Electron

OIL LEVEL MONITOR - MNO

Manual

INDEX

INTRODUCTION

The Oil Level Monitor for Transformers and Reactors **MNO,** is a high-precision microprocessed equipment that indicates the oil level in a scale that varies between 0 and 100%, and provides this indication in an analog output (0 to 1, 0 to 5, 0 to 10, 0 to 20 or 4 to 20mA), and an RS-485 serial output with Modbus RTU and DNP 3 (L1) protocol allowing remote access to the Monitor through a supervisory system.

The **MNO** was built in compliance with strict quality standards and uses state-of-the-art electronic components (SMD), its hardware was designed to withstand severe working conditions, and can be installed directly in power transformers and reactors, in panels in the yard of power substations, offshore platforms and chemical industries. Meets the levels of demands, supportability and reliability according to IEC, DIN, IEEE, ABNT standards.

As a signal input the **MNO** has 1 input for configurable resistive signal from 0 to 1000 ohms, and current signal input from 4 to 20mA, for the monitored value (measured) it is possible to make 3 levels of programming for contact actuation (High Level, Low Level and Shutdown), 3 independent NAF relay outputs and 1 NC fault signaling relay, 1 configurable analog output that can be from 0 to 10; 0 to 20 or 4 to 20mA, 1 RS-485 output with Modbus RTU and DNP 3.0 protocol, all parameters can also be configured directly on the front of the equipment or via the RS-485 serial output.

KEY FEATURES

Communication Protocols

- DNP3 – Level 1 (SERIAL)
- Modbus-RTU (SERIAL)

Communication Ports

- **USB**
  - 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 2,400 to 57,600 bps

Feeding

- Universal Power 48-265 Vdc/Vac;

Hardware

- High mechanical resistance case, built entirely in aluminum;
- Degree of protection (NBR IEC 60529), IP40 (Front) and IP30 (rear);
- 48x96x83.5mm;
- 2 years warranty;

Human Machine Interface (HMI)

- 4-digit red high-brightness numeric display;
- 4 Navigation keys;
- 4 LED's on the front for event indications;
- Intuitive menus for consultation and parameterization;
- Accuracy of 1 decimal place;
- Stores in memory the maximum and minimum levels reached;
- Parameterization via software

Measurement Input

- Configurable resistive from 0 to 1000 ohms, and current signal input from 4 to 20mA
- Measurement range from 0 to 100%

Digital Relay Outputs

- 1 Relay (NAF) with a capacity of 10 amps for High level alarm with programmable hysteresis;
- 1 Relay (NAF) with a capacity of 10 amps for Low level alarm with programmable hysteresis;
- 1 Relay (NAF) with a capacity of 10 amps for TRIP (shutdown) low/high level;
- 1 Relay (NAF) with a capacity of 10 amperes for Fault Indication (watchdog);

Analog Output

- 01 Analog output from 0 to 1mA, 0 to 5mA, 0 to 10mA, 0 to 20mA or 4 to 20mA user configurable;

TECHNICAL DATA

Level Monitor - Oil MNO	
Operating Voltage	48 a 265 Vcc/Vca 50/60 Hz
Operating Temperature	-40 to +85°C
Consumption	< 15 W
Level Measurement Input	Float (0 to 1000 ohms and 4 to 20 mA)
Measurement Range	0 to 100%
Analog Output and Maximum Load Options	0 ... 1 mA – 8000 Ohms
	0 ... 5 mA – 8000 Ohms
	0 ... 10 mA – 8000 Ohms
	0 ... 20 mA – 8000 Ohms
	4 ... 20 mA – 8000 Ohms
Maximum Error of Measurement Inputs	0.25% of end-of-scale
Maximum Analog Output Error	0.25% of end-of-scale
Outgoing Contacts	4 – Free of Potential
Maximum Switching Power	40W / 250 VA
Maximum Driving Current	6.0 A
Communication Port	RS485; Modbus RTU; DNP3 L1; DNP3 L1
Auto Baud Rate	2,400 to 57,600 bps
Box (DIN IEC 61554)	48 x 96 x 83,5 mm – Aluminium
Equipment Attachment	Flush Panel Mounting
Degree of Protection (NBR IEC 60529)	IP40 (front) and IP30 (rear)

Table 1 – Technical data of the MNO.

