

# STS 3000 light with TD 5000

Power Factor and Capacitance diagnostic system  
for power apparatus



## Power Factor and Capacitance diagnostic system for power apparatus

- Fully automatic
- Tan-Delta, capacitance, dissipation factor measurements and exciting current test
- Variable output frequency: 1- 500 Hz
- Output voltage from 12 V up to 12 kV
- Local control with a large graphic display
- Test & Data Management Software for database, storage and report
- Optional remote control with PADS- Power Apparatus Diagnostic Software for automatic testing, assessment and report
- USB interface and Ethernet interface for PC connection
- Compact and lightweight
- Patented technology for capacitance and Tan Delta measurement.

## A P P L I C A T I O N

The following points show the tests that can be performed on power transformer and high-voltage apparatus:

- Tan Delta (or dissipation factor DF): from 0 to more than 100%.
- Capacitance: from 1 pF to 200 μF.
- Power factor : from 0 to 100%.

### GENERAL CHARACTERISTICS

The STS 3000 light & TD 5000 sets perform the measurement of the Tan Delta, of the dissipation factor and of the capacitance of a transformer or of any device, at the frequency of the mains or in a wide frequency range. The measurement is performed by the TD 5000 module, which is equipped with a patent pending technology.

The TD 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.

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 3000 light. Type of generator: voltage generator with electronic control.

### SYSTEM DESCRIPTION

The STS family includes three models : STS 5000, STS 4000 and STS 3000 light. STS 3000 light is the control unit, which allows controlling the TD 5000 module. STS 4000 has, additionally, a DC current generator, an AC voltage or current generator, an AC HV generator and external current and voltage meters.

STS 5000 has, additionally, an AC high current generator, and a DC high current generator. All models can be connected to the Tan Delta module TD 5000; STS 5000 and STS 4000 can be connected also to the very high current module BUX 3000, or to the line and ground tester STLG.

The 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.

Thanks to this, the STS 3000 light & TD 5000 set is 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 device, allows to download, review and print test settings and results. In the PC control mode, the optional PADS software allows performing the same tests as in the local mode, with the same control windows.

PADS operates with all Windows® versions.

The ease of operation has been the first goal of STS 3000 light & TD 5000 sets. This is why the LCD display is so large and the dialogue in MENU mode is made easy. STS 3000 light 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 is supplied.

### TDMS, the PADS host

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 saved in the TDMS database for historical results analysis.

The TDMS database organizes test data and results for the majority of electrical apparatuses tested with ISA test sets and related software.

### PADS - Power Apparatus Diagnostic Software

PADS - Power Apparatus Diagnostic Software is a powerful software application, optionally included in TDMS software, that allows the remote control of the STS family: STS 5000, STS 4000, STS 3000 light. The software performs various tasks, such as:

- . Control STS and TD remotely from PC
- . Create test plan
- . Download stored test results via Ethernet cable
- . Create and customize test reports
- . Print test results
- . Open and save results in TDMS database.

