USER MANUAL

Treetech

SMART DEVICE FOR OLTC TORQUE

Contents

Illustrations

Tables

1 Preface

1.1 Legal information

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

This document belongs to Treetech Tecnologia 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

Treetech 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. Treetech Tecnologia assumes no responsibility resulting from the application or use of any product or circuit described herein, nor does it transfer any licenses or patents under its rights, nor the rights of third parties.

Treetech Tecnologia may hold patents or other types of intellectual property registrations and rights described in the content of this document. Possession of this document by any person or entity does not grant them any rights to these patents or registrations.

1.2 Presentation

This manual presents all recommendations and instructions for the installation, operation, and maintenance of the Smart Device for OLTC Torque - SDM.

1.3 Typographical conventions

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

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

Italics: Foreign language terms, alternative terms, or terms used outside of formal contexts are italicized.

Underlined: References to external documents.

1.4 General and safety information

This section will present relevant aspects regarding the security, installation, and maintenance of the SDM.

1.4.1 Safety symbols

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

Warning:
This symbol is used to highlight certain observations, alerting the user to a potentially dangerous operational or maintenance procedure that requires greater care in its execution. Minor to moderate injuries may occur, as well as damage to equipment.

Attention:
This symbol is used to alert the user to a potentially dangerous operational or maintenance procedure where extreme caution must be exercised. Serious injury or death may occur. Possible damage to equipment will be irreparable.

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

1.4.2 General symbols

This manual uses the following general-purpose symbols:

Important
This symbol is used to highlight information.

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

1.4.3 Minimum recommended profile for the SDM operator and maintainer

The installation, maintenance, and operation of equipment in electrical substations require special care, and therefore, all recommendations in this manual, applicable standards, safety procedures, safe work practices, and good judgment must be used during all stages of handling the Smart Device for OLTC Torque - SDM.

Only authorized and trained personnel, operators and maintenance staff, should handle this equipment.

To handle the SDM, the professional must:

1. Be trained and authorized to operate, ground, power on, and power off the SDM, following maintenance procedures in accordance with established safety practices, which are the sole responsibility of the SDM operator and maintainer;
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 of SDM, as well as its configuration;
4. Follow the regulatory recommendations regarding interventions on any type of equipment within an electrical 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	Range/description
Application	Equipment for indoor use in substations, industrial environments and similar settings.
Indoor/outdoor use	Indoor 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-condensing
Storage	3...98 % - Non-condensing
Voltage fluctuation of the power supply (IEC EN 61010-1)	Up to ±10% of nominal voltage
Overvoltage (IEC EN 61010-1)	Category II
Pollution level (IEC EN 61010-1)	Level 2
Atmospheric pressure** (IEC EN 61010-1)	80...110 kPa

* Altitudes above 2000 m already have successful applications.

** Pressures below 80 kPa already have successful applications.

1.4.5 Instructions for testing and installation

This manual should be available to those responsible for the installation, maintenance, and users of the Smart Device for OLTC Torque - SDM.

To ensure user safety, equipment protection, and proper operation, the following minimum precautions must be followed during the installation and maintenance of the SDM.

1. Read this manual carefully before installing, operating, and maintaining the SDM. Errors in the installation, maintenance, or adjustments of the SDM may cause false alarms, failure to issue relevant alarms, and thus lead to a misunderstanding of the true health and operational status of the transformer or application, since the SDM is designed to withstand electrical substation environments, also encompassing industrial and commercial environments.

2. The installation, adjustments, and operation of the SDM must be performed by trained personnel familiar with power transformers, control devices, and substation equipment control circuits, or by individuals familiar with and trained to implement the IED in their application, whether it be a motor, reactor, panel, or installation where they wish to apply the SDM.

3. Special attention should be given to the SDM installation, including the type and gauge of cables, installation location and commissioning, including the correct parameterization of the equipment.

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

Do not install SDM near heat sources such as heating resistors, incandescent lamps, and high-power devices or devices with heat sinks. Installation near ventilation openings or where it may be exposed to forced airflow, such as the inlet or outlet of cooling fans or forced ventilation ducts, is also not recommended.

If the panel where the SDM is installed has a window, use a G20 or higher film to prevent direct sunlight (ultraviolet rays) from reaching the equipment. If the window glass is dark, this procedure is not necessary.

1.4.6 Instructions for cleaning and decontamination

Be careful when cleaning the SDM. Use **only** a damp cloth with soap or detergent diluted in water to clean the housing, faceplate, 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.

Turn off and unplug the equipment before cleaning any of its parts.

1.4.7 Instructions for inspection and maintenance

For inspection and maintenance of the SDM, the following observations should be followed:

Do not open your equipment. There are no user-serviceable parts inside. This must be done by Treetech technical support or technicians accredited by them. This equipment is completely maintenance-free, and visual and operational inspections, periodic or not, can be performed by the user. These inspections are not mandatory.

All parts of this equipment must be supplied by Treetech, or one of its authorized suppliers, according to its specifications. If the user wishes to acquire them in another way, they must strictly follow Treetech's specifications for this. This will 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.

Opening the SDM at any time will void the product warranty. In cases of improper opening, Treetech will also be unable to guarantee its correct functioning, regardless of whether the warranty period has expired or not.

1.5 Customer service

Are you already familiar with our online customer service platform?

CS

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 Treetech product application up-to-date.

The Treetech knowledge base is also available, including catalogs, manuals, application notes, frequently asked questions, and more.

In some cases, it will be necessary to send the equipment to Treetech's Technical Assistance. Our Customer Service department will explain the entire procedure and provide the necessary contact information.

1.6 Warranty terms

The Smart Device for OLTC Torque - SDM will be guaranteed by Treetech for a period of 2 (two) years, starting from the date of purchase, exclusively against any manufacturing defects or quality flaws that render it unsuitable for regular use.

The warranty will not cover damage to the product resulting from accidents, mistreatment, improper handling, incorrect installation and application, inadequate testing, or if the warranty seal is broken.

Any need for technical assistance should be communicated to Treetech or its authorized representative, presenting the equipment along with the corresponding proof of purchase.

Treetech provides no express or implied warranty other than those stated above. Treetech does not guarantee the suitability of the SDM for a particular application.

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

Under no circumstances shall the seller be liable for any losses incurred, including but not limited to: loss of profits or income, inability to use the SDM or any associated equipment, capital costs, costs of purchased energy, costs of substitute equipment, installations or services, downtime costs, claims from the buyer's customers or employees, regardless of whether such damages, claims or losses are based on contract, warranty, negligence, tort or otherwise. Under no circumstances shall the seller be liable for any personal injury of any kind.

2. Introduction

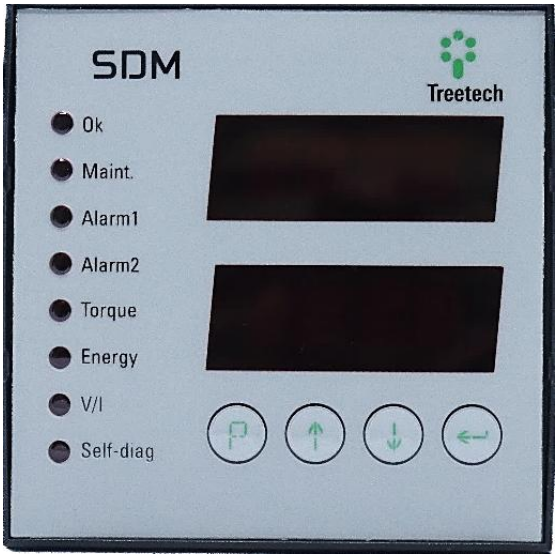


Figure 1 - SDM front panel

Because it has moving parts that switch high voltages and currents, the On-Load Tap Changer (OLTC) is statistically one of the main sources of transformer failures, with mechanical failures contributing to this. To detect these defects in their early stages and reduce the probability of unexpected shutdowns, the SDM monitors the OLTC torque, alerting to changes in its typical operating curve (signature), which indicate developing faults.

The energy for the tap changer's operation is supplied by a motorized mechanism, which exerts greater or lesser torque at each stage of the tap changing process, creating a typical signature that, under normal conditions, repeats with each tap changing operation. Mechanical problems in the tap changer will alter this signature, allowing for early-stage detection.

Since the torque developed by the motor is proportional to the electrical power, the SDM indirectly monitors motor consumption by measuring it, with the aim of detecting and issuing alarms in case of any changes in the signatures or time for changing the tap. This allows mechanical faults in the tap changer to be detected at an early stage.

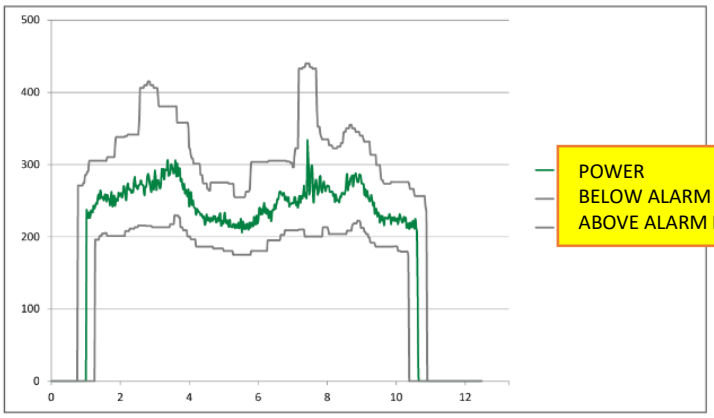


Figure 2 - Power curve with alarm envelopes

Power curve during tap changer ion:

s example, a maneuver with values within the alarm envelopes generated from reference learning.

- "OK" status indication on the IED.

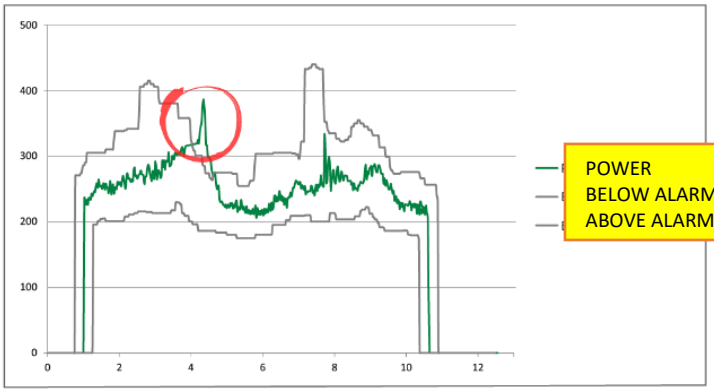


Figure 3 - Power curve exceeding the alarm value

- In this example, a maneuver with exceeding the alarm pes.

- Alarm indication on the IED and output relays.

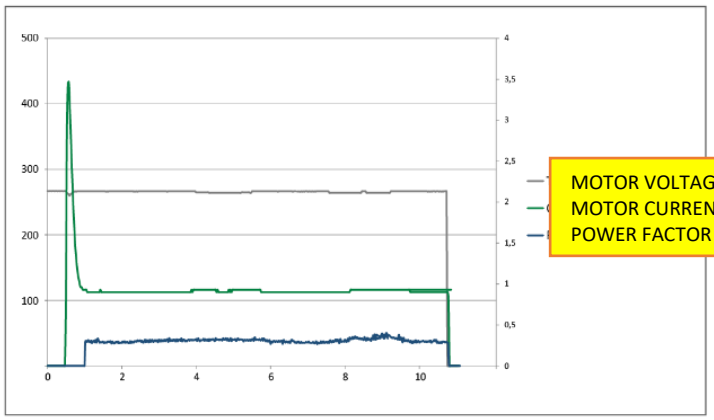


Figure 4 - Current, voltage, and power factor curve

Current, voltage, and power factor curve:

- In this example, voltage, current, and power factor values are shown during the tap changer's operation, which can also be obtained from oscillographies.

The Smart Device for OLTC Torque - SDM monitors various variables, depending on the equipment model used (basic or with optional features).

- Oscillography of currents, voltages, and power consumed by the motor during operation, in single-phase or three-phase mode;
- Tap position of the OLTC, via potentiometric transmitter (ring) or 4 to 20 mA analog current input (**TAPP/TAPI** option);
- Temperature of the drive mechanism (**HTCV** option);
- Anti-condensation heater current of the drive mechanism (**HTCV** option);
- Line current interrupted by the OLTC contacts (**OLMT** option);
- Auxiliary contact for motor circuit breaker alarm and/or actuated control (**HTCV** option).

For OLTC diagnosis, SDM correlates these measurements with expert engineering algorithms, obtaining useful information for diagnosis and prognosis, as applicable:

- Power signature, energy and time energy and time spent by the engine during operation;
- Engine starting current;
- Minimum and maximum voltages in the motor during operation;
- Undervoltage and overvoltage of the motor power supply;
- Number of operations and service time of the OLTC, total and after the last maintenance (**OLMT** option);
- Integration of the switched current, indicative of wear on the OLTC contacts, both complete and after the last maintenance (**OLMT** option);
- Time remaining for maintenance based on service life, number of operations, and switched current integration (**OLMT** option);
- Operation of the heating mechanism, preventing water condensation and oxidation (**HTCV** option);
- Drive mechanism temperature too low or too high (**HTCV** option).

Using measurements and calculations from engineering algorithms, the SDM emits alarms in case of abnormalities, as well as maintenance warnings with advance notice programmed by the user, activating output contacts.

2.1 Features and functions

Robust hardware

IED (Intelligent Electronic Device) specifically designed for substation yard conditions (interference, extreme temperatures), operating at temperatures from -40 to +85 °C. Complete absence of mechanical parts for parameterization and calibration.

Local indication

Local indication of voltage, current, and power factor of the OLTC motor on a high-brightness LED display, readable in any lighting and temperature conditions.

Monitoring of the OLTC maneuver

Engineering algorithm for calculating torque and energy used during maneuvering, issuing alarms based on energy consumption and operating curve.

OLTC tap measurement

Inputs for indicating tap position via potentiometric sensors or analog inputs.

Internal clock

Adjustment maintained for 48 hours in case of power failure, without the use of batteries - Maintenance-free equipment.

Analog voltage inputs

Inputs for up to three voltages and four currents for reading line current or anti-condensation heater current.

Analog temperature inputs

Input for Pt100 type sensor for measuring the temperature of the drive mechanism, ambient temperature or other temperature desired by the user.

Self-diagnosis

Self-diagnosis relays, for indicating internal faults and integration failures with peripheral equipment, such as other sensors.

Digital inputs and outputs

Inputs for the digital signal indicating the status of the power circuit breaker of the the OLTC motor. Output relays for alarm indications and self-diagnoses.

Communication ports

RS-485 serial communication port for integration with supervisory or remote monitoring systems. Open communication protocols Modbus® RTU and DNP3 RTU.

Embedded operating system

The SDM has an embedded operating system, customized by Treetech. This ensures greater stability and reliability of the product's firmware operation, as well as future-proofing.

2.1.1 Inputs

- ✓ 3 VMT voltage inputs for measuring the supply voltage of the three motor phases or the OLTC voltage;
- ✓ 4 current inputs, 3 for measuring the phase currents of the OLTC motor and 1 for measuring the line current of the heating system, OLTC drive mechanism;
- ✓ 1 input for auxiliary contact of the DJMAL motor circuit breaker;
- ✓ 1 input for tap measurement via potentiometric transmitter (optional);
- ✓ 1 input for tap measurement via analog signal (optional);
- ✓ 1 input for Pt100 type RTD temperature sensor with self-calibration, 0.2% full-scale accuracy and high stability over a wide ambient temperature range.

2.1.2 Outputs

- ✓ Outputs for 5 programmable relays, including 3 reversible relays and 2 normally open relays for alarm activation, shutdown, self-diagnoses, and other operations.

2.1.3 Communication

- ✓ 1 RS-485 serial communication port;
- ✓ Modbus®RTU and DNP3 communication protocol, with timestamp support, capable of signaling events such as alarms, shutdowns, etc., with 1 ms accuracy.

2.2 Optional functions

Depending on the request, the SDM can be supplied with one or more of the following optional functions.

2.2.1 HTCV – Monitoring of the anti-condensation system and control power supply

Monitoring of the anti-condensation system operation by measuring the heater current and panel temperature. It also enables monitoring of the tap changer control voltage via the input voltage.

The proper functioning of this function requires the correct connection of the control voltage, current sensors (CT), and temperature sensors (Pt100) to the equipment.

2.2.2 TAPP/TAPI – OLTC position measurement

Allows connection of a potentiometric transmitter (ring) or an analog signal for indicating the tap position of the OLTC in the SDM. The SDM can use this measurement to assist in the calculations of the tap changer maintenance assistant, another optional function of the SDM. For reading the tap position via analog signal, the option is represented by the name “TAPI”.

2.2.3 OLMT – OLTC maintenance assistant

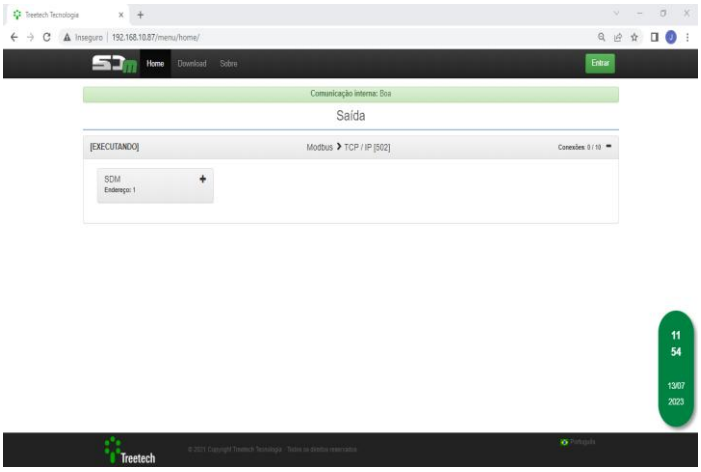
This optional item expands the functionality of SDM, providing several additional pieces of information:

- Number of operations and service time of the tap changer, total and after the last maintenance;
- Integration of the switched current, indicative of wear on the tap changer contacts, both total and after the last maintenance. It also allows measuring the line current (LC);
- Time remaining for maintenance based on service time and number of operations.

2.2 Webpage

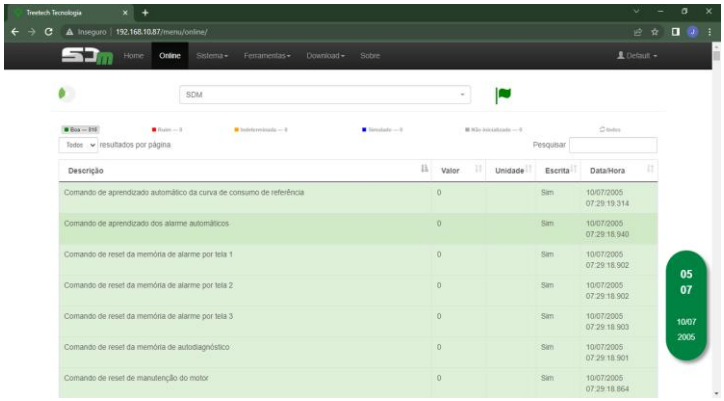
User-friendly web interface

Using the latest HTML5 and Bootstrap technologies, all SDM management and configuration is done directly through the device's web interface, without the need for a license or installation of proprietary software.



Remote network monitoring

It is possible to monitor the communication status and error statistics of the SDM.
Access to IED details allows monitoring of measurement values in real time.



2.3 Basic operating philosophy

The On-Load Tap Changer (OLTC) is one of the main sources of failures in power transformers, primarily due to the presence of moving parts that conduct and interrupt high currents while subjected to high electrical potential.

In addition to thermal failures, some common failure modes in tap changers are mechanical in nature, either in the motorized drive mechanism or in the tap changer itself, and can indirectly lead to failures with a high degree of severity.

The energy required for the mechanical actuation of the OLTC is supplied by a motorized mechanism which, depending on the effort required to overcome each stage of the tap changing process, will exert greater or lesser torque, creating a typical operating torque curve (signature or fingerprint) that, under normal conditions, repeats itself similarly with each tap changing performed. This signature is obtained by oscillography of the motor's current and voltage during its operation.

Changes in the mechanical operation of the tap changer will cause changes in this signature, allowing for the detection of mechanical faults at an early stage.

Since the torque developed by an electric motor is proportional to the mechanical power, and this in turn is proportional to the electrical power consumed, the torque can be monitored indirectly by measuring the motor's power consumption. It's important to consider that the ultimate goal is to detect changes in torque over the tap changer's lifespan, not to perform exact measurements of the absolute torque value.

The SDM performs online monitoring of the torque developed by the motor during the various stages of commutation, allowing the detection of mechanical faults in the OLTC before they reach a level of severity that could cause more significant problems.

To calculate torque, the SDM monitors the current consumed by the motor during its operation. Voltage monitoring in this case is optional, but highly recommended, as it allows for obtaining other important variables for a comprehensive assessment of the mechanical assembly's condition. The OLTC motor can be powered by three-phase or single-phase alternating current at 50 Hz or 60 Hz, as well as direct current. Each power supply type has a specific engineering model, allowing the SDM to perform its function regardless of the power supply the motor receives.

In addition, the SDM can monitor the anti-condensation heater current, line current, tap changer position, and drive mechanism temperature, providing a complete diagnosis of the tap changer mechanical drive system.

It is possible to program independent alarm levels for each parameter. If an alarm condition occurs, the SDM will activate reversible dry contacts, allowing those responsible to take appropriate action immediately.

For some output contacts, regardless of the operating mode, the contact with the opposite function is also available (reversible). This allows for diverse data acquisition logics to be implemented without the need for duplication or inversion of contacts. The SDM has a self-diagnosis relay, signaling any measurement fault, lack of auxiliary power, or internal fault in the device. This contact is also reversible.

Furthermore, the SDM allows storing past data and events in a log of up to 10,389 records in a circular memory, whose recording period can be adjusted according to the user's needs. To download the log and oscillography data, Treetech provides software or a spreadsheet for this purpose. This function is only available for download in Modbus® RTU. The information stored in the mass memory is:

- Date and time of events;

- Alarms triggered;
- Self-diagnoses that occurred;
- Measurements taken.

2.4 Intended use

The SDM indirectly monitors motor consumption, which is related to the torque developed, as it is proportional to electrical power. The energy to operate the OLTC is supplied by a motorized mechanism that applies variable torque at each tap changing stage, resulting in a typical signature that repeats with each commutation. By measuring motor consumption, the SDM identifies abnormal variations in the commutator torque signatures. These changes may indicate wear, lubrication problems, or structural failures.

The SDM can be supplied with one or more optional functions. If desired, one alternative is to use the SDM to indicate the tap position of the On-Load Tap Changer (OLTC), activating the optional TAPP/TAPI command.

Moreover, it is possible to further expand the functionalities of the SDM by activating the OLMT (OLTC Maintenance Assistant) command. This activation provides several additional pieces of information, such as the number of operations performed, the tap changer's service time, and the integration of the switched current. Data such as the remaining time for maintenance based on the service time and the total number of operations performed are also provided.

Another optional function is HTCV, which allows the SDM to be used to monitor the operation of the anti-condensation system by measuring the heater current and panel temperature.

3 Design and installation

3.2 System topology

The SDM has a basic topology, relating its inputs to its outputs, but depending on the existence or not of associated optional functions, this topology may have some elements included in its scope. It is worth adding that not all optional functions can be active at the same time.

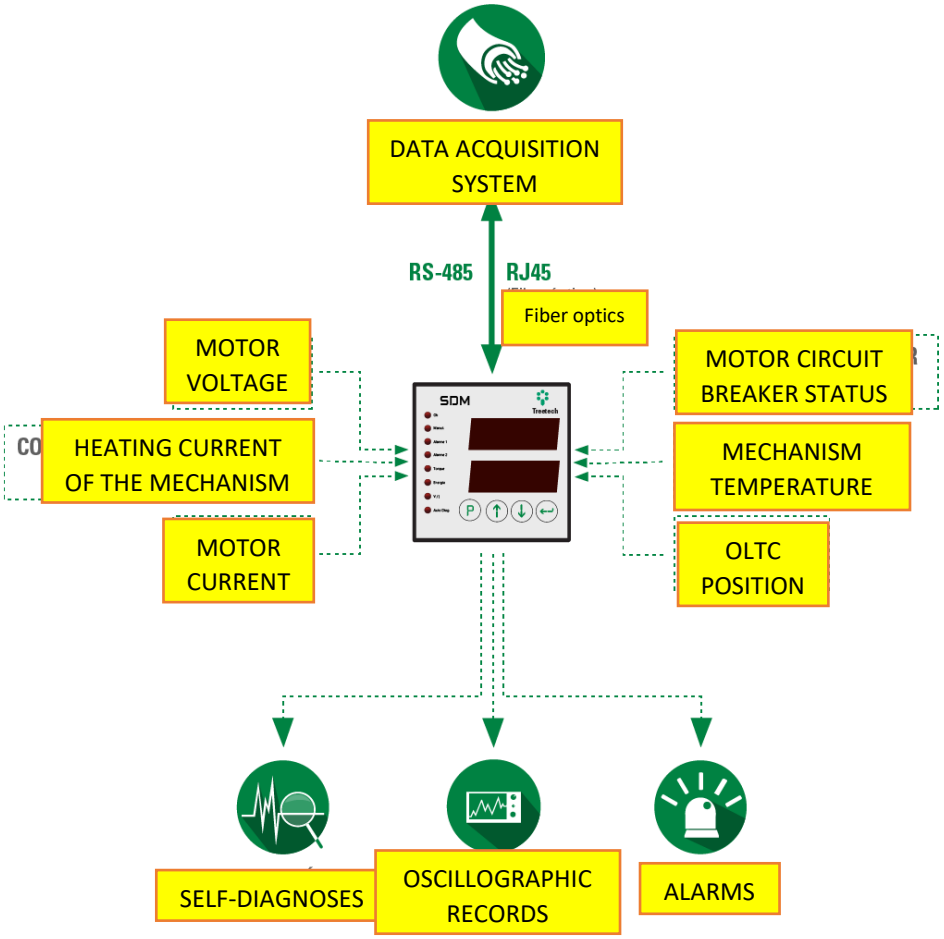


Figure 5 - System topology

The items **needed** to install the system are:

- Smart Device for OLTC Torque – SDM;
- External window CTs with sectionalizable core (clip-on). The quantity will vary according to the application (single-phase or three-phase) and must be included in the purchase order;*
- Auxiliary PT. The quantity will vary according to the application (single-phase or three-phase) and must be included in the purchase order;*
- Three-wire shielded cable for RTD sensor connection and tap measurement;*
- Two-wire shielded twisted-pair cable for RS-485 serial communication or three-wire for RS-232;*
- Suitable location for installation or Treetech quick installation panel;*
- Pt100 for temperature measurement;*

- Shunt resistor for DC current measurement.*

* Accessories are purchased upon request and according to application needs.

3.3 Communication port topology

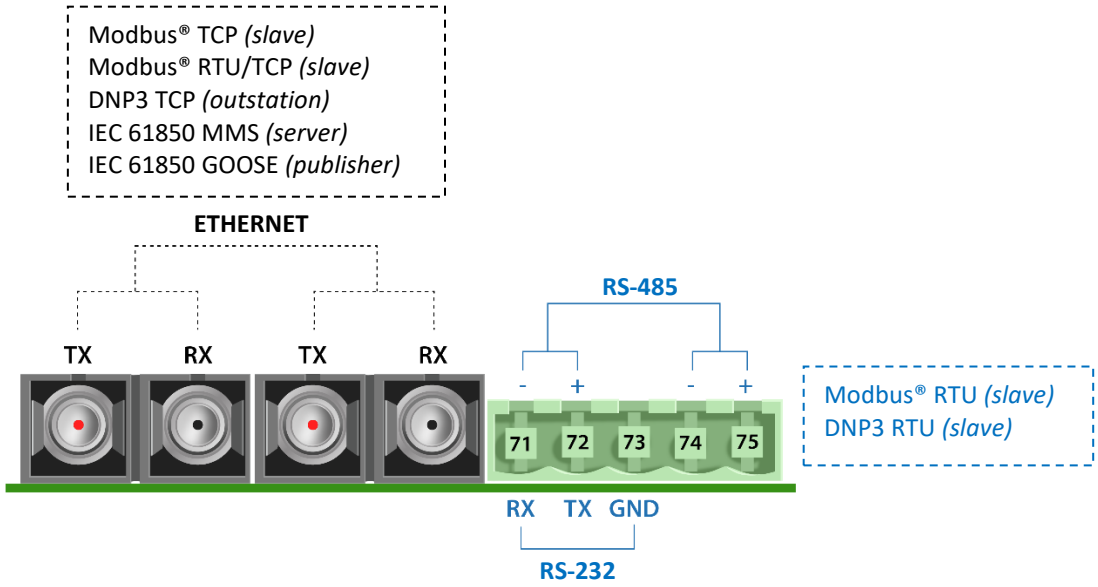


Figure 6 - Topology of available ports in the Ethernet fiber optic model

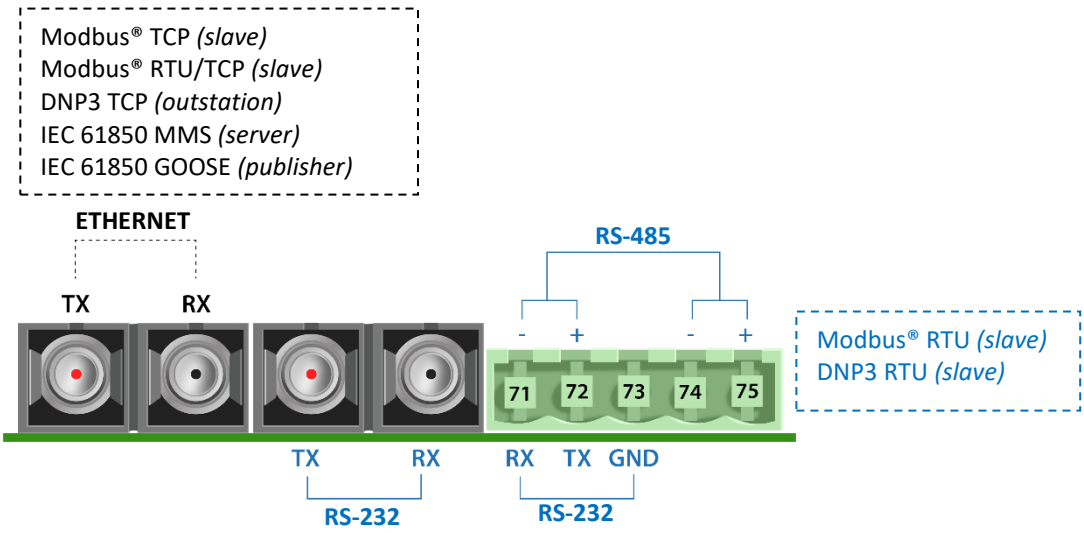


Figure 7 - Topology of available ports in the Ethernet + serial fiber optic model

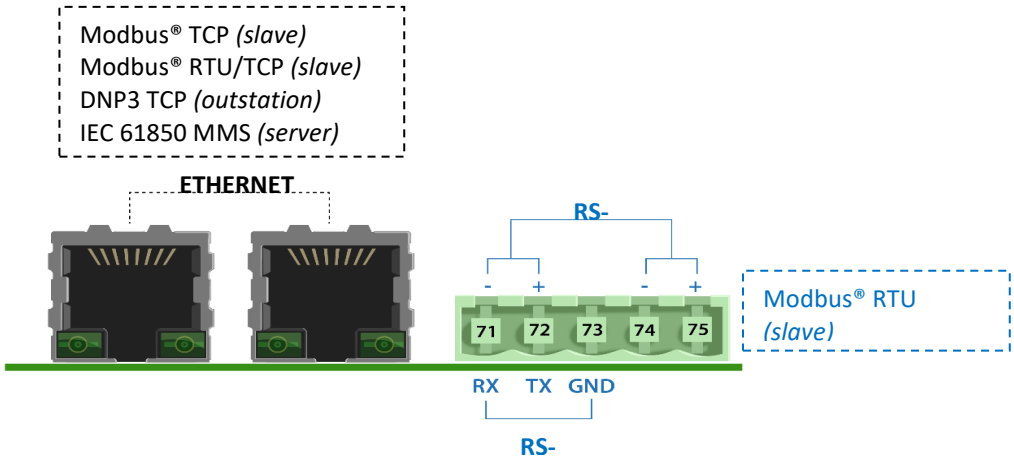


Figure 8 - Topology of ports available in the RJ45 model

3.4 General considerations

The temperature sensor must be connected to the SDM via shielded cable, without interrupting the shielding, which should only be grounded at the end connected to the SDM.

