USER MANUAL



Treetech

SDG

SMART DEVICE GATEWAY

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1 Foreword

1.1 Legal information

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1.1.1 Disclaimer

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1.2 Presentation

This manual presents all the recommendations and instructions for installation, operation and maintenance of the Smart Device Gateway - SDG.

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.
- Underlined: References to external documents.

1.4 General and safety information

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

1.4.1 Safety symbols

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



Warning
This symbol is used to alert the user of potentially dangerous operating or maintenance procedures in which higher caution must be taken. Minor or moderate injuries may occur, as well as damage to the equipment.



Caution
This symbol is used to alert the user of a potentially dangerous operating or maintenance procedure, which demands extreme caution in its conduction. There may occur serious injuries or even death. Possible damages to the equipment may be irreparable.



Risk of electric shock
This symbol is used to alert the user of an operating or maintenance procedure that may result in electric shock if not strictly overseen. There may be minor, moderate, serious injuries or death.

1.4.2 General symbols

This manual uses the following general symbols:



Important
This symbol is used to highlight important information.



Tip
This symbol represents instructions that facilitate the use or access to functions in the SDG.

1.4.3 Minimum profile recommended for SDG 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 Smart Device Gateway - SDG.



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

To handle the SDG, the operator should:

- ✓ Be trained and authorized to operate, ground, turn on and off the SDG, following maintenance procedures in accordance with established safety practices, which are the sole responsibility of the SDG operator and maintainer;
- ✓ Be trained in the use of PPEs, CPEs and first-aid;
- ✓ Be trained in the working principles of the SDG, as well as its configuration;
- ✓ Follow regulatory recommendations regarding interventions in any type of equipment included in an electric power system;
- ✓ Have basic knowledge of TCP/IP networks to access the SDG web page through its IP in an internet browser.

1.4.4 Environmental and voltage conditions required to installation and operation

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

Table 1 - Operation conditions

Condition	Range/description
Aplication	Equipment for sheltered use in substations, industrial and similar environments.
Indoor/outdoor use	Indoor use
Protection level (IEC 60529)	IP20
Altitude (IEC EN 61010-1)	Up to 2000 m
Temperature (IEC EN 61010-1)	
Operation	-40...+85 °C
Storage	-40...+85 °C
Relative humidity (IEC EN 61010-1)	
Operation	5...95 % - uncondensed
Storage	3...98 % - uncondensed
Supply voltage fluctuation (IEC EN 61010-1)	Up to ±10 % of rated voltage
Overvoltage (IEC EN 61010-1)	Category II
Pollution level (IEC EN 61010-1)	Level 2
Atmospheric pressure (IEC EN 61010-1)	80...110 kPa

1.4.5 Test and installation instructions

This manual must be available to those responsible for installation, maintenance and users of the Smart Device Gateway - SDG.

To ensure user safety, equipment protection and correct operation, the following minimum precautions must be followed during the SDG installation and maintenance:

1. Carefully read this manual before installing, operating and maintaining the SDG. Errors in the installation, maintenance or adjustments of the SDG can cause communication failures, errors in commands and even the shutdown (trip) of an asset;

2. The installation, adjustments and operation of the SDG must be carried out by trained personnel familiar with IEDs and control devices and command circuits of substation equipment;

3. Special attention must be given to the electrical installation of the SDG, including the type and gauge of the cables and terminal blocks used, as well as the procedures for putting into service (commissioning), including the correct parameterization of the equipment.



This IED must be installed in a sheltered environment (a panel without doors in a control room or an enclosed panel in cases of outdoor installation) that does not exceed the temperature and humidity specified for the equipment.



Do not install this IED near heat sources such as heating resistors, incandescent lamps and high power devices or with heat sinks. It is also not recommended to install it near ventilation holes or where it may be hit by forced airflow, such as the outlet or inlet of cooling fans or forced ventilation ducts.

1.4.6 Cleaning and decontamination instructions

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



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

1.4.7 Inspection and maintenance instructions

For inspection and maintenance on the SDG, the following observations must be followed:



Do not open the equipment. There are no parts which can be repaired by the user inside it. This procedure must be done only by Treetech technical support, or professionals certified by Treetech. This equipment is completely maintenance free, and visual and operational inspections, periodic or not, can be done by the user. These inspections are not mandatory.

Opening the LAP at any time will lead to product warranty loss. In case of inappropriate opening, Treetech cannot ensure the product correct functioning, regardless of whether the warranty period has 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 users wish to acquire them in another way, they must strictly follow Treetech's specifications for this purpose. Thus, 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 risks.

1.4.8 Disposal and end-of-life instructions for the product

This product is subject to the European Directive 2012/19/EU on Waste Electrical and Electronic Equipment (WEEE). To ensure responsible disposal in accordance with the law, please follow the guidelines below:



Upon reaching the end of its useful life, this equipment **should not be disposed of with regular household waste.**

Proper disposal:

- ✓ Dispose of the product at a collection point specializing in electronic waste or authorized recycling centers;
- ✓ Consult local authorities, distributors, or the manufacturer for information on the nearest collection points;
- ✓ Proper disposal helps protect the environment, allows for the recycling of materials, and reduces risks to human health caused by harmful substances present in electronic equipment.

1.5 EC Declaration of Conformity (ECD/EU Declaration of Conformity)

This equipment complies with the essential requirements of the following applicable European directives:

- Directive 2014/30/EU (Electromagnetic Compatibility – EMC);
- Directive 2014/35/EU (Low Voltage – LVD);
- Directives 2011/65/EU and 2015/863/EU (RoHS).

The product meets the corresponding harmonized standards and complies with the technical requirements established by the European Union.

The product meets the relevant harmonized standards and complies with the technical requirements established by the European Union. For more details, please refer to the SDG Declaration of Conformity document.

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1.6 Technical support

Do you already know our online customer service platform?

CS

On the CS page the fast and direct communication channel with our support team is available. Ask questions, solve problems and have up to date the application of your Treetech product. Moreover, Treetech's knowledge base is also available, including catalogs, manuals, application notes, frequent questions and other useful resources.

It may be necessary to send the equipment to Treetech's technical support in some cases. In the CS we present all the necessary procedure and contacts.

1.7 Warranty terms and conditions

The Smart Device Gateway – SDG, will be guaranteed by Treetech for a period of two (2) years from the acquisition date, exclusively against any manufacturing defects or quality defects that make it inappropriate for regular use.

The warranty will not cover product damage suffered as result of accidents, mistreatment, incorrect handling, incorrect installation and application, inadequate testing or in case of breach of the warranty seal.

Any need for technical assistance must be communicated to Treetech or its authorized representative, with the presentation of the equipment along with the respective purchase invoice.

No express or implied warranties other than those mentioned above are provided by Treetech. Treetech does not provide any guarantee of suitability of the SDG for a particular application.

The seller shall not be liable for any damage to property or for any loss and damage arising out of, connected with, or resulting from the purchase of the equipment, its performance or any services possibly provided along with the SDG.

In no event shall the seller be liable for damages incurred, including, but not limited to: loss of profits or income, impossibility of using the LAP or any associated equipment, capital costs, costs of purchased energy, costs of equipment, facilities or substitute services, downtime costs, buyers', customers' or employees' claims, regardless of whether such damages, claims or damages are based on contract, warranty, negligence, tort or otherwise. Under no circumstances will the seller be liable for any personal injury of any kind.

2 Introduction



Figure 1 - Smart Device Gateway - SDG

Modern substations integrate a lot of equipment into their systems, which often have different communication protocols. For these devices to communicate efficiently, it is necessary to have a flexible and efficient functionalities gateway that meets the most demanding speed and robustness requirements for the safe operation of the system.

Treetech's Smart Device Gateway - SDG meets this demand, performing efficient and secure communication to allow data transmission to supervisory, data acquisition or online monitoring systems using different communication protocols.

For this, Treetech's SDG was specially designed to integrate harmoniously and completely with any product that supports Modbus®, DNP3 and IEC 61850 protocols, acting as an extension of the same with the function of expanding its communication possibilities.

In this way, the SDG goes beyond a simple protocol converter, acting with greater efficiency and reliability compared to generic products on the market.

2.1 Characteristics

ROBUST HARDWARE

The SDG was designed to work in a substation electrical environment and can be installed directly on the transformer panel.

EMBEDDED OPERATING SYSTEM

The SDG has an embedded operating system, customized by Treetech. This ensures greater stability and reliability of operation of the product firmware.

MANAGEMENT OF USERS AND ACCESS PROFILES

To ensure data access security, the SDG works with profiles of different levels of operation, configuration, and administration access.

CUSTOMIZATION OF IEDS PROTOCOL MAPS

Through a friendly interface, the user is able to edit or create custom IED mappings, including merging IEDs and converting protocols.

CLOCK SYNCHRONISM

SDG allows configuration of clock synchronization via NTP or PTP protocol.

REMOTE UPDATE

Through the web interface, the firmware update process becomes extremely simple and intuitive.

SELF-DIAGNOSIS AND ALERTS

Self-diagnosis for detecting internal failures and RGB LED for signaling communication problems and alerts.

DIGITAL INPUTS AND OUTPUTS

There are a total of 7 fast-acting dry contact inputs for monitoring accessories and protections. They operate with an internal low voltage reference providing user safety. It also includes a self-diagnosis relay.

COMMUNICATION LOG DOWNLOAD

The SDG provides in its interface the download of the log of the communication protocols to facilitate the diagnosis of the network.

EXPERTISE IN EMBEDDED SYSTEMS

Treetech has experts in embedded operating systems with extensive experience in the area. This knowledge has been built into the SDG, making it an extremely safe and stable product, while remaining easy to operate.

REDUCED SIZE

Despite its advanced features, the SDG has an extremely small physical size, 38x114x155 mm (in the RJ45 model) and 38x 114x155 mm (in the FOFO or FO-Serial models).

STANDARD IP ACCESS BUTTON

The Smart Device Gateway includes a user-available button that allows the use of the factory default IP when network parameters are forgotten.

2.1.1 Inputs

- ✓ 7 inputs for monitoring dry contacts.

2.1.2 Outputs

- ✓ 1 relay for self-diagnosis indication.

2.1.3 Communication

- ✓ 1 RS-485 serial communication port;
- ✓ 1 RS-485 or RS-232 serial communication port;
- ✓ 2 Ethernet RJ45 ports (RJ45 model)*;
- ✓ 2 fiber optic Ethernet ports (FOFO model)*;
- ✓ 1 fiber optic Ethernet port and 1 serial fiber optic port (model FOSR)*;
- ✓ Modbus®, DNP3 and IEC 61850 MMS, AMPQ and API communication protocol, with timestamp support, capable of signaling events with 1 ms precision.

* The customer must choose only one of the 3 configurations.

2.2 Web page

FRIENDLY WEB INTERFACE

Using the latest HTML5 and Bootstrap technologies, all SDG management and configuration are done directly on the equipment's web interface, without the need for a license or proprietary software installation.

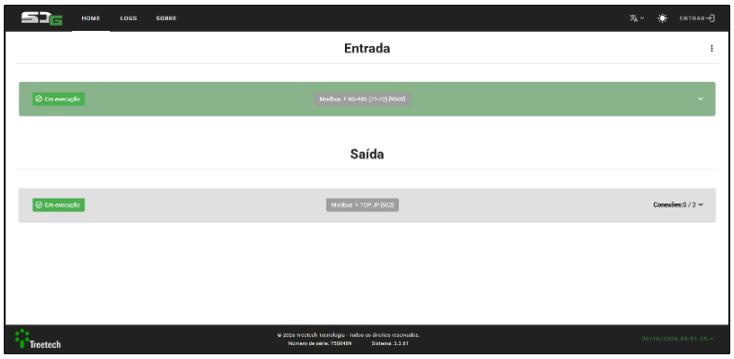


Figure 2 – Web page

REMOTE NETWORK SUPERVISION

It is possible to supervise the communication status and error statistics of the SDG.

Access to the details of the IEDs connected to the SDG allows you to follow the measurement values in real time.

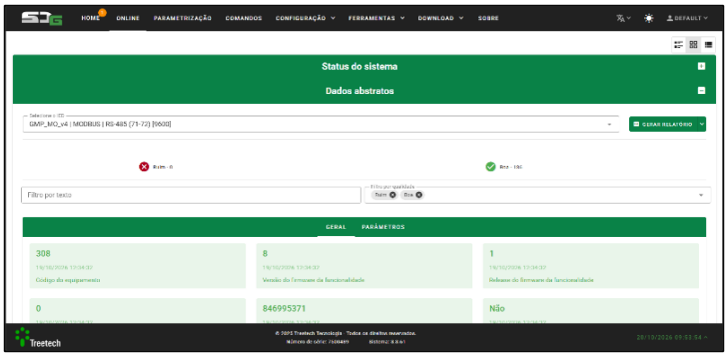


Figure 3 – Online tab

2.3 Basic operating philosophy

The Smart Device Gateway - SDG was designed to work directly with data acquisition and distribution from monitoring IEDs. It allows data acquisition from IEDs in Modbus® (RTU, TCP and/or RTU/TCP) and DNP3 (RTU and/or TCP) protocols. Once the acquisition is made, it is possible to redistribute this data into one or more protocols among Modbus® (RTU, TCP and/or RTU/TCP), DNP3(RTU and/or TCP) and IEC 61850 MMS, AMQP and API.

Such uniqueness is achieved thanks to a data architecture created in the SDG called abstract data. In it, the acquisition of data in a given protocol causes it to be stored in an abstract variable that is not linked to any protocol. Thus, the data can be manipulated in several ways: protocol conversion, joining or separating bits and even duplication. You can also configure abstracts to simulate user-determined values.

The data distribution part of the SDG output protocols is totally flexible, allowing the creation of virtual IEDs. These can compose data from one or more IEDs mapped to the input. In addition, the addressing in the output protocols can also be customized.

All configuration is done through a simple and intuitive web page. Once configured, it is possible to monitor the status of active communication networks and download communication logs.

The Smart Device Gateway (SDG) is a device that has two communication ports available for interconnection with other systems. These ports can be configured according to the following options: 2 fiber optic connections, or 1 fiber optic connection and 1 serial fiber optic connection, or even 2 RJ45 connections.

It is important to point out that the two communication ports are independent of each other, as long as the “Bridge” mode is selected in the “System” → “Network” section of the web page, which means that they operate in isolation and do not share network addressing or processing resources. Each port is associated with a unique Internet Protocol (IP) address, thus ensuring the individuality of each connection and allowing efficient and independent communication with other devices or systems on the network.

Through this versatile configuration and the availability of different communication interfaces, the SDG offers a flexible and adaptable solution to meet the specific connectivity needs of different scenarios and applications.