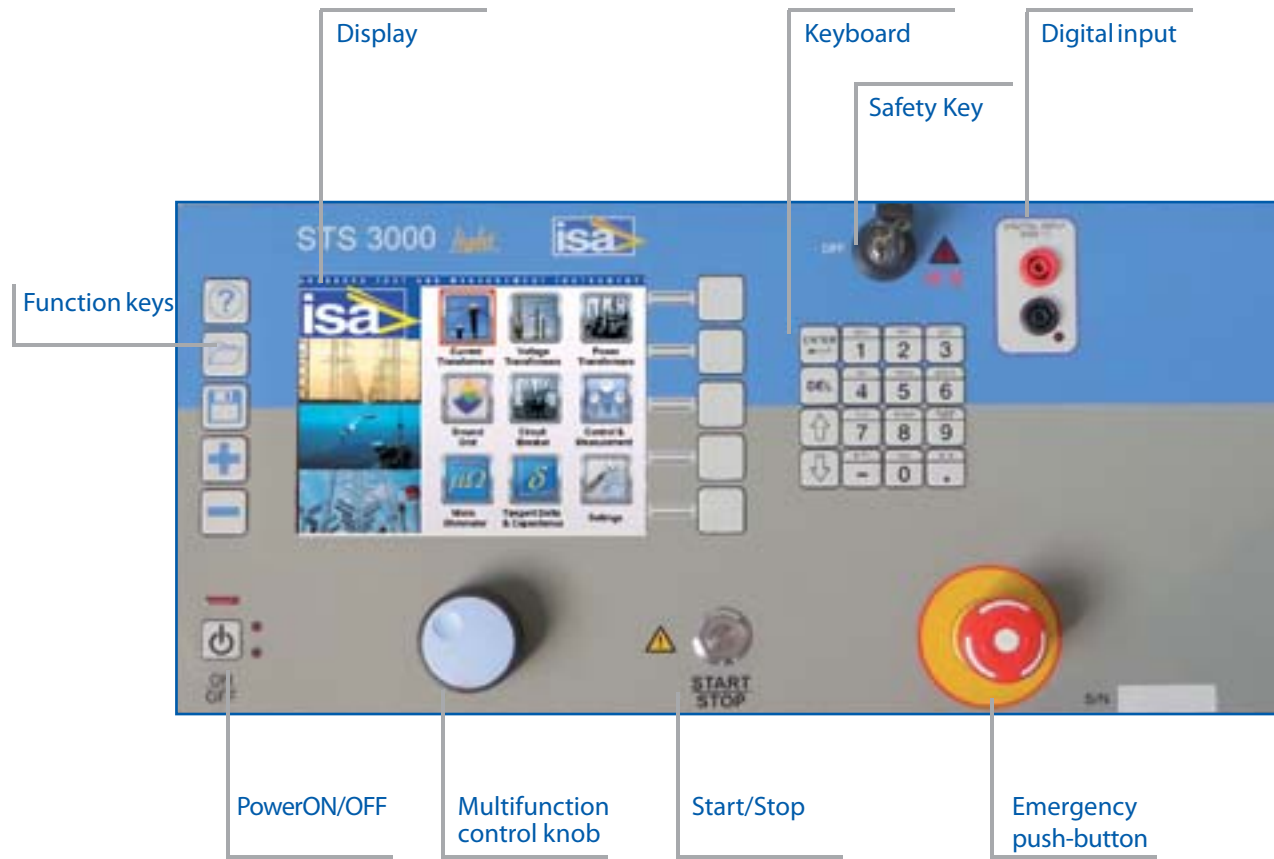
This program runs under Windows® environment.

Please refer to PADS datasheet for more information.

Note: Windows is trademark of Microsoft Corporation.



