
English

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# TECHNICAL MANUAL

# IDM

## ON LOAD TAP CHANGER TORQUE MONITOR

Treetech

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# 1 Foreword

## 1.1 Legal Information

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## 1.2 Presentation

This manual presents all the recommendations and instructions for installation, operation and maintenance of the Tap Changer Torque Monitor – IDM.

## 1.3 Typographical Conventions

Throughout this text, the following typographical conventions were adopted:

**Bold:** Symbols, terms and words that are in bold have greater contextual importance. Therefore, pay attention to these terms.
*Italics:* Terms in foreign language, alternative or with their use outside the formal situation are written in italics.

## 1.4 General and Safety Information

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

### 1.4.1 Safety Symbols

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

**Caution**
The **Caution** symbol is used to alert the user of a potentially hazardous operating or maintenance procedure that demands greater caution in its conduction. There may be minor or moderate injuries, as well as damages to the equipment.

**Warning**
The **Warning** symbol is used to alert the user of a potentially hazardous operating or maintenance procedure in which extreme caution must be taken. There may be serious injuries or death. Possible damages to the equipment are irreparable.

**Electric Shock Hazard**
The **Electric Shock Hazard** symbol is used to alert the user of an operating or maintenance procedure that may result in electric shock if not strictly observed. There may be minor, moderate, serious injuries or death.

### 1.4.2 General Symbols

This manual uses the following general symbols:

**Important**
The **Important** symbol is used to highlight relevant information.

**Tip:**
The **Tip** symbol represents instructions that facilitate use and access of functions in the IDM.

### 1.4.3 Minimum profile recommended for the IDM operator and maintainer

Installation, maintenance and operation of equipment in electric power substations require special cares and, therefore, all recommendations of this manual, applicable standards, safety procedures, safe work practices and good judgment must be used during all handling stages of the Tap Changer Torque Monitor (IDM).
For use of this manual, an authorized and trained person has knowledge of the inherent risks – both electrical and environmental – involved in handling the IDM.

Only authorized and trained personnel – operators and maintainers – should handle this equipment.

a) The operator or maintainer must be trained and authorized to operate, ground, turn on and turn off the IDM, following maintenance procedures according to the safety practices established, under the sole responsibility of the IDM operator and maintainer;
b) Be trained in the use of IPEs, CPEs and first-aid;
c) Trained in the working principles of the IDM, as well as its configuration.
d) Follow regulatory recommendations regarding interventions in any type of equipment included in an Electric Power System.

### 1.4.4 Environmental and voltage conditions required for installation and operation

The table below lists important information on the environmental and voltage requirements:

**Table 1 – Operating conditions.**

| Condition | Interval/Description |
|---|---|
| Application | Equipment for sheltered use in substations, industrial environments and similar. |
| Internal/External Use | Internal Use |
| Degree of Protection (IEC 60529) | IP 20 |
| Altitude* (IEC EN 61010-1) | Up to 2000 m |
| Temperature (IEC EN 61010-1) | |
| Operation | -40 °C to +85 °C |
| Storage | -50 °C to +95 °C |
| Relative Humidity (IEC EN 61010-1) | |
| Operation | 5% to 95% – Uncondensed |
| Storage | 3% to 98% – Uncondensed |
| MAINS Supply Voltage Fluctuation (IEC EN 61010-1) | Up to ±10% of the Rated voltage |
| Overvoltage (IEC EN 61010-1) | Category II |
| Level of Pollution (IEC EN 61010-1) | Level 2 |
| Atmospheric Pressure** (IEC EN 61010-1) | 80 kPa to 110 kPa |

* Altitudes greater than 2000 m already have successful applications.
* Pressures of less than 80 kPa already have successful applications.

### 1.4.5 Instructions for test and installation

**This manual must be available to those responsible for installation, maintenance and users of the Tap Changer Torque Monitor – IDM.**

To guarantee user safety, equipment protection and correct operation, the following minimum cares must be followed during the IDM installation and maintenance:

1. Read this manual carefully before installation, operation and maintenance of the IDM. Errors in installation, maintenance or adjustments of the IDM can cause undue operations of the tap changer in load, unsatisfactory voltage regulation, undue alarms or pertinent alarms may also fail to be emitted.
2. The installation, adjustments and operation of the IDM must be done by personnel trained and acquainted with the electric motors, power transformers, tap changers on load or voltage regulators, control devices and control circuits of substation equipment.
3. Special attention must be paid to installation of the IDM (Chapter 3 - Project and Installation), including the type and size of the cables and terminal strips used, as well as the procedures for commissioning (Chapter 6 – Commissioning to start service), including correct parameterization of the equipment (Chapter 5 - Parameterization).

The IDM must be installed in a sheltered environment (a panel without doors in a control room or in a closed panel, in cases of outdoor installation) where the temperature and humidity specified for the equipment are not exceeded.

Do not install the IDM near sources of heat like heat resistors, incandescent lamps and devices with high power or with heat dissipaters. Its installation near ventilation orifices or where it can be affected by forced air flow, like outlet or inlet of cooling fans or forced ventilation ducts, is not recommended

On conducting dielectric strength tests on the wiring (applied voltage), the ground cables connected to terminal 17 of the IDM must be disconnected in order to prevent destruction of the protections against overvoltage existing inside the device due to application of high voltages for a long period (e.g.: 2 kV for 1 minute).

### 1.4.6 Cleaning and decontamination instructions

Take care when cleaning the IDM. Use ONLY a cloth wet with soap or detergent diluted in water to clean the cabinet, front plate or any other part of the equipment. Do not use abrasive materials, polishers or aggressive chemical solvents (like alcohol or acetone) on any of its surfaces.

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

### 1.4.7 Inspection and maintenance instructions

The following observations must be followed for inspection and maintenance of the IDM:

Do not open the equipment. In it, there are no parts reparable by the user. This should be done by the Treetech technical assistance, or by technicians accredited by it.
This equipment is completely maintenance-free, being that visual and operational inspections, periodical or not, may be conducted by the user. These inspections are not mandatory.

Opening of the IDM at any time will imply in loss of the product warranty. In cases of undue opening of the equipment, Treetech will also not be able to warrant its correct functioning, regardless of the warranty period having expired or not.

All parts of this equipment must be supplied by Treetech, or by one of its accredited suppliers, according to its specifications. If the user wishes to purchase it otherwise, he must strictly follow Treetech's recommendations for this. This way, the performance and safety for the user and the equipment will not be compromised. If these specifications are not followed, the user and the equipment may be exposed to unforeseen and unnecessary risks.

## 1.5 Technical Assistance

To obtain technical assistance for the IDM or any other Treetech product, contact us through the address below:

**Treetech Sistemas Digitais Ltda. – Assistência Técnica**
Rua José Alvim, 100 – Salas 03 e 04 – Centro
Atibaia – São Paulo – Brazil
Zip Code: 12940-800
CNPJ [Corporate taxpayer's roll]: 74.211.970/0002-53
IE [State Tax ID]: 190.159.742.110
PHONE: +55 (11) 2410-1190 x201
FAX: +55 (11) 4413-5991
Email: suporte.tecnico@treetech.com.br
Site: http://www.treetech.com.br

## 1.6 Warranty Term

The Tap Changer Torque Monitor – IDM will be warranted by Treetech for the term of 2 (two) years, counted as of the date of purchase, exclusively against eventual manufacturing defects or quality defects that make it improper for regular use.

The warranty will not cover damages suffered by the product as a result of accidents, mistreatment, inaccurate handling, inaccurate installation and application, improper tests or in case of breaking of the warranty seal.

The eventual need for technical assistance must be communicated to Treetech or to its authorized representative, with presentation of the equipment accompanied by the respective proof of purchase.

Treetech does not provide any express or implied warranty, other than that provided above. Treetech does not provide any guarantee of the IDM’s adaptation to a particular application.

The seller will not be charged for any type of damage to property or any losses and damages that arise, whether connected, or that result from purchase of the equipment, its performance or any service possibly provided together with the IDM.

Under no circumstance will the seller be held responsible for losses, including but not limited to: losses of profits or earnings, impossibility of use of the IDM or any associated equipment, capital costs, acquired energy costs, equipment costs, substitute installations or services, costs of interruptions, complaints from customers or employees of the buyer, regardless of whether said damages, complaints or losses are based on contract, warranty, negligence, offense or any other. Under no circumstance will the seller be charged for any personal damage, of any kind.

## 1.7 Review Log

**Table 2 - Reviews**

| *Review* | *Date* | *Description* | *Author* |
|---|---|---|---|
| 1.00 | 13/apr/2015 | First issue (translated from 2.30 Portuguese version) | João Victor Miranda |
| 1.10 | 02/dec/2015 | Electric installation figures updated | João Victor Miranda |
| 1.20 | 12/feb/2016 | Figures 5,6 and 15 updated | João Victor Miranda |
| 1.30 | 28/aug/2017 | Representatives and optional accessories updated | João Victor Miranda |
| 1.40 | 03/oct/2017 | Fax and picture 5 updated | João Victor Miranda |
| 2.71 | 24/jul/2018 | Update of the nomenclature and description of the DNP3 option (subchapters 2.2 and 2.3) | João Victor Miranda |
| 2.72 | 11/oct/2018 | Update of connection diagram | João Victor Miranda |

# 2 Introduction

Due to having mobile parts that switch high voltages and currents, the On Load Tap Changer is statistically one of the main sources of failures in transformers, with the mechanical failures contributing toward this. To detect such defects at an early stage and reduce the probability of unexpected stops, the IDM monitors the OLTC torque online, warning of changes in its typical signature that indicate failures in development.
The power to operate the tap changer is supplied by a motorized mechanism, which exerts greater or lesser torque in each change stage, creating a typical "signature" that under normal conditions is repeated with each change made. Mechanical problems in the tap changer will alter this signature, allowing their detection at an early stage.
Since the torque developed by the motor is proportional to the electric power, the IDM monitors it indirectly, measuring the motor's consumption, with the aim of detecting and emitting alarms in case of eventual changes in this signature or in the change time. Mechanical failures in the tap changer can thus be detected at an early stage. For this, the IDM Torque Monitor supervises several variables online, according to version of the equipment used (Basic or with Optional Items):

- Oscillography of the currents, voltages (Optional Connection) and power consumed by the motor during the operations, in single-phase or three-phase mode;
- Position of the changer TAP, through potentiometric transmitter or current input, e.g.: 4-20 mA (*Optional function*);
- Activation mechanism temperature (*Optional function*);
- Current of the anti-condensation heater of the activation mechanism (*Optional function*);
- Line current interrupted by the changer contacts (*Optional function*);
- Auxiliary contact of circuit breaker alarm of the motor and/or actuated control (*Optional function*).

For diagnosis of the OLTC, the IDM correlates these measurements with specialist engineering algorithms, obtaining useful information for diagnosis and prognosis, where applicable:

- Signature of power, energy and times spent by the motor during the operation;
- Motor starting current;
- Minimum and maximum voltages in the motor during the operation;
- Under and overvoltage of the motor supply;
- No. of operations and time of service of the changer, total and after the last maintenance (*Optional function*);
- Integration of the switched current, indicating wear of the changer contacts, total and after the last maintenance (*Optional function*);
- Time remaining for maintenance due to time of service, number of operations and integration of the switched current (*Optional function*);
- Functioning of the mechanism heater, preventing condensation of water and oxidation (*Optional function*);
- Very low or high activation mechanism temperature (*Optional function*).

With the measurements and calculations of the engineering algorithms, the IDM emits alarms in case of abnormalities, as well as notices of maintenance in advance as programmed by the user, with activation of the output contacts.

## 2.1 Main Characteristics

The Tap Changer Torque Monitor – IDM has a series of useful characteristics, described below:

- IED (Intelligent Electronic Device) designed specifically for the substation yard conditions (interferences, high temperatures);
- Local indication of the Voltage, Current and Power Factor in display;
- Single-phase and three-phase DC, AC voltage measurement range;
- Engineering Algorithm for calculation of the torque and energy used during the switch;
- High brilliance LED type display for easy visualization;
- RS-485 Serial communication port for integration to remote supervision or monitoring systems. Modbus RTU or DNP3 open communication protocols *(Optional)*;
- Inputs for up to three voltages and four currents.
- A current input may be used for measurement of the line current *(Optional)* or of the current of the activation mechanism's anti-condensation heater *(Optional)*.
- Inputs for indication of the TAP position through potentiometric sensors or analog inputs (*mA*) *(Optional)*.
- Digital signal of the control circuit breaker state or activation motor of the tap changer *(Optional)*.
- Input for Pt-100 type sensor for measurement of the activation mechanism temperature, ambient temperature or other desired by the user *(Optional)*.
- Self-diagnosis for detection of internal failures.
- Output relays for indications of alarm and self-diagnosis;
- Total absence of mechanical parts for parameterization and calibration.


**Figure 1** - Tap Changer Torque Monitor – IDM

## 2.2 Optional Functions

According to the request, the IDM can be supplied with one or more optional functions listed below:

### Optional 1 – Protocol DNP3:

Level 1 DNP3 slave communication protocol, RTU, with support for timestamp with 1 ms accuracy. Through the DNP3 protocol, the user can access parameter query and programming, checking of analog and digital measurements, and alarm events.

### Optional Item 2 - Mass Memory:

Allows storage of data and past events in a log of up to 10,389 records in a circular memory, which can have its recording period adjusted according to the user’s need. The information stored is:

- Date and time of the events;
- Alarms that occurred;
- Self-diagnoses that occurred;
- Measurements made;

### Optional Item 3 - Monitoring of Heating and Command Voltage:

Allows the IDM to monitor the current and temperature of the heating system, also allowing the programming of some conditions for the heating system to be turned on or off. The control voltage can also be monitored when this option is active.

The good functioning of this function requires correct connection of the control voltage, of the CT current sensors and PT100Ω temperature sensors to the equipment.

### Optional Item 4 - Measurement of Tap Changer Position:

Allows connecting a potentiometric transmitter or an mA analog signal for indication of the TAP position of the changer in the IDM. The IDM can use this measurement to simply indicate the TAP position of the changer or to aid in calculations of the changer’s maintenance assistance, another optional function of the IDM. Also allows measuring the line current (IL).

### Optional Item 5 - Changer Maintenance Assistant:

This optional item expands the IDM’s functionalities, providing various additional information:

- No. of operations and time of service of the changer, total and after the last maintenance;
- Integration of the switched current, indicating wear of the changer contacts, total and after the last maintenance. Indication of the line current;
- Time remaining for maintenance due to time of service, number of operations.

## 2.3 Basic Philosophy of Operation

The On Load Tap Changer is one of the main sources of failures in power transformers, mainly due to mobile parts that conduct and interrupt high currents when subjected to high electric powers.
Besides the thermal failures (*See Manual of the TM-1 - Changer Temperature Differential*), some of the common modes of failure in changers are mechanical, whether in the motorized activation mechanism, or in the changer itself, which can lead indirectly to failures with high level of severity.

The energy required for mechanical activation of the changer is provided by a motorized mechanism that, depending on the effort made to overcome each stage of the change process, will exert a greater or lesser torque, in order to create a signature or digital impression of torque that, under normal operating conditions, is repeated in approximately equal manner with each change made. This *signature* is obtained through a current and voltage oscillogram – if being used – used by the motor of the changer during its operation.

Changes in mechanical functioning of the changer will cause changes in this signature, allowing the detection of mechanical failures 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 electric power consumed, the torque can be monitored by measuring the motor's consumption, also considering that the final objective is to detect changes in torque during the changer's life, and not to make accurate measurements of the torque's absolute value.

The IDM conducts the online monitoring of the torque developed by the motor during the various stages of the switching, allowing the detection of mechanical failures in the changer before these reach a level of severity that can cause problems of greater proportion.

To calculate the torque, the IDM monitors the current consumed by the motor during its functioning. Monitoring of the voltage in this case is optional, but highly recommended since with it, it is possible to obtain other important variables for an overall evaluation of the mechanical assembly's state. The motor of the changer can be supplied with three-phase or single-phase AC voltage at 50 Hz or 60 Hz, in addition to DC voltage. Each supply type has a specific engineering model that allows the IDM to perform its function regardless of which supply the motor receives.

In addition, the IDM can monitor the current of the anti-condensation heater, the line current, changer position and activation mechanism temperature, promoting a full diagnosis of the changer's mechanical activation system. All these sensors are connected directly to the IDM, there being no need for external transducers.

The RS-485 serial communication channel, through the Modbus protocol, allows access to the programming and consultation of the parameters, online measurements and memory of the IDM's oscillograms

Through the DNP3 protocol (*optional*), the user can access parameter query and programming, checking of analog and digital measurements, and alarm events.

It is possible to program independent alarm levels for each magnitude. In case there is an alarm condition, the IDM will activate reversible dry contacts, allowing those responsible to soon take applicable conducts.

For some output contacts, regardless of the mode of functioning, the contact with the opposite function also becomes available (reversible). Thus, various data acquisition logics can be conducted without the need for duplication or inversion of contacts. The IDM has a self-diagnosis relay, signaling any measurement failure condition, lack of auxiliary supply or internal failure to the device. This contact is also reversible.

# 3 Project and Installation

## 3.1 System Topology

The IDM has a basic topology, relating its inputs with its outputs, but depending on the existence or not of the associated optional functions, this topology can have some elements included in its scope. Note that not all optional items may be active at the same time.

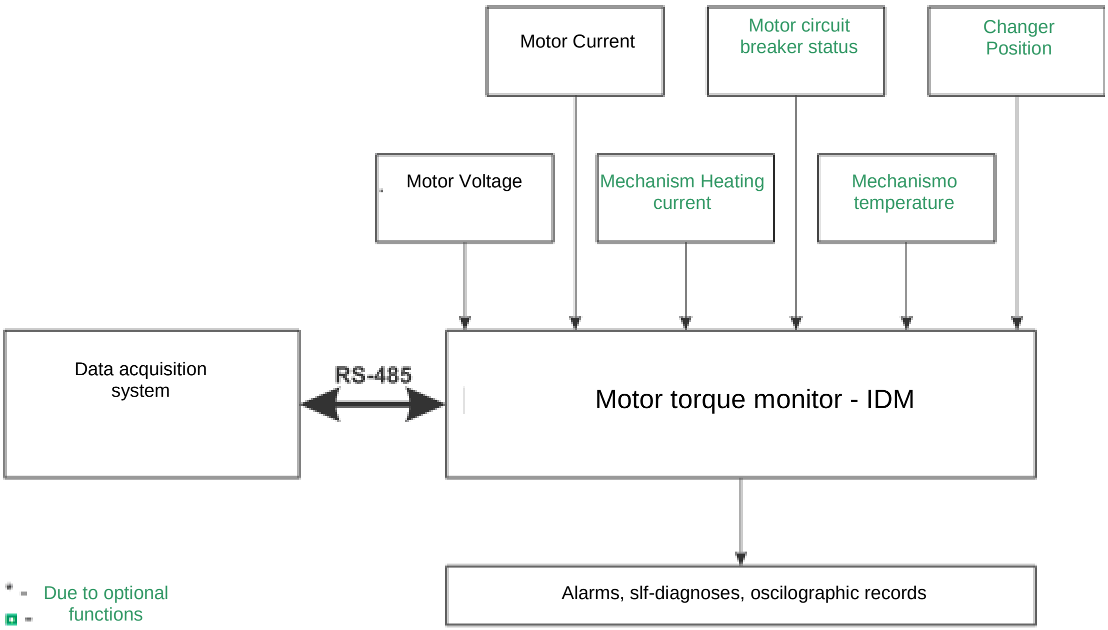



**Figure 2 – Composition of the Torque Monitoring System**

The items required for installation of the IDM Torque Monitor are:

- IDM Torque Monitor;
- External window CTs with selectable core (Clip-On) that come with the IDM. The quantity will vary according to the application (*single-phase or three-phase*) and must be indicated in the purchase order;
- Optional connections for measurement of the motor voltages, with mandatory use of external PT if the Phase-Neutral voltage exceeds 265 Vac (single-phase) or the Phase-Phase voltage exceeds 240 Vac (three-phase);
- Three-way shielded cable for connection of the RTD type sensor (*optional*);
- Two way twisted-pair cable for serial communication (*optional*);
- Housing for unsheltered installation (optional).

## 3.2 General Considerations

The temperature sensor (RTDs) must be connected to the IDM Torque Monitor through shielded cable, without interruption of the grid, which must be grounded only at the end connected to the IDM.

The RS-485 serial communication must be interconnected by means of a twisted-pair cable, maintaining the grid without interruption up to its end, grounding only one of the ends. The maximum distance allowed for this type of serial communication is 1200 meters, according to the TIA/EIA-485-A -1998 standard.

The torque alarm contacts and self-diagnosis, besides being reversible, can be configured to operate in normally closed (NC) or normally open (NO) mode in the Relays menu, section 5.13.2. Thus, it is possible to obtain several advantages from this flexibility. One of them is the duplication of contacts only considering an inverse logic of operation in the final application, without detriment to the safety or speed of operation of the contact for the critical application.

Details on how to conduct the electrical installation are given in section 3.4 Electrical Installation.

## 3.3 Mechanical Installation

The IDM Tap Changer Torque Monitor must be installed protected from weather conditions, whether inside panels or in housings in buildings. In any case, there must be anti-condensation system.

The IDM Tap Changer Torque Monitor is suitable for embedded installation, and can be fixed, for instance, in doors or front plates of panels. The clamps for fastening are supplied together with the IDM.

Figure 3 and Figure 4 show the main dimensions of the equipment, as well as cutout dimensions in the plate for its insertion.

Special attention must be paid to the thickness of the painting of the plate where the cutout is made because in some cases, when painting of high thickness is used, the reduction in the cutout area can even prevent the equipment's insertion. The connection terminals are installed in the rear part of the IDM, in two removable connectors, to facilitate the connections. Cables of 0.3 to 2.5 $mm^2$ may be used, bare or with *pin* or *needle* type terminals.

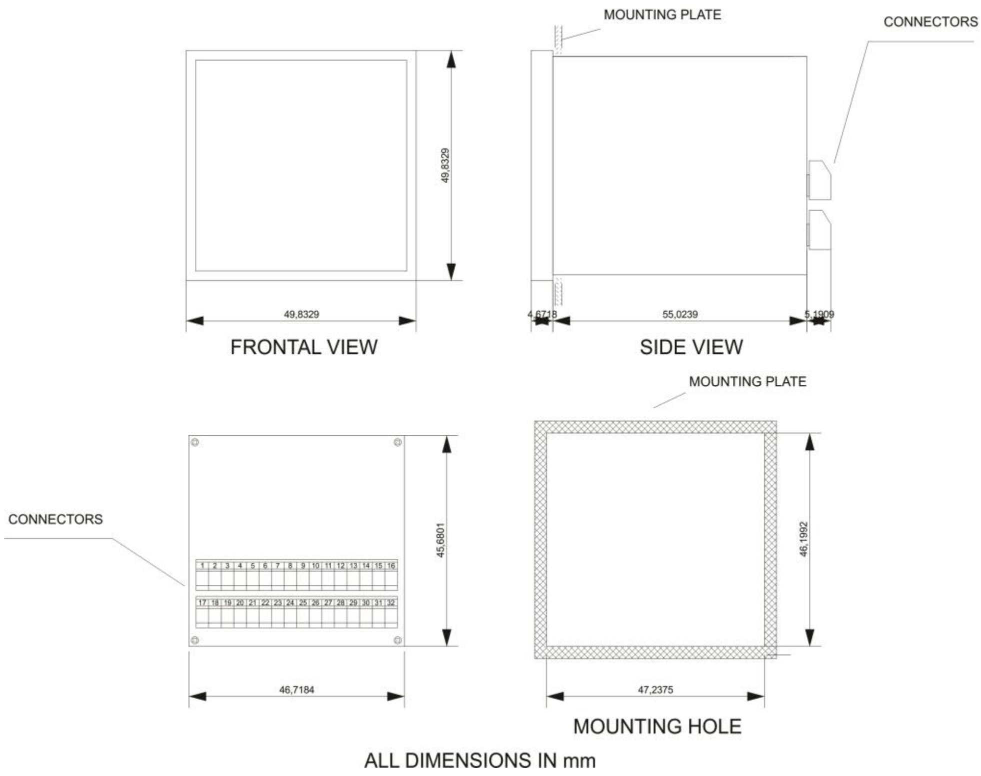



**Figure 3 - IDM Dimensions**

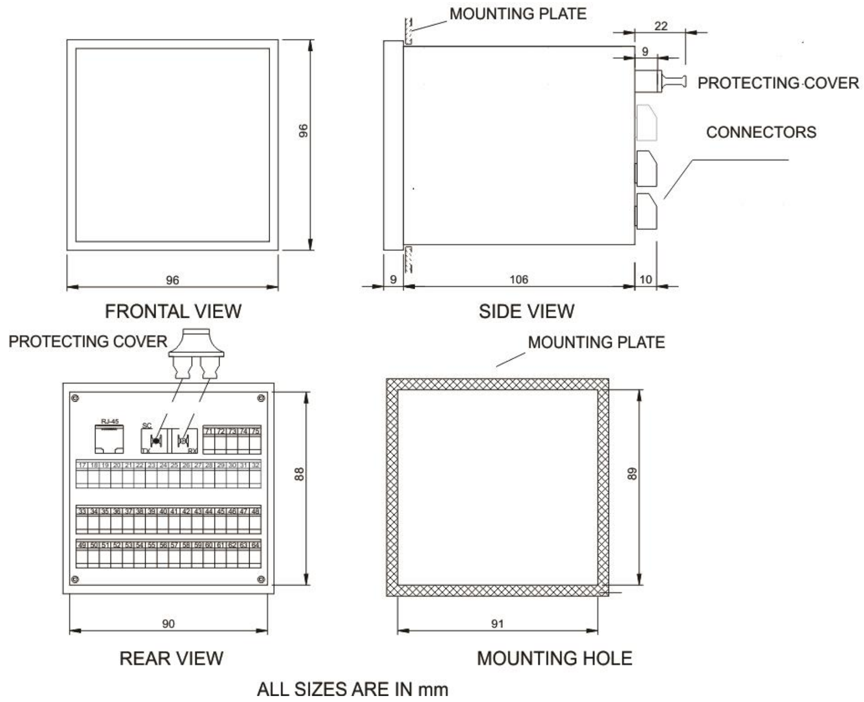



**Figure 4 – SDM Dimensions**

## 3.4 Electrical Installation

The IDM is a versatile equipment that can meet various types of applications.
Therefore, its installation requires a level of study and care greater than in an equipment exclusively dedicated to a single application or task.

