- **Multi function system for testing substation equipment such as: current, voltage and power transformers, all type of protection relays, energy meters and transducers**
- **Primary injection testing capabilities**
- **3000 V AC high-pot test**
- **Generates up to 800 A (option up to 2000A)**
- **Microhmmeter function (option): up to 400A DC**
- **Large graphical display**
- **Test results and settings are saved into local memory**
- **RS232 interface for pc connection**
- **Compact and lightweight (29 kg)**

A P P L I C A T I O N

T3000 is a unique solution for all testing operations during commissioning and maintenance of substations, as it allows performing the test on both, relays of all types and of current and voltage transformers. Also capable of testing energy meters and transducers. In addition T3000 incorporates a powerful multi-meter and phase angle meter, with oscilloscope functions.

The following table lists the tests that can be performed on Current Transformers (CT), Voltage Transformers (VT) and Power Transformers (PT).

N.	TEST	TEST DESCRIPTION
1	CT	Ratio, polarity and burden, Current mode
2	CT	Burden; secondary side
3	CT	Excitation curve
4	CT	Winding or burden resistance
5	CT	Voltage withstand
6	CT	Polarity by impulses
7	CT	Ratio, Voltage mode
8	VT	Ratio; polarity
9	VT	Burden, secondary side
10	VT	Ratio, electronic transformers
11	VT	Voltage withstand
12	VT	Secondary over-current protection
13	PT	Ratio per TAP
14	PT	Resistance of TAP Changer contacts
15	GR	Earth resistance
16	GR	Soil resistività

T3000

The table below lists the relays that can be set and tested by T3000.

RELAY TYPE	IEEE NO
Distance (3 sets)	21
Synchronizing	25
Over/under-voltage	27/59
Power, varmetric or wattmetric	32/92
Under current	37
Reverse phase current	46
Instantaneous overcurrent	50
Ground fault	50N
Timed overcurrent	51
Power factor	55
Directional overcurrent	67
Directional ground fault	67N
Automatic recluse	79

RELAY TYPE	IEEE NO
Frequency	81
Frequency rate of ch'ange	81
Motor protection	86
Differential (starter only)	87
Directional voltage	91
Tripping relay	94

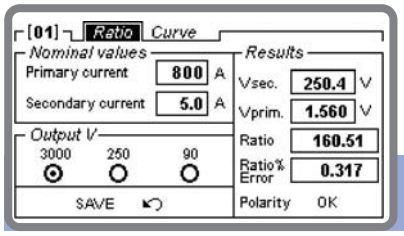
OTHER DEVICES

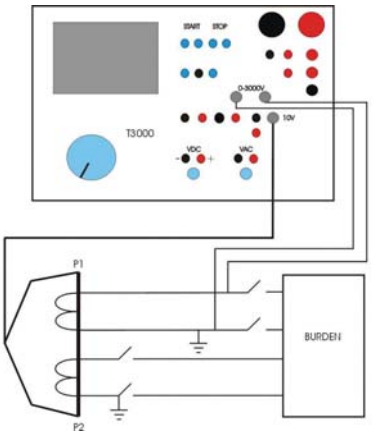
Voltage regulation
Timers
Transducers
Energy meters

Typical application

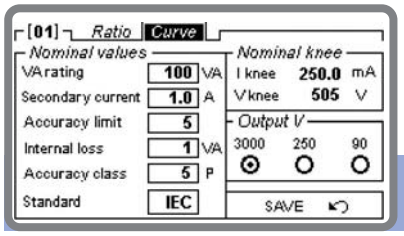
Test of Current Transformer

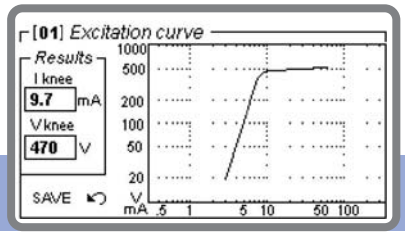
- CT RATIO V AND POLARITY - VOLTAGE METHOD
  USED OUTPUT: 90V, 250V or 3000 V AC.
  USED INPUT: LOW AC VOLTAGE - 10 V AC.

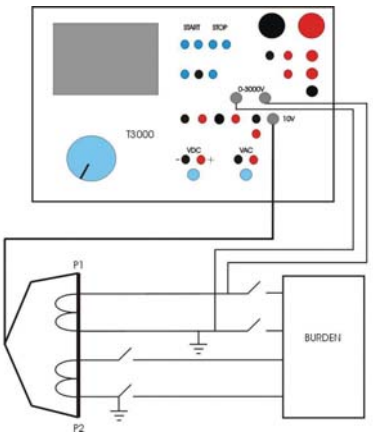




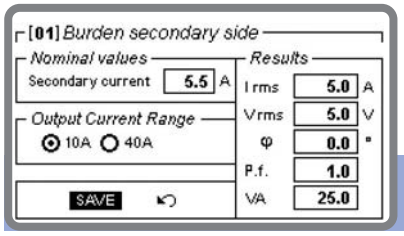
- CT EXCITATION
  USED OUTPUT: 90V, 250V or 3000 V AC.
  USED INPUT: Internal measurement.