2.4 Intended use

The intended use of the Smart Device Gateway - SDG is to facilitate the acquisition and distribution of data from monitoring devices in industrial and automation environments. It was designed to work with different communication protocols on its inputs and outputs, including Modbus® (RTU, TCP and/or RTU/TCP), DNP3 (RTU and/or TCP) and IEC 61850 MMS, AMQP and API.

Note: The SDG does not implement the PRP and RSTP protocols; these are handled by the switch or another network management device.

3 Design and installation

3.1 System topology

The monitoring functionality integrated by the SDG allows the connection with IEDs in a fast and effective way, extending the reliability of these equipments to a new standard of communication.

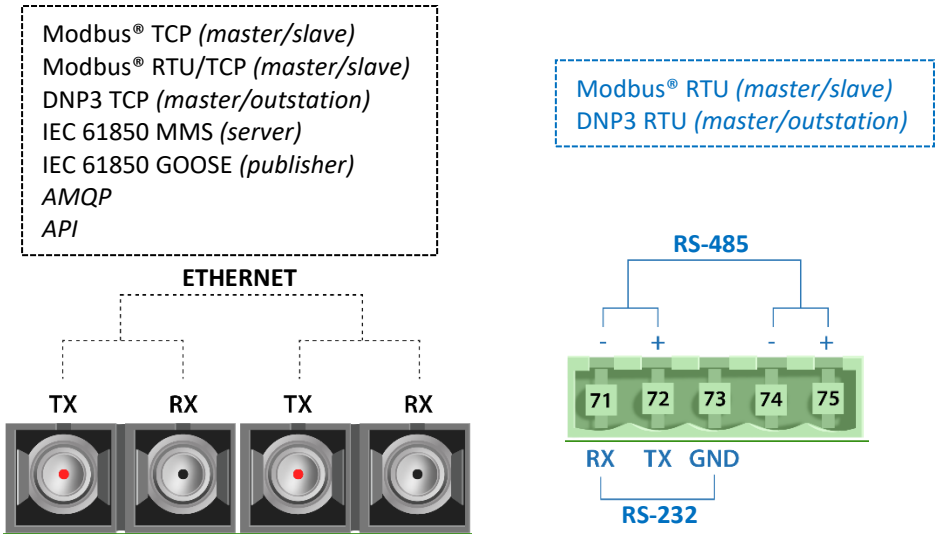


Figure 4 – Topology of the ports available in the fiber optic Ethernet model (FOFO)

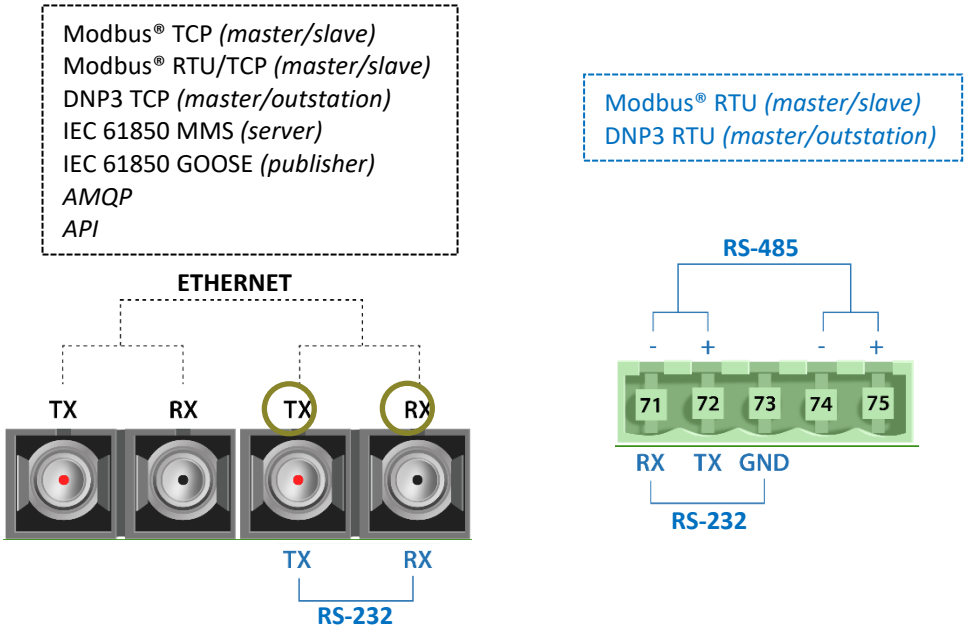


Figure 5 – Topology of the ports available in the fiber optic model Ethernet + serial (FOSR)

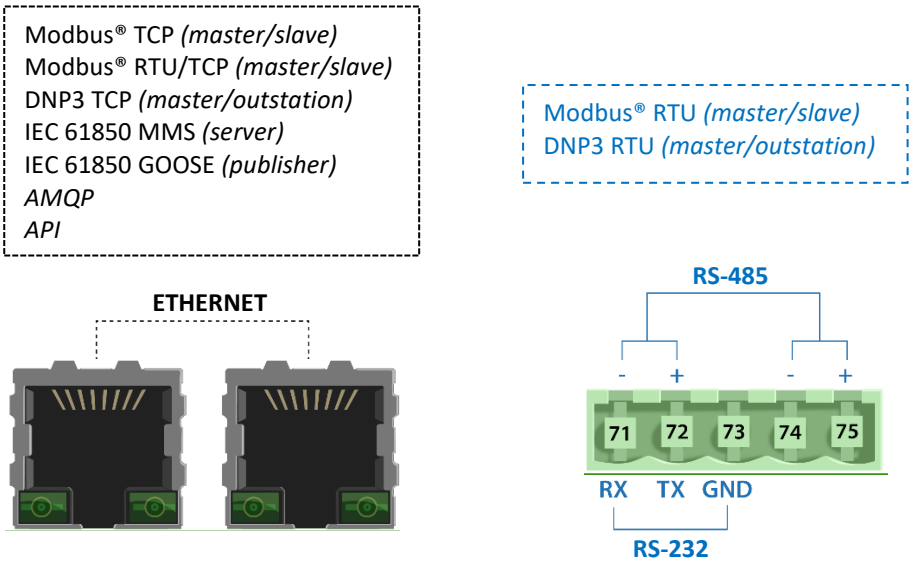


Figure 6 – Topology of the ports available in the RJ45 model (RJ45)