TYPE TESTS

- Applied Voltage **(IEC 60255-5):** 2kV / 60Hz / 1 min. (against land);
- Voltage Impulse **(IEC 60255-5):** 1.2/50 sec. / 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;
- Immunity to Surtos **(IEC60255-22-5):** phase/neutral 1KV, 5 per 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 Ensaio **(IEC60068-21-14):** - 10ºC + 70ºC / 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 58 Hz / 1G from 58 to 150 Hz / 8min/axis;

CONNECTION DIAGRAMS

MNO – mA signal input **(ACTIVE 15Vdc)** MNO – mA signal input **(PASSIVE 24Vdc)**

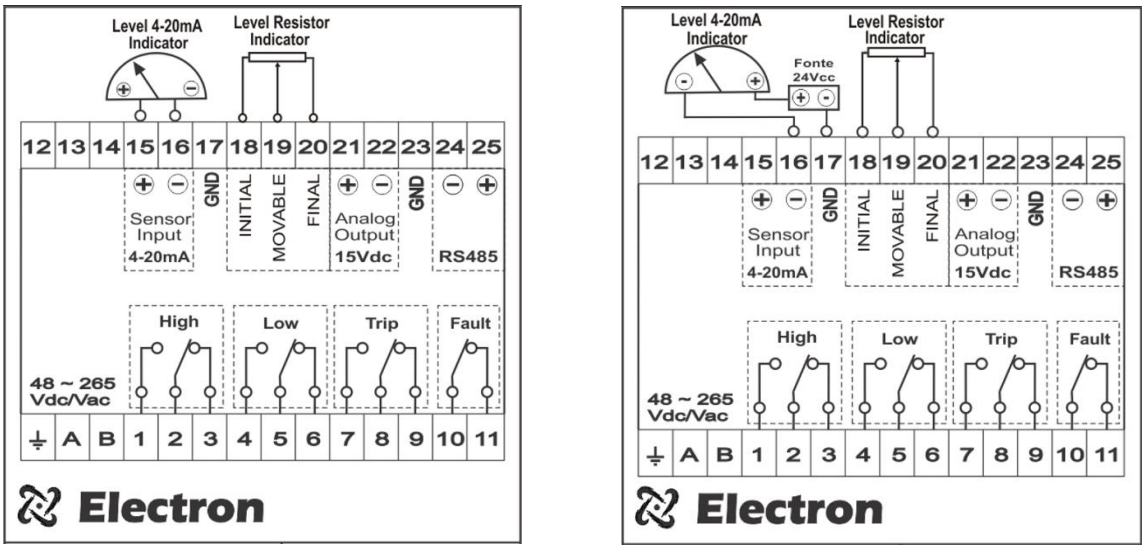
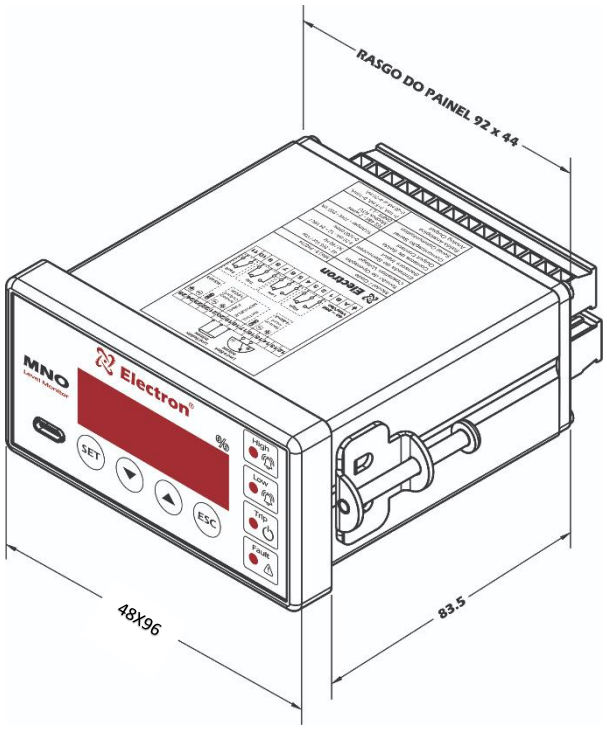


