

Festo AX Motion Insights Pneumatic



GSDA-ATP-*-PCY

This document describes how to set up AX Motion Insights Pneumatic from connectivity to asset onboarding and monitoring of pneumatic actuators.

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1 Introduction

Festo AX Motion Insights Pneumatic (AX MIP) is an industrial app for continuous monitoring of pneumatic cylinders. It comes with a standardized AI model and a user interface as well as a connectivity adapter and PLC function blocks for data acquisition.



Festo AX Motion Insights Pneumatic



Improving machine uptime with AI-based predictive maintenance linear pneumatic actuators



AX Motion Insights
Pneumatic



- ✓ **Continuous monitoring** of pneumatic actuation chain for wear-out and anomalies
- ✓ **Included connectivity through PLC**
- ✓ **No data science** know-how needed

2 System Requirements

2.1 PLC

- Siemens S7 PLC (300/400 or 1200/1500 series)
 - Min. TIA V16 or S7 Classic
 - Ability to install function block into PLC
- Rockwell/Allen-Bradley RS-Logix
 - RSTUDIO up to version 20
 - RSTUDIO up to version 35
 - Ability to install function block into PLC
- Beckhoff TwinCAT3
 - Ability to install function block into PLC

2.2 Automation equipment

- 2x limit/reed switches on each cylinder
- Cylinder travel time must fit to this formula:
 - Travel time of cylinder **greater than** 10 times PLC cycle time

2.3 Computer hardware/runtime environment

2.3.1 Hardware

The Industrial App runs on industrial PCs, virtual machines (VM) or other devices and computing instances that meet the following hardware requirements:

- CPU: min. 4-core, x86-64bit (Core i5 or higher)
- HDD: 120 GB or more
- RAM: 8 GB or more
- 1x Ethernet network interface

2.3.2 Network

- Ethernet network access to all involved PLCs

For retrieval of the industrial app “AX Motion Insights Pneumatic” from Festo’s central container registry, temporary internet access is necessary. After installation, the internet access can be turned off.

2.3.3 Software / runtime environment

- Installed Docker runtime (OCI container)
- Support for Linux-Containers
- Docker-Compose v2.0
- WebUI: optimized for Webkit-based browsers and Firefox
- UI is optimized for a resolution of: 1024x768 or higher

2.3.4 Industrial AI Core

Festo AX Motion Insights Pneumatic consists of two parts: the Asset Type Package (here: Pneumatic Cylinders (product: GSDA-ATP-*-PCY) and the Industrial AI Core that builds the foundation for it (product: GSDA-AIC). Many asset types, also those for different components, such as Electrical Axis, Energy, etc. can run on an Industrial AI Core. Each installation of Festo AX Motion Insights Pneumatic needs an Industrial AI Core as foundation.



2.4 Security/Intended Use

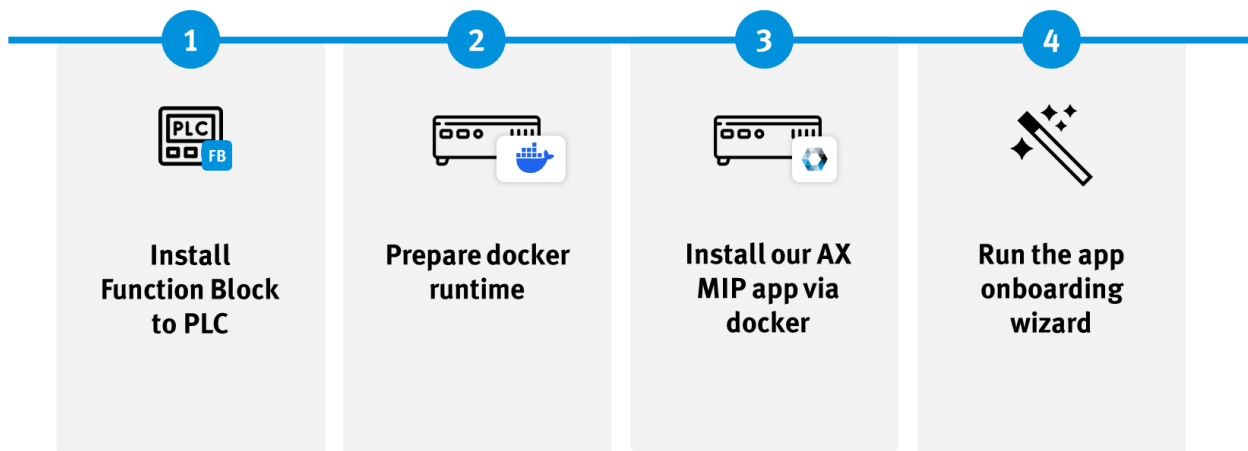
Festo AX Motion Insights Pneumatic (AX MIP) is an industrial app, provided as a set of docker containers, for continuous monitoring of pneumatic cylinders. Therefore, it gathers data from a function block inside a PLC via proprietary PLC protocols, converts and streams the data over MQTT, analyses the data regarding anomalies of the connected pneumatic actuator and persists the data and the results in a data storage (default a PostgreSQL database).