RS-485 serial communication must be interconnected using a shielded twisted-pair cable, maintaining an uninterrupted shield until its termination, grounding only one end, preferably closer to the SDM. The maximum permitted distance for this type of serial communication is 1200 meters, according to the TIA/EIA-485-A-1998 standard.

Torque alarm and self-diagnosis contacts, in addition to being reversible, can be configured to operate in normally closed (NC) or normally open (NO) mode through product parameterization. This flexibility offers several advantages. One of them is the duplication of contacts by simply considering an inverse operating logic in the final application, without compromising the safety or speed of contact operation for the critical application.

3.5 Mechanical installation

The SDM should be installed protected from the elements, either inside panels or sheltered in buildings. In either case, an anti-condensation system must be in place.

The SDM is suitable for recessed installation and can be fixed, for example, to doors or front panels. The fixing clips are supplied with the product.

Special attention should be paid to the thickness of the paint layers on the sheet metal where the cutout is made, because in some cases, when high-thickness paint is used, the reduction in the cutout area may even prevent the insertion of the equipment. The connection terminals are installed on the back of the SDM, in two removable connectors, to facilitate coupling. Cables from 0.3 to 2.5 mm², bare or with pin or needle type terminals, can be used.

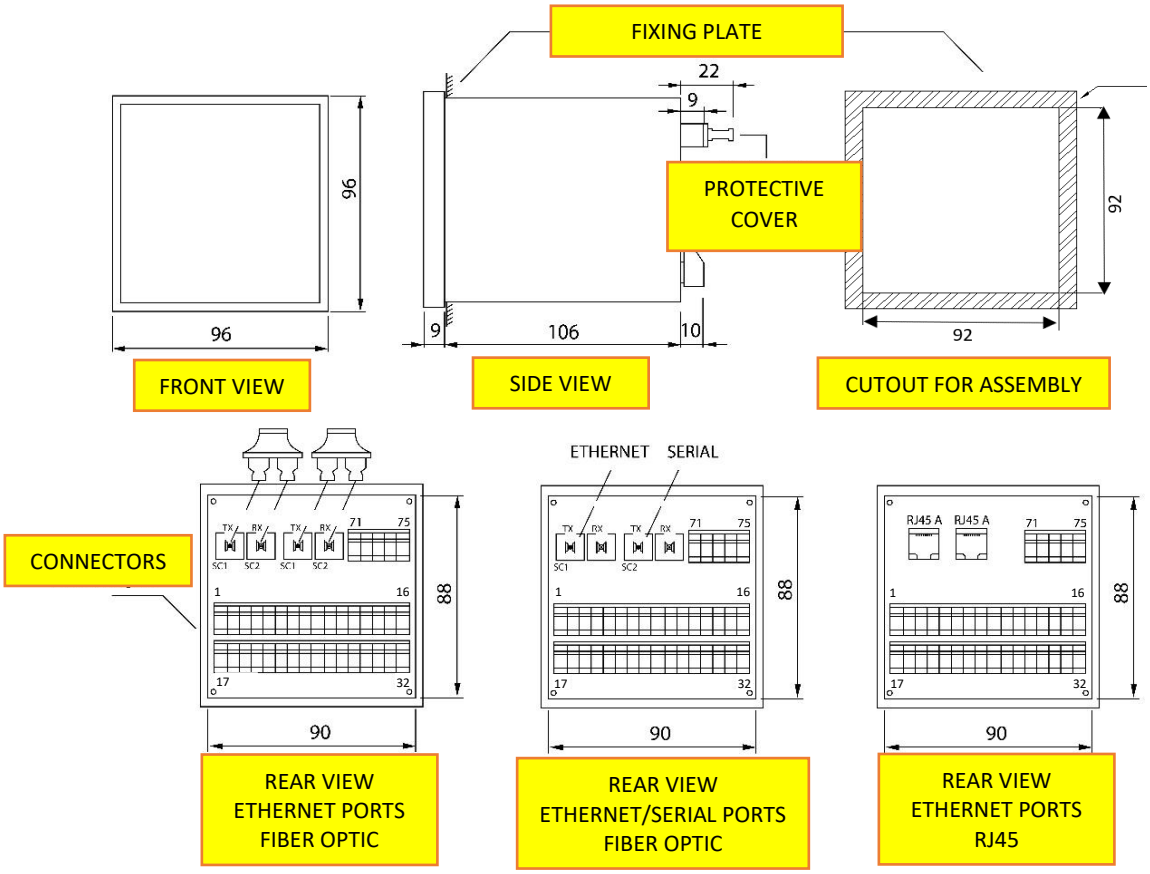


Figure 9 - SDM dimensions

3.6 Electrical installation

The SDM is a versatile equipment and can be used in a variety of applications. Therefore, its installation requires a higher 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 SDM.
Know the functional, electrical, and configuration characteristics of the SDM.
This way you will be able to take full advantage of the equipment and minimize risks to your safety.

The SDM offers various electrical installation configurations. These configurations are determined by whether the application in question will utilize the available options.

This equipment operates at dangerous voltage levels, which could cause death or serious injury to the operator or maintenance personnel.

Some special precautions must be taken for the design and installation of SDM, as described below.

A circuit breaker must be used immediately before the power input (85 to 265 Vdc/Vac, <5 W, 50/60 Hz), corresponding to pins 01 and 02 of the SDM. This circuit breaker must have the number of poles corresponding to the number of phases used in the power supply – the poles must only interrupt the phases, and never the neutral or ground – and provide thermal and electrical protection to the conductors supplying the equipment. The circuit breaker must be close to the equipment and easily workable by the operator. Additionally, it must have an indelible identification showing that it is the electrical disconnection device of the SDM.

A circuit breaker must be used immediately before the power input of motors VMT1, VMT2, and VMT3 (0 to 265 Vac (single-phase), 0 to 240 Vac (three-phase), 0 to 300 Vdc), corresponding to pins 29, 31, and 32 of the SDM. This circuit breaker must have the number of poles corresponding to the number of phases used in the power supply – the poles must only interrupt the phases, and never the neutral or ground – and provide thermal and electrical protection to the conductors supplying the equipment. The circuit breaker must be close to the equipment and easily workable by the operator.

The minimum isolation for circuits connected to the SDM is 300 Vrms for auxiliary equipment and transducers, such as Pt100, and for self-powered equipment up to 50 Vrms. The minimum isolation is 1.7 kVrms for equipment powered up to 300 Vrms, according to IEC EN 61010-1. These values refer to the intrinsic isolation of the devices connected to the SDM. Cases where this value does not apply to equipment or devices connected to the SDM will be explicitly stated in this manual.

The standard schematic diagram of SDM connections shows all the possible connections that SDM provides, identifying them as shown in the following figure.

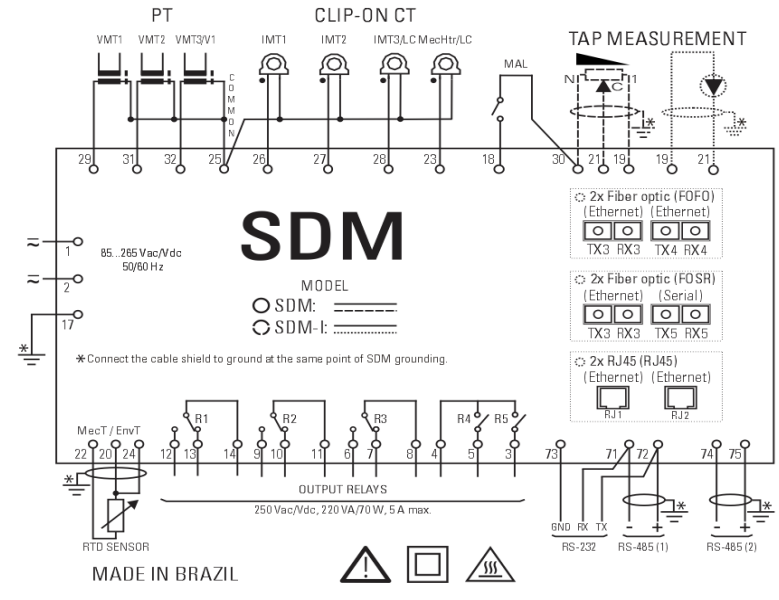


Figure 10 - SDM input and output terminals

If the **TAPP** option is active, you must choose at the time of ordering whether a potentiometric transmitter will be connected to inputs 19, 21, and 30, or whether an analog input will be connected to inputs 19 and 21. This choice affects some internal hardware settings that are defined during the SDM manufacturing process.

During parameterization, it may be necessary to choose whether the CT connected to terminals 23 and 25 will be used for heating monitoring (optional **HTCV**) or for OLTC maintenance (optional **OLMT**), because in the case of monitoring a three-phase motor, it will not be possible to use inputs 25 and 28 to monitor the line current IL.

Another choice that must be made is whether the temperature sensor (RTD), connected to pins 20, 22, and 24, will be used to measure the temperature of the mechanism, the environment, or another one.

Most of these choices are governed by the options purchased by the user, the type of motor (single-phase or three-phase), and the priority that some measurements have over others depending on the application. For example, the user may prefer to use the fourth CT input to measure line current and leave heating monitoring dependent on the RTD sensor temperature reading.

Special attention should be paid to the correct connection of components to the SDM at all stages of installation. Errors in connecting the equipment can cause risks to the operator and irreversible damage to the equipment. Damage due to improper use is not covered by the warranty.

3.6.2 Input terminals

For ease of understanding, the SDM can be divided into blocks of input and output terminals, as shown in the following table. These blocks will be explained individually.

Table 2 - SDM input terminals

INPUTS	TERMINALS
Power supply and grounding: Inputs for universal power supply from 85 to 265 Vdc/Vac, 50/60 Hz, < 5 W.	01 – dc/ac 02 – dc/ac 17 – ground
VMT1 voltage input: Voltage input used to measure the supply voltage of the first (or only) phase of the OLTC motor. The measurement range, for three-phase or single-phase AC motors, is 0 to 550 Vac on the primary of the auxiliary PT with a maximum error of 3%, or, in the case of DC motors, 0 to 300 Vdc at the SDM terminals with a maximum error of 0.5%.	29 – VMT1+ 25 – Common
VMT2 voltage input: Voltage input used only in the case of three-phase motors to measure the supply voltage of the second phase of the OLTC motor. The measurement range is 0 to 550 Vac on the primary of the auxiliary TP with a maximum error of 3%.	31 – VMT2+ 25 – Common
VMT3 / V1 voltage input: Voltage input used to measure the third-phase motor supply voltage (VMT3) in the case of three-phase motors or the OLTC control voltage (V1). The measurement range, for three-phase or single-phase AC motors, is 0 to 550 Vac on the primary of the auxiliary TP with a maximum error of 3%, or, in the case of DC motors, 0 to 300 Vdc at the SDM terminals with a maximum error of 0.5%.	32 – VMT3+/V1 25 – Common

IMT1 current input: Measures the current of the first (or only) phase of the OLTC motor. The measurement range on the primary of the auxiliary CT is 0 to 10 A AC, 14 A peak, and 1% measurement error in the 0.5 to 10 A AC range.	26 – IMT1 25 – Common
IMT2 current input: Measures the current of the second phase of the OLTC motor. The measurement range on the primary of the auxiliary CT is 0 to 10 A AC, 14 A peak, and a 1% measurement error in the 0.5 to 10 A AC range.	27 – IMT2 25 – Common
IMT3 / IL current input: Measures the line current or third phase of the OLTC motor. The measurement range on the primary of the auxiliary CT is 0 to 10 A AC, 14 A peak, and 1% measurement error in the 0.5 to 10 A AC range.	28 – IMT3/IL 25 – Common
I_{heat}Mec / IL current input: Measures the line or heating current of the heating system's drive mechanism of the OLTC. The measurement range on the primary side of the auxiliary CT is 0 to 10 Aca, 14 A peak, and a 1% measurement error in the 0.5 to 10 Aca range.	23 – MecHtr/LC 25 – Common
Input for auxiliary contact of the DJMAL motor circuit breaker: This is a dry contact that must be connected to the auxiliary contact of the motor circuit breaker to indicate its status.	18 – DJMAL 30 – Common
Tap measurement by potentiometric transmitter: For the tap position measurement option to function correctly, a potentiometric ring or an analog signal must be connected to the SDM. If the first option is chosen, this section describes where and how the ring should be connected.	19 – Minimum tap 30 – Maximum tap 21 – Cursor
Tap measurement via analog signal: Another option for measuring the tap position is to connect an analog mA signal to the SDM to indicate the position of the OLTC. This section describes in detail how to make this connection.	19 – mA (-) 21 – mA (+)
Temperature sensor – Tmec (MecT) / Tamb (EnvT): To monitor the temperature of the drive mechanism, the ambient temperature, or any other temperature desired by the user, the SDM provides an input for a Pt100 transistor, which must be installed according to the description in this section.	20 – RTD 22 – RTD 24 – RTD

3.6.2.1 Power supply and grounding

The SDM has a universal power input (85 to 265 Vdc/Vac, 50/60 Hz). Powering the SDM through the substation's auxiliary services is advisable, especially when it is integrated into a serial communication network for data collection purposes for supervisory or monitoring systems.

3.6.2.2 VTM1

The first-phase motor supply voltage (VMT1) should be connected to this input. Pin 25 is the common point for all SDM voltage and current measurements, and pin 29 is the VMT1 measurement input. The use of fuse terminals in the voltage measurement circuit is recommended.

It is possible to monitor the supply voltage of four different types of motors: single-phase, two-phase, and three-phase direct current (DC) and alternating current (AC) motors.

In a DC motor, the SDM voltage inputs support measurements up to 300 VDC. Voltage and current measurements should be performed according to the diagram below:

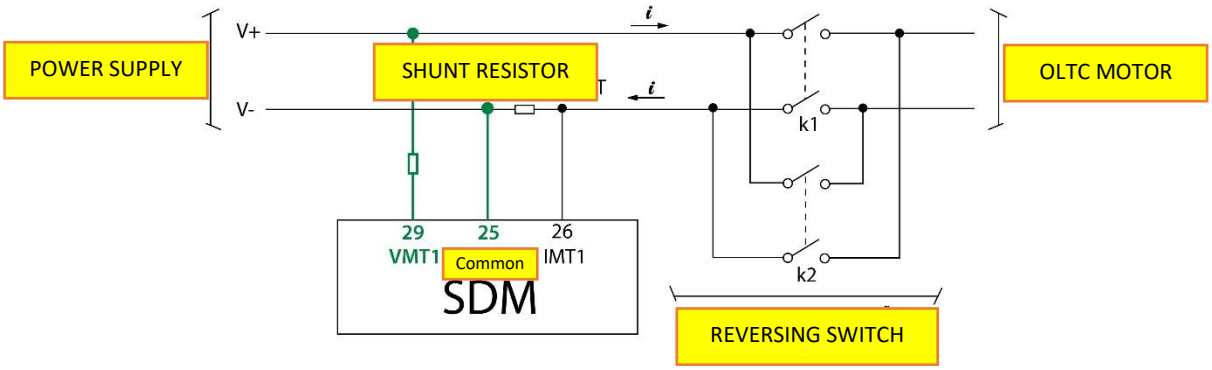


Figure 11 - Voltage and current connection for DC motors

Note that measurements on the DC motor must be installed before any reversing switch to prevent the power supply polarity change from causing a short circuit at pin 25.

In a single-phase or two-phase AC motor, the voltage measurement should be performed as shown in the figure below:

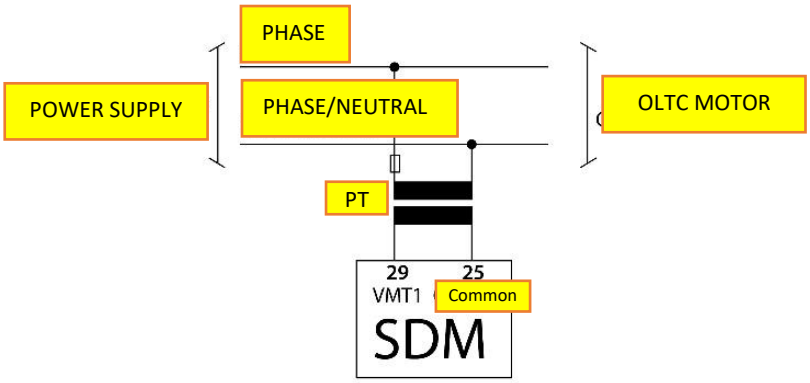


Figure 12 - Voltage connection for AC motors F-N/F-F with the aid of a PT

Since point 25 is common to all voltage and current measurements, it is important to take care to avoid short circuits.

For three-phase AC motors, voltage measurements should be performed as shown in the following figure:

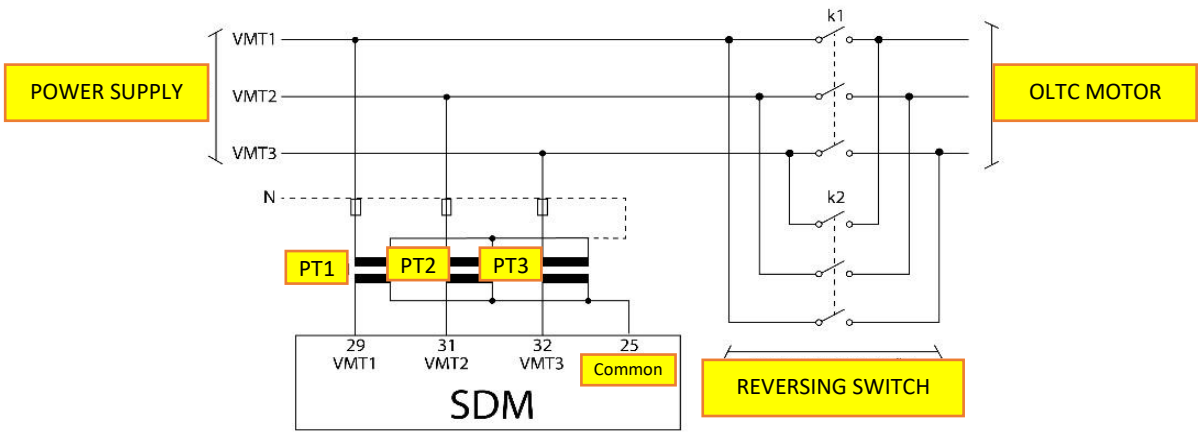


Figure 13 - Installation for measuring voltage in three-phase motors using potential transformers (PTs)

The SDM voltage inputs for AC motors support measurements up to 550 Vac using an auxiliary potential transformer. The auxiliary PT is used to isolate the voltage circuit being measured and is therefore mandatory. It also reduces the voltage when it exceeds the IED's measurement limit. In addition to the PT, a fuse terminal is essential. This will provide a preventative function against surges.

In the figure, connecting the primary of the potential transformers to the neutral is not mandatory, since the star connection between them creates a virtual neutral. Another important point is that the voltage connections must be made before the changeover switch, because if done afterwards, the power factor measurement (cos ϕ) will be affected.

3.6.2.3 VTM2

If the motor to be monitored is three-phase, the voltage of the second phase of the three-phase motor (VMT2) must be connected to inputs 31 and 25, as can be seen in the previous figure.

3.6.2.4 VTM3 or V1

Initially, this is the input for the third-phase voltage of a three-phase motor (VMT3). However, if the motor is single-phase, it is possible to use this input to monitor the power supply to the motor control circuit (V1). The optional **HTCV** allows this input to be used for this purpose.

The electrical connection for measuring VMT3 should be made according to the figure above. To measure the control voltage V1 in the case of alternating current supply, the electrical connection should be made according to the figure below, in the representation furthest to the right.

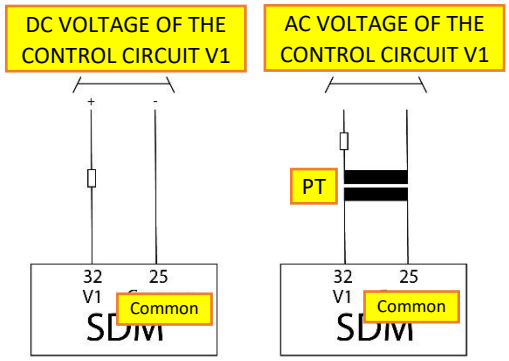


Figure 14 - Connection for measuring DC (left) and AC (right) voltage of the motor control circuit

3.6.2.5 IMT1

The main measurement of the SDM is the current flowing through the commutator motor, as explained in the chapter 2.3. When the motor is alternating current, the IMT1 current measurement should be made by wrapping the first phase wire of the motor with a clip-on current transformer (CT) and connecting it to inputs 26 and 25 of the SDM. The method for making this connection can be seen in the following figures.

Installation on single-phase AC motors should be done according to the following diagram:

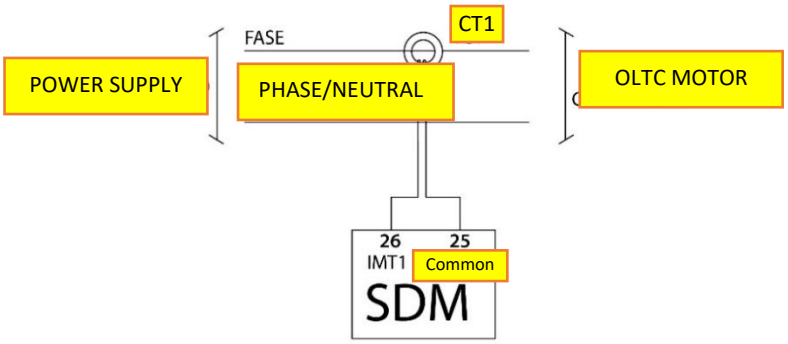


Figure 15 - Measuring the supply current of a single-phase AC motor

For three-phase motors, the complete connection diagram for the supply currents is shown in the following figure:

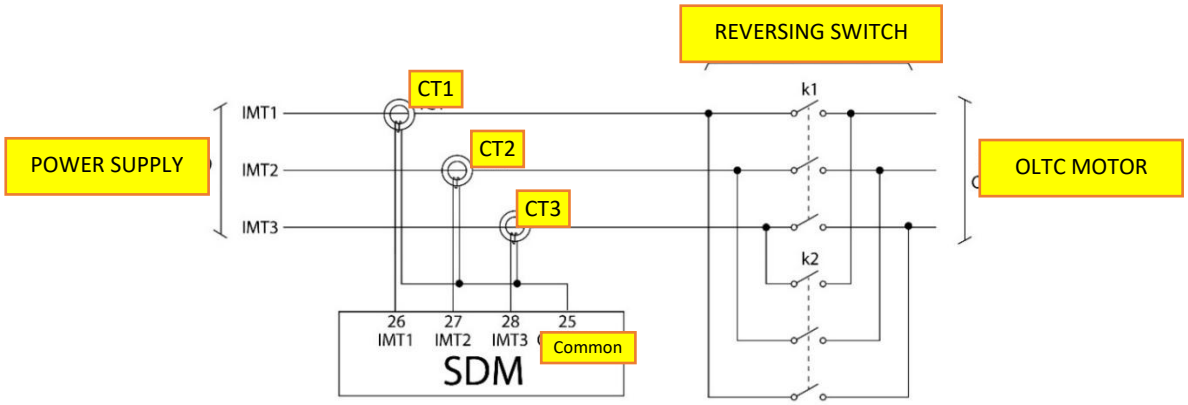


Figure 16 - Measuring the supply currents of a three-phase motor

Note that the current transformers (CTs) were installed before the reversing switch to allow for accurate measurement of the power factor (cos ϕ). When the motor is direct current (DC), the current measurement must be done using a shunt resistor, and the figure below shows how to make this connection:

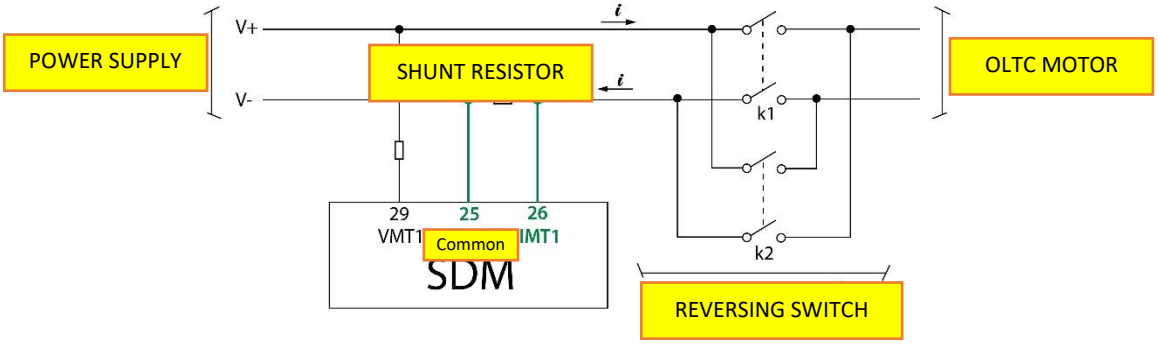


Figure 17 - Connection for measuring voltage and current of the DC motor

Here it is important to note three points:

- The connections must be made before the reversing switch to prevent the polarity of the power supply from reversing and causing a short circuit at pin 25;
- The shunt resistor must be installed on the return cable (V-) to prevent a short circuit at pin 25;

- The most positive terminal of the resistor should be connected to pin 26 of the SDM board, and the most negative terminal to pin 25.

To calculate a suitable shunt resistor value, use the following relationship:

$$\frac{1{,}4896}{99{,}99} \leq R_{shunt} \leq \frac{1{,}4896}{I_m}$$

Where I_m is the motor supply current passing through the shunt resistor. Next, in **Erro! Fonte de referência não encontrada.**, typical shunt resistor values are presented, along with the respective parameter that should be entered in the RIM1 setting. The RIM2 setting should be 1 for the shunt resistors shown in the table. For other values and to obtain the RIM setting, consult Treetech support.

Table 3 - Table with commercial values

Shunt Resistor			DC motor	SDM	
I (A)	V (mV)	R (Ω)	I peak (A)	RIM1 Parameter	RIM2 Parameter
10	60	0,06	20	5267	1
8	150	0,01875	40	16853	1
10	150	0,015	40	21067	1
8	300	0,0375	30	8427	1
10	300	0,03	40	10533	1

3.6.2.6 IMT2

This is the input for the second stage of the motor's power supply, IMT2.

3.6.2.7 IMT3 or IL

This is the input for the third-phase motor power supply current, IMT3. The optional **OLMT** allows this input to be used to measure the line current IL instead of measuring IMT3, but this will only be possible for motors that are not three-phase.

The connection for measuring IMT3 should be made according to the previous figure, while below shows the installation for measuring the line current IL and heating current I_{heat}.

