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TOT-R

Digital Transformer Top-Oil Temperature Controller

Instruction Manual



Lanso Konly (Shanghai) Instruments Co., Ltd.

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TOT-R
Digital Transformer Top-Oil Temperature Controller



1.Safety Warnings

1.1.General Safety Specifications

1. This product is a precision instrument matched with high-voltage transformers. It shall only be installed and operated by qualified high-voltage electricians who are familiar with the operation and maintenance specifications of power equipment.
2. Before installation, commissioning and maintenance of the equipment, read this manual in full to be familiar with product performance, parameters and operating procedures.
3. Unauthorized disassembly, refitting or modification of the equipment structure and internal wiring is strictly prohibited. The manufacturer shall not be liable for equipment failures or safety accidents caused by unauthorized operations.
4. The equipment is a precision measuring device. Violent impact, dropping, extrusion and water immersion are strictly prohibited. Avoid using it illegally in harsh environments with strong corrosion, heavy vibration, ultra-high temperature or ultra-high humidity.

1.2.High-Voltage Operation Safety Warnings

1. The transformer body and its matched instruments operate in a high-voltage environment. Before any work, the equipment power supply must be cut off, pressure relieved, and warning tags hung. Strictly follow the power safety work procedure: power cut-off, voltage test, earthing, tag hanging and barrier installation.
2. Installation, disassembly, wiring and maintenance are strictly prohibited while the equipment is energized or pressurized, to prevent accidents such as high-voltage electric shock and oil-gas ejection injury.
3. Insulating protective gear must be worn for on-site operations, and national and power industry safety regulations for high-voltage work shall be complied with.

1.3.Installation and Commissioning Safety

1. Before installation, verify the product model, technical parameters and applicable scenarios to confirm compatibility with transformer parameters. Incorrect installation and mixed use are prohibited.
2. Piping and connections shall be tightly sealed with no risk of gas or oil leakage. A tightness test must be performed after installation.
3. Wiring work shall be carried out strictly in accordance with the wiring diagram. Separate power circuits, low-voltage circuits and communication lines. Wrong connection, loose connection and short-circuiting are prohibited.

2.Product Introduction

The Transformer Digital Oil Temperature Controller (TOT) is a special instrument designed to measure the oil surface temperature of oil-immersed transformers. It is also applicable to temperature detection and control of other equipment.
This instrument features excellent protection performance and can operate continuously under all weather conditions outdoors. Multiple sets of adjustable control switches are built inside the instrument, which can be used separately for transformer cooling system control and signal alarming. It can output signals corresponding to temperature values for computer systems. The device can transmit collected real-time temperature data to the monitoring terminal via Modbus RS485 to achieve uninterrupted and accurate monitoring. It supports two-way communication, enables intelligent management of operating temperatures of power equipment, and ensures the safe operation of power grid equipment.

3.Working Principle

The thermal bulb of the transformer digital oil temperature controller is inserted into the mounting hole on the top layer of the transformer oil tank. Its temperature varies with the temperature of transformer oil. When the temperature reaches the setpoint, it actuates the microswitch and outputs ON/OFF control signals to drive the cooling system, so as to control the temperature rise of the transformer.
Integrated digital remote transmission is available. Signals inside the thermal bulb can be transmitted remotely to digital remote gauges in the control room or digital storage transmitters in the remote terminal box. Both can store more than 10,000 records of monitoring data and operating status information which can be exported. The device provides local indication for communication faults, self-test failures and other abnormalities. It can simultaneously display and control the top-oil temperature of the transformer, enabling all-weather unattended substation management.

4.Main Technical Parameters

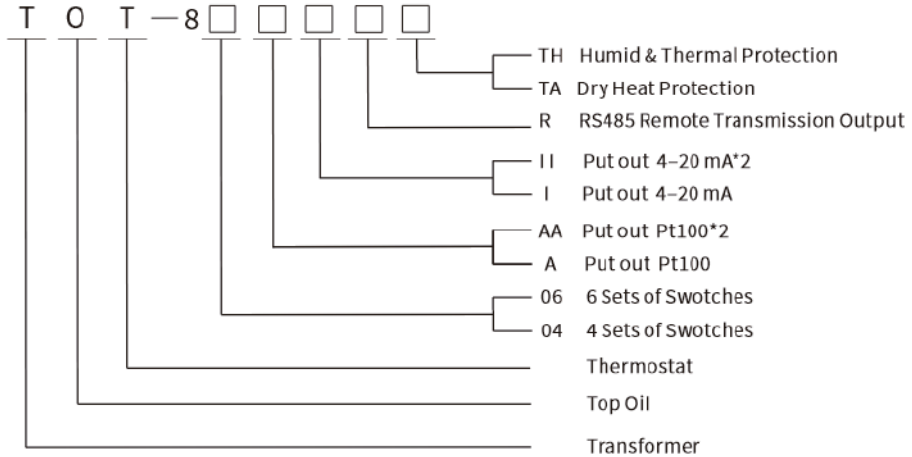
Table 1 Transformer Digital Oil Temperature Controller Parameter Table

