Electron

Thermal Protection Relay – EP3-IoT

Manual

INDEX

INTRODUCTION

The EP3 IOT **Thermal Protection Relay** was developed to simultaneously supervise up to 3 (three) 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** 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.

The EP3 IOT **Thermal Protection Relay** has a built-in WiFi modem with a 3 dBi antenna. When **enabled by the user**, this feature allows the Internet connection. Once connected, the EP3 IOT makes the data immediately 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 **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 TOOLS, MACHINE LEARNING, DATABASE, PROGRAMMABLE FUNCTIONS, CALCULATIONS AND NOTIFICATIONS, MAINTENANCE SCHEDULE.** In the event of a loss of internet connection, the **EP3 IOT** stores all measurements for 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 **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 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 **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 supervisory. 3 independent temperature setpoints are available for each sensor and 3 relays, 2 isolated, independent and potential-free actuation 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 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 or shutdown. 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 case, 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**
  - 802.11 b/g/n/e/i standards;
  - 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 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 3 monitored temperatures;
- 4 Navigation keys;
- 11 LEDs 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 Relay Outputs

- 01 Relay (NAF) with a capacity of 10 amperes for Temperature Alarm;
- 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.

TIPO trials met

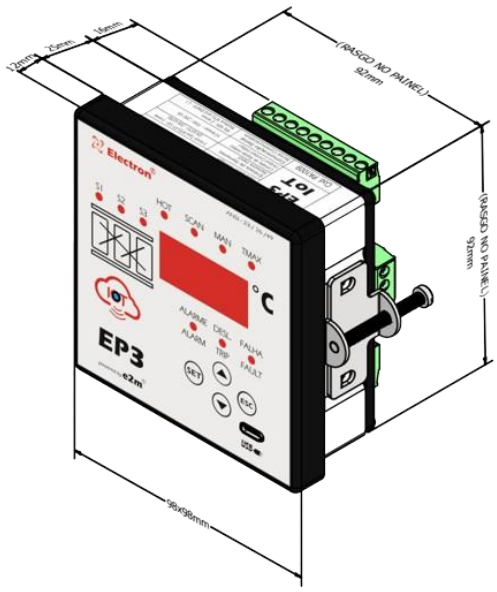
- Applied Voltage (IEC 60255-5): 2kV / 60Hz / 1 min. (against land);
- Voltage Impulse (IEC 60255-5): 1.2/50 μsec. / 5kV / 3 sec. and 3 sec. / 5 sec. Interval;
- Electrostatic Discharges (IEC 60255-22-2): Air mode = 8KV / Contact mode = 6 KV;
- Immunity to radiated electromagnetic disturbance (IEC61000-4-3): 80 to 1000 MHz / 10V/m;
- Immunity to Fast Electric Transients (IEC60255-22-4): Alim/Entr. /Outputs=4KV/common 2Kv;
- Surge Immunity (IEC60255-22-5): phase/neutral 1KV, 5 per polar (±) – phase-to-ground/neutral-to-ground 2KV, 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 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 EP3-IoT	
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)**
Measurement Range	0ºC to 200ºC
Maximum Measurement Input Error	0.5% end of scale
Maximum Analog Output Error	0.5% end of scale
Outgoing 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 wires (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 Clip
Protection	IP40 (Front), IP 20 (Connectors)

Table 1 – Technical Data of the EP3-IOT Thermal Protection Relay

DIMENSIONS AND CONNECTION DIAGRAM



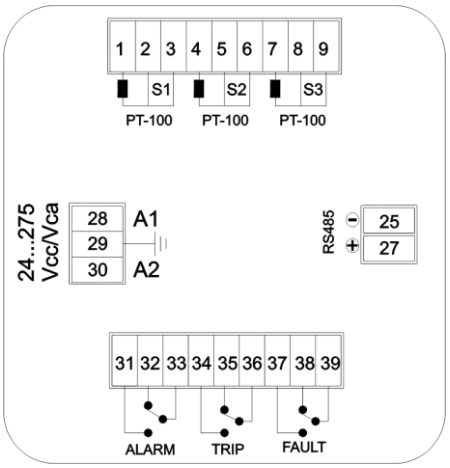
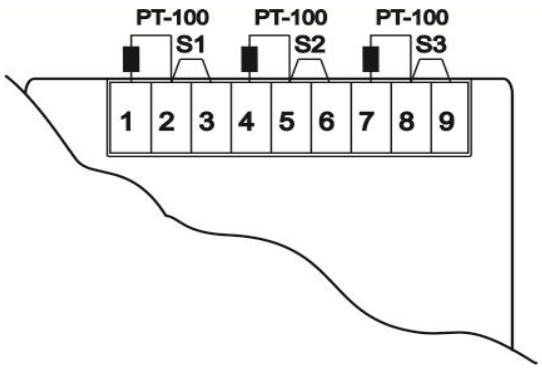