3.1.1 Application examples

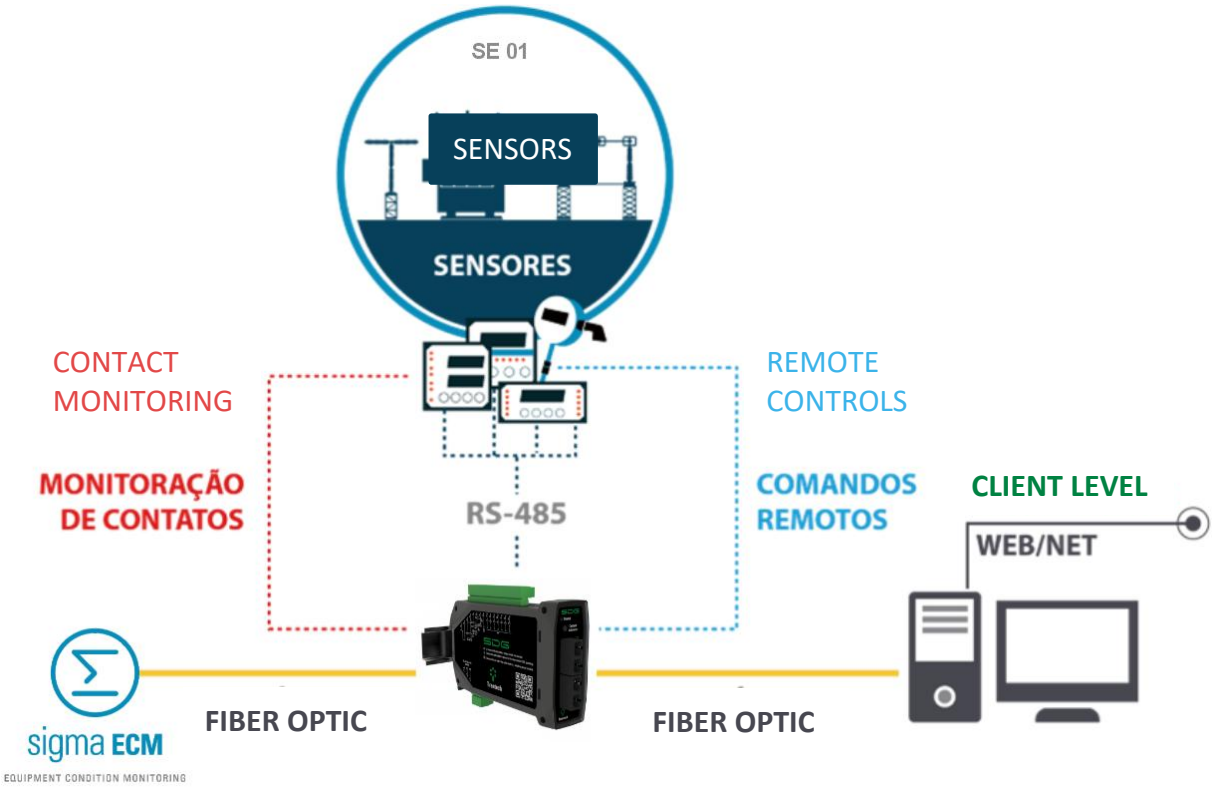


Figure 7 – Transformer scanning application example with SDG

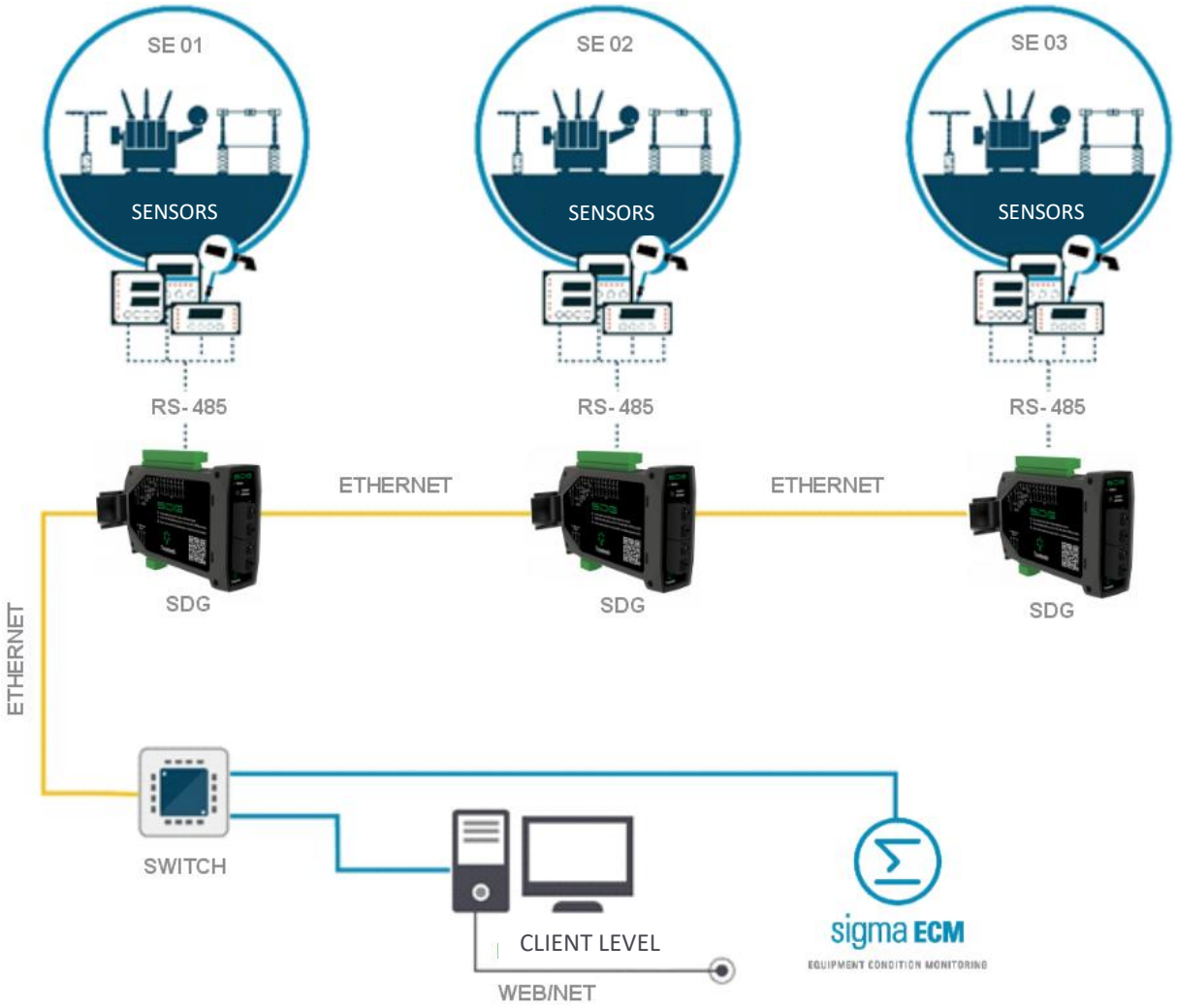


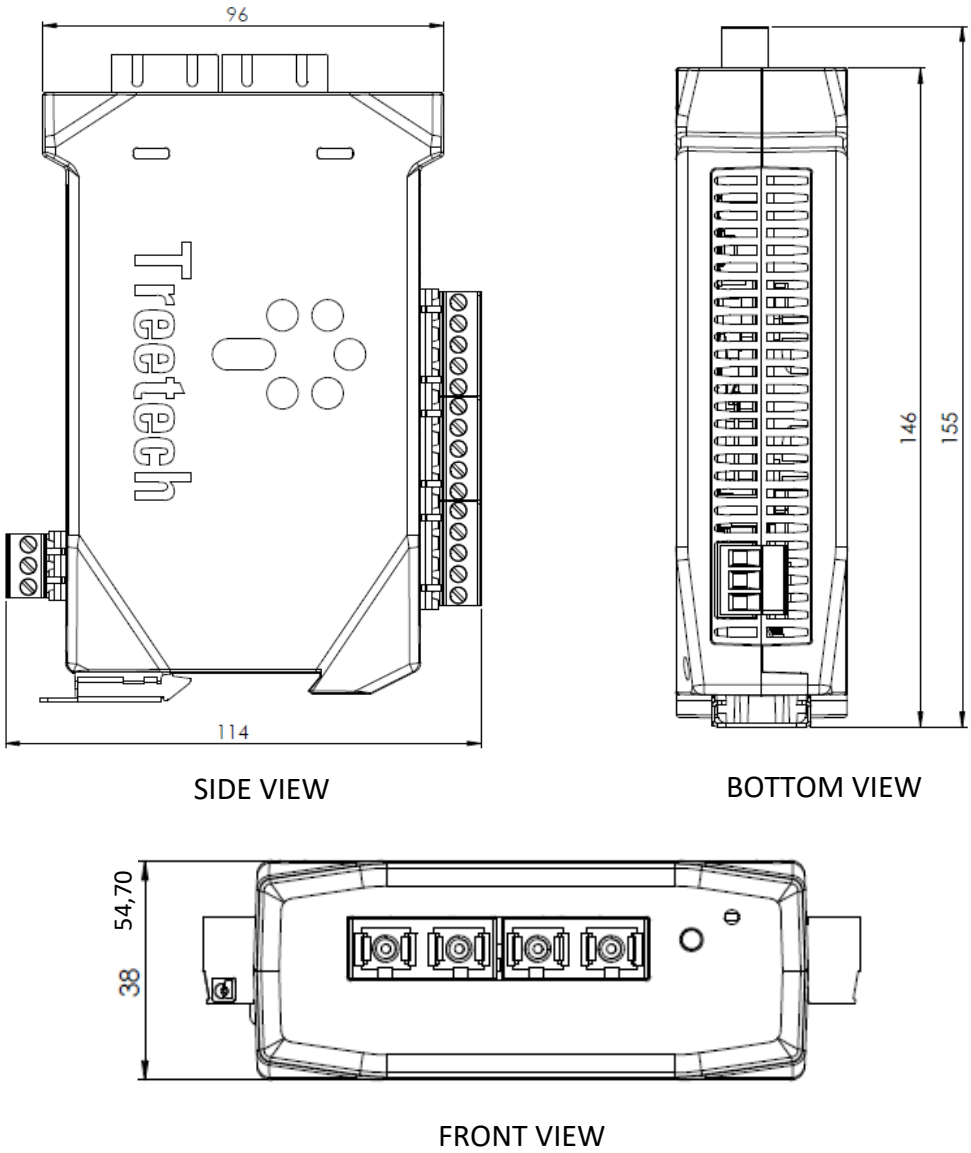
Figure 8 – Example of application that integrates several SDGs, which distribute data to more than one network

3.2 Mechanical installation

The Smart Device Gateway - SDG must be installed protected from the weather, inside panels or sheltered in a control room, for example. In either case, there must be an anti-condensation system.

The SDG is suitable for recessed installation and can be attached, for example, to doors or panel front plates. Fixing clips are supplied with the equipment. The following figures show the main dimensions of the equipment.

Special attention must be paid to the thickness of the paint layers on the plate where the cutout is made, because in some cases, when high-thickness paint is used, the reduction of the cutout area can even prevent the insertion of the equipment. The connection terminals are installed on the back of the SDG, in three removable connectors, in order to facilitate the connections. Cables from 0.3 to 2.5 mm2, 22 to 12 AWG, bare or with pin (or needle) type terminals can be used.



SIDE VIEW

BOTTOM VIEW

FRONT VIEW

Figure 9 - Dimensions of SDG FOFO and FOSR (in mm)

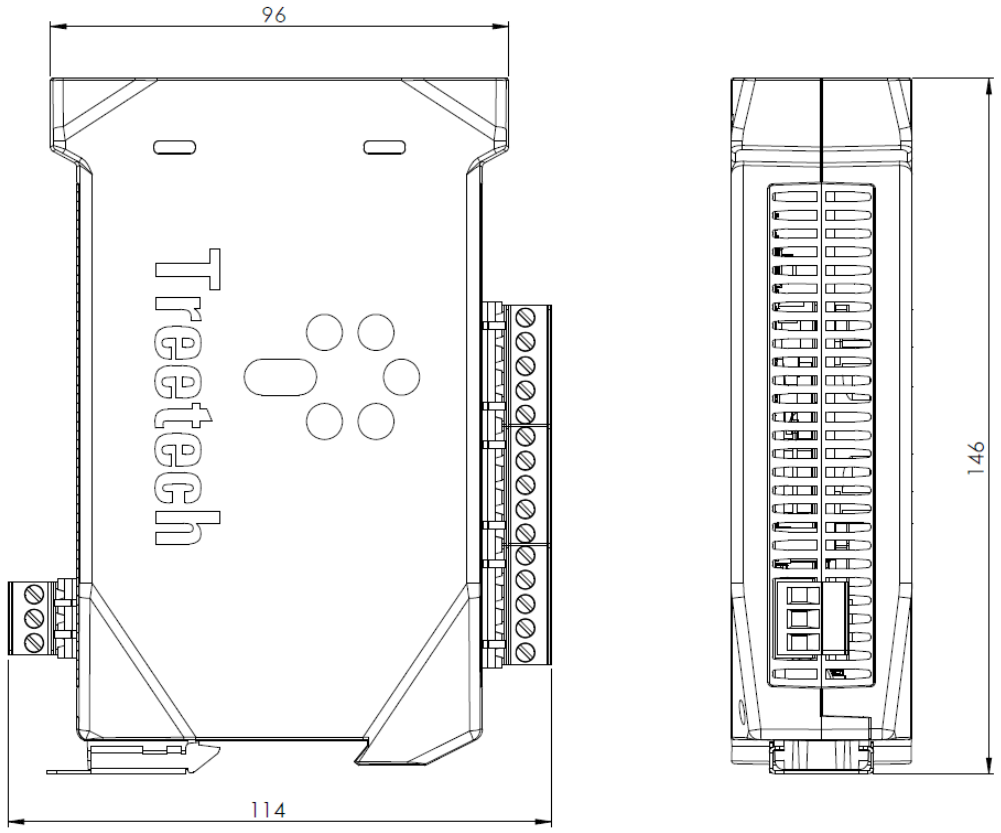


Figure 10 - SDG RJ45 Dimensions (in mm)

3.3 Electrical installation

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



Study and understand the application in which you intend to use the SDG. Get to know the functional, electrical and configuration characteristics of the SDG. In this way, you will be able to take full advantage of the equipment and minimize the risks to your safety.



This equipment works at dangerous supply voltage levels, which can cause death or serious injury to the operator or maintainer.



A circuit breaker must be used immediately before the power input (universal power - 85 to 265 Vac/Vdc, ≤ 13 W, 50/60 Hz), which corresponds to pins 2 and 3 of the SDG. This circuit breaker must have the number of poles corresponding to the number of phases used in the power supply - and the poles must only interrupt the phases, and never the neutral or ground - and provide thermal and electrical protection to the conductors that supply the equipment.
The circuit breaker must be close to the equipment and easily maneuvered by the operator. Additionally, it must have indelible identification showing that it is the SDG electrical disconnect device.



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



The minimum insulation for circuits connected to the SDG is 300 Vrms for auxiliary equipment and transducers and for equipment with its own power supply up to 50 Vrms.
The minimum isolation is 1.7 kVrms for equipment powered up to 300 Vrms, according to IEC 61010-1.
These values are relative to the intrinsic isolation of the devices connected to the SDG. Cases in which this value does not apply to equipment or devices connected to the SDG will be explicitly informed in this manual.

The standard schematic diagram of the SDG connections shows all the connection possibilities that the equipment provides.

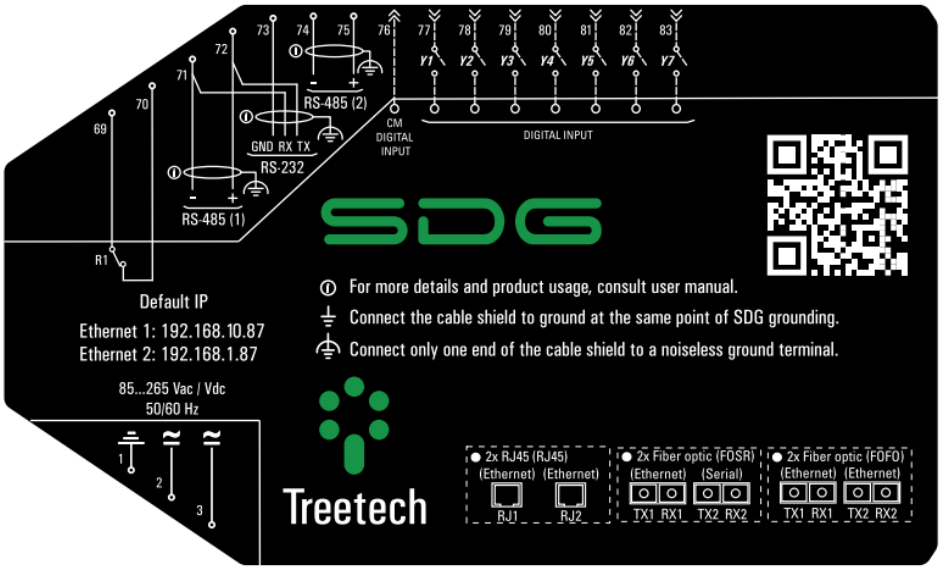


Figure 11 - Wiring diagram showing SDG input and output terminals

Special attention must be given to the correct connection of the components to the SDG at all stages of the installation. Errors in connecting the equipment can cause risks or even irreversible damage to the operator. Damage due to misuse is not covered by the warranty.



Figure 12 - Electrical connection diagram label in SDG

Below is the CE certification label, which identifies the product's compliance with European Union standards and technical requirements.

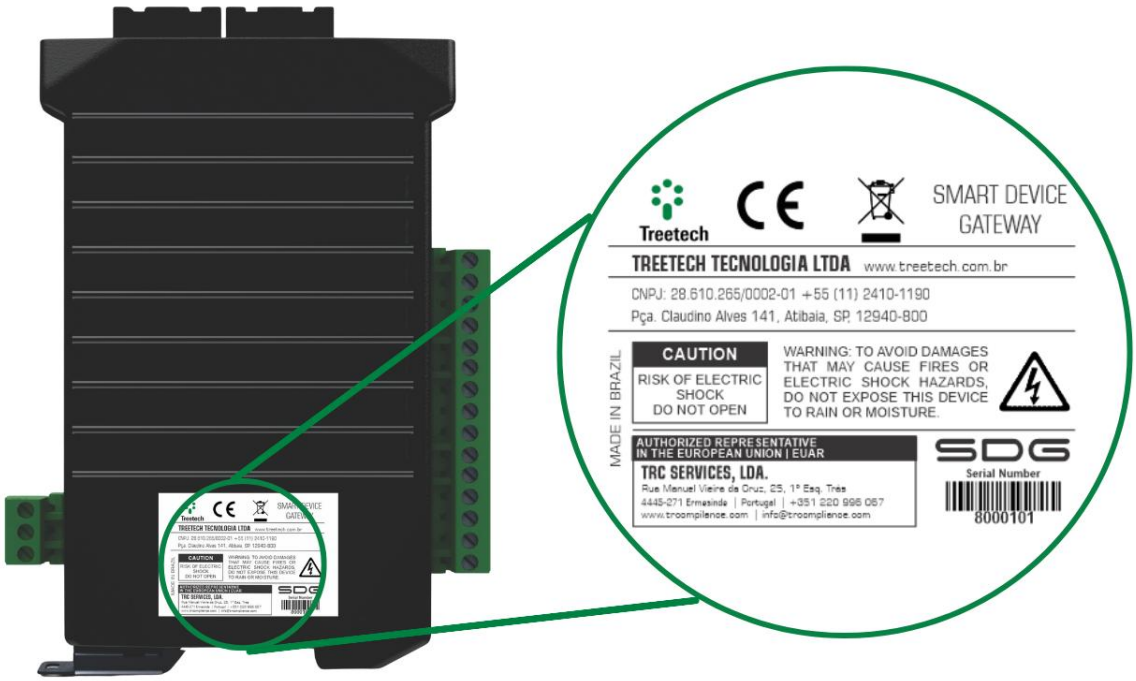


Figure 13 - CE certification label

In the following sections, the connections and functions of the inputs, outputs and communications of the equipment will be presented in more detail.

3.3.1 Input, output and communication terminals

Table 2 - SDG input terminals

Inputs	Terminals
Power and Grounding Inputs for universal power supply 85 to 265 Vac/Vdc, 50/60 Hz, ≤ 13 W.	1 – ground 2 – dc/ac 3 – dc/ac
Dry contact inputs These are the inputs for monitoring dry contacts.	76 – C1 (common) 77 – Y1 78 – Y2 79 – Y3 80 – Y4 81 – Y5 82 – Y6 83 – Y7

Table 3 - SDG output terminals

Outputs	Terminals
Self-diagnosis relay One potential free NC (Normally Closed) relay for self-diagnosis.	69 – NC 70 – Common

Table 4 - SDG communication terminals

Communication	Terminals
Ethernet port Communication port via RJ45 or multimode fiber optic SC for communication between SDG and control/supervisory system or communication with IEDs. Input protocols: Modbus® TCP (master), Modbus® RTU/TCP (master) and DNP3 TCP (master). Output protocols: Modbus® TCP (slave), Modbus® RTU/TCP (slave), DNP3 TCP (outstation) and IEC 61850 (server/publisher), AMQP and API.	RJ45 - 1 RJ45 - 2 TX/RX - 1 TX/RX - 2
Serial fiber optic port Communication port via multimode SC optical fiber for communication between SDG and control/supervisory system or communication with IEDs. Input protocols: Modbus® RTU (master), DNP3 RTU (master). Output protocols: Modbus® RTU (slave), DNP3 RTU (outstation).	TX/RX - 3 TX/RX - 4
RS-485 communication ports The SDG has two RS-485 serial communication ports, which are intended to allow the connection between the SDG and any supervisory or monitoring system owned by the user or for communication with other IEDs. Communication is done using the Modbus® (master/slave) or DNP3 (master/outstation) protocol, via shielded twisted pair cable.	71 - (-) 72 - (+) 74 - (-) 75 - (+)
RS-232 communication port The SDG has an RS-232 communication port for connection with any control, supervisory, monitoring or IEDs system. Communication is done using the Modbus® (master/slave) or DNP3 (master/outstation) protocol. It is recommended to use 3-way braided and shielded cable.	71 - RX 72 - TX 73 - GND

3.3.1.1 Power and grounding

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

3.3.1.2 Dry contact inputs

The SDG can continuously monitor the status of up to 7 external contacts.

3.3.1.3 Self-diagnosis relay

This relay is responsible for signaling power failures or any internal failure detected by the self-diagnosis system. When the SDG is energized, the contact of this relay changes state, returning to the off position in the event of internal faults or lack of power.

