Smart Sense

# GETTING STARTED

## QUICK START

Version: KSS-QS-EN-1.0.1

SMART, CONNECTED. KAIRO

## WARNING:
## IMPORTANT INFORMATION FOR THE READER

**1.** This manual is intended to introduce the customer to the list of the essential actions to perform in order to start using rapidly the Kairo's SmartSense System (KSS).
**2.** After a short introduction to the KSS the user is guided on the essential operations required to install and configure a minimal functional system using the Kairo's SmartSense components (gateway and sensors) and the Kairo's Cloud Platform (KCP) as main interface to configuring the system and collecting data.
**3.** An usecase example is also provided as final chapter just to show the main features of the system and give the user a clear understanding of the interface of the system.
**4.** Details regarding all the features and menu of the cloud interface and the charateritics and behaviour of any SmartSense components are intentionally omitted to focus more on the essential configuration and operative steps. For additional information the user is recommended to consult the specific user manual of the product or the service.
**5.** Accessing the cloud platform requires at least an active account with username and password. In case of a first access, please contact your local distributor to get a valid set of account credentials.
**6.** The access to the cloud platform might be granted with some initial data already pre-configured: in this case some steps of the following guide could be skipped.

*The information in this manual is subject to change without notice.*
*It is the user's responsibility to verify that the hardware and the software in her/his possession/use is among those covered by this manual.*

## CONTACTS

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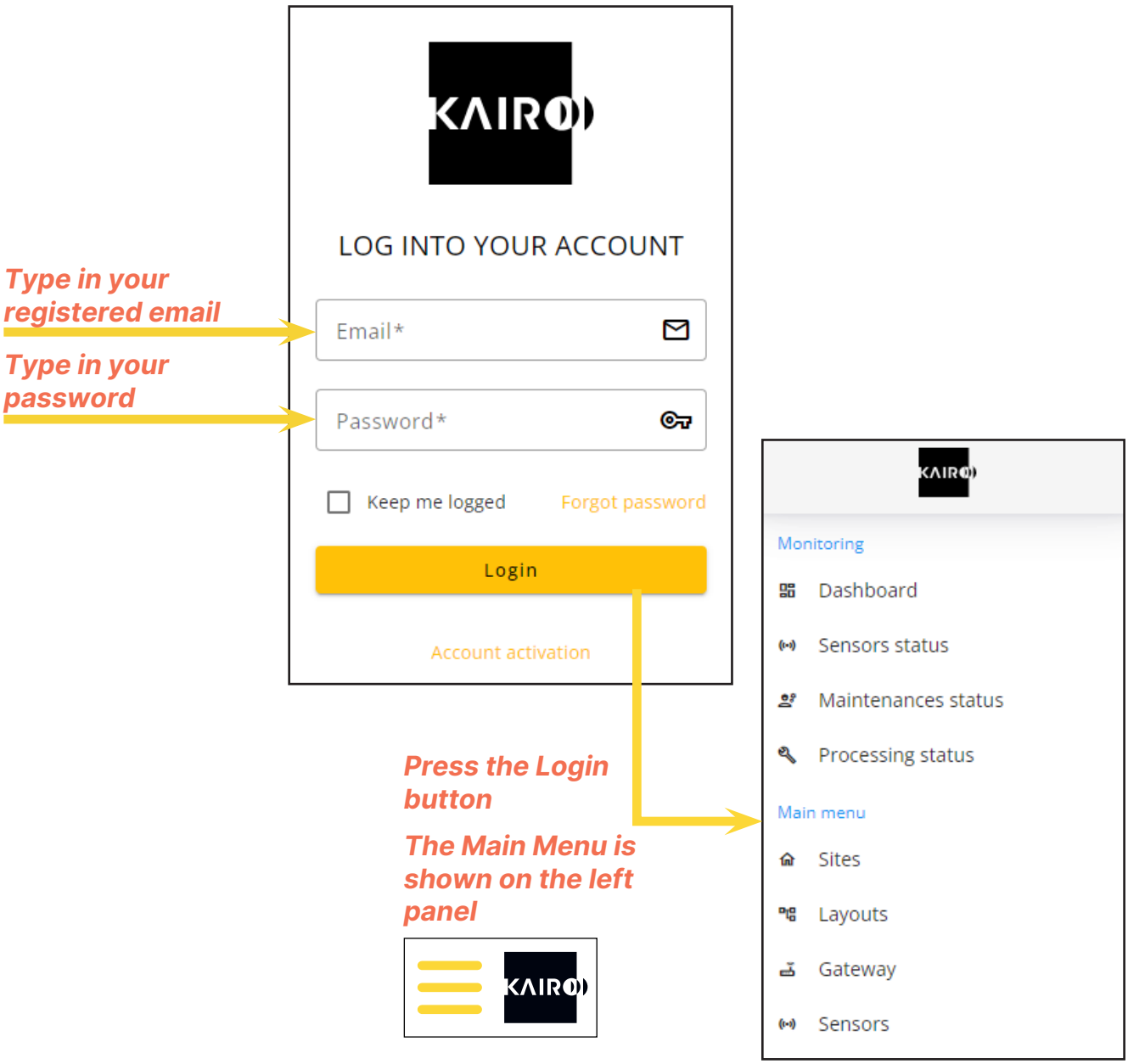
# CONTENTS

# 1. COMMISSIONING IN 5 STEPS

## *1.1 STEP 1 of 5: Logging into the KCP*

The Kairo's cloud platform (KCP) is accessible at the following address:

**https://smartsense.kairo.cloud/login**




| *Result of the actions performed* | |
|---|---|
| **Move to STEP 2** | **Contact your distributor asking for an account** |

## *1.2 STEP 2 of 5: Connecting a gateway to the network*

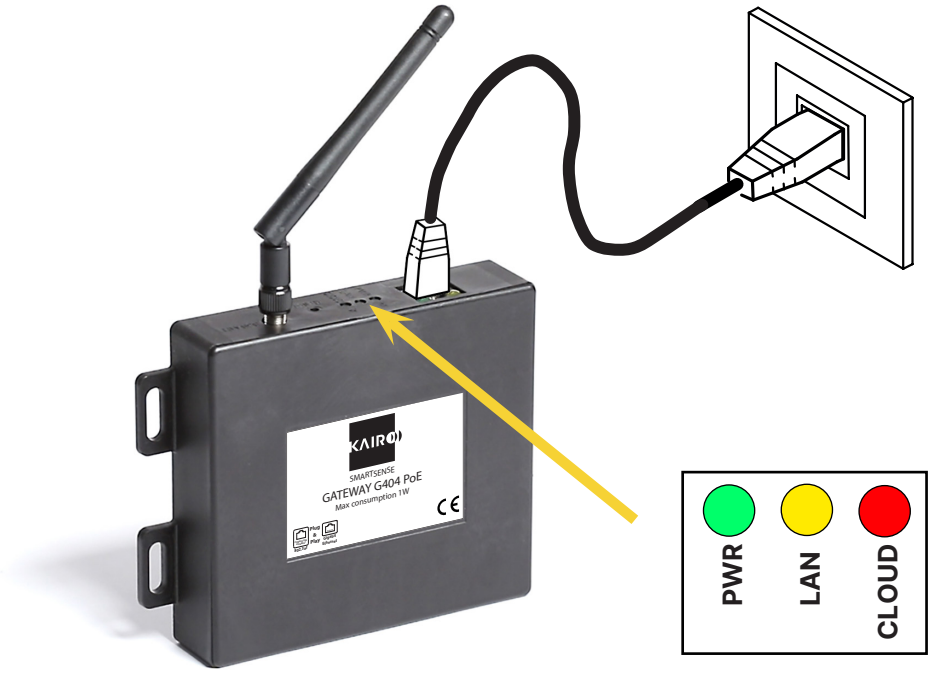
The Kairo's gateway is a Power Over Ethernet device (PoE) which means it uses a single standard ethernet cable for both communication and power supply.

The socket used to connect the gateway must be of a PoE type. In case this is not available, an additional component has to be placed in between the gateway and the socket (i.e. a power injector, PoE ethernet switch, a PoE supply unit or similar).

As a factory default every gateway is configured in DHCP mode (its IP address will be provided by an external network unit, i.e. firewall or router).

Before starting connecting the gateway, please read the specific user manual available at the following address:

**https://www.kairo.solutions/downloads/**




***Connect the gateway to a PoE socket***

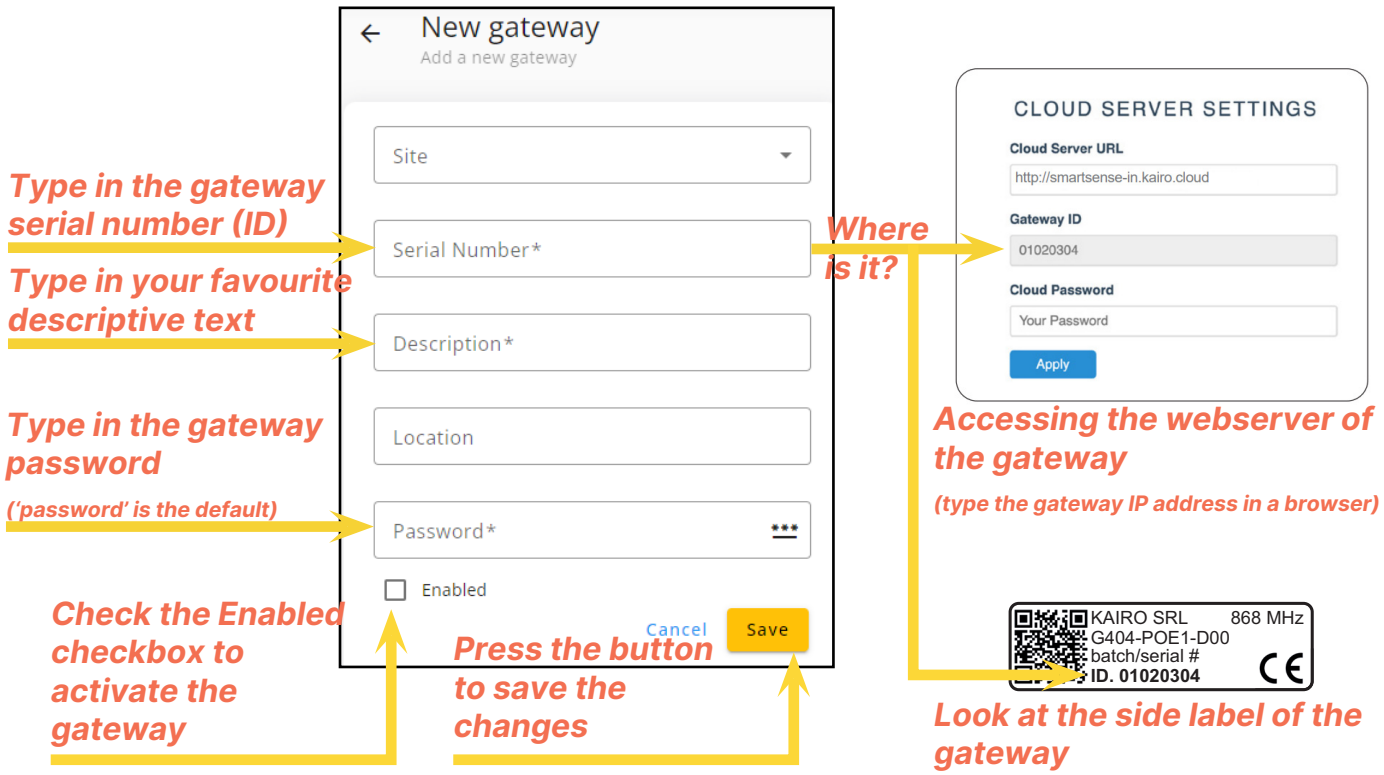



***After few seconds this must be the configuration of the gateways LEDs***

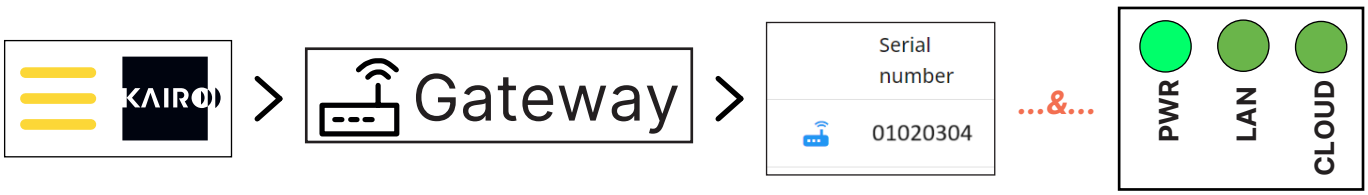
| *Result of the actions performed* | |
|---|---|
| **Move to STEP 3** | **Contact your IT dept. asking for support**<br>**Contact your distributor** |

## *1.3 STEP 3 of 5: Connecting a gateway to the cloud*

A gateway can be connected to the cloud by registering the gateway ID into the platform. Navigate the main menu, select the gateway section and press on the '+' icon to add a new gateway. Fill in the mandatory data field identified with the (*) symbol. Please refer to the gateway instruction manual for additional details.

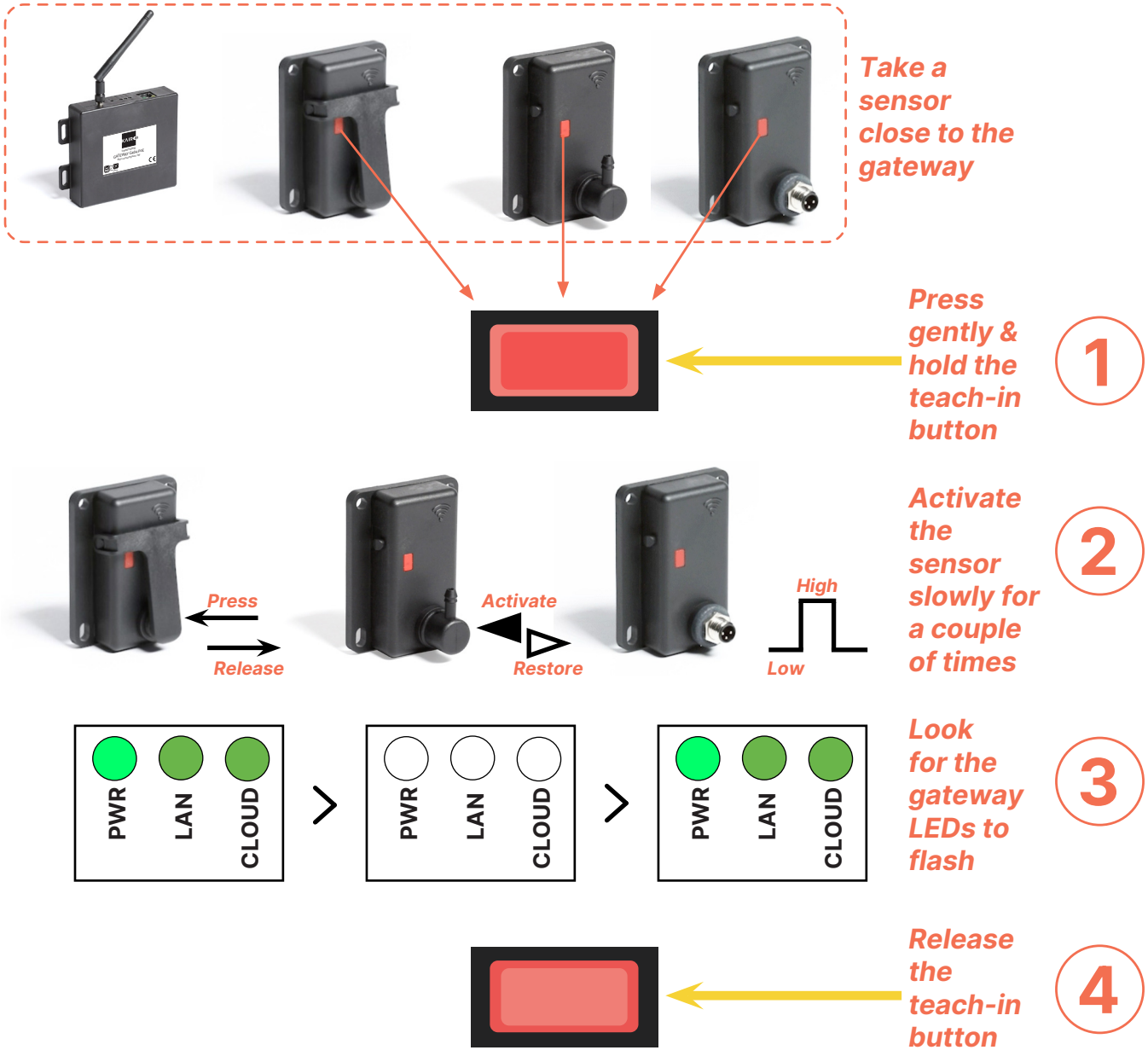

Check the presence of the new gateway ID into the list of available gateways. Now all the physical LEDs of the gateway should be in green color (i.e. gateway is powered, it has received a valid IP address and it is correctly connected to the cloud platform).




| *Result of the actions performed* | |
|---|---|
| **Move to STEP 4** | **Retry from Step 2**<br>**Read gateway manual**<br>**Contact your distributor** |

## 1.4 STEP 4 of 5: Connecting a sensor to the cloud

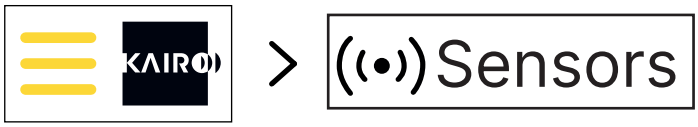
A sensor can be connected to the cloud by pairing it with a gateway (teach-in procedure). The operation must be performed placing the sensor close to a gateway. Actuate slowly the sensor (commutating and restoring) while pressing and holding its red teach-in button. In case of a successful operation all the three LEDs of the gateway blink once.




| *Result of the actions performed* | |
|---|---|
| **Move to STEP 5** | **Retry from Step 4**<br>**Read sensor manual**<br>**Contact your distributor** |

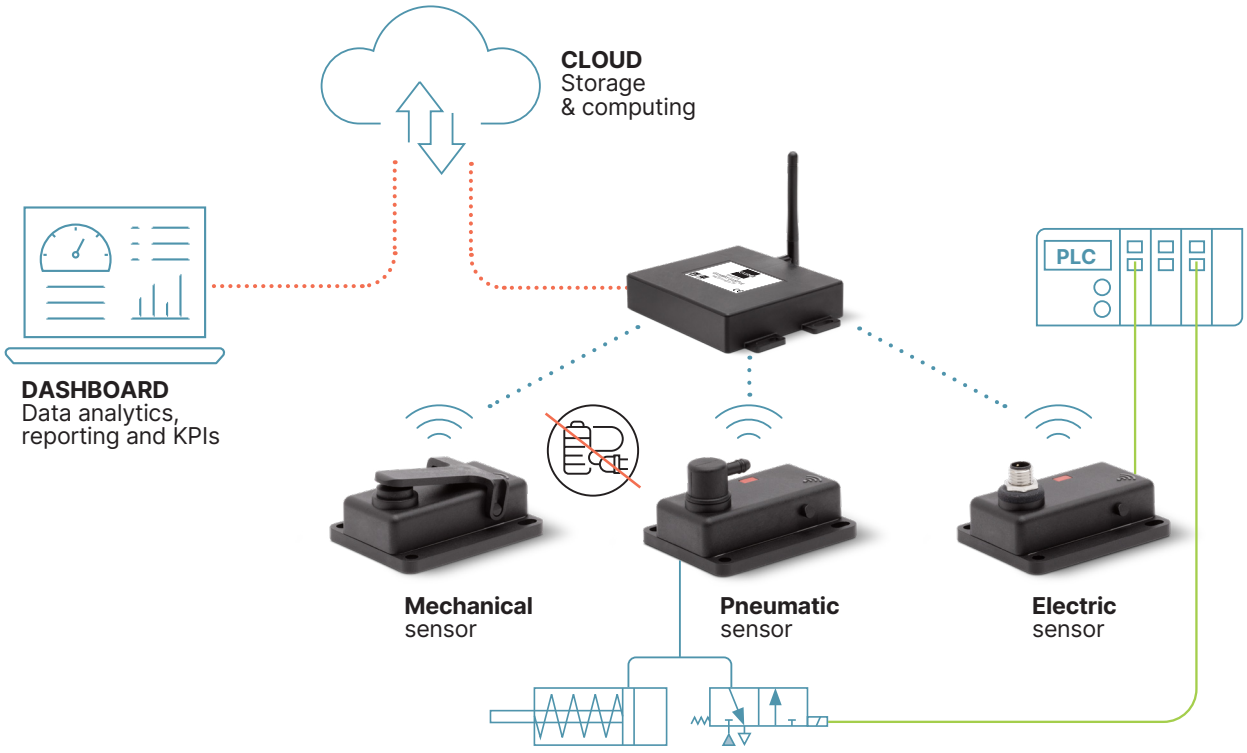
## *1.5 STEP 5 of 5: Configuring a sensor*

Once the teach-in operation between a sensor and a gateway is completed correctly, the sensor ID appears in the list of the available sensors in the cloud platform.





If all the previous steps have been completed correctly, any subsequent activation of the sensor will be caught by the gateways the sensor has been paired with. Paired gateways send collected data to the cloud, where they become available worldwide for consultation and analysis.




*Result of the actions performed*

**Commissioning COMPLETED!**

**Retry from Step 4**

**Read sensors manuals**

**Contact your distributor**

## 2. INTRODUCING THE CLOUD PLATFORM

The Kairo's cloud platform can be navigated using the panel on the left divided into two categories: *Monitoring* and *Main Menu*. The table below summarizes briefly the functionality of any category shown in this panel highlighting also the entries most relevant for a user who starts evaluating the platform for the first time.