Study and understand the application in which you intend to use the IDM.
Know the functional, electrical and configuration characteristics of the IDM.
You will thus be able to take full advantage of the equipment and minimize risks to your safety.

The IDM has different electrical installation configurations. These configurations are determined if the application in question will use the optional items available.

This equipment works at hazardous levels of power supply, and can cause death or serious injuries to the operator or maintainer.

Some special cares must be followed for design and installation of the IDM, as described below.

A circuit breaker must be used immediately before the power supply input (Universal supply - 38 ~ 265 Vdc/Vac, <5 W, 50/60 Hz), which corresponds to the pins 1 and 2 IDM. This circuit breaker must have a number of poles corresponding to the number of phases used in the supply – being that the poles must interrupt only the phases, and never the neutral or ground – and provide the conductors that supply the equipment with thermal and electrical protection.
The circuit breaker must be near the equipment and easily maneuverable by the operator. It must also have an indelible identification showing that it is the electrical connection device of the IDM.

A circuit breaker must be used immediately before the supply input of the motors VMT1, VMT2 and VMT3 (*Universal supply* 0 to 265 Vac (single-phase) or 0 to 240 Vac (three-phase) or 0 to 300 Vdc, which correspond to pins 29, 31 and 32 IDM. This circuit breaker must have a number of poles corresponding to the number of phases used in the supply – being that the poles must interrupt only the phases, and never the neutral or ground – and provide the conductors that supply the equipment with thermal and electrical protection.
The circuit breaker must be near the equipment and easily maneuverable by the operator.

The following circuit breaker specification is recommended, when exclusively for the IDM:
**AC/DC Supply, Phase-Neutral:** Single-pole circuit breaker, 1 A ≤ In ≤ 2 A, curve B or C, NBR/IEC 60947-2, NBR/IEC 60898 or IEEE 1015-2006 standards;
**AC/DC Supply, Phase-Phase:** Two-pole circuit breaker, 1 A ≤ In ≤ 2 A, curve B or C, NBR/IEC 60947-2, NBR/IEC 60898 or IEEE 1015-2006 standards.

The minimum insulation for the circuits connected to the IDM is 300 Vrms for auxiliary equipment and transducers, like Pt-100 and for equipment with own supply with 50 $V_{rms}$.
The minimum insulation is 1.7 kVrms for equipment supplied with up to 300 Vrms, according to IEC EN 61010-1.
These values are related to intrinsic insulation of the devices connected to the IDM. Cases in which this value does not apply to equipment or devices connected to the IDM will be explicitly informed in this manual.

The standard schematic diagram of the IDM connections shows all the connection possibilities provided by the IDM, identifying them according to Figure 5.

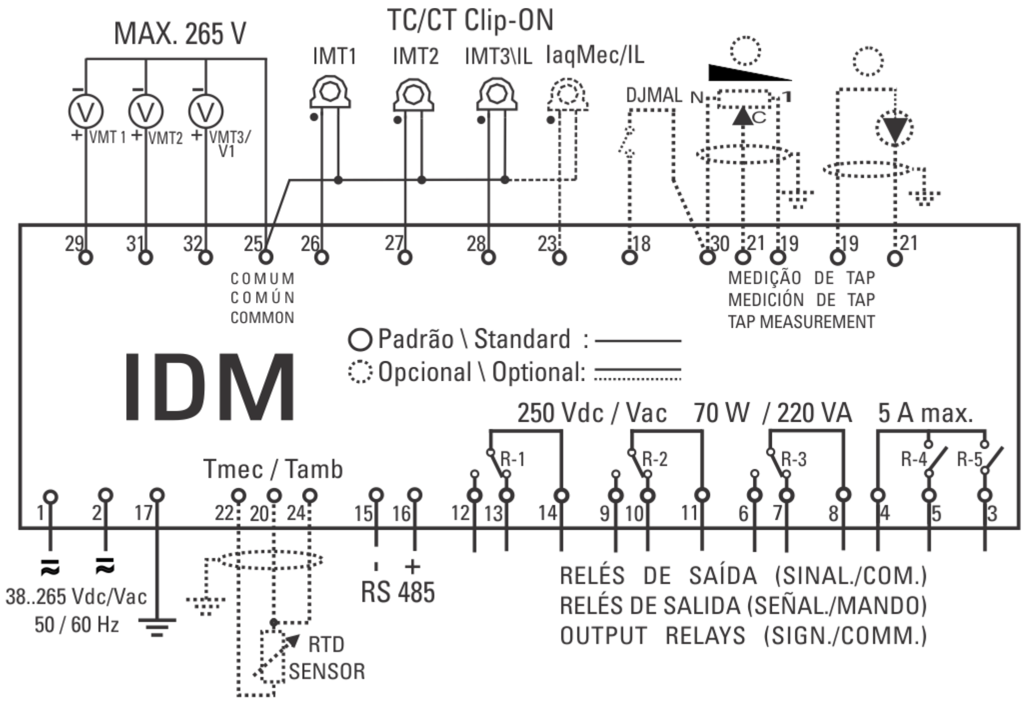



**Figure 5 - IDM input and output terminals**

If the Changer Position (4) option is active, one must choose when placing the order if a potentiometric transmitter will be connected in inputs 19, 21 and 30 or if an mA analog input will be connected in inputs 19 and 21. This choice affects some internal configurations of the hardware that are defined during manufacture of the IDM.

During the parameterization, there may be the need to choose if the CT connected to terminals 23 and 25 will serve to monitor the heating (optional item 3) or maintenance of the changer (optional item 5), because in case of monitoring of a three-phase motor, it will not be possible to use input 25-28 to monitor line current (IL).

Another choice that must be made is if the temperature RTD sensor, connected to pains 20, 22 and 24, will be used to measure the temperature of the mechanism, environment or other.

Majority of these choices are governed by the optional items acquired by the user, type of motor (single-phase or three-phase) and by the priority that some measurements have over others, depending on the application. For example, the user may prefer to use the fourth CT input (see Figure 5) to measure the line current and leave monitoring of the heating depending on reading of temperature of the RTD sensor.

The application diagram, in case none of the optional items 3, 4 and 5 is used, will be simplified as follows:

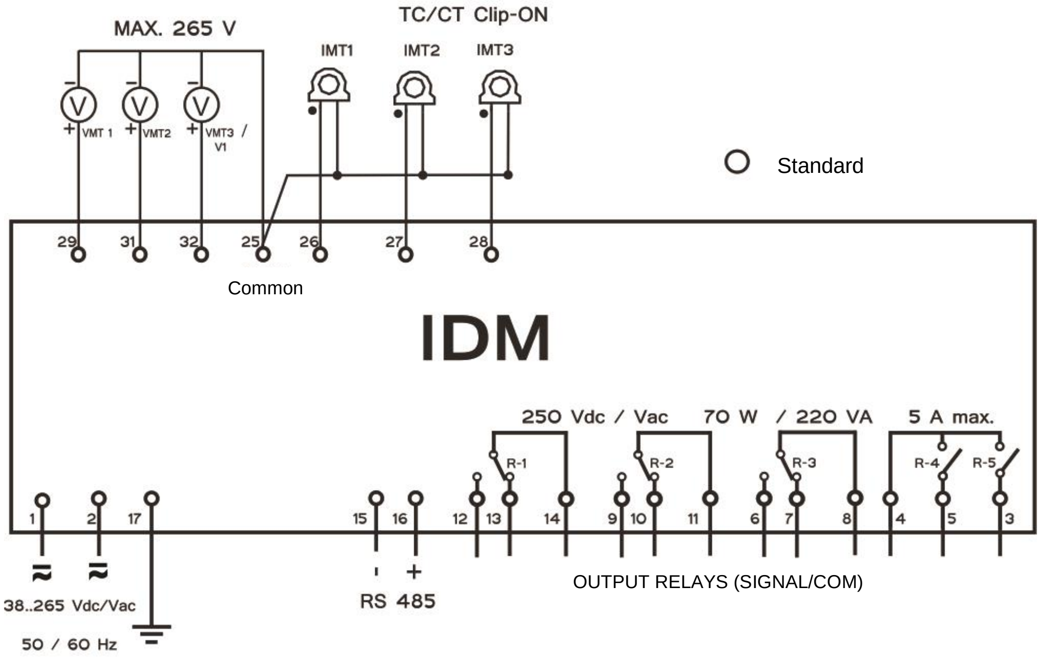



**Figure 6 - IDM input and output terminals in their standard configuration**

Special attention must be paid to correct connection of the IDM components in all stages of the installation. Errors in connection of the equipment can cause risks to the operator and irreversible damages to it. Damages due to incorrect use are not covered by the warranty.

## 3.4.1 Input Terminals

The IDM can be divided, to simplify understanding, into input and output terminal blocks. These blocks will be explained individually. The input block is shown in Table 3. In it, there is a brief description of the items, which are numbered for later detailing.

**Table 3: IDM Input Terminals**

| INPUTS | TERMINALS |
|---|---|
| 01) Supply and Ground:<br><br>Inputs for universal supply 38 to 265 Vdc/Vac, 50/60 Hz, <5 W. | *1 – dc/ac*<br>*2 – dc/ac*<br>*17 – ground* |

| | |
|---|---|
| **02) RS-485 Port – Serial Communication Network with Monitoring or Supervision System:**<br><br>Connection to the monitoring or supervision system, using the MODBUS-RTU or DNP3 protocol (optional 1), through twisted-pair and shielded cable. | *15 – (-)*<br>*16 – (+)* |
| **03) VMT1 Voltage Input:**<br><br>Voltage input used to measure the supply voltage of the first (or only) phase of the changer motor. The measuring range is 0 to 265 Vac (single-phase) or 0 to 240 Vac (three-phase) or 0 to 300 Vdc. The measurement error is 1% of the measurement in the range 80...265Vac (single-phase) or 80...240Vac (three-phase) or 100...300Vdc. | *29 – VMT1+*<br>*25 – Common* |
| **04) VMT2 Voltage Input:**<br><br>Voltage input used to measure the supply voltage of the second phase of the changer motor. The measuring range is 0 to 265 (single-phase) or 0 to 240 Vac (three-phase) or 0 to 300 Vdc. The measurement error is 1% of the measurement in the range 80...265Vac (single-phase) or 80...240Vac (three-phase) or 100...300Vdc. | *31 – VMT2+*<br>*25 – Common* |
| **05) VMT3/V1 Voltage Input:**<br><br>Voltage input used to measure the supply voltage of the motor's third phase (*VMT3*) or the control voltage of the changer (*V1*). The measuring range is 0 to 265 Vac (single-phase) or 0 to 240 Vac (three-phase) or 0 to 300 Vdc. The measurement error is 1% of the measurement in the range 80...265Vac (single-phase) or 80...240Vac (three-phase) or 100...300Vdc. | *32 – VMT2+/V1*<br>*25 – Common* |
| **06) IMT1 Current Input:**<br><br>Measures the current of the first (or only) phase of the changer motor. The measuring range is 0...10 Aac, 14 A peak, and error 1% of the measurement in the range 0.5...10 Aac. | *26 – IMT1*<br>*25 – Common* |
| **07) IMT2 Current Input:**<br><br>Measures the current of the second phase of the changer motor. The measuring range is 0...10 Aac, 14 A peak, and error 1% of the measurement in the range 0.5...10 Aac. | *27 – IMT2*<br>*25 – Common* |

| | |
|---|---|
| **08) IMT3/IL Current Input:**<br><br>Measures the current of the third phase of the changer motor. The measuring range is 0...10 Aac, 14 A peak, and error 1% of the measurement in the range 0.5...10 Aac. | *28 – IMT3*<br>*25 – Common* |
| **09) IaqMec/IL Current Input:**<br><br>Measures the line current or heating of the heating system of the changer activation mechanism. The measuring range is 0...10 Aac, 14 A peak, and error 1% of the measurement in the range 0.5...10 Aac. | *23 – IaqMec/IL*<br>*25 – Common* |
| **10) Input for Auxiliary Contact of the DJMAL Motor Circuit Breaker:**<br><br>Involves a dry contact that must be connected to the auxiliary contact of the motor circuit breaker to indicate its state. | *18 – DJMAL*<br>*30 – Common* |
| **11) TAP Measurement through Potentiometric Transmitter:**<br><br>For the measurement option of the TAP position to function correctly, one must connect a potentiometric transmitter or an mA analog signal to the IDM. If you choose the first option, this item describes where and how the transmitter should be connected. | *30 – TAP minimum*<br>*19 – TAP maximum*<br>*21 – Cursor* |
| **12) TAP measurement through mA Analog Signal:**<br><br>The other option to measure the TAP position is to connect an mA analog signal to the IDM that informs the current position of the changer. This item describes in detail how to make this connection. | *19 - mA+*<br>*21 - mA-* |
| **13) Temperature sensor – Tmec / Tamb:**<br><br>To monitor the temperature of the activation mechanism, the ambient temperature, or any other desired by the user, the IDM provides an input for PT100, which must be installed according to this item's description. | *20 – RTD*<br>*22 – RTD*<br>*24 – RTD* |

## 1) Supply and Ground

The IDM has two universal supply inputs (38 to 265 Vdc/Vac 50/60 Hz). Supplying the IDM through auxiliary services of the substation is advisable, especially when it is integrated to a serial communication network for the purpose of gathering data for supervision or monitoring systems.

## 2) RS-485 Port - Supervision System

The IDM may optionally be connected to a data acquisition system (supervision or monitoring system) through the RS-485 serial communication port.

Up to 31 equipment can be interconnected in a same communication network. The standard communication protocol is Modbus RTU, and the DNP3 protocol is available as option (other protocols on request). Consult the document "Communication Protocol" for greater detail on them.

The interconnection between the IDM and the data acquisition system must be made through a shielded twisted-pair cable, keeping the grid without interruption in the entire route. If there is need for intermediary terminal strips for interconnection of the serial communication, also pass the cable shielding through terminal strip, preventing its interruption. The cable section without shielding due to the splice must be as short as possible, it being advisable to ground the cable shielding through only one end. The maximum distance of 1300 m must be observed between the ends of the communication network.

> In case of communication problems, especially where there are long networks (distance greater than 1,000 m) and high transmission rates (greater than 9,600 bps), the use of a termination resistor of 120Ω at each end of the serial communication network may solve these transmission errors due to attenuation of the signal's reflection in the cable.
> Another measure that can be attempted is the installation of pull-up and pull-down resistors in only one point of the network, as indicated in
> Figure **7**. The direct voltage of 5 V for supply of the pull-up and pull-down resistors may be internal to the data acquisition system. Note that some communication equipment may already have these resistors installed internally, waiving the use of external resistors.

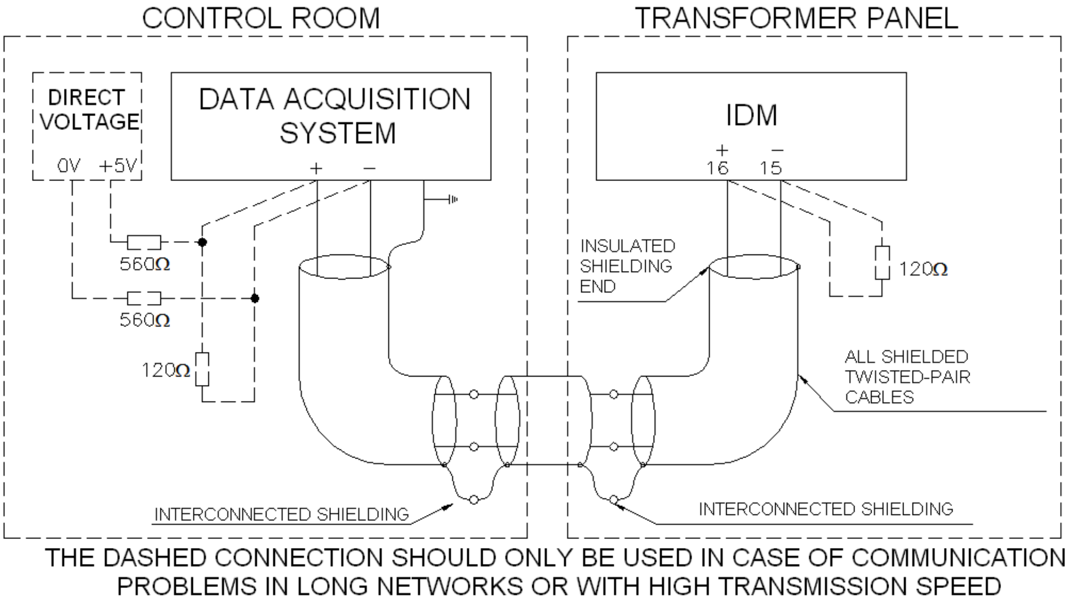



**Figure 7 - Connection and grounding of the shielding of the RS-485 serial communication**

## 3) VMT1:

The supply voltage of the first phase of the motor (VMT1) must be connected to this input. Pin 25 is the common point of all the voltage and current measurements of the IDM and 29 is the VMT1 measurement input.

With the IDM, it is possible to monitor the supply voltage of three different types of motor: CC, CA 1Φ and 3Φ. The connection diagrams for each one of the cases can be seen below.

In a DC motor, the voltage inputs of the IDM support measurements of up to 300 Vdc. The voltage and current measurements must be made according to the diagram below:

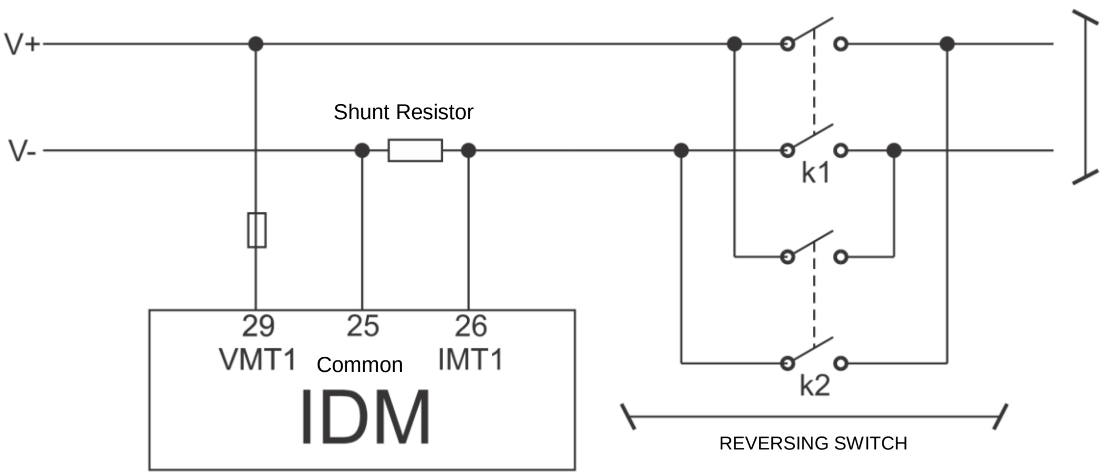



**Figure 8 – Voltage and current connection for DC motors.**

Note that the measurements in the DC motors must be installed before any reversing switch to prevent change in polarity of the supply from causing a short-circuit in pin 25.

In a single-phase AC motor, the voltage measurement must be made according to the figure below:

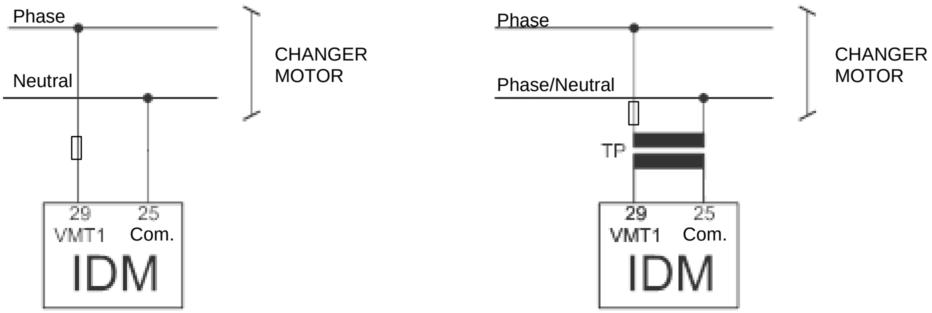



**Figure 9 – Voltage connection for single-phase AC motors without and with the aid of PT.**

The IDM's voltage inputs for the single-phase AC motors support measurements of up to 265V AC or 300V DC. For this, if the motor is supplied with voltages that exceed 265V, use a PT to aid the measurement and then parameterize its ratio according to section 5.4.

Since point 25 is common to all the voltage and current measurements, it is important to take care to prevent short-circuits. If the motor's negative supply differs from the reference, the voltage measurement must be made using a PT and the terminal of the secondary connected to pin 25 must be grounded, as seen in the figure above.

For three-phase AC motors, the voltage measurement must be made according to the figure below:

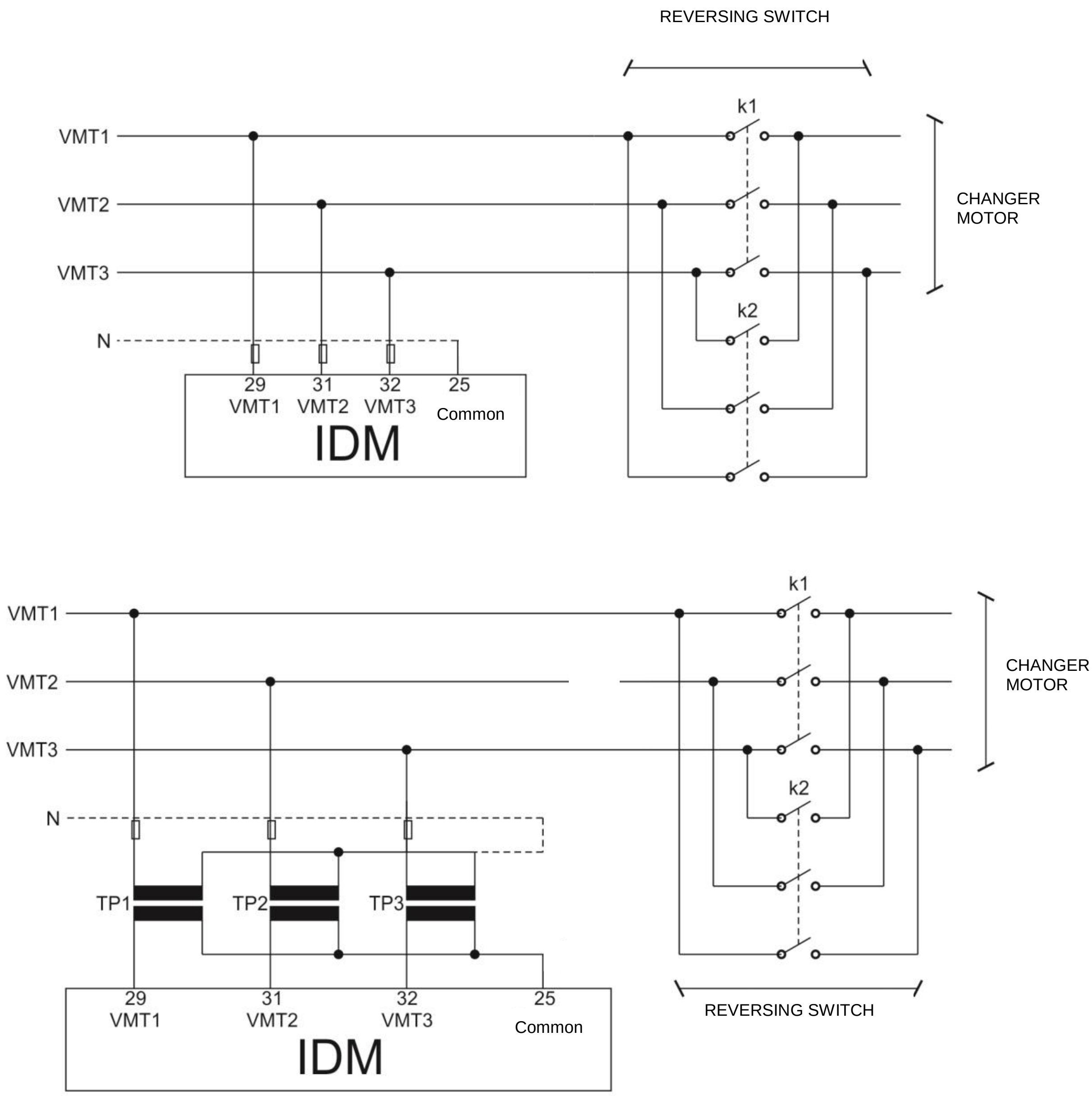



**Figure 10 – Installation for measurement of the voltage in three-phase motors without and with the use of PTs.**

The IDM's voltage inputs for the three-phase AC motors support measurements of up to 240V AC or 300V DC. For this, if the motor is supplied with voltages that exceed 240V, use a PT to aid the measurement. Besides the PT, it is essential to use a fuse terminal. This will have a preventive function against surges.