Fig. 1 – EP3-IoT Dimensions Fig. 2 – EP3-IoT IoT Connection Diagram



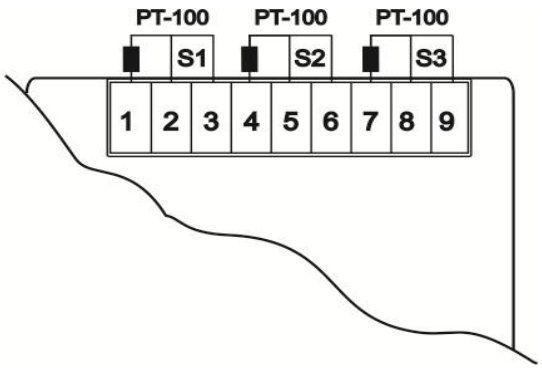


Fig. 3 – Diagram 2-wire connection sensors Fig. 4 – Diagram 3-wire connection sensors

APPLICATION EXAMPLE

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

OPERATION CHART

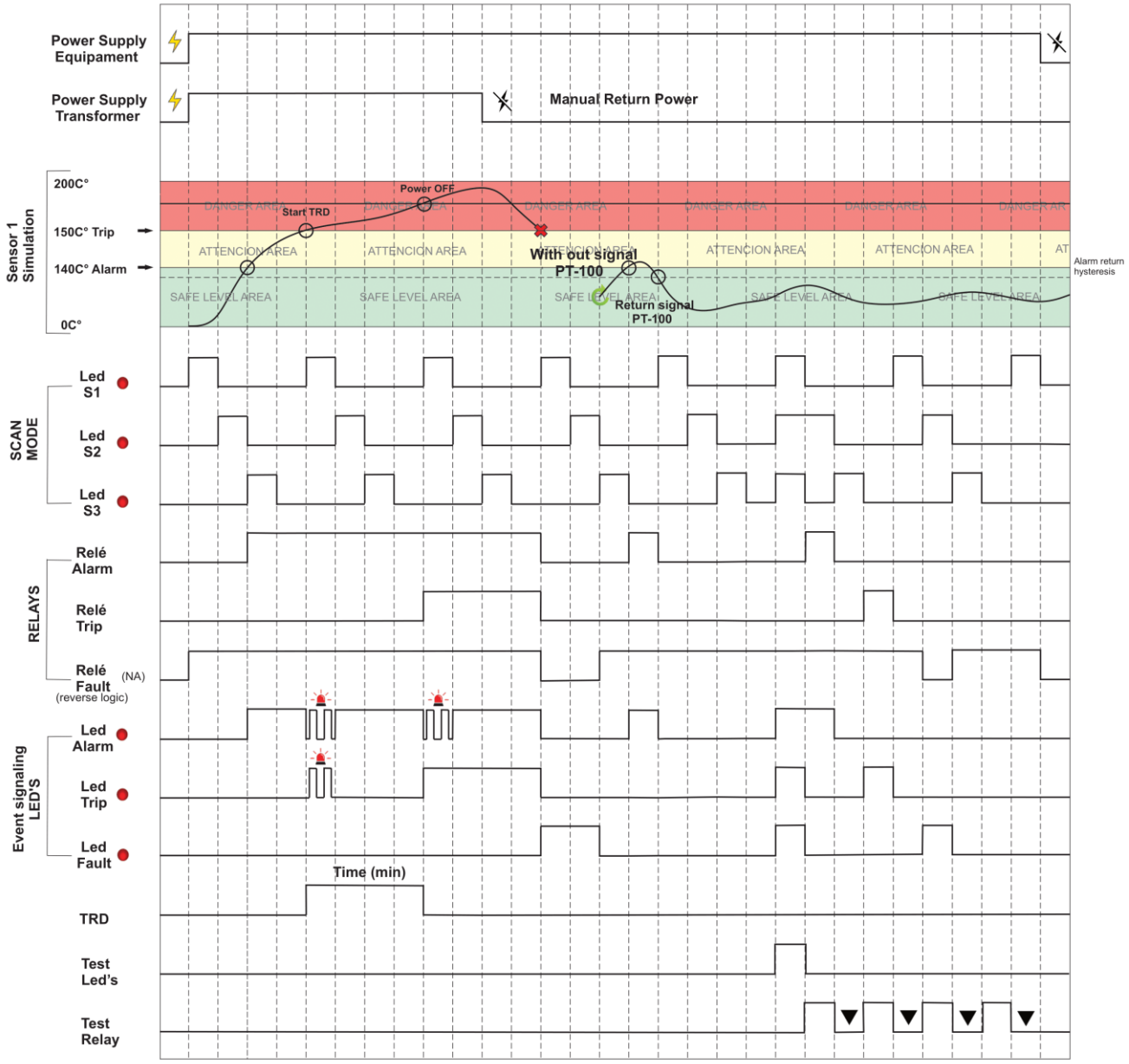


Fig. 6 – Operation Chart

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 Comb	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
	Leds and Displays	Test drive LEDs and display segments			X		
	Navigation buttons	Navigation test of the navigation buttons			X		
	Sensor Input	Verify sensor inputs using a reference source				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 Current Signal 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				
	**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 **EP3-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.

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 (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.

Electron PT100 STE Temperature Sensor Page Link:
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.

Dual Port Panel for Outdoor Use – IP 55 Page Link:
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).

