

USER MANUAL



Treetech

MO

Moisture Monitor



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1 Preface

1.1 Legal Information

The information contained in this document is subject to change without prior notice.

This document belongs to Treotech Tecnologia Ltda. and may not be copied, transferred to third parties, or used without express authorization, in accordance with Law 9.610/98.

1.1.1 Disclaimer

Treotech Tecnologia reserves the right to make changes without prior notice to all products, circuits, and functionalities described herein in order to improve their reliability, function, or design. Treotech Tecnologia assumes no liability arising from the application or use of any product or circuit described herein, nor does it convey any license or patent rights of its own or of third parties.

Treotech Tecnologia Ltda. may hold patents or other types of registrations and intellectual property rights described in the content of this document. Possession of this document by any person or entity does not confer upon them any rights regarding these patents or registrations.

1.2 Presentation

This manual presents all recommendations and instructions for the installation, operation, and maintenance of the Moisture Monitor.

1.3 Typographic Conventions

Throughout this text, the following typographic conventions have been adopted:

Bold: Symbols, terms, and words in bold carry greater contextual importance. Therefore, pay attention to these terms.

Italics: Foreign-language terms, alternatives, or terms used outside of a formal context are italicized.

Underline: References to external documents.

1.4 General and Safety Information

This section presents relevant aspects regarding the safety, installation, and maintenance of the MO.

1.4.1 Safety symbols

This manual uses three types of risk classification, as shown below:

**Caution:**

This symbol is used to alert the user to a potentially hazardous operating or maintenance procedure that requires extra care during execution. Minor or moderate injuries may occur, as well as damage to the equipment.

**Warning:**

This symbol is used to alert the user to a potentially dangerous operating or maintenance procedure requiring extreme caution. Serious injury or death may occur. Potential equipment damage will be irreparable.

**Risk of electric shock:**

This symbol is used to alert the user to an operating or maintenance procedure that, if not strictly followed, could result in electric shock. Minor, moderate, or severe injury, or death, may occur.

1.4.2 General symbology

This manual uses the following general-purpose symbols:

**Tips**

This symbol represents instructions that facilitate the use of or access to functions in the MO.

**Important**

This symbol is used to highlight information.

1.4.3 Minimum recommended profile for the MO operator and maintainer

The installation, maintenance, and operation of equipment in electrical substations require special care; therefore, all recommendations in this manual, applicable standards, safety procedures, safe work practices, and good judgment must be applied during all stages of handling the Moisture Monitor - MO.



Only authorized and trained personnel—operators and maintenance staff—may handle this equipment.

To handle the MO, the professional must:

1. Be trained and authorized to operate, ground, energize, and de-energize the MO, following maintenance procedures in accordance with established safety practices, which are the sole responsibility of the MO operator and maintenance personnel;
2. Be trained in the use of PPE (Personal Protective Equipment), CPE (Collective Protective Equipment), and first aid;
3. Be trained in the operating principles and configuration of the MO;
4. Follow regulatory recommendations regarding interventions on any type of equipment within an electric power system.

1.4.4 Environmental and voltage conditions required for installation and operation

The following table lists important information regarding environmental and voltage requirements.

Table 1 - Operating conditions

Condition	Interval/description
Application	Equipment for sheltered use in substations, industrial environments and similar environments.
Indoor/outdoor use	Internal use
Degree of protection (IEC 60529)	IP20
Altitude* (IEC EN 61010-1)	Up to 2000 m
Temperature (IEC EN 61010-1)	
Operation	-40...+85 °C
Storage	-50...+95 °C
Relative humidity (IEC EN 61010-1)	
Operation	5...95 % - Non-condensed
Storage	3...98 % - Non-condensed
Power supply voltage fluctuation (IEC EN 61010-1)	Up to $\pm 10\%$ of nominal voltage
Overvoltage (IEC EN 61010-1)	Category II
Pollution degree (IEC EN 61010-1)	Grade 2
Atmospheric pressure** (IEC EN 61010-1)	80...110 kPa

* There are already successful applications at altitudes above 2,000 m.

** There are already successful applications at pressures below 80 kPa.



1.4.5 Testing and installation instructions

This manual must be available to those responsible for the installation and maintenance of the Moisture Monitor, as well as to its users.

To ensure user safety, equipment protection, and correct operation, the following minimum precautions must be observed during the installation and maintenance of the MO.

1. Read this manual carefully before installing, operating, or maintaining the MO. Errors in installation, maintenance, or configuration can lead to false alarms or the failure to trigger necessary alarms, potentially resulting in a misunderstanding of the transformer's actual health and operating condition.
2. Installation, configuration, and operation of the MO must be performed by personnel trained and familiar with power transformers (insulated with mineral or vegetable oil), control devices, and substation equipment control circuits.
3. Special attention must be paid to the installation of the MO, including cable type and gauge, installation location, and commissioning, as well as the correct parameterization of the equipment.



The MO must be installed in a sheltered environment (a doorless panel in a control room or an enclosed panel for outdoor installations) that does not exceed the temperature and humidity limits specified for the equipment.



Do not install the MO near heat sources such as heating resistors, incandescent lamps, high-power devices, or components with heat sinks. Installation near ventilation openings or areas subject to forced airflow, such as cooling fan intakes or exhausts, or forced-air ducts, is also not recommended.



If the panel where the MO is installed has a window, use G20 or higher-grade tint film to prevent direct sunlight (ultraviolet rays) from striking the equipment. If the window glass is dark, this measure is not necessary.

1.4.6 Cleaning and decontamination instructions

Exercise caution when cleaning the MO. Use **only** a damp cloth with soap or detergent diluted in water to clean the cabinet, front panel, or any other part of the equipment. Do not use abrasive materials, polishes, or harsh chemical solvents (such as alcohol or acetone) on any of its surfaces.

1.4.7 Inspection and maintenance instructions

For inspection and maintenance of the MO, the following points must be observed:



Do not open the equipment. It contains no user-serviceable parts. Servicing must be performed by Treotech technical support or by technicians accredited by the company. This equipment is completely maintenance-free; however, the user may perform visual and operational inspections, whether periodic or otherwise, if desired. These inspections are not mandatory.



Opening the MO at any time will void the product warranty. In cases of unauthorized opening, Treotech cannot guarantee proper operation, regardless of whether the warranty period has expired.



All parts for this equipment must be supplied by Treotech or one of its authorized suppliers, in accordance with Treotech's specifications. Should the user wish to acquire them from another source, they must strictly adhere to Treotech's specifications to ensure that the performance and safety of both the user and the equipment are not compromised. Failure to follow these specifications may expose the user and the equipment to unforeseen risks.

1.5 Customer Service

Are you already familiar with our online customer service platform?

CS

<https://sac.treotech.com.br/pt-BR/support/solutions/69000431975>

SAC



On the CS page, you'll find a quick and direct communication channel with our support team. Get your questions answered, resolve problems, and keep your Treotech product application up-to-date.

The Treotech knowledge base is also available, featuring catalogs, manuals, application notes, FAQs, and more.



In some cases, it will be necessary to send the equipment to Treotech's Technical Support department. Our Customer Service team will provide the full procedure and necessary contact details.



1.6 Warranty Terms

Treetech warrants the Moisture Monitor for a period of two (2) years from the date of purchase, exclusively against manufacturing defects or quality flaws that render it unfit for regular use.

The warranty does not cover damage to the product resulting from accidents, abuse, improper handling, incorrect installation or application, inadequate testing, or the breaking of the warranty seal.

The warranty does not cover damage to the product resulting from accidents, abuse, improper handling, incorrect installation or application, inadequate testing, or the breaking of the warranty seal.

No express or implied warranties other than those stated above are provided by Treetech. Treetech provides no warranty regarding the suitability of the MO for any specific application.

The seller shall not be held liable for any property damage or for any losses or damages arising from, connected to, or resulting from the purchase of the equipment, its performance, or any service provided in conjunction with the MO.

Under no circumstances shall the seller be held liable for incurred losses, including but not limited to: loss of profits or revenue; inability to use the MO or any associated equipment; cost of capital; cost of purchased energy; cost of substitute equipment, facilities, or services; downtime costs; or claims by the buyer's customers or employees—regardless of whether such damages, claims, or losses are based on contract, warranty, negligence, tort, or any other legal theory. Under no circumstances shall the seller be held liable for personal injury of any kind.



Do not attempt to access the equipment's factory menu (FABR). Attempting to access this menu with an incorrect password will cause the display to show the message "VOID"; after a few attempts, access to the equipment's menus will be completely blocked, and the warranty will be voided.

2 Introduction



Figure 1 - The Moisture Monitor MO on the left and the moisture/oil sensor on the right

Excess moisture in the insulating oil of high-voltage equipment, such as transformers and reactors, leads to well-known adverse effects—such as reduced dielectric strength and moisture migration into the insulating paper—creating risks of bubble formation and accelerated aging at high temperatures, thereby jeopardizing the equipment's service life and integrity.

The Moisture Monitor - MO consists of a moisture/oil sensor (MO Sensor), installed in contact with the oil, and an Interface Module; together, they enable the online measurement and monitoring of moisture in the oil, providing valuable information for diagnosing the equipment's current condition:

- Measurement of water saturation percentage in the oil and oil temperature (RS%);
- Calculation of the water saturation percentage converted to a user-selected reference temperature (RS% @ T_{REF}), making it possible to determine, for example, what the water saturation value would be at a standard temperature or at the lowest expected oil temperature during transformer operation;
- Water saturation percentage converted to a second temperature value, measured via a Pt100 sensor input (RS% @ T_2), making it possible to determine, for example, what the water saturation value would be if the transformer were de-energized and cooled to ambient temperature (in this case, T_2 would be the ambient temperature, measured by a Pt100 sensor);
- Water content in the oil in parts per million (ppm), calculated from the water saturation percentage and oil temperature measurements, using user-programmable water solubility constants;
- Calculation of the trend (rate of increase or decrease) of the water content in the oil in ppm per day (ppm/24h).

