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REV. 1

**RELTEST 1000
THREE PHASE
RELAY TEST SET**

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1 GENERAL

RELTEST 1000 is an advanced multi-functional relay test set, designed for the testing of modern (numeric) protection relays used in distribution, transmission, smart grid and renewable energy plants.

Main features are:

- Advanced multifunctional relay test set, specially designed for distribution, smart grid and renewable energy plants.
- Local control, via keyboard and color display.
- Remote control with the Advanced Test & Data Management Software.
- Three independent AC voltage, adjustable from 0 to 400 V.
- Fourth independent AC voltage output, adjustable from 0 to 130 V.
- One current output, from 0 to 15 A, switchable on 3 phase sockets.
- One independent current output, adjustable from 0 to 1 A.
- Frequency generator: 40 - 400 Hz.
- Battery simulator.
- Two separate timer inputs.
- Four auxiliary relay outputs.
- Optional IEC 61850-8 communication interface.
- Optional six low level outputs.
- USB interface.
- Internal memory for test results storage and saving.
- Automatic test report.
- Lightweight and easy to carry.

The test set can be controlled locally, without the connection to a PC, by means of a graphical colour display, a keypad, a rotary switch and function keys. The unit can be controlled also by the software TDMS, which provides a complete set of test programs. In both cases, it is possible to test the relays listed in the following table.

RELAY TYPE	IEEE NO
DISTANCE RELAY	21
SYNCHRONIZING DEVICE	25
UNDER/OVER-VOLTAGE RELAY	27/59
DIRECTIONAL POWER RELAY	32
INSTANTANEOUS OVER-CURRENT RELAY	50
INVERSE TIME OVER-CURRENT RELAY	51
DIRECTIONAL ZERO SEQUENCE OVER-CURRENT RELAY	67N
AUTOMATIC RECLOSING RELAY	79
FREQUENCY RELAY	81
DIFFERENTIAL PROTECTION RELAY	87

The use of RELTEST is extremely easy: once connections are performed, the operator can select the desired test by a menu. **Tests can be performed locally or by PC control.** Test results are automatically saved and then downloaded in the PC using the software TDMS, provided with the test equipment, for final storage and printing.

The following is the test set front panel.



NOTA: WINDOWS è un marchio di MICROSOFT inc.

2 APPLICABLE STANDARDS

The test set and optional modules conform to the EEC directives regarding Electromagnetic Compatibility and Low Voltage instruments.

2.1 ELECTROMAGNETIC COMPATIBILITY

European directive no. 2004/108/EC. Applicable Standard : EN61326:2006.

EMISSION

- EN 61000-3-2: Harmonic content caused by the supply. Acceptable limits: basic.
- EN 61000-3-3: Limitation of voltage fluctuations and flicker. Acceptable limits: basic.
- CISPR11 (EN 55011 class A): Limits and measurement methods of radio-electric disturbances for industrial, medical and scientific instruments at radio-electric frequencies.

Acceptable limits for conducted emission:

- . 0.15-0.5 MHz: 79 dB pk; 66 dB avg.
- . 0.5-5 MHz: 73 dB pk; 60 dB avg.
- . 5-30 MHz: 73 dB pk; 60 dB avg.

Acceptable limits for radiated emission:

- . 30-230 MHz: 40 dB (30 m)
- . 230-1000 MHz: 47 dB (30 m)

IMMUNITY

- EN 61000-4-2: Immunity tests for ESD. Test values: 8 kV in air; 4 kV in contact.
- EN 61000-4-3; Immunity tests for radio frequency interference. Test values ($f= 900 \pm 5$ MHz): field 10 V/m, modulated AM 80%; 1 kHz
- EN 61000-4-4; Immunity tests for high speed transients (burst). Test values: 2 kV peak; 5/50 ns.
- EN 61000-4-5; Immunity tests for surge. Test values: 1 kV peak differential mode; 2 kV peak common mode; 1.2/50 us.
- EN 61000-4-6: immunity to low-voltage sinusoidal waveform. Test values: 0.15-80 MHz, 3 Vrms, 80% AM 1 kHz.
- EN 61000-4-8: Immunity tests for low frequency magnetic fields. Test values: 30 Arms/m.
- EN 61000-4-11: Immunity test for power supply drops. Test value: 1 cycle; 100% drop.

