Electron

Thermal Protection Relay – EP3-IoT

Manual

INDEX

INTRODUCTION

The EP3 IOT **Thermal Protection Relay** is designed to simultaneously supervise up to three (3) temperature channels. It is used to protect and monitor dry transformers, motors, bearings, machinery, and industrial processes as specified in the **ANSI table**. The **EP3 IOT** is a highly accurate and reliable instrument, controlling alarms and shutdowns (TRIP), with timing options.

The EP3 IOT **Thermal Protection Relay** has been 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 IEC, DIN, IEEE and ABNT standards.

The EP3 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 connection to the Internet. Once the connection is established, **the EP3 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.

In this way, you get full control to monitor in real time all measured quantities, drives, 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 **EP3 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, MACHINE LEARNING, DATABASE, PROGRAMMABLE FUNCTIONS, CALCULATIONS AND NOTIFICATIONS, MAINTENANCE SCHEDULE tools.** In the event of a loss of internet connection, the **EP3 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 queries, calculations, and more.

It is also possible to use the API available on the platform to integrate **EP3 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 the transformer's 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 EP3 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 supervisor. 3 independent temperature setpoints are available for each sensor and 3 relays, 2 isolated, independent and potential-free drive relays (NO) that can be used for alarms, shutdowns (TRIP), and 1 isolated, independent and potential-free relay (NC) to indicate faults (watchdog).

The display mode on the display 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 **EP3 IOT™** software with **BLUETOOTH** or **USB connection.**

The EP3 IOT **Thermal Protection Relay** is built in a high mechanical strength aluminum housing, with measurements of 98x98x37mm, following DIN IEC 61554 standards for panel fixing.

MAIN FEATURES

Communication Protocols

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

Communication Ports

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

Dimensions & Power Supply

- 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 3 monitored temperatures;
- 4 Navigation keys;
- 11 LED's on the front for event indications;
- Intuitive menus for consultation and parameterization

Measurement Input

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

Digital Outputs to Relays

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

TYPE Tests Attended

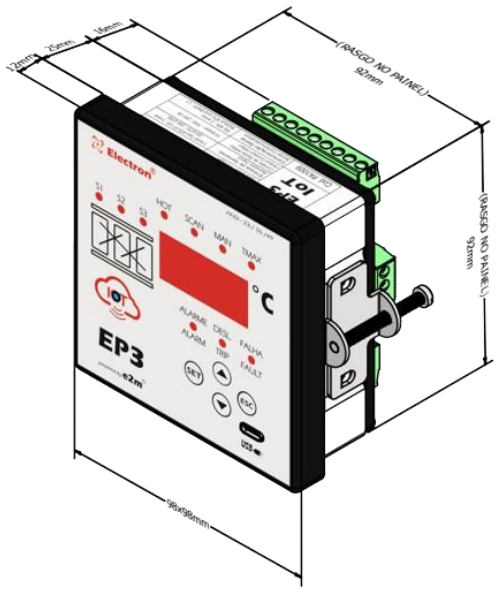
- Applied Voltage (IEC 60255-5): 2kV / 60Hz / 1 min. (against the ground);
- Voltage Impulse (IEC 60255-5): 1.2 / 50 μ sec. / 5kV / 3 neg. and 3 pos. / 5 sec. Interval;
- Electrostatic Discharges (IEC 60255-22-2): Air mode = 8KV / Counted mode = 6 KV;
- Immunity to radiated electromagnetic disturbance (IEC61000-4-3): 80 to 1000 MHz / 10V/m;
- Immunity to Fast Electrical Transients (IEC60255-22-4): Alim/Input/Outputs=4KV/Common 2Kv;
- Surge Immunity (IEC60255-22-5): 1KV phase/neutral, 5 per polar (±) – 2KV phase-to-ground/neutral-to-ground, 5 per 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-axis / 10 to 150Hz / 2G / 160min / axis;
- Vibration Response (IEC60255-21-1): 3-axis / 0.075mm-10 at 58Hz / 1G from 58 to 150Hz / 8min / axis.

TECHNICAL DATA

EP3-UIoT THERMAL PROTECTION RELAY	
Operating Voltage	24 to 275 Vdc/VAC 50/60 Hz
Operating Temperature	-40ºC to + 85ºC
Power Consumption	< 15 W
Temperature Measurement Input	Up to 3 Sensors - PT100 Ohm at 0°C, 2 and 3 wires **(EN 60751 - DIN 43760)**
Measuring Range	0ºC to 200ºC
Maximum Input Measurement Error	0.5% end-of-scale
Maximum Analog Output Error	0.5% end-of-scale
Output Contacts	3 (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-wire (ANSI/TIA/EIA-485A)
WI-FI	Standards B/G/N/E/I
	WPA/WPA2/WPA-Enterprise;
	Up to 150Mbps data rate
	Built-in 3dBi 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) and 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 Cleat
Protection	IP40 (Front), IP 20 (Connectors)