Based on the information above, alarm threshold values are programmed into the MO.

2.1 Features and functions

Self-diagnosis

Self-diagnosis function, featuring an NC output relay and display indication, for detecting any fault condition involving the sensor, connection cables, auxiliary power supply, or an internal failure of the MO.

IED (Intelligent Electronic Device)

Designed specifically for substation yard conditions (interference, extreme temperatures) and suitable for integration into supervisory or monitoring systems via the RS485 port (standard Modbus or DNP3).

Robust hardware

The TS design exceeds EMC (Electromagnetic Compatibility) standards to withstand the harsh electromagnetic conditions of substations and an operating temperature range of -40 to +85°C.

Internal clock

Internal clock with time retention for 48 hours in the event of a power failure, without the use of batteries; maintenance-free equipment.

No mechanical parts

Complete absence of mechanical parts for parameterization or calibration.

Compact and versatile

The MO features compact dimensions, resulting in space and installation cost savings.

LED display

High-brightness 4-digit LED display for easy viewing under any lighting conditions.

Relays

Six user-programmable output relays for alarm indications.

Current loop output

Programmable analog output for remote indication of measured and calculated variables. Programmable output range: 0 to 1 mA, 0 to 5 mA, 0 to 10 mA, 0 to 20 mA, or 4 to 20 mA.

Serial communication

RS-485 serial communication port for integration with supervisory or remote monitoring systems. Open communication protocols: Modbus RTU or DNP.



2.1.1 Inputs

- ✓ Input for the MO sensor.
- ✓ If the optional feature is active, an additional input can be used for Pt100 sensors featuring self-calibration, 0.2% full-scale accuracy, and high stability across a wide ambient temperature range.

2.1.2 Outputs

- ✓ Current loop (mA) analog output, user-programmable to remotely indicate measured and calculated variable values;
- ✓ NC contact for self-diagnosis or power loss indication;
- ✓ 6 programmable dry contacts (4 NO contacts + 2 changeover NO/NC contacts) for alarm signaling.

2.1.3 Communication

- ✓ 1 RS-485 serial communication port;
- ✓ Modbus® and DNP3 (optional) communication protocols with timestamp support, capable of signaling events such as alarms, shutdowns, cooling activation, etc., with 1 ms precision.

2.2 Optional Functions

Mass memory

Mass memory for storing measurements of relative saturation, water content in oil, oil temperature, sensor 2 temperature (if used), water content trend, and alarm events, based on an internal clock tracking day, month, year, hour, minute, and second. A memory recording can be triggered by:

- ✓ A user-selected time interval between recordings, or;
- ✓ The occurrence of any alarm.

The device's mass memory operates on a FIFO (First-In, First-Out) basis; that is, upon reaching the end of the memory, the oldest data are overwritten by new data. A new memory recording can be triggered by a time interval or by a change in oil temperature or water content in oil measurements exceeding the configured limits. The memory capacity is 1,489 records, with each record containing the measurements.

DNP3 protocol

User-selectable communication protocol between Modbus and DNP3, with support for 1 ms precision timestamps.



2.3 Basic Operating Philosophy

The Moisture Monitor (MO) measures the moisture content in the oil; its sensor is installed in direct contact with the oil, typically at a valve located where oil circulation is good.

The sensor measures the relative water saturation percentage in the oil: the ratio of dissolved water content (ppm) to water solubility (ppm) in the oil. Based on this measurement, the device calculates the water content in ppm and converts the relative saturation values to both reference and ambient temperatures.

To signal conditions where excess water in the oil could endanger the equipment, alarm limits based on the various measured and calculated parameters can be programmed into the MO; dry-contact relays can also be configured to activate when alarms occur.

In addition to alarm relays, the MO features a dedicated contact for self-diagnosis, signaling measurement failures, loss of auxiliary power, or internal device faults.

The equipment also provides an analog current loop (mA) output, which the user can program to remotely indicate measured temperature values.

An RS-485 serial communication channel enables communication with supervisory systems or other equipment, while also allowing access to configuration settings and data, including parameters, measurements, and memory logs. Users can select between Modbus and DNP3 communication protocols.

2.3.1 Relative saturation and water content

Relative saturation is the ratio of the dissolved water content in the oil (ppm) to the water solubility in the oil (ppm), where solubility represents the maximum water content that the oil could dissolve. Therefore, the water content in the oil (in ppm) corresponds to the relative saturation multiplied by the water solubility.

$$\text{Relative Saturation} = \frac{\text{Dissolved water content in the oil}}{\text{Water solubility in the oil}}$$

The solubility of water in oil depends on the oil's specific characteristics (composition, acidity, etc.), is calculated using its solubility constants (parameters **A1/A2** and **B** from Chapter 5), and also varies with temperature. For this reason, the moisture/oil sensor also measures the oil temperature.

The water-in-oil solubility constants are programmed by the user using typical values for the specific oil type or values obtained through testing. For details on how to determine oil solubility via testing, please refer to this article: [Determination of Water Solubility in Oil, by MO](#).

Based on the calculated water solubility and the relative saturation measurement, the MO can then calculate the water content in the oil, in ppm.

2.3.2 Conversions of relative saturation for different temperatures

Given that water solubility in oil varies with temperature, it is natural for relative saturation to vary as well, even if the water content in ppm remains constant. Consequently, as the oil cools, water solubility decreases, increasing the relative saturation.

If the oil temperature drops sufficiently, a point is reached where solubility approaches the water content, leading to the formation of free water in the oil and a risk of equipment failure. It is generally accepted that relative saturation levels exceeding 50% pose a risk of free water formation in the oil.

It follows from the above that a situation may arise where equipment operating at high temperatures presents no risk of free water formation, yet—upon being de-energized and cooling to ambient temperature—that same equipment develops free water in the oil, thereby preventing it from being re-energized.

For this reason, in addition to measuring water saturation at the equipment's current temperature, the MO also performs calculations to convert the water saturation to two other temperature values using the water-in-oil solubility constants A and B:

- A user-programmed reference temperature, which can be a standard value to allow comparisons between units of equipment or the lowest expected ambient temperature throughout the year;
- The temperature measured at the second Pt100 sensor input on the MO, typically used to measure ambient temperature. This allows the MO to calculate in real-time the extent to which water saturation in the oil would rise if the equipment were de-energized. Use of this second temperature measurement input is optional.

3 Design and Installation

3.1 System Topology

For ease of understanding, the MO can be divided into blocks of input, output, and communication terminals. These blocks will be explained individually. Basically, the Temperature Supervisor system consists of:

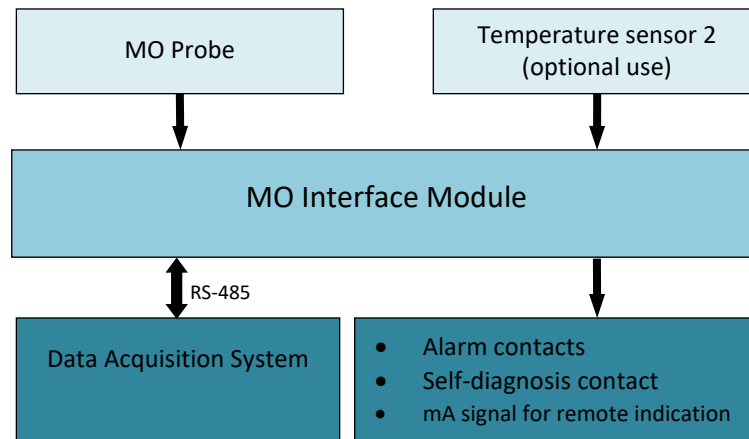


Figure 2 - Interconnection block diagram

The main items required for installation are:

- Moisture/oil sensor – MO Probe;
- MO Interface Module;
- Temperature sensor 2 (optional use, e.g., for ambient temperature measurement);
- 6-conductor shielded cable to connect the moisture/oil sensor to the Interface Module;
- 3-conductor shielded cable to connect temperature sensor 2 (if used) to the Interface Module;
- 2-conductor shielded twisted-pair cable for serial communication and/or remote indication via current loop (if used);
- Panel for mounting the Interface Module (if applicable);
- Basic supplies: Teflon tape, conduits, etc.



3.2 Electrical Installation

The MO is a versatile piece of equipment capable of handling a wide variety of applications.

Consequently, its installation requires a greater level of study and care than equipment dedicated exclusively to a single application or task.



Study and understand the application in which you intend to use the MO, and familiarize yourself with its functional, electrical, and configuration characteristics. This way, you will be able to get the most out of the equipment and minimize safety risks.



This equipment operates at dangerous supply voltage levels, which may result in death or serious injury to the operator or maintenance personnel.

Certain special precautions must be observed for the design and installation of the MO, as described below.



A circuit breaker must be installed immediately upstream of the power input (*universal power supply*: 38–265 VDC/VAC, <8 W, 50/60 Hz), corresponding to pins 18 and 19 of the MO.

The circuit breaker must have a number of poles matching the number of phases used in the power supply; the poles must interrupt only the phase lines—never the neutral or ground—and must provide thermal and electrical protection for the equipment's power conductors. Additionally, the breaker must be located near the equipment and be easily accessible to the operator.

Furthermore, it must bear an indelible label identifying it as the electrical disconnection device for the MO.