Parameter Category	Parameter Item	Technical Index
Environmental Parameters	Operating Ambient Temperature	-40°C～ +55°C
	Storage Temperature	-40°C～ +55°C
	Storage Relative Humidity	≤85%RH（No Condensation）
	IP Rating	IP67
Performance Parameters	Indication Accuracy	± 1.5% FS
	Measuring Range	0°C～ +150°C（Other ranges optional）
Electrical Parameters	Operating Power Supply	DC24V/AC220V（Optional）
	Switch Contact Capacity	AC220V 10A(Resistive Load) / DC220V 0.3A(Resistive Load)
	Communication Protocol	RS485 MODBUS
	Remote Output	Passive Output：Pt100 Active Output：4-20mA，2 x 4-20mA、4-20mA & 0-5VDC
	Number of Switches	4 or 6 independent adjustable switches

	Switch Differential	5°C±3°C All switches are adjustable over the full range
	Dielectric Strength - Contact Terminals	2000 VAC to earth, duration 60 s
	Dielectric Strength - Remote Transmission Terminals	500 VAC to earth, duration 60 s
Mechanical Performance	Mounting Method	Stainless Steel Anti-vibration Mounting Hole Pitch 80mm x 100mm(Standard) or 144mm x 210mm(Optional)
Material	Enclosure Material	Die-cast aluminum with RAL7035 powder coating
	Capillary	Copper-nickel element with stainless steel protection
	View Window	UV-resistant Tempered Glass

5.Model Designation

Transformer Digital Oil Temperature Controller Model Designation



6.Installation and Commissioning

6.1.Outline Dimensions and Installation Drawings

Outline Dimension Parameters

The standard overall dimensions, mounting cutout dimensions and interface dimensions of this product series are shown in the attached drawings at the end of this manual. For specially customized dimensions, refer to the customized drawings.