AX MIP is mainly designed to operate on shopfloor level on e.g. an edge computer inside an internal network with no permanent access to the public internet. If you choose distribute the Docker container of MIP on different hosting systems or to operate MIP (partly) in a public cloud, please ensure to secure all communication channels like the MQTT broker with methods of authentication like username/password or certificates. Furthermore, keep in mind to restrict the access to the ports of the system via an appropriate firewall configuration (open only necessary ports and filter IP addresses for the access).

AX MIP is a recommendation system, that gives maintenance engineers insights about the health of the connected pneumatic equipment. Therefore, AX MIP analysis data continuously by the use of algorithms from the field of machine learning. To ensure satisfying results, only data from the MIP function block should be analyzed with AX MIP. Furthermore, it is not recommended to automate an intervention in the control system of the machine based on analysis results from AX MIP.

3 Installation and Commissioning

To setup the entire AX Motion Insights Pneumatic (AX MIP) industrial app, these steps have to be conducted:



3.1 Setup of connectivity – installing function blocks on PLCs

The installation of the MIP function block is described in detail separately for each supported PLC vendor. See Support Portal of Festo in the section “Expert knowledge”, also the function blocks can be downloaded there.

[Festo AX Motion Insights Pneumatic - Expert knowledge](#)

Products
Downloads

Downloads for Festo AX Motion Insights Pneumatic GASA-MIP Terms and conditions of use for electronic documentation

Product information 1

User documentation 0

Certificates 0

Software 0

Expert knowledge 5

Training 0

	Copy link	Download
Application Note Festo AX Motion Insights Pneumatic General Information for set-up and monitoring MIP	🔗	📄
Application Note Motion Insights Pneumatic Function Block for Siemens S7-300 PLC Integration of MIP Function Blocks Siemens Step7; Library included	🔗	📄
Application Note Motion Insights Pneumatic Function Block for Siemens TIA Portal Integration of MIP Function Block with Siemens TIA Portal; Library included	🔗	📄

3.2 Installation and setup of AX MIP containers

To learn more about “Container Applications” please refer to a google search and possible resources (last checked: Feb 2024):

Title	Author	URL
“Docker overview”	docker.com	https://docs.docker.com/get-started/overview/
„Docker 101 Tutorial“	docker.com	https://www.docker.com/101-tutorial/
„Introduction to Docker containers“	Microsoft Learn	https://learn.microsoft.com/en-us/training/modules/intro-to-docker-containers/
„Using tar archives to install offline“	docker.com	https://docs.docker.com/reference/cli/docker/image/save/ https://docs.docker.com/reference/cli/docker/image/load/

Table 3.1: Container Applications

The tutorials also explain on how to install a docker runtime on your preferred environment.

3.2.1 Provisioning of relevant information after purchase

After purchase an email is sent to the purchasing entity that includes all relevant information to fulfill the installation. The email looks like this:

Additional Information to your purchase of AX Motion Insights Pneumatic

Antworten
All



Additional information to your purchase

Thank you for your recent purchase of the software license to our **AX Motion Insights Pneumatic** software. Please forward this mail to the person commissioning the AX Motion Insights Pneumatic software as it provides all necessary information to complete the installation and commissioning.

1



Install Function Block to PLC

2



Prepare docker runtime

3



Install our AX MIP app via docker

4



Run the app onboarding wizard

Follow these steps to commission and set up your AX Motion Insights Pneumatic (AX MIP) instance:

1. Install provided function block into the PLC and instantiate it for as many cylinder as you want to connect.
2. If not existing: Install a docker runtime environment on your runtime target machine (Industry PC or virtual machine or similar)
3. Download setup files and licenses from this link: [Download Files](#)
4. Login to our docker registry with the credentials provided below.
5. Unzip downloaded files
6. Navigate to directory where files are unzipped and look for

```
docker-compose.yml
```
7. Run

```
docker compose up
```

to retrieve containers and run AX Motion Insights Pneumatic

The email contains brief step-by-step instructions and links to all relevant document and most important setup and license files (“Download files” Link). Through this link a .zip is provided. It includes the following files:

Filename	Description
.env	File containing all relevant environment variables for the AX MIP instance, such as version, host name information, credentials. Besides other it is used by the docker-compose.yml to setup all containers accordingly. Note: Depending on local file explorer settings, this file might be hidden. Modifications to this file should only be made by knowledgeable persons.
docker-compose.yml	The docker-compose.yml file is a configuration file used in Docker to define and manage multi-container applications. It is used to specify the services, networks, and volumes required for AX MIP to run. The docker-compose.yml, defines the different containers in the AX MIP installation, their dependencies, and the configuration options for each container. Note: Modifications to this file should only be made by knowledgeable persons.
<uuid>-<package>-<nr>.lic	License file for each purchased AX MIP license. The number of .lic files in that package is equal to the number of licenses purchased through Festo online sales channel. The content of the license has to be copied to activate the license in one specific instance of AX MIP.
mosquitto.conf	File containing the configuration for the external facing MQTT broker that can be used to ingest data to Festo AX MIP. Additionally this MQTT broker can also be used to subscribe to the results of MIP. Note: Modifications to this file should only be made by knowledgeable persons.

