

STS 5000

Multifunction substation maintenance & commissioning test system for current, voltage and power transformers.

Capacitance / Tan Delta diagnostic system with the optional module TD 5000.



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Multifunction substation maintenance & commissioning test system for current, voltage and power transformers.

Capacitance/TanDelta diagnostic system with the optional module TD 5000.

- Fully automatic
- Primary injection testing capabilities: up to 800 A or up to 3000 A, with the optional module BUX 3000
- Variable output frequency: 15 - 500 Hz
- Power dissipation factor test with the optional module TD 5000 (voltage up to 12 kV)
- 2000 V AC high-pot test
- Large graphic display
- Advanced Test & Data Management Software for test set control, results storage and analysis
- USB interface and Ethernet interface for PC connection
- Compact and lightweight
- Patent pending technology for capacitance and Tan Delta measurement



A P P L I C A T I O N

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

N.	TEST	TEST DESCRIPTION
1	CT	Ratio, Voltage mode
2	CT	Ratio, polarity and burden with high AC current
3	CT	Burden; secondary side
4	CT	Excitation curve
5	CT	Winding or burden resistance
6	CT	Voltage withstand
7	CT	Polarity check
8	CT	Rogowski coil transformers
9	CT	Low power transformers
10	CT	Tan Delta measurements
11	VT	Ratio; polarity
12	VT	Burden, secondary side
13	VT	Ratio, electronic transformers
14	VT	Voltage withstand
15	VT	Polarity check
16	VT	Tan Delta measurements
17	PT	Ratio per TAP
18	PT	Static and dynamic resistance of Tap Changer contacts
19	PT	Excitation current
20	PT	Short-circuit impedance
21	PT	Tan Delta measurements
22	CB	High DC current micro-Ohmmeter test
23	CB	Tan Delta measurements
24	CB, RELAY	Current threshold and timing
25	R	Ground resistance and resistivity
26	R	Step and touch voltages
27	L	Measurement of line impedance and of the related parameters
28	OTHERS	Sequencer

Tests are performed in accordance with the following IEC standards: EN 60044-1; EN 60044-2; EN 60044-5; EN 60044-7; EN 60044-8; EN 60076-1, and also in accordance with ANSI/IEEE C57.13.1.

The following optional modules enhance the STS 5000 features.

- The high voltage (HV) generator TD 5000 performs the measurement of the tan Delta, capacitance and power factor of any device, at the frequency of the mains or in a wide frequency range.
- The Circuit Switch option STCS performs the automatic measurement of PT's transformer ratios, of the winding resistances and of the short-circuit inductances, testing also the operation of the Load or no-Load Tap Changer.
- The extremely high current BUX 3000 option performs high current tests, with currents up to 3000 A.
- The oil tester STOIL tests the dielectric oil of a power transformer.

SYSTEM DESCRIPTION

The STS family includes **3 models**: STS 5000, STS 4000 and STS 3000. STS 4000 is not equipped with: AC and DC high current outputs. STS 3000 is not equipped with: AC and DC high current outputs, AC and DC high and low voltage outputs. All models can be connected to the Tan Delta module TD 5000 and to the very high current module BUX 3000.

STS 5000 includes a **six-outputs generator**: high AC current; low AC current; high DC current; low DC current; high AC voltage; low AC voltage.

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, that make STS 5000 a very powerful testing device, with manual and automatic testing capabilities, and with the possibility to transfer test results to a PC via USB, ETHERNET or Pen Drive. In the PC control mode, the TDMS software allows performing the same tests as in the local mode, with the same control windows. It allows also to download, display and analyse test results obtained in local mode. TDMS operates with all Windows® versions.

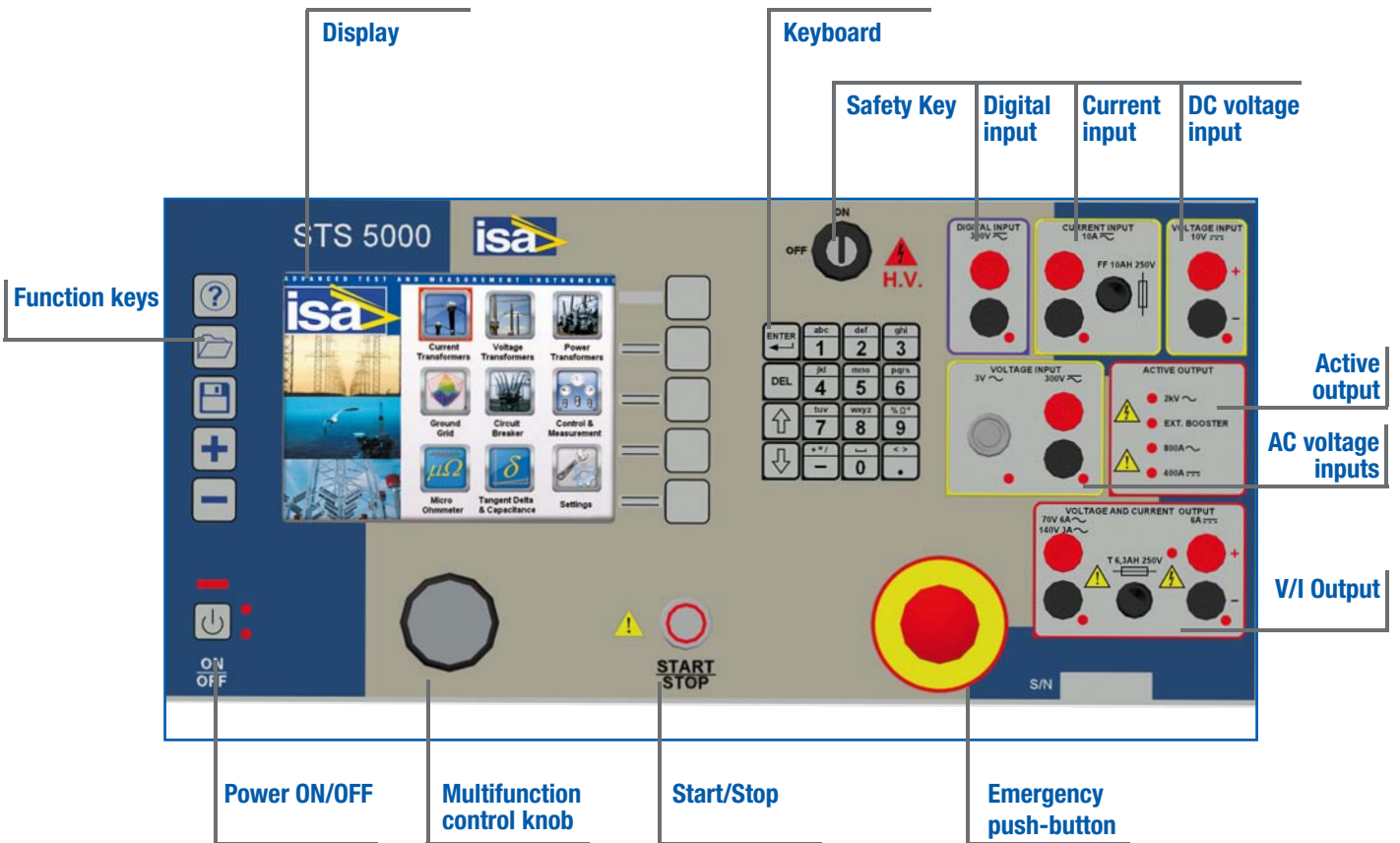
The **ease of operation** has been the first goal of STS 5000. This is why the LCD display is so large and the dialogue in MENU mode is made easy. STS 5000 includes three measurement inputs:

- . DC voltage (10 V DC).
- . AC voltage:
 - .. High range (300 V AC)
 - .. Low range (3 V AC)
- . Current (10 A AC or DC).