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

SPECIFICATIONSFOR ORDER

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

GETTING TO KNOW EP3 IOT

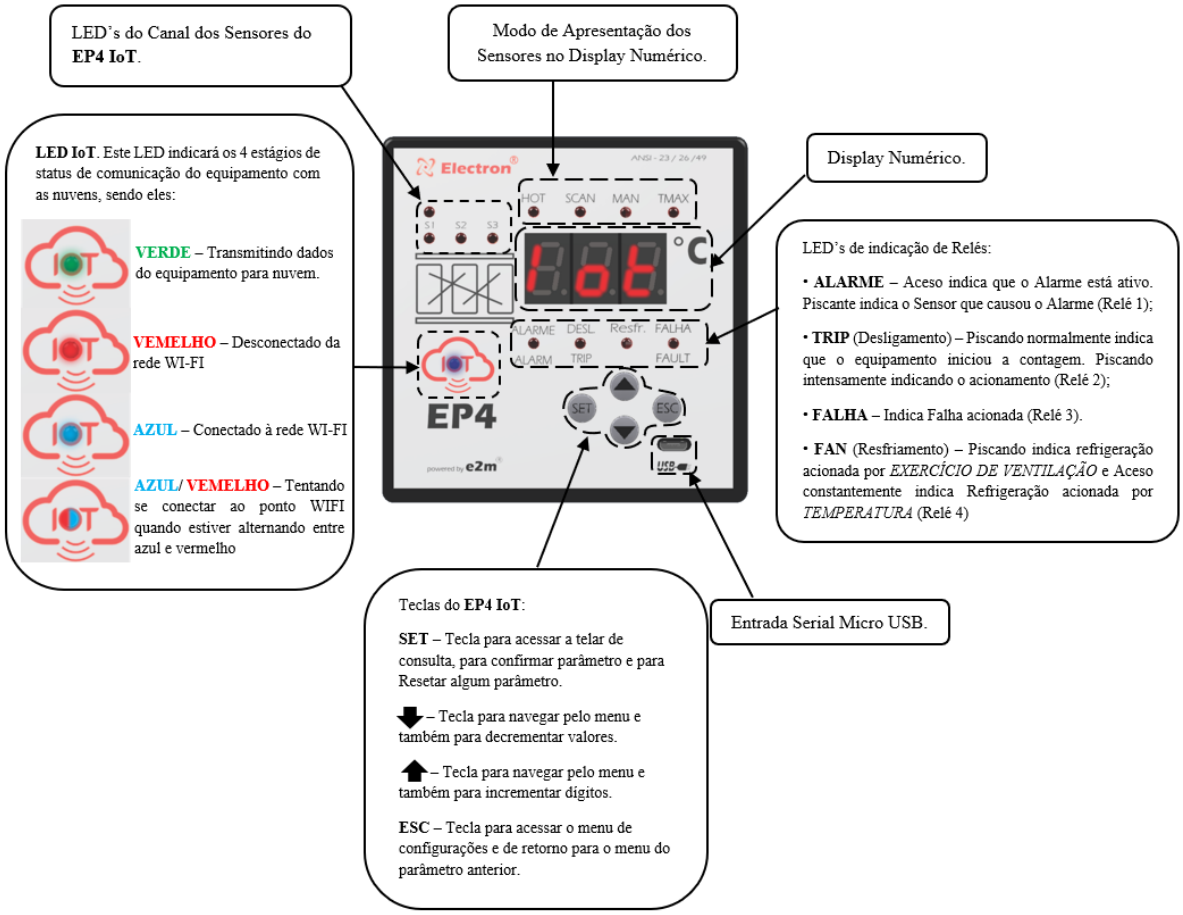
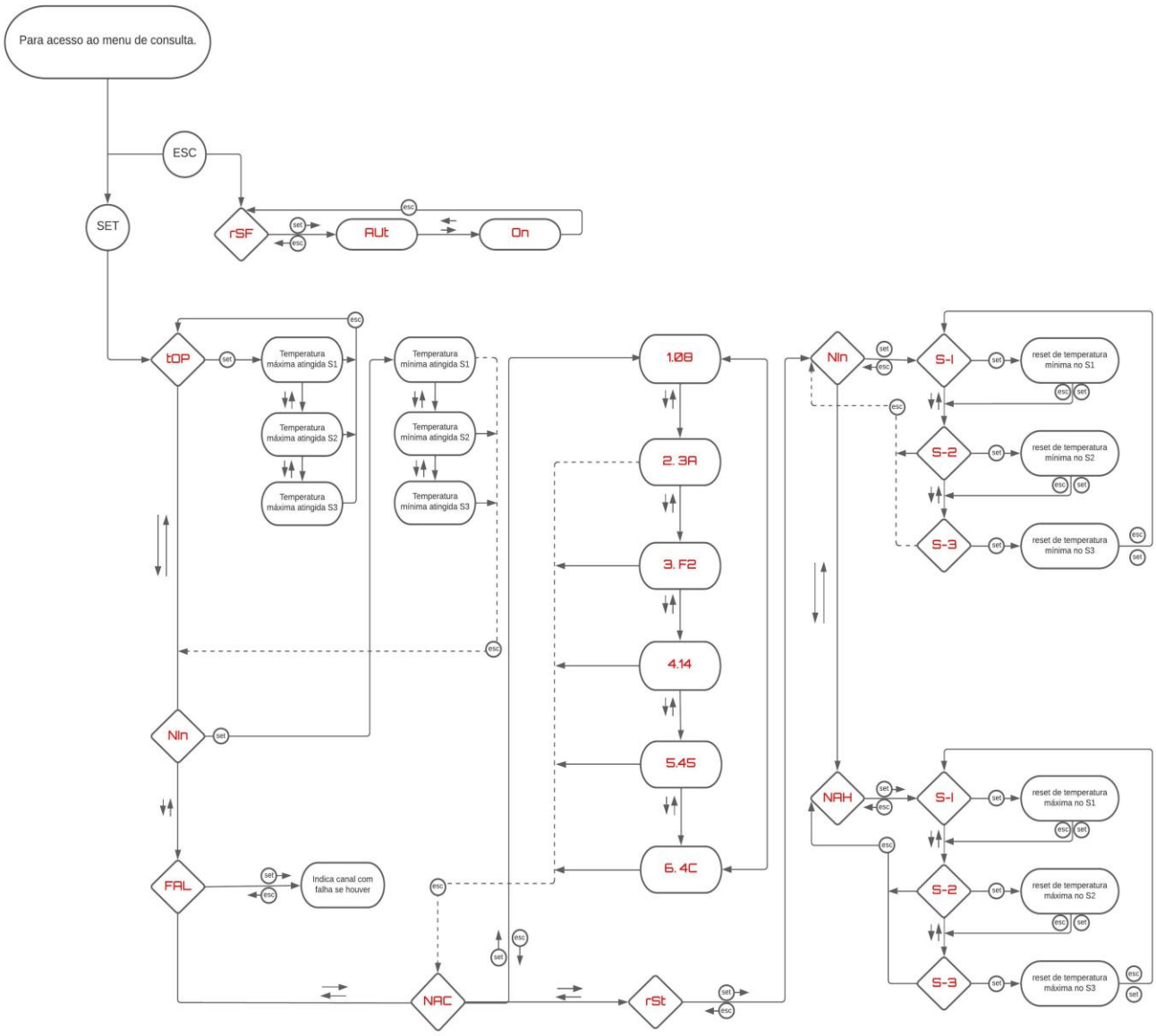


*Fig. 7 – Front **EP3-IoT***

QUERY MENU FLOWCHART

In the query and parameterization menu, use the **SET** key to confirm, the **ESC** key to go back/out, and the increment and decrement keys" ˅ ˄ to navigate.