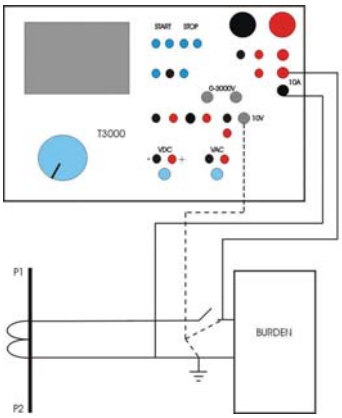




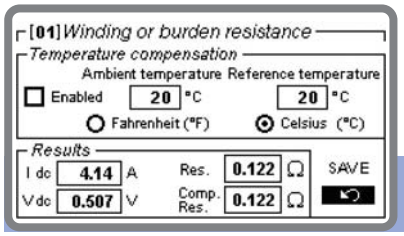


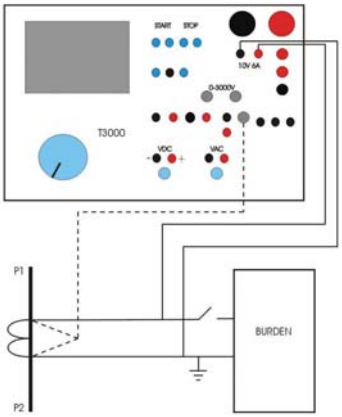
- CT BURDEN SECONDARY SIDE:
  USED OUTPUT: 10 A or 40 A AC.
  USED INPUT: LOW AC VOLTAGE - 10 V AC.



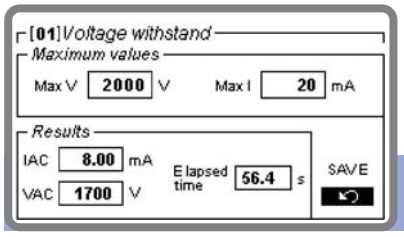


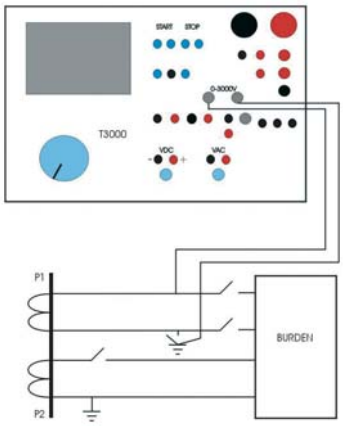
- WINDING RESISTANCE:
  USED OUTPUT: 6 A DC.
  USED INPUT: 10 V DC.



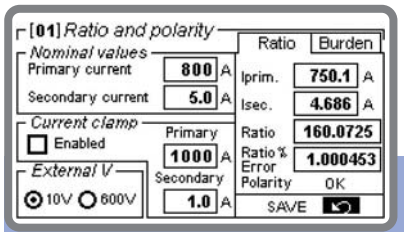


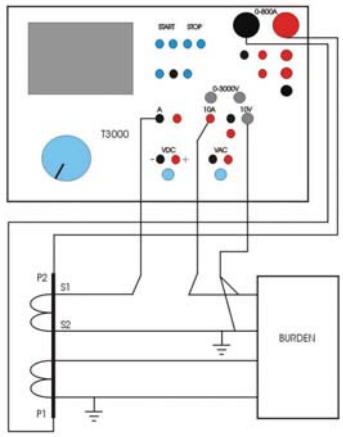
- VOLTAGE WITHSTAND:
  USED OUTPUT: 3000 V AC.
  USED INPUT: Internal measurement.





- CT RATIO AND POLARITY – CURRENT METHOD
  USED OUTPUT: 800 A AC.
  USED INPUT: LOW AC CURRENT - 10 A AC.

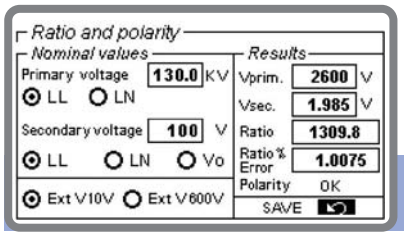


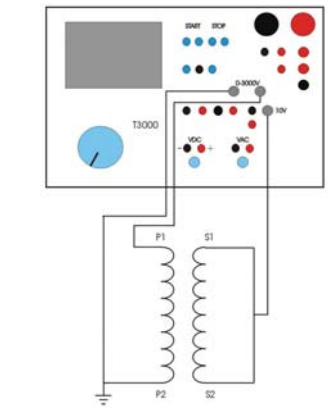


Typical application

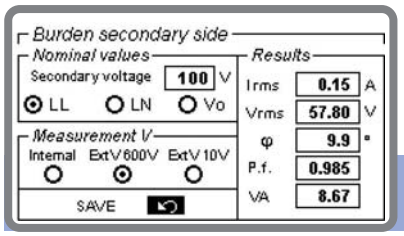
Test of Voltage Transformer

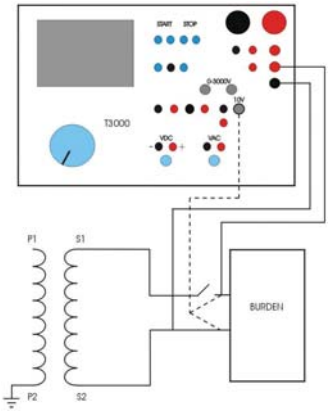
- VT RATIO AND POLARITY
  USED OUTPUT: 3000 V AC.
  USED INPUT: LOW or HIGH AC VOLTAGE - 10 V AC OR 600 V AC.



