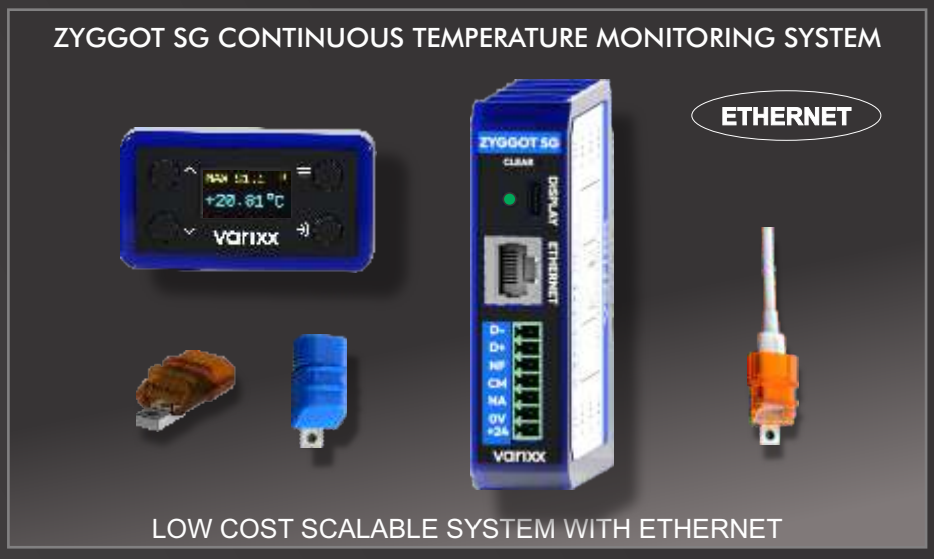
ZYGGOT SG INTELIGENT THERMOGRAPHY SYSTEM

ONLINE, SCALABLE, LOW-COST CONTINUOUS TEMPERATURE MONITORING

ZYGGOT SG - MANUAL



World's First Online Thermography System (2004).
World Leader in Continuous Temperature Monitoring.
World's First UV Arc Protection System.*
Over 1 Million Sensors Installed Worldwide.
* Patent Nº PI 0903809-4

MANUAL ZYGGOT SG - V1.3 - ENGLISH - August 2025

varixx

INDEX

Note: This manual is written in English and the same manual is also available on the website Varixx.com and Varixx.com.br in Portuguese (PT-BR).

ZYGGOT SG THERMOGRAPHY

CONTINUOUS TEMPERATURE MONITORING SYSTEM

SCREEN OF A BROWSER CONNECTED TO SG VIA ETHERNET USING THE PAGE SERVER RUNNING DIRECTLY ON THE GATEWAY. (ZERO PROGRAMMING)

REMOTE CONTROL AND DATA READING BY ETHERNET

HISTORY

Varixx was the world's first company to introduce a Continuous, Online, Networked Temperature Monitoring System in 2004 and is a market leader in this area. The low-cost **ZYGGOT SG** system, introduced as a complement to our traditional Zyggot family, was designed to allow "online" monitoring of the temperatures of components and low-voltage internal connections in CCM or Data Center Drawers, Shielded Busbars and Low-Voltage Electrical Panels with low cost, easy installation, high reliability, high scalability and Ethernet communication.

The **ZYGGOT** system introduced, many years ago, an important innovation to the market, since safety standards began to prohibit the opening of energized electrical panels for any type of measurement, including temperature measurements with manual point-of-use measuring guns or thermography cameras, without the use of appropriate protective clothing.

Two important features of the new **ZYGGOT SG** system are that it is highly scalable, with up to 400 sensors per gateway, and easy installation and programming, with auto-addressing of all sensors in the network.

Two types of intelligent sensors, **Single Port** and **Double Port**, allow for easy adjustment of the number of sensors in the system, with network cables of multiple lengths, supplied ready to use without the need for any tools, simply by connecting them to the USB Type C ports of the sensors and gateway.

The low-cost Gateway can be installed inside pull-out drawers and, using single port sensors, monitor up to 8 points, for example 3 input clamps, 3 output clamps and 2 additional points, for example contactor bodies.

The sensors are intelligent, using a One Wire communication network. The Double Port sensors can be chained with up to 50 sensors per Port and up to 300 meters of cable per gateway port, totaling 400 sensors per gateway.

The sensors have a high-temperature polycarbonate body with unlimited durability and are easily fixed to the points of interest with a single screw.

The entire system can be installed at up to 800 VAC, supporting a test voltage of 2600 VAC (2 x nominal V + 1000, according to standards).

A small, low-cost controller with a color display, ultra-easy to install in a standard 22 mm button hole, installed on the front of the pull-out drawer or panel, allows the system to be programmed and the temperature to be monitored at all points. Simply connect it to the corresponding port on the gateway with the same cable as the sensors, with USB Type-C ports, i.e., without the need for any tools.

A single 24 VDC source, also provided, powers the entire system. The sensors are powered by the One Wire network itself.

Both the sensors and each gateway port have colored LEDs for easy diagnostics during installation and commissioning. To address the entire network, a single command is required on the controller with display and the system will do all the work, numbering the sensors in their physical installation order. The sensors communicate over a network and if one of them fails, all the others continue to operate normally and the failure indication is shown on the front display.

An RS485 port on the front of the Gateway allows connection to a Modbus network and another RJ45 port allows Ethernet connection. The gateway includes a web page server and therefore all that is needed is a browser with the IP address programmed into the gateway to access all the data, programming and operation of the system, which can then be readed from anywhere in the world, allowing full remote control.

The **ZYGGOT SG** complements the ZYGGOT line, which includes the world's first ultraviolet radiation arc detection system - ZYGGOT ARC, which provides up to 150x reduction in incident energy, the ZYGGOT V5F THM systems, the ZYGGOT THM+ARC integrated systems, the ZYGGOT TOH systems that integrate THM, Ozone and Humidity, the ZYGGOT Image system and others.

APPLICATION

Low Voltage Electrical Panels, CCM Drawers, Data Center Drawers, Shielded Busbars.

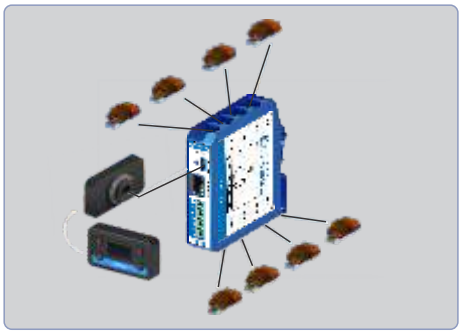
BENEFITS

* Low cost.
* Easy installation and programming.
* High scalability.
* High reliability.
* Modbus and Ethernet communication

System Features

* Applicable in low voltage.
* Up to 50 dual-port sensors per Gateway port, in a **One Wire** network, with mini USB type C connections.
* Up to 400 total sensors per Gateway.
* Smart Sensors powered by the network itself.
* Two types of sensors, Mono Port and Dual Port, allow easy system configuration.
* Sensors with high-temperature polycarbonate body and unlimited durability.
* Controller with color graphic display for easy installation in a standard 22 mm hole.
* Programmable alarm levels.
* Sensor status monitoring.
* Digital alarm output.
* Each sensor and each gateway port has a multi-colored LED that can be controlled from the front panel to facilitate its location and address on the network and also indicate operating and addressing status.
* Has an Ethernet connection with a page server, facilitating data monitoring from anywhere on the planet, simply using a browser or DCS systems. * A single 24 VDC power supply, provided, powers the entire system via the network cables.

*** Includes a Web Page Server running on the Gateway for full Remote Control and Operation**



KEY POINTS

ZYGGOT

MAIN ADVANTAGES

- TESTABLE WITH SYSTEM OFF
- WITH MODBUS AND ETHERNET
- HIGHLY SCALABLE
- EASELY INSTALLATION
- AUTO ADDRESSING OF SENSORS
- NETWORKED SMART SENSORS
- PROGRAMMABLE ALARM LEVELS
- MONITORS SENSORS STATUS
- DOES NOT USE BATTERIES
- HIGH RELIABILITY
- REAL TIME CLOCK BY ETHERNET (NTP)
- LOW ACQUISITION AND INSTALLATION COST
- HAS WEB PAGE SERVER
- ETHERNET REMOTE READINGS AND CONTROL

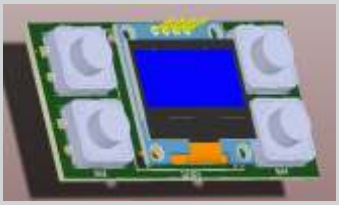
KEY POINTS

- Color display on the door.
- Has Ethernet communication.
- Continuous online temperature monitoring.
- Has a web page server running on the Gateway.
- Easy to specify, install and do commissioning.
- Up to 8 or up to 400 sensors per gateway with 8 ports per gateway.
- Use of Multi Gateways, allows high selectivity for alarms.
- Modbus RTU communication.
- Intelligent digital sensors in One Wire network, not susceptible to electrical noise as can occur with analog sensors.
- Each gateway can monitor up to 50 sensors per port and up to 400 sensors per gateway.
- No installation tools required. Simply connect the ready-made cables with mini USB Type C connectors.

MAIN FEATURES

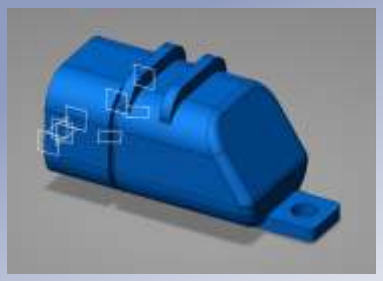
- Monitors the status of all sensors in the system.
- Just one command is enough for the gateway to automatically address all sensors in their physical order in the system.
- Use of multiple gateways, one in each pull-out drawer for example, allows high selectivity for detection and alarm.
- Displays all temperatures on the front display.
- Easy programming via the 4 buttons on the front module with display or PC or Ethernet.
- 1 digital output on the gateway allows you to trigger audible alarms and others.
- Modbus RTU + Ethernet
- Power supply for sensors via the One Wire network itself.
- A browser with the gateway's IP address is all you need to read and control the system remotely from anywhere in the world easily, without the need for additional programming (internal page server).

CONTROL MODULE WITH DISPLAY (FRONT)


IC CONTROL BOARD WITH DISPLAY


CONTROL MODULE WITH DISPLAY (REAR)

SMART SINGLE PORT SENSOR


SMART SENSOR DOUBLE VERTICAL DOOR


SMART SENSOR DOUBLE VERTICAL DOOR

TECHNOLOGY AND TECHNICAL DETAILS

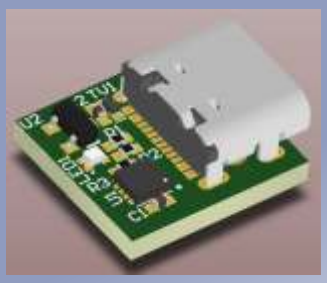
TOPOLOGY DESCRIPTION

Each sensor has a dedicated microprocessor, temperature sensor, analog-digital converter, and electrical insulation system, in addition to One Wire communication hardware.
Each sensor has a multi-color LED that changes under relay command to facilitate diagnosis and check addressing.
The Gateway addresses all sensors in their physical order, indicating the progress of addressing through the LEDs on each sensor and gateway ports.
The system allows easy reconfiguration in the event of an increase in sensors, for example.
The control module automatically indicates sensors that are not responding or have a fault.
The front control module with display is easily installed on the front of the pull-out drawer or panel using a standard 22 mm hole, like that of pushbuttons, and is fixed with a polycarbonate nut in the same way as a pushbutton. The command module does not have embedded software and can be freely hot or cold swapped, starting to operate instantly (Hot Plug In).
The **One Wire** network is highly reliable, immune to electromagnetic disturbances and allows sensor failures to be ignored without affecting the operation of other sensors in the network.

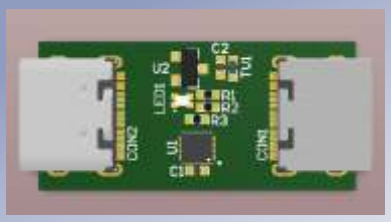
The **ZYGGOT SG** system gateway has a web page server, making it easy to read from anywhere in the world using a browser with the IP address of each Gateway page.

A single 24 VDC power supply is used to power the entire system.
The high-insulation interconnection cables (minimum 2600 VAC) are supplied in multiple lengths, with mini USB Type C connectors, and can be connected without the use of tools, making installation easier.
The gateway can be installed on a common rail used in electrical panels, making installation easier and taking up minimal space in the drawer or panel.
The Single Port sensors are used primarily inside MCC or Data Center drawers, making installation easier, with one of the 8 sensors connected to each gateway port.
The Double Port sensors can be daisy-chained, with each one connected to the output of the previous one, making installation easier in low-voltage panels or shielded busbars. Each gateway port can receive up to 50 sensors with up to 300 meters of cable.

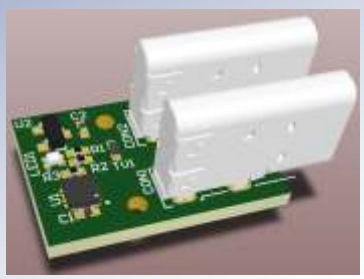
REMOTE CONTROL AND DATA READING BY ETHERNET



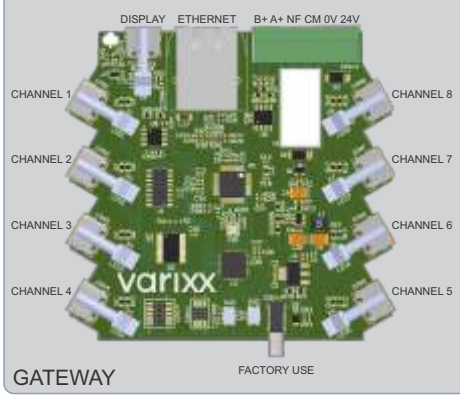
SMART SINGLE DOOR SENSOR



SMART SENSOR DOUBLE HORIZONTAL PORT

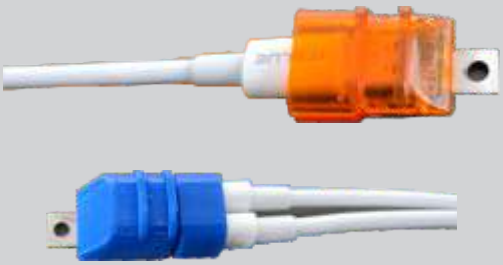


SMART SENSOR DOUBLE VERTICAL PORT



GATEWAY

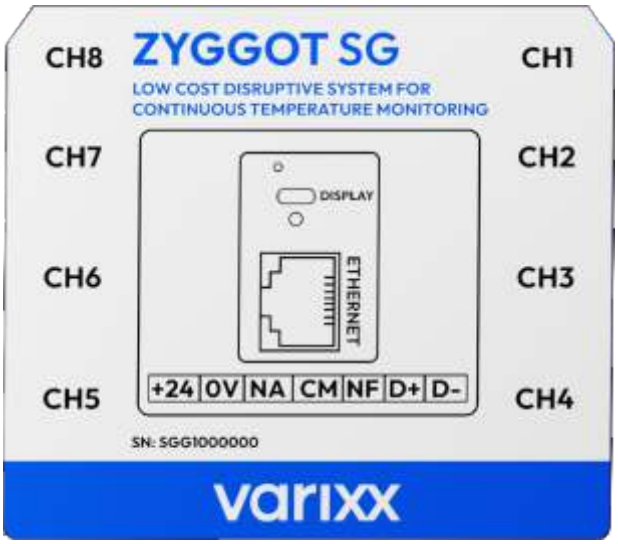
SENSOR INTELIGENTE MONOPORTA



SMART SENSOR DOUBLE VERTICAL PORT

SG GATEWAY WITH 8 PORTS/CHANNELS FOR SENSORS

OVERLAY AND SIDE LABEL OF SG GATEWAY AND TECHNICAL DATA



Features of VZSG/S01/24 Mono Port Sensor

> 24VDC power supply via network cable.
> Has a Mini USB Type C port.
> Minimum power supply voltage of 5 VDC.
> Maximum power supply voltage of 30 VDC.
> Multi-colored LED indicating location, status and faults.
> Automatic network addressing.
> Measurement range: -55°C to 150°C.
> Maximum sensor temperature: 150°C.
> High-temperature polycarbonate body
> Fixing by 3 mm screw hole.

Features of VZSG/S02/24 Vertical Dual Port Sensor

> 24VDC power supply via network cable.
> Has two Mini USB Type C ports arranged side by side vertically.
> Minimum power supply voltage of 5 VDC.
> Maximum power supply voltage of 30 VDC.
> Multi-colored LED indicating location, status and faults.
> Automatic network addressing.
> Measurement range: -55°C to 150°C.
> Maximum sensor temperature: 150°C.
> High-temperature polycarbonate body
> Fixing by 3 mm screw hole.

Features of VZSG/S03/24 Horizontal Dual Port Sensor

> 24VDC power supply via network cable.
> Has two Mini USB Type C ports arranged side by side horizontally.
> Minimum power supply voltage of 5 VDC.
> Maximum power supply voltage of 30 VDC.
> Multi-colored LED indicating location, status and faults.
> Automatic network addressing.
> Measurement range: -55°C to 150°C.
> Maximum sensor temperature: 150°C.
> High-temperature polycarbonate body
> Fixing by 3 mm screw hole.

CABLES

The sensor network is easy to assemble thanks to the two mini USB Type C connectors on the sensors and the mini USB shielded cables supplied in different sizes by Varixx, ready to use.

PROGRAMMING TOOLS

A PC program is provided free of charge by Varixx and allows the parameterization and testing of the Gateway, (which can also be programmed by the command module with display).

GATEWAY COMMUNICATION PORTS

The VZSG/G01/24 Gateway has 8 One Wire network communication ports, one RS485 port with Modbus RTU protocol, for communication with supervisory systems or for optional connection to a PC for parameterization, one RJ485 Ethernet port and one port for connection of the control module with display.

DIGITAL GATEWAY OUTPUT

The Gateway has 1 digital output with Normally Open dry contact for use as alarm signaling.

GATEWAY INDICATOR LEDs

The Gateway has 1 RGB LED on each port with the following color scheme:
a) «**Green**» with each channel flashing «**Orange**» on each scan if the gateway is programmed, configured and without alarms or trips.
b) «**Red**» in case of sensor not responding or channel disconnected. Same goes for the control module door LED.
c) «**Off**», «**Green**» or «**Red**» in case of use of the «Find» command by the command module. In this case, the color of the port LED follows the color determined for at least one of the sensors on the channel. For example: if there are 10 sensors on channel 1 and if the «Find» command is sent in menu 2.4 to sensor 1.5 in «Red», the color of the LED on port 1 and also on sensor 1.5 will be red. When exiting the «Find» screen in menu 2.4, the gateway and sensor LEDs return to normal condition.

SENSOR INDICATOR LEDs

Each smart sensor has 1 RGB LED with the following color scheme:
a) «**Green**» flashing with each scan of the respective sensor.
b) «**Off**», «**Green**» or «**Red**» if the «Find» command is used by the command module. For example: if there are 10 sensors on channel 1 and the «Find» command is sent in menu 2.4 to sensor 1.5 in «Red», the color of the LED of sensor 1.5 will remain red continuously while the other sensors in the system will remain «OFF». When exiting the «Find» screen in menu 2.4, the LEDs of the gateways and sensors return to their normal condition. The color of the LED on the gateway port follows the color determined for at least one of the sensors in the channel.