The following circuit breaker specification is recommended when used exclusively for the MO:

- AC/DC supply, Phase-Neutral: Single-pole circuit breaker, $1\text{ A} \leq I_n \leq 2\text{ A}$, curve B or C, standards NBR/IEC 60947-2, NBR/IEC 60898, or IEEE 1015-2006;
- AC/DC supply, Phase-Phase: Two-pole circuit breaker, $1\text{ A} \leq I_n \leq 2\text{ A}$, curve B or C, standards NBR/IEC 60947-2, NBR/IEC 60898, or IEEE 1015-2006.



The minimum insulation for circuits connected to the MO is 300 V_{rms} for auxiliary equipment and transducers, such as Pt100s. For self-powered equipment, it is up to 50 V_{rms}.

The minimum isolation is 1.7 kV_{rms} for equipment powered at up to 300 V_{rms}, in accordance with IEC EN 61010-1.

These values refer to the intrinsic isolation of the devices connected to the MO. Instances where this value does not apply to equipment or devices connected to the MO will be explicitly stated in this manual.

Figure 3 shows the general wiring diagram for the MO installation, including the interconnection between the moisture and interface sensors and their inputs and outputs.

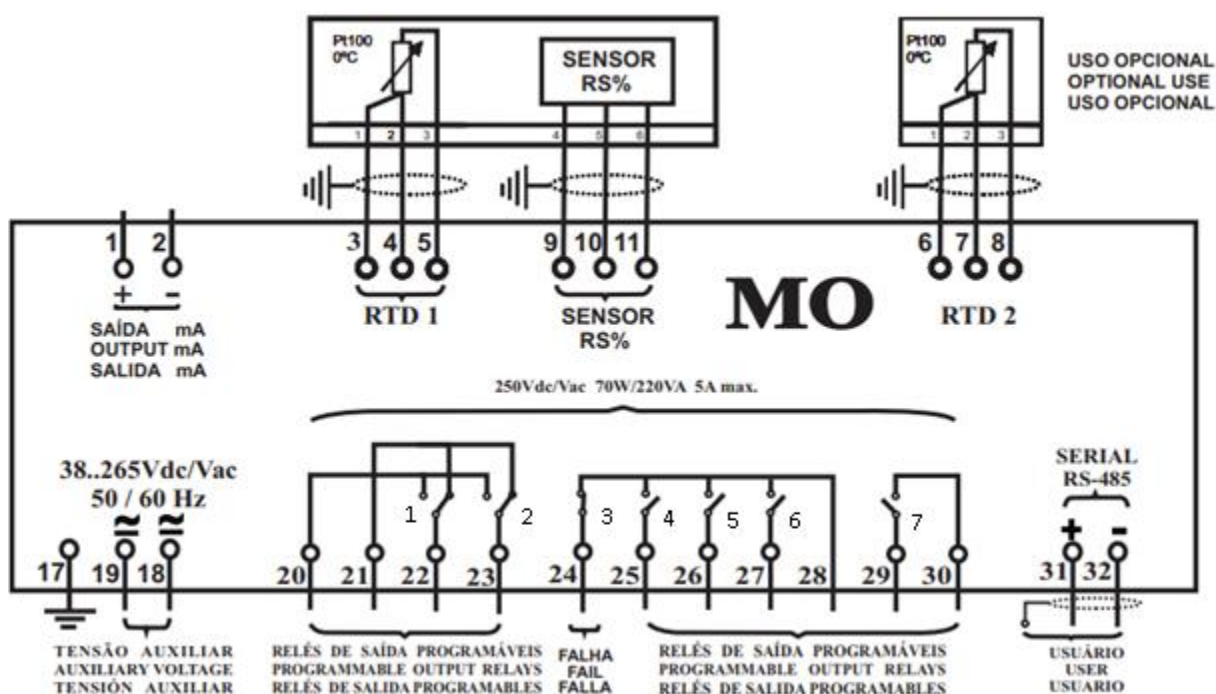


Figure 3 - Wiring diagram

3.2.1 Input and output terminals

The MO Moisture Monitor Interface Module has the following inputs and outputs:

Table 2 - MO input terminals

INPUTS	TERMINALS	
Auxiliary power supply and ground Universal power supply input (38 ~ 265 VDC/VAC, <8W, 50/60Hz)	17 - Ξ 18 - DC/AC 19 - DC/AC	
Moisture/oil sensor inputs One input for direct connection of the moisture/oil sensor	Pt100Ω sensor 0°C: RS% sensor:	3, 4 and 5 9, 10 and 11
Temperature sensor 2 input One optional input for direct connection of a Pt100 Ω sensor (at 0°C)	6, 7 and 8	
RS-485 port Connection to the data acquisition system (MODBUS-RTU or DNP3 protocol) via shielded twisted-pair cable	31 - (+) 32 - (-)	

Table 3 - MO output terminals

OUTPUTS	TERMINALS	
mA output A remote indication output with user-selectable variable and output range: 0...1, 0...5, 0...10, 0...20, or 4...20 mA	1 - (+) 2 - (-)	
Programmable relays Six potential-free alarm contacts for signaling	Relay 1	22 - (NC) 21 - (common) 20 - (common)
	Relay 2	23 - (NC) 21 - (common) 20 - (common)
	Relay 4	25 - (NO) 28 - (common)
	Relay 5	26 - (NO) 28 - (common)
	Relay 6	27 - (NO) 28 - (common)
	Relay 7	29 - (NO) 30 - (common)

Self-diagnosis relay

Potential-free NC contact for signaling power supply failure, connection cable or sensor faults, or internal failure

Relay 3

24 - (NC)

28 - (common)

3.2.2 Power supply and ground

The MO features a universal power input (38 to 265 VDC/VAC, 50/60 Hz).

Powering the equipment via the substation's auxiliary power supply is advisable, particularly when it is integrated into a serial communication network for data collection by supervisory or monitoring systems.

3.2.3 MO sensor and temperature sensor 2

The humidity and oil sensor must be connected to the Interface Module using a shielded cable without interrupting the shield; the shield must be grounded only at the end near the Interface Module. If intermediate terminal blocks are required for this connection, the cable shield must also be routed through a terminal block without being interrupted, as shown in Figure 4.

The unshielded cable section resulting from the splice must be kept as short as possible. This applies to temperature sensor 2, typically used for ambient temperature measurement: a shielded cable must be used, grounded only at the end near the MO, with the shield kept continuous, as shown in the figure below.

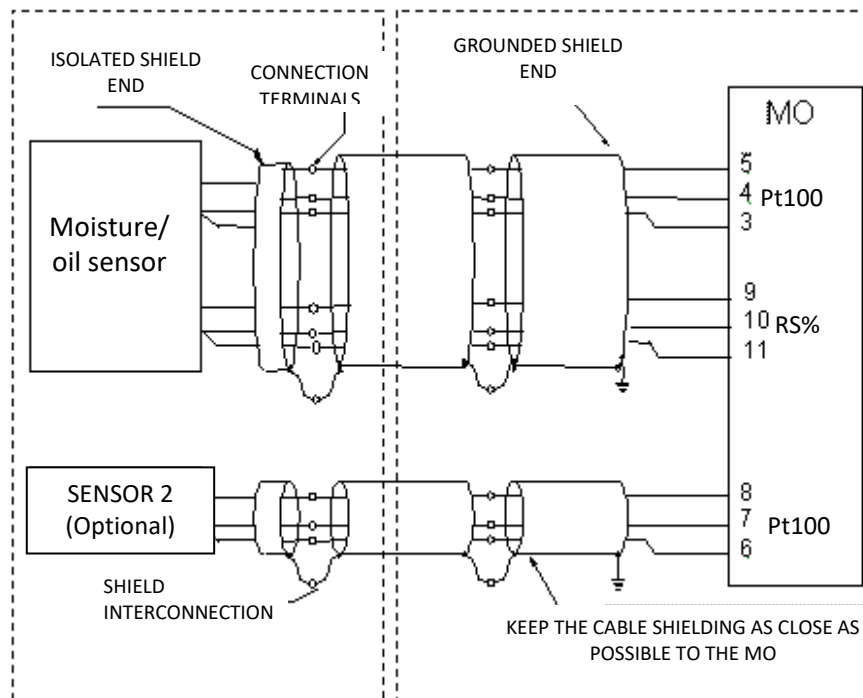


Figure 4 - Details of the shielding for the moisture/oil sensor connection cables

3.2.4 Analog output

The MO features a current-loop (mA) analog output that can be user-programmed to remotely indicate measured and calculated values. It is possible to program the output current range



and the scale start and end points, as well as select which variable is indicated on the analog output, as explained in subsection 5.4.

The maximum output voltage for the current loop is 10 V, resulting in the maximum loads in ohms shown below:

Table 4 - Maximum load of the current loop output

Output option	Maximum load
0...1 mA	10 k Ω
0...5 mA	2 k Ω
0...10 mA	1 k Ω
0...20 mA	500 Ω
4...20 mA	500 Ω

It is advisable to use a shielded twisted-pair cable, grounded at only one end, to minimize interference.

3.2.5 Relays

The MO features seven potential-free relays: four Normally Open (NO) relays and two changeover relays for alarm functions (user-programmable as per subsection 5.3), and one Normally Closed (NC) relay for self-diagnosis.

The relay contacts can switch loads of up to 250 V DC/AC, with a maximum power rating of 70 W / 250 VA (based on resistive loads). Their continuous current-carrying capacity (limited by Joule heating) is 5 A. For further information, please refer to our article [Relay specifications](#).



In the event of MO de-energization, the relays will return to their initial state.

3.2.6 Serial communication

The MO can be connected to a data acquisition system (supervisory or monitoring system) via the RS-485 serial communication port.

