STS 3000 light
with TD 5000

Power Factor and Capacitance diagnostic system
for power apparatus

www.isatest.com
**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.

### APPLICATION

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

The 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 with TD 5000

Function keys
Multifunction control knob
Start/Stop
Emergency push-button

STS 3000 light - FRONT PANEL

Display
Keyboard
Digital input

Safety Key

STS 3000 light - SIDE PANELS

External booster output
Remote start
External devices input
Interfaces

Safety warnings
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.

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.

POWER FACTOR, 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 the test 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 following:
- 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.

**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 ± 15%; 48-62 Hz
- Current: 8 A
- Frequency resolution: 10 mHz; accuracy 10 ppM.

**Digital input**
- Characteristics of the Digital 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.

**TD 5000 SPECIFICATION**

The following specification refers to the TD 5000 module alone.

**Generator characteristics**

<table>
<thead>
<tr>
<th>MAX VOLTAGE</th>
<th>CURRENT</th>
<th>DURATION</th>
<th>FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1200 V AC</td>
<td>1 V</td>
<td>±0.2% ±0.05V</td>
<td>&lt;0.3% +1V</td>
</tr>
<tr>
<td>≤10 A (or Br 30 mA)</td>
<td>0.1 mA</td>
<td>±0.2% ±0.1 mA</td>
<td>&lt;0.5%</td>
</tr>
<tr>
<td>&lt;10 mA AC (≤10 mA)</td>
<td>0.1 µA</td>
<td>±0.2% ±0.1 µA</td>
<td>&lt;0.5% +1 µA</td>
</tr>
</tbody>
</table>

- 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 500 pF. Resolution: 6 digits. Accuracy, typical: ±0.03% of the value ±0.1 pF; guaranteed: <0.1% of the value +1 µF (from 45 to 70 Hz).
  - Measurement range 2: from 5 µF to 200 µF. Resolution: 6 digits. Accuracy, typical: ±0.1% of the value ±0.1 nF; guaranteed: ±0.5% of the value ±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 ±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 ±0.01%; guaranteed: ±0.5% of the value ±0.02%.

- **Voltage and current output metering accuracy and resolution.**

- **Internal measure**
  - Resolution: 6 digits.
  - Guaranteed accuracy: ±0.5% of the value ±0.02%.

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

- **Power factor PF**
  - Measurement range 1: from 0 to 10% (capacitive). Resolution: 5 digits; 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: 5 digits; accuracy, typical: 0.3% of the value ±0.02%; guaranteed: 0.5% of the value ±0.02%.

- **Impedance**
  - Measurement range 1: from 1 H to 10 kH. Resolution (6 digits): 0.1 mW; accuracy, typical: ±0.5% of the value ±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 ±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 µA; accuracy, typical: 0.2% of the value ±0.1 µA; guaranteed: 0.3% of the value ±0.1 µA.
  - 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 µV, at 50 Hz in any direction.

**STS 3000 light with TD 5000**

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

**CAP-CAL CALIBRATION 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.

**COMPARISON TABLE OF THE STS FAMILY**

<table>
<thead>
<tr>
<th>STS MODEL</th>
<th>HIGH CURRENT, AC &amp; DC</th>
<th>HIGH VOLTAGE</th>
<th>LOW AC-DC OUTPUTS</th>
<th>OPTIONAL TAN DELTA TESTS WITH TD 5000</th>
<th>OPTIONAL HIGH AC CURRENT WITH BUX 3000</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS 5000 1)</td>
<td>NOT AVAILABLE</td>
<td>NOT AVAILABLE</td>
<td>NOT AVAILABLE</td>
<td>NOT AVAILABLE</td>
<td>NOT AVAILABLE</td>
</tr>
<tr>
<td>STS 4000 1)</td>
<td>NOT AVAILABLE</td>
<td>NOT AVAILABLE</td>
<td>NOT AVAILABLE</td>
<td>NOT AVAILABLE</td>
<td>NOT AVAILABLE</td>
</tr>
<tr>
<td>STS 3000 light with TD 5000</td>
<td>NOT AVAILABLE</td>
<td>NOT AVAILABLE</td>
<td>NOT AVAILABLE</td>
<td>NOT AVAILABLE</td>
<td>NOT AVAILABLE</td>
</tr>
</tbody>
</table>

1) For USA and Germany only the STS 3000 light test set with TD 5000 module is available.
### COMPARISON TABLE OF THE STS FAMILY TESTS