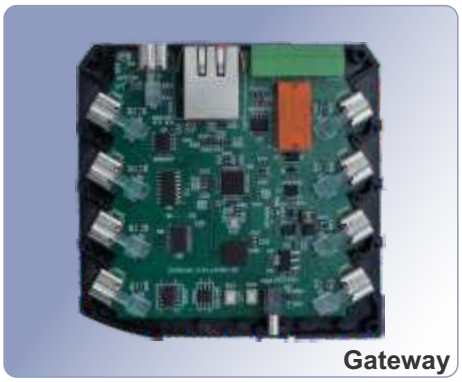
NOTE: An Alarm condition due to "Sensor not responding" or other occurrence does not disable the operation of the other sensors in the network, which continue to operate normally.

MINI USB MULTI-FUNCTION SENSOR CONNECTOR

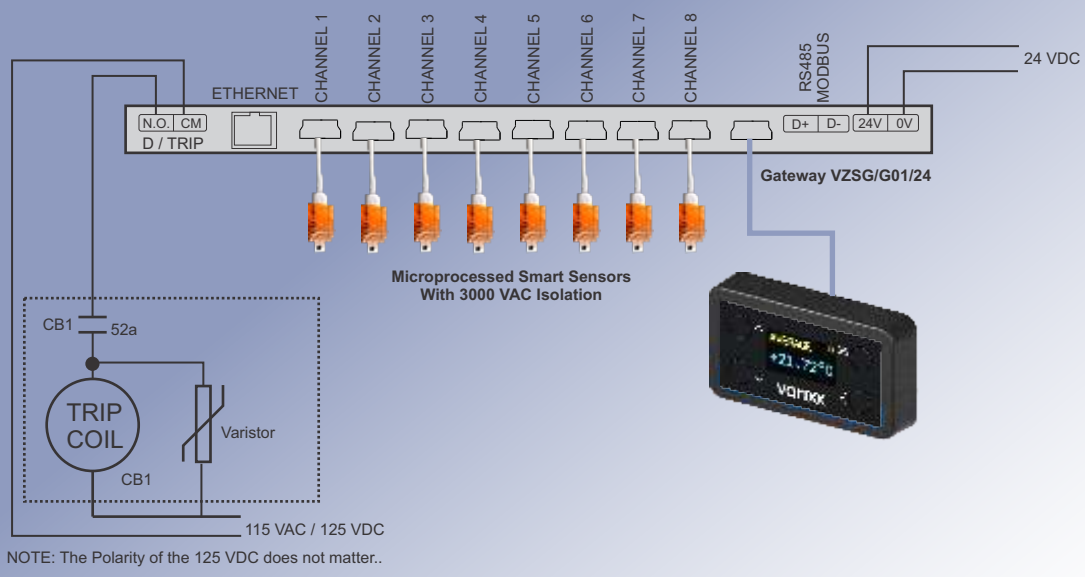
The mini-USB Type-C connectors on the sensor are used for both communication over the One Wire network and for power supply using a standard mini-USB/USB cable (supplied in multiple lengths). The sensors' dual mini-USB ports make it easy to cascade a network. One port is an input and the other is an output, replicating the signal to the next sensor.

ATTENTION

The order in which the input and output ports are connected is not important and cannot be reversed for correct operation.


Gateway

EXAMPLE OF A TYPICAL APPLICATION WITH MONO-PORT SENSORS



NOTE: The Polarity of the 125 VDC does not matter..

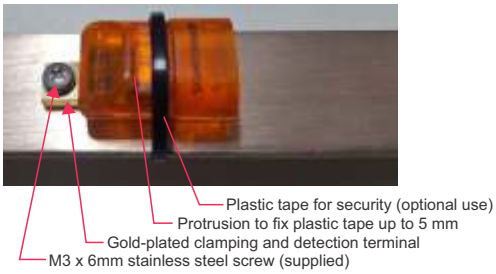
THE OUTPUT CAN BE USED FOR AN ALARM SIGNAL INSTEAD OF A TRIP

EXAMPLE OF INTERNAL APPLICATION TO EXTRACTIBLE DRAWERS OF MCCs OR DATA CENTERS.

In this application, a gateway and up to 8 Single Port sensors are used, with each sensor connected to one of the gateway ports. Up to 3 temperatures close to the input clamps and 3 close to the output clamps, plus two additional internal points, can then be monitored.

Note that in this example, a circuit breaker trip coil is used, but preferably only an alarm signal should be used, since a possible temperature rise allows intervention to be programmed as quickly as possible, without the need for tripping, as is the case with arc-flash detection systems.

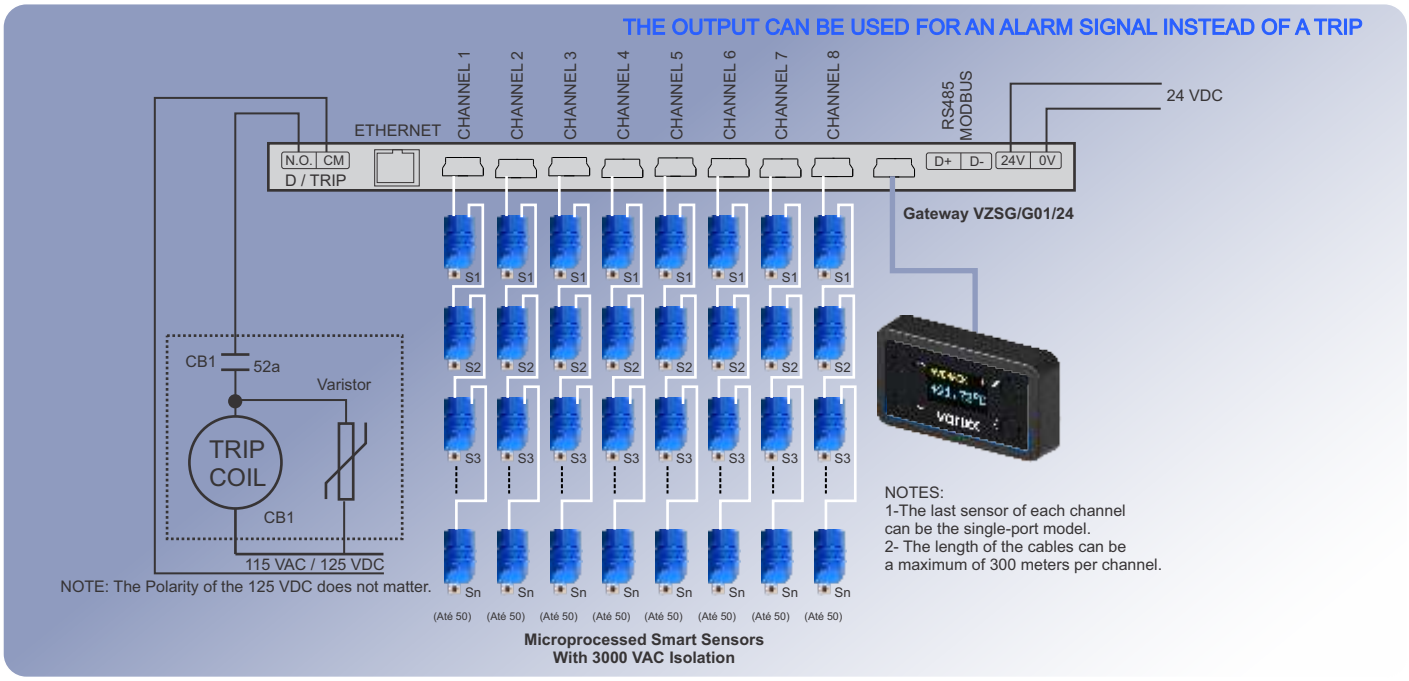
Single-door sensor installed, without the network cable



Single-port sensor installed, with network cable connected

(Coin for size comparison)

EXAMPLE OF A TYPICAL APPLICATION WITH DUAL PORT SENSORS



EXAMPLE OF APPLICATION INTERNALLY TO LOW VOLTAGE ELECTRICAL PANELS OR SHIELDED BUSBAR

In this application, a gateway and up to **50 Dual Port** sensors are used for each gateway port, totaling up to **400** sensors, each sensor having one input port and one output port, which are connected in cascade. Temperatures can then be monitored at any connection points on the panel or at specific connection points on multi-phase shielded busbars.

In the case of shielded busbars, for example, the external part, close to each connection, can be monitored, which will experience a temperature rise if the internal connection shows oxidation or a tightening failure with consequent overheating.

Note that in this example, a circuit breaker trip coil is used, but preferably an alarm signal should only be used, since an eventual temperature rise allows intervention to be programmed as quickly as possible, without the need for tripping, as is the case with arc-flash detection systems.

COMMUNICATION PROTOCOLS INCLUDED

> Ethernet IP
> IEC 61850 (for substation)
> Modbus TCP/UDP
> MQTT Message Queuing Telemetry Transport (IOT - Internet Of Things)
> API RESTful - Representational State Transfer (WEB services)

DUAL PORT SENSOR WITHOUT AND WHITH NETWORK CABLES CONNECTED AND SHOWING NETWORK IN AND OUT MARKINGS

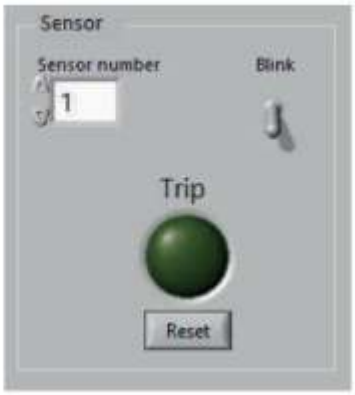
(Coin for size comparison)

OPTIONAL GATEWAY PROGRAMMING WITH PC SOFTWARE

ZYGGOT SG PROGRAMMING SOFTWARE

Zyggot Superger is a configuration software that performs parameterization and configuration of all versions of Zyggot relays and devices. The software is available for free download from the Varixx website (varixx.com.br or varixx.com). The figure below shows the software's home screen. Always download the latest version from the website before using it so that it includes your equipment in its library.

The software automatically recognizes the device and the port to which it is connected to the computer. If the port is not recognized, you can manually select the port using the Manual Connection box. When choosing to connect manually, you must select the serial port to which the device is connected and press the Connect button.



COMPOSITION AND TECHNICAL DATA OF THE ZYGGOT SG SYSTEM

Applications and General Features

• Applicable in low voltage, up to 800 VAC (tested with 2x Nominal +1KV).
• Applicable in CCM drawers.
• Applicable in Data Center systems with extractable drawers.
• Applicable in Busbar monitoring (shielded busbars).
• Sensors powered by the One Wire network itself.
• A single 24 VDC source powers the entire system.
• Up to 400 sensors per Gateway in the version with double-port sensors.
• Up to 8 sensors per Gateway in the version with single-port sensors.
• Does not use batteries.
• Continuous temperature readings of each point automatically.
• Self-addressable - each sensor is detected and addressed automatically.
• Polycarbonate sensors for high temperatures (up to 150 °C).
• Concatenated sensors, if one fails the others continue to operate.
• Very low consumption.
• Very low acquisition and installation costs.

Communication

• Modbus RTU communication (RS485).
• Ethernet communication (RJ45).

Temperatures

• Measurement: -55°C to 150°C
• Maximum sensor temperature: 150°C
• Gateway ambient temperature: -30°C to 105°C

Gateway Output

• 1 Output: 5A / 250 VAC or 5A / 30 VDC. (dry contact).

Resolution and Accuracy

• Resolution: 0.01 °C
• Accuracy better than 0.2 % of the measured value from +10 °C to +45 °C.
• Accuracy better than 0.3 % of the measured value from -40 °C to +105 °C.
• Accuracy better than 0.4 % of the measured value from -55 °C to +150 °C.

Interconnection Cables

• Interconnection cables supplied in lengths from 20 cm to 8 meters.
• Cables with USB C connectors on both ends, ready to use.
• Maximum network length for each channel: up to 300 meters for dual-port sensors.

Sensor Types

• Single Port One Wire Sensor for use with up to 8 sensors per Gateway.
• Dual Port One Wire Sensor with vertical connectors. For systems with up to 400 concatenated sensors, up to 50 per channel.
• Dual Port One Wire Sensor with horizontal connectors. For systems with up to 400 concatenated sensors, 50 per channel.

Programming

• Easily programmable via the control module itself in the drawer or panel door.
• Complete programming, including alarm level, communication parameters, etc.

Codes

• Gateway: VZSG/G01/24
• Single Door Sensor: VZSG/S01/24
• Double Door Vertical Sensor: VZSG/S02/24
• Double Door Horizontal Sensor: VZSG/S03/24
• Control Module with Display: VZSG/M01/24
• Power Supply 6A/24 VDC: VPS6024
• Power Supply 12A/24 VDC: VPS12024

ZYGGOT GATEWAY VZSG/G01/24

Communication:	Modbus RTU and Ethernet
Output:	1 dry contact (alarm) 5A/250VAC
Sensors:	8 or up to 400 per Gateway
Power Supply:	24 VDC Nominal (5 to 30 VDC)
Consumption without Display:	73 mA
Consumption with Display:	81 mA
Measuring Range:	-55 °C to +150 °C
Room Temperature:	-30°C to +125°C
Dimensions:	22W x 91H x 98D mm
Material:	ABS

SMART SENSORS ZYGGOT VZSG/S0X/24 and VZSG/D0X/24

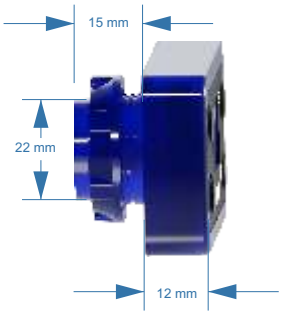
Communication:	One Wire Network
Ports:	1 or 2 depending on the model
Number of Sensors:	8 or up to 400 per Gateway
Power Supply by Network:	24 VDC (5 - 30 VDC)
Consumption with LED off:	250 uA
Consumption with LED on:	5 mA
Measuring Range:	-55 °C to +150 °C
Maximum temperature:	+150 °C
Dimensions VZSG/S01/24:	18W x 12H x 33D mm
Dimensions VZSG/S02/24:	17W x 18H x 38D mm
Dimensions VZSG/S03/24:	30W x 12H x 55D mm
Material:	Policarbonato

CONTROL MODULE VZSG/M01/24

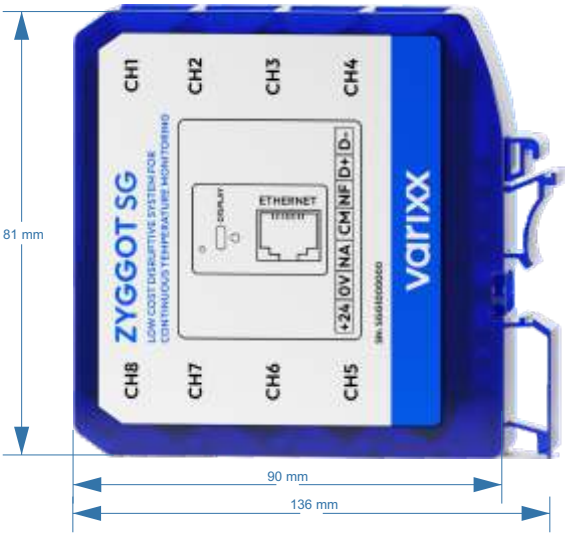
Communication:	Modbus Network
Display:	Color LCD (Liquid Crystal Display)
Buttons:	4 for operation and programming
Power Supply by Network:	24 VDC (5 - 30 VDC)
Consumption:	8 mA
Measuring Range:	-55 °C to +150 °C
Room Temperature:	-40 °C to + 80°C
Dimensions:	66W / 37H / 13D mm
Material:	ABS

MECHANICS AND OPERATING BUTTONS

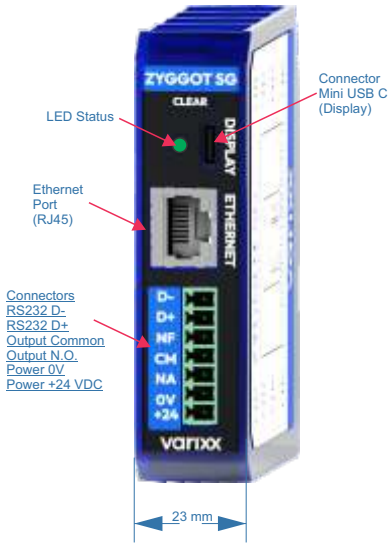
Control Module / Display



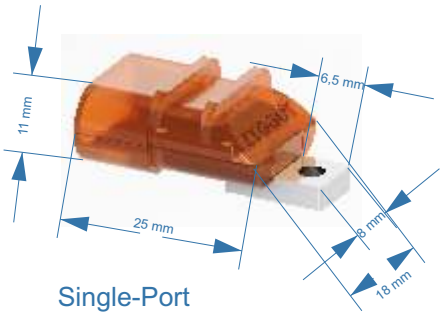
Control Module / Display



GATEWAY

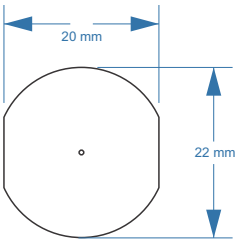


GATEWAY

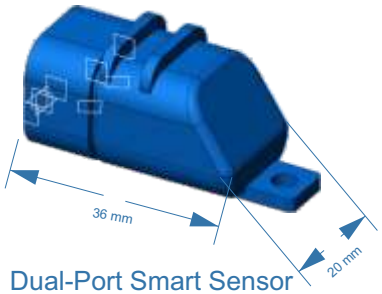


Single-Port
Smart Sensor

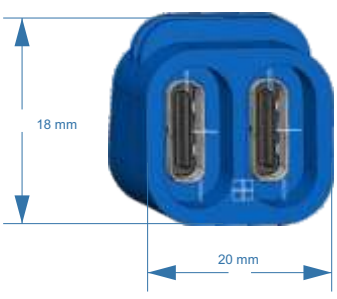
Dual-Port
Smart Sensor



Panel Drilling for
the Control Module



Dual-Port Smart Sensor



Dual-Port
Smart Sensor

USE WITHOUT THE COMMAND MODULE

HOW TO USE THE SYSTEM WITHOUT USING THE CONTROL MODULE WITH DISPLAY.

Despite the low cost of the control module and its small size, which facilitates its installation, there may be cases where the user does not want to install it on the front of the drawers. This is perfectly possible, as all system functionality does not depend on it. The control module serves to program the system and display values and alarms, but this same data can be acquired through various communication modes, and programming can also be performed remotely, thus eliminating the need for its use.
There are two ways to program the system to eliminate the need for the control module, as explained below.

MODE 1: USE OF A SINGLE COMMAND MODULE TO PROGRAM ALL INSTALLED SYSTEMS.

This mode requires the user to have a single command module on hand during system startup, which will be used to program all systems and then stored in a safe place.
This mode requires the user to have access to the mini-USB connection cable to be connected to the command module in each drawer. This can complicate operation somewhat. The command module can be connected and disconnected without any problems with the system powered on (Hot Plug In).

Sequence:
1. Connect the command module to the cable connected to the corresponding gateway port.
2. Wait for it to initialize.
3. Download the parameters as explained in the corresponding topic in this manual.
4. Uncouple the command module.
5. Hide the mini-USB cable used for operation in the drawer or remove it.
6. The system will operate normally without the command module even if it is de-energized and then re-energized.

MODE 2: REMOTE PROGRAMMING OVER ETHERNET USING THE ZYGGOT SG REMOTE CONTROL FEATURE.

This mode requires the user to know the IP address of each Zyggot SG system installed and connected to their LAN.
There are two ways to obtain this IP address so that the Ethernet connection can identify it and access its programming and readings.
Mode A: The Zyggot SG is always delivered in DHCP (Dynamic Host Configuration Protocol) mode. DHCP is a protocol that automatically provides IP addresses and other parameters to devices connecting to a network. Therefore, when the Zyggot SG is connected to your LAN, it appears in the list of network devices with an IP address assigned by the router. Use this IP address and proceed as specified below.
Mode B: With a single command module, during startup, temporarily connect the command module to the gateway and program the desired static IP address. Afterward, disconnect the command module and perform any subsequent programming and program changes remotely via Ethernet, as explained below.