Figure 1 – Connection diagrams

DIMENSIONS



Note: Slot in the panel must be 92x44mm

Figure 2 – Dimension

APPLICATION EXAMPLE

Figure 3 – Application Example

OPERATION CHART

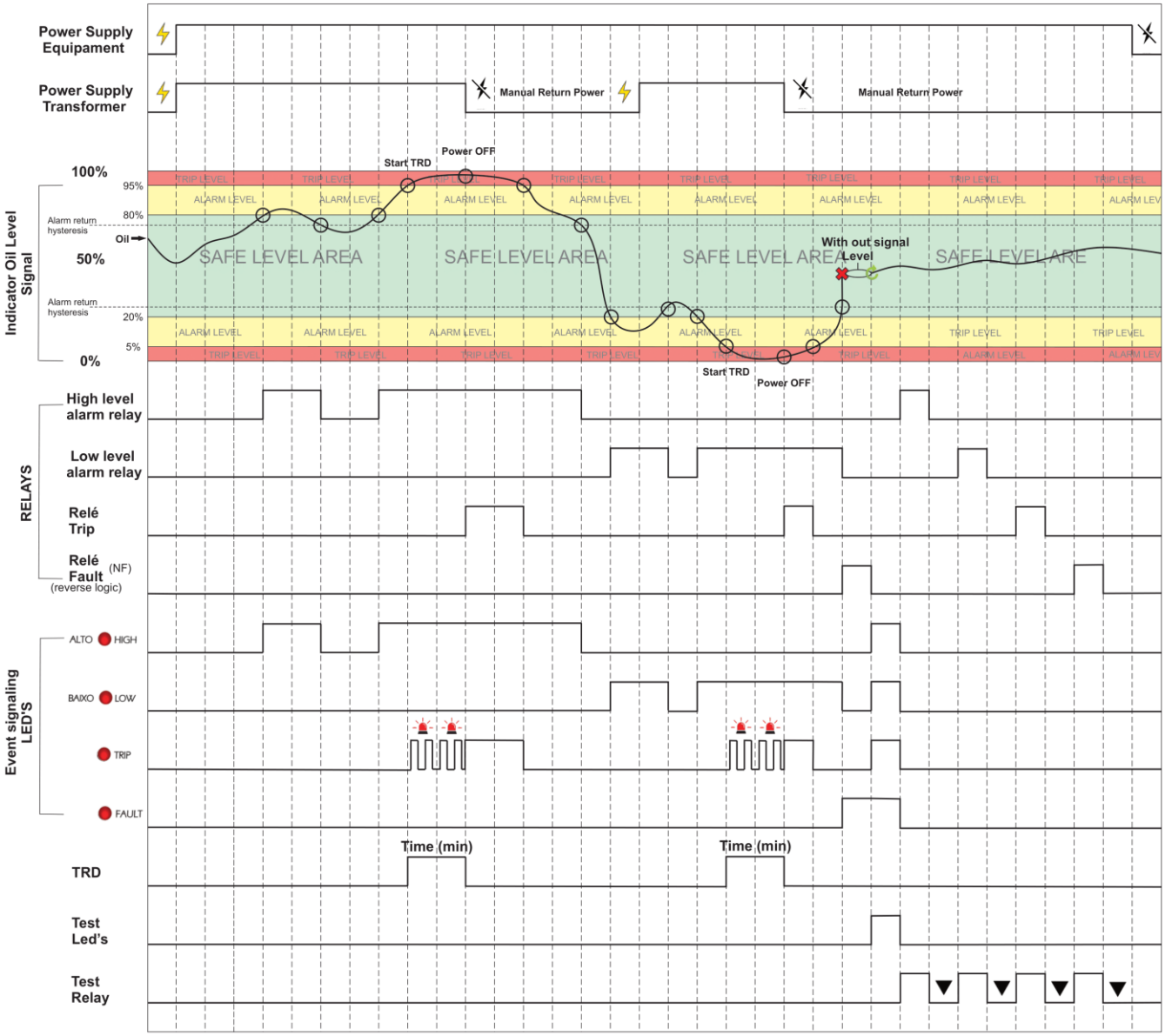


Figure 4 – Operation Graph

PREVENTIVE MAINTENANCE

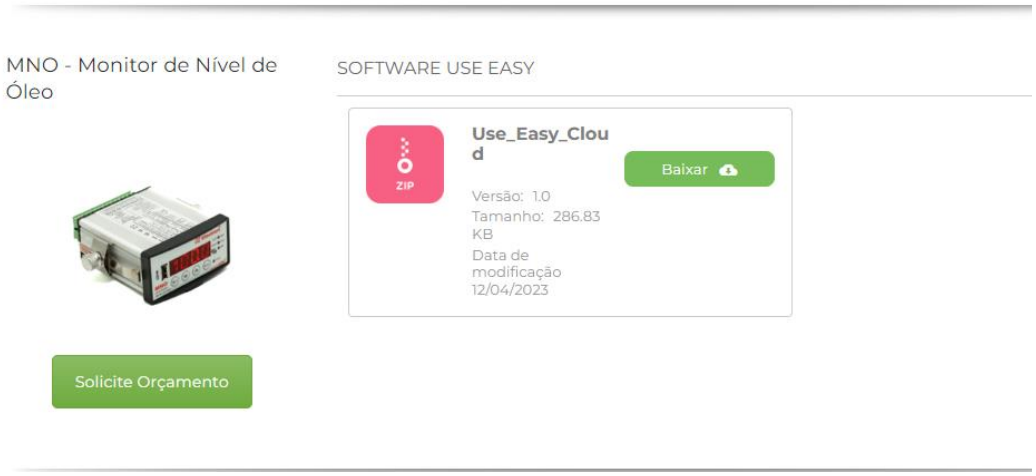
PREVENTIVE AND CORRECTIVE MAINTENANCE							
Items to be checked preventively			Verification Frequency				Corrective action