1.2 LOW VOLTAGE DIRECTIVE

European directive n. 2006/95/EC. Applicable standard, for a class I instrument, pollution degree 2, installation category II: CEI EN 61010-1. In particular:

- Dielectric Rigidity: 1.4 kV AC, 1 minute.
- Isolation resistance: > 2 MOhm.
- Earth resistance : < 0.1 Ohm.
- Dispersion current: < 5 mA.
- Inputs/outputs protection: IP 2X - IEC 60529.

1.3 ENVIRONMENTAL

- Operating temperature: 0 - 50°C; storage: -25°C to 70°C.
- Relative humidity : 5 - 95%, not condensing.
- Vibration: IEC 60068-2-6 (20 m/s² at 10 – 150 Hz);
- Shock: IEC 60068-2-27 (15 g; 11 ms; half-sine).
- Altitude: less than 2000 m.
- Noise: less than 75 dB.

3 CHARACTERISTICS

3.1 THREE PHASE VOLTAGE GENERATOR

The test set has three phase voltage outputs.

- Three AC voltage outputs, separately adjustable. Output range (phase voltage): from 0 V to 100 V AC, or from 0 to 400 V AC (corresponding to 170 V or 690 V phase to phase voltages).
- Connection: 4 safety sockets (3 phases and a common neutral). For delta connected relays, it is possible to forget the neutral socket.
- Possibility to set the amplitude of the outputs independently for each output, continuously.
- Resolution: 50 mV on the 100 V range; 200 mV on the 400 V range.
- Accuracy: $\pm 0.5\%$ of the output $\pm 0.2\%$ of the range.
- Distortion, with resistive burden and the rated maximum power: 0.1%.
- Maximum distortion: 0.5%.
- Angles adjustable from 0° to 360° .
- Angle resolution: 0.5° ; angle accuracy: 1° .
- Voltage outputs have the neutral in common and are isolated from mains and ground.
- Power available for each phase: 20 VA continuously, at the voltage of the selected range.
- Possibility to set independently the pre-fault and the fault output amplitudes.

3.2 FOURTH VOLTAGE GENERATOR

The test set has a fourth voltage output, with the same neutral of phase voltages, but independently adjustable.

- Two voltage ranges: 13 V or 130 V AC.
- Possibility to set the output amplitude from zero to the maximum value, continuously.
- Connection: two safety sockets.
- Resolution: 6 mV on the 13 V range, 60 mV on the 130 V range.
- Accuracy: $\pm 0.5\%$ of the output, $\pm 0.2\%$ of the range.
- Distortion, with resistive burden and the rated maximum power: 0.1%.
- Maximum distortion: 0.5%.
- Angle adjustable from 0° to 360° .
- Angle resolution: 0.5° ; angle accuracy: 1° .
- The output is isolated from mains and ground.
- Available power: 0.6 VA at 13 V; 6 VA at 130 V, continuously.
- Possibility to set independently the pre-fault and the fault output amplitudes.

3.3 MAIN CURRENT GENERATOR

The main current output has the neutral isolated from the voltage outputs, adjustable independently with respect to voltages; besides, it can be switched on the 3 phase sockets.

- Current range: 15 A AC.
- Connection: four safety sockets, marked IN, I1, I2 and I3.

- Output selection: automatic, according to the selected fault.
- Possibility to set the output amplitude from zero to the maximum value, continuously.
- Resolution: 7 mA.
- Accuracy: $\pm 0.5\%$ of the output, $\pm 0.2\%$ of the range.
- Distortion, with resistive burden and the rated maximum power: 0.5%.
- Maximum distortion: 1 %.
- Angle adjustable between 0° and 360° .
- Angle resolution: 0.5° ; angle accuracy: 1° .
- The output is isolated from mains and ground.
- Available power: 25 VA continuously, at the maximum current.

