

# EBV

User Manual

## Configuration Tool



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## 1 Introduction

This tool allows to configure and monitor the EBV valve for a proper system commissioning, monitoring and trouble shooting.

The connection between the computer and the actuator can be done either by using a USB/RS485 converter (CONV-USB-RS485) with a serial communication bus and Modbus protocol (RTU) or by the microUSB port.

Two different configuration tools are available:

- the Modbus Configuration tool suitable for the configuration and real-time monitoring of the valve by Modbus protocol (RTU); the USB/RS485 converter (CONV-USB-RS485) is needed;
- the USB Configuration Tool suitable for the configuration and diagnostic of the valve (not suitable for real-time monitoring) by USB; a simple microUSB-USB cable is needed.

### 1.1 Revision History

Rev.	Date	Description
1.0	9 Apr 2021	First edition
1.1	7 May 2021	Added the management of the upgrade firmware via USB
1.2	10 Sep 2021	Updated baud rate table (removed baud rates 38400 and 57600)
1.3	21 Mar 2022	Added management of the electronic emergency return board Inserted pictures with the iSMA CONTROLLI background Updated document with the iSMA CONTROLLI layout
1.4	22 Aug 2022	Updated the pictures of the Diagnostic and Maximization $\Delta T$ tabs
1.5	17 Nov 2022	Added Modbus database table
1.6	9 Feb 2024	Updated Modbus database

*Table 1. Revision history*

## 2 Safety Rules

- Do not use different types of cable to create the same network, but always and only use the same type of cable. The network cable is crossed by SELV safety voltage signals and must not be wired in channels intended for cables with dangerous voltages (for example 230 V AC) or carriers of high currents, especially if in alternating current. Also avoid parallel paths to these power cables.
- Wire the cable as straight as possible, avoiding folds with tight bending radius, let alone wrapping it in unnecessary charges; Do not twist the cable around power conductors and, if you have to cross them, provide a 90° cross between the cable and these conductors.
- Keep away from electromagnetic field sources, in particular from large motors, switchboards, neon ballasts, antennas of all types; Avoid that the pull tension of the cables exceeds 110N (11.3 kg) to prevent ironing.
- Evaluate the route in advance so as to shorten it as much as possible and take note of the addresses of the instruments connected with particular reference to their location in orderly sequence. This can be very useful in maintenance; We recommend that you take note of the Modbus address and report it on the product label in the space provided for it.
- Do not invert the polarity "+" and "-" at the connection terminals; Avoid short pieces of cable in the connection terminals to the instruments, in order to allow a possible maintenance without tearing or pulling of the cable itself;
- Identify the start and end terminations and avoid "open" segments; Termination resistors and network polarization The slew-rate control, common to all our converters, and the baud rate limited to 9600 baud (bit/sec) make termination resistors unnecessary. The RS485 network requires polarization typically borne by the master device; the regulator does not have polarization resistors. The transceiver used by the actuator allows to drive up to 256 knots.

## 3 Modbus Configuration Tool Installation

### 3.1 Hardware Requirements

- Processor: last generation;
- RAM: 2 GB;
- operating system: Windows 7, Windows 10;
- .NET Framework 4.6.1 (or higher);
- USB-RS485 serial converter (CONV-USB-RS485).
- Not fully compatible with 800x600 screen resolution.

**Note:** the .NET Framework may not appear in the list of installed software on Windows 10, as it is already installed by default by the operating system.

### 3.2 Software Setup

This tool is supplied with a self-installing file: "Configuration Tool EBV - Modbus".

By starting the self-installing file, depending on the operating system, the user may be asked to give permissions to make changes to the device, press the "YES" button.

After the installation wizard, the software is ready for use.

### 3.3 USB-RS485 Serial Converter Installation

CONV-USB-RS485 is a USB to RS485 converter. This device has a transparent connector on the PC side that allows to check the connection to the USB port of the PC and the transmission and reception of data in progress.

From the side of the actuator, the wires to be used are only 3 of the 6 total that compose the cable, in particular:

1. ORANGE 
2. YELLOW 
3. BLACK (GND)

To use the device, it is necessary to install the driver located in the program folder installed through the setup (**Configuration Tool EBV Modbus**). If required by the operating system, search for the driver by selecting the folder in which to search for it (select the configuration tool folder: Configuration Tool EBV Modbus\Driver).

## 4 USB Configuration Tool Installation

### 4.1 Hardware Requirements

- Processor: last generation;
- RAM: 2 GB;
- operating system: Windows 7, Windows 10;
- .NET Framework 4.6.1 (or higher);
- cable USB to micro USB.

**Note:** the .NET Framework may not appear in the list of installed software on Windows 10, as it is already installed by default by the operating system.

### 4.2 Software Setup

This tool is supplied with a self-installing file: "Configuration Tool EBV - USB".

By starting the self-installing file, depending on the operating system, the user may be asked to give permissions to make changes to the device, press the "YES" button.

During installation, a message will appear informing the user that the destination folder does not exist and if you want it to be created, press the "YES" button.

Once the configurator has been installed, through the Windows Explorer, access the folder of the newly installed program (Program Files (x86) \ EBV USB Configurator) and click twice on the installer file:

- `sam-ba_2.18.exe`

that will start the installation wizard of the software necessary to use the firmware upgrade functionality via USB.

Follow the instructions showed in the guide screens without changing anything.

At the end of the installation, an "Atmel" folder will be created in the "Program Files (x86)" folder which contains a "sam-ba\_2.18" folder, these two folders **must not be deleted or modified**.

After the installation wizard, the software is ready for use.

## 5 User Interface

### 5.1 General Functionalities

This chapter describes the user interface of the Modbus Configuration Tool, which is the most complete of the 2 available tools. In the user interface of the USB configuration tool the "Info" tab not include the functionality to show the charts, but is possible to use the USB Configuration Tool in offline mode (simulator).

Opening the application, the following user interface will be shown:

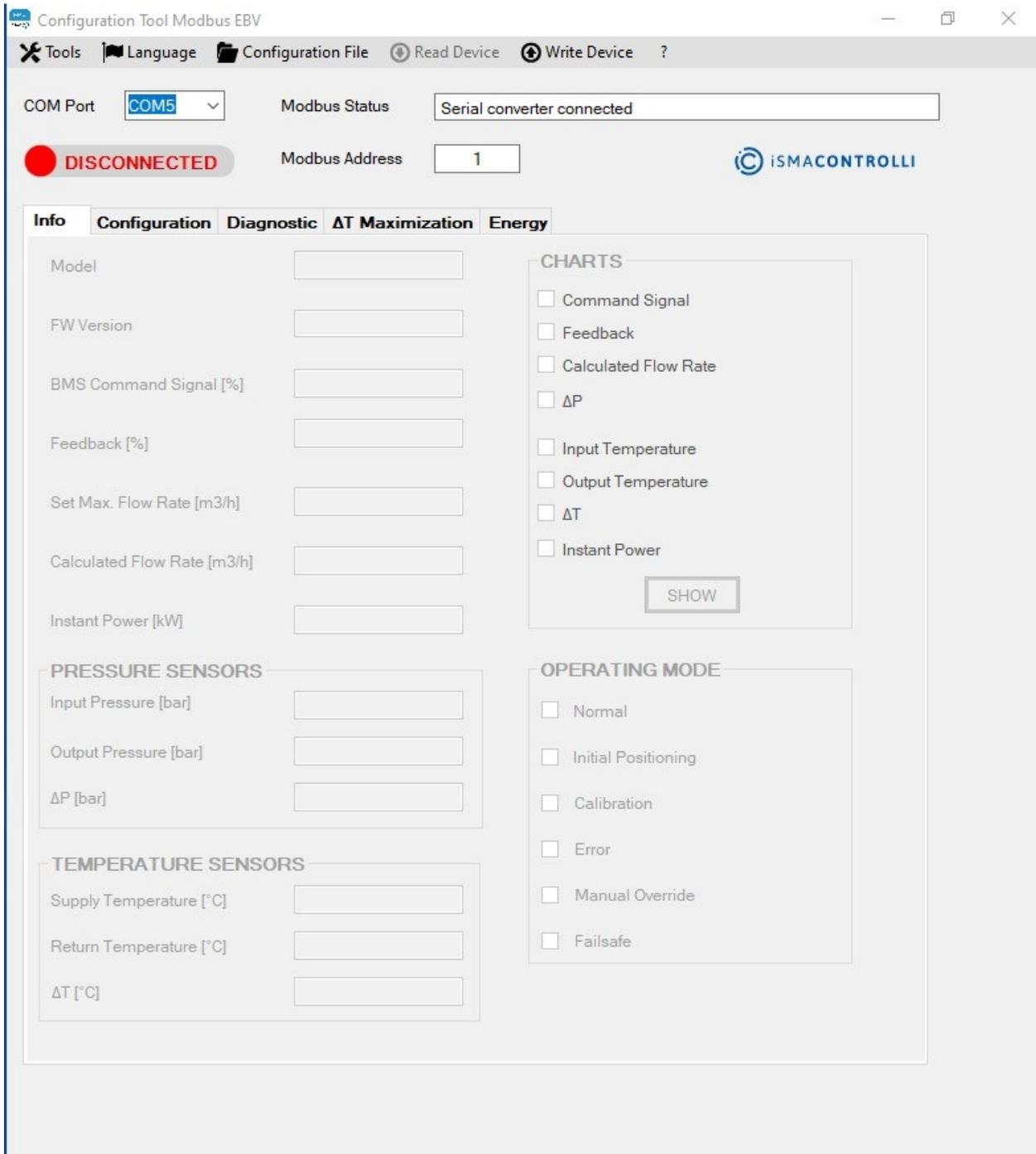


Figure 1. User Interface at the startup

To enable the tabs is necessary to select the COM connected to the USB-RS485 converter and press the toggle button with label "DISCONNECTED". If the connection is successful, all tabs will be enabled.

If the converter is already connected to the USB port when starting the application, the COM port to which the converter is connected will automatically appear in the drop-down menu and it will be sufficient to press the toggle button and if the connection is successful all the tabs will be enabled.

The user interface allows the following functionalities:

- read the main characteristics of the actuator and show real time graphics (the 'Info' tab);
- configure the actuator (the 'Configuration' tab);
- check the actuator status and its anomalies (the 'Diagnostic' tab);
- enable the  $\Delta T$  maximization function (the 'Maximization Delta T' tab). This tab is visible only if the temperature sensors are present;
- show the energy data (the 'Energy' tab). This tab is visible only if the temperature sensors are present;
- set the Modbus parameters to connect to the actuator with the Modbus master (not present for USB version);
- upload a configuration file or download the set parameters in a configuration file;
- select the language (Italian or English).

When each tab is selected all parameters shown in the page will be refreshed.

### Warning!

To read a parameter inside the tab, it is necessary to click with the mouse on the corresponding label. If the value to be read is inside a section (e.g., PRESSURE SENSORS), clicking the label of the specific section will perform a reading of all the values inside it.

To write a parameter inside a text box, it is necessary to press Enter after the new value is entered or after selecting the item from a drop-down menu.

The main window at the top shows the following drop-down menu:

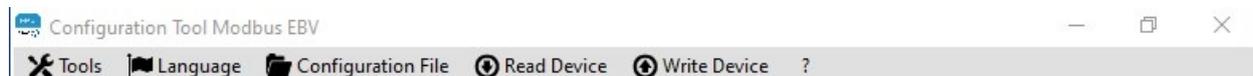


Figure 2. Drop-down menu

- **Tools:** selecting this item allows to define the Modbus connection options related to the CONV-USB-RS485 converter. If the user intends to change the Modbus connection options, the parameters have to be changed before clicking the toggle button to connect to the Modbus configuration tool;

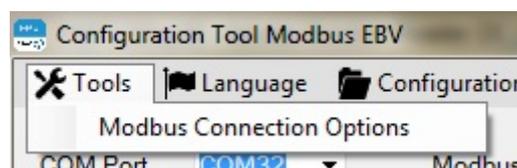


Figure 3. Tools menu

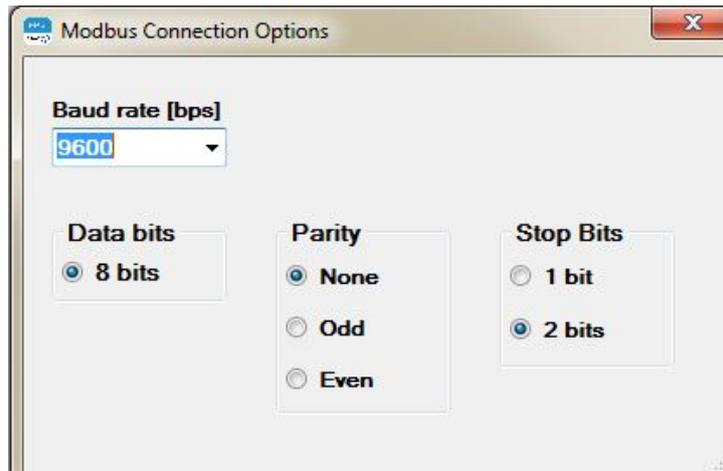


Figure 4. Modbus connection options

- **Language:** selecting this item allows to choose a proper language: Italian or English;



Figure 5. Language menu

- **Configuration File:** selecting this item allows to:
  - **Load File:** to load a .csv file with actuator parameters and send them to the actuator;
  - **Read File:** to load a .csv file without sending them to the actuator, but only on the tabs of the configurator. If the "CONNECT" toggle button has not yet been pressed, a pop-up window will be displayed asking if the system has the 2 temperature probes, the specific tabs will be displayed depending on the choice selected;
  - **Save File:** to save a .csv file with the parameters set on the configurator.

**Note:** only writable parameters will be saved in the .csv file.

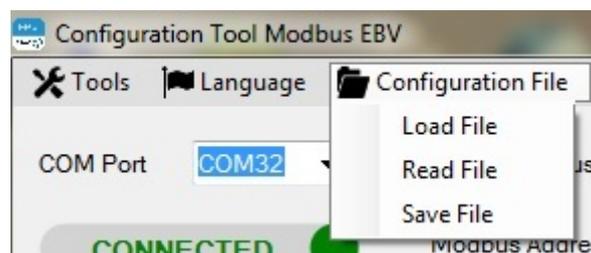


Figure 6. Configuration File menu

- **Read Device:** selecting this item is possible to update the values in all tabs of the Configuration Tool.
- **Write Device:** selecting this item is possible to write all configuration parameters into the actuator.
- **?:** selecting this item is possible to read the software version of the Configuration Tool.

The following others items are shown:

- **CONNECT/DISCONNECT toggle button:** used to connect/disconnect to the Modbus configuration tool.

Default settings for the connection are: baud rate 9600, no parity, and 2 stops bits.

When the application starts, the toggle button is in the "DISCONNECTED" status; to initiate the communication between the actuator and master, it is necessary to click the toggle button to "CONNECTED".

To check if the connection was successful, the "Modbus Status" label will show "OK".



Figure 7. Status USB shows the status of the USB communication

To disconnect the Modbus communication between the actuator and master, click the toggle button when it is in the CONNECTED status. If disconnecting is successful, the message DISCONNECTED appears in the Modbus Status field.

- **COM PORT (drop-down list):** if the serial converter is already present at startup, only the relative COM port is shown. Otherwise, press the "COM PORT" label above the dropdown menu; all the COM ports active on the PC will be listed. To select the correct COM port, which the USB-RS485 converter is connected to, follow the procedure in [paragraph 4.2](#).
- **MODBUS ADDRESS (text box):** it shows the Modbus address of the device, of which all the operations will be performed through the configurator. By default, the set value is address 1.
- **MODBUS STATUS (text box):** this field allows to view the status of the Modbus communication showing the outcome of the performed actions. If the action is successful, the "OK" status is shown.

## 5.2 Modbus Configuration

At the top of the main window, there is a dropdown list that displays the COM port currently in use by the PC. To identify the number of the serial port (**COM Port**), which the USB-RS485 converter is connected to, it is necessary to access the PC control panel, and select "Device Manager":

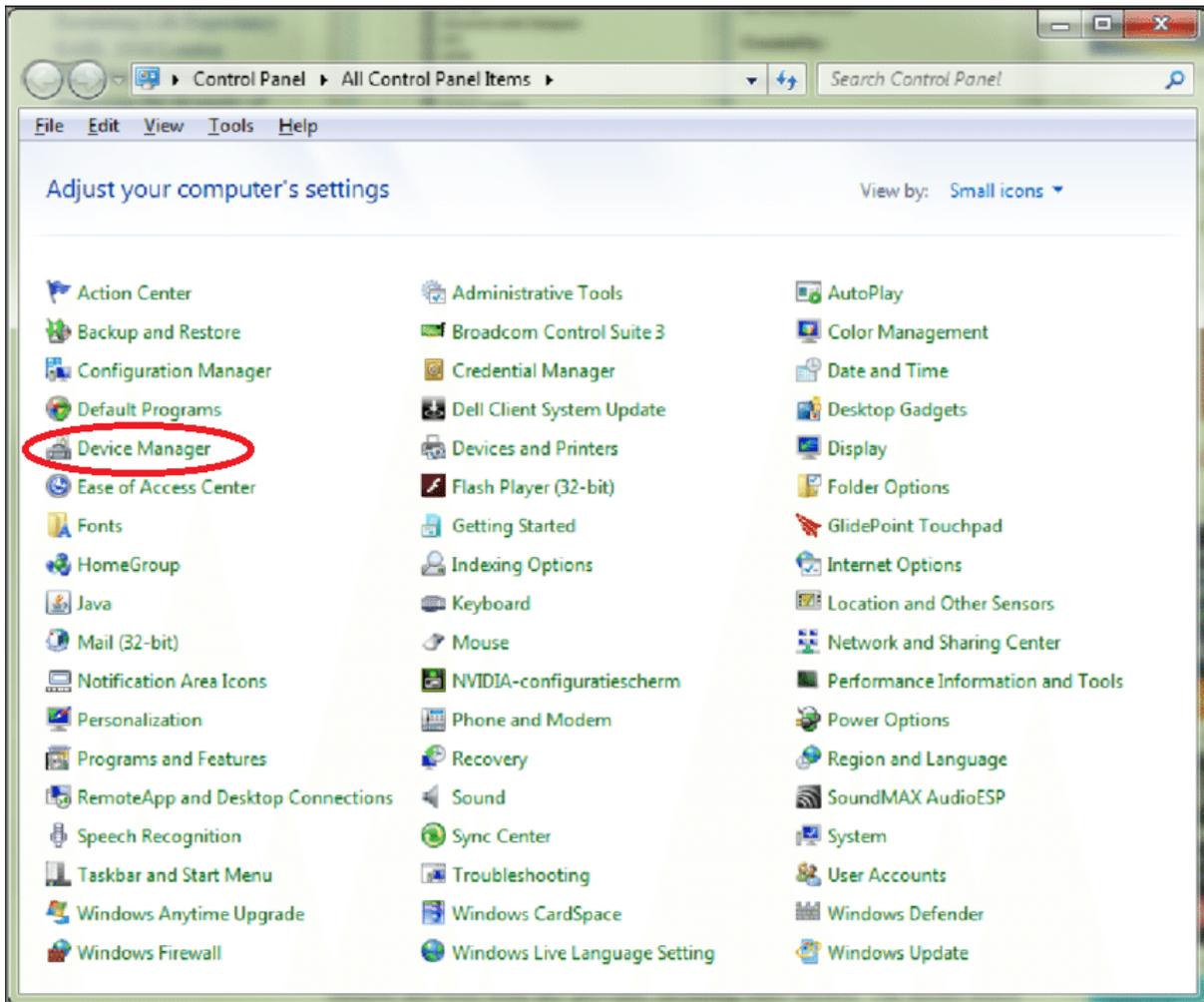


Figure 8. Device Manager in the Windows Control Panel

On the page, select the Ports (COM and LPT) field to check the serial port number, which the serial converter is connected to (COM5, in the example below).

