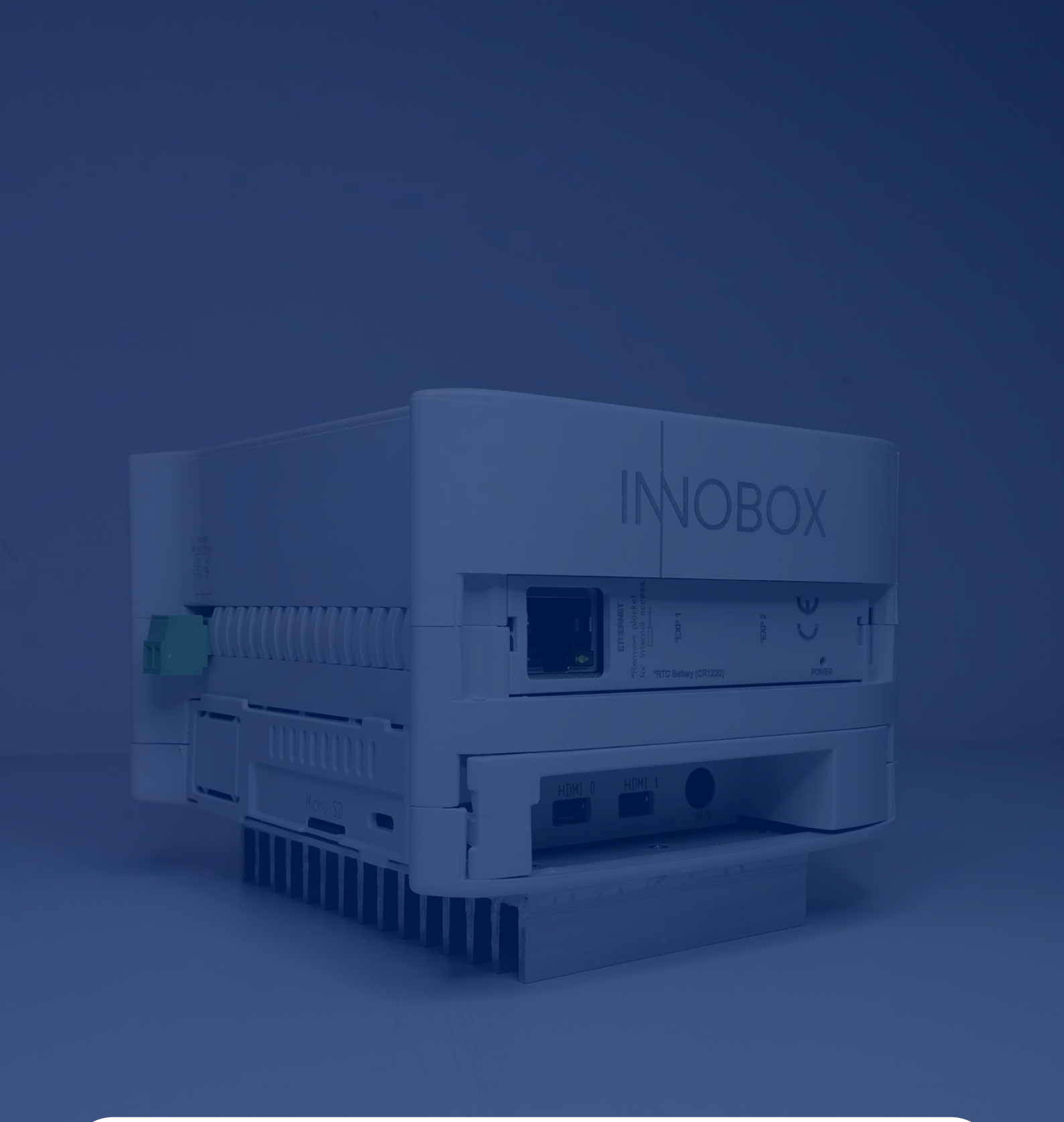

Manual

Operation and configuration

Industrial IoT solution for industrial machines

INNOBOX

CONTENT

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1. Introduction

The objective of this manual is to explain the purpose of the device, as well as to serve as a guide during installation and initial configuration.

1.1. What is Innobox?

It is a "Plug&Play" device, easily configurable, which is used to obtain the KPIs (Key Performance Indicators) that indicate the quality of the machine's work, the use it is given, the efficiency of the production and formats applied, the most common errors, ...