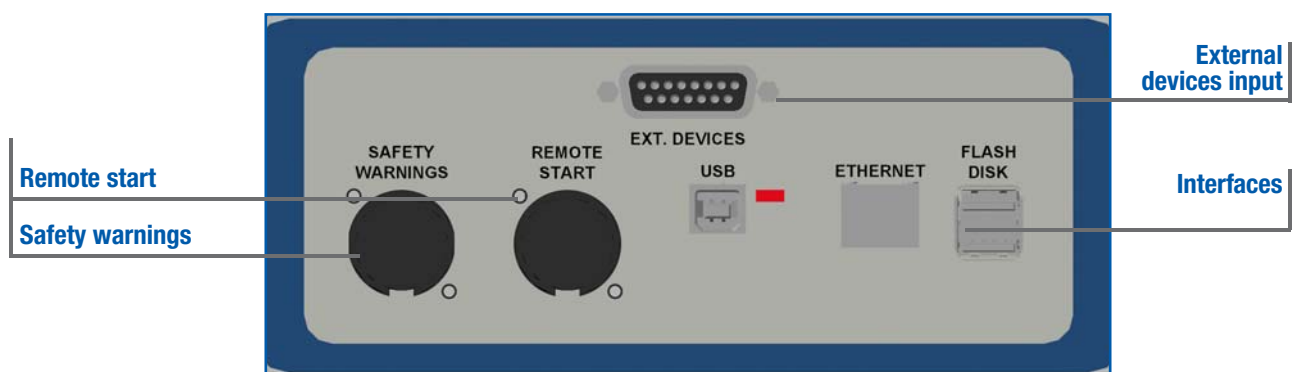
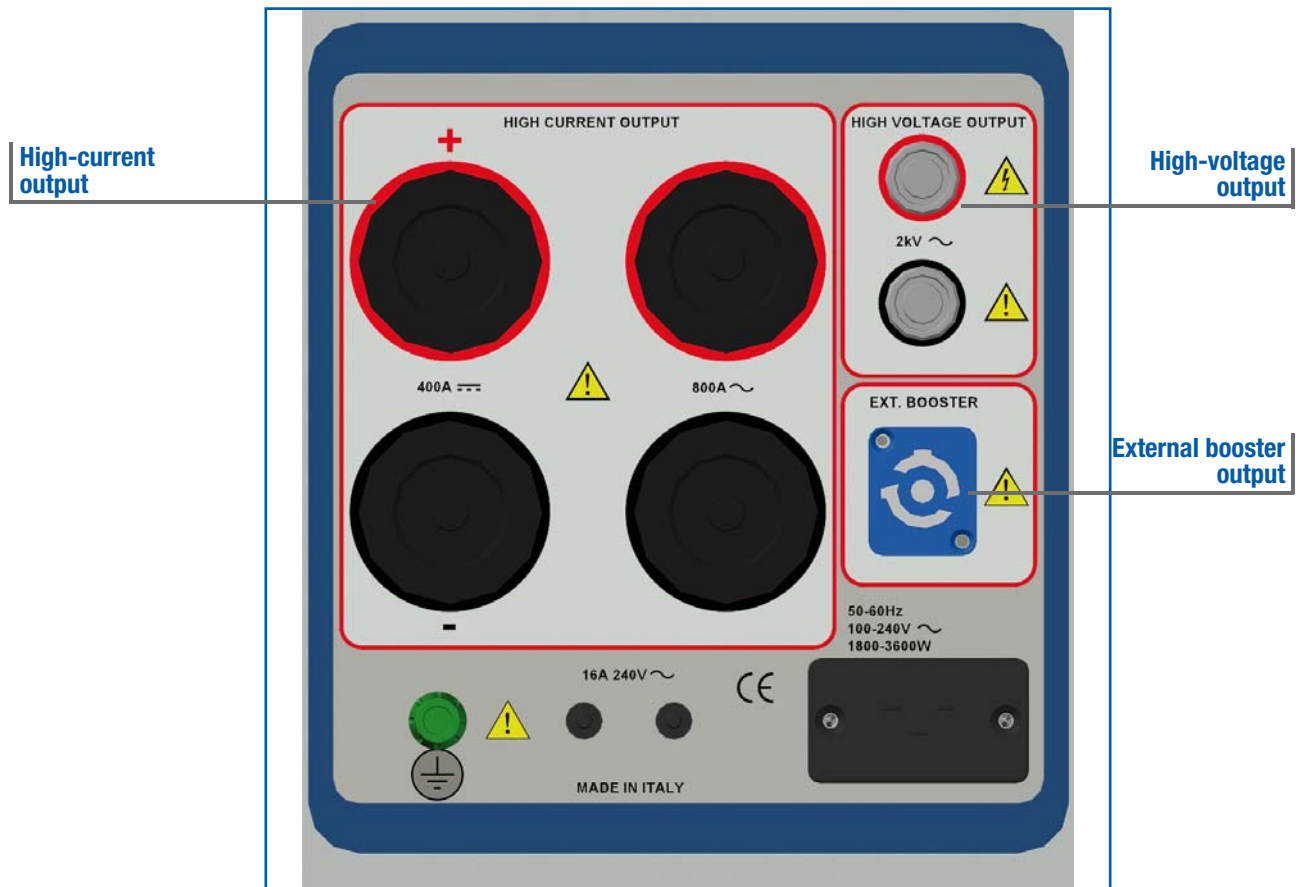
All these inputs are independent among them and allow the measurement of CT or VT outputs or of another source.

In addition, a digital input (up to 300 V) is available: it can measure the timing of a wet or dry contact. The instrument is housed in a transportable aluminium box, which is provided with removable cover and handles for ease of transportation. A transport trolley can also be supplied upon request.

STS 5000 - FRONT PANEL



STS 5000 - SIDE PANELS

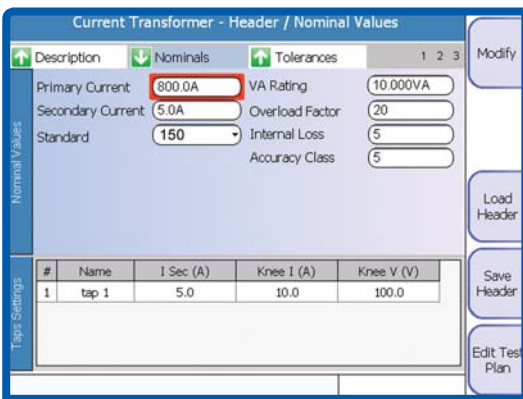


TEST PLAN EDITOR

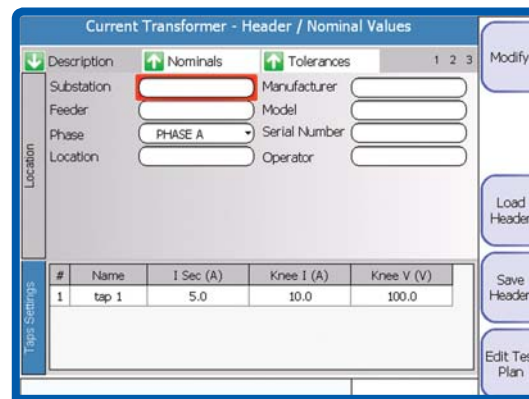
TEST PLAN EDITOR is an **innovative and advanced software module allowing the operator to define and plan a sequence of tests**. The operator defines the desired sequence of tests and sets the parameters of each test. TEST PLAN EDITOR creates a sequence of tests to be performed automatically. This feature is **available for the test of current, voltage and power transformers**. It is also possible to create a test sequence for primary and secondary injection.

Test plans can be saved or recalled, like test results. **Up to 64 settings can be stored and recalled**. Settings are permanently stored in the memory and new settings can be written to the same address after confirmation. During the test, test results can be stored in the memory. At the end of test, settings and test results can be transmitted to a PC provided with TDMS. The software allows saving, exporting and analysing test results.

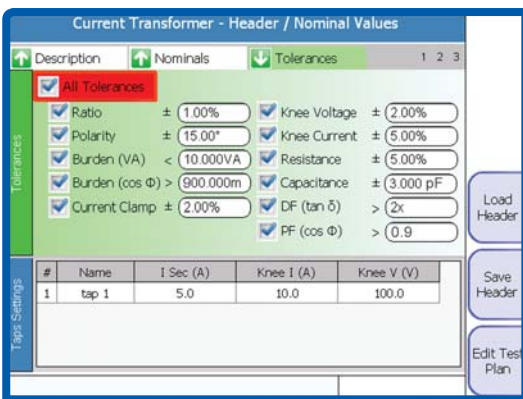
EXAMPLES OF TEST PLAN EDITOR FOR CT TESTS



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



Tests header window: reference data for the test.



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 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 and TDMS.

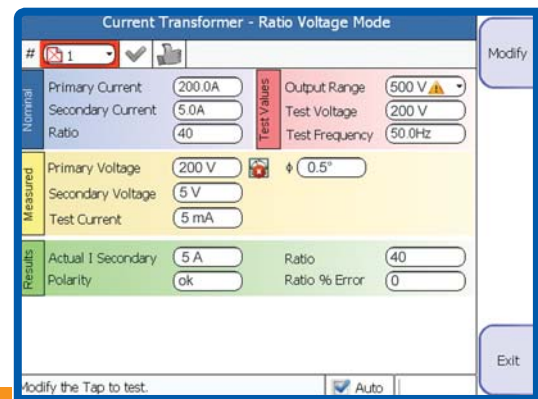
TEST OF CURRENT TRANSFORMER

• CT RATIO AND POLARITY VOLTAGE METHOD

The ratio measurement is performed applying high-voltage AC to the CT secondary and measuring the CT primary voltage.