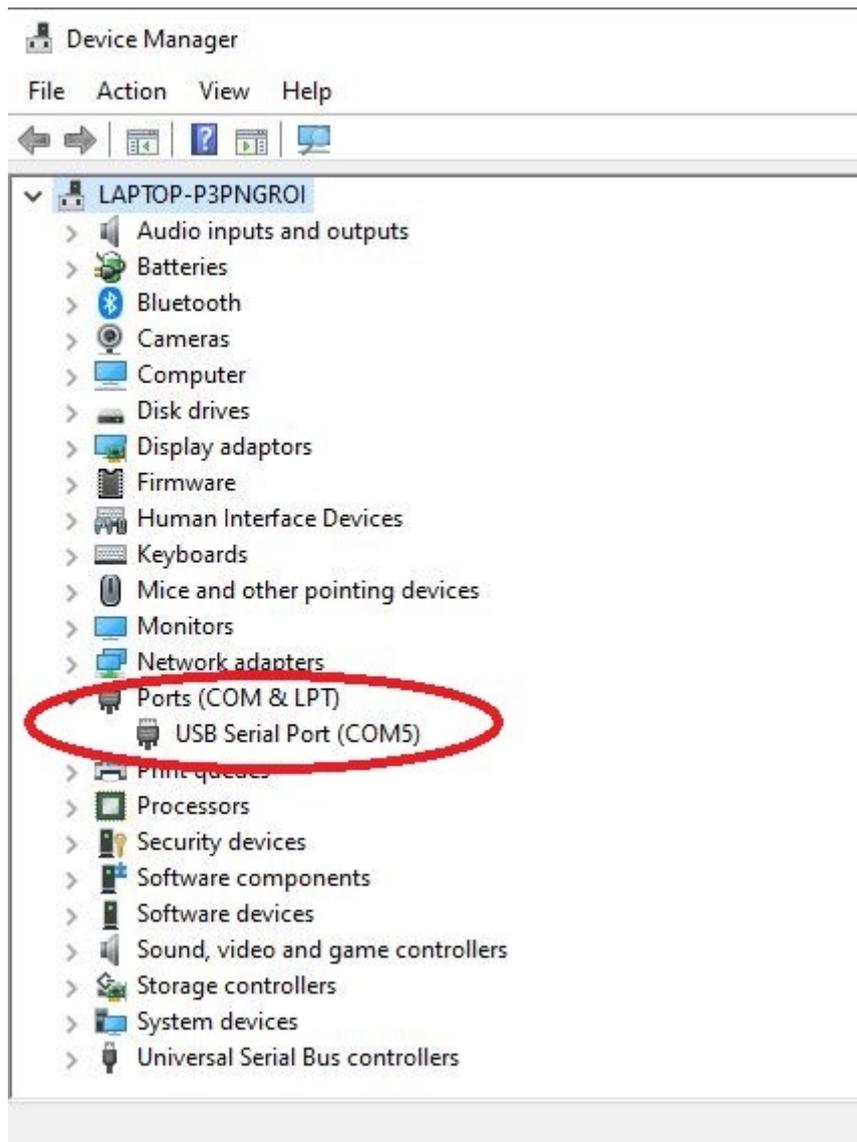


Figure 9. Windows Device Manager

Once the COM port has been selected, press the "CONNECTED/DISCONNECTED" toggle button and verify that the Modbus status is "OK".

As indicated in the previous paragraph, the Modbus configuration parameters of the master can be selected through the dropdown menu: "Tools" → "Modbus Connection Options".

By default, the communication parameters are: 9600, no parity, and 2 stop bits.

### 5.3 Info Tab

In this window, it is possible to read the main data about the actuator:

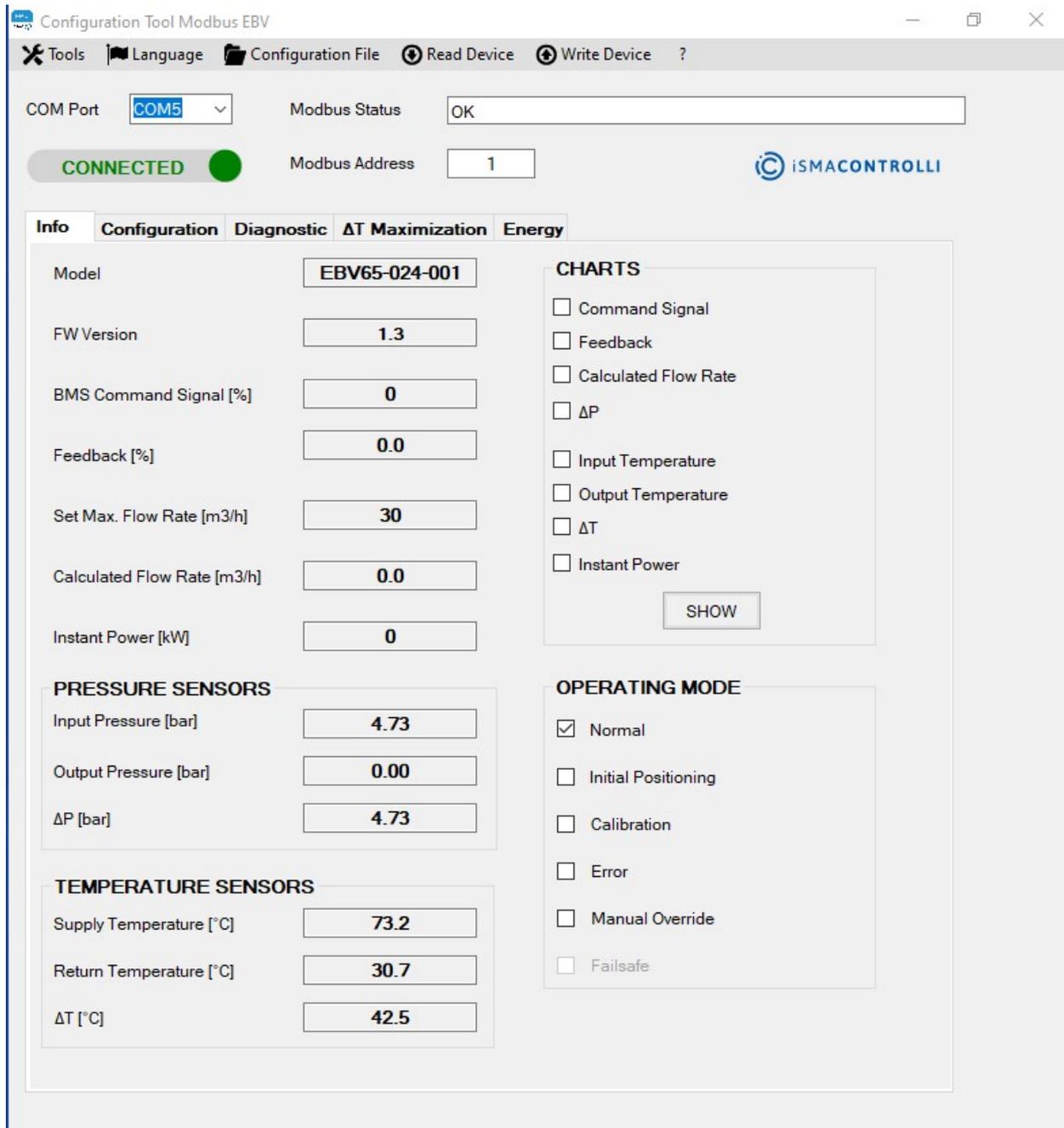


Figure 10. Info tab

- **Model:** represents the product part number. The alphanumeric code is composed as follows:

**EBVX-X-XXX**

The first X represents the DN of the valve, the second X—the power supply of the actuator, and a group of the 3 Xs indicates the configuration: with/without emergency return, Modbus/Cloud, with/without temperature sensors. An example of code is the following: EBV150-24-000, which represents an EBV model with DN150 valve, powered at 24 V AC without emergency return, Modbus communication, and without temperature sensors.

The value cannot be changed by the configurator.

- **FW Version:** identifies the current version of the firmware installed on the actuator;

- **BMS Command Signal [%]**: represents the current Modbus command signal value (between 0-100%); it is a read-only value;
- **Feedback [%]**: allows to identify the position of the actuator in the range 0-100% of the stroke;
- **Set Max. Flow Rate [m<sup>3</sup>/h]**: represents the maximum flow rate available for 100% control signal, which the dynamic balancing is performed on. Its value cannot be higher than the nominal flow rate value. It is a read-only value;
- **Calculated Flow Rate [m<sup>3</sup>/h]**: represents the flow rate calculated as a function of the pressure sensors measurements, the valve position, and the valve flow characteristic. It is a read-only value;
- **Input Pressure [bar]**: represents the pressure value, in bars, detected by the sensor positioned at the valve inlet port (it is the sensor connected to the A1 input of the terminal block). It is a read-only value;
- **Output Pressure [bar]**: represents the pressure value, in bar, detected by the sensor positioned at the valve outlet port (it is the sensor connected to the A2 input of the terminal block). It is a read-only value;
- **ΔP [bar]**: represents the value of the difference between the input and output pressure measured in bar. It is a read-only value.

In addition, at the opening of the tab, the information relating to the inlet pressure, outlet pressure, and delta P can be read simultaneously by pressing the "PRESSURE SENSORS" label at the top of the section relating to this information.

- **Supply Temperature [°C]**: represents the temperature value, in °C, detected by the sensor positioned at the valve inlet port (it is the sensor connected to the T1 input of the terminal block). It is a read-only value.

If a value equal to 500.0 is displayed, it means that the supply sensor (T1) is disconnected or faulty, and the relative "TEMPERATURE SENSORS" groupbox is disabled (the groupbox is gray). If the system includes temperature sensors, this error condition is also highlighted in the Diagnostics tab. The sensor in anomaly determines the disabling of other controls related to the use of the delta T, which will be described in relevant paragraphs.

- **Return Temperature [°C]**: represents the temperature value, in °C, detected by the sensor positioned at the valve outlet port (it is the sensor connected to the T2 input of the terminal block). It is a read-only value.

If a value equal to 500.0 is displayed, it means that the return sensor (T2) is disconnected or faulty, and the relative "TEMPERATURE SENSORS" groupbox is disabled (the groupbox is gray). If the system includes temperature sensors, this error condition is also highlighted in the Diagnostics tab. The sensor in anomaly determines the disabling of other controls related to the use of the delta T, which will be described in the relevant paragraphs.

- **ΔT [°C]**: represents the value of the difference between the supply and return temperature measured in °C. It is a read-only value;

In addition, at the opening of the tab, the information relating to the inlet temperature, outlet temperature, and delta T can be read simultaneously by pressing the "TEMPERATURE SENSORS" label at the top of the section relating to this information.

This section is enabled only if the EBV system has 2 temperature sensors, otherwise it is disabled highlighted by the gray labels.

If the temperature sensors have problems or are not connected, no value will be displayed.

- **Instant Power [kW]:** power detected at the instant in which the reading of the value is requested based on the calculated flow rate value and the delta T at that instant. It is a read-only value.

If the supply and/or return temperature sensors are disconnected or faulty (for systems that provide them), this item will be disabled (gray background) and no value will be displayed.

- **CHARTS:** by checking the items listed in this section it is possible to view the graphs of the desired variables. The graphs are grouped into 2 types: the balancing ones (command signal, feedback, calculated flow rate, Delta P) and the energy ones (supply temperature, return temperature, delta T, and instant power). The latter are only enabled if the system has 2 temperature sensors, otherwise they are disabled (gray background) and cannot be selected. Pressing the "CHARTS" button a window will appear with the previously selected charts. The 2 types of variables are represented on 2 different graphic areas (see figure 11).

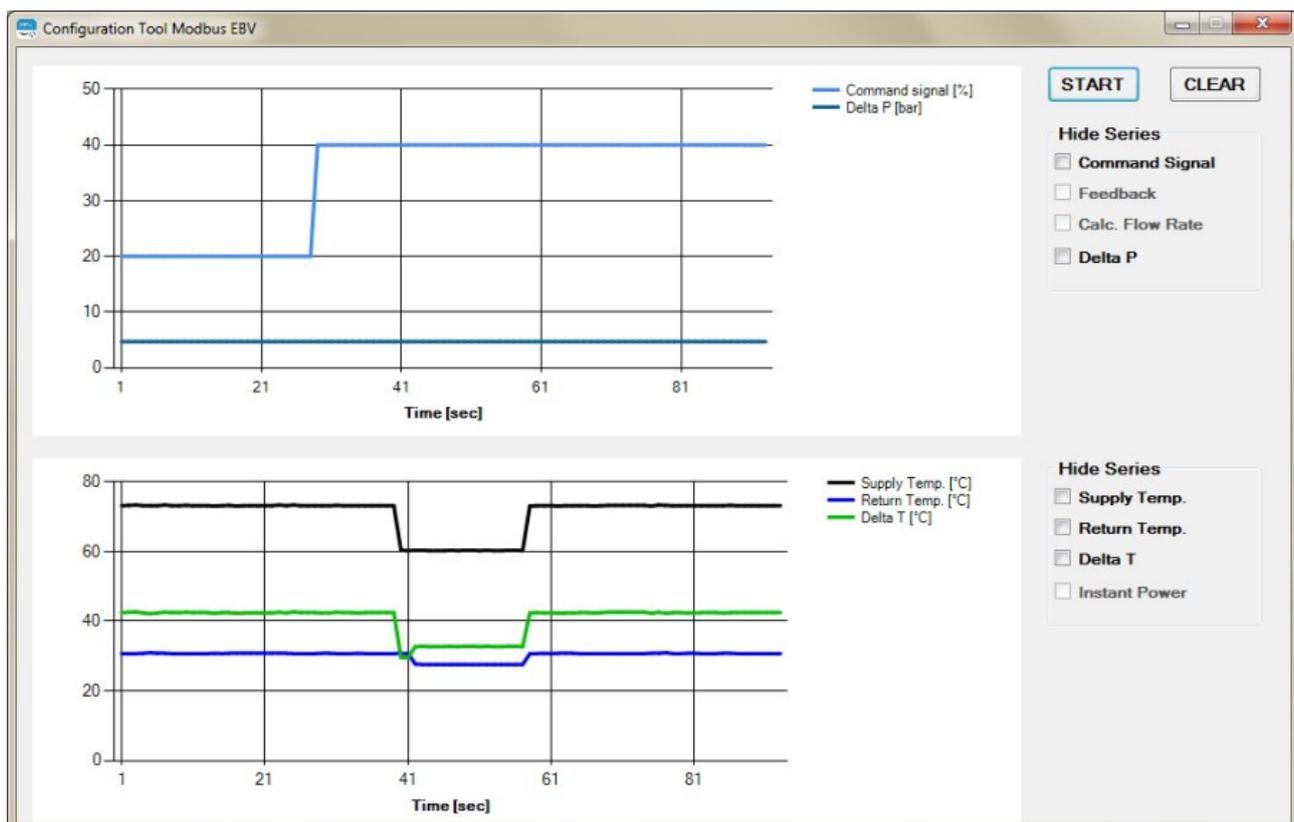


Figure 11. Window of the charts

The window shows the 2 areas for the 2 types of charts described above. The charts displayed are those selected in the "Info" tab and are updated every second starting from the opening of the window in the specific chart area.

It is possible to stop the updating and display of the graphs by pressing the button with the word "STOP" and resume updating the display by pressing the button with the word "START" (the same button therefore allows to stop or restart the display). When the

display is resumed, the first data displayed will be the current one and not the one at the time of the stop (therefore the data will be lost during the time the chart stops).

It is possible to hide one or more plotted graphs from the display by placing the check mark on the specific series in the "**Hide series**" section (the series is hidden, but the acquired data continues to be stored anyway).

It is again possible to show the previously hidden graphs by removing the check mark from the specific box, as mentioned the graphs will show temporal continuity in the data even if they were hidden.

The "**RESET**" button allows to delete the graphs drawn from the relative display area.

After 90 minutes the charts are no longer updated because the maximum number of data that can be displayed has been reached. A pop-up message warns the user and asks if the data must be saved to a file (.csv), if you press the "Yes" button a window is opened for saving the file and once the name of the file is indicated the charts in the two areas are deleted. By pressing the "No" button the data is not saved on the file and the charts will be deleted. By pressing the "**START**" button it will be possible to restart the data display from the current instant.

- **OPERATING MODE:** section shows the operating status of the actuator which can be one of those listed below:
  - Normal: the actuator is working following the command signal at its input; therefore it is not in the initial positioning, learning, emergency return or manual command inserted phases.
  - Initial positioning: the actuator is moving towards the initial position determined by the dip 1 or if the dip switches are disabled based on the action type value set in the "Configuration" window for piloting via modbus.
  - Calibration: the actuator is calibrating the stroke.
  - Error: indicates that one or more errors have occurred, the details of the error are visible in the "Errors" section of the "Diagnostics" tab.
  - Manual override: indicates that the manual command has been inserted, the actuator does not respond to the command signal until the manual override is disengaged and the initial positioning ends.

## 5.4 Configuration Tab

In this window it is possible to set the following valve configuration parameters:

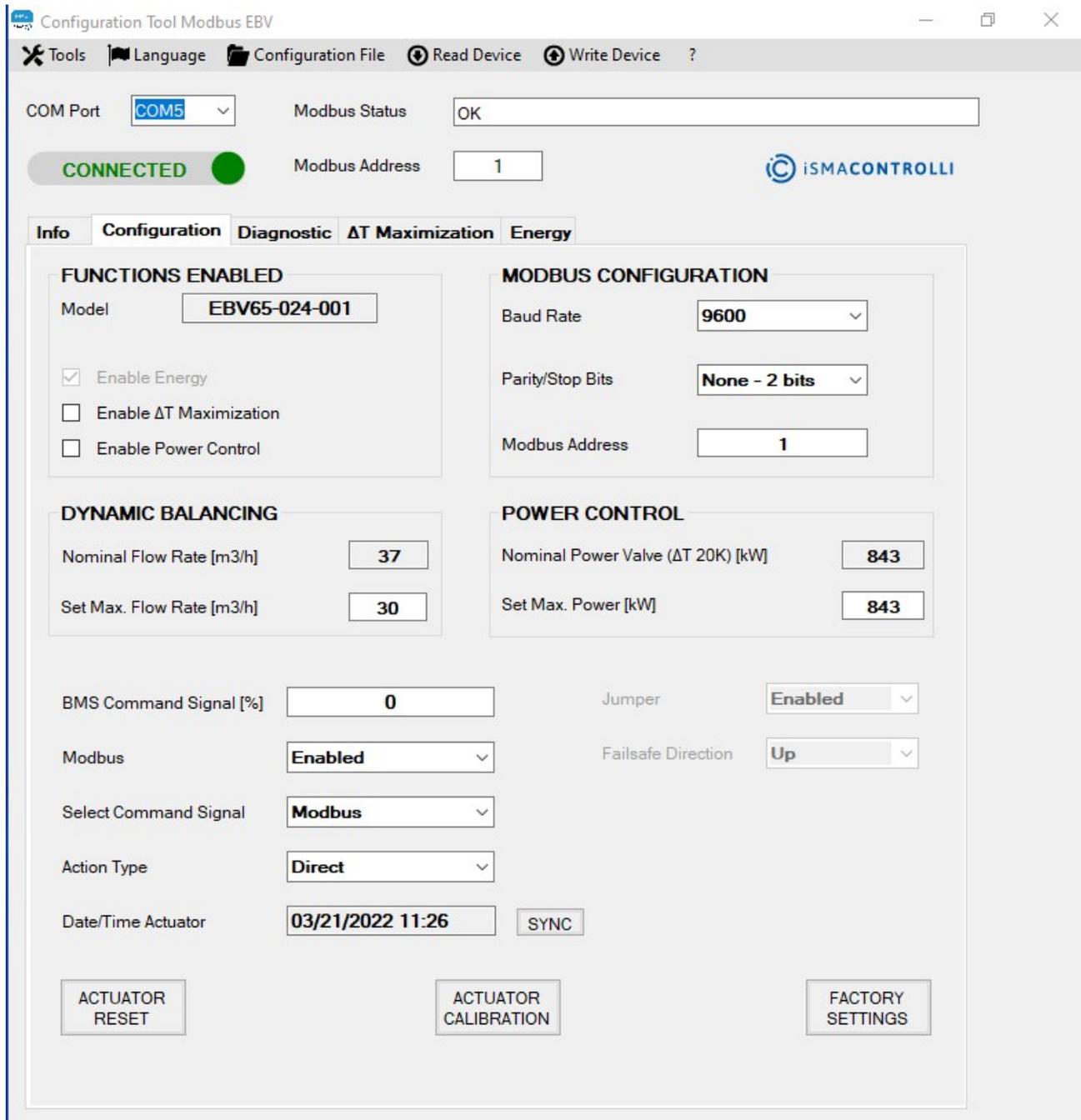


Figure 12. Configuration tab

- **FUNCTIONS ENABLED:** the model text box shows the valve model to which the configurator is currently connected (the meaning of the code has been explained in chapter 6 under "Model"). Depending on the model, the possible functions that can be activated are shown. In particular, if the system has 2 temperature sensors, the following functions are displayed: "Enable Energy" which is activated by default (it has the check mark automatically), "Enable Delta T Maximization" and "Enable Power Control". Otherwise none of the 3 functions can be activated and dynamic balancing is always active by default. It is possible to enable / disable a specific function by clicking on the relevant box (by adding or removing the check mark).
- **MODBUS CONFIGURATION:** allows to set the Modbus configuration parameters of the actuator, in particular:
  - **Baud Rate:** selectable values are 9600 or 19200.

