses

Measurement ranges: from 0 to 10kW or 100kW or 1mW. Resolution (6 digits): 0.1 mW; accuracy: <0.5% of the value ± 1 mW. The same ranges and accuracies are applied to reactive and apparent power measurements

Inductance

The TDX5000 can measure inductance between 1 H and 200 10 MH. There are 2 automatic ranges:

• Measurement range 1: from 1 H to 10 kH. Resolution (6 digits): 0.1 mH; accuracy, typical: 0.3% of the value ± 0.5 mH; guaranteed: 0.5% of the value

• Measurement range 2: from 100 H to 10 MH. Resolution (6 digits): 1 H; accuracy, typical: 0.3% of the value; guaranteed: <0.5% of the value

No Load / Excitation current

The TDX5000 can measure no load / excitation current between 0 and 300 mA. There are 2 automatic ranges:

• Range 1: 10 mA. Resolution: 0.1 µA; accuracy, typical: 0.2% of the value ± 0.1µA; guaranteed: 0.3% of the value ± 0.1µA

• Range 2: 300 mA. Resolution 1 mA; accuracy, typical: 0.2% of the value ± 1 mA; guaranteed: 0.5% of the value ± 0.5% of the range

Output frequency

AC output frequency range: 1 to 500 Hz

Max interference conditions at line

• Electrostatic: 15 mA rms of the interference current into any lead or cable with no loss of measurement accuracy. Applicable to a maximum ratio of interference current to specimen current 20:1

• Electromagnetic: 500 µT, at 50/60 Hz in any direction

Digital input

Binary input used only for RCTD - Compensating reactor option

Display

The large graphic display has the following characteristics:

• Pixels: 640 x 480, coloured
• LCD type: TFT
• View area: 132 x 99 mm
• Backlight

Local test set control

Local test control: by the START / STOP pushbutton. After the test selection, pressing it, the output is generated, according to the type of test. During ON, if a manual control test is selected, the operator adjusts the output at the desired value.
Test saving:
• Automatic save
• After operator confirmation

Other Characteristics

Communication interfaces

• Slave USB and ETHERNET for the PC connection
• USB port for the USB key

Interfaces to external modules:

• Alarms to a flashing light
• Remote start input

Main supply

• 100-230 V ± 15%; (85 ÷ 264V); 47÷63 Hz
• Maximum supply current: 16 A
• Standard plug: schuko
Other plugs: on requirement (for example with socket type CEE, NEMA, CEI, BS, AS and others)

Dimensions: 450 (W) x 530 (H) x 215 (D) mm

Weight: 39 kg

Protections

• Short circuit protection: if maximum current limits and time duration of power transformer generators are trespassed, the generation is interrupted, and the operator is warned by an alarm message.

• Emergency switch: if emergency pushbutton is pressed, all main generation will stop immediately.
• High Voltage Lock: the HV output is controlled by a key lock. if not turned on, the HV output will be not generated.
• Ground Detection: if the test set is not connected to the ground, it does not allow power generation and warns the operator with a diagnostic message and a fixed led light
• Warning Strobe Light
• Remote Safety Switch

Accessories Supplied

Connection Cables

• One mains supply cable, 2 m long
• One grounding cable, 6 m long as standard or as option with increased lenght
• One ETHERNET interface cable
• One USB pen drive
• 1 High voltage coaxial cable double shielded, 20 m long, 25 kV, with earth screen, for the connection to the device under test, terminated on the device side with an isolated tearproof plug or hook and on the TDX 5000 side with two plugs: one for the HV and the other one for the ground. The cable is mounted on a wheel
• 1 clamp, 25 mm opening, with a connector which mates with the HV cable
• 1 bigger clamp, 60 mm opening, with a connector which mates with the HV cable
• 2 shielded connection cables, 20 m long, for the connection to the metering points. Terminated on the TDX 5000 side with the metering connector and on the device side with a plug. Cables are mounted on wheels
• 2 clamps, 25 mm opening, terminated with sockets, which allow connecting to the metering point
• 2 Kelvin type clamps, 65 mm opening, with plugs, which allow connecting to the metering point
• 1 hot collar cable, 1m long, with connector

Transport Case

As option, transport case with wheels and handles, with IP67 to protect against dust and water. The transport case allows delivering TDX 5000 with no concern about shocks up to a fall of 1 m.