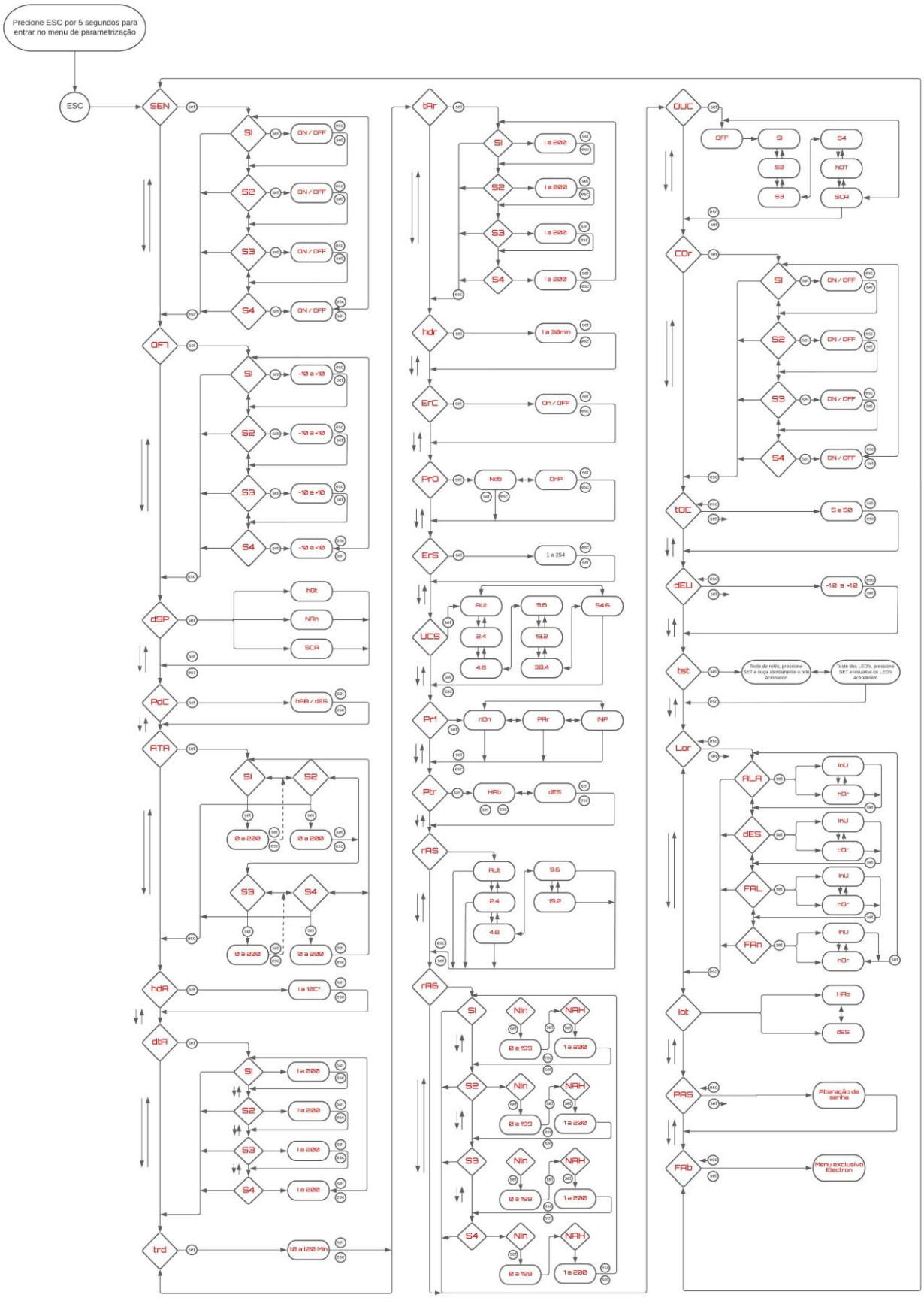


STATUS MENU

Press SET to access the query menu.