- **Bit Parity/Stop:** with parity bit selectable None, Odd or Even and stop bit selectable between 1 or 2.

The factory settings of the actuator are: 9600, No parity bit and 2 stop bits.

- **Modbus Address:** allows to set the modbus address of the actuator.

To write the value in the actuator, press "**Enter**" on the keyboard after selecting the desired value.

- **Set Maximum Flow rate [m<sup>3</sup>/h]:** represents the flow rate the user wants to have with 100% control signal and on which the dynamic balancing is performed. Its value cannot be higher than the nominal flow rate value. In order to set this value in the actuator, press the "Enter" button on the keyboard after entering the desired value in the appropriate text box.
- **Nominal Flow rate [m<sup>3</sup>/h]:** this value (reading only) is characteristic of the selected valve, it represents the maximum flow rate related to that valve.
- **Valve Nominal Power ( $\Delta T$  20 K) [kW]:** represents the maximum power value that the selected valve is able to supply at  $\Delta T = 20$  K. It is a read-only value as it is characteristic of the valve.

If the supply and/or return temperature sensors are disconnected or faulty (when available), this item will be disabled and the relative "POWER CONTROL" groupbox will also be disabled (the groupbox is grayed out).

- **Set Max Power [kW]:** represents the power value to be supplied at 100% control signal. To write this value in the actuator, press the "Enter" key on the keyboard.

If the supply and/or return temperature sensors are disconnected or faulty (when available), this item will be disabled and the relative "POWER CONTROL" groupbox will also be disabled (the groupbox is grayed out).

- **Data/Time Actuator:** when the tab is opened, the text box displays the current date and time of the PC, by pressing the "SYNC" button this information is saved in the actuator. At the same time, the clock error displayed in the "Diagnostics" tab disappears. Each time the actuator turns off (the error condition is indicated in the "Diagnostics" tab), the date and time must be synchronized. The synchronization of the date and time is necessary for the Energy function (so if the 2 temperature sensors are present), otherwise it is not necessary.

By clicking on the "Actuator Date / Time" label, the date and time inside the actuator is read and displayed in the text box.

- **Select Command Signal:** if the Modbus is enabled, this menu allows to select the type of command signal for driving the actuator (by default, set to Modbus command). To write the selected value into the actuator, press the "Enter" key on the keyboard.
- **BMS Command Signal [%]:** allows to set the Modbus command for positioning the actuator between 0-100% (1% step). To send the command to the actuator, press the "Enter" key on the keyboard.
- **Action Type:** if Modbus is enabled, this menu allows to select the action type of the actuator (direct or reverse). To write the selected value into the actuator, press the "Enter" key on the keyboard.
- **Modbus:** allows to enable/disable the dip switches present on the actuator. If the dip switches are enabled, the command signal type and the type of action are set via the

dip switches, if disabled they are set via Modbus. To write the selected value into the actuator, press the "Enter" key on the keyboard.

- **Jumper:** allows to select if the emergency return direction is determined by the jumper inside the emergency return board (enabled) or by the Modbus register (addr. 5 bit 1). It's enabled only if the actuator model expects the emergency return board.
- **Failsafe Direction:** it allows to select the emergency return direction (up or down) if "Enable Jumper" is disabled. It's enabled only if the actuator model expects the emergency return board.
- **Actuator Calibration:** by clicking this button, it is possible to force the calibration of the actuator stroke.
- **Actuator Reset:** by clicking this button, a software reset of the actuator is performed.
- **Factory settings:** by clicking this button, the actuator reload inside the memory the default values (factory values). This action overwrites the configuration and data inside the actuator.

The variables in this window are read from the actuator and displayed when the "Configuration" tab is pressed from any tab or by pressing the "Update Page" item from the drop-down menu.

It is also possible to make an instant reading of a text box by clicking on the corresponding label.

## 5.5 Diagnostic Tab

In this window it's possible to view the status of the actuator and the presence of any anomalies:

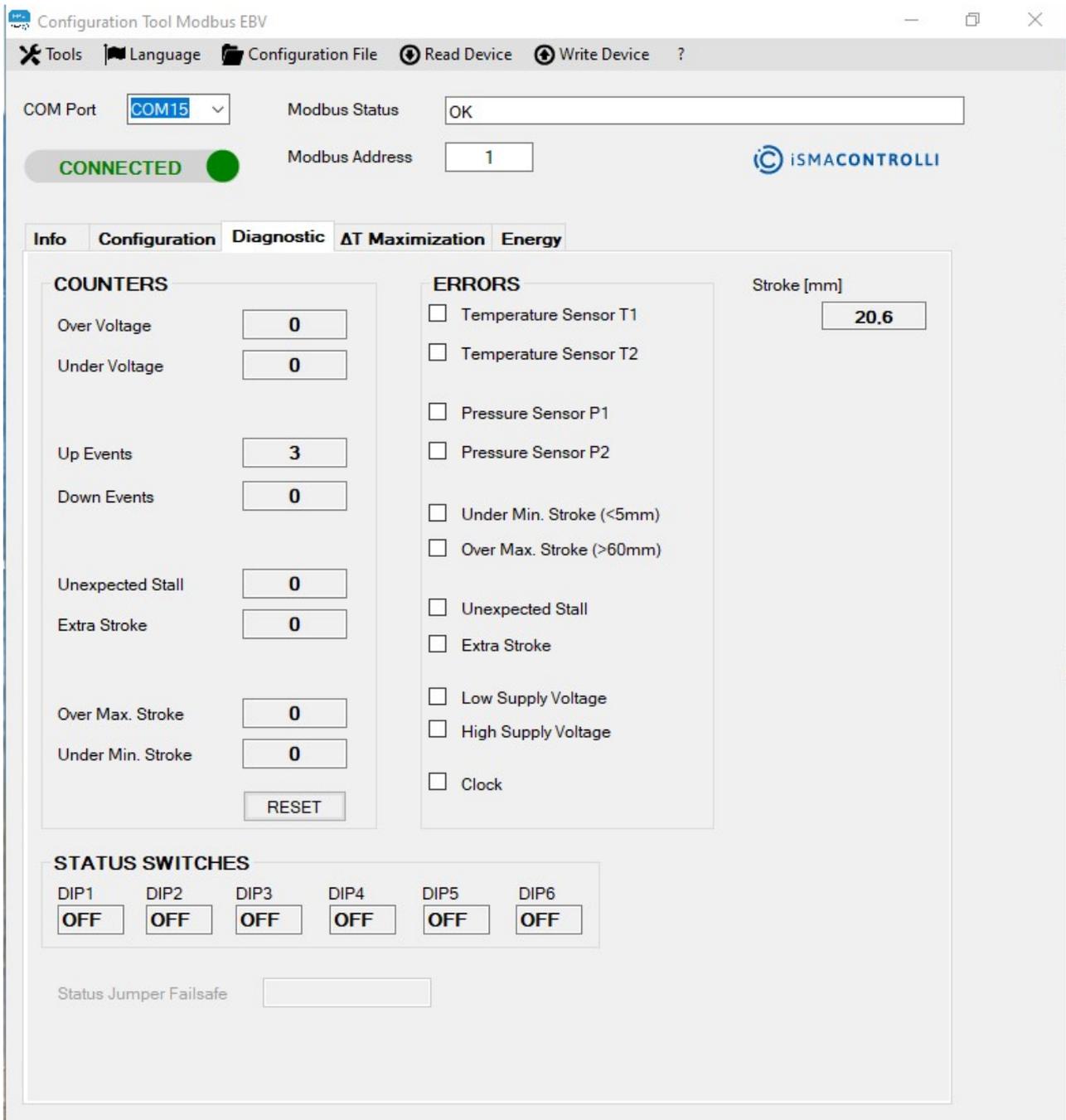


Figure 13. Diagnostic tab

- **Stroke [mm]:** represents the value of the actuator stroke calculated in mm during the calibration phase. It is a read-only value.

The section "COUNTERS" displays the number of events (mainly anomalies) that have occurred in the actuator. The events that can be viewed are:

- **Over Voltage:** shows how many high voltage supply anomalies have occurred.
- **Under Voltage:** shows how many low voltage supply anomalies have occurred.
- **Up Events:** identifies the number of times that the actuator it has been found with the stem fully retracted.
- **Down Events:** identifies the number of times that the actuator it has been found with the stem fully extended.
- **Unexpected Stall:** identifies an anomaly of unexpected stall and this value represents the number of times that a stall has occurred within the stroke.

- **Extra Stroke:** identifies an extra stroke anomaly, this value represents the number of times an extra-stroke has occurred compared to the stroke calculated during the learning phase (out-of-range stroke).
- **Over Max. Stroke:** shows how many stroke anomalies calculated by the actuator in the learning phase (stroke greater than 60 mm) have occurred.
- **Under Min. Stroke:** shows how many stroke anomalies calculated by the actuator in the learning phase (stroke less than 5 mm) have occurred.

The section "ERRORS" shows the possible errors present on the actuator:

- **Temperature Sensor T1:** the temperature sensor connected to the terminal indicated with T1 (supply temperature) has an anomaly (if temperature sensors are available in the connected valve model).
- **Temperature Sensor T2:** the temperature sensor connected to the terminal indicated with T2 (return temperature) has an anomaly (if temperature sensors are available in the connected valve model).
- **Pressure Sensor P1:** the pressure sensor connected to the terminal indicated with A1 (input pressure) has an anomaly.
- **Pressure Sensor P2:** the pressure sensor connected to the terminal indicated with A2 (output pressure) has an anomaly.
- **Under Min. Stroke (<5 mm):** during the calibration phase, a stroke was calculated below the minimum allowed value.
- **Over Max. Stroke (>60 mm):** during the calibration phase, a stroke above the maximum allowed value was calculated.
- **Unexpected Stall:** the actuator is in an unexpected stall condition in the stroke range.
- **Extra Stroke:** the actuator is in an extra-stroke condition; therefore, the actuator is in a position beyond the calculated stroke.
- **Low Supply Voltage:** the power supply of the actuator is below the minimum allowed threshold (therefore the performance of the actuator is not guaranteed).
- **High Supply Voltage:** the power supply of the actuator is above the maximum allowed threshold (the performance of the actuator is not guaranteed).
- **RESET:** this button allows to reset the event counters.
- **Clock:** indicates that the time and date have not been set in the actuator since the last time the actuator was switched on (it is only necessary in the case of using the Energy information). Synchronization is carried out in the "Configuration" tab as described in the specific paragraph.
- **STATUS SWITCHES:** allows to read the dip switches configuration present on the actuator.
- **Status Jumper Failsafe:** it shows the jumper status (up or down) to indicate if the jumper on the emergency return board is inserted or not (it determines the failsafe direction). The Status jumper failsafe has meaning only if "Jumper" is set on "Enabled".

Active errors are highlighted in red colour.

The variables present in this window are read when the "Diagnostics" tab is pressed from any tab or when the "Read Device" item from the drop-down menu is pressed and also each time the section title at the top of the corresponding group of information is selected.

## 5.6 Delta T Maximization Tab

In this window it is possible to configure and check the parameters of the  $\Delta T$  maximization function.

This tab is visible only if the system has 2 temperature sensors.

To save the set values, press the "Enter" key on the keyboard.

If one or both temperature sensors are disconnected or faulty, the items in this tab are all disabled (gray color) until the situation is restored.

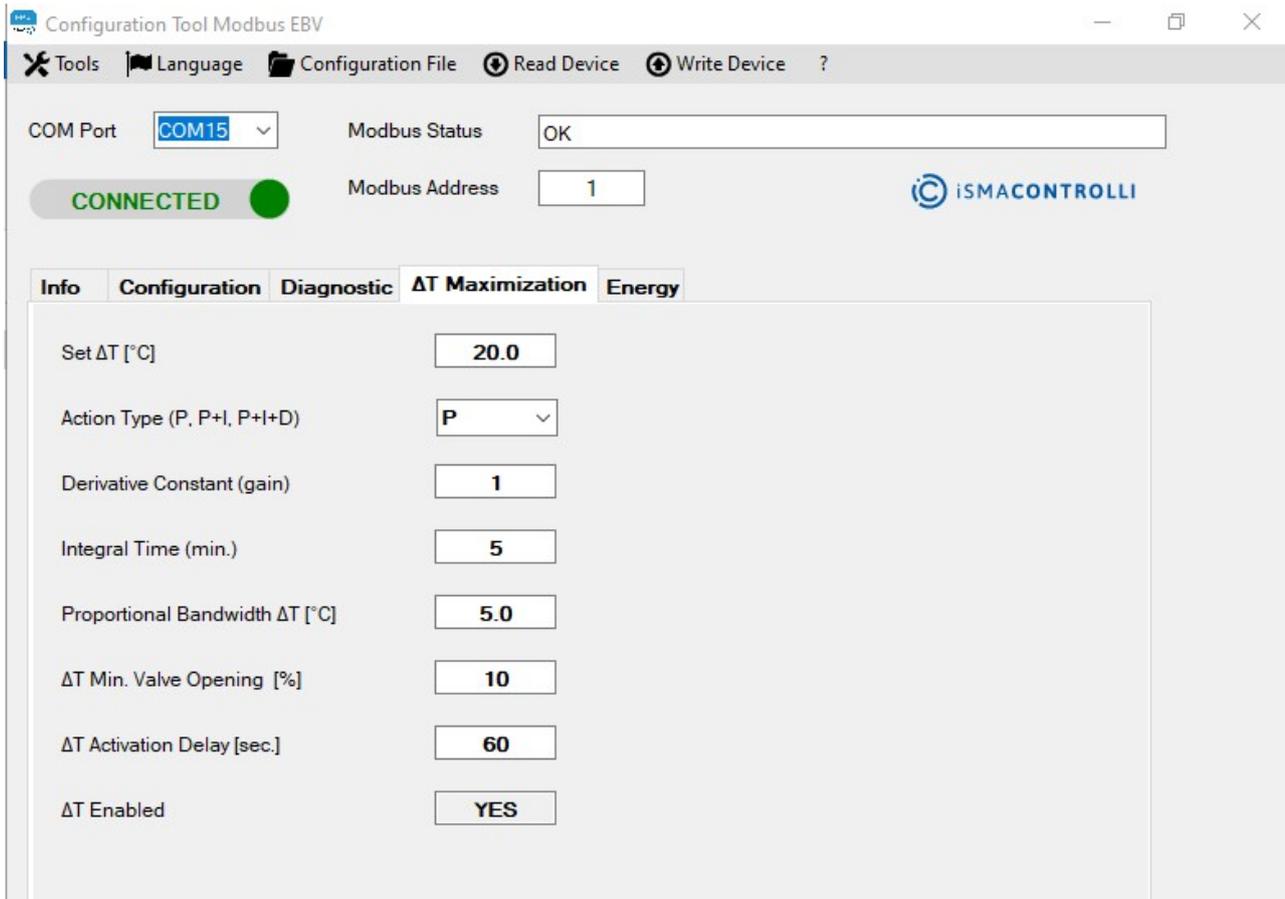


Figure 14. Visualization of the Delta T Maximization tab

- **$\Delta T$  Set [°C]:** represents the temperature value to be maintained to optimize heat exchange.
- **Action Type (P, P+I, P+I+D):** represents the type of control of the system to be used for maximizing  $\Delta T$ . To write the selected value into the actuator, press the "Enter" key on the keyboard.
- **Derivative Constant (gain):** represents the contribution of the derivative action.
- **Integral Time [min]:** value that defines the time within which the proportional action is proposed again.
- **Proportional bandwidth  $\Delta T$  [°C]:** represents the value beyond which want the output to be 100%.
- **$\Delta T$  Min. Valve Opening [%]:** represents the minimum loop output value (expressed as a percentage) necessary to ensure a minimum of leakage in the system.
- **$\Delta T$  Activation Delay [sec]:** represents the delay value for the activation of the loop (expressed in seconds), to allow the sensors to detect the water temperature.

- **Enable  $\Delta T$** : allows to enable the  $\Delta T$  maximization function. It is a read-only value and is set automatically if the  $\Delta T$  maximization function is activated in the "Configuration" tab.

To save into the actuator the desired value it's necessary to press "Enter" key on the keyboard.

The variables in this window are read by the actuator and displayed when the " $\Delta T$  Maximization" tab is pressed from any tab or by pressing the "Read Device" item from the drop-down menu.

It is also possible to make a real time reading of a text box by clicking on the corresponding label.

## 5.7 Energy Tab

In this window the user can view all the information relating to the energy calculation (heating and cooling energy) carried out by the actuator.

This tab is visible only if the system has 2 temperature sensors.

If one or both temperature sensors are disconnected or faulty, the items in this tab are all disabled (gray color) until the situation is restored.

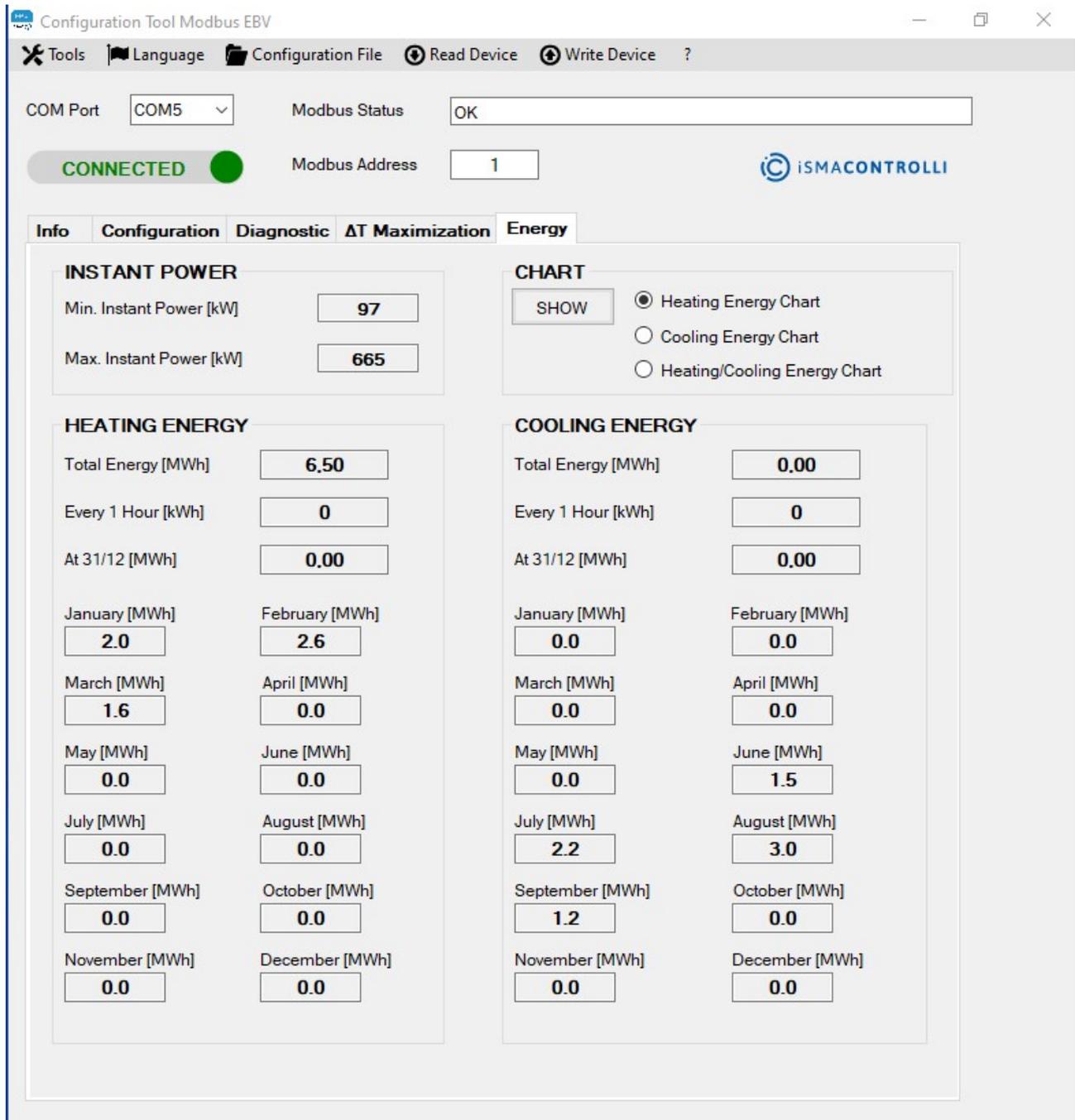


Figure 15. Visualization of the Energy tab

The information visible in this window are:

**INSTANT POWER** section:

- **Min. Instant Power [kW]:** displays the minimum instantaneous power value since the last power-on.
- **Max. Instant Power [kW]:** displays the maximum instantaneous power value since the last power-on.

