Treetech

TM1/TM2

Temperature Monitors

PRODUCT CATALOG

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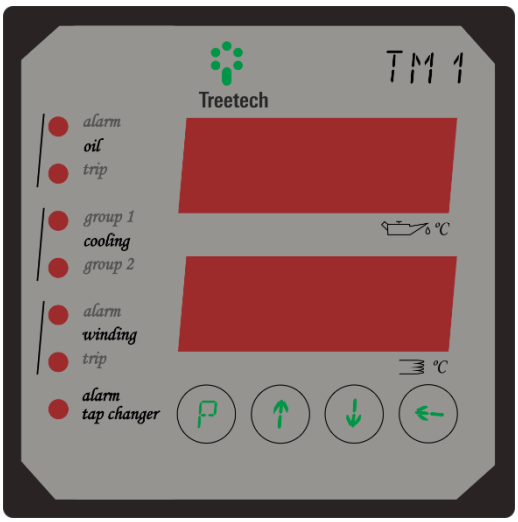
TEMPERATURE MONITORING

More than just digital thermometers, Treetech's TM Temperature Monitors form a complete Temperature Monitoring system for transformers and reactors immersed in oil. Designed as a modular system, it can be used in simple, low-cost applications, as well as in complete monitoring systems. The system is comprised of modules TM1 and TM2:



- TM1, monitors the temperature of the oil and one winding. The device is equipped with:
  - ✓ Configurable input for one 4-lead RTD sensor, for oil temperature, or two 3-lead sensors- redundant reading of oil temperature1) or simple reading for oil temperature and one additional temperature (e.g.: ambient or LTC).
  - ✓ One load current measuring input, for calculating temperature of the winding.
- TM2, applied as complement to TM1, monitors the temperature of one or two additional windings. It is equipped with:
  - ✓ Input for connection of additional RTD sensors, user configurable for one 4-lead sensor, or two 3-lead sensors, allowing measurement of one or two additional temperatures (for example, bottom oil, LTC, ambient temperature or others).
  - ✓ Two current measuring inputs, for calculating the temperature of two additional windings.

FEATURES AND FUNCTIONS

IED

- ✓ This IED (Intelligent Electronic Device) features a modern and compact design, specifically engineered for applications in transformers within substations and industrial or commercial facilities.

COOLING EXERCISE

- ✓ The cooling exercise function prevents fan inactivity during periods of low loading or low ambient temperature.
- ✓ 4 groups of forced cooling that can operate individually or collectively.
- ✓ Applicable as pre-cooling for transformers subject to predictable cyclic loads, capable of operating before a load peak.

- ✓ Automatic alternation of forced cooling groups.

ALARMS AND SELF-DIAGNOSTICS

- ✓ Alarm issuance in case of abnormalities and self-diagnosis for internal fault detection and integration with other sensors.

COMMUNICATION PROTOCOLS

- ✓ RS-485 serial communication port for integration with supervision or remote monitoring systems. Communication protocols include Modbus® RTU or DNP3.

INTERNAL CLOCK

- ✓ Adjustment maintained for 48 hours in case of power loss without the use of batteries - maintenance-free equipment.

OIL TEMPERATURE MEASUREMENT

- ✓ Measurement of top oil temperature using either a 3-wire Pt100 sensor, a 4-wire Pt100 sensor, or two 3-wire Pt100 sensors (redundant temperature measurement and validation).

PREDICTION OF FINAL GRADIENT

- ✓ Calculation of the forecast for the final temperature gradient between oil and winding for the current load.

MASS MEMORY (Default)

- ✓ Non-volatile memory for storing measurements and alarm events, shutdowns, and others. User-programmable interval between recordings and temperature and voltage variation for recording.

MULTI-GRADIENT FUNCTION

- ✓ The TM1/TM2 features the multi-gradient function because the thermal behavior of a transformer varies according to the activation of its cooling stages. This functionality enables the equipment to adjust thermal parameters based on the active cooling stage.

OPTIONAL FUNCTIONS

DNP3 –DNP3 Protocol

User-selectable communication protocol between Modbus and DNP3, with support for timestamping accurate to 1 ms.