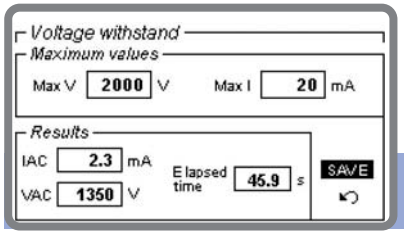


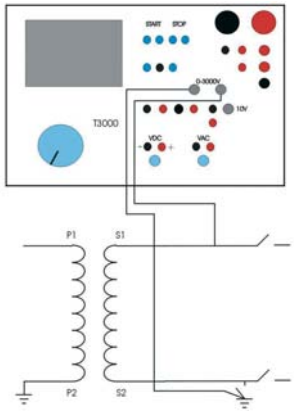
- VT BURDEN
  USED OUTPUT: 10 A AC.
  USED INPUT: LOW or HIGH AC VOLTAGE - 10 V AC OR 600 V AC.



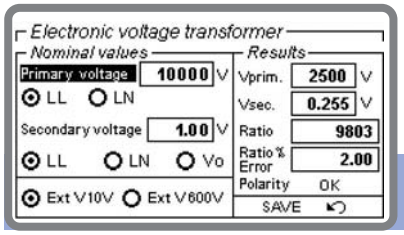


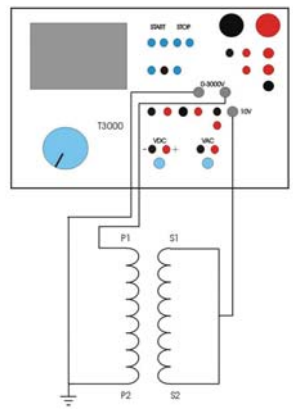
- VOLTAGE WITHSTAND
  USED OUTPUT: 3000 V AC.
  USED INPUT: Internal measurement.





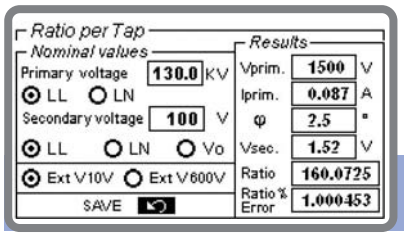
- RATIO OF ELECTRONIC VOLTAGE TRANSFORMER
  USED OUTPUT: 3000 V AC.
  USED INPUT: LOW or HIGH AC VOLTAGE - 10 V AC OR 600 V AC.

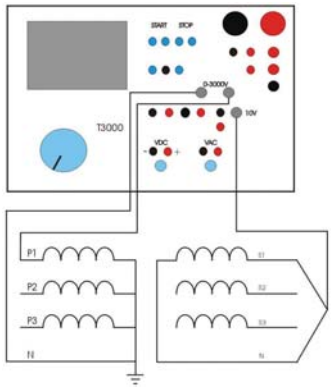




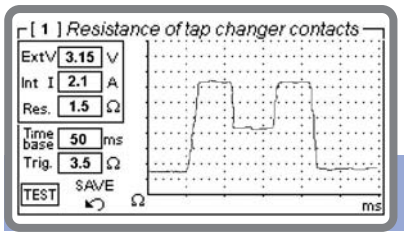
Typical application
Power Transformer

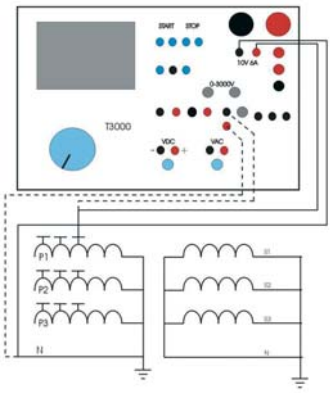
- RATIO PER TAP
  USED OUTPUT: 3000 V AC.
  USED INPUT: LOW or HIGH AC VOLTAGE - 10 V AC OR 600 V AC.





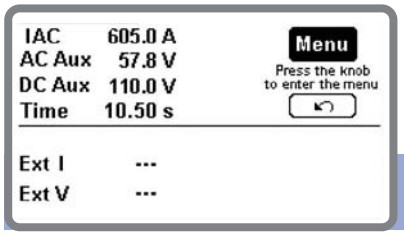
- TAP CHANGER RESISTANCE AND CONTINUITY
  USED OUTPUT: 6 A DC.
  USED INPUT: 10 V DC.