There are four key KPIs:

a. **OEE** – This indicates the percentage of correct operation and use of the machine, calculated from 3 variables:
   1. **Availability** - Actual time in productive working mode of the total machine operating time.
   2. **Efficiency** - Comparison between the theoretical output expected by the specified recipe and the actual output.
   3. **Quality** - percentage of good production out of the total production realised.

b. **MTBF** – Mean Time Between Failures.

c. **MTTR** – Mean Time To Repair.

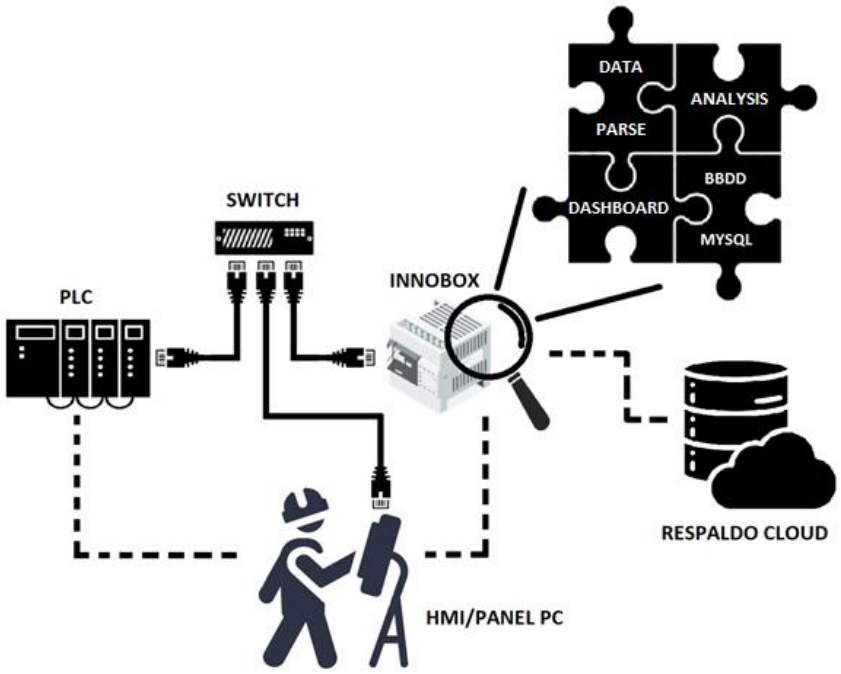
d. **MTFF** – Mean Time First Failure.

or cases in which the device is used to monitor a specific machine within a production line, the device differentiates between the OEE of the machine and the overall OEE of the line, differentiating between cases in which the line is stopped due to the machine in question or not.

In addition, the device uses the data generated by the PLC to generate statistics on the general operation of the machine, as well as offering the functions of datalogger (creating CSV files with the desired values tailored to the customer), predictive production (with real data from previous productions) or preventive maintenance (being able to control when it is necessary to carry out some maintenance task on mechanical elements of the machine before a real problem is generated).

1.2. How does it work?

To obtain this calculated data, the device must be connected to the same network as the PLC controlling the machine to be monitored and pass the necessary specific variables to it.



Once everything is linked, the device listens to this data, recording the changes in different historical tables in the internal database, which are exploited by the different monitoring screens. These screens allow us to know the current status of the machine, see an analysis of the production or the alarms generated, comparative work shifts and other functionalities, explained in its specific manual.

1.3. Data requirements

In order to function properly, the Innobox requires this information:

1.3.1. Production variables

These are the variables that allow the device to know the status of the machine, the production it is performing and provide the necessary information for KPI calculations.

- Status variables, Booleans indicating when the machine is running, paused, installing a new format or recipe, waiting for incoming material, output blocked or at a planned stop.
- Information about the recipe or format, such as its unique code, descriptive name, expected theoretical output and parts ordered.
- Production counters, being essential those of correct pieces and rejected pieces, but leaving six extra counters at the user's disposal to be able to visualise the data of interest.

1.3.2. Machine alarms

Alarms generated by the PLC that you want to keep in history, being able to read as many boolean, integer and double integer variables as you have defined in the machine. The

value received will be the one that will be compared with the definitions indicated later to show the corresponding description.