Input parameters are: the nominal primary and secondary current, from which the program computes the nominal ratio, the voltage range, the nominal test voltage and the test frequency. The display shows:

- The voltage output, the secondary voltage and the current during the test;
- Actual ratio and ratio error;
- Phase shift and polarity.



TEST OF CURRENT TRANSFORMER

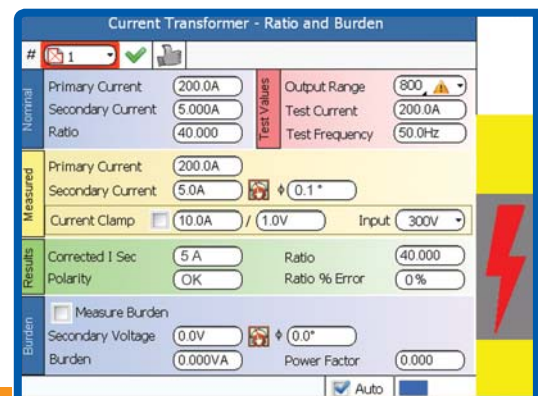
• CT RATIO, POLARITY AND BURDEN CURRENT METHOD

The ratio measurement is performed applying high current to the CT primary and measuring the CT secondary current. The burden can be by-passed or left in series for the measurement. In this instance, the voltage drop is measured. The secondary current can be measured by a clamp. Input parameters are: the nominal primary and secondary current, from which the program computes the nominal ratio and the nominal test current. The display shows:

- The actual primary current;
- The corresponding secondary current;
- The value of the secondary current with the nominal primary current;
- Actual ratio and ratio error;
- Phase shift and polarity.

When the burden is tested, the following parameters are displayed:

- The voltage drop across the burden;
- For the burden: VA rating at the nominal current, angle and power factor.



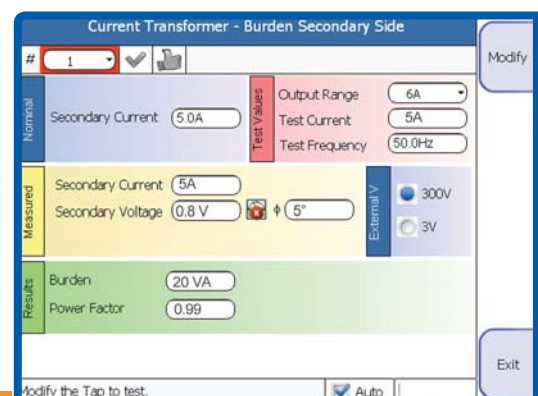
TEST OF CURRENT TRANSFORMER

• CT BURDEN SECONDARY SIDE

The burden measurement is performed applying low AC current to the CT burden and measuring the voltage drop.

Input parameters are: the nominal secondary current and the nominal test current. The display shows:

- The actual current output;
- The voltage drop across the burden;
- For the burden: VA rating at the nominal current, angle and power factor.

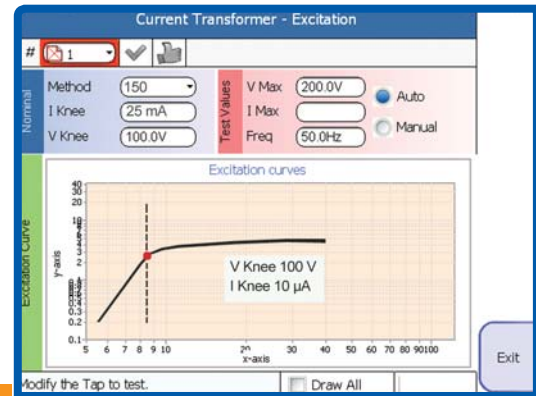


TEST OF CURRENT TRANSFORMER

• CT EXCITING CURVE

The exciting curve is tested connecting the high AC voltage to the CT secondary, ramping the voltage and measuring at the meantime the output current and voltage. Input parameters are taken from the CT nominal value window. Other inputs are: maximum test voltage, maximum current and test frequency. The test set controls the output voltage and current during the test and stops as the knee is recognized. The display shows:

- The characteristic curve;
- The actual voltage knee and the error with respect to the nominal;
- The actual current error at knee.

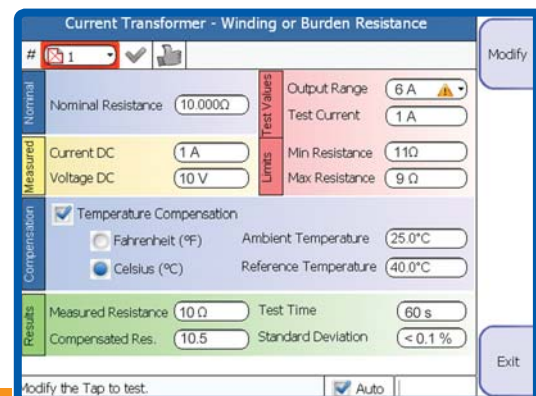


TEST OF CURRENT TRANSFORMER

• WINDING RESISTANCE

The resistance (not impedance) is measured connecting the low DC current source to the winding or burden, and measuring the test current and the voltage drop. Input parameters are: the nominal resistance, the connected output, the test current and the resistance limits. It is also possible to compensate the test temperature. The test set controls the output current and voltage during the test, and stops as the test current is reached. The display shows:

- The test current;
- The voltage drop;
- The measured resistance and the compensated resistance;
- The test duration and the current deviation when the measurement was achieved.



TEST OF CURRENT TRANSFORMER

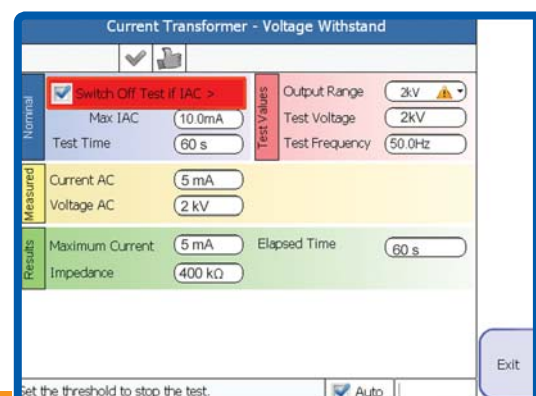
• VOLTAGE WITHSTAND

The test is performed connecting the high AC voltage source between the CT secondary cabling and the ground.

Input parameters are: maximum test current (with automatic switch-off), test time, output range, test voltage, test frequency.

The display shows:

- During the HV ramping, the test voltage and current;
- As the test is completed, the maximum current, the total elapsed time and the isolation impedance.

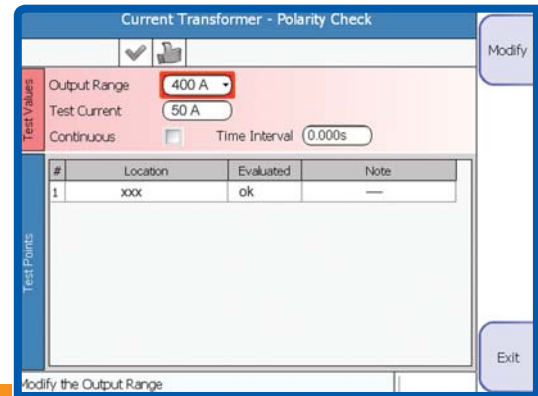


TEST OF CURRENT TRANSFORMER

• REMOTE POLARITY CHECK

The test is performed generating a special AC current on the primary side, and measuring the induced secondary current on the optional PLCK polarity checker.

Input parameters are: the test current, the time interval and the test result (OK or NO). The display shows the test current and records the test result of the different points.



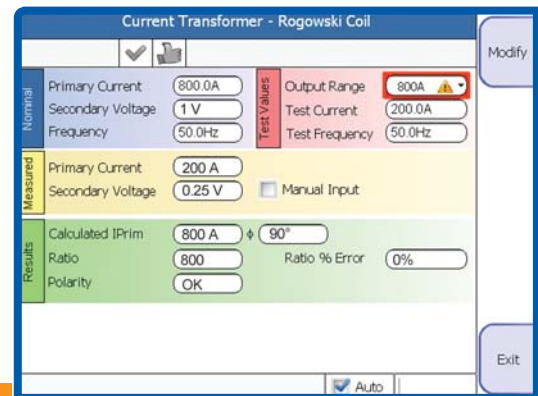
TEST OF CURRENT TRANSFORMER

• ROGOWSKI COIL

The test is performed connecting the high AC current source to the primary side, and connecting the CT secondary side to the low-voltage measurement. Input parameters are: the nominal primary current and the nominal secondary voltage, from which the program computes the nominal ratio, the current range, the test current and the test frequency.