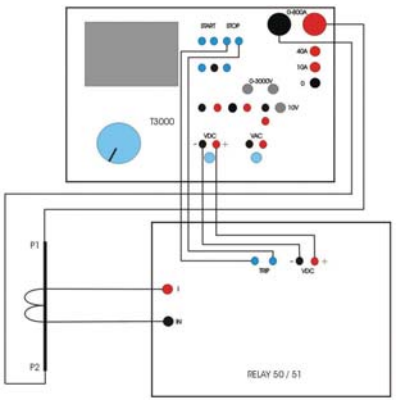




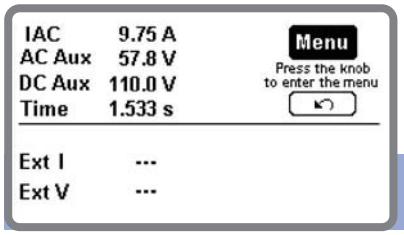
Typical application
Relay Testing

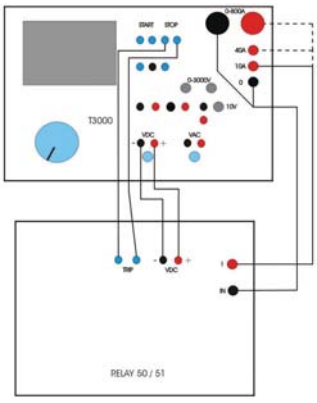
- PRIMARY INJECTION
  USED OUTPUT: 800 A.
  USED INPUT: TIMER.





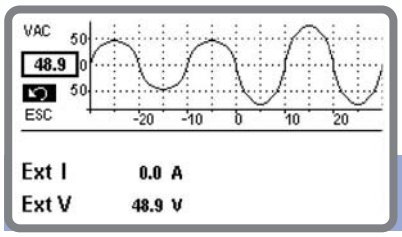
- SECONDARY INJECTION
  USED OUTPUT: 800 A, 40 A or 10 A.
  USED INPUT: TIMER.





T3000

- SCOPE FUNCTION
  USED OUTPUT: ANY.
  USED INPUT: V and I.



SYSTEM DESCRIPTION

T3000 contains three independent generators:

- Main generator. It has six outputs: High AC current; Low AC current; Low DC current; Current impulses; High AC voltage; Low AC voltage 1.
- Auxiliary AC voltage generator 2: it generates an independent, phase adjustable AC voltage.
- Auxiliary DC voltage generator, to feed relays under test.

All outputs are adjustable and metered on the large, graphic LCD display. With the multi-purpose control knob and the graphic LCD display it is possible to enter the MENU mode, that allows to control all functions, and makes T3000 the most powerful testing device, with manual and automatic testing capabilities, and with the possibility to transfer test results to a PC via the RS232 interface. These results can be recorded, displayed and analysed by the powerful TDMS software, which operates with all WINDOWS versions, starting from WINDOWS 98 included.
Additional features are:

. Oscilloscope function: it is possible to display the current and voltage waveform measured;
. Two independent measurement inputs, for current and voltage, and with High and Low inputs each, allow measuring CT or VT outputs or any other source;
. The optional thermal printer gives the immediate printout of the CT saturation curve and other test results;
. An auxiliary output contact, that follows START and STOP inputs, allows simulating the circuit breaker.

The instrument is housed in a transportable aluminium box, which is provided with removable cover and handles for ease of transportation.

T3000 Specification

Main Generator

The main generator has six outputs: High AC current; Low AC current; Low DC current; Current impulses; High AC voltage; Low AC voltage. Output adjustment is performed via a knob. The following specification applies to the separate usage of these outputs.

High AC current output

APPLICATION:
. CT TESTING: RATIO, POLARITY, BURDEN
. RELAY TESTING
. PRIMARY INJECTION

HIGH POWER RANGE

CURRENT OUTPUT A	OUTPUT POWER VA	LOAD TIME s	RECOVERY TIME min
100	600	steady	-
150	800	15 min	30
200	1000	4 min	15
400	1600	15	5
600	2000	5	3
800	2000	1	2

LOW POWER RANGE

CURRENT OUTPUT A	OUTPUT POWER VA	LOAD TIME s	RECOVERY TIME min
30	60	steady	-
50	80	10 min	10

Low AC current output

APPLICATION:
. CT TESTING: BURDEN, SECONDARY SIDE
. VT TESTING: OVERCURRENT PROTECTION

Note: WINDOWS is a trademark of MICROSOFT inc.

HIGH POWER RANGE

RANGE A AC	CURRENT OUTPUT A	OUTPUT POWER VA	LOAD TIME s	RECOVERY TIME min
40	12	300	steady	-
	18		15 min	30
	24		4 min	15
	36	800	15	5
	48		5	3
	60	1000	1	2
10	5	400	steady	-
	7.5		15 min	30
	10	800	60	15
	15		30	10
	20	1000	15	5

LOW POWER RANGE

RANGE A AC	CURRENT OUTPUT A	OUTPUT POWER VA	LOAD TIME s	RECOVERY TIME min
40	12	60	steady	-
	18		10 min	30
	24		60	10
	36		1	2
10	5	60	steady	-
	6		10 min	45
	7		60	2
	10		1	2

Low DC current output

APPLICATION:

. CT TESTING: WINDING RESISTANCE, BURDEN RESISTANCE

. PT TESTING: TAP-CHANGER CONTACT RESISTANCE

CURRENT OUTPUT A	LOAD RESISTANCE Ohm	OUTPUT POWER W	LOAD TIME min	RECOVERY TIME min
6	0	0	steady	-
3	2	18	steady	-
1	8	8	steady	-

Current impulses output

APPLICATION:

. CT TESTING: POLARITY TEST WITH IMPULSE METHOD

- Current range: from 0 to 10 A peak.