If the SDG processor temperature exceeds 90°C, **a message will be displayed indicating that the update is not possible at this time** for safety reasons; in this case, please wait for the temperature to decrease. However, if the SDG processor temperature is equal to or greater than 102°C, **the self-diagnosis relay will be activated**, and a warning will be displayed on the web page.

When all devices (IEDs) mapped to the input of an SDG experience communication failure (indicated in red on the web interface), **the system will automatically activate the self-diagnosis relay.**

3.3.1.4 RS-485 communication ports

The SDG can be connected to a data acquisition system (supervisory or monitoring system) or to other IEDs through the RS-485 serial communication ports. Up to 31 devices can be interconnected in the same communication network. The communication protocols available for this connection are Modbus® RTU (master/slave) or DNP3 RTU (master/outstation).

The interconnection of the RS-485 serial communication network must be carried out using a shielded, twisted pair cable, keeping the mesh without interruption throughout the route. If there is a need for intermediate terminals to interconnect the serial communication, also pass the cable shielding through the terminal, avoiding its interruption. The unshielded cable section due to the splice should be as short as possible, and it is advisable that the cable shield be grounded at only one end. It is advisable to use a 120 Ω terminating resistor at each end of the serial communication network to attenuate signal reflections.

In conjunction with the termination resistors, pull-up and pull-down resistors must be used at just one point in the network, as shown in the figure below. The 5 V direct voltage for powering the pull-up and pull-down resistors can be internal to the data acquisition system or IED. Note that some communication equipment may already have these resistors installed internally, dispensing with the use of external resistors. The maximum distance of 1200 m between the ends of the communication network must be obeyed.

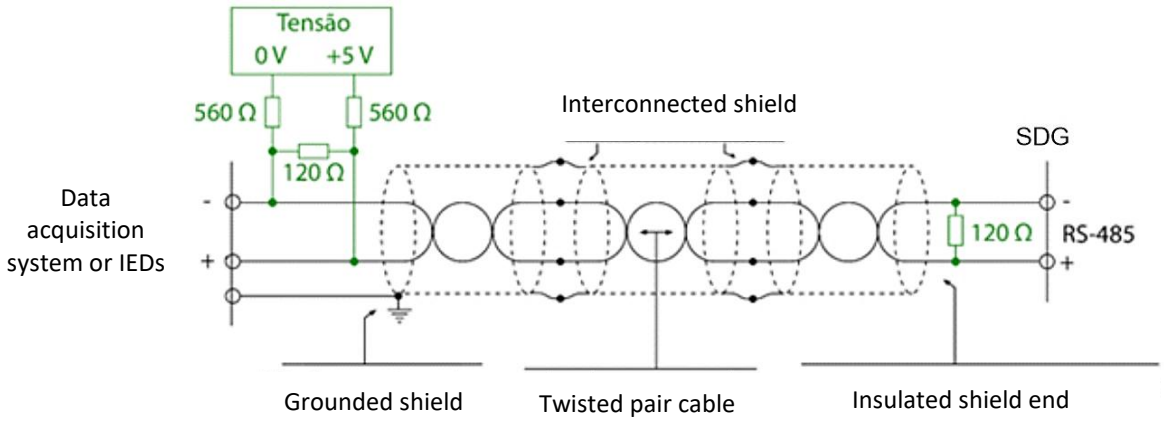


Figure 14 - RS-485 serial communication shield connection and grounding

4 Operation

Smart Device Gateway - SDG queries and configurations must be carried out through the web page. If there is any failure or intercurrence, the front LED will change color.

4.1 Button function

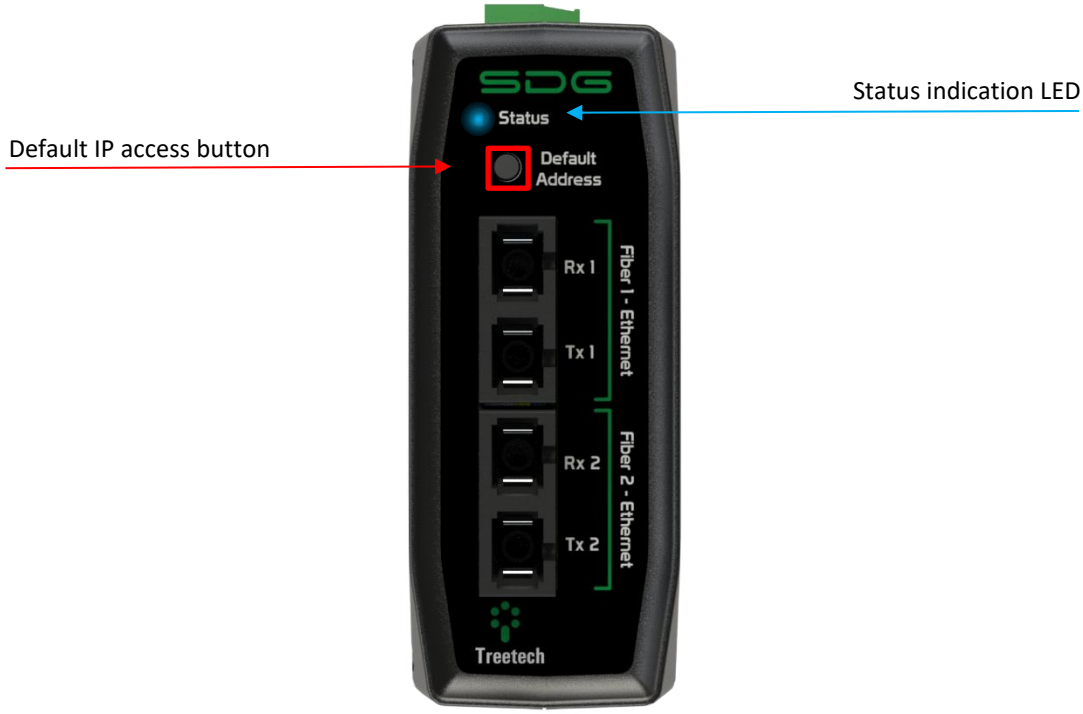


Figure 15 - “Default Address” button

The button located on the front of the SDG allows quick access to the device's default IP addresses. By default:

- ✓ IP “Fiber 1 - Ethernet”: 192.168.10.87;
- ✓ IP “Fiber 2 Ethernet”: 192.168.1.87.

If you forget the IP address configured on your device, follow the steps below:

- ✓ Press the front SDG button for 5 seconds;
- ✓ The LED will start flashing, indicating that the equipment is temporarily operating with the factory default IP address;
- ✓ Access the web interface using the default IP address corresponding to the desired interface;

- ✓ On the web interface, the user will be able to view the previously configured IP address;

- ✓ For the equipment to revert to the previous IP address, it will be necessary to confirm the change directly on the web page or restart it via the power supply.

4.2 Status LED

The SDG is equipped with an LED located on the front, which has crucial functionalities to indicate device status and communication. When turning on the board, the LED will show a green light, indicating that the SDG is working. During the boot process, once the kernel is loaded, the LED color will change to blue. After the system assumes its main function, the LED will start to replicate the color of the incoming communication, providing valuable information about the status of connected equipment.

Table 5 - Front LED color code

Color	Function
White	Waiting for input devices to initialize
Green	All input devices are communicating correctly
Orange	There is equipment in different conditions. It is necessary to enter the web page to see more details
Blue	SDG initialization
Red	All input devices are offline

5 Web interface

The management and configuration interface for the Smart Device Gateway (SDG) runs entirely within a web environment, eliminating the need for proprietary software installations or usage licenses. The system allows the user to oversee network status, monitor communication statistics for IEDs (using both master and slave protocols), and track measurement values in real time.

To access the interface, enter the device's IP address into the address bar of an up-to-date, compatible web browser (such as Google Chrome, Microsoft Edge, or Mozilla Firefox).

5.1 General information about the page

To facilitate navigation within the SDG web interface, a standardized set of symbols is used throughout various sections of the system. The display of certain fields and features may vary depending on whether the user is logged in or logged out, as well as on the user's access profile—limiting what can be viewed or adjusted to only those with the appropriate permissions.

Language

The SDG web interface is available in three languages: Portuguese, English, and Spanish. Users can select their preferred language, ensuring greater accessibility and a better understanding of the information while operating or configuring the equipment.



Figure 16 - Language tab

Information

This icon provides contextual information about the page and is mainly displayed in the configuration areas. It is useful for clarifying quick doubts during parameter adjustment.



Figure 17 - Informational icon

5.2 Login

5.2.1 General information regarding login

Username and password

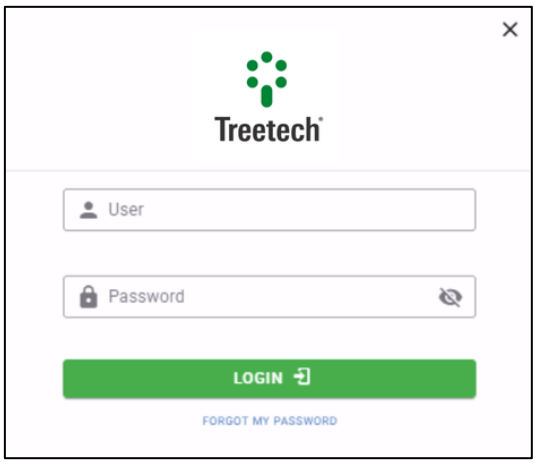


Figure 18 - Login screen

To access further details about the IED and acquire data online via the webpage, you must have a valid username and password. Click **Login** in the top-right corner of the page and then enter your login credentials.

The **default** username and password are:

Username: default **| Password:** Default123

Incorrect username and/or password

If the username and/or password are incorrect, a message in a red box will appear, indicating the error and the number of remaining attempts. Once the maximum number of allowed attempts (up to 3) is reached, the login will be temporarily blocked for approximately 1 minute; however, it will still be possible to log in using a different profile, if necessary.

Time limit

If a user logs in but remains inactive within the system, the session will expire after ten minutes. During the final thirty seconds, a window with a countdown timer will appear to alert the user that the session is about to end.

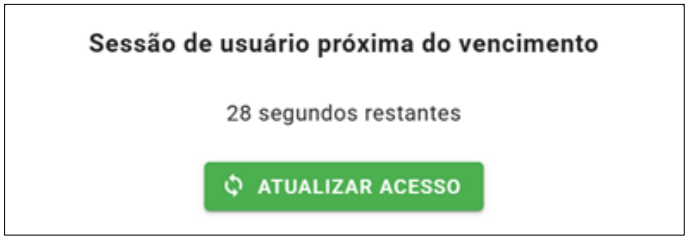


Figure 19 - Time limit

5.2.2 Editing profiles

Note: To edit, create, or manage access profiles, you must be logged into the system. If a session is already active, ensure that your account has the necessary permissions to perform the desired changes.

To edit your own profile, click on the **Default** option (or on the name of the logged-in user) and select **Edit profile**, as shown in the figure below.



Figure 20 - Editing profiles

Next, the screen will be displayed, as shown below, with data available for editing.
It is worth noting that this availability varies according to the user's **permission level**.

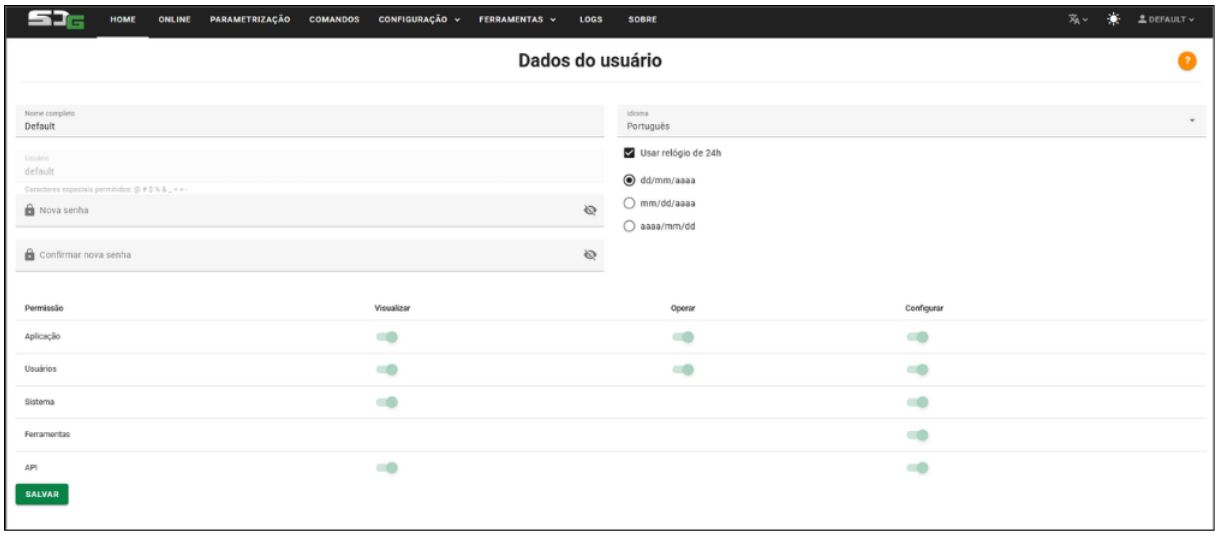


Figure 21 - Editing user data

5.2.3 Creating or managing profiles

To create a profile or manage existing profiles, go to **Users**, as shown in the following figure.



Figure 22 - Creating or managing profiles

Next, the screen will be displayed, as shown below, with data available for editing. It is worth noting that this availability varies according to the user's **permission level**.



Figure 23 - Creating and managing profiles

Options

Brings together features for monitoring, controlling, and maintaining the system's user registry, encompassing activity tracking, backup management, and data importation.



Figure 24 - Download options

- **Access Log:** Records the history of system events, showing the date, time, and actions performed by users**.**
- **Export Users:** Downloads a backup of the user list in an encrypted format (.user); recommended for maintenance and updates.
- **Import Users:** Restores user data from an encrypted file (.user).

"Create, Edit, or Delete" buttons

Provide full control over system access, including adding new users, updating registration data, and removing accounts.



Figure 25 - Create, edit, or delete users

Create user

Upon selecting **Create**, the screen below will be displayed, where you can enter the new user's details and configure their access profile.