The display shows:

- The range current and the test current;
- The actual test current, the secondary voltage and the value of the primary current with the nominal secondary voltage;
- Actual ratio and ratio error;
- Phase shift and polarity.



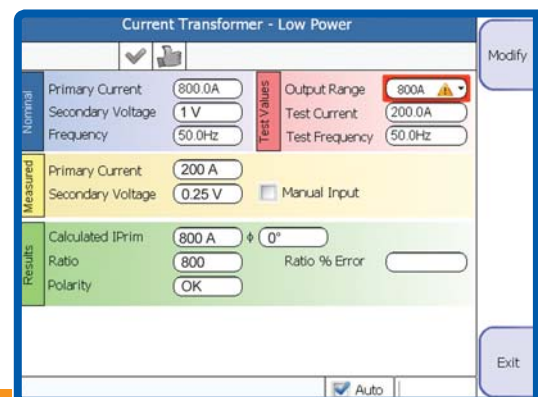
TEST OF CURRENT TRANSFORMER

• LOW POWER

The test is performed connecting the high AC current source to the primary side, and connecting the CT secondary side to the low-voltage measurement. Input parameters are: the nominal primary current and the nominal secondary voltage, from which the program computes the nominal ratio, the current range, the test current and the test frequency.

The display shows:

- The range current and the test current;
- The actual test current, the secondary voltage and the value of the primary current with the nominal secondary voltage;
- Actual ratio and ratio error;
- Phase shift and polarity.



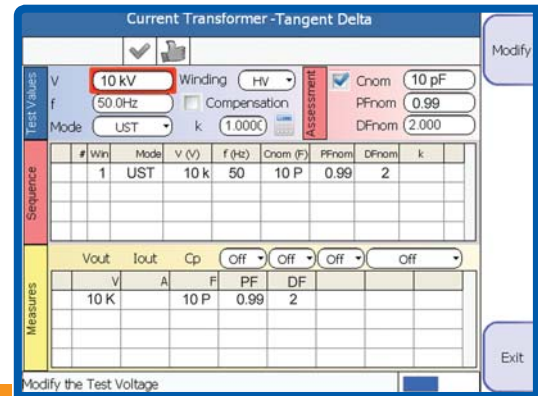
TEST OF CURRENT TRANSFORMER

• POWER FACTOR, CAPACITANCE AND TAN DELTA

with the TD 5000 optional module

The test is performed using the TD 5000 optional module, and then connecting 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;
- Power data: active, reactive and apparent;
- Impedance: module, argument and components.

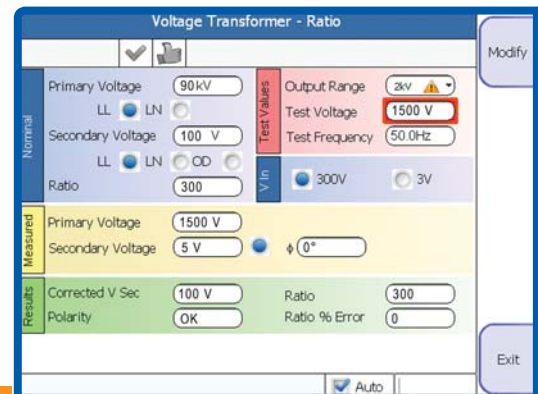


TEST OF VOLTAGE TRANSFORMER

• VT RATIO AND POLARITY

The ratio measurement is performed applying high voltage to the VT primary, and measuring the VT secondary voltage. Input parameters are: the nominal primary and secondary voltage, from which the program computes the nominal ratio, type of connection (Y or Delta), the HV range, the nominal test voltage and frequency and the selected voltage meter. The display shows:

- The actual test voltage;
- The secondary voltage;
- The value of the secondary voltage with the nominal primary voltage;
- Actual ratio and ratio error;
- Phase shift and polarity.



TEST OF VOLTAGE TRANSFORMER

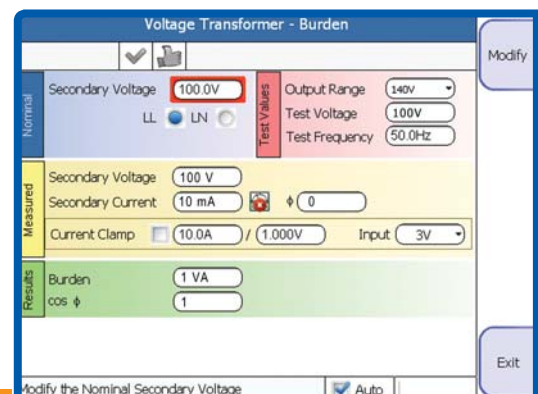
• VT BURDEN

The burden measurement is performed applying low AC voltage to the VT burden, and measuring the corresponding current.

Input parameters are: the nominal secondary voltage, the voltage range, the test voltage and frequency.

The display shows:

- The actual voltage output;
- The output current;
- For the burden: VA rating at the nominal voltage, angle and power factor.

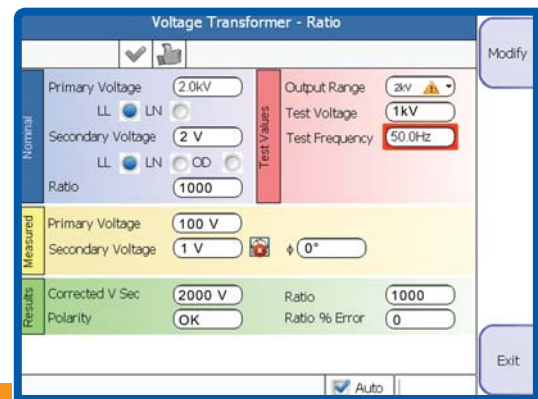


TEST OF VOLTAGE TRANSFORMER

• RATIO OF ELECTRONIC TRANSFORMER

The ratio measurement is performed applying high voltage to the VT primary, and measuring the low-level VT secondary voltage. Input parameters are: the nominal primary and secondary voltage, from which the program computes the nominal ratio, type of connection (Y or Delta), the HV range, the nominal test voltage and frequency. The display shows:

- The actual test voltage;
- The secondary voltage;
- The value of the secondary voltage with the nominal primary voltage;
- Actual ratio and ratio error;
- Phase shift and polarity.



TEST OF VOLTAGE TRANSFORMER

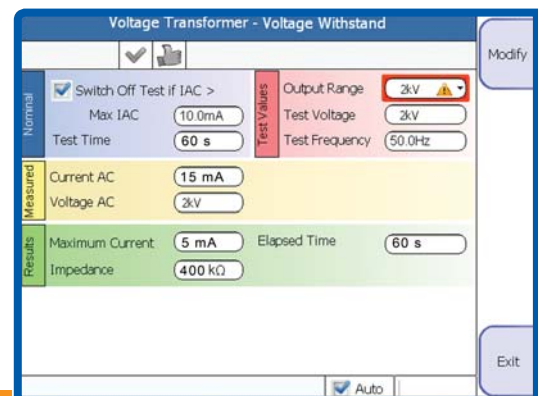
• VOLTAGE WITHSTAND

The test is performed connecting the high AC voltage between the VT secondary cabling and the ground.

Input parameters are: maximum test current (with automatic switch-off), test time, output range, test voltage and test frequency.

The display shows:

- During the HV ramping, the test voltage and current;
- As the test is completed, the maximum current, the total elapsed time and the isolation impedance.

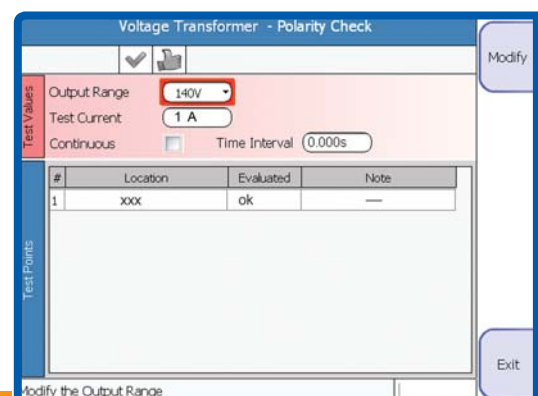


TEST OF VOLTAGE TRANSFORMER

• POLARITY CHECK

The test is performed connecting the high AC current source to the primary side, and measuring the induced secondary current on the optional polarity sensor.

Input parameters are: the test current, the time interval and the test result (OK or NO). The display shows the test current and records the test result of the different points.