PCOL – Pre-cooling

Pre-cooling can extend the insulation useful life of transformers subject to overloading by activating cooling groups when user selected load levels are reached. Taking advantage of the large thermal inertia of the oil, the forced cooling systems are activated even before the temperature rises, thus increasing the time required to reach high temperature levels, which would cause accelerated shortening of insulation life cycle. The following parameters are programmed by users:

- ✓ Loading percentages for individual activation of up to four cooling stages.
- ✓ Hysteresis for shut off forced cooling stages in case of load reduction.

FEXC – Fan and Pump Exercise

The fan exercise function keeps fans and / or pumps from remaining inactive for prolonged periods of time in transformers operating under low load conditions or during periods of low ambient temperatures. This avoids axle blocking due to accumulation of dirt, grease dry out or bird nesting. Fans are switched on every day, based on the equipment's internal clock, and depending on selections made by users:

- ✓ Hour and minute for start up of fans and/or pumps.
- ✓ Total daily fan and/or pump operation time, from 0 to 999 minutes.

OLTD – Temperature Differential for the Load Tap Changer

Load Tap Changers are one of the main sources of transformer failure. Measuring the temperature difference between the LTC oil and transformer oil may give an indication of a thermal failure event in the equipment before reaching a level of severity that could lead to a major failure. Since this difference is subject to the influence of external variables, monitoring is carried out in two different ways, to increase efficiency of diagnosis and avoid false alarms:

- ✓ Monitoring of instant difference triggers fast response alarms, in case of high intensity defects, even in case of short duration events.
- ✓ Monitoring of difference with long term filter triggers alarms sensitive to permanent defects, even in case of low intensity, with longer detection times.

In three-phase transformers using three single-phase tap changers in separate oil chambers the three temperature differences can be monitored separately.

TECHNICAL SPECIFICATIONS

CONDITIONS	INTERVAL/DESCRIPTION
Supply voltage	38 to 265 Vac/Vdc
Frequency	50 or 60 Hz
Maximum consumption	<8 W
Operating temperature	-40 a +85°C
Protection degree	IP20
Wire size (except CT inputs)	0,3 to 2,5 mm^2, 22...12 AWG
Wire size (CT inputs)	One or two 1,5 a 2,5 mm^2, 16 to 12 AWG (using appropriate ring-type terminal lugs)
Mounting	Built in panel
ANALOG OUTPUTS	
Outputs	2 (with common positive) for each device (TM1 or TM2)
Maximum error	0,5% of full scale
Options (selections) and maximum load	0...1 mA, 10 kΩ 0...5 mA, 2 kΩ 0...10 mA, 1 kΩ 0...20 mA, 500 Ω 4...20 mA, 500 Ω
RELAY OUTPUTS	
Relay outputs	Potential free contacts
Type and functions (standard)	5 NO (normally open) → Alarms and trips 3 NC (normally closed) → 2 for forced cooling and 1 for self-diagnosis
Maximum switching power	70 W (dc) / 220 VA (ac) non-inductive
Maximum switching voltage	250 Vac / Vdc
Maximum conduction current	5 A
Maximum interruption current	5 A, 250 Vac, cosϕ = 1 5 A, 30 Vdc, 0 ms 0,175 A, 125 Vsc, DC13 or L/R = 40 ms