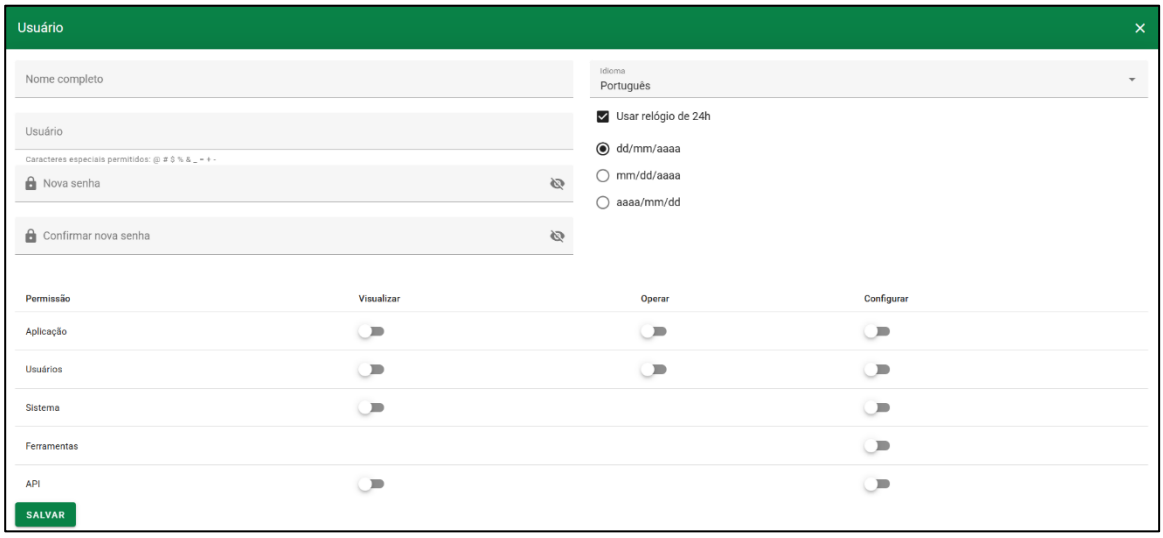


Figure 26 - Register user

In the other columns, the access level for each tab is detailed, with options including **View**, **Operate**, and **Configure**.

- **View:** The user can see the configurations but cannot modify, delete, or create anything;
- **Operate:** The user can enable or disable existing configurations and also change the protocol address of any IED;
- **Configure:** The user has full control to modify, delete, and create configurations within the system.

5.3 Online

In the **Online** section of the SDG, there are panels that display the system status and abstract data regarding the equipment.

5.3.1 System status

The **System status** panel displays operational information about the SDG itself, such as processor temperature, board temperature, CPU usage, and RAM usage, among others. It also shows the status of digital inputs, which can, for example, be associated with the self-diagnosis relays of IEDs.

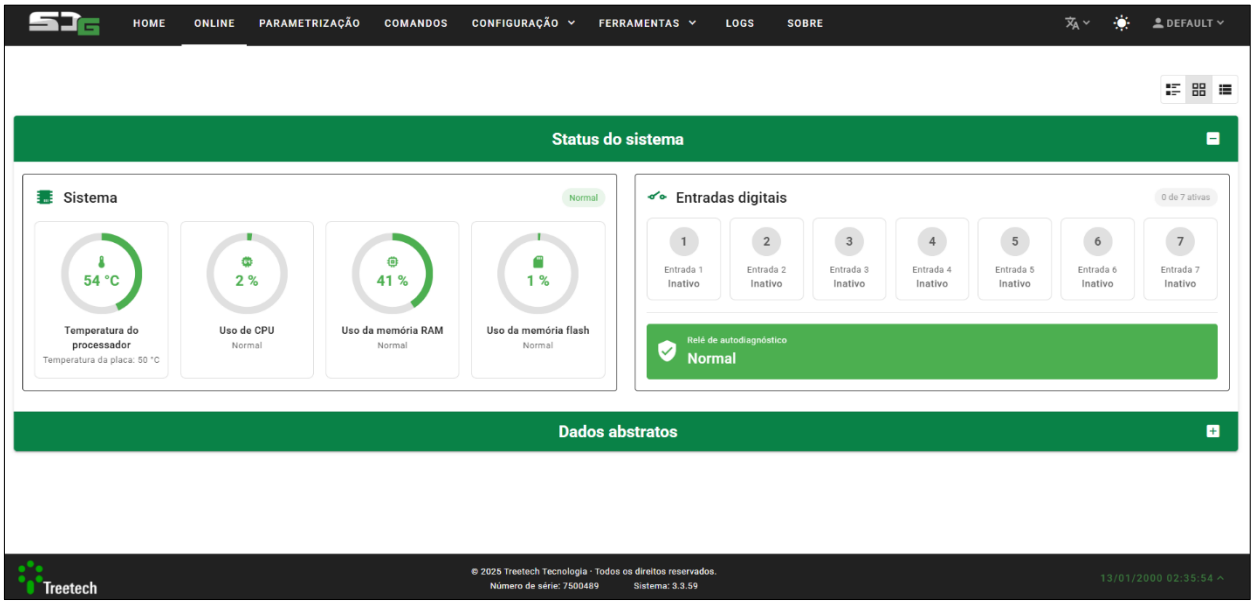


Figure 27 - System status

5.3.2 Abstract data

In the **Abstract data** pane, the user can select an IED connected to the SDG to view its readings, monitor its communication status (with quality indications of **Good**, **Bad**, or **Initializing**), and consult or modify its operating parameters.

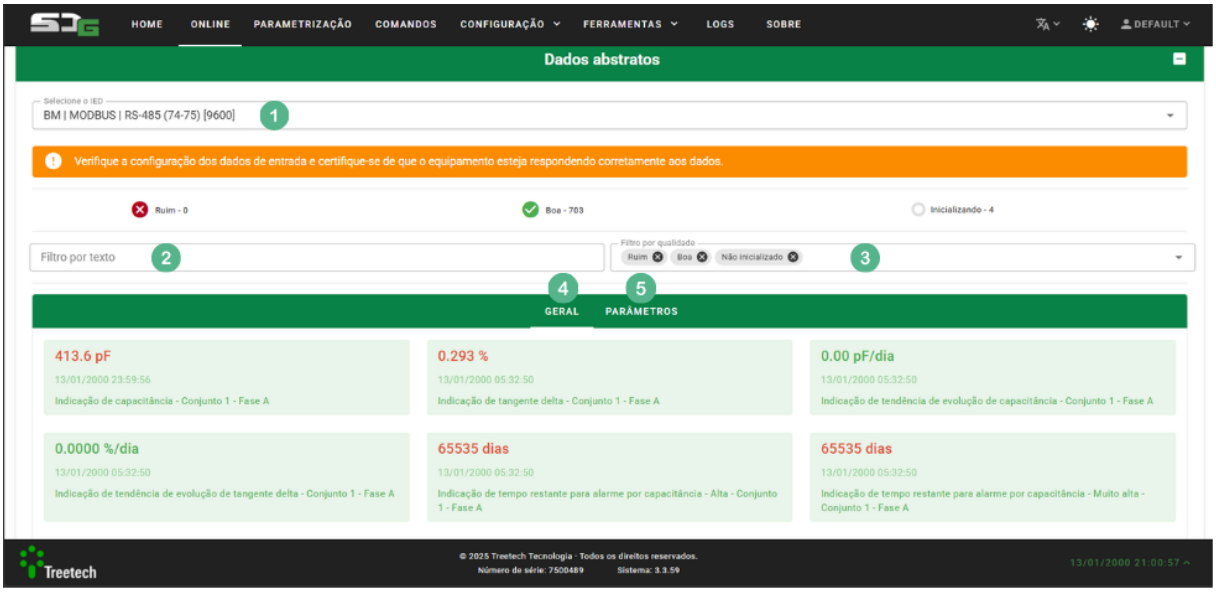


Figure 28 - Abstract data

1. **IED selection box:** Allows for the selection of a connected IED for monitoring or parameterization;
2. **Text filter:** Makes it easier to locate parameters for reading or configuration;
3. **Quality filter:** Filters the display of parameters based on their communication quality status (Good, Bad, or Initializing);
4. **General:** A tab that displays operational parameters available for reading;
5. **Parameters:** A tab that allows for viewing and modifying the device's parameters.

   Note: Depending on the specific IED being connected, other screens may be displayed in addition to the **Parameters** and **General** tabs.

Changing a parameter in the Online section

To change a parameter in the **Online** section, follow this procedure:

1. **Select the parameter you wish to modify and click Change.**



Figure 29 - Changing a parameter in the Online section

2. **Enter the new value for the parameter and click Save to confirm the change.**



Figure 30 - Changing a parameter in the Online section

5.4 Parameterization and Commands

5.4.1 Parameterization

In the **Parameterization** section, it is possible to view and modify the equipment's parameters directly.

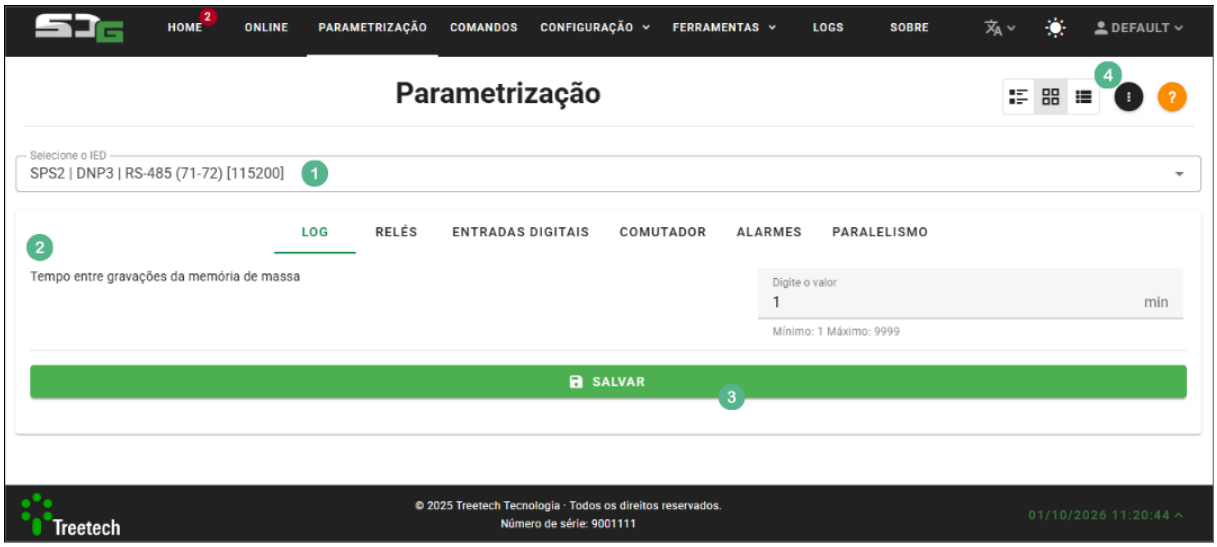


Figure 31 - Parameterization section

- **1. Selection box:** Select the IED you wish to configure.
- **2. Parameter selection:** Choose the desired parameter and modify its value.
- **3. Save:** Click **Save** to confirm the changes made on the current screen.
- **4. Import, export, and reports:** Allows for the generation of parameter reports in CSV format, the export of **parameters from the selected IED** to another SDG, and the import of parameters from IEDs associated with other SDGs.



Figure 32 - Import or export parameters and generate a CSV report from the IED

Note: Changes must be saved individually on each screen before navigating away. If you navigate to another screen without saving, the modified value will be temporarily retained, allowing you to return and complete the save process.

5.4.2 Commands

In the **Commands** section, you can view and change the state of IED commands. To perform an action, select the IED, locate the desired command, and click **Execute command**.

Note: The SDG defines pulse-type binary points as “commands.”

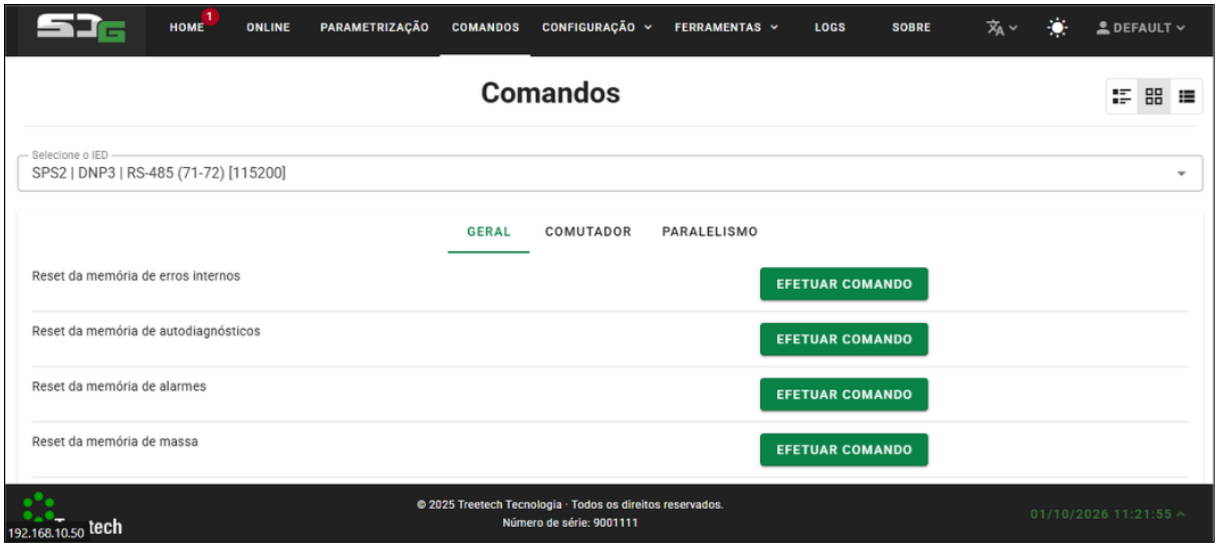


Figure 33 - Command section

5.5 Configuration

5.5.1 Protocols

The **Protocols** submenu is designed for viewing, editing, and configuring communication for IED applications, as well as for importing templates, configuring abstract definitions, adding IEDs, and editing inputs and outputs.