Heavy duty transport case

Optional Accessories

RCTD Compensating Reactor

This module is useful for testing Tan Delta in rotating machines with TDX 5000 and allows increasing the test current and getting the maximum test voltage with high capacitive burdens. Each RCTD is composed by two inductors with a nominal value of 40H and a steady current of 0.4A. The maximum current on each inductor can be up to 1A for more than 10s. The inductors can be connected in parallel on the load in order to increase the test frequency. It is possible to connect two RCTD in parallel in order to have three or four inductors connected together (2 x 80 H total).

RCTD

Digital Thermo Hygrometer

Tan Delta tests are influenced by temperature and humidity.
The option allows measuring these parameters and to input them into the test settings. Meter characteristics:

- Temperature range: -10÷60°C
- Temperature measurement accuracy: ± 0.4°C
- Accuracy of humidity measurement: ± 2.5% RH, over the whole range
- Humidity measurement range: 5÷95% RH
- Dimensions: 141 x 71 x 27 mm. Weight: 150 g

Digital Thermo Hygrometer

CAP - CAL Calibrator Module

Purpose of the calibrator is to check the correctness of TDX 5000 measurement. The calibrator includes an extremely high accuracy high voltage capacitor, which comes with a certificate issued by ISA lab.

CAP - CAL

STOIL Cell for the HV Test of the Dielectric Oil

The option allows testing (Power Factor, Capacitance and Tan Delta) that the oil characteristics of isolation are met and that there is no contamination.
The option is made of a suitable glass container with electrodes; the electrodes are connected to TDX 5000 for the test execution. The test result, displayed by TDX 5000, is the oil Tan Delta. Cell characteristics are the followings:

- Maximum test voltage: 12 kV
- Cell volume: about 1l
- Capacitance of the empty cell: 60 pF

Oil cell

RTD Capacitance for transformer ratio at high voltage

This option allows to measure the turn ratio of the transformers using the high voltage generator up to 12kV. The RTD is a simple capacitance turn ratio precision: 0.1%

Remote Safety Switch

It's possible add further remote safety switch with cable length as required. If it is desired to start the test remotely from the test set, the optional switch allows to do it, up to the distance of 20 m, which is the length of the cable provided. It's possible to add further remote safety switch with cable length as required.

Warning Strobe Light

The warning strobe light alerts when the test is completed, or when there are alarms. The light is self-powered, and turns on (flashes) upon the test set command. A siren is also included. Hook for HV connection

In add to the HV clamps included with the standard cable set, it is possible to order an hook to connect the HV cable with internal diameter 100 mm and length 250 mm.

Hook for HV connection

In add to the HV clamps included with the standard cable set, it is possible to order an hook to connect the HV cable with internal diameter 100 mm and length 250 mm.

IN-A and IN-B current measure inputs up to 10A

Optionally IN-A and IN-B current inputs can measure up to 10A for a maximum of 10s. These inputs have the same characteristics as for standard inputs 5A, refer to chapter 3.3. This option must be selected at the order

Optional Software

PADS - Power Apparatus Diagnostic Software

PADS - Power Apparatus Diagnostic Software is a powerful software application, included in TDMS software, that allow the remote control of the STS family: STS 5000, STS 4000, TDX 5000. Please refer to PADS datasheet for more information.

Applicable Standards

The test set conforms to the EEC directives regarding Electromagnetic Compatibility and Low-Voltage instruments.

• Electromagnetic Compatibility: Directive 2014/30/UE.
Applicable Standard: EN61326-1:2013; IEC61000-6-5

• Low Voltage Directive: Directive n. 2014/35/UE.
Applicable standards: CEI EN61010-1:2010
In particular:

- Input/output protection: IP 2X - IEC69529; IP 4X for HV output
- Operating temperature: -10÷55 °C; storage: -20÷70 °C
- Relative humidity: 0÷95% without condensing