**HEATING ENERGY** section:

- **Total Energy [MWh]:** represents the energy (heating energy) used up to that moment.
- **Every 1 Hour [MWh]:** represents the energy (heating energy) used in the previous hour.

- **At 31/12 [MWh]:** represents the energy (heating energy) used up to 31 December of the current year.
- **January [MWh]:** represents the energy (heating energy) used in the month of January.
- **February [MWh]:** represents the energy (heating energy) used in the month of February.
- **March [MWh]:** represents the energy (heating energy) used in the month of March.
- **April [MWh]:** represents the energy (heating energy) used in the month of April.
- **May [MWh]:** represents the energy (heating energy) used in the month of May.
- **June [MWh]:** represents the energy (heating energy) used in the month of June.
- **July [MWh]:** represents the energy (heating energy) used in the month of July.
- **August [MWh]:** represents the energy (heating energy) used in the month of August.
- **September [MWh]:** represents the energy (heating energy) used in the month of September.
- **October [MWh]:** represents the energy (heating energy) used in the month of October.
- **November [MWh]:** represents the energy (heating energy) used in the month of November.
- **December [MWh]:** represents the energy (heating energy) used in the month of December.

#### COOLING ENERGY section:

- **Total Energy [MWh]:** represents the energy (cooling energy) used up to that moment.
- **Every 1 Hour [MWh]:** represents the energy (cooling energy) used in the previous hour.
- **At 31/12 [MWh]:** represents the energy (cooling energy) used up to 31 December of the current year.
- **January [MWh]:** represents the energy (cooling energy) used in the month of January.
- **February [MWh]:** represents the energy (cooling energy) used in the month of February.
- **March [MWh]:** represents the energy (cooling energy) used in the month of March.
- **April [MWh]:** represents the energy (cooling energy) used in the month of April.
- **May [MWh]:** represents the energy (cooling energy) used in the month of May.
- **June [MWh]:** represents the energy (cooling energy) used in the month of June.
- **July [MWh]:** represents the energy (cooling energy) used in the month of July.
- **August [MWh]:** represents the energy (cooling energy) used in the month of August.
- **September [MWh]:** represents the energy (cooling energy) used in the month of September.
- **October [MWh]:** represents the energy (cooling energy) used in the month of October.
- **November [MWh]:** represents the energy (cooling energy) used in the month of November.
- **December [MWh]:** represents the energy (cooling energy) used in the month of December.

**CHARTS:** after selecting the variables (heating energy, cooling energy or both) to plot, pressing the "SHOW" button displays a histogram chart of the energy for the 12 months of the year (see figure 16).

The variables present in this window are read by the actuator and displayed when the "Energy" tab is pressed from any tab or by pressing the "Refresh Page" item from the drop-down menu.

It is also possible to perform an instant reading of the information contained in the various sections by clicking on the relevant header label.

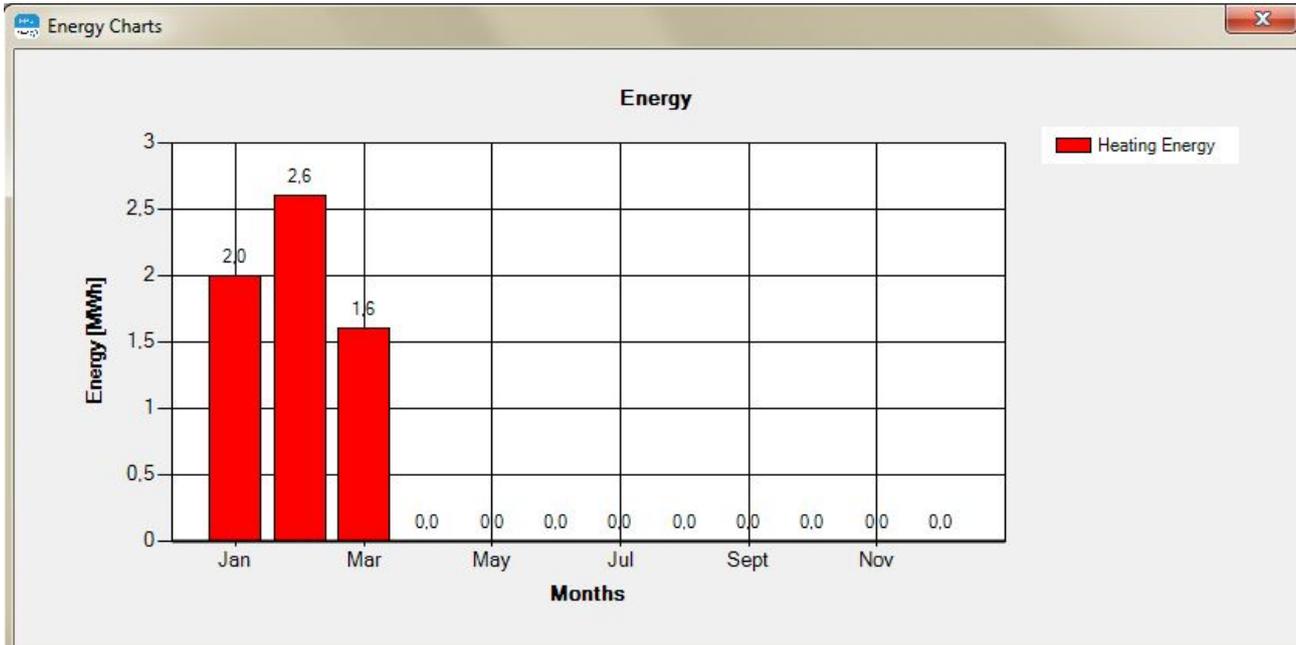


Figure 16. Window of the histogram chart of the energy

## 6 Configuration Tool USB EBV

The Configuration Tool USB EBV allows to read and write only the configuration information of the valve.

In this Configuration Tool the "Info" tab is missing and it is therefore not possible, for example, to set a command signal to move the actuator or view the graphs of the of the real time valve position, but allows the firmware upgrade (in fact there is the "FW Update" tab in addition to the Modbus version) and to open the Configuration Tool in "Offline" mode (simulator) that allows to interact with the user interface even if the actuator and USB cable are not connected.

When the USB cable is connected between the PC and the actuator, the motor is disabled and therefore if the actuator was moving before the connection, it will stop immediately and then resume the movement towards the previously calculated position once the cable is disconnected.

It is recommended to start the application with the USB cable disconnected on the PC side.

At the first start, you will be asked for authorization to install the USB driver software of the actuator, press the "Install this driver software anyway" option.

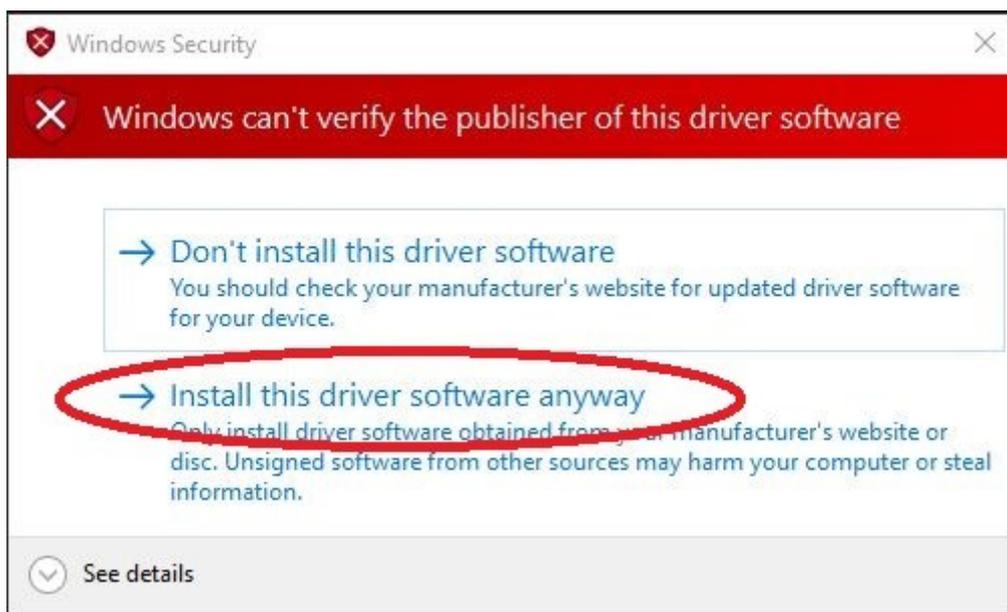


Figure 17. Confirm message of the driver installation

At the start-up the Configuration Tool EBV USB is opened in offline mode. The offline mode allows to interact with the user interface even if the actuator and serial converter are not connected. In this mode it's possible to simulate all Configuration Tool operations except the "Update Page" and "Load File" because these operations need to have the actuator and the serial converter connected.

To switch to the Configuration Tool mode is enough to click on the "OFFLINE" check box to remove the mark.

When the application is started, if the cable is already connected or is connected after opening the configurator, the COM port to which the actuator is connected will be

automatically recognized. If the COM port does not appear automatically in the list, the procedure for detecting the COM port is indicated in paragraph 4.2.

In the "Device Manager" window of the Windows OS under "Ports (COM and LPT)" the device will be identified by the description "Controlli USB" with the assigned COM port number next to it in brackets.

For the functions and meanings of the various EBV USB Configurator tabs, see the previous paragraphs.

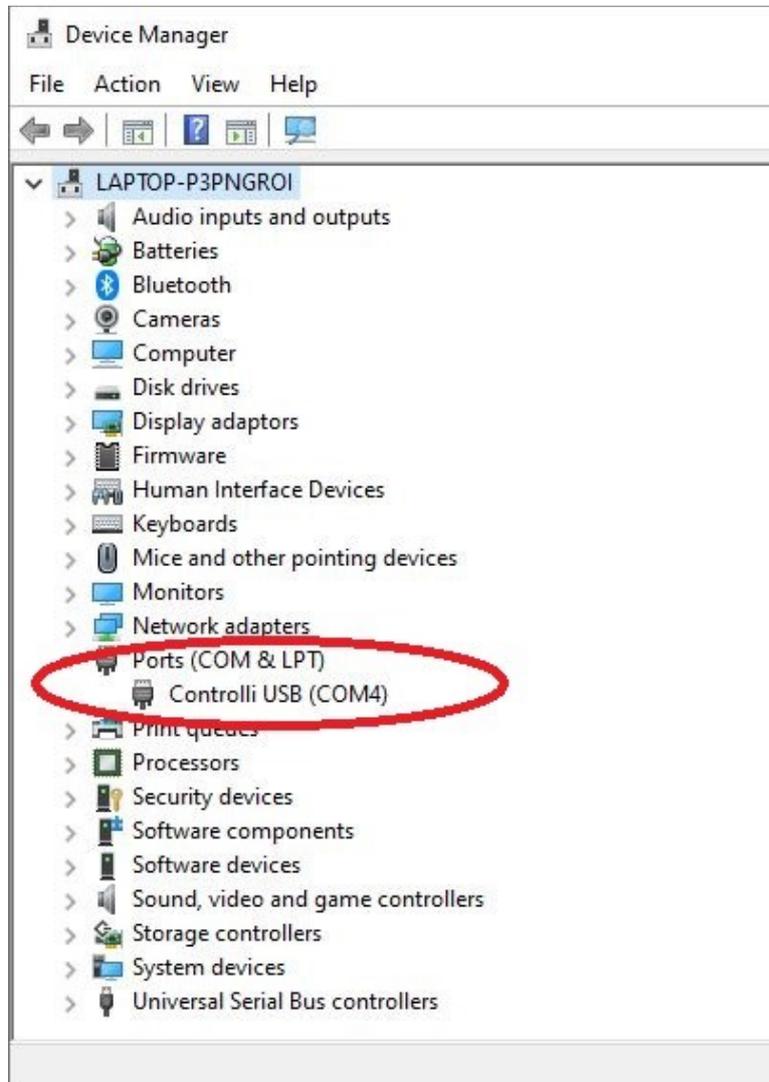


Figure 18. Windows device manager to identify the COM port of the actuator

## 6.1 Upgrade FW Tab

In this window it is possible to upgrade the actuator firmware.

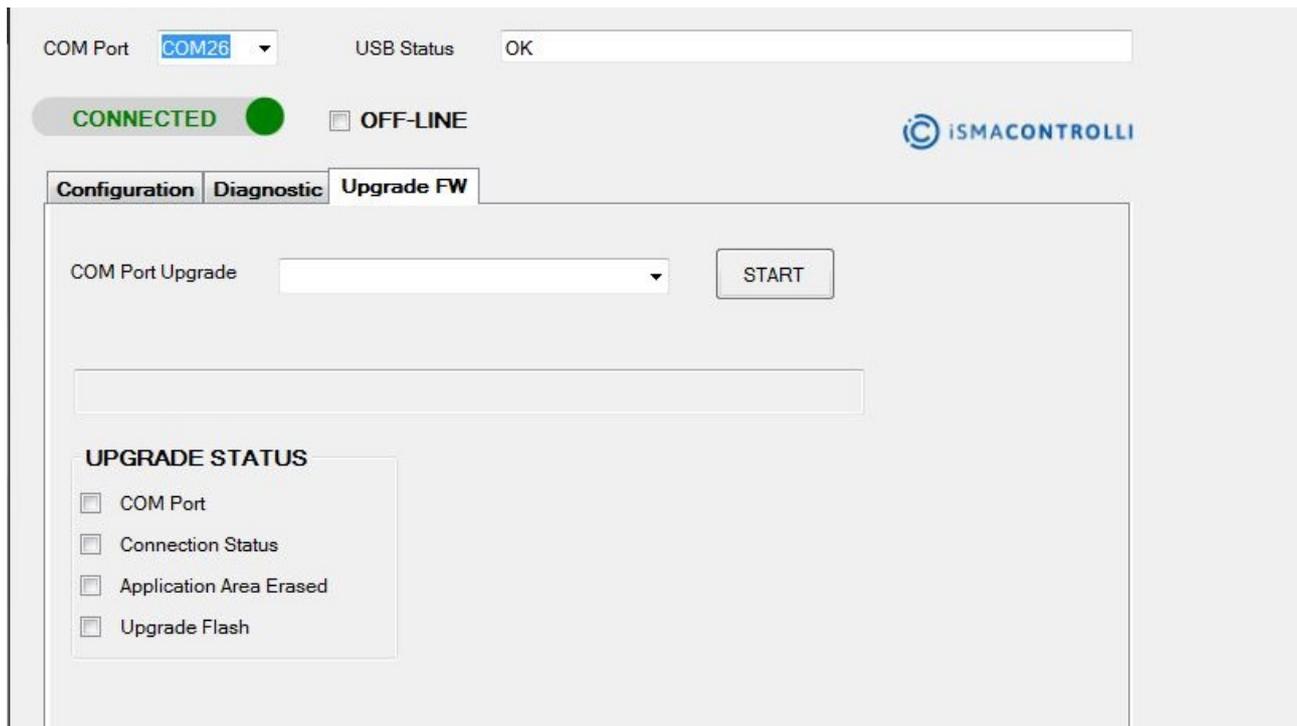


Figure 19. Visualization of the FW Upgrade tab

- **COM Port Upgrade:** this drop-down menu displays the COM port used by the bootloader for the firmware update. The corrected COM port is detected automatically ONLY if DIP3 is in the ON position (if the dip3 is initially in the OFF position, after having moved it to ON it is necessary to reset the actuator, this operation is done automatically by the configurator).

If the automatic search for the COM port is not completed successfully (maximum search time is 90 seconds), pressing the "Upgrade COM Port" label displays all the available COM ports of the computer with their description (the one relating to the bootloader is Bossa Program Port (mainly on Windows 7) or AT91 USB To Serial Converter (mainly on Windows 10)), by selecting the correct COM port and pressing the "Enter" key on the keyboard, the update procedure continues.

- **START:** the button allows to continue or repeat an operation in case of errors in the automatic procedure, it must be PRESSED ONLY when a pop-up window warns that it must be used.
- **UPGRADE STATUS:** this section includes the status of the firmware upgrade. At the end of the download procedure, the operations marked with a tick in the box and the relative description with a green background were successful, while those without a tick and with the description on a red background failed.

There is also a text box that shows the operation to be performed or the operation in progress and notification messages for the user during the firmware upgrade procedure.

The first operation to perform is to copy the new firmware file (MVEIoT.bin) in the installation folder of the Configuration Tool EBV USB (Program Files (x86) \ Configuration Tool EBV USB) at the same level as where the executable file of the configurator is located (Configuration Tool EBV USB.exe).

The file name must NOT be changed (MVEIoT.bin).

By pressing on the tab, a message asks for confirmation of the desire to update the firmware and suggests leaving only the connection cable between the PC and EBV actuator connected to the USB ports. Pressing the "Yes" button automatically starts the upgrade procedure, pressing the "No" button cancels the start of the procedure (to start it later, change the tab and select the "FW upgrade" tab again or press the drop-down menu item "Update Page").

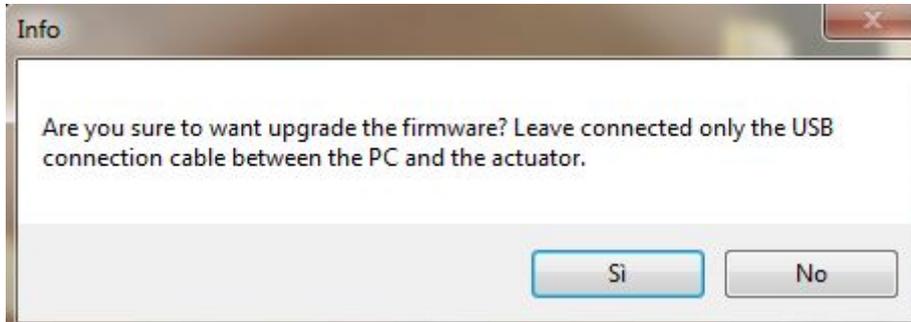


Figure 20. Confirm message of starting firmware upgrade procedure

The upgrade procedure, which starts automatically, is divided into the following steps (various messages will be displayed to guide the user in the upgrade, read very carefully what is requested for each message):

**Step 1:** Saving the configuration file with the data currently present in the actuator (because the firmware upgrade will erase completely the EBV memory). In this way it will be possible to reload all the necessary information once the new firmware has been updated, as the configuration parameters, the anomaly event counters and the energy data. For saving, a window will be open where to specify the file name to save.