High AC voltage output

Two version are available: 3000V or 1200V output.

APPLICATION:

. CT TESTING: EXCITATION CURVE, VOLTAGE WITHSTAND

. VT TESTING: RATIO, POLARITY, ELECTRONIC VOLTAGE TRANSFORMER

. PT TESTING: RATIO PER TAP

HIGH POWER RANGE

3000 V version

VOLTAGE OUTPUT V	CURRENT OUTPUT A	OUTPUT POWER VA	LOAD TIME min	RECOVERY TIME min
3000	0.2	600	steady	-
	0.6	1800	1	8

In alternative

1200V version

VOLTAGE OUTPUT V	CURRENT OUTPUT A	OUTPUT POWER VA	LOAD TIME min	RECOVERY TIME min
1200	0.5	600	steady	-
1200	1.5	1800	1	8

LOW POWER RANGE

VOLTAGE OUTPUT V	CURRENT OUTPUT A	OUTPUT POWER VA	LOAD TIME min	RECOVERY TIME min
600	0.1	60	steady	-
500	0.2	120	1	8

Low AC voltage output

APPLICATION:

. CT TESTING: RATIO WITH VOLTAGE METHOD

. VT TESTING: BURDEN SECONDARY SIDE

VOLTAGE V AC	VOLTAGE OUTPUT V	output POWER VA	LOAD TIME min	ReCOVERY TIME min
250	250	125	steady	-
	200	200	3	9

Auxiliary AC voltage

APPLICATION: . RELAY TESTING

RANGE V	MAX CURRENT mA
65	500
130	250
260	125

Auxiliary AC voltage

APPLICATION: . RELAY TESTING

Phase angle sfifter

- Phase angle adjustment: via the multi-function knob.
- Phase angle range: from 0° to 360°.
- Adjustment resolution: 1° (one degree).

Frequency & frequency rate of change generator

- Frequency range: 40 Hz to 500 Hz.
- Frequency adjustment: 1 mHz, via control knob.
- Frequency ROC range: from 0.01 Hz/s to 99.99 Hz/s.

Auxiliary DC voltage

- DC voltage ranges: 130 V or 240 V.
- DC voltage power: 90 W at full range, continuous duty, with a current limit of 0.9 A @ 130 V and 0.45 A @ 240 V.

Timer

Available measurements:

- Timer start: at test start, or by an external contact;
- Metering of elapsed time between START and STOP;
- Current generation elapsed time.
- Time can be metered as seconds or cycles.

. Inputs: free of voltage or with voltage.
. Programmable voltage threshold: 12 V or 80 V.
. Metering range, in seconds: from 0 to 99999.9 s.
. Resolution: 1 ms (up to 9.999 s).
. Metering range, in cycles: from 0 to 5999999 (60Hz).
. Resolution: 0.1 cycles (up to 999 cycles).

Counting mode: this mode is foreseen for the test of energy meters. Maximum input frequency: 10 kHz.

Auxiliary binary Output

Contact range: 5 A; 250 V AC; 120 V DC.

Measuring Section

Output measurements

Current and voltage AC and DC outputs measurement accuracy: ± 0.5%.
Phase angle measurement accuracy: 1°.
Frequency accuracy: 1 mHz.
Other measurements available on T3000:
The following measurement are calculated from the T3000 generated outputs:

OUTPUT MEASUREMENTS:

ACTIVE POWER	P
REACTIVE POWER	Q
APPARENT POWER	S
POWER FACTOR	p.f.
IMPEDANCE	Z and j
ACTIVE IMPED. COMPONENT	R
REACTIVE IMPEDANCE COMP.	X
RATIO	CT or VT or PT
POLARITY	CT or VT or PT
BURDEN	CT
VOLTAGE AND CURRENT KNEE	

External Inputs Measurement

Current measurements

. Two inputs: 20 mA AC or DC or 10 A AC.
. Accuracy: 0.5%

Possibility to display the current waveform.

Voltage measurement

. Two inputs: 10 V or 600 V, AC or DC.
. Accuracy: 0.5%

Possibility to display the voltage waveform.
Other measurements available on the T3000 calculated from external inputs.