In the first case of the figure above, if there is no neutral phase in the motor's supply, or if it is not equal to the reference, just point 25 being grounded in the reference circuit will suffice. In the second phase of the figure, the connection of the primary of the PTs to the neutral phase is also optional since the Δ connection between them creates a virtual neutral.

Another important point is that the connection of the voltages must be made before the reversing switch because if done after, the measurement of cosϕ will be affected.

### 4) VMT2:

If the motor to be monitored is three-phase, the voltage of the second phase of the three-phase motor (VMT2) must be connected in inputs 31 and 25, as can be seen in Figure 10.

### 5) VMT3 or V1:

At first this is the input for the voltage of the motor’s third phase (VMT3). However, if the motor is single-phase, there is the possibility of using this input to monitor the power of the motor’s control circuit (V1). *Optional Item 3: Monitoring of the Heating and Control Voltage*, allows use of this input for this purpose.

The electrical connection to measure VMT3 must be made according to Figure 10. To measure V1, the electrical connection must be made according to Figure 11.

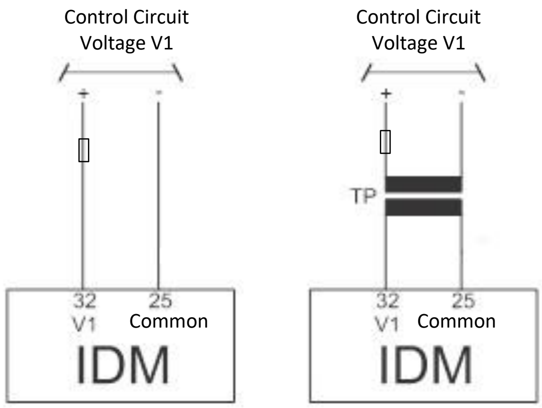



**Figure 11 – Connection to measure the voltage of the motor’s control circuit without and with use of a PT.**

Since point 25 is common to all the voltage and current measurements, it is important to take care to prevent short-circuits. If the control circuit’s negative supply differs from the reference, the voltage measurement must be made using a PT and the terminal of the secondary connected to pin 25 must be grounded, as seen in the figure above.

### 6) IMT1:

The main measurement of the IDM is the current that flows through the changer’s motor, as explained in chapter 2.3, the IMT1 current must be done by enveloping the wire of the first phase of the motor with a clip-on CT and connecting it to inputs 26 and 25 of the IDM. The manner of making this connection can be seen in the diagrams below.

The installation in single-phase AC motors must be done according to the following diagram:

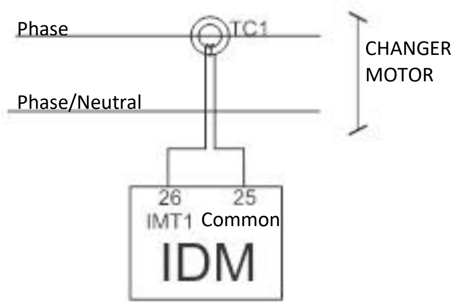



**Figure 12 – Measurement of supply current of an AC motor 1Φ.**

For single-phase motors, the full connection diagram of the supply currents is as follows:

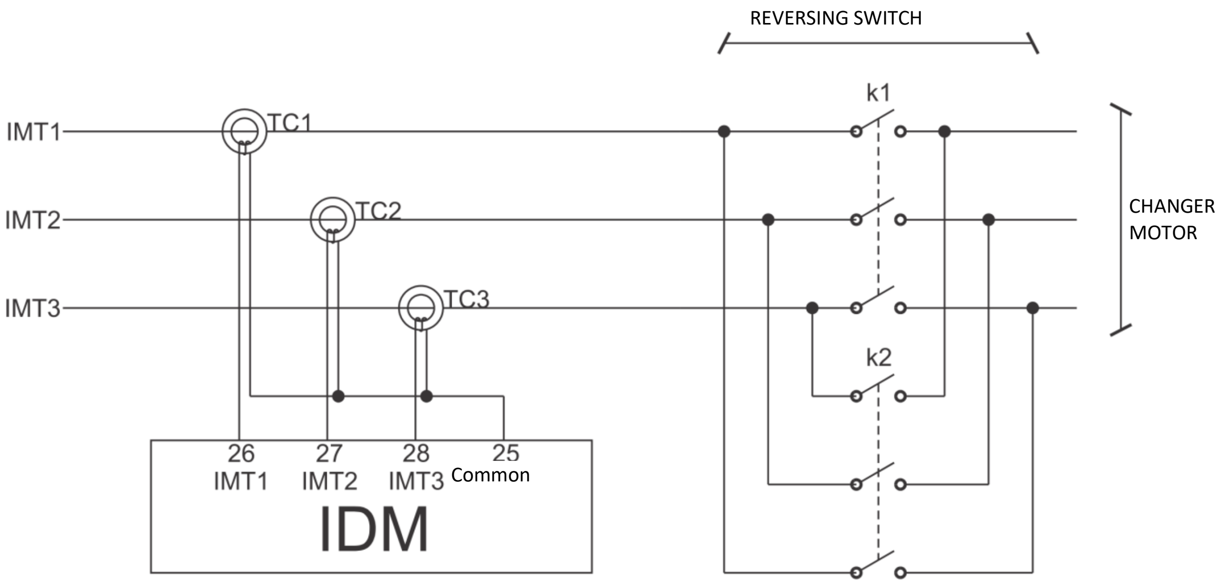



**Figure 13 – Electrical connection diagram to measure the currents.**

Note that the CTs were installed before the reversing switch to allow correct measurement of the cosϕ.

When a direct current (DC) motor, the current must be measured using a shunt resistor and Figure 14 shows how to make this connection:

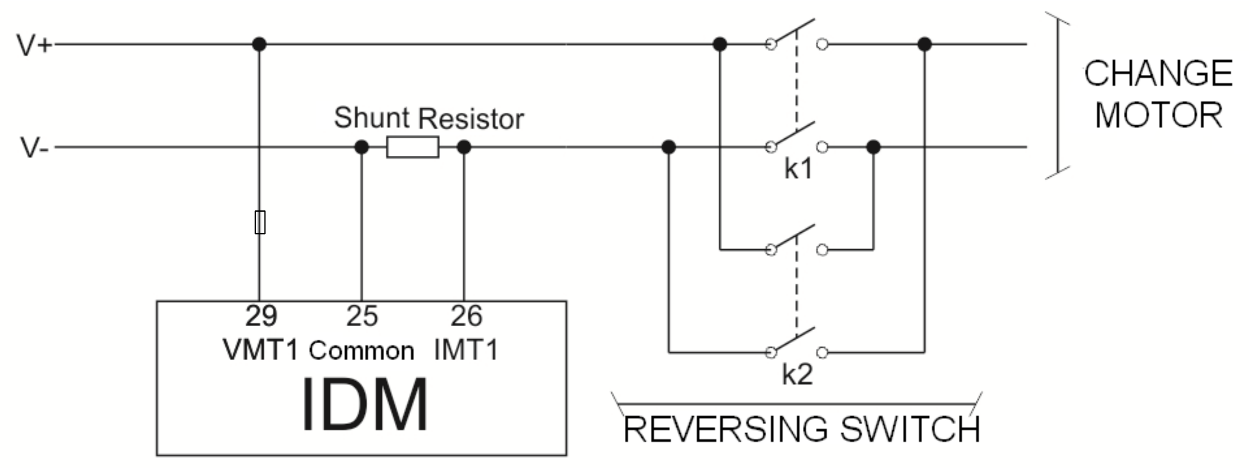



**Figure 14 – Voltage and current measurement connection from the DC motor to the IDM.**

Here, it is important to note three points:

- The connections must be made before the reversing switch to prevent inversion of the power supply's polarity from causing a short-circuit in pin 25;
- The shunt resistor must be installed in the return cable (V-) to prevent a short-circuit in pin 25;
- The positive pole of the resistor must be connected to pin 26 and the negative to pin 25;

To calculate an adequate 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 supply current of the motor that flows through the shunt resistor. In section 5.4, parameterize the relationship of the shunt resistor for the measurement made to be correct.

### 7) IMT2:

This is the input for the current of the second phase of the supply, IMT2, of the motor. The connection must be made according to Figure 13.

### 8) IMT3 or IL:

This is the input for the current of the third phase of the motor's supply, IMT3. *Optional Item 5: Maintenance of the Tap Changer* 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 to measure IMT3 must be made according to Figure 13, while Figure 15 shows the installation to measure the IL current.

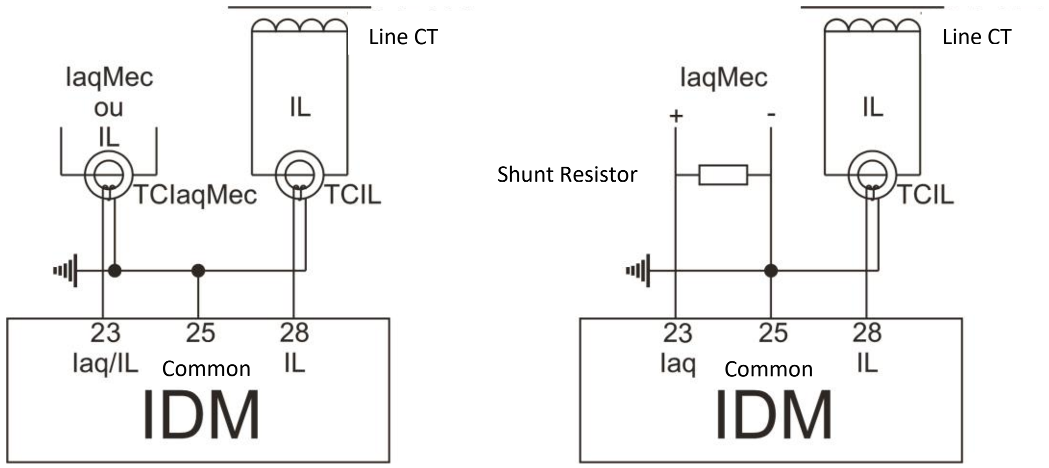



**Figure 15 – Diagram for measurement of the line and heating currents.**

The figure above shows the two connection options for IL. Only one input may be chosen to make this measurement. Note also that, since the line current (IL) is always alternating, this measurement can only be done with the use of a CT.

If input 28 is used to measure the supply current of the third phase of the motor (IMT3, Figure 13), it will not be available for measurement of the line current. If input 23 is used to measure the heating current of the mechanism (IaqMec), it may not be used to measure the line current.

## 9) IaqMec or IL:

In the last input for the IDM currents, the currents of one of the following measurements may be connected: heating current of the heating system (IaqMec) or line current (IL). This is the only input for measurement of the IaqMec, while IL can also be connected to input 28. Therefore, priority in this input must be given to the measurement of IaqMec, when its measurement is vital.

In any case, the installation diagram can be found in Figure 15 in the previous item. If the heating current (IaqMec) is DC, the measurement must be made using a shunt resistor, according to the second diagram of the figure. In this case, the choice of resistor must respect the following relationship:

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

## 10) DJMAL:

For the changer motor to start operating, there is need for, besides the control signal, the motor’s protective circuit breaker to be closed. Since the circuit breaker can open, removing the motor from operation for various reasons, it is important to know its state to evaluate the motor’s readiness.

The dry contact available between pins 18 and 30 serves exactly to meet this purpose and must be connected according to Figure 16. The availability of this measurement depends on activation of *optional item 3: Heating* *and Control Voltage*. The monitoring of DJMAL may be done even if optional item 4: *Changer Position* is active and a potentiometric transmitter is used because pin 30 may be used in both applications simultaneously.

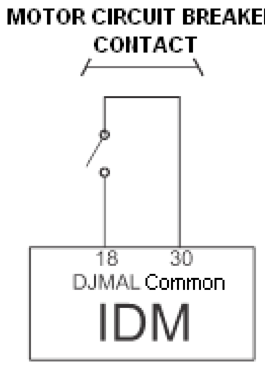



**Figure 16 – Connection of the dry contact to monitor the state of the motor's auxiliary circuit breaker.**

## 11) Potentiometric Transmitter:

*Optional Item 4: Changer Position* allows the user to use the IDM to follow up the changer's TAP position. For this, a sensoring must be installed in the changer, and the IDM may read two types of them: potentiometric transmitter and mA analog signal. When the manufacturer does not provide an analog output or for any reason this is not available, it is possible to install a potentiometric transmitter in the changer to make the TAP position measurements.

The connection of the potentiometric position transmitter of the on load tap changer to the IDM is made through three wires: the cursor, beginning and end of the potentiometric transmitter. The three wires must have the same length and size. For this connection, shielded cable should be used in the entire route from the changer cabinet to the IDM with the  shielding grounded in a single point.

If a single shielded cable is not used for the entire route, for example, the intermediary connection terminals, continuity of the shielding must be guaranteed, through connection of the ends of the shielding of the various cables, as can be seen in **Figure 17**. The section from the cable without shielding due to the splice must be as short as possible.

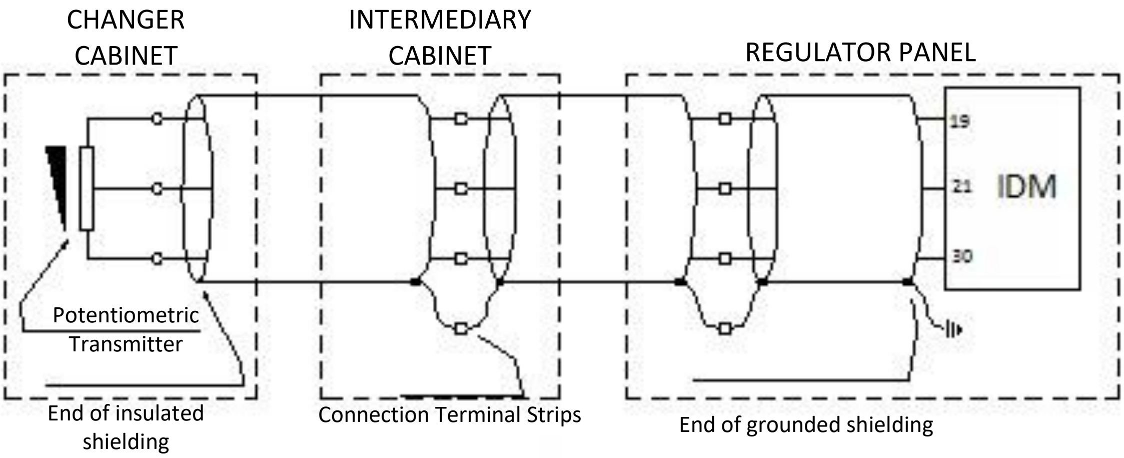



**Figure 17 - Connection of the TAP measurement cable shielding**

The IDM automatically compensates the resistance of the potentiometric transmitter's connection cables up to the AVR, and for such the three wires must have the same length and size, the maximum resistance allowed for each one of the wires being 8Ω. In function of this maximum resistance and size of the cables used, the maximum length allowed for these can be obtained. Considering cables with typical resistances of 13.3 Ω/km, 7.98 Ω/km and 4.95 Ω/km for the sizes of 1.5mm$^2$, 2.5mm$^2$ and 4mm$^2$ respectively (non-tin plated cables, stranding class 4), we have the maximum lengths presented in the table below.

**Table 4 - Maximum length for the TAP measurement cable sizes**

| Cable Size | 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 position of the changer respectively.
In case of changers with “intermediary” positions, that is, transition positions that have the same voltage as other adjacent positions, as exemplified in the table below, the potentiometric transmitter resistors referring to these positions must be removed and/or short-circuited, as shown in the example of **Figure 18**. All intermediary positions (in the example, 6A, 6 and 6B) will be indicated as TAP “6”, since they have the same voltage.

**Table 5 - Resistance of the cursor indicating the TAP position.**

| TAP Position | Voltage (V) | Current (A) | Cursor Resistance/Initial Position (example: 10Ω/step) |
|---|---|---|---|
| 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* |

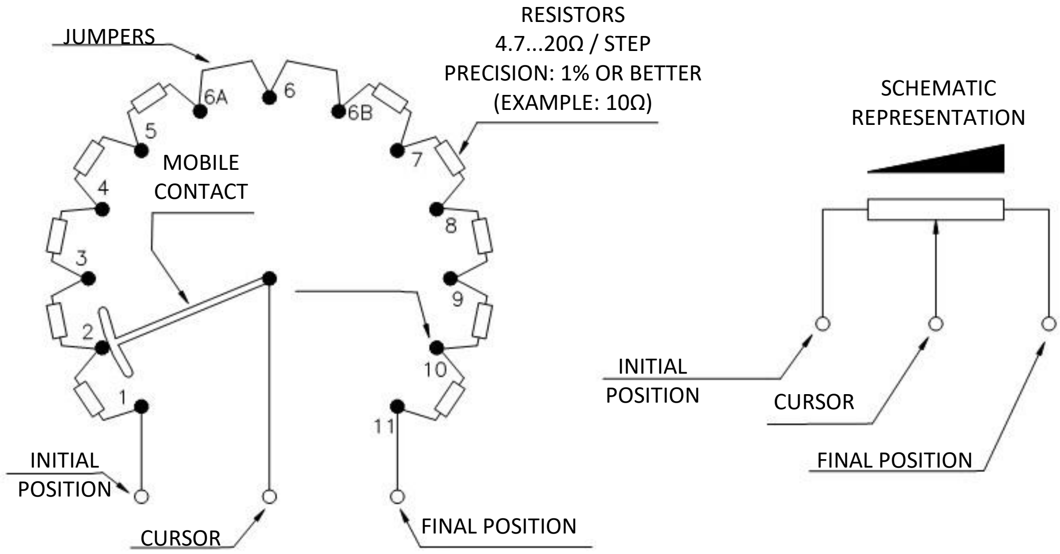



**Figure 18 - Configuration of the potentiometric transmitter's resistors in the intermediary positions of the on load tap changer**

The IDM allows the resistance per step of the potentiometric transmitter to be in the range of 4.7 to 20Ω , and the transmitter's total resistance of 9.4 to 1000Ω. O value of each individual resistor is shown in **Figure 18**. The mobile contact (cursor) of the potentiometric transistor can be of the “close before open” or “open before close” type, regardless. The resistances of the potentiometric transmitter must be of precision, that is, with maximum error tolerance of 1%.

The current position of the on load tap changer's TAP associated with it can be informed in the single numerical, bilateral numerical or alphanumerical formats (for example: 1...17, -8...0...8, or 8L...N...8R respectively).

## 12) Clip-On CTs

The Clip-On CTs must be connected in the output of the circuit breaker or in the inlet of the motor. If you choose to connect in the output of the motor's circuit breaker, you must check if there are other loads connected to this same circuit breaker because the IDM should only read the current that goes to the motor.

To guarantee that the phase is the same of the current and voltage, the CTs must be connected in the same points because there are reversing contactors, responsible for inverting the phases and thus changing the phase between voltage and current.

The following characteristics must be observed when using the Clip-On CTs:

- Phase (PT/CT): the CTs must be in synchrony with the voltages (In phase)  CT phase A in voltage phase A, CT phase B in voltage phase B, CT phase C in Voltage phase C. (Check continuity between the IDM and Terminal Strips)
- CT Polarity: The Clip-On CT has polarity and it is defined by a little green ball painted on the body of the CT closest to the white wire.  In practice, the connection must follow the criterion below:

  Clip-on CT clamped with the "Black and white" wires directed toward the side of the load:
  Common wire of the CTs: Black wire.
  Parameter in the product: CT-Normal

  Clip-on CT clamped with the "Black and white" wires directed toward the side of the supply
  Common wire of the CTs: White wire.
  Parameter in the product: CT-Normal

- Check the measurements of PHI A,  PHI B and PHI C during activation of the motor.  They must measure between 270 and 360 degrees.
- Check the value of PF "power factor", it must display between 0 and 1.auto

## 13) TAP measurement through mA Analog Signal:

If an analog output is available for connection with the IDM, the installation of position measurement becomes much simpler, just connect it to pins 19 and 21 as in the figure below:

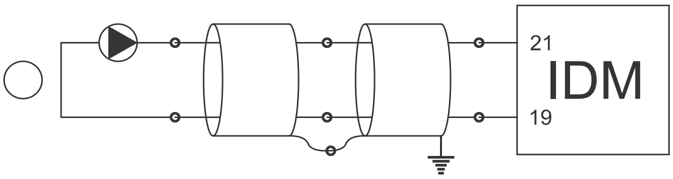



**Figure 19 – TAP position measurement through mA Analog Signal.**

The cable used for this connection must be shielded and grounded in only one of the ends. The cable sections without shielding must be as short as possible, and if there is need to make a splice, also pass the shielding through the terminal strip so that it is not interrupted.

### 14) Temperature Sensors – RTD 1 to 6

An RTD temperature sensor can be connected to the IDM through shielded cables, without interrupting the grid, which must be grounded only at the end connected to the IDM, as close to this as possible. If there is need for intermediary terminal strips for interconnection of the RTD sensor, also pass the cable shielding through terminal strip, preventing its interruption. The section of cable without shielding due to the splice must be as short as possible, as shown in Figure 20.

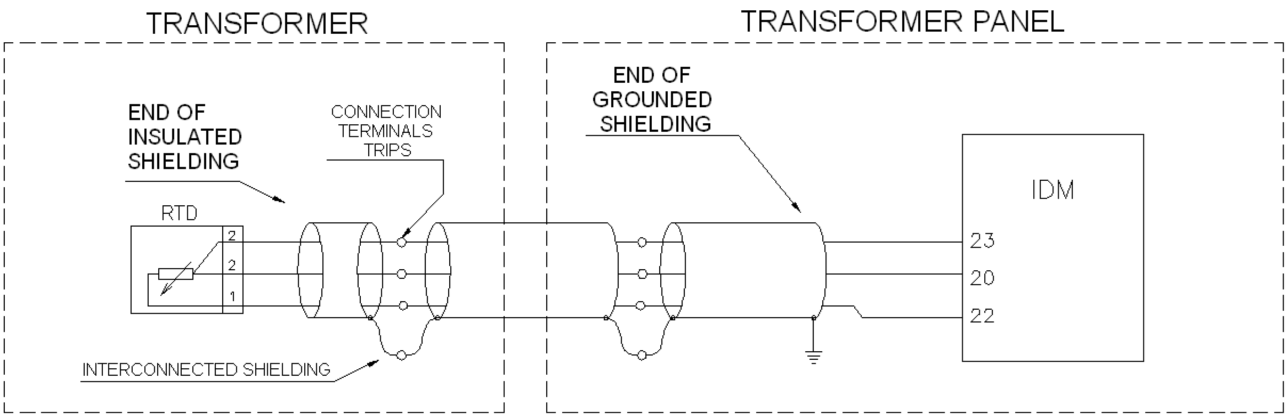



**Figure 20: Connection of the interconnection shielding between RTD sensors and the IDM**

### 3.4.2 Output Terminals

The IDM can be divided, to simplify understanding, into input and output terminal blocks. The output block is shown in the table below:

**Table 6: IDM Output Terminals**

<table>
<tr><th>OUTPUTS</th><th colspan="2">TERMINALS</th></tr>
<tr><td rowspan="3">01)Convertible Relays:<br>The IDM has three convertible output relays between NO and NC that can be used for various purposes, like announcing alarms or sending signal to turn off the circuit breaker.</td><td>1</td><td>12 – NO<br>13 – NC<br>14 – Common</td></tr>
<tr><td>2</td><td>9 – NO<br>10 – NC<br>11 – Common</td></tr>
<tr><td>3</td><td>6 – NO<br>7 – NC<br>8 – Common</td></tr>
<tr><td>02)NO Relays:<br>The IDM also has two more normally open (NO) output relays. These can also be used for the same functions as the convertible relays.</td><td colspan="2">05 – NO R4<br>03 – NO R5<br>04 – Common</td></tr>
</table>

#### 1) Convertible Logic Relays:

These are relays that can function as NO or NC, depending on the output that the user chooses to connect his application. The IDM has three of these relays, which can be used to send alarm, blocking signals, control heating or cooling systems, among countless other applications.