TEST OF VOLTAGE TRANSFORMER

• POWER FACTOR, CAPACITANCE AND TAN DELTA

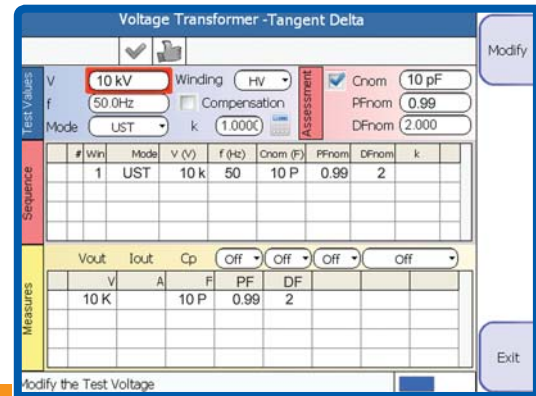
with the TD 5000 optional module

The test is performed using the TD 5000 optional module, and then connecting the high AC voltage source to the 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;
- Power data: active, reactive and apparent;
- Impedance: module, argument and components.



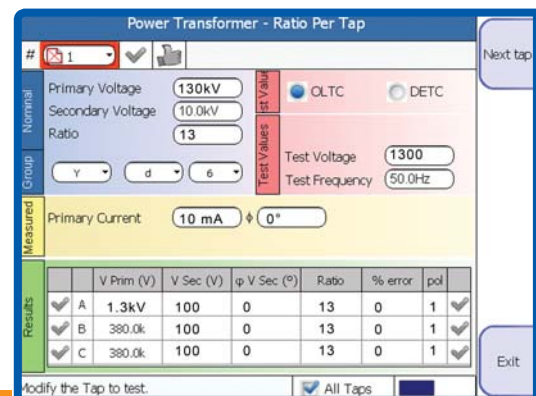
TEST OF POWER TRANSFORMER

• RATIO PER TAP

The ratio measurement is performed applying high voltage to the VT primary, and measuring the VT secondary voltage for each tap. If the STCS option is available, connection is performed via the option, and the test is completely automatic. Input parameters are: the nominal primary and secondary voltage, from which the program computes the nominal ratio, type of connection (Y or Delta), the type of Tap changer, the HV range, the nominal test voltage and frequency and the selected voltage meter.

The display shows:

- The test current and angle;
- The test voltage, primary and secondary;
- Actual ratio and ratio error;
- Phase shift and polarity.

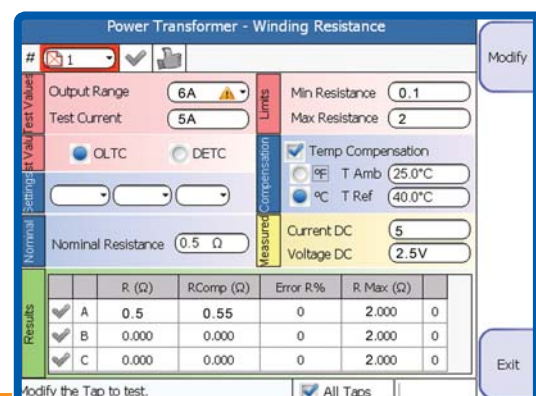


TEST OF POWER TRANSFORMER

• STATIC AND DYNAMIC WINDING RESISTANCE AND TAP CHANGER TEST

The test is performed applying low DC current to the VT primary plus Tap Changer and measuring the voltage drop. The tester measures the resistance peak during the switch and the resistance after the selection. If the STCS option is available, the connection is performed via the option and the test is completely automatic. Input parameters are: the tap number, the type of Tap changer, the current range, the test current, the nominal resistance and the resistance limits. It is also possible to compensate the test temperature. The test set controls the output current during the test and issues the Tap Change command. The display shows:

- The test current;
- The tap number;
- For the static resistance: the test voltage and resistance, also compensated;
- For the dynamic resistance: the measured value or the maximum resistance during the selection.



TEST OF POWER TRANSFORMER

• EXCITING CURRENT

The test is performed using the TD 5000 optional module, and then connecting 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;
- The power losses;
- The reactance.

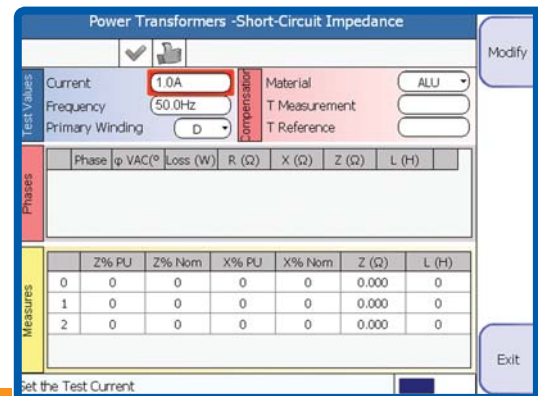


TEST OF POWER TRANSFORMER

• SHORT-CIRCUIT IMPEDANCE

The test is performed applying low AC current to the winding under test, while other windings are short-circuited and measuring the associated voltage and phase shift. If the STCS option is available, the connection is performed via the option and the test is completely automatic. Input parameters are: the test current and frequency, the type of winding and the phase under test. It is also possible to compensate the test temperature. The test set measures the output voltage and computes the related parameters. The display shows:

- Phase shift; the power loss; the R, X, Z and inductance of the transformer;
- The same parameters, but expressed in Per Unit.



TEST OF POWER TRANSFORMER

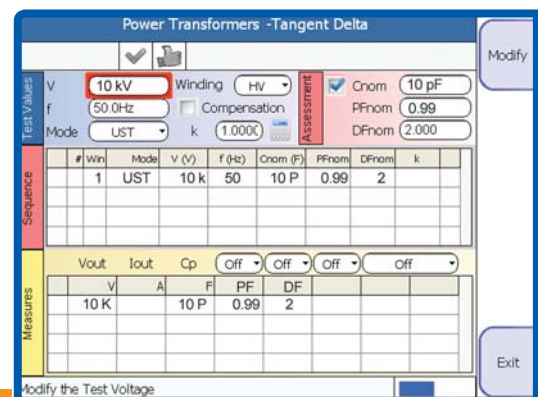
• POWER FACTOR, CAPACITANCE AND TAN DELTA with the TD 5000 optional module

The test is performed using the TD 5000 optional module, and then connecting 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;
- Power data: active, reactive and apparent;
- Impedance: module, argument and components.



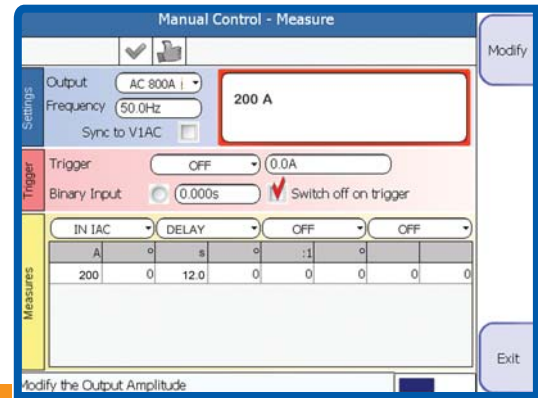
CB AND RELAY TESTS

• CB; PRIMARY AND SECONDARY RELAY TESTS

The selection allows ramping or injecting the test parameter and measuring the relay threshold and trip delay of a MV CB or of a relay. It is also possible to measure external voltages and currents. With the option BUX 3000 it is possible to perform high current tests, up to 3000 A. Input parameters are: current range, output current, output voltage and frequency. It is possible to enable the time measurement on the digital input or on the fall of the applied current (MV CB tests) and to set the type of digital input (wet or dry). The display shows the following data:

Input parameters are: current range, output current, output voltage and frequency. It is possible to enable the time measurement on the digital input or on the fall of the applied current (MV CB tests) and to set the type of digital input (wet or dry). The display shows the following data:

- Test current or test voltage;
- Trip delay;
- External voltage and current measurements.

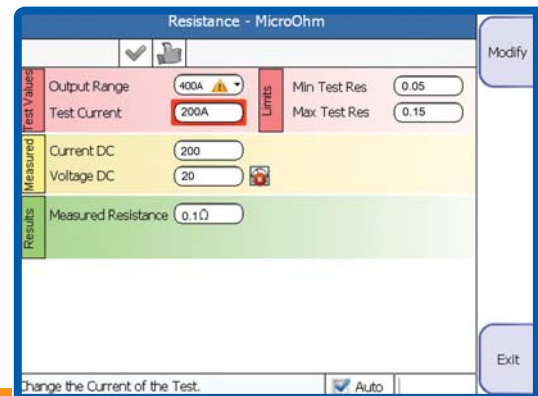


CIRCUIT BREAKER TESTING

• CONTACT RESISTANCE DC

The contact resistance test is performed using the high DC current output. The test set measures the contact resistance down to the μOhm range. With the same selection it is also possible to measure higher resistances. Input parameters are: current output range, test current and resistance limits. The display shows:

- DC current;
- DC voltage;
- Resistance.