### Monitoring

| ***Icon*** | ***Label*** | ***Description*** |
|---|---|---|
|  | Dashboard | Summarizes the most relevant data available in the platform with a high level graphical interface |
|  | Sensor status | Shows a panel containing the average cycle time and alarms triggered by each sensor listed in the platform |
|  | Maintenance status | Shows a summary of the maintanances defined for any asset (number of cycles performed, next maintenance scheduled, maintenance alarms) |
|  | Processing status | Shows a summary of the status of production process (cycle time, quantity expected and produced, and performace alarms). |

### Main menu

| ***Icon*** | ***Label*** | ***Description*** |
|---|---|---|
|  | Sites | Allows to map the structure of the user organization by defining the operational sites |
|  | Layouts | Allows to map the structure of the user organization by defining the logical aggregation of productive areas per any site |
|  | Gateway | Shows the list of the available gateway properly configured in the platform (please also refer to Step 3 of this guide) |
|  | Sensors | Shows the list of the available sensors properly configured in the platform (please also refer to Step 4 and Step 5 of this guide) |
|  | Batches | Allows to define the production batches associated to a site |
|  | Assets | Allows to configure preventive maintenance steps associated to one or more specific sensors that count the number of cycle performed by an asset |
|  | Processes | Allows to configure a production process associated to one specific sensor which counts for the number of items produced per working cycle |
|  | Alarms | Allows to manage alarms triggered by the platform (maintenance and performance) |
|  | User management | Allows to set and modify user profile preferences |

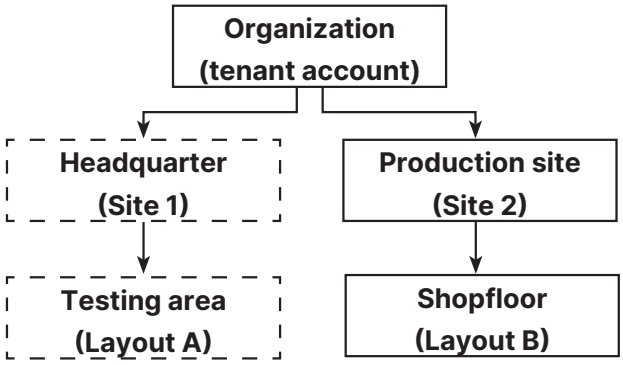
# 3. USECASE EXAMPLE: INJECTION MOULDING PROCESS

## *3.1 Introduction*

In this section, the monitoring of an injection moulding process is described as a simple usecase. The goal is to monitor the activity of a specific mould that can be achieved by installing on the mould a SmartSense mechanical sensor (i.e. S101-ME11-D00). The direct installation of a sensor on a mould allows for several benefits as for example:

- monitoring the cycle time of the mould independently of the injection moulding machine it is used on (as an advanced feature it will also be possible to monitor the duty cycle, i.e. how long the mould stays closed within the whole cycle);
- counting for the real number of cycles made by the mould during its entire lifetime (i.e. triggering maintenance alarms in real time on the basis of the absolute number of cycles performed and independently on the used injection machines);
- checking the location of the mould within the same plant or over multiple plants (by using plant specific installed gateways as global geographical marking sources).

The following example shows the basic steps required for a minimal and functional configuration of the Kairo's Cloud Platform, starting by the definition of an elementary organization chart of a generic company. This initial step is purely descriptive but it is mandatory as it is used to aggregate information and allows different users and companies to log into the platform and safely access only to their own data. Referring to the chart below, only the boxes delimited by continuous lines are relevant to the purpose of monitoring the production process thus they will be the only ones inserted into the cloud platform.




The tenant account is the account used to log into the cloud platform and it is assigned from Kairo to any user of a company upon request. All the other layers underneath the organization can be defined directly from the user.

Once the organization chart has been correctly implemented, the next step is to configure at least one sensor and one gateway into the KCP: the sensor is the physical one installed on the mould, whereas the gateway is the unit for collecting the sensor's data which is usually installed nearby the injection moulding machine equipped with the mould. The steps required to add the sensor and gateway are intentionally skipped here below as they have been already introduced at the beginning of this guide (please refer to chapter 1).

Once the physical sensor is installed on the mould, it becomes part of the mould for its entire lifetime. This is relevant as it allows for the monitoring of the mould even in case the mould is moved from machine to machine or from facility to facility. As the sensor and the mould become a single entity, the ID number of the sensor can be used to uniquely identify this entity worldwide. Indeed, it is possible to use indistinctly the word *mould* or the specific *sensor ID* to refer to the same physical asset.

With the sensor and the gateway properly configured in the KCP, the user is then required to:

A. assign to the specific sensor ID some descriptive and functional parameters of the mould;

B. define a maintenance plan for the mould.

The point A is necessary to monitor the productivity of the mould in terms of cycle time and quantity produced.

The point B is required to trigger the generation of two levels of alarm (warning and error) whenever the absolute number of cycles made by the mould becomes equal or greater than the specific predefined threshold values. In order to standardize the user interface and the workflow for different usecase scenarios, maintenance plans are edited in the KCP as properties of an asset. Therefore, the creation of the mould also as an asset is shown below along with its specific set of alarm thresholds.

The final section of the example is dedicated to the analysis and interpretation of production data collected by the sensor installed on the mould. Interactive timeseries charts are used to present the data samples collected from a production process initially stable at the nominal cycle time. Next, an increase in cycle time beyond the warning and error thresholds is simulated to show the generation of productivity alarms and their handling. The example concludes with the description of alarms generated by the maintenance plan and the automatic detection of the mould going offline (i.e. long time not receiving data from sensor).

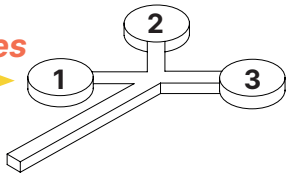
The following data are used in example for the sake of demonstration:

- the mould has 3 cavities (every cycle, 3 units of the same product are produced);
- the nominal cycle time is 5 seconds (3 units in 5 seconds);
- 2 maintenance checks are scheduled at different number of cycles:
    * check of the water lines after 3'000 cycles;
    * check of the ejector pins after 20'000 cycles.

***The mould is monitored by:***

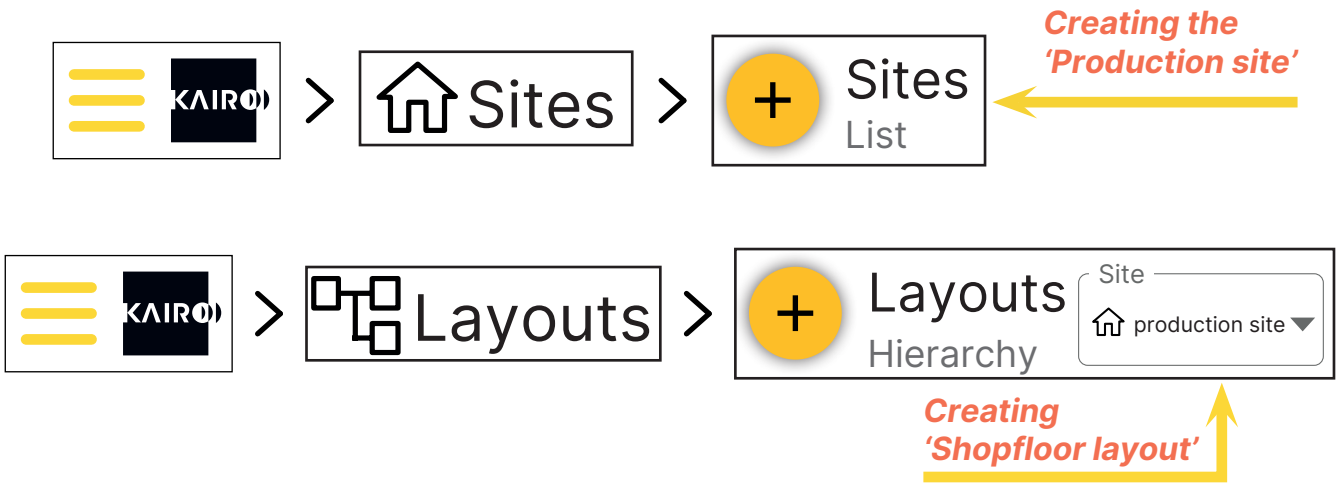
- ***assigning its working parameters to the installed sensor ID***
- ***defining a maintenance plan for the mould as an asset***

***3 cavities***

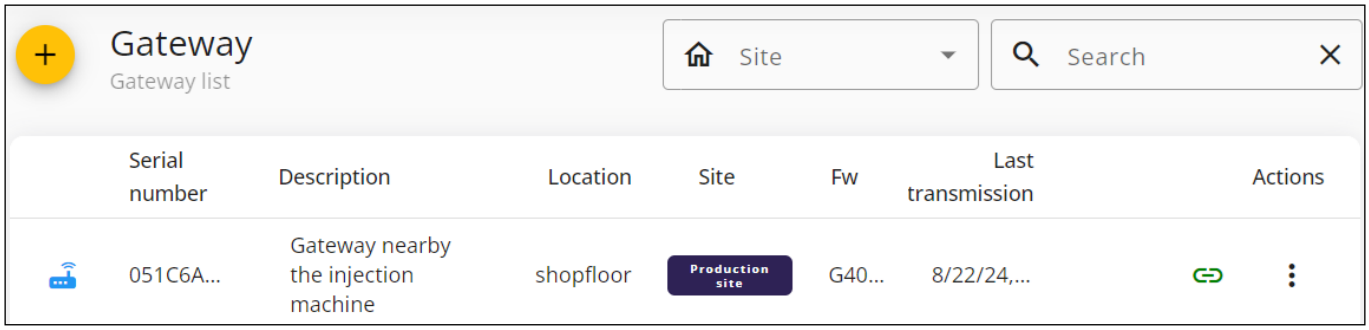


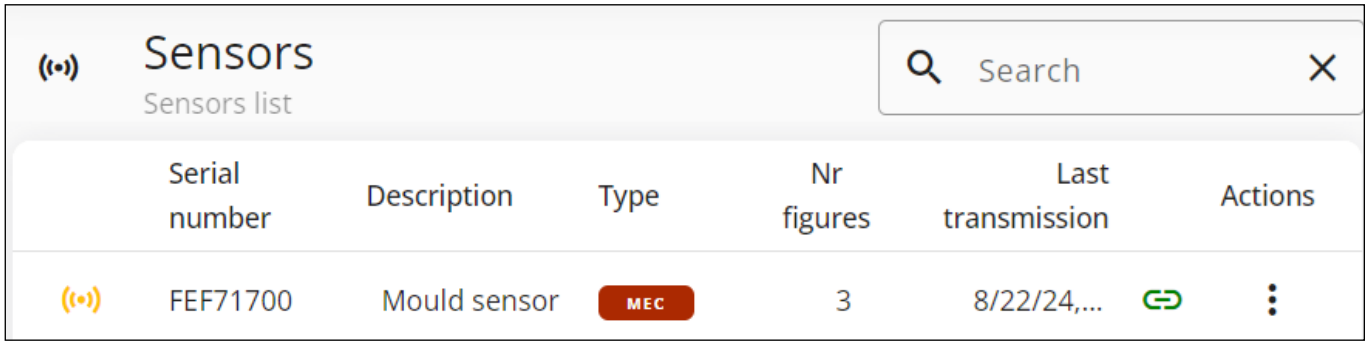
## *3.2 Mapping the process*

The pictures below show how to create the site and a layout for a specific site (please also refer to the schema shown in §3.1).