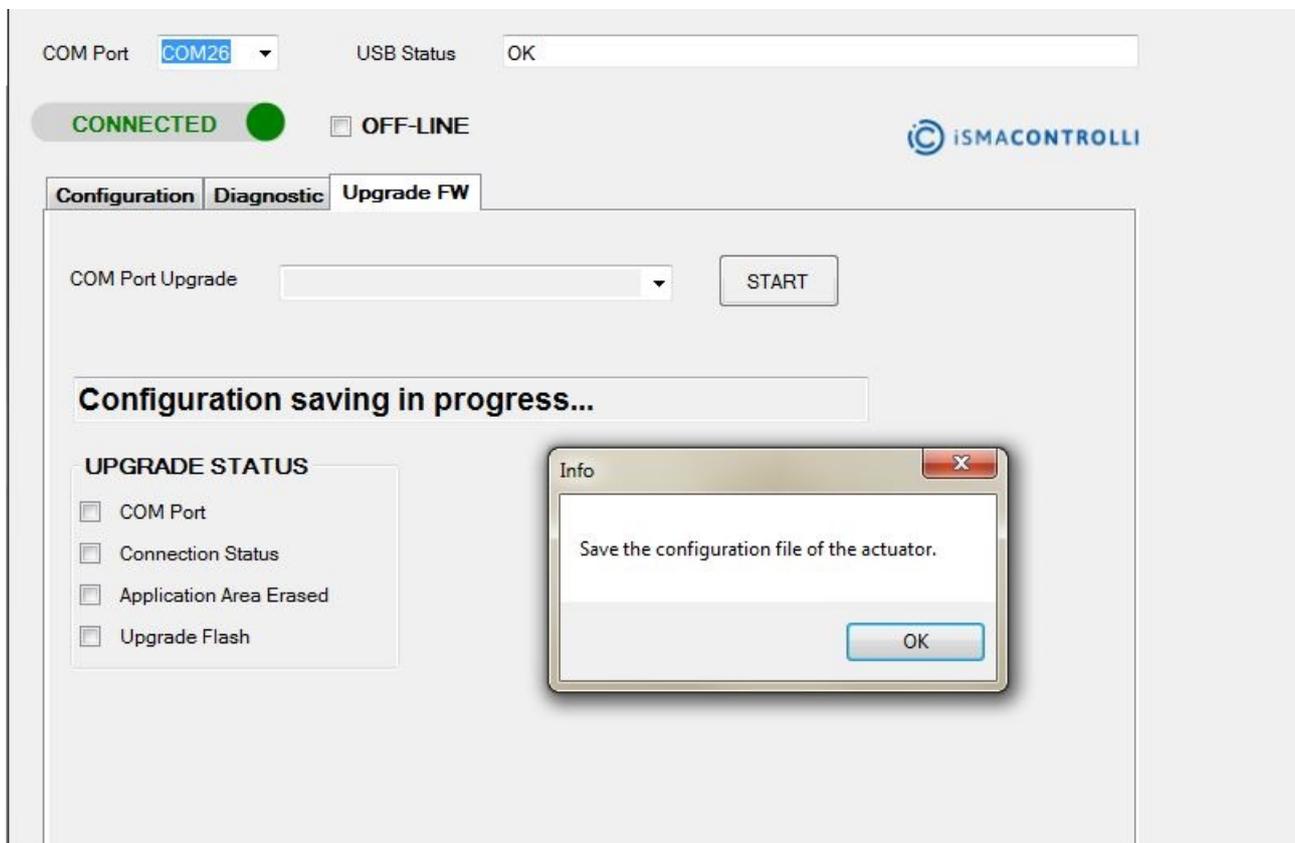


Figure 21. Saving actuator configuration in progress

**Step 2:** Move the DIP switch 3 to the ON position (essential!) and only after press the "OK" button of the message. To facilitate the movement of the DIP 3 it is suggested to get a small screwdriver or an object with a small tip.

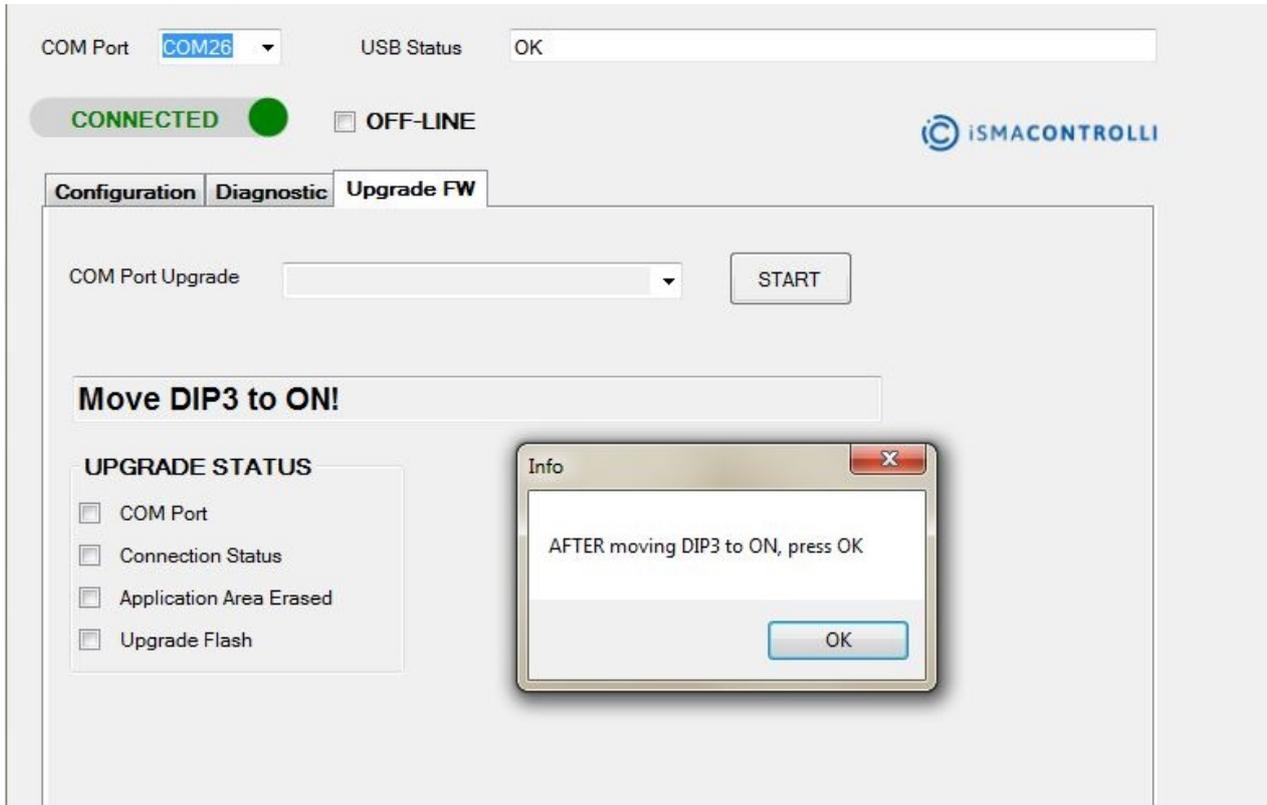


Figure 22. Info message: move DIP 3 in ON

**Step 3:** The actuator will automatically perform a Reset to enter in the bootloader mode.

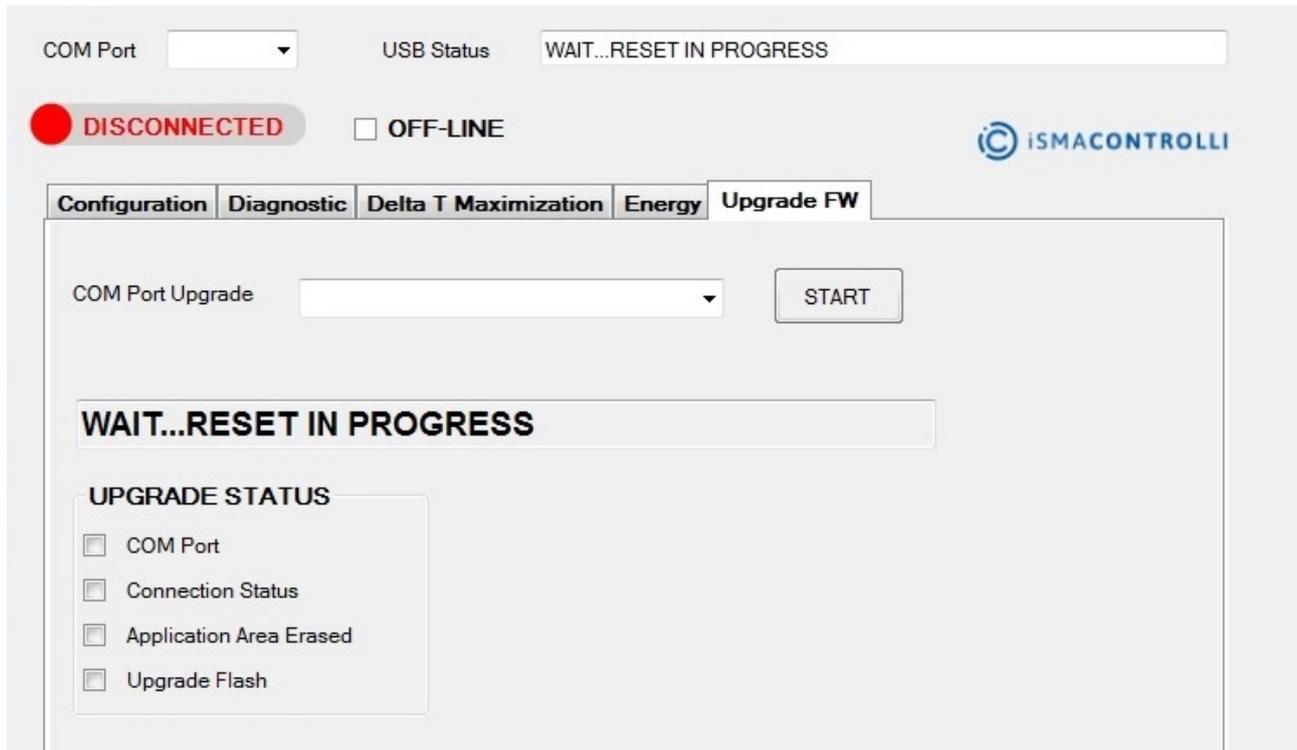


Figure 23. Reset actuator to set the actuator in bootloader mode

**Step 4:** An automatic search is performed to find the COM port used by the bootloader (the search has a maximum duration of 90 seconds (marked by a continuously rotating wheel) so that, if it is the very first time that the system enters in bootloader mode, the Windows operating system has time to install the corresponding driver and recognize the specific COM port).

On Windows 10 it may occur that the correct driver is not automatically recognized, and the bootloader COM port driver must be updated, otherwise it is not recognized with the specific name, but with a generic USB Serial Port. To update the driver, from the Windows "Device Manager" panel, open the "Ports (COM and LPT)" item and right-click on the COM detected for the bootloader and press the "Update Driver" item and search for the driver in the "drv" folder of the configurator folder.

If the COM port driver update was carried out within 90 seconds, the port will be automatically detected and will be displayed in the appropriate drop-down menu next to the "Update COM Port" label.

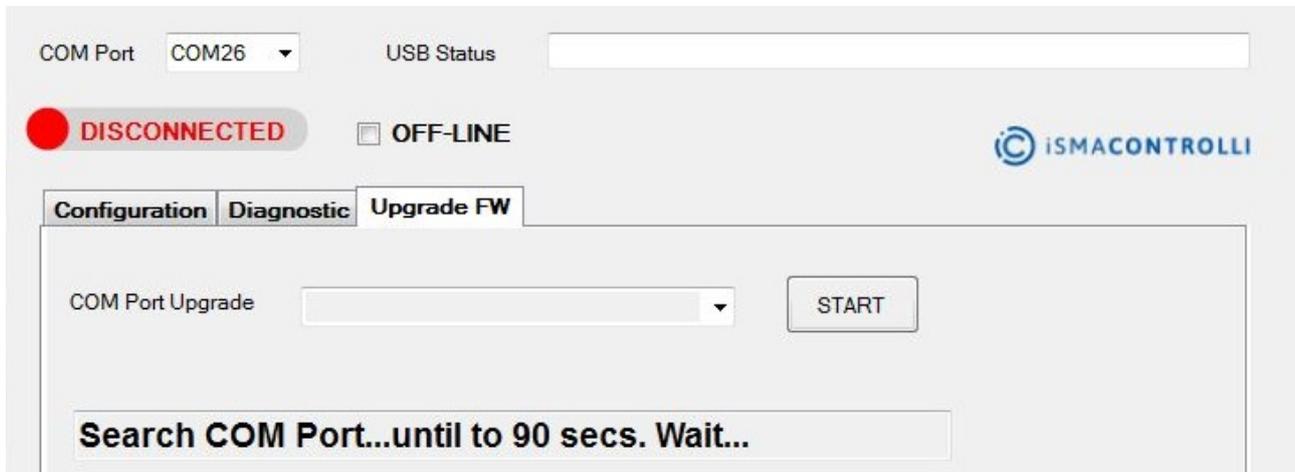


Figure 24. Automatic search of the COM port for bootloader

**Step 5:** If the COM port was not automatically detected (because for example the driver update took longer than 90 seconds), you can manually search for the available COM ports by clicking on the "COM Port Upgrade" label.

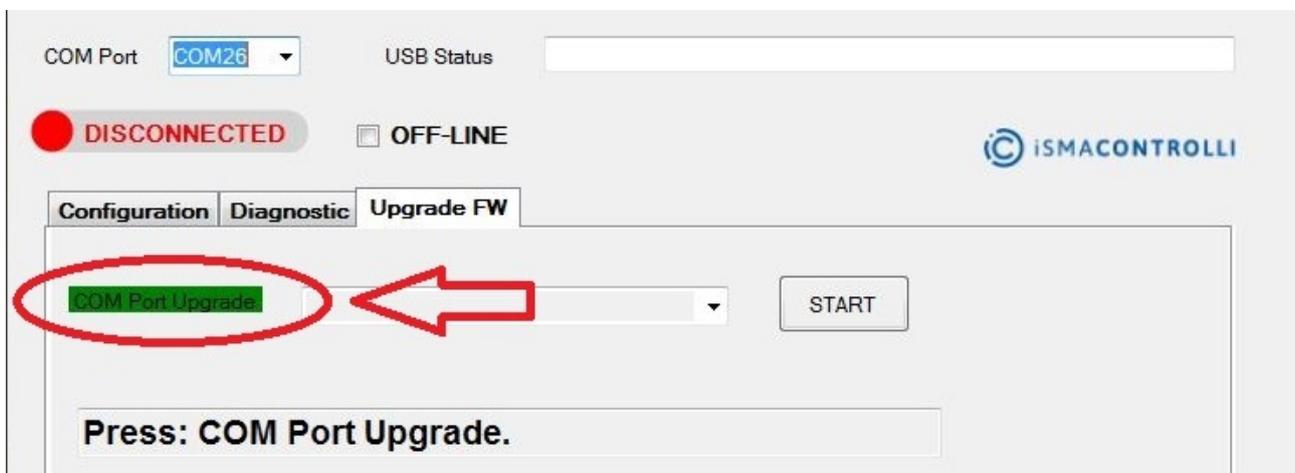


Figure 25. Manual search of the COM port if automatic search has not been successful

If COM ports have been found, they will be visible in the relative drop-down control and the availability of active COM ports on the PC will be indicated by the green background and therefore it will be possible to check which are by pressing the small arrow pointing down at the end of the drop-down control (beyond the COM also indicates the complete name of the connected device, as showed in the "Windows Device Manager).

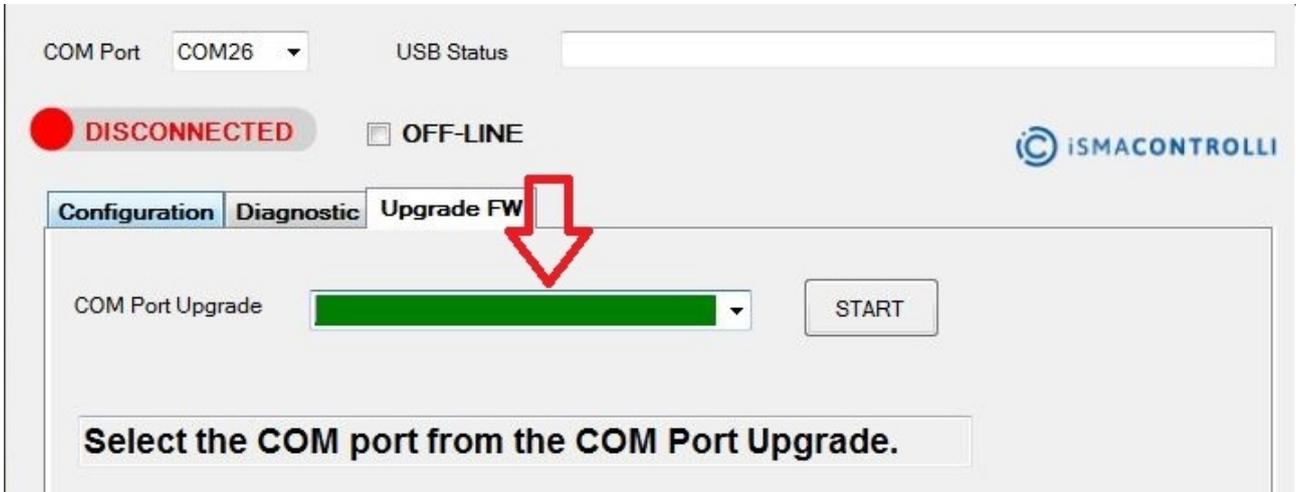


Figure 26. COM port detected through manual search

Once the COM has been selected it is necessary to press the Enter key on the keyboard.

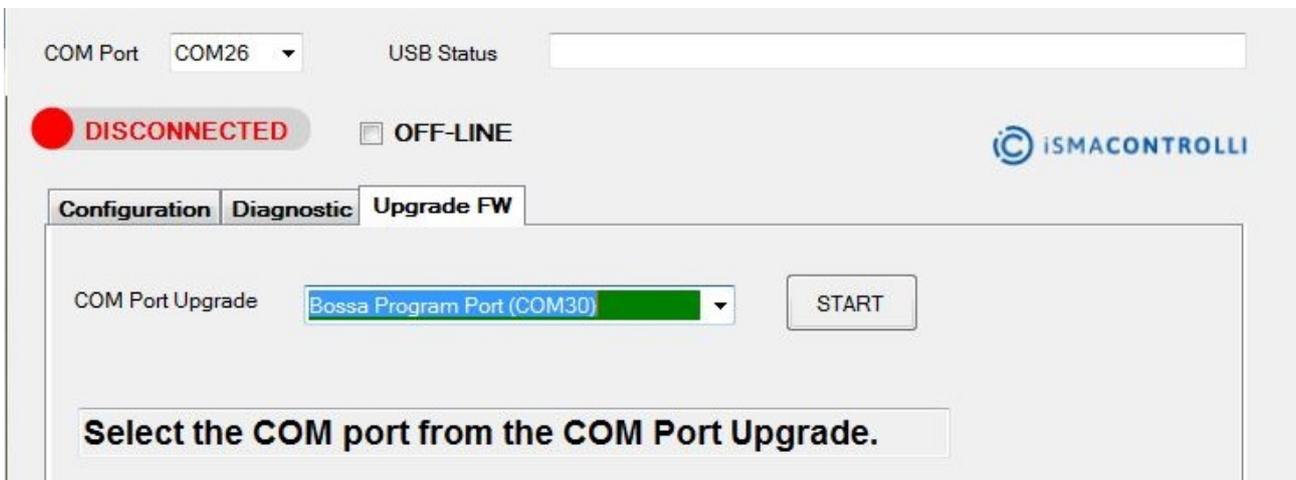


Figure 27. Visualization of the COM port for the bootloader

If the desired COM port has not been found, it's possible to press the "COM Port Upgrade" label up to a maximum of 3 times to perform the manual search.

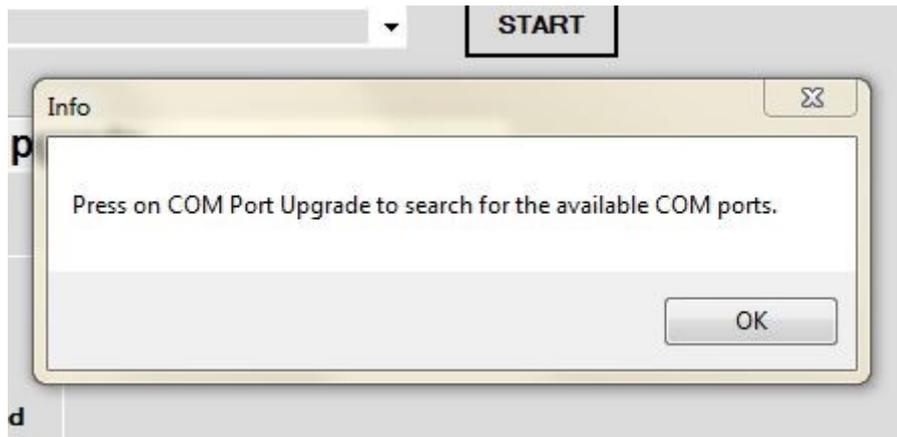


Figure 28. Message of the operation to perform to search COM port manually

**Step 6:** If the COM port has been detected (regardless of whether with the method in point 4 or point 5), a DOS command prompt window will open automatically, which first checks if the "sam-ba\_2.18" has been installed (as indicated in chapter 3.2). In case of forgetfulness, it will carry out the setup and the user will have to follow the instructions on the screen as already indicated in chapter 3.2 without changing any items.