Table 1 – EP3-IOT Thermal Protection Relay Technical Data

DIMENSIONS AND CONNECTION DIAGRAM



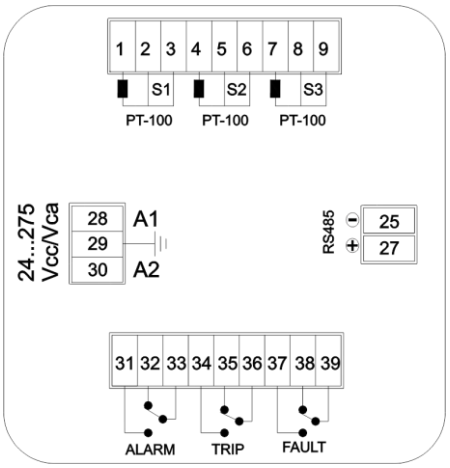
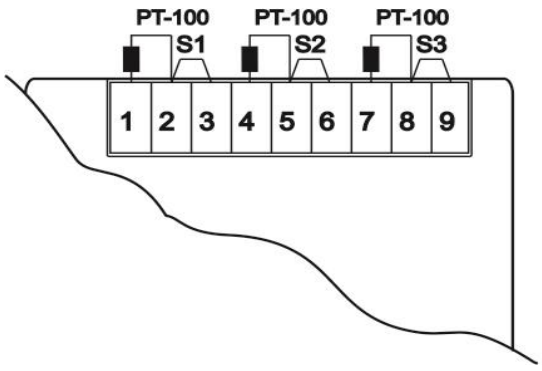


Fig. 1 – EP3-IoT Dimensions Fig. 2 – EP3-IoT IoT Connection Diagram



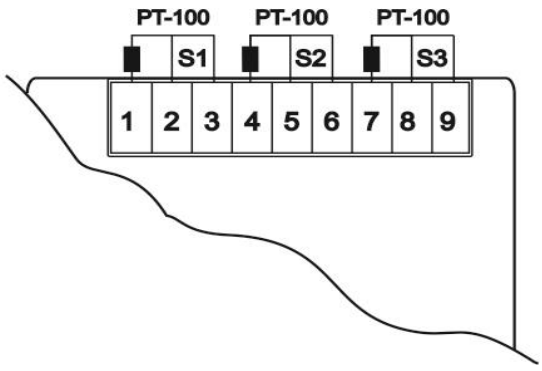


Fig. 3 – Diagram of 2-wire connection sensors Fig. 4 – Diagram of 3-wire connection sensors