Table 3.2: File names with descriptions

3.2.2 Pre-Requisites to install and run AX MIP

AX MIP is provided as “docker container application”. To run AX MIP, e.g. on an Industry PC, “Docker” must be installed on the device/OS. Please refer to the provided information in chapter 0 or search for preferred and up-to-date installation instructions. This part is not covered in this application note.

It is highly recommended to also know about command line interaction, such as Bash or Windows PowerShell. For installation, the target device must be connected to the internet (to get the containers). After that, the internet connection can be disconnected again.

3.2.3 Retrieve container from Festo’s container registry

Upon purchase you receive an email with instructions and credentials to access our public container registry and retrieve (“download”) AX MIP containers.

The address of Festo AX’s container registry is:

festoaxregistry.azurecr.io

3.2.4 Authenticate / Login to registry

To authenticate to our registry a login command has to be executed. This authenticates the client to our public Festo AX container registry and allows for pulling of repositories and their stored container(s).

Insert on command line/terminal:

```
docker login -u <user> -p <password> festoaxregistry.azurecr.io
```

The credentials to <user> and <password> are automatically sent after purchase of AX MIP through our online sales channel, e.g. Festo App World. If not available to reader of this document, get in contact with the people that performed the purchase through our online sales channel.



Note

- In case you can not access this registry, check the firewall settings according to <https://learn.microsoft.com/en-us/azure/container-registry/container-registry-firewall-access-rules>

3.2.5 Start with docker compose file

The docker compose file is also attached to the after sales email and is the central setup file to retrieve all containers and set them up in the correct order and configuration. It is configured as an easy-to-use setup. It can be edited and adjusted to individual needs. Note: Modifications to this file should only be made by knowledgeable persons.

Open up a command interface and navigate to the directory where the docker-compose.yml is stored.

To start the application enter the following command. Upon first execution or after version changes in the docker compose file, the containers are retrieved from the central repository and installed locally.

Insert on command line/terminal:

```
docker compose up
```

To stop the container from running again, enter the following command:

Insert on command line/terminal:

```
docker compose down
```

3.2.6 Version update

If there is a new version released, the update procedure only needs a docker compose down, change of the version tag at the beginning of the .env file and run docker compose up again like described in 3.2.5:

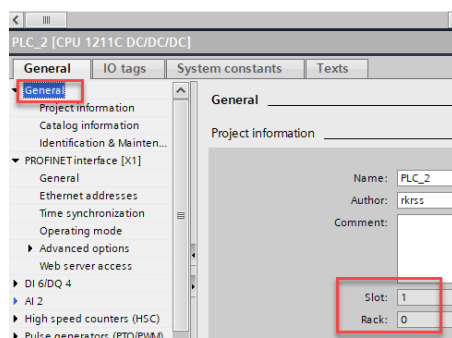
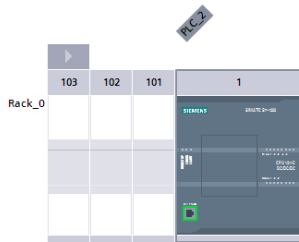
```
##BEGIN OF COMMON SECTION
# Version of the Containerset
VERSION=xx.y.zz
```

3.3 Running AX MIP Connect Wizard

To establish the connection to AX MIP, some settings must be configured. Browse to <ip-address> :8007 on your AX MIP installation and follow the instructions of the wizard.

Example of using Siemens S7 connection:

- Add a name for the PLC as ID to recognize the machine etc. later on in AX.
- The rack and slot information of the PLC details are taken from TIA Portal:



- To add the data blocks that have been created in TIA, click the “+” icon.
- Either single values or ranges to scan can be entered for the DBs.
- The polling interval should be assigned according to the cycle time of the cylinder to be monitored. E.g. if the cylinder moves every 5s, the polling interval can be down to 1s.



Note

- Configuration and settings are slightly different with other PLC connections like Beckhoff, Rockwell or OPC-UA.

- For the MQTT connection a broker, which is part of the docker-compose.yml, can be used with standard settings:

✓

✓

✓

4

5

PLC TypePLC DetailsOverviewMQTTCompleted

MQTT

Protocol *
tcp://

Host *
mosquitto-extern

Port *
1883

Client Id
Standard

Quality of service
0

Optional you may set a custom client id

☒ Basic Authentication

☐ Certificates

User *
user

Password *
••••••••

Test connection

Connected

MQTT Connection

Set up your MQTT connection here. You can use basic authentication or certificates.

