

Microprocessor protection and automation devices

THE TЭMП 2501 MICROPROCESSOR PROTECTION TERMINALS

It is well known that microprocessor protection devices have indisputable advantages over electromechanical and static ones. That is why since 2002 JSC "VNIIR" develops and produces the TЭMП 2501 series microprocessor protection terminals. This devices are notable for:

- precision and constancy of characteristics;
- low maintenance expenditures and high reliability due to continuous self-diagnostics;
- possibility of measurement, indication and recording of modes and events;
- possibility to build a full-scale process control system with use of the microprocessor terminals as an interface unit.

The TЭMП 2501 devices are intended for secondary side connections at substations with alternating, rectified alternating or direct control currents. They provide protection, automation, indication and control functions and are intended for switchgears with a voltage of 0.4–35 kV in power networks with a dead-grounded or insulated neutral. The devices can be mounted in stationary and pullout switchgears, power distribution panels and switchboards at electric power stations and substations. The parameters of the devices permit their installation in places with harsh temperature conditions. They can be used both when building new substations and when reconstructing existing ones, including those equipped with protection systems based on electromechanical relays. They are compatible with oil-immersed, sulphur hexafluoride [SF6] and vacuum circuit-breakers, furnished with various drive mechanisms. The TЭMП 2501 terminals are assembled of high-quality components and employ up-to-date technical solutions. The TЭMП 2501 series include four types of the terminals:

- universal protection terminal for secondary connections (0,4-35 kV) – TЭMП 2501-1X;
- protection terminal for section transformer with a voltage of 6-10 kV – TЭMП 2501-2X;
- protection terminal for outgoing lines (0,4-35 kV) – TЭMП 2501-31;
- protection terminal for middle-capacity synchronous and induction motors (6-10 kV) – TЭMП 2501-4X,

where X in the type designations stands for a version of the terminal.

All types of the terminals, except the TЭMП 2501-31, have to mounting versions: with rear wiring connection (TЭMП 2501-X1) and with front wiring connection (TЭMП 2501-X2). The TЭMП 2501-31 terminal is produced only with rear wiring connection for mounting in a horizontal position. The other terminal types with rear wiring connection have an additional version for vertical mounting (TЭMП 2501-X3). The latter can be used in combination with the KPY-TEL switchgears by "Tawrida-Electric Ltd.". The main parameters of the TЭMП 2501 complete devices are shown in Table 1.

Table 1.

TЭMП 2501 Technical Parameters

Rated values	
Supply voltage range (auxiliary services supply), V	110/220 d.c./a.c.
Rated frequency, Hz	50 ± 5
Rated voltage range, V	88...242 a.c./d.c.
Mass, kg	<4
Analog input signals	
Rated input phase current (I _{rat}), A	1/5
Rated ground-fault input current (I _{rat}), A	0,2/1
Rated frequency, Hz	50 ± 5
Rated input voltage (U _n), V	100 / 110
Power consumption, V·A per phase	<0,3
Measurement range	
Phase current, A	0...63 x I _n
Phase-to-ground current, A	0...21 x I _n
Phase voltage, V	0 ... 2 x U _n
Logical input signals	
Supply rated voltage (auxiliary services supply), V	110/220 d.c./a.c.
Number of logical input signals TЭMП 2501-1X, 2X	8
TЭMП 2501- 31	5
Power consumption per input, W	<0,8
Break contacts / contacts of signal relays and self-diagnostics system	
Number of output relays TЭMП 2501-1X, 2X	10
TЭMП 2501- 31	5
Maximum contact voltage, V d.c.	300
a.c.	440
Continuous current, A	5

General Parameters	
Ambient temperature range, 0C	-40...55
Power consumption, W	<7

Apart from the main protection and automation functions, the ТЭМП 2501 microprocessor devices provide an oscillography function (except the ТЭМП 2501-31 terminal that does not support this function) and recording of fault-mode parameters including that necessary for diagnostics of the primary-side equipment. All the parameters recorded and oscillograms are saved to a nonvolatile memory wherein they can be kept for up to 100 years. The built-in real-time clock with an autonomous power supply provides registration of a fault time even without timing from the process control system. This feature simplifies analysis of fault conditions at remote and non-attended substations, having, as a rule, an a.c. auxiliary service supply that can be de-energized in case of a local fault. All the devices have a full-scale self-diagnostics system providing checking of the main units of the terminal and blocking its operation if a steady fault has been detected.