1.3.3. Maintenance variables

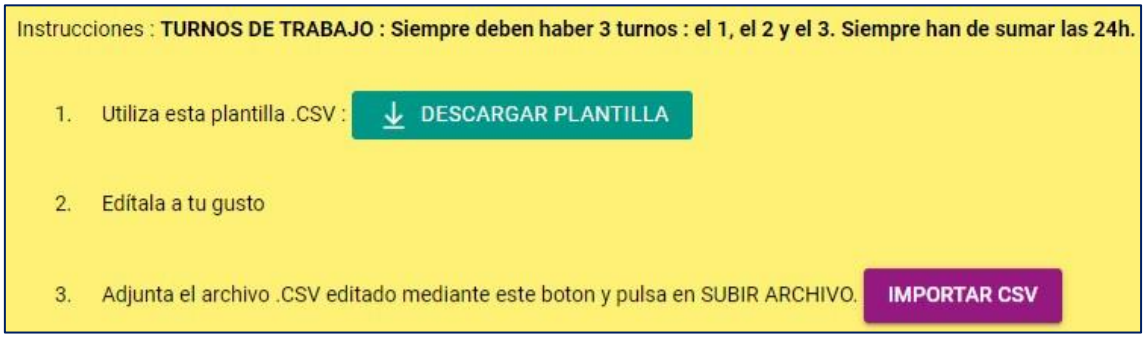
Boolean variables indicating that a mechanical element is working. This can be analysed by time on, such as a bit indicating that a motor or a belt is working, or by operating cycles, such as a bit that causes a piston to move in or out. Subsequent definitions will indicate the lifetime of each element and the specific task to be performed.

1.3.4. Variables to monitor (free)

The datalogger functionality is at the customer's complete disposal and any type of variable can be defined (with some limitations depending on the communication protocol, as indicated in its section). These variables will be linked and waiting to be listened to at the user's request from the corresponding screen.

1.3.5. Operating definitions

In order for the information displayed to be complete, certain descriptions and methods need to be reported to the device. In the corresponding section of the configurator, the user will find example csv templates for the following tables:



1.3.5.1. Production receipts

CÓDIGO RECETA	NOMBRE RECETA	PRODUCCIÓN TEÓRICA (u/h)	DESCRIPCIÓN RECETA	
0	sin_receta	0	Sin producción	NO EDITABLE
1	receta_1	35000	Puertas	
2	receta_2	21000	Ventanas	
3	receta_3	6000	Pedales	
4	receta_4	12000	Retrovisores	
5	receta_5	500	Faros	

As we have seen in section 1.3.1, this is the information corresponding to the recipes, plus a brief description if desired. When creating a new production record, the device will look for this information in the variables received from the PLC; if it is not found, the recipe code (the

only field that is strictly necessary) will be compared to get it, so it is important that it is in one of the two places.

IMPORTANT: Recipe code 0 is reserved for when the machine is idle, so as not to affect efficiency and availability calculations.

1.3.5.2. Working shifts

CÓDIGO TURNO (interno)	NOMBRE TURNO	HORA INICIO	HORA FINAL
1	mañana	6:00:00	13:59:59
2	tarde	14:00:00	21:59:59
3	noche	22:00:00	5:59:59

This information is only used to assign a work shift to each production in order to be able to make comparisons.

IMPORTANT: The shifts must be as shown in the example template, and only the name and timetable can be edited.

1.3.5.3. Alarm descriptions

TIPO	BYTE	VALOR	DESCRIPCIÓN EN CATALÁN	DESCRIPCIÓ	DESCRIPCIÓN EN INGLÉS
BYTE	0	1	Text d'alarma quan byte de la memòria 0 té valor 1	Texto de ala	Alarm text when byte from memory 0 has value 1
BYTE	0	2	Text d'alarma quan byte de la memòria 0 té valor 2	Texto de ala	Alarm text when byte from memory 0 has value 2
BYTE	0	10	Text d'alarma quan byte de la memòria 0 té valor 10	Texto de ala	Alarm text when byte from memory 0 has value 10
BYTE	1	100	Text d'alarma quan byte de la memòria 1 té valor 100	Texto de ala	Alarm text when byte from memory 1 has value 100
BYTE	1	101	Text d'alarma quan byte de la memòria 1 té valor 101	Texto de ala	Alarm text when byte from memory 1 has value 101
BYTE	1	102	Text d'alarma quan byte de la memòria 1 té valor 102	Texto de ala	Alarm text when byte from memory 1 has value 102

The template of this section may vary from one communication protocol to another, as well as by type of variable, but in all cases the type (bool, int or dint), the offset of the variable, the alarm value and the corresponding description shall be indicated.