APPLICATION EXAMPLE

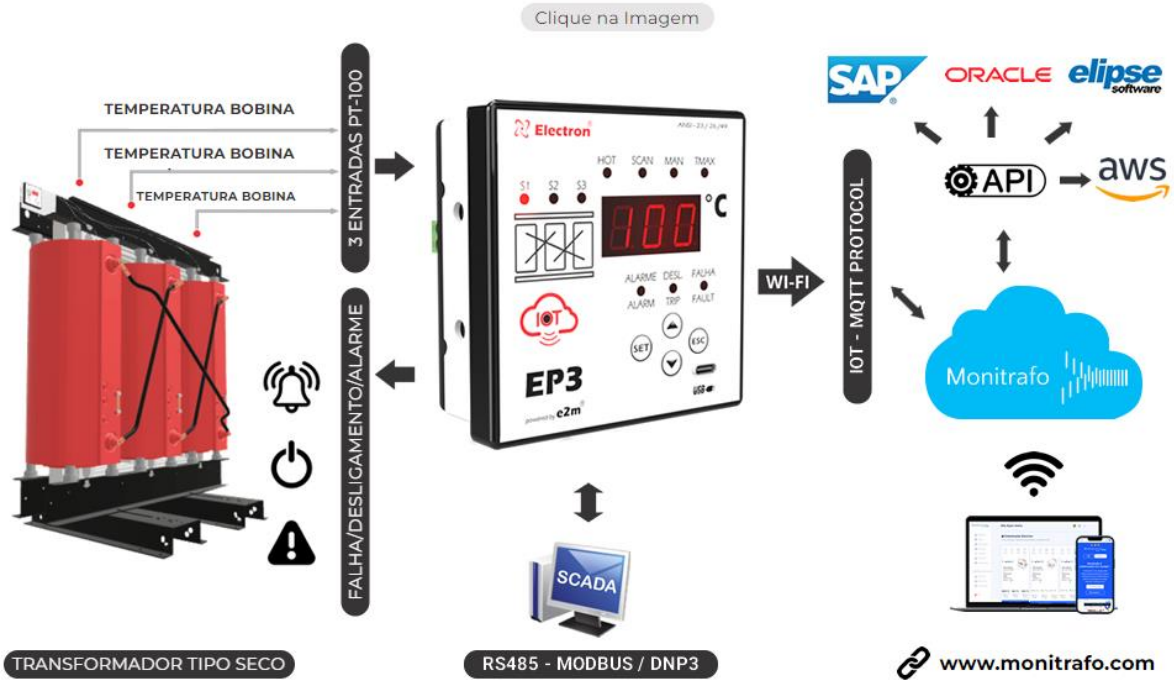


Fig. 5 – Application Example Sending Data to MONITRAFO.com

OPERATION CHART

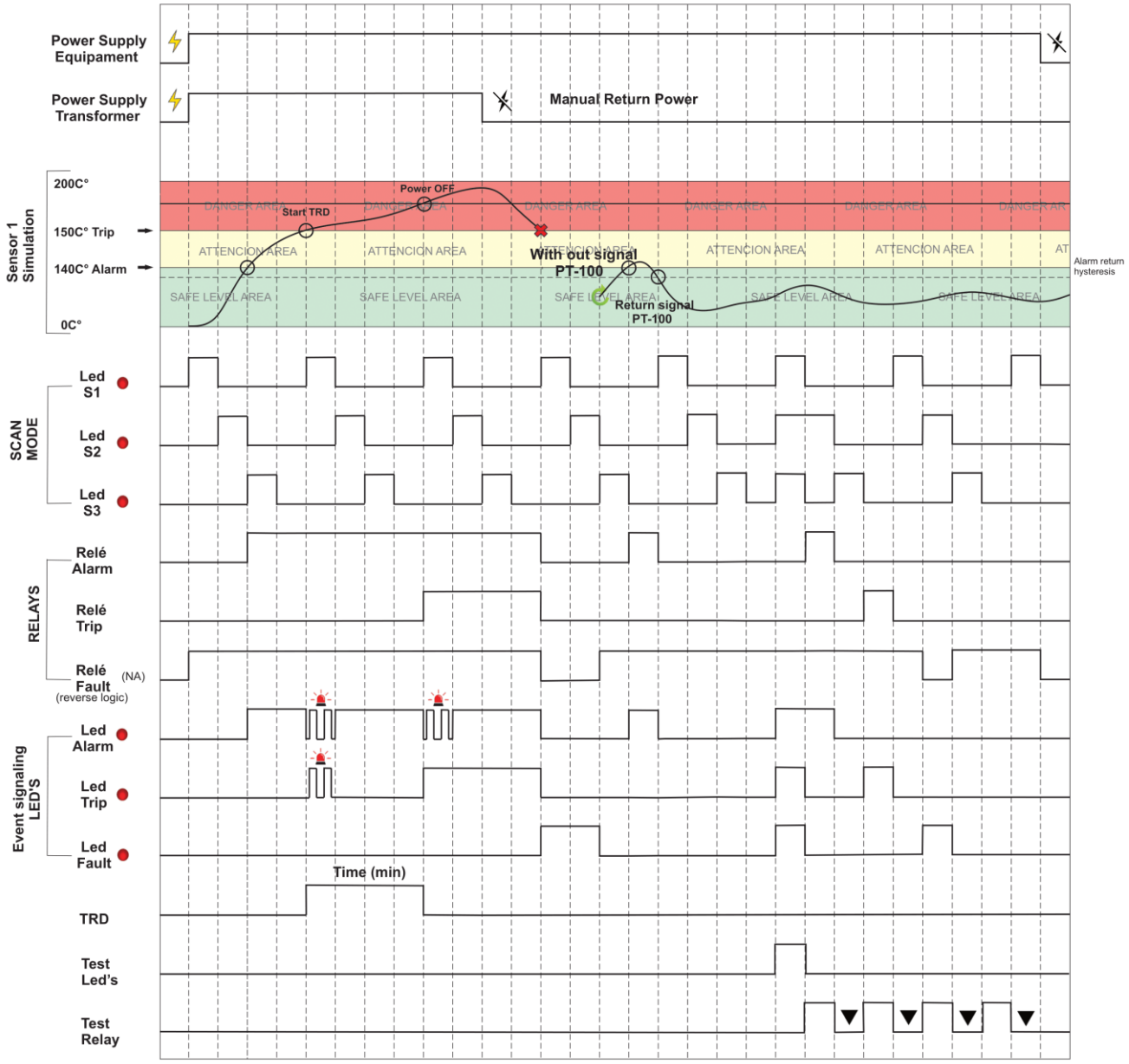


Fig. 6 – Operation Chart

PREVENTIVE MAINTENANCE

PREVENTIVE AND CORRECTIVE MAINTENANCE							
Items to be checked preemptively			**Frequency of Verification**				**Corrective action**
SHARE	**Verification Elements**	**ACTIVITIES**	**Every Month**	**Every 3 Months**	**Every 6 Months**	**Every 1 Year**	**When Needed**
VERIFICATION	Fastening clip and snap to the rail	Fixing to the panel door or panel bottom		**X**			Retightening, Fitting, changing terminals or changing screws
	Terminal blocks and connector comb	Attachment and attachment to the equipment		**X**			
		Tightening the screws in fixing the conductors		**X**			
	Sensors	Integrity / Positioning / Fixation			**X**		Replacement, Repositioning and/or Attachment of Sensors
	Sensor Well in Oil Transformers	Oil level in the well			**X**		Filling with oil to the indicated level
TESTS & MEASUREMENTS	Digital Relays and Outputs	Individual drive test			**X**		Refer to technical assistance from Electron do Brasil
	Led's and Displays	Test Lead Led's and Display Segments			**X**		
	Navigation buttons	Navigation test of navigation buttons			**X**		
	Sensor Input	Benchmarking sensor inputs using a standard				**X**	
	Input voltage Supply equipment	Measure Power Input Voltage			**X**		Override voltage input values according to equipment model
	RS-485 communication outputs	Communication and command testing in the supervisory system			**X**		Refer to technical assistance from Electron do Brasil
	Milliampere Current Signal Inputs	Measuring, comparing, and gauging input signal in passive and/or active mode			**X**		
	Signal outputs of milliampere current	Measuring, comparing, and gauging input signal in passive and/or active mode			**X**		
CLEANING	Terminal blocks and connector comb and junction box	Debris, Impurities and Moisture	**X**				Cleaning with a dry cloth, compressed air and vacuum cleaner
	Aluminum Equipment Enclosure		**X**				
	Front Display of the equipment		**X**				