Save

Back

Cancel

- user/PW: the broker is configured to allow anonymous connections, so you can define user and password by your own. Changes can be made in the mosquitto.conf file and/or by adding a password file: [Authentication methods | Eclipse Mosquitto](#)

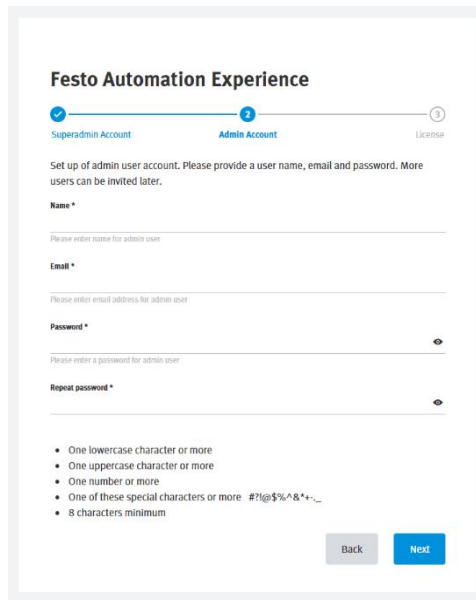
3.3.1 Adding more than one PLC connection

PLC Connections						↻ Rescan	🔄 Refresh	📄 Export	➕ Add PLC
Id	Protocol	Host	Port	Connection details	Status				
>	MIP_Lab_EA	s7	192.168.0.111	102	remote-rack: 0, remote-slot: 1	● Connected			
>	Error_FBs	s7	192.168.0.190	102	remote-rack: 0, remote-slot: 1	● Connected			
>	Simulation	s7	192.168.0.186	102	remote-rack: 0, remote-slot: 1	● Connected			

3.4 Initial Setup: user creation

To further work in the main application browse to <ip-address> without any additional port information (it uses standard http port 80).

During startup, you will be asked to create initial user accounts for Superadmin and Admin:



3.5 License Activation



Note

- **Make sure to have a running CodeMeter server for the license management. Check the application note about it:**
[Festo Support Portal](#)

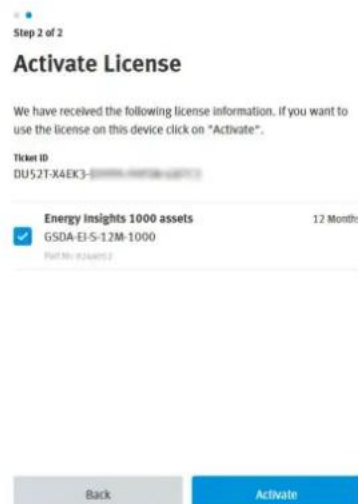
1. When starting, a license is needed to enable the app. Enter the license key received from Festo via email, the key and its format look like this example: 7PSSA-LFHTF-2YQBD-QKCEN-LLW6H



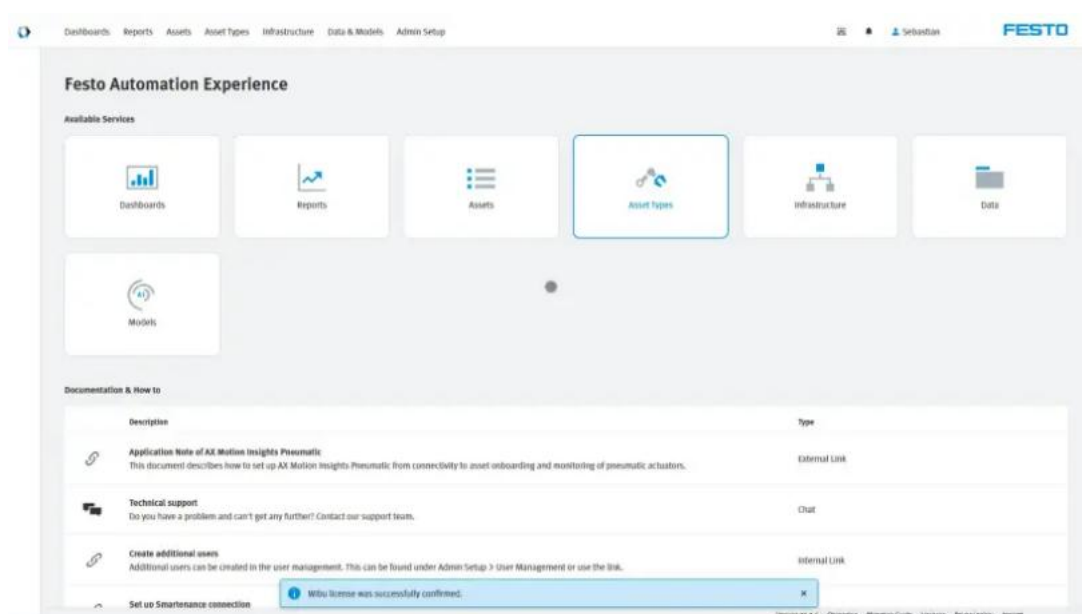
- The license information is retrieved from the central server, so an internet connection is needed