1.3.5.4. Maintenance tasks

NOMBRE ELEMENTO	VARIABLE	TIPO	TIEMPO/CICLOS DE VIDA	ACTIVO	DESCRIPCIÓN TAREA EN CATALÁN	DESCRIPCIÓN TAREA EN CASTELLANO	DESCRIPCIÓN TAREA EN INGLÉS
Motobomba E123	machine_ON	1	500	1	Ajust de cargols per vibracions	Ajuste de tornillos por vibraciones	Vibration screw adjustment
Cilindro SQ45	work_flank	2	100	1	Neteja del pistò	Limpieza del pistón	Piston cleaning
Motor C123	machine_ON	1	800	0	Greixar les peces mòvils	Engrasar las piezas móviles	Grease movable parts
Correa D3	machine_ON	1	1500	0	Neteja de superfície i tensat	Limpieza de la superficie y tensado	Surface cleaning and tensioning

The maintenance functionality relies exclusively on this information to perform its task. The fields must be filled in according to the following scheme:

- The VARIABLE field must be the same as the one indicated when defining the variable to relate the element to it.

- The element name fields and descriptions will be displayed as literals on the screen, so it is recommended that they be clear and descriptive.

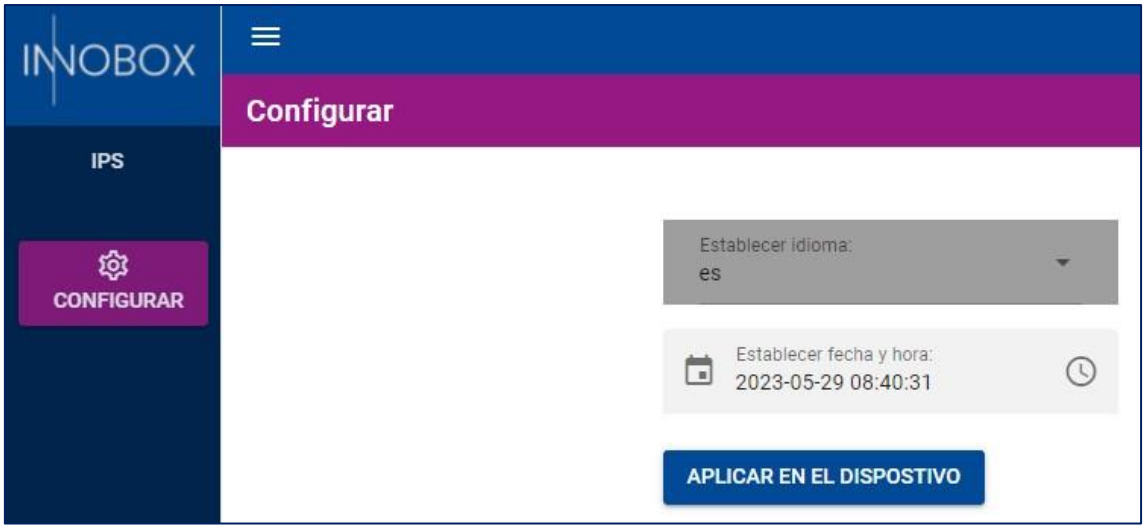
- The TYPE is the read mode indicator; 1 to read edges, 2 to count the time the bit is true.

- The LIFE TIME/CYCLES refers to the maximum that an element will support before requiring maintenance. The system will trigger a pre-alarm when the time/cycles counted reaches 70% of that indicated here and an alarm when it reaches 90%.

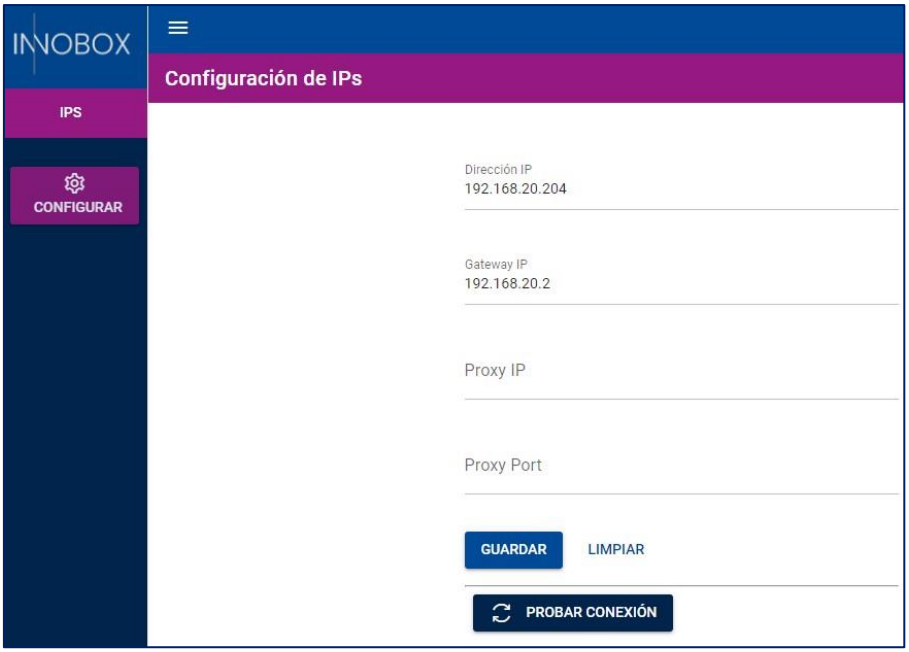
- The ACTIVE field is used to activate the listening of the variable, so that the process can be parameterised and activated only when needed.