Status 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.
Nin	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.
NAC	------	Displays the MAC number of the equipment that identifies your network card.
rSt	------	Menu to reset the maximum temperatures reached.
➢ To access the menu (RSF) press the ESC key.		
RSF	------	Enable/Disable

CONFIGURATION FLOWCHART



SETUP MENU

To access the setup menu, press the ESC key 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 channels display mode. ➢ Hot – Viewing the channel with the displays the sensor channel with the highest current temperature. ➢ Nan – Viewing the temperature channels manually. ➢ SCA – Scan mode that scans all temperature measurement channels.
Of7	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 configure the Alarm activation temperature (High Temperature Alarm). When any sensor reaches the set temperature, the ALARM relay is activated 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 **SET key**.
Hda	------	Menu for setting Hysteresis (Alarm Off 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) programmed at 5°C, the ALARM relay LED will be flashing 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 **SET 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, starting the time count (trd) for the shutdown. During counting, the time set in trd will also be shown on the numeric 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 TRIP relay LED 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. If the configured value is "0", the TRIP relay will trigger immediately. Set the shutdown temperature of each sensor and confirm by pressing the **SET key**.
trd	------	Menu to adjust the Timing for the shutdown from 0 to 20 minutes. When the temperature of the S1, S2, or S3 sensors of the dtA reaches the configured value, the EP3 will start counting down the time. If the configured value is "0" the TRIP relay will trigger immediately. Set the desired Shutdown time and confirm by pressing the **SET key**.
Pro	Ndb DnP	Menu to enable one of two Communication Protocol options: - Press the SET key on Mdb to enable the Modbus RTU communication protocol. - Press the SET key in DnP to enable DNP 3.0 communication protocol
ERS	------	Serial Network Parameterization Menu

UCS	Aut 2,4 4,8 9,6 19,2 38,4 54,6	Communication speed parameterization menu. ➢ Automatic; ➢ 2.400; ➢ 4.800; ➢ 9.600; ➢ 19.200; ➢ 38.400; ➢ 54.600.
PRI	Non PAIR INP	Parameterization menu and communication parity. ➢ Non = none ➢ Pair ➢ Odd
PTR	Hab DES	Parameters Write Protection Menu: Enables write-protect Disables write-protect 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/S3	Maximum current output range setting menu and minimum to mirror the Read Temperature.
OUC	OFF S1 S2 S3 Hot Sca	Menu to adjust the channel to be transmitted in the analog output: OFF Disables analog temperature transmission output; S1 Enables Sensor 1 temperature on Analog Output; S2 Enables Sensor 2 temperature on Analog Output; S3 Enables Sensor 3 temperature on 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 setup presentation time in the "tOC" menu.
Cor	S1/S3	Enable/Disable.
toc	------	Parameterization menu to configure the time (Seconds) of stabilization 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 to the current outputs by adding or subtracting the configured value. Set the value to add or subtract from the quantity mirrored by current output Before making any changes to the offset of the output of 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 in the Ra6 menu is configured to mirror the correct sensor. So that this correction parameterization can be done The deviation has to be linear

LED	------	Press the SET key and watch all the leds light up.
RELAY	ALARM TRIP FAULT	 Attention when using this menu, it activates the relays and lights up the EP3 IOT LEDs so that the operator can make sure they work. However, if the monitor is in operation and the TRIP relay (shutdown) is connected to the system protection, it will activate and the protection and the system will operate by turning off 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" (Relay FAULT).
Lor	wing DES Fal	Menu for choosing Relay Activation 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 Wifi Communication.
Pas	------	Parameterization menu for changing password.
Fab	------	Exclusive Electron menu.

DEFECT SOLUTION

The sensor will automatically return to reading mode when the error is normalized, to reset the **EP3 IOT** press the **SET key** for approximately 5 seconds until the word rsT appears on the display, then release and the **EP3 IOT Protection Relay** will restart. The **EP3 IOT** will trigger the **FAULT** relay (terminals 37, 38 and 39) in case the display shows the **OFF** parameter or if there is a power outage.

Display	Cause	Solution
Off	**EP3 IOT** receives no 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 bad contact 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 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 **EP3 IOT** directly in the sun, whenever it is installed in the field it is important to have 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 **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 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.