STS 3000 light - FRONT PANEL



STS 3000 light - SIDE PANELS



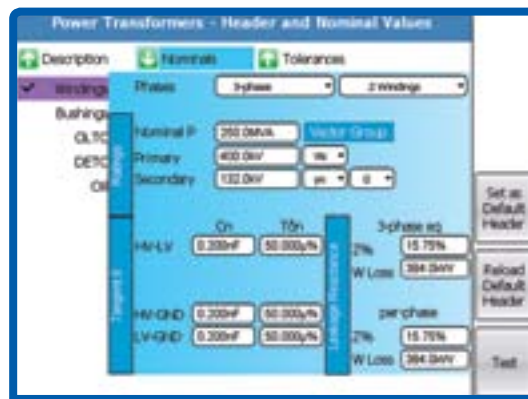


## TEST HEADER

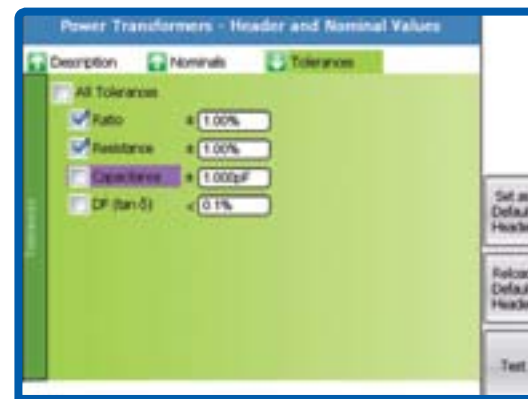
Before starting a test, all relevant test object data are input into the header, which is made of four screens. These data are used by the device for the following test execution. If, during tests, some results do not conform and nominal data are to be modified, the change is made in the Header, so that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

If the device is a PT, the Capacitance tests and the no-load 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.

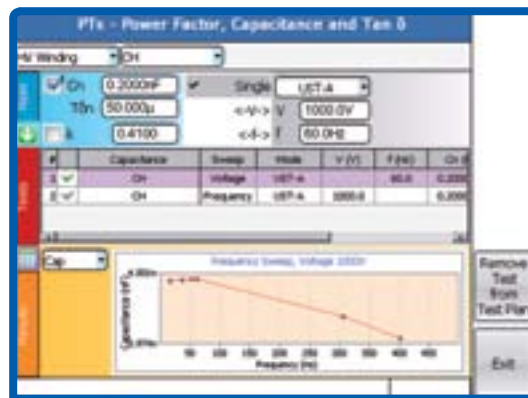
### EXAMPLES OF TEST PLAN EDITOR FOR PT TESTS



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



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



Test result: PT power factor.



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

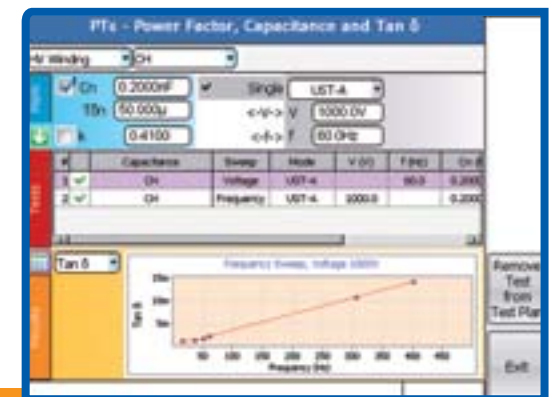
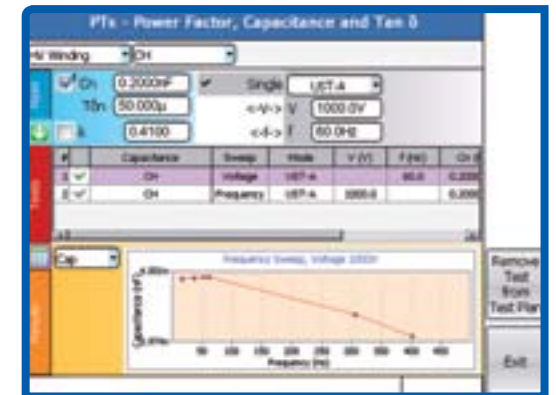
## POWERFACTOR, CAPACITANCE AND TAN-DELTA FOR CT, VT, POWER TRANSFORMER AND CB

### • POWER FACTOR, CAPACITANCE AND TAN DELTA

The test is performed connecting the TD 5000 high AC voltage source to test the target. The module allows for the complete testing of the PT: not only the measurements related to the windings, but also the tests of the bushings. 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.