Sequence:
1- Find the dynamic IP address or set the static IP address as explained above.
2- Use the Zyggot SG Web Page Server feature included with the gateway. Simply access the internal page using the established IP address using any browser to access the adjacent page with the various protocols and features.
3- Click on the "Remote Display" window. A screen with a complete clone of the control module will appear, whose operation and readings will be exactly the same as operating a real physical control module. Operation is quick.
4- Use the mouse to click on the virtual buttons and perform the programming and view the readings as explained in the corresponding topic in this manual.

REMOTE CONTROL AND DATA READING BY ETHERNET

LIST OF MENUS AND DATA SCREENS

MENU	Description	View – 0	Edit – 1	Admin – 2
MENU	Main Menu	x	x	x
SAVE	Save Data		x	x
1. STATUS	Status	x	x	x
2. CHANNEL	Channel	x	x	x
2.1 TOTAL	Channel Total	x	x	x
2.2 OFFLINE	Channel Offline	x	x	x
2.3 INDEX	Channel Index		x	x
2.4 FIND	Channel Find	x	x	x
2.5 CLEAR	Channel Clear		x	x
2.6 INFO	Channel Info	x	x	x
3. ALARM	Alarm	x	x	x
3.1 STATUS	Alarm Status	x	x	x
3.2 OVER TEMP	Alarm Over Temperature	x	x	x
3.3 UNDER TEMP	Alarm Under Temperature	x	x	x
3.4 SETUP	Alarm Setup		x	x
3.4.1 ALL	Alarm Setup All Channel		x	x
3.4.2 CHAN.	Alarm Setup By Channel		x	x
3.5 OUTPUT	Alarm Output		x	x
4. SCREEN	Screen		x	x
4.1 LOCALE	Screen Locale		x	x
4.2 CLOCK	Screen Clock		x	x
4.2.1 ADJUST	Screen Clock Adjust		x	x
4.3 DELAY	Screen Delay		x	x
4.4 TIMEOUT	Screen Timeout		x	x
4.6 SHOW 1	Screen Show 1		x	x
4.7 SHOW 2	Screen Show 2		x	x
4.8 TEST	Screen Test		x	x
5. PROTOCOL	Protocol			x
5.1 MODBUS	Protocol Modbus			x
5.2 API WEB	Protocol Restful – API			x
5.3 MQTT IOT	Protocol Mqtt – IOT			x
5.3.1 BROKER	Protocol Mqtt Broker			x
5.3.2 LOGIN	Protocol Mqtt Login			x
6. ETHERNET	Ethernet			x
6.1 E STATUS	Ethernet Status			x
6.2 AUTO	Ethernet Auto			x
6.3 STATIC	Ethernet Static			x
6.3.1 ADDRES	Ethernet Static Address			x
6.3.2 GATEWY	Ethernet Static Gateway			x
6.3.2 MASK	Ethernet Static Mask			x
6.4 DNS	Ethernet Dns			x
6.4 DNS BKP	Ethernet Dns Backup			x
6.4 DNS MAIN	Ethernet Dns Main			x
6.5 NTP TIME	Ethernet Ntp			x
6.5.1 NTP SV	Ethernet Ntp Server			x
6.6 PING	Ethernet Ping			x
6.6.1 RESULT	Ethernet Ping Result			x
7. SERIAL	Serial RS485			x
8. LOGIN	Login	x	x	x
9. PASSWORD	Password		x	x
0. ABOUT	About	x	x	x

Menu list showing the 3 levels namely:

Level 0 (View): Only data and parameter display, without allowing parameter changes or automatic indexing of sensors. However, it allows the location of sensors in the network using the "Find" command. This is the normal operating level, which must be active during use on the factory floor. Every time engineering personnel "log in" to levels 1 or 2, they must be careful to log out after any programming. When logging out, they return to level "0".

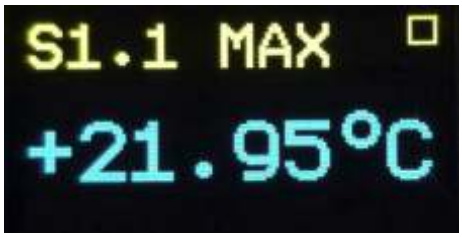
Level 1 (Edit): When logged in at this level, a padlock with the number 1 is displayed on the top yellow line of the display. At this level, you can perform various parameter programming, index network sensors, etc. through menus and submenus from 0 to 4.8 plus 8. Always log out when you have finished making changes to return to level «0».

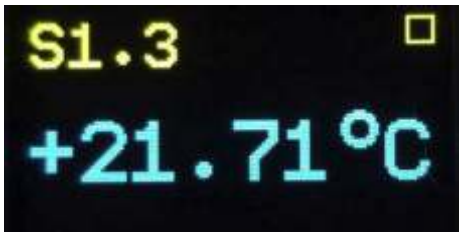
Level 2 (Admin): When logged in at this level, a padlock with the number 2 is displayed on the top yellow line of the display. At this level, you can perform all possible parameter programming and index network sensors, etc., using menus and submenus 0 to 9. Always log out when you have finished making changes to return to level «0».

Attention: In the menus and submenus, whenever you change parameters, do not exit the screen using the «**Menu**» key, but rather select the field with the exit symbol in the upper yellow line in the right corner and press «**Enter**» to access the screen to save the new parameters, when the screen below will appear. Select «Save» and press «**Enter**» to save or «No» and «**Enter**» to not save.

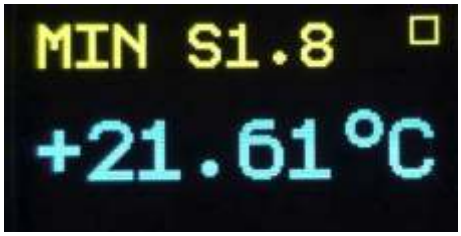
SCREENS + OPERATION / VIEWING

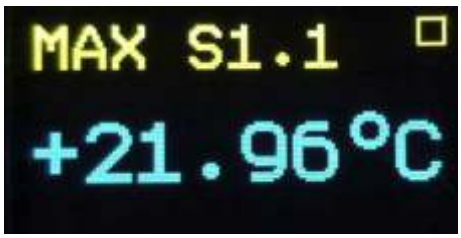
Splash Screen: Shown for a few seconds when turning on.





Temperature Screen: In this example there are 9 sensors on channel 1 and 1 sensor each on channels 2 to 8.
In this topic we will only use the «**Up**» and «**Down**» keys.





Data Screens - Individual Temperatures for Each Sensor, Maximum, Minimum and Average:

When the system is turned on, the display will sequentially show all the system temperatures with the change speed set in menu **4. Screen** > **4.3 Delay** > **Next Sens**: «0.5s», «1s», «3s», «Off» and for the position without **sensor - Empty Chn**: «**0.3s**», «**0.5s**», «**1s**», «**Off**».

When pressing the «**Up**» or «**Down**» keys, the sequential paging stops and you can manually page through all the system sensors.

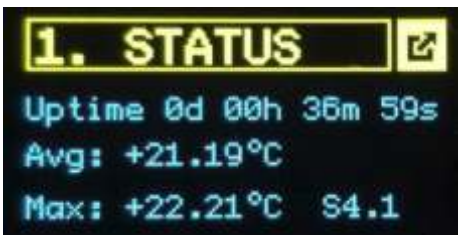
If the display is in «**Off**», the page will not be automatically scrolled and you will need to press «**Up**» or «**Down**» to display the next or previous sensor.

If it is not in «**Off**», when one of the «**Up**» or «**Down**» keys is pressed, the display stops for 3 seconds at the next sensor before returning to automatic scanning if no key is pressed in sequence.

When in **Level 0**, that is, in temperature display mode, when the «**Enter**» key is pressed, the average temperature of all readings («**Average**») will be displayed and if it is pressed again, the «**Minimum**» temperature of all sensors will be displayed and if it is pressed again, the «**Maximum**» temperature of all sensors will be displayed.
If no other key is pressed, the display automatically returns to showing the temperatures sequentially.

SCREENS + OPERATION «LEVEL 0 > VIEW»

Level 0 Menu Screens: If you are in the "Not logged in" condition, that is, if you are not logged in to menu levels "**1**" or "**2**", the operation will be at level "**0**", that is, allowing only basic operations. This is the level at which the system should be on the factory floor, so that no one who does not know the level 1 and 2 passwords can change the programming. The level 1 and 2 passwords leave the factory as "1" and "2" respectively, and once the system is installed, the engineering manager should change them at his/her discretion and only inform the personnel duly authorized to perform programming.
The screen above are called up by pressing the "**Menu**" key and paged through using the "**Up**" and "**Down**" keys. Select **1.STATUS** and press «**Enter**» and the following screen will be displayed, scrolled by the «**Up**» and «**Down**» keys, with system information, namely: «Up Time» (on time), average, maximum and minimum temperatures.
Press the «Menu» key to return to menu level 0.

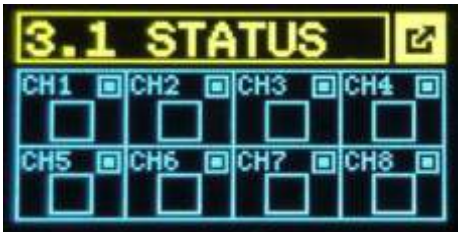


Level 0 Menu Screens: Select **2.1.TOTAL** and press «Enter» and the screen below will be displayed with information on the number of sensors from 1 to 50 in each channel from 1 to 8. In the example below there are 9 sensors in channel 1 and 1 sensor each in channels from 2 to 8. Press the «**Menu**» key to return to menu level 0.

Level 0 Menu Screens: Select **2.2.OFFLINE** and press «**Enter**» and the screen below will be displayed with information on the number of «Not Responding» sensors in each channel from 1 to 8. In the example below there are no «Offline» sensors. Press the «**Menu**» key to return to the level 0 menu.

Level 0 Menu Screens: Select **2.4.FIND** and press «Enter» and the screen below will be displayed.
On this screen you can control the change of LED colors for each sensor independently or for all sensors on a given channel or all sensors in the system in order to check operation, locate a given sensor or locate all sensors on a given channel. Use the «**Up**» and «**Down**» keys to select each field in the «**Channel**» field and choose between the options «All», «CH1» to «CH8» and select the options «All» or Sensor from «SN1» to «SN50» in the «**Sensor**» field.
Select «**RED**», «**GREEN**» or «**OFF**» to change the colors of the chosen LEDs.
When you exit this screen, the colors return to normal, i.e. flashing green for each sensor responding.
Press the «Menu» key to return to menu level 0.

Level 0 Menu Screens: Select **3.1.A STATUS** (Alarm Status) and press «**Enter**» and the screen below will be displayed with information on whether the alarm is triggered or not on each channel from 1 to 8. In the example below, there is no channel with an alarm triggered. Press the «**Menu**» key to return to the level 0 menu.



Level 2 Menu Screens: Select **3.2. Over Temperature** or **3.3. Under temperature** and press «**Enter**» and one of the following screens will be displayed. In these screens you can check the over or under temperature alarm temperatures programmed for each channel from 1 to 8 but you cannot change them (this is only possible in the Setup menu).
Press the «**Menu**» key to return to the level 2 menu.

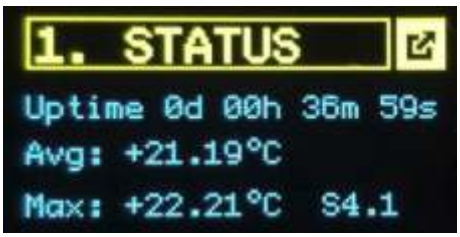
Level 0 Menu Screens: Select **0.ABOUT** and press «**Enter**»

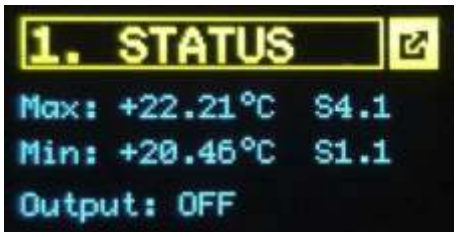
Level 0 Menu Screens: Select **8.LOGIN** and press «**Enter**» and the screen below will be displayed.
In this screen you can select the level in «User» (View #0, Edit #1 and Admin #2) using the «**Up**» «**Down**» and «**Enter**» keys. Enter the «Password» for the level selected above and press «**Enter**». The top line in yellow will show a padlock symbol and the number 1 or 2 depending on the level. Until you «Logout» or restart the system, or the automatic logout timer elapses, the current level will be maintained.

SCREENS + PROGRAMMING «LEVEL 1 > EDIT»

Level 1 Menu Screens: Once you have selected "User" Level 1 in the previous menu and logged in, the system will be operating in the "Level 1" menu and the top line in yellow will show a padlock symbol and the number 1. Using the "**Up**" and "**Down**" keys you can access the submenus shown in the screens above.
Select **1. STATUS** and you will see the screen below, as previously explained in level 0.

Select **1.STATUS** and press «**Enter**» and the following screens will be displayed, scrolled by the «**Up**» and «**Down**» keys, with system information, namely: «Up Time» (on time), average, maximum and minimum temperatures.
Press the «**Menu**» key to return to menu level 0.





Select **2.CHANNEL** and press «**Enter**» and the screens below will be displayed, paged by the «**Up**» and «**Down**» keys with several sub-menus.
Press the «**Menu**» key to return to the level 1 menu.

Level 1 Menu Screens: Select **2.1.TOTAL** and press «**Enter**» and the screen below will be displayed with information on the number of sensors from 1 to 50 in each channel from 1 to 8. In the example below there are 9 sensors in channel 1 and 1 sensor each in channels from 2 to 8. Press the «**Menu**» key to return to the level 1

Level 1 Menu Screens: Select **2.2.OFFLINE** and press «**Enter**» and the screen below will be displayed with information on the number of «Not Responding» sensors in each channel from 1 to 8. In the example below there are no «Offline» sensors. Press the «**Menu**» key to return to the level 1 menu.

Level 1 Menu Screens: Select **2.4.FIND** and press «**Enter**» and the screen below will be displayed.
On this screen you can control the change of LED colors for each sensor independently or for all sensors on a given channel or all sensors in the system in order to check operation, locate a given sensor or locate all sensors on a given channel.
Use the «**Up**» and «**Down**» keys to select each field in the «Channel» field and choose between the options «All», «CH1» to «CH8» and select the options «All» or Sensor from «SN1» to «Sn50» in the «Sensor» field.
Select «RED», «GREEN» or «OFF» to change the colors of the chosen LEDs.
When you exit this screen, the colors return to normal, i.e. flashing green for each sensor responding.
Press the «**Menu**» key to return to the level 1 menu.

Level 1 Menu Screens: Select **2.3.INDEX** and press «**Enter**» and the screen below will be displayed.
In this screen you can command the execution of the automatic indexing of all the sensors in the system or only in one of the channels from 1 to 8.
To index in all channels in the «Channel» field select «ALL». This will index all the sensors of the 8 channels. To index only the sensors of a certain channel, select «CH1» to «CH8» as required.
Note that the channel indicator bars will be empty, without blue filling if the sensors were not previously indexed.
After selecting the above channels or all «ALL» select the «**>**» icon and press «**ENTER**».
When pressing «**Enter**» all the channel bars (or the selected channel) will be filled in blue. Note that in this operation the colors of the sensor LEDs change to "red" sequentially and then to green, remaining green after indexing is complete and returning to their normal condition, which is blinking green sequentially when exiting the menus and the system is in the temperature display mode.
Note: Indexing is done by the physical sequence of the sensors in the network.
Press the "**Menu**" key to return to the level 1 menu.

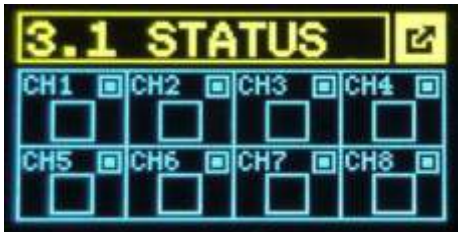
SCREENS + PROGRAMMING «LEVEL 1 > EDIT»

Level 1 Menu Screens: Select **2.5.CLEAR** and press «Enter» and the screen below will be displayed.
On this screen you can command the cleaning or deindexing of all sensors in the system or only one of the channels from 1 to 8. To deindex all channels in the «Channel» field select «ALL». To deindex only the sensors of a given channel, select «CH1» to «CH8» as required.
After selecting the above channels or all «ALL» select «Clear» and press «**ENTER**».
This operation must be performed when changing the number of sensors in the network. Then you must perform the indexing operation as described in the previous item **2.3 INDEX**. for correct system operation.
Press the «**Menu**» key to return to the level 1 menu.

Level 1 Menu Screens: Select **2.6.INFO** and press «**Enter**» and the screen below will be displayed.
This screen shows the number and status of the sensors for each channel.
Selecting the channel in the corresponding field will show the number of indexed sensors.
Selecting the indexed sensor number in the sensor field will show the status «Online» if it is responding or «Offline» if it is not responding or has been removed from the network.
Press the «**Menu**» key to return to the level 1 menu.

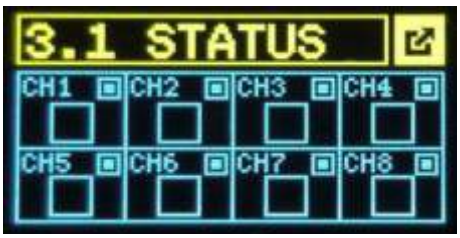
Select **3.ALARM** and press «**Enter**» and the screen below will be displayed, scrolled by the «Up» and «Down» keys with 4 sub-menus: **3.1 A STATUS**, **3.2 A LEVEL**, **3.3 A SETUP** and **3.4 A OUTPUT**.
Press the «**Menu**» key to return to the level 1 menu.

Level 1 Menu Screens: Select **3.1. STATUS** (Alarm Status) and press «**Enter**» and the screen below will be displayed with information on whether the alarm is triggered or not on each channel from 1 to 8. In the example below, there is no channel with an alarm triggered. Press the «**Menu**» key to return to the level 1 menu.



Select **3.ALARM** and press «**Enter**» and the screen below will be displayed, scrolled by the «**Up**» and «**Down**» keys with 5 sub-menus: **3.1 STATUS**, **3.2 Over Temp**, **3.3 Under Temp**, **3.4 SETUP** and **3.5 OUTPUT**.
Press the «**Menu**» key to return to the level 1 menu.

Level 1 Menu Screens: Select **3.1.A STATUS** (Alarm Status) and press «**Enter**» and the screen below will be displayed with information on whether the alarm is triggered or not on each channel from 1 to 8. In the example below, there is no channel with an Alarm Triggered. Press the «**Menu**» key to return to the level 1 menu.

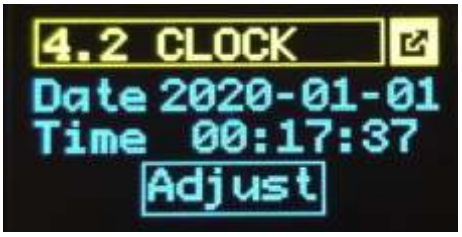


Level 1 Menu Screens: Select **3.2. Over Temperature** (Level) and press «Enter» and the screen below will be displayed.
On this screen you can check the over-temperature alarm temperatures programmed for each channel from 1 to 8 but you cannot change them (this is only possible in the Setup menu).
In the example below they are all at level 080 °C
Press the «**Menu**» key to return to the level 1 menu.

Level 1 Menu Screens: Select **3.2. Under Temperature** (Level) and press «**Enter**» and the screen below will be displayed.
On this screen you can check the Under-temperature alarm temperatures programmed for each channel from 1 to 8 but you cannot change them (this is only possible in the Setup menu).
In the example below they are all at level 080 °C
Press the «**Menu**» key to return to the level 1 menu.