EXTERNAL INPUTS MEASUREMENTS:

ACTIVE POWER	P
REACTIVE POWER	Q
APPARENT POWER	S
POWER FACTOR	p.f.
IMPEDANCE	Z and j
ACTIVE IMPEDANCE COMP.	R
REACTIVE IMPEDANCE COMP.	X
FREQUENCY	f
PHASE ANGLE	IEXT to V AUX
PHASE ANGLE	VEXT to V AUX
RESISTANCE	R

Ratio Measurement

Ratio: 0.1 to 999; 0.1%
Ratio: 999 to 3000; 0.3%
Ratio: 3000 to 9999; 1%

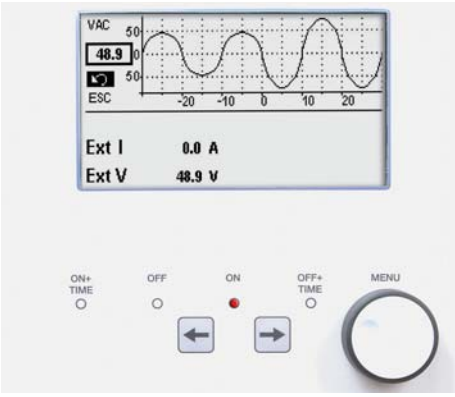
Scope Function

T3000 has an additional oscilloscope function that allows to display current and voltage waveforms.

Graphical display

The large graphical display has the following characteristics:

- Pixels: 240x128;
- backlight colour: white;
- LCD type: FSTN;
- View area: 135x80 mm.



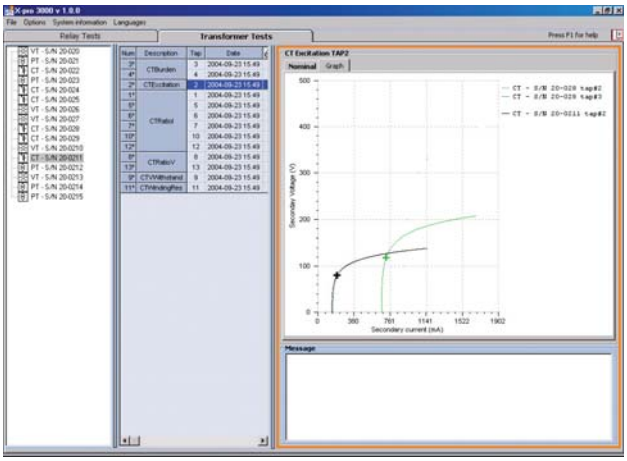
Local Memory

Test results can be stored in the T3000 local memory (up to 500 results may be stored).

At the end of test, settings and test results can be transmitted to a PC provided with TDMS.
The software allows saving test results and examining them. TDMS is also a powerful report editor that allows to prepare professional test reports.
Test settings can be stored and recalled from the memory. Up to 10 settings can be stored and recalled.

TDMS Software

When the PC is connected, settings can be created and transferred into T3000 using TDMS.
TDMS is a user friendly software that allows via a graphical interface, to control the set-up of T3000 and to download test results. TDMS is also a powerful report editor that allows to create professional test reports that can be exported in Access format.



Software TDMS - CT test

Other characteristics

. Interface: serial RS232; baud rate 57600 baud
. Mains supply: 230 V ± 10%; 50-60 Hz, OR 115 V ± 10%; 50-60 Hz; to be specified at order. (There are power reduction for mains voltage below 220V).
. Dimensions: 450 (W) x 320 (D) x 240 (H) mm.
. Weight: 29 kg.

ACCESSORIES

THE FOLLOWING ACCESSORIES ARE SUPPLIED WITH T3000

Connection cable and test connectors

- One Mains supply cable, 2 m long.

- One Grounding cable, 4 m long, terminated on one side with a 4 mm banana plug, and on the other side with an earth connection clamp.
- One Interface cable for RS232 port.
- Two High voltage connection cables, 4 m long, 5 kV, with earth screen. Terminated on both sides with HV connectors.
- Two Clamps for the HV connection.
- Two High current connection cables, 100 sq. mm, 4 m long. Terminated on one side with the high current connector, and on the other side with the high current clamp.
- Two Low current connection cables, 10 sq. mm, 4 m long. Terminated on both sides with a 4 mm banana plug.
- Four Clamps to connect low voltage or low current or measurements.
- One Cable for low voltage or low current connection, shielded, 4 m long. Terminated on one side with the measurement connector, and on the other side with two 4 mm banana plugs.
- Voltage outputs (4 cables: 2 red and 2 black);
- Measurement inputs (4 cables: 2 red and 2 black);
- Auxiliary output (2 cables: 1 red and 1 blue);
- Trip inputs (4 cables; blue).
- The instrument comes complete with the following items:
  . User's manual;
  . Spare fuses (no. 5), T16A;
  . Software TDMS with user manual.

Optional accessories

Thermal printer

The optional thermal printer, for the printout of the V-I curve in the CT saturation test and other test results. Thermal Paper 48 mm wide.

Transit case

Heavy duty aluminium transit case with wheels allows delivering T3000 with no concern about transport shocks.