Up to 31 devices can be interconnected on the same communication network. The standard communication protocol is Modbus RTU, but the DNP3 protocol can also be used.

The connection between the MO and the data acquisition system must be made using a shielded twisted-pair cable, ensuring the shield remains continuous along the entire run. If intermediate terminal blocks are required for the serial communication connection, the cable shield must also be routed through a terminal to avoid breaking the shield continuity. Any unshielded section of cable resulting from a splice must be kept as short as possible, and it is recommended that the cable shield be grounded at only one end. The maximum distance of 1,200 meters between the ends of the communication network must be observed.



In the event of communication problems, particularly involving long networks (distances exceeding 1000 m) and high transmission rates (above 9600 bps), using a 120 Ω termination resistor at each end of the serial communication network can resolve transmission errors by attenuating signal reflection in the cable.

Another measure that can be attempted is the installation of pull-up and pull-down resistors at a single point on the network, as shown in Figure 5. The 5 V DC supply for the pull-up and pull-down resistors can be provided internally by the data acquisition system. Note that some communication equipment may already have these resistors installed internally, eliminating the need for external resistors.

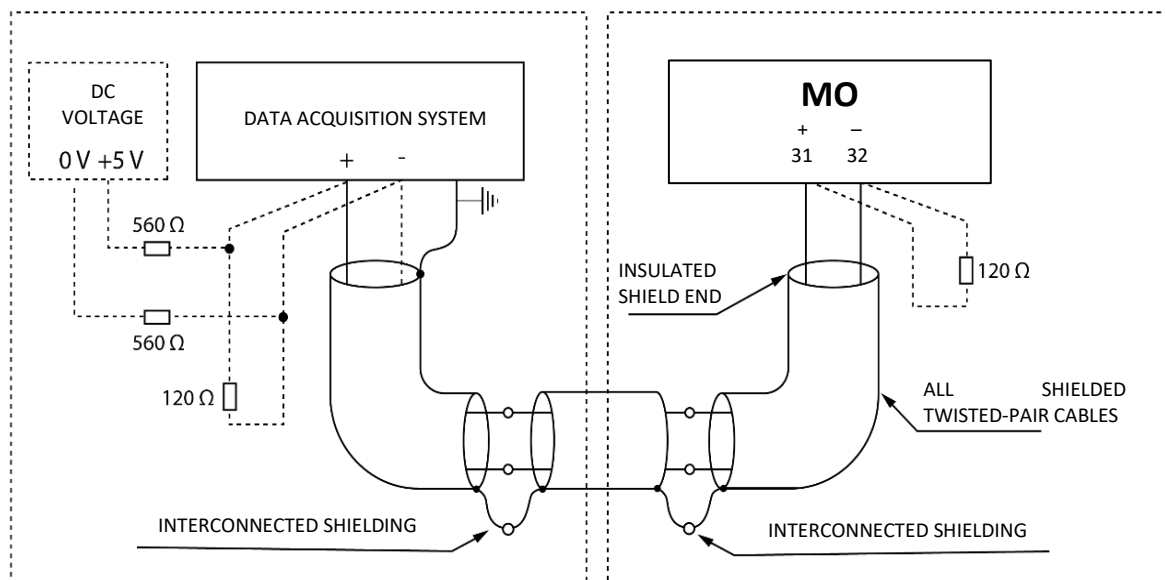


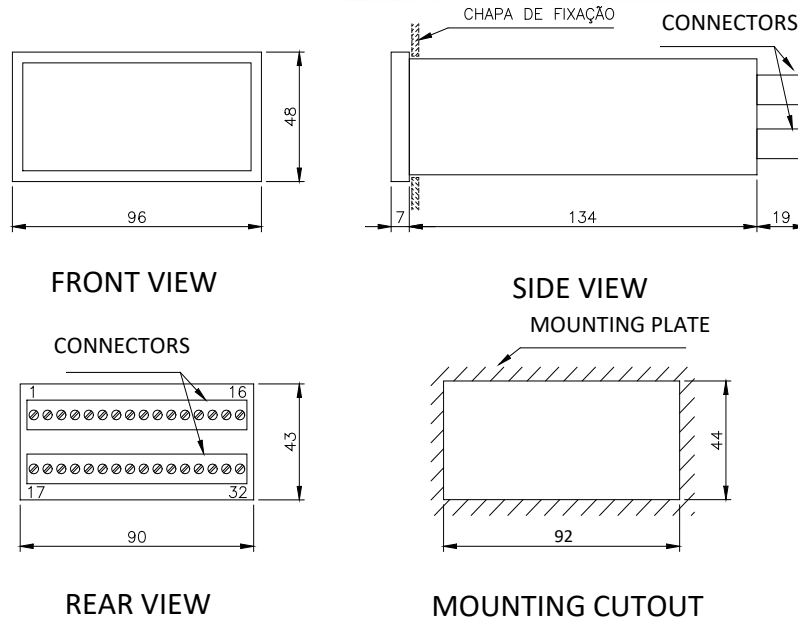
Figure 5 - Details of serial communication cable shielding

3.3 Mechanical Installation

3.3.1 Interface Module

Module must be installed in a location protected from the elements, such as inside panels or within a building. The use of an anti-condensation system is recommended. The Interface Module is suitable for flush mounting and can be secured, for example, to panel doors or front plates using the supplied mounting clips.

Figure 6 shows the main dimensions of the equipment, as well as the dimensions of the panel cutout required for its installation. Special attention should be paid to the thickness of the paint layers on the panel where the cutout is made; in some cases, when a thick paint coating is used, the reduction in the cutout area may prevent the module from being inserted. The connection terminals are located on the rear of the MO unit, within two removable connectors, to facilitate wiring. Cables ranging from 0.3 to 2.5 mm² may be used, either bare or fitted with pin-type (or needle-type) terminals.



ALL DIMENSIONS IN mm

Figure 6 - Interface Module dimensions

3.3.2 MO Sensor

The MO moisture/oil sensor must be installed on a valve of at least $\frac{1}{2}$ " that allows it to come into contact with the oil being measured. The valve used must be a full-bore type, such as a ball valve or gate valve.



Valves that do not allow free passage, such as globe valves, should not be used.

The moisture/oil sensor can be supplied with a probe in three different lengths; the appropriate length must be selected based on the distance from the threaded mounting point to the oil flow, as illustrated in the following figures. This ensures that the sensor tip is inserted into the oil flow.

The moisture/oil sensor features a $\frac{1}{2}$ " BSP (standard) or $\frac{1}{2}$ " NPT (upon request) male thread, which can be mounted directly onto the valve—provided it has a compatible thread—or installed using a suitable adapter.

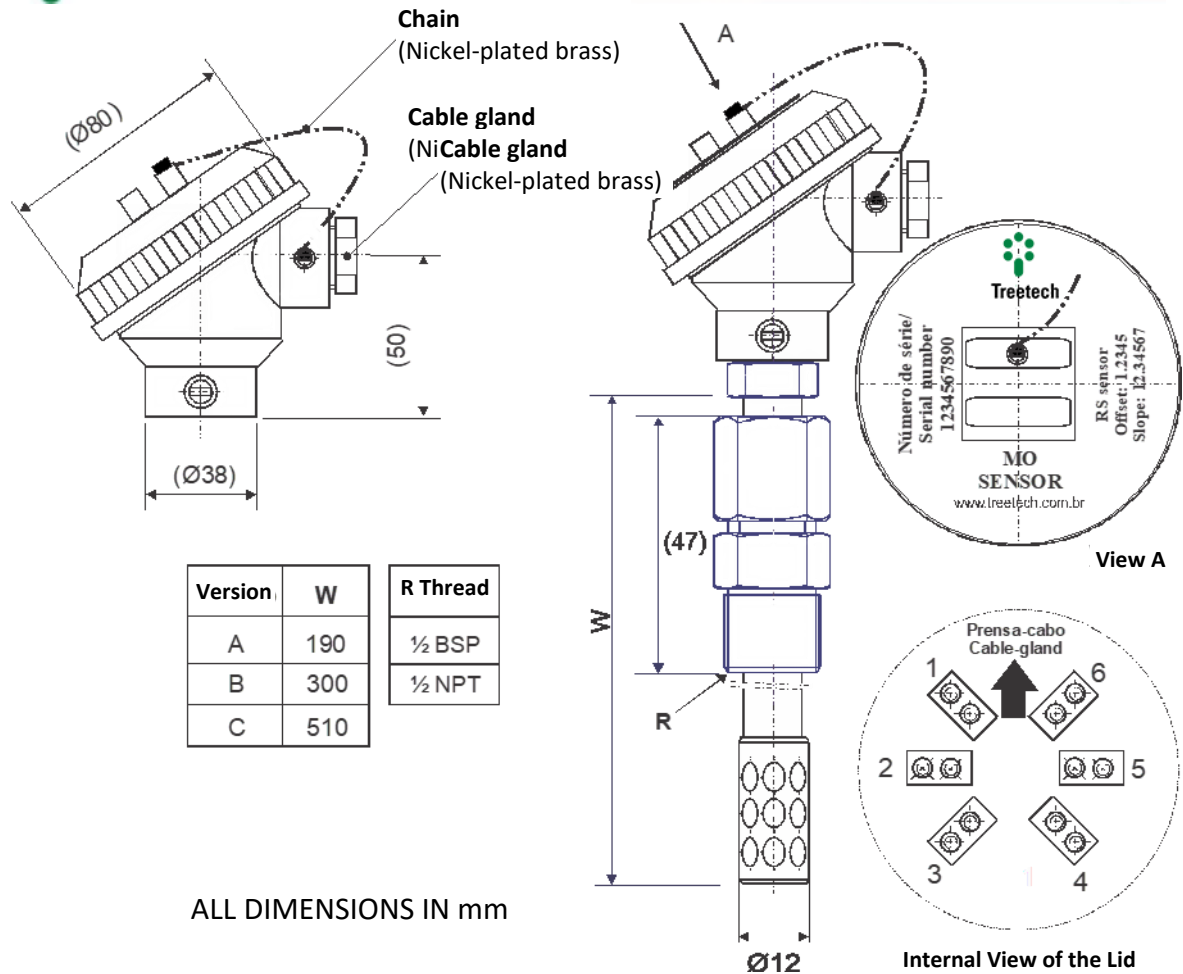


Figure 7 - Sensor module with head

The sensor must be installed in an area with good oil circulation, so that the moisture measurement is representative of the equipment's overall condition.