Level 1 Menu Screens: Select **4.1.SCREN** and press «**Enter**» and the screen below will be displayed.
On this screen you can set or program the temperature unit to be displayed (Celsius or Fahrenheit) and the world time zone (-12 to +12) in relation to the Greenwich meridian which is reference 0 (UTC 0). In central Brazil, for example, you should select «-3».
Press the «**Menu**» key to return to the level 1

Level 1 Menu Screens: Select **4.2.CLOCK** and press «Enter» and the screen below will be displayed.
On this screen you can set or program the gateway's internal clock.
Select the «Adjust» field and press «**Enter**».
Select the «DT» field and enter the current date.
Select the «TM» field and enter the current time.
Once the correct data has been entered, select the «Set» field and press «**Enter**».
Note that this data can be entered manually here or obtained automatically by the gateway from the NTP servers if selected further on in the corresponding menu and the system is connected to the internet.
Select the «Adjust» field and press enter and the following screen will be displayed with **submenu 4.2.1**
Select the date and time fields as required and then select the «Set» field and press «Enter» to enter the new values.
Press the «**Menu**» key to return to the level 1 menu.



SCREENS + PROGRAMMING «LEVEL 1 > EDIT»

Level 1 Menu Screens: Select **4.3.DELAY** and press «**Enter**» and the screen below will be displayed.

On this screen you can set or program the automatic sequencing times of the temperature display screens (View) for both the operating sensor positions and the empty sensors (Empty).
You can select for **Next Sens**.: **0.5 s**, **1 s**, **3 s**, **Off** and for **Empty Chn**: **0.3 s**, **0.5 s**, **1 s**, **Off**.
If **Off** is selected, the display changes only occur manually using the «**Up**» and «**Down**» keys.

Press the «**Menu**» key to return to the level 1 menu.

Level 1 Menu Screens: Select **4.4.TIMEOUT** and press «Enter» and the screen below will be displayed.
On this screen you can set the «Timeouts» of the menus in two variations. You can select for **Quit Menu**: **15 s**, **30 s**, **3 s** and **Off**; for **Restore**: **3 s**, **5 s**, **10 s** and **Off**; and for **Logout** between **15 m**, **45 m**, **90 m** and **Off**.
If **Off** is selected, automatic menu exits only occur manually by pressing the «**Up**» and «**Down**» keys.
On the save screen, select «Yes» to save or «No» to not save and press «**Enter**».

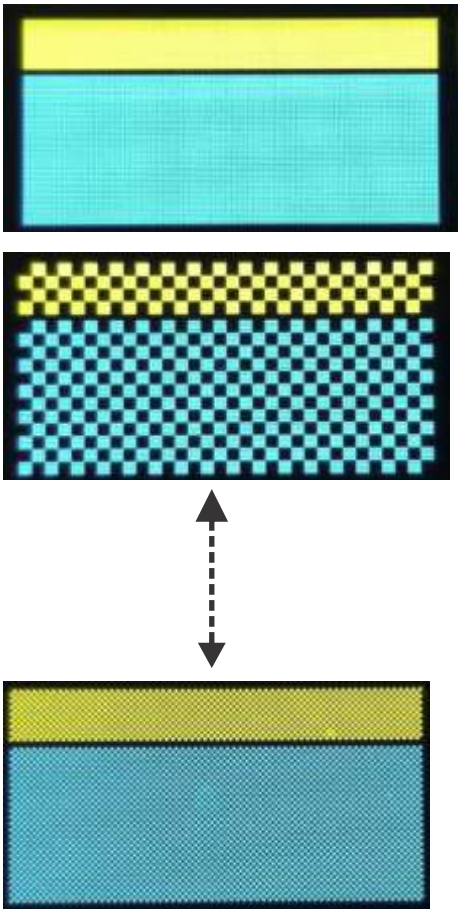
Level 1 Menu Screens: Select **4.6.SHOW 1** and press «**Enter**» and the screen below will be displayed.
On this screen you can select the data that will be displayed on the temperature display screens.
Select the required field and press «**Enter**» and observe the filling of the indication square, which will be filled in blue if enabled.
The fields «ALL», «Max», <Min», «Average», «CH. Sn» and «Ch Max» are available.
The last two are exclusive. Selecting one deselects the other.
Press the «**Menu**» key to return to the level 1 menu.

Level 1 Menu Screens: Select **4.7.SHOW 2** and press «**Enter**» and the screen below will be displayed.
On this screen you can set or program the data that will be displayed on the temperature display screens.
The fields «**Empty Channel**» and «**Alarm Output**» are available.
Select the required field and press «**Enter**» and observe the filling of the indication square, which will be filled in blue if enabled.

Press the «Menu» key to return to the level 1 menu.

Level 1 Menu Screens: Select **4.8.TEST** and press «**Enter**» and 6 screens will be displayed below, scrolled by the «**Up**» and «**Down**» keys.
In these screens, all pixels are tested by drawing different graphic patterns in order to ensure that all pixels are intact.

Press the «**Menu**» key to return to the level 1 menu.



Level 1 Menu Screens: Select **8.LOGIN** and press «**Enter**» and the screen below will be displayed.
On this screen, you can use the «**Up**» «**Down**» and «**Enter**» keys to select the level in «User» between (View #0, Edit #1 and admin #2). Enter the «Password» for the level selected above and press «**Enter**». For example, to select level 1, enter Password <1> and press «**Down**» until you select the entry «Login» and press «**Enter**». The top line in yellow will show a padlock symbol and the number 1. Until you «Logout» on this same screen 8 or log in to another level, the operation will remain at user level **1 Admin**.

Press the «**Menu**» key to return to the level 1 menu.

Level 1 Menu Screens: Select **8.PASSWORD** and press «**Enter**» and the screen below will be displayed.
On this screen you can change the password for entering the level **1** menu.
Select the «Password» field and enter the new alphanumeric value, then select the «Change» field and press «**Enter**».
Until you log out of at the menu 8, even if you have changed the password, the operation will remain at level **1 Edit**.
After logging out, you will be asked for the new password to enter this level again.

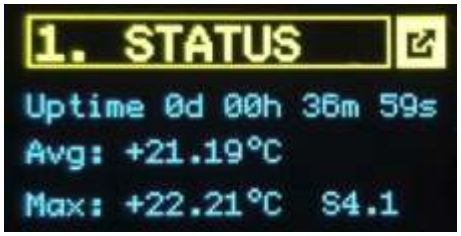
Press the «**Menu**» key to return to the level 1 menu.

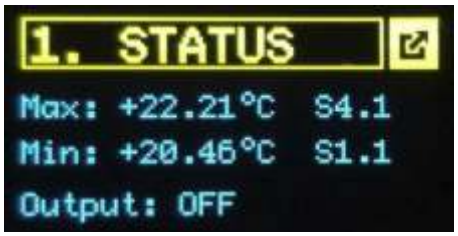
Level 1 Menu Screens: Select **0.ABOUT** and press «**Enter**» and the screen below will be displayed.
On this screen you can read the system information, namely: Hardware Version, Software Version, Date and Varixx web address.
Press the «**Menu**» key to return to the level 1 menu.

SCREENS + PROGRAMMING «LEVEL 2 > ADMIN»

Level 2 Menu Screens: Once you have selected «**User**» **Level 2 - ADMIN** in menu 0 or 1 in the Login field and logged in, the system will be operating in the «**Level 2**» menu and the top line in yellow will show a padlock symbol and the number 2. Using the «**Up**» and «**Down**» keys you can access the submenus shown in the screens above.
Select **1. STATUS** and you will see the screen below, as previously explained in level 1.

Select **1.STATUS** and press «**Enter**» and the following screen will be displayed, scrolled by the «**Up**» and «**Down**» keys, with system information, namely: **Up Time**, **Average**, **Maximum** and **Minimum** temperatures.
Press the «**Menu**» key to return to the level 2 menu.





Level 2 Menu Screens: Select **2.1.TOTAL** and press «**Enter**» and the screen below will be displayed with information on the number of sensors from 1 to 50 in each channel from 1 to 8. In the example below there are 9 sensors in channel 1 and 1 sensor each in channels from 2 to 8.
Press the «**Menu**» key to return to menu level 2.

Level 2 Menu Screens: Select **2.2.OFFLINE** and press «**Enter**» and the screen below will be displayed with information on the number of Offline (Not Responding) sensors in each channel from 1 to 8. In the example below there are no «Offline» sensors.
Press the «**Menu**» key to return to the level 2 menu.

Level 2 Menu Screens: Select **2.4.FIND** and press «**Enter**» and the screen below will be displayed.
On this screen you can control the change of LED colors for each sensor independently or for all sensors on a given channel or all sensors in the system in order to check operation, locate a given sensor or locate all sensors on a given channel.
Use the «**Up**» and «**Down**» keys to select each field «**Channel**» and choose between the options «**All**», «**CH1**» to «**CH8**» and select «**Sensor**» field and choose between the options «**All**» or specific sensor from «**SN1**» to «**SN50**».
Select «RED», «GREEN» or «OFF» to change the colors of the chosen LEDs.
When you exit this screen, the colors return to normal, i.e. flashing green for each sensor responding.
Press the «**Menu**» key to return to the level 2 menu.

Level 2 Menu Screens: Select **2.3.INDEX** and press «**Enter**» and the screen below will be displayed.
In this screen you can command the execution of the automatic indexing of all the sensors in the system or only in one of the channels from 1 to 8.
To index in all channels in the «**Channel**» field select «**ALL**». This will index all the sensors of the 8 channels. To index only the sensors of a certain channel, select «**CH1**» to «**CH8**» as required.
Note that the channel indicator bars will be empty, without blue filling if the sensors were not previously indexed.
After selecting the above channels or all «ALL» select the «**>**» icon and press «**ENTER**».
When pressing «**Enter**» all the channel bars (or the selected channel) will be filled in blue. Note that in this operation the colors of the sensor LEDs change to **red** sequentially and then to **green**, remaining green after indexing is complete and returning to their normal condition, which is blinking **green** sequentially when exiting the menus and the system is in the temperature display mode.
Note: Indexing is done by the physical sequence of the sensors in the network.

Press the "**Menu**" key to return to the level 2 menu.

SCREENS + PROGRAMMING «LEVEL 2 > ADMIN»

Level 2 Menu Screens: Select **2.5.CLEAR** and press «**Enter**» and the screen below will be displayed.
On this screen you can command the cleaning or deindexing of all sensors in the system or only one of the channels from 1 to 8. To deindex all channels in the «**Channel**» field select «**ALL**». To deindex only the sensors of a given channel, select «**CH1**» to «**CH8**» as required.
After selecting the above channels or all «ALL» select «**Clear**» and press «**ENTER**».
This operation must be performed when changing the number of sensors in the network. Then you must perform the indexing operation as described in the previous item 2.3 INDEX. for correct system operation.
Press the «**Menu**» key to return to the level 2 menu.

Level 2 Menu Screens: Select **2.6.INFO** and press «**Enter**» and the screen below will be displayed.
This screen shows the number and status of the sensors for each channel.
Selecting the channel in the corresponding field will show the number of indexed sensors.
Selecting the indexed sensor number in the sensor field will show the status «Online» if it is responding or «Offline» if it is not responding or has been removed from the network.
Press the «**Menu**» key to return to the level 2 menu.

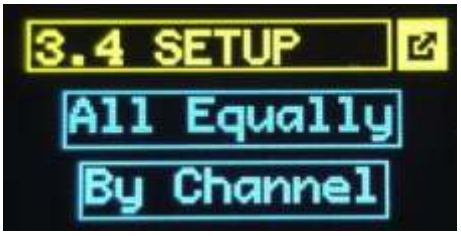
Select **3.ALARM** and press «**Enter**» and the screen below will be displayed, scrolled by the «**Up**» and «**Down**» keys with 5 sub-menus: **3.1 STATUS**, **3.2 Over Temp**, **3.3 Under Temp**, **3.4 SETUP** and **3.5 OUTPUT**.
Press the «**Menu**» key to return to the level 2 menu.

Level 2 Menu Screens: Select **3.ALARM** and press «**Enter**» and the screen below will be displayed, scrolled by the «**Up**» and «**Down**» keys with 5 sub-menus: **3.1 STATUS**, **3.2 Over Temp**, **3.3 Under Temp**, **3.4 SETUP** and **3.5 OUTPUT**.
Press the «**Menu**» key to return to the level 2 menu.

Level 2 Menu Screens: Select **3.2. Over Temperature** (Level) and press «**Enter**» and the screen below will be displayed.
On this screen you can check the over-temperature alarm temperatures programmed for each channel from 1 to 8 but you cannot change them (this is only possible in the Setup menu).
In the example below they are all at level 080 °C
Press the «**Menu**» key to return to the level 2 menu.

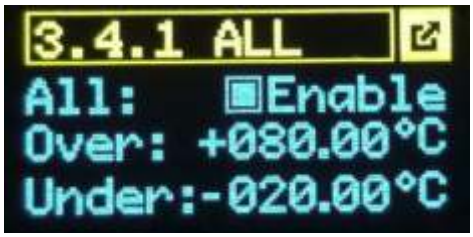
Level 2 Menu Screens: Select **3.2. Under Temperature** (Level) and press «**Enter**» and the screen below will be displayed.
On this screen you can check the Under-temperature alarm temperatures programmed for each channel from 1 to 8 but you cannot change them (this is only possible in the Setup menu).
In the example below they are all at level 080 °C
Press the «**Menu**» key to return to the level 2 menu.

Level 2 Menu Screens: Select **3.3.SETUP** and press «**Enter**» and the screen below will be displayed.
On this screen you can choose how to program the temperature levels: independently for each channel from 1 to 8 or by channel.
Select the channel in the «All Equally» field to program all channels equally or select «By Channel» to program each channel differently and the corresponding submenus below will open.
Press the «**Menu**» key to return to the level 2 menu.



Level 2 Menu Screens: **3.4.1 ALL**
On this screen, you can program the temperature levels for all channels equally and enable or disable the temperature alarm.
To enable or disable all channels, select the «Enable» field and press «**Enter**» and observe the filling of the indication square, which will be filled in blue if enabled.
Select the «Over» field and enter the desired temperature level for the over-temperature alarm between -29.00 °C and +159.99 °C.
Select the «Under» field and enter the desired temperature level for the under-temperature alarm between -29.00 °C and +159.99 °C.
Note that to make it easier to enter numbers, you can first select the two initial fields and (hundreds and tens) and then the final field (units).
Attention: After making the changes, select the field with the exit symbol in the upper yellow line on the right corner and press «**Enter**» to access the screen to save the new parameters or press the «**Menu**» key to return to the level 2 menu without saving.

On the save screen, select «Yes» to save or «No» to not save and press «**Enter**».



Level 2 Menu Screens: **3.4.2 CHAN.**
On this screen, you can program the independent temperature levels for each channel and enable or disable the temperature alarm.

Select the channel in the «CH1» to «CH8» fields.
To enable or disable each channel independently, select the «Enable» field and press «**Enter**» and observe the filling of the indication square, which will be filled in blue if enabled.

Select the «Over» field and enter the desired temperature level for the over-temperature alarm in the field between -29.00 °C and +159.99 °C.
Select the «Under» field and enter the desired temperature level for the under-temperature alarm between -29.00 °C and +159.99 °C.

Note that to make it easier to enter numbers, you can first select the two initial fields and (hundreds and tens) and then the final field (units).

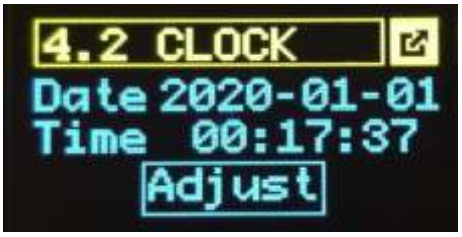
Attention: After making the changes, select the field with the exit symbol in the upper yellow line on the right corner and press «**Enter**» to access the screen to save the new parameters or press the «**Menu**» key to return to the level 2 menu without saving.

On the save screen, select «Yes» to save or «No» to not save and press «**Enter**».

Level 2 Menu Screens: Select **3.5.OUTPUT** and press «Enter» and the screen below will be displayed.
On this screen you can set or program the operating conditions of the gateway's digital output between the options **Over Temp**, **Offline**, **Both** and **None** (disabled).
Select the required field and press «**Enter**» and observe the filling of the indication square, which will be filled in blue if enabled.
On the save screen select «Yes» to save or «No» to not save and press «**Enter**».

Level 2 Menu Screens: Select **4.1.SCREN** and press «**Enter**» and the screen below will be displayed.
On this screen you can set or program the temperature unit to be displayed (Celsius or Fahrenheit) and the world time zone (-12 to +12) in relation to the Greenwich meridian, which is reference 0 (UTC 0). In central Brazil, for example, you should select «-3».
Press the «**Menu**» key to return to the level 2 menu.

Level 2 Menu Screens: Select **4.2.CLOCK** and press «**Enter**» and the screen below will be displayed.
On this screen you can set or program the gateway's internal clock.
Select the «Adjust» field and press «**Enter**».
Select the «DT» field and enter the current date.
Select the «TM» field and enter the current time.
Once the correct data has been entered, select the «Set» field and press «**Enter**».
Note that this data can be entered manually here or obtained automatically by the gateway from the NTP servers if selected further on in the corresponding menu and the system is connected to the Internet.
Select the «Adjust» field and press enter and the following screen will be displayed with **submenu 4.2.1**
Select the date and time fields as required and then select the «Set» field and press «**Enter**» to enter the new values.
Press the «**Menu**» key to return to menu level 2.



SCREENS + PROGRAMMING «LEVEL 2 > ADMIN»

Level 2 Menu Screens: Select **4.3.DELAY** and press «Enter» and the screen below will be displayed.
On this screen you can set or program the automatic sequencing times of the temperature display screens (View) for both the operating sensor positions and the empty sensors (Empty).
You can select for **Next Sens**.: **0.5 s**, **1 s**, 3 s and **Off**. and for **Empty Chn**: **0.3 s**, **0.5 s**, **1 s** and **Off**.
If Off is selected, the display changes only occur manually using the «**Up**» and «**Down**» keys.
On the save screen select «Yes» to save or «No» to not save and press «**Enter**».

Level 2 Menu Screens: Select **4.4.TIMEOUT** and press «Enter» and the screen below will be displayed.
On this screen you can set the «Timeouts» of the menus in two variations. You can select for **Quit Menu**: **15 s**, **30 s**, **3 s** and **Off**; for **Restore**: **3 s**, **5 s**, **10 s** and **Off**; and for **Logout** between **15 m**, **45 m**, **90 m** and **Off**.
If **Off** is selected, automatic menu exits only occur manually by pressing the «**Up**» and «**Down**» keys.
On the save screen, select «Yes» to save or «No» to not save and press «**Enter**».