SHARE	Verification Elements	ACTIVITIES	Every Month	Every 3 Months	Every 6 Months	Every 1 Year	When Needed
VERIFICATION	Fastening clip and snapping to the rail	Fixing to the panel 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			
	Indicaores	Integrity / Positioning / Fastening			X		Replacement, repositioning and/or fixing of indicators
	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		
	Entry of Indicators	Measure indicator 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 SOFTWARE FOR PARAMETERIZATION - USEEASY

1) Go to the software page on our Website https://electron.com.br/site/softwares/

2) Find your equipment and download the corresponding software



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 MNO operation.

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/

GETTING TO KNOW THE MNO

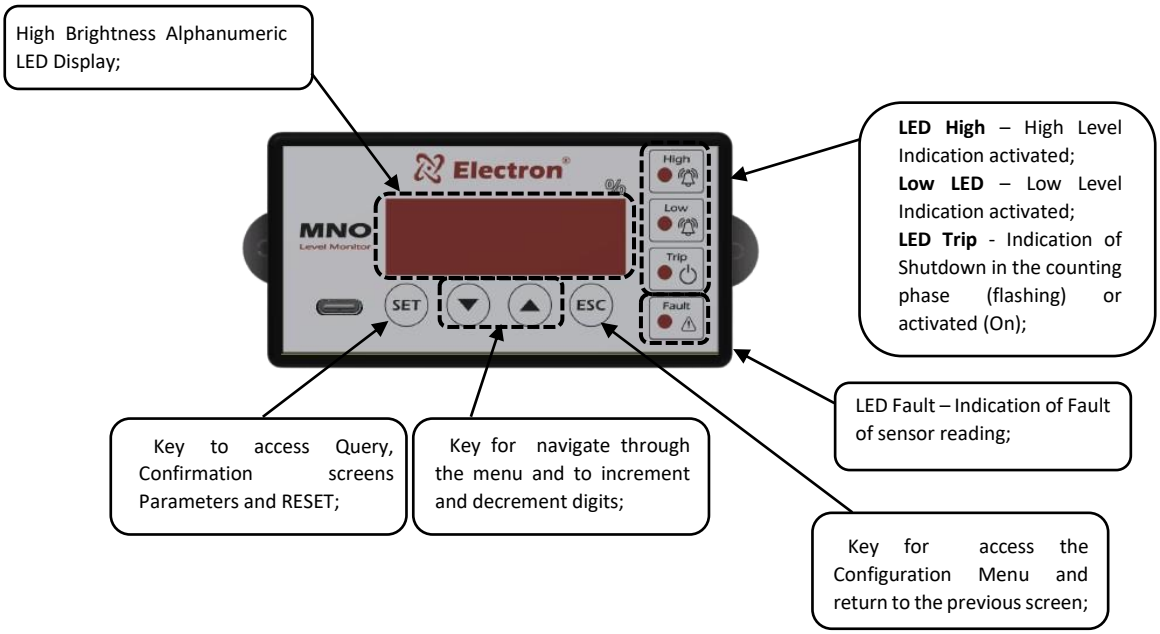
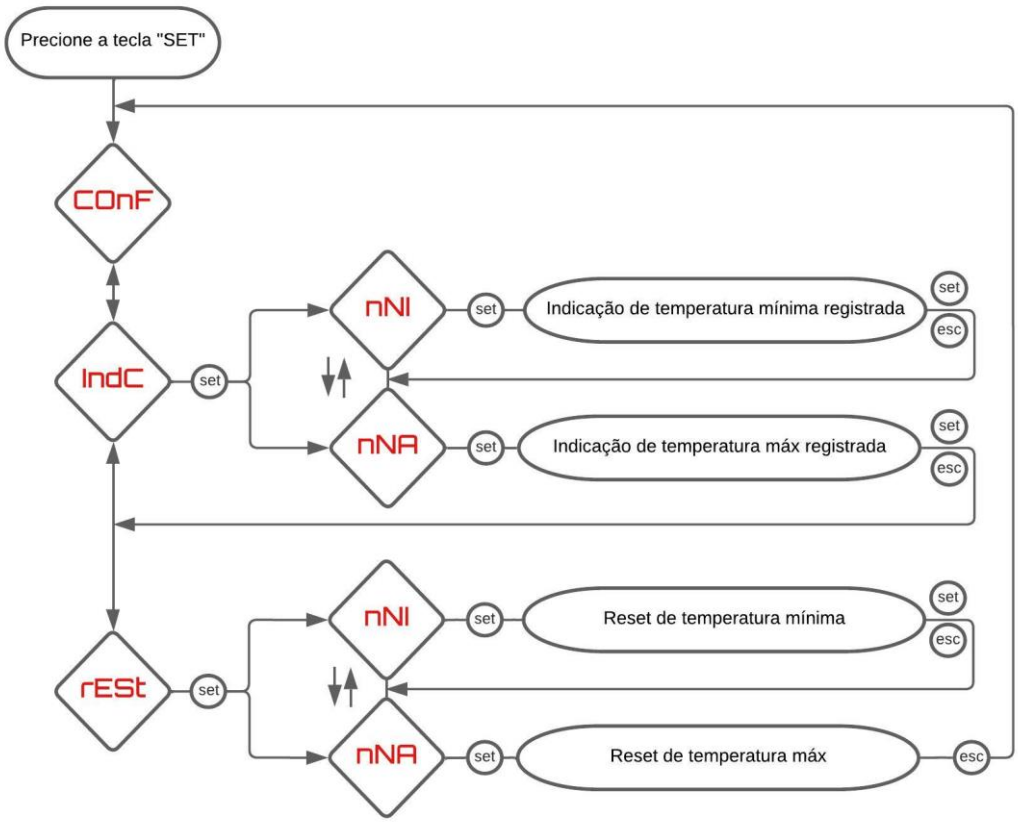