CIRCUIT BREAKER TESTING

• POWER FACTOR, CAPACITANCE AND TAN DELTA

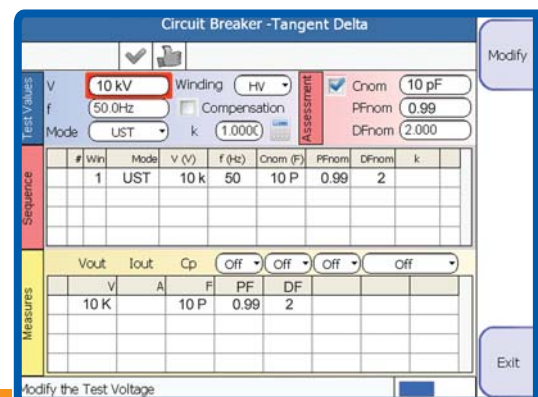
with the TD 5000 optional module

The test is performed using the TD 5000 optional module and then connecting 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;
- Power data: active, reactive and apparent;
- Impedance: module, argument and components.



OTHER FUNCTIONS

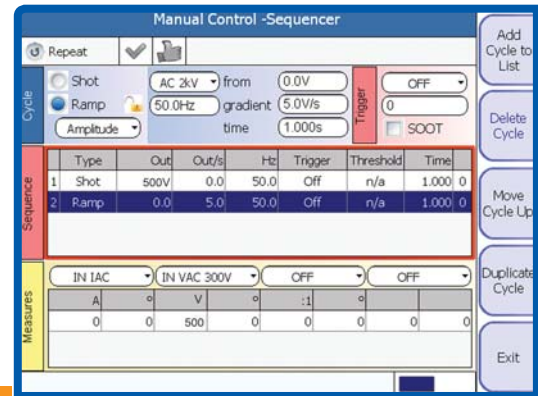
• SEQUENCER

The selection allows programming any series of ramp or step generation of any of the available outputs.

Input parameters are: type of test (shot or ramp), selected output, output value or rate of change, cycle duration, frequency and trigger enable.

The display shows the following data:

- Test parameters for each cycle;
- Corresponding test results.

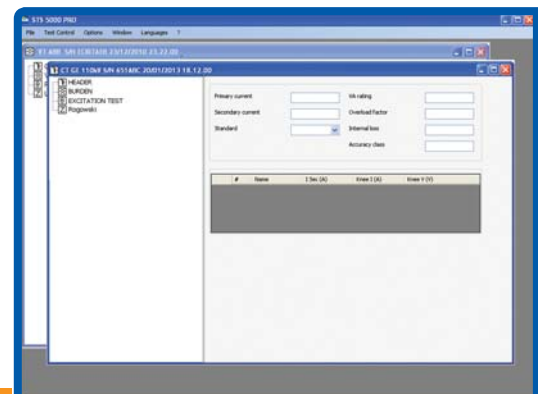


• TDMS SOFTWARE

The software allows:

- setting-up test plans;
- executing test;
- saving test results;

using the same window of the local control. It allows also saving set-up and results created locally. TDMS is also a powerful report editor that allows to create professional test reports that can be exported in Access format.



STS 5000 SPECIFICATION

MAIN GENERATOR

The main generator has six outputs: High AC current, High DC current, Low AC current, Low DC current, High AC voltage, Low AC voltage. Output adjustment is automatically performed once the test has been set. The following specification applies to the separate use of these outputs.

High AC current output - supply 230 V AC ^{*/**}

CURRENT OUTPUT A AC	MAX POWER VA	MAX TEST DURATION s	FREQUENCY Hz
800	4800	25	15 to 500
600	3780	200	15 to 500
400	2560	500	15 to 500
300	1940	15 min	15 to 500
200	1300	> 2 hours	15 to 500

.Connection: two high-current safety sockets, with safety protection.

. Accuracy: $\pm 0.1\%$ of the reading $\pm 0.1\%$ of the range.

High DC current output - supply 230 V AC ^{*/**}

CURRENT OUTPUT A DC	MAX POWER W	MAX TEST DURATION s
400	2600 W	140
300	1950 W	3 min
200	1300 W	> 2 hours
100	630 W	>> 2 hours

. Connection: two high-current sockets, with safety protection.

. Accuracy: $\pm 0.2\%$ of the reading $\pm 0.05\%$ of the range.

Low AC current output ^{**}

- . Maximum output current: 6 A or 3 A AC.
- . Maximum output voltage: 70 V AC or 140 V AC.
- . Maximum output power: 420 VA.
- . Connection: two safety 4 mm banana sockets.

Low DC current output ^{**}

- . Maximum output current: 6 A or 3 A DC.
- . Maximum output voltage: 65 or 130 V DC.
- . Maximum output power: 390 W.
- . Connection: two safety 4 mm banana sockets.

High AC Voltage output - supply 230 V AC ^{**}

The high AC voltage output is isolated by a HV switch inside the test set. This switch is closed only when the operator selects a high-voltage test, after the enable key is turned ON and after the START button is pressed.

Three voltage ranges are available.

MAX VOLTAGE OUTPUT V	CURRENT OUTPUT A	OUTPUT POWER VA	MAX TEST DURATION s	FREQUENCY Hz
2000	1.25	2500	60	15 to 500
2000	1	2000	130	15 to 500
2000	0.5	1000	> 2 hours	15 to 500
1000	2.5	2500	60	15 to 500
1000	2	2000	130	15 to 500
1000	1	1000	> 2 hours	15 to 500
500	5	2500	60	15 to 500
500	4	2000	130	15 to 500
500	2	1000	> 2 hours	15 to 500

. Output connection: two HV safety sockets.

. Accuracy: $\pm 0.05\%$ of the reading $\pm 0.05\%$ of the range.

The test set measures the current generated by the HV output.

CURRENT RANGE A	ACCURACY
5	$\pm 0.2\%$ reading $\pm 0.05\%$ range
0.5	$\pm 0.05\%$ reading $\pm 0.05\%$ range
0.05	$\pm 0.1\%$ reading $\pm 0.01\%$ range

Notes:

. Tolerances are typical values.

. Output power is reduced with the supply of 110 V.

Low AC Voltage output ^{**}

- . Voltage range: 140 or 70 V AC.
- . Output power: 420 VA.
- . Frequency range: 15 - 500 Hz.
- . Connection: two safety 4 mm banana sockets.

Output frequency

- . AC output frequency range: 15 to 500 Hz.
- . Frequency resolution: 10 mHz; accuracy 10 ppM.

*** Not available on the STS 4000 model.**

**** Not available on the STS 3000 model.**

EXTERNAL INPUT MEASUREMENTS

Current and Voltage

It is possible to meter the current and the voltage of an external generator. Three metering groups are available:

- AC or DC current, up to 10 A.
- AC voltage, with two connections:
 - o High range, up to 300 V AC.
 - o Low range, up to 3 V AC.
- DC voltage, up to 10 V DC.

The selected input is shown in the front panel by an LED.

Resolution and accuracy

INPUT	RANGE	ACCURACY ± % reading ± % range
AC CURRENT	1 A; 10 A	±0.05 ±0.05
DC CURRENT	1 A; 10 A	± 0.03 ±0.08
HIGH AC VOLTAGE	300 mV; 3 V; 30 V; 300 V	±0.15 ±0.05 ±0.05 ±0.05
LOW AC VOLTAGE	30 mV 300 mV 3 V	±0.1 ±0.25 ±0.08 ±0.08 ±0.03 ±0.08
DC VOLTAGE	10 mV; 100 mV 1 V; 10 V	±0.05 ±0.15 ±0.03 ±0.08

Timer

The test set allows testing protection relays. In this mode of operation, the test current or voltage can be ramped or stepped. As the output changes, a timer is started; the timer stops as the Digital In input senses that the relay has tripped or the output in cut (MV CB tests).

Characteristics of the Digital In input:

- The input may be selected as Normal Open, Normal Closed.
- Type of input: either dry or under voltage. Maximum input: 300 V AC or DC.
- Voltage thresholds: 5 V, 24 V, 48 V or > 80 V.
- Timer resolution: 1 ms.
- Timer accuracy, digital input: ± 0.001% of the measurement ± 0.1 ms, for input lasting more than 1 ms.
- Maximum measured time: 9,999 s.

Phase angle

The test set measures the phase angle between the two AC selected parameters which are used during the test.

MEASUREMENT	RANGE	RESOLUTION	ACCURACY
PHASE	0 - 360	0.01°	±0.1°

OTHER MEASUREMENTS:

Starting from the internal and external measurements, the test set computes the following parameters:

RATIO	CT, PT
POLARITY	CT, PT
BURDEN	CT, VT
SATURATION KNEE	CT
RESISTANCE	CB

For the CT, VT and PT ratio measurement, the following applies.