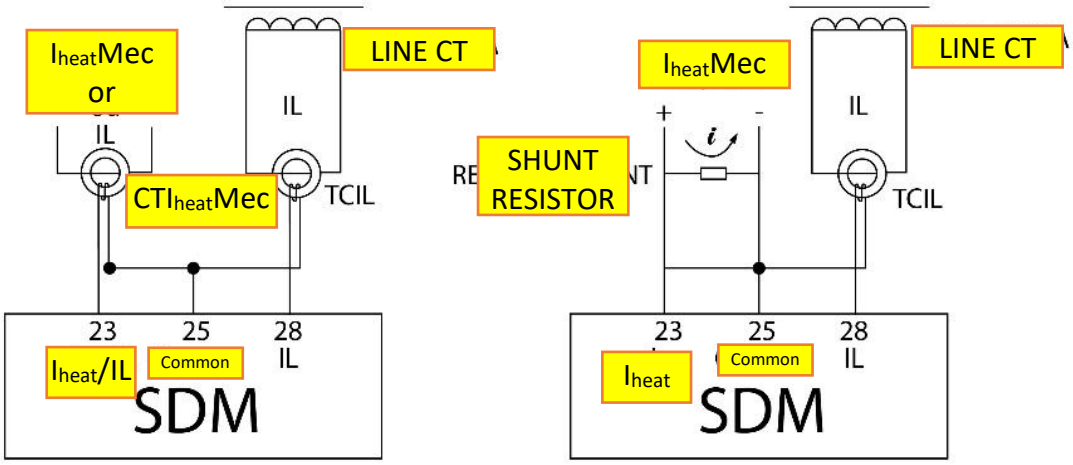


Figure 18 - (a) I_{heat} using a clip-on current transformer; (b) I_{heat} using a shunt resistor

The image above shows the two connection options for IL. Only one input can be chosen to make this measurement. Note also that, since line current (IL) is always alternating, this measurement can only be made using a current transformer (CT).

If input 28 is used to measure the third-phase motor supply current, it will not be available for measuring line current. If input 23 is used to measure the mechanism heating current (I_{heat}Mec), it cannot be used to measure line current.

3.6.2.8 I_{heat}Mec or IL

In the last SDM current input, currents from one of the following measurements can be connected: heating system current (I_{heat}Mec/MecHtr) or line current (IL/LC). This is the only input for measuring I_{heat}Mec, while IL can also be connected to input 28. Therefore, priority on this input should be given to measuring IheatMec when its measurement is vital.

In either case, the installation diagram can be found in the figure above from the previous item. If the heating current (I_{heat}Mec) is DC, the measurement must be made using a shunt resistor, according to the second diagram in the figure. In this case, the choice of resistor must respect the following relationship:

$$\frac{1{,}4896}{99{,}99} \leq R_{shunt} \leq \frac{1{,}4896}{I_{heatMec}}$$

3.6.2.9 DJMAL

For the OLTC motor to start operating, in addition to the control signal, the motor's protective circuit breaker must be closed. Since the circuit breaker can trip, taking the motor out of operation for various reasons, it's important to know its status to assess the motor's readiness.

The dry contact between pins 18 and 30 serves precisely this purpose and should be connected as shown in the figure below. DJMAL monitoring can be performed even if the optional **TAPP** is active and a potentiometric transmitter (ring) is used, as pin 30 can be used in both applications simultaneously.

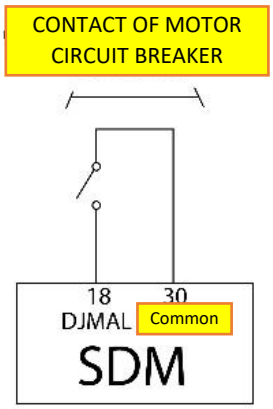


Figure 19 - Dry contact connection for monitoring the status of the auxiliary motor circuit breaker.

3.6.2.10 Tap measurement – Potentiometric transmitter

The optional **TAPP** allows the user to use the SDM to monitor the tap position of the OLTC. For this, some type of sensor must be installed on the OLTC, and the SDM can read two types of sensors: potentiometric transmitter (ring) or analog signal. When the manufacturer does not provide an analog output or for some other reason it is unavailable, it is possible to install a potentiometric transmitter on the OLTC to perform tap position measurements.

The connection of the potentiometric position transmitter of the on-load tap changer to the SDM is made using three wires: the cursor, the start, and the end of the potentiometric transmitter. All three wires must have the same length and gauge. Shielded cable must be used for this connection along the entire path from the tap changer cabinet to the SDM, with the shielding grounded at a single point.

If a single shielded cable is not used for the entire run, due, for example, to intermediate connection terminals, continuity of the shielding must be ensured by connecting the ends of the shields of the various cables. The unshielded section of cable due to the splice should be as short as possible.

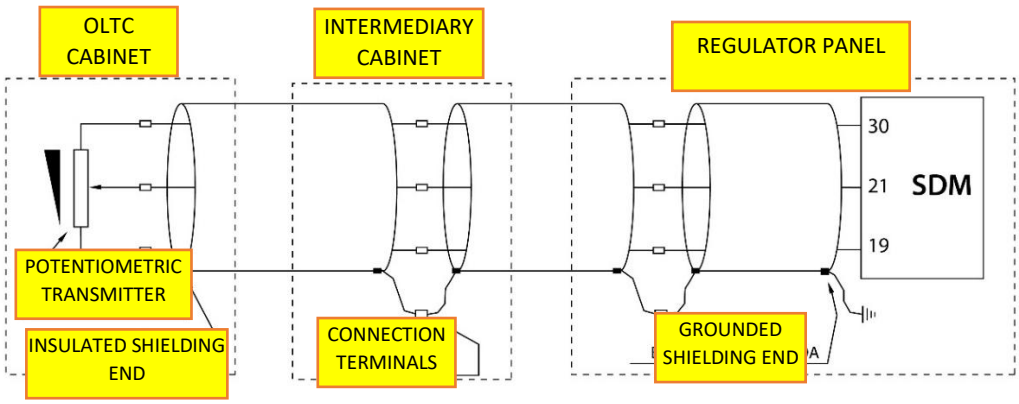


Figure 20 - Connection of the tap measurement cable shielding

The SDM automatically compensates for the resistance of the connecting cables from the potentiometric transmitter to it, and for this, the three wires must have the same length and

gauge, with the maximum permissible resistance for each wire being 8 Ω. Based on this maximum resistance and the gauge of the cables used, the maximum permitted length can be obtained. Considering cables with typical resistances of 13.3 Ω/km, 7.98 Ω/km and 4.95 Ω/km for gauges of 1.5 mm², 2.5 mm² and 4 mm² respectively (untinned cables, stranding class 4), we have the maximum lengths presented in the following table.

Table 4 - Maximum length for tap measuring cable gauges

Cable gauge	Typical resistance	Maximum length
0.5 mm^2	39.0 Ω/km	200 m
0.75 mm^2	26.0 Ω/km	300 m
1 mm^2	19.5 Ω/km	400 m
1.5 mm^2	13.3 Ω/km	600 m
2.5 mm^2	7.98 Ω/km	1000 m
4 mm^2	4.95 Ω/km	1600 m

The tap position transmitter of the on-load tap changer must be of the potentiometric type, with its resistance varying from zero to the maximum value for the initial and final positions of the tap changer, respectively.

In the case of tap changers with intermediate positions, that is, transition positions that have the same voltage as other adjacent positions, as exemplified in the table below, the resistors of the potentiometer transmitter referring to these positions must be short-circuited, as shown in the example in the figure above. All intermediate positions (in the example in the figure, 6A, 6 and 6B) will be indicated as tap 6, since they have the same voltage. In the example in the table below, a step resistance of 10 Ω/step is considered.

Table 5 - Resistance of the cursor indicating the tap position

Tap position	Voltage (V)	Current (A)	Resistance between cursor and initial position
1	12420	3220.6	0
2	12696	3150.6	10
3	12972	3083.6	20
4	13248	3019.3	30
5	13524	2957.7	40
6A	13800	2898.6	50
6			50
6B			50
7	14076	2841.7	60
8	14352	2787.1	70
9	14628	2734.5	80

10	14904	2683.8	90
11	15180	2635.0	100

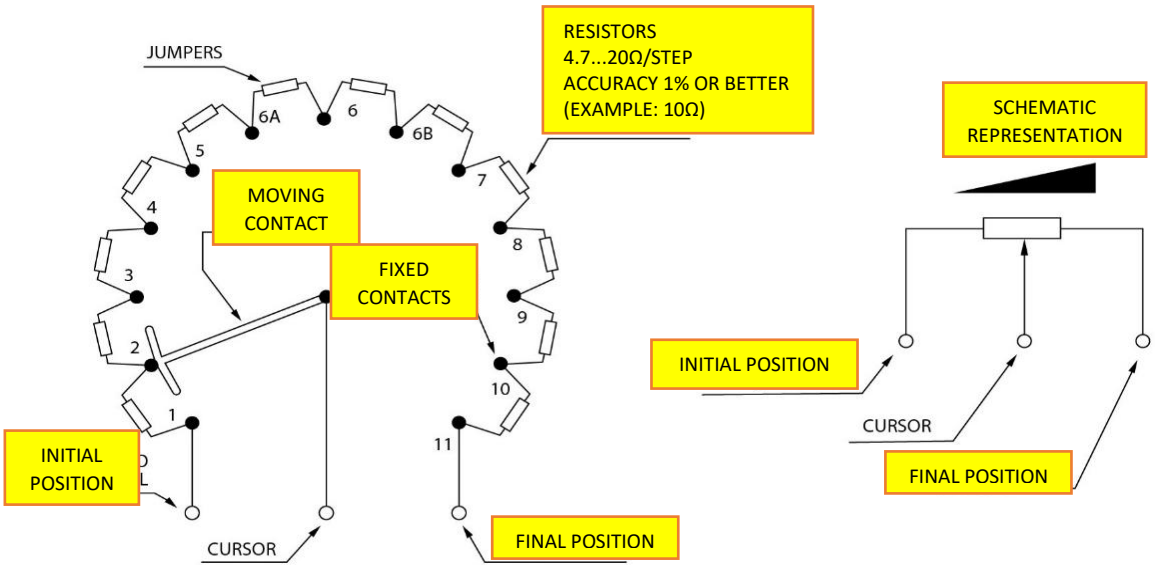


Figure 21 - Configuration of the potentiometric transmitter resistors in the intermediate positions of the on-load tap changer

The SDM allows the resistance per step of the potentiometric transmitter to be in the range of 4.7 to 20 Ω, and the total resistance of the transmitter from 9.4 to 1000 Ω. The value of each individual resistor is shown in the figure above. The moving contact (cursor) of the potentiometric transmitter can be either of the "closes before it opens" or "opens before it closes" type, interchangeably. The resistances of the potentiometric transmitter must be precision resistors, i.e., with error tolerances of no more than 1%.

The current position of the on-load tap changer associated with it can be reported in simple numeric, two-sided numeric, or alphanumeric formats (e.g., 1...17, -8...0...8, or 8L...N...8R respectively).

3.6.2.11 Tap measurement – Analog signal

If an analog output is available for connection to the SDM, the installation of the position measurement becomes much simpler, simply connecting it to pins 19 and 21 as shown in the figure below:

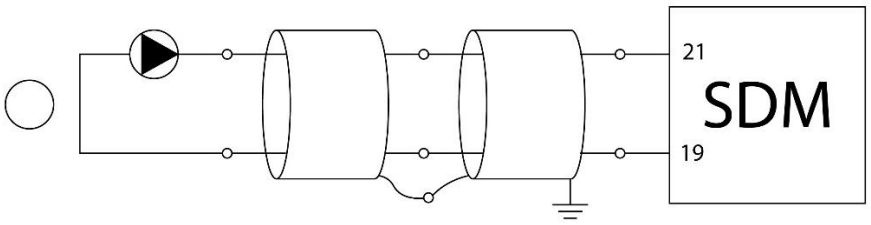


Figure 22 - Tap position measurement via analog signal

The cable used for this connection must be shielded and grounded at only one end. Unshielded cable sections should be as short as possible, and if a splice is necessary, the shielding should also be passed through the terminal so that the connection is not interrupted.

3.6.2.12 Clip-on CTs

Clip-on current transformers (CTs) must be connected to the circuit breaker output or the motor input. If you choose to connect to the motor circuit breaker output, you should check if there are other loads connected to the same circuit breaker, as the SDM should only read the current going to the motor.

To ensure that the phase is the same for both current and voltage, the current transformers (CTs) must be connected to the same points, as there are reversing contactors responsible for inverting the phases and thus changing the phase between voltage and current.

The following characteristics should be observed when using the clip-on CT:

- Phase (PT/CT): the CTs must be synchronized with the voltages. Phase A CT at phase A voltage, Phase B CT at phase B voltage, Phase C CT at phase C voltage. Check continuity between the SDM and terminals;
- CT polarity: The clip-on current transformer has its polarity indicated by a green dot painted on the body of the transformer, closest to the white wire. In practice, the connection should be based on the figure below.

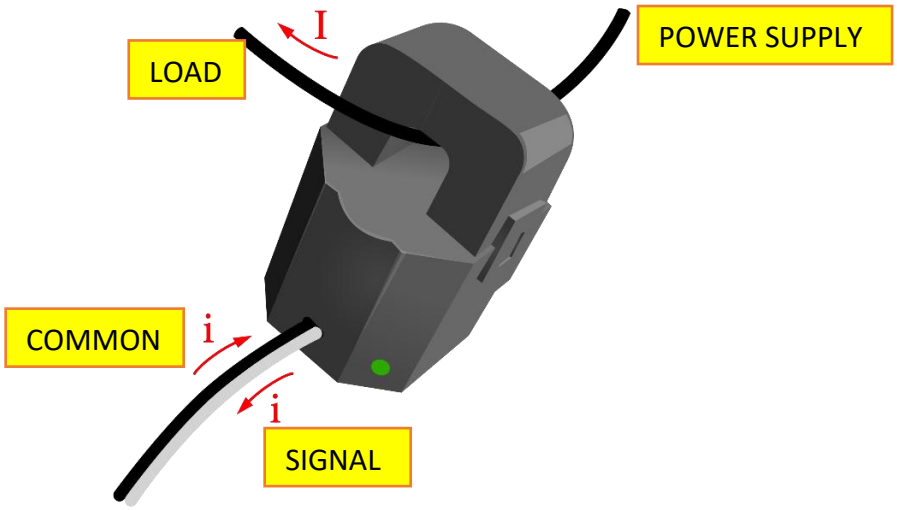


Figure 23 - Polarities and directions of currents in a clip-on CT

- Check the angle measurements of phases A, B, and C during motor activation. They should measure between 270 and 360 degrees;
- Check the power factor (PF) value, which should be between 0 and 1.

3.6.2.13 Temperature sensor

An RTD temperature sensor can be connected to the SDM using shielded cables, without interrupting the shield, which should only be grounded at the end connected to the SDM, as

close as possible to it. If intermediate terminals are needed to interconnect the RTD sensor, also run the cable shielding through the terminal, avoiding its interruption. The unshielded cable section due to the splice should be as short as possible, as shown in the following figure.

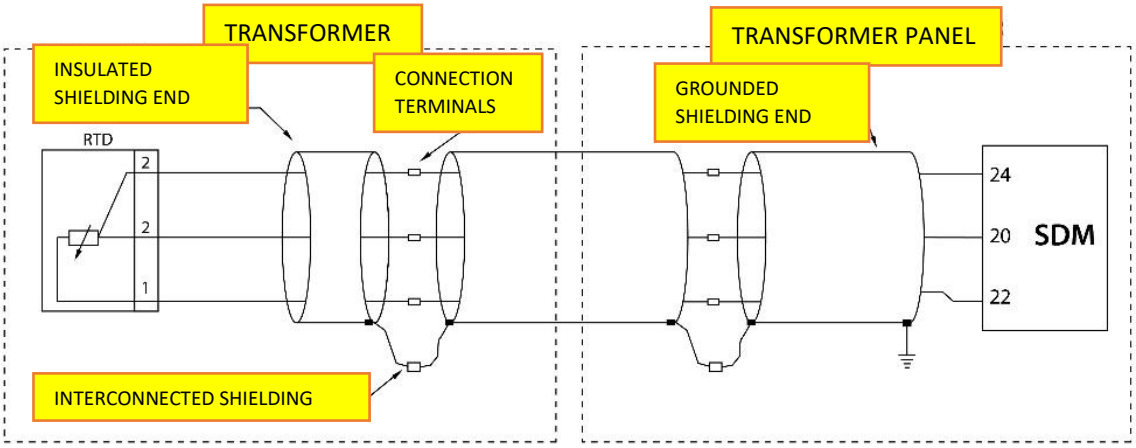


Figure 24 - Connection of the shielding for the interconnection between RTD sensors and the SDM

3.6.3 Output terminals

For ease of understanding, the SDM can be divided into input and output terminal blocks. The output block is shown in the table below:

Table 6 - SDM output terminals

OUTPUTS	TERMINALS		
Reversible logic relays The SDM has three reversible output relays that can be either normally open (NO) or normally closed (NC) and can be used for various purposes, such as announcing alarms or sending a signal to trip a circuit breaker.	R1 12 – NO 13 – NC 14 – Common	R2 09 – NO 10 – NC 11 – Common	R3 06 – NO 07 – NC 08 –Common
Normally open (NO) type relays The SDM also has two more normally open output relays. These can also be used for the same functions as the reversible relays.	05 – NO (R4) 03 – NO (R5) 04 – Common		

3.6.3.1 Reversible logic relays

These are relays that can function as normally open (NO) or normally closed (NC) depending on the output the user chooses to connect their application to. The SDM has three of these relays, which can be used to send alarm signals, block signals, control heating or cooling systems, among numerous other applications.

The relay contacts can switch loads up to 250 Vdc/Vac, with a maximum power of 70 W/250 VA, considering resistive loads. Their continuous current carrying capacity (limited by the Joule

effect) is 5 A. The following figure shows the devices in the SDM configuration. For more information, see the Relay specifications page.

3.6.3.2 Normally open relays

There are two such relays in the SDM, but in the parameterization they can be configured to operate as normally open (NO) or reversed as normally closed (NC). In the second case, while the SDM is energized, the relay will operate as NC, but if the equipment, or just the relay, is de-energized, the contact will open. Their applications are as varied as those of reversible relays.

The relay contacts can switch loads up to 250 Vdc/Vac, with a maximum power of 70 W or 220 VA, considering resistive loads. Their continuous current carrying capacity (limited by the Joule effect) is 5 A. The figure below shows the devices in the SDM configuration.

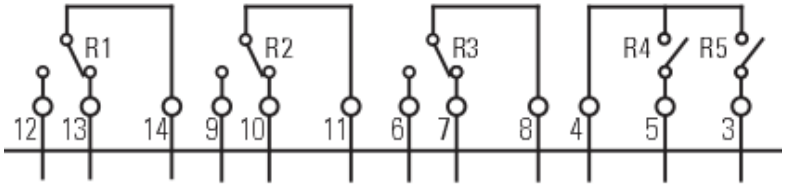


Figure 25 - SDM output relays

3.6.4 Communication ports

Table 7 - SDM communication terminals

Communication	Terminals
Ethernet port Communication port via RJ45 or SC multimode fiber optic cable for communication between SDM and control/supervisory system or communication with IEDs. Output protocols: Modbus® TCP (slave), Modbus® RTU/TCP (slave), DNP3 TCP (outstation), and IEC 61850 (server and publisher).	RJ45 – 1 RJ45 – 2 TX/RX – 3 TX/RX – 4
Serial fiber optic port Multimode fiber optic communication port (SC) for communication between the SDM and the control/supervisory system or communication with the IEDs. Output protocols: Modbus® RTU (slave), DNP3 RTU (outstation).	TX/RX – 5
RS-485 communication ports The SDM has three RS-485 serial communication ports. Two of them, located on terminals 71 and 72, and 74 and 75, are intended to allow connection between the SDM and some user-owned supervisory or monitoring system. Communication is done using the Modbus® or DNP3 protocol, via shielded twisted-pair cable.	71 – (-) 72 – (+) 74 – (-) 75 – (+)

RS-232 communication port The SDM has an RS-232 communication port for connection to a control, supervisory, or monitoring system. Communication is done using the Modbus® or DNP3 protocol, using a 3-wire twisted-pair shielded cable.	71 – RX 72 – TX 73 – GND

3.6.4.1 Precautions when installing an RS-485 network

The SDM can optionally be connected to a data acquisition system (supervisory or monitoring system) via the RS-485 serial communication ports located on terminals 71 and 72, and 74 and 75.

Up to 31 devices can be interconnected on the same RS-485 serial communication network. The communication protocols available for this connection are Modbus® and DNP3.

The interconnection between the SDM and the data acquisition system must be made using a shielded twisted-pair cable, maintaining an uninterrupted shield throughout the entire path. If intermediate terminals are needed for serial communication interconnection, the cable shield should also pass through the terminal to avoid interruption. The unshielded cable section due to the splice should be as short as possible, and it is advisable that the cable shield be grounded at only one end. It is advisable to use a 120 Ω termination resistor at each end of the serial communication network to attenuate signal reflections. Pull-up and pull-down resistors should be used in conjunction with the termination resistors at only one point in the network, as shown in the figure below. The 5 V DC power supply for the pull-up and pull-down resistors can be internal to the data acquisition system. Note that some communication equipment may already have these resistors installed internally, eliminating the need for external resistors. The maximum distance of 1200 m between the ends of the communication network must be observed.

In the case of long communication networks and high transmission rates (greater than 9600 bps), it is advisable to use a 120 Ω termination resistor at each end of the serial communication network to attenuate signal reflections. In conjunction with the termination resistors, pull-up and pull-down resistors should be used at only one point in the network, as shown in the figure below. The 5 V DC power supply for the pull-up and pull-down resistors can be internal to the data acquisition system. Note that some communication equipment may already have these resistors installed internally, eliminating the need for external resistors.

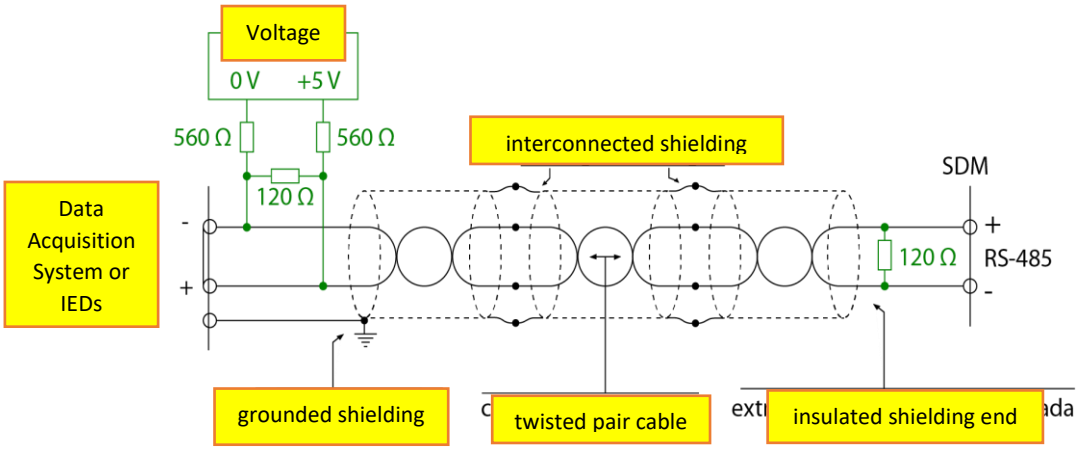


Figure 26 - Connection with pull-up and pull-down resistors

4 Access to the SDM information

All operations on the Smart Device for OLTC Torque - SDM are performed via the keypad on its front panel; no external switches or buttons are required. Voltages, currents, and other measured quantities will be displayed, and alarm conditions will be indicated by the signaling LEDs.

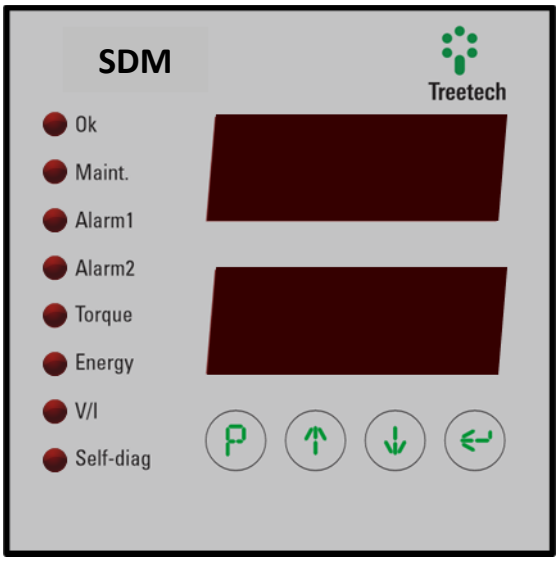


Figure 27 - SDM front display

4.1 Signaling LEDs

The SDM has 8 indicator LEDs that will light up according to their respective event.

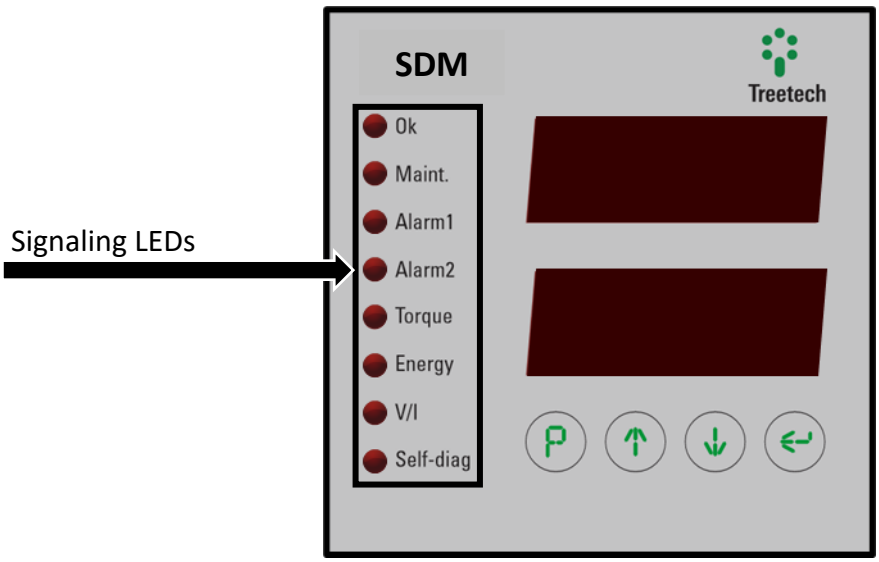


Figure 28 - SDM signaling LEDs

The meanings of the LEDs and keys on the SDM front panel have the following functions, as shown in the table below.

Table 8 - Description of LEDs

Description of LEDs	
Ok	It lights up when there is no active alarm.
Maint.	It lights up when a blue classification alarm is active.
Alarm 1	It lights up when a yellow classification alarm is active.
Alarm 2	It lights up when a red classification alarm is active.
Torque	It lights up when an unexpected variation in the torque developed by the motor is detected during its operation.
Energy	It lights up when the amount of energy required to operate the motor during the tap changing process is significantly different from what is expected.
V / I	When lit, it indicates that there is a problem with undervoltage, overvoltage, or current in some phase of the motor.
Self-diag.	It lights up when a self-diagnosis is detected within the SDM itself.

Table 9 - Description of the SDM keys

Description of the keys	
	**Programming key:** Allows password access to enter the configuration menus. Within these menus, it exits the ongoing menu, returning to the previous level menu. If activated while changing a parameter, it returns to the previous level menu without saving the changes made.
	**Up key:** Navigates to the menus and increments programmed values.
	**Down key:** Navigates to the menus and decrements programmed values.
	**Enter key:** Selects the menu option and parameters displayed, saves the programmed values.

4.2 Query screens

4.2.1 General screen

When you turn on the SDM, the first screens the user sees are the query screens and measurement display. These are divided into two sections. The first is accessible as soon as the device is started. Use the arrow keys  and  to navigate between the screens shown below.

Table 10 - SDM query screens

SDM query screens	
Voltage of the 1st phase of the motor This shows the voltage of the first phase of the motor's power supply. In DC and single-phase motors, this will be the only measurement of this type.	
Current of the 1st phase of the motor This shows the current of the first phase of the motor's power supply. In DC and single-phase motors, this will be the only measurement of this type.	
Angle ϕ between the voltage and current phases in the 1st phase of the motor	

In alternating current motors, there is a phase shift between the voltage and current of the phase. PHI1 is the angle ϕ of the first phase.	
Voltage of the 2nd phase of the motor This displays the voltage of the second phase of the motor's power supply. This measurement is only shown for three-phase motors.	
Current of the 2nd phase of the motor This displays the current of the second phase of the motor's power supply. This measurement is only shown for three-phase motors.	
Angle ϕ between the voltage and current phases in the 2nd phase of the motor This shows the angle ϕ measurement of the second phase. For three-phase motors only.	
Voltage of the 3rd phase of the motor This displays the voltage of the third phase of the motor's power supply. This measurement is only shown for three-phase motors.	
Current of the 3rd phase of the motor This displays the current of the third phase of the motor's power supply. This measurement is only shown for three-phase motors.	
Angle ϕ between the voltage and current phases in the 3rd phase of the motor This shows the angle ϕ measurement of the third phase. For three-phase motors only.	
OLTC motor power factor In AC motors, there is a factor related to active, reactive, and apparent power. It is a relationship between the angle of the current and voltage.	
Voltage between phases A and B (1 and 2) The SDM measures the voltage between the phase and the reference of the three phases of the three-phase motor and calculates the voltage between any two phases according to a vector difference: $$V_{AB}^2 = V_A^2 + V_B^2 - 2V_A V_B \cos 120°$$ The V_{ab} value, calculated between the first and second phases, is displayed on this screen.	
Voltage between phases B and C (2 and 3) Similar to the previous item, the voltage between phases 2 and 3 is shown here.	
Voltage between phases C and A (3 and 1) Voltage between the last pair of phases, 3 and 1.	
Auxiliary contact of the circuit breaker Through the dry contact between pins 18 and 30, the SDM can monitor the state of the auxiliary motor circuit breaker. Check here if it is open or closed.	 
Tap position With the optional tap position measurement (optional TAPP or optional TAPI) active, read the current tap position here.	
Previous position of the tap This information is the tap position the tap changer was in before its current position.	
Line current It shows the line current. This measurement is also used in calculating contact wear due to switched current.	
Date and time information Use the arrow keys to continue navigating through the other information, or press on this screen to access the submenu and view date and time data. Once inside, navigate using the arrow keys and . To return to the previous level, press .	 
ECOM Information from the SDM communication interface, such as status, IP, gateway, mask, and DNS. Press on this screen to access the submenu and view communication data.	