The contacts of the relays can change loads in up to 250 Vdc/Vac, with maximum power of 70 W or 220 VA, considering resistive loads. Its conduction capacity (limit due to the Joule effect) is 5 A, uninterruptedly. The Figure 21 shows the devices in the IDM.

#### 2) Normally Open Relays:

There are two of these relays in the IDM, but in the parameterization they can be configured to function normally as NO or inverted as NC. In the second case, while the IDM is powered up, the relay will function as NC, but if the equipment, or only the relay, is powered down, the contact will open. Its applications are as varied as those of reversible relays.

The contacts of the relays can change loads in up to 250 Vdc/Vac, with maximum power of 70 W or 220 VA, considering resistive loads. Its conduction capacity (limit due to the Joule effect) is 5 A, uninterruptedly. The figure below shows the devices in the IDM.

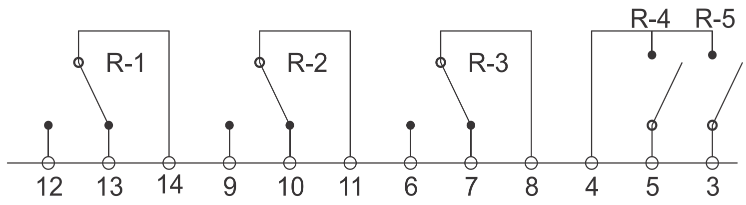



**Figure 21 – IDM output relays**

# 4 Access to the IDM Information:

All operations in the Torque Monitor for IDM Tap Changers are conducted through the keyboard of its front panel, external switches or buttons not being required. The voltages, currents and other magnitudes measured will be indicated in the display, and the conditions of alarms will be indicated by the signaling LEDs.

The LED in front of the IDM has the following functions:

-**Ok**: It remains on when there is no active alarm.

-**Manut.**: [Maintenance] Comes on when a blue classification alarm is active.

-**Alarme 1**: [Alarm 1] Comes on when there is an active yellow classification alarm.

-**Alarme 2**: [Alarm 2] Comes on when a red classification alarm is active.

-**Torque**: Comes on when an unexpected variation in the torque developed by the motor during its operation is detected.


The **top** display shows a message of at most four letters that indicate the menu name, variable or measurement that is being shown in the bottom display.

The **bottom** display shows the value or state of the menu, variable or measurement selected.

-**Energia**: [Energy] When the amount of energy to operate the motor during the switching differs greatly from that expected, this LED will come on.

-**V/I:** When on, indicates if there is any problem of under or overvoltage or under current or overcurrent in any phase of the motor.

-**Auto Diag.:** [Self-Diagnosis] LED comes on when an error in the IDM itself is detected.

The function of each key in the front can be described as follows in the majority of situations:

Programming Key: The measurement keys allow access to the password to enter the programming menu. In the programming menus, abandons the current menu, returning to the menu of the previous level. If activated during change of a parameter, returns to the menu of the previous level without saving the change made.

Up Key: navigation to the menus and increases programmed values.

Down Key: navigation to the menus and decreases programmed values.

Enter Key: Selects the menu option and parameters presented in the display, except for programmed values and moves to the next level.

## 4.1 Consultation Keys:

On turning on the IDM, the first screens that the user has access to are the consultation keys and display of the measurements. They are divided into two sections. The first is accessible as soon as the device is turned on. Use the ↑ and ↓ arrows to navigate between the keys shown below:

### Voltage of the Motor 1st Phase

Shows the voltage of the motor's first supply phase. In the DC and single-phase motors, it will be the only measurement of this type.


### Current of the Motor 1st Phase

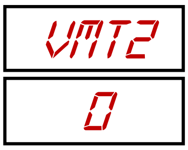
Shows the current of the motor's first supply phase. In the DC and single-phase motors, it will be the only measurement of this type.


### Angle ϕ Between Voltage and Current Phases in the 1st Phase of the Motor

In alternating current motors, there is a phase shift between the phase voltage and current. PHI1 is the angle ϕ of the first phase.


### Voltage of the Motor 2nd Phase

Shows the voltage of the motor's second supply phase. This measurement is displayed in three-phase motors only.




### Current of the Motor 2nd Phase

Shows the current of the motor's second supply phase. This measurement is displayed in three-phase motors only.


### Angle ϕ Between Voltage and Current Phases in the 2nd Phase of the Motor

Shows the measurement of angle ϕ of the second phase. For three-phase motors only.


### Voltage of the Motor 3rd Phase

Shows the voltage of the motor's third supply phase. This measurement is displayed in three-phase motors only.

## Current of the Motor 3rd Phase

Shows the current of the motor's third supply phase. This measurement is displayed in three-phase motors only.

IMT3
7.00

## Angle ϕ Between Voltage and Current Phases in the 3rd Phase of the Motor

Shows the measurement of angle ϕ of the third phase. For three-phase motors only.

PHI3
0.0

## Changer Motor Power Factor

In inductive circuits, such as that of some motor types, there is always a factor between the active and reactive power. This ratio is presented for single-phase and three-phase AC motors.

PFMT
0.999

## Voltage Between Phases A and B (1 and 2)

The IDM measures the voltage between the phase and 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 value $V_{ab}$, calculated between the first and second phase, is displayed in this screen.

VAB
0.0

## Voltage Between Phases B and C (2 and 3)

Likewise the previous item, the voltage between phases 2 and 3 is displayed here.

VBC
0.0

## Voltage Between Phases C and A (3 and 1)

Voltage between the last pair of phases, 3 and 1.

VCA
0.0

## Circuit Breaker Auxiliary Contact

Through the dry contact between pins 18 and 30, the IDM can monitor the state of the motor's auxiliary circuit breaker. Consult here if it is open or closed.

CTDJ
ABER

## Mechanism Temperature

If the temperature measured by the PT100Ω of the IDM is that of the mechanism, consult it here.

MECT
0.0

## Ambient Temperature

If the temperature measured by the PT100Ω of the IDM is the ambient temperature, consult it here. Since the equipment has only one input for the temperature sensor, there will be measurement of TAM or TMEC, but never both at the same time.

AMBT
0.0

## Mechanism Heating System Current

Shows the current of the mechanism's heating system, when measured.

MECI
0.0

## Voltage of the Motor Control Circuit (V1)

Displays the voltage of the motor's control circuit. Due to occupying all the voltage inputs, three-phase motors will not present the possibility of this measurement.

COMV
127

## TAP Position

With the option of measuring position of the active tap changer (4), read the current position of the TAP here.

TPOS
4

## TAP Former Position

This information is the TAP position in which the tap changer was found before the current one.

TFPO
5

## Line Current

Shows the line current. Measurement also used in calculating wear of the contact by switched current.

LI
20

## Date and Time Information

Use the arrows to continue navigating between the other information or press ↵ in this screen to access the submenu and consult data on date and time. Once inside, navigate using the ↑ and ↓ arrows. Press P to return to the previous level.

TIME
--->

↵ →Day: DAY / 9 →↑→ Month: MONT / 3 →↑→ Year: YEAR / 86

→↑→ Hour: HOUR / 9 →↑→ Minute: MIN / 27 →↑→Second: SEC / 22

→↑→GMT Time Zone: UTC / -3

From any information screen that does not serve as input for any submenu, access the second information section by quickly pressing the ↵ key. After, using the ↑ and ↓ arrows, navigate between the keys shown below:

## Oscillogram Circular Counter

The oscillogram circular counter indicates the slot where the last oscillogram was recorded.

OSCC
60

## Voltage Minimum

Shows the minimum attained by the motor voltage during the last operation.

MIMU
1.1

## Voltage Maximum

Shows the maximum attained by the motor voltage during the last operation.

MAMU
10.1

## Peak Current

Peak current attained during the last motor operation.

MTIP
7.0

## Motor Energy

Total energy spent by the motor during the last operation.

MTE
0.08

## Operation Time

Time during which the motor operated in the last switching.

OPET
999.9

## Minimum Control Voltage

Lowest voltage recorded in the supply of the control circuit during an operation. Available for Single-Phase DC and AC motors when in assembly with option 3.

MICU
1.3

## Maximum Control Voltage

Highest voltage recorded in the supply of the control circuit during an operation. Available for Single-Phase DC and AC motors when in assembly with option 3.

MACU
10.1

## Learning Status

Submenu that shows the learning status of the various variables of the IDM that are adjusted by this type of process.

STMO
--->

Use the arrows to continue navigating between the other information or press in this screen to access the submenu and consult its information. Once inside, navigate using the and arrows. Press to return to the previous level.

### Signature Status Without Intermediary TAPs

Indicates if the signature of the operations without intermediary TAPs is being referenced or if the operations are already being monitored.

STSO
REFE

### Signature Status With One Intermediary TAP

Indicates if the signature of the operations with one intermediary TAP is being referenced or if the operations are already being monitored.

STSI
REFE

### Signature Status With Two Intermediary TAPs

Indicates if the signature of the operations with two intermediary TAP is being referenced or if the operations are already being monitored.

STS2
REFE

### Signature Status With Three Intermediary TAPs

Indicates if the signature of the operations with three intermediary TAP is being referenced or if the operations are already being monitored.

STS3
REFE

### Signature Status With Four Intermediary TAPs

Indicates if the signature of the operations with four intermediary TAP is being referenced or if the operations are already being monitored.

STS4
REFE

### Automatic Mode Alarm by temperature Status

Indicates the learning status of the alarms by temperature, in case the automatic mode for definition of the thresholds is chosen by the user.

TSTA
REFEI

### Automatic Mode Alarm by Oscilography Status

Indicates the learning status of the alarms by oscilography, in case the automatic mode for definition of the thresholds is chosen by the user.

OSTA
REFE

## Counters for Maintenance

If the changer's maintenance option is active in the IDM, this information submenu will provide the content of the operation counters of relevant operation and maintenance.

CTOM
--->

Use the arrows to continue navigating between the other information or press in this screen to access the submenu and consult its information. Once inside, navigate using the and arrows. Press to return to the previous level.

### Number of Operations - Part 1

Most significant part of the number of operations already conducted by the OLTC.

NTT1
0

### Number of Operations - Part 2

Less significant part of the number of operations already conducted by the OLTC.

NTT2
65

### Number of Operations Since the Last Maintenance - Part 1

Least significant part of the number of operations conducted by the OLTC since the last maintenance.

NTM1
0

### Number of Operations Since the Last Maintenance - Part 2

Most significant part of the number of operations conducted by the OLTC since the last maintenance.

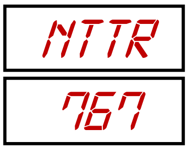
NTM2
65

## Average of Operations

Average of OLTC daily operations.


## Time for Maintenance Per Number of Operations

Time remaining for maintenance by number of operations.

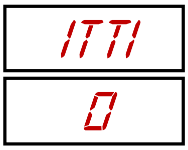



In some variables, when the value exceeds 9999, the top display will show a number “n” followed by the letter “k” and the bottom display will show three more digits. The value displayed at the top represents the quantity of thousands and the value displayed at the bottom represents the units, tens and hundreds.

If, for example, the top display shows 32k and the bottom 767, it means that the value of the variable is 32767.

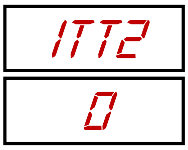
## Switched Current Integration - Part 1

Four most significant digits out of the total switched current integration.



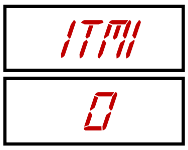

## Switched Current Integration - Part 2

Four least significant digits out of the total switched current integration.




## Current Integration Since the Last Maintenance - Part 1

Four most significant digits of the switched current integration since the last maintenance.




## Current Integration Since the Last Maintenance - Part 2

Four least significant digits of the switched current integration since the last maintenance.


## Current Integration Average

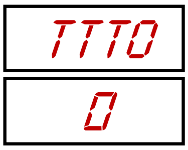
Daily average of the switched current integration increase.


## Time for Maintenance Per Current Integration

Time remaining for maintenance by current integration


## Time of Service

Changer total time of service.



### Time of Service Since the Last Maintenance

Time of service since the last maintenance

**TTMA**
**0**

### Time for Maintenance Per Time of Service

Time remaining for maintenance by time of service

**TTTR**
**1825**

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

## 4.2 Version:

To check the version of the IDM firmware, from the consultation screens, simultaneously press the and keys. The full number of the firmware version will be displayed in a screen as follows:

### Product Information

The top display will show it in the equipment name.
The bottom display will show the equipment firmware version.

**IDM**
**V1.20**

Using the keys, it is possible to navigate between the following additional information:

### Release

A control number of the manufacturer.

**RLS**
**358**

### Serial Number

The next screen displays the product serial number.

**[SER]**
**NUM**

### Product Serial Number

The top display shows the four most significant digits of the serial number.
The bottom display shows the four least significant digits of the serial number.

**1234**
**5678**

To exit these screens and return to the previous level, press or .

## 4.3 Alarms:

In case of an alarm, the IDM displays will blink, showing a message like this one:


The message shown in the top display indicates which out of the three alarm sections the code shown in the display belongs to. The value shown in the bottom display contains four digits, each digit may represent up to four different alarms, of values 1, 2, 4 and 8. The value shown in the digit will be the sum of the value of all the active alarms of that digit. If, for example, a certain digit is showing the number 7, we know that alarms 1, 2 and 4 are active at the moment.

To access the memory of the alarms, from the consultation screens, first press the key and then the key without releasing the former until the first of the following screens appears:

MAL1
Alarms memory screen 1


MAL2
Alarms memory screen 2


MAL3
Alarms memory screen 3


Then, using the arrows, it is possible to visit three alarm memory screens: AL1M, AL2M e AL3M. The code shown in the display below is the sum of the value of the alarms of each position, similar to that described right in the beginning of this same section 4.3.

To clear the alarm memory, press and hold the key for a few seconds. If a value persists in the display, it is because this alarm is still active. Note that on consulting the alarm memory, it is possible to know which of them were active since the last time that the memory was cleared, but it is not possible to know the period in which the alarm was active or how many times this occurred. Press to return to the screens of the previous level.

Consult the table below to know individually the code of each alarm of the IDM:

**Table 7 – Alarm Codes of the IDM**


| Code | Description |
|---|---|
| 0001 | Very low motor voltage |
| 0002 | Low motor voltage |
| 0004 | High motor voltage |
| 0008 | Very high motor voltage |
| 0010 | Very low motor voltage during the operation |
| 0020 | Low motor voltage during the operation |
| 0040 | High motor voltage during the operation |
| 0080 | Very high motor voltage during the operation |
| 0100 | Very low motor control circuit voltage |
| 0200 | Low motor control circuit voltage |
| 0400 | High motor control circuit voltage |
| 0800 | Very high motor control circuit voltage |
| 1000 | Very low motor control circuit voltage during the operation |
| 2000 | Low motor control circuit voltage during the operation |
| 4000 | High motor control circuit voltage during the operation |
| 8000 | Very high motor control circuit voltage during the operation |


| Code | Description |
|---|---|
| 0001 | Very low operation energy |
| 0002 | Low operation energy |
| 0004 | High operation energy |
| 0008 | Very high operation energy |
| 0010 | Very low operation time |
| 0020 | Low operation time |
| 0040 | High operation time |
| 0080 | Very high operation time |
| 0100 | Very low mechanism temperature |
| 0200 | Low mechanism temperature |
| 0400 | High mechanism temperature |
| 0800 | Very high mechanism temperature |
| 1000 | Low heater current with low mechanism temperature |
| 2000 | High heater current with high mechanism temperature |
| 4000 | - |
| 8000 | - |


| Code | Description |
|---|---|
| 0001 | High current peak |
| 0002 | Very high current peak |
| 0004 | Consumption curve during the operation below the signature limits |
| 0008 | Consumption curve during the operation above the signature limits |
| 0010 | Maintenance alert by number of operations. |
| 0020 | Advance notice programmed for maintenance by number of operations |
| 0040 | Maintenance notice by current integration |
| 0080 | Advance notice programmed for maintenance by current integration |
| 0100 | Maintenance alert by time of service. |
| 0200 | Advance notice programmed for maintenance by number of operations |
| 0400 | Open motor circuit breaker |
| 0800 | Motor in trigger |
| 1000 | - |
| 2000 | - |
| 4000 | - |
| 8000 | - |

## 4.4 Self-diagnosis:

When any internal or installation failure is detected in the IDM, the following message will blink in the display:

To access the memory of the self-diagnoses, from the consultation screens, first press the key and then the key without releasing the former until the following screen appears:


To clear the self-diagnosis memory, press and hold the key for a few seconds. Errors that are still active will remain in the display.

The value shown in the bottom display is like the alarm code: it contains four digits, each digit may represent up to four different alarms, of values 1, 2, 4 and 8. The value shown in the digit will be the sum of the value of all the active alarms of that digit. If, for example, a certain digit is showing the number B, we know that alarms 1, 2 and 8 of that position are active at the moment.

Consult the table below to know individually the code of each self-diagnosis generated by the IDM:

**Table 8 – Codes of digit 1 of self-diagnoses generated by the IDM**

| Code | Description |
|---|---|
| 0001 | Error in parameterization kept in the FLASH* |
| 0002 | Error in reading of the RTDs* |
| 0004 | TEMP leap error |
| 0008 | Calibration error in the temperature PT100* |
| 0010 | Reading error in the temperature PT100* |
| 0020 | Transmitter reading error |
| 0040 | Transmitter A/D error |
| 0080 | - |
| 0100 | Error in reading of the AC channel (VMT1) |
| 0200 | Error in reading of the AC channel (VMT2) |
| 0400 | Error in reading of the AC channel (VMT3/V1) |
| 0800 | Error in reading of the AC channel (IMT1) |
| 1000 | Error in reading of the AC channel (IMT2) |
| 2000 | Error in reading of the AC channel (IMT3/IL) |
| 4000 | Error in reading of the AC channel (IAQMEC/IL) |
| 8000 | Internal analog reference signal error* |

*Internal Error.

**Table 9 – Codes of digit 2 of self-diagnoses generated by the IDM**

| Code | Description |
|---|---|
| 0001 | Writing error in the Flash oscillation* |
| 0002 | Writing error in the Flash learning* |
| 0008 | SPI Conflict* |

*Internal Error.

In many cases, the cause of a self-diagnosis alarm has roots external to the equipment and can be solved by correcting parameterization errors or ensuring that there are no installation errors like bad contacts.

In case of the occurrence of a self-diagnosis marked with an (*) in the table above, the error will very likely be caused by an internal error of the equipment. In this case, contact the Treetech technical support.

# 5 Parameterization

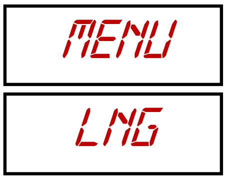
To guarantee its correct operation, several parameters must be adjusted in the IDM that will provide the equipment with necessary information for its functioning.

The programmable parameters are organized in their menus with password-protected access. In the main menu, the user will have access to the programming submenus, where he can navigate and adjust the values according to the transformer's characteristics and needs of the users.

To access the programming menu of the Tap Changer Torque Monitor, press the key and hold it for 5 seconds. The access password screen will be displayed. Using the and keys, adjust the password. (range = 0 to 999). If the initial indication is 421, then the password is "0", which is the original value from the factory. This password can be changed by the user. After setting the password, press and release the key to enter the programming menu.

Use the and keys to select a submenu. When the desired submenu appears in the device screen, press the key to proceed with the programming. Press the key at any time to return to the main menu. **The parameters related to the optional items will only be shown if these are available.**

## 5.1 LNG Menu - Language




On guaranteeing access with the correct password, the first visible menu with the parameterizations is LNG, where one can choose the IDM language.

By pressing to enter, we have the first and only variable to be set here:

### LNG – Language


Select the desired language for the product interface using and . Press to confirm and return to the parameterization menus or to return to the parameterization menus without saving any changes.
**Setting range:** PORT (Portuguese), ENGL (English), ESPN (Spanish)
**Standard Value:** PORT

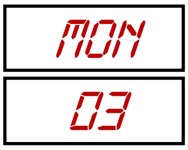
## 5.2 CLK Menu - Clock


From the parameterization menus, using the arrow, the RELG menu will be displayed, where one can set the date and time of the IDM clock. Press to enter your variables:

## Day - Day

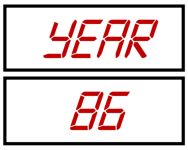

Use the arrows to choose the day, then press to save changes and go to the next variable or to return to the previous menu without saving changes in this variable.
**Setting range:** 1 to 31
**Standard Value:** 1

## MON – Month




Use the arrows to choose the month, then press to save changes and go to the next variable or to return to the previous menu without saving changes in this variable.
**Setting range:** 1 to 12
**Standard Value:** 1

## YEAR – Year

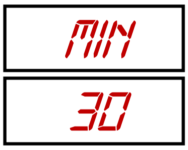



Use the arrows to choose the month, then press to save changes and go to the next variable or to return to the previous menu without saving changes in this variable.
**Setting range:** 0 to 99
**Standard Value:** 0

## HOUR – Hour

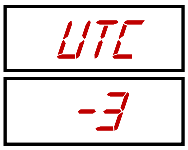

Use the arrows to choose the month, then press to save changes and go to the next variable or to return to the previous menu without saving changes in this variable.
**Setting range:** 0 to 23
**Standard Value:** 0

## MIN – Minute




Use the arrows to choose the month, then press to save changes and return to the parameterization menu or to return to the previous menu without saving changes in this variable.
**Setting range:** 0 to 59
**Standard Value:** 0

## UTC – Time Zone




Use the arrows to choose the local time zone in relation to the Greenwich meridian (**GMT**), then press to save changes and return to the parameterization menu or to return to the previous menu without saving changes in this variable.
**Setting range:** -12 to +12 in steps of 1 hour
**Standard Value:** -3 h

## 5.3 CONF Menu - Setting

The Setting menu allows setting aspects of the IDM communication functioning. Its variables are as follows:

MENU
CONF

### PROT – Protocol

Choose the communication protocol you want the IDM to use to communicate with the data acquisition system. The availability of the DNP3 depends on the purchase of optional item 1:
**Setting range:** Modb - Modbus, dNP – DNP3
**Standard Value:** Modb

PROT
MODB

### AddR – Address

Define here the address of this equipment in the network.
**Setting range:** 1 to 255
**Standard Value:** 22

ADDR
22

### BDR – Baud Rate

Select the communication baud rate.
**Setting range:** 4.8, 9.6, 19.2, 38.4, 57.6 or 115.2 kbps.
**Standard Value:** 9.6 kbps.

BDR
9.6

## 5.4 MOTR Menu - Motor

This menu presents the parameters related to monitoring of the changer motor:

MENU
MOTR

### MTPS – Motor Selection

Choose the motor type corresponding to that monitored.
**Setting range:** AC M Single-Phase – Motor, AC T – Motor Three-Phase, dC – Direct Current Motor.
**Standard Value:** dC

MTPS
DC

### VMTE – Motor Voltage

Choose between activating or not monitoring of the voltage of the motor's supply phases.
**Setting range:** ON, OFF
**Standard Value:** OFF

VMTE
OFF

## IMTE – Motor Current

Choose between activating or not monitoring of the current of the motor's phases.

**Setting range:** ON, OFF

**Standard Value:** OFF

IMTE

OFF

## CTPT – PT/CT Lab

Depending on how the voltage and current sensors are connected to the motor, there may be a phase shift between the measurements. If the motor monitored is DC, this variable will not exist. Select the phase shift of your assembly.

**Setting range:** 0, 30, 60, 90, 120, 150, 180, 210, 240, 270, 300 or 330 º

**Standard Value:** 0

CTPT

0

## ROPT – PT Ratio

PT Ratio for voltage measurement in the motor.

**Setting range:** 0.10 to 10.00 in steps of 0.01

**Standard Value:** 1

RCT1

1

## RCT1 – CT Ratio or Shunt 1

Ratio of the CTs or shunts used to measure current in the motor.

**Setting range:** 1 to 9999

**Standard Value:** 3000

RIMI

3000

## RCT2 – CT Ratio or Shunt 2

Sometimes there is need to connect a CT and/or shunt, two CTs or two shunts in cascade to put the current in a range that can be monitored by the IDM. This parameter is in relation to the transformation ratio of the second CT.

**Setting range:** 1 to 9999

**Standard Value:** 1

RCT2

1

## NVTM – Motor Nominal Voltage

Setting the motor supply nominal voltage

**Setting range:** 0 to 600 with step of 1 V

**Standard Value:** 220

NVTM

220

## TON – Trigger for Motor in Operation

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

**Setting range:** 0.1 to 99.9 with steps of 0.1 A

**Standard Value:** 0.5 A

TON

0.5

## TOFF – Trigger for Motor Out of Operation

When the motor's supply current is less than the value determined herein, it will be considered as out of operation. Used to finalize the motor oscillography.

**Setting range:** 0.1 to 99.9 with steps of 0.1 A

**Standard Value:** 0.5 A

TOFF

0.5

## 5.5 OSCL Menu -Oscillography

Menu for setting aspects of the IDM oscillography:


### INOS – Recording Interval

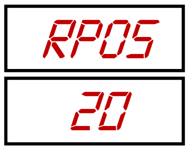
Interval between successive recordings in the oscillography.
**Setting range:** 0.025 to 1,000 with steps of 0.025 s
**Standard Value:** 0.050s


### TNOS – Number of Points

Total number of recordings of each oscillography.
**Setting range:** 100 to 500 with steps of 1 recording.
**Standard Value:** 500.