- Range: 0 to 9999;
- Resolution: 1;
- Accuracy: ±0.15% of the reading ± 0.15% of the range.

For the resistance test, the following applies:

SOURCE	RANGE	ACCURACY
HIGH DC CURRENT	10 µOhm to 400 A	0.7% 0.5%
LOW DC CURRENT	100 mOhm to 6 A	0.3% 0.2%
DC V METER	100 Ohm to 20 kOhm	0.6% 0.5%

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 CONTROL

Local test control: by the START / STOP pushbutton. After 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.
- USB port for optional keyboard or mouse.

Interfaces to external modules:

- Commands to TD 5000 and STCS.
- Alarms to a flashing light.
- Remote start input.

Mains supply

100-230 V \pm 15%; 50-60 Hz.

Maximum supply current: 16 A.

Dimensions: 450 (W) x 400 (H) x 230 (D) mm.

Weight: 29 kg.

STANDARD ACCESSORIES

STANDARD (OPTIONAL) CONNECTION CABLES

NOTE: standard cables can also be ordered separately.

- . One mains supply cable, 2 m long.
- . One grounding cable, 6 m long.
- . One interface cable for the USB port.
- . One ETHERNET interface cable.
- . One USB pen drive.
- . One mating connector for the Remote Start input connector.
- . One mating connector for the Safety Warnings connector.
- . Two high-current connection cables, 70 sq. mm, 6 m long (*10 m long optionally*), for tests up to 800 A.
- . Two high-voltage connection cables, 6 m long (*10 m long optionally*), 5 kV, with earth screen.
- . Six connection cables (three red and three black,) 2.5 sq. mm, 6 m long (*10 m long optionally*), for the connection of: DC current output, low AC voltage output and digital input.
- . Four clamps to connect low voltage or low current or measurements, two red and two black, with a short cable terminating with a banana socket.
- . One cable for the 3 V measurement connection, shielded, 6 m long (*10 m long optionally*).
- . One cable for the 10 V measurement connection, shielded, 2.5 sq. mm, 6 m long (*10 m long optionally*).
- . Four crocodiles for measurements connections (two red and two black).
- . One connection cables transport case.

TRANSPORT CASE

The transit case allows delivering STS 5000 with no concern about shocks up to a fall of 1 m. This case is supplied with handles and wheels.



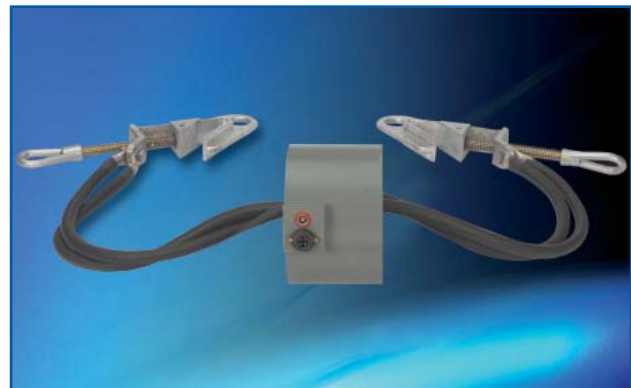
OPTIONAL ACCESSORIES

BUX 3000 - VERY HIGH CURRENT BOOSTER

The very high current booster option allows performing high-current primary tests, with currents up to 3000 A.

The option is made of a module, which incorporates:

- A power transformer, which generates a low-voltage, high-current output.
- A metering CT, which measures the output current, and sends the metering to STS 5000.



Option features:

TEST CURRENT A	OUTPUT POWER VA	TEST DURATION s
1000	900	INFINITE
2000	2400	300
3000	4800	60

- Weight: 16 kg.
 - Dimensions: external diameter 190 mm; height 120 mm.
- BUX 3000 is supplied with the high current cable, made of 4 cables, 95 sq. mm, 1.2 m long, with high current clamps and 2 connection cables: one with the power supply, 20 m long; the other one, 20 m long, with the output current measurement. In addition, the option is provided with 2 metering cables for the connection of the CT secondary.

STCS CIRCUIT SWITCH MODULE

When it is necessary to perform one of the following tests:

- Winding resistance.
- Short-circuit inductance.
- PT ratios.



The external module STCS allows performing them automatically. The connection to the phases of the transformer under test (and to STS 5000) is performed just once; then all tests are performed without interruptions. During the test, when taps are to be tested, the device issues the corresponding command to the tap changer (or load changer); so, also tap ratio measurements are automated. STCS is powered and controlled by STS 5000. During tests, the suitable high or low STS 5000 voltage outputs (AC or DC) are connected to STCS. The corresponding measurements are connected to STS 5000 voltage measurement inputs.

The option comes complete with the following connection cables (they can also be ordered separately):

- . Ten coaxial cables marked with different colours, for the connection to the PT primary or secondary side of the current or voltage output and of the measurement input, and of the Tap Changer commands. Cables are 15 m long, mounted on wheels.
- . Two cables, 2 m long (one red and one black) for the connection to the HV output.
- . Six cables, 2 m long (three red and three black) for the connection to: DC current generator, 300 V AC meter and 10 V DC meter.
- . One connection cable to the EXT. DEVICES connector of STS 5000.
- . Six adapters, from banana to terminator.
- . Eight clamps, for the connection of the generator and of the meter to the PT primary or secondary.
- . One connection cables transport case.

EARTH RESISTANCE AND RESISTIVITY TEST KIT

The option is the kit of connection cables and auxiliary spikes that allows executing these tests. The kit is made of the following devices.

A) Current generation.

- One cable for the connection of STS 5000 to the auxiliary spike, 100 m long, 2.5 sq. mm cross section, wound on a wheel.
- Three cables for the following connections: of STS 5000 to the above wheel, of the two earth spikes between them, and of the measurement input to the measurement wheel; 4 m long, 2.5 sq. mm cross section.
- Two cables for the connections of STS 5000 to the local earth system, both for generation and measurement, 10 m long, 2.5 sq. mm cross section.
- Two auxiliary earth spikes, screw shaped, for the dispersion of the current into the soil. Length: 0.95 m; screwed section 0.6 m. Material: zinc-plated iron.
- Handle to screw the spike into the ground.
- One current clamp to connect STS 5000 to the local earth system.

B) Voltage measurement

- One cable for the connection of STS 5000 to one voltage spike, 50 m long, 2.5 sq. mm cross section, wound on a wheel.
- Two auxiliary earth spikes, to measure the voltage drop; material: zinc-plated iron; length: 0.5 m.
- One measurement clamp to connect STS 5000 to the local earth system.

SU 3000 SAFETY DEVICE FOR THE LINE IMPEDANCE MEASUREMENT

The purpose of the SU3000 optional device is to protect the operator against possible high-voltage spikes. SU 3000 incorporates:

- A voltage suppressor, rated 1000 V AC and 15 kVA;
- An ON/OFF switch, rated 375 A steady, 2000 A peak, 1500 V AC.

Weight: 20 kg.

Dimensions: 55 x 45 x 25 cm.

STOIL CELL FOR THE HV TEST OF THE DIELECTRIC OIL

The option allows testing 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 the option TD 5000 for the test execution. The test result, displayed by STS 5000, is the oil tan Delta. Cell characteristics are the followings.

- Maximum test voltage: 2 kV.
- Cell volume: about 0.4 l.
- Capacitance of the empty cell: about 50 pF.

The option comes complete with two HV connection cables, 2 m long.

CAP-CAL CALIBRATOR MODULE

Purpose of the calibrator is to check the correctness of TD 5000 measurement and, if necessary, to calibrate it.

The calibrator includes an extremely high accuracy high voltage capacitor, which comes with a certificate issued by INRIM, the Italian primary laboratory.

PLCK POLARITY CHECKER MODULE

Checking the correct connection of CT's and VT's to protection relays is a problem because relays can be hundreds of meters away from the transformer. PLCK easily solves the issue. When this test is started, STS 5000 generates a special, not sinusoidal waveform, which is injected into the connection cables. The polarity check is easily performed by connecting it at the relay site. PLCK has two lights: green and red. The green light turns on when the polarity is correct; the red light turns on when the polarity is wrong.

REMOTE SAFETY SWITCH

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.

DIGITAL THERMO HYGROMETER

A number of tests performed by STS, such as coil resistance, Tan Delta 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°C to 60°C.
- . Temperature measurement accuracy: $\pm 0.4^\circ\text{C}$.
- . Humidity measurement range: 5% to 95% RH.
- . Accuracy of humidity measurement: $\pm 2.5\%$ RH, over the whole range.
- . Dimensions: 141 x 71 x 27 mm.
- . Weight: 150 g.