Figure 4 – Front MNO

QUERY MENU FLOWCHART



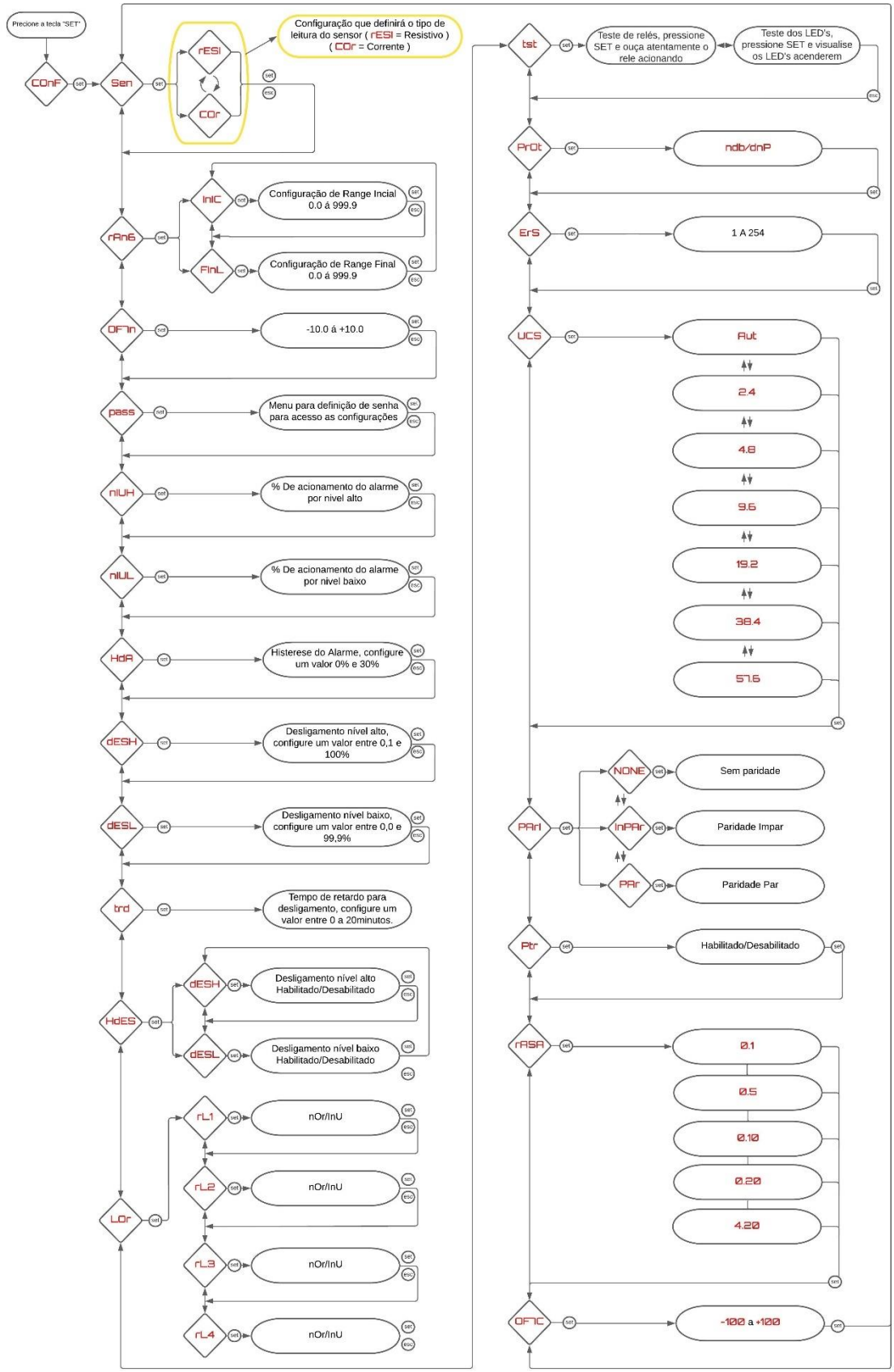
CONSULTATION MENU

To enter the consult menu, press the "SET" key.

→ Menu to check the maximum and minimum level recorded by the indicator;		
Menu	**Parameter**	**Description**
INdC	**nNI**	Screen to consult the Maximum Level register by the indicator;
	nNA	Screen to consult the Minimum Level registered by the indicator.

→ Menu to delete the Maximum and/or Minimum Level record		
Menu	**Parameter**	**Description**
Rest	**nNI**	Press SET and the equipment will perform a RESET of the current value of the Maximum Level recorded by the indicator;
	nNA	Press SET and the equipment will perform a RESET of the current value of the Minimum Level recorded by the indicator;
NOTE: When deleting the current maximum and or minimum values, the current record automatically becomes the memorized value		

CONFIGURATION MENU FLOWCHART



SETUP MENU

Pressing the SET key on the **CONF option** will appear on the display a four-digit number that is the reminder of the password that is configured on the equipment and soon after 0000 will appear Use the increment and or decrement key to enter the password, to confirm the chosen number and move on to the next square press the SET key, To return to the previous number, press the ESC key. Confirming the four digits, if the password is correct, you will enter the configuration menu with the acronym RESI on the display. Otherwise, it will come back on the **OOOO** display.

NOTE. The factory password is **OOOO** and the reminder number is 1807, if the user changes this password in the **PASS** menu and forgets, just send the reminder number to ELECTRON and the product password will be reset.

SETUP MENU

→ Menu to Set the sensor reading type.		
Menu	**Parameter**	**Description**
Sen	**rESI**	Setting that will define the type of sensor reading to be Resistive;
	Colour	Setting that will set the sensor reading type to be Current;
NOTE: It is very important to select the correct sensor reading type, otherwise your equipment will burn out.		

→ Menu to Configure the Input Signal Reading Range.		
Menu	**Parameter**	**Description**
rAn6	**InIC**	Initial reading range setting from 0.0 to 999.9;
	FInL	Reading range setting End from 0.0 to 999.9;

→ Menu to Configure the Buoy Level Reading OFFSET.		
Menu	**Parameter**	**Description**
OF7n	**-10** to **10**	Parameterize the OFFSET value to allow a correction to be made in the presentation of the Buoy Level by adding or subtracting the configured value;
NOTE: Before making any change in the float level offset, check if the Initial and Final resistance setting is correctly configured. In order for this correction adjustment to be made in the level reading, the deviation has to be linear, that is, the same deviation from the beginning to the end of the scale.		