At the same time, preference should be given to areas with lower temperatures to increase measurement accuracy (for example, in typical mineral oil, a 1% variation in relative saturation corresponds to a change of just over 1 ppm in water content at 40°C, whereas at 80°C, that same 1% variation corresponds to more than 4 ppm). Also, observe the operating temperature limits for the oil and moisture sensor: -40°C to +85°C.

3.3.3 MO Sensor installation procedure

To install the MO sensor, consult the guide on the Customer Service page: [MO Sensor installation procedure](#).

4 Operation

4.1 Key Functions

All operations on the Moisture Monitor are performed using the display, LEDs, and keys on the front panel of the Interface Module, with the following functions:

Key	Function
	Programming key: provides access to the password required to enter configuration menus. Within these menus, it exits the current menu and returns to the previous level. If pressed while modifying a parameter, it returns to the previous menu level without saving the change.
	Up key: navigates through menus and increases programmed values.
	Down key: navigates through menus and decreases programmed values.
	Enter key: selects the menu option or parameter shown on the display and saves programmed values.

Figure 8 - Key functions

4.2 Query Screens

4.2.1 Variable indications

During normal operation, the Moisture Monitor MO displays the value of the variable indicated by the illuminated LED to its left, selected from the following options:

RS% - (Relative Water Saturation in Oil, in %)

RS% @ t_{ref} (Relative Saturation converted to reference temperature t_{ref} , in %)

RS% @ t_2 (Relative Saturation converted to temperature t_2 , in %)

H₂O ppm (Water Content in Oil, in ppm)

Temp. Óleo (Oil temperature at the moisture/oil sensor, in °C)

Any of the above measurements can be viewed by pressing the  and  keys. The LEDs will indicate which measurement is currently shown on the MO display.

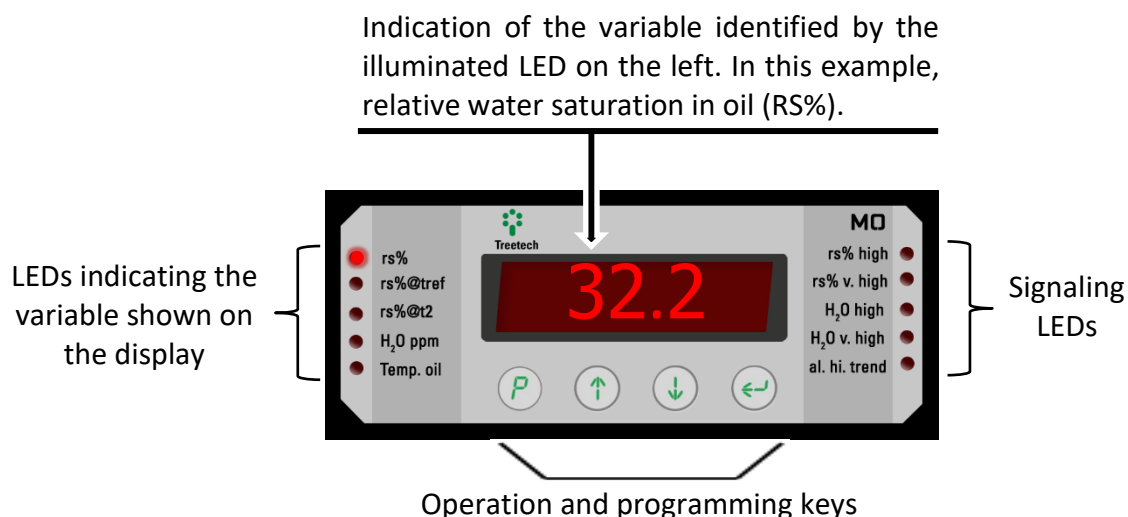


Figure 9 - Display indication of variables

4.3 Alarm Indications

When the programmed alarm value for any of the variables (relative saturation %, water content in ppm, or water content trend) is reached, the condition is signaled by the corresponding LED to the right of the display, as shown in the example in Figure 3.2. The output contact(s) programmed for this event are also activated.

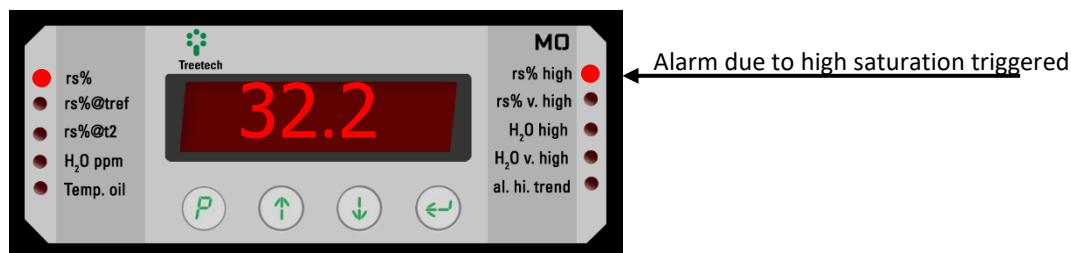


Figure 10 - Example of alarm indication

4.4 Viewing Additional Variables

In addition to the variables indicated by the LEDs to the left of the display, the MO also provides the following variables, which can be viewed via the front keypad. They are:

MAX	TEND - Trend of the evolution (rate of increase or decrease) of the water content in the oil in ppm per day (ppm/24h);
MAX	T2 - Temperature measured by temperature sensor 2 (if used);
HORA	HORA - Current hour from the equipment's internal clock;
MIN	MIN - Minute corresponding to the current time from the equipment's internal clock;

SEG

SEG - Second corresponding to the current minute from the equipment's internal clock;

dIA

DIA - Current day from the equipment's internal calendar;

MES

MÊS - Current month from the equipment's internal calendar;

ANO

ANO - Current year from the equipment's internal calendar.

To view these variables, press the  key; the abbreviation “TEND” will appear on the display, alternating with the recorded value for measuring the trend of water content evolution in the oil. Pressing the  key successively advances the query to the following variables: T2 (only if temperature sensor 2 is used), HOUR, MIN, SEC, DAY, MONTH, and YEAR. Pressing the  key returns the query to the previous variables. At any time, press the  key to return to the standard variable display. This will also happen if no user intervention occurs within a period of 20 seconds.

4.5 Self-diagnosis Indications

If the MO's self-diagnosis system detects a problem with the measurement sensors, connection cables, or an internal fault, the corresponding error code will appear on the display, alternating with the code “ERR” (see error table, Chapter IV).

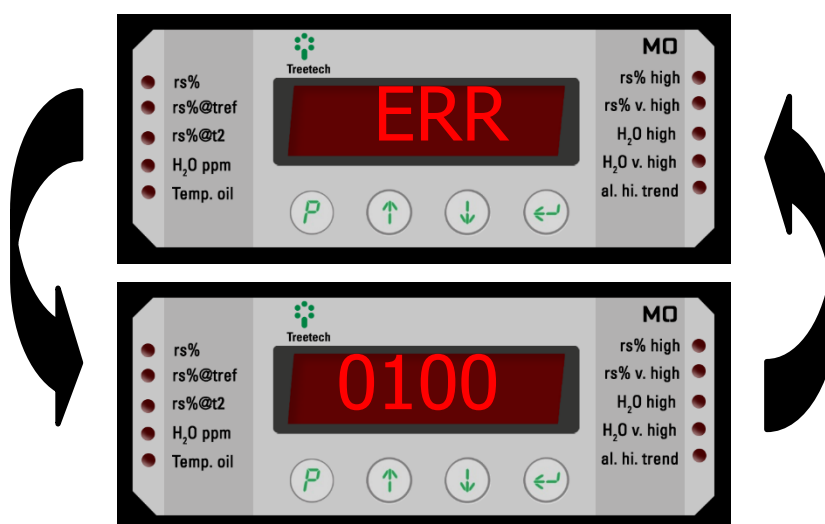


Figure 11 - Indications of self-diagnosis

Pressing the  or  keys returns the display to the variable readout, reverting to the error code display after a period of inactivity.

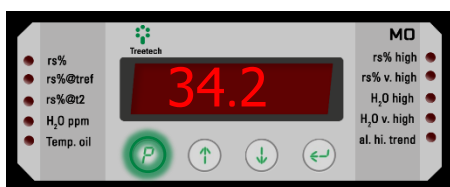
5 Parameterization

To ensure correct system operation, various parameters must be configured in the MO Interface Module; these provide the equipment with the information necessary for its functioning. Adjustments can be made using the front keypad and display, or via parameterization software connected through the RS485 serial communication port.

The programmable parameters are organized into menus protected by password access. From the main menu, the user can access programming submenus to navigate and adjust values according to the transformer's characteristics and user requirements.