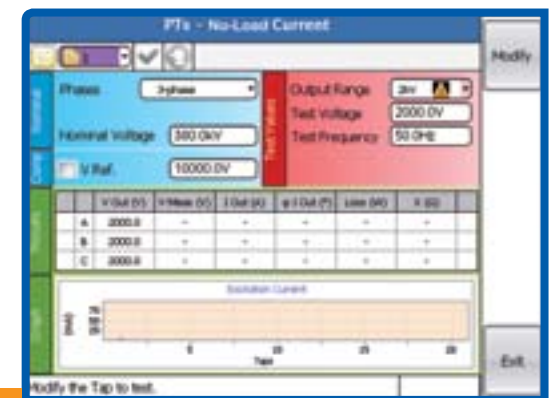


### • NO-LOAD CURRENT / EXCITATION CURRENT FOR POWER TRANSFORMER

The test is performed connecting the TD 5000 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.



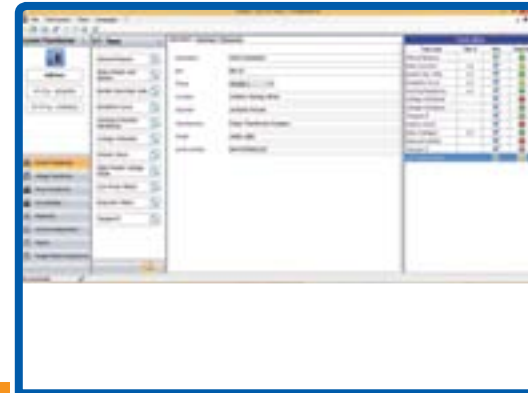
## OTHER FUNCTIONS

### OPTIONAL PADS SOFTWARE

The optional PADS software allows:

- . setting-up test plans
- . executing the test
- . saving test results,

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



## STS 3000 light SPECIFICATION

The following specification refers to the STS 3000 light module alone.

### HIGH POWER OUTPUT TO THE EXTERNAL MODULES

The output feeds the external modules type TD 5000. Output characteristics are the followings:

- . Output not isolated from the mains supply
  - . Output voltage: adjustable from 0 to 220 V AC
  - . Output frequency: 1 Hz to 500 Hz
  - . Output power; supply 230 V: 1500 VA steady, 4000 VA during 5 minutes; 5000 VA during 25 s.
  - . Output power; supply 110 V: 1360 VA steady, 2500 VA during 1 minute; 3150 VA during 25 s.
- This output goes to a safety connector.

### Output frequency

- . AC output frequency range: 1 to 500 Hz
- . Frequency resolution: 10 mHz; accuracy 10 ppm.

### Digital input

Characteristics of the Digital In input:

- . The input may be selected as Normal Open or 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.

### 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 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:

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

### Mains supply

- . 100-230 V  $\pm$  15%; 48-62 Hz
- . Maximum supply current: 16 A.

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

Weight: 16 kg.



STS 3000 light and TD 5000

## TD 5000 SPECIFICATION

The following specification refers to the TD 5000 module alone.

### 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<sup>1</sup>: the maximum voltage output may decrease for frequency below 50Hz and above 400Hz.

Note<sup>2</sup>: at 10 kV the output (current value and duration) has the same characteristic.

Voltage and current output metering accuracy and resolution.

INTERNAL MEASURE	RESOLUTION	TYPICAL ACCURACY $\pm$ % (rdg) $\pm$ % (rg)	GUARANTEED ACCURACY $\pm$ % (rdg) $\pm$ % (rg)
12000 V AC	1V	$\pm$ 0.2% $\pm$ 0.5V	<0.3%+1V
5 A AC (@ inputs A or B > 10 mA)	0.1 mA	$\pm$ 0.2% $\pm$ 1 mA	<0.5%
<10 mA AC (@ inputs A or B)	0.1 $\mu$ A	$\pm$ 0.2% $\pm$ 0.1 $\mu$ A	<0.3%+0.1 $\mu$ A

. Frequency range: 1 to 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).