2. Installation and activation of the device to the system

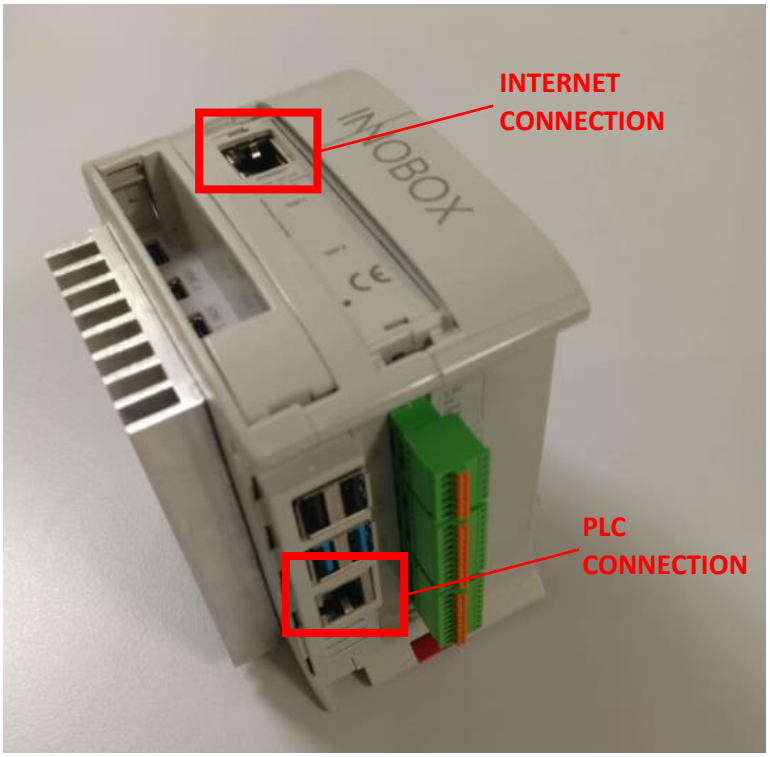
To configure the IP of the device, the necessary data of the PLC and the necessary information in the database for the correct operation of the device, the user has a "Wizard" that will guide him step by step, which can be accessed from any browser with the URL http://10.10.10.20, if the Ethernet side port is connected to a computer with a static IP within the range (such as 10.10.10.25).



When accessing the configurator, choose the language of the page. On the left side you can see the available menus. The first time, only the one that allows you to enter the new IP and Gateway to the device will be active.



For the configuration to be effective, the device must be rebooted using the button on the display. Once this is done, the device can be placed in its final location inside the panel and connected to the network. The side port is the communication port with the PLC, while the port located at the top of the device is responsible for outputting it to the internet in case you want to communicate with the cloud.



Continuing with the configuration (which we access again by entering the newly configured IP), the device licence must be registered.

In this menu, the user must upload the .enc file and enter the activation code provided by the cloud platform where the product must first be registered. How to register the product is explained in the corresponding manual.

With this, the device is ready to configure the PLC information.

3. Initial configuration

The next step is to select the desired provider and configure the data, divided into four blocks:

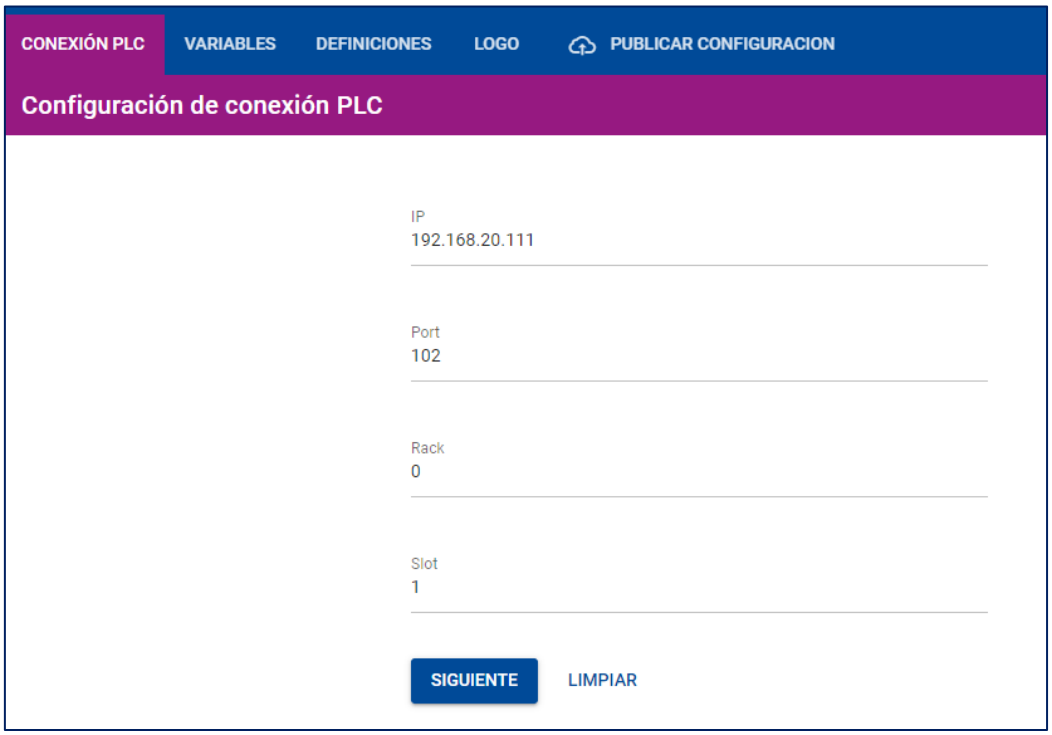
- **PLC connection**. Here you define the access data of the selected PLC.
- **Variables.** Here you define the production variables, the alarms to be controlled, the variables useful for monitoring elements and carrying out preventive maintenance and the variables that you want to use with the datalogger functionality (all these functionalities are explained in point 1.3).
- **Definitions.** Here you can download the specific csv template to fill in each of the tables. The restrictions mentioned above must be taken into account.
- **Logo.** Where to upload the png image that you want to appear on the different dashboards.

At the end of each of the settings, the PUBLISH CONFIGURATION button will start the configured system.

Since the definition of variables is different for each protocol, we will explain in detail how to enter them for the currently available providers.

3.1 Siemens for ethernet (S7 or higher)

For Siemens, you have to define the IP address, the communication port, the Rack and the Slot in the PLC CONNECTION tab.



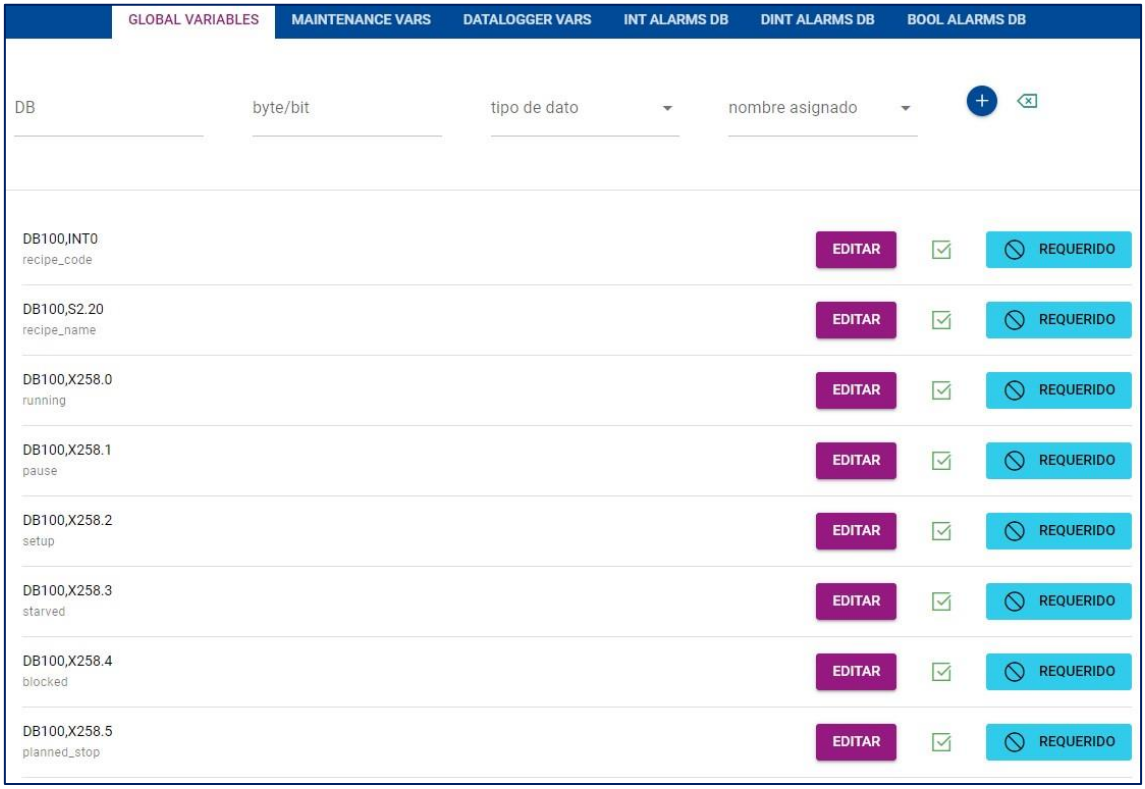
After saving the PLC parameters, the next step is to define the variables.