It is important that "sam-ba\_2.18" is installed before starting the configuration tool for the first time.

If the "sam-ba\_2.18" program is already installed, the update progress operations will be displayed (the erase of the application memory area, the download of the new application into memory and finally a comparison is made between the application just downloaded in memory and the uploaded file to verify that what has been downloaded in memory is correct).

```

C:\Windows\system32\cmd.exe

FIRMWARE UPGRADE
STARTING Erase Application Area <Flash>
Wait please...
STARTING Write Application <Flash>
Wait please...
STARTING Compare EBU Flash Memory <application area> with the firmware send <.bin>
Wait please...
  
```

Figure 29. Command Prompt with the operation in progress to upgrade the firmware

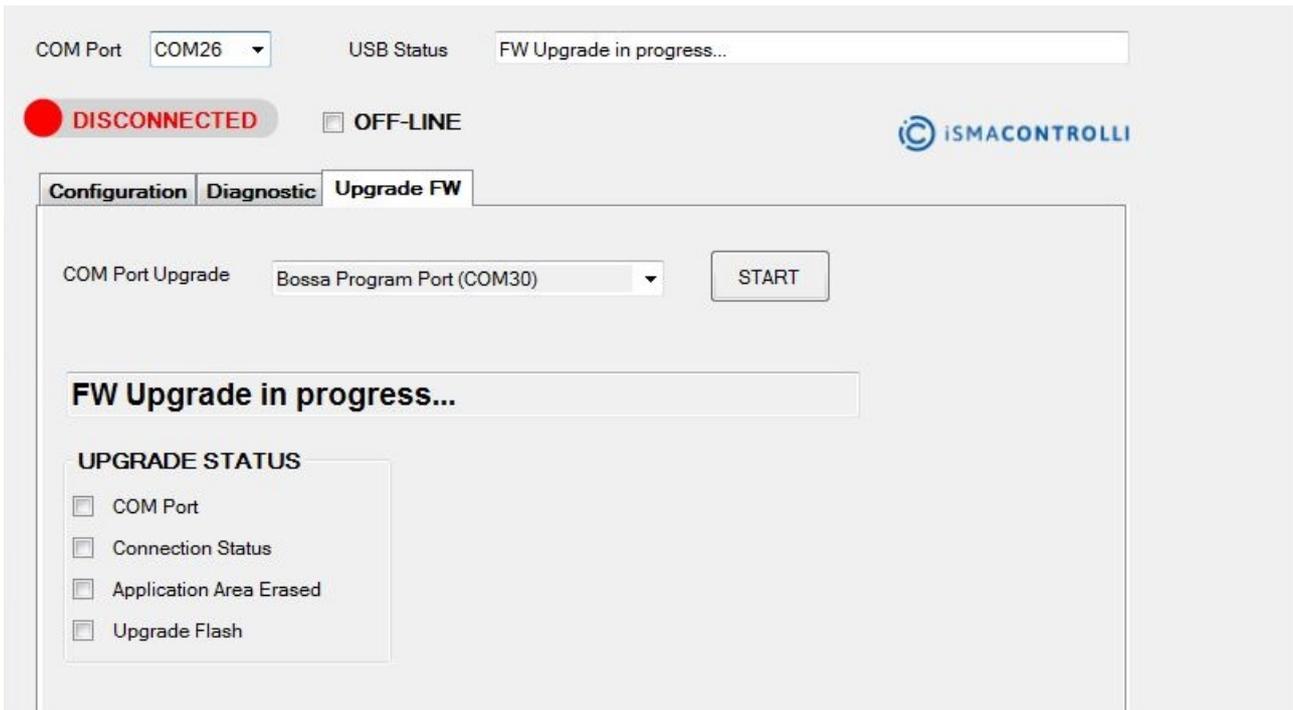


Figure 30. Firmware downloading in progress

Step 7: The result of the various operations is indicated at the end of the procedure in the "UPGRADE STATUS" section, if the operation was successful in addition to having the box checked, the description of the operation is on a green background, while in the event of an error there will be no check mark and the error description will be on a red background.

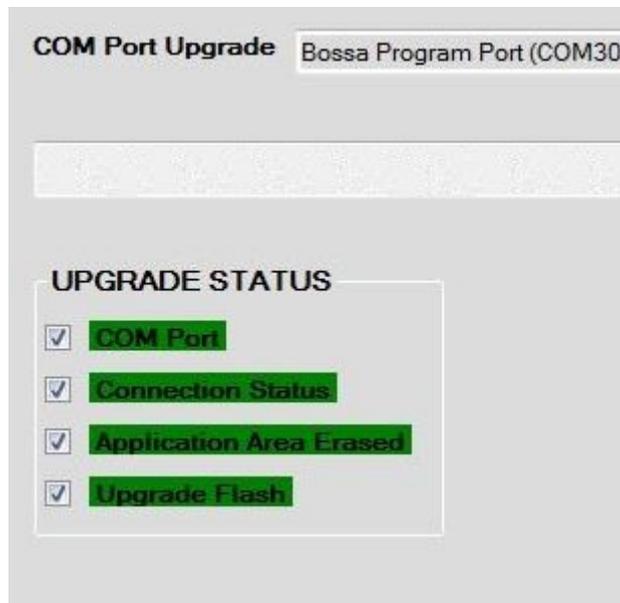


Figure 31. Firmware upgrading successful

In case of errors, the firmware upgrade procedure can be repeated only once by pressing the "START" button when the following information message appears:

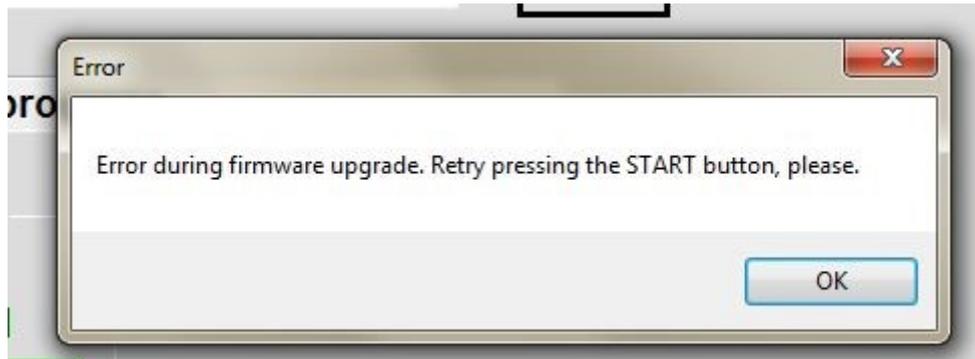


Figure 32. Error message during firmware downloading

Step 8: If the upgrade operation was successful (or if the second upgrade attempt failed), messages will be displayed to the user asking to:

- Set the DIP 3 to OFF and ONLY then press the "OK" button.

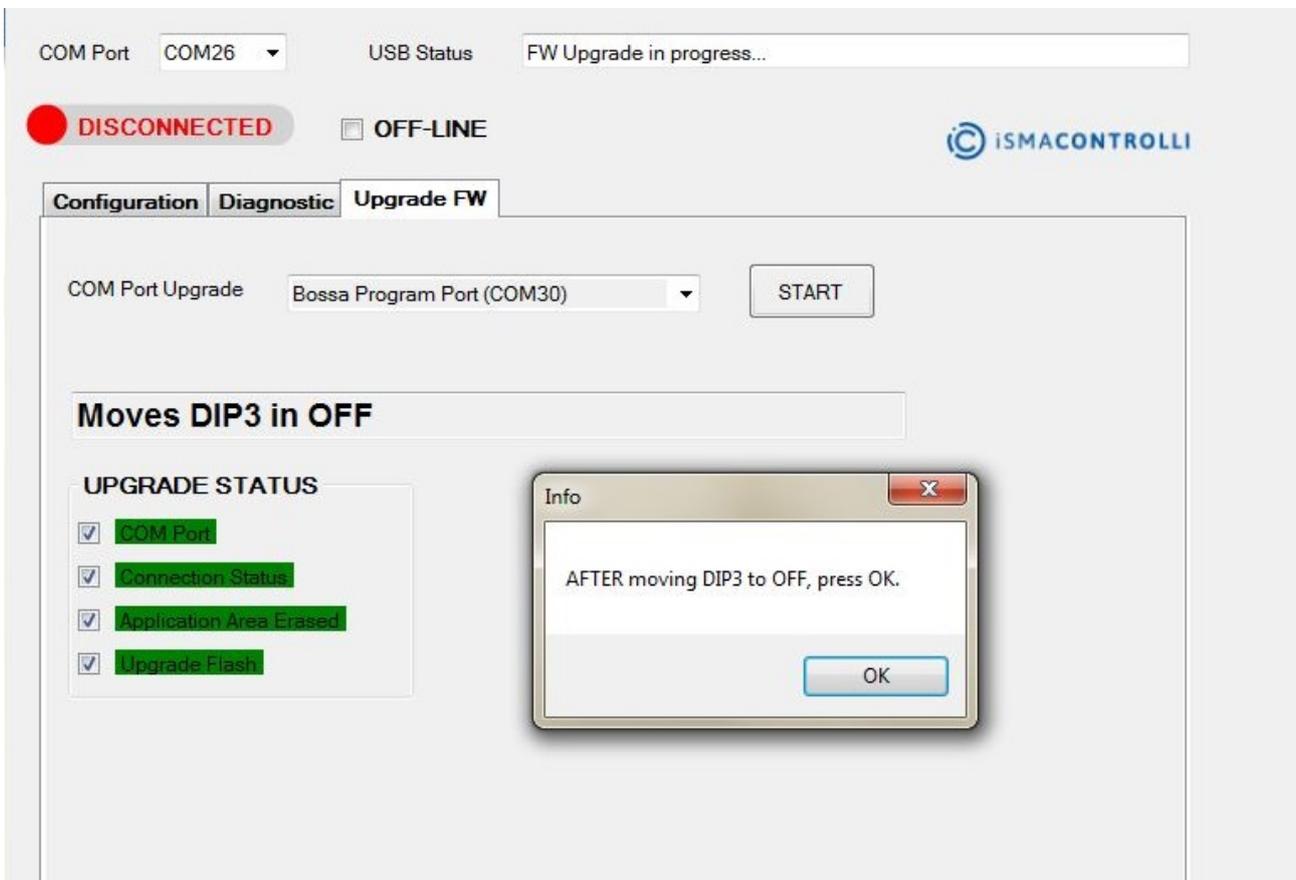


Figure 33. Message to move DIP3 in OFF position

- Turn off the actuator, wait 5 seconds and turn it on again and then press the "OK" button:

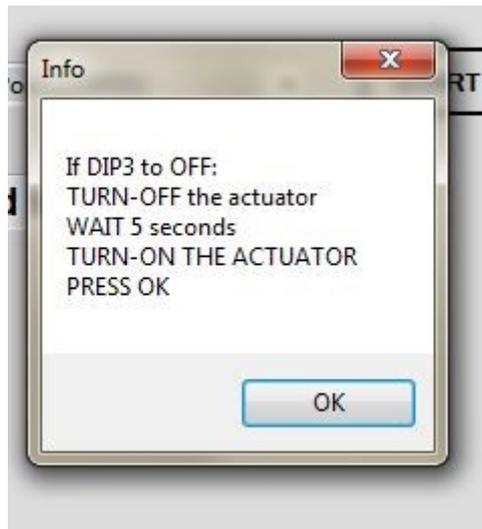


Figure 34. Operations to perform after to have moved DIP3 in OFF position

- Finally, press the "DISCONNECTED" button to connect again the configurator to the actuator:

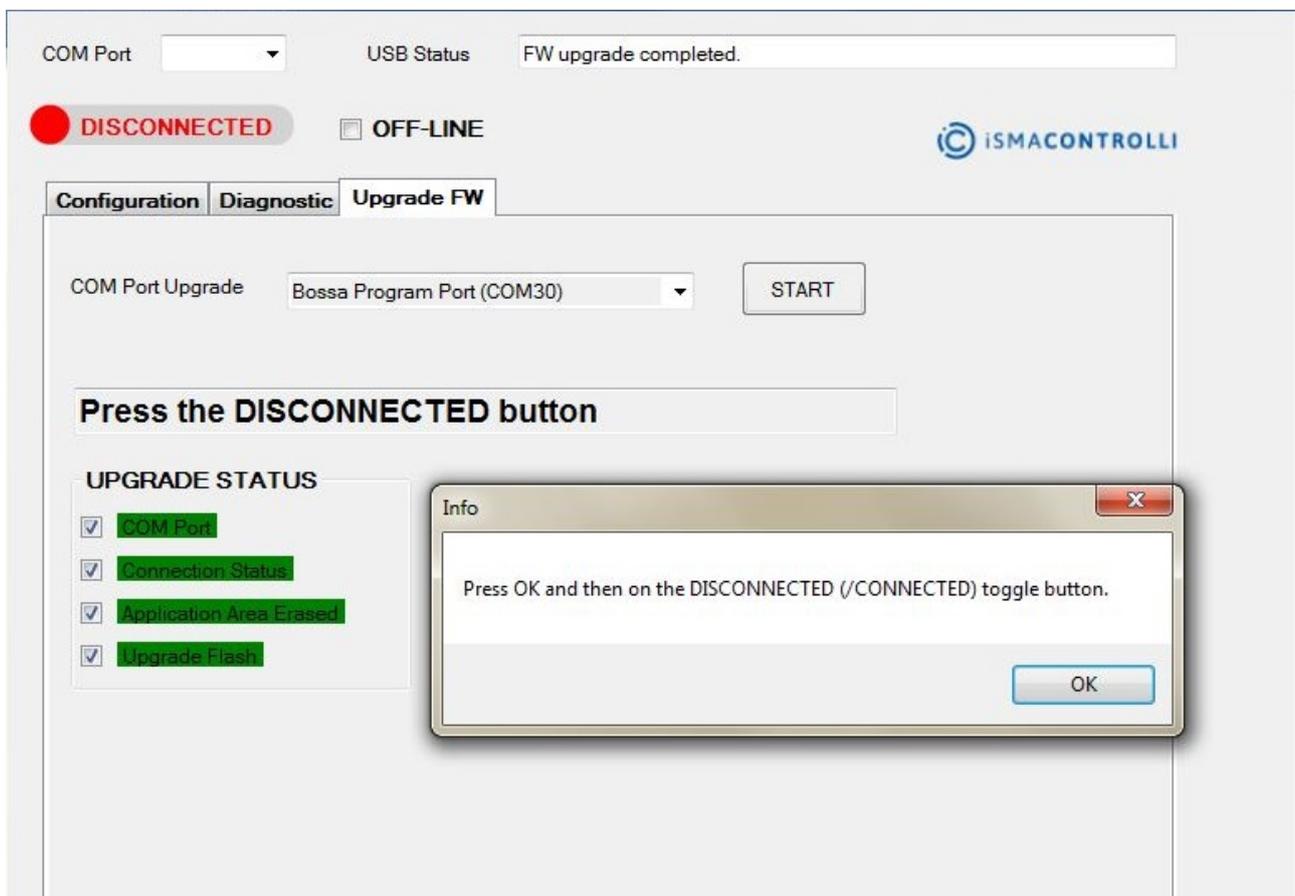


Figure 35. Connect the actuator at the ending of the procedure

- If the connection is successful, a pop-up message asks to select the configuration file (previously saved in step 1) to be loaded on the actuator (therefore the connection procedure to the actuator must be successful).

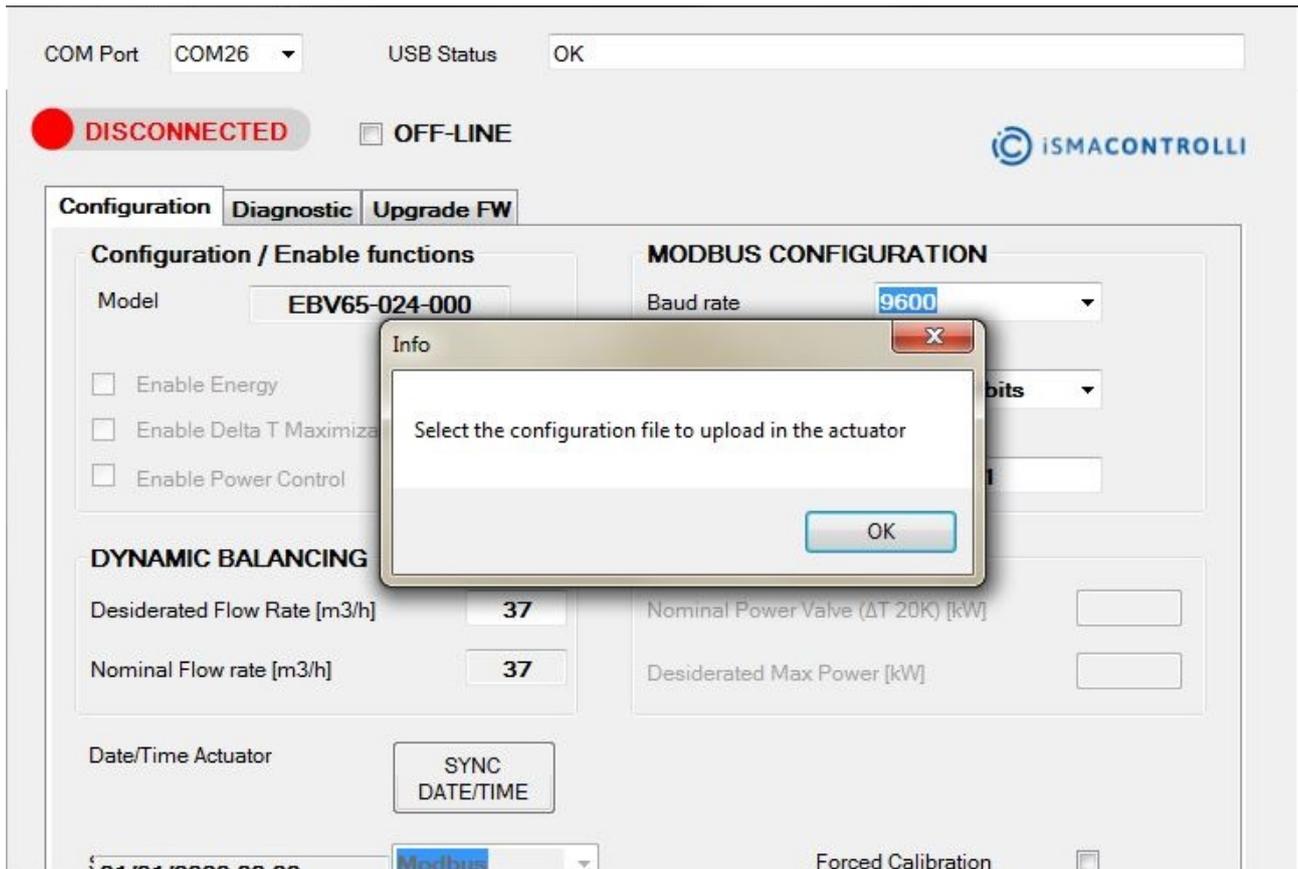


Figure 36. Select the configuration file to reload the data, saved into configuration file before upgrade, inside the database

- Once the file is selected, loading of the data starts and the progress is indicated by a status bar.