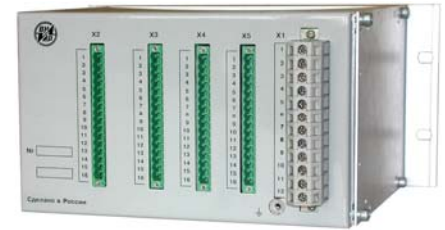
When using protection devices at substations with alternating control current, it is essential to provide a small readiness time after the device is switched on. This ensures fast protection operation in case of a short-circuit in the line protected, if it is switched on simultaneously with application of the control voltage to the device. The ТЭМП 2501 terminals fully satisfies this requirement as it has a readiness time of no more than 0.25 s. All the terminals have two setting groups that permit fast switching between the operating modes.

The ТЭМП 2501-1X, 2X, 4X have an alphanumeric LCD (2 lines of 16 characters) and a keyboard with 6 buttons for viewing parameters and configuring the device. There are two ports: the front one (RS-232) for connection to a PC and the rear one (20 mA current loop) for communication with the process control system. The ТЭМП 2501-31 has LED indication and a keyboard with 5 buttons. Parameter viewing and device configuration are performed with a PC connected to the front port using special software.

THE TЭMΠ 2501-3X PROTECTION AND CONTROL DEVICE FOR OUTGOING LINES WITH VOLTAGE OF 6-35 kV

GENERAL INFORMATION

The "TЭMΠ 2501-1X" terminals provide relay protection, automation and control functions in power networks with alternating, rectified alternating or direct control currents. They are intended for different feeders and lines at industrial enterprises and electric power substations with a voltage of 0.4–35 kV.



SPHERE OF USE

- electric power networks;
- cable networks;
- electric power stations (thermoelectric, hydropower, nuclear etc.);
- industrial enterprises;
- oil and gas processing plants;
- water supply facilities.

OBJECTS OF INSTALLATION

- ✓ stationary and pullout switchgears of 6-10 kV;
- ✓ power distribution panels and switchboards;
- ✓ auxiliary transformer substations (0.4 kV).

PROTECTED OBJECTS

- overhead and cable lines;
- section and lead-in switches;
- low and medium capacity asynchronous motors;
- lines to auxiliary transformers (6/0.4 kV).

PROTECTION FUNCTIONS

- three-stage unidirectional overcurrent protection with 2 step acceleration at switch closure;
- single-step unidirectional overcurrent protection against ground faults;
- protection against unbalanced load (open-phase fault protection);
- circuit-breaker failure protection (CBFP) with three single-phase current relays;
- undervoltage protection*.

AUTOMATION FUNCTIONS

- two-stage automatic reclosing (AR);
- underfrequency load shedding (ALS)* ;
- automatic load transfer (ALT) *;
- protection against repeated contact closing in the switch.

CONTROL FUNCTIONS

- local and remote control of the switch;
- monitoring of control circuits (with switch position relays).

MEASUREMENT, REGISTRATION, INDICATION

- measurement of three-phase and neutral currents;
- indication of current and fault parameters in real or relative units;
- recording of fault parameters;
- built-in oscilloscope providing fault parameter curves;
- indication of current state of logical input signals and output relays;
- real-time clock and calendar.

COMMUNICATION WITH PC AND PROCESS CONTROL

- connector for communication with process control systems (rear port – 20 mA current loop);
- connector for communication with personal computer (front port – RS232 interface);
- software providing remote control of the terminal.

INPUT CIRCUITS AND OUTPUT RELAYS:

- eight isolated logical input circuits;
- three output relays with normally-open contacts;
- six signaling output relays with two-way contacts;
- polarized "command fixing" output relay with two-way contacts.

MAIN ADVANTAGES:

- suitable for substations with alternating control current;
- low readiness time not exceeding 0.2 s;
- wide choice of automation and protection functions in one device;
- small overall dimensions and weight;
- wide operating temperature range: from –25 to 55 °C (from –40°C if specially ordered);

- two setting groups;
- programmable application of logical input circuits and output relays;
- price is 1.5–2 times smaller than that of most analogs.