→ Menu for setting a password to access the settings.		
Menu	**Parameter**	**Description**
PASS	**0000** to **9999**	Menu for setting a password to access the settings;
NOTE: If the default password is 0000, it will not require a password when entering the setup menu.		

→ Menu to set up High Level Alarm.		
Menu	**Parameter**	**Description**
nIUH	**00.0.to 100.0**	Parameterize the value in percentage (%) to trigger the High Level Alarm to trigger Relay 1 (terminals 1, 2 and 3) as soon as the tank reaches the parameterized value;

→ Menu to set the Low Level Alarm.		
Menu	**Parameter**	**Description**
nIUL	**00.0.**to **100.0**	Parameterize the value in percentage (%) to trigger the Low Level Alarm to trigger Relay 2 (terminals 4, 5 and 6) as soon as the tank reaches the parameterized value;

→ Menu for Hysteresis adjustment, level difference between turning on and off the Alarm.		
Menu	**Parameter**	**Description**
Hda	**0.0.**to **30.0**	Example: If the **nIUH** is programmed at 65% and the **HdA** is programmed at 5, the Alarm will turn off only when the level reaches 59.9%, i.e. 5% below the **nIUH parameter**. If the **nIUL** is set to 20% and the **HdA** is set to 5, the Alarm will turn off only when the level reaches 25.1%, i.e. 5% above the **nIUL** parameter. Use the increment key or the decrement key to set the Alarm Off Hysteresis value. Confirm by pressing the SET key;

→ Menu to configure High Level Shutdown.		
Menu	**Parameter**	**Description**
dESH	**00.0.**to **100.0**	Parameterize the value in percentage (%) to trigger the High Level Shutdown to trigger Relay 3 (terminals 7, 8 and 9) as soon as the tank reaches the parameterized value. Confirm by pressing the SET key;

→ Menu to configure Low Level Shutdown.		
Menu	**Parameter**	**Description**
Off	**00.0.**to **100.0**	Parameterize the value in percentage (%) to trigger the High Level Shutdown to trigger Relay 3 (terminals 7, 8 and 9) as soon as the tank reaches the parameterized value. Confirm by pressing the SET key;

→ Menu to configure the Delay Time for Shutdown.		
Menu	**Parameter**	**Description**
trd	**0** to **20**	Parameterize the value between 0 and 20 Minutes, this means that after the equipment reaches the parameterized level for shutdown, it will have a delay of x minutes to activate the relay and turn off the transformer;

→ Menu to Enable Shutdown		
Menu	**Parameter**	**Description**
Lor	**rL1**	**nOr** - Initial Relay Condition 1 "Normal";
		InU - Initial Condition of Relay 1 "Inverse";
	rL2	**nOr** - Initial Condition of Relay 2 "Normal";
		InU - Initial Condition of Relay 2 "Inverse";
	rL3	**No.** - Initial Condition of Relay 3 "Normal";
		InU - Initial Condition of Relay 3 "Inverse";
	rL4	**nOr** - Initial Condition of Relay 4 "Normal";
		InU - Initial Condition of Relay 4 "Inverse";

→ Menu to perform tests at relays and LEDs.		
Menu	**Parameter**	**Description**
Tst	**REL1**	Activates Relay 1 by pressing the SET key;
	REL2	Activates Relay 2 by pressing the SET key;
	REL3	Activates Relay 3 by pressing the SET key;
	REL4	Activates Relay 4 by pressing the SET key;
	Leds	Activates all the LED's of the equipment when pressing the SET key;
NOTE: The relay test may trigger the circuit breaker panel. It is recommended that the test be carried out with the terminals disconnected from the circuit.		

→ Communication Protocol setting menu.		
Menu	**Parameter**	**Description**
Prot	**dnP**	Configures DNP3 LV.1 Communication Protocol;
	Ndb	Configures the Modbus Communication Protocol;
NOTE: It is important that this configuration is correct, otherwise you will not be able to communicate correctly with your supervisory system.		