- Select the licenses you want to activate on this device/AX instance and click on "Activate"

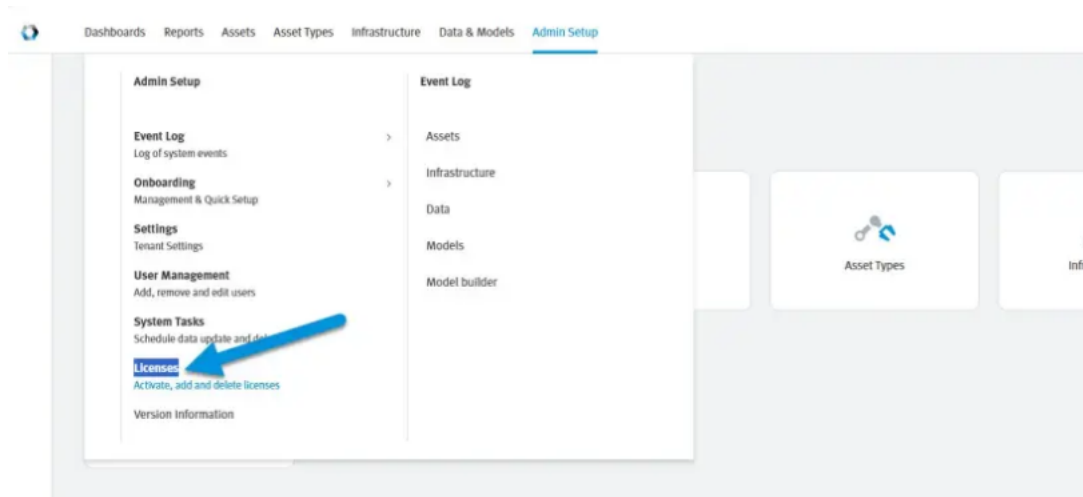


- The license is activated. An internet connection is needed for that handshake

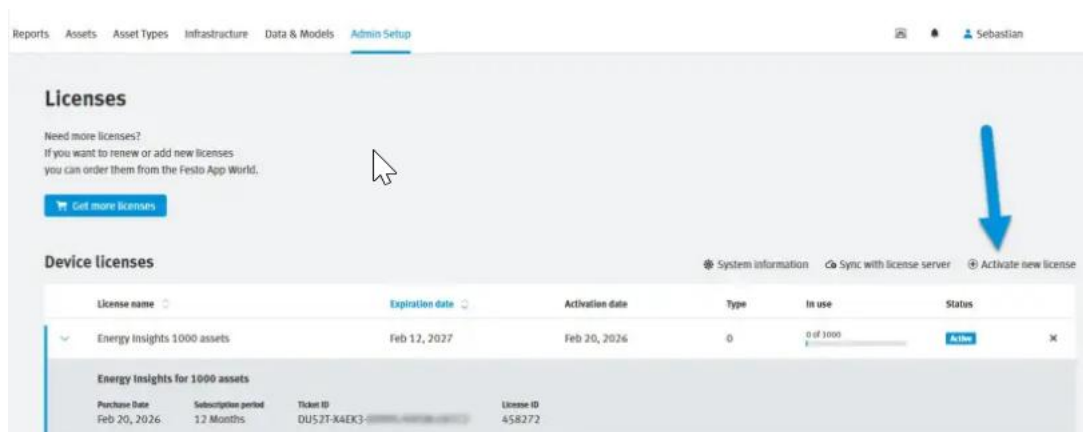


Installation and Commissioning

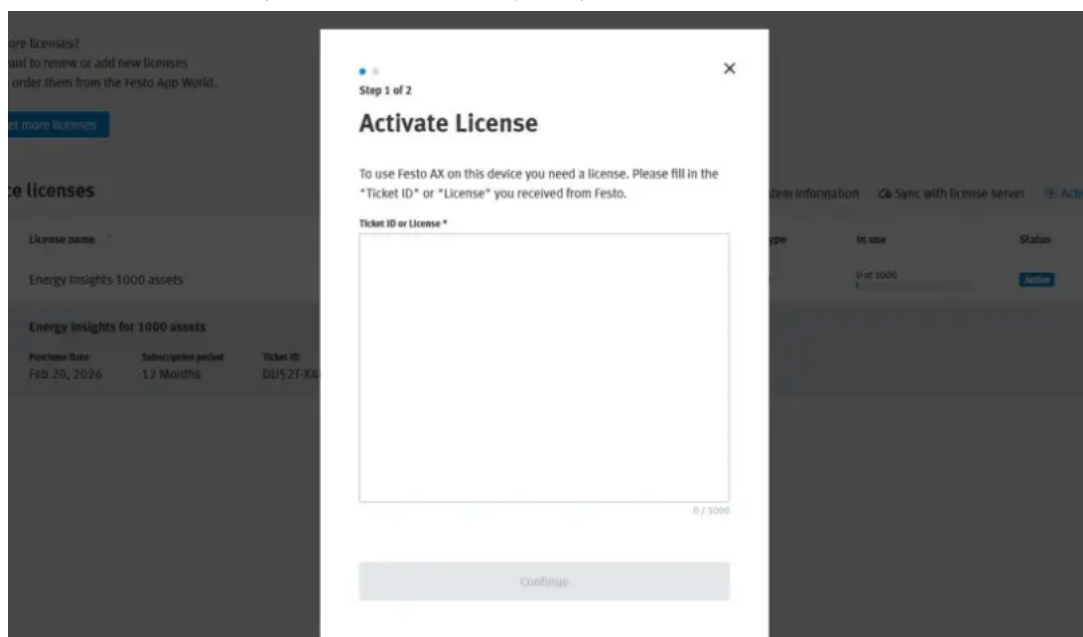
5. To see an overview of all licenses, go to "Admin Setup" > "Licenses"



6. You will get an overview of all activated licenses and their consumption. Additionally, you can activate more licenses from that screen, and deactivate licenses by clicking on the "x"



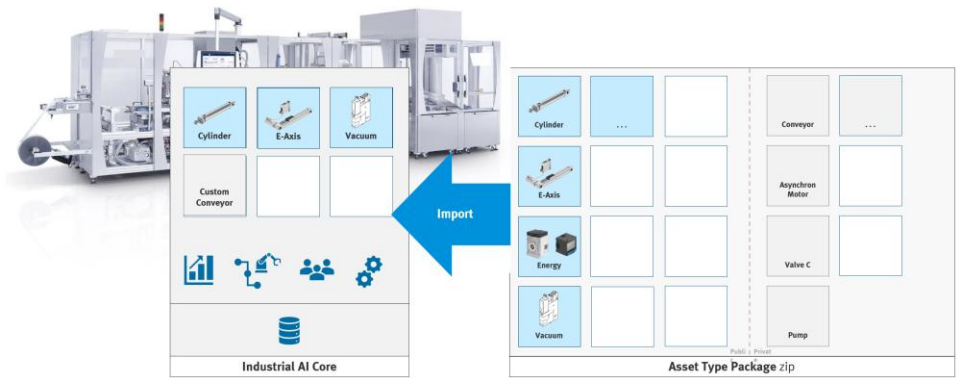
7. To activate another license, paste in the license key and proceed as shown above



4 Onboarding of Assets

4.1 Importing Asset Type Packages

To get started with Festo AX Motion Insights Pneumatic, you still need to import the according Asset Type Package into AX Industrial AI Core.



Navigate to Asset Types > Import and choose *AssetType-MIP.zip* from your download package.

If there is already another Asset Type in the system, you need to click on the icon:

The screenshot shows the 'Import asset type' dialog in the AX Industrial AI Core interface. The dialog is titled 'Import asset type' and has a close button (X) in the top right corner. It contains a section for 'Asset type file' with a checkmark icon and the filename 'AssetType-MIP.zip'. Below this, there is a checkbox labeled 'Multiple asset types in one zip file'. The 'Name' field is filled with 'AssetType-MIP' and has a placeholder text 'Please type in asset type name'. The 'Description' field is empty and has a placeholder text 'Optional asset type description' and a character count '0 / 255'. At the bottom, there are two buttons: 'Cancel' and 'Import'.