<table>
<thead>
<tr>
<th>NO.</th>
<th>TEST OF</th>
<th>TEST DESCRIPTION</th>
<th>STS 5000</th>
<th>STS 4000</th>
<th>STS 3000 light with TD 5000</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CT</td>
<td>Ratio, Voltage mode</td>
<td>✔️</td>
<td>✔️</td>
<td>NOT AVAILABLE</td>
</tr>
<tr>
<td>2</td>
<td>CT</td>
<td>Ratio, polarity and burden with high AC current</td>
<td>✔️</td>
<td>✔️</td>
<td>WITH BUX 3000</td>
</tr>
<tr>
<td>3</td>
<td>CT</td>
<td>Burden; secondary side</td>
<td>✔️</td>
<td>✔️</td>
<td>NOT AVAILABLE</td>
</tr>
<tr>
<td>4</td>
<td>CT</td>
<td>Excitation curve</td>
<td>✔️</td>
<td>✔️</td>
<td>NOT AVAILABLE</td>
</tr>
<tr>
<td>5</td>
<td>CT</td>
<td>Winding or burden resistance</td>
<td>✔️</td>
<td>✔️</td>
<td>NOT AVAILABLE</td>
</tr>
<tr>
<td>6</td>
<td>CT</td>
<td>Voltage withstand</td>
<td>✔️</td>
<td>✔️</td>
<td>NOT AVAILABLE</td>
</tr>
<tr>
<td>7</td>
<td>CT</td>
<td>Remote polarity check</td>
<td>✔️</td>
<td>✔️</td>
<td>NOT AVAILABLE</td>
</tr>
<tr>
<td>8</td>
<td>CT</td>
<td>Rogowski coil transformers</td>
<td>✔️</td>
<td>✔️</td>
<td>WITH BUX 3000</td>
</tr>
<tr>
<td>9</td>
<td>CT</td>
<td>Low power transformers</td>
<td>✔️</td>
<td>✔️</td>
<td>WITH BUX 3000</td>
</tr>
<tr>
<td>10</td>
<td>CT</td>
<td>Tan(δ) measurements</td>
<td>WITH TD 5000</td>
<td>WITH TD 5000</td>
<td>✔️</td>
</tr>
<tr>
<td>11</td>
<td>VT</td>
<td>Ratio; polarity</td>
<td>✔️</td>
<td>✔️</td>
<td>NOT AVAILABLE</td>
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<tr>
<td>12</td>
<td>VT</td>
<td>Burden, secondary side</td>
<td>✔️</td>
<td>✔️</td>
<td>NOT AVAILABLE</td>
</tr>
<tr>
<td>13</td>
<td>VT</td>
<td>Ratio, electronic transformers</td>
<td>✔️</td>
<td>✔️</td>
<td>NOT AVAILABLE</td>
</tr>
<tr>
<td>14</td>
<td>VT</td>
<td>Voltage withstand</td>
<td>✔️</td>
<td>✔️</td>
<td>NOT AVAILABLE</td>
</tr>
<tr>
<td>15</td>
<td>VT</td>
<td>Remote polarity check</td>
<td>✔️</td>
<td>✔️</td>
<td>NOT AVAILABLE</td>
</tr>
<tr>
<td>16</td>
<td>VT</td>
<td>Tan(δ) measurements</td>
<td>WITH TD 5000</td>
<td>WITH TD 5000</td>
<td>✔️</td>
</tr>
<tr>
<td>17</td>
<td>PT</td>
<td>Ratio per TAP</td>
<td>✔️</td>
<td>✔️</td>
<td>NOT AVAILABLE</td>
</tr>
<tr>
<td>18</td>
<td>PT</td>
<td>Static and dynamic resistance of Tap Changer contacts</td>
<td>✔️</td>
<td>✔️</td>
<td>NOT AVAILABLE</td>
</tr>
<tr>
<td>19</td>
<td>PT</td>
<td>Excitation current</td>
<td>WITH TD 5000</td>
<td>WITH TD 5000</td>
<td>✔️</td>
</tr>
<tr>
<td>20</td>
<td>PT</td>
<td>Short circuit impedance</td>
<td>✔️</td>
<td>✔️</td>
<td>NOT AVAILABLE</td>
</tr>
<tr>
<td>21</td>
<td>PT</td>
<td>Tan(δ) measurements</td>
<td>WITH TD 5000</td>
<td>WITH TD 5000</td>
<td>✔️</td>
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<tr>
<td>22</td>
<td>CB</td>
<td>High DC current micro-Ohmmeter test</td>
<td>✔️</td>
<td>✔️</td>
<td>NOT AVAILABLE</td>
</tr>
<tr>
<td>23</td>
<td>CB</td>
<td>Tan(δ) measurements</td>
<td>WITH TD 5000</td>
<td>WITH TD 5000</td>
<td>✔️</td>
</tr>
<tr>
<td>24</td>
<td>VTCRRELAY</td>
<td>Current threshold and timing</td>
<td>✔️</td>
<td>✔️</td>
<td>NOT AVAILABLE</td>
</tr>
<tr>
<td>25</td>
<td>R</td>
<td>Ground resistance and resistivity</td>
<td>✔️</td>
<td>✔️</td>
<td>NOT AVAILABLE</td>
</tr>
<tr>
<td>26</td>
<td>R</td>
<td>Step and touch voltages</td>
<td>✔️</td>
<td>✔️</td>
<td>NOT AVAILABLE</td>
</tr>
<tr>
<td>27</td>
<td>L</td>
<td>Measurement of line impedance and of the related parameters</td>
<td>✔️</td>
<td>✔️</td>
<td>NOT AVAILABLE</td>
</tr>
<tr>
<td>28</td>
<td>OTHER</td>
<td>Sequencer</td>
<td>✔️</td>
<td>✔️</td>
<td>NOT AVAILABLE</td>
</tr>
</tbody>
</table>

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