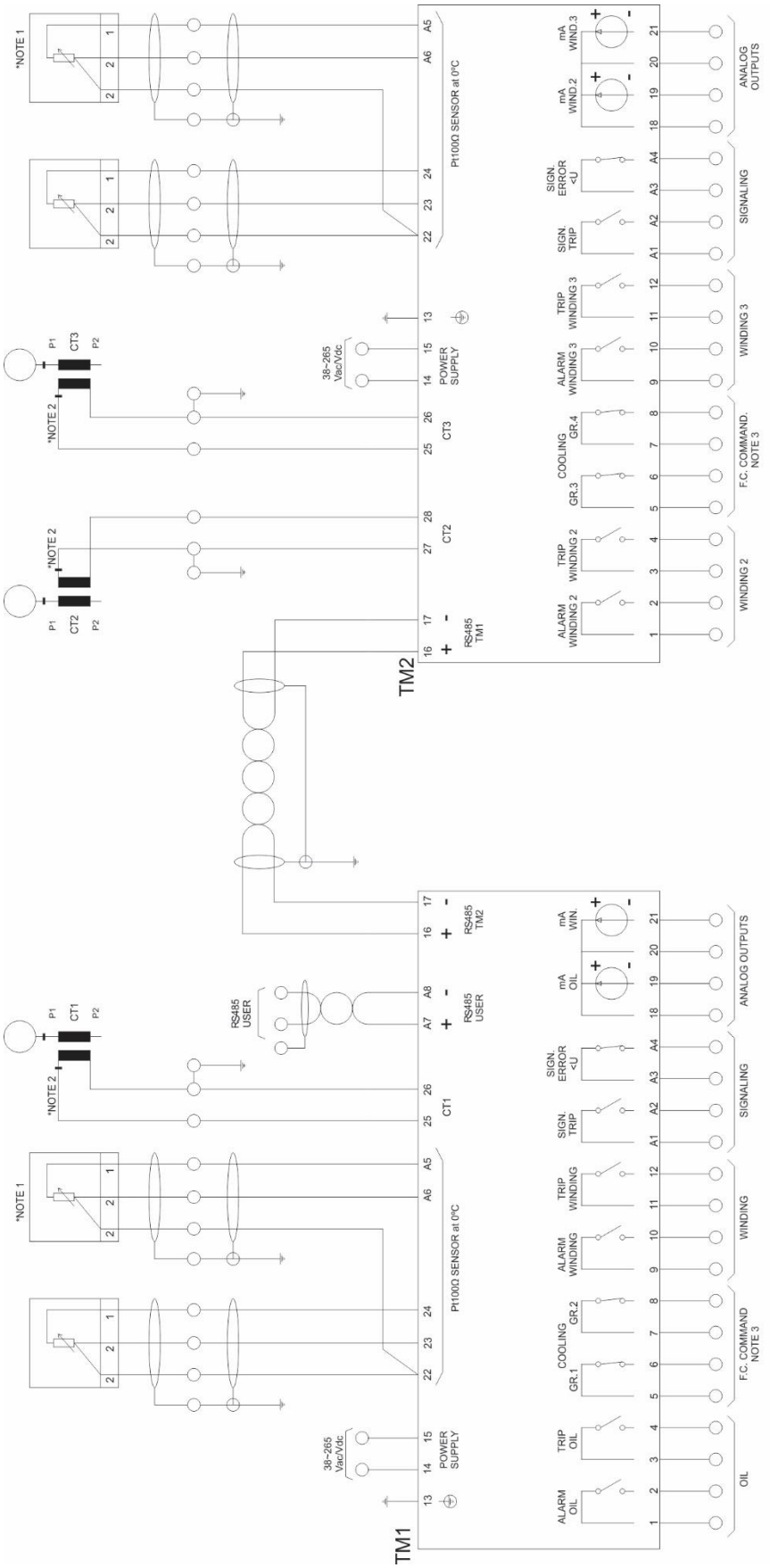
	0,500 A, 125 Vdc, DC13 or L/R = 40 ms (*with reverse bias diode or surge suppression diode).*
DIRECT TEMPERATURE MEASUREMENTS (oil, ambient, LTC)	
Sensor	Inputs for RTD sensors with continuous self-calibration Pt100Ω @ 0 °C
Measuring range	-55...200 °C
Maximum error @ 20 °C	0,4 % of full scale
Deviation by temperature variation	20 ppm/ °C
Connection options for each device (TM1 or TM2)	Two 3-wire sensors, one 4-wire sensor, or one 3-wire sensor.
WINDING TEMPERATURE MEASUREMENT	
Mathematical models applied	Calculated ABNT NBR 5416 (1997), IEEE C57.91 (1995), IEC 60076-7 (2005)
AC measurement input	Direct CT measurement or external clip-on CT
Working range	0...10 A
Maximum error @ 20 °C	0,5 % of end of scale (1% with clip-on CT)
Deviation by temperature variation	50 ppm/ °C
COMMUNICATION	
Communication protocols (access through TM1)	Modbus® RTU (standard) / DNP3 level 1 (optional)
Serial communication ports	1 RS-485, interconnection TM1/TM2 or IRIG-B 1 user selectable RS-485 / RS-232, supervision system (at TM1 only)
MASS MEMORY	
Recording interval	1 tp 120 minutes
Temperature variation for recording	1 to 20 °C
Capacity TM1 without LTC Temperature Differential TM1 with LTC Temperature Differential TM1+TM2 without LTC Temperature Differential TM1+TM2 with LTC Temperature Differential	 1465 registers 948 registers 848 registers 645 registers