ATENÇÃO	**1 - Keeping the equipment within the ideal working temperature (50°C to 60°C) prolongs the useful life and avoids corrective maintenance.** **2 - The accumulation of dust and impurities in the installations can cause short circuits and burnout 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 in order to offer a complete solution to meet your application with practicality. We have listed some of the main accessories that can be used for **EP3-IoT operation.**

PT-100 STFE Temperature Sensor: This sensor can be constructed with silicone, stainless steel or Teflon bulb. With a choice of 2 kV, 10 kV or 15 kV electrical insulation capacity. The PT-100 STFE temperature sensor has as its measuring principle the evaluation of the variation of electrical resistance with temperature using the temperature coefficient of pure platinum (0.385 Ohm/K) in accordance with IEC 751 (DIN 43760). Ideal for temperature monitoring of dry-type transformer windings 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.

Electron PT100 STFE Temperature Sensor Page Link:
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 head (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 inclement weather and electrical disturbances for temperature monitoring of transformers and machines that require high measurement accuracy in environments subject to electrical noise and weathering. 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.

Electron PT100 STFE Temperature Sensor Page Link:
https://electron.com.br/site/produtos/rtd-pt100/

Double Door Panel for Outdoor/Outdoor Use: Box for external use with double door for mounting instruments, accessories and passing control and power wires 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 weather resistant and its degree of protection is IP 55, as per NBR IEC 60529:2017.

Outdoor Dual Door Panel Page Link – 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 a fixed and constant equivalent resistance signal for selection between 3 different ranges, 0 °C (100 Ohms), 26 °C (110.9 Ohms) and 200 °C (175.86 Ohms).

Reference Card page link for PT-100 signal:
https://electron.com.br/site/produtos/