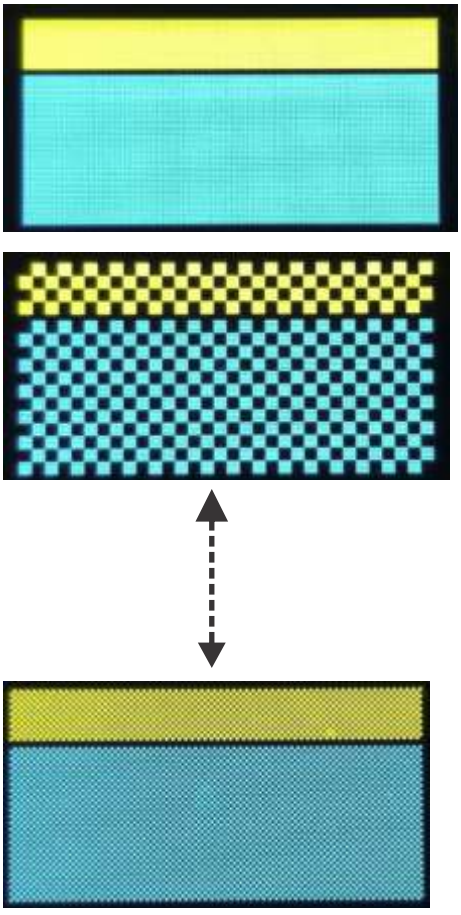
Level 2 Menu Screens: Select **4.6.SHOW 1** and press «**Enter**» and the screen below will be displayed.
On this screen you can set or program the data that will be displayed on the temperature display screens.
Select the required field and press «**Enter**» and observe the filling of the indication square, which will be filled in blue if enabled.
The fields «**ALL**», «**Max**», «**Min**», «**Average**», «**CH. Sn**» and «**Ch Max**» are available.
The last two are exclusive. Selecting one deselects the other.
On the save screen, select «Yes» to save or «No» to not save and press «**Enter**».

Level 2 Menu Screens: Select **4.7.SHOW 2** and press «**Enter**» and the screen below will be displayed.
On this screen you can set or program the data that will be displayed on the temperature display screens.
The fields «**Empty Channel**» and «**Alarm Output**» are available.
Select the required field and press «**Enter**» and observe the filling of the indication square, which will be filled in blue if enabled.

Press the «**Menu**» key to return to the level 2 menu.

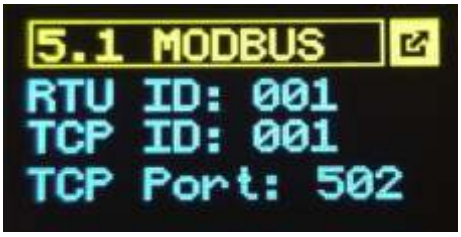
Level 2 Menu Screens: Select **4.8.TEST** and press «**Enter**» and 6 screens will be displayed below, scrolled by the «**Up**» and «**Down**» keys.
In these screens, all pixels are tested by drawing different graphic patterns in order to ensure that all pixels are intact.

Press the «**Menu**» key to return to the level 2 menu.



Select **5.PROTOCOL** and press «**Enter**» and the screen below will be displayed, scrolled by the «**Up**» and «**Down**» keys with 3 sub-menus, namely: **5.1 MODBUS**, **5.2 WEB API** and **5.3 MQTT IOT**.
On the save screen select «Yes» to save or «No» to not save and press «**Enter**».

Level 2 Menu Screens: Select **5.1.MODBUS** and press «**Enter**» and the screen below will be displayed.
On this screen you can set or program the parameters related to Modbus communication via the gateway serial port.
In the **RTU ID** field, enter the address from 001 to 254.
In the **TCP ID** field, enter the address from 001 to 254.
The port used will always be port 502.
On the save screen, select «Yes» to save or «No» to not save and press «**Enter**».



Level 2 Menu Screens: Select **5.2. WEB API** and press «**Enter**» and the screen below will be displayed.
On this screen you can obtain the system's http address and the list of available data.
Note that the SG system already has a web page server and all you need is a browser connected to the system's **http address** to obtain a screen identical to the control module display with working buttons and all functions, including programming. You can operate from anywhere in the world.
On the save screen, select «Yes» to save or «No» to not save and press «**Enter**».

Level 2 Menu Screens: Select **5.3.AMQTT IOT** and press «**Enter**» and the screen below will be displayed.
On this screen you can enter the **Broker** parameter for the **MQTT IOT** Internet of Things protocol.
In the «**Broker**» field, enter the appropriate parameter.
In the «**Enable**» field, select to enable and the square will be filled in blue.
In the «**Login**» field, enter the «**U**» and «**P**» parameters as required.
See more details on how the MQTT protocol works later in this manual.
On the save screen select «Yes» to save or «No» to not save and press «**Enter**».

Select **6.ETHERNET** and press «**Enter**» and the screen below will be displayed, scrolled by the «**Up**» and «**Down**» keys with 6 sub-menus: **6.1 STATUS**, **6.2 AUTO**, **6.3 STATIC**, **6.4 DNS**, **6.5 NTP TIME** and **6.6 PING**.
On the save screen select «Yes» to save or «No» to not save and press «**Enter**».

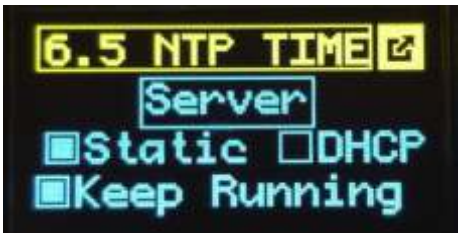
Level 2 Menu Screens: Select **6.1.E STATUS** and press «**Enter**» and the screen below will be displayed.
On this screen you can obtain all the parameters and Status of the Ethernet protocol as configured.
Use the «**Up**» and «**Down**» keys to scroll through the 9 available lines: **IP Config**, **IP Addr**, **Mask**, **Gateway**, **DNS Main**, **DNS Backup**, **DNS Fall** and **MAC**.

Level 2 Menu Screens: Select **6.2.AUTO** and press «**Enter**» and the screen below will be displayed.
On this screen you can select between Ethernet IP Auto (DHCP) or Static IP. Select the option and press «**Enter**». Note the blue filled square. The two options are exclusive, that is, selecting one excludes the other.
After the selection above, select the «**Change/Renew**» field and press «**Enter**».
On the save screen select «Yes» to save or «No» to not save and press «**Enter**».

Level 2 Menu Screens: Select **6.3.STATIC** and press «**Enter**» and the screen below will be displayed.
In this screen you can select the Ethernet Address, Mask and Gateway IP. You can enter the parameters manually or choose one of the previously established patterns **A**, **B** or **C** and edit the parameters entered. To initially select pattern **A**, for example, select field **A** and press «**Enter**». To clear the parameters, select the eraser symbol and press «**Enter**».
On the save screen select «Yes» to save or «No» to not save and press «**Enter**».

Level 2 Menu Screens: Select **6.4. DNS** and press «**Enter**» and the screen below will be displayed.
On this screen you can enter the Ethernet DNS MAIN IP and Ethernet DNS BACKUP IP parameters.
After entering the above data, select the back symbol on the top yellow line and press «**Enter**» and the screen will appear to allow you to save the new data or not. On this screen, choose «**Save**» or «**No**» and press «**Enter**»
On the save screen select «Yes» to save or «No» to not save and press «**Enter**».

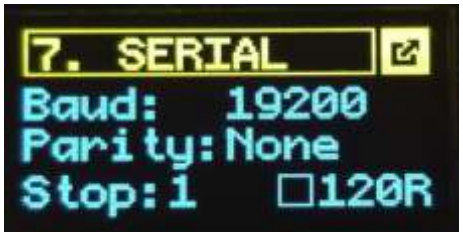
Level 2 Menu Screens: Select **6.5.NTP TIME** and press «**Enter**» and the screen below will be displayed.
On this screen you can enter the parameters related to the NTP (Network Time Protocol) protocol for obtaining times from specific global servers.
Select the «Server» field and press «Enter» to enter the server name.
Choose between «**Static**» and «**DHCP**» modes.
The selected mode will have a blue square filled in. Select the «**Keep Running**» mode and press «**Enter**» to activate it if necessary.
Press the «**Menu**» key to return to the level 2 menu.



Level 2 Menu Screens: Select **6.6.PING** and press «**Enter**» and the screen below will be displayed.
On this screen you can enter the target's IP address and send a data packet to test the communication; Select the «**Target**» field and enter the IP address manually or select the «**GW**» field to select a pre-established pattern that can also be edited manually.
After entering, select the «**Send**» field and press «**Enter**». The results will be displayed on the following screen.
On the save screen select «Yes» to save or «No» to not save and press «**Enter**».

SCREENS + PROGRAMMING «LEVEL 2 > ADMIN»

Level 2 Menu Screens: Select **7.SERIAL** and press «**Enter**» and the screen below will be displayed.
On this screen you can enter the parameters related to serial communication on the gateway's RS485 port. Select the «**Baud**» field and choose between the Baud Rate options 1200, 2400, 4800, 9600, 19200, 38400, 57600 and 115200.
Select the «**Parity**» field and choose between the options None, Even and Odd.
Select the «**Stop**» field and select Stop Bit between the options 1, 1.5 and 2.
Select the **"120R**" field and enable or disable the insertion of the gateway's network termination resistor. This resistor has a value of 120 Ohms.
On the save screen select «Yes» to save or «No» to not save and press «**Enter**».



Level 2 Menu Screens: Select **8.LOGIN** and press «**Enter**» and the screen below will be displayed.
On this screen, you can use the «**Up**» «**Down**» and «**Enter**» keys to select the level in «**User**» between (View #0, Edit #1 and admin #2). Enter the «**Password**» for the level selected above and press «**Enter**». For example, to select level 2, enter Password <**2**> and press «**Down**» until you select the entry «**Login**» and press «**Enter**». The top line in yellow will show a padlock symbol and the number 2. Until you «Logout» on this same screen 8 or log in to another level, the operation will remain at user level **2 Admin**, with access to all programming possibilities.
On the save screen select «Yes» to save or «No» to not save and press «**Enter**».

Level 2 Menu Screens: Select **9.PASSWORD** and press «Enter» and the screen below will be displayed.
On this screen you can change the password for entering the level 2 menu.
Select the «**Password**» field and enter the new alphanumeric value, then select the «**Change**» field and press «**Enter**».
Until you log out of menu 8, even if you have changed the password, the operation will remain at level **2 Admin**.
After logging out, you will be asked to enter the new password again for login at this level.
On the save screen select «Yes» to save or «No» to not save and press «**Enter**».

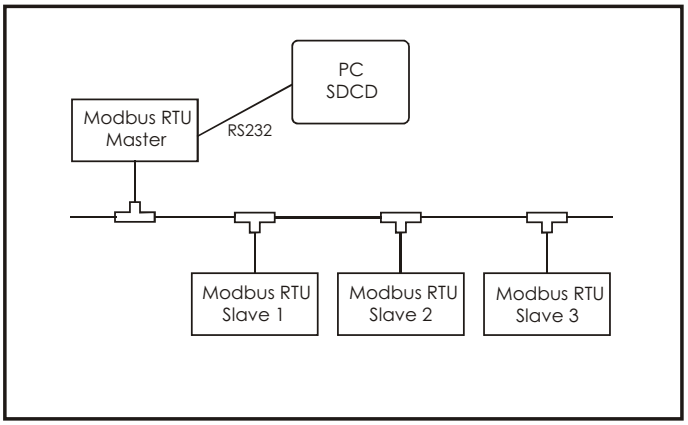
Level 2 Menu Screens: Select **0.ABOUT** and press «**Enter**» and the screen below will be displayed.
On this screen you can read the system information, namely: **Hardware Version**, **Software Version**, **Date** and **Varixx web address**.
Press the «**Menu**» key to return to the level 2 menu.

MODBUS

A complete explanation of the Modbus RTU or ASCII protocol is not within the scope of this manual. It is assumed that the user who will apply the same using this protocol, must have sufficient knowledge for this.

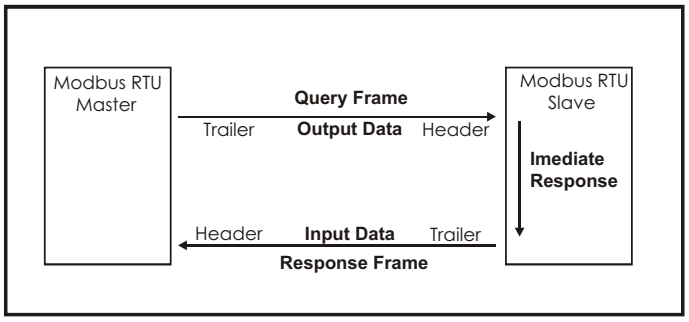
Also, in this manual we will only provide the basic addresses of the memory map to perform the usual operations of reading faults and others. Any parameter programming must be performed on the device itself, as it is normally done only once, during Startup.

Next, there will be a short introduction to the Modbus communication network before the memory map presentation.



Devices communicate using a master-slave technique, in which only one device (the master) can initiate transactions (called 'queries'). The other devices (the slaves) respond by supplying the requested data to the master, or by taking the action requested in the query. Typical master devices include host processors and programming panels. Typical slaves include programmable controllers, motor controllers, load monitors etc, see Fig

The master can address individual slaves. Slaves return a message (called a 'response') to queries that are addressed to them individually.
The Modbus protocol establishes the format for the master's query by placing into it the device address, a function code defining the requested action, any data to be sent, and an error
checking field. The slave's response message is also constructed using Modbus protocol. It contains fields confirming the action taken, any data to be returned and an error-checking field. If an error occurred in receiving the message, or if the slave is unable to perform the requested action, the slave will construct an error message and send this as its response, see Fig.



Address field

The address field of a message frame contains eight bits. The individual slave devices are assigned addresses in the range of 1 - 247. A master addresses a slave by placing the slave address in the address field of the message.
When the slave sends its response, it places its own address in this address field of the response to let the master know which slave is responding.

Function field

The function code field of a message frame contains eight bits. Valid codes are in the range of 1 - 6, 15, 16 and 23. When a message is sent from a master to a slave device, the function code field tells the slave what kind of action to perform.
Examples are:
• to read the ON/OFF states of a group of inputs;
• to read the data contents of a group of parameters;
• to read the diagnostic status of the slave;
•to write to designated coils or registers within the slave.

When the slave responds to the master, it uses the function code field to indicate either a normal (error-free) response or that some kind of error occurred (called an exception response). For a normal response, the slave simply echoes the original function code. For an exception response, the slave returns a code that is equivalent to the original function code with its most significant bit set to a logic 1.
In addition to its modification of the function code for an exception response, the slave places an unique code into the data field of the response message. This tells the master what kind of error occurred, or the reason for the exception.
The master device's application program has the responsibility of handling exception responses. Typical processes are to post subsequent retries of the message, to try diagnostic messages to the slave and to notify operators. Additional information about function codes and exceptions comes later.

Data field

The data field is constructed using sets of two hexadecimal digits (8 bits), in the range of 00 to FF hexadecimal.
The data field of messages sent from a master to slave devices contains additional information which the slave must use to take the action defined by the function code. This can include items like discrete and register addresses, the quantity of items to be
handled and the count of actual data bytes in the field.
For example, if the master requests a slave to read a group of holding registers (function code 03), the data field specifies the starting register and how many registers are to be read. If the master writes to a group of registers in the slave (function code 10 hexadecimal), the data field specifies the starting register, how many registers to write, the count of data bytes to follow in the data field, and the data to be written into the registers.
If no error occurs, the data field of a response from a slave to a master contains the data requested. If an error occurs, the field contains an exception code that the master application can use to determine the next action to be taken.

CRC Error checking field

The error checking field contains a 16 bit value implemented as 2 bytes. The error check value is the result of a Cyclical Redundancy Check (CRC) calculation performed on the message contents.
The CRC field is appended to the message as the last field in the message. When this is done, the low-order byte of the field is appended first, followed by the high-order byte. The CRC high-order byte is the last byte to be sent in the message. Additional information about CRC calculation are found in this manual.

MODBUS - GENERIC DETAILS

Using Modbus Slave Communications

Overview:
The ZYGGOT SG GATEWAY allows the serial port to act as a Modbus/RTU slave. The Modbus function supports the RTU mode of operation at a variety of baud rates and protocol frames. Port activity status, an activity timer, and support for call-on-exception operation are also supported.

Basic Operation:
Time Out Timer:
The Modbus function contains a timer that is reset upon receipt of a valid message addressed to this function. If communications cease between the master and this function, this timer expires, which sets an inactivity timeout bit in the status word. As soon as communications are reestablished, both the timer and the inactivity timeout bit in the status word are reset.

Exception Reporting:
Exception reporting is a method of immediately informing the master that the slave has important information pending. This method is typically used in applications where modems are used as the communication channel, and slaves are polled for data at long intervals. Once the connection is established, the master and slave require some cooperative functionality to determine the address of the calling slave. Since this functionality is not standardized or part of the Modbus protocol, the Modbus function contains two alternative methods so that the one most suitable for the master can be selected.
The first method involves the slave responding to the non-standard Modbus "Get Slave Address" request, which is transmitted by the master after the connection is established. Since this is just a response to a Modbus request, this method does not require Exception Messaging to be enabled. This is the method used by ZYGGOT. Using this method with a third-party master may require that the master be modified to support this command. The Modbus request and response frames are shown below:

Request:

ADDR	FUNC
0	65 (41H)

Response:

ADDR	FUNC	DATA
(SLAVE ADDR)	65(41H)	(SLAVE ADDR)

O segundo método envolve o envio pelo escravo de uma resposta não solicitada (mensagem de exceção) ao mestre assim que a conexão é estabelecida (disponível apenas por solicitação). O padrão de byte específico usado para a Mensagem de Exceção depende daquele suportado pelo mestre. Quando enviado, o cabeçalho apropriado e as somas de verificação são inseridos automaticamente pela função Modbus. A contagem de bytes atua como o gatilho que inicia a transmissão da resposta. Quando a contagem de bytes passa de zero para um número específico, esse número de bytes é enviado. Uma vez transmitida, a função Modbus responde às solicitações do mestre conforme o esperado.

Master Mapping:
To access a memory point or memory flag via Modbus, the master must be configured for the point type and offset. This is typically done using one of two methods. The first method uses the traditional addressing scheme where the highest digit represents the point type and the lowest digits represent the point offset (starting with point 1). Since only four types can be represented in this manner, the Modbus function groups multiple data tables into a single point type array.

The traditional «RTU Reference» column below specifies the starting address of each table. The second method requires the master to be configured with the specific Modbus command and offset. The supported Modbus commands and associated offset are also illustrated below.

Communication port buffer

The **ZYGGOT** firmware maintains a transmit buffer and a receive buffer. When a Send or Receive task is executed, data is transferred between the appropriate buffer and the program registers.

For a «Comm Port Transmit» element, the «TX Count» word contains the number of characters moved from the program registers to the transmit buffer. This number may be less than the requested number if the comm port buffer is full.

For a «Comm Port Receive» element, the «RX Count» word contains the number of characters moved from the receive buffer into the program area. This number may be less than the requested number if the comm port buffer contains fewer characters than requested.

Serial Port
The serial port physically present on the ZYGGOT unit.

Handshaking
Handshaking is a method by which the end destination of a transmission can control how much and when data is sent to it.

NOTE: For the purposes of this discussion, the source end is defined as the unit that is transmitting data. The destination end is defined as the unit that actually receives the data.
The handshake is configured in the software. The source unit sends as many bytes of data as possible as quickly as possible for a given baud rate. No consideration is given to the capabilities of the destination end.

XON/XOFF -- (Also called software handshaking) The destination end keeps track of how many characters it has received and the size of its internal buffers. If the buffer becomes full or the unit is unable to receive any more characters, it must transmit the XOFF (transmit off) character. The source end must then stop transmitting data until a subsequent XON character is sent by the destination end.

Because there is some heavy software overhead involved, the timing of transmissions is variable. The destination must first determine that it is full and then transmit the XOFF signal. The source end must read the XOFF signal and react to it. In the meantime, several additional bytes of data may be sent. It is up to the destination end to ensure that it sends the XOFF signal soon enough so that the buffer does not overflow.

The XON and XOFF characters are predefined by the ASCII character set. XON is 11 hexadecimal or 17 decimal. XOFF is 13 hexadecimal or 19 decimal. XON/XOFF handshaking is most often used where only ASCII values are being sent. XON/XOFF cannot easily be used where binary data is involved, because the XON/XOFF codes are also valid binary codes.
Note that XON/XOFF handshaking usually implies a full duplex communication channel (both ends can transmit simultaneously), since the destination end must transmit the XOFF characters at any time (including in the middle of a transmission from the source end).
The advantage of XON/XOFF handshaking is that it can be implemented using a three-wire (TX/RX/Common) cable easily and inexpensively.