Once inside, navigate using the arrow Keys and . To return to the previous level, press .	

From any screen that doesn't serve as an entry point to a submenu, access the second information section by quickly pressing the key. Then, using the arrow Keys and , navigate between the screens shown below.

Table 11 - Continuation of the SDM query screens

Continuation of the SDM query screens	
Circular oscillography counter The circular oscillography counter indicates the index of the record where the last oscillography was recorded.	
Minimum voltage Minimum voltage reached by the motor during the last operation.	
Maximum voltage Maximum voltage reached by the motor during the last operation.	
Peak current Peak current reached during the last motor operation.	
Motor energy Total energy consumed by the motor during the last operation.	
Operating time Time during which the motor operated during the last commutation.	
Recording interval Interval between successive recordings in oscillography.	
Learning status Submenu that shows the learning status of the various SDM variables that are adjusted by this type of process. Use the arrow keys to continue navigating through the other information, or press on this screen to access the submenu and view its information. Once inside, navigate using the arrow keys and . To return to the previous level, press .	 
Counters for maintenance If the OLTC maintenance option is active in the SDM, this information submenu will provide the content of the relevant operation and maintenance counters. Use the arrow keys to continue navigating through the other information, or press on this screen to access the submenu and view its information. Once inside, navigate using the arrow keys and . To return to the previous level, press .	 

4.2.2 Information from the “TIME” submenu

By accessing the “TIME” submenu, you can view the product's date and time information.

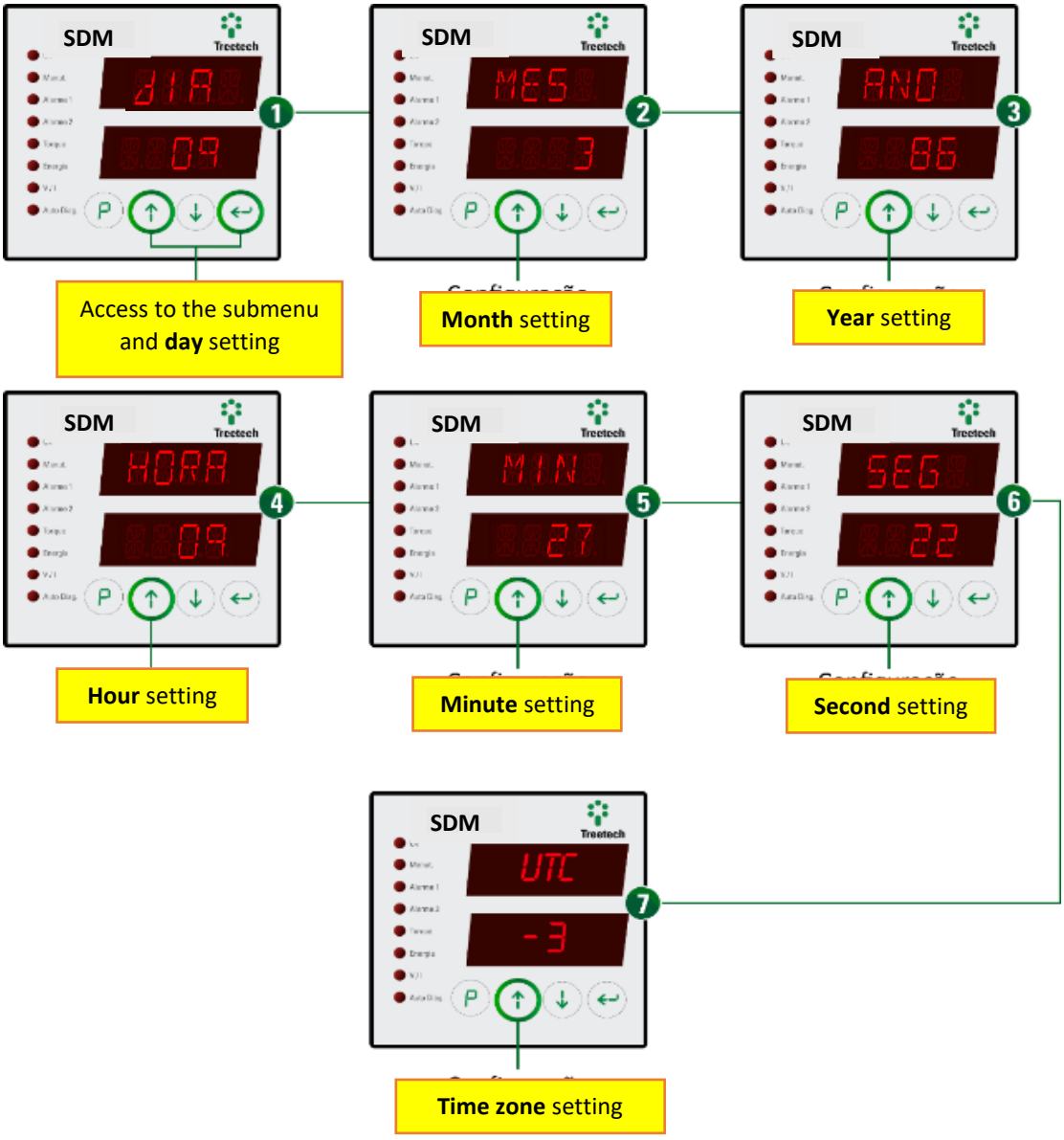


Figure 29 - Navigating date/time information

Once all the desired queries have been made in this menu, quickly press the P key to return to the previous query screen section.

4.2.3 Information from the "ECOM" submenu

By accessing the “ECOM” submenu, it is possible to view the IP, mask, gateway, and DNS information for the primary interface, as well as the IP and mask information for the secondary interface.

Table 12 - Information from the "ECOM" submenu

Information from the "ECOM" submenu

Communication status Submenu that displays the communication status of the various SDM networks that are adjusted by this type of process.	
NET1 (IP, MAS, GAT, DN1, DN2) Use the arrow keys to continue navigating through the other information, or press on this screen to access the submenu and view data about the IP address of network 1. Once inside, navigate using the arrow keys and . To return to the previous level, press .	
NET2 (IP, MAS) Use the arrow keys to continue navigating through the other information, or press on this screen to access the submenu and view data about the IP address of network 2. Once inside, navigate using the arrow keys and . To return to the previous level, press .	
MAC address Use the arrow keys to continue navigating through the other information, or press on this screen to access the submenu and view data about the MAC address. Once inside, navigate using the arrow keys and . To return to the previous level, press .	

4.2.3.1 Primary network interface “NET 1”

IP

The next 4 screens comprise the IP address of the SDM's primary network interface. Navigate through them using the arrow keys and .

Subnet mask

The next 4 screens comprise the subnet mask of the SDM's primary network interface. Navigate through them using the arrow keys and .

Default gateway

The next four screens comprise the default gateway for the SDM's primary network interface. Navigate through them using the arrow keys and .

DNS 1

The next 4 screens comprise DNS 1 of the SDM's primary network interface. Navigate through them using the arrow keys and .

DNS 2

The next 4 screens comprise the DNS 2 of the SDM's primary network interface. Navigate through them using the arrow keys and .

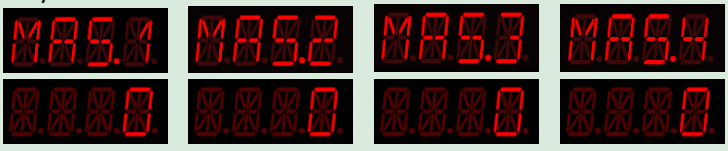
4.2.3.2 Secondary network interface “NET 2”

IP

The next 4 screens comprise the IP address of the SDM's secondary network interface. Navigate through them using the arrow keys and .

Subnet mask

The next 4 screens comprise the subnet mask of the SDM secondary network interface. Navigate through them using the arrow keys and .



4.2.4 Information from the “MAC” submenu

Control address for media access

The next 6 screens comprise the MAC address of the SDM's secondary network interface. Navigate through them using the arrow keys and .

4.2.5 Information from the "STMO" submenu

By accessing the “STMO” submenu, it is possible to view information about the learning process status of the various SDM variables that are adjusted by this type of process.

Table 13 - Information from the "STMO" submenu

Information from the "STMO" submenu	
Signature status without intermediate taps Indicates whether the signature of operations without intermediate taps is being referenced or if the operations are already being monitored.	
Learning status of the alarms due to temperature Indicates the learning status of alarms due to temperature, if the automatic threshold setting mode is selected by the user.	
Learning status of the alarms due to oscillography Indicates the learning status of alarms due to oscillography, if the automatic threshold setting mode is selected by the user.	

4.2.6 Information from the "CTOM" submenu

By accessing the “CTOM” submenu (if the OLTC maintenance option is active in SDM), it is possible to view information about the contents of the relevant operation and maintenance counters.

Table 14 - Information from the "CTOM" submenu

Information from the "CTOM" submenu	
Number of operations, part 1 Most significant portion of the number of operations already carried out by the OLTC.	
Number of operations, part 2 Least significant portion of the number of operations already carried out by the OLTC.	
Number of operations since the last maintenance, part 1 Most significant portion of the number of operations performed by the OLTC since the last maintenance.	
Number of operations since the last maintenance, part 2	

Least significant portion of the number of operations performed by the OLTC since the last maintenance..	
Average number of operations Average daily operations of the OLTC.	
Time for maintenance based on the number of operations Time remaining for maintenance by number of operations. In some variables, when the value exceeds 9999, the top display will show the number "n" followed by the letter "k", and the bottom display will show three more digits. The value shown above represents the thousands, and the value shown below represents the units, tens, and hundreds. If, for example, the top display shows 32k and the bottom display shows 767, it means that the value of the variable is 32767.	
Integration of switched current, part 1 The four most significant digits of the total integration of the switched current.	
Integration of switched current, part 2 The four least significant digits of the total integration of the switched current.	
Integration of the current since the last maintenance, part 1 Four most significant digits of the integration of the switched current since the last maintenance.	
Integration of the current since the last maintenance, part 2 Four least significant digits of the integration of the switched current since the last maintenance.	
Average of integration of current Average daily increase in integration of the switched current.	
Time for maintenance based on integration of current Time remaining for maintenance based on current integration.	
Service time Total time in days of OLTC in service.	
Service time since last maintenance Service time since last maintenance.	
Time for maintenance based on service time Time remaining for maintenance based on service time.	

4.2.7 Version

To check the SDM firmware version from the query screens, simultaneously press the P and ↵ keys. The complete firmware version number will be displayed on a screen like the following. Using the arrow keys, you can navigate between the additional information presented below. To exit these screens and return to the previous level, press P or ↵.

Table 15 - Version information

Version information	
Product information The top display will show the device name. The bottom display will show the device firmware version.	
Release Firmware build version.	
Bootloader Product bootloader version.	
Bootloader/release Bootloader build version.	
Serial number The next screen displays the product's serial number.	
Product serial number The top display shows the three most significant digits of the serial number. The bottom display shows the three least significant digits of the serial number (Ex.: 123456).	
Hardware Hardware model. **SDM:** 1 input for potentiometric transmitter for measuring the tap position (“POTE”). **SDM-I:** 1 current loop input for measuring the tap position (“CORR”).	

Options Shows the enabled options in the SDM.	
Information menu Displays the equipment board versions in SDM.	

4.2.7.1 Active options menu

Table 16 - Active options menu

Active options menu	
Active options Pressing ↵ on this screen will display the active options. If no options are active, no information will be displayed.	
DNP3 communication protocol Indicates that the optional DNP3 protocol is active.	
Mass memory Indicates that mass storage is active. **Note:** Mass storage is available as a standard feature of the equipment.	
Monitoring of the anti-condensation system and control power supply Indicates that the optional monitoring of the anti-condensation system and control power supply is active.	
OLTC position measurement Indicates that the optional OLTC position measurement is active.	
OLTC maintenance assistant Indicates that the optional OLTC maintenance assistant is active.	

Contact Customer Service if you wish to activate mass memory.

4.2.7.2 Menu and information

Table 17 - Menu and information

Menu and information	
Information menu Pressing ↵ on this screen will display the available board versions for the equipment.	
Motherboard version Indicates the current motherboard version of the equipment.	
Front board version Indicates the current front borad version of the equipment.	
CBR Indicates the version of the secondary board.	
CBTP Indicates the hardware model.	
CBMJ Indicates the first part of the system version number of the communication board.	
CBMD Indicates the second part of the system version number of the communication board.	
CBMN Indicates the third part of the system version number of the communication board.	

4.2.8 Waiting screen

After programming a parameter that influences the display screens, such as a parameter that can generate or remove the display of certain values, a **WAIT** message will appear for about 5

seconds when returning to the display screens. This same message appears when any reset command is executed via the communication protocol.

Figure 30 - WAIT screen

4.2.9 Alarms

If an alarm occurs, the displays will flash showing a message like this:

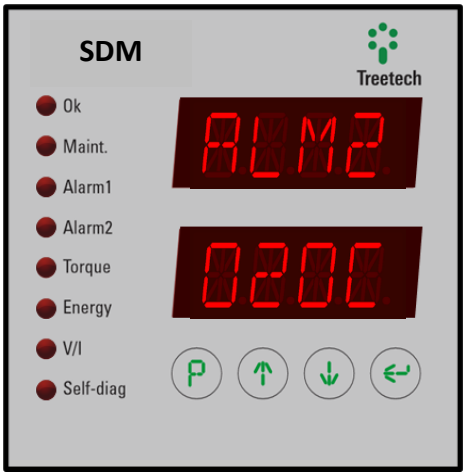


Figure 31 - Alarm occurrence screen

The message shown on the top display indicates which of the three alarm sections the code displayed on the bottom display belongs to. The value shown on the bottom display contains four digits, each digit representing up to four different alarms, with values 1, 2, 4, and 8. The value shown for the digit will be the sum of the values of all active alarms for that digit. For example, if a certain digit is showing the number 7, we know that alarms 1, 2, and 4 are currently active.

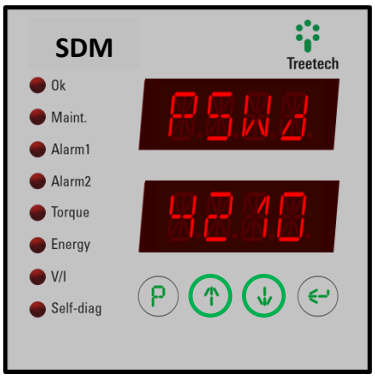
5 Parameterization

To ensure its correct operation, several parameters must be adjusted in the SDM to provide the equipment with the necessary information for its functioning. Adjustments can be made via its front keypad, with the aid of the display, or via RS-485 communication, available to the user on the rear connector of the device.

The programmable parameters are organized into several submenus, all within a main menu with password-protected access. Within each submenu, the user will have access to a set of parameters that must be adjusted according to the needs of each application and the characteristics of the equipment where the SDM is applied.

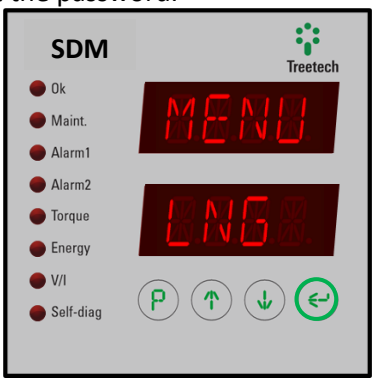
The parameters relating to optional items will only be shown if these items are available.
Access to programming menus:

1) On the general display screen, press and hold the key for 5 seconds.



2) The access password screen will be displayed. Using the and keys, adjust the password.

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



4) The first menu (LNG) is displayed. Use the and keys to select a menu and press to access its parameters.

The password can be reset by the user.

The initial number shown when you reach the second image can be used to recover your password if you forget it. Please provide this number to our Customer Service department.

5.2 Parameter map

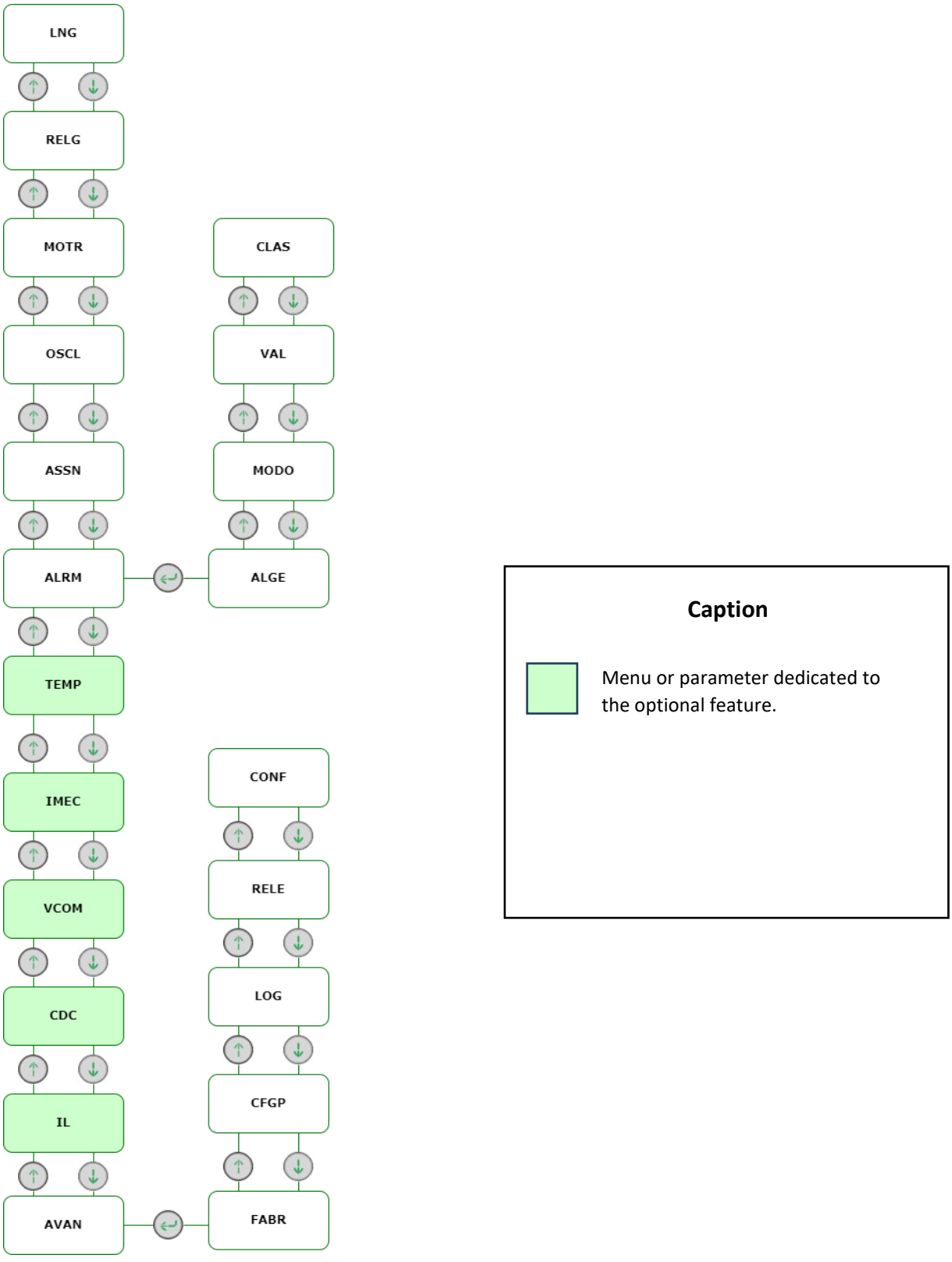


Figure 32 - Parameter map

After 25 seconds of inactivity within a menu, the system returns to a previous level.

5.3 LNG Menu - Language

By ensuring access with the correct password, the first visible menu within the settings is “LNG”, where the SDM language can be chosen.

IDI - Language

This parameter allows you to select the desired language for the product interface.

Adjustment range: PORT (Portuguese), ENGL (English) and ESPN (Spanish).
Default value: PORT.

5.4 RELG Menu - Clock

Allows you to adjust the device's calendar.

DIA - Day

Adjusting the current day in the device's calendar.

Adjustment range: 1 to 31.
Default value: 1.

MES - Month

Adjusting the current month in the device's calendar.

Adjustment range: 1 to 12.
Default value: 1.

ANO - Year

Adjusting the current year in the device's calendar.

Adjustment range: 0 to 37.
Default value: 0.

HORA - Hour

Adjusting the current hour in the device's clock.

Adjustment range: 0 to 23.
Default value: 0.

MIN - Minute

Adjusting the current minute to the time displayed on the device's clock.

Adjustment range: 0 to 59.
Default value: 0.

UTC - Time zone

Use the arrows to select your local time zone relative to the Greenwich meridian.

Adjustment range: -12 to +12 h.
Default value: 0 h.

5.5 MOTR Menu - Motor

This menu displays the parameters related to monitoring the OLTC motor.

MTSL - Motor selection

Choose the type of motor that corresponds to the one being monitored.

Adjustment range:

AC M = single-phase motor.
AC T = three-phase motor.
DC = DC motor.

Default value: AC M.

VMTH - Motor voltage

Choose whether or not to enable monitoring of the motor power supply phase voltage.

Note: When the OFF option is selected, the values related to motor voltage will no longer be displayed on the query screens until the ON option is selected again.

Adjustment range: ON or OFF.
Default value: ON.

IMTH - Motor current

Choose whether or not to enable motor phase current monitoring.

Note: When the OFF option is selected, the values related to motor current will no longer be displayed on the query screens until the ON option is selected again.

Adjustment range: ON or OFF.
Default value: ON.

TCTP - PT/CT phase difference

Depending on how the voltage and current sensors are connected to the motor power supply, there may be a phase difference between the measurements. Select the correct phase difference according to your setup.

Note: This parameter is displayed if the **AC T** or **AC M** option is selected in the **MTSL** parameter; if the **DC** option is selected, this parameter will remain hidden.

Adjustment range: 0, 30, 60, 90, 120, 150, 180, 210, 240, 270, 300 or 330°.
Default value: 0°.

RDVM - PT ratio

PT ratio for measuring voltage in the motor.

Adjustment range: 0.10 to 10.00.
Default value: 1.00.

RIM1 - CT or shut 1 ratio

The ratio of the auxiliary current transformer (CT) or shunt resistor 1 used for current measurement in the SDM. In the case of alternating current motors, this parameter defines the ratio of the auxiliary CT used (or the first CT if two CTs are used), while for direct current motors it defines the ratio of the shunt resistor. For the shunt ratio, consult the table in the IMT1 item in the Input Terminals menu.

Adjustment range: 1 to 32767.
Default value: 3100.

RIM2 - CT 2 ratio

Sometimes it is necessary to connect two current transformers (CTs) in cascade to bring the current into a range monitorable by SDM. This parameter is related to the transformation ratio of the second CT.

Adjustment range: 1 to 32767.
Default value: 1.

5.6 OSCL Menu - Oscillography

SDM oscillography settings menu.

TON - Trigger for motor in operation

When the motor's supply current reaches the value specified here, it will be considered to be in operation. Used to trigger the motor's oscillography.

Adjustment range: 0.1 to 99.9 A.
Default value: 99.9 A.

TOFF - Trigger for out-of-operation motor

When the motor's supply current falls below the value specified here, it will be considered out of operation. Used to finalize the motor oscillography.

Adjustment range: 0.1 to 99.9 A.
Default value: 99.9 A.

OSRA - Previous records maintained

Number of records prior to the trigger to be maintained in the oscillography.

Adjustment range: 5 to 200.
Default value: 20.

AMON - Number of trigger on samples

Number of trigger ON samples required to consider the start of the maneuver valid.

Adjustment range: 1 to 50.
Default value: 7.

AMOF - Number of trigger off samples

Number of trigger OFF samples required to consider the end of the maneuver valid.

Adjustment range: 1 to 50.
Default value: 7.

ONS1 - Sequential indexing part 1

Sequential number from 0 to 999999 for indexing oscillograms. ONS1 represents the 3 most significant digits of this number.

Adjustment range: 0 to 999.
Default value: 0.

ONS2 - Sequential indexing part 2

Sequential number from 0 to 999999 for indexing oscillograms. The ONS2 represents the 3 least significant digits of this number.

Adjustment range: 0 to 999.
Default value: 0.

OSI1 - Oscillography of current - 1st phase

Allows you to choose whether the power supply current of the first, or only, phase of the motor will be recorded during oscillography.

Adjustment range: ON to record, OFF to not record.
Default value: ON.

OSI2 - Oscillography of current - 2nd phase

Allows you to choose whether the second-phase motor supply current will be recorded during oscillography.

Note: Since they do not have other power supply phases, when monitored, single-phase AC motors and DC motors do not display parameters like this one, related to other phases. In other words, it will only be displayed if the **MTSL** parameter in the **MOTR** menu is set to the **AC T** option.

Adjustment range: ON to record, OFF to not record.
Default value: ON.

OSI3 - Oscillography of current - 3rd phase

Allows you to choose whether the third-phase motor supply current will be recorded during oscillography.

Note: Since they do not have other power supply phases, when monitored, single-phase AC motors and DC motors do not display parameters like this one, related to other phases. In other words, it will only be displayed if the **MTSL** parameter in the **MOTR** menu is set to the **AC T** option.

Adjustment range: ON to record, OFF to not record.
Default value: ON.

OSV1 - Oscillography of voltage - 1st phase

Allows you to choose whether the supply voltage of the first, or only, phase of the motor will be recorded during oscillography.

Adjustment range: ON to record, OFF to not record.
Default value: ON.

OSV2 - Oscillography of voltage - 2nd phase

Allows you to choose whether the second-phase motor supply voltage will be recorded during oscillography.

Note: Since they do not have other power supply phases, when monitored, single-phase AC motors and DC motors do not display parameters like this one, related to other phases. In other words, it will only be displayed if the **MTSL** parameter in the **MOTR** menu is set to the **AC T** option.

Adjustment range: ON to record, OFF to not record.
Default value: OFF.

OSV3 - Oscillography of voltage - 3rd phase

Allows you to choose whether the third-phase motor supply voltage will be recorded during oscillography.

Note: Since they do not have other power supply phases, when monitored, single-phase AC motors and DC motors do not display parameters like this one, related to other phases. In other words, it will only be displayed if the **MTSL** parameter in the **MOTR** menu is set to the **AC T** option.

Adjustment range: ON to record, OFF to not record.
Default value: ON.

OSPF - Oscillography of power factor

Allows you to choose whether the motor's power factor will be recorded during operation in the oscillography. Since they do not display this factor, this option is not available for DC motors.

Adjustment range: ON to record, OFF to not record.
Default value: ON.

CRT'x' - Reference counter of type 'x'

This menu contains the settings for reference count types 0 through 4.
The 'x' indicates the relay number.
Example: CRT0**,** CRT1, CRT2, CRT3 and CRT4.

Counts the number of times the reference learning system of type 'x' has been completed, where 'x' ranges from 0 to 4.

Note: To enable the **MTT1**, **MTT2**, **MTT3**, and **MTT4** parameters, access the **TINP** parameter in the **ASSN** menu.

Adjustment range: 0 to 255.
Default value: 0.

5.7 ASSN Menu - Motor signature

The SDM uses oscillography to assemble the motor's operating profile during commutation. This allows for the evaluation of motor performance and the detection of any issues causing it to deviate from its normal operating condition. This menu allows you to configure various aspects related to how the motor signature is obtained and used.

MTTP - Motor start-up time

Motor start-up time, during which the starting current is monitored but the fuel consumption curve is not.

Adjustment range: 0.00 to 99.99 seconds.
Default value: 3.00 seconds.

NMAO - Number of learning operations

Number of motor operations to be used in learning the signature of the reference consumption curve.

Adjustment range: 1 to 100.
Default value: 10.

NMAI - Number of learning operations with intermediate taps

Number of motor operations to be used in learning the signature of the reference consumption curve when performed in intermediate positions.

Adjustment range: 1 to 100.
Default value: 10.

ASC - Alarm sensitivity of the torque curve

Number of samples outside the motor torque signature curve for alarm activation.

Adjustment range: 1 to 50.
Default value: 2.

MASX - Side margin of the signature

Tolerance margin used to determine the lateral limits (x-axis) for the motor's power consumption signature curve.

Adjustment range: 5 to 20.
Default value: 10.

MASI - Bottom margin of the signature

Margin of tolerance used to determine the lower limit (y-axis) for the electric motor's power consumption signature curve.

Adjustment range: 0.1 to 100.0 %.
Default value: 20.0 %.

MASS - Top margin of the signature

Margin of tolerance used to determine the upper limit (y-axis) for the electric motor's power consumption signature curve.

Adjustment range: 0.1 to 100.0 %.
Default value: 20.0 %.

TINT - Intermediate taps

Select the number of intermediate taps that the longest tap changing process has.

Adjustment range: 0 to 4.
Default value: 0.

MTTO - Motor operating time

Nominal motor operating time for a typical tap change. This value is used to recognize that this type of tap change is occurring.