→ Menu for setting the address of your device on the network		
Menu	**Parameter**	**Description**
ERS	**1 -254 to**	Select a number between 1 and 254 to be the network address of the equipment;

→ Menu to configure the Serial Communication Speed;		
Menu	**Parameter**	**Description**
UCS	**AUTO**	Automatically detects the communication speed;
	2.4	Fixed communication speed at 2,400 bps;
	4.8	Fixed communication speed at 4,800 bps
	9.6	Fixed communication speed at 9,600 bps;
	19.2	Fixed communication speed at 19,200 bps;
	38.4	Fixed communication speed at 38,400 bps;
	57. 6	Fixed communication speed at 57,600 bps;

→ Menu for choosing Communication Parity		
Menu	**Parameter**	**Description**
Pari	**NONE**	No Parity;
	InPAR	Paridade impar;
	Pair	Parity even;

→ Parameter Recording Protection Menu;		
Menu	**Parameter**	**Description**
PTR	**Hab**	Enables write-protect
	des	Disables write protection;

→ Menu for selecting the current output value (Terminals 21 and 22). Select the Output option and confirm by pressing the SET key;		
Menu	**Parameter**	**Description**
RASA	**0.1**	Enables current output to 0 to 1mA;
	0.5	Enables current output to 0 to 5mA;
	0.10	Enables current output to 0 to 10mA;
	0.20	Enables current output to 0 to 20mA;
	4.20	Enables current output for 4 to 20mA;

→ Menu to Configure the Buoy Level Reading OFFSET.		
Menu	**Parameter**	**Description**
OF7C	-100 to +100	Parameterize the OFFSET value to allow a correction to be made in the presentation of the Buoy Level by adding or subtracting the configured value;

DEFECT SOLUTION

Display	**Cause**	**Solution**
OFF	There is no reliability in the signal received by the MNO sensor	Check and replace if the sensor cable is not shielded.
		Check the grounding of the sensor cable.
		Check and correct possible bad contact.

The **MNO** will automatically return to the reading mode when normalized, to reset the **MNO** press the SET key for approximately 5 seconds, until the word REST appears on the display, then release and the equipment will restart.

The **MNO** has a fault contact (relay 4), it will act in case of SOFF or if there is a power outage.

IMPORTANT RECOMMENDATIONS

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

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

2. Use 120 Ohm resistors in the communication network (Rs485) at the 2 ends of the transmission line (start and end) in order to generate the potential difference necessary for the correct operation of the communication network.

3. Do not use the **MNO** directly on the SUN, whenever it is installed in the field it is important to have a panel with smoked glass, so that the ultraviolet rays that attack the front polycarbonate are filtered, in this way the life of the equipment will be prolonged.

IMPORTANT RECOMMENDATIONS CABLING

Recommended Cabling for connection (NBR-5410 and NBR-14039 Standards)		
Connection	**Material**	**Quality**
Grounding	NU Copper	High Electrical Conductivity.
	Tinned Copper	Corrosion resistance.
	Copper Tape	Lightning Protection.
	Grounding Mesh	Uniform fault current distribution.
	Grounding Rod	Creates a path of Low resistance to the earth.
RS-485 Communication	Belden 9841 (24AWG)	Twisted pair, shielded and Low Capacitance.
	Alpha Wire (22AWG)	
Feeding	EPR	Resistance to heat, humidity, chemical agents and withstand up to 90°C.
	XLPE	
Sensors	PT-100 Blindado (3x24 AWG) - Electron	Mechanical resistance and noise protection.
Relay Output	Armored Multiway Rope	Mechanical resistance and noise protection.

Cabling Recommended for connecting current inputs/outputs					
Connection	**Material**	**Range**	**Impedance**	**Distance**	**Minimum Gauge**
Analog Outputs / TC / Tap Inputs	Armored Multiway Rope	0...1mA	8kΩ	<100m	0.14 to 0.25mm²
				>100m	0.35 to 0.5mm²
		0...5mA	1.6kΩ	<100m	0.2 to 0.35mm²
				>100m	0.5 to 0.75mm²
		0...10mA	800Ω	<100m	0.25 to 0.5mm²
				>100m	0.75 to 1.0mm²
		0...20mA	400Ω	<100m	0.5 to 0.75mm²
				>100m	1.0 to 1.5mm²
		4...20mA	400Ω	<100m	0.5 to 0.75mm²
				>100m	1.0 to 1.5mm²

Table 3 – Cabling Recommendation

WARRANTY TERM

The Electron Oil Level Monitor has a warranty period of two years from the date of sale recorded 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.

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

The damage is caused by a drop 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 emergency care, it is recommended to send as much information as possible regarding the defect detected. It will be analyzed and subjected to complete functional tests.

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

DECLARATION OF CONFORMITY

Available for Downloads on the Website:

http://electron.com.br/wp/wp-content/uploads/2014/09/CARTA-DE-CONFORMIDADE-PORTUGUÊS.pdf