MODBUS - GENERIC DETAILS

HARDWARE -- Also called RTS/CTS handshaking. Hardware handshaking requires extra signals to be sent between the two units, so it is more expensive to implement due to the increased number of wires in the interconnect cables.
In operation, the destination end determines that it is idle and asserts its CTS (Clear To Send) signal. In response, the source end sends data as long as the CTS signal remains active.
Many devices have the RTS/CTS signals hardwired directly into the hardware. Thus, an inactive CTS signal from the destination end can instantly shut down the source end. These hardware operations can be very fast because no software control is required in this case. Furthermore, this form of handshaking can be used regardless of the nature of the data being transmitted, ASCII or binary encoded.
Full Duplex Multi-Drop -- In a full-duplex multi-drop situation, all available units are connected in parallel. For the receiver circuitry, this is not a problem as long as the load on the network is not excessive. All units have their receivers enabled at all times.
Every message sent by the system is somehow identified by a receiving address. All units will receive all messages. All units check the delivery address against their own address and only the unit with the matching address responds.
When a unit determines that it has something to transmit, it turns on its transmitter, sends the necessary data packet, and then turns off its transmitter.
Full Duplex Multi-drop is typically found in multi-master or peer-to-peer systems where all units have a roughly equal chance of needing to transmit a message. Often, units need to verify that the message sent was sent correctly so that the receiver is on at all times.
The advantage of this system is that many units can be connected to a simple three-wire cable (RX/RX/Common). The disadvantage of this system is the increased complexity of the firmware and software.
Half-Duplex Multi-Drop -- Half-Duplex Multi-Drop operation is identical to Full-Duplex, except that the transmitting unit's receiver is disabled when the unit is transmitting. All units keep their transmitters disabled and receivers enabled at all times, except when they need to transmit. Typically, protocols dictate that only the unit matching the drop address may transmit. This unit turns on its transmitter, turns off its receiver, sends the required data packet, then disables its transmitter and enables its receiver. Half-Duplex Multi-Drop is typically found in Master/Slave systems where one unit is designated the Master and all other units are Slaves. The Master transmits a message to a Slave, then disables its transmitter. All slaves hear the message, but only the slave with the matching "drop address" will turn on its transmitter and respond.

DATA TYPES

OData can be stored or used in several different formats. The format used depends on how the information is to be interpreted. Typical interpretations are binary bit patterns, unsigned numbers, signed numbers, floating point values, and strings.

Type Name Description

BOOL Boolean: A single BIT. Can only contain the values '0' or '1'.
BYTE: A string of 8 consecutive bits. Byte values are used where the data value is not as important as the bit patterns (shifts and rotations).
WORD: Word A string of 16 consecutive bits. Word values are used where the data value is not as important as the bit patterns (shifts and rotations).
DWORD: Double Word - A string of 32 consecutive bits. DWORD values are used where the data value is not as important as the bit patterns (shifts and rotations).
INT: Integer - A 16-bit signed value. Integers are used where the data value is expected to be in the range -32,768 to +32,767
SINT: Short Integer - An 8-bit signed value. Short integers are used where the data value is expected to be in the range -128 to +127.
DINT: Double Integer - A 32-bit signed value. Double integers are used where the data value is expected to be in the range -2,147,483,648 to +2,147,483,647.
UINT: Unsigned Integer - A 16-bit unsigned value. Unsigned integers are used where the data value is expected to be in the range -0 (zero) to 65,535.
USINT: Unsigned Short Integer - An 8-bit unsigned value. Unsigned short integers are used where the data value is expected to be in the range 0 (zero) to 255
UDINT: Unsigned Double Integer - A 32-bit unsigned value. Unsigned double integers are used where the data value is expected to be in the range 0 (zero) to 4,294,967,296.
REAL Floating Point: A 32-bit value. Values are stored and operated on in IEEE single-precision (six-digit) format. Values range from -3.40282E+38 to +3.40282E+38.
STRING: A variable-length sequence of characters. Each character is represented by one byte.
Bits in word registers can be used as Boolean values. In this case, «Bit Offset Addressing» is used to specify the «Register Type», «Offset» and «Bit Offset» for the required bit.
Using boolean registers to represent real numbers is generally inefficient.

MODBUS - GENERIC DETAILS

Real Numbers
A number which contains an explicit decimal point is known as a REAL or Floating Point number. The numbers are termed "real" because they reflect the real value of a measurement (to the accuracy of the system) in whole units and fractional parts of units without artificial truncation to some less-precise format such as integers.
The location of the decimal point (thus determining the number of whole units and fractional parts) is contained with the number itself. Since for any given real number the decimal point can be in a different position, real number are often called floating point. In ZYGGOT, the terms real and floating point are used interchangeably.

FORMAT
Real numbers are usually input and displayed as a six digit field:

3.12159 654321

If the number is too large or too small to be represented using only six digits, the number is displayed as a six-digit field plus an exponent:
1.03647e+12 9.73157e-22

For display purposes, the format consists of a six-digit value with floating decimal point, and an optional exponent. If the number to be displayed can be displayed in six digits or less, there is no exponent:

+3.14159 -654321 12 .001357 -.000032

The sign, '+' or '-', is optional. If the sign is not included, then '+' is assumed.
Numbers with more decimal places are displayed using Scientific Notation. This displays a six-digit number with decimal point and an exponent. The exponent part is indicated by the letter 'E' or 'e', the sign of the exponent ('+' or '-') and a two-digit number that is the exponent. For example:

.0000000004567 = 4.567e-10 3143286945 = 3.14329e+09

Note that in the second example some precision is lost, because there are only six significant digits possible.

Internally, floating point numbers are stored in single-precision 32-bit IEEE format. This format uses a 23-bit mantissa (the value portion), an 8-bit exponent, and a single sign bit.

It is important to note that 32 bits are required for storage. In the ZYGGOT V5F this requires two (2) consecutive 16-bit word registers, presumably %R.

RANGE
Given the single precision 32-bit IEEE format, acceptable values range from +/-3.40282E+38 (a very small fractional number) to +/-3.40282E+38 (a very large integer number).

SIGNIFICANT DIGITS
The real number format supports six (6) significant digits. When more than six (6) significant digits are displayed, only the first six can be counted on for accuracy.

3.14159265 = 3.14159 2535.00000045 = 2535

ENTERING FLOATING POINT VALUES
All floating numbers must adhere to the above format.
If an exponent is included, the mantissa (value) portion must also contain a decimal point. Note that if the entered format is other than x.yyy, the decimal point is moved and the exponent adjusted accordingly:

123.456e+3 = 123456 [The actual value can be displayed with six digits and no exponent]

143.643E-12 = 1.43643E-10 [Decimal point is moved and exponent adjusted]

A decimal point must be included to reduce any ambiguities. For example, 123e10 should be entered as 123.0e10, or better still 1.23e12.

Neither the mantissa nor the exponent may contain spaces.
"123 45e-12" and "4.3256e -23" will not be interpreted correctly because of the embedded spaces.

Both the mantissa and the exponent may contain a sign, + or -; i.e.:
"-1.3245e+12" or "4.243e-8". if the sign is missing then the associated part is assumed to be positive, "1.2345e10".

ERRORS

OVERFLOW is the most common error. This occurs when the result of a real number operation is greater than +3.40282E+38 or less than -3.40282E-38. For example, the equation
1.2345E-20 * 2.3456E-20
certainly causes this problem.

INFINITY
In case of an overflow result, power flow through the offending element is OFF, and the resulting value is set to Positive Infinity (if the value is greater than +3.40282E+38) or Negative Infinity (if the value is less than -3.40282E+38).

NOT A NUMBER (NAN)
If an infinity result is passed through to other calculations, the result can be undefined. This is know as Not a Number (NAN).
In the case of a NAN result, power flow through the offending element is OFF.
If a NAN result is passed through to another element, it feeds through to successive elements.

MODBUS - GENERIC DETAILS

Register Types

Controllers offer a wide variety of Register Types. In most cases, the controller treats register types as if they were memory locations.
The following is a list of register types implemented normally available but not all are available for the user.

%AI Analog Input
16-bit input registers used to gather analog input data such as voltages, temperatures, and speed settings coming from an attached device.
%AQ Analog Output
16-bit output registers used to send analog information such a voltages, levels or speed settings to an attached device.
%I Digital Input
Single-bit input registers. Typically, an external switch is connected to the registers.
%K Key Bit
Single-bit flags used to give the programmer direct access to any front panel keys appearing on a unit. Only the OCS series has keypads.
%Q Digital Output
Single-bit output registers. Typically, these bits are connected to an actuator, indicator light or alarm annunciator.
%R General Purpose Register
Retentive 16-bit registers.
%S System Bit
Single-bit bit coils predefined for system use.
%SR System Register
16-bit registers predefined for system use.
%T Temporary Bit
Non-retentive single-bit registers.

Bit-Mapped Addressing of 32-bit Registers

Bit-mapped addressing of 32-bit registers is not allowed. Bit offset values range from 1 to 16.
In order to access all 32 bits in a double register it is necessary to address the upper word of the register separately. Storage is such that the lower word is stored in the first (base) register, and the upper word is stored in the next consecutive register.
For example. if the 32-bit binary 0000000000000001 0000000000000100 value (65540 decimal) is loaded into register %R43, %R43 contains 0000000000000100 and %R44 contains 0000000000000001. Therefore, to check Bit 17 of the DWORD stored at %R43, one must check Bit 1 of %R44, addressed as %R44.1.

Numbering Base

In ZYGGOT all offsets begin with 1 (one). 0 (zero) is not valid for register offset nor bit offset addressing.
Register offsets are thus in the range of 1 to X, where X is the maximum number of register in this model. For example, if the selected type has 2048 %R registers, they are addressed as %R01 through %R2048.

Bit Offsets are in the range of 1 to 16.

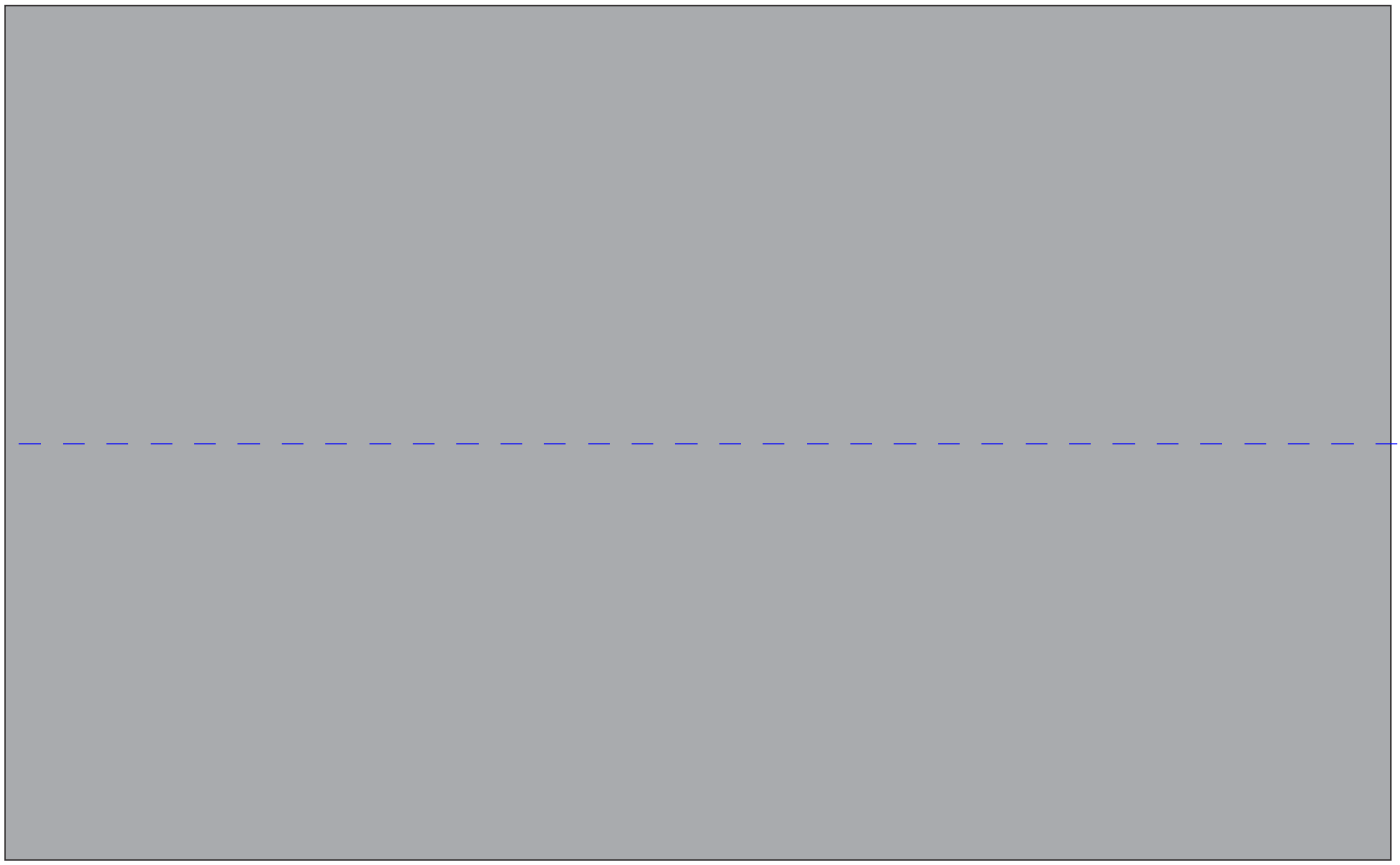
Groups of Boolean registers can be accessed as a 16-bit register. In this case, though, the Bit offset must lie on a 16-bit boundary, 1, 17, 33, etc.

FACTORY DEFAULT SETTING

The SG Gateway leaves the factory ready to use with the settings below.

GATEWAY SG	
ADDRESS	1
BAUDRATE	19200
PARITY	N ONE
DATA BITS	8
STOP BITS	1
HANDSHAKE	MD HALF
PROTOCOL	MODBUS RTU
PORT MODE	RS485

GENERAL SPECIFICATIONS



MQTT - GENERIC DETAILS

MQTT, or **Message Queuing Telemetry Transport**, is a machine-to-machine communication protocol that allows the exchange of messages and commands between devices in a secure and simple manner. It is a standard protocol widely used in machine-to-machine communication. Another area of use that is also growing is for IoT (Internet of Things) connectivity. The **MQTT** protocol was created to replace HTTP, which, despite being widely used, had several security and reliability issues.

In an **MQTT** protocol, data is published and received through a type of server called a Broker.

All communication takes place through topics, which are the addresses to which messages will be forwarded. The devices that send messages are called **Publishers**. The devices that wish to receive these messages subscribe to this address and are called **Subscribers**.

Whenever a device publishes a message to a topic, everyone who is following that topic receives the message. The **Broker** only makes this connection between the person publishing and the interested party; it does not alter or store the information, it only forwards it.

This form of communication is simple, fast and very efficient, ideal for applications with sensors, industrial automation, or devices connected to the Internet (IoT).

The most commonly used types of brokers are: VerneMQ, Mosquitto, EMQX and HiveMQ.

Before starting to configure an **MQTT Broker**, some prerequisites are necessary.

You must have an environment with administrator access to the operating system, whether Windows or another, to perform the installation and configuration of the services. In addition, it is essential that the equipment or server has a stable connection to the network, since the Broker will be responsible for managing communications between clients and devices.

For production environments, a minimum infrastructure with good processing and memory performance is also recommended, especially if the broker is responsible for a large volume of simultaneous connections.

Step by Step Installation

1-Configuring the MQTT Broker. In this guide, we will use Mosquitto as an example, one of the most popular and widely adopted MQTT Brokers on the market.

The process includes installing the Broker, making basic configuration adjustments (communication port, user authentication and access permissions), as well as security settings using TLS/SSL encryption.

On Linux (Ubuntu/Debian), open the terminal and run the following commands:

sudo apt update

sudo apt install mosquitto mosquitto-clients

On Windows, go to the official Mosquitto website (https://mosquitto.org/download/) and download the installer compatible with your operating system version. Follow the instructions in the installation wizard.

After installation, you can adjust the main configuration file, usually located in /etc/mosquitto/mosquitto.conf (Linux) or in the installation folder (Windows).

The main adjustments include:

Communication port: The default port is 1883 for connections without TLS;

Creating users and passwords: Create a password file with the command:

sudo mosquitto_passwd -c /etc/mosquitto/passwd usuario

Then add the configuration in the file **.conf**:

allow_anonymous false

password_file /etc/mosquitto/passwd

Adjust **Access Control (ACL)**: This defines who can publish or subscribe to specific topics.
For production environments, it is recommended to enable encrypted communication. This ensures that transmitted data cannot be intercepted by third parties. To do this, you must:
Generate a digital certificate (purchase it from a certification authority);
Add the lines below to the file

mosquitto.conf:
listener 8883
cafile /etc/mosquitto/certs/ca.crt
certfile /etc/mosquitto/certs/server.crt
keyfile /etc/mosquitto/certs/server.key

Note: Port 8883 is the default for secure MQTT connections.

With the Broker configured and running, test communication using **MQTT** clients:

To post a message:

mosquitto_pub -h localhost -t "teste/topico" -m "Olá, MQTT!"

This test must be done on the same computer with two instances of the terminal open, precisely because it is using **-h (host)** as localhost. In other words, only the machine will be able to communicate with itself.

In order for other devices connected to the same network to communicate with the **Broker**, the following code must be added to the "**mosquitto.conf**" file:

listener 1883

The code will open the communication port so that any device with a valid IP on the network can connect to the **Broker**. Once this is done, you must run the following code in the terminal:

mosquitto -c "Local\de\caminho\do\mosquitto.conf" -v

You must specify the path of the mosquitto.conf file to run with the settings made.

Once this is done, the Broker will run and any device on the same network will be able to connect using the computer's IP (the port must not be blocked by a firewall).

To subscribe to a topic:

mosquitto_sub -h localhost -t "teste/topico"

When you publish a message, it will immediately appear on the terminal of the client that is subscribed to the topic.

Monitor the **Broker**'s operation logs to ensure that everything is working correctly. On Linux, you can access the logs at:

tail -f /var/log/mosquitto/mosquitto.log

This helps identify connection issues, authentication errors and behavior of connected clients.

The correct configuration of an MQTT Broker is essential to ensure a secure, efficient and stable data flow in industrial communication, IoT and automation.

This protocol can be used, for example, in continuous temperature monitoring - Online Thermography, where it fits perfectly with the **Zyggot SG** system.