CURRENT CLAMP

The current clamp allows to avoid the opening of the secondary current circuit when performing the primary test of CT burden. The clamp ratio is 1000/1; maximum primary current 100 A and maximum cable diameter 12 mm.

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.

TRANSPORT CASES

Transport cases for STS 5000, TD 5000 and BUX 3000 are available; all of them allow transporting the device with non concern about shocks or falls up to 1 m. The case is complete with handles and wheels.

FOLDABLE TROLLEY

The trolley eases the transport of STS 5000, especially when the optional TD 5000 has to be used too. The trolley is designed to host both instruments and also the high-voltage cable for TD 5000.



PROTECTIONS

- If the test set is not connected to the ground, the test set does not allow for power generation, and warns the operator with a diagnostic message and a fixed LED light.
- Fuses on: the mains supply, the low-power current and voltage outputs and the current meter input.
- At power-on, a diagnostic sequence controls the test set. In case of problems, the operator is alerted by a message.
- Emergency pushbutton: if pressed, all outputs are removed.
- The high-voltage output has the following protections: confirmation key; the HV is generated only if selected.
- Thermal sensors.
- 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.

APPLICABLE STANDARDS

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

A) Electromagnetic Compatibility: Directive no. 2004/108/EC. Applicable Standard : EN61326-1:2006

B) Low Voltage Directive: Directive n. 2006/95/EC.

Applicable standards:




- . CEI EN 61010-1:2001. In particular:
- . Input/output protection: IP 2X - IEC69529; IP 4X for HV output.
- . Operating temperature: -10° to 55 °C; storage: -20 °C to 70 °C.
- . Relative humidity: 5-95% without condensing.

ORDERING INFORMATION

CODE	MODULE
10175	STS 5000 - supplied with TDMS software, standard test cable kit and transport case
20175	STS 4000 - supplied with TDMS software, standard test cable kit and transport case
30175	STS 3000 - supplied with TDMS software, standard test cable kit and transport case
11175	TD 5000 module for the high-voltage test of Tan Delta for transformers and bushings, supplied with test cables, transport case and trolley
50175	BUX 3000 - External Advanced Booster up to 3000 A supplied with transport case
12175	STCS Circuit switch module
19102	Earth Resistance and Soil Resistivity Kit
26102	SU 3000 Safety grounding unit for line impedance measurement

CODE	MODULE
13175	STOIL Cell for the electric test of insulating oil of the transformer
40175	CAP-CAL Calibration module
41175	PLCK - Polarity checker
42175	Remote safety switch
44175	Digital thermo hygrometer
16102	Current Clamp 1/1000 Max 100A
43175	Warning strobe light
17175	Heavy duty plastic transport case for STS 5000
51175	Heavy duty plastic transport case for BUX 3000
19175	Heavy duty plastic transport case for TD 5000
18175	Trolley for STS family test sets and TD 5000
15175	Cable test kit with case for STS 5000
16175	Optional long cable test kit for STS 5000
14175	Cable test kit for TD 5000
22175	Cable test kit for STCS

COMPARISON TABLE OF THE STS FAMILY

STS MODEL	HIGH CURRENT, AC & DC	HIGH VOLTAGE	LOW AC-DC OUTPUTS	OPTIONAL TAN DELTA TESTS WITH TD 5000	OPTIONAL HIGH AC CURRENT WITH BUX 3000
STS 5000 ¹⁾ 	✓	✓	✓	✓	✓
STS 4000 ¹⁾ 	NOT AVAILABLE	✓	✓	✓	✓
STS 3000 	NOT AVAILABLE	NOT AVAILABLE	NOT AVAILABLE	✓	✓

¹⁾ For USA and Germany, only STS 3000 test set with optional module TD 5000 and/or BUX 3000 is available.

Capacitance and Tan Delta diagnostic system for high-voltage apparatus

- **Optional module for STS 5000, STS 4000 and STS 3000 test sets**
- **Tan Delta, capacitance, dissipation factor measurements and for exciting current test**
- **Output voltage up to 12 kV**
- **Variable output frequency: 15 - 500 Hz**
- **Test & Data Management Software**
- **Compact and lightweight**
- **Patent pending technology**

General characteristics

The high-voltage generator TD 5000 performs the measurement of the Tan Delta, of the dissipation factor and of the capacitance of a transformer or of a bushing, at the frequency of the mains or in a wide frequency range. The measurement is performed by the module, which is equipped with a patent pending technology.

The measurement circuitry incorporates a reference high voltage capacitor, rated 200 pF, with a tan delta better than 0.005%, plus 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.

Available test selections:

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

TD 5000 is powered and controlled by STS 5000, STS 4000 or STS 3000. Type of generator: HV generator with electronic control.

A P P L I C A T I O N

The following table lists the tests that can be performed on power transformers and high-voltage apparatus:

- tan Delta (or dissipation factor DF): from 0 to more than 100%.
- Capacitance: from 1 pF to 3 μF.
- Power factor : from 0 to 100%.
- Excitation current test: 5 A AC.



Generator characteristics

MAX VOLTAGE OUTPUT V	CURRENT OUTPUT A	MAX OUTPUT DURATION T Max	FREQUENCY Hz
12000	300 mA	120 s	15 to 500
12000	125 mA	> 1 hour	15 to 500

Output measurements

OUTPUT	RESOLUTION	TYPICAL ACCURACY ± % (rdg) ± % (rg)
12000 V AC	1 V	± 0,2% ± 0,5 V
5 A AC	1 mA	± 0,2% ± 1 mA
8 mA AC	1 µA	± 0,2% ± 0,1 µA

Connections: by two HV connectors, a ground socket and two measurement sockets

Test measurements

• Capacitance:

- Measurement range 1, from 1 pF to 100 nF. Resolution: 6 digits. Accuracy: ± 0.03% of the value ± 0.1 pF.
- Measurement range 2, from 10 nF to 3 µF. Resolution: 6 digits; accuracy: ± 0.1% of the value ± 10 pF.

• Tan Delta or dissipation factor DF:

- Measurement range 1: from 0 to 10% (capacitive). Resolution: 5 digits; accuracy: 0.05% of the value ± 0.005 %.
- Measurement range 2: from 0 to 100%. Resolution: 5 digits; accuracy: 0.3% of the value ± 0.01 %.
- Measurement range 3: over 100%. Resolution: 5 digits; accuracy: 0.5% of the value ± 0.03 %.

• Power factor PF (or cos(φ)):

- Measurement range 1: from 0 to 10% (capacitive). Resolution: 5 digits; accuracy: 0.05% of the value ± 0.005 %.
- Measurement range 2: from 0 to 100%. Resolution: 5 digits; accuracy: 0.3% of the value ± 0.02 %.

• Power:

- Measurement ranges: 10 kW, 100 kW, 1 MW. Resolution: 0.1 mW; accuracy, typical: 0.5% of the value ± 1 mW; guaranteed: 1% of the value ± 2 mW.

• Inductance:

- Measurement range 1: from 100 H to 1 MH. Resolution: 1 H; accuracy, typical: 0.5% of the value ± 0.5 H; guaranteed: 1% of the value ± 1 H;
- Measurement range 2: from 1 H to 10 kH. Resolution: 0.1 mH; accuracy, typical: 0.5% of the value ± 0.5 mH; guaranteed: 1% of the value ± 1 mH.

TD 5000 Dimensions: 440 (W) x 345 (H) x 210 (D) mm.

Weight: 25 kg.



STS 5000 and TD5000

STANDARD ACCESSORIES

TESTING CABLES

The option comes complete with the following connection cables:

- Two connection cables to the EXT. DEVICES connector of STS 5000.
- Two connection cables to the BOOSTERS connector of STS 5000.
- One high-voltage connection cable, 20 m long, 25 kV, with earth screen, for the connection to the device under test. The cable is mounted on a wheel.
- Two shielded connection cables, 20 m long, for the connection to the metering points. Cables are mounted on wheels.
- Four grounding cables: one 6 m long, two 1 m long and one 2 m long.
- One clamp, 5 kV isolation, with a connector which mates with the HV cable.
- Two clamps, terminated with banana sockets, which allow connecting to the metering point.
- One connection cables transport case.



TRANSPORT TROLLEY

The trolley eases the transport of TD 5000 and is designed to host both instruments and also the high-voltage cable.

TRANSPORT CASE

The transit case allows delivering TD 5000 with no concern about shocks up to a fall of 1 m.



ORDERING INFORMATION

CODE	MODULE
11175	TD 5000 module for the high-voltage test of Tan Delta for power transformers and HV devices, supplied with testing cables, transport case and trolley
14175	Cable test kit for TD 5000
19175	Heavy duty plastic transport case for TD 5000



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EN - STS 5000 & TD 5000
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