Adjustment range: 0.1 to 60.0 seconds.
Default value: 5.0 seconds.

APRD - Learning

It initiates a learning period, during which the equipment reads some of the tap changer operations and learns its operating pattern.

Adjustment range: YES for learning mode, NO for normal operation mode.
Default value: NO.

5.8 ALRM Menu - Alarms

In this menu, the user accesses the settings for alarms generated by the SDM. Alarms can be configured in different aspects, therefore this menu contains four submenus, which divide the alarm settings according to the categories listed below.

If the alarm is classified as deactivated (the indication "- " will appear on the display) and the IED will not display the alarm message even if the alarm conditions are met. In this case, the point corresponding to the alarm in the communication protocols will also not be changed.

5.8.1 ALGE Submenu - General alarm settings

These are some general settings, such as timings, advance warnings, and other more generic aspects of how alarms work.

VTAL - Timing for the alarm due to command voltage

Timing for triggering the alarm due to over or undervoltage in the power supply of the OLTC motor control circuit.

Adjustment range: 0 to 60 seconds.
Default value: 15 seconds.

NTMX - Operations for maintenance

Enter the number of operations the OLTC can perform before maintenance is required.

Note: This parameter belongs to the optional **OLMT - OLTC Maintenance Assistant.**

Adjustment range: 1k to 999k.
Default value: 150k.

ITMX - Limit of the integration of the switched current

By integrating the value of the switched current, it is possible to estimate the wear level of the OLTC contact. Enter the value of this sum that makes maintenance necessary.

Note: This parameter belongs to the optional **OLMT - OLTC Maintenance Assistant.**

Adjustment range: 1k to 999k p.u^{n}
Default value: 150k p.u^{n}

TTMX - Maximum service time

The OLTC may require periodic maintenance based on service life. Adjust this time here.

Note: This parameter belongs to the optional **OLMT - OLTC Maintenance Assistant.**

Adjustment range: 1 to 32767 days.
Default value: 1825 days.

SCTR - Advance notice of maintenance

To facilitate planning, SDM considers the trend of various criteria and provides advance notice of when maintenance is needed. The lead time is adjusted in this parameter.

Note: This parameter belongs to the optional **OLMT - OLTC Maintenance Assistant.**

Adjustment range: 1 to 99 days.
Default value: 30 days.

TTAL - Timing for alarms due to temperature

Adjust how long a temperature must stay outside its range before an alarm is triggered.

Note: This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range: 0 to 120 seconds.
Default value: 20 seconds.

TMMB - Very low mechanism temperature

Very low temperatures in the OLTC actuation mechanism can weaken or even render the equipment unusable. Adjust this parameter to the temperature below which the mechanism would be critically cold.

Note: This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range: -55 to 20 °C.
Default value: -20 °C.

TMB - Low mechanism temperature

This is an alert that the temperature in the OLTC actuation mechanism is low. Its value should precede that of **TMMB** as a form of warning.

Note: This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range: -55 to 20 °C.
Default value: -10 °C.

TMA - High mechanism temperature

Enter the temperature value at which the OLTC drive mechanism can be considered too hot. Exceeding this value will trigger an alert indicating that the mechanism is getting hotter than recommended.

Note: This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range: 20 to 90 °C.
Default value: 70 °C.

TMMA - Very high mechanism temperature

Just as very low temperatures are harmful to the OLTC, so are very high temperatures. Adjust the temperature above which the mechanism will be considered too hot, triggering an alarm.

Note: This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range: 20 to 90 °C.
Default value: 80 °C.

TMLR - Temperature to turn on heating

Define the temperature below which the OLTC mechanism heating system should be activated.

Note: This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range: -40 to 40 °C.
Default value: 0 °C.

TMDR - Temperature to turn off heating

Set the temperature above which the heating system of the mechanism should be switched off.

Note: This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range: 0 to 55 °C.
Default value: 30 °C.

TIAL - Timing for alarms

Adjust the timing so that all alarms due to heating mechanism current are triggered.

Note: This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range: 0 to 30 seconds.
Default value: 20 seconds.

5.8.2 MODO Submenu - How the alarms work

The SDM is an intelligent device, and one of its capabilities is to use a sampling period to learn the appropriate operating conditions for the motor and the OLTC. Once the normal conditions are learned, it calculates alarm thresholds as a percentage of the normal value. In this submenu, you choose whether the alarm operating points will be calculated automatically or entered manually as absolute values. In automatic mode, it is recommended to enter times where consistent values can be obtained and observable values can be ensured, avoiding abrupt fluctuations.

MODO - Operating mode

Choose whether the alarms should be set to automatic or manual mode.

If manual mode is selected, the submenu ends here; otherwise, the adjustment screens described below will be available.

Adjustment range: MAN for manual mode, AUTO for automatic mode.
Default value: AUTO.

TAPR - Learning time

The time that the data sampling will serve as a learning basis for the alarms.

Adjustment range: 1 to 9999 hours.
Default value: 240 hours.

APRD - Reset learning

If the operating conditions of the SDM change significantly, such as when the OLTC is replaced or when the initial learning occurs during a very turbulent period, the learning process should be reset so that the device can readjust.

Adjustment range: YES to starting new learning, NO to maintaining already established profiles.
Default value: NO.

5.8.3 VAL Submenu - Alarm threshold values

Many alarms occur when the measured value exceeds a pre-established range of acceptable values. In this submenu, it is possible to configure thresholds for the measured quantities to trigger alarms.

Enabled according to operating mode: manual or automatic.

Manual mode: Thresholds for alarms below or above set values.

Automatic mode: Percentage below or above the values obtained after the sampling and learning period.

VMMB - Very low motor supply voltage

This parameter sets when the OLTC motor's supply voltage is too low, indicating that there may be problems getting it to work when needed.

Adjustment range - manual mode: 0.0 to 600.0 V.
Default value: 90.0 V.
Adjustment range - automatic mode: 0.0 to 100.0 %.
Default value: 20.0 %.

VMB - Low motor supply voltage

This parameter sets when the OLTC motor supply voltage is low.

Adjustment range - manual mode: 0.0 to 600.0 V.
Default value: 100.0 V.
Adjustment range - automatic mode: 0.0 to 100.0 %.
Default value: 10.0 %.

VMA - High motor supply voltage

This parameter sets when the OLTC motor supply voltage is high.

Adjustment range - manual mode: 0.0 to 600.0 V.
Default value: 150.0 V.
Adjustment range - automatic mode: 0.0 to 100.0 %.
Default value: 10.0 %.

VMMA - Very high motor supply voltage

This parameter determines when the OLTC motor supply voltage is too high, indicating that there may be problems if the motor is started.

Adjustment range - manual mode: 0.0 to 600.0 V.
Default value: 160.0 V.
Adjustment range - automatic mode: 0.0 to 100.0 %.
Default value: 20.0 %.

UMMB - Very low motor voltage during operation

Voltage may vary during motor operation. This parameter should be adjusted to the voltage value below which it is considered too low to occur during motor operation.

Adjustment range - manual mode: 0.0 to 600.0 V.
Default value: 160.0 V.
Adjustment range - automatic mode: 0.0 to 100.0 %.
Default value: 20.0 %.

UMB - Low motor voltage during operation

In this parameter, the voltage value below which it is considered too low to occur during motor operation must be adjusted.

Adjustment range - manual mode: 0.0 to 600.0 V.
Default value: 180.0 V.
Adjustment range - automatic mode: 0.0 to 100.0 %.
Default value: 10.0 %.

UMA - High motor voltage during operation

In this parameter, the voltage value above which it is considered high to occur during motor operation must be adjusted.

Adjustment range - manual mode: 0.0 to 600.0 V.
Default value: 240.0 V.
Adjustment range - automatic mode: 0.0 to 100.0 %.
Default value: 10.0 %.

UMMA - Very high motor voltage during operation

In this parameter, the voltage value considered too high to occur during motor operation must be adjusted.

Adjustment range - manual mode: 0.0 to 600.0 V.
Default value: 260.0 V.
Adjustment range - automatic mode: 0.0 to 100.0 %.
Default value: 20.0 %.

IPA - High peak current

Especially during motor start-up, the current can rise well above its nominal value; however, it must not get out of control. Adjust here the value from which the peak current can be considered high.

Adjustment range - manual mode: 0.1 to 999.9 A.
Default value: 150.0 A.
Adjustment range - automatic mode: 0.0 to 100.0 %.
Default value: 10.0 %.

IPMA - Very high peak current

Adjust here the value from which the peak current can be considered too high.

Adjustment range - manual mode: 0.1 to 999.9 A.
Default value: 200.0 A.
Adjustment range - automatic mode: 0.0 to 100.0 %.
Default value: 20.0 %.

EMB'x' - Very low operating energy with 'x' intermediate tap

As explained earlier, the energy consumed during operation is proportional to the torque developed by the motor throughout the operation. If its value is too low, the motor may be disconnected from the load; if too high, it may be stalled.

The parameters **EMB'x'**, **EB'x'**, **EA'x'**, **EMA'x'**, **OMB'x'**, **OB'x'**, **OA'x'** and **OMA'x'** contain the settings for intermediate tap positions from 0 to 4.

The 'x' indicates the number of intermediate taps.

Example: EMB0, EMB1, EMB2, EMB3 and EMB4.

When the energy consumed by the motor during operation falls below the value programmed in this variable, the alarm due to "Operating energy too low with 'x' intermediate tap" will be triggered. The variables numbered with 'x' from 0 to 4 represent the alarm thresholds for transitions with 'x' intermediate taps.

Note:

- To enable the **EMB1**, **EMB2**, **EMB3**, and **EMB4** parameters, access the TINT parameter in the **ASSN** menu.
- This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range - manual mode: 0.000 to 32.767 Wh.
Default value: 0.100 Wh.
Adjustment range - automatic mode: 0.0 to 100.0 %.
Default value: 40.0 %.

EB'x' - Low operating energy with 'x' intermediate tap

When the energy consumed by the motor during operation falls below the value programmed in this variable, the alarm due to "Low operating energy with 'x' intermediate taps" will be triggered.

Note:

- To enable the **EB1**, **EB2**, **EB3**, and **EB4** parameters, access the **TINT** parameter in the **ASSN** menu.
- This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range - manual mode: 0.000 to 32.767 Wh.
Default value: 0.200 Wh.
Adjustment range - automatic mode: 0.0 to 100.0 %.
Default value: 30.0 %.

EA'x' - High operating energy with 'x' intermediate tap

When the energy consumed by the motor during operation exceeds the value programmed in this variable, the alarm due to "High operating energy with 'x' intermediate taps" will be triggered.

Note:

- To enable parameters **EA1**, **EA2**, **EA3**, and **EA4**, access the **TINT** parameter in the **ASSN** menu.
- This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range - manual mode: 0.000 to 32.767 Wh.
Default value: 4.000 Wh.
Adjustment range - automatic mode: 0.0 to 100.0 %.
Default value: 30.0 %.

EMA'x' - Very high operating energy with 'x' intermediate tap

When the energy consumed by the motor during operation exceeds the value programmed in this variable, the alarm due to "Operating energy too high with 'x' intermediate taps" will be triggered.

Note:

- To enable the **EMA1**, **EMA2**, **EMA3**, and **EMA4** parameters, access the **TINT** parameter in the **ASSN** menu.
- This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range - manual mode: 0.000 to 32.767 Wh.
Default value: 4.500 Wh.
Adjustment range - automatic mode: 0.0 to 100.0 %.
Default value: 40.0 %.

OMB'x' - Very low operating time with 'x' intermediate tap

If the operation lasts less than programmed here, an alarm will be triggered indicating that this operation occurred in a very short time. The variables numbered with 'x' from 0 to 4 represent the alarm thresholds for transitions with 'x' intermediate taps. In this case, 'x' intermediate taps.

Note: To enable the **OMB1**, **OMB2**, **OMB3**, and **OMB4** parameters, access the **TINT** parameter in the **ASSN** menu.

Adjustment range - manual mode: 0.0 to 999.9 seconds.
Default value: 1.0 seconds.
Adjustment range - automatic mode: 0.0 to 100.0 %.

Default value: 20.0 %.

OB'x' - Low operating time with 'x' intermediate tap

If the operation lasts less than the programmed time, an alarm will be triggered indicating that the operation occurred in a short time.

Note: To enable parameters **OB1**, **OB2**, **OB3**, and **OB4**, access the **TINT** parameter in the **ASSN** menu.

Adjustment range - manual mode: 0.0 to 999.9 seconds.
Default value: 2.0 seconds.
Adjustment range - automatic mode: 0.0 to 100.0 %.
Default value: 10.0 %.

OA'x' - High operating time with 'x' intermediate tap

If the operation lasts longer than programmed here, an alarm will be triggered indicating that this operation took longer than expected.

Note: To enable the **OA1**, **OA2**, **OA3**, and **OA4** parameters, access the **TINT** parameter in the **ASSN** menu.

Adjustment range - manual mode: 0.0 to 999.9 seconds.
Default value: 90.0 seconds.
Adjustment range - automatic mode: 0.0 to 100.0 %.
Default value: 10.0 %.

OMA'x' - Very high operating time with 'x' intermediate tap

If the operation lasts longer than programmed here, an alarm will be triggered indicating that the operation took too long.

Note: To enable the **OMA1**, **OMA2**, **OMA3**, and **OMA4** parameters, access the **TINT** parameter in the **ASSN** menu.

Adjustment range - manual mode: 0.0 to 999.9 seconds.
Default value: 120.0 seconds.
Adjustment range - automatic mode: 0.0 to 100.0 %.
Default value: 20.0 %.

MDIS - Triggered motor

If the motor remains running for longer than programmed here, the motor alarm will be triggered.

Adjustment range: 0.0 to 999.9 seconds.
Default value: 100.0 seconds.
Adjustment range - automatic mode: 0.0 to 200.0 %.
Default value: 50.0 %.

IAQB - Low heating current

Enter the minimum acceptable current value for the heating system.

Note: This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range: 0.0 to 50.0 A.
Default value: 0.0 A.
Adjustment range - automatic mode: 0.0 to 100.0 %.
Default value: 10.0 %.

IAQA - High heating current

Enter the maximum acceptable current value for the heating system.

Note: This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range: 0.0 to 50.0 A.
Default value: 50.0 A.
Adjustment range - automatic mode: 0.0 to 100.0 %.
Default value: 10.0 %.

VCMB - Very low control voltage

It will trigger if the measured voltage value of the motor control circuit is below the value programmed here.

Note: This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range: 0.0 to 300.0 V.
Default value: 90.0 V.
Adjustment range - automatic mode: 0.0 to 100.0 %.
Default value: 20.0 %.

VCB - Low control voltage

It will trigger if the measured voltage value of the motor control circuit is below the value programmed here.

Note: This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range: 0.0 to 300.0 V.
Default value: 100.0 V.
Adjustment range - automatic mode: 0.0 to 100.0 %.
Default value: 10.0 %.

VCA - High control voltage

It will trigger if the measured voltage value of the motor control circuit is above the value programmed here.

Note: This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range: 0.0 to 300.0 V.
Default value: 150.0 V.
Adjustment range - automatic mode: 0.0 to 100.0 %.
Default value: 10.0 %.

VCMA - Very high control voltage

It will trigger if the measured voltage value of the motor control circuit is above the value programmed here.

Note: This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range: 0.0 to 300.0 V.
Default value: 160.0 V.
Adjustment range - automatic mode: 0.0 to 100.0 %.
Default value: 20.0 %.

UCMB - Very low control voltage during operation

It will trigger if the measured voltage value of the motor control circuit during operation is below the value programmed here.

Note: This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range: 0.0 to 300.0 V.
Default value: 90.0 V.
Adjustment range - automatic mode: 0.0 to 100.0 %.
Default value: 20.0 %.

UCB - Low control voltage during operation

It will trigger if the measured voltage value of the motor control circuit during operation is below the value programmed here.

Note: This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range: 0.0 to 300.0 V.
Default value: 100.0 V.
Adjustment range - automatic mode: 0.0 to 100.0 %.
Default value: 10.0 %.

UCA - High control voltage during operation

It will trigger if the measured voltage value of the motor control circuit during operation is above the value programmed here.

Note: This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range: 0.0 to 300.0 V
Default value: 150.0 V
Adjustment range - automatic mode: 0.0 to 100.0 %
Default value: 10.0 %

UCMA - Very high control voltage during operation

It will trigger if the measured voltage value of the motor control circuit during operation is above the value programmed here.

Note: This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range: 0.0 to 300.0 V.
Default value: 160.0 V.
Adjustment range - automatic mode: 0.0 to 100.0 %.
Default value: 20.0 %.

If you are monitoring a three-phase motor as if it were a single-phase motor and this alarm is set in manual mode, remember to enter the energy value divided by 3, since only one phase will be monitored. This must be done for all energy variables, identifiable by their dimensional unit: Wh.

5.8.4 CLAS Submenu - Alarm classification

Not all alarms have the same severity level, nor should they be addressed with the same approach. Depending on your convenience, in this submenu the user can classify the various alarms into three different categories or deactivate them. The blue category is the least serious and should be used mainly for warnings; the yellow category should be used when a serious problem is detected; and the red category when the situation is urgent. These categories are configurable in the relay outputs. It is worth noting that all alarm types are classified here; for example, classifying an alarm as having a low operating time means classifying this alarm for all intermediate tap situations.

VMMB - Very low motor supply voltage

Define the classification of this alarm.

Adjustment range:

-- = Disabled.

AZ = Blue.
AM = Yellow.
VM = Red.

Default value: VM.

VMB - Low motor supply voltage

Define the classification of this alarm.

Adjustment range:

-- = Disabled.
AZ = Blue.
AM = Yellow.
VM = Red.

Default value: AM.

VMA - High motor supply voltage

Define the classification of this alarm.

Adjustment range:

-- = Disabled.
AZ = Blue.
AM = Yellow.
VM = Red.

Default value: AM.

VMMA - Very high motor supply voltage

Define the classification of this alarm.

Adjustment range:

-- = Disabled.
AZ = Blue.
AM = Yellow.
VM = Red.

Default value: VM.

UMMB - Very low motor voltage during operation

Define the classification of this alarm.

Adjustment range:

-- = Disabled.
AZ = Blue.
AM = Yellow.
VM = Red.

Default value: AM.

UMB - Low motor voltage during operation

Define the classification of this alarm.

Adjustment range:

-- = Disabled.
AZ = Blue.
AM = Yellow.
VM = Red.

Default value: AZ.

UMA - High motor voltage during operation

Define the classification of this alarm.

Adjustment range:

-- = Disabled.
AZ = Blue.
AM = Yellow.
VM = Red.

Default value: AZ.

UMMA - Very high motor voltage during operation

Define the classification of this alarm.

Adjustment range:

-- = Disabled.
AZ = Blue.
AM = Yellow.
VM = Red.

Default value: AM.

IPA - High peak current

Define the classification of this alarm.

Adjustment range:

-- = Disabled.
AZ = Blue.
AM = Yellow.
VM = Red.

Default value: AM.

IPMA - Very high peak current

Define the classification of this alarm.

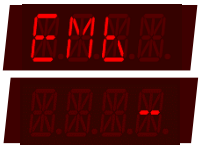
Adjustment range:

-- = Disabled.
AZ = Blue.
AM = Yellow.
VM = Red.

Default value: VM.

EMB - Very low operating energy

Define the classification of this alarm.



Adjustment range:

-- = Disabled.
AZ = Blue.
AM = Yellow.
VM = Red.

Default value: --.

EB - Low operating energy

Define the classification of this alarm.

Adjustment range:

-- = Disabled.
AZ = Blue.
AM = Yellow.
VM = Red.

Default value: --.

EA - High operating energy

Define the classification of this alarm.

Adjustment range:

-- = Disabled.
AZ = Blue.
AM = Yellow.
VM = Red.

Default value: --.

EMA - Very high operating energy

Define the classification of this alarm.

Adjustment range:

-- = Disabled.
AZ = Blue.
AM = Yellow.
VM = Red.

Default value: --.

OMB - Very low operating time

Define the classification of this alarm.

Adjustment range:

-- = Disabled.
AZ = Blue.
AM = Yellow.
VM = Red.

Default value: --.

OB - Low operating time

Define the classification of this alarm.

Adjustment range:

-- = Disabled.
AZ = Blue.
AM = Yellow.
VM = Red.

Default value: --.

OA - High operating time

Define the classification of this alarm.

Adjustment range:

-- = Disabled.
AZ = Blue.
AM = Yellow.
VM = Red.

Default value: --.

OMA - Very high operating time

Define the classification of this alarm.

Adjustment range:

-- = Disabled.
AZ = Blue.
AM = Yellow.

VM = Red.

Default value: --.

MDIS - Triggered motor

Define the classification of this alarm.

Adjustment range:

-- = Disabled.
AZ = Blue.
AM = Yellow.
VM = Red.

Default value: VM.

DJAL - Motor circuit breaker open

Define the classification of this alarm.

Adjustment range:

-- = Disabled.
AZ = Blue.
AM = Yellow.
VM = Red.

Default value: AM.

NTAL - Maintenance notice by number of operations

Define the classification of this alarm.

Note: This parameter belongs to the optional **OLMT - OLTC Maintenance Assistant**.

Adjustment range:

-- = Disabled.
AZ = Blue.
AM = Yellow.
VM = Red.

Default value: AM.

ITAL - Maintenance notice by integral of the current

Define the classification of this alarm.

Note: This parameter belongs to the optional **OLMT - OLTC Maintenance Assistant.**

Adjustment range:

-- = Disabled.

AZ = Blue.
AM = Yellow.
VM = Red.

Default value: AM.

TCAL - Maintenance notice by service time

Define the classification of this alarm.

Note: This parameter belongs to the optional **OLMT - OLTC Maintenance Assistant.**

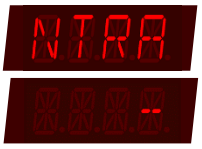
Adjustment range:

-- = Disabled.
AZ = Blue.
AM = Yellow.
VM = Red.

Default value: AM.

NTRA - Advance notice by number of operations

Define the classification of this alarm.



Note: This parameter belongs to the optional **OLMT - OLTC Maintenance Assistant.**

Adjustment range:

-- = Disabled.
AZ = Blue.
AM = Yellow.
VM = Red.

Default value: AZ.

ITRA - Advance notice due to current integration

Define the classification of this alarm.

Note: This parameter belongs to the optional **OLMT - OLTC Maintenance Assistant.**

Adjustment range:

-- = Disabled.
AZ = Blue.
AM = Yellow.
VM = Red.

Default value: AZ.

TTRA - Advance notice due to service time

Define the classification of this alarm.

Note: This parameter belongs to the optional **OLMT - OLTC Maintenance Assistant.**

Adjustment range:

-- = Disabled.
AZ = Blue.
AM = Yellow.
VM = Red.

Default value: AZ.

TMMB - Very low mechanism temperature

Define the classification of this alarm.

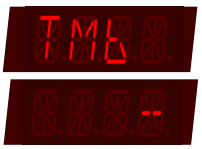
Adjustment range:

-- = Disabled.
AZ = Blue.
AM = Yellow.
VM = Red.

Default value: --.

TMB - Low mechanism temperature

Define the classification of this alarm.



Note: This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range:

-- = Disabled.
AZ = Blue.
AM = Yellow.
VM = Red.

Default value: --.

TMA - High mechanism temperature

Define the classification of this alarm.

Note: This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range:

-- = Disabled.

AZ = Blue.
AM = Yellow.
VM = Red.

Default value: --.

TMMA - Very high mechanism temperature

Define the classification of this alarm.

Note: This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

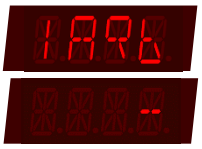
Adjustment range:

-- = Disabled.
AZ = Blue.
AM = Yellow.
VM = Red.

Default value: --.

IAQB - Low heating current

Define the classification of this alarm.



Note: This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range:

-- = Disabled.
AZ = Blue.
AM = Yellow.
VM = Red.

Default value: --.

IAQA - High heating current

Define the classification of this alarm.

Note: This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range:

-- = Disabled.
AZ = Blue.
AM = Yellow.
VM = Red.

Default value: --.

VCMB - Very low control voltage

Define the classification of this alarm.

Note: This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range:

-- = Disabled.
AZ = Blue.
AM = Yellow.
VM = Red.

Default value: VM.

VCB - Low control voltage

Define the classification of this alarm.

Note: This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range:

-- = Disabled.
AZ = Blue.
AM = Yellow.
VM = Red.

Default value: AM.

VCA - High control voltage

Define the classification of this alarm.

Note: This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range:

-- = Disabled.
AZ = Blue.
AM = Yellow.
VM = Red.

Default value: AM.

VCMA - Very high control voltage

Define the classification of this alarm.

Note: This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range:

-- = Disabled.
AZ = Blue.
AM = Yellow.
VM = Red.

Default value: VM.

UCMB - Very low control voltage during operation

Define the classification of this alarm.

Note: This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range:

-- = Disabled.
AZ = Blue.
AM = Yellow.
VM = Red.

Default value: VM.

UCB - Low control voltage during operation

Define the classification of this alarm.

Note: This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range:

-- = Disabled.
AZ = Blue.
AM = Yellow.
VM = Red.

Default value: AM.

UCA - High control voltage during operation

Define the classification of this alarm.

Note: This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range:

-- = Disabled.
AZ = Blue.
AM = Yellow.
VM = Red.

Default value: AM.

UCMA - Very high control voltage during operation

Define the classification of this alarm.

Note: This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range:

-- = Disabled.
AZ = Blue.
AM = Yellow.
VM = Red.

Default value: VM.

If the alarm is classified as deactivated (the indication "- " will appear on the display) and the IED will not display the alarm message even if the alarm conditions are met. In this case, the point corresponding to the alarm in the communication protocols will also not be changed.

5.9 TEMP Menu - Mechanism temperature (Optional)

By connecting an RTD temperature sensor to the SDM, it becomes possible to measure a temperature of the user's preference.

Since there is only one thermometer input, you must choose between measuring the engine mechanism temperature or the ambient temperature. This menu specifies whether temperature sensing is enabled and, if so, what temperature will be measured.

Note: This menu will only be displayed if the **HTCV** option is enabled.

TMEN - Mechanism temperature

If there is an RTD temperature sensor such as a Pt100 connected to the SDM and the user wants to use it to monitor the mechanism's temperature, this variable needs to be enabled.

Adjustment range: YES to enable monitoring, NO to disable monitoring.
Default value: NO.

TAEN - Ambient temperature

If an RTD sensor is connected, but the intention is to measure ambient temperature, disable the previous option and enable this one.

This screen will only appear if the previous option is disabled, and both should be disabled if no sensor is connected.

Adjustment range: YES to enable monitoring, NO to disable monitoring.
Default value: NO.

SML - RTD sensor temperature simulator

Enable this variable when, instead of a Pt100, a temperature simulator is connected to the SDM for testing.

Adjustment range: -- to disable simulation, 1 to enable simulation.
Default value: --

5.10 IMEC Menu - Mechanism heater current (Optional)

The optional **HTCV** offers the possibility of monitoring the heating current of the OLTC drive mechanism; here, the parameters for the necessary measurements are adjusted.

IMEN - Heating system current

Select here the type of current that powers the mechanism's heater or, if there is no heating current to monitor, disable the function.

Note: If a three-phase motor is being monitored and this parameter is enabled (DC or AC value), it will not be possible to monitor the line current - **IL Menu - Line current (Optional).**

Adjustment range:

-- = disabled.
DC = DC current.
AC = AC current.

Default value: --

RIA1 - CT 1 ratio

Specify here the relationship of the current transformer (CT) or shunt resistor used to measure the heater current.

Adjustment range: 1 to 10000.
Default value: 3100.

RIA2 - CT 2 ratio

If the measurement is made using two transformation elements, the relationship of the second measuring CT must be parameterized here.

Adjustment range: 1 to 10000.
Default value: 1.

5.11 VCOM Menu - Control voltage (Optional)

Another possibility offered by the **HTCV** option is monitoring the power supply voltage of the OLTC control circuit. Here, the variables relevant to the necessary measurements are parameterized.

VCEN - Power supply for the OLTC control circuit

This option should be disabled **--** if there is no connection to measure the supply voltage; otherwise, configure whether the measured voltage is direct current (**DC**) or alternating current (**AC**).

Note: This parameter will not be displayed if the monitored motor is three-phase. Consult the "Motor selection" parameter in the **MOTR Menu - Motor** to select the type of motor to be monitored.

Adjustment range:

-- = disabled.
DC = to enable with DC voltage.
AC = to enable with AC voltage.

Default value: --

RDVC - PT ratio

Select the PT ratio used to measure the control voltage.

Adjustment range: 0.10 to 10.00.
Default value: 1.00.

5.12 CDC Menu - On-load tap changer (Optional)

This menu contains the parameters that define the properties of the monitored OLTC and some other settings related to monitoring and maintenance functions.

Note: This parameter will only be displayed if the **TAPP/TAPI** or **OLMT** options are active.

TCIN - Nominal current

OLTC nominal current for calculating the current integral.

Note: This parameter belongs to the optional **OLMT - OLTC Maintenance Assistant.**

Adjustment range: 1 to 9999 A.
Default value: 1000 A.

IEXP - Exponent of current

Exponent of the switched current for calculating tap changer contact wear.

Note: This parameter belongs to the optional **OLMT - OLTC Maintenance Assistant.**

Adjustment range: 1.00 to 5.00.
Default value: 2.00.

NTT1 - Total number of operations, part 1

Total number of operations already performed by the tap changer before the SDM was installed. This variable will be incremented by the SDM as the OLTC is used.

Due to the limited space available on the SDM display, enter the three most significant digits in this operation.

