Electron

Thermal Protection Relay – EP4-IoT

Manual.

INDEX

INTRODUCTION

The EP4 IOT **Thermal Protection Relay** was developed to simultaneously supervise up to 4 (four) temperature channels. It is used to protect and monitor dry transformers, motors, bearings, machinery, and industrial processes, as specified in the **ANSI table**. The **EP4 IOT** is a high precision and reliability instrument, controlling transformer ventilation (ON/OFF), alarms and shutdowns (TRIP), with timing options.

The EP4 IOT **Thermal Protection Relay** was built following strict quality standards and uses high-quality electronic components and state-of-the-art technology (SMD). Its hardware is designed to withstand harsh working conditions and can be installed directly in transformers, panels in power substation yards, offshore platforms and chemical industries. It meets the levels of demand, supportability and reliability established by the IEC, DIN, IEEE and ABNT standards.

With signal inputs, the **EP4 IOT** allows the connection of up to 4 PT100 temperature sensors (EN60751-DIN 43760) and up to 1 universal and configurable 2-wire 15 VDC active analog output, with a range of 0 to 1mA, 0 to 5mA, 0 to 10mA, 0 to 20mA, or 4 to 20mA. This output can be used to reflect the highest temperature recorded at the time. The analog output also has the SCAN function, which simultaneously reflects all the values of the temperature channels. This configuration can be carried out directly on the **EP4 IOT** dashboard or via the **EP4 IOT™ software** with **BLUETOOTH** or **USB connection.**

The EP4 IOT **Thermal Protection Relay** has a built-in **WiFi** modem with a built-in 3 dBi antenna. When **enabled by the user**, this feature allows the Internet connection. Once the connection is established, the **EP4 IOT** immediately makes the collected and measured data available on an **MQTT Broker Server**. This is accessible through the MONITRAFO.com monitoring platform, where users can easily sign up, choose the plan that best suits their needs, and set up projects with one or multiple substations or transformers.

This way, you get full control to monitor in real time all measured quantities, triggers, alarms, maintenance, transformer health status and much more. This can be done using the platform in any internet browser or through the MONITRAFO APP, available on the **Play Store** (Android) and the **App Store** (iOS).

The **EP4 IOT** uses the **MQTT** communication protocol, integrating with the **MONITRAFO.com** platform to enable complete online monitoring of your transformer. In addition, it integrates **ARTIFICIAL INTELLIGENCE TOOLS, MACHINE LEARNING, DATABASE, PROGRAMMABLE FUNCTIONS, CALCULATIONS AND NOTIFICATIONS, MAINTENANCE SCHEDULE.** In the event of a loss of internet connection, the **EP4 IOT** stores all measurements from the period when communication was unavailable. When the connection is restored, the data is sent to the **MONITRAFO.com** and stored in a database for querying, calculating, and more.

It is also possible to use the API available on the platform to integrate **EP4 IOT** with other platforms, such as **Azure, Google Cloud, AWS, IBM, SAP**, among others.

Thanks to the implementation of these advanced technologies, the **transformer becomes a smart device** capable of identifying changes in transformer behavior within its standard operating cycle and sending notifications via email, SMS, and apps whenever the system detects these abnormal variations. This provides you with a robust tool that significantly enhances your ability to make effective decisions.

In addition, the **EP4 IOT** Thermal Protection Relay also has an RS-485 digital output with Modbus-RTU protocol and DNP 3* (L1), which allows access to all parameters, including remote commands for real-time triggers using a SCADA supervisory. 3 independent temperature setpoints are available for each sensor and 4 relays, 3 isolated, independent and potential-free actuation relays (NO) that can be used for alarms, shutdowns (TRIP) and FAN activation (ventilation), and 1 isolated, independent and potential-free relay (NC) to indicate faults (watchdog).

The display mode is fully user configurable, allowing you to maintain the highest temperature on the display at the time, any of the temperatures selected by the operator or use the SCAN function that features a continuous scan of all temperature channels. The front indicator LEDs and the data communication port make it possible to identify the channel

that caused the alarm, shutdown or activation of the fans. All functions and parameterizations can be easily configured directly on the device panel or via the **EP4 IOT™** software with **BLUETOOTH** or **USB connection.**

The EP4 IOT Thermal Protection Relay is built in a high mechanical strength aluminum box, measuring 98x98x37mm, following DIN IEC 61554 standards for panel fixing.