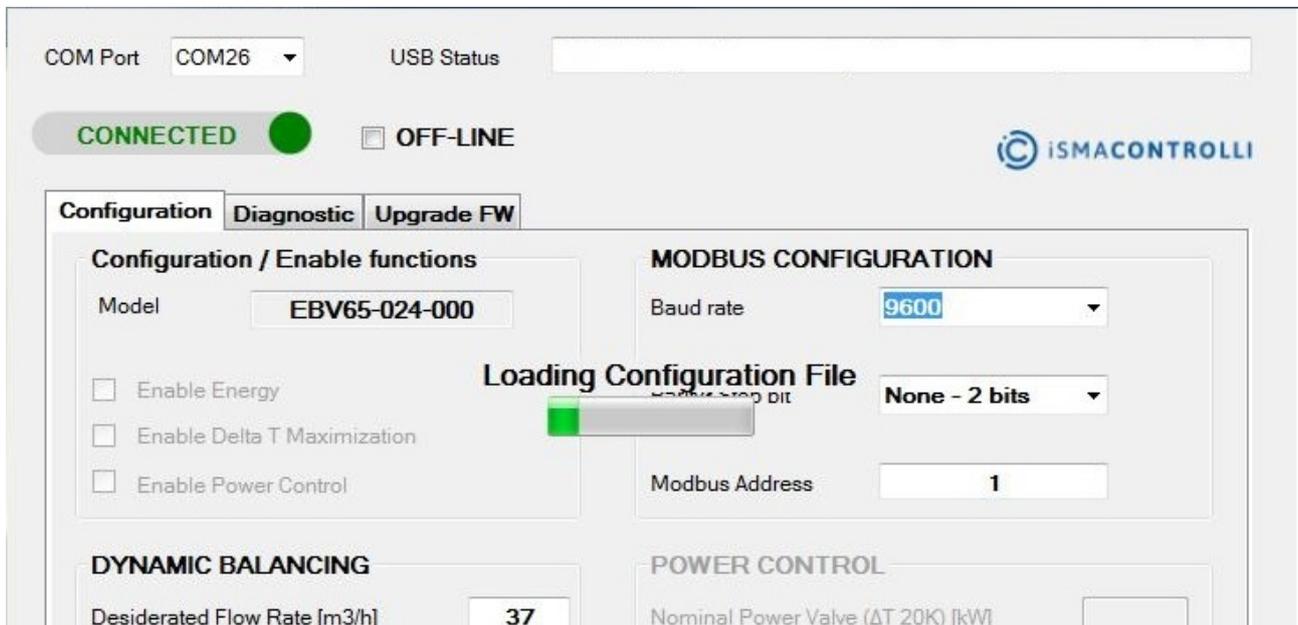


Figure 37. Progress bar to show the configuration file data loading into the actuator

In case of errors during the data download, the same file can be loaded again by selecting from the drop-down menu, located in the upper side of the configurator window, the item "Configuration File" and then the subitem "Load File".

When the connection is made successfully, check in the "FW version" text box that the version has been updated (if the version does not correspond to the desired one,

proceed from the beginning).

## 7 Modbus Database Description

The purpose of the following chapter is to provide the description of the variables present in the Modbus database for the operation of the EBV system.

The database has been divided into the following functional areas:

1. CONFIGURATION
2. DIAGNOSTIC
3. INPUT/OUTPUT
4. DYNAMIC BALANCING LOOP
5.  $\Delta T$  MAXIMIZATION LOOP
6. ENERGY CALCULATION LOOP
7. LOOP OUTPUTS
8. POWER CONTROL FUNCTION

The following table shows the Modbus database with the descriptions of all registers.

Decim. Addr.	Register name	Access	Description	Persistence	Group
0	System configuration	Read/Write	Actuator model	YES	Configuration
1	Modbus Baud-rate	Read/Write	Modbus transmission speed	YES	
2	Modbus parameter connection	Read/Write	Modbus parameter connection (data bits, parity bit and stop bits)	YES	
3	Modbus address	Read/Write	Modbus address	YES	
4	Type of control	Read/Write	Select the actuator type of control: 0: Modbus (dip switch disabled) 1: 0- 10 V (dip switch disabled) 2: 2 - 10 V (dip switch disabled) 3: 0 - 5 V (dip switch disabled) 4: 5 - 10 V (dip switch disabled) 5: 2 - 6 V (dip switch disabled) 6: 6 - 10 V (dip switch disabled)	YES	
5	Direct/Reverse & Failsafe direction settings	Read/Write	Select the actuator's action (direct or reverse) and fail-safe direction:	YES	

Decim. Addr.	Register name	Access	Description	Persistence	Group
			Bit 0: direct action (1-default); reverse action (0) Bit 1: fail-safe DOWN (1); fail-safe UP (0-default)		
6	Force calibration	Read/Write	Force calibration (valve stroke learning); 1 - force calibration (automatic reset of value after calibration)	NO	
7	Enable dip switches and Jumper (emergency return board)	Read/Write	Enable dip switches and jumper on the emergency return board: 00 - Dip swiches and Jumper enabled 01 - Dip swiches enabled and Jumper disabled 10 - Dip swiches disabled and Jumper enabled 11 - Dip swiches and Jumper disabled	YES	
8	Reserved				
9	Reserved				
10	Functions enable	Read/Write	Actuator function setting (0-enable): bit 3: enable dynamic balancing function bit 4: enable ΔT maximization loop bit 5: enable power control function	YES	Configuration
11	Reserved				
12	Firmware version	Read-only	Format X.Y X = Major version (most significant byte) Y = Minor version (less significant byte)	YES	Configuration
13	DIP Switch & Push Button & Jumper Status	Read-only	DIP switches and jumper status:	NO	

Decim. Addr.	Register name	Access	Description	Persistence	Group
			bit 0: DIP1 status: "Direct Action (OFF) – Reverse Action (ON)" bit 1: DIP2 status: "Modulating Control (OFF) - Not Used (ON)" bit 2: DIP3 status: "Normal Operation (OFF) - Bootloader (ON)" bit 3: DIP4 status: "0-10V" (OFF) - "2-10V" (ON)" bit 4: DIP5 status: " Not Used " bit 5: DIP6 status: "Voltage Control (OFF)" - Current Control bit 6: Push button status: "Active" (Pressed) - Not Active (Released) bit 7: Jumper status: "Fail-safe Down" (Jumper Insert) - " Fail-safe Up"		
14-18	Reserved				
19	Over Voltage Events (24 Vac > 20%) (230V > 10%)	Read/Write	Over Voltage events (24 Vac > 20%) (230V > 10%)	YES	Alarms/Diagnostic
20	Under Voltage Events (24 Vac < 20%) (230V < 10%)	Read/Write	Under Voltage events (Vac < 20%) (230V < 10%)	YES	
21	Fully open events	Read/Write	Fully opened events	YES	
22	Fully close events	Read/Write	Fully closed events	YES	
23	Unexpected stall condition events (within calculated stroke)	Read/Write	Unexpected stall condition events (within calculated stroke)	YES	
24	Unexpected stall condition events (outside calculated stroke)	Read/Write	Unexpected stall condition events (outside calculated stroke)	YES	
25	Valve stroke error > Max (60 mm)	Read/Write	Valve stroke error > Max (60 mm)	YES	

Decim. Addr.	Register name	Access	Description	Persistence	Group
26	Valve stroke error < min (5 mm)	Read/Write	Valve stroke error < min (5 mm)	YES	
27	Actuator operating mode	Read only	Actuator operating mode (0 - Not Active) (1 - Active): bit 0: Normal running bit 1: Init Position phase bit 2: Calibration phase bit 3: Fail Safe phase bit 4: Error bit 5: Manual Override phase	NO	
28	Error type	Read only	Error type: (0- No error) (1- Error): bit 0: T1 temperature sensor error (out of range) bit 1: T2 temperature sensor error (out of range) bit 2: A1 pressure sensor error bit 3: A2 pressure sensor error bit 4: valve stroke < 5 mm. bit 5: valve stroke > 60 mm. bit 6: unexpected stall condition event (within calculated stroke) bit 7: unexpected stall condition event (outside calculated stroke) bit 8: under voltage error bit 9: over voltage error bit 10: time clock error	NO	
29-32	Reserved				
33	Actuator reset	Read/Write	Force actuator reset (1)	NO	Configuration
34	BMS Command (0 – 100%)	Read/Write	BMS command (0-100%)	NO	Input/Output

Decim. Addr.	Register name	Access	Description	Persistence	Group
35-36	Reserved				
37	Feedback (valve position 0-100%)	Read only	Actuator position (0-100%) (multiplied by 10)	NO	Input/Output
38-42	Reserved				
43	Nominal flow rate valve	Read only	Nominal flow rate valve (m <sup>3</sup> /h * 10) - Q <sub>nom</sub> kvs valve	YES	Dynamic balancing function
44	Max desiderated flow rate	Read/Write	Max desiderated flow rate (m <sup>3</sup> /h * 10) - Q <sub>max</sub>	YES	
45	Valve stroke (mm*100)	Read/Write	Valve stroke (mm*100) - after calibration phase	YES	
46	Inlet pressure	Read only	Inlet pressure (bar * 100)	NO	
47	Outlet pressure	Read only	Outlet pressure (bar * 100)	NO	
48	ΔP	Read only	Inlet-outlet differential pressure (bar * 100)	NO	
49-94	Reserved				
95	Calculated flow rate	Read only	Calculated flow rate (m <sup>3</sup> /h * 100 through ΔP)	NO	Dynamic balancing function
96-99	Reserved				
100	Set ΔT	Read/Write	Set ΔT (°C * 10)	YES	ΔT Maximization Loop
101	Loop type (action)	Read/Write	Loop type : P, P+I, P+I+D	YES	
102	Derivative time (gain)	Read/Write	Derivative time of the ΔT maximization loop (gain)	YES	
103	Integrale time	Read/Write	Integral time of the ΔT maximization loop (min.)	YES	
104	Proportional bandwidth	Read/Write	Proportional bandwidth of the ΔT	YES	

Decim. Addr.	Register name	Access	Description	Persistence	Group
			maximization loop (°C*10)		
105	% minimum opening valve	Read/Write	Set minimum opening valve when the temperature loop is active (multiplied by 10)	YES	
106	Delay activation	Read/Write	Delay activation of the $\Delta T$ maximization loop (seconds)	YES	
107	Enable $\Delta T$ maximization loop	Read only	Enable $\Delta T$ maximization loop 0 = No , 1 = Yes. It's automatically enabled when temperature sensors are selected (address 0)	YES	
108	Input temperature	Read only	Input temperature (°C * 10)	NO	
109	Output temperature	Read only	Output temperature (°C*10)	NO	
110	$\Delta T$	Read only	$\Delta T$ value (T1 - T2) (°C * 10)	NO	
111-116	Reserved				
117	Minimum instantaneous power	Read only	Minimum instant power (kW)	NO	Energy function
118	Maximum instantaneous power	Read only	Maximum instant power (kW)	NO	
119	Instantaneous power	Read only	Instant power (kW)	NO	
120	Total Energy (heating)	Read only	Energy (heating) less significant word (kWh)	YES	
121	Total Energy (heating)	Read only	Energy (heating) more significant word (kWh)	YES	
122	Total Energy (cooling)	Read only	Energy (cooling) less significant word (kWh)	YES	
123	Total Energy (cooling)	Read only	Energy (cooling) more significant word (kWh)	YES	
124-133	Reserved				

Decim. Addr.	Register name	Access	Description	Persistence	Group
134	Energy (heating) every 30 minutes	Read only	Energy (heating) stored every 30 minutes (kWh)	YES	Energy function
135	Energy (cooling) every 30 minutes	Read only	Energy (heating) stored every 30 minutes (kWh)	YES	
136	Energy (heating) every hour	Read only	Energy (heating) stored every hour (kWh)	YES	
137	Energy (cooling) every hour	Read only	Energy (cooling) stored every hour (kWh)	YES	
138	Energy (heating) 31/12	Read only	Energy (heating) 31/12 less significant word (kWh)	YES	
139	Energy (heating) 31/12	Read only	Energy (heating) 31/12 more significant word (kWh)	YES	
140	Energy January (heating)	Read only	Energy (Heating) month 1 (MWh * 10)	YES	
141	Energy February (heating)	Read only	Energy (Heating) month 2 (MWh * 10)	YES	
142	Energy March (heating)	Read only	Energy (Heating) month 3 (MWh * 10)	YES	
143	Energy April (heating)	Read only	Energy (Heating) month 4 (MWh * 10)	YES	
144	Energy May (heating)	Read only	Energy (Heating) month 5 (MWh * 10)	YES	
145	Energy June (heating)	Read only	Energy (Heating) month 6 (MWh * 10)	YES	
146	Energy July (heating)	Read only	Energy (Heating) month 7 (MWh * 10)	YES	
147	Energy August (heating)	Read only	Energy (Heating) month 8 (MWh * 10)	YES	
148	Energy September (heating)	Read only	Energy (Heating) month 9 (MWh * 10)	YES	
149	Energy October (heating)	Read only	Energy (Heating) month 10 (MWh * 10)	YES	

Decim. Addr.	Register name	Access	Description	Persistence	Group
150	Energy November (heating)	Read only	Energy (Heating) month 11 (MWh * 10)	YES	
151	Energy December (heating)	Read only	Energy (Heating) month 12 (MWh * 10)	YES	
152	Energy (cooling) 31/12	Read only	Energy (Cooling) 31/12 less significant word (kWh)	YES	
153	Energy (cooling) 31/12	Read only	Energy (Cooling) 31/12 more significant word (kWh)	YES	
154	Energy January (cooling)	Read only	Energy (Cooling) month 1 (MWh * 10)	YES	
155	Energy February (cooling)	Read only	Energy (Cooling) month 2 (MWh * 10)	YES	
156	Energy March (cooling)	Read only	Energy (Cooling) month 3 (MWh * 10)	YES	
157	Energy April (cooling)	Read only	Energy (Cooling) month 4 (MWh * 10)	YES	
158	Energy May (cooling)	Read only	Energy (Cooling) month 5 (MWh * 10)	YES	
159	Energy June (cooling)	Read only	Energy (Cooling) month 6 (MWh * 10)	YES	
160	Energy July (cooling)	Read only	Energy (Cooling) month 7 (MWh * 10)	YES	
161	Energy August (cooling)	Read only	Energy (Cooling) month 8 (MWh * 10)	YES	
162	Energy September (cooling)	Read only	Energy (Cooling) month 9 (MWh * 10)	YES	
163	Energy October (cooling)	Read only	Energy (Cooling) month 10 (MWh * 10)	YES	
164	Energy November (cooling)	Read only	Energy (Cooling) month 11 (MWh * 10)	YES	
165	Energy December (cooling)	Read only	Energy (Cooling) month 12 (MWh * 10)	YES	
166-180	Reserved				

Decim. Addr.	Register name	Access	Description	Persistence	Group
181	Clock: Minutes	Read/Write	Minutes of the clock function	YES	Energy function
182	Clock: Hours	Read/Write	Hours of the clock function	YES	
183	Clock: Day	Read/Write	Day of the clock function	YES	
184	Clock: Month	Read/Write	Month of the clock function	YES	
185	Clock: Year	Read/Write	Year of the clock function	YES	
186	Restore factory settings	Read/Write	Initialization to factory settings (with value 1)	NO	Configuration
187-191	Reserved				
192	BMS output loop	Read only	% BMS output loop (multiplied by 10)	NO	Loop Outputs
193	Reserved				
194	$\Delta T$ output loop	Read only	% $\Delta T$ output loop (multiplied by 10)	NO	Loop Outputs
195	$\Delta P$ output loop	Read only	% $\Delta P$ output loop (multiplied by 10)	NO	
196	Reserved				
197	Power output loop	Read only	% Power output loop (multiplied by 10)	NO	Loop Outputs
198	Reserved				
199	"Active" output loop	Read only	% "Active" output loop (multiplied by 10)	NO	Loop Outputs
200-205	Reserved				
206	Nominal power valve	Read only	Nominal power valve (kW)	YES	Power Control function
207	Max desiderated power	Read/Write	Max desiderated power (kW)	YES	
208-230	Reserved				

Table 2. Modbus database description

Each register in the database can be visible, both for reading and for writing. The database is divided into the following functional areas:

## 7.1 Configuration Area

### 7.1.1 Register address 0: System Configuration

This registry shows product part number.

### 7.1.2 Register address 1: Modbus Baud Rate

It defines the possibility to set the Modbus protocol baud rate according to the following possibilities:

Address 1 (Value)	Modbus Baud Rate
1	9600
2	19200

Table 3. Selection of the baud rate

### 7.1.3 Register address 2: Modbus Communication Parameters

Defines the Modbus communication parameters according to the following possibilities:

Address 2 (Value)	Modbus Communication Parameters
1	1-8-N-2 (1 bit di start, 8 di dati, senza parità e 2 bit di stop)
2	1-8-O-1 (1 bit di start, 8 di dati, parità dispari e 1 bit di stop)
3	1-8-E-1 (1 bit di start, 8 di dati, parità pari e 1 bit di stop)
4	1-8-N-1 (1 bit di start, 8 di dati, senza parità e 1 bit di stop)

Table 4. Modbus communication parameters

### 7.1.4 Register address 3: Modbus Address

Defines the Modbus address of the device from 1 to 255.

### 7.1.5 Register address 4: Command Signal

Defines the type of actuator command signal (selectable via Modbus only if dip switches are disabled):

Address 4 (Value)	Command Signal
0	Modbus (the command of the actuator is set via the Modbus command into the range 0-100%)
1	0 - 10 V (the Modbus connection can be present to configure and monitor the system)

Address 4 (Value)	Command Signal
2	2 - 10 V (the Modbus connection can be present to configure and monitor the system)
3	0 - 5 V (the Modbus connection can be present to configure and monitor the system)
4	5 - 10 V (the Modbus connection can be present to configure and monitor the system)
5	2 - 6 V (the Modbus connection can be present to configure and monitor the system)
6	6 - 10 V (the Modbus connection can be present to configure and monitor the system)
7	3 Points command (the Modbus connection can be present to configure and monitor the system). In EBV system is not possible to set this configuration.

Table 5. Selection of the command signal if dip switches are enabled

The 4-20mA command can only be set via DIP switches.

### 7.1.6 Register Address 5: Command signal action and setting of the emergency return direction

Defines the action type of the command signal (direct or reverse action) and the direction of the actuator in case of emergency return (function present only for models with emergency return).

Address 5 (Value)	Configuration of the Actuator Action and Fail-safe Direction
Bit 0	Direct action (bit0=1); reverse (bit0=0)
Bit 1	Fail-safe DOWN (bit1=1); fail-safe UP (bit1=0)

Table 6. Selection of the action and failsafe direction of the actuator (if DIP switches are disabled)

### 7.1.7 Register Address 6: Forced Calibration of the Stroke

Defines the possibility of performing forced calibration of the stroke (by writing the bit 0 to 1). At the end of the calibration the bit is automatically reset.

### 7.1.8 Register Address 7: Enable DIP Switch & Jumper for Emergency Return

Defines the enabling of the dip switches and the jumper for selecting the direction in case of emergency return according to the following table:

Address 7 (Value)	Enabling
0	DIP switches and jumper enabled
1	DIP switches enabled and jumper disabled
2	DIP switches disabled and jumper enabled

Address 7 (Value)	Enabling
3	DIP switches and jumper disabled

Table 7. Enabling of the DIP switches and jumper of the emergency return board

### 7.1.9 Register Address 10: Operation Status Word Loop

Defines the enabling of the EBV system operating loops according to the following table:

Address 10 (bits)	Status Word Loop (PSW)
Bit 0	Not used by the EBV system
Bit 1	Not used by the EBV system
Bit 2	Not used by the EBV system
Bit 3	BYPASS $\Delta P$ operation (with bit3=0 the $\Delta P$ algorithm is active)
Bit 4	BYPASS $\Delta T$ operation (with bit4=0 the algorithm is active)
Bit 5	BYPASS POWER operation (with bit5=0 the power management algorithm is active)
Bit 6	Not used by the EBV system

Table 8. Status word to active/deactive the loops

### 7.1.10 Register Address 12: Firmware Version of the Board

Defines the firmware version of the board according to the following code:

- Most significant byte: a number from 0 to 255 to identify an important firmware revision of the board.
- Least significant byte: a number from 0 to 255 to identify less significant changes such as "bug fixing".

### 7.1.11 Register Address 13: DIP Switches & Push Button & Jumper Status

Defines the status of the dip switches, the push button (used for the forced calibration of the stroke) and the jumper (used to define the direction of the emergency return) according to the following table:

Address 13 (bits)	DIP Switch & Push Button & Jumper Status
Bit 0	Direct action (bit0 = 1). Reverse action (bit0 = 0)
Bit 1	Modulating control (bit1 = 1). 3 POINTS control (bit1 = 0)
Bit 2	No Sequence (bit2 = 1). Sequence (bit2 = 0).
Bit 3	0-10V control (bit3 = 1). 2-10 V control (bit3 = 0).

Address 13 (bits)	DIP Switch & Push Button & Jumper Status
Bit 4	0-5V/2-6V control (bit4 = 1). 5-10 V/6-10 V control (bit4 = 0)
Bit 5	Voltage control (bit5 = 1). Current control (bit5 = 0).
Bit 6	Push Button status (for calibration). Pressed (bit6 = 1), Released (bit6 = 0)
Bit 7	Jumper status. Bit7 = 1 (fail-safe DOWN). Bit7 = 0 (fail-safe UP).