SPECIFICATION FOR ORDER

- Temperautra Monitor for Dry Type Transformer Model : ***EP3-IOT***

GETTING TO KNOW EP3 IOT

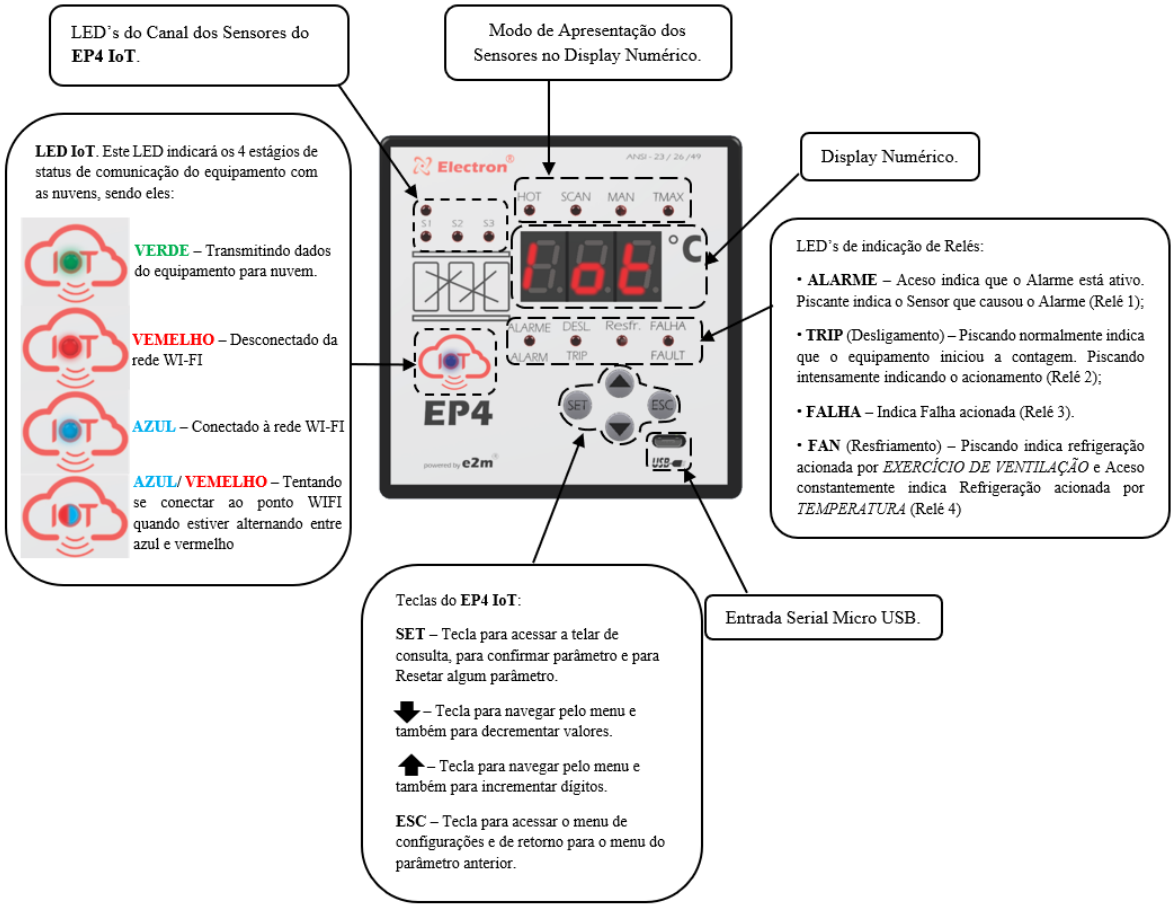
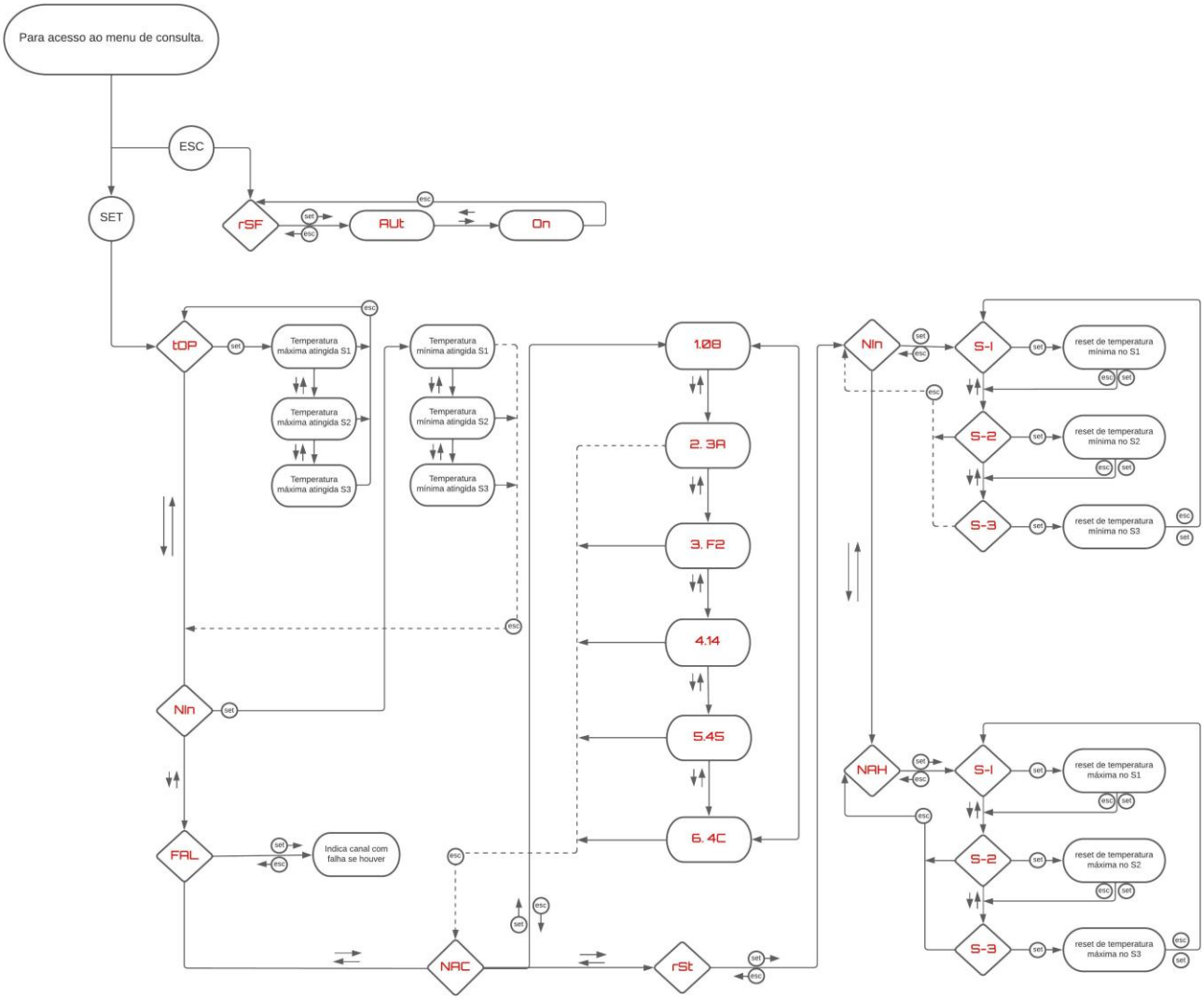