Note: This parameter belongs to the optional **OLMT - OLTC Maintenance Assistant.**

Adjustment range: 0 to 999.
Default value: 0.

NTT2 - Total number of operations, part 2

Due to the limited space available on the SDM display, enter the three least significant digits in this operation.

Note: This parameter belongs to the optional **OLMT - OLTC Maintenance Assistant.**

Adjustment range: 0 to 999.
Default value: 0.

NTM1 - Operations after maintenance, part 1

Number of operations performed by the tap changer after maintenance before monitoring begins. This variable will be incremented by the SDM as the OLTC is used.

Due to the limited space available on the SDM display, enter the three most significant digits in this operation.

Note: This parameter belongs to the optional **OLMT - OLTC Maintenance Assistant.**

Adjustment range: 0 to 999.
Default value: 0.

NTM2 - Operations after maintenance, part 2

Due to the limited space available on the SDM display, enter the three least significant digits in this operation.

Note: This parameter belongs to the optional **OLMT - OLTC Maintenance Assistant.**

Adjustment range: 0 to 999.
Default value: 0.

ITT1 - Total integration of current, part 1

Integration of the switched current throughout all operations performed by the tap changer before the SDM was installed. This variable will be incremented by the SDM as the OLTC is used.

Due to the limited space available on the SDM display, enter the four most significant digits in this operation.

Note: This parameter belongs to the optional **OLMT - OLTC Maintenance Assistant.**

Adjustment range: 0 to 9999 p.u.^{n}
Default value: 0 p.u.^{n}

ITT2 - Total integration of current, part 2

Due to the limited space available on the SDM display, enter the three least significant digits in this operation.

Note: This parameter belongs to the optional **OLMT - OLTC Maintenance Assistant.**

Adjustment range: 0 to 999 p.u.^{n}
Default value: 0 p.u.^{n}

ITM1 - Integration of the current after maintenance, part 1

Integration of the current switched by the tap changer after maintenance before monitoring begins. This variable will be incremented by the SDM as the OLTC is used.

Due to the limited space available on the SDM display, enter the four most significant digits in this operation.

Note: This parameter belongs to the optional **OLMT - OLTC Maintenance Assistant.**

Adjustment range: 0 to 9999 p.u.^{n}
Default value: 0 p.u.^{n}

ITM2 - Integration of the current after maintenance, part 2

Due to the limited space available on the SDM display, enter the three least significant digits in this operation.

Note: This parameter belongs to the optional **OLMT - OLTC Maintenance Assistant.**

Adjustment range: 0 to 999 p.u.^{n}
Default value: 0 p.u.^{n}

TTTO - Total service time

Total OLTC service time before SDM installation. This variable will be incremented by SDM as OLTC is used.

Note: This parameter belongs to the optional **OLMT - OLTC Maintenance Assistant.**

Adjustment range: 0 to 32767 days.
Default value: 0 days.

TTMA - Service time since last maintenance

OLTC service time since the last maintenance was performed. This variable will be incremented by the SDM as the OLTC is used.

Note: This parameter belongs to the optional **OLMT - OLTC Maintenance Assistant.**

Adjustment range: 0 to 32767 days.
Default value: 0 days.

NMTT - Interval for determining daily average

Define here the time interval needed to determine the average daily operations of the OLTC.

Note: This parameter belongs to the optional **OLMT - OLTC Maintenance Assistant.**

Adjustment range: 1 to 90 days.
Default value: 15 days.

NRST - Maintenance reset

When OLTC maintenance is performed, you must select YES in this item so that the counters that depend on the last maintenance are reset and the SDM continues to provide good assistance by notifying you when new maintenance is due.

Note: This parameter belongs to the optional **OLMT - OLTC Maintenance Assistant.**

Adjustment range: YES to reset, NO to keep the values.
Default value: NO.

PTEN - Tap position

You can enable the tap position measurement function by selecting “YES” in this item.

Note: This parameter belongs to the optional **TAPP/TAPI - OLTC Position Measurement.**

Adjustment range: YES to measuring, NO to not measuring.
Default value: YES.

NTAP - Number of taps

Specify here the number of taps the tap changer has.

Note: This parameter belongs to the optional **TAPP/TAPI - OLTC Position Measurement.**

Adjustment range: 2 to 50.
Default value: 33.

INDI - Type of indication

Choose the method for displaying the tap position from the listed options.

Note: This parameter belongs to the optional **TAPP/TAPI - OLTC Position Measurement.**

Adjustment range:

SMPL = simple.
ALFI = inverted alphanumeric.
ALF = alphanumeric.
BLTI = inverted bilateral.
BLT = bilateral.

Default value: SMPL.

CENT - Central tap

Specify the center tap of the tap changer. The count is from the start of the resistor reading to the neutral.

Note: This parameter belongs to the optional **TAPP/TAPI - OLTC Position Measurement.**

Adjustment range: 2 to 50.
Default value: 17.

SINC - Synchronization time

Specify the expected time to complete a tap change operation. Use the longest switching time.

Note: This parameter belongs to the optional **TAPP/TAPI - OLTC Position Measurement.**

Adjustment range: 1 to 100 seconds.
Default value: 10 seconds.

FSR - Analog scale

This parameterization item will only exist if the option for measuring the tap position at the time of purchase of the SDM is analog input reading (optional **TAPI**). Here you must enter the mA signal scale of the analog output from those listed below.

Note: This parameter belongs to the optional **TAPI** available exclusively for SDM-I.

Adjustment range: 0-5 mA, 0-10 mA, 0-20 mA and 4-20 mA.
Default value: 0-20 mA.

5.13 IL Menu - Line current (Optional)

Monitoring line current, besides being important in itself, is also used to calculate the wear of the tap changer contact when used in conjunction with the optional **OLMT**.

Note: This parameter will only be displayed if the **OLMT** option is active.

ILEN - Line current

Choose whether line current monitoring should be enabled or not. Although this menu is still present when the motor is three-phase and heating system current monitoring is enabled, the YES value cannot be selected because all current inputs will be occupied monitoring the motor supply current and the heating current.

Adjustment range: YES to monitor, NO to not monitor.
Default value: YES.

RDI1 - Auxiliary CT

Transformation ratio parameter of the auxiliary CT, which is directly connected to the SDM. Suitable for readings up to 10 A.

Adjustment range: 1 to 32767.
Default value: 3100.

RDI2 - High voltage CT

High-voltage CT ratio parameter, on which the auxiliary CT performs the current measurement used by the SDM.

Adjustment range: 1 to 32767.
Default value: 400.

5.14 AVAN Menu - Advanced

This menu contains four submenus for configuring advanced SDM operating parameters.

5.14.1 CONF Submenu - Advanced settings

It covers some settings not addressed in the basic setup menu.

DISP - Display

Choose whether the measurement displayed during normal operation of the device should remain the last one viewed by the user, or whether the display information should scroll through all measurements.

Adjustment range: FIXED - no scrolling, ALT - scrolling.
Default value: FIXED.

CDEN - Auxiliary contact

Monitors the position of the motor's auxiliary contact. If the motor contact is detected as open, a warning will be triggered, but this logic between the open contact and the warning can be reversed in the following item.

Adjustment range: YES to monitor, NO to not monitor.
Default value: YES.

CDJ - Auxiliary contact mode

Choose whether the motor auxiliary contact will operate in normal or reverse mode. If reverse mode is selected, the motor auxiliary contact position warning will be issued if it is in the closed position.

Note: This parameter will only be displayed if the **YES** option is selected in the **CDEN - Auxiliary contact** parameter (the parameter preceding this one).

Adjustment range: INVE - inverted logic, NORM - normal logic.
Default value: NORM.

TC 1 - Polarity of CT 1

Set the polarity of the connection of CT 1, connected to pins 26 and 25.

Adjustment range: NORM - normal polarity, INVE - inverted polarity.
Default value: NORM.

TC 2 - Polarity of CT 2

Set the polarity of the connection of CT 2, connected to pins 27 and 25.

Adjustment range: NORM - normal polarity, INVE - inverted polarity
Default value: NORM.

TC 3 - Polarity of CT 3

Set the polarity of the connection of CT 3, connected to pins 28 and 25.

Adjustment range: NORM - normal polarity, INVE - inverted polarity.
Default value: NORM.

HIST - Hysteresis

To prevent alarms from being activated and deactivated many times due to small variations around a single event, it is advisable to set a hysteresis for alarm deactivation.

Adjustment range: 0.0 to 10.0 %
Default value: 2.0 %

TDBC - Debouncing time

Wait for the programmed debouncing time to define the effective state change of external contacts.

Note: This parameter will only be displayed if the **YES** option is selected in the **CDEN - Auxiliary contact** parameter**.**

Adjustment range: 10 to 100 ms.
Default value: 30 ms.

NPWD - New password

Here, the user can choose a new password to protect access to the configuration menus. If the password is forgotten, please contact Treetech's Customer Service.

Adjustment range: 0 to 8191.
Default value: 0.

5.14.2 RELE Submenu - Relays

The SDM has output relays that can be programmed to activate lighting panels and other systems related to the alarm status. In this submenu, the relays can be tested and their functions programmed.

5.14.2.1 RL 'x' Submenu - Configuration of relay 'x'

This menu contains the settings for relays 1 through 5. These settings are repeated for the different relays.

The 'x' indicates the relay number.

Example: RL1, RL2, RL3, RL4 and RL5.

Configure whether the selected relay should operate in normal or reverse mode, as well as its activation conditions.

MODO - Relay mode

Relays 1 through 3 can operate in either NO (Normally Open) or NC (Normally Closed) modes depending on the SDM's electrical setup. Hardware-wise, relays 4 and 5 are always NO. However, the SDM allows the electrical setup logic to be reversed via firmware so that all relays can operate in both NO and NC modes.

Adjustment range: NORM - normal, INVE - inverted.
Default value: NORM.

FALH - Self-diagnosis

Decide whether the relay should be activated when self-diagnoses are active in the SDM.

Adjustment range: YES to activate, NO to not activate.
Default value: NO.

SMFR - *Traffic light* signaling

The traffic light is a variable that stores the overall state of the alarms. If there are no active alarms, its state will be green; if there are any active yellow alarms, its state will be yellow, and so on. It is possible to configure one or more relays to be activated in the case of a specific state of the SMFR variable. If the user's interest is to activate a relay to warn of the occurrence of yellow and red severity alarms without worrying about knowing exactly which of the two alarm types occurred, simply parameterize this item as VMAM in only one relay. Since the traffic light can only assume four values: green (0), blue (1), yellow (2), or red (3), one possibility to obtain the complete state of this variable is to program two different relays as follows:

Relay 1: parameterized to “VMAM”. Relay 2: parameterized to “VMAZ”.

This will produce the following outputs on relays 1 and 2:

Table 18 - Relay output for *traffic light* signaling

Relay 1	Relay 2	Interpretation
0	0	0, Green
0	1	1, Blue
1	0	2, Yellow
1	1	3, Red

Adjustment range:

- = The relay is not triggered for any SMFR state.
VD = Activates relay if SMFR is 0.
AZ = Activates relay if SMFR is 1.
AZVD = Activates relay if SMFR is 0 or 1.
AM = Activates relay if SMFR is 2.
AMVD = Activates relay if SMFR is 0 or 2.
AMAZ = Activates relay if SMFR is 1 or 2.
AAVD = Aciona relé caso SMFR seja 0, 1 or 2.
VM = Activates relay if SMFR is 3.
VMVD = Activates relay if SMFR is 0 or 3.
VMAZ = Activates relay if SMFR is 1 or 3.
VAZV = Activates relay if SMFR is 0, 1 or 3.
VMAM = Activates relay if SMFR is 2 or 3.
VAMV = Activates relay if SMFR is 0, 2 or 3.
VMAA = Activates relay if SMFR is 1, 2 or 3.
VAAV = Activates relay if SMFR is in any of the states.

Default value: -

VMMB - Very low motor supply voltage

Decide whether the relay should be activated when this alarm is active.

Adjustment range: YES to activate, NO to not activate.
Default value: NO.

VMB - Low motor supply voltage

Decide whether the relay should be activated when this alarm is active.

Adjustment range: YES to activate, NO to not activate.
Default value: NO.

VMA - High motor supply voltage

Decide whether the relay should be activated when this alarm is active.

Adjustment range: YES to activate, NO to not activate.
Default value: NO.

VMMA - Very high motor supply voltage

Decide whether the relay should be activated when this alarm is active.

Adjustment range: YES to activate, NO to not activate.
Default value: NO.

UMMB - Very low motor voltage during operation

Decide whether the relay should be activated when this alarm is active.

Adjustment range: YES to activate, NO to not activate.

Default value: NO.

UMB - Low motor voltage during operation

Decide whether the relay should be activated when this alarm is active.

Adjustment range: YES to activate, NO to not activate.
Default value: NO.

UMA - High motor voltage during operation

Decide whether the relay should be activated when this alarm is active.

Adjustment range: SIM para acionar, NAO - não aciona
Default value: NO.

UMMA - Very high motor voltage during operation

Decide whether the relay should be activated when this alarm is active.

Adjustment range: YES to activate, NO to not activate.
Default value: NO.

IPA - High peak current

Decide whether the relay should be activated when this alarm is active.

Adjustment range: YES to activate, NO to not activate.
Default value: NO.

IPMA - Very high peak current

Decide whether the relay should be activated when this alarm is active.

Adjustment range: YES to activate, NO to not activate.
Default value: NO.

EMB - Very low operating energy

Decide whether the relay should be activated when this alarm is active.

Adjustment range: YES to activate, NO to not activate.
Default value: NO.

EB - Low operating energy

Decide whether the relay should be activated when this alarm is active.

Adjustment range: YES to activate, NO to not activate.
Default value: NO.

EA - High operating energy

Decide whether the relay should be activated when this alarm is active.

Adjustment range: YES to activate, NO to not activate.
Default value: NO.

EMA - Very high operating energy

Decide whether the relay should be activated when this alarm is active.

Adjustment range: YES to activate, NO to not activate.
Default value: NO.

OMB - Very low operating time

Decide whether the relay should be activated when this alarm is active.

Adjustment range: YES to activate, NO to not activate.
Default value: NO.

OB - Low operating time

Decide whether the relay should be activated when this alarm is active.

Adjustment range: YES to activate, NO to not activate.
Default value: NO.

OA - High operating time

Decide whether the relay should be activated when this alarm is active.

Adjustment range: YES to activate, NO to not activate.
Default value: NO.

OMA - Very high operating time

Decide whether the relay should be activated when this alarm is active.

Adjustment range: YES to activate, NO to not activate.
Default value: NO.

MDIS - Triggered motor

Decide whether the relay should be activated when this alarm is active.

Adjustment range: YES to activate, NO to not activate.
Default value: NO.

DJAL - Motor circuit breaker open

Decide whether the relay should be activated when this alarm is active.

Adjustment range: YES to activate, NO to not activate.
Default value: NO.

NTAL - Maintenance notice by number of operations

Decide whether the relay should be activated when this alarm is active.

Note: This parameter belongs to the optional **OLMT - OLTC Maintenance Assistant**.

Adjustment range: YES to activate, NO to not activate.
Default value: NO.

ITAL - Maintenance notice by integration of current

Decide whether the relay should be activated when this alarm is active.

Note: This parameter belongs to the optional **OLMT - OLTC Maintenance Assistant.**

Adjustment range: YES to activate, NO to not activate.
Default value: NO.

TCAL - Maintenance notice by service time

Decide whether the relay should be activated when this alarm is active.

Note: This parameter belongs to the optional **OLMT - OLTC Maintenance Assistant.**

Adjustment range: YES to activate, NO to not activate.
Default value: NO.

NTRA - Advance maintenance notice by number of operations

Decide whether the relay should be activated when this alarm is active.

Note: This parameter belongs to the optional **OLMT - OLTC Maintenance Assistant.**

Adjustment range: YES to activate, NO to not activate.
Default value: NO.

ITRA - Advance maintenance notice by integration of current

Decide whether the relay should be activated when this alarm is active.

Note: This parameter belongs to the optional **OLMT - OLTC Maintenance Assistant.**

Adjustment range: YES to activate, NO to not activate.
Default value: NO.

TTRA - Advance maintenance notice by service time

Decide whether the relay should be activated when this alarm is active.

Note: This parameter belongs to the optional **OLMT - OLTC Maintenance Assistant.**

Adjustment range: YES to activate, NO to not activate.
Default value: NO.

TMMB - Very low mechanism temperature

Decide whether the relay should be activated when this alarm is active.

Note: This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range: YES to activate, NO to not activate.
Default value: NO.

TMB - Low mechanism temperature

Decide whether the relay should be activated when this alarm is active.

Note: This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range: YES to activate, NO to not activate.
Default value: NO.

TMA - High mechanism temperature

Decide whether the relay should be activated when this alarm is active.

Note: This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range: YES to activate, NO to not activate.
Default value: NO.

TMMA - Very high mechanism temperature

Decide whether the relay should be activated when this alarm is active.

Note: This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range: YES to activate, NO to not activate.
Default value: NO.

IAQB - Low heating system current

Decide whether the relay should be activated when this alarm is active.

Note: This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range: YES to activate, NO to not activate.
Default value: NO.

IAQA - High heating system current

Decide whether the relay should be activated when this alarm is active.

Note: This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range: YES to activate, NO to not activate.
Default value: NO.

VCMB - Very low motor control circuit voltage

Decide whether the relay should be activated when this alarm is active.

Note: This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range: YES to activate, NO to not activate.
Default value: NO.

VCB - Low motor control circuit voltage

Decide whether the relay should be activated when this alarm is active.

Note: This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range: YES to activate, NO to not activate.
Default value: NO.

VCA - High motor control circuit voltage

Decide whether the relay should be activated when this alarm is active.

Note: This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range: YES to activate, NO to not activate.
Default value: NO.

VCMA - Very high motor control circuit voltage

Decide whether the relay should be activated when this alarm is active.

Note: This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range: YES to activate, NO to not activate.
Default value: NO.

UCMB - Very low control circuit voltage during operation

Decide whether the relay should be activated when this alarm is active.

Note: This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range: YES to activate, NO to not activate.
Default value: NO.

UCB - Low control circuit voltage during operation

Decide whether the relay should be activated when this alarm is active.

Note: This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range: YES to activate, NO to not activate.
Default value: NO.

UCA - High control circuit voltage during operation

Decide whether the relay should be activated when this alarm is active.

Note: This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range: YES to activate, NO to not activate.
Default value: NO.

UCMA - Very high control circuit voltage during operation

Decide whether the relay should be activated when this alarm is active.

Note: This parameter belongs to the optional **HTCV - Monitoring of anti-condensation system and control power supply.**

Adjustment range: YES to activate, NO to not activate.
Default value: NO.

In fact, there are many more alarms than relays to signal them, but a relay can be triggered for more than one reason, and this allows you to know the status of the alarms by category.

To read all alarms individually remotely, Treetech relies on the SIGMA monitoring system (sold separately), which also integrates with other substation equipment and allows for online tracking and recording of all measurements and oscillography.

5.14.2.2 TRLS Submenu - Relay testing

Allows you to test the operation of each SDM output relay by forcing it to activate. When this menu is accessed, all SDM relays return to the off state.

This menu contains the settings for relays 1 through 5. These settings are repeated for the different relays.

The ‘x’ indicates the relay number.

Example: ARL1, ARL2, ARL3, ARL4 and ARL5.

ARL'x' - Testing relay 'x'

Use the arrow o select YES and close the relay contact. Once in the YES position, use the arrow o return to the NO position, opening the contact again. Once relay 'x' has been sufficiently tested, press to move to the next relay. Test it in the same way. When all five relays have been tested, pressing again will return the user to the initial screen of this menu. At this point, the relays left in the closed position during the test will automatically reopen to avoid disrupting their normal operation. Similarly, if the key is pressed at any point during the tests, the submenu will be abandoned and all relays that have been closed will be reopened.

Adjustment range: YES (tests/closes relay), NO (does not test/open relay).
Default value: NO.

5.14.3 LOG Submenu - Historical record

This submenu provides access to all parameters related to the SDM measurement history, which is recorded in a data log.

TLG - Recording interval in the LOG

The LOG records the measurements and states of most SDM variables over time. The longer the interval between records, the longer the memory will last and the longer the period covered by the LOG will be; however, the data resolution will be reduced. When the LOG memory is full, the oldest information will be overwritten.

Adjustment range: 1 to 1440 min.
Default value: 60 min.

RST - LOG reset

In some situations, such as when installing SDM on a different tap changer, it is not necessary to maintain the operation history of the old tap changer. By selecting YES for this item, the LOG will be deleted and its memory will be freed up for new recordings.

Adjustment range: YES - resets memory, NO - no action.
Default value: NO.

To download the logs and oscillography, please refer to the guides below:

- Guide for downloading IDM/SDM mass storage
- Guide for downloading IDM/SDM oscillography

5.14.4 CFGP Submenu - Equipment reset

This parameter allows you to reset all equipment parameters to factory defaults. For security, this parameter is protected by the same password used to access the menus.

Adjustment range: YES, NO.
Default value: NO.

5.14.5 FABR Submenu - Factory

It allows access to factory settings. It is for the exclusive use of Treetech's technical support team and is password protected, not being accessible to the equipment operator.

When attempting to access the factory menu with the wrong password, the SDM will display the message "VOID" on its screen for a few seconds. The duration of this message display increases with each subsequent incorrect password attempt. After 5 incorrect password attempts, the SDM will completely block access to this menu, and the "VOID" message will become permanently displayed. Although the equipment's operation will not be affected, this constitutes a loss of warranty.

6 Web Interface

6.1 User-friendly web interface

Using the latest HTML5 and Bootstrap technologies, the entire SDM management and configuration interface is done directly on the device's web page, without the need for a usage license or installation of proprietary software.

6.2 Access to the web interface

To access the SDM webpage, simply type the device's IP address into a web browser that supports HTML5.
The configured IP addresses can be viewed on the front panel of the device. To do this, navigate to the ECOM menu using the ↓ key and press the ↵ key.
Then, press the ↑ key. With the device screen showing "NET1", press ↵. The IP octets will be displayed separately; simply use the ↑ key to navigate between them.

Figure 33 - SDM front panel displaying the IP address for accessing the webpage

6.3 Home page

From this screen, you can get an overview of the SDM homepage.

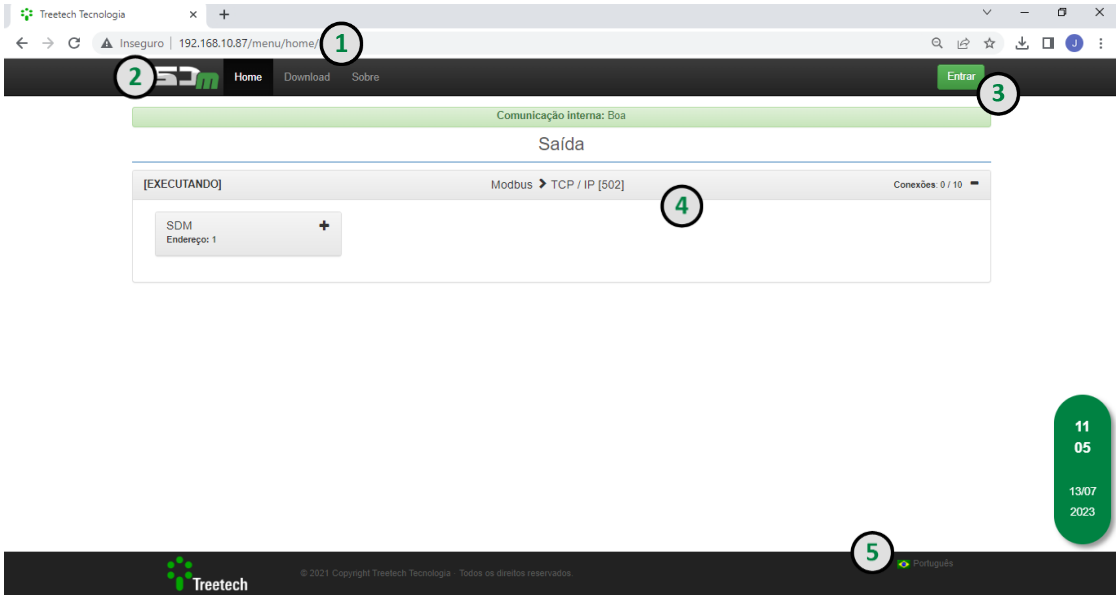


Figure 34 - Home screen of the SDM webpage

1 IP ADDRESS

The IP address displayed on the front of the product must be entered into a web browser that supports HTML5.

2 PRODUCT IDENTIFICATION

In the upper left corner of the screen, the SDM logo identifies the IED.

3 LOGIN

A green button located in the upper right corner of the screen allows the user to log in to the system and access other screens.

4 OUTPUT GROUPS

In the central part of the screen, the user can view and interact with the expandable blocks that represent the SDM's output connections and their information, as well as the status and history of the communication.

5 LANGUAGE

In the bottom right corner of the home screen, the user can select the language. To do this, simply click on the flag of the country of origin of the desired language.

6.4 Login

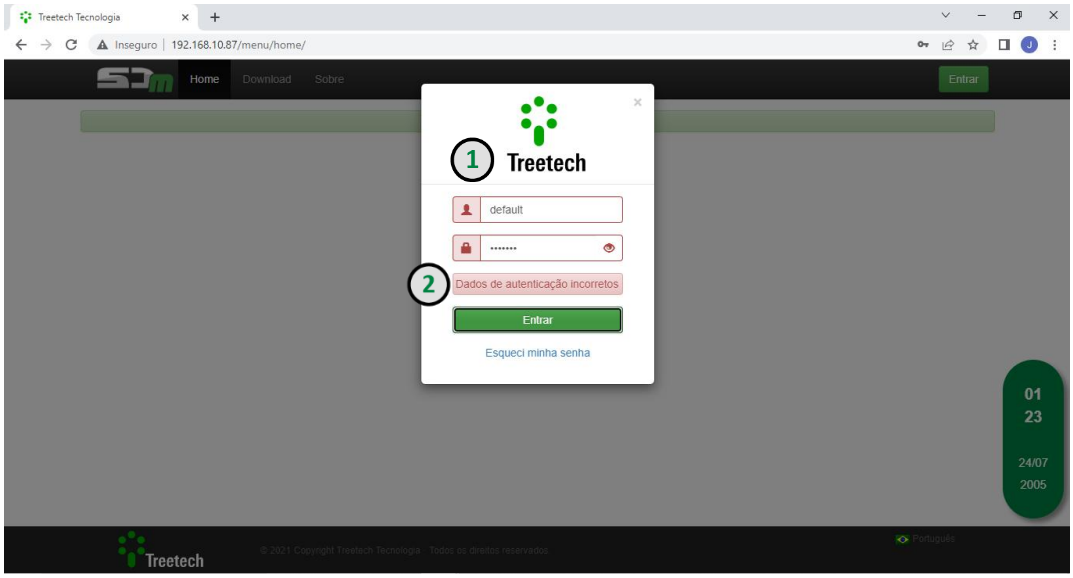


Figure 35 - Entering login and password

1 LOGIN AND PASSWORD

To access more details about the IED and obtain data online via the webpage, users need a valid login and password. To log in, simply click the green "Login" button located in the upper right corner of the screen.

A window will appear with space for username and password. After filling in the spaces, simply click the green "Login" button to access the system.

2 WRONG LOGIN AND/OR PASSWORD

If the login and/or password are incorrect, a message in red, inside a box of the same color, will be displayed, alerting you to the error.

3 TIME LIMIT

If a user logs in but does not remain active browsing the system, the session expires after ten minutes. In the final thirty seconds, a countdown window alerts the user that the session is ending.