5.1 Accessing the Programming Menu

To access the programming menu of the Moisture Monitor MO, follow the procedure below:



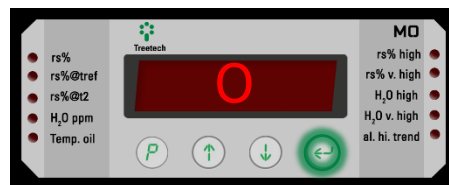
1) On the general display screen, press  and hold it for 3 seconds.



2) The password entry screen will be displayed. Press the  key to enter the password value.



3) Use the  and  keys to adjust the password.



4) After setting the password, press the  key to enter the first programming menu.

The factory password is 0 (zero) and can be reprogrammed by the user (see the CNF submenu).



5) The first submenu (ALRM) is displayed. Use the  and  keys to select a submenu and press  to access its parameters.



The initial number displayed when reaching the third figure can be used to recover the password if forgotten. Please provide this number to our Technical Support Department.

The programmable parameters are divided into several menus: ALRM (alarm settings), CNF (device settings), SENS (relative saturation sensor characteristics), MED (oil characteristics), LOG (data logging settings, only if the equipment is equipped with this optional function), RLG (clock settings), FAB (factory menu, password-protected), and DWL (firmware update).

5.2 Parameterization Map

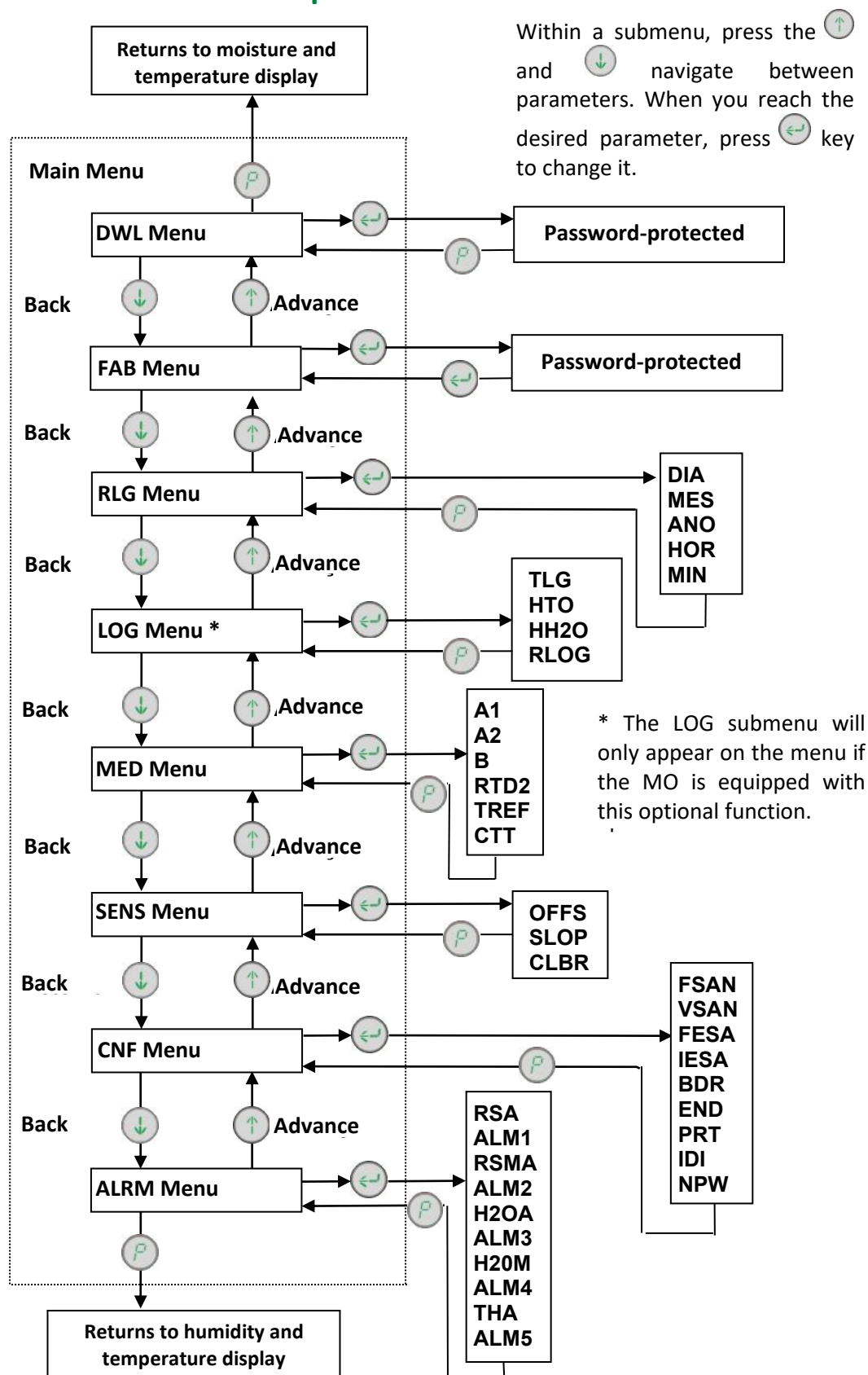


Figure 12 - Submenu access structure



5.3 ALRM Menu - Alarm

Provides access to all alarm-related parameters of the MO.

ALRM

RSA - Alarm due to high water-in-oil saturation

Determines the setpoint for triggering the alarm due to high relative water saturation in the oil.

RSA

Adjustment range: 0 to 100%, in 1% steps

Default value: 50 %

ALM1 - Relay for signaling the alarm due to high water-in-oil saturation

Selection of the relay that will activate upon an alarm due to high relative water saturation in the oil.

ALM1

The same relay can be used to simultaneously signal other alarm conditions.

Adjustment range: NULL, RL1, RL2, RL4, RL5, RL6 and RL7

Default value: RL4

RSMA - Alarm due to very high water-in-oil saturation

Determines the threshold for triggering the alarm due to very high relative water saturation in the oil.

RSMA

Adjustment range: 0 to 100%, in 1% steps

Default value: 75 %

ALM2 - Relay for signaling the alarm due to high water-in-oil saturation

Selection of the relay that will actuate upon the occurrence of an alarm due to very high relative water saturation in the oil.

ALM2

The same relay can be used to simultaneously signal other alarm conditions.

Adjustment range: NULL, RL1, RL2, RL4, RL5, RL6 and RL7

Default value: RL5

H2OA - Alarm due to high water-in-oil content

Determines the threshold for the alarm due to high water content in the oil.

H2OA

Adjustment range: 0 to 500 ppm, in 1 ppm steps

Default value: 50 ppm

ALM3 - Relay for signaling the alarm due to high water-in-oil content

Selection of the relay that will activate upon an alarm due to high water content in the oil.



The same relay can be used to simultaneously signal other alarm conditions.

Adjustment range: NULL, RL1, RL2, RL4, RL5, RL6 and RL7

Default value: RL6

H2OM - Alarm due to very high water-in-oil content

Determines the threshold for the alarm due to very high water content in the oil.



Adjustment range: 0 to 1000 ppm, in steps of 1 ppm

Default value: 75 ppm

ALM4 - Relay for signaling the alarm due to very high water-in-oil content

Selection of the relay that will activate upon an alarm due to very high water content in the oil.



The same relay can be used to simultaneously signal other alarm conditions.

Adjustment range: NULL, RL1, RL2, RL4, RL5, RL6 and RL7

Default value: NULL

THA - Alarm due to high trend in the evolution of water-in-oil content

Determines the threshold for the alarm due to high trend in the evolution of water content in the oil.



Adjustment range: 0 to 50.0 ppm/day, in 0.1 ppm/day steps

Default value: 25.0 ppm/day

ALM5 - Relay for signaling THA alarm (High trend in the evolution of water-in-oil content)

Selection of the relay that will actuate upon an alarm due to high trend in the evolution of water content in the oil.



The same relay can be used to simultaneously signal other alarm conditions.

Adjustment range: NULL, RL1, RL2, RL4, RL5, RL6 and RL7

Default value: RL7



5.4 CNF Menu - Configuration

Provides access to all general configuration parameters of the MO.

CNF

FSAN - Analog output range

Selects the current loop output range.

Adjustment range: 0-1, 0-5, 0-10, 0-20 and 4-20 mA

Default value: 0-5 mA

FSAN

VSAN - Analog output variable

Selection of the variable associated with the current loop output.

Adjustment range:

RS = Percentage of water saturation in the oil;

RSTR = Percentage of water saturation in the oil, calculated based on the reference temperature;

RST2 = Percentage of water saturation in the oil, calculated based on temperature 2;

H2O = Water content in the oil;

TO = Oil temperature;

T2 = Temperature measured by sensor 2;

TEND = Trend of the water content in the oil over time.

Default value: RS

VSAN

FESA - Analog output full-scale value

Defines the correspondence between the final current of the analog output and the last value on the scale of the measured quantity.

Adjustment range: -55 to 500 in steps of 1

Default value: 33

FESA

IESA - Analog output scale start value

Defines the correspondence between the initial analog output current and the first scale value of the measured quantity.

Adjustment range: -55 to 500 in steps of 1

Default value: 15

IESA

BDR - Baud rate

Selects the serial communication speed.

Adjustment range: 9.6, 19.2, and 38.4 kbps

bdR

Default value: 19.2 kbps

END - Address

MO address on the serial communication network.

Adjustment range: 1 to 31 in steps of 1

Default value: 1

END

PRT - Protocol

Type of protocol to be used for communication with the data acquisition device.

Adjustment range: Mdb (Modbus) or dNP (DNP3).

Default value: dNP

pRT

IDI - Language

Interface language selection.

Adjustment range:

POR = Portuguese;

ENG = English;

ESP = Spanish.