Figure 1: Overall Product Outline Dimension Drawing

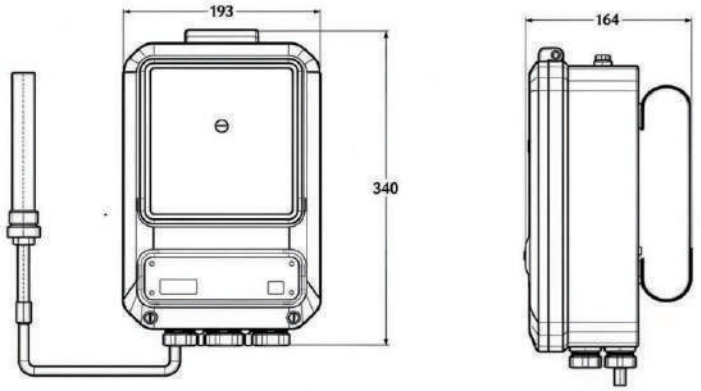


Fig. 1 Overall Product Outline Dimension Drawing

Figure 2: Equipment Mounting Cutout Schematic Diagram

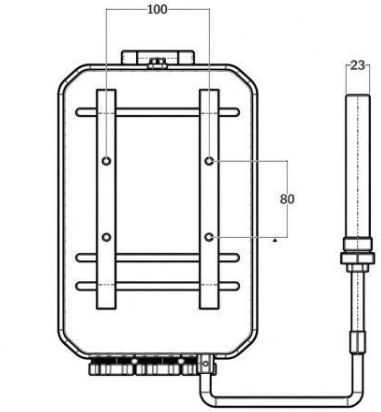


Fig. 2 Equipment Mounting Cutout Schematic Diagram

Figure 3: Cutout and Mounting Dimension Drawing of Digital Temperature Indicator

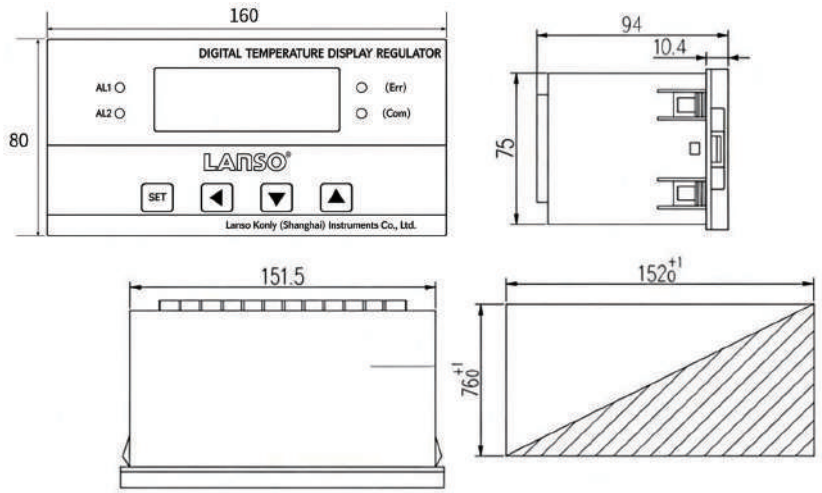


Fig. 3 Cutout and Mounting Dimensions of Digital Temperature Indicator

Figure 4: Electrical Wiring Terminal Schematic

(See customer drawing for details)

6.2.Pre-installation Inspection

1. Inspect that the product has no damage, the housing is free of cracks, and the display screen is intact without breakage.
2. Check that sealing joints are in good condition, free of scratches and deformation, and all accessories are complete.
3. Verify that the product model, parameters and set values conform to equipment requirements.
4. Confirm the mounting base is flat, rust-free and clean of debris; the equipment shall be in power-off and pressure-relieved state.

6.3.Mounting Procedures

1. Temperature bulb mounting: Fill the thermometer pocket of the transformer oil tank with insulating oil. Wrap sealing tape on the temperature bulb, insert it slowly into the sleeve to the bottom with an insertion depth ⩾150 mm. Tighten the sealing connector by turning the nut. Do not twist the temperature bulb body to avoid oil leakage.
2. Gauge head fixing: Mount the thermometer gauge head vertically on the bracket at the transformer side wall without tilting.

3. Capillary tube routing: Leave slack allowance for the capillary tube. Sharp bends and squeezing are prohibited. Secure the capillary at intervals of approx. 300 mm. Coil excess tubing into large loops with diameter ⩾200 mm and fix them, fitted with protective sheath.
4. Commissioning and sealing: Verify temperature setpoints (fan start, high-temperature alarm, over-temperature trip). Perform simulation check of functions. Lock the gauge cover and complete waterproof sealing.

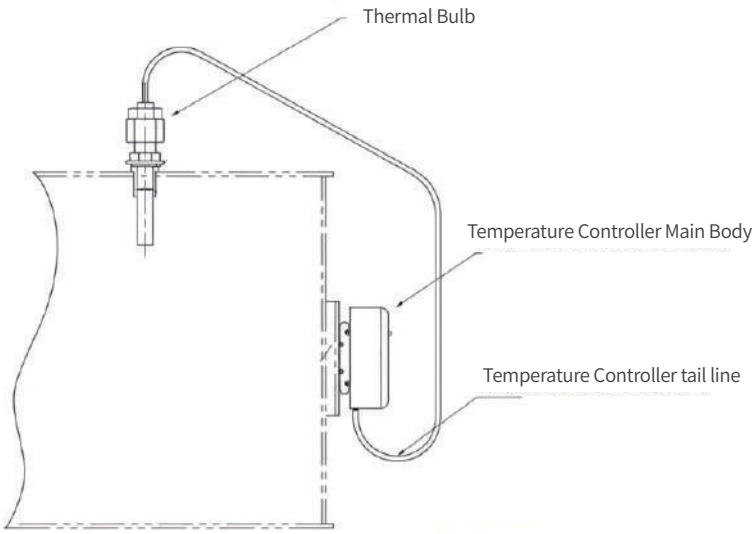


Fig. 4 Installation Schematic

6.4.Wiring Specifications

1. Wire strictly in accordance with the wiring schematic. Distinguish power terminals, switch signal terminals and communication terminals.
2. Alarm / trip / fan contacts, Pt100 remote transmission and power supply: terminals shall be tightly fastened and the enclosure reliably earthed.
3. Cables shall be crimped securely with intact insulation, no bare copper wires, and routed neatly and properly.
4. The communication cable shall be shielded twisted pair, earthed at one end to reduce electromagnetic interference.
5. Recheck all wiring after completion to eliminate wrong connection, missing connection and loose connection.