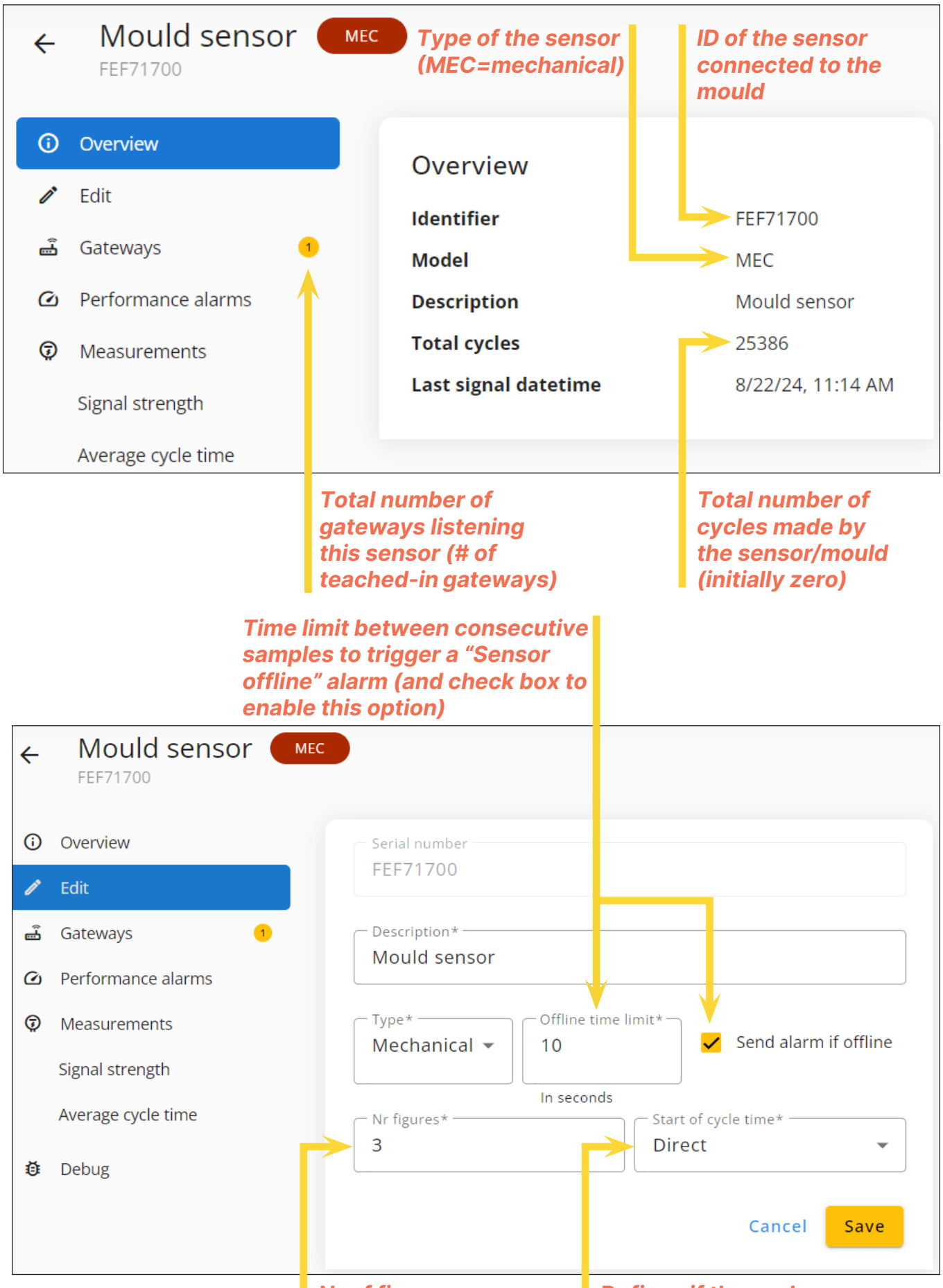


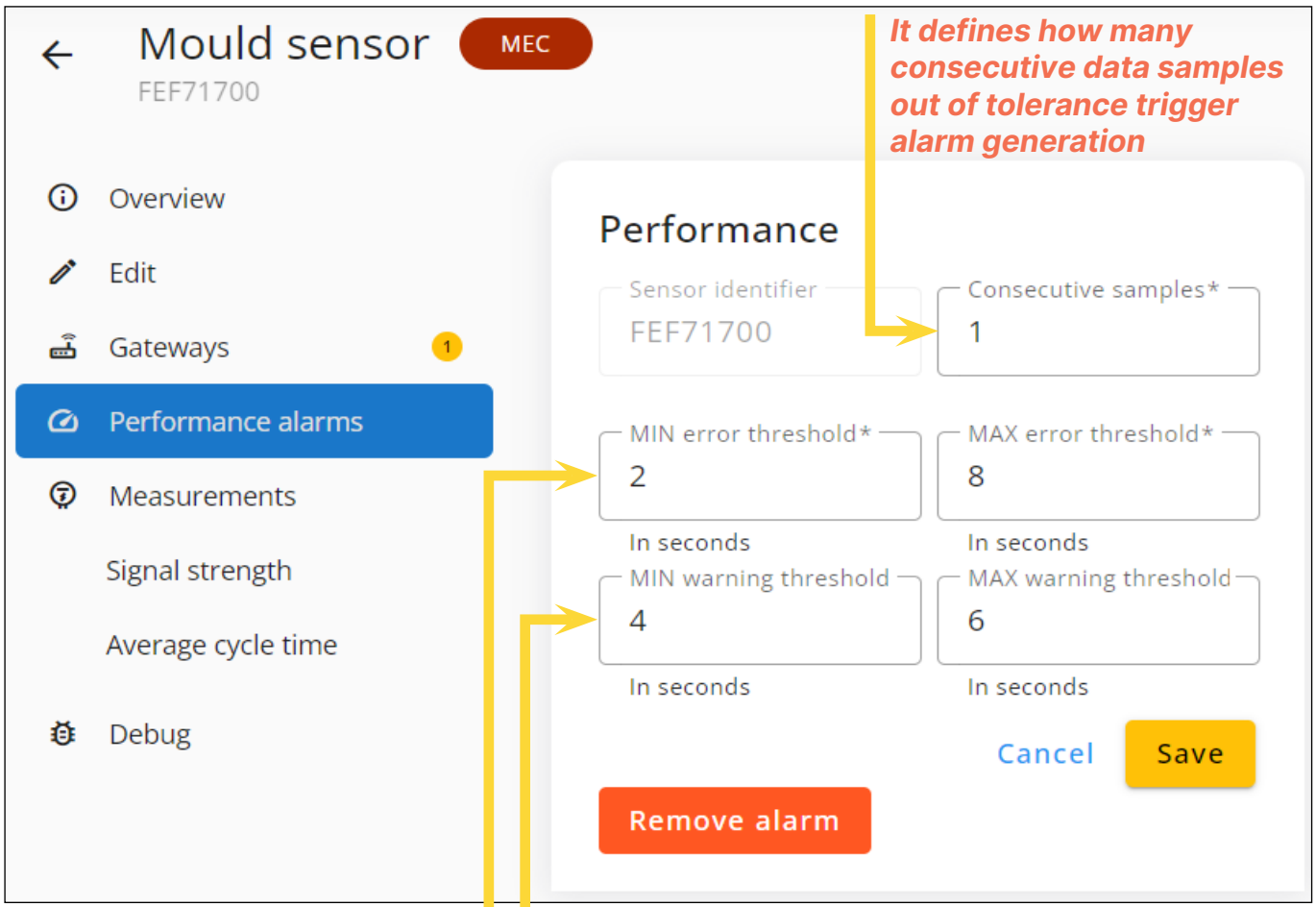

The screenshots below show how the gateway and the sensor should have been created in the Kairo's Cloud Platform upon a correct completion of all the steps listed in Chapter 1 (please note that the IDs of both gateway and sensor must match the ID marked on the installed physical units).




By clicking the rows of the specific gateway and sensor in the respective gateway and sensor table, it is possibile to view the details of both the components and eventually modify their settings. This is particularly relevant for the sensor as it is necessary to set at least the number of cavities of the mould and the values of the threshold on the cycle time for alarm generation.


Mould sensor
MEC
FEF71700
Type of the sensor (MEC=mechanical)
ID of the sensor connected to the mould
Overview
Edit
Gateways
1
Performance alarms
Measurements
Signal strength
Average cycle time
Overview
Identifier
FEF71700
Model
MEC
Description
Mould sensor
Total cycles
25386
Last signal datetime
8/22/24, 11:14 AM
Total number of gateways listening this sensor (# of teached-in gateways)
Total number of cycles made by the sensor/mould (initially zero)
Time limit between consecutive samples to trigger a "Sensor offline" alarm (and check box to enable this option)
Mould sensor
MEC
FEF71700
Overview
Edit
Gateways
1
Performance alarms
Measurements
Signal strength
Average cycle time
Debug
Serial number
FEF71700
Description*
Mould sensor
Type*
Mechanical
Offline time limit*
10
In seconds
Send alarm if offline
Nr figures*
3
Start of cycle time*
Direct
Cancel
Save
Nr of figures (cavities) of the mould: every cycle counts by Nr Figures
Defines if the cycle starts at rising edge of sensor signal (Direct) or falling edge (Inverse)



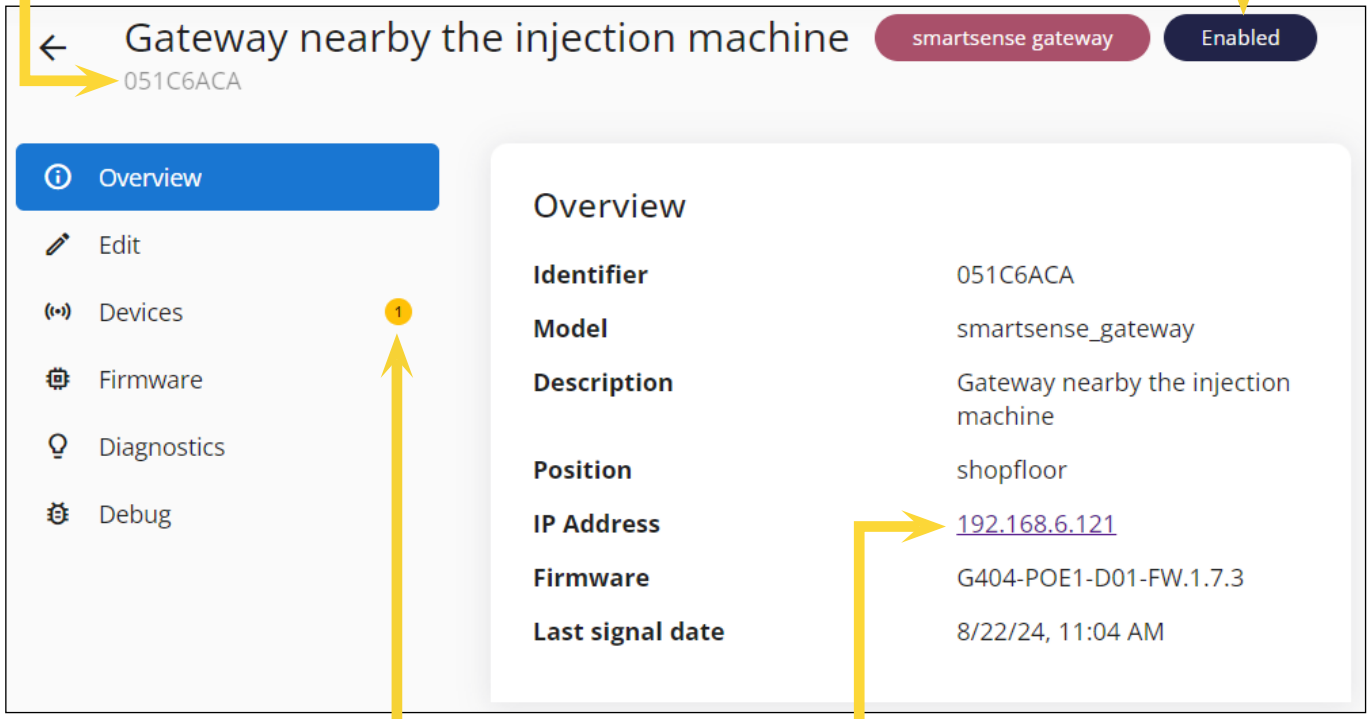

*It defines how many consecutive data samples out of tolerance trigger alarm generation*