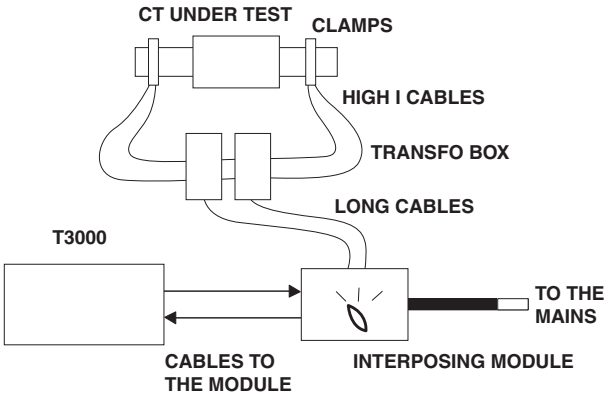
Current clamp

The current clamp allows to avoid the opening the secondary current circuit when performing the primary test of CT burden.
Earth resistance and soil resistivity kit.
Complete kit including cables, drums and spikes.

Optional Modules

Very High Current Booster BU2000 for T3000 Test sets

The very high current booster option allows performing high current primary injections with currents up to 4000 A.
The Current Booster BU2000 for T3000 and T2000 Test sets is designed around the concept to avoid wasting power on the connection cables, by putting the power transformers as close as possible to the test object. This approach is particularly useful when the test is performed on CT's in the field, that are from 5 to 10 meters above the ground. The solution is sound because the weight of transformer plus cable plus clamps is comparable to the weight of the connection cables.
The higher the test current, the higher the weight of the transformers, but also the higher the weight of the connection cables. With this solution, the connection cable to the power source is much lighter, does not pose any major problem of voltage drop, and can be any length.
The following drawing shows the connections between T3000, the IM2000 Interposing Module and the transformers (up to 4).



The following table summarizes the available configurations and the corresponding performances.

Number of transformers No	Weight Kg	Maximum load mOhm	Maximum current A	Duty cycle s
1	19.5	1.5	1000	100
		0.15	2000	6
2	29.5	2.4	1000	900
		0.6	2000	27
		0	3000	6
4	49.5	6	1000	900
		2.4	2000	27
		0.8	3000	6
		0.6	4000	2
		2.6	1000	INFINITE
		0.6	2000	900
		0	3000	100

For more detailed technical information please see the BU2000 data sheet.

High IDC Module - 400A

The high DC current module allows the measurement of the low contact resistance of high voltage breakers or of joints.
The option is connected to the high AC current output of T3000; the current measurement is connected to the low DC current measurement input; the drop voltage is connected to the low voltage measurement input. DC current output is: 100 A steady; 200 A for 4 minutes; 400 A for 15 s.
The selection of this function is performed via menu;
the screen displays: test current; joint voltage; contact resistance. Resistance measurement ranges: µOhm 100.0, 1.000, 10.00, 100.0 mOhm; 1.000 Ohm, auto-ranging.
The connection cables are included with the option.

Current booster - 2000A AC

The current booster module allows performing high current primary tests. The option is connected to the high AC current output of T3000, and boosts the output current on two ranges: 1000 A or 2000 A. Output characteristics are the following.

RANGE A	OUTPUT A	POWER VA	TEST DURATION	
1000	500	800	4	min
	1000	1400	15	s
2000	1000	800	4	min
	2000	1200	15	s

Current output is measured by connecting the option to the external high current measurement.
The selection of this function is performed via menu; the screen displays the output current as kA.
The connection cables are included with the option.

Safety Features and Protections

- Fuse on the mains supply.
- At power-on, a diagnostic sequence controls:
  . Key microprocessor board components;
  . Auxiliary supply voltages.

If something is wrong, the operator is alerted by a message.

- Emergency pushbutton: if pressed, all main outputs are removed.
- The high voltage output has the following protections:
  . Confirmation key: if not turned, the HV output is not generated;
  . The HV is generated only if selected.
- Thermal NTC sensor on the main and auxiliary transformers. In case of over-temperature, an alarm message is displayed.
- Thermal sensors or the SCR that controls current injection, and of the internal temperature. In case of over-temperature, an alarm message is displayed.
- If maximum current limits and time duration of power transformer generators are reached, the generation is interrupted, and the operator is warned by an alarm message.
- The DC current source is protected against over-voltages. In addition, the output is automatically kept to zero as test stops, so that any residual energy on the external load is discharged.
- The auxiliary AC voltage is protected by an electronic circuit that stops the voltage generation and opens the connection to outputs socket in case of overload (short circuit included). In case of intervention, an alarm message is displayed. Via the control knob the operator can reset the alarm and close the relay to restore operation. The auxiliary AC voltage is also protected by a thermo switch that intervenes in case of over-heating. In case of intervention, an alarm message is displayed.
- The DC voltage generator is protected by a current limiter. The user notices the low voltage and removes the overload. The fuse protects the case of counter-feed.
- Re-triggering fuse on the auxiliary contact.
- Timer inputs are protected against wrong selections. If the voltage free input is selected and a voltage is applied less than 250 V AC or 275 V DC, circuits will not be damaged.
- Trip inputs and the auxiliary relay contacts are protected by devices rated 380 V AC, which limit the maximum voltage between sockets and among sockets and ground.
- The 20 mA measurement input is protected by a fuse.

APPLICABLE STANDARDS

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

A) Electromagnetic Compatibility:
Directive no. 89/336/CEE dated may 3, 1989, modified by the directive 92/31/CEE dated may 5, 1992.