Default value: POR.

Idl

NPW - New password

Setting the new password for accessing the parameterization menu.

Adjustment range: 0 to 999 in steps of 1

Default value: 0 (factory setting)

NPW

5.5 SENS Menu - Sensor

Allows you to specify the characteristics of the water saturation sensor to the Interface Module. The values for these parameters can be obtained from the data sheet supplied with the moisture and oil sensor or directly from the label attached to it.

SENS

OFFS - Offset

Program the specific value for the moisture/oil sensor connected to the Interface Module, obtained from the label affixed to the MO sensor or its data sheet.

OFFS

Adjustment range: 0.600 to 1.200 mV, in 0.001 steps

Default value: 0.840

SLOP - SLOPE

Program the specific value for the moisture/oil sensor connected to the Interface Module, obtained from the label attached to the MO sensor or its data sheet.



Adjustment range: 28.00 to 32.00 mV, in 0.01 steps

Default value: 30.00

CLBR - Relative saturation measurement fine-tuning

Allows the user to perform a fine calibration of the relative saturation measurement (RS%) via an offset adjustment.



Adjustment range: -10.0% to +10.0% in 0.1% steps

Default value: 7.0 %

5.6 MED Menu - Measurement

Allows adjustment of the calculation parameters used by the MO, such as water-in-oil solubility characteristics and others.



A1 - Part 1 of the water-in-oil solubility constant

Parameters A1 and A2 represent the value of constant A for water-in-oil solubility. Typical values based on the oil type (see Table 5) or values obtained from tests can be set.



Adjustment range: 1.0 to 9.9, in 0.1 steps

Default value: 7.0

A2 - Part 2 of the water-in-oil solubility constant

Component of parameter **A1** used to determine the typical value.



Adjustment range: 0 to 999, in steps of 1

Default value: 700

The final solubility value is the concatenation of parameters A1 and A2; therefore, the value of A1 represents only the ones and tenths places, while the value of A2 represents the hundredths. Example: 7.0 and A2 = 895 → Solubility = 7.0895.

Table 5 - Typical water solubility values in oil types (A)

Oil type	Typical value of A
Mineral	7.0895
Silicone	6.2906
Envirotemp FR3	5.3318



B - Water-in-oil saturation constant

The value of B represents the water-in-oil solubility constant B. Like parameters A1 and A2, it can be set to a typical value based on the oil type or to values obtained from tests.



Adjustment range: 0 to 3000, in steps of 1

Default value: 1567

Table 6 - Typical water solubility values in oil types (B)

Oil type	Typical value of B
Mineral	1567
Silicone	1187
Envirotemp FR3	687

RTD2 - Enable temperature sensor 2

Allows enabling or disabling the input for temperature sensor 2, typically used for ambient temperature measurement. When this sensor is not used, the input must be disabled to prevent a false self-diagnosis alarm.



Adjustment range:

ON = Input for sensor 2 enabled

OFF = Input for sensor 2 disabled

Default value: ON

TREF - Reference temperature for calculation

This parameter represents the reference temperature used in the calculation of relative saturation converted to the reference temperature.



Adjustment range: -55 to 200 °C, in 1 °C steps

Default value: 5 °C

CTT - Time constant for trend calculation

Time constant of the first-order digital filter used to calculate the trend in the water content of the oil. This filtering prevents temporary fluctuations in water content from resulting in high trend values that would trigger false alarms.



Adjustment range: 1 to 30 days, in 1-day steps

Default value: 5 days



5.7 LOG Menu – Measurement and event log (optional)

Allows for the adjustment of settings for recording measurements and events in the MO's mass memory. This submenu appears only if the MO is equipped with this optional feature.

A digital display showing the word "LOG" in red capital letters on a black background.

The MO's mass memory operates on a FIFO (First In, First Out) basis; that is, once the memory is full, the oldest data is overwritten by new data. Memory recording can be triggered by a time interval or by changes in oil temperature or water-in-oil content measurements.

The memory capacity is 1,489 records; each record includes measurements of relative saturation, water-in-oil content, oil temperature, sensor 2 temperature (if used), water content trend, and alarm occurrences.

TLG - Memory recording interval

Determines the time interval for the MO to perform a new recording to mass storage.

A digital display showing the letters "TLG" in red capital letters on a black background.

Adjustment range: 1 to 1000 minutes, in 1-minute steps

Default value: 5 minutes.

HTO - Oil temperature hysteresis

Determines a variation value in the oil temperature; if this value is exceeded, the MO performs a new recording in the mass memory.

A digital display showing the letters "HTO" in red capital letters on a black background.

Adjustment range: 0.1 to 10 °C, in 0.1 steps

Default value: 0.1 °C

HH2O - Water-in-oil content hysteresis

Determines the magnitude of the change in oil water content (in ppm) that, if exceeded, triggers the monitoring unit to record a new entry in the mass memory.

A digital display showing the letters "HH2O" in red capital letters on a black background.

Adjustment range: 0.1 to 5 ppm, in 0.1 steps

Default value: 0.5 ppm

RLOG - Log reset

Resets the MO mass memory. Upon selecting the "YES" option and confirming, all data in the mass memory will be erased.

A digital display showing the letters "RLOG" in red capital letters on a black background.

Adjustment range: YES or NO

Default value: NO

5.8 RLG Menu - Clock

Allows adjustment of the device's clock and calendar.

A digital display showing the letters "RLG" in red capital letters on a black background.

MES - Month

Adjustment of the current month in the equipment's calendar.

Adjustment range: months 1 to 12, in 1-month steps

Default value: 6 months

A digital display showing the text "MES" in red on a dark background.

DIA - Day

Adjustment of the current day in the equipment's calendar.

Adjustment range: day 1 to 31, in 1-day steps

Default value: day 15

A digital display showing the text "dIA" in red on a dark background.

ANO - Year

Adjustment of the current year in the equipment's calendar.

Adjustment range: year 06 (2006) to 99 (2099), in 1-year steps

Default value: year 06 (2006)

A digital display showing the text "ANO" in red on a dark background.

HOR - Hours

Adjustment of the current hour on the equipment's clock.

Adjustment range: 0 to 23 hours, in 1-hour steps

Default value: 14 hours

A digital display showing the text "HORA" in red on a dark background.

MIN - Minutes

Adjustment of the minutes on the equipment's clock.

Adjustment range: 0 to 59 minutes, in 1-minute steps

Default value: 33 minutes

A digital display showing the text "MIN" in red on a dark background.

5.9 FAB Menu - Factory

Provides access to factory parameters. It is for the exclusive use of Treotech technical support, is password-protected, and is not accessible to the equipment operator.

A digital display showing the text "FAB" in red on a dark background.

5.10DWL Menu

The DWL menu is for the exclusive use of technical support and is password-protected; it is not accessible to the user.

A digital display showing the text "dWL" in red on a dark background.

6 Commissioning for Entry into Service

Once the equipment has been installed in accordance with Part II of this manual, commissioning must follow the basic steps below.

- ✓ Verify the mechanical installation of the moisture/oil sensor and the Interface Module according to the recommendations in Chapter 5. Special care must be taken to ensure the moisture/oil sensor probe does not come too close to areas subject to high electric fields, so as not to compromise the transformer's insulation.
- ✓ Verify the electrical installation according to the recommendations in Chapter 6. Check the correctness of the electrical connections (e.g., via continuity tests).
- ✓ If performing dielectric strength tests on the wiring (applied voltage test), disconnect the ground cable attached to terminal 17 of the Interface Module to avoid destroying the overvoltage protection devices inside the unit. These protection devices are internally connected between the input/output terminals and ground, clamping the voltage at approximately 300V. Applying high voltages for an extended period (e.g., 2kV for 1 minute) would destroy these protection devices.
- ✓ Reconnect the ground cable to terminal 17 of the Interface Module if it was disconnected for the applied voltage test. Power up the Interface Module using any voltage in the range of 38 to 265V DC/AC (50/60Hz).
- ✓ Perform all parameterization of the Interface Module according to the instructions in Chapter 5. The parameterization settings can be recorded on the form provided on the next page and must include:
- ✓ Verify that the indications for relative saturation and water content in the oil are consistent with the actual values in the oil. If necessary, readjust the water solubility constants for oil A and B according to the procedure described in subsection Erro! Fonte de referência não encontrada..
- ✓ Verify that the oil temperature readings from the moisture/oil sensor and ambient temperature (if used) are correct.
- ✓ Using a DC milliammeter, verify that the current loop output corresponds to the value of the assigned variable.
- ✓ Using a continuity tester, test the operation of the alarm contacts. Contact actuation can be forced by lowering the alarm settings to values below the ongoing measurements.

6.1 Parameterization Sheet

Below is the link—along with a QR code—directing you to our Wiki and Customer Service page. It contains a spreadsheet (which can be printed) listing all MO parameters, designed to assist with the equipment parameterization process.

Parameterization sheet:

<https://sac.treetech.com.br/pt-BR/support/solutions/articles/69000864819-folha-de-parametriza%C3%A7%C3%A3o-do-mo>

Folha de parametrização



7 Troubleshooting

Should you encounter difficulties or problems while operating the system, we suggest consulting the possible causes and simple solutions presented below. If this information is insufficient to resolve the issue, please contact Treotech technical support or your authorized representative.

7.1 The MO Displays Self-diagnosis Messages

The self-diagnosis function implemented in the MO allows for the detection and diagnosis of faults—whether external to the equipment or internal—enabling the user, in most cases, to quickly identify and resolve the issues.

Upon detecting a problem, the MO activates its self-diagnosis contact and displays the code “ERR” alternating with the specific fault code, as shown in the figure. The fault code is indicated on the four-digit display in hexadecimal format.