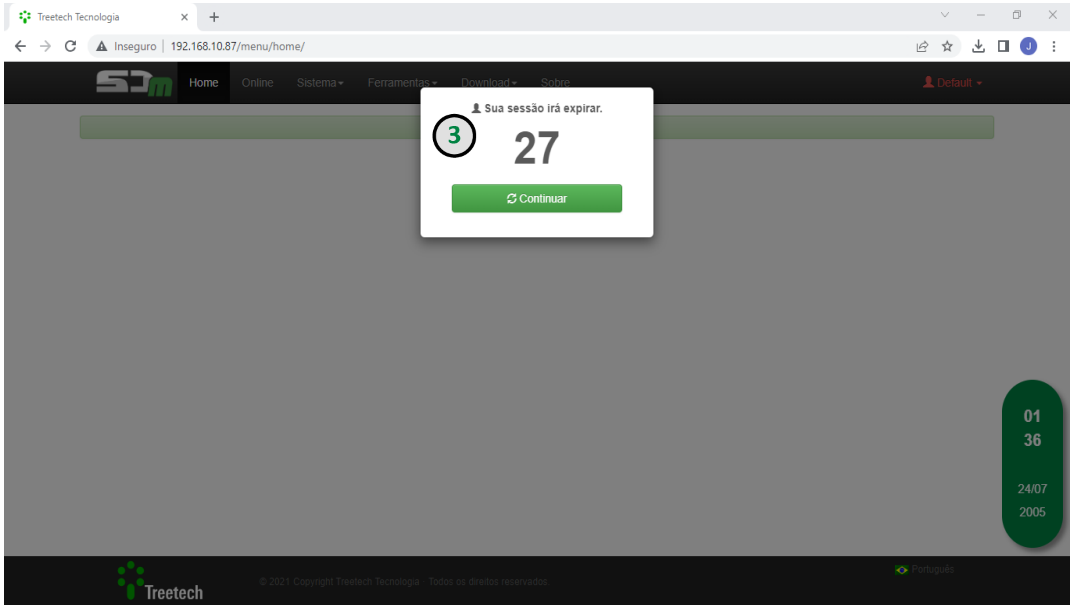


Figure 36 - Time limit

6.5 Editing the profile

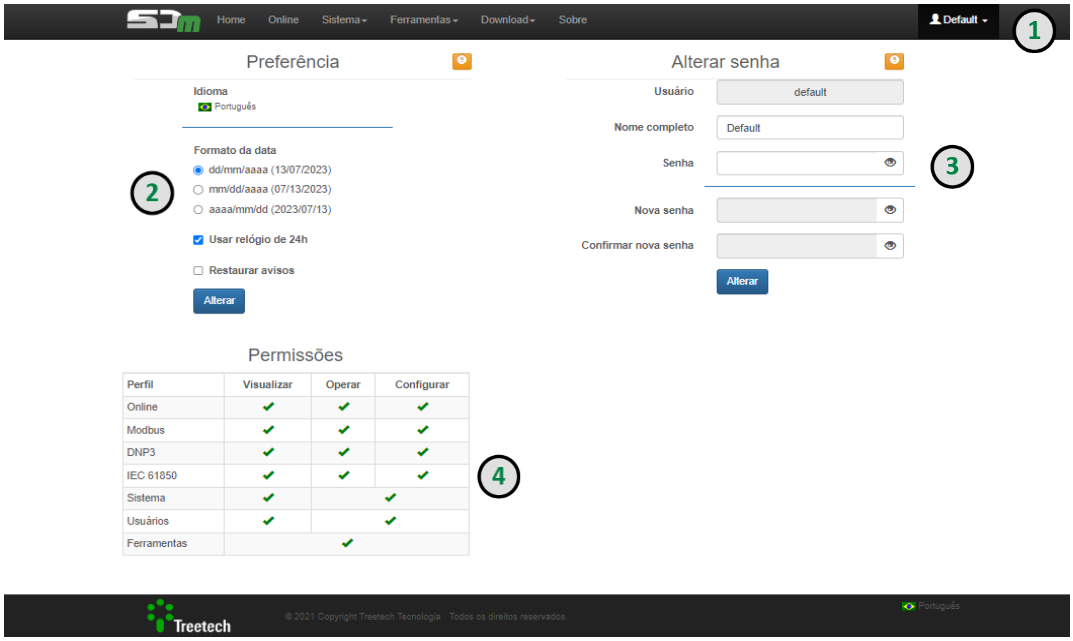


Figure 37 - Editing your profile on the SDM webpage

1 ACCESS

If a user wants to make changes to their profile, such as changing their password or login, they simply need to click on their username, located in the upper right corner of the screen. In the menu that expands, the user should click the "Edit profile" button to access the page shown above.

2 LANGUAGE, DATE FORMAT, CLOCK AND WEB PAGE NOTICES

On the left side of the screen, the user can configure display preferences. Here, you can select the language, the date format (dd/mm/yyyy, mm/dd/yyyy, or yyyy/mm/dd). Additionally, the clock display format (12 or 24-hour) can be changed, as well as whether to allow the opening of dialog boxes with warnings. Click the blue "Change" button to confirm the changes.

3 PASSWORD

On the right side of this screen, the user can change their password. To do this, they must first identify themselves by entering their login and current password. After that, the new password can be changed and confirmed. Click the blue "Change" button to confirm the changes.

4 OPTIONAL PERMISSIONS AND SETTINGS

In the lower left corner of the screen, a table is displayed indicating the current user's permissions for each feature. Just below the table, there is a checkbox that enables or disables a set of optional advanced settings for some screens.

6.6 User registration

On this page, you can view which users are registered to use the system, as well as make changes to these users and register new ones. Different access profiles can be assigned to each user.

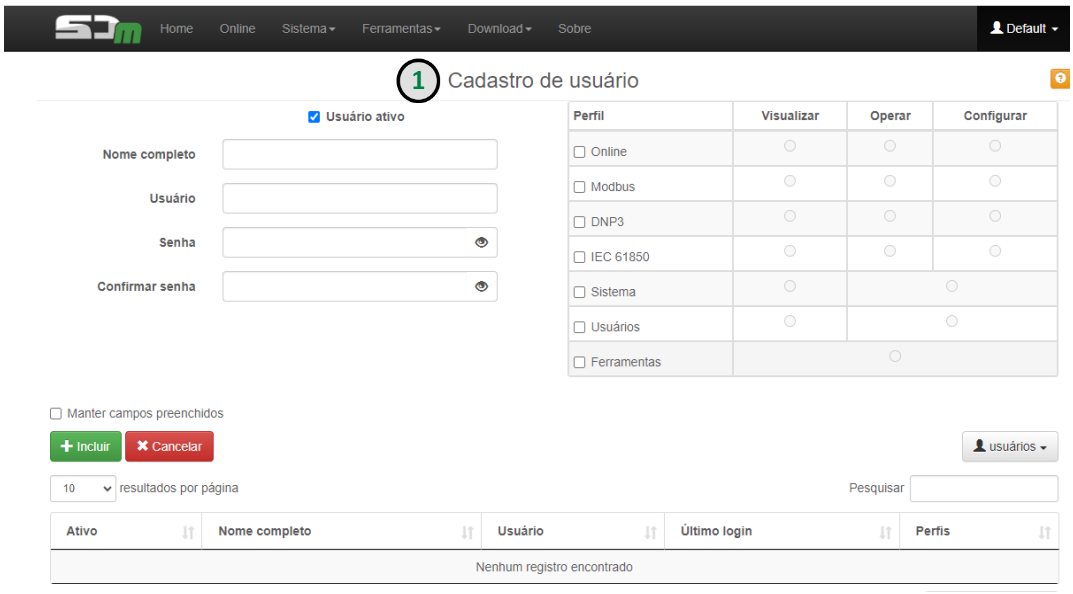


Figure 38 - User tab on the SDM webpage

1 ADDING A NEW USER

To allow other users to access the webpage, the administrator user must access the Users tab, located in the top bar of the screen.

Four fields must be completed to add a new user: Full Name, Username, Password, and Password Confirmation.

In the upper right corner of the screen, permissions for the new user are selected from a table with four columns. In the Profile column, the tabs the new user will have access to are: Online, Modbus®, DNP3, IEC 61850, System, Users, and Tools.

In the other columns, the level of access to each tab is detailed between the View, Operate, and Configure options.

- **VIEW:** The user will only be able to view the settings, but will not be able to modify, delete, or create anything.
- **OPERATE:** The user will be able to activate and deactivate existing settings and also change the protocol address of any IED.
- **CONFIGURE:** The user has complete control to modify, delete, and create settings in the system.

6.7 Online

Through this page, the user has access to all the variables read and their respective values. It is also possible to make changes (writes) to the written or simulated variables.

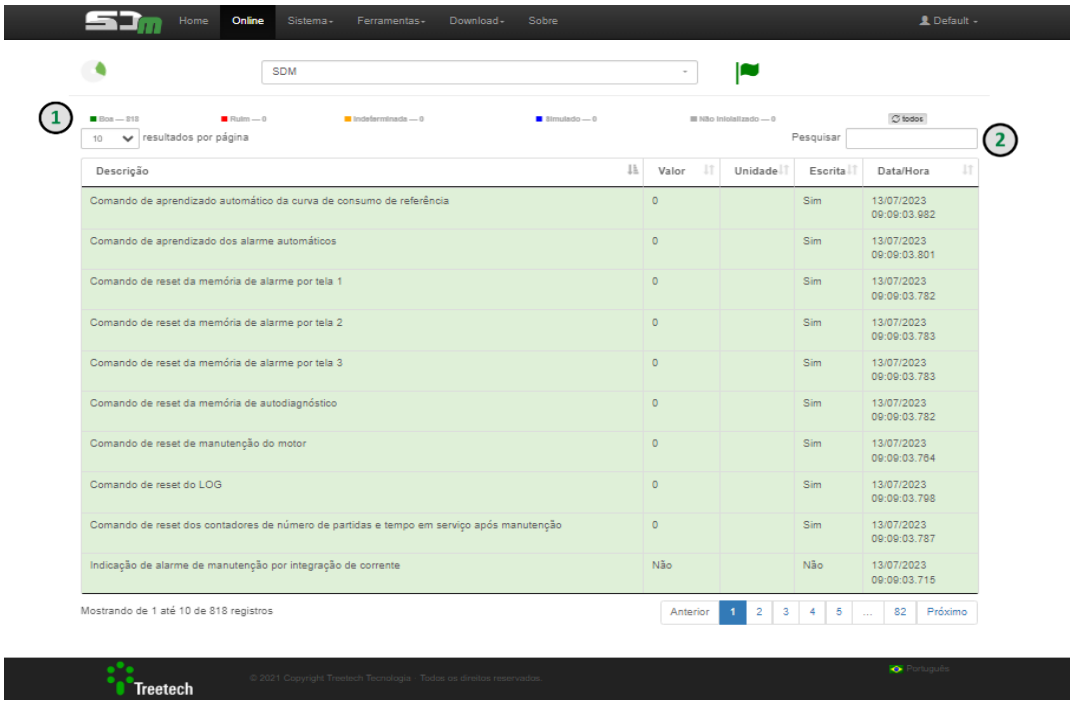


Figure 39 - Online menu on the SDM webpage

1 STATUS

The legends explain the colors of each Abstract in the table: green lines represent good communication; red lines, bad communication; yellow lines, unstable communication, referred to here as indeterminate; blue lines are used when that abstract is configured as simulated; gray lines indicate that that abstract has never been read.

2 FILTERS AND NAVIGATION IN THE TABLE

The table header allows the user to sort the Abstracts by Name, Value, Unit, Writing, Description, and Date/Time.

6.8 System

Through this menu, the user can access network settings, system clock and date adjustments, the process manager, system restart and restore commands, the update screen, export and import settings functions, and access options.

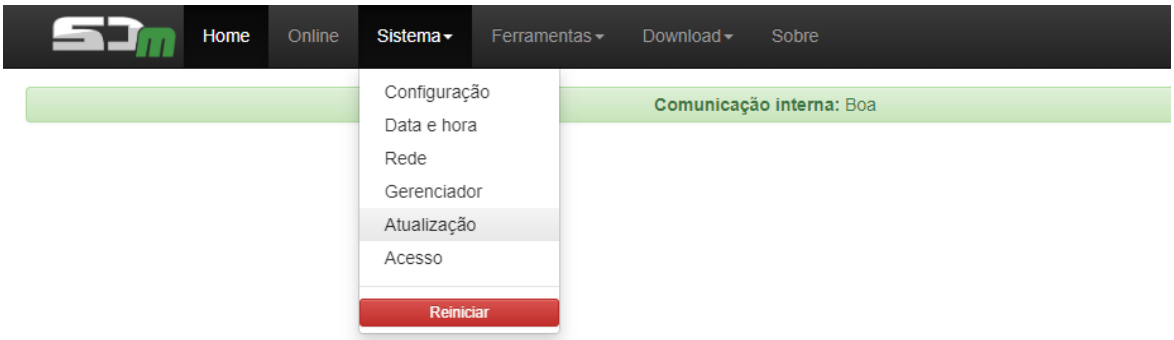


Figure 40 - System menu

6.8.1 Settings

To facilitate navigation, the SDM webpage uses a general symbology that is repeated across multiple pages. Depending on the user's profile permissions, some fields may not be available. To access the SDM webpage navigation, follow the instructions below:

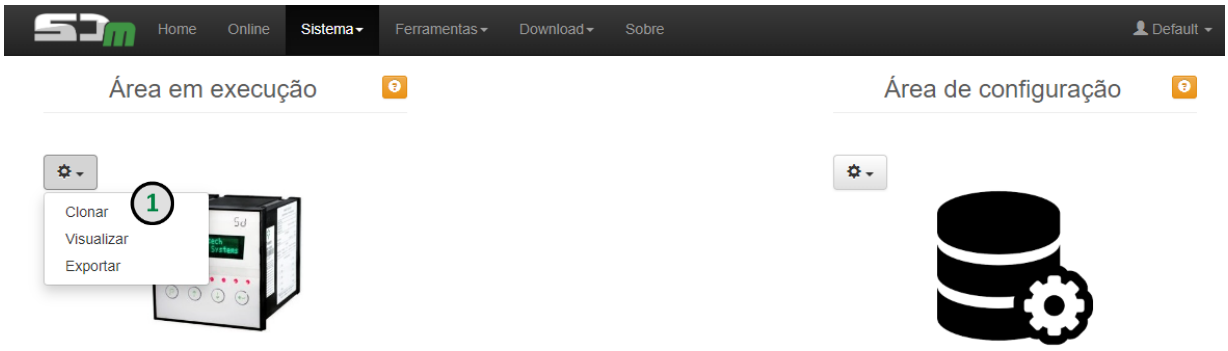


Figure 41 - System tab > Settings > Clone

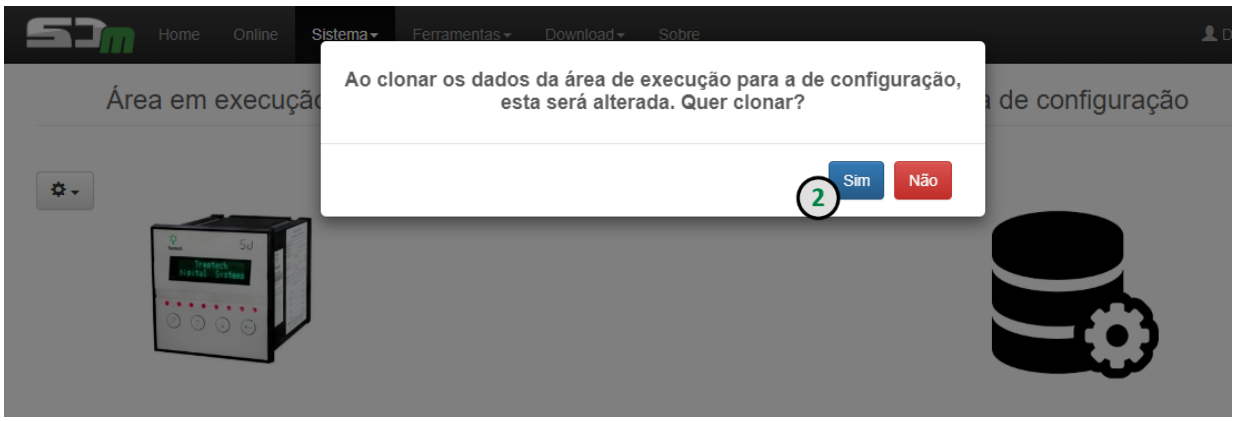


Figure 42 - Clone option > Yes

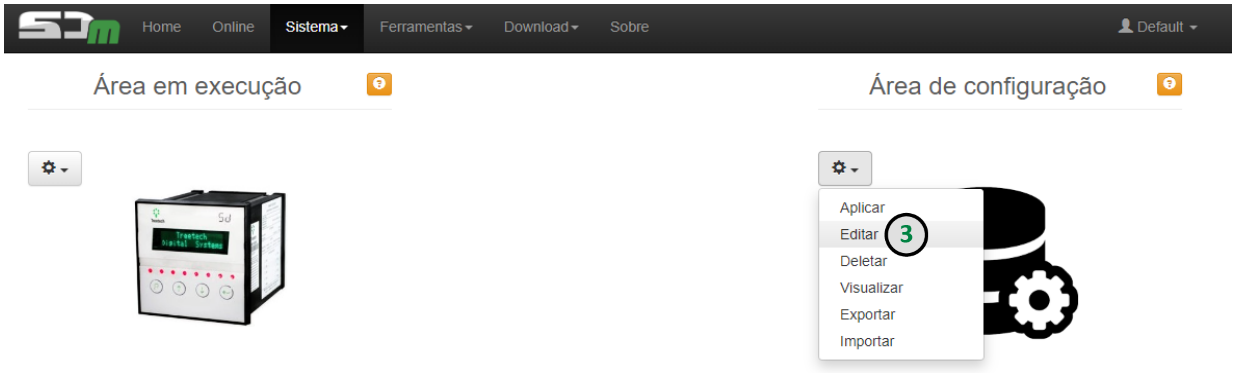


Figure 43 - Edit option

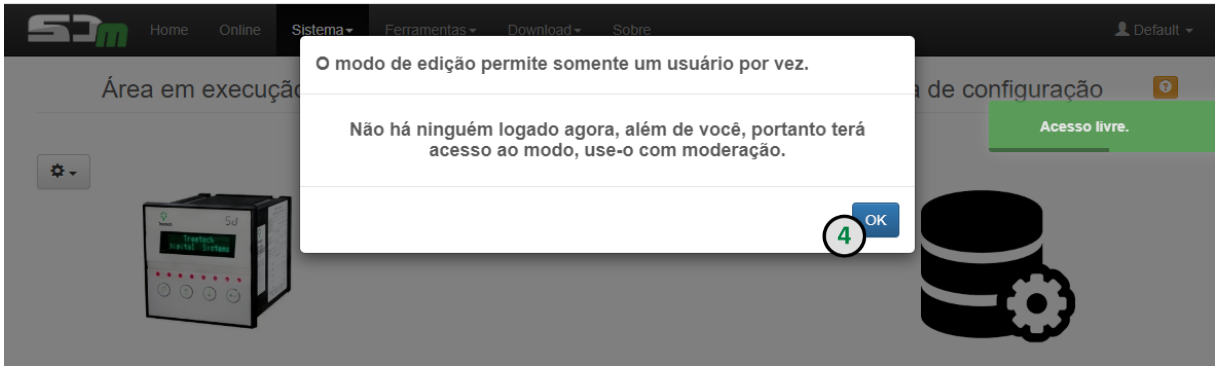


Figure 44 - OK option

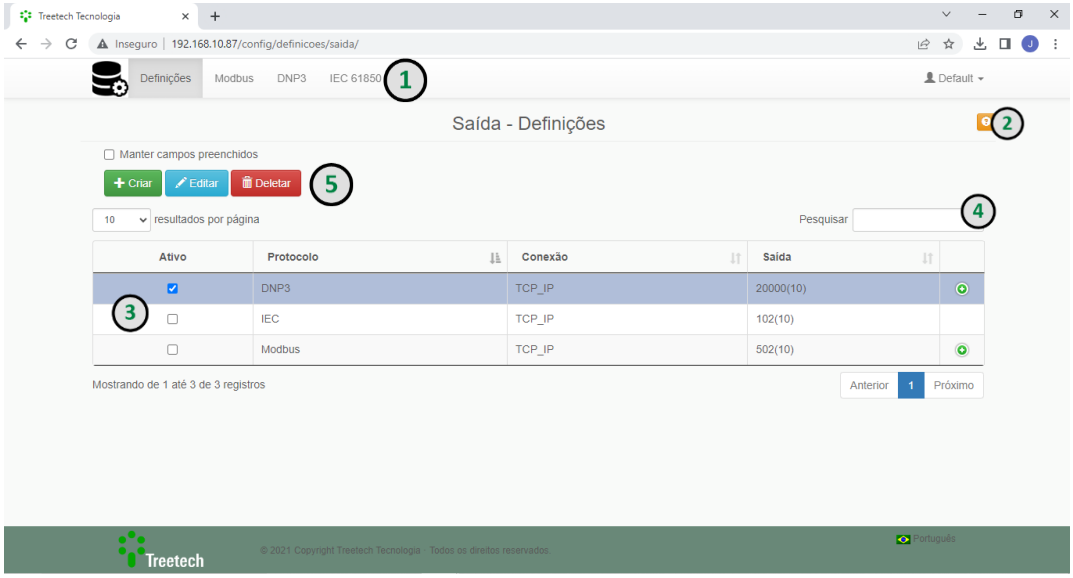


Figure 45 - General navigation through the webpage

1 TABBED NAVIGATION

At the top of the screen, the user can navigate using tabs.

2 HELP BUTTONS

A small orange button with a question mark is located in strategic and easily visible points on the screen. By clicking the button, the user will have access to explanatory information about the fields and elements contained on the corresponding screen.

3 ACTIVE

This checkbox, labeled “Active,” appears consistently on some forms. It is used to activate or deactivate the items associated with it.

These also appear within the table and can be used as a quick access point to activate or deactivate items.

Some "Active" checkboxes have an interlocking system that prevents them from being activated.

4 SEARCH BOX

To filter the content shown in the table, use the search box, usually located above a table.

5 ACTION BUTTONS

Three buttons—one green, one light blue, and one red—located above the table are used to perform actions. Additionally, a checkbox to keep the fields filled will be available just above the buttons so that, upon completion of the action, the fields are either preserved or not in the form.

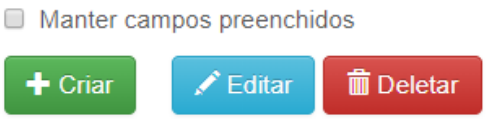


Figure 46 - Action buttons

Clicking the **Create** button will open an empty form with the necessary fields for creating a dataset.

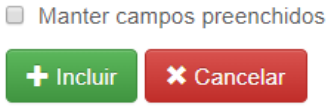


Figure 47 - Action buttons - Create

Below the form, two buttons will appear: **Add**, to confirm the inclusion of the data, and **Cancel**, if the user wishes to return to the previous step and undo the creation action.

Both the **Edit** and **Delete** buttons will only be available when one of the table rows is selected.

Clicking the **Edit** button will open the form with the fields already filled in according to the selected row.

Figure 48 - Action buttons - Edit

Below the form, two buttons will appear: **Confirm**, to confirm the changes made, and **Cancel**, if the user wishes to return to the previous step and undo the editing action.

Clicking the **Delete** button will bring up a dialog box asking you to confirm the deletion of the selected row in the table.

6.8.1.1 Protocols

This section is used to create and configure output connections. You can configure the points to be distributed across the SDM output connections, available in Modbus, DNP3, and IEC 61850 protocols. For more details on this menu, consult the [IED Configuration Guide].

Figure 49 - Point configuration tab of the SDM

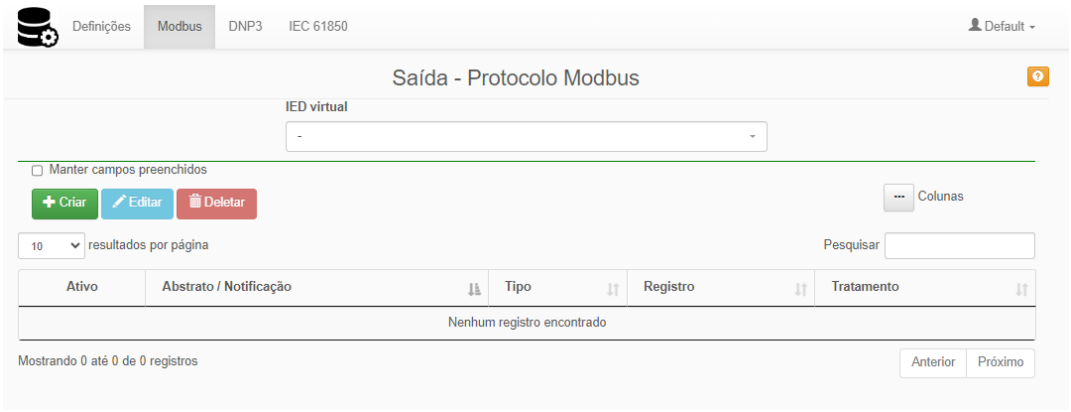


Figure 50 - Modbus configuration tab

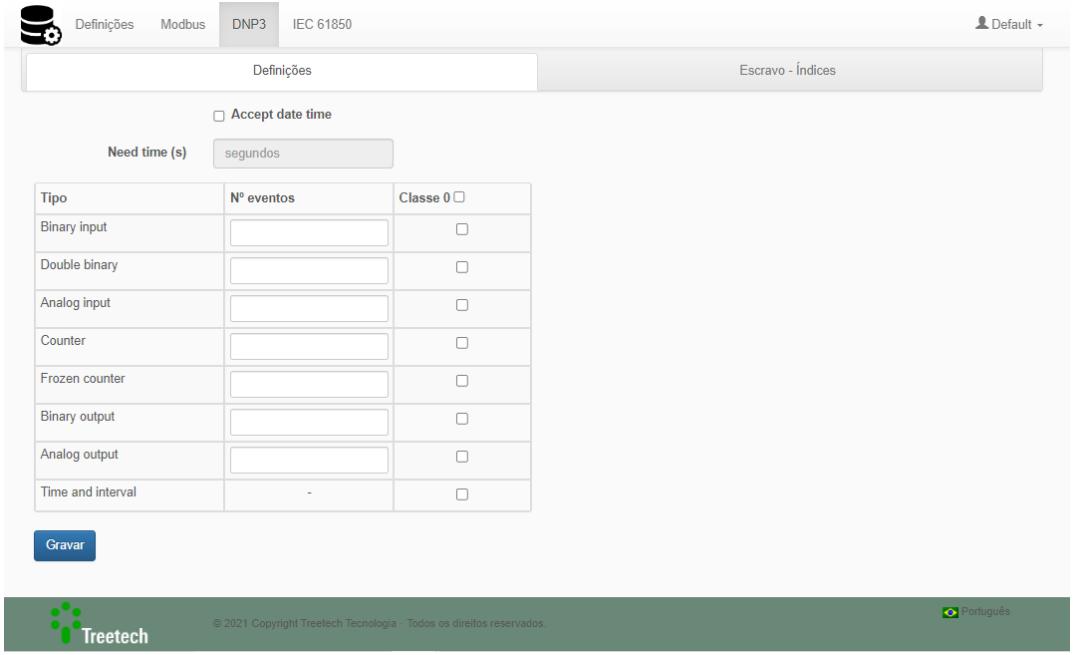


Figure 51 - DNP3 configuration tab

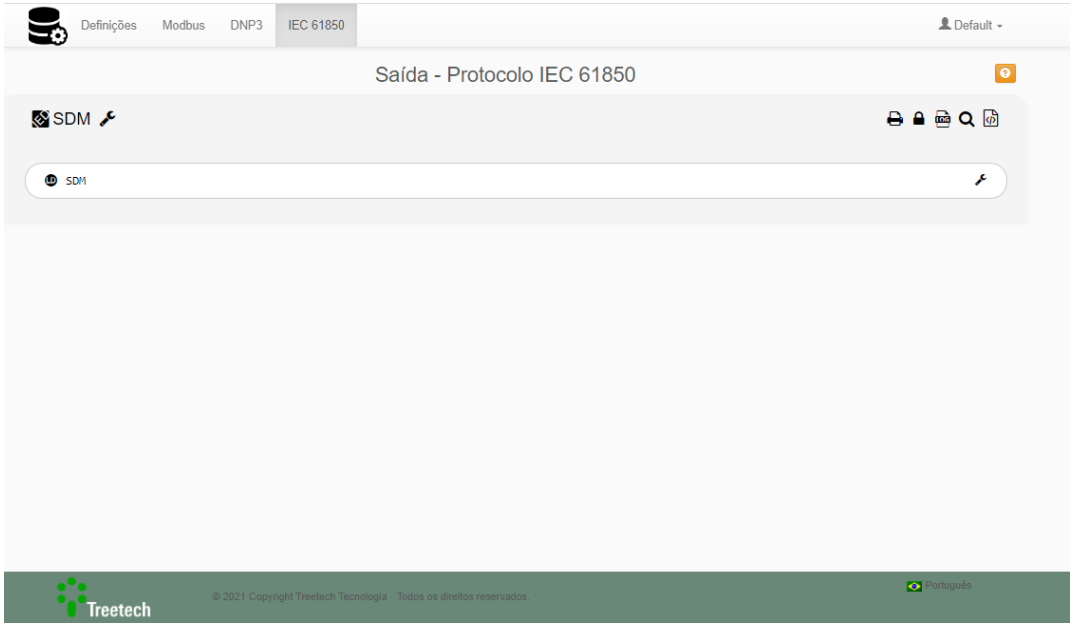


Figure 52 - IEC 61850 configuration tab

6.8.1.2 Export / Import

On this screen, using the “Export” button, you can transfer user settings, mapping, and IEC 61850 data to a .back file. Additionally, the reverse process can be done using the “Import” button.

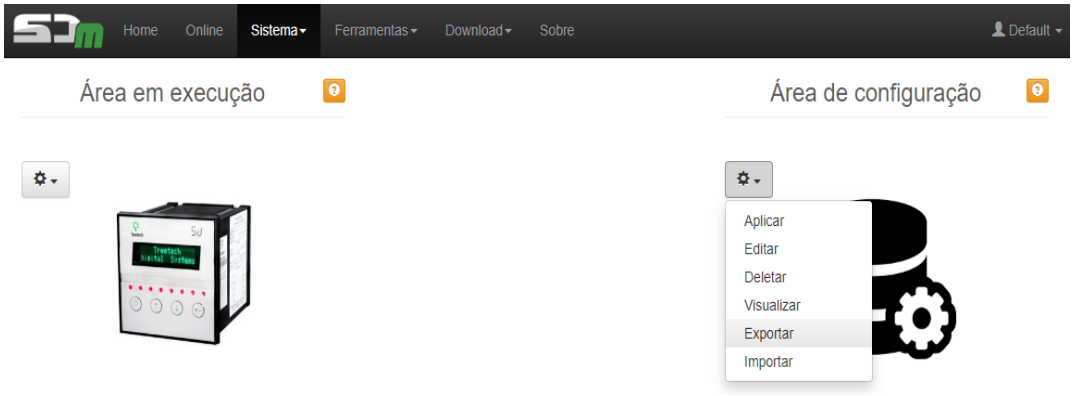


Figure 53 - System tab > Settings > "Export / Import" on the SDM webpage

6.8.2 Date and time

On this screen, the user can modify the SDM date and time.

Figure 54 - System tab > "Date and Time" on the SDM webpage

1 NTP/RTC SOURCE

On the Source button, two options are available: NTP, which uses Ethernet settings to update the clock; and RTC, which allows manual time adjustment.

If the chosen option is NTP, the user must also select the time zone, IP address, and update interval. It may be necessary to configure an IP address in the Gateway field of the IP configuration so that the SDM can access the NTP IP address.