6.5.Equipment Commissioning

1. Recheck wiring and mounting tightness before power-on. Power can be applied only after confirmation of correctness.
2. Observe the device display and indicator status after power-up. The unit shall start normally without alarms.
3. Verify the accuracy of measured values and confirm stable readings with no drift.
4. Simulate over-limit operating conditions to test normal output of alarm and interlock signals.
5. Set communication parameters for intelligent devices to ensure normal communication and data upload to the background monitoring system.
6. Record commissioning data after completion and keep acceptance records on file.

7.Communication Protocol

7.1.Scope

This protocol describes the communication format of the LANSO Digital Transformer Oil Temperature Controller.

7.2.Default Communication Parameters

1.Baud Rate：9600
2.Data Bits：8bits
3.Parity：None
4.Stop Bits：1bit
5.Communication Mode: RS485 2-wire A/B, serial communication using the Modbus RTU protocol
6.Slave Address: 1

7.3.Communication Frame Format

Address	Function Code	Data Field	CRC16
1byte	1byte	Nbyte	2byte

Table 2 Communication Format

7.4.Function Code Definitions

Function Code	Name	Direction	Purpose	Single-access Limit
0x03/ 0x04	Read Holding Registers / Read Input Registers	Master → Slave	Read registers in each data area	Up to 125 registers
0x06	Write Single Holding Register	Master → Slave	Write a single parameter or trigger a command	1 register

Table 3 Function Code Definition

Within a single register, data is stored in big-endian format (high byte first). For data of 32 bits or more spanning multiple registers, this specification uniformly adopts the ABCD order (high word first). Example: for the value 0x12345678, register REGN contains 0x1234 and register REGN+1 contains 0x5678.
The RTU frame is appended with a 2-byte CRC16 at the end. The checksum covers the slave address, the function code and the data field, and is transmitted low byte first. Algorithm: initial value 0xFFFF, polynomial 0xA001 (i.e., the standard Modbus CRC16).

7.5.Register Description

No.	Name	Register Address	Data Type	Length	Remarks
1	Operating Status	0x0000	Int16u	2	Bit0: Event generated Bit1: Optoelectronic module fault Bit2: Temperature sensor fault Bit3: High temperature alarm Bit4: Low temperature alarm Bit5: Fiber-optic communication fault Bit6: Fiber-optic data anomaly 1 = active/fault, 0 = normal
2	Temperature	0x0001-0x0002	Float	4	Unit：°C
3	Slave Address	0x1000	Int16u	2	Valid Range 1–247
4	Baud Rate	0x1001	Int16u	2	0：2400 1：4800 2：9600 3：19200 4：38400 5：115200
5	Parity	0x1002	Int16u	2	0 = None, 1 = Even, 2 = Odd
6	Stop Bits	0x1003	Int16u	2	0 = 1 stop bit 1 = 2 stop bits

No.	Name	Register Address	Data Type	Length	Remarks
7	RTC	0x1004-0x1006	BCD	6	Year, month, day, hour, minute and second, each occupying 1 byte
8	Protocol Version	0x1100	Int16u	2	0x0100 indicates protocol V1.0
9	Firmware Version	0x1102–0x1111	Int32u	4	High word: major version; low word: minor version
10	Hardware Version	0x1112–0x1121	Int32u	4	High word: major version; low word: minor version
11	Device Type	0x1200	Int16u	2	0x0002: Digital transformer oil temperature gauge
12	Device Model	0x1201–0x1210	char[32]	32	ASCII string, 32 characters, padded with 0x00 if shorter
13	Serial Number	0x1211–0x1220	char[32]	32	16 registers, 32 characters
14	Save Communication Parameters Command	0x1300	Int16u	2	Write 0xA55A to trigger saving of parameters to Flash
15	Apply Communication Parameters Command	0x1301	Int16u	2	Write 0x5AA5 to soft-reset the serial port and apply the new parameters
16	Temperature Alarm Threshold 1	0x2000 - 0x2001	Float	4	Unit: °C
17	Temperature Alarm Threshold 2	0x2002 - 0x2003	Float	4	Unit: °C
18	Temperature Alarm Threshold 3	0x2004 - 0x2005	Float	4	Unit: °C
19	Temperature Alarm Threshold 4	0x2006 - 0x2007	Float	4	Unit: °C
20	Device Reset	0x2E00	Int16u	2	1：Device reset
21	Restore Factory Defaults Command	0x2F00	Int16u	2	1：Parameters restored to factory defaults

Table 4 Register Description

7.6.Examples

The following examples assume a slave address of 0x01, a baud rate of 9600, no parity, 1 stop bit, and a 2-byte CRC16 at the end of each frame calculated using the algorithm described above.