*min and max threshold level for the ERROR alarm generation*

*min and max threshold level for the WARNING alarm generation*

*The gateway must be enabled in the platform to allow for data collection*

*Gateway ID*

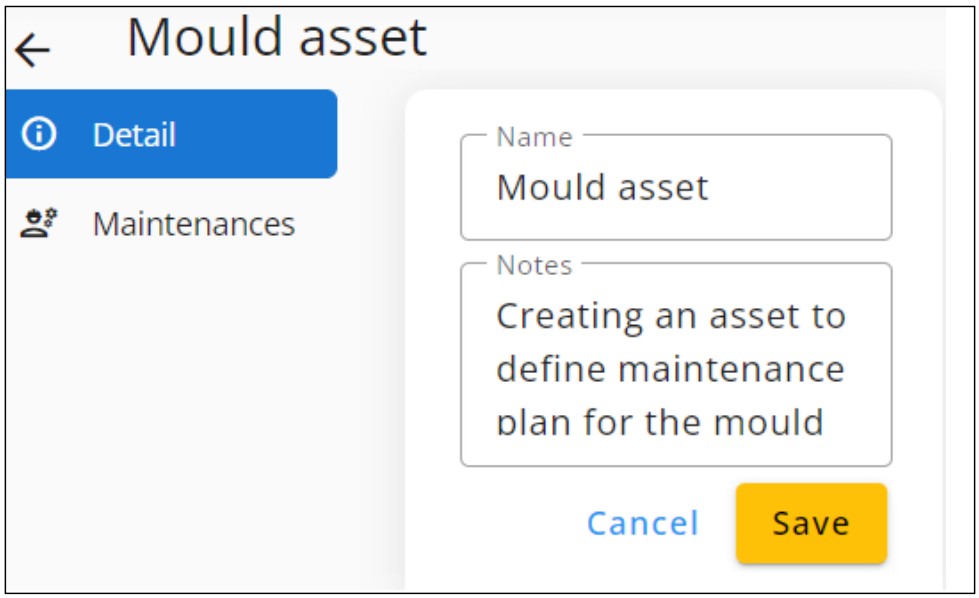



*Total number of sensors the gateway is listening*

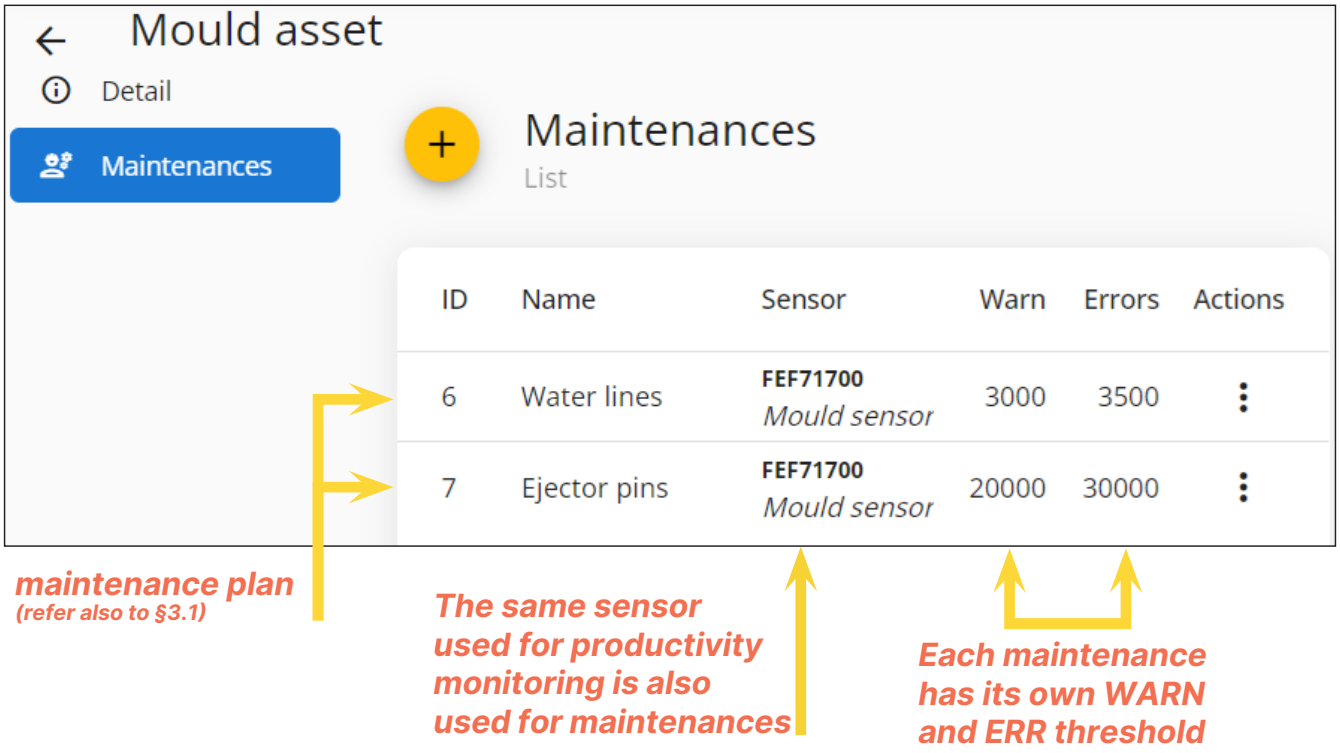
*IP address of the gateway*

*(useful to access the internal webserver and for diagnostics)*

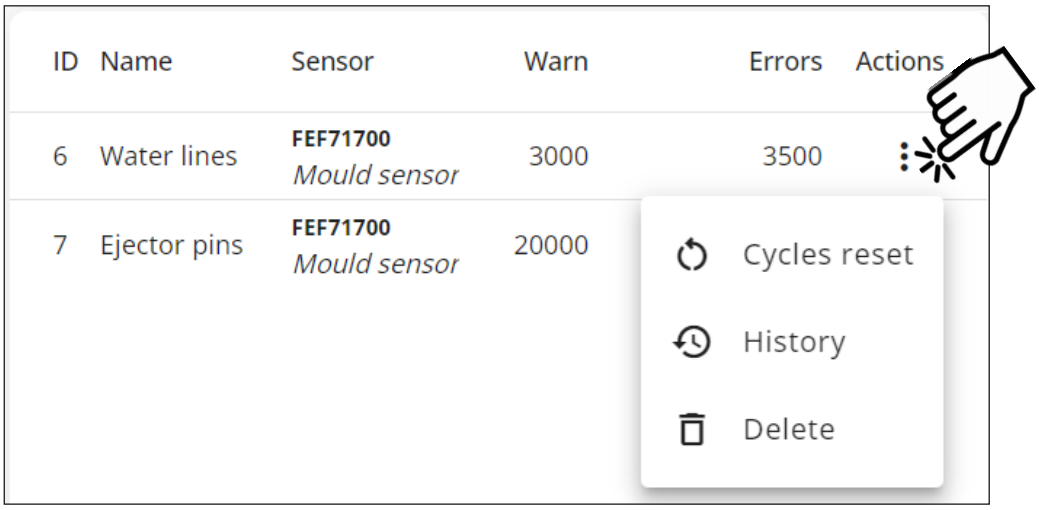
At this point the platform is configured to collect data from the mould (i.e. its sensor) and the productivity of the mould can be monitored (cycle time and quantity). In order to schedule a maintenance plan for the mould (and then enabling automatic notification), the mould has to be defined also as an asset (please also refer to §3.1).


Once the asset has been created by editing a name and a short description, it is possibile to assign to the asset a list of maintenance checks (i.e. maintenance plan) by defining the sensor used as source of data for counting cycles and the threshold levels. In this usecase example, the mould is equipped with only one sensor used for identification, performance and maintenance purposes then the same sensor ID it is used as source of data.

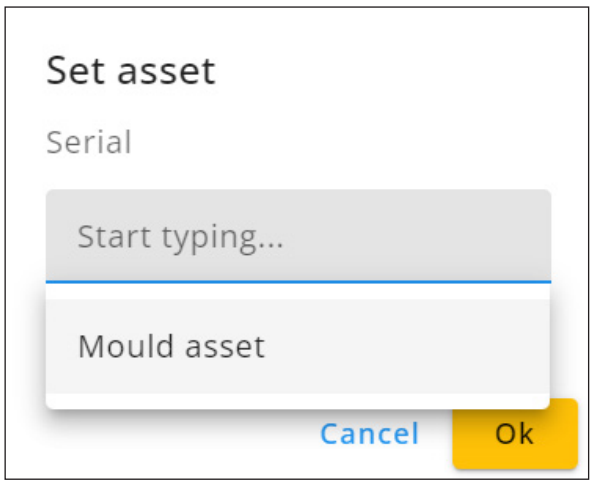


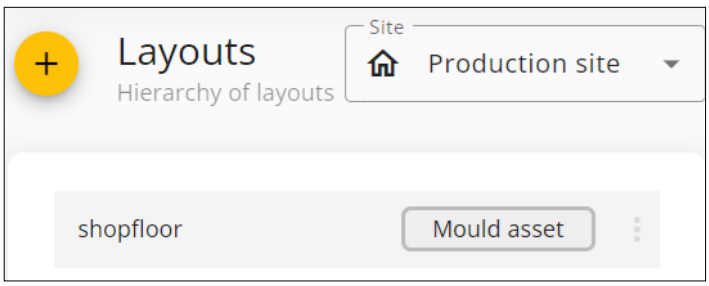
Each maintenance step can be modified by clicking on the the specific table row. An additional submenu is also accessible by clicking on the three vertical dots on the right side of the row. Using this menu it is possible to reset the counter of the sensor (mould). This is useful, for example, after a maintenance step has been processed to allow for a restart of production conserving the same periodic maintenance control.