*this functions are realized by connection of external circuits

TECHNICAL PARAMETERS

Rated Values	
supply voltage range (auxiliary services supply)	88...242 V a.c./d.c.
rated frequency	50 ± 5 Hz
rated voltage	110 V, a.c. or d.c. 220 V, a.c. or d.c.
current circuits	
rated input phase current, I_n	1 A or 5 A, four channels
rated ground-fault input current, I_n	0,2 A or 1 A
power consumption	no more than 0,3 VA per phase
measurement range	
phase current	0...63 x I_n
phase-to-ground current	0...21 x I_n
logical input signals	
number of logical input signals	8
power consumption per input	0,8 W
break contacts / contacts of alarm relays and self-diagnostics system	
number of output relays	10
maximum operating voltage	300 V d.c. 400 V a.c.
maximum continuous current	5 A
general parameters	
protection degree from the front	IP 40 (recessed mounting)
protection degree from the back (communication connectors)	IP 20
ambient temperature range	from -40 to 55 °C
power consumption in control/operation mode	no more than 7/15 W
mass	4 kg, maximum

PROTECTION PARAMETERS

Functionality	operate current setting parameters			operating time setting parameters		number of stage time delays
	range, x I_n	error, %		range, s	error, %	
		$I_{cp} < 0,5 \times I_n$	$I_{cp} \geq 0,5 \times I_n$			
overcurrent protection						
3-rd stage	0,1...5,0	5	3	0,05...300*	2	2
2-nd stage	0,25...40,0	5	3	0,05...300	2	3
1-st stage	0,25...40,0	5	3	0,05...30,0	2	1
protection against phase-to-ground faults	0,1...2,5	5	3	0,05...300*	2	2
protection against unbalanced load (open-phase fault), ΔI in % of I_{ph}	10...100	5		1...300	2	2
circuit-breaker failure protection	0,05 x I_n	5		0,1...1,0	2	1

*the stages have delays both independent from current and varying as a function of current.

RECORDER OF PARAMETERS IN ABNORMAL MODES

number of analog channels	4 (active values of I_A, I_B, I_C, I_0)
number of logical signals	40 (8 input + 10 output + 22 internal)
sampling frequency, Hz	200
recording duration	
• pre-fault conditions, s	0,5
• fault conditions, s	0,5 ... 5,0
number of oscillograms	up to 32
recorder of abnormal modes	recording of last 5 events
overall recording time, no less, s	up to 35

DEVICE DESIGN

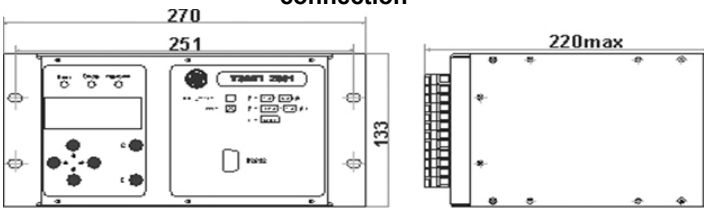
There are two types of the terminal design: with rear wiring connection and with front wiring connection. In the first case, the connectors for current circuits, control power supply and logical input/output signals are mounted on the rear wall of the terminal. In the second case, the current circuit connector is installed on the left wall whereas the others – on the upper wall of the terminal.

The base of the terminal constitutes a cassette wherein are installed the following blocks: measurement block, block of input transformers, logical input signal block, block of output relays, indication block and power supply. On the front panel are installed 3 LED alarm indicators, alphanumeric LCD (2 lines of 16 characters) for indicating parameters (such as settings, currents measured etc.), 6 control buttons and a RS232 port for connecting a personal computer.

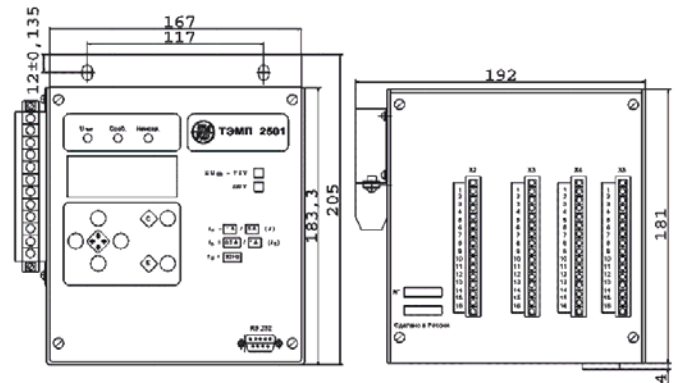


OVERALL DIMENSIONS:

«ТЭМП2501-11», horizontal version with rear wiring connection



«ТЭМП2501-12» with front wiring connection



«ТЭМП 2501-13» vertical version with rear wiring connection