*Fig. 8 – Front **EP3-IoT** with serial input.*

QUERY MENU FLOWCHART

In the query and parameterization menu, use the SET key to confirm, the **ESC** key **to** go back/exit, and the increment and decrement keys to ⌄ ⌃ navigate.

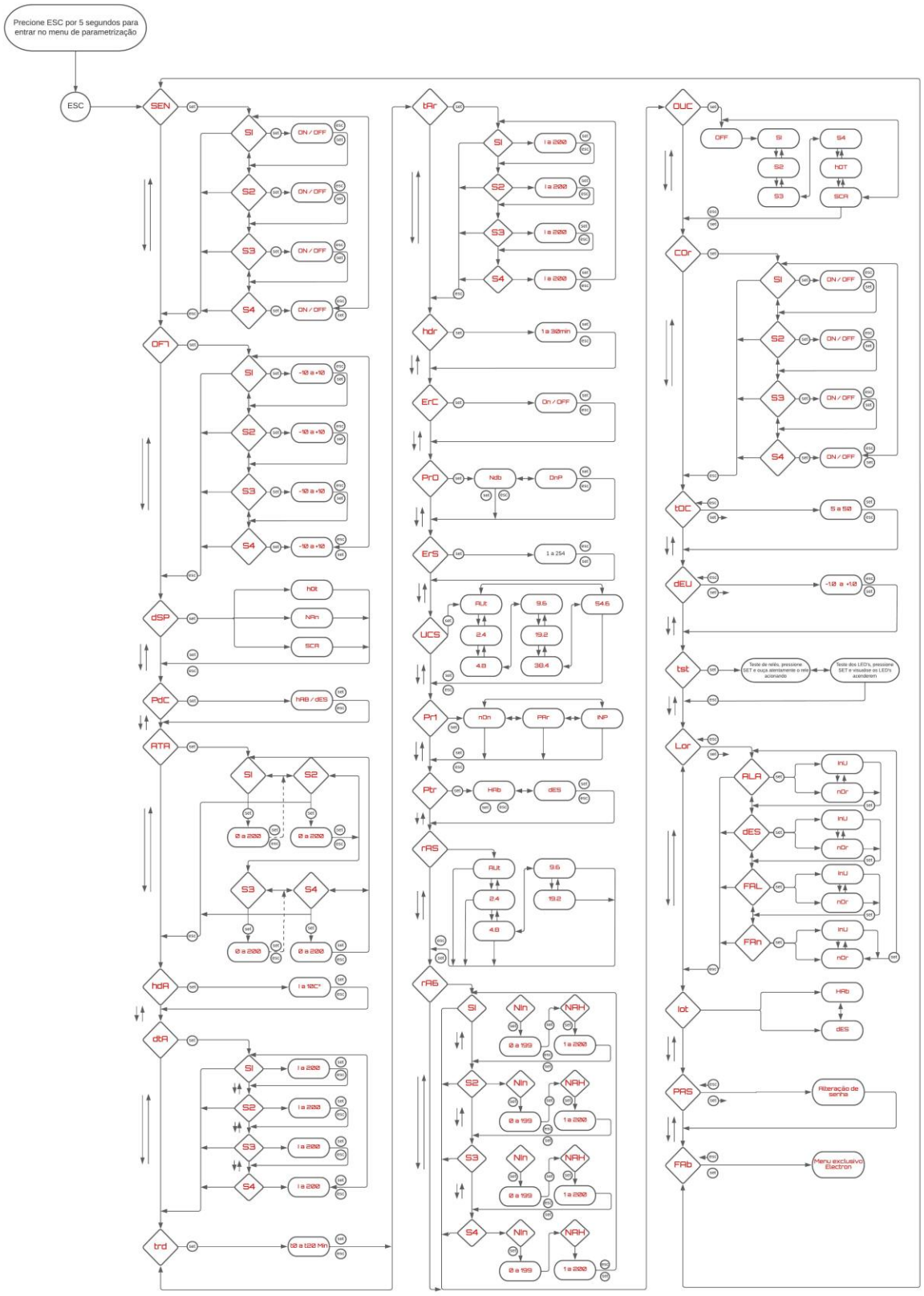


QUERY MENU

Press SET to access the query menu.

Query Menu		
Parameter	**Variable**	**Description**
toP	S1/S3	Menu to view the maximum temperature reached by each sensor. Use the increment and decrement keys to select the desired sensor and view its maximum temperature.
Min	S1/S3	Menu to view the minimum temperature reached by each sensor. Use the increment and decrement keys to select the desired sensor and view its minimum temperature.
FAL	------	Menu to view which temperature channel is failing.
MAC	------	Displays the MAC number of the machine that identifies your network card.
rSt	------	Menu to reset the maximum temperatures reached.
➢ To access the (RSF) menu, press the ESC button.		
rSF	------	Enable/Disable

CONFIGURATION FLOWCHART



CONFIGURATION MENU

To access the configuration menu, press the ESC screen for approximately 5 seconds.

Parameter	Variable	Description
SEn	S1/S3	Menu to enable or disable the temperature channel for sensor reading (ON/OFF).
dSP	Hot nAn SCA	Temperature channel display mode. ➢ Hot – Visualization of the channel with the highest temperature. ➢ Nan – Visualization of temperature channels manually. ➢ SCA – Scan mode that checks all temperature measurement channels.
oF1	S1/S3	Parameterization menu to set temperature deviation correction. (-10 to +10)
PdC	HAb/dES	Parameterization menu to define whether or not there will be a need for a decimal place.
AtA	S1/S3	Menu to set the temperature to trigger the Alarm (High Temperature Alarm). When any sensor reaches the set temperature, the ALARM relay is triggered and the ALARM LED on the front of the equipment starts flashing indicating that the alarm is active. Set the desired ALARM relay trigger temperature for each sensor and confirm it by pressing the SAT key.