KEY FEATURES

Communication Protocols

- MQTT – TLS/SSL - WIFI
- DNP3 – Level 1 (SERIAL)
- DNP3 – Level 1 (TCP/IP) - WIFI
- Modbus-RTU (SERIAL)
- Modbus-RTU (TCP/IP) - WIFI

Communication Ports

- **Built-in WIFI modem**
  - Padrões 802.11 b/g/n/e/i;
  - WPA/WPA2/WPA-Enterprise security protocol;
  - AES/RSA/ECC/SHA encryption;
  - Data rate up to 150 Mbps;
  - 3 dBi (isotropic decibel) recessed antenna
  - Transmit Power up to 21 dBm (decibel milliwatt);
- **Bluetooth**
  - Class 2 – 2.5 mW (4 dBm);
  - FIPS encryption;
  - Version 4.2 BR / EDR and BLE (Low Energy);
- **USB**
  - Version 2.0;
  - Transfer rate 480Mbps;
  - Type-C connector
- **RS 485**
  - ANSI/TIA/EIA-485-A standard;
  - Max. 32 equipments;
  - Half duplex;
  - Multipoint;
  - Max. distance 1,200 meters;
  - 2 metallic wires;
  - Auto speed from 1,200 to 57,600 bps

Dimensions and Power

- Compact Equipment with a depth of 37mm;
- Universal Power Supply 24-275 Vdc / Vac;

Human Machine Interface (HMI)

- Red high-brightness numeric display with 3 digits;
- Simultaneous indication of the 4 monitored temperatures;
- 4 Navigation keys;
- 13 LED's on the front for event indications;

- Intuitive menus for consultation and parameterization

Measurement Input

- 4 inputs for temperature measurement with PT100 3-wire sensor (EN60751-DIN43760);
- 0.5% Accuracy (FS)
- Temperature measurement range 0ºC to 200°C;

Digital Relay Outputs

- 01 Relay (NAF) with a capacity of 10 amperes for Temperature Alarm;
- 01 Relay (NAF) with a capacity of 10 amperes for FAN (cooling);
- 01 Relay (NAF) with a capacity of 10 amperes for TRIP (shutdown);
- 01 Relay (NAF) with a capacity of 10 amperes for Fault Indication (watchdog);
- Intuitive menus for consultation and parameterization.
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Analog Output

- 01 Analog Output (Active 15Vdc) from 0 to 1mA, 0 to 5mA, 0 to 10mA, 0 to 20mA or 4 to 20mA user configurable;

TIPO trials met

- Applied Voltage (IEC 60255-5): 2kV / 60Hz / 1 min. (against land);
- Voltage Impulse (IEC 60255-5): 1.2/50 μsec. / 5kV / 3 sec. and 3 sec. / 5 sec. Interval;
- Electrostatic Discharges (IEC 60255-22-2): Air mode = 8KV / Counted mode = 6 KV;
- Immunity to radiated electromagnetic disturbance (IEC61000-4-3): 80 to 1000 MHz / 10V/m;
- Immunity to Fast Electrical Transients (IEC60255-22-4): Alim/Input/Outputs=4KV/common 2Kv;
- Imunity to Surtos (IEC60255-22-5): phase/neutral 1KV, 5 by polar (±) – phase-earth/neutral-earth 2KV, 5 by polar (±);
- Immunity to conducted Electromagnetic disturbances (IEC61000-4-6): 0.15 to 80 MHz / 10V/m;
- Climate Test (IEC60068-21-14): – 40°C + 85°C / 72 hours;
- Vibration Resistance (IEC60255-21-1): 3 axes / 10 to 150Hz / 2G / 160min/axis;
- Vibration Response (IEC60255-21-1): 3-axis / 0.075mm-10 at 58 Hz / 1G from 58 to 150 Hz / 8min / axis.