Ordering Information

CODE	MODULE
65175 38175	TDX 5000 - with TDMS software*, standard test cable kit and heavy duty transport case
10176T	PADS software (trasfo)- Power transformer and Tan Delta test module
40175	CAP-CAL Calibration module
42175	Remote safety switch
44175	Digital thermo hygrometer
43175	Warning strobe light
47175 48175 19175	RCTD - Compensating reactor for TDX 5000 Cable test kit for RCTD Transport case for RCTD
13175	STOIL Cell for the eletric test of insulating oil of the transformer
68175	Trolley for TDX 5000
66175	Cable test kit for TDX 5000
41185	RTD capacitance for transformer ratio at high voltage
42185	Hook for HV connection
50185	IN-A and IN-B current measure inputs up to 10 A

**PADS - Power Apparatus Diagnostic Software is NOT included into basic unit price. It should be expressly ordered.*

Comparison Table of the STS Family

STS MODEL	HIGH CURRENT, AC & DC	HIGH VOLTAGE	LOW AC-DC OUTPUTS	TAN DELTA TESTS	OPTIONAL HIGH AC CURRENT WITH BUX
STS 5000 [1]	✓	✓	✓	✓ *with TD 5000*	✓
STS 4000 [1]	NOT AVAILABLE	✓	✓	✓ *with TD 5000*	✓
TDX 5000	NOT AVAILABLE	NOT AVAILABLE	NOT AVAILABLE	✓	NOT AVAILABLE

[1] *For USA and Germany, only TDX 5000 and STS 3000 light with TD 5000 are available.*

Comparison Table of the STS Family Tests

NO.	TEST OF	TEST DESCRIPTION	STS 5000	STS 4000	TDX 5000
1	CT	Ratio, Voltage mode	✓	✓	NOT AVAILABLE
2	CT	Ratio, polarity and burden with high AC current	✓	WITH BUX	NOT AVAILABLE
3	CT	Burden; secondary side	✓	✓	NOT AVAILABLE
4	CT	Excitation curve	✓	✓	NOT AVAILABLE
5	CT	Winding or burden resistance	✓	✓	NOT AVAILABLE
6	CT	Voltage withstand	✓	✓	NOT AVAILABLE
7	CT	Remote polarity check	✓	NOT AVAILABLE	NOT AVAILABLE
8	CT	Rogowski coil transformers	✓	WITH BUX	NOT AVAILABLE
9	CT	Low power transformers	✓	WITH BUX	NOT AVAILABLE
10	CT	Tan(δ) measurements	WITH TD 5000	WITH TD 5000	✓
11	VT	Ratio; polarity	✓	✓	NOT AVAILABLE
12	VT	Burden, secondary side	✓	✓	NOT AVAILABLE
13	VT	Ratio, electronic transformers	✓	✓	NOT AVAILABLE
14	VT	Voltage withstand	✓	✓	NOT AVAILABLE
15	VT	Remote polarity check	✓	NOT AVAILABLE	NOT AVAILABLE
16	VT	Tan(δ) measurements	WITH TD 5000	WITH TD 5000	✓
17	PT	Ratio per TAP	✓	✓	NOT AVAILABLE
18	TP	Vector Group	✓	✓	NOT AVAILABLE
19	PT	Static and dynamic resistance of Tap Changer contacts	✓	✓	NOT AVAILABLE
20	PT	No Load / Excitation current	WITH TD 5000	WITH TD 5000	✓
21	PT	Short circuit impedance	✓	✓	NOT AVAILABLE
22	PT	Tan(δ) measurements	WITH TD 5000	WITH TD 5000	✓
23	PT	Ratio with RTD	WITH TD 5000	WITH TD 5000	✓
24	CB	High DC current micro-Ohmmeter test	✓	NOT AVAILABLE	NOT AVAILABLE
25	CB	Tan(δ) measurements	WITH TD 5000	WITH TD 5000	✓
26	VT CB RELAY	Current threshold and timing	✓	✓	NOT AVAILABLE
27	R	Ground resistance and resistivity	✓	✓	NOT AVAILABLE
28	R	Step and touch voltages	✓	✓	NOT AVAILABLE
29	L	Measurement of line impedance and of the related parameters	✓	✓	NOT AVAILABLE
30	Capacitor Banks	Measurement of the capacitance	WITH TD 5000	WITH TD 5000	✓

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