If the source is RTC, the user, in addition to selecting a time zone, must manually adjust the date and time on the device. To make it easier, it is possible to copy the date and time from the local computer by clicking on the icons next to the adjustment fields.

6.8.3 Network

The network settings are available on this screen.

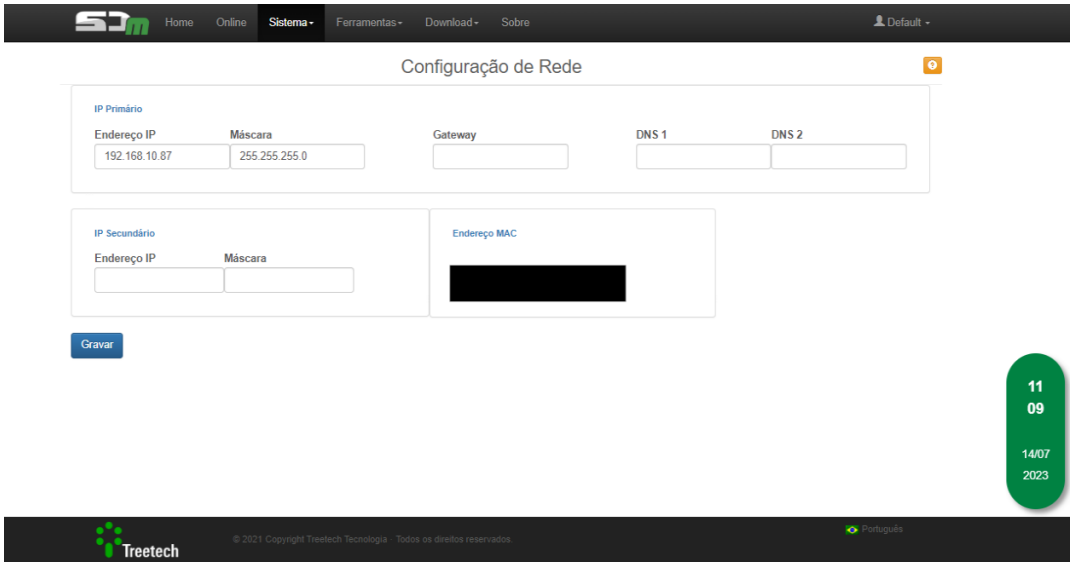


Figure 55 - System tab > "Network' on the SDM webpage

The user can manually modify the IP address and subnet mask of both the primary and secondary IP addresses. Additionally, it's possible to change the gateway address, DNS 1, and DNS 2.

6.8.4 Manager

This screen contains the SDM process manager.

Figure 56 - System tab > "Manager" on the SDM webpage

1 ACTION BUTTONS

The "Start" button – in a green box – and the "Stop" button – in a red box – allow the user to start or stop the SDM processes.

2 LABELS

Below the buttons, small colored labels show the possible states of each process: good, bad, indeterminate, initializing, and inactive.

3 LIST OF PROCESSES

Below the search box, a list of found processes is displayed. They can be organized according to the column names shown in the table header: processes, connection.

6.8.5 Update

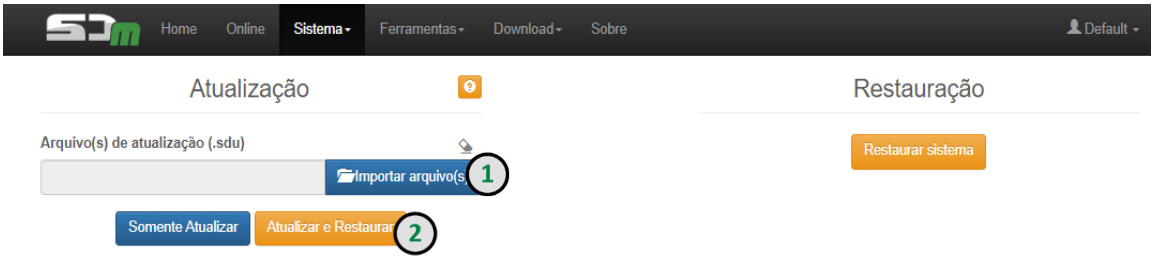


Figure 57 - System tab > “Update” on the SDM webpage

1 IMPORT FILE

By clicking the blue “Import file(s)” button, a window will appear, allowing the user to select the “.sdu” format file for the equipment update.

Update only / update and restore:

After importing the update file, simply click on one of the options below to update the device.

- Update Only: It will perform the update without restoring factory settingsi;
- Update and Restore: it will perform the update and restore factory settings; this is necessary in cases where the update includes changes to the application version.

When updating by restoring factory settings, the user's login password will be requested, and it will be possible to select the "Keep IP address" option. If this option is not selected, the device will revert to the default IP address (192.168.10.87).

Restore system

Just as it allows the user to restart the IED, the SDM web page also provides the possibility of restoring all factory settings of the product. To do this, click the orange "Restore System" button. The user's login password will be requested. Only authorized users can perform this operation. It will also be possible to check the "Keep IP address" option so that the user maintains access at the same address that is already configured. If this option is not checked, the equipment will return to the default IP (192.168.10.87).

2 UPDATE AND RESTORE

The “Restore factory defaults” checkbox allows the user to update the product and simultaneously restore the product settings according to the new firmware. If the user does not check the box, the update will be performed while maintaining the current settings.

6.8.6 Access

On this screen, you can configure secure access to the webpage using the HTTPS protocol. For more information about this configuration, please access the **Digital Certificate Quick Guide** available on our platforms.

Figure 58 - System tab > “Access” on the SDM webpage

6.9 Tools

6.9.1 DNP3 Decoder

A DNP3 decoder is used to analyze received DNP3 messages, interpret the different fields and data structures, and extract the relevant information contained in these messages. It can be used to debug DNP3 networks, monitor data traffic, log events, and analyze system performance. The decoder is also useful for testing the compliance of DNP3 implementations and verifying that devices are communicating correctly within the network.

Figure 59 - Tools tab > “DNP3 Decoder” on the SDM webpage

6.9.2 Mirroring

This module describes a communication interface operating on differential lines. Each device activates its transmitter only when it needs to transmit, keeping it off the rest of the time to allow other devices to transmit data. At any given time, only one device can transmit, which characterizes this network as half-duplex.

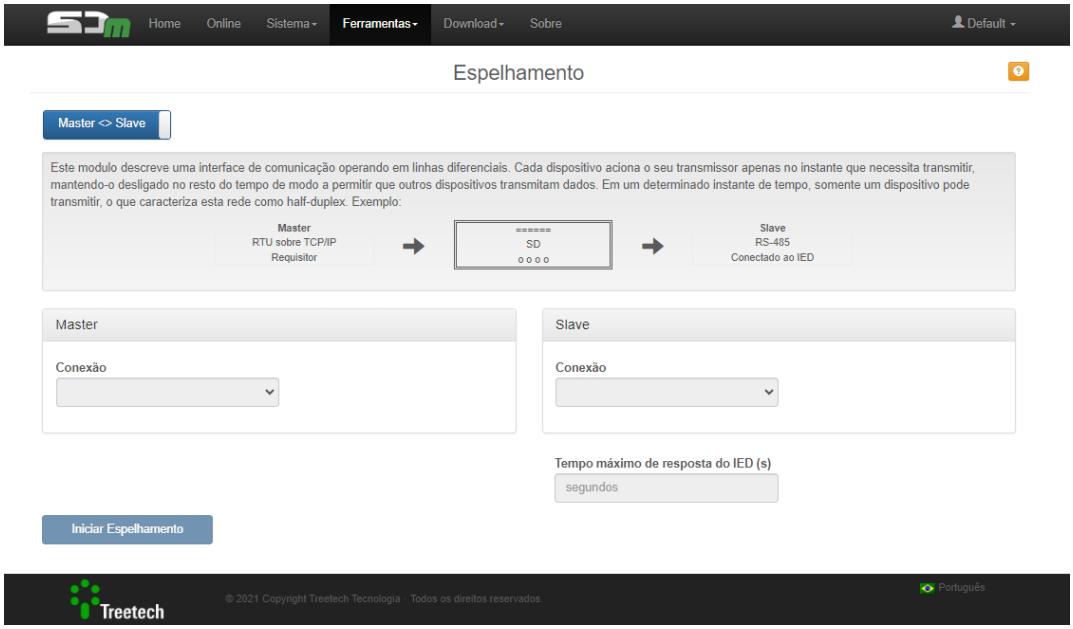


Figure 60 - Tools tab > “Mirroring” on the SDM webpage

6.9.3 Loader

This screen allows you to perform firmware and bootloader updates.

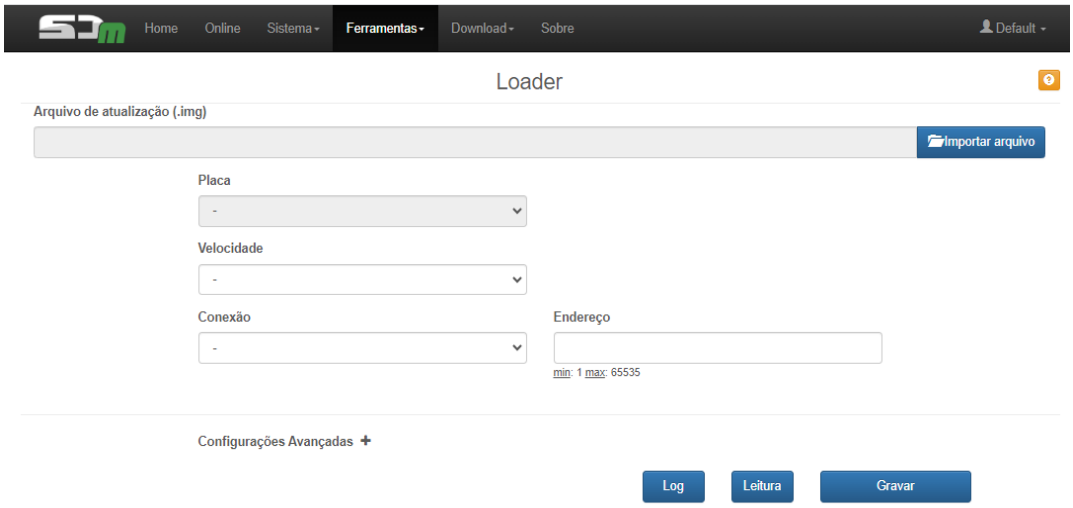


Figure 61 - Tools tab > “Loader” on the SDM webpage

6.10 Download

6.10.1 Oscillography

The "Oscillography" page, accessed via the "Download" menu, allows the user to access oscillography data and download selected items.

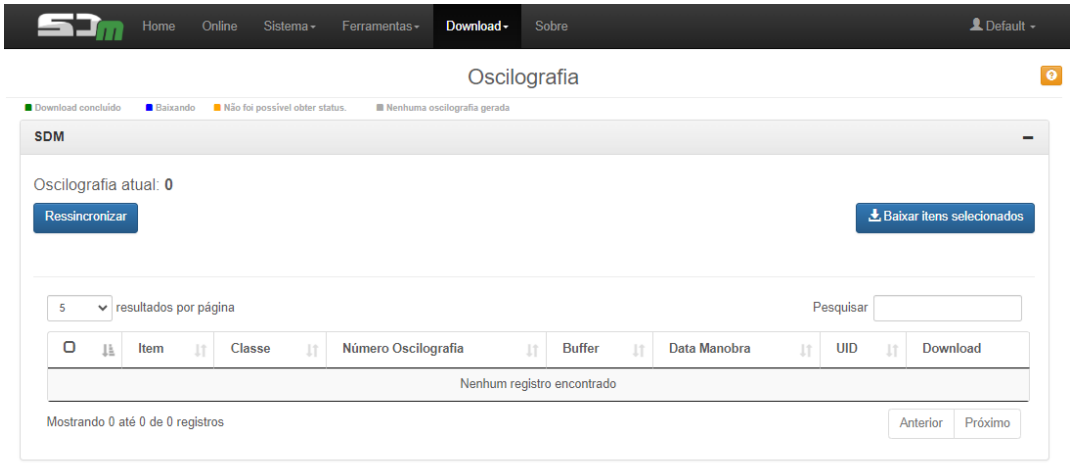


Figure 62 - Download tab > “Oscillography” on the SDM webpage

6.10.2Log

The “Log” page, accessed via the “Download” menu, allows the user to download a text file containing the communication log for all ports and protocols used. It is also possible to download the log of current processes and configurations for submission to Treetech in case of a support request.

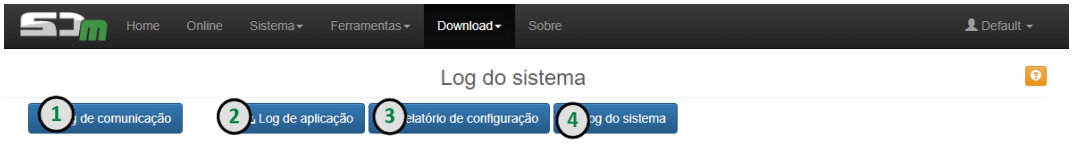


Figure 63 - Download tab > “Log” on the SDM webpage

1 DOWNLOAD COMMUNICATION LOG

To download the communication log, the user must click on the first blue box on the left side of the screen. The downloaded text file represents the history of incoming and outgoing communication.

2 DOWNLOAD APPLICATION LOG

The application log is also recorded, and a report can be downloaded by the user. Simply click on the second blue box. Although the user can download it, **access to this log is restricted to Treetech technical support**.

3 DOWNLOAD CONFIGURATION REPORT

Another type of log available for download is the configuration log. The third blue box allows you to download this report. Although the user can download it, **access to this log is restricted to technical support**.

4 DOWNLOAD SYSTEM LOG

The last log available for download is the system log. To download it, simply click on the fourth blue box. Although the user can download it, **access to this log is restricted to Treetech technical support**.

6.11 About

This is the system information query screen. Here the user can find data such as: equipment serial number, system version, and installed application version. Additionally, by interacting with the buttons below the screen, the user can access information such as Changelog, Processes, Parameters, and Homologation.

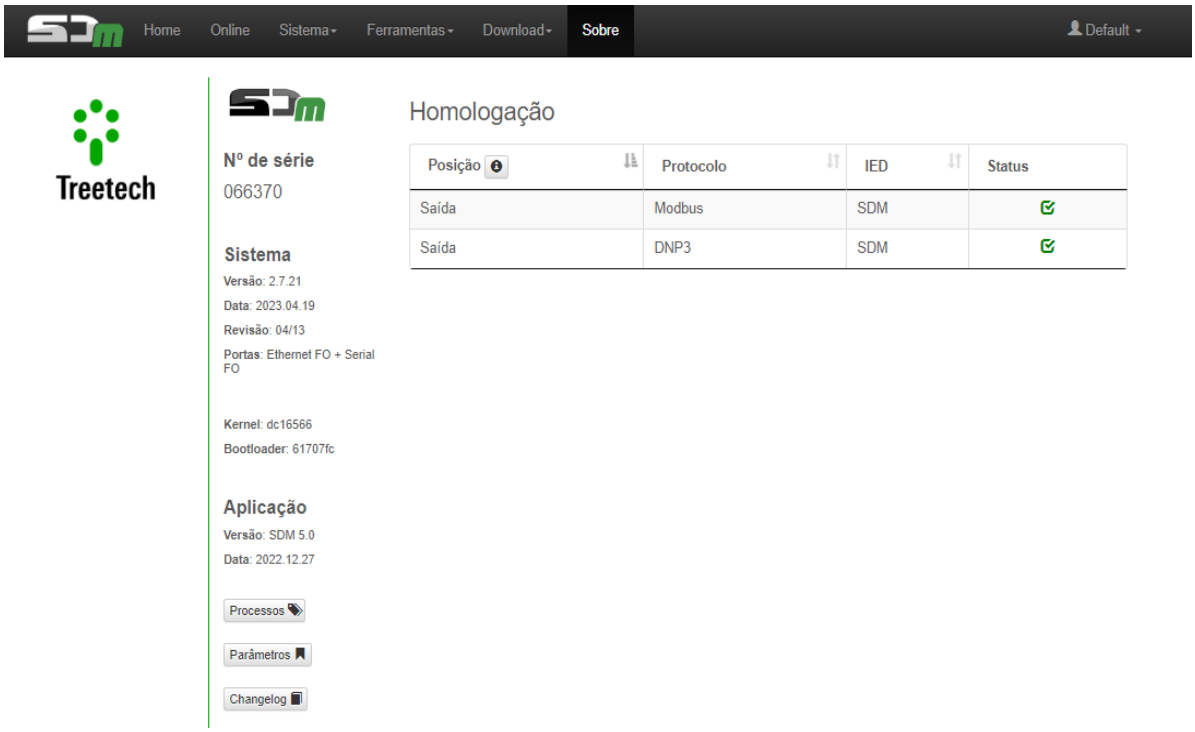


Figura 64 - About tab on the SDM webpage

7 Commissioning for entry into service

Once the equipment has been installed, commissioning should follow these basic steps:

- ✓ Check the correctness of the electrical connections (e.g., through continuity tests) and correct if necessary;
- ✓ Before energizing the OLTC, or before removing the short circuit from the secondary of the CTs, verify that the current transformer circuits are correctly connected to the SDM input, ensuring that no CT is open;
- ✓ Energize the SDM with the appropriate voltage;
- ✓ Perform all SDM parameterization;
- ✓ Using a computer, cables, communication converters, and appropriate software, check the operation of the SDM's RS-485 port;
- ✓ Using a continuity indicator, test the operation of the alarm contacts. The closing and opening of the contacts can be forced by changing the operating mode from NO (Normally Open) to NC (Normally Closed) and vice versa;
- ✓ Perform maneuvers on the OLTC for the SDM to generate the motor signature reference learning. The maneuvers can be monitored in the “Learning status” submenu, in the “Query screen” menu;
- ✓ After the learning process is complete, check the alarm and self-diagnosis memory. Normalize the SDM so that the "OK" LED remains lit and the alarm memory is reset;
- ✓ Perform the maneuvers and verify that the obtained values are consistent;
- ✓ It is possible to download oscillograms using software for the SDM. This allows you to verify if the maneuvers are consistent and if the reference curve was generated correctly.

8 Troubleshooting

8.1 The equipment displays alarm messages on the screen

The message shown on the top display indicates which of the three alarm sections the code displayed belongs to. The value shown on the bottom display contains four digits, each digit representing up to four different alarms, with values 1, 2, 4, and 8. The value shown for the digit will be the sum of the values of all active alarms for that digit. For example, if a certain digit is showing the number 7, we know that alarms 1, 2, and 4 are currently active.

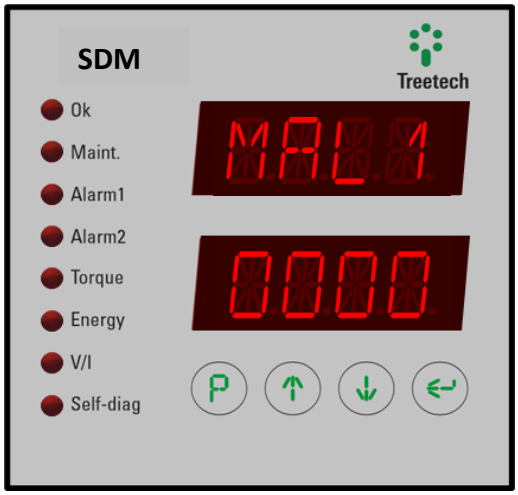


Figura 65 - Alarm indication in SDM

8.2 Viewing alarm memory

The Alarm Memory function allows you to know all the events that occurred in the SDM. This memory is non-volatile and cumulative, meaning it allows you to know all the events that occurred, but not when they occurred. If there are two different events, the result shown in the position relative to that event is the sum of them.

The Alarm Memory is accessed by pressing the keys P and ↑ sequentially.

There are three alarm memory screens, identified by the abbreviations **MAL1**, **MAL2** and **MAL3**, which can be accessed by pressing the ↑ and ↓ keys. On each screen, the abbreviation **MAL1**, **MAL2** or **MAL3** is displayed alternately with a numerical code that identifies the events that occurred.

To clear (reset) the Alarm Memory, press the ↵ key for 5 seconds. If there are any active alarms, the memory will be reset, indicating their occurrence. Press the P key to return to the indication screen.

To interpret the codes provided by the alarm memory, consult the code table by clicking the link below or scanning the QR code to be redirected to Treetech's Customer Service.

Alarm memory

8.3 The equipment displays self-diagnosis messages on the screen

The SDM has self-diagnosis warnings **DG1** and **DG2**, which appear alternately along with the code on the display in case of an anomaly.

The SDM displays the self-diagnosis code flashing slowly on its screen, and its indicator LED is activated and remains steady (for about 1 second).

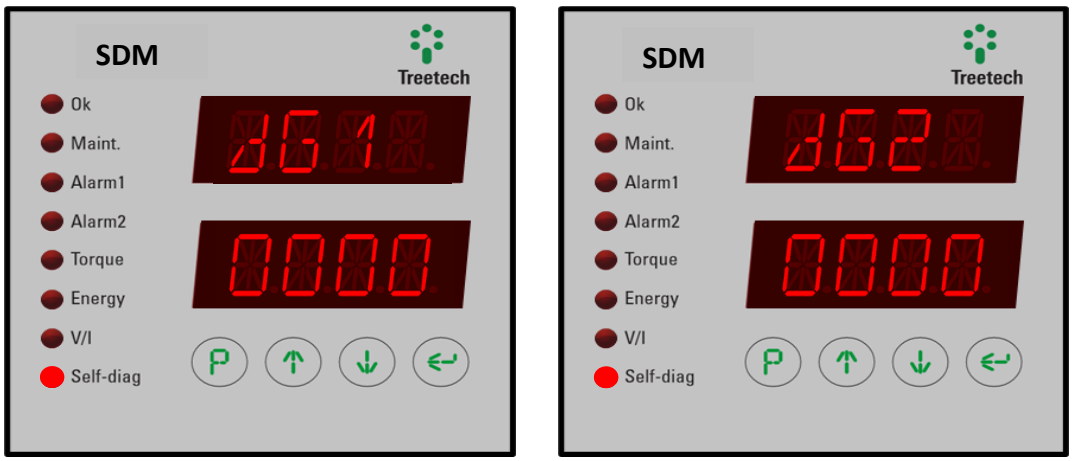


Figure 66 - Self-diagnosis indication in SDM

8.3.1 Viewing self-diagnosis memory

The SDM firmware constantly verifies the integrity of its functions and the temperature sensors connected to it through its circuits and self-diagnosis algorithms. Any detected anomaly is signaled through the fault contact and through self-diagnosis messages displayed on the equipment's screen, assisting in the fault diagnosis and resolution process.

The Self-Diagnosis Memory function allows you to track all diagnostic events that have occurred in the SDM, such as poor connections in the temperature sensor wiring or internal faults. This memory is non-volatile and cumulative, meaning it allows you to track all events that have occurred, but not when they occurred.

The Self-Diagnosis Memory is accessed by sequentially pressing the P and ↓ keys. There are two Self-Diagnosis Memory screens, identified by the abbreviations **MdG1** and **MdG2**, which

can be accessed by pressing the ↑ and ↓ keys. On each screen, the abbreviation **MdG1** or **MdG2** is alternately indicated with a numerical code that identifies the events that occurred.

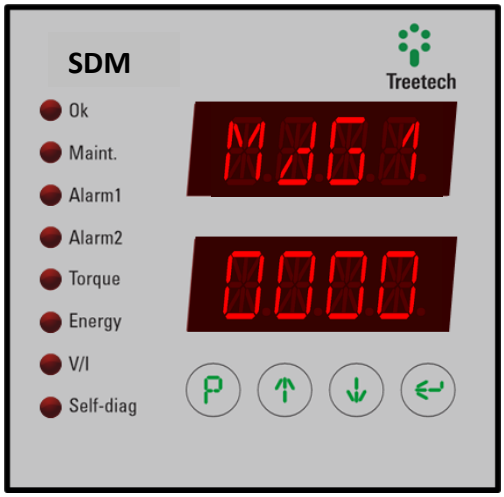


Figure 67 - Consulting the self-diagnosis memory

To clear (reset) the self-diagnostic memory, press the ↵ key for 5 seconds. If there are any active diagnostics, the memory will be reset, indicating their occurrence. Press the P key to return to the display screen.

To check the procedure in case of self-diagnosis and possible errors generated by the SDM, follow the instructions by clicking the link below or scanning the QR code to be redirected to Treetech's Customer Service.

Self-diagnosis

9 Technical data and type tests

9.1 Technical data

Table 19 - Technical data

Hardware	Range/description
Supply voltage	38...265 Vac/Vdc, 50/60 Hz
Maximum consumption	< 8 W
Operating temperature	-40...+85 °C
Degree of protection	IP20
Connections	0.3...2.5 mm², 22...12 AWG
Mounting	Panel mounting
Current (AC/DC)	4x external clip-on CT, measuring range of 0...10 Aca rms on the primary of the CT in AC. 0...10 Acc on the primary of the current transformer using a shunt resistor for DC.
Voltages (AC/DC)	3x auxiliary PT, measuring range of 0...265 Vac rms on the primary of the PT for AC. 0...300 Vdc, for DC.
Nominal frequency	50/60 ± 2 Hz
Temperatures	1x Pt100 type temperature sensor, range -55...+200 °C
Dry contacts	1, free of potential
Tap positions	2...50 positions
Resistance per step	4.7...20 Ω
Total resistance	9.4...1000 Ω
Analog input	Input range of 0...5, 0...10, 0...20, or 4...20 mA
Currents	0.5% of the measurement in the range of 0.5...10 Aca in the primary of the CTs, for CA.
Voltages	1% of the measurement + PT error, for AC. 0.5% of the measurement + shunt resistor error, for indirect DC current reading. 0.5% of the measurement, for DC.
Temperatures	0.5% of full scale + sensor error
Relay outputs	3 reversible + 2 NO
Maximum switching power	70 W/250 VA
Maximum switching voltage	250 Vac/Vdc
Maximum current conduction	5 A
Serial communication ports	1 TIA-485-A (RS-485)
Communication protocols	Modbus® RTU
Standard version	Oscillographs of 10 OLTC motor operations
Version with MMEM	Oscillographic recordings of 90 OLTC motor operations, logs of alarms, events, and measurements.

9.2 Type tests

The SDM is a device built on the Smart Sensor 3 platform and tested according to the following table:

Table 20 - Type tests

Type tests	Information
Immunity to outbreaks (IEC 60255-22-5)	
Differential mode	1 kV (+/-)
Common mode	2 kV (+/-)
Immunity to electrical transients (IEC 60255-22-1)	
Peak value 1st cycle	2.5 kV common mode 1 kV Differential mode
Frequency	1 MHz
Repetition rate	200 outbreaks/s
Applied voltage (IEC 60255-5)	
Dielectric strength	2 kV, 60 Hz, 1 min
Voltage impulse	5 kV (+/-)
Immunity to radiated electromagnetic fields (IEC 60255-22-3)	
Frequency	80...2500 Mhz
Modulation index	80 %, 1 kHz sinusoidal
Field strength	10 V/m
Power supply	220 V, 60 Hz
Immunity to conducted electromagnetic disturbances (IEC 60255-22-6)	
Field strength	10 Vrms
Frequency	0.15...80 MHz
Modulation	80 %, 1 kHz sinusoidal
Modulation index	150 kHz, 80 MHz
Sweep frequency	27...68 MHz
Fixed frequencies	20 s
Power supply	220 V, 60 Hz
Immunity to industrial frequency magnetic fields (IEC 61000-4-8)	
Magnetic field strength and direction	30 A/m 3 orthogonal axes
Electrostatic discharges (IEC 60255-22-2)	
Intensity and voltage	Air mode 15 kV 220 V, 60 Hz
Immunity to fast electrical transients (IEC 60255-22-4)	
Power supply, inputs and outputs	4 kV (+/-)
Current outputs	2 kV (+/-)
Power failure (IEC 61000-4-11)	
Voltage drops	0...80 % de U 1/2...300 cycles 85 V and 265 V 50/60 Hz
Short interruptions	5 seconds 85 V and 265 V 50/60 Hz
Tolerance to cold (IEC 60068-2-1)	
Temperature	-40 °C
Test time	16 hours
Tolerance to dry heat (IEC 60068-2-2)	
Temperature	85 °C
Test time	16 hours

Tolerance to humid heat (IEC 60068-2-78)	
Temperature and humidity	40 °C, 85% RH
Test time	24 hours
Thermal cycle (IEC 60068-2-14)	
Temperature range	-40...+85 °C
Total test time	120 hours
Response to vibration (IEC 60255-21-1)	
Application method	Sinusoidal
Amplitude	0.075 mm (10...59 Hz); 1G (59...150 Hz);
Duration	8 min/axis
Durability to vibration (IEC 60255-21-1)	
Application method	Sinusoidal
Amplitude	2G (10...150 Hz)
Duration	160 N/axis

10 Specification for order

1. Product name

Smart Device for OLTC Torque - SDM.

2. Quantity

The number of units.

3. Model

Choose one of the following options:

- **SDM:** 1 input for potentiometric transmitter for measuring tap position.
- **SDM-I:** 1 current loop input for measuring tap position.

4. Options

Depending on your choices, there are different available options, as shown in the table below.

SDM	SDM-I	
✓	✓	DNP3
✓	✓	HTCV
✓	✗	TAPP
✗	✓	TAPI
✓	✓	OLMT

CAPTION	
✓	Available
✗	Not available

Treetech
BRASIL
Treetech Tecnologia Ltda
Rua José Alvim, 112, Centro
CEP 12.940-750 – Atibaia/SP
+55 11 2410-1190
www.treetech.com.br