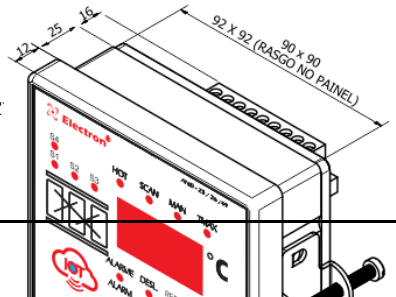
TECHNICAL DATA

THERMAL PROTECTION RELAY EP4-IoT	
Operating Voltage	24 a 275 Vcc/Vca 50/60 Hz
Operating Temperature	-40ºC to + 85ºC

Power Consumption	< 15 W
Temperature Measurement Input	Rated 4 Sensors - PT100 Ohm at 0°C, 2 and 3 fios **(EN 60751 - DIN 43760)**
Measurement Range	0ºC to 200ºC
Active Analog Output 15Vdc and Maximum Load.	0 ... 1mA - 8000 Ohms
	0 ... 5mA - 1600 Ohms
	0 ... 10mA - 800 Ohms
	0 ... 20mA - 400 Ohms
	4 ... 20mA - 400 Ohms
Maximum Measurement Input Error	0.5% end of scale
Maximum Analog Output Error	0.5% end of scale
Outgoing Contacts	4 (NAF) – Potential Free
Maximum Switching Power	70 W / 250 VA
Maximum Switching Voltage	250 Vac/125Vdc
Maximum Driving Current	10 Amps
Front Communication Port	USB 2.0 - Type-C connector
Serial Communication Port	RS 485 – 2 fios (ANSI/TIA/EIA-485A)
WI-FI	Padrões b/g/n/e/i
	WPA/WPA2/WPA-Enterprise;
	Up to 150Mbps data rate
	3dBi recessed antenna
	Up to 21dBm Transmit Power
Bluetooth	Version 4.2 BR/EDR and BLE (Low Energy)
Communication Protocol	Modbus RTU, Modbus TCP (WI-FI), DNP3 L1, DNP3 L1 – TCP (WI-FI) e MQTT TLS/SSL – (WIFI)
Auto Baud Rate	1,200 to 57,600bps
IEC 61554 DIN Box	98 x 98 x 37 mm or 98 x 98 x 57 mm
Fixation	Panel Door with Steel Clip
Protection	IP40 (Front), IP 20 (Connectors)

Table 1 – Technical Data of the EP4-IOT Thermal Protection Relay

DIMENSIONS AND CONNECTION DIAGRAM



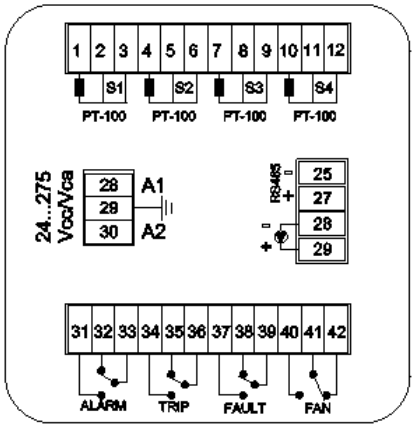
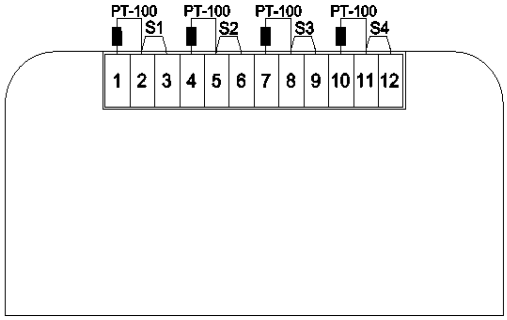


Fig. 1 – EP4-IoT Dimensions Fig. 2 – EP4-IoT IoT Connection Diagram



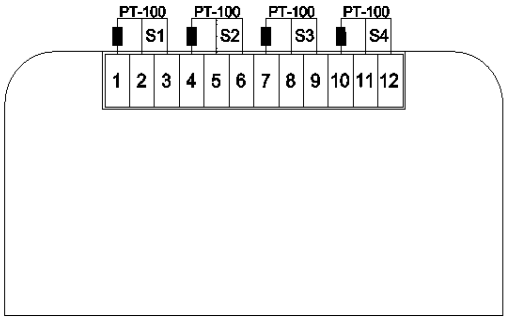


Fig. 3 – Diagram 2-wire connection sensors Fig. 4 – Diagram 3-wire connection sensors