3.4 SECOND CURRENT GENERATOR

The test equipment is provided with an additional current output, adjustable independently. The neutral is in common with the neutral of the phase current,

- Current ranges: 0.1 A and 1 A AC.
- Connection: two safety sockets.
- Possibility to set the output amplitude from zero to the maximum value, continuously.
- Resolution: 0.1 mA on the 0.1 A range, 1 mA on the 1 A range.
- Accuracy: $\pm 0.5\%$ of the output, $\pm 0.2\%$ of the range.
- Distortion, with resistive burden and the rated maximum power: 0.5%.
- Maximum distortion: 1 %.
- Angle: adjustable from 0° to 360° .
- Angle resolution: 0.5° ; angle accuracy: 1° .
- The output is isolated from mains and ground.
- Available power: 0.2 VA at 0.1 A; 2 VA continuously, at 1 A.

3.5 OUTPUTS COMBINATIONS

Above outputs are available in the following combinations.

- Three phase voltages and the fourth voltage;
- Three phase voltages and the main current;
- Three phase voltages and the second current.

Other combinations are not available. For all practical uses, this is not a limitation.

3.6 OUTPUT FREQUENCY

- Frequency range: adjustable from 40 Hz to 400 Hz.
- Possibility to set separately the outputs frequency before and during the fault.
- Possibility to have two different frequencies on two outputs (for synchronizing relay test)
- Accuracy: $\pm 0,1$ mHz.
- Resolution: 1 mHz.
- Rate of change programmable between $\pm 0,1$ Hz/s and ± 999 Hz/s.

3.7 BATTERY SIMULATOR

- Unregulated DC generator : it follows the mains.
 - Voltage values with supply of 230 V: 110, 48, 24 V DC $\pm 15\%$.
 - Voltage values with supply of 115 V: 55, 24, 12 V DC $\pm 15\%$.

- Corresponding power: 30W , 22W, 11W.
- Connection: two safety sockets.
- The output generation is controlled by the test program.
- The output is isolated from mains, ground and all other outputs.

3.8 TRIP INPUTS

- Digital inputs: two inputs, isolated and programmable independently.
- Connections: two safety banana sockets, marked C1 and C2.
- Inputs can be independently selected as dry or with voltage, from 4.5 to 400 V DC.
- For each input, the display shows when the input is closed (or the voltage is applied).
- Selection of the type of input: Voltage clean, 24 V or 80 V; software controlled. The selection clean/voltage is displayed on the screen.
- For all selections, inputs are protected against voltages up to the maximum specified above.
- Selections: Normally Open (N.O.) or Normally Closed (N.C.), independent for each input.

3.9 TIMER

Time measurements available:

- Timing from the start of the test (injection) until any logical combination of Close or Open of the selected inputs.
- Timing from an external contact.
- Timer range: 0 to 9,999.999 s; resolution: 0.1 ms
- Timer accuracy: 0.01% of the measure \pm 1 ms, for input changes lasting more than 1 ms.

3.10 AUXILIARY OUTPUTS

- Four auxiliary relay contacts (A1, B1, C1, D1), timed, voltage clean, whose make terminations are connected to safety banana connectors.
- The open or closed state of the relay is shown on the display.
- Characteristics of the contacts with a resistive load:
 - AC: 250 V; 5 A; 1250 VA;
 - DC: 120 V; 0.2 A; 24 W.
- Range of programmable delay with respect to test start: from 0 to 999.99 s.
- Nominal switch delay with respect to test start: 5 ms.

3.11 GRAPHIC DISPLAY AND LOCAL CONTROL

- Large color graphic display, type TFT, backlighted, 320 x 240 pixels.
- Keyboard: 12 keys, 5 function keys and one digital encoder.

3.12 LOCAL AND PC CONTROL

The test equipment local control is performed by the multifunctional knob, keyboard and display.