Table 9. Information about the status of dip switches, push button and the jumper on the emergency return board

## 7.2 Diagnostic

### 7.2.1 Register Address 19: Over Voltage Events

The system over voltage events are stored in this address, that is:

- 24 V + 20%
- 230 V + 10%

Default value is 0 and will start from 1 with the first error event.

If the value of the register reaches the maximum limit (65534 = 0xFFFFE) this value will remain in memory.

### 7.2.2 Register Address 20: Under Voltage Events

The system under voltage events are stored in this address, that is:

- 24 V - 20%
- 230 V - 10%

Default value is 0 and will start from 1 with the first error event.

If the value of the register reaches the maximum limit (65534 = 0xFFFFE) this value will remain in memory.

### 7.2.3 Register Address 21: Number of Full Opening Event

This address stores the valve full opening events. The default value is 0 and will start from 1 which corresponds to 10 total valve opening (in order to avoid continuous writing on the memory that could damage the component). If the value of the Register reaches the maximum limit (65534 = 0xFFFFE) this value will remain in memory.

### 7.2.4 Register Address 22: Number of Full Closing Events

This address stores the valve full closing events. The default value is 0 and will start from 1 which corresponds to 10 total valve opening (in order to avoid continuous writing on the memory that could damage the component). If the value of the register reaches the maximum limit (65534 = 0xFFFFE) this value will remain in memory.

## 7.2.5 Register Address 23: Unexpected Stall Events Within the Stroke

Unexpected stall events within the valve stroke are stored in this address. The default value is 0 and will start from 1 which corresponds to 1 unexpected stall event. If the value of the register reaches the maximum limit (65534 = 0xFFFFE) this value will remain in memory.

## 7.2.6 Register Address 24: Unexpected Stall Events Outside the Stroke

This address stores unexpected stall events outside the stroke valve (extra stroke). The default value is 0 and will start from 1 which corresponds to 1 unexpected stall event. If the value of the register reaches the maximum limit (65534 = 0xFFFFE) this value will remain in memory.

## 7.2.7 Register Address 25: Stroke Calculation Events Greater Than 60 mm

This address stores the calculation events of the stroke greater than 5mm (during the calibration phase). The default value is 0 and will start from 1 which corresponds to 1 calculation event of the stroke less than 5mm. If the value of the Register reaches the maximum limit (65534 = 0xFFFFE) this value will remain in memory.

## 7.2.8 Register Address 26: Stroke Calculation Events Less Than 5 mm

This address stores the calculation events of the stroke less than 5mm (during the calibration phase). The default value is 0 and will start from 1 which corresponds to 1 calculation event of the stroke less than 5mm. If the value of the Register reaches the maximum limit (65534 = 0xFFFFE) this value will remain in memory.

## 7.2.9 Register Address 27: Operating States

The operating states of the system are stored in this address according to the following table:

Address 27 (bits)	Operating States
Bit 0	Normal (bit0 = 1). In this state the system works normally.
Bit 1	Initial positioning (bit1 = 1). After switching-on or after using the manual override, the actuator performs the initial positioning in the direction defined by the action type (direct or reverse).
Bit 2	Calibration (bit2 = 1). In this operating state, the actuator is calculating the valve stroke.
Bit 3	Fail Safe (bit3 = 1). In this operating state, the actuator is performing an emergency return.
Bit 4	Error (bit4 = 1). In this operating state, the actuator is faulty. The type of error is indicated in the address word 28

Address 27 (bits)	Operating States
Bit 5	Manual override (bit5 = 1). In this operating state, the manual override is active.

Table 10. Operating mode of the actuator

## 7.2.10 Register Address 28: Type of Error

The types of errors are stored in this address according to the following table:

Address 28 (bits)	Errors
Bit 0	Supply temperature sensor error (T1). This error (bit0 = 1) indicates an out-of-scale value of the supply temperature sensor (if provided).
Bit 1	Return temperature sensor error (T2). This error (bit1 = 1) indicates an out-of-scale value of the return temperature sensor (if provided).
Bit 2	Input pressure sensor error (P1). This error (bit2 = 1) indicates an out-of-range value of the inlet pressure sensor (if provided).
Bit 3	Output pressure sensor error (P2). This error (bit3 = 1) indicates an out-of-range value of the outlet pressure sensor (if provided).
Bit 4	Calculation error of the valve stroke less than 5 mm. This error (bit4 = 1) indicates that the stroke value calculated by the calibration phase is less than 5 mm.
Bit 5	Calculation error of the valve stroke greater than 60 mm. This error (bit5 = 1) indicates that the stroke value calculated by the calibration phase is greater than 60 mm.
Bit 6	Unexpected stall error within the calculated stroke. This error (bit6 = 1) indicates an unexpected stall within the calculated stroke.
Bit 7	Unexpected stall error outside the calculated stroke. This error (bit7 = 1) indicates an unexpected stall outside the calculated stroke.
Bit 8	Low voltage error. This error (bit8 = 1) indicates that the value of the supply voltage is below 20% of the nominal value.
Bit 9	High voltage error. This error (bit9 = 1) indicates that the value of the supply voltage is above 20% of the nominal value.
Bit 10	Clock error. This error (bit10 = 1) indicates that the time and date values have not been initialized (from the BMS or the cloud). It's set to 0 by the firmware once the time and date have been set.

Table 11. List of the error types of the actuator

## 7.3 Area Input/Output

### 7.3.1 Register Address 33: Actuator Reset

Through this register it is possible to perform a forced reset of the system by forcing its value to 1.

### 7.3.2 Register Address 34: Command Signal from the BMS (0-100%)

This register contains the value of the BMS command in the range 0-100%.

### 7.3.3 Register Address 37: Feedback Signal

This register contains the value of the valve position (feedback) in the range 0-100%.

The value contained in the register is multiplied by 10.

## 7.4 Dynamic Balancing ( $\Delta P$ Algorithm)

This section of the database contains the registers necessary for calculating the flow rate by measuring the input and output pressure of the valve and knowing the characteristic curve of the valve. For each nominal diameter of the valve (DN) the characteristic curve is obtained through 4 segments (the angular coefficient "m" and the offset "q" are defined for each segment).

### 7.4.1 Register Address 43: Nominal Flow Rate (m<sup>3</sup>/h)

This database register contains the nominal valve flow value (Kvs) defined according to the selected DN:

Valve	DN	Nominal Flow Rate (m <sup>3</sup> /h)
2FGB65B	65	37
2FGB80B	80	59
2FGB100B	100	77
2FGB125B	125	118
2FGB150B	150	177

Table 12. Nominal flow rate for each managed valve model

### 7.4.2 Register Address 44: Maximum Desired Flow Rate (m<sup>3</sup>/h)

This database register contains the maximum flow rate value of the desired valve which also corresponds to a percentage of the value defined in the address register 43. By default, the maximum desired flow rates are set at the nominal flow rate.

The value is stored into the register multiplied by 10.

### 7.4.3 Register Address 45: Valve Stroke (mm)

This database register contains the calculated valve stroke value. The value stored in the register is multiplied by 100. A value of 500 corresponds to a stroke of 5 mm.

### 7.4.4 Register Address 46: Input Pressure (bar)

This database register contains the value of the valve input pressure (P1). The value stored in the register is multiplied by 100. A value of 1600 corresponds to an inlet pressure of 16 bar.

### 7.4.5 Register Address 47: Output Pressure (bar)

This database register contains the value of the valve output pressure (P2). The value stored in the register is multiplied by 100. A value of 1600 corresponds to an outlet pressure of 16 bar.

### 7.4.6 Register Address 48: Pressure Difference (bar)

This database register contains the value of P1-P2 ( $\Delta P$ ). The value stored in the register is multiplied by 100. A value of 1600 corresponds to a pressure difference of 16 bar.

### 7.4.7 Register Address 95: Calculated flow rate (m<sup>3</sup>/h)

This database register contains the calculated flow rate value.

The value stored in the register is multiplied by 100.

## 7.5 $\Delta T$ Maximization (Maximization $\Delta T$ Algorithm)

This section of the database contains the register necessary for  $\Delta T$  maximization.

The function allows to optimize the efficiency of the system by avoiding that the difference between the supply and return temperatures is not less than a certain value ( $\Delta T$  set register).

The function creates a minimum limit that intervenes when the  $\Delta T$  is lower than the  $\Delta T$  set by limiting the water flow needed to ensure efficient heat exchange.

### 7.5.1 Register Address 100: $\Delta T$ Set (°C)

This database register contains the value of the  $\Delta T$  set.

The value stored in the register is multiplied by 10.

### 7.5.2 Register Address 101: Action Type of the Loop

This database register contains the type of loop action that can be:

Address 101 (Value)	Action Type
0	Proportional (P)
1	Proportional Integral (PI)

Address 101 (Value)	Action Type
2	Proportional Integral Derivative (PID)

Table 13. Selection of the action type of the  $\Delta T$  maximization loop

### 7.5.3 Register Address 102: Derivative Time

This database register contains the derivative time of the derivative action expressed as "gain" from 1 to 1000 (default value is 1).

### 7.5.4 Register Address 103: Integral Time (min)

This database register contains the integral time of the integral action expressed in minutes.

### 7.5.5 Register Address 104: Proportional Bandwidth $\Delta T$ ( $^{\circ}\text{C}$ )

This database register contains the proportional band of the  $\Delta T$  loop. The value stored in the register is multiplied by 10.

### 7.5.6 Register Address 105: Minimum Output Value $\Delta T$ (%)

This database register contains the minimum loop output value (expressed as a percentage) necessary to ensure a minimum of leakage in the system.

The value is stored into the register multiplied by 10.

### 7.5.7 Register Address 106: Activation Delay $\Delta T$ (sec)

This database register contains the delay value for the activation of the loop (expressed in seconds), to allow the sensors to detect the water temperature.

### 7.5.8 Register Address 107: Enable $\Delta T$

This database register contains the loop enable value. A value of 1 in the register indicates that the loop is enabled. The value 0 indicates that it is disabled.

### 7.5.9 Register Address 108: Supply Temperature ( $^{\circ}\text{C}$ )

This database register contains the supply temperature value. The value stored in the register is multiplied by 10.

If the sensor is disconnected or faulty, the stored value is 5000.

### 7.5.10 Register Address 109: Return Temperature ( $^{\circ}\text{C}$ )

This database register contains the return temperature value.

The value stored in the register is multiplied by 10.

If the sensor is disconnected or faulty, the stored value is 5000.

### 7.5.11 Register Address 110: $\Delta T(^{\circ}\text{C})$

This database register contains the value of the difference between the supply and return temperatures ( $\Delta T$ ).

The value stored in the register is multiplied by 10.

If the supply and/or return temperature sensor is disconnected or faulty, the stored value is 5000.

## 7.6 Energy Calculation Loop

This section of the database contains the registers necessary for calculating the power and energy consumed by the system.

### 7.6.1 Register Address 117: Minimum Instantaneous Power (kW)

This database register contains the minimum value of the instantaneous power until that point.

### 7.6.2 Register Address 118: Maximum Instantaneous Power (kW)

This database register contains the maximum value of the instantaneous power until that point.

### 7.6.3 Register Address 119: Instantaneous Power (kW)

This database register contains the calculated value of the instantaneous power.

If the supply and/or return temperature sensor is disconnected or faulty, the stored value is 65535.

### 7.6.4 Register Address 120: Energy – Heating (kWh)

This database register contains the least significant word of the total energy (heating) consumed.

The value stored in the register is expressed in kWh.

### 7.6.5 Register Address 121: Energy – Heating (kWh)

This database register contains the most significant word of the total value of energy (heating) consumed. The value stored in the register is expressed in kWh. The combination of the 2 registers provides the energy (warm) consumed up to that moment. The data is stored in the internal memory of the actuator every hour, so in case of shutdown at the next restart, the data in the database will be updated at the last hour of operation.

### 7.6.6 Register Address 122: Energy – Cooling (kWh)

This database register contains the least significant word of the total energy (cooling) consumed.

The value stored in the register is expressed in kWh.

### **7.6.7 Register Address 123: Energy – Cooling (kWh)**

This database register contains the most significant word of the total value of energy (cooling) consumed. The value stored in the register is expressed in kWh. The combination of the 2 registers provides the energy (cold) consumed up to that moment. The data is stored in the internal memory of the actuator every hour, so in case of shutdown at the next restart, the data in the database will be updated at the last hour of operation.

### **7.6.8 Register Address 134: Energy – Heating (kWh) (30 Minutes)**

This database register contains the value of the energy (heating) consumed between 25 and 30 minutes before the current time.

### **7.6.9 Register Address 135: Energy – Cooling (kWh) (30 Minutes)**

This database register contains the value of the energy (cooling) consumed between 25 and 30 minutes before the current time.

### **7.6.10 Register Address 136: Energy – Heating (kWh) (1 Hour)**

This database register contains the value of the energy (heating) consumed in the 60 minutes before the current time.

### **7.6.11 Register Address 137: Energy – Cold (kWh) (1 Hour)**

This database register contains the value of the energy (cooling) consumed in the 60 minutes before the current time.

### **7.6.12 Register Address 138: Energy – Heating (kWh) (12/31)**

This database register contains the least significant word of the value of energy (heating) consumed in the year before the current year.

The value stored in the register is expressed in kWh.

### **7.6.13 Register Address 139: Energy – Heating (kWh) (12/31)**

This database register contains the most significant word of the value of the energy (heating) consumed in the year before the current year.

The value stored in the register is expressed in kWh.

The combination of the 2 registers provides the energy (warm) consumed in the year before the current year.

### **7.6.14 Register Address 140: Energy – Heating (kWh) (January)**

This database register contains the value of the energy (heating) consumed in the month of January.

### **7.6.15 Register Address 141: Energy – Heating (kWh) (February)**

This database register contains the value of the energy (heating) consumed in the month of February.

### **7.6.16 Register Address 142: Energy – Heating (kWh) (March)**

This database register contains the value of the energy (heating) consumed in the month of March.

### **7.6.17 Register Address 143: Energy – Heating (kWh) (April)**

This database register contains the value of the energy (heating) consumed in the month of April.

### **7.6.18 Register Address 144: Energy – Heating (kWh) (May)**

This database register contains the value of the energy (heating) consumed in the month of May.

### **7.6.19 Register Address 145: Energy – Heating (kWh) (June)**

This database register contains the value of the energy (heating) consumed in the month of June.

### **7.6.20 Register Address 146: Energy – Heating (kWh) (July)**

This database register contains the value of the energy (heating) consumed in the month of July.

### **7.6.21 Register Address 147: Energy – Heating (kWh) (August)**

This database register contains the value of the energy (heating) consumed in the month of August.

### **7.6.22 Register Address 148: Energy – Heating (kWh) (September)**

This database register contains the value of the energy (heating) consumed in the month of September.

### **7.6.23 Register Address 149: Energy – Heating (kWh) (October)**

This database register contains the value of the energy (heating) consumed in the month of October.

### **7.6.24 Register Address 150: Energy – Heating (kWh) (November)**

This database register contains the value of the energy (heating) consumed in the month of November.

### **7.6.25 Register Address 151: Energy – Heating (kWh) (December)**

This database register contains the value of the energy (heating) consumed in the month of December.

### **7.6.26 Register Address 152: Energy – Cooling (kWh) (12/31)**

This database register contains the least significant word of the value of energy (cooling) consumed in the year before the current year.

The value stored in the register is expressed in kWh.

### **7.6.27 Register Address 153: Energy – Cooling (kWh) (12/31)**

This database register contains the most significant word of the value of the energy (cooling) consumed in the year before the current year.

The value stored in the register is expressed in kWh.

The combination of the 2 registers provides the energy (cold) consumed in the year before the current year.

### **7.6.28 Register Address 154: Energy – Cooling (kWh) (January)**

This database register contains the value of the energy (cooling) consumed in the month of January.

### **7.6.29 Register Address 155: Energy – Cooling (kWh) (February)**

This database register contains the value of the energy (cooling) consumed in the month of February.

### **7.6.30 Register Address 156: Energy – Cooling (kWh) (March)**

This database register contains the value of the energy (cooling) consumed in the month of March.

### **7.6.31 Register Address 157: Energy – Cooling (kWh) (April)**

This database register contains the value of the energy (cooling) consumed in the month of April.

### **7.6.32 Register Address 158: Energy – Cooling (kWh) (May)**

This database register contains the value of the energy (cooling) consumed in the month of May.

### **7.6.33 Register Address 159: Energy – Cooling (kWh) (June)**

This database register contains the value of the energy (cooling) consumed in the month of June.

### **7.6.34 Register Address 160: Energy – Cooling (kWh) (July)**

This database register contains the value of the energy (cooling) consumed in the month of July.

### **7.6.35 Register Address 161: Energy – Cooling (kWh) (August)**

This database register contains the value of the energy (cooling) consumed in the month of August.

### **7.6.36 Register Address 162: Energy – Cooling (kWh) (September)**

This database register contains the value of the energy (cooling) consumed in the month of September.

### **7.6.37 Register Address 163: Energy – Cooling (kWh) (October)**

This database register contains the value of the energy (cooling) consumed in the month of October.

### **7.6.38 Register Address 164: Energy – Cooling (kWh) (November)**

This database register contains the value of the energy (cooling) consumed in the month of November.

### **7.6.39 Register Address 165: Energy – Cooling (kWh) (December)**

This database register contains the value of the energy (cooling) consumed in the month of December. Register Address 180

Not used by the EBV system.

### **7.6.40 Register Address 181: Minutes**

This database register contains the value of the minutes received during the time synchronization phase.

### **7.6.41 Register Address 182: Hours**

This database register contains the value of the hours received during the time synchronization phase.

### **7.6.42 Register Address 183: Day**

This database register contains the value of the day received during the time synchronization phase.

### **7.6.43 Register Address 184: Month**

This database register contains the value of the month received during the time synchronization phase.

### 7.6.44 Register Address 185: Year

This database register contains the value of the year received during the time synchronization phase.

### 7.6.45 Register Address 186: Restore Factory Settings

This database register allows to reset EEPROM area.

Writing the value to 1 will reset the memory area to the default values. It will be written to 0 automatically after restore.

## 7.7 Loop Outputs

This section of the database contains the registers corresponding to the various outputs of the system control loops.

### 7.7.1 Register Address 192: Loop Output BMS (%)

This database register contains the percentage output value of the BMS loop.

The value is stored into the register multiplied by 10.

### 7.7.2 Register Address 193

Not used by the EBV system.

### 7.7.3 Register Address 194: Loop Output $\Delta T$ (%)

This database register contains the percentage output value of the  $\Delta T$  loop.

The value is stored into the register multiplied by 10.

If one or both of the temperature sensors are disconnected or faulty, the stored value is 5000.

### 7.7.4 Register Address 195: Loop Output $\Delta P$ (%)

This database register contains the percentage output value of the dynamic balancing function calculated by measuring the differential pressure and the valve characteristic.

The value is stored into the register multiplied by 10.

### 7.7.5 Register Address 197: Output Power Loop (%)

This database register contains the percentage output value of the power regulation loop.

The value is stored into the register multiplied by 10.

If one or both temperature sensors are disconnected or faulty, the stored value is 5000.

### 7.7.6 Register Address 199: Operating Loop Output (%)

This database register contains the percentage out value of the operational loop resulting from the actually enabled functions.

The value is stored into the register multiplied by 10.

## 7.8 Power Control Loop

This section of the database contains the registers needed to manage a power loop. The maximum power values obtainable by the valve are determined according to the  $\Delta T$  of 6K, 10K, 15K, 20K.

Valve	DN	Max. Power (kW) $\Delta T$ 6K	Max. Power (kW) $\Delta T$ 10K	Max. Power (kW) $\Delta T$ 15K	Max. Power (kW) $\Delta T$ 20K
2FGB65B	65	253	422	633	843
2FGB80B	80	403	672	1009	1345
2FGB100B	100	527	878	1316	1755
2FGB125B	125	807	1345	2017	2690
2FGB150B	150	1210	2017	3026	4034

Table 14. Max. power values for every valve model

### 7.8.1 Register Address 206: Nominal Power of the Valve (KW)

This database register contains the value of the nominal power of the valve chosen according to the values shown in the previous table.

### 7.8.2 Register Address 207: Maximum Desired Power Set (KW)

This database register contains the value of the desired maximum power set which will depend on the DN of the selected valve according to the maximum values defined in the previous table.