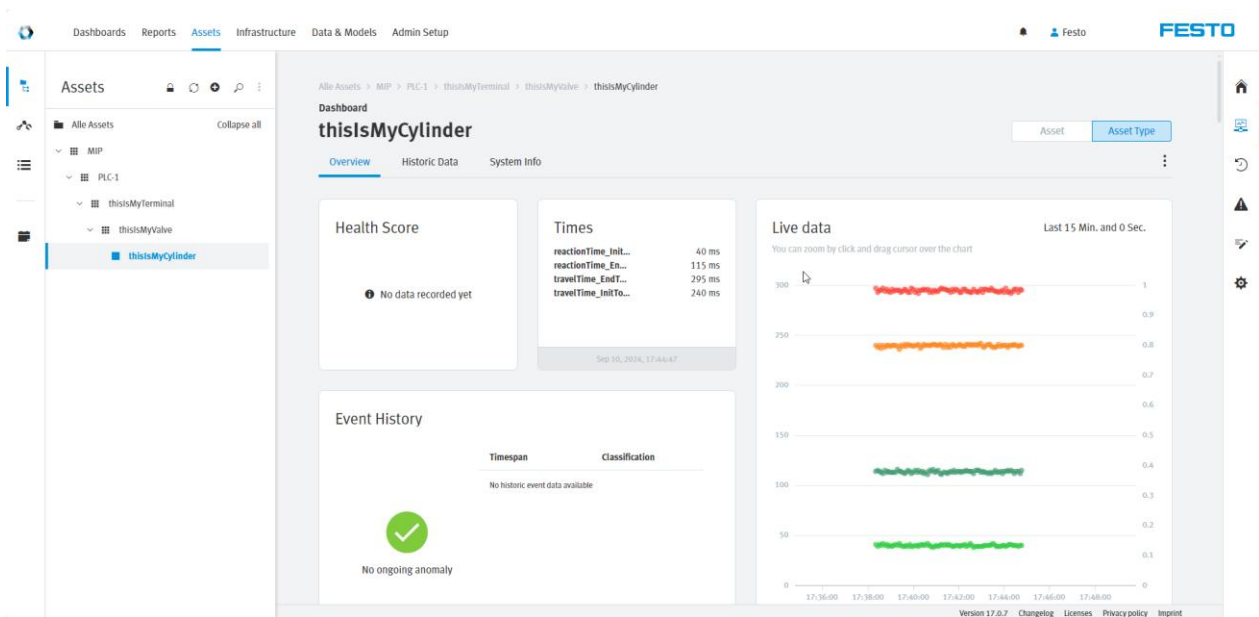
4.2 Automatic Onboarding

Once the connectivity with the PLC function block is set up and the connectivity wizard is completed to set up the connection to the PLC(s), AX MIP Connector scans the PLC for existing assets (identified by data blocks).

⇒ **AX MIP onboards newly found assets automatically to the application!**

These new assets will be shown besides the already onboarded assets in the asset hierarchy (under “Assets”) according to their structure

“PLC Name” > “Valve Terminal ID” > Valve ID > “Cylinder ID”/Asset name.



4.3 Manual offboarding / deletion of assets

In case there are assets, that you don't need to monitor anymore, they have to be deleted in the AX MIP UI manually. Make sure, that you also deactivate the according function block on the PLC or at least the connection in the MIP Connector (see 3.1, exclude the corresponding DB number), otherwise the asset will be auto-onboarded again.

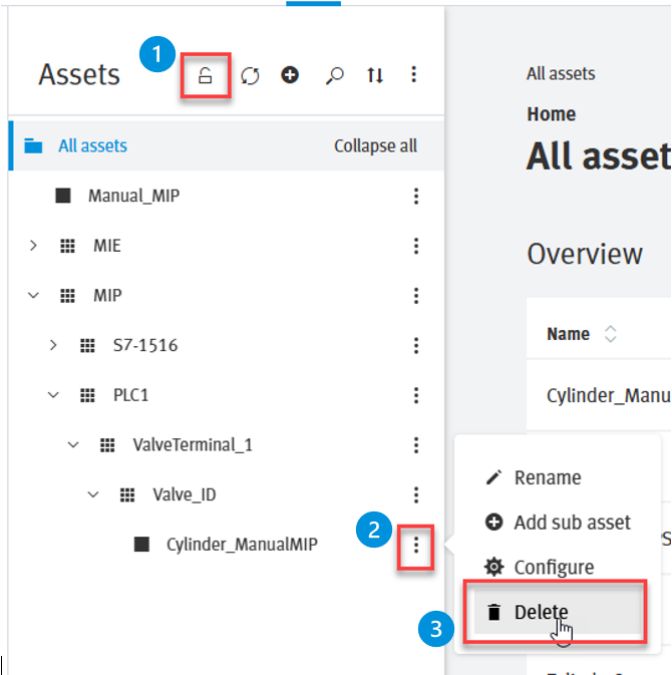
Turn on edit mode of the asset tree, then delete the assets via right click on the context menu of each assets bottom up.



Note

- For versions > 22.x.x the asset tree is in read-only mode by default. To make it editable, deactivate the feature toggle “Asset Tree Read Only” when logged in with the superadmin account (see chapter 3.4)
- For Energy Insights assets, any change in the hierarchy is not permitted!