### RPOS – Former Records Maintained

Number of records prior to the trigger to be maintained in the oscillography.
**Setting range:** 5 to 200 with steps of 1.
**Standard Value:** 20




### SNO1 - Indexing Sequence Part 1

Serial number from 0 to 999999 for indexing of the oscillograms. ONS1 represents the 3 most significant digits of this number.
**Setting range:** 0 to 999 with steps of 1.
**Standard Value:** 0


### SNO2 - Indexing Sequence Part 2

Serial number from 0 to 999999 for indexing of the oscillograms. ONS1 represents the 3 least significant digits of this number.
**Setting range:** 0 to 999, in steps of 1.
**Standard Value:** 0


### IOS1 - 1st Phase Current Oscillography

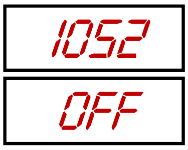
Allows choosing if during the oscillography the supply current of the first, or only, phase of the motor will be recorded.
**Setting range:** ON - Records, OFF - Does not record.
**Standard Value:** ON

## IOS2 - 2nd Phase Current Oscillography

Allows choosing if during the oscillography the supply current of the second phase of the motor will be recorded. Since they do not have other supply phases, when monitored, the Single-Phase AC motors and DC motors do not display menus like this, in relation to the other phases.

**Setting range:** ON - Records, OFF - Does not record.

**Standard Value:** OFF




## IOS3 - 3rd Phase Current Oscillography

Allows choosing if during the oscillography the supply current of the third phase of the motor will be recorded. Not available for DC motors or Single-Phase AC motors.

**Setting range:** ON - Records, OFF - Does not record.

**Standard Value:** OFF


## VOS1 - 1st Phase Voltage Oscillography

Allows choosing if during the oscillography the supply voltage of the first, or only, phase of the motor will be recorded.

**Setting range:** ON - Records, OFF - Does not record.

**Standard Value:** ON


## VOS2 - 2nd Phase Voltage Oscillography

Allows choosing if during the oscillography the supply voltage of the second phase of the motor will be recorded. Not available for DC motors or Single-Phase AC motors.

**Setting range:** ON - Records, OFF - Does not record.

**Standard Value:** OFF


## VOS3 - 3rd Phase Voltage Oscillography

Allows choosing if during the oscillography the supply voltage of the third phase of the motor will be recorded. Not available for DC motors or Single-Phase AC motors.

**Setting range:** ON - Records, OFF - Does not record.

**Standard Value:** OFF


## PFOS – Power Factor Oscillography

Allows choosing if the power factor of the motor will be recorded in the oscillography during its operation. Due to lacking this factor, this choice is not available for DC motors.

**Setting range:** ON - Records, OFF - Does not record.

**Standard Value:** ON

### TRC0 – Type 0 reference counter

Counts the number of times that the type 0 reference learning system was completed.
**Setting range:** 0 - 255.
**Standard Value:** 0


### TRC1 – Type 1 reference counter

Counts the number of times that the type 1 reference learning system was completed.
**Setting range:** 0 - 255.
**Standard Value:** 0


### TRC2 – Type 2 reference counter

Counts the number of times that the type 2 reference learning system was completed.
**Setting range:** 0 - 255.
**Standard Value:** 0


### TRC3 – Type 3 reference counter

Counts the number of times that the type 3 reference learning system was completed.
**Setting range:** 0 - 255.
**Standard Value:** 0


### TRC4 – Type 4 reference counter

Counts the number of times that the type 4 reference learning system was completed.
**Setting range:** 0 - 255.
**Standard Value:** 0


## 5.6 SIGN Menu - Motor Signature

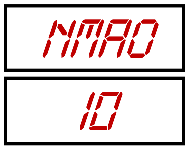
The IDM uses some oscillograms to draw up the motor's operation profile during the switching. It is thus possible to evaluate the motor's performance and detect if anything is causing it to leave its normal operating condition. This menu allows the setting of various aspects related to how the motor signature is obtained and used:

### MTTS – Motor Starting Time

Motor starting time, during which the starting current is monitored and the consumption curve is not monitored.
**Setting range:** 0 to 99.99, in steps of 0.01 s
**Standard Value:** 3s

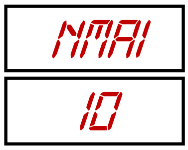

### NMAO – Number of Learning Operations

Number of motor starts to be used in learning of the reference consumption curve.
**Setting range:** 1 to 100, in steps of 1.
**Standard Value:** 10



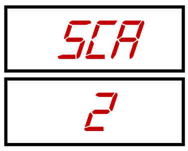

### NMAI – Number of Learning Operations with Intermediary TAPs

Number of motor starts to be used in learning of the reference consumption curve when a change in TAP with intermediary positions is detected.
**Setting range:** 1 to 100, in steps of 1.
**Standard Value:** 10




### SCA –Signature Counter Alarm

Number of points off the signature curve of the engine torque needed for alarm activation.
**Setting range:** 1 to 50, in steps of 1.
**Standard Value:** 2

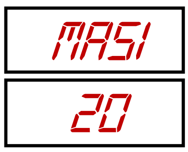



### MASX – Signature Side Margin

Tolerance margin used to determine the side limits (x axis) for the motor consumption signature curve.
**Setting range:** 1 to 20, in steps of 1 sample
**Standard Value:** 20

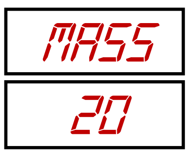

### MASI – Signature Lower Margin

Tolerance margin used to determine the lower limit for the motor consumption signature curve.
**Setting range:** 0.1 to 100, in steps of 0.1%
**Standard Value:** 20%



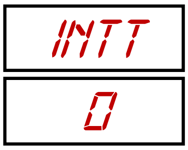

### MASS – Signature Upper Margin

Tolerance margin used to determine the upper limit for the motor consumption signature curve.
**Setting range:** 0.1 to 100, in steps of 0.1%
**Standard Value:** 20%



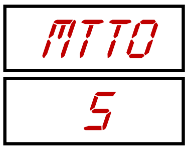
## INTT - Intermediary TAPs

Selects the number of intermediary TAPs that the longest switching has.
**Setting range:** 0 to 4, in steps of 1.
**Standard Value:** 0



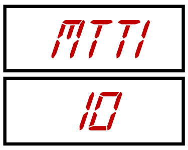

## MTTO – Motor Operation Time

Motor nominal operation time for a common TAP change. This value is used to recognize that this type of TAP transition is occurring.
**Setting range:** 0.1 to 60, in steps of 0.1 s
**Standard Value:** 5s



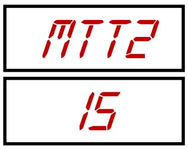

## MTT1 – Motor Operation Time with 1 Intermediary TAP

Motor nominal operation time for a TAP change with an intermediary position. This value is used to recognize that this type of TAP transition is occurring. This screen will only occur if “TINT” ≥ 1.
**Setting range:** 0.1 to 60, in steps of 0.1 s
**Standard Value:** 10s



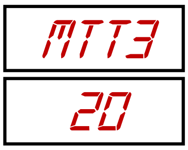

## MTT2 – Motor Operation Time with 2 Intermediary TAPs

Motor nominal operation time for a TAP change with two intermediary positions. This value is used to recognize that this type of TAP transition is occurring. This screen will only occur if “TINT” ≥ 2.
**Setting range:** 0.1 to 60, in steps of 0.1 s
**Standard Value:** 15s



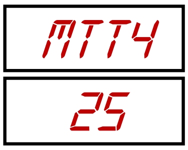

## MTT3 – Motor Operation Time with 3 Intermediary TAPs

Motor nominal operation time for a TAP change with three intermediary positions. This value is used to recognize that this type of TAP transition is occurring. This screen will only occur if “TINT” ≥ 3.
**Setting range:** 1 to 20%, in steps of 1 %.
**Standard Value:** 20s




## MTT4 – Motor Operation Time with 4 Intermediary TAPs

Motor nominal operation time for a TAP change with four intermediary positions. This value is used to recognize that this type of TAP transition is occurring. This screen will only occur if “TINT” = 4.
**Setting range:** 0.1 to 60, in steps of 0.1 s
**Standard Value:** 25s



### LERN – Learning


Controls the beginning of a learning period, when the equipment reads some operations of the changer and learns its standard of operation.
**Setting range:** SIM – [YES] Learning mode, NAO - [NO] Normal operating mode.
**Standard Value:** NAO [No]

## 5.7 ALRM Menu - Alarms


In this menu, the user gains access to the settings of the alarms generated by the IDM. Alarms can be set in different aspects, therefore, there are three submenus in this menu, which divide the settings of the alarms according to the categories listed below:

### GEAL – General Settings


Are some general settings, like timing, advance alerts and other more generic aspects of the functioning of alarms.

**Navigation:** Use and to navigate between the menus and to enter one of them. The key returns to the level of the previous menu without saving changes. The description of this submenu is in section 5.7.1.

### MOdE – Mode of Functioning


In this submenu, it is possible to set the mode of functioning of some alarms, such as, for example, if they will be in automatic mode or not and how the automatic mode should function.

**Navigation:** Use and to navigate between the menus and to enter one of them. The key returns to the level of the previous menu without saving changes. The description of this submenu is in section 5.7.2.

### VAL - Threshold Values


Many alarms occur when the value measured extrapolates a pre-established margin of acceptable values. In this submenu, it is possible to set thresholds for the magnitudes measured to activate the alarms.

**Navigation:** Use and to navigate between the menus and to enter one of them. The key returns to the level of the previous menu without saving changes. The description of this submenu is in section 5.7.3.

### CLAS - Classification


Not all alarms have the same level of gravity or not all must be met with the same approach. In this submenu the user can classify the various alarms into different categories according to his convenience..

**Navigation:** Use and to navigate between the menus and to enter one of them. The key returns to the level of the previous menu without saving changes. The description of this submenu is in section 5.7.4.

### 5.7.1 GEAL Submenu – General Settings

Are some general settings, like timing, advance alerts and other more generic aspects of the functioning of alarms:


#### ALTV – Control Voltage Alarm Timing

Timing to trigger the alarm due to over or under-voltage in supply of the OLTC motor control circuit.
**Setting range:** 0 to 60 with steps of 1s.
**Standard Value:** 4s


#### NTMX – Operations for Maintenance

Enter the number of operations that the OLTC can perform before it needs maintenance.
**Setting range:** 1 x thousand to 999 x thousand in steps of 1 x thousand.
**Standard Value:** 150 x thousand


#### ITMX – Switched Current Integration Limit

On integrating the value of the switched current, it is possible to estimate the level of wear of the OLTC contact. Enter the value of this sum that makes maintenance necessary.
**Setting range:** 1 x thousand to 999 x thousand in steps of 1 x thousand p.u$^n$.
**Standard Value:** 150 x thousand p.u$^n$


#### TTMX – Maximum Time of Service

The OLTC may need periodical maintenance by time of service. Set this time here.
**Setting range:** 1 to 9999, in steps of 1 day.
**Standard Value:** 1825 days

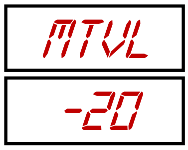

#### RTMA – Advance Maintenance Alert

To facilitate planning, the IDM considers the trend of the various criteria and alerts the time of maintenance in advance. How much in advance is set in this parameter.
**Setting range:** 1 to 99, in steps of 1 day.
**Standard Value:** 30 days

## ALTT – Temperature Alarm Timing

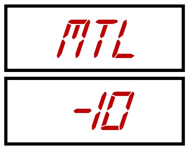

Set how long a temperature should remain outside its range for an alarm to be set off.
**Setting range:** 0 to 120 in steps of 1s.
**Standard Value:** 60s

## MTVL – Very Low Temperature of the Mechanism



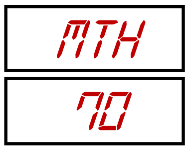

Very low temperatures in the changer's activation mechanism can weaken or even render use of the equipment impossible. Set in this parameter the temperature below which the mechanism would be critically cold.
**Setting range:** -55 to +20, in steps of 1ºC.
**Standard Value:** -20 °C

## MTL – Low Temperature of the Mechanism



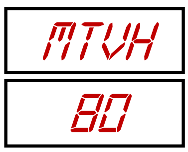

This is an alert that the temperature in the changer's activation mechanism is low. Its value must precede that of "TMMb" as a form of prior notice.
**Setting range:** -55 to +20, in steps of 1ºC.
**Standard Value:** -10 °C

## MTH – High Temperature of the Mechanism




Enter the temperature value for which the OLTC's activation mechanism can be considered high. On exceeding this value, an alert will be activated that the mechanism is becoming hotter than is recommended.
**Setting range:** 20 to 90, in steps of 1ºC.
**Standard Value:** 70 °C

## MTVH – Very High Temperature of the Mechanism




Likewise very low temperatures, very high temperatures are also harmful to the OLTC. Set the temperature above which the mechanism is considered too hot, triggering an alarm.
**Setting range:** 20 to 90, in steps of 1ºC.
**Standard Value:** 80 °C

## HRLT – Temperature to Turn On Heating


Define the temperature below which the OLTC mechanism's heating system must be turned on.
**Setting range:** -40 to 40, in steps of 1ºC.
**Standard Value:** 0 °C

## HRHT – Temperature to Turn Off Heating


Define the temperature above which the mechanism's heating system must be turned off.
**Setting range:** 0 to 55, in steps of 1ºC.
**Standard Value:** 30 °C

## ALMT - Alarm Timing


Set the timing for all the other alarms to be triggered.
**Setting range:** 0 to 30 in steps of 1s.
**Standard Value:** 20s

### 5.7.2 MOdE Submenu – Operation mode


The IDM is an intelligent device, and one of its capacities is to be able to use a sampling period to learn the suitable operating conditions for the motor and OLTC. Once the normal conditions are learned, it calculates the thresholds of the alarms in function of a percentage of the normal value.

In this submenu, one chooses if the points of operation of the alarms will be calculated automatically or entered manually in absolute values.

## MOdE – Operation mode


Choose if the alarms must be parameterized in automatic mode or manual mode.
If you choose manual mode, the submenu ends here, otherwise, the setting screens described below will be available.
**Setting range:** MAN - Manual mode, AUTO - Automatic mode.
**Standard Value:** AUTO

## TLRN - Learning Time


Time during which the data sampling will serve as learning basis for the alarms.
**Setting range:** 1 to 9999 with steps of 1h.
**Standard Value:** 240h

## LERN – Learning Reset


If the IDM's functioning conditions change greatly, when the OLTC is changed or when the first learning occurs in a very turbulent period, one must reset the learning for the device to be able to adapt.
**Setting range:** SIM – [YES] Starts new learning, NAO - [NO] Maintains profiles already collected.
**Standard Value:** NAO [No]

### 5.7.3 VAL Submenu - Threshold Values

Many alarms occur when the value measured extrapolates a pre-established margin of acceptable values. In this submenu, it is possible to set thresholds for the magnitudes measured to activate the alarms.


If the mode of operation chosen is manual, the setting range and standard value for the parameters are the absolute values that appear first. If automatic mode is chosen, the setting range and standard values will be the percentages that appear below.

The description of the modes of functioning can be found in section 5.7.2.

#### VMVL - Very Low Motor Voltage

The parameter establishes when the supply voltage of the OLTC is too low, indicating that there may be problems in making it function when necessary.


**Setting range:** 0 to 600, in steps of 0.1V.
**Standard Value:** 90V
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 20%

#### VML- Low Motor Voltage

The parameter establishes when the supply voltage of the OLTC motor is low.


**Setting range:** 0 to 600, in steps of 0.1V.
**Standard Value:** 100V
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 10%

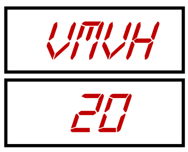
#### VMH - High Motor Voltage

The parameter establishes when the supply voltage of the OLTC motor is high.


**Setting range:** 0 to 600, in steps of 0.1V.
**Standard Value:** 150V
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 10%

#### VMVH - Very High Motor Voltage

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




**Setting range:** 0 to 600, in steps of 0.1V.
**Standard Value:** 160V
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 20%

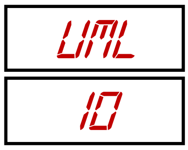
## UMVL - Motor Voltage During Operation Very Low

The voltage may vary during the motor's operation. In this parameter, the voltage value below which it is considered too low to occur during the motor's operation must be set.


**Setting range:** 0 to 600, in steps of 0.1V.
**Standard Value:** 160V
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 20%

## UML - Motor Voltage During Operation Low

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




**Setting range:** 0 to 600, in steps of 0.1V.
**Standard Value:** 180V
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 10%

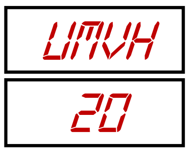
## UMH - Motor Voltage During Operation High

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


**Setting range:** 0 to 600, in steps of 0.1V.
**Standard Value:** 240V
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 10%

## UMVH - Motor Voltage During Operation Very High

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




**Setting range:** 0 to 600, in steps of 0.1V.
**Standard Value:** 260V
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 20%

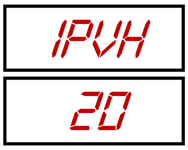
## IPH - High Current Peak

Mainly during starting of the motor, the current may rise more than its nominal value, even then, it must not go out of control. Set here the value as of which the current peak can be considered high.


**Setting range:** 0.1 to 999.9, in steps of 0.1A.
**Standard Value:** 150A
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 10%

## IPVH - Very High Current Peak

Set here the value as of which the current peak can be considered very high.
**Setting range:** 0.1 to 999.9, in steps of 0.1A.
**Standard Value:** 200A
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 20%




## EVL0 - Very Low Operation Energy

As explained in chapter 2.3, the energy consumed during the operation is proportional to the torque developed by the motor during the operation. If its value is too low, it may be that the motor is disconnected from the load, if too high, it may be that it is locked.

When the energy consumed by the motor during the operation is below the value programmed in this variable, the alarm due to very low operation energy will be activated.


Since there are TAP transitions with intermediary positions, the variables numbered "n" from 0 to 4 represent the thresholds of the alarms for the transitions with "n" intermediary TAPs. When "n=0" (case of this variable), we have common transitions: without intermediary TAPs.
**Setting range:** -99.99 to 99.99, in steps of 0.1W.h.
**Standard Value:** 0.1W.h
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 20%

> If a three-phase motor is being monitored as if it were a single-phase motor and this alarm is being set in manual mode, remember to enter the energy value divided by 3, after all, only one phase will be monitored. This must be done for all energy variables, recognizable by their dimensional unit: W.h.
>
> If the value of the alarms is being set in automatic mode, proceed normally.

## EL0 - Low Operation Energy

When the energy consumed by the motor during the operation is below the value programmed in this variable, the alarm due to low operation energy will be activated.
**Setting range:** -99.99 to 99.99, in steps of 0.1W.h.
**Standard Value:** 0.2W.h
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 10%

## EH0 - High Operation Energy

When the energy consumed by the motor during the operation is above the value programmed in this variable, the alarm due to high operation energy will be activated.


**Setting range:** -99.99 to 99.99, in steps of 0.1W.h.
**Standard Value:** 4W.h
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 10%

## EVH0 - Very High Operation Energy

When the energy consumed by the motor during the operation is above the value programmed in this variable, the alarm due to very high operation energy will be activated.


**Setting range:** -99.99 to 99.99, in steps of 0.1W.h.
**Standard Value:** 4.5W.h
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 20%

## EVH1 – Very Low Operation Energy with 1 Intermediary TAP

When the energy consumed by the motor during the operation is below the value programmed in this variable, the alarm due to *Very Low Operation Energy with 1 Intermediary TAP* will be activated.


Since there are TAP transitions with intermediary positions, the variables numbered "n" from 0 to 4 represent the thresholds of the alarms for the transitions with "n" intermediary TAPs. In this case, 1 Intermediary TAP.
**Setting range:** -99.99 to 99.99, in steps of 0.1W.h.
**Standard Value:** 0.1W.h
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 20%

## EL1 – Low Operation Energy with 1 Intermediary TAP

When the energy consumed by the motor during the operation is below the value programmed in this variable, the alarm due to *Low Operation Energy with 1 Intermediary TAP* will be activated.


**Setting range:** -99.99 to 99.99, in steps of 0.1W.h.
**Standard Value:** 0.2W.h
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 10%

## EL1 – High Operation Energy with 1 Intermediary TAP

When the energy consumed by the motor during the operation is above the value programmed in this variable, the alarm due to *High Operation Energy with 1 Intermediary TAP* will be activated.


**Setting range:** -99.99 to 99.99, in steps of 0.1W.h.
**Standard Value:** 4W.h
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 10%

## EVH1 – Very High Operation Energy with 1 Intermediary TAP

When the energy consumed by the motor during the operation is above the value programmed in this variable, the alarm due to *Very High Operation Energy with 1 Intermediary TAP* will be activated.


**Setting range:** -99.99 to 99.99, in steps of 0.1W.h.
**Standard Value:** 4.5W.h
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 20%

## EVL2 – Very Low Operation Energy with 2 Intermediary TAPs

When the energy consumed by the motor during the operation is below the value programmed in this variable, the alarm due to *Very Low Operation Energy with 2 Intermediary TAPs* will be activated.


Since there are TAP transitions with intermediary positions, the variables numbered “n” from 0 to 4 represent the thresholds of the alarms for the transitions with “n” intermediary TAPs. In this case, 2 Intermediary TAPs.
**Setting range:** -99.99 to 99.99, in steps of 0.1W.h.
**Standard Value:** 0.1W.h
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 20%

## EL2 – Low Operation Energy with 2 Intermediary TAPs

When the energy consumed by the motor during the operation is below the value programmed in this variable, the alarm due to *Low Operation Energy with 2 Intermediary TAPs* will be activated.


**Setting range:** -99.99 to 99.99, in steps of 0.1W.h.
**Standard Value:** 0.2W.h
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 10%

## EH2 – High Operation Energy with 2 Intermediary TAPs

When the energy consumed by the motor during the operation is above the value programmed in this variable, the alarm due to *High Operation Energy with 2 Intermediary TAPs* will be activated.


**Setting range:** -99.99 to 99.99, in steps of 0.1W.h.
**Standard Value:** 4W.h
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 10%

## EVH2 – Very High Operation Energy with 2 Intermediary TAPs

When the energy consumed by the motor during the operation is above the value programmed in this variable, the alarm due to *Very High Operation Energy with 2 Intermediary TAPs* will be activated.


**Setting range:** -99.99 to 99.99, in steps of 0.1W.h.
**Standard Value:** 4.5W.h
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 20%

## EVL3 – Very Low Operation Energy with 3 Intermediary TAPs

When the energy consumed by the motor during the operation is below the value programmed in this variable, the alarm due to *Very Low Operation Energy with 3 Intermediary TAPs* will be activated.


Since there are TAP transitions with intermediary positions, the variables numbered "n" from 0 to 4 represent the thresholds of the alarms for the transitions with "n" intermediary TAPs. In this case, 3 Intermediary TAPs.
**Setting range:** -99.99 to 99.99, in steps of 0.1W.h.
**Standard Value:** 0.1W.h
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 20%

## EL3 – Low Operation Energy with 3 Intermediary TAPs

When the energy consumed by the motor during the operation is below the value programmed in this variable, the alarm due to *Low Operation Energy with 3 Intermediary TAPs* will be activated.


**Setting range:** -99.99 to 99.99, in steps of 0.1W.h.
**Standard Value:** 0.2W.h
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 10%

## EH3 – High Operation Energy with 3 Intermediary TAPs

When the energy consumed by the motor during the operation is above the value programmed in this variable, the alarm due to *High Operation Energy with 3 Intermediary TAPs* will be activated.


**Setting range:** -99.99 to 99.99, in steps of 0.1W.h.
**Standard Value:** 4W.h
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 10%

## EVH3 – Very High Operation Energy with 3 Intermediary TAPs

When the energy consumed by the motor during the operation is above the value programmed in this variable, the alarm due to *Very High Operation Energy with 3 Intermediary TAPs* will be activated.


**Setting range:** -99.99 to 99.99, in steps of 0.1W.h.
**Standard Value:** 4.5W.h
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 20%

## EVL4 – Very Low Operation Energy with 4 Intermediary TAPs

When the energy consumed by the motor during the operation is below the value programmed in this variable, the alarm due to *Very Low Operation Energy with 4 Intermediary TAPs* will be activated.


Since there are TAP transitions with intermediary positions, the variables numbered "n" from 0 to 4 represent the thresholds of the alarms for the transitions with "n" intermediary TAPs. In this case, 4 Intermediary TAPs.
**Setting range:** -99.99 to 99.99, in steps of 0.1W.h.
**Standard Value:** 0.1W.h
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 20%

## EL4 – Low Operation Energy with 4 Intermediary TAPs

When the energy consumed by the motor during the operation is below the value programmed in this variable, the alarm due to *Low Operation Energy with 4 Intermediary TAPs* will be activated.