## TEST MEASUREMENTS

### Capacitance

- . Measurement range 1: from 1 pF to 5  $\mu$ F. Resolution: 6 digits. Accuracy, typical:  $\pm$  0.03% of the value  $\pm$  0.1 pF; guaranteed: < 0.1% of the value +1pF (from 45 to 70 Hz).
- . Measurement range 2: from 5  $\mu$ F to 200  $\mu$ F. Resolution: 6 digits. Accuracy, typical:  $\pm$ 0.1% of the value  $\pm$ 0.1 nF, guaranteed: <0.5% of the value  $\pm$ 1 nF.

### Tan Delta or dissipation factor DF

- . Measurement range 1: from 0 to 10% (capacitive). Resolution: 5 digits; accuracy, typical: 0.05% of the value  $\pm$  0.005 %; guaranteed: 0.1% of the value  $\pm$  0.005 % (from 45 to 70 Hz, current < 10 mA).
- . Measurement range 2: from 0 to 100%. Resolution: 5 digits; accuracy, typical: 0.3% of the value  $\pm$  0.01 %; guaranteed: 0.5% of the value  $\pm$  0.02 %.

- . Measurement range 3: over 100%. Resolution: 5 digits; accuracy, typical: 0.5% of the value  $\pm$  0.03 %; guaranteed: 0.8% of the value  $\pm$  0.05 %.

### Power factor PF (or cos( $\phi$ ))

- . Measurement range 1: from 0 to 10% (capacitive). Resolution: 5 digits; accuracy, typical: 0.05% of the value  $\pm$  0.005 %; guaranteed: 0.1% of the value  $\pm$  0.005 % (from 45 to 70 Hz, current < 10 mA).
- . Measurement range 2: from 0 to 100%. Resolution: 5 digits; accuracy, typical: 0.3% of the value  $\pm$  0.02 %; guaranteed: 0.5% of the value  $\pm$  0.02 %.

### Impedance

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

### Power

. Measurement ranges: 10 kW, 100 kW, 1 MW. Resolution (6 digits): 0.1 mW; accuracy: <0.5% of the value  $\pm$  1 mW. The same ranges and accuracies are applied to reactive and apparent power measurements.

### Inductance

- . Measurement range 1: from 1 H to 10 kH. Resolution (6 digits): 0.1 mH; accuracy, typical: 0.3% of the value  $\pm$  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.

### Excitation current

- . Range 1: 10 mA. Resolution: 0.1  $\mu$ A; accuracy, typical: 0.2% of the value  $\pm$  0.1  $\mu$ A; guaranteed: 0.3% of the value  $\pm$  0.1  $\mu$ A.
- . Range 2: 300 mA. Resolution 1 mA; accuracy, typical: 0.2% of the value  $\pm$  1 mA; guaranteed: 0.5% of the value  $\pm$  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  $\mu$ T, at 50 Hz in any direction.

TD 5000 Dimensions: 440 (W) x 345 (H) x 210 (D) mm. Weight: 25 kg.



## STANDARD ACCESSORIES

### TD 5000 TESTING CABLES

NOTE: these cables can also be ordered separately. TD 5000 comes complete with the following connection cables:

- . 1 yellow-green connection cable, 6 m long, for the ground connections, terminated with terminator on one side, and with a clamp on the other side.
- . 2 yellow-green connection cables, 1 m long, for the ground connections, terminated with terminators.
- . 1 yellow-green connection cable, 2 m long, for the ground connections, terminated with terminators.
- . 1 power cable to the BOOSTERS connector of STS, 1 m long.
- . 1 power cable to the BOOSTERS connector of STS, 2 m long.
- . 1 High voltage connection cable, 20 m long, 25 kV, with earth screen, for the connection to the device under test, terminated on the device side with an isolated banana plug, and on the TD 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, 40 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 TD 5000 side with the metering connector, and on the device side with a banana plug. Cables are mounted on wheels.
- . 2 clamps, 25 mm opening, terminated with banana sockets, which allow connecting to the metering point.
- . 2 Kelvin type clamps, 40 mm opening, with banana plugs, which allow connecting to the metering point.
- . 1 hot collar cable, 1m long, with connector.
- . 1 signals connection cable to the EXT. DEVICES connector of STS, 1 m long.
- . 1 signals connection cable to the EXT. DEVICES connector of STS, 2 m long.
- . 1 connection cables transport case.