TYPE TESTING

CONDITIONS	INTERVAL/DESCRIPTION
Immunity to surges (IEC 60255-22-5)	
Differential mode	1 kV, 5 per polarity (+/-)
Common mode	2 kV, 5 per polarity (+/-)
Immunity to electric transients (IEC 60255-22-1 and IEEE C37.90.1)	
Peak value of 1st cycle	2,5 kV common mode, 1 kV dif. mode
Frequency	1,1 MHz
Time and repetition	2 seconds, 400 surges/s
Decay to 50%	5 cycles
Voltage pulse (IEC 60255-5)	
Waveform	1,2 / 50 s
Amplitude	5 kV
Pulse number	3 negatives and 3 positives, 5s interval
Applied voltage (IEC 60255-5)	
Bearable voltage at the industrial frequency	2 kV 60 Hz 1 min. against ground
Immunity to irradiated electromagnetic fields (IEC 61000-4-3 / IEC60255-22-3)	
Frequency	26 to 1000 MHz
Field intensity	10 V/m
Immunity to conducted electromagnetic disturbances (IEC 60255-22-6)	
Frequency	0,15 to 80 MHz
Field intensity	10 V/m
Electrostatic Discharges (IEC 60255-22 and IEEE C37.90.3)	
Air mode	8 kV, ten discharges per polarity
Contact mode	6 kV, ten discharges per polarity
Fast electrical transient immunity (IEC60255-22-4 and IEEE C37.90.1)	
Power supply, inputs and outputs	4 kV
Serial communication	2 kV
Climatic test (IEC 60068-2-14)	
Temperature range	-40 to +85 °C
Total rest time	96 hours
Vibration response (IEC 60255-21-1)	
Application mode	3 axes (X, Y and Z), sinusoidal
Amplitude	0,075 mm from 10 to 58 Hz
Duration	1 G from 58 to 150 Hz

	8 min/axes
Vibration resistance (IEC 60255-21-1)	
Application mode	3 axes (X, Y and Z), sinusoidal
Frequency	10 to 150 Hz
Amplitude	2 G
Duration	160 min/axis
Short duration overload (IEEE C57.109-1993 and NBR 8145/83)	On AC current measurement input

CONNECTION DIAGRAM

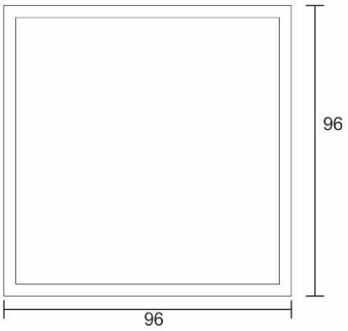


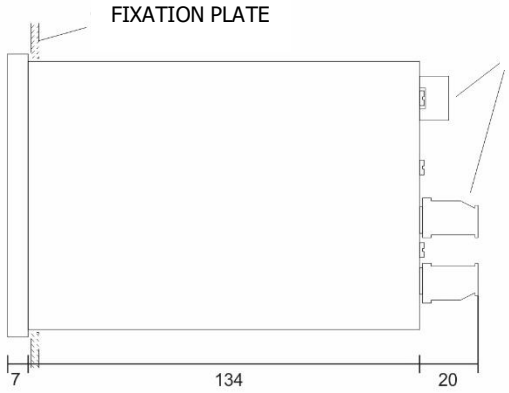
*NOTE 1: SEE RTD SENSOR CONNECTION OPTIONS
THE TOP OIL TEMPERATURE MEASUREMENT (1 OR 2 SENSORS) MUST BE CONNECTED TO TM1.
OTHER RTD SENSORS INPUTS AT TM1 AND TM2 MAY BE USED BY THE USER

*NOTE 2: CONNECTION OF TCs MUST BE MADE IN ACCORDANCE WITH THE TEMPERATURE MONITOR MODEL PURCHASED.
FOR DIRECT CONNECTION OF TC s 0-10A OR USE TC s EXTERNAL BOX (OPTIONAL ACCESSORIES)
SEE TECHNICAL MANUAL FOR CONNECTION DETAILS.

*NOTE 3: THE COOLING CONTROL CONTACTS IN TM2 MAY BE EMPLOYED AS REDUNDANCY TO THE TM1'S,
CONNECTING IN PARALLEL FOR THE CONTROL OF 2 GROUPS OF COOLING.