**Setting range:** -99.99 to 99.99, in steps of 0.1W.h.
**Standard Value:** 0.2W.h
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 10%

## EH4 – High Operation Energy with 4 Intermediary TAPs

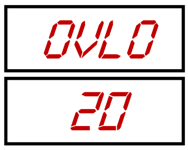

When the energy consumed by the motor during the operation is above the value programmed in this variable, the alarm due to *High Operation Energy with 4 Intermediary TAPs* will be activated.
**Setting range:** -99.99 to 99.99, in steps of 0.1W.h.
**Standard Value:** 4W.h
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 10%

## EVH4 – Very High Operation Energy with 4 Intermediary TAPs


When the energy consumed by the motor during the operation is above the value programmed in this variable, the alarm due to *Very High Operation Energy with 4 Intermediary TAPs* will be activated.
**Setting range:** -99.99 to 99.99, in steps of 0.1W.h.
**Standard Value:** 4.5W.h
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 20%

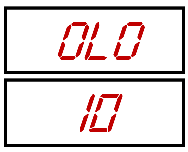
## OVL0 – Very Low Operation Time

If the operation lasted less than that programmed here, the alarm indicating that this operation occurred in a very short time will be activated.




Since there are TAP transitions with intermediary positions, the variables numbered "n" from 0 to 4 represent the thresholds of the alarms for the transitions with "n" intermediary TAPs. When "n=0" (case of this variable), we have common transitions: without intermediary TAPs.
**Setting range:** 90 to 999.9, in steps of 0.1 s.
**Standard Value:** 1s
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 20%

## OL0 – Low Operation Time




If the operation lasted less than that programmed here, the alarm indicating that this operation occurred in a short time will be activated.
**Setting range:** 90 to 999.9, in steps of 0.1 s.
**Standard Value:** 2s
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 10%

## OH0 – High Operation Time

If the operation lasted longer than that programmed here, the alarm indicating that this operation occurred in a long time will be activated.
**Setting range:** 90 to 999.9, in steps of 0.1 s.
**Standard Value:** 90s
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 10%


## OVH0 – Very High Operation Time

If the operation lasted longer than that programmed here, the alarm indicating that this operation occurred in a very long time will be activated.
**Setting range:** 90 to 999.9, in steps of 0.1 s.
**Standard Value:** 120s
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 20%

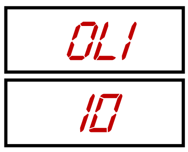

## OVL1 – Very Low Operation Time with 1 Intermediary TAP

If the operation lasted less than that programmed here, the alarm indicating that this operation occurred in a very short time will be activated.

Since there are TAP transitions with intermediary positions, the variables numbered "n" from 0 to 4 represent the thresholds of the alarms for the transitions with "n" intermediary TAPs. In this case, 1 Intermediary TAP.
**Setting range:** 90 to 999.9, in steps of 0.1 s.
**Standard Value:** 1s
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 20%


## OL1 – Low Operation Time with 1 Intermediary TAP

If the operation lasted less than that programmed here, the alarm indicating that this operation occurred in a short time will be activated.
**Setting range:** 90 to 999.9, in steps of 0.1 s.
**Standard Value:** 2s
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 10%

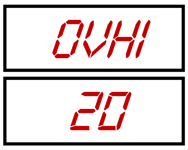



## OH1 – High Operation Time with 1 Intermediary TAP

If the operation lasted longer than that programmed here, the alarm indicating that this operation occurred in a long time will be activated.
**Setting range:** 90 to 999.9, in steps of 0.1 s.
**Standard Value:** 90s
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 10%

## OVH1 – Very High Operation Time with 1 Intermediary TAP

If the operation lasted longer than that programmed here, the alarm indicating that this operation occurred in a very long time will be activated.




**Setting range:** 90 to 999.9, in steps of 0.1 s.
**Standard Value:** 120s
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 20%

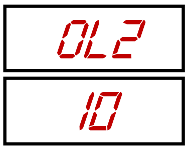
## OVL2 – Very Low Operation Time with 2 Intermediary TAPs

If the operation lasted less than that programmed here, the alarm indicating that this operation occurred in a very short time will be activated.


Since there are TAP transitions with intermediary positions, the variables numbered "n" from 0 to 4 represent the thresholds of the alarms for the transitions with "n" intermediary TAPs. In this case, 2 Intermediary TAPs.
**Setting range:** 90 to 999.9, in steps of 0.1 s.
**Standard Value:** 1s
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 20%

## OL2 – Low Operation Time with 2 Intermediary TAPs

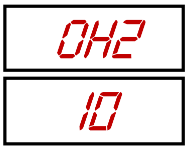
If the operation lasted less than that programmed here, the alarm indicating that this operation occurred in a short time will be activated.




**Setting range:** 90 to 999.9, in steps of 0.1 s.
**Standard Value:** 2s
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 10%

## OH2 – High Operation Time with 2 Intermediary TAPs

If the operation lasted longer than that programmed here, the alarm indicating that this operation occurred in a long time will be activated.




**Setting range:** 90 to 999.9, in steps of 0.1 s.
**Standard Value:** 90s
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 10%

## OVH2 – Very High Operation Time with 2 Intermediary TAPs

If the operation lasted longer than that programmed here, the alarm indicating that this operation occurred in a very long time will be activated.


**Setting range:** 90 to 999.9, in steps of 0.1 s.
**Standard Value:** 120s
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 20%

## OVL3 – Very Low Operation Time with 3 Intermediary TAPs

If the operation lasted less than that programmed here, the alarm indicating that this operation occurred in a very short time will be activated.


Since there are TAP transitions with intermediary positions, the variables numbered “n” from 0 to 4 represent the thresholds of the alarms for the transitions with “n” intermediary TAPs. In this case, 3 Intermediary TAPs.
**Setting range:** 90 to 999.9, in steps of 0.1 s.
**Standard Value:** 1s
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 20%

## OL3 – Low Operation Time with 3 Intermediary TAPs

If the operation lasted less than that programmed here, the alarm indicating that this operation occurred in a short time will be activated.


**Setting range:** 90 to 999.9, in steps of 0.1 s.
**Standard Value:** 2s
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 10%

## OH3 – High Operation Time with 3 Intermediary TAPs

If the operation lasted longer than that programmed here, the alarm indicating that this operation occurred in a long time will be activated.


**Setting range:** 90 to 999.9, in steps of 0.1 s.
**Standard Value:** 90s
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 10%

## OVH3 – Very High Operation Time with 3 Intermediary TAPs

If the operation lasted longer than that programmed here, the alarm indicating that this operation occurred in a very long time will be activated.


**Setting range:** 90 to 999.9, in steps of 0.1 s.
**Standard Value:** 120s
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 20%

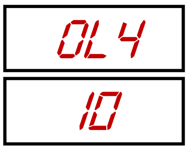
## OVL4 – Very Low Operation Time with 4 Intermediary TAPs

If the operation lasted less than that programmed here, the alarm indicating that this operation occurred in a very short time will be activated.


Since there are TAP transitions with intermediary positions, the variables numbered "n" from 0 to 4 represent the thresholds of the alarms for the transitions with "n" intermediary TAPs. In this case, 4 Intermediary TAPs.
**Setting range:** 90 to 999.9, in steps of 0.1 s.
**Standard Value:** 1s
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 20%

## OL4 – Low Operation Time with 4 Intermediary TAPs

If the operation lasted less than that programmed here, the alarm indicating that this operation occurred in a short time will be activated.




**Setting range:** 90 to 999.9, in steps of 0.1 s.
**Standard Value:** 2s
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 10%

## OH4 – High Operation Time with 4 Intermediary TAPs

If the operation lasted longer than that programmed here, the alarm indicating that this operation occurred in a long time will be activated.


**Setting range:** 90 to 999.9, in steps of 0.1 s.
**Standard Value:** 90s
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 10%

## OVH4 – Very High Operation Time with 4 Intermediary TAPs

If the operation lasted longer than that programmed here, the alarm indicating that this operation occurred in a very long time will be activated.


**Setting range:** 90 to 999.9, in steps of 0.1 s.
**Standard Value:** 120s
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 20%

## MTRG – Triggered Motor

If the motor remains in operation for longer than that programmed here, the alarm due to triggered motor will be activated.


**Setting range:** 90 to 999.9, in steps of 0.1 s.
**Standard Value:** 100s
**Setting range:** 0 to 200, in steps of 0.1%
**Standard Value:** 50%

## HILW – Low Heating Current

Enter the minimum current value accepted by the heating system.
**Setting range:** 0 to 50, in steps of 0.1A.
**Standard Value:** 0A
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 10%


## HIHG – High Heating Current

Enter the maximum current value accepted by the heating system.
**Setting range:** 0 to 50, in steps of 0.1A.
**Standard Value:** 50A
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 20%


## VCVL - Very Low Control Voltage

*Very Low Control Voltage* Alarm triggers if the measured voltage value of the motor control circuit is below that programmed here.
**Setting range:** 0 to 300, in steps of 0.1V.
**Standard Value:** 90V
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 20%


## VCL - Low Control Voltage

*Low Control Voltage* Alarm triggers if the measured voltage value of the motor control circuit is below that programmed here.
**Setting range:** 0 to 300, in steps of 0.1V.
**Standard Value:** 100V
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 10%


## VCH - High Control Voltage

*High Control Voltage* Alarm triggers if the measured voltage value of the motor control circuit is above that programmed here.
**Setting range:** 0 to 300, in steps of 0.1V.
**Standard Value:** 150V
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 10%

## VCVH - Very High Control Voltage

*Very High Control Voltage* Alarm triggers if the measured voltage value of the motor control circuit is above that programmed here.


**Setting range:** 0 to 300, in steps of 0.1V.
**Standard Value:** 160V
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 20%

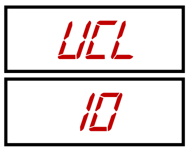
## UCVL - Very Low Control Voltage During Operation

*Very Low Control Voltage During Operation* Alarm triggers if the measured voltage value of the motor control circuit is below that programmed here.


**Setting range:** 0 to 300, in steps of 0.1V.
**Standard Value:** 90V
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 20%

## UCL - Low Control Voltage During Operation

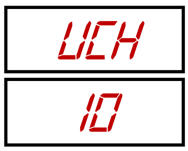
*Low Control Voltage During Operation* Alarm triggers if the measured voltage value of the motor control circuit is below that programmed here.




**Setting range:** 0 to 300, in steps of 0.1V.
**Standard Value:** 100V
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 10%

## UCH - High Control Voltage During Operation

*High Control Voltage During Operation* Alarm triggers if the measured voltage value of the motor control circuit is above that programmed here.




**Setting range:** 0 to 300, in steps of 0.1V.
**Standard Value:** 150V
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 10%

## UCVH - Very High Control Voltage During Operation

*Very High Control Voltage During Operation* Alarm triggers if the measured voltage value of the motor control circuit is above that programmed here.


**Setting range:** 0 to 300, in steps of 0.1V.
**Standard Value:** 160V
**Setting range:** 0 to 100, in steps of 0.1%
**Standard Value:** 20%

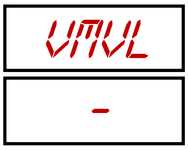
### 5.7.4 CLAS Submenu - Classification

Not all alarms have the same level of gravity or not all must be met with the same approach. In this submenu the user can classify the various alarms into three different categories or deactivate them according to his convenience.


The blue category is less serious, and must be used mainly for notifications, the yellow must be used when a serious problem is detected and the red when the situation is urgent.

Note that here every type of alarm is classified, for example, on classifying the alarm due to low operation time, we are classifying this alarm for all intermediary TAP situations.

#### VMVL - Very Low Motor Voltage

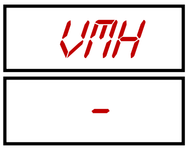



Define the classification of this alarm.
**Setting range:** - - Deactivated, BL – Blue, YL – Yellow, RD - Red
**Standard Value:** -

#### VML - Low Motor Voltage

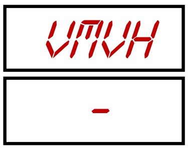

Define the classification of this alarm.
**Setting range:** - - Deactivated, BL – Blue, YL – Yellow, RD - Red
**Standard Value:** -

#### VMH - High Motor Voltage



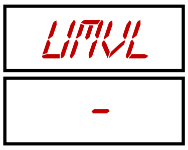

Define the classification of this alarm.
**Setting range:** - - Deactivated, BL – Blue, YL – Yellow, RD - Red
**Standard Value:** -

#### VMVH- Very High Motor Voltage



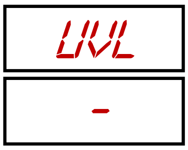

Define the classification of this alarm.
**Setting range:** - - Deactivated, BL – Blue, YL – Yellow, RD - Red
**Standard Value:** -

#### UMVL - Motor Voltage During Operation Very Low



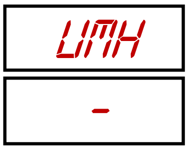

Define the classification of this alarm.
**Setting range:** - - Deactivated, BL – Blue, YL – Yellow, RD - Red
**Standard Value:** -

### UVL - Motor Voltage During Operation Low



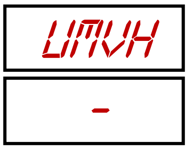

Define the classification of this alarm.
**Setting range:** - - Deactivated, BL – Blue, YL – Yellow, RD - Red
**Standard Value:** -

### UMH - Motor Voltage During Operation High



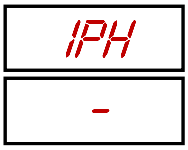

Define the classification of this alarm.
**Setting range:** - - Deactivated, BL – Blue, YL – Yellow, RD - Red
**Standard Value:** -

### UMVH - Motor Voltage During Operation Very High



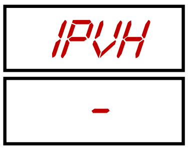

Define the classification of this alarm.
**Setting range:** - - Deactivated, BL – Blue, YL – Yellow, RD - Red
**Standard Value:** -

### IPH – High Peak Current




Define the classification of this alarm.
**Setting range:** - - Deactivated, BL – Blue, YL – Yellow, RD - Red
**Standard Value:** -

### IPVH – Very High Peak Current

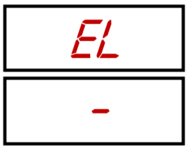



Define the classification of this alarm.
**Setting range:** - - Deactivated, BL – Blue, YL – Yellow, RD - Red
**Standard Value:** -

### EVL - Very Low Operation Energy

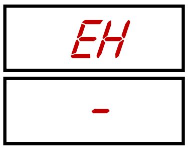

Define the classification of this alarm.
**Setting range:** - - Deactivated, BL – Blue, YL – Yellow, RD - Red
**Standard Value:** -

### EL - Low Operation Energy




Define the classification of this alarm.
**Setting range:** - - Deactivated, BL – Blue, YL – Yellow, RD - Red
**Standard Value:** -

### EH - High Operation Energy




Define the classification of this alarm.
**Setting range:** - - Deactivated, BL – Blue, YL – Yellow, RD - Red
**Standard Value:** -

## EVH - Very High Operation Energy

Define the classification of this alarm.

**Setting range:** - - Deactivated, BL – Blue, YL – Yellow, RD - Red

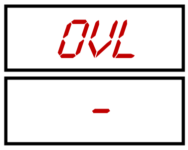
**Standard Value:** -


## OVL – Very Low Operation Time

Define the classification of this alarm.

**Setting range:** - - Deactivated, BL – Blue, YL – Yellow, RD - Red

**Standard Value:** -

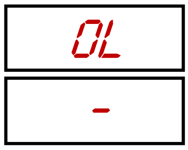



## OL – Low Operation Time

Define the classification of this alarm.

**Setting range:** - - Deactivated, BL – Blue, YL – Yellow, RD - Red

**Standard Value:** -

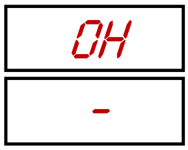



## OH – High Operation Time

Define the classification of this alarm.

**Setting range:** - - Deactivated, BL – Blue, YL – Yellow, RD - Red

**Standard Value:** -

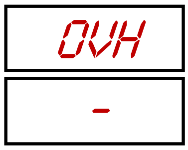



## OVH – Very High Operation Time

Define the classification of this alarm.

**Setting range:** - - Deactivated, BL – Blue, YL – Yellow, RD - Red

**Standard Value:** -




## MTRG – Triggered Motor

Define the classification of this alarm.

**Setting range:** - - Deactivated, BL – Blue, YL – Yellow, RD - Red

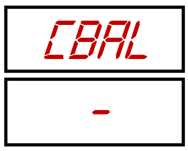
**Standard Value:** -


## CBAL – Open Motor Circuit Breaker

Define the classification of this alarm.

**Setting range:** - - Deactivated, BL – Blue, YL – Yellow, RD - Red

**Standard Value:** -

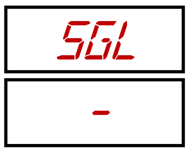



## SGL – Consumption Curve Under the Curve

Define the classification of this alarm.

**Setting range:** - - Deactivated, BL – Blue, YL – Yellow, RD - Red

**Standard Value:** -

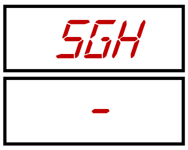


## SGH – Consumption Curve Above the Curve

Define the classification of this alarm.

**Setting range:** - - Deactivated, BL – Blue, YL – Yellow, RD - Red

**Standard Value:** -




## WOMA - Maintenance Alert by Number of Operations.

Define the classification of this alarm.

**Setting range:** - - Deactivated, BL – Blue, YL – Yellow, RD - Red

**Standard Value:** AM


## WIMA - Maintenance Alert by Current Integral.

Define the classification of this alarm.

**Setting range:** - - Deactivated, BL – Blue, YL – Yellow, RD - Red

**Standard Value:** AM


## WTSV - Maintenance Alert by Time of Service.

Define the classification of this alarm.

**Setting range:** - - Deactivated, BL – Blue, YL – Yellow, RD - Red

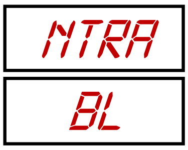
**Standard Value:** AM


## NTRA - Advance Alert by Number of Operations.

Define the classification of this alarm.

**Setting range:** - - Deactivated, BL – Blue, YL – Yellow, RD - Red

**Standard Value:** AZ




## ITRA - Advance Alert by Current Integration.

Define the classification of this alarm.

**Setting range:** - - Deactivated, BL – Blue, YL – Yellow, RD - Red

**Standard Value:** AZ


## TTRA - Advance Alert by Time of Service.

Define the classification of this alarm.

**Setting range:** - - Deactivated, BL – Blue, YL – Yellow, RD - Red

**Standard Value:** AZ


## MTVL – Very Low Temperature of the Mechanism

Define the classification of this alarm.

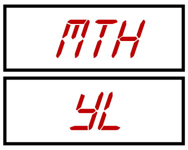
**Setting range:** - - Deactivated, BL – Blue, YL – Yellow, RD - Red

**Standard Value:** VM

## MTL – Low Temperature of the Mechanism


Define the classification of this alarm.
**Setting range:** - - Deactivated, BL – Blue, YL – Yellow, RD - Red
**Standard Value:** AM

## MTH – High Temperature of the Mechanism




Define the classification of this alarm.
**Setting range:** - - Deactivated, BL – Blue, YL – Yellow, RD - Red
**Standard Value:** AM

## MTVH – Very High Temperature of the Mechanism


Define the classification of this alarm.

**Setting range:** - - Deactivated, BL – Blue, YL – Yellow, RD - Red
**Standard Value:** VM

## HILW – Low Heating Current


Define the classification of this alarm.
**Setting range:** - - Deactivated, BL – Blue, YL – Yellow, RD - Red
**Standard Value:** AM

## HIHG – High Heating Current


Define the classification of this alarm.
**Setting range:** - - Deactivated, BL – Blue, YL – Yellow, RD - Red
**Standard Value:** AM

## VCVL - Very Low Control Voltage


Define the classification of this alarm.
**Setting range:** - - Deactivated, BL – Blue, YL – Yellow, RD - Red
**Standard Value:** VM

## VCL - Low Control Voltage


Define the classification of this alarm.
**Setting range:** - - Deactivated, BL – Blue, YL – Yellow, RD - Red
**Standard Value:** AM

## VCH - High Control Voltage


Define the classification of this alarm.
**Setting range:** - - Deactivated, BL – Blue, YL – Yellow, RD - Red
**Standard Value:** AM

### VCVH - Very High Control Voltage


Define the classification of this alarm.
**Setting range:** - - Deactivated, BL – Blue, YL – Yellow, RD - Red
**Standard Value:** VM

### UCVL - Control Voltage During Operation Very Low


Define the classification of this alarm.
**Setting range:** - - Deactivated, BL – Blue, YL – Yellow, RD - Red
**Standard Value:** VM

### UCL - Low Control Voltage During Operation


Define the classification of this alarm.
**Setting range:** - - Deactivated, BL – Blue, YL – Yellow, RD - Red
**Standard Value:** AM

### UCH - High Control Voltage During Operation

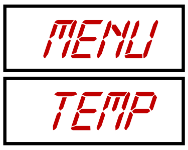

Define the classification of this alarm.
**Setting range:** - - Deactivated, BL – Blue, YL – Yellow, RD - Red
**Standard Value:** AM

### UCVH - Very High Control Voltage During Operation


Define the classification of this alarm.
**Setting range:** - - Deactivated, BL – Blue, YL – Yellow, RD - Red
**Standard Value:** VM

## 5.8 TEMP Menu - Mechanism Temperature

On connecting an RTD temperature sensor to the IDM, there is the possibility of measuring a temperature of the user's preference.




Due to having only one inlet for thermometer, one must choose between temperature of the motor mechanism or ambient temperature.

In this menu, one defines if there is temperature sensing and, if yes, which temperature will be measured.

### MECT - Mechanism Temperature

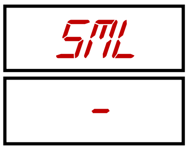

If there is an RTD temperature sensor like the PT100Ω connected to the IDM and the user wishes to use it to monitor the mechanism temperature, one must enable this variable.
**Setting range:** YES - Enables monitoring, NO - Disables monitoring.
**Standard Value:** NO

### AMBT – Ambient Temperature


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

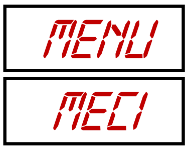
This screen will only appear if the former option is disabled and both must be disabled if there is no sensor connected.
**Setting range:** YES - Enables monitoring, NO - Disables monitoring.
**Standard Value:** NO

### SML – RTD Sensor Temperature Simulator



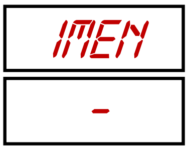

Enable this variable when, instead of a PT100Ω, a temperature simulator is connected to the IDM.
**Setting range:** - – Disable simulation, 1 – Enable simulation.
**Standard Value:** -

## 5.9 MECI Menu - Mechanism Heater Current




Option number 3 offers the possibility of monitoring the heating current of the OLTC activation mechanism, here, the parameters for the necessary measurements are adjusted.

### IMEN - Heating System Current




Select here the type of current that supplies the mechanism heater or, if there is no heating current to monitor, disable the function.
**Setting range:** - – Disable, dC – DC Current, AC – AC Current.
**Standard Value:** -

### CTR1 – CT 1 Ratio

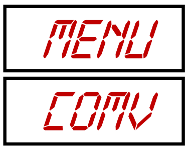

Parameterize here the CT ratio or shunt resistance used to measure the heater current.
**Setting range:** 1 to 10000, in steps of 1.
**Standard Value:** 3000

### CTR2 – CT 2 Ratio


If the measurement is done using two transformation elements, the ratio of the second shunt resistor or measuring CT must be parameterized here.
**Setting range:** 1 to 10000, in steps of 1.
**Standard Value:** 1

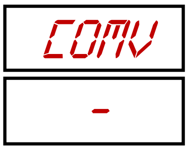
## 5.10 COMV Menu – Control Voltage

Another possibility created by option 3 is to monitor supply of the changer's control circuit voltage. Here, the variables pertinent to the necessary measurements are parameterized.




### VCEN - OLTC Control Circuit Supply

This option must be in disabled mode (-) if there is no connection to measure the supply voltage, otherwise, parameterize if the voltage measured is direct (DC) or alternating (AC).
**Setting range:** - – Disables, dC – Enables with DC voltage, AC – Enables with AC voltage.
**Standard Value:** -




### PTRT – PT Ratio

Select the PT ratio used to measure the control voltage.
**Setting range:** 0.10 to 10.00 in steps of 0.01
**Standard Value:** 1.00


## 5.11 OLTC Menu - On Load Tap Changer

In this menu we find the parameters that define the properties of the OLTC monitored and some other settings related to its monitoring and maintenance functions.


### CTNI - Nominal Current

Nominal current of the changer for calculation of the current integral.
**Setting range:** 1 to 9999 with step of 1.
**Standard Value:** 1000 A


### IEXP - Current Exponent

Switched current exponent to calculate wear of the changer contact.
**Setting range:** 1 to 5 with step of 0.01.
**Standard Value:** 2

## SNT1 - Switching of the Current with One Intermediary Position

When there is an operation with intermediary positions, there may be more than one moment in which the current is switched.


Parameterize here how many times the switched current must be counted in a transition with one intermediary position.