Using the same menu, any single maintenance step can be deleted and its history can be viewed.

Optionally, an asset can be associated to an existing layout: this helps filtering data in more complex scenario where several assets and layouts are present. The association can be done by using the *Allocate entity* submenu option of the specific layout and by typing (or selecting from drop down menu) an existing asset.

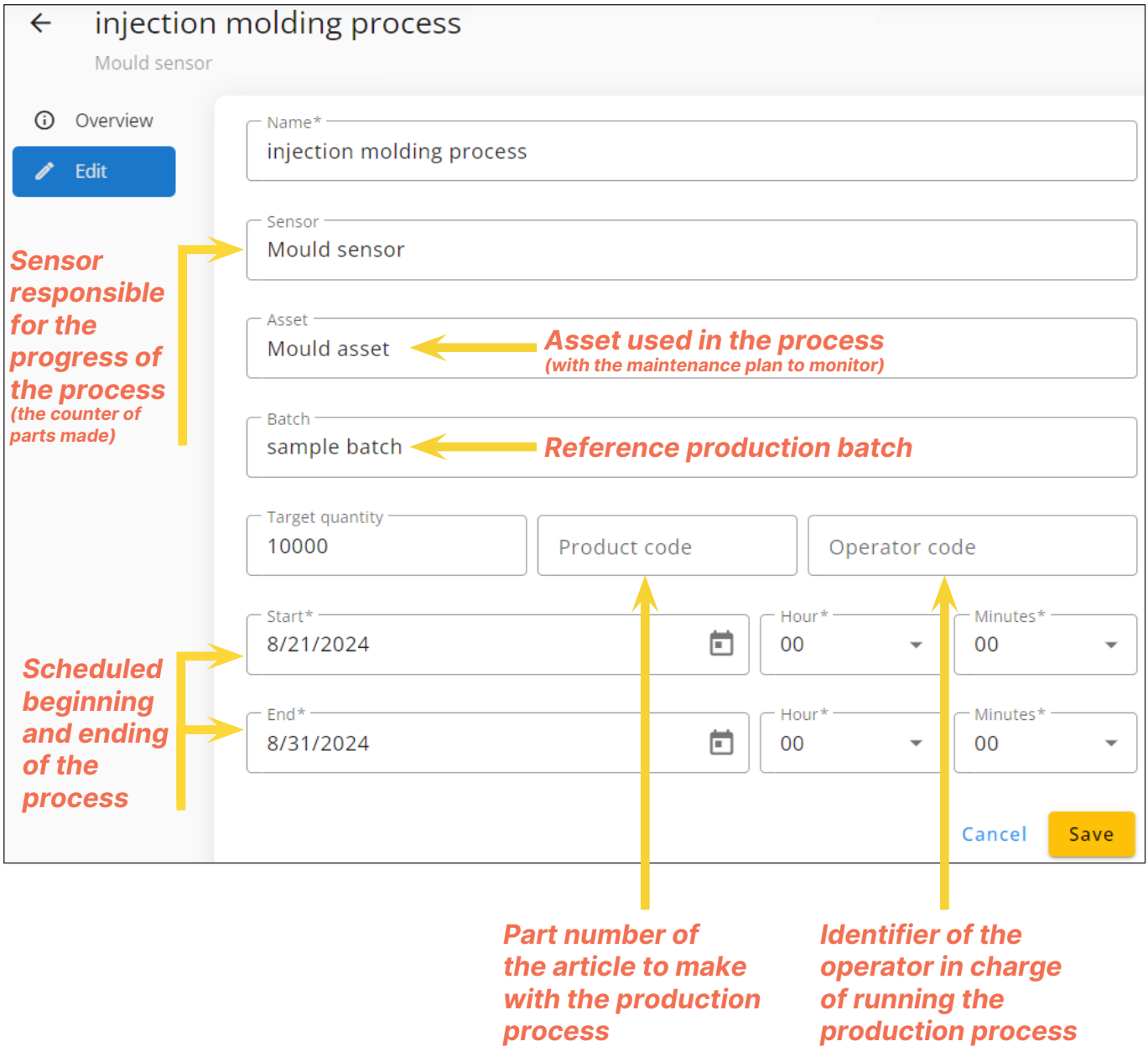



As final configuration step, the creation of both a production batch and a production process is necessary. Without batches and processes it is still possible to use the KCP to collect data samples from sensor and monitor the cycle time but the alarm generation would be disabled.


The definition of a batch requires the user to simply assign a custom name and eventually a code to the batch.


The definition of a production process requires more data as shown in the picture below.



## *3.3 Monitoring of the mould*

The monitoring engine of the Kairo's Cloud Platform works by defining two different types of alarm:

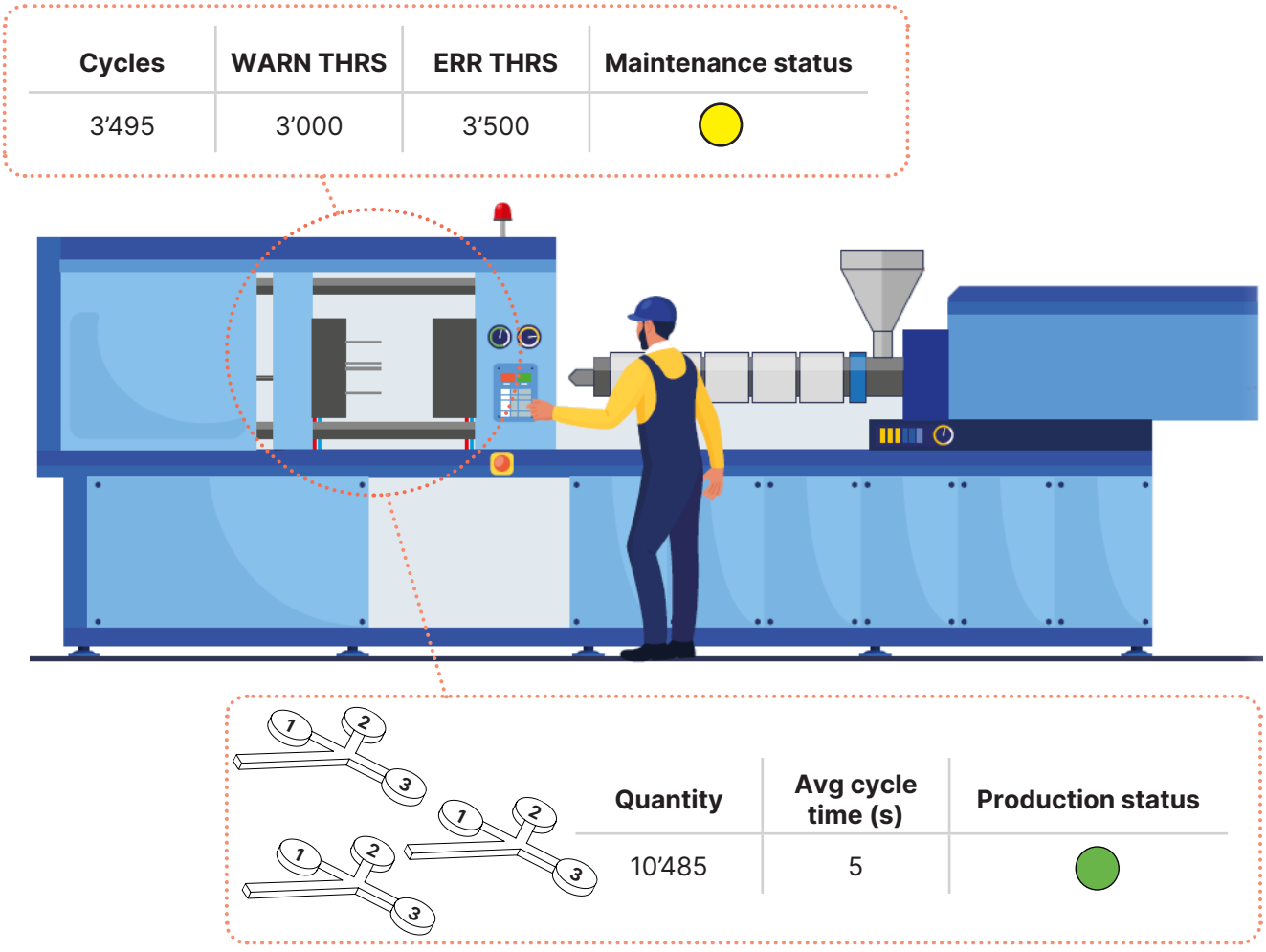
- a warning alarm (by setting the WARN threshold) which represents a pre-critical situation that can be notified to the user in order to prevent the genesis of more critical situations;
- an error alarm (by setting the ERR threshold) that represents the critical situation for which the user is expected to react fast.

Both these thresholds can be set by the user on the basis of the absolute number of cycles of an asset (i.e. the maintenance plan) and/or the cycle time or the quantity produced per production batch (i.e. relative number of cycles). The cycle time is typically used to notify underproduction or overproduction while the production process is running. While an underproduction mainly means loss of efficiency, an over production could lead to quality issues of products.

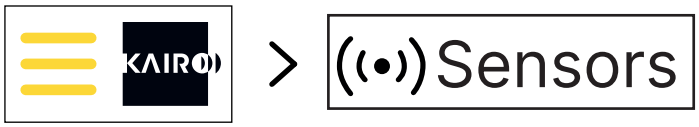
From a maintenance standpoint, the total number of cycles made by an asset is visualized and compared with a first set of WARN and ERR thresholds eventually generating an alarm event;

From a productivity standpoint, an alarm event is automatically generated when the value of cycle time speeds up or speeds down respect to the nominal cycle time crossing. The cycle time is compared with a second set of WARN and ERR thresholds.