*NOTE 4: ALL CONTACTS ARE SHOWN IN CONDITION OF TM1 AND TM2 DE-ENERGIZED





PRODUCT DIMENSIONS

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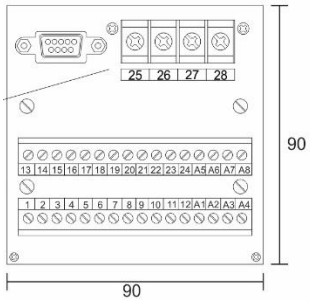
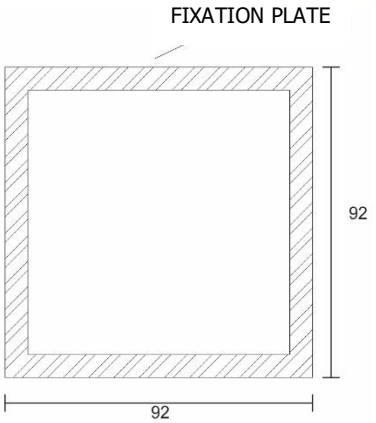


REAR VIEW



INSTALATION CUT

ALL DIMENSIONS IN mm

ESSENTIAL ACCESSORIES

Pt100 Ω TEMPERATURE SENSOR AT 0 °C

Essential for measuring the temperature at the top of the oil in power transformers, switch temperature, ambient temperature, and other general measurements.

SPLIT-CORE CURRENT TRANSFORMER

The use of external split-core window-type CTs (Current Transformers) is required for reading the load currents of the transformer.

RECOMMENDED ACCESSORIES

SIGMA ECM® MONITORING SOFTWARE

In addition to online temperature monitoring of your assets, with our monitoring system and specialized team, it is possible to track the status of your assets beyond data reading. Monitoring is done through analysis of the information collected by the IEDs installed on your assets.

WEATHER SHELTER

If ambient temperature measurement is desired in outdoor locations, a weather shelter should be used to protect the Pt100 sensor, minimizing errors such as the sun, rain, wind, etc. would cause in measurements.

QUICK INSTALLATION PANEL - QIP

Treetech's Quick Installation Panel (QIP) are designed to facilitate the assembly and installation of IEDs, control, and protection devices in substation equipment.

THERMOWELL

The main function of the thermowell is to protect the measuring point against pressure loss, leakage, or possible contamination. Added to these benefits is the ease of removal and replacement of the sensor for maintenance purposes.

ORDER SPECIFICATIONS

1. Product name:

- ✓ Temperature Monitor - TM1 or Temperature Monitor - TM2.

2. Quantity:

- ✓ The devices quantity.

3. Type of CT connection:

- ✓ Standard model for direct CT connection (0 a 10 A).
- ✓ External clip-on CT (clip-on CTs not included, must be ordered separately as optional accessories).

4. Relay contact configuration

Some TM relays can be configured with NO (Normally Open) or NC (Normally Closed) contacts. If you require a specific configuration, please specify it in the order as shown in the table below.

STANDARD	CONFIGURATION	TM1 RELAYS	TM2 RELAYS
NO	NO or NC	**Oil alarm**	**Winding 2 alarm**
NO	✖	**Oil shutdown**	**Winding 2 off**
NC	NO or NC	**Forced cooling 1**	**Forced cooling 1**
NC	NO or NC	**Forced cooling 2**	**Forced cooling 2**
NO	NO or NC	**Winding alarm 1**	**Winding alarm 3**
NO	✖	**Winding 1 off**	**Winding 3 off**
NO	NO or NC	**Programmable**	**Programmable**
NC	NO or NC	**Fault**	**Fault**

Note: If no configuration is specified, the device will be shipped with the default configuration.

LEGEND	
NO or NC	**Configurable**
✖	**Not configurable**

Note:

The shutdown relays are **NOT** configurable;

5. Desired optional functions:

- ✓ DNP3 - DNP3 protocol.
- ✓ PCOL - Pre-cooling.
- ✓ FEXC - Fan exercise.
- ✓ OLTD - LTC Temperature Differential.

Attention: The Temperature Monitor TM2 must operate obligatorily with Temperature Monitor TM1 and cannot be operated alone.

6. Accessories

- ✓ Specification of the accessory and quantity.

Treetech

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www.treetech.com.br