B) Low Voltage Directive:
Directive n. 73/23/CEE, modified by the directive 93/68/CEE.
Applicable standards, for a class I instrument, pollution degree 2, Installation category II:

. CEI EN 61010-1. In particular:
. Inputs/outputs protection: IP 2X - CEI 70-1.

T3000

. Operating temperature: 0 to 50 °C; storage: -40 °C to 70 °C.
. Relative humidity: 10 - 80% without condensing.

Ordering information:

CODE	MODULE
	T3000
10102	complete with software TDMS. 3000 V OUTPUT - Power supply 230 V ± 10%
15102	Test cables kit
20102	complete with software TDMS. 3000 V OUTPUT - Power supply 115 V ± 10%
15102	Test cables kit
30102	complete with software TDMS. 1200 V OUTPUT - Power supply 230 V ± 10%
15102	Test cables kit
40102	complete with software TDMS. 1200 V OUTPUT - Power supply 115 V ± 10%
15102	Test cables kit

Option for T3000

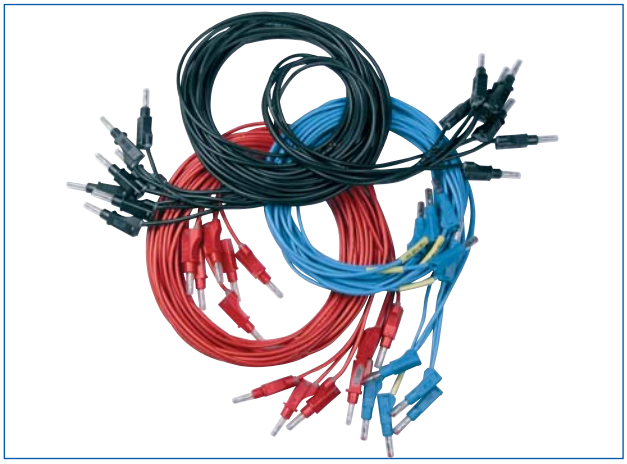
CODE	MODULE
17102	Transit case
16102	Current Clamp 1/1000 Max 100A - Ø 12 mm
14102	Thermal Printer 4.5"
13102	High I DC module 400 A
12102	Current Booster 2000 A
50102	BU2000 - External Advanced Booster up to 2000 A: (1) Main Module with high current clamps and high current cables, 20m connecting cables.
51102	BU2000 - External Advanced Booster up to 3000 A: Main Module with high current clamps, high current cables, Auxiliary Module (1), Interposing Module, connecting cables.
52102	BU2000 - External Advanced Booster up to 4000 A: Main Module with high current clamps, high current cables, Auxiliary Module (3), Interposing Module, connecting cables.
53102	BU2000 - Interposing Module
54102	BU200 - Auxiliary Module
55102	BU2000 (50102) - Heavy Duty transport case
56102	BU2000 (51102; 52102) - Heavy Duty Transport case
40093	D/1000 differential relay test module
19102	Earth Resistance and Soil Resistivity Kit
16093	FT1000
26102	SU 3000 Safety grounding unit for line impedance measurement.

T3000 ACCESSORIES

T3000 - Transit case

T3000 - Transit case for Cables

T3000 - Current Clamp



T3000 - Set of Test Leads

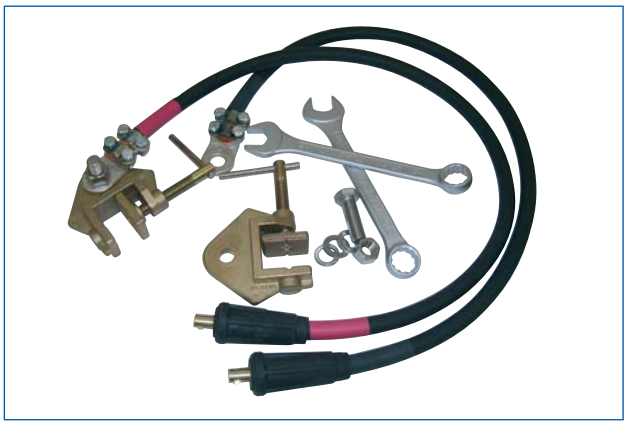
T3000 - High voltage Test Cables

T3000 - Grounding Cable

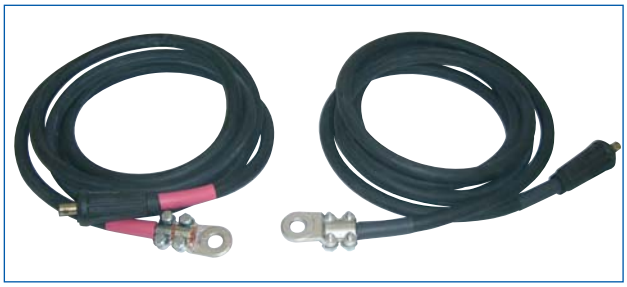
T3000 - Low current Cables

T3000 - Measuring Cable

T3000 - Serial Cable



T3000 - High current Cables with Clamps and mounting Kit



T3000 - High current Cables