HdA	------	Menu for setting Hysteresis (Alarm Shutdown Hysteresis). Temperature difference to deactivate the ALARM relay can be adjustable with values between 0ºC and 10ºC. Example: If the temperature (AtA) is programmed at 100°C and the difference (hdA) is programmed at 5°C, the ALARM relay LED is blinking between the 95°C and 100°C ranges and will turn off only when the temperature reaches any value below 94.9°C. Set the desired Alarm Hysteresis value and confirm it by pressing the **SAT key**.
dtA	S1/S3	Menu for setting Shutdown Temperature (High Temperature Shutdown). When the sensor reaches the temperature set in this menu (dtA), the TRIP relay LED will start flashing, initiating the time count (trd) for shutdown. During the countdown, the time set in trd will also be shown on the numerical display. Example: If the Display displays d 1 it means that the shutdown will occur within 1 minute. At the end of the count, the LED of the TRIP relay will be flashing intensely on the front of the equipment indicating its activation and the equipment that the system is protecting will be turned off. In case the set value is 0', the TRIP relay will trigger immediately. Set the shutdown temperature of each sensor and confirm by pressing the **SAT key**.
trd	------	Menu to adjust the Timer for the shutdown from 0 to 20 minutes. When the temperature of the dtA's S1, S2, or S3 sensors reaches the set value, the EP4 will start counting down the time to perform the shutdown. In case the configured value is '0', the TRIP relay will trigger immediately. Set the desired Shutdown time and confirm by pressing the **SAT key**.
tAr	S1/S3	Menu to adjust the Cooling Drive Temperature (Ventilation). Upon reaching the value programmed in this parameter, the FAN Relay will activate and its respective LED will illuminate, indicating the activation of cooling.
HdR	------	Cooling Hysteresis Menu, temperature difference to turn the Chiller on and off.Example: If the temperature set in the TAR menu is 65°C and this menu, hdR, is set to 5°C, the chiller will deactivate when the temperature is less than or equal to 59.9°C. That is, with exactly 5°C difference less than the parameterized value in the TAR menu.
ErC	------	Menu programming of the daily exercise of the fans. 0n Daily exercise disabled; 0FF Daily exercise enabled;