The control menu allows to set the type of fault. Then the test is launched, including two type of tests: threshold measurement and time measurement. Test results are shown on the display, and can be saved and retrieved. With the PC connection, the user has available TDMS - Test and Data Management software.

3.13 PROTECTIONS

- Auto diagnostic at power-on.
- Electronic protection on voltage outputs and a fuse on the auxiliary outputs.
- Thermal protection against over-heating.
- Trigger input protection against selection error.

3.14 INTERFACE AND SOFTWARE

- PC interface: USB.
- Internal memory: more than 500 test results.
- TDMS Software for the test result management, storage and saving.

3.15 POWER SUPPLY AND DIMENSIONS

- Mains supply: 85 to 264 VAC 50/60Hz; 120 to 370 VDC.
- Weight: 13 kg.
- Dimensions: 46 (W) x 35 (H) x 17 (D) cm.

3.16 ACCESSORIES

Accessories supplied with the test equipment:

- Power supply cable and USB cable;
- Connection cables to the relays:
 - N. 6 red cables, 2.5 mm² section, 2 m long, terminated with 4 mm safety banana plugs;
 - N. 1 yellow cable, 2.5 mm² section, 2 m long, terminated with 4 mm safety banana plugs;
 - N. 1 blue cable, 2.5 mm² section, 2 m long, terminated with 4 mm safety banana plugs;
 - N. 6 black cables, 2.5 mm² section, 2 m long, terminated with 4 mm safety banana plugs.
- N. 10 adaptors.
- Grounding cable, 2 m long, yellow/green, with clamp.
- Spare fuses.
- TDMS Software and operator manuals.

4 OPTIONS

4.1 IEC 61850-8 COMMUNICATION INTERFACE

This option, to be mounted inside the test set, allows the management and handling of IEC61850-8 messages. The option is supplied with RJ45 Ethernet crossed cable for the connection to the relay under test.

4.2 SIX LOW LEVEL SIGNAL OUTPUTS

Optionally, the test set can be equipped with six low-level voltage outputs. The purpose of these outputs is to allow testing newest protection relays with low voltage (sensor) inputs. The dedicated connector carries six analog signals, that correspond to the three voltages and to the three currents. NOTE: on these outputs, there are available three phase current outputs, instead of the single phase, switched main current output. When these outputs are selected, power outputs are not generated.

The option is made of the electronic circuit, which is installed into RELTEST. Additionally, we offer also the connection cables to two types of relays: see here after. Output characteristics are the following ones.

- Number of outputs: 6.
- Connection: three connectors (one per phase), type RJ45. Each connector carries the current and voltage signals.
- Full range voltage output: 7.07 Vrms.
- Full range current output: 7.07 Vrms.
- Output current: 5 mA max.
- Resolution: 0.43 mV .
- Accuracy, in the temperature range of 25 ± 2 °C, and with frequency from 40 to 70 Hz: 0.05% of range typical, 0.1% of range guaranteed.
- Distortion: 0.1%.
- Output frequency: 0 to 500 Hz.
- Output accuracy; full temperature range, frequency 0 to 40 Hz: $\pm 0.2\%$ of the range.
- Output accuracy; full temperature range, 500 Hz maximum attenuation: 1%.
- The display shows the programmed output values.

4.3 LOW LEVEL CONNECTION CABLES

4.3.1 THYTRONIC THYSENSOR

The set is foreseen for relays types NA60, NV10.

The set is made of three cables, 2 m long, terminated with RJ45 connectors. Each cable carries one voltage and one current. The connection to the test set and to the relay is direct.

4.3.2 ABB models REF542PLUS and REF601

The option includes two adaptors.

The first one has six cables, 2 m long, with BNC connectors, for the connection to the relay: 3 I, 3 V, and also three cables with RJ45 connectors, to the test set.

The second one has three cables, 2 m long, with RJ45 connectors, for the current and voltage signals to the relay, and also three cables with RJ45 connectors, to the test set.

4.4 HEAVY DUTY TRANSPORT CASE

Heavy duty transport case (Discovery type) with wheels, cover and handle.