Execution area

- **1. Edit:** Allows for changing the communication type and data (basic or advanced), as well as configuring the IEDs.
- **2. View:** Displays the abstract data present in the device.
- **3. Additional actions menu:** Provides the following options:

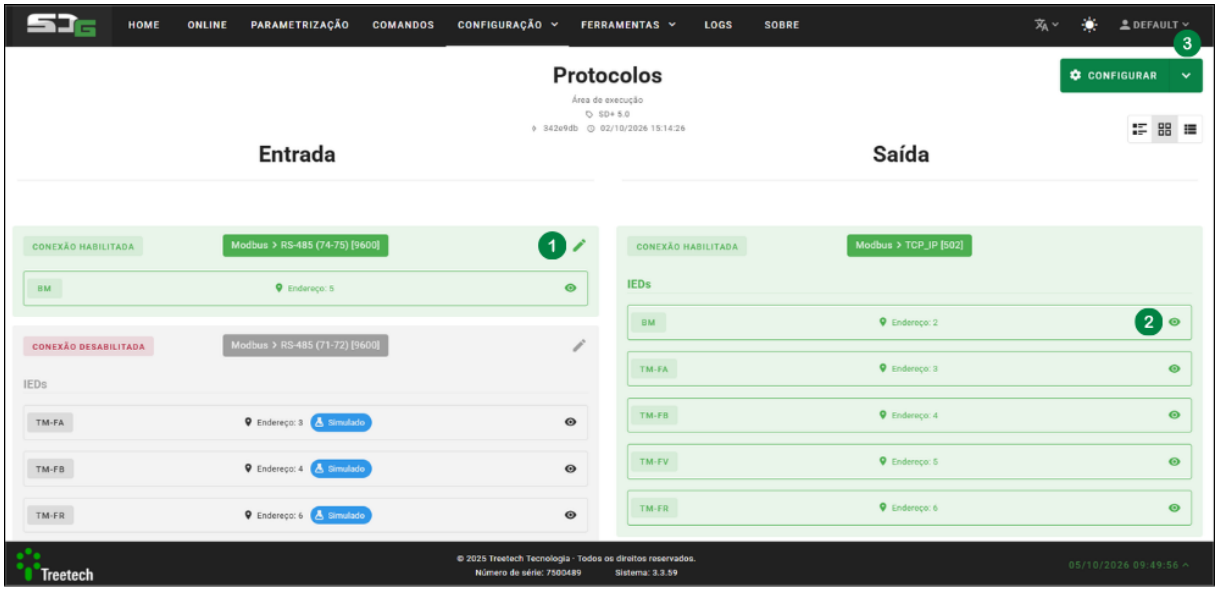


Figure 34 - Configuration of inputs and outputs

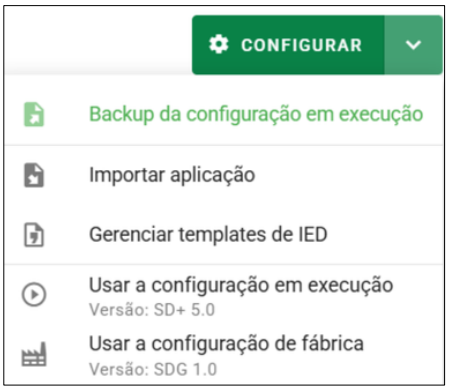


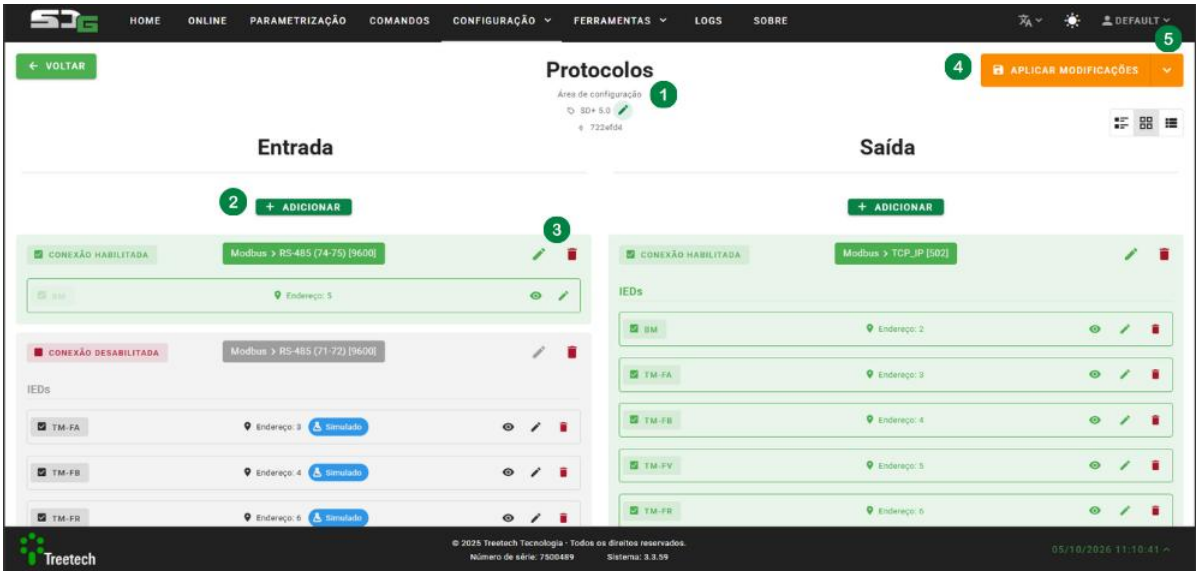
Figure 35 - Additional actions menu for the execution area

- **Backup of the running configuration:** Exports the applications configured on the current SDG;
- **Import application:** Imports configurations from another SDG to reuse existing data;
- **Manage templates:** Manages and loads the protocol maps required to configure the equipment;
- **Use running application:** Applies the developed configuration directly to the runtime environment;
- **Use factory-mode application:** Restores the equipment to its original factory settings.

Configuration area

Figure 36 - Configuration area

To access the configuration area, click **Configure**, located in the execution area.



- **1. Edit application name:** Allows the user to change the name assigned to the application currently in use;
- **2. Add IED:** Accesses the configuration interface for adding new IEDs (Intelligent Electronic Devices) to the communication network (inputs and outputs);
- **3. Edit or delete:** Allows the user to modify the settings of an existing IED or remove it from the application;
- **4. Apply changes:** Confirms and saves the modifications made to the current application;

1. **Note: After applying the changes, the SDG will briefly restart.**

- **5. Additional actions menu:**

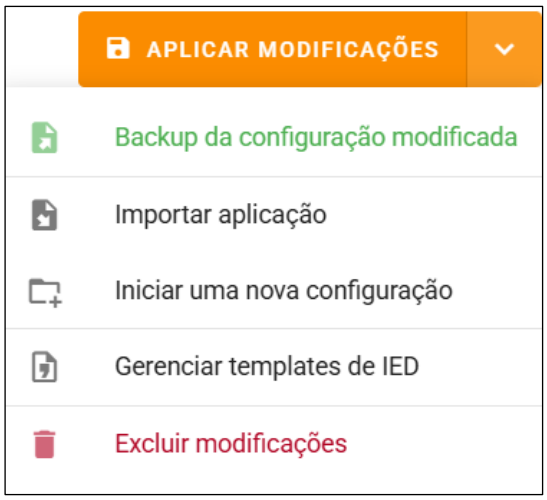


Figure 37 - Additional actions menu in the settings area

- **Backup of modified configuration:** Creates a backup copy of the changes made before applying them;
- **Import application:** Loads and applies settings exported from another SDG;
- **Start a new configuration:** Resets the environment, initiating a complete parameterization from scratch;
- **Manage templates:** Accesses the area for importing and organizing protocol maps (templates);
- **Discard modifications:** Cancels any changes made that have not yet been applied, reverting to the previous state.

5.5.2 Date and time

Allows for the configuration of date and time in the following ways:

- **RTC source:** Enables manual time adjustment;
- **NTP source:** Uses Ethernet settings to update the clock;
- **PTP source:** Used to synchronize device clocks within real-time networks, providing high-precision timekeeping across systems.



Figure 38 - Date and time settings

5.5.3 Network Configuration

Allows the user to edit the IP addresses for Ethernet ports and add DNS servers.



Figure 39 - Network configuration

The user can manually modify the IP address and subnet mask for both the primary and secondary IP configurations. Additionally, it is possible to change the gateway address, as well as DNS 1 and DNS 2.

Operating modes:

- **Bridge:** Both Ethernet communication ports share the same IP address, subnet mask, and gateway;
- **Independent:** Both Ethernet communication ports operate independently, each with its own distinct IP address, subnet mask, gateway, and MAC address.

5.5.4 Manager

This screen allows for the administration of SDG processes and the downloading of log files. The following key features are available:

- **Process control:** Allows for stopping or resuming the execution of the device's processes.
- **Log download:** Using the **User Log** and **Communication Log** buttons, the user can download specific logs for each protocol or service for analysis and monitoring purposes.

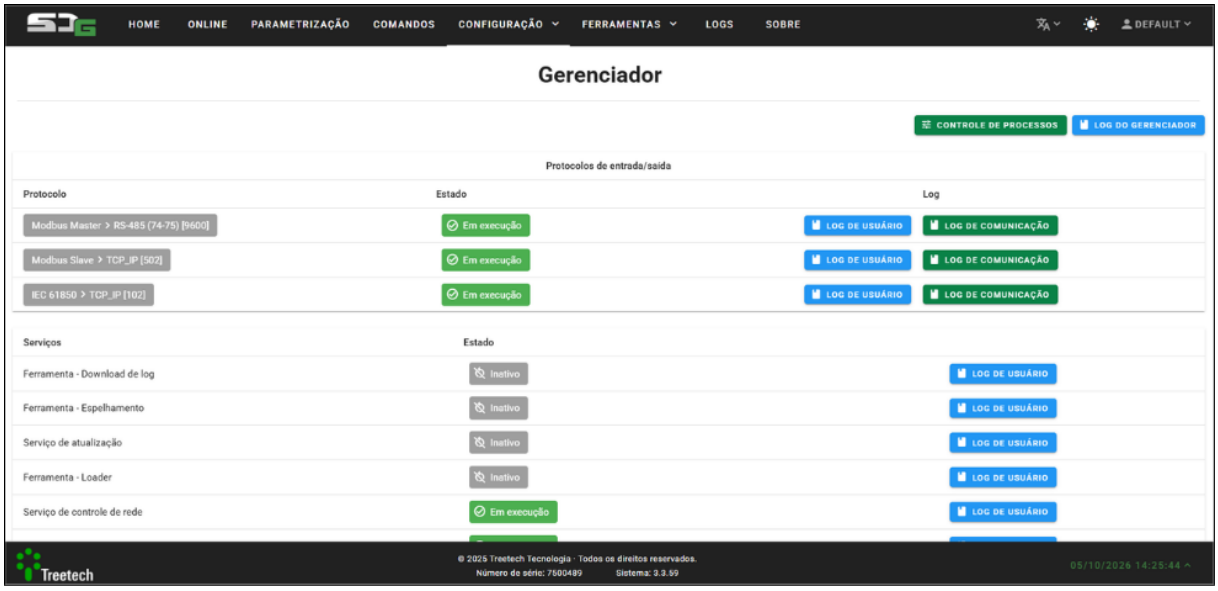


Figure 40 – SDG Task Manager

5.5.5 Update

On this screen, the user can perform a version update and restore the SDG settings.

Device update

After importing the update file, select one of the options below to apply it:

- **Update Only:** Performs a system update while maintaining current settings, without restoring factory defaults.
- **Update and Restore:** Applies the update and simultaneously restores the device to its factory defaults. This option is required when the update includes changes to the application version.
    - **Note:** When using this option, you will be prompted for your login password. You may select the **Keep IP address** option to preserve access on the configured network. If this option is left unchecked, the device will revert to its factory default IP address (**192.168.10.87** or **192.168.1.87**, depending on the connection port).

System restore

Allows the user to reset all product settings to factory defaults, without performing a version update. To carry out this procedure:

1. Click the **Restore System** button.
2. Enter your user login password (this operation is restricted to users with the appropriate access permissions).
3. Select the **Keep IP address** option if you wish to retain the current network address. If this option is left unchecked, the device will revert to its factory default IP address (**192.168.10.87** or **192.168.1.87**, depending on the connection port).

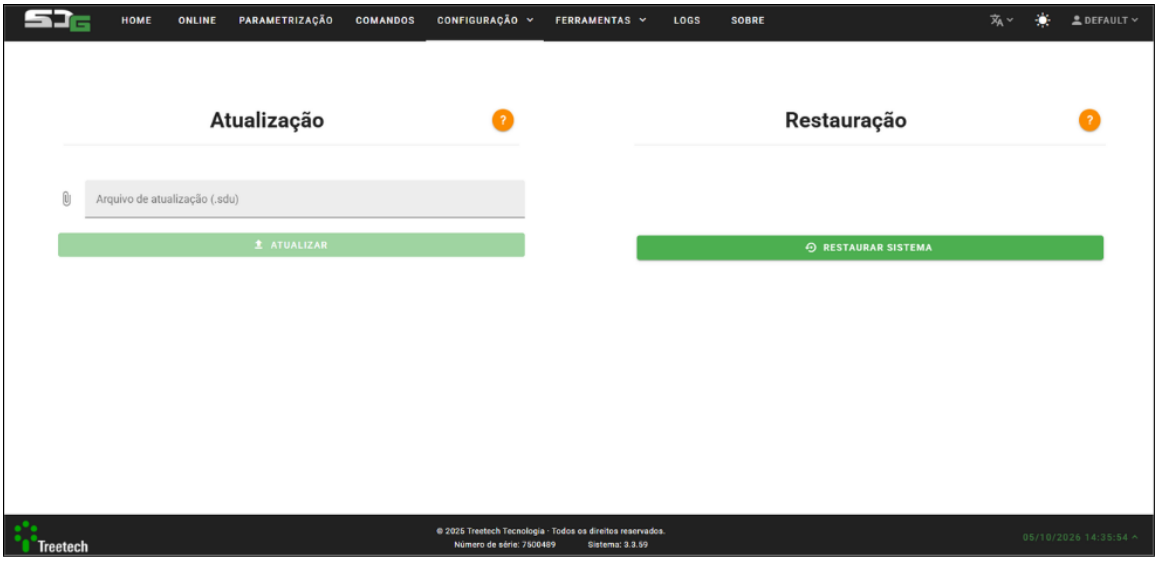


Figure 41 - System update and restoration

5.5.6 Access

This section allows the user to change the SDG transfer protocol.

- **HTTP:** Data travels in plain text. Anyone on the same network can read the information being sent;
- **HTTPS:** Uses SSL/TLS encryption protocols to scramble data during transmission. If someone intercepts the data, they will not be able to read its content.

Note: To use the HTTPS option, you must submit a certificate linked to your browser; this certificate is generated by the SDG.