		Select the desired option and confirm by pressing the **SAT key**. After 1 minute of programming confirmation at 0n the Ventilation Exercise will be triggered for the first time for 5 minutes (FAN LED flashing), this cycle will repeat every 24-hour interval after the first activation. NOTE: If the equipment is de-energized, the cycle will be repeated.
Pro		Menu to enable one of the two Communication Protocol options: - Press the SET key on Mdb to enable the Modbus RTU Communication Protocol. - Press the SET key on DnP to enable DNP Communication Protocol 3.0
ErS	------	Serial network parameterization menu
UCS		Communication speed parameterization menu. ➢ Automatic; ➢ 2.400; ➢ 4.800; ➢ 9.600; ➢ 19.200; ➢ 38.400; ➢ 54.600.
Prl		Parameterization menu and communication parity. ➢ Non = none ➢ Pair ➢ Odd
Ptr		Write Protection Parameter Menu: Enables write protection; Disables write protection; Select the Output option and confirm it by pressing **SET.**
rAS	------	Menu to set the scale at the current output: ➢ 4.20 ➢ 0.20 ➢ 0.10 ➢ 0.5 ➢ 0.1
rA6	S1/S4	Maximum current output range setting menu and to mirror the Read Temperature.
OUC		Menu to adjust the channel to be transmitted on the analog output: OFF Disables the analog output of temperature transmission; S1 Enables the temperature of Sensor 1 on the Analog Output; S2 Enables the temperature of Sensor 2 on the Analog Output; S3 Enables the temperature of Sensor 3 on the Analog Output; 54 Enables the temperature of Sensor 4 on the Analog Output; hOT Enables the highest temperature on the Analog Output; SCA Enables the mirroring of the analog output in scan mode, to enable the sensors see the "Iot" menu. And set up presentation time in the "tOC" menu.
Cor	S1/S3	Enable/Disable.
tOC	------	Parameterization menu to configure the stabilization time (Seconds) of the analog output, when using the "OUC" menu in "SCA" mode.
dEU	------	Menu to adjust the deviation of the current output. Allows you to make a correction on the current outputs by adding or subtracting the configured value. ut1 - Set the value to add or subtract from the quantity mirrored by current output Before making any changes to the offset of the Current Check: If the rAS menu setting is correct 0-1 mA, 0-5 mA, 0-10 mA, 0-20 mA or 4-20 mA, if menu rA6 is configured with the correct start and end of scale and if the Ra6 menu is

		configured to mirror the correct sensor. So that this correction parameterization can be made The deviation has to be linear
LEd'S	------	Press the SET key and watch all the led's light up.
rELES	ALArM trIP FAULt FAn	 Attention: when using this menu, it activates the relay outputs and lights up the EP4 IOT LEDs so that the operator can make sure they work. However, if the monitor is in operation and the TRIP (shutdown) relay is connected to the system protection, it will trigger and the protection and the system will operate by shutting down the transformer or the machine it is protecting. RL 1 - "Activates relay 1 after pressing the SET button" (ALARM Relay). RL 2 - "Activates relay 2 after pressing the SET button" (TRIP Relay). RL3 - "Activates relay 3 after pressing the SET button" (FAULT Relay). RL4 - "Activates relay 4 after pressing the SET button" (FAN Relay).
Lor	ALA dES FAL FAn	Menu for choosing Relay Drive Logic. nOr – Initial Conditions of the "Normal" Relay. inU – Initial Conditions of the "Inverse" Relay. Select the desired Logic and confirm by pressing the SET key.
Iot	HAb dES	Parameterization menu to Enable/Disable Communication, Wifi communication
PAS	------	Parameterization menu for password change.
FAb	------	Exclusive Electron menu.

DEFECT SOLUTION

The sensor will automatically return to reading mode when the error is normalized, to reset the EP4 IOT press the **SET** key **for approximately 5 seconds until the word** rsT appears on the display**,** then release and the EP4 IOT Protection Relay will reset. The **EP4 IOT** will trigger the FAULT relay (terminals 37, 38 and 39) in the event that the display shows the **OFF** parameter or if there is a power drop.

Display	Cause	Solution
	The **EP4 IOT** does not receive a signal Reliable Sensor	• Check and replace the sensor cable if it is not shielded. • Check the grounding of the sensor cable. • Check and eliminate possible miscontact in the connectors. • Replacement of the temperature sensor if it is damaged.

IMPORTANT RECOMMENDATIONS

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

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

2. Do not use the **EP3 IOT** directly in the sun, whenever it is installed in the field it is important that it has a panel with tinted 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 **EP3 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 for which it is intended.

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/breach 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;

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

• The damage is caused by a fall or impact;

• Water or any other liquid infiltrates;

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

Use of the warranty

To take advantage of this guarantee, the customer must send the product to Electron along with a copy of the purchase invoice, properly packaged, so that no damage occurs during transport. For an emergency service, it is recommended to send as much information as possible regarding the detected defect. This will be analysed and subjected to full functional testing.

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.