There is need for *option 4: Chanter Position* to be active for this parameter to be used by the IDM.
**Setting range:** 1 to 5 with step of 1.
**Standard Value:** 1

## SNT2 - Switching of the Current with Two Intermediary Positions

Parameterize here how many times the switched current must be counted in a transition with two intermediary positions.


There is need for *option 4: Chanter Position* to be active for this parameter to be used by the IDM.
**Setting range:** 1 to 5 with step of 1.
**Standard Value:** 1

## SNT3 - Switching of the Current with Three Intermediary Positions

Parameterize here how many times the switched current must be counted in a transition with three intermediary positions.


There is need for *option 4: Changer Position* is active.
**Setting range:** 1 to 5 with step of 1 for this parameter to be used by the IDM.
**Standard Value:** 1

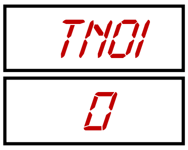
## SNT4 – Switching of the Current with Four Intermediary Positions

Parameterize here how many times the switched current must be counted in a transition with four intermediary positions.


There is need for *option 4: Changer Position* is active.
**Setting range:** 1 to 5 with step of 1 for this parameter to be used by the IDM.
**Standard Value:** 1

## TNO1 - Total Number of Operations, Part 1

Total number of operations already conducted by the changer before installing the IDM. This variable will be increased by the IDM in the extent in which the OLTC is used.



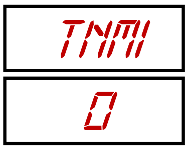

Since this can be a very large number and only four digits fit into the IDM display, the three most significant must be entered in this part...
**Setting range:** 0 to 999 with step of 1.
**Standard Value:** 0

## TNO2 - Total Number of Operations, Part 2


... and the three least significant in this.
**Setting range:** 0 to 999 with step of 1.
**Standard Value:** 0

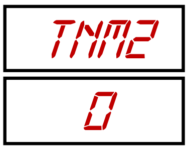
## TNM1 – Operations After Maintenance, Part 1

Number of operations performed by the changer after maintenance before starting the monitoring. This variable will be increased by the IDM in the extent in which the OLTC is used.




Since this can be a very large number and only four digits fit into the IDM display, the three most significant must be entered in this part...
**Setting range:** 0 to 999 with step of 1.
**Standard Value:** 0

## TNM2 – Operations After Maintenance, Part 2




... and the three least significant in this.
**Setting range:** 0 to 999 with step of 1.
**Standard Value:** 0

## IIT1 - Current Total Integration, Part 1

Integration of the switched current along all the operations already conducted by the changer before installing the IDM. This variable will be increased by the IDM in the extent in which the OLTC is used.


Since this can be a very large number and only four digits fit into the IDM display, the four most significant must be entered in this part...
**Setting range:** 0 to 9999 with step of 1 p.u.$^{n}$.
**Standard Value:** 0

## IIT2 - Current Total Integration, Part 2

IIT2
0

... and the three least significant in this.
**Setting range:** 0 to 999 with step of 1 p.u.$^{n}$.
**Standard Value:** 0

## IIM1 – Current Integration After Maintenance, Part 1

IIM1
0

Integration of the current switched by the changer after maintenance before start of the monitoring. This variable will be increased by the IDM in the extent in which the OLTC is used.

Since this can be a very large number and only four digits fit into the IDM display, the four most significant must be entered in this part...
**Setting range:** 0 to 9999 with step of 1 p.u.$^{n}$.
**Standard Value:** 0

## IIM2 – Current Integration After Maintenance, Part 2

IIM2
0

... and the three least significant in this.
**Setting range:** 0 to 999 with step of 1 p.u.$^{n}$.
**Standard Value:** 0

## TTSO - Total Time of Service

TTSO
0

Total time of service of the OLTC before installation of the IDM. This variable will be increased by the IDM in the extent in which the OLTC is used.
**Setting range:** 0 to 32767 with step of 1 day.
**Standard Value:** 0

## STMA - Time of Service Since the Last Maintenance

STMA
0

Time of service of the OLTC since the last time its maintenance was conducted. This variable will be increased by the IDM in the extent in which the OLTC is used.
**Setting range:** 0 to 32767 with step of 1 day.
**Standard Value:** 0

## AVTI- Interval for Daily Mean

AVTI
15

Define here the time interval required to determine the mean of daily operations of the OLTC.
**Setting range:** 1 to 90 with step of 1 day.
**Standard Value:** 15 days

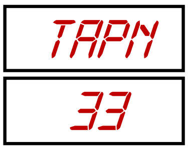
## CRST - Maintenance Reset


When the OLTC maintenance is conducted, there is need to select SIM [Yes] in this item for the counters that depend on the last maintenance to be reset and for the IDM to continue providing a good assistance on notifying the moment of a new maintenance.
**Setting range:** YES – Reset, NO – Nothing happens.
**Standard Value:** NO

## TMES – TAP Position


If option number 4 is activated, it will be possible to enable the function that measures the TAP position by selecting *SIM* [YES] in this item.
**Setting range:** YES Measures, NO - Does not measure.
**Standard Value:** YES

## TAPN – Number of TAPs

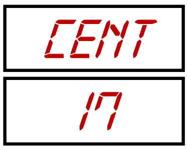



Parameterize here the number of TAPs that the changer has.
**Setting range:** 2 to 50 with step of 1 TAP.
**Standard Value:** 33 TAPs

## IndI – Type of Indication

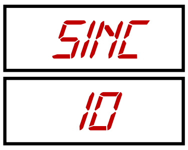

Choose the method of presenting the TAP position from the options listed.
**Setting range:** SMPL – Single, ALFI: - Inverted alphanumeric, ALF – Alphanumeric, bLTI – Inverted bilateral, bLT – Bilateral
**Standard Value:** SMPL

## CENT – Central TAP




Parameterize the central TAP of the changer.
**Setting range:** 2 to 50 with step of 1 TAP.
**Standard Value:** 17

## SINC – Synchronism Time




Inform the time expected to conduct a full TAP change operation.
**Setting range:** 1 to 100 with step of 1s.
**Standard Value:** 10s

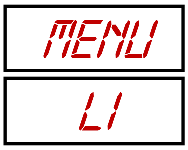
## RESI – Resistance per Step


This parameterization item will exist only if the method for measuring the TAP position chosen at the time of purchase of the IDM is the potentiometric transmitter. The values of the resistances of the changer steps must be entered here.
**Setting range:** 4.7 to 20 with step of 0.1Ω.
**Standard Value:** 10.0 Ω

### AOR – Analog Scale


This parameterization item will exist only if the method for measuring the TAP position chosen at the time of purchase of the IDM is mA analog input. Enter here the scale of the mA signal of the analog output from those cited below.
**Setting range:** 0-5 mA, 0-10 mA, 0-20 mA, 4-20 mA.
**Standard Value:** 0-20mA

## 5.12 LI Menu - Line Current




Monitoring of the line current, besides being important itself, is also used to calculate wear of the changer contact when in assembly with option 5, *circuit breaker* maintenance.

The variables eventually parameterized for this monitoring are as follows:

### ILEN - Line Current


Choose if monitoring of the line current must be activated or not. Although this menu is still present when the motor is three-phase, the SIM value will not be recorded because all the current inputs will be busy monitoring its supply current.
**Setting range:** YES Monitors, NAO – NO Does not monitor.
**Standard Value:** YES

### RdI1 – Auxiliary CT


Parameter of the transformation ratio of the auxiliary CT, which is connected directly to the IDM.
**Setting range:** 1 to 32767, in steps of 1.
**Standard Value:** 3000

### RdI2 – High Voltage CT


Parameter of the high voltage CT ratio, over which the auxiliary CT measures the current used by the IDM. It is the CT ratio of the line, seen in Figure 15 of section 3.4.1.
**Setting range:** 1 to 32767, in steps of 1.
**Standard Value:** 400

## 5.13 ADVA Menu - Advanced


Four submenus will be found in this menu intended for setting the advanced parameters of the IDM functioning. They are:

### CONF – Advanced Settings


Covers some basic settings not addressed in the basic setting menu.

**Navigation:** Use ↑ and ↓ to navigate between the menus and ↵ to enter one of them. The P key returns to the level of the previous menu without saving changes. The description of this submenu is in section 5.13.1.

### RELA - Function of the Relays


The IDM has output relays that can be programmed to activate light boards and other systems interested in knowing the state of the alarms. In this submenu, the relays can be tested and have their functions programmed.

**Navigation:** Use ↑ and ↓ to navigate between the menus and ↵ to enter one of them. The P key returns to the level of the previous menu without saving changes. The description of this submenu is in section 5.13.2.

### LOG - Historical Record


With **option 2 - Mass Memory**, the log of the IDM measurements is recorded while there is space in the memory. Set in this menu aspects of these records.

**Navigation:** Use ↑ and ↓ to navigate between the menus and ↵ to enter one of them. The P key returns to the level of the previous menu without saving changes. The description of this submenu is in section 5.13.3.

### FACT - Factory


Menu for exclusive use by manufacturer.

> On making an attempt to access the factory menu with wrong password, the IDM will show in its display the VOID message for a few seconds. The time of indication of this message increases in the extent in which new attempts are made with wrong password.
> After 5 attempts with wrong password, the IDM will fully block access to this menu and the VOID message will be permanently indicated. Although the equipment's functioning is not affected, said fact configures loss of warranty.

## 5.13.1 CONF Submenu – Advanced Settings


Covers some basic settings not addressed in the basic setting menu.

## dISP – Display


Choose if the measurement shown in the display during normal operation of the device should continue to be the last visited by the user or if the display information must roll alternating between all the measurements.
**Setting range:** FIXE - Does not roll, ALT - Rolls.
**Standard Value:** FIXE

## CdEN – Auxiliary Contact


Having chosen here *YES*, the IDM will monitor the motor's auxiliary contact position. If the contact is detected as open, an alert will be activated, but this logic between the open contact and notice may be inverted in the next item.
**Setting range:** YES – Monitors, NO - Does not monitor.
**Standard Value:** YES

## CCB – Auxiliary Contact Mode

Depending on how the connections are made or the objective of monitoring the auxiliary contact, choose if the contact will function in normal mode or inverted mode.

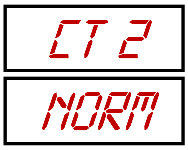

If inverted mode is chosen, the notice of the auxiliary contact's position will be issued if it is in the closed position.

This item will be presented only if chosen to monitor the auxiliary contact selecting *YES* in the previous item.
**Setting range:** INVE – Inverted logic, NORM – Normal logic.
**Standard Value:** NORM

## CT 1 – Polarity of CT 1


Parameterize the connection polarity of CT 1, connected to pins 26 and 25.
**Setting range:** NORM – Normal polarity, INVE – Inverted polarity.
**Standard Value:** NORM

## CT 2 – Polarity of CT 2




Parameterize the connection polarity of CT 2, connected to pins 27 and 25.
**Setting range:** NORM – Normal polarity, INVE – Inverted polarity.
**Standard Value:** NORM

## CT 3 – Polarity of CT 3

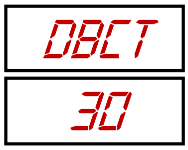

Parameterize the connection polarity of CT 3, connected to pins 28 and 25.
**Setting range:** NORM – Normal polarity, INVE – Inverted polarity.
**Standard Value:** NORM

## HYST - Hysteresis

For the alarms not to be activated and deactivated many times on account of small variations around a single event, it is interesting to regulate a hysteresis to shut down the alarms.
**Setting range:** 0 to 10, in steps of 0.1%
**Standard Value:** 2.0%

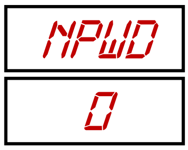

## DBCT – Debouncing Time

Performs debouncing of the inputs of external contacts, according to the debouncing time programmed.
**Setting range:** 10 to 100, in steps of 1 ms.
**Standard Value:** 30ms




## NPWd – New Password

Here the user can choose a new password to protect access to the parameterization menus. In case the password is forgotten, contact the Treetech technical support.
**Setting range:** 0 to 8191, in steps of 1.
**Standard Value:** 0




### 5.13.2 RELA Submenu - Relays

The IDM has output relays that can be programmed to activate light boards and other systems interested in knowing the state of the alarms. In this submenu, the relays can be tested and have their functions programmed.


## RL “n” – Relay Selection

First, use the  and  arrows to choose which relay you wish to configure. There are five relays that can be configured. When “n” is equal to the number of the relay desired, select it by pressing it . Once in the relay setting submenu, navigate with the arrows, confirm with  and return to the previous screen with .


The relay setting submenu can be seen in the following section: 5.13.2.1.

## RLYT – Relay Test

After using the arrows to cover all the RL “n” s, the last option will be TRLS. By pressing , the alarm test submenu will be opened there, which can be checked in the section 0.

### 5.13.2.1 RL "n" Submenu – Relay Setting


Configure if the relay selected should function in normal or inverted mode as well as its activation conditions.

#### MOdE – Relay Mode


Relays 1 to 3 may function in NO or NC modes, depending on how electrical installation of the IDM is done. By hardware, relays 4 and 5 are always NO.

However, the IDM allows the electrical assembly logic to be inverted by firmware such that all the relays can function in NO and NC modes.
**Setting range:** NORM – Normal, INVE – Inverted.
**Standard Value:** NORM

#### FAIL - Self-diagnosis


Decide if the relay must be activated when there is active self-diagnosis in the IDM.

**Setting range:** YES Activates, NO Does not activate.
**Standard Value:** NO

## SMPR - Semaphore

The semaphore is a variable that stores the general state of the alarms. If there are no active alarms, its status will be green, if there is any active yellow alarm, its status will be yellow and so on. It is possible to set one or more relays to be activated in case of a specific status of the SMFR variable.

If the user's interest is to activate a relay to notify the occurrence of alarms with yellow or red gravity without being concerned with knowing exactly which of the two alarm types occurred, just parameterize this item as RY in only one relay.

Since the semaphore can only assume four values: green (0), blue (1), yellow (2) or red (3), a possibility to obtain the full status of this variable is to program two different relays as follows:

**Relay 1**: Parameterize RYVMAM. **Relay 2**: Parameterize R B.

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


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

**Setting range:**

- : Relay is not activated for any SMFR status.<br>
G : Activates Relay if SMFR = 0, Green.<br>
B : Activates Relay if SMFR = 1, Blue.<br>
BG : Activates Relay if SMFR = 0 or 1, Green or Blue.<br>
Y : Activates Relay if SMFR = 2, Yellow.<br>
YG : Activates Relay if SMFR = 0 or 2, Green or Yellow.<br>
YB : Activates Relay if SMFR = 1 or 2, Blue or Yellow.<br>
YBG : Activates Relay if SMFR = 0, 1 or 2, Green, Blue or Yellow.<br>
R : Activates Relay if SMFR = 3, Red.<br>
RG : Activates Relay if SMFR = 0 or 3, Green or Red.<br>
RB : Activates Relay if SMFR = 1 or 3, Blue or Red.<br>
RBG : Activates Relay if SMFR = 0, 1 or 3, Green, Blue or Red.<br>
RY : Activates Relay if SMFR = 2 or 3, Yellow or Red.<br>
RYG : Activates Relay if SMFR = 0, 2 or 3, Green, Yellow or Red.<br>
RYB : Activates Relay if SMFR = 1, 2 or 3, Blue, Yellow or Red.<br>
RYBG : Activates Relay if SMFR is in any one of the states 0, 1, 2 or 3.

**Standard Value:** -

## VMVL - Very Low Motor Voltage


Decide if the relay must be activated when this alarm is active.
**Setting range:** YES - Activates, NO - Does not activate.
**Standard Value:** NO

## VML - Low Motor Voltage


Decide if the relay must be activated when this alarm is active.
**Setting range:** YES - Activates, NO - Does not activate.
**Standard Value:** NO

## VMH - High Motor Voltage


Decide if the relay must be activated when this alarm is active.
**Setting range:** YES - Activates, NO - Does not activate.
**Standard Value:** NO

## VMVH - Very High Motor Voltage


Decide if the relay must be activated when this alarm is active.
**Setting range:** YES - Activates, NO - Does not activate.
**Standard Value:** NO

## UMVL - Motor Voltage During Operation Very Low


Decide if the relay must be activated when this alarm is active.
**Setting range:** YES - Activates, NO - Does not activate.
**Standard Value:** NO

## UML - Motor Voltage During Operation Low


Decide if the relay must be activated when this alarm is active.
**Setting range:** YES - Activates, NO - Does not activate.
**Standard Value:** NO

## UMH - Motor Voltage During Operation High


Decide if the relay must be activated when this alarm is active.
**Setting range:** YES - Activates, NO - Does not activate.
**Standard Value:** NO

## UMVH - Motor Voltage During Operation Very High

Decide if the relay must be activated when this alarm is active.

**Setting range:** YES - Activates, NO - Does not activate.

**Standard Value:** NO


## IPH – High Peak Current

Decide if the relay must be activated when this alarm is active.

**Setting range:** YES - Activates, NO - Does not activate.

**Standard Value:** NO


## IPVH – Very High Peak Current

Decide if the relay must be activated when this alarm is active.

**Setting range:** YES - Activates, NO - Does not activate.

**Standard Value:** NO


## EVL - Very Low Operation Energy

Decide if the relay must be activated when this alarm is active.

**Setting range:** YES - Activates, NO - Does not activate.

**Standard Value:** NO


## EL - Low Operation Energy

Decide if the relay must be activated when this alarm is active.

**Setting range:** YES - Activates, NO - Does not activate.

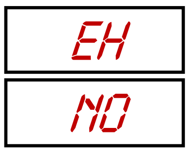
**Standard Value:** NO


## EH- High Operation Energy

Decide if the relay must be activated when this alarm is active.

**Setting range:** YES - Activates, NO - Does not activate.

**Standard Value:** NO




## EVH - Very High Operation Energy

Decide if the relay must be activated when this alarm is active.

**Setting range:** YES - Activates, NO - Does not activate.

**Standard Value:** NO

## OVL – Very Low Operation Time


Decide if the relay must be activated when this alarm is active.
**Setting range:** YES - Activates, NO - Does not activate.
**Standard Value:** NO

## OL – Low Operation Time


Decide if the relay must be activated when this alarm is active.
**Setting range:** YES - Activates, NO - Does not activate.
**Standard Value:** NO

## OH – High Operation Time


Decide if the relay must be activated when this alarm is active.
**Setting range:** YES - Activates, NO - Does not activate.
**Standard Value:** NO

## OVH – Very High Operation Time


Decide if the relay must be activated when this alarm is active.
**Setting range:** YES - Activates, NO - Does not activate.
**Standard Value:** NO

## MTRG – Triggered Motor


Decide if the relay must be activated when this alarm is active.
**Setting range:** YES - Activates, NO - Does not activate.
**Standard Value:** NO

## CBAL – Open Motor Circuit Breaker


Decide if the relay must be activated when this alarm is active.
**Setting range:** YES - Activates, NO - Does not activate.
**Standard Value:** NO

## SGL – Consumption Curve Under the Signature


Decide if the relay must be activated when this alarm is active.
**Setting range:** YES - Activates, NO - Does not activate.
**Standard Value:** NO

## SGA – Consumption Curve Above the Signature


Decide if the relay must be activated when this alarm is active.
**Setting range:** YES - Activates, NO - Does not activate.
**Standard Value:** NO

## WOMA - Maintenance Alert by Number of Operations.

Decide if the relay must be activated when this alarm is active.
**Setting range:** YES - Activates, NO - Does not activate.
**Standard Value:** NO


## WIMA - Maintenance Alert by Current Integral.

Decide if the relay must be activated when this alarm is active.
**Setting range:** YES - Activates, NO - Does not activate.
**Standard Value:** NO


## WTSV - Maintenance Alert by Time of Service.

Decide if the relay must be activated when this alarm is active.
**Setting range:** YES - Activates, NO - Does not activate.
**Standard Value:** NO


## NTRA - Advance Maintenance Alert by Number of Operations.

Decide if the relay must be activated when this alarm is active.
**Setting range:** YES - Activates, NO - Does not activate.
**Standard Value:** NO


## ITRA - Advance Maintenance Alert by Current Integration.

Decide if the relay must be activated when this alarm is active.
**Setting range:** YES - Activates, NO - Does not activate.
**Standard Value:** NO


## TTRA - Advance Maintenance Alert by Time of Service.

Decide if the relay must be activated when this alarm is active.
**Setting range:** YES - Activates, NO - Does not activate.
**Standard Value:** NO


## MTVL – Very Low Temperature of the Mechanism

Decide if the relay must be activated when this alarm is active.
**Setting range:** YES - Activates, NO - Does not activate.
**Standard Value:** NO


## MTL – Low Temperature of the Mechanism

Decide if the relay must be activated when this alarm is active.
**Setting range:** YES - Activates, NO - Does not activate.
**Standard Value:** NO

## MTH – High Temperature of the Mechanism

Decide if the relay must be activated when this alarm is active.
**Setting range:** YES - Activates, NO - Does not activate.
**Standard Value:** NO

MTH / NO

## MTVH – Very High Temperature of the Mechanism

Decide if the relay must be activated when this alarm is active.
**Setting range:** YES - Activates, NO - Does not activate.
**Standard Value:** NO

MTVH / NO

## HILW – Low Heating System Current

Decide if the relay must be activated when this alarm is active.
**Setting range:** YES - Activates, NO - Does not activate.
**Standard Value:** NO

HILW / NO

## HIHG– High Heating System Current

Decide if the relay must be activated when this alarm is active.
**Setting range:** YES - Activates, NO - Does not activate.
**Standard Value:** NO

HIHG / NO

## VCVL - Very Low Motor Control Circuit Voltage

Decide if the relay must be activated when this alarm is active.
**Setting range:** YES - Activates, NO - Does not activate.
**Standard Value:** NO

VCVL / NO

## VCL - Low Motor Control Circuit Voltage

Decide if the relay must be activated when this alarm is active.
**Setting range:** YES - Activates, NO - Does not activate.
**Standard Value:** NO

VCL / NO

## VCH - High Motor Control Circuit Voltage

Decide if the relay must be activated when this alarm is active.
**Setting range:** YES - Activates, NO - Does not activate.
**Standard Value:** NO

VCH / NO

## VCVH - Very High Motor Control Circuit Voltage

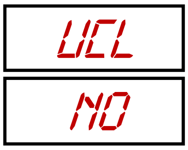
Decide if the relay must be activated when this alarm is active.
**Setting range:** YES - Activates, NO - Does not activate.
**Standard Value:** NO

VCVH / NO

### UCVL - Very Low Control Circuit Voltage During Operation


Decide if the relay must be activated when this alarm is active.
**Setting range:** YES - Activates, NO - Does not activate.
**Standard Value:** NO

### UCL - Low Control Circuit Voltage During Operation




Decide if the relay must be activated when this alarm is active.
**Setting range:** YES - Activates, NO - Does not activate.
**Standard Value:** NO

### UCH - High Control Circuit Voltage During Operation


Decide if the relay must be activated when this alarm is active.
**Setting range:** YES - Activates, NO - Does not activate.
**Standard Value:** NO

### UCVH - Very High Control Circuit Voltage During Operation


Decide if the relay must be activated when this alarm is active.
**Setting range:** YES - Activates, NO - Does not activate.
**Standard Value:** NO

In fact, there are more alarms than relays to signalize them, but a relay can be activated for more than one reason and this allows one to know the status of the alarms per category.

To read all the alarms individually remotely, an interesting option would be to acquire a monitoring system like the SIGMA from Treetech, which also integrates other equipment of the substation and allows one to follow up and record all measurements and oscillograms online.

#### 5.13.2.2 RLYT Submenu – Relay Test

In this submenu, test the functioning of the relays in sequence. Press to enter.

## ARL"n" – Test of Relay "n"

Use the arrow to select SIM [Yes] and close the relay contact. Once in the SIM [Yes] position, use the arrow to return to the NAO [No] position, opening the contact again. Once relay "n" has been sufficiently tested, press to move to the next relay. Test it in the same way.

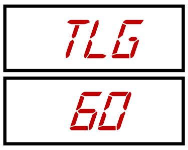

Once the five relays have been tested, on pressing again, the user returns to the initial screen of this menu. In this moment, the relays forgotten in the closed position during the test will reopen automatically so as not to compromise their normal functioning. Likewise, on pressing the key at any time of the tests, the submenu will be abandoned and all relays that have been closed will be reopened.
**Setting range:** SIM – [Yes] Test/close relay, NAO – [No] Do not test/open relay.
**Standard Value:** NAO [No]

### 5.13.3 LOG Submenu - Historical Record


With **option 2 - Mass Memory**, the history of the IDM measurements is recorded in a LOG. Set in this menu aspects of these records.

## TLG – LOG Recording Interval

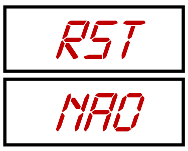
The measurements and states of majority of the IDM variables over time are recorded in the LOG.




The larger the interval between the records, the longer the memory will last and the greater the period covered by the LOG, however, the data resolution will be reduced. When the LOG memory becomes full, the older information will be substituted by the newer information.
**Setting range:** 1 to 1440 with steps of 1 min.
**Standard Value:** 60 min

## RST - LOG Reset

In some situations, when the IDM is installed in a different changer, it makes no sense to keep the operation log of the former changer.