### TRANSPORT CASE FOR STS 3000 light & TD 5000

STS 3000 light and TD 5000 are supplied with a suitable and rugged transport case. The transit case allows delivering STS 3000 light and TD 5000 with no concern about shocks up to a fall of 1 m. The case is supplied with handles and wheels.

### FOLDABLE TROLLEY FOR STS 3000 light & TD 5000

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



## OPTIONAL ACCESSORIES

### CAP-CAL CALIBRATOR MODULE

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

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

### 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.

### RCTD - COMPENSATING REACTOR

This module is available for TD 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.

## 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, STS 3000 light. 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.

- 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
31175	STS 3000 light - 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
10176P	PADS software (primary)- Primary, CTs, VTs test module
10176T	PADS software (trasfo)- Power transformer and Tan Delta test module
10176F	PADS (full)- Full software suite (includes 10176P & 10176T)
40175	CAP-CAL Calibration module
42175	Remote safety switch
44175	Digital thermo hygrometer
43175	Warning strobe light
47175	RCTD - Compensating reactor for TD 5000
48175	Cable test kit for RCTD
19175	Transport case for RCTD
17175	Heavy duty plastic transport case for STS 3000 light
19175	Heavy duty plastic transport case for TD 5000
18175	Trolley for STS family test sets and TD 5000
14175	Cable test kit for TD 5000

\*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	OPTIONAL TAN DELTA TESTS WITH TD 5000	OPTIONAL HIGH AC CURRENT WITH BUX 3000
STS 5000 <sup>1)</sup>	✓	✓	✓	✓	✓
STS 4000 <sup>1)</sup>	NOT AVAILABLE	✓	✓	✓	✓
STS 3000 light with TD 5000	NOT AVAILABLE	NOT AVAILABLE	NOT AVAILABLE	✓	NOT AVAILABLE

<sup>1)</sup> For USA and Germany only the STS 3000 light test set with TD 5000 module is available.

# STS 3000 light with TD 5000

## COMPARISON TABLE OF THE STS FAMILY TESTS

NO.	TEST OF	TEST DESCRIPTION	STS 5000	STS 4000	STS 3000 light with TD 5000
1	CT	Ratio, Voltage mode	✓	✓	NOT AVAILABLE
2	CT	Ratio, polarity and burden with high AC current	✓	WITH BUX 3000	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 3000	NOT AVAILABLE
9	CT	Low power transformers	✓	WITH BUX 3000	NOT AVAILABLE
10	CT	Tan( $\delta$ ) 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( $\delta$ ) measurements	WITH TD 5000	WITH TD 5000	✓
17	PT	Ratio per TAP	✓	✓	NOT AVAILABLE
18	PT	Static and dynamic resistance of Tap Changer contacts	✓	✓	NOT AVAILABLE
19	PT	Excitation current	WITH TD 5000	WITH TD 5000	✓
20	PT	Short circuit impedance	✓	✓	NOT AVAILABLE
21	PT	Tan( $\delta$ ) measurements	WITH TD 5000	WITH TD 5000	✓
22	CB	High DC current micro-Ohmmeter test	✓	NOT AVAILABLE	NOT AVAILABLE
23	CB	Tan( $\delta$ ) measurements	WITH TD 5000	WITH TD 5000	✓
24	VTCBRELAY	Current threshold and timing	✓	✓	NOT AVAILABLE
25	R	Ground resistance and resistivity	✓	✓	NOT AVAILABLE
26	R	Step and touch voltages	✓	✓	NOT AVAILABLE
27	L	Measurement of line impedance and of the related parameters	✓	✓	NOT AVAILABLE
28	OTHER	Sequencer	✓	✓	NOT AVAILABLE



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