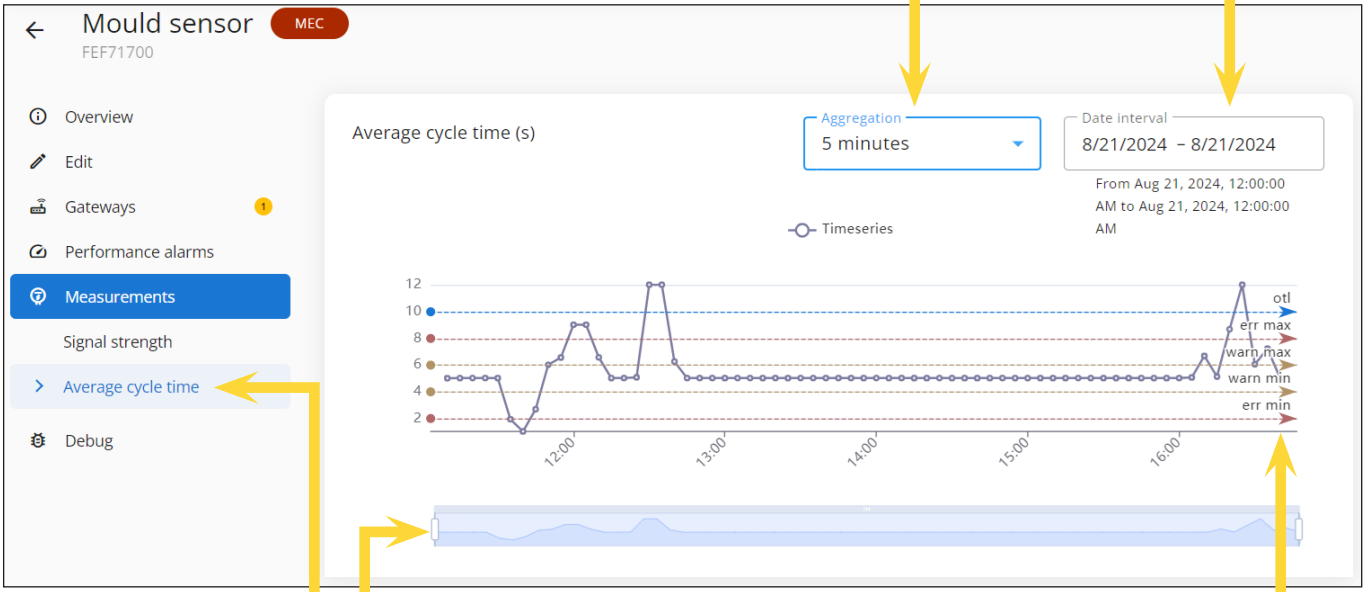
In the KCP the status of the production process and alarms are visually summarized with virtual LEDs.



Charts of data collected by Kairo's sensors are accessible by clicking on the *Measurements* submenu item of the ***Sensors*** section. The user can select timeseries charts of signal strength or cycle time: the former represents the strength of the radio signals transmitted from sensors as they are collected by the gateways, the latter represents the average cycle time of sensor on the basis of the aggregation selected by the user (in case the *None* option is selected, all the raw data are shown).




***Data points in charts can be shows aggregated: by selecting 5 minutes, every data point is the avarage of the previous 5 minutes data within the selected date interval***

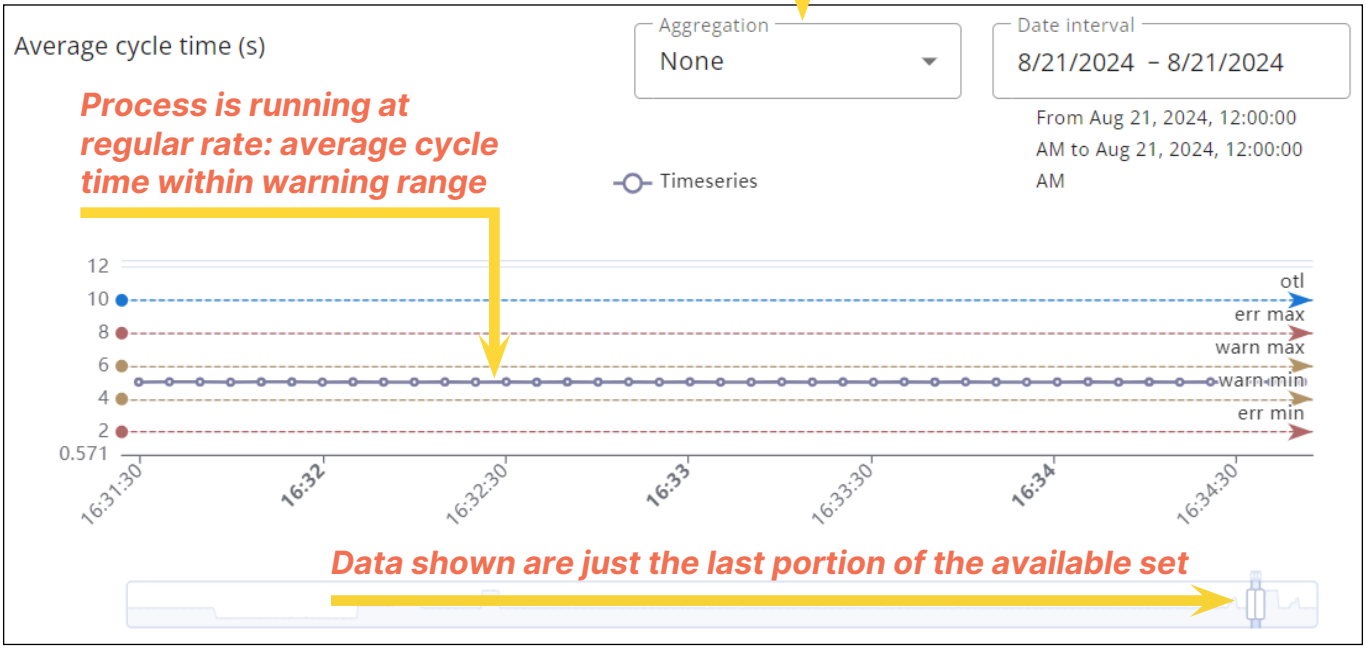



***Average cycle time chart is selected***

***Data shown in the chart are limited to the orizon selected with the scrollbars***

***Threshold as defined in the Performance alarms***

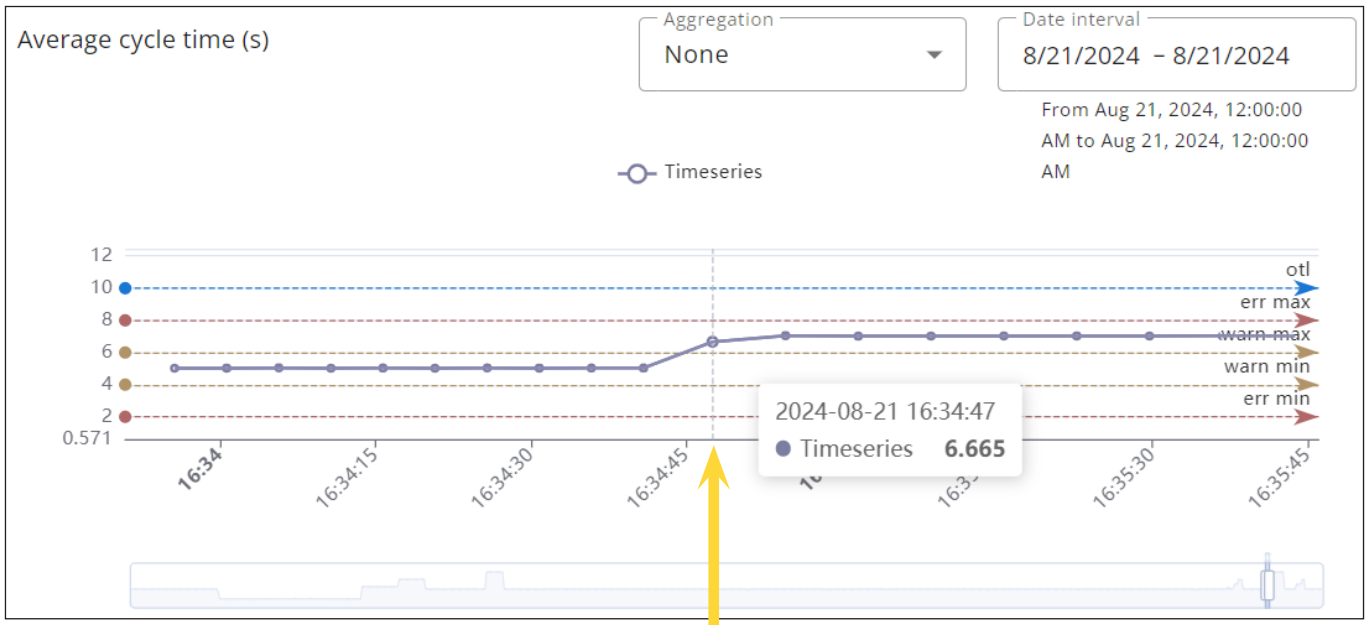
***All samples (no aggregation)***




***Process is running at regular rate: average cycle time within warning range***

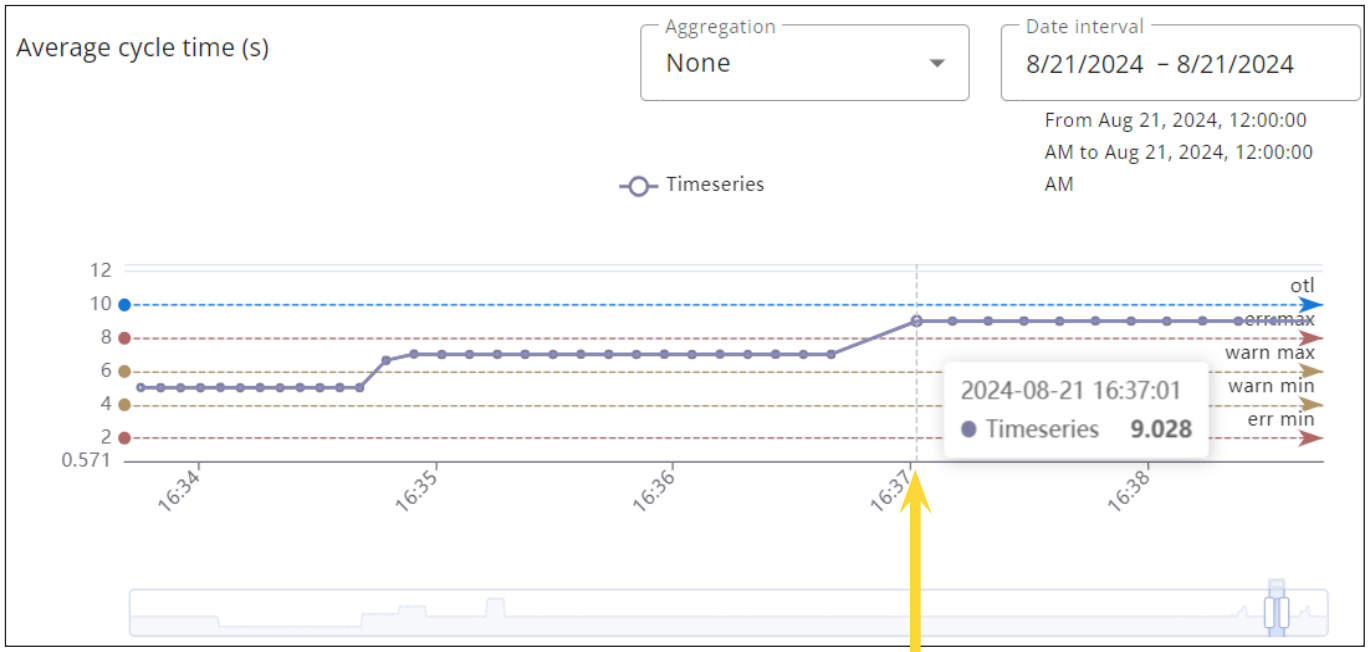
***Data shown are just the last portion of the available set***

Whenever the curve of the collected data goes beyond a *warn* or an *err* threshold and remains out of the allowed range for at least a number of samples equal or greater than the *Consecutive samples* parameter, an alarm is generated. In §3.2 the ***Consecutive samples*** parameter is set to 1 then a single cycle with duration exceeding the warn threshold triggers immediately the generation of a ***Warning*** type alarm as shown in the picture below.