On choosing SIM [Yes] in this item, the LOG will be deleted and its memory cleared for new recordings.
**Setting range:** SIM – [Yes] Resets the memory, NAO - [No] Does nothing.
**Standard Value:** NAO [No]

# 6 Commissioning to start service

Once the equipment has been installed according to Project and Installation of this manual, the commissioning must follow the basic steps below:

- Check the mechanical and electrical installations according to recommendations of *chapter 3 – Design and Installation* of this manual. Check accuracy of the electrical connections (e.g.: through continuity tests).
- Before powering up the changer, or before removing the short-circuit from the secondary of the CTs, check if the circuits of the current transformers are connected accurately to the IDM input, ensuring that no CT is open;
- Power up the IDM with appropriate voltage.
- Make the entire parameterization of the IDM, according to the instructions of *chapter 5 - Parameterization* of this manual. The parameterization made must be noted down in the form provided in Appendix A – Parameterization Tables of the Torque Monitor for Tap Changers IDM / SDM.
- With a continuity indicator, test the operation of the alarm contacts. Closing and opening of the contacts can be forced by changing their mode of operation from NO to NC and vice-versa.

With suitable computer, communication converters and software, where applicable, check the functioning of the RS-485 port of the IDM;

# 7 Technical Data

| | |
|---|---|
| Supply Voltage: | 38 to 265 Vac/Vdc 50/60 Hz |
| Maximum consumption: | ≤13 W |
| Operation Temperature: | -40 to +85 °C |
| Degree of Protection: | IP 20 |
| Connections: | 0.3 to 2.5 mm2, 22 to 12 AWG |
| Fixation: | Fixation in panel |
| Measurement Inputs | |
| Currents: | 4 external clip-on CTs 0...10 Aac rms / Other ranges upon request |
| Voltages: | 3 of 0...265 Vac P-N or 0...240 Vac P-P or 0...300Vdc. Other ranges with external PT |
| Temperatures: | 1 Pt100 Ω sensor at 0 ºC range-55 to 200 ºC |
| Dry contacts: | 1 potential free |
| TAP: | Potentiometric transmitter, or current loop 0-5, 0-10, 0-20 or 4-20 mA |
| Maximum errors | |
| Currents: | 1% of the measurement in the range 0.5...10 Aac |
| Voltages: | 1% of the measurement in the range 80...265 Vac (single-phase)/ 80...240 Vac (three-phase) / 100...300 Vdc |
| Temperatures: | 0.5% of the end of scale + sensor error |
| Outputs to relays: | 3 reversible + 2 NO/NC (specify in the purchase) |
| Maximum switching power: | 70 W(dc) / 220 VA(ac) |
| Maximum switching voltage: | 250 Vdc / 250 Vac |
| Maximum conduction current: | 5 A |
| Serial Communication Ports: | 1 RS-485 standard |
| Communication Protocols: | Modbus RTU, DNP3 (Optional) |

# 8 Type Tests

The IDM is an equipment built on the **SmartSensor 1** platform and tested according to the table:

| | |
|---|---|
| Immunity to Surges (IEC 60255-22-5 and IEC 61000-4-5): | |
| Differential mode: | 1kV, 5 per polarity (+/-) |
| Common Mode: | 2kV, 5 per polarity (+/-) |
| Immunity to Electric Transients (IEC 60255-22-1, IEC 61000-4-12 and IEEE C37-90-1) | |
| 1st Cycle peak value, Frequency, Time and Repetition rate, Peak Value, Decay at 50% | 2.5 kV common mode, 1 kV diff. mode, 1MHz, 2 sec., 200 surges/s, 5 cycles |
| Voltage Impulse (IEC 60255-5): | |
| Waveform, Amplitude, Number of pulses: | 1.2/50 µs, 5kV, 3 negative and 3 positive, 5-s interval |
| Applied Voltage (IEC 60255-5): | |
| Withstand voltage at power frequency: | 2kV 60 Hz 1min. against ground |
| Immunity to Radiated Electromagnetic Fields (IEC 60255-22-3 and IEC 61000-4-3): | |
| Frequency, Field intensity: | 80 to 2500 MHz, 10 V/m |
| Immunity to Conducted Electromagnetic Disturbances (IEC 60255-22-6 and IEC 61000-4-6): | |
| Frequency, Field intensity: | 0.15 to 80 MHz, 10 V/m |
| Immunity to power frequency magnetic fields (IEC 61000-4-8): | |
| Magnetic field intensity and direction: | 30 A/m, 3 orthogonal axes |
| Electrostatic discharges (IEC 60255-22-2, IEC 61000-4-2 and IEEE C37.90.3): | |
| Intensity and repetitions: | 15kV air mode, ten discharges per polarity |
| Immunity to Fast Electric Transients (IEC 60255-2-4, IEC 61000-4-4 and IEEE C37-90-1): | |
| Supply, inputs and outputs: | 4kV |
| Power supply failure (IEC 60255-22-11 and IEC 61000-4-11): | |
| Voltage Drops: | 0-80% of U, 1/2 at 300 cycles, 85 V and 265 V, 50/60 Hz |
| Short interruptions: | 5 seconds, 85 V and 265 V, 50/60 Hz |
| Withstanding of cold (IEC 60068-2-1): | |
| Temperature, Test time: | -40°C, 16 hours |
| Withstanding of dry heat (IEC 60068-2-2): | |
| Temperature, Test time: | +85°C, 16 hours |
| Withstanding of wet heat (IEC 60068-2-78): | |
| Temperature and humidity, Test time: | +40°C, 85% rel. hum., 24 hours |
| Thermal cycle (IEC 60068-2-14): | |
| Temperature range, Total test time: | -40 to +85°C, 96 hours |
| Response to vibration (IEC 60255-21-1): | |
| Manner of Application, Duration, Frequency, Intensity: | 3 axes, sinusoidal 8 min/axis, 0.075 mm from 10 to 58 Hz, 1 G from 58 to 150 Hz |
| Resistance to vibration (IEC 60255-21-1): | |

| | |
|---|---|
| Manner of Application, Duration, Frequency, Intensity: | 3 axes, sinusoidal 160 min/axis, 10 to 150 Hz, 2G |

Electrical safety (EN 61010-1):

Protections against electric shock, mechanical risk, risk due to fluids and spreading of flame

Resistance to heat and protective devices

# 9 Specification for order

The IDM is a universal equipment, with its features selected in its programming menus through its front panel or communication ports. The supply input is universal (38 to 265 Vdc/Vac, 50/60 Hz).
Thus, in the purchase order of the device, there is only need to specify:

- Specialist Monitor for Tap Changer Torque - IDM
- Quantity;
- Quantity of external window CTs with selectable core (Clip-On). The quantity will vary according to the application (*single-phase or three-phase*) and must be indicated in the purchase order;
- Basic Version or Optional Items desired;
    - If the option of TAP measurement is requested, there is need to inform if a potentiometric transmitter or mA analog signal will be used to make the measurement;

# 10 Appendices

## 10.1 Appendix A – Parameterization Tables of the Torque Monitor for Tap Changers IDM / SDM

Table 10 was elaborated for equipment from the firmware version 1.10.
The aim of this table is to aid the procedure of documentation of the parameters used in the equipment, assisting the work of the operator and, eventually, of the technical assistance.
Some submenus and parameters are shown only if the respective optional functions are available.

**Table 10 - Auxiliary table for parameterization of the Tap Changer Torque Monitor – IDM / SDM**

| Tap Changer Torque Monitor (IDM / SDM) – Parameterization Sheet | | | |
|---|---|---|---|
| **Serial No.:** | | **Date:** | |
| **Identification:** | | **Responsible:** | |

| Submenu | Parameter | Description | Set Value |
|---|---|---|---|
| **LNG** | LNG | Local interface language | |
| **CLK** | MODE | Internal clock or NTP server | |
| | DAY | Day | Day |
| | MON | Month | Month |
| | YEAR | Year | Year |
| | HOUR | Hour | H |
| | MIN | Minute | min |
| | UTC | GMT Time Zone | |
| **CONF** | PROT | Communication Protocol | |
| | ADDR | Address in the serial communication | |
| | BDR | Serial communication baud-rate | kbps |
| **MOTR** | MTPS | Supply type selection | DC, M or T |
| | VMTE | Enables voltage monitoring | |
| | IMTE | Enables current monitoring | |
| | CTPT | Phase shift between PT and CT | degrees |
| | ROPT | PT Ratio | |
| | RCT1 | Window CT Ratio | |
| | RCT2 | CT Ratio | |
| | NVTM | Motor nominal voltage | V |
| | TON | Voltage value to trigger ON | V |
| | TOFF | Voltage value to trigger OFF | V |
| **OSCL** | INOS | Interval between successive recordings | S |
| | TNOS | Total number of recordings of each oscillography | |
| | RPOS | No. of records prior to the trigger | |
| | SNO1 | Serial no. of the operation, most significant part | |
| | SNO2 | Serial no. of the operation, least significant part | |
| | IOS1 | Enables IMT1 to be recorded in the oscillography | YES or NO |

| Submenu | Parameter | Description | Set Value |
|---|---|---|---|
| | IOS2 | Enables IMT2 to be recorded in the oscillography | YES or NO |
| | IOS3 | Enables IMT3 to be recorded in the oscillography | YES or NO |
| | VOS1 | Enables VMT1 to be recorded in the oscillography | YES or NO |
| | VOS2 | Enables VMT2 to be recorded in the oscillography | YES or NO |
| | VOS3 | Enables VMT3 to be recorded in the oscillography | YES or NO |
| | PFOS | Enables the power factor to be recorded in the oscillography | YES or NO |
| SIGN | MTTS | Starting time, during which the starting current is monitored, not the consumption curve. | s |
| | NMA0 | Number of operations for learning of the signature curve without intermediary TAPs | |
| | NMAI | Number of operations for learning of the signature curve with intermediary TAPs | |
| | SCA | Number of points off the signature curve of the engine torque needed for alarm activation. | |
| | MASX | Maximum deviation in the "x" axis | % |
| | MASI | Lower limit for signature | % |
| | MASS | Upper limit for signature | % |
| | INTT | Maximum quantity of intermediary TAPs | 1 to 4 |
| | MTT0 | Time of operation without intermediary TAPs | s |
| | MTT1 | Time of operation with 1 Intermediary TAP | s |
| | MTT2 | Time of operation with 2 Intermediary TAPs | s |
| | MTT3 | Time of operation with 3 Intermediary TAPs | s |
| | MTT4 | Time of operation with 4 Intermediary TAPs | s |
| | LERN | Learning curve reset | |
| GEAL | ALTV | Timing for alarm due to under and overvoltage | s |
| | NTMX | Number of operations for maintenance alert | |
| | ITMX | Current integration for maintenance alert | $p.u.^n$ |
| | TTMX | Time of service for maintenance alert | days |
| | RTMA | Time in advance for issuance of maintenance alert | days |
| | ALTT | Timing for alarms due to temperature | min |
| | MTVL | Alarm due to very low mechanism temperature | ºC |

| Submenu | Parameter | Description | Set Value |
|---|---|---|---|
| | MTL | Alarm due to low mechanism temperature | ºC |
| | MTH | Alarm due to high mechanism temperature | ºC |
| | MTVH | Alarm due to very high mechanism temperature | ºC |
| | HRLT | Temperature below which the mechanism heating resistance is turned on | ºC |
| | HRHT | Temperature above which the mechanism heating resistance is turned on | ºC |
| | ALMT | Timing for alarms | s |
| **MODE** | MODE | Choose mode used to activate the alarms | AUTO, MAN |
| | TLRN | Time of learning for the samples | h |
| | LERN | Learning reset | YES or NO |
| **VAL** | **If "Mode = Automatic", values in "%". If "Mode = Manual", absolute values.** | | |
| | VMVL | Very low motor voltage alarm | V or % |
| | VML | Low motor voltage alarm | V or % |
| | VMH | High motor voltage alarm | V or % |
| | VMVH | Very high motor voltage alarm | V or % |
| | UMVL | Voltage in the motor during operation very low alarm | V or % |
| | UML | Voltage in the motor during operation low alarm | V or % |
| | UMH | Voltage in the motor during operation high alarm | V or % |
| | UMVH | Voltage in the motor during operation very high alarm | V or % |
| | IPH | High current peak alarm | A or % |
| | IPVH | Very high current peak alarm | A or % |
| | EVL0 | Very low operation energy without intermediary TAPs alarm | W.h or % |
| | EL0 | Low operation energy without intermediary TAPs alarm | W.h or % |
| | EH0 | High operation energy without intermediary TAPs alarm | W.h or % |
| | EVH0 | Very high operation energy without intermediary TAPs alarm | W.h or % |
| | EVL1 | Very low operation energy with 1 intermediary TAP alarm | W.h or % |
| | EL1 | Low operation energy with 1 intermediary TAP alarm | W.h or % |
| | EH1 | High operation energy with 1 intermediary TAP alarm | W.h or % |

| Submenu | Parameter | Description | Set Value |
|---|---|---|---|
| | EVH1 | Very high operation energy with 1 intermediary TAP alarm | W.h or % |
| | EVL2 | Very low operation energy with 2 intermediary TAPs alarm | W.h or % |
| | EL2 | Low operation energy with 2 intermediary TAPs alarm | W.h or % |
| | EH2 | High operation energy with 2 intermediary TAPs alarm | W.h or % |
| | EVH2 | Very high operation energy with 2 intermediary TAPs alarm | W.h or % |
| | EVL3 | Very low operation energy with 3 intermediary TAPs alarm | W.h or % |
| | EL3 | Low operation energy with 3 intermediary TAPs alarm | W.h or % |
| | EH3 | High operation energy with 3 intermediary TAPs alarm | W.h or % |
| | EVH3 | Very high operation energy with 3 intermediary TAPs alarm | W.h or % |
| | EVL4 | Very low operation energy with 4 intermediary TAPs alarm | W.h or % |
| | EL4 | Low operation energy with 4 intermediary TAPs alarm | W.h or % |
| | EH4 | High operation energy with 4 intermediary TAPs alarm | W.h or % |
| | EVH4 | Very high operation energy with 4 intermediary TAPs alarm | W.h or % |
| | OVL0 | Very low operation time without intermediary TAPs | s or % |
| | OL0 | Low operation time without intermediary TAPs | s or % |
| | OH0 | High operation time without intermediary TAPs | s or % |
| | OVH0 | Very high operation time without intermediary TAPs | s or % |
| | OVL1 | Very low operation time with 1 intermediary TAP | s or % |
| | OL1 | Low operation time with 1 intermediary TAP | s or % |
| | OH1 | High operation time with 1 intermediary TAP | s or % |
| | OVH1 | Very high operation time with 1 intermediary TAP | s or % |
| | OVL2 | Very low operation time with 2 intermediary TAPs | s or % |
| | OL2 | Low operation time with 2 intermediary TAPs | s or % |
| | OH2 | High operation time with 2 intermediary TAPs | s or % |
| | OVH2 | Very high operation time with 2 intermediary TAPs | s or % |
| | OVL3 | Very low operation time with 3 intermediary TAPs | s or % |

| Submenu | Parameter | Description | Set Value |
|---|---|---|---|
| | OL3 | Low operation time with 3 intermediary TAPs | s or % |
| | OH3 | High operation time with 3 intermediary TAPs | s or % |
| | OVH3 | Very high operation time with 3 intermediary TAPs | s or % |
| | OVL4 | Very low operation time with 4 intermediary TAPs | s or % |
| | OL4 | Low operation time with 4 intermediary TAPs | s or % |
| | OH4 | High operation time with 4 intermediary TAPs | s or % |
| | OVH4 | Very high operation time with 4 intermediary TAPs | s or % |
| | MTRG | Motor in trigger | A or % |
| | HILW | Low heating current | A or % |
| | HIHG | High heating current | or % |
| | VCVL | Very low control voltage | V or % |
| | VCL | Low control voltage | V or % |
| | VCH | High control voltage | V or % |
| | VCVH | Very high control voltage | V or % |
| | UCVL | Very low control voltage during operation | V or % |
| | UCL | Low control voltage during operation | V or % |
| | UCH | High control voltage during operation | V or % |
| | UCVH | Very high control voltage during operation | V or % |
| CLAS | VMVL | Very low motor voltage alarm | –, B, Y, R |
| | VML | Low motor voltage alarm | –, B, Y, R |
| | VMH | High motor voltage alarm | –, B, Y, R |
| | VMVH | Very high motor voltage alarm | –, B, Y, R |
| | UMVL | Voltage in the motor during operation very low alarm | –, B, Y, R |
| | UML | Voltage in the motor during operation low alarm | –, B, Y, R |
| | UMH | Voltage in the motor during operation high alarm | –, B, Y, R |
| | UMVH | Voltage in the motor during operation very high alarm | –, B, Y, R |
| | IPH | High current peak alarm | –, B, Y, R |

| Submenu | Parameter | Description | Set Value |
|---|---|---|---|
| | IPVH | Very high current peak alarm | –, B, Y, R |
| | EVL | Very low operation energy alarm | –, B, Y, R |
| | EL | Low operation energy alarm | –, B, Y, R |
| | EH | High operation energy alarm | –, B, Y, R |
| | EVH | Very high operation energy alarm | –, B, Y, R |
| | OVL | Very low operation time | –, B, Y, R |
| | OL | Low operation time | –, B, Y, R |
| | OH | High operation time | –, B, Y, R |
| | OVH | Very high operation time | –, B, Y, R |
| | MTRG | Motor in trigger | –, B, Y, R |
| | CBAL | Open motor circuit breaker | –, B, Y, R |
| | SGL | Operation curve below the signature | –, B, Y, R |
| | SGH | Operation curve above the signature | –, B, Y, R |
| | WOMA | Maintenance alert by number of operations. | –, B, Y, R |
| | WIMA | Maintenance notice by current integration | –, B, Y, R |
| | WTSV | Maintenance alert by time of operation. | –, B, Y, R |
| | NTRA | Advance maintenance alert by number of operations. | –, B, Y, R |
| | ITRA | Advance maintenance alert by current integration. | –, B, Y, R |
| | TTRA | Advance maintenance alert by time of service. | –, B, Y, R |
| | MTVL | Very low control temperature | –, B, Y, R |
| | MTL | Low control temperature | –, B, Y, R |
| | MTH | High control temperature | –, B, Y, R |
| | MTVH | Very high control temperature | –, B, Y, R |
| | HILW | Low heating current | –, B, Y, R |
| | HIHG | High heating current | –, B, Y, R |
| | VCVL | Very low control voltage | –, B, Y, R |

| Submenu | Parameter | Description | Set Value |
|---|---|---|---|
| | VCL | Low control voltage | –, B, Y, R |
| | VCH | High control voltage | –, B, Y, R |
| | VCVH | Very high control voltage | –, B, Y, R |
| | UCVL | Very low control voltage during operation | –, B, Y, R |
| | UCL | Low control voltage during operation | –, B, Y, R |
| | UCH | High control voltage during operation | –, B, Y, R |
| | UCVH | Very high control voltage during operation | –, B, Y, R |
| TEMP | MECT | Enables monitoring of the mechanism temperature | YES or NO |
| | AMBT | Enables monitoring of the ambient temperature | YES or NO |
| | SML | Enables the RTD sensor temperature simulator | YES or NO |
| MECI | IMEN | Enables and selects the supply of the mechanism heater current. | Option |
| | CTR1 | Clip-on CT ratio | |
| | CTR2 | CT Ratio | |
| COMV | COMV | Enables and selects the supply of the control voltage. | Option |
| | PTRT | PT Ratio | |
| OLTC | CTNI | Nominal current | A |
| | IEXP | Integration exponent | |
| | SNT1 | How often integrate the current when there is one intermediate tap | |
| | SNT2 | How often integrate the current when there are two intermediate taps | |
| | SNT3 | How often integrate the current when there are three intermediate taps | |
| | SNT4 | How often integrate the current when there are four intermediate taps | |
| | TNO1 | Total number of operations, most significant part | |
| | TNO2 | Total number of operations, least significant part | |
| | TNM1 | Number of operations since last maintenance, most significant part | |
| | TNM2 | Number of operations since last maintenance, least significant part | |
| | IIT1 | Total current integration, most significant part | p.u.n |
| | IIT2 | Total current integration, least significant part | p.u.n |

| Submenu | Parameter | Description | Set Value |
|---|---|---|---|
| | IIM1 | Current integration since last maintenance, most significant part | p.u.n |
| | IIM2 | Current integration since last maintenance, least significant part | p.u.n |
| | TTSO | Total time of service | Days |
| | STMA | Time of service since the last maintenance | Days |
| | AVTI | Time interval to calculate the daily mean | Days |
| | CRST | Changer maintenance reset | YES or NO |
| | TMES | Enables TAP monitoring | YES or NO |
| | TAPN | Number of changer TAPs | |
| | INDI | Type of indication | Option |
| | CENT | Central TAP | |
| | SINC | Time of a complete TAP change | s |
| | RESI | Resistance of the potentiometric transmitter step | Ω |
| | AOR | mA analog signal scale | Option |
| IL | ILEN | Enable monitoring of the line current | YES or NO |
| | RDI1 | Auxiliary CT Ratio | |
| | RDI2 | High voltage CT ratio | |
| CONF | DISP | Rolling of screens | YES or NO |
| | CDEN | Monitoring of the circuit breaker contact | YES or NO |
| | CCB | Circuit breaker use mode | NORM or INV |
| | CT 1 | CT 1 Mode | NORM or INV |
| | CT 2 | CT 2 Mode | NORM or INV |
| | CT 3 | CT 3 Mode | NORM or INV |
| | HYST | Hysteresis of the alarms | % |
| | DBCT | Debouncing time | Ms |
| | NPWD | New password | |
| RL”n” | **Note down the setting for each one of the five relays:** | | **R1 R2 R3 R4 R5** |
| | MODE | Mode of functioning of the relays | NORM or INV |

| Submenu | Parameter | Description | Set Value | | | | | |
|---|---|---|---|---|---|---|---|---|
| | FAIL | Self-diagnosis | | | | | | YES or NO |
| | SMPR | Semaphore signal | | | | | | Option |
| | VMVL | Very low motor voltage | | | | | | YES or NO |
| | VML | Low motor voltage | | | | | | YES or NO |
| | VMH | High motor voltage | | | | | | YES or NO |
| | VMVH | Very high motor voltage | | | | | | YES or NO |
| | UMVL | Very low motor voltage during operation | | | | | | YES or NO |
| | UML | Low motor voltage during operation | | | | | | YES or NO |
| | UMH | High motor voltage during operation | | | | | | YES or NO |
| | UMVH | Very high motor voltage during operation | | | | | | YES or NO |
| | IPH | High peak current | | | | | | YES or NO |
| | IPVH | Very high peak current | | | | | | YES or NO |
| | EVL | Very low operation energy | | | | | | YES or NO |
| | EL | Low operation energy | | | | | | YES or NO |
| | EH | High operation energy | | | | | | YES or NO |
| | EVH | Very high operation energy | | | | | | YES or NO |
| | OVL | Very low operation time | | | | | | YES or NO |
| | OL | Low operation time | | | | | | YES or NO |
| | OH | High operation time | | | | | | YES or NO |
| | OMVH | Very high operation time | | | | | | YES or NO |
| | MTRG | Motor in trigger | | | | | | YES or NO |
| | CBAL | Open motor circuit breaker | | | | | | YES or NO |
| | SGL | Consumption curve below the signature | | | | | | YES or NO |
| | SGH | Consumption curve above the signature | | | | | | YES or NO |
| | WOMA | Maintenance alert by number of operations. | | | | | | YES or NO |
| | WIMA | Maintenance notice by current integration | | | | | | YES or NO |

| Submenu | Parameter | Description | Set Value | | | | | |
|---|---|---|---|---|---|---|---|---|
| | WTSV | Maintenance alert by time of service. | | | | | | YES or NO |
| | NTRA | Advance notice for maintenance by number of operations | | | | | | YES or NO |
| | ITRA | Advance notice for maintenance by current integration | | | | | | YES or NO |
| | TTRA | Advance notice for maintenance by time of service | | | | | | YES or NO |
| | MTVL | Very low mechanism temperature | | | | | | YES or NO |
| | MTL | Low mechanism temperature | | | | | | YES or NO |
| | MTH | High mechanism temperature | | | | | | YES or NO |
| | MTVH | Very high mechanism temperature | | | | | | YES or NO |
| | HILW | Low heating current | | | | | | YES or NO |
| | HIHG | High heating current | | | | | | YES or NO |
| | VCVL | Very low control voltage | | | | | | YES or NO |
| | VCL | Low control voltage | | | | | | YES or NO |
| | VCH | High control voltage | | | | | | YES or NO |
| | VCVH | Very high control voltage | | | | | | YES or NO |
| | UCVL | Very low control voltage during operation | | | | | | YES or NO |
| | UCL | Low control voltage during operation | | | | | | YES or NO |
| | UCH | High control voltage during operation | | | | | | YES or NO |
| | UCVH | Very high control voltage during operation | | | | | | YES or NO |
| **LOG** | TLG | Time for log record | | | | | | Min |
| | RST | LOG Reset | | | | | | YES or NO |

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