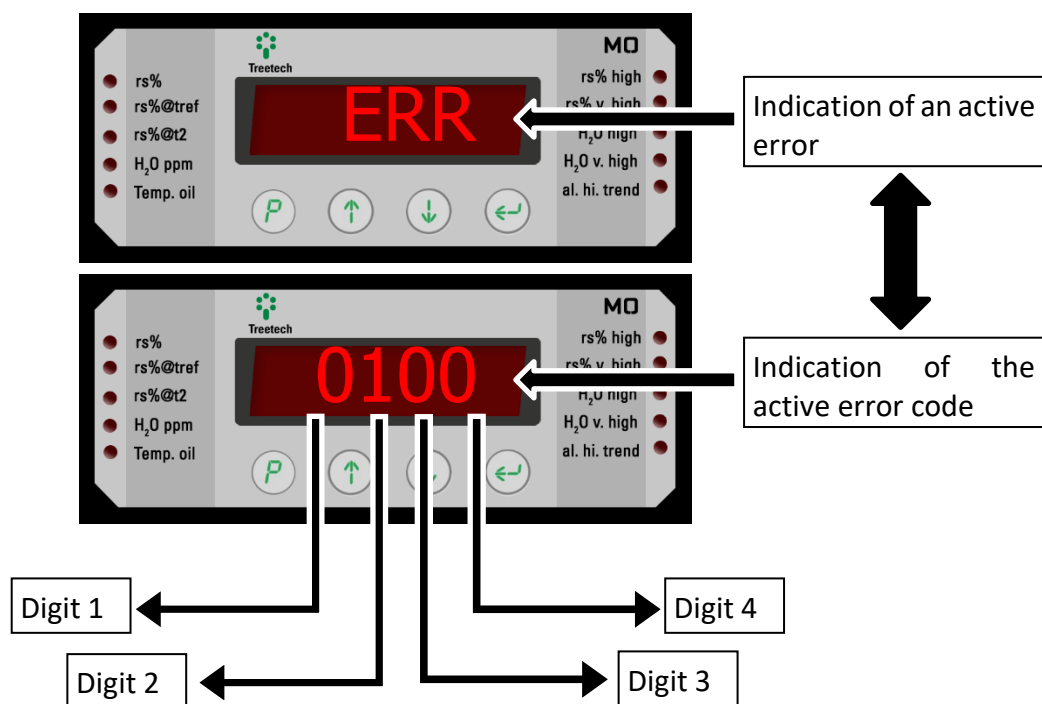


Figure 13 - Indications of self-diagnosis

To check the procedure for self-diagnosis and possible errors generated by the MO, follow the instructions by clicking the link below or scanning the QR code to be redirected to Treotech Customer Service.

Self-diagnosis:

sac.treetech.com.br/pt-BR/support/solutions/

Autodiagnóstico





8 Technical Data and Type Tests

8.1 Technical Data

Table 7 - Interface module

Tests	Range / Description
Supply voltage:	38...265 VAC/VDC, 50/60 Hz
Maximum consumption:	< 8 W
Operating temperature:	-40...+85 °C
Protection rating:	IP 20
Mounting:	Panel mounting
Connections - Removable terminals:	0.3...2.5 mm ² , 22...12 AWG

Table 8 - Temperature measurement

Temperature Measurement	
Sensor:	Pt100...0 °C with continuous self-calibration
Measurement range:	-55...+200 °C
Maximum error at 20 °C:	0.2% of full scale
Temperature-induced drift:	20 ppm/ °C
Connection options:	Up to 2 three-wire sensors

Table 9 - Water saturation percentage measurement

Water Saturation Percentage Measurement	
Input type:	Treetech oil and moisture sensor
Measurement range:	Treetech oil and moisture sensor
Maximum error at 20°C:	± 2 % water saturation
Connection:	Three-wire
Relay outputs:	Potential-free contacts
Type and functions (standard):	5NO (configurable) + 3NC (2 configurable and 1 self-diagnosis)
Maximum switching power:	70 W (dc) / 220 VA (ac)
Maximum switching voltage:	250 Vdc / Vac
Maximum continuous current:	5 A
Analog outputs:	2 with common positive
Variables:	Programmable
Maximum error:	0.5% of full scale
Maximum load:	0...1 mA, 10 kΩ, 0...5 mA, 2 kΩ, 0...10 mA, 1 kΩ 0...20 mA, 500 Ω, 4...20 mA, 500 Ω.
Serial communication ports:	1 RS485 (for MO) + 1 RS485 / RS232 (for supervisory system)
Communication protocols:	Modbus RTU and DNP3 Level 1
Mass storage (optional):	Non-volatile FIFO (First In, First Out)
Recording interval:	1 to 1000 hours
Capacity:	1489 records

Table 10 - Moisture/oil sensor

Operating temperature - Ambient:	-40...+85 °C
Operating temperature - Oil:	-40...+85 °C
Storage temperature:	-51...+125 °C
Typical response time:	10 minutes



Maximum process pressure:	0.1 MPa (1.0 bar) / Full vacuum
Protection rating:	IP 66 (NEMA 4)
Connections:	6 wires 0.3...1.5 mm ² , 22...14 AWG
Installation:	1/2" or larger ball or gate valve
Valve connection:	1/2" BSP (standard) or 1/2" NPT (optional) thread

8.2 Type Tests

The MO is a device built on the Smart Sensor 2 platform, which underwent the following type tests:

Table 11 - Tests performed

Tests	Range / Description
Immunity to Surges (IEC 60255-22-5) Phase-to-neutral surges: Phase-to-earth and neutral-to-earth surges:	1 kV, 5 per polarity (+/-) 2 kV, 5 per polarity (+/-)
Immunity to Electrical Transient (IEC 60255-22-1 and IEEE C37.90.1) 1st cycle peak value: Frequency: Duration and repetition rate: 50% decay:	2.5 kV 1.1 MHz 2 seconds, 400 surges/s 5 cycles
Voltage Impulse (IEC 60255-5) Waveform: Amplitude and energy: Number of pulses:	1.2 / 50 μ s 5 kV 3 negative and 3 positive, 5 s interval
Applied Voltage (IEC 60255-5) Power-frequency withstand voltage:	2 kV 60 Hz 1 min. to ground
Immunity to Radiated Electromagnetic Fields (IEC 61000-4-3 / IEC60255-22-3) Frequency: Field strength:	26 to 1000 MHz 10 V/m
Immunity to Conducted Electromagnetic Disturbances (IEC 60255-22-6) Frequency: Field strength:	0.15 to 80 MHz 10 V/m
Electrostatic Discharge (IEC 60255-22-2 and IEEE C37.90.3) Air mode: Contact mode:	8 kV, ten discharges/polarity 6 kV, ten discharges/polarity
Immunity to Fast Electrical Transient (IEC60255-22-4 and IEEE C37.90.1): Test on power supply, inputs and outputs: Test on serial communication:	4 kV 2 kV
Climatic Test (IEC 60068-2-14) Temperature range: Total test time:	-40 to +85 °C 96 hours
Vibration Response (IEC 60255-21-1) Application mode: Amplitude: Duration:	3 axes (X, Y, and Z), sinusoidal 0.075 mm from 10 to 58 Hz 1 G from 58 to 150 Hz 8 min/axis
Vibration Resistance (IEC 60255-21-1) Application mode: Frequency: Intensity: Duration:	3 axes (X, Y, and Z), sinusoidal 10 to 150 Hz 2 G 160 min/axis

9 Ordering Specifications

The Moisture Monitor MO is a universal device; its characteristics are selected via programming menus using the front panel or the RS232 or RS485 ports. It features a universal power supply input.

Therefore, when ordering the device, it is only necessary to specify:

9.1 Moisture Monitor MO - Interface Module

1. Product name

Moisture sensors - MO

2. Quantity

Number of units.

3. Desired optional functions

Option 1: Mass memory

Option 2: DNP3 protocol

9.2 Moisture Monitor MO - MO Probe

1. Product name

Moisture sensors - MO

2. Quantity

Number of units.

3. Desired connector version

Removable plug

Head

4. Desired probe length version

A (190 mm)

B (300 mm)

C (510 mm)

5. Desired connection thread type

½" BSP thread (Standard)

½" NPT thread

10 Accessories

There are accessories that complement the MO; depending on the selected functions, some are required for operation, while others are optional. For more information on the accessories supplied by Treotech, please consult our [accessories catalog](#).

10.1 Optional Accessories

10.1.1 Quick installation panel - PIR

The Moisture Monitor Interface Module must always be installed sheltered from the elements; therefore, it is typically mounted inside the transformer control panel. In cases where this is not practical—such as when retrofitting older transformers—the Interface Module can be supplied in an easy-to-install, weatherproof enclosure.

Features	Range/description
Transformer mounting	Screw-mounted or high-load-capacity magnets
MO mounting	In a pull-out rack
Wiring connection	Removable multipole plugs at the bottom of the enclosure
Protection rating	IP55
Insulation test	2 kV, 50/60 Hz, 1 min



10.1.2 Meteorological shelter

The Moisture Monitor MO features a second input for a temperature sensor; the measurement from this sensor is used to calculate the percentage of water saturation in the oil at that specific temperature. Typically, this input is used to measure ambient temperature, allowing for the monitoring of water saturation levels in the oil should the transformer be de-energized.

Ambient temperature is measured using a Pt100 (0°C) temperature sensor installed in a meteorological shelter, which minimizes measurement errors caused by factors such as sun, rain, and wind. If required, Treotech offers suitable sensors and meteorological shelters for this measurement, available as optional accessories.





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