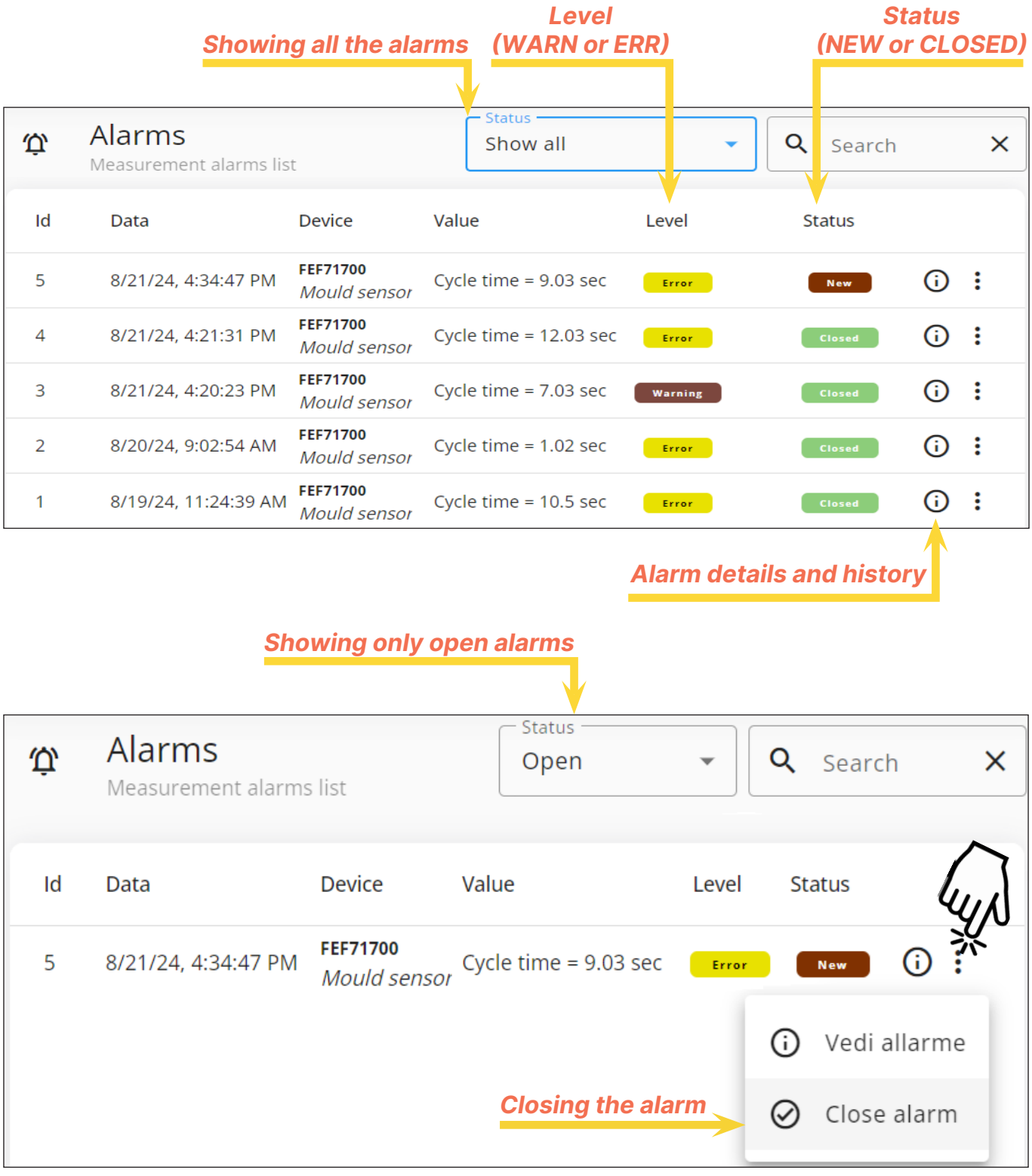

***The value of the detected cycle time exceeds the warning maximum threshold generating an alarm (WARN)***

In case the measured cycle time keeps increasing eventually passing the ***err*** threshold, the severity of the previously generated alarm increase to *Error* and an additional notification is sent to user.

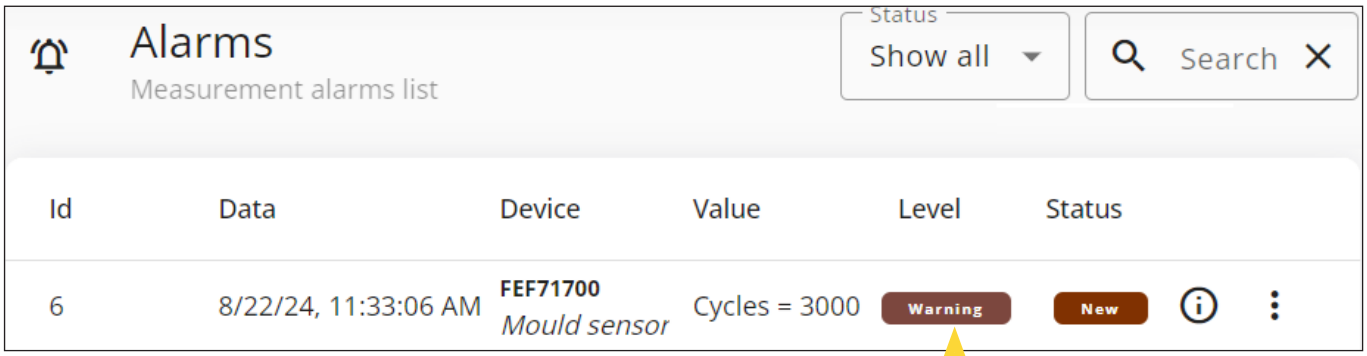



***The value of the detected cycle time becomes greater than the error maximum threshold increasing the alarm priority (from WARN to ERR)***

All the generated alarms remain available in the list of *Alarm list* waiting for a user to take the physical necessary actions to restore the nominal production process. The closing of an alarm requires a user to assign the alarm to him/herself before changing the status of the alarm from *New/Opened* to *Closed*.

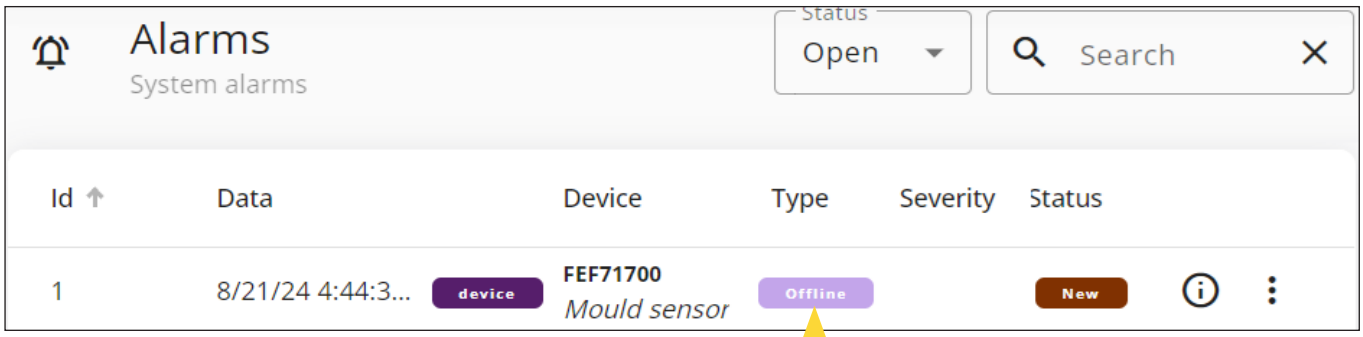
Alarms related to maintenances are also shown in the *Alarms* menu be selecting the category *Maintenance*.


***Warning alarm triggered as the number of cycle is greater than the WARN threshold defined for the 'water lines' check***

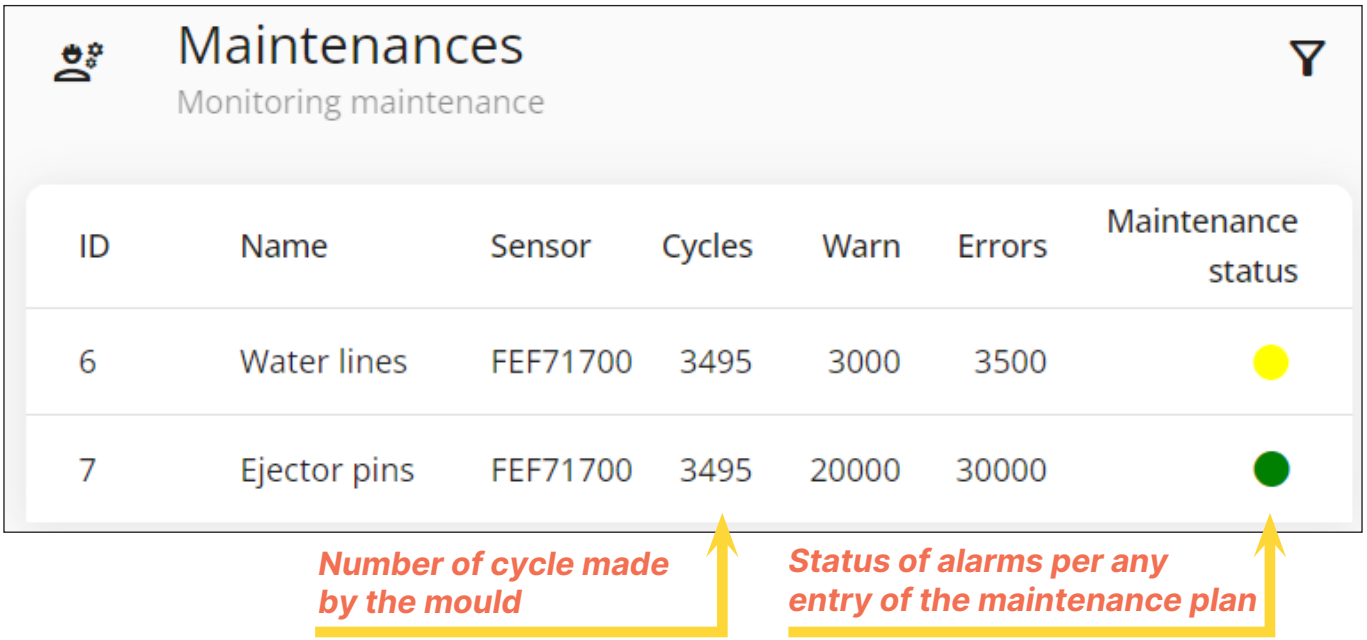
The *Alarm* menu also contains the category *System* which lists all the alarms related to unusual condition of the hardware components automatically detected by the platform as, for example, the case of the mould going offline during a production. This condition is detected by the platform comparing the time elapsed since the last data sample with the value of the *Offline time limit* parameter assigned to the mould sensor.

All the different alarms can be handled similarly by the user with the procedure already described for the specific case of the performace alarms.


***Offline alarm generated as a consequence of a long time elapsed since last collected data sample***
***(refer also to §3.2)***

A summary of the maintenance alarms is available in the *Monitoring* section of the main menu.

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