IEC 61850 - GENERIC DETAILS

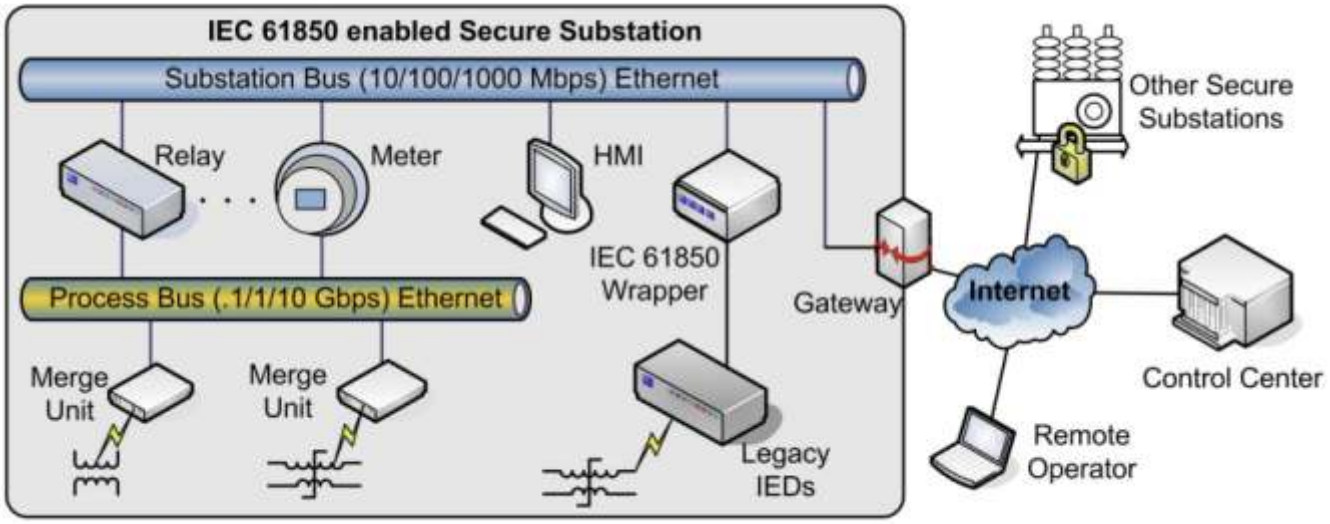
IEC 61850 is an international communication standard protocol that achieves station-wide communication uniformity through a series of standardizations of device functions. Widely used in the power industry, The IEC 61850 standard puts forward the concept of information layering in the substation, both from the logical and physical levels. The substation automation system is divided three levels: The Station Level, The Bay Level and The Process Level. The ACSI is used to exchange data between the levels.

IEC 61850 summarises the communication services necessary for the transmission of information within a substation, designing an Abstract Communication Service Interface (ACSI) that is independent of network and application layer protocols.

The service implementation of the IEC 61850 standard is divided into three parts: the MMS service, the GOOSE service, and the SV service.

The MMS Service is used between the Station Level and the Bay Level of the IEC 61850 standard. It achieves interoperability between different manufacturing devices in a network environment by using an object-oriented modeling approach of the actual devices.
The GOOSE (Generic Object Oriented Substation Event) is a fast messaging mechanism in IEC 61850 for transmitting important real-time signals between IEDs in a substation.
The SV (Simpled Values) is used for Sampled Value Transmission at the Process Level, which is the most commonly used service for real-time measurement data in smart substations.

The IEC 61850 standard was originally proposed by the International Electrotechnical Commission (IEC) in 1995 to provide a globally applicable communication standard for power system automation. In March 1999, a committee draft of IEC 61850 was submitted. Subsequently, a ballot draft and a final draft were submitted. In June 2000, IEC TC57 decided to use IEC 61850 as the basis for the development of a standard for a seamless communication system for power systems. Between 2002 and 2005, various sub-sections of the IEC 61850 standard were published as International Standards.



• IEC61850-enabled IEDs get digitalized power grid condition data via process bus and merge units.
• IEDs communicate with each other using substation buses.
• Legacy devices use IEC61850 wrapper.
• An object model describing the information available from the different primary equipment and from the substation automation functions.
– Abstract definitions of services, data and Common Data Class, independent of underlying protocols.
• A specification of the communication between the IEDs of the substation automation system.
– Maps the services to actual protocols.
• A configuration language.
– Exchange configuration information

API RESTful - GENERIC DETAILS

RESTful (representational state transfer) API (application programming interface) DLs (description languages) are formal languages designed to provide a structured description of a RESTful web API that is useful both to a human and for automated machine processing. API description languages are sometimes called interface description languages (IDLs). The structured description might be used to generate documentation for human programmers; such documentation may be easier to read than free-form documentation, since all documentation generated by the same tool follows the same formatting conventions. Additionally, the description language is usually precise enough to allow automated generation of various software artifacts, like libraries, to access the API from various programming languages, which takes the burden of manually creating them off the programmers.

There are two previous major description languages: WSDL 2.0 (Web Services Description Language) and WADL (Web Application Description Language). Neither is widely adopted in the industry for describing RESTful APIs, citing poor human readability of both and WADL being actually unable to fully describe a RESTful API.

The principle behind building RESTful APIs is known under the acronym HATEOAS (Hypermedia as the Engine of Application State). In this approach, the client software is not written to a static interface description shared through documentation. Instead, the client is given a set of entry points and the API is discovered dynamically through interaction with these endpoints. HATEOAS was introduced in Roy Fielding's doctoral thesis Architectural Styles and the Design of Network-based Software Architectures. HATEOAS is one of the key elements distinguishing REST from RPC mechanisms.

By applying the principle of generality to the components interface, we can simplify the overall system architecture and improve the visibility of interactions. Multiple architectural constraints help in obtaining a uniform interface and guiding the behavior of components.

The following four constraints can achieve a uniform REST interface:
Identification of resources – The interface must uniquely identify each resource involved in the interaction between the client and the server.
Manipulation of resources through representations – The resources should have uniform representations in the server response. API consumers should use these representations to modify the resource state in the server.
Self-descriptive messages – Each resource representation should carry enough information to describe how to process the message. It should also provide information on the additional actions that the client can perform on the resource.
Hypermedia as the engine of application state – The client should have only the initial URI of the application. The client application should dynamically drive all other resources and interactions with the use of hyperlinks.
In simpler words, REST defines a consistent and uniform interface for interactions between clients and servers. For example, the HTTP-based REST APIs make use of the standard HTTP methods (GET, POST, PUT, DELETE, etc.) and the URIs (Uniform Resource Identifiers) to identify resources.

The client-server design pattern enforces the separation of concerns, which helps the client and the server components evolve independently.
By separating the user interface concerns (client) from the data storage concerns (server), we improve the portability of the user interface across multiple platforms and improve scalability by simplifying the server components.
While the client and the server evolve, we have to make sure that the interface/contract between the client and the server does not break.

Statelessness mandates that each request from the client to the server must contain all of the information necessary to understand and complete the request.
The server cannot take advantage of any previously stored context information on the server.
For this reason, the client application must entirely keep the session state.

The cacheable constraint requires that a response should implicitly or explicitly label itself as cacheable or non-cacheable.
If the response is cacheable, the client application gets the right to reuse the response data later for equivalent requests and a specified period.

The layered system style allows an architecture to be composed of hierarchical layers by constraining component behavior. In a layered system, each component cannot see beyond the immediate layer they are interacting with.
A layman's example of a layered system is the MVC pattern. The MVC pattern allows for a clear separation of concerns, making it easier to develop, maintain, and scale the application.

REST also allows client functionality to be extended by downloading and executing code in the form of applets or scripts.
The downloaded code simplifies clients by reducing the number of features required to be pre-implemented. Servers can provide part of the features delivered to the client in the form of code, and the client only needs to execute the code.

The key abstraction of information in REST is a resource. Any information that we can name can be a resource. For example, a REST resource can be a document or image, a temporal service, a collection of other resources, or a non-virtual object (e.g., a person).
The state of the resource at any particular time is known as the resource representation. The resource representations consist of:
* The data
* The metadata describing the data and
* The hypermedia links that can help the clients transition to the next desired state.
A REST API consists of an assembly of interlinked resources. This set of resources is known as the REST API's resource model.

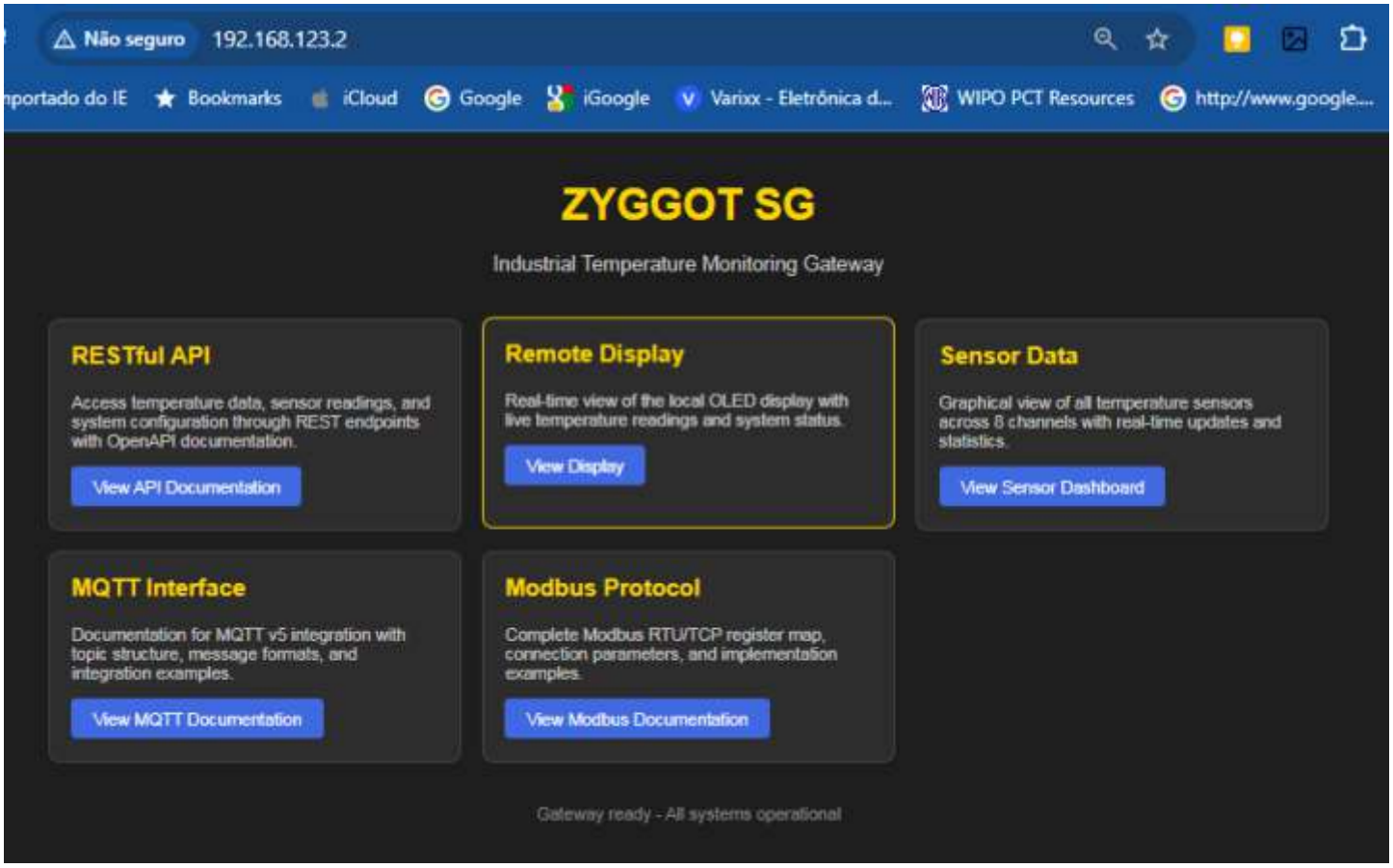
REST uses resource identifiers to identify each resource involved in the interactions between the client and the server components.
The data format of a representation is known as a media type. The media type identifies a specification that defines how a representation is to be processed.

A RESTful API looks like hypertext. Every addressable unit of information carries an address, either explicitly (e.g., link and id attributes) or implicitly (e.g., derived from the media type definition and representation structure).
Hypertext (or hypermedia) means the simultaneous presentation of information and controls such that the information becomes the affordance through which the user (or automaton) obtains choices and selects actions.
Remember that hypertext does not need to be HTML (or XML or JSON) on a browser. Machines can follow links when they understand the data format and relationship types.

Further, resource representations shall be self-descriptive: the client does not need to know if a resource is an employee or a device. It should act based on the media type associated with the resource.
So in practice, we will create lots of custom media types – usually one media type associated with one resource.
Every media type defines a default processing model. For example, HTML defines a rendering process for hypertext and the browser behavior around each element.
Media Types have no relation to the resource methods GET/PUT/POST/DELETE/… other than the fact that some media type elements will define a process model that goes like "anchor elements with an href attribute create a hypertext link that, when selected, invokes a retrieval request (GET) on the URI corresponding to the CDATA-encoded href attribute."

ETHERNET REMOTE CONTROL AND DATA

GENERAL SPECIFICATIONS - HOME PAGE - REMOTE CONTROL PAGE



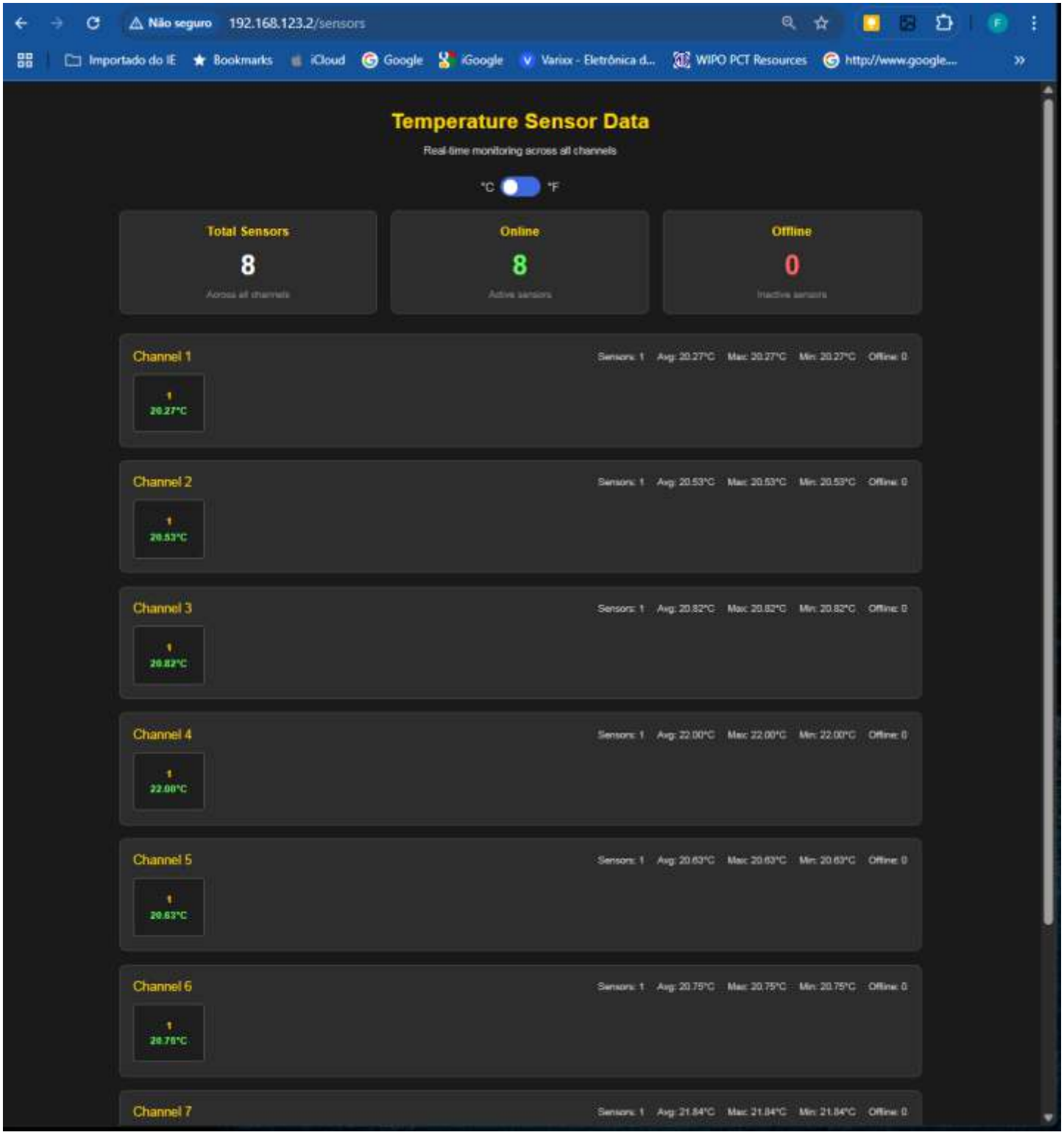
Control Page - Home: Once the appropriate Ethetnet communication parameters have been configured in the control module, whether with Static IP or dynamic IP with DHCP, a browser with the address http://xxx.xxx.xxx.xxx is enough to access this initial screen, without the need for any programming (Zero Programming) to have access to all the Operation Functionalities, Data, Modbus Documentation, MQTT Documentation and API Documentation for eventual integration (Embeding) with the user's SDCDs.

Remote Display: Click on the "Remote Display" item on the Home screen and the window on the side will open.
With just a few clicks of the mouse, you can operate the entire control as if you were in front of it, from anywhere in the world.
You can program, select parameters, read the temperatures of all sensors, etc.
The great advantage is that no programming is required, since the web page server resides internally in the Zyggot SG Gateway. Simply access and use it.

Note: None of these remote control features are necessary for normal use of the system in a panel, for example. In normal use, simply turn on and operate, without the need for any external programming or external software. All these features only add capabilities so that an advanced user can add remote operation features and automate data acquisitions, if desired.

ETHERNET REMOTE CONTROL AND DATA

GENERAL SPECIFICATIONS - SENSOR DATA

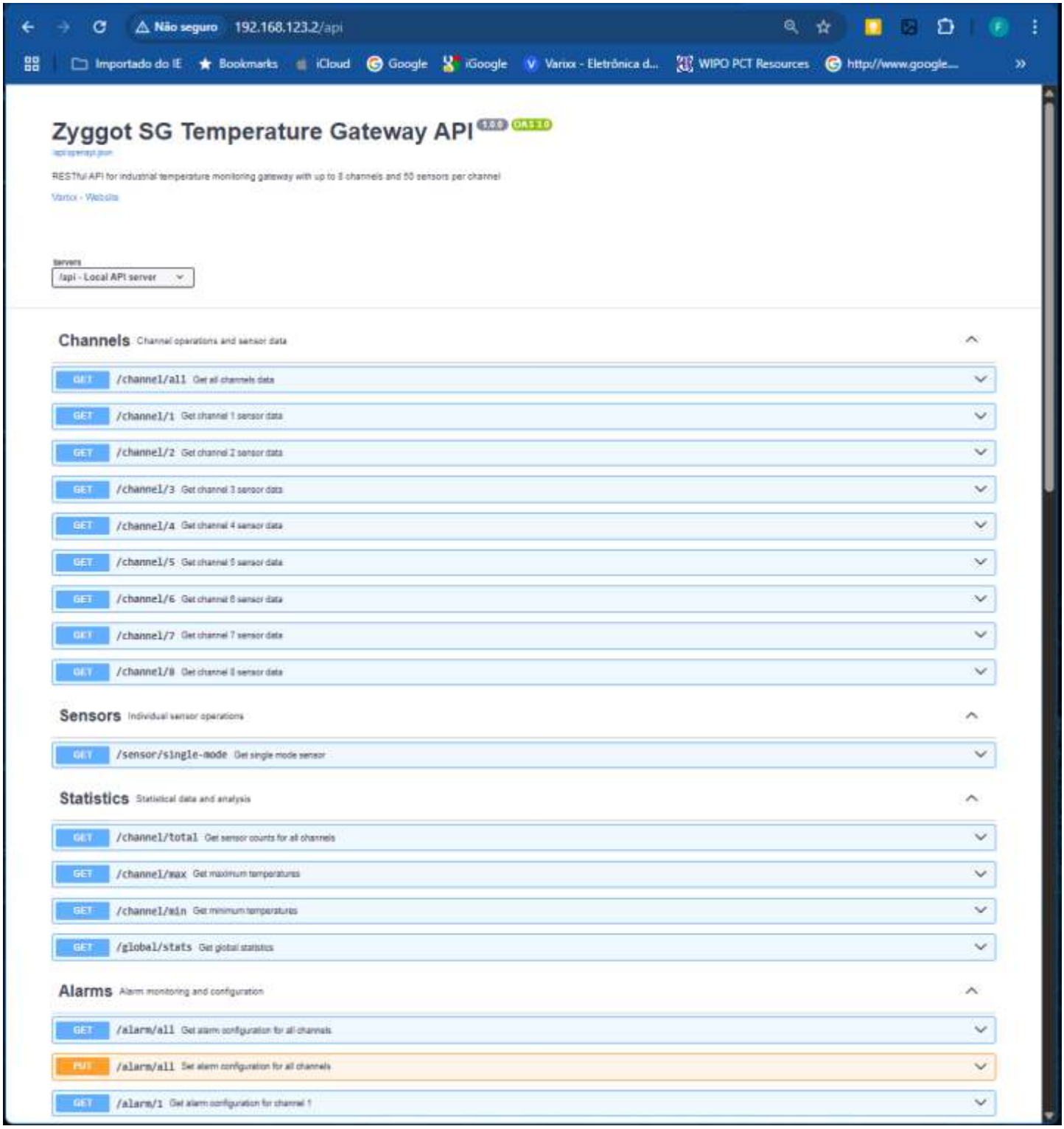


Sensor Data: Click on the "Sensor Data" item on the Home screen and the window above will open.
Here, you can quickly browse through all the system's sensors with a few clicks of the mouse, without having to operate the buttons on the Remote Control Module.