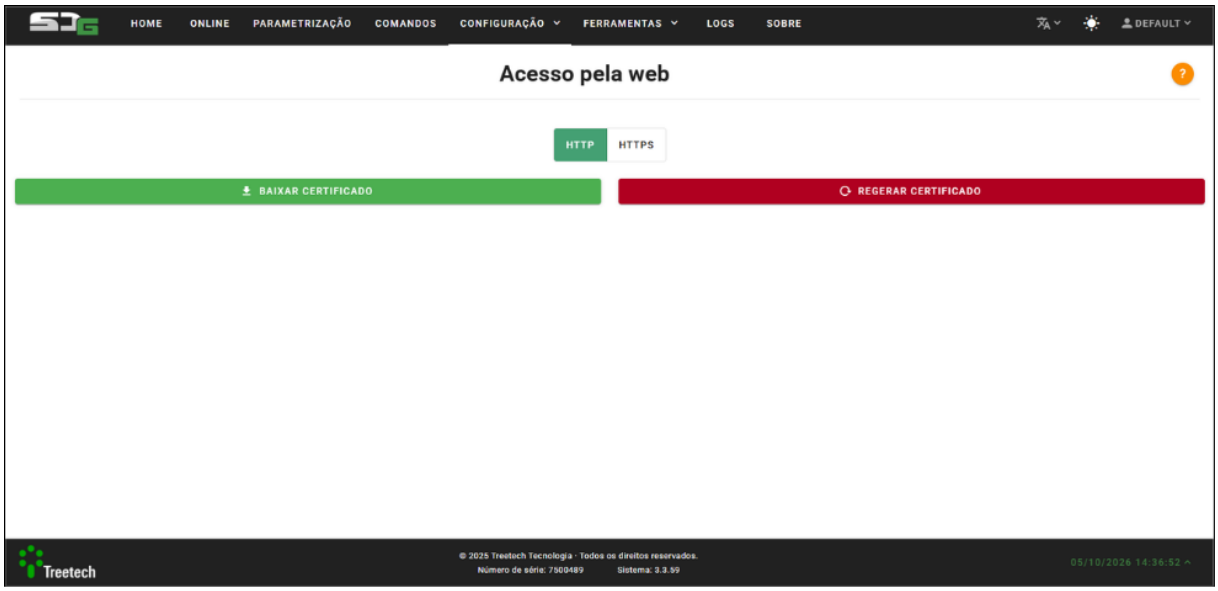


Figure 42 - Access - Change transfer protocols (HTTP or HTTPS)

5.6 Tools

5.6.1 Mirroring

The SDG mirroring tool allows for the routing and replication of data across the equipment's various communication interfaces.

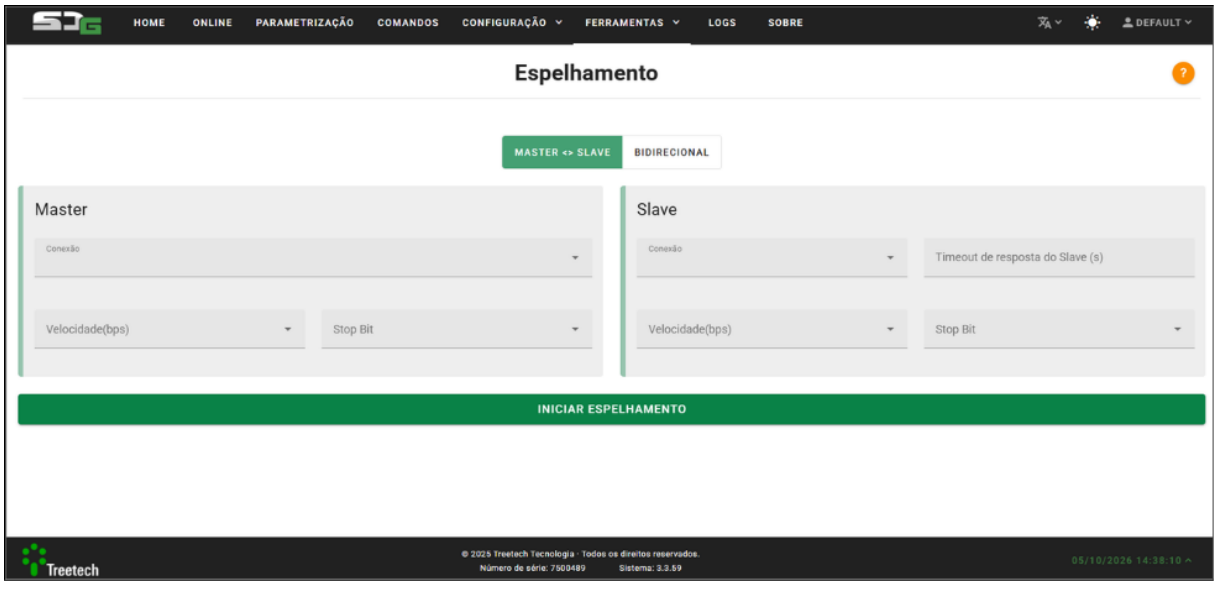


Figure 43 - Mirroring tool

To ensure the integrity of information exchange and alignment with the facility's physical infrastructure, the user must configure the port's operating mode according to two primary topologies:

- **Master-Slave:** In this configuration, the network operates under a strict hierarchy, based on the principle of a shared bus;

- **Bidirectional:** In this configuration, the network operates autonomously and simultaneously, without a rigid hierarchical subordination for accessing the transmission medium.

5.6.2 Loader: Firmware update for IEDs

In this section, the user can perform firmware updates for the connected IEDs.

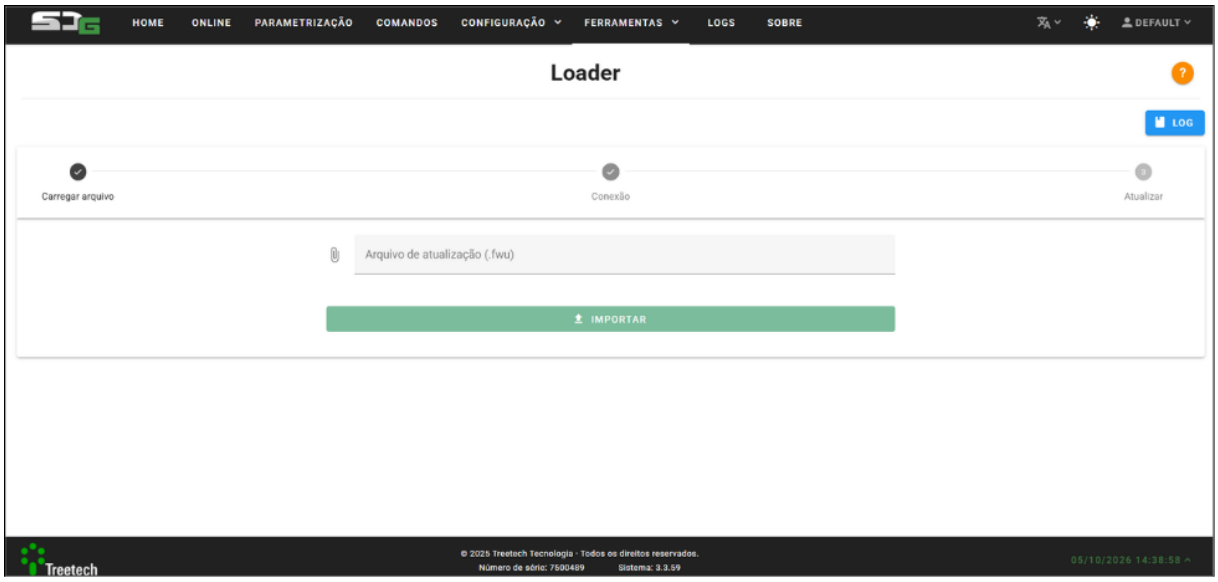


Figure 44 - Loader - IED update

- **Step 1 - Import:** Select the desired file with the .fwu extension and click Import. The device (SDG) will restart briefly once this step is complete.
- **Step 2 - Device Selection:** Select the IED to be updated from the list. The SDG will send a command to restart the selected IED; if the restart is successful, the system will enable the next step**.**
- **Step 3 - Update:** Click the corresponding button to begin the firmware update process for the IED.

Note: Before starting the update procedure, please observe the following safety recommendations:

- **Compatibility:** Verify that the firmware file to be imported is fully compatible with the model and current version of the equipment;
- **Backup:** It is recommended to back up all current system configurations and parameter settings before proceeding;
- **Stable power supply:** Ensure that the equipment is operating with a continuous and stable power supply;
- **Do not interrupt:** Under no circumstances should the power supply or communication be interrupted during the process.

5.6.3 Downloading IED Logs

In this section, the user can download logs from connected IEDs.

- **Step 1:** Select the IED under “Download logs” and choose the IED model;
- **Step 2:** Choose which device data you wish to download under “Downloads”;
- **Step 3:** The requested data will be displayed on a preview screen for review or export.

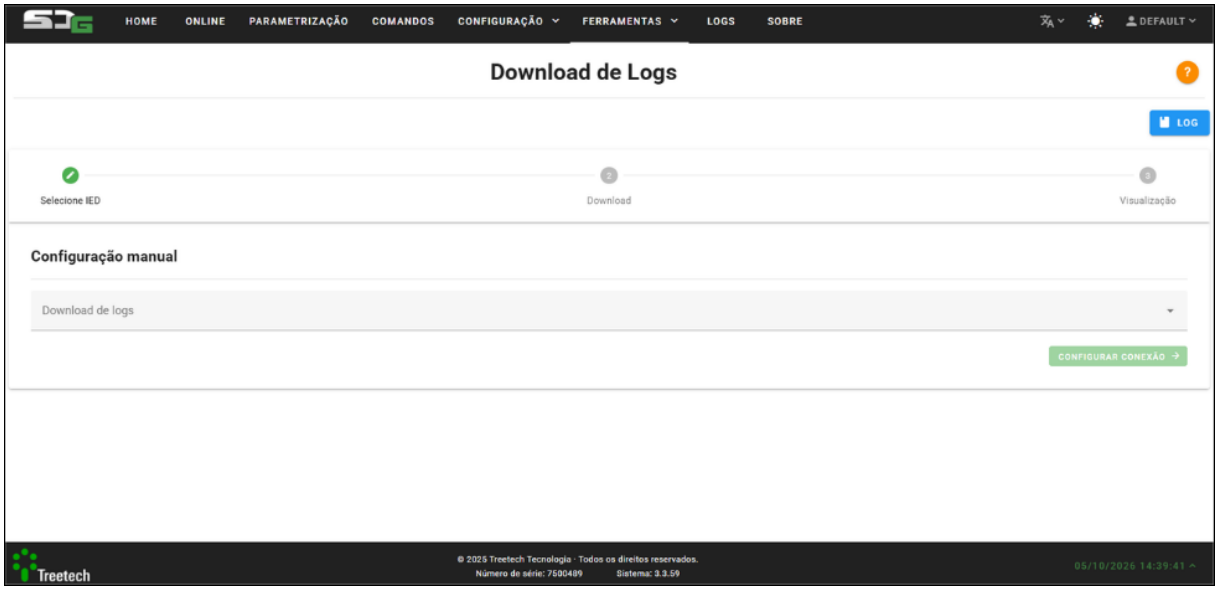


Figure 45 - IED log download

5.6.4 Network Test

The **Network Test** tool was developed to facilitate connectivity diagnostics. It allows the user to execute "ping" commands directly from the SDG interface to verify physical and logical communication with the IED.



Figure 46 - Network test

5.7 Download

5.7.1 Logs

In this section, the user can download the logs for the SDG itself.

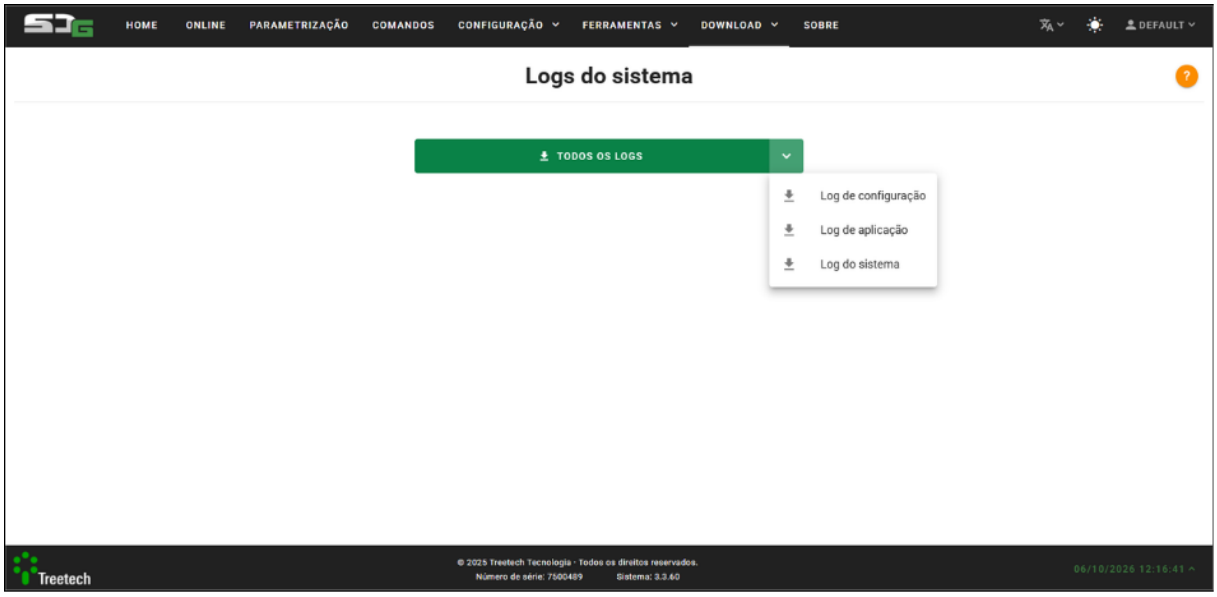


Figure 47 - SDG log download

- **All logs:** Allows for downloading all logs at once;
- **Configuration log:** This file is available for download; however, access to its content is restricted to the Treetech technical support team.
- **Application log:** This file is available for download; however, access to its content is restricted to the Treetech technical support team.
- **System log:** This file is available for download; however, access to its content is restricted to the Treetech technical support team.

5.7.2 Oscillography

Some Treetech IEDs (such as the IDM, IDX, and IDS models) have the capability to generate oscillography records. Users can access and download these files via the **Download > Oscillography** menu.

Note: Downloading oscillography records via the SDG is compatible exclusively with Treetech-branded IEDs.