For the production variables, the user has a default Data Block that can be loaded into the PLC and easily linked to the corresponding program variables. This DB is the one that will be displayed when loading the PRODUCTION VARIABLES tab. In the case of wanting to point to the exact variable without going through this DB, it will be necessary to edit each one of them. Depending on the memory area in which they are located, the addresses must be written according to the table that can be found in the following link:

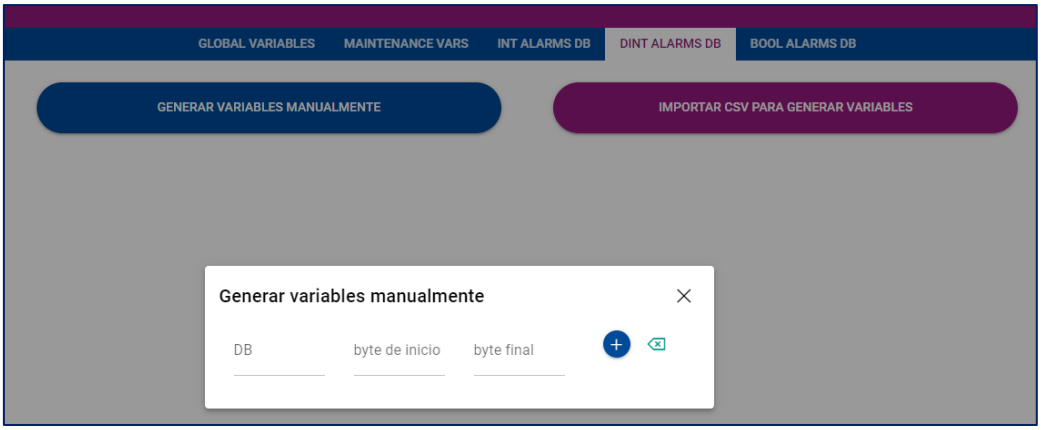
https://flows.nodered.org/node/node-red-contrib-s7

Address	Step7 equivalent	JS Data type	Description
`DB5,X0.1`	`DB5.DBX0.1`	Boolean	Bit 1 of byte 0 of DB 5
`DB23,B1` or `DB23,BYTE1`	`DB23.DBB1`	Number	Byte 1 (0-255) of DB 23
`DB100,C2` or `DB100,CHAR2`	`DB100.DBB2`	String	Byte 2 of DB 100 as a Char
`DB42,I3` or `DB42,INT3`	`DB42.DBW3`	Number	Signed 16-bit number at byte 3 of DB 42
`DB57,WORD4`	`DB57.DBW4`	Number	Unsigned 16-bit number at byte 4 of DB 57

In the end, the DB should look like this:



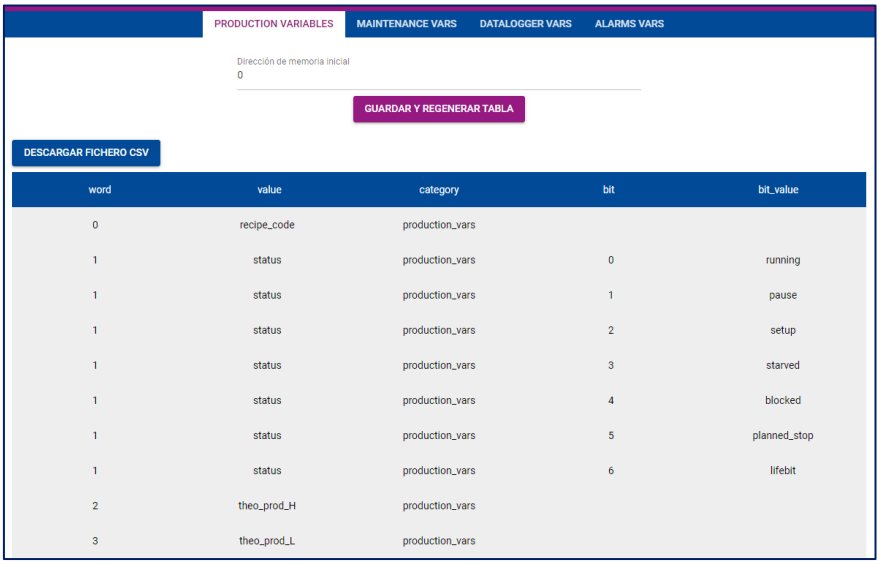
With the production variables defined, we will go on to enter the variables for maintenance. In this case, only Boolean variables must be introduced one by one and with a limitation of 20. In the case of the datalogger, the introduction will be similar but without limitations of either type or quantity.



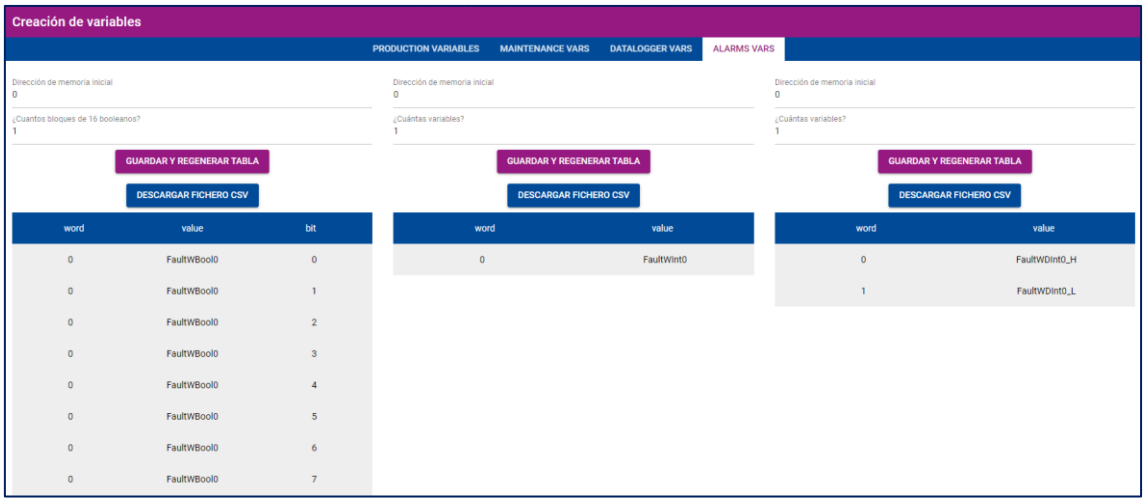
When entering the alarm variables, we have the boolean, integer and double integer block, where we can indicate the starting DB and the number of variables if they are correlative or enter a csv with the whole definition. Given that the files must have a specific format, each block has specific templates with the expected format.

3.2 Generic Modbus

For the system to work with modbus, it is necessary to indicate the IP and port of access to the PLC and the number of the unit where all the variables to be defined are located. Unlike the free configuration allowed by Siemens PLCs, the modbus protocol is more restrictive, which is why you can choose the starting bit of the block of variables, but all the variables must be within the same Unit Id, be correlative and with the assigned positions that can be viewed in the table shown on each of the screens.



word	value	category	bit	bit_value
0	recipe_code	production_vars		
1	status	production_vars	0	running
1	status	production_vars	1	pause
1	status	production_vars	2	setup
1	status	production_vars	3	starved
1	status	production_vars	4	blocked
1	status	production_vars	5	planned_stop
1	status	production_vars	6	lifebit
2	theo_prod_H	production_vars		
3	theo_prod_L	production_vars		



4. Conclusion

Once all the necessary data, the definitions for the database and the desired logo have been entered, by means of the Apply Configuration button, the device will store all the information, reboot and start up ready to start working with the direct data from the PLC. Together with this configuration manual, you will find the explanatory manual of the different data exploitation screens and other functionalities that the system makes available to the user.

INNOBOX

INNOVA IT, SL
C/ Llauder, 22. 08302 Mataró (España)
Tel: +34 902 109 963
comercial@innovait.cat
https://innobox.innovait.cat/