APPLICATION EXAMPLE

Fig. 5 – Example of Application sending data to MONITRAFO.com

OPERATION CHART

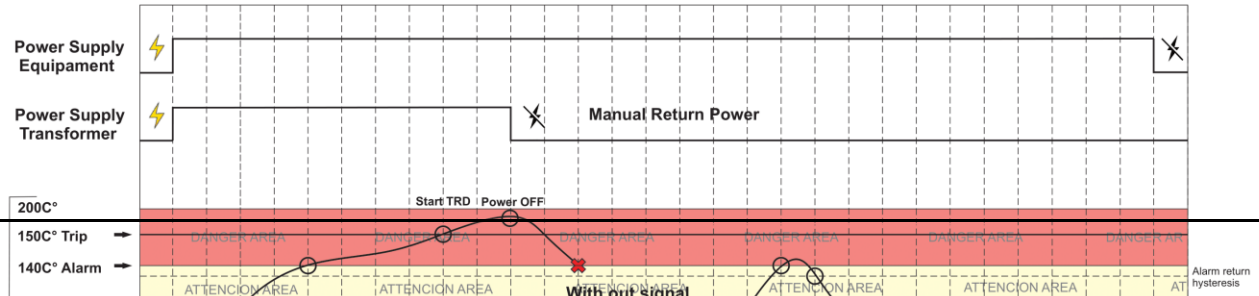


Fig. 6 – Operation Chart

PREVENTIVE MAINTENANCE

PREVENTIVE AND CORRECTIVE MAINTENANCE		
Items to be checked preventively	**Verification Frequency**	**Corrective action**

SHARE	Verification Elements	ACTIVITIES	Every Month	Every 3 Months	Every 6 Months	Every 1 Year	When Needed
VERIFICATION	Fastening clip and snapping to the rail	Fixing to the panel door or panel bottom		X			Retightening, Fitting, Terminal Change, or Screw Change
	Terminal blocks and connector pente	Attachment and attachment to equipment		X			
		Tightening of the screws in the fastening of the conductors		X			
	Sensors	Integrity / Positioning / Fastening			X		Replacement, repositioning and/or fixing of sensors
	Sensor well in oil transformers	Oil level in the well			X		Oil filling to indicated level
TESTS & MEASUREMENTS	Relays and Digital Outputs	Individual drive test			X		Forward to Electron do Brasil technical assistance
	Led's e Displays	Test Triggering Led's and Display Segments			X		
	Navigation buttons	Navigation test of the navigation buttons			X		
	Sensor Input	Gauge sensor inputs using a standard				X	
	Input voltage of equipment supply	Measure Supply Input Voltage			X		Override voltage input values according to equipment model
	RS-485 Communication Outputs	Communication and command testing in the supervisory system			X		Forward to Electron do Brasil technical assistance
	Milliampere running Sinal inputs	Measure, compare and measure input signal in passive and/or active mode			X		
	Signal Outputs of milliampere current	Measure, compare and measure input signal in passive and/or active mode			X		
CLEANING	Terminal blocks and connector comb and connection box	Debris, Impurities and Moisture	X				Cleaning with a dry cloth, compressed air and vacuum cleaner
	Aluminum Equipment Enclosure		X				
	Front of the Equipment Display		X				

ATENÇÃO

1 - Keeping the equipment within the ideal working temperature (50°C to 60°C) extends the useful life and avoids corrective maintenance.

2 - The accumulation of dust and impurities in the facilities can cause short-circuiting and burning of equipment and sensors.

3 - After 10 years of use, it is recommended to replace the equipment.

Table 2 – Preventive maintenance

INSTALLATION ACCESSORIES

Electron do Brasil has a line of accessories that can be purchased together aiming to offer a complete solution to meet your application with practicality. We have listed some of the main accessories that can be used for EP4-IoT operation.

PT-100 STFE Temperature Sensor: This sensor can be constructed with silicone, stainless steel, or Teflon bulb. With electrical insulation capacity options of 2 kV, 10 kV or 15 kV. The PT-100 STFE temperature sensor has as its measurement principle to evaluate the variation of electrical resistance with temperature using the temperature coefficient of pure platinum (0.385 Ohm/K), according to IEC 751 (DIN 43760). Ideal for temperature monitoring of windings of dry-type transformers due to its high precision and quality of materials, the PT-100 3-wire sensor is widely used in the market, as it greatly reduces the possibility of measurement error due to the compensation principle of the third terminal of the sensor.