1.Read Real-time Data

Read (addresses 0x0000–0x0002, 3 registers in total). The request frame is:

01 03 00 00 00 03 05 CB

The slave responds with function code 0x03, a byte count of 0x06 and 6 bytes of data.

01 03 06 00 00 41 C8 28 F6 2A F1

This indicates that the device is in normal state, with a temperature of 25.02 °C.

2. Write Parameters and Save

Change the baud rate code to 3 (19200), i.e., write 0x0003 to 0x1001:

01 06 10 01 00 03 9C CB

After confirmation, trigger the saving (write 0xA55A to 0x1300):

01 06 13 00 A5 5A 76 25

The communication parameters take effect after a restart, or write 0x5AA5 to 0x1301:

01 06 13 01 5A A5 26 55

8.Operation Instructions

8.1.Thermostat Switch Setting

This product is pre-configured according to customer requirements before delivery. If no requirements are raised by the customer, default values will be adopted. Refer to the instrument contact indicator plate (shown in Fig.5) for actual set values.

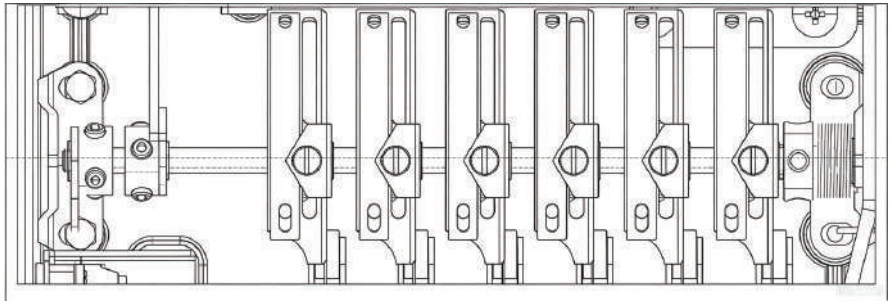


Fig. 5 Cam Structure Schematic

If the user needs to change the set value, follow the steps below:

a As shown in Fig.5: Use a flat-tip screwdriver to loosen the screw on the contact indicator needle. Rotate the dial so that the tip of the contact indicator needle points to the required setpoint, then tighten the screw.

b As shown in Fig.5: Gently push down the limiting plate by hand to rotate the dial, moving the instrument indicator slowly toward the upper temperature limit. The switch contact will close each time passing a setpoint. Use this method to verify whether the temperature setting is correct. Repeat the above steps if inaccurate until calibrated.
c When manually testing the switch, do not pull the indicator needle directly by hand. Pull the pull rod on the left side of the cam for verification.

9.Transportation and Storage

9.1.Transportation Requirements

1. Handle the product with care during transportation. Throwing, impact and heavy stacking are strictly prohibited.
2. The transport case shall be protected against rain, moisture and shock to avoid direct exposure to rain and snow.
3. The stacking height during transportation shall not exceed the limit marked on the package. Inversion and side placement are forbidden.

9.2.Storage Requirements

1. The product shall be stored in an indoor warehouse that is dry, ventilated, dust-free and free of corrosive gas.
2. Storage ambient temperature: -40°C～ +55°C, relative humidity ⩽85%RH, no condensation.
3. Store the product in original packaging, placed away from the ground and walls to prevent moisture and collision damage.
4. For long-idle equipment, periodic inspection is required to prevent seal aging and component moisture ingress.

10.Disclaimer

1. This manual provides general standard descriptions of the product. The manufacturer reserves the right to optimize the product structure, parameters and appearance without prior notice, provided that the core performance of the product remains unaffected.

2. The company shall not bear any legal or economic liability for equipment damage, project losses or safety accidents caused by user operation not in accordance with this manual, unauthorized modification or improper use of the equipment.
3. The content of this manual is for product reference only. The technical parameters stipulated in the contract shall take precedence over the general parameters in this manual.
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