Note: None of these remote control features are necessary for normal use of the system in a panel, for example. In normal use, simply turn on and operate, without the need for any external programming or external software. All these features only add capabilities so that an advanced user can add remote operation features and automate data acquisitions, if desired.

ETHERNET REMOTE CONTROL AND DATA

GENERAL SPECIFICATIONS - RESTFUL API

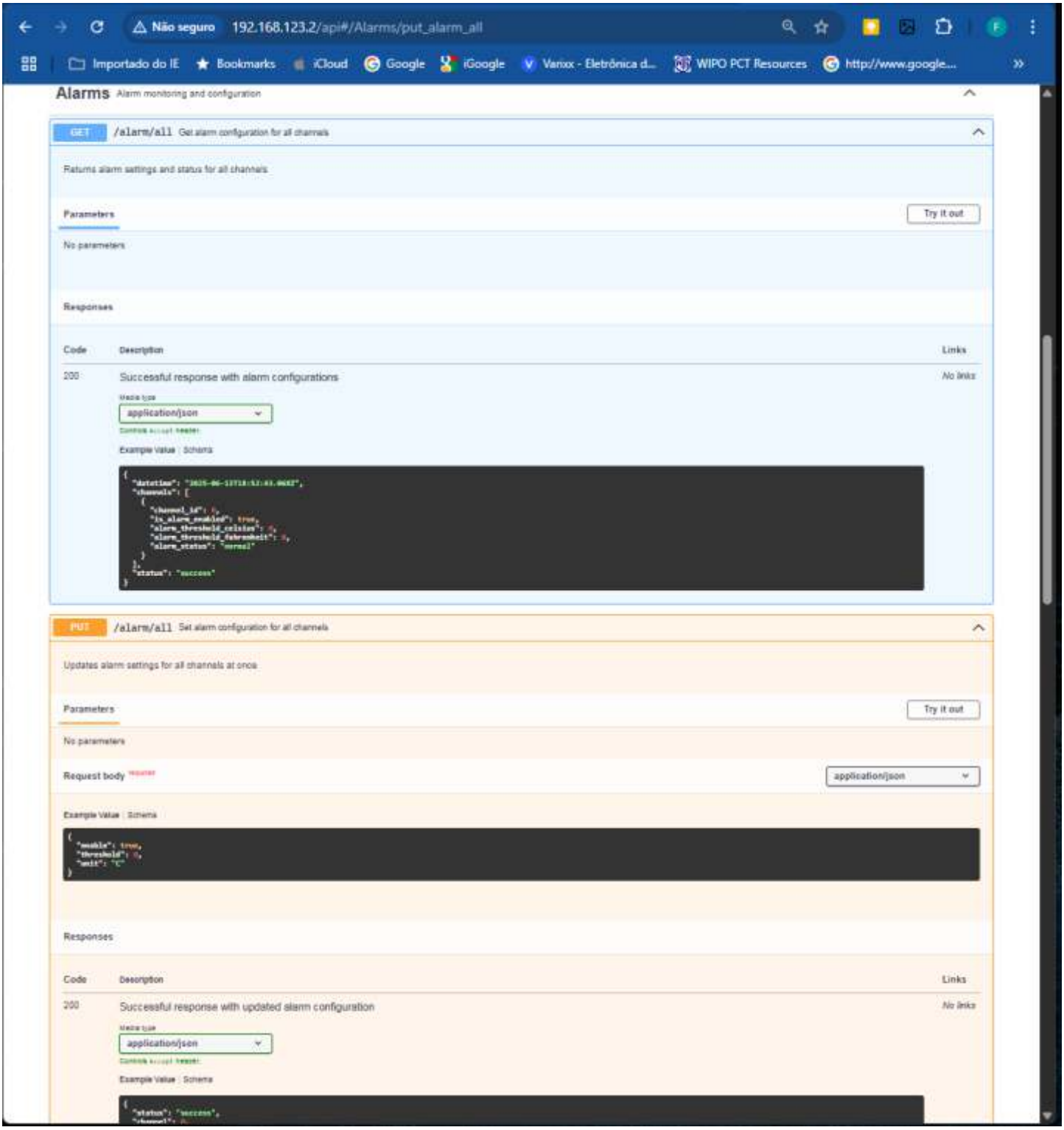


Restful API: Click on the "Restful API" item on the Home screen and the window above will open.
In it, with mouse clicks, you can view and open all the system APIs, made available so that the user can embed them in DCS process controllers if desired. In the screen above, you can see a small part of them, still closed. On the next page, there is an example of a screen with two APIs open after clicking on the arrows on the right side of each one.

Note: None of these remote control features are necessary for normal use of the system in a panel, for example. In normal use, simply turn on and operate, without the need for any external programming or external software. All these features only add capabilities so that an advanced user can add remote operation features and automate data acquisitions, if desired.

ETHERNET REMOTE CONTROL AND DATA

GENERAL SPECIFICATIONS - RESTFUL API

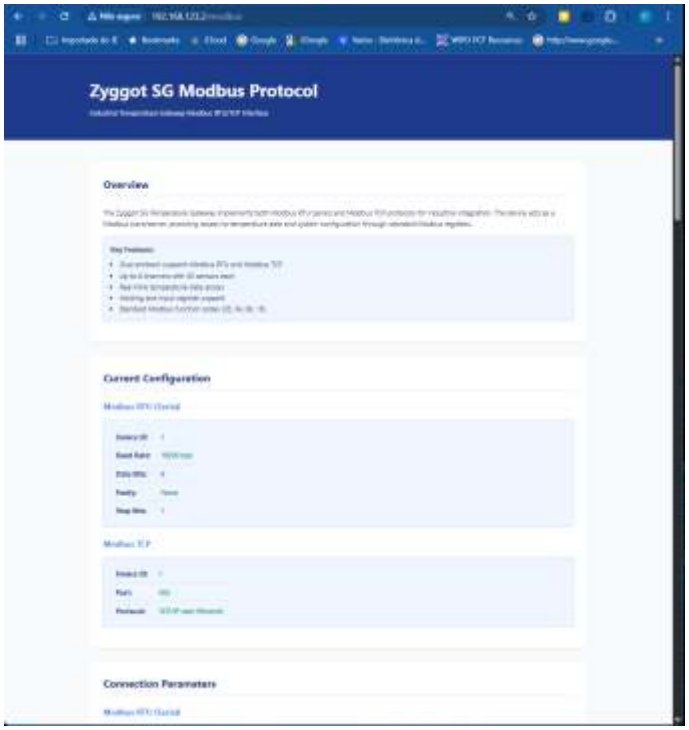


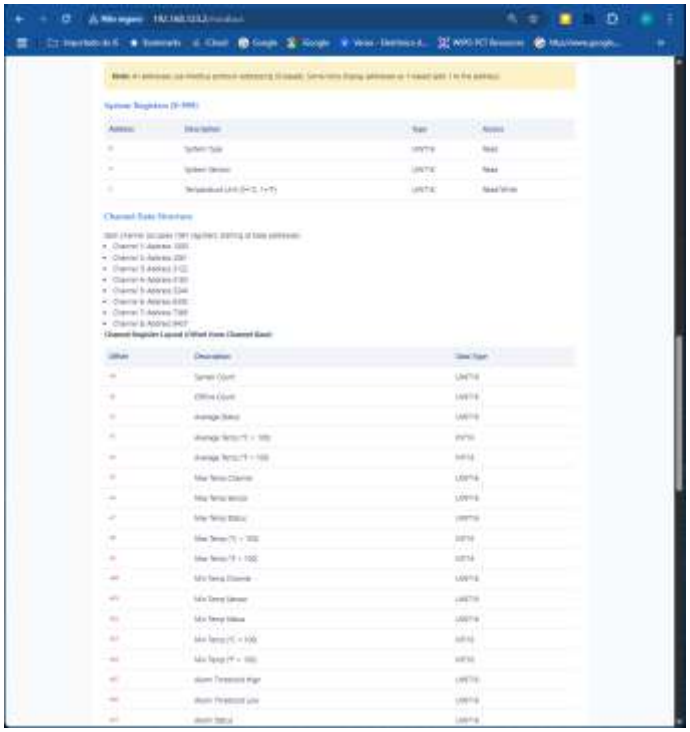
Restful API: Click on the "Restful API" item and the page will open showing all the system APIs, available so that the user can embed them in SDCD process controllers if desired. In the screen above you can see an example of a screen with two APIs open after clicking on the arrows on the right side of each one.

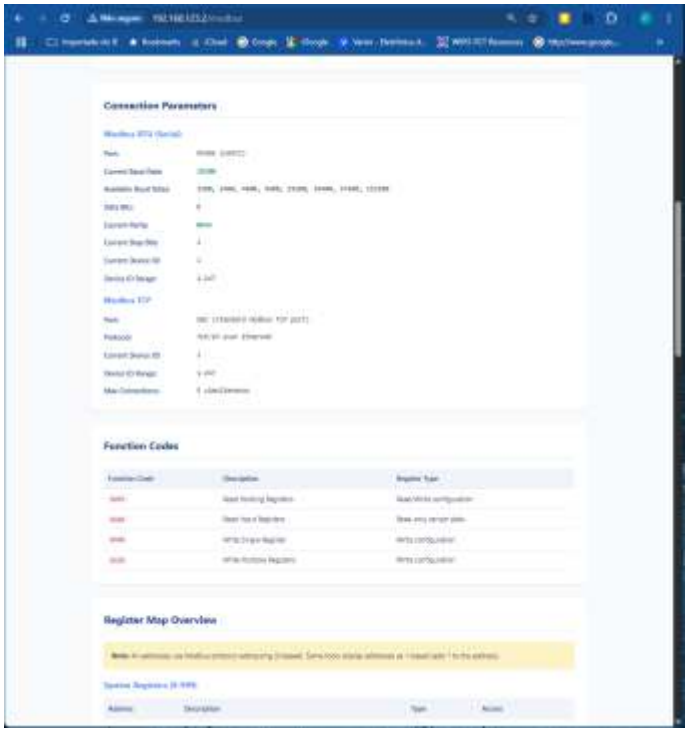
Note: None of these remote control features are necessary for normal use of the system in a panel, for example. In normal use, simply turn on and operate, without the need for any external programming or external software. All these features only add capabilities so that an advanced user can add remote operation features and automate data acquisitions, if desired.

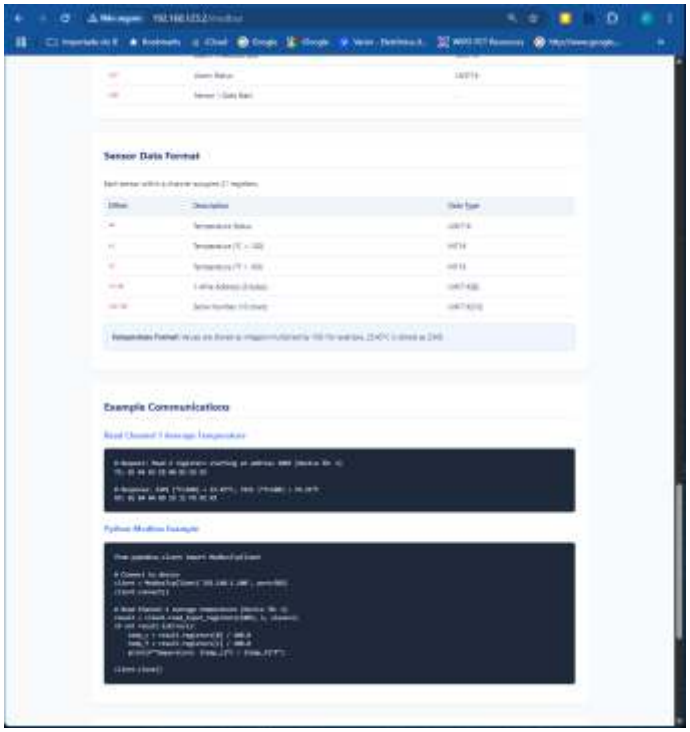
ETHERNET REMOTE CONTROL AND DATA

GENERAL SPECIFICATIONS - MODBUS PROTOCOL





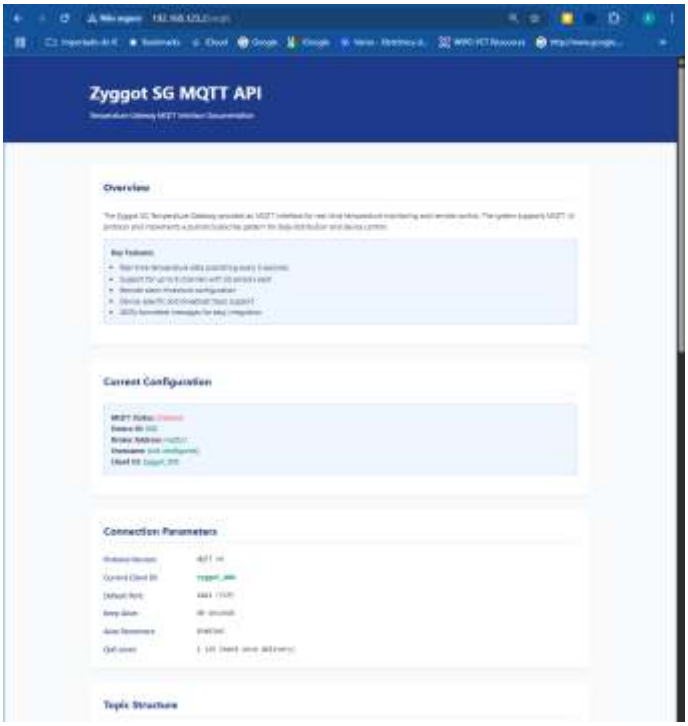


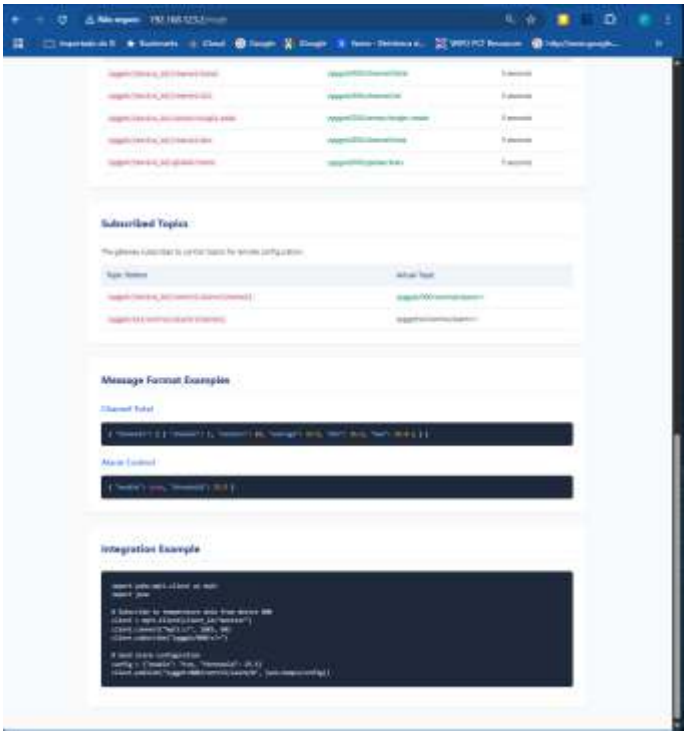


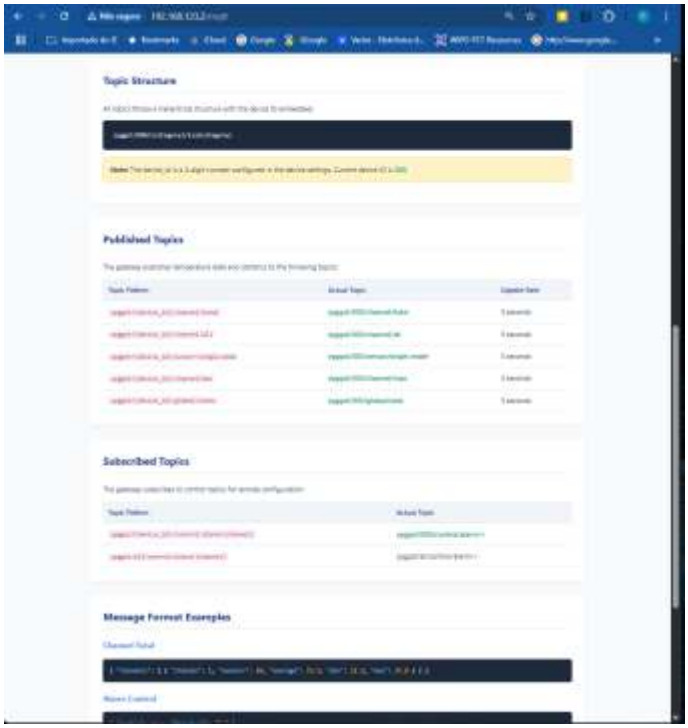
Modbus Protocol: Click on the «Modbus Protocol» item and a page will open showing all the data related to the Modbus Protocol, such as Data Type, Register Map, etc. This data allows the user to, if desired, access all the system data via Modbus communication directly with the Gateway via the RS232 port or via Ethernet (Modbus Over Ethernet). It is therefore possible to connect the Zyggot SG directly to the user's DCS system, for example. You can see a small example of embedded code in Python language.

ETHERNET REMOTE CONTROL AND DATA

GENERAL SPECIFICATIONS - MQTT PROTOCOL INTERFACE







MQTT Protocol Interface: Click on the “MQTT Interface” item and the page will open showing all the data related to the MQTT Protocol, such as Data Type, Record Map, etc. This data allows the user to, if desired, access all the system data via IoT (Internet of Things). It is therefore possible to connect the Zyggot SG to a local Wi-Fi system (LAN) for example using a standard Broker software and obtain the data published by the Zyggot SG continuously. You can see a small example of embedded code in Python language, if applicable.

Note: None of these remote control features are necessary for normal use of the system in a panel, for example. In normal use, simply turn on and operate, without the need for any external programming or external software. All these features only add capabilities so that an advanced user can add remote operation features and automate data acquisitions, if desired.

ABOUT VARIXX

For over 40 years, Varixx has pursued its vocation for developing high-tech products and focuses its efforts on serving the industrial market with quality and speed. Our know-how in power electronics has allowed us to offer the market a wide range of products that have become known for their long service life and reliability. We were the creators of the global online thermography market, with the Zyggot line, which is becoming a global reference in the market for temperature monitoring and diagnostics and arc flash detection in electrical systems in general.

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