Link da página do sensor de temperatura PT100 STFE da Electron:
https://electron.com.br/site/produtos/rtd-pt100-2/

PT-100 STE Temperature Sensor: This sensor is constructed of AISI-304 stainless steel bulb, injected aluminum pumphead (IP 65) and adjustable gland with 3/4" and 1/2" BSP threads, or can be manufactured according to design. Its measurement principle is to evaluate the variation of electrical resistance with temperature using the temperature coefficient of pure platinum (0.385 Ohm/K), according to IEC 751 (DIN 43760). Ideal for installations subject to weather and electrical disturbances for temperature monitoring of transformers and machines that require high measurement accuracy in environments subjected to electrical noise and weather. The PT-100 3-wire sensor is widely used in the market, as the possibility of measurement error is greatly reduced due to the compensation principle of the third terminal of the sensor.

Link da página do sensor de temperatura PT100 STFE da Electron:
https://electron.com.br/site/produtos/rtd-pt100/

Double door panel for outdoor/outdoor use: Box for outdoor use with double port for mounting instruments, accessories and passing control wires and power of the power transformer. The external door contains a glass display with UV protection for viewing the quantities measured by the temperature monitor and the panel contains special paint that is resistant against weather and its degree of protection is IP 55, as per NBR IEC 60529:2017.

Link da página do painel de porta dupla para uso externo – IP 55:
https://electron.com.br/site/produtos/painel-para-uso-externo-ip55/

PT-100 signal reference card: This accessory was developed to verify the temperature value displayed by equipment with PT-100 3-wire RTD sensor input. It consists of precision resistors that send an equivalent fixed and constant resistance signal for selection between 3 different ranges, 0 °C (100 Ohms), 26 °C (110.9 Ohms) and 200 °C (175.86 Ohms).

Link da página do Cartão Referência para sinal de PT-100:
https://electron.com.br/site/produtos/

SPECIFICATIONSFOR ORDER

- Temperature Monitor for Dry Type Transformer model : ***EP4-IOT***

IMPORTANT RECOMMENDATIONS

Before putting the equipment into operation, check the following recommendations*:*

1. All sensors as well as the equipment must be grounded, do not use the same grounding point for power supply and for the sensor if it is used, ensure that there is no potential difference between them. Properly grounded sensors and power prevent malfunctions or damage in cases of disturbances, surges, and inductions in the equipment.

2. Do not use the **EP4 IOT** directly in the sun, whenever it is installed in the field it is important that it has a panel with smoked glass, in order to filter the ultraviolet rays that attack the front polycarbonate, in this way the life of the equipment will be prolonged.

WARRANTY TERM

The **EP4 IOT** Electron has a warranty period of two years from the date of sale stated on the invoice, with coverage for any manufacturing defects that make it unsuitable or unsuitable for the applications it is intended for.

Disclaimer of Warranty

The warranty does not cover transportation expenses for technical assistance, freight and insurance for shipment of a product with evidence of defect or malfunction. The following events are also not covered: Natural wear and tear of parts due to continuous and frequent use, damage to the outside caused by falls or improper packaging; attempt to repair/break a seal with damage caused by persons not authorized by Electron and in disagreement with the instructions that are part of the technical description.

Loss of Warranty

The product will automatically lose its warranty when:

• The instructions for use and assembly contained in this manual and the installation procedures contained in the NBR 5410 Standard are not observed;

• Subjected to conditions outside the limits specified in the respective technical descriptions;

• Violated or repaired by a person other than Electron's technical team;

• The damage is caused by a fall or impact;

• Infiltration of water or any other liquid occurs;

• Overload occurs that causes degradation of the components and parts of the product.

Use of the warranty

To enjoy this warranty, the customer must send the product to Electron along with a copy of the purchase invoice properly packaged so that there is no damage in transport. For an emergency service, it is recommended to send as much information as possible, regarding the defect detected. This will be analyzed and subjected to full functional tests.

The analysis of the product and its eventual maintenance will only be carried out by the technical team at the headquarters of Electron do Brasil.