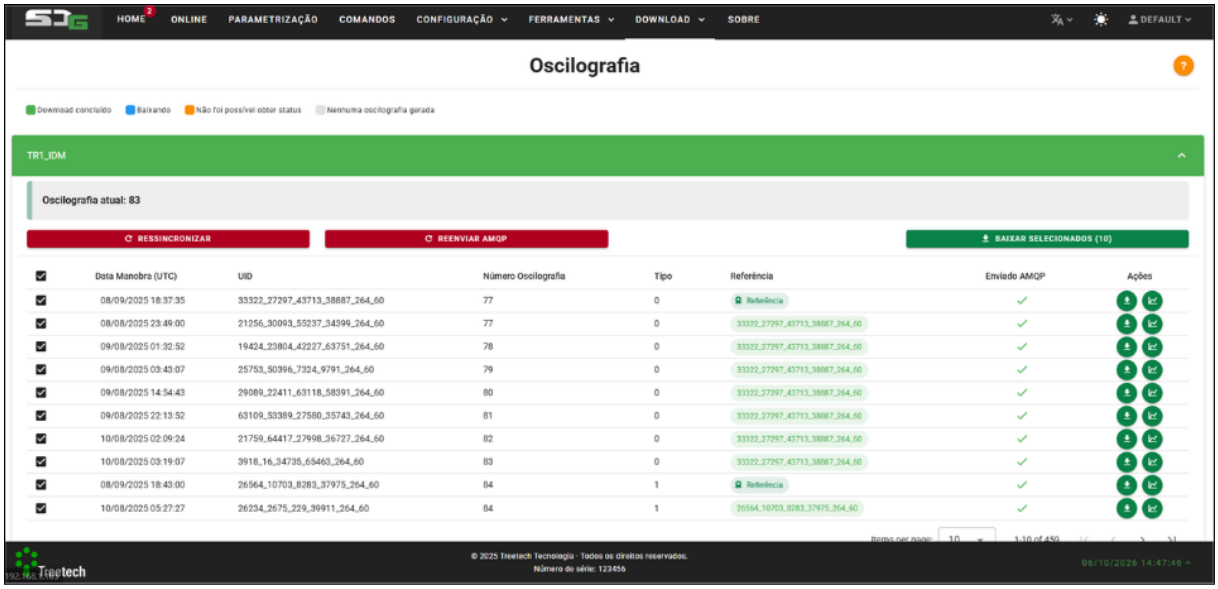


Figure 48 - Oscillography download

IED Identification and Status

In the visualization block, the IED is identified by its name in the top bar, and its visual indicator reflects its communication status, in accordance with the system's general legend. The interface also displays three essential counters for monitoring data retrieval:

- **Current Oscillography:** Indicates the number of the latest record generated by the device;
- **Synchronizing Oscillography:** Indicates the record number currently being read by the SDG;
- **Incomplete Downloads:** Indicates the number of process failures resulting from potential communication errors.

Downloading

Files can be extracted to the user's computer in two ways:

- **Individual Download:** Click the **green button** located at the far right of the row corresponding to the desired oscillography record;
- **Bulk Download:** Select the checkboxes next to the records you wish to download. Then, click the **Download Selected Items** button, located above the table on the right-hand side.

Resynchronize

The **Resynchronize** button allows the user to clear the current reading history and force the SDG to initiate a new download process from scratch. When this command is triggered, an alert message will appear, requesting user confirmation. Executing this operation only deletes the index of previously mapped files, forcing a complete new scan. **The actual files and data stored on the equipment remain intact and are not deleted.**

Graphical analysis

The system enables the direct visualization and graphical analysis of oscillography records without the need to download the file. To do this, click the **graphical analysis button** (located next to the green download button) in the row corresponding to the desired record. A new window will open, displaying the waveforms and detailed values for the event.

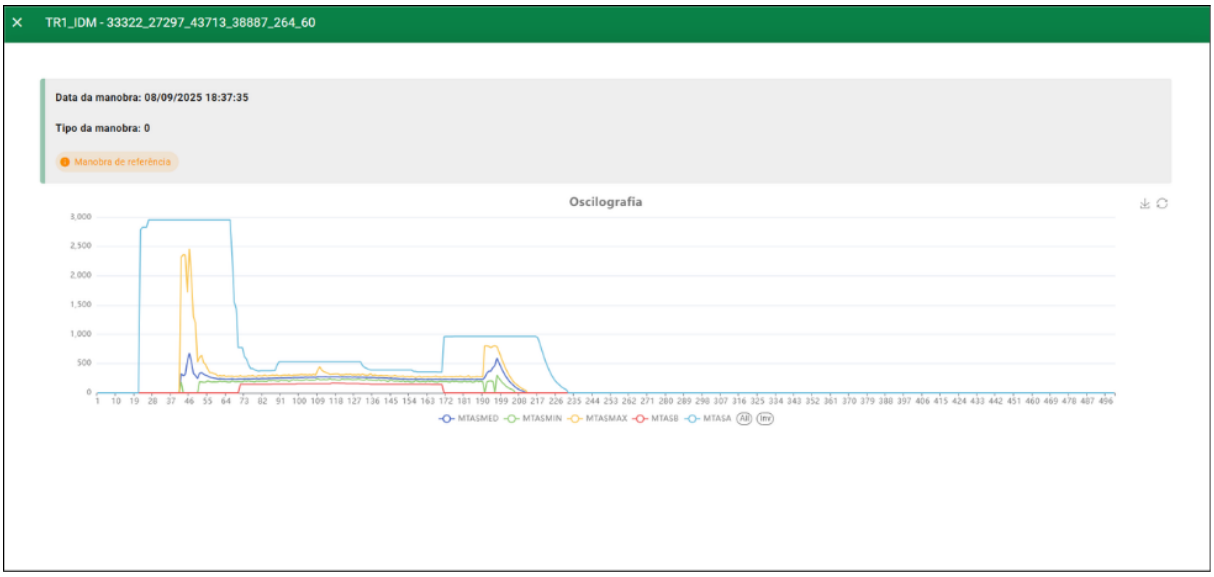


Figure 49 - Graphical analysis of oscillographic records

5.8 About

This is the system information inquiry screen. Here, the user can find data such as the equipment serial number, the system version, and the version of the installed application.

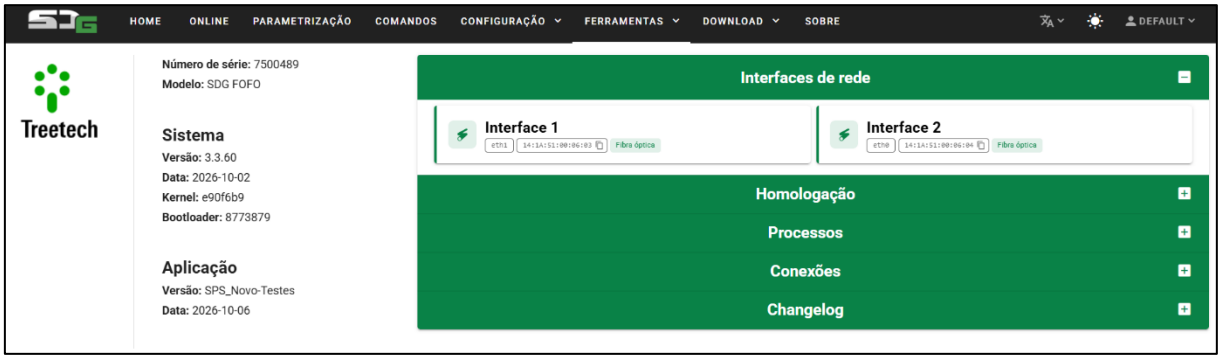


Figure 50 - About screen

6 Troubleshooting

Troubleshooting the SDG (Smart Device Gateway) involves identifying and correcting issues related to the communication and network configuration of devices connected to it. The SDG plays a crucial role in converting communication protocols, allowing interoperability between different devices in a system.

When any alert or warning messages occur on the page in the SDG, it is important to perform a series of checks to troubleshoot the problem. First of all, it is necessary to examine the entire communication circuit, checking the integrity of the cables, connections and devices involved. Make sure there are no physical issues that could be causing the communication to fail.

In addition, it is essential to review the network settings, such as address and baud-rate, of equipment connected to the SDG.

Check that the IP address, subnet mask, default gateway and other network settings are correctly configured and compatible with the network infrastructure in use.

In addition to the measures mentioned previously, it is essential that the SDG user pays attention to the color of the LED located on the front of the equipment, as it plays an important role in signaling communication issues and alerts, providing visual information about the system's status.

The status LED indicates the system's operational condition through five specific colors. Blue and white signify the SDG’s initialization phases and the state of waiting for connected equipment, respectively. During monitoring, green confirms that all inputs are communicating correctly; orange alerts the user to anomalous states that require checking the web interface; and red warns that all devices are offline.

Observing the LED color and associating it with specific problems can help you quickly identify communication failure situations. This information can be used as a starting point to guide troubleshooting steps and direct the appropriate action, whether it be performing additional checks on connected devices, network settings or contacting the appropriate technical support...

If, after these checks, the problem persists and cannot be resolved internally, it is recommended to contact Treetech's Customer Service Center (CS). The CS is prepared to deal with technical questions related to the SDG and offer additional support in solving more complex problems.

It is important to emphasize the importance of following the manufacturer's guidelines and using the support resources available. By relying on the support of Treetech’s CS, it is possible to obtain specialized assistance and ensure an efficient problem resolution process at the SDG, minimizing interruptions and maintaining the proper functioning of the communication system.

7 Commissioning

Once the installation of the equipment has been carried out according to the instructions in this manual, the commissioning must follow the basic steps below:

- ✓ Check mechanical and electrical installations;
- ✓ Check, with the aid of a multimeter, the correct electrical connection of the equipment;
- ✓ Connect the ground cable to terminal 1 of the SDG;
- ✓ Power the SDG on terminals 2 and 3 with a supply voltage of 85 to 265 Vac/Vdc, 50/60 Hz;
- ✓ Carry out all the SDG configuration according to the instructions in the previous chapters, via the web page;
- ✓ With a computer, communication converters and suitable software, as applicable, check the operation of the SDG communication ports according to the application used;
- ✓ Simulate the performance of monitored external contacts and observe whether the outputs are operating correctly according to programming.

8 Technical data and type tests

8.1 Technical data

Table 6 - Technical data

Hardware	Range/description
Supply voltage	85...265 Vac/Vdc, 50/60 Hz
Maximum consumption	< 12 W
Operating temperature	-40... 85°C
Degree of protection	IP20
Connections	0,3…2,5mm², 22…12 AWG
Fixation	Panel
Inputs	
Dry contacts	7 inputs and 1 common
Contacts power supply	Internal reference supply
Outputs	
Relay output	1 NC relay (normally closed)
Maximum switching power	70 W (dc) / 200 VA (ac)
Maximum switching voltage	250 Vdc / 250 Vac
Maximum switching current	5 A
Network interface	
Serial communication ports	1 RS-485 (TIA-485-A), 1 RS-485 (TIA-485-A) or 1 RS-232 (TIA-232-F)
Communication ports IEEE 802.3 (10/100 Mbps)1	Available in models: RJ45: 2 Ethernet RJ45 (10/100BASE-T) FOFO: 2 Ethernet Fiber Optic (10/100BASE-FX; MM 1310nm SC connector) FOSR: 1 Ethernet Fiber Optic (10/100BASE-FX; MM 1310nm SC connector) + 1 Serial Fiber Optic (MM 850nm SC connector)
Master / Client protocols	Modbus® (RTU and TCP) and DNP3 (RTU and TCP)
Slave / Server protocols	Modbus® (RTU and TCP) and DNP3 (RTU and TCP) IEC 61850 (MMS server / GOOSE Publisher)[2]
Dimensions	
SDG Dimension (Fiber Optic)	54,70 mm x 114 mm x 155 mm
SDG Dimension (RJ45)	54,70 mm x 114 mm x 146 mm

8.2 Type tests

Table 7 - Type tests

Immunity to high energy surges (IEC 60255-22-5)	
Differential mode	1 kV (+/-)
Common mode	2 kV (+/-)
Immunity to electrical transients (1 MHz Burst, IEC 60255-22-1)	
Peak value 1st cycle	2,5 kV common mode, 1 kV differential mode
Frequency	1 MHz
Repetition rate	200 bursts/s
Applied voltage (IEC 60255-5)	
Dielectric strength	2 kV at 60 Hz for 1 minute
Voltage impulse	5 kV (+/-)
Immunity to radiated electromagnetic fields (IEC 60255-22-3)	
Frequency	80... 2500 MHz
Repetition rate	10 V/m
Immunity to conducted electromagnetic disturbances (IEC 60255-22-6)	
Field strength	10 Vrms
Frequency	0.15 to 80 MHz
Index of modulation	80% and 1 kHz sinusoidal
Sweep frequency	150 kHz to 80 MHz
Fixed frequencies	27 to 68 MHz
Duration	20 s
Power supply	220 V / 60 Hz
Immunity to industrial frequency magnetic fields (IEC 61000-4-8)	
Magnetic field strength and direction	30 A/m 3 orthogonal axes
Electrostatic discharges (IEC 60255-22-2)	
Intensity and voltage	15 kV air mode 220 V / 60 Hz
Immunity to fast electrical transients (IEC 60255-22-4)	
Power, inputs and outputs	4 kV (+/-)
Current outputs	2 kV (+/-)

Emission tests (IEC 60255–25)	
Conducted emission limits (Class A)	79 dB (uV) @ 150 kHz… 500 kHz (QP) 73 dB (uV) @ 500 kHz… 30 MHz (QP) 66 dB (uV) @ 150 kHz… 500 kHz (AV) 60 dB (uV) @ 500 kHz… 30 MHz (AV)
Radiated emission limits (Class A)	40 dB (uV/m) @ 30 MHz… 230 MHz (QP) 47 DB (uV/m) @ 230 MHz… 1 GHz (QP)
Power failure (IEC 61000-4-11)	
Voltage drops	0-80 of U ½… 300 cycles 85V and 265V 50/60 Hz
Short interruptions	5 seconds 85V and 265V 50/60 Hz
Cold withstand (IEC 60068-2-1)	
Temperature	-40
Test time	16 hours
Dry heat withstand (IEC 60068-2-2)	
Temperature	+85 °C
Test time	16 hours
Moist heat withstand (IEC 60068-2-78)	
Temperature	+40 °C at 85% RH
Test time	24 hours
Thermal cycle (IEC 60068-2-14)	
Temperature range	-40… 85 °C
Total test time	120 hours
Response to vibration (IEC 60255-21-1)	
Application mode	Sinusoidal
Amplitude	0,075 mm (10… 59 Hz) 1 G (59… 150 Hz)
Duration	8 min/axis
Vibration durability (IEC 60255-21-1)	
Application mode	Sinusoidal
Amplitude	2G (10… 150 Hz)
Duration	160 min/axis

9 Order specification

In the SDG purchase order, it is necessary to specify the following items:

1. Product's name

Smart Device Gateway - SDG.

2. Quantity

The number of units.

3. Communication setup

Choose one of the following options:

- **FOFO -** 2x *Ethernet* F.O. (10/100BASE-FX; MM 1310 nm SC connector; MM 1310 nm SC connector).
- **FOSR -** 1x *Ethernet* F.O. (10/100BASE-FX; MM 1310 nm SC connector) + 1x Serial F.O. (MM 850 nm SC connector).
- **RJ45 -** 2x *Ethernet* RJ45 (10/100BASE-T).

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