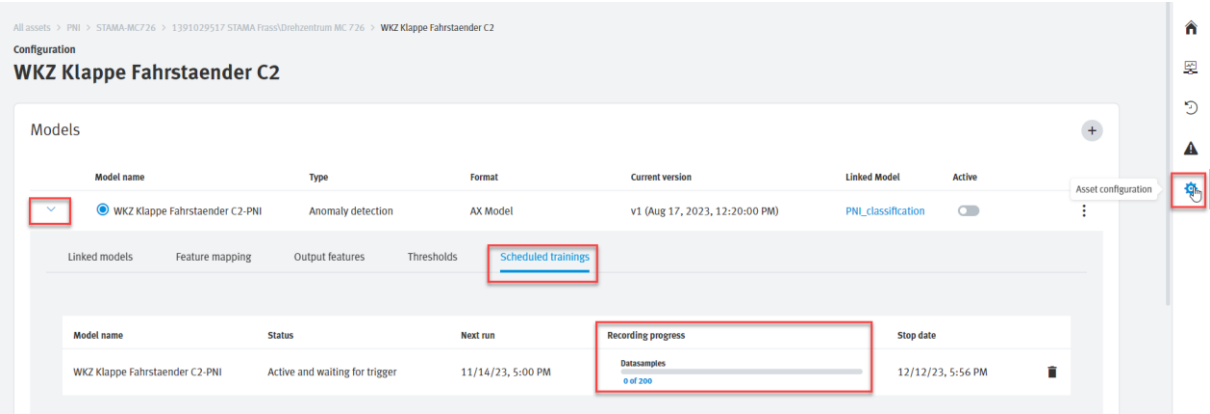
By deleting the assets, the according license will be released then.



4.4 Model-Finetuning / Training / Update

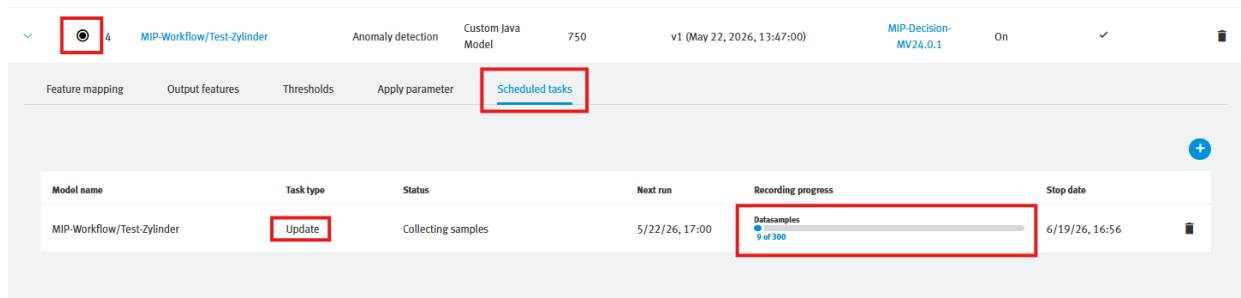
Before the anomaly detection is active, a first initial training has to be finished. Therefore a scheduled training is configured by default. You can check the progress in the asset settings.

AX MIP needs at least 750 “good” cycles for initialization. “Good” means, the cylinder must be in a good condition working in its usual behavior. This is the “baseline” for the ongoing anomaly detection.



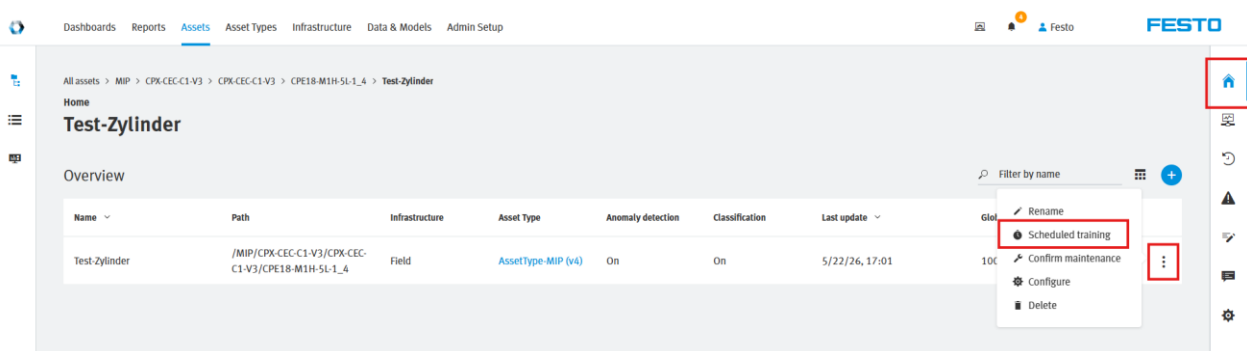
Onboarding of Assets

The input feature ‘part_number’ represents the part number or recipe that is produced by the machine. The behaviour of the cylinder can differ between different part numbers which should not lead to a false analysis result of the model (false positive). Therefore, the main model distinguishes between part numbers and learns the behaviour of each. The model detects automatically if there is a new part number and starts collecting training data in batches of 300 cycles. As soon as 300 cycles of the new part number have been collected a model update is executed.



Feature mapping	Output features	Thresholds	Apply parameter	Scheduled tasks	
Model name	Task type	Status	Next run	Recording progress	Stop date
MIP-Workflow/Test-Zylinder	Update	Collecting samples	5/22/26, 17:00	Datasamples 9 of 300	6/19/26, 16:56

A retraining of all models can be triggered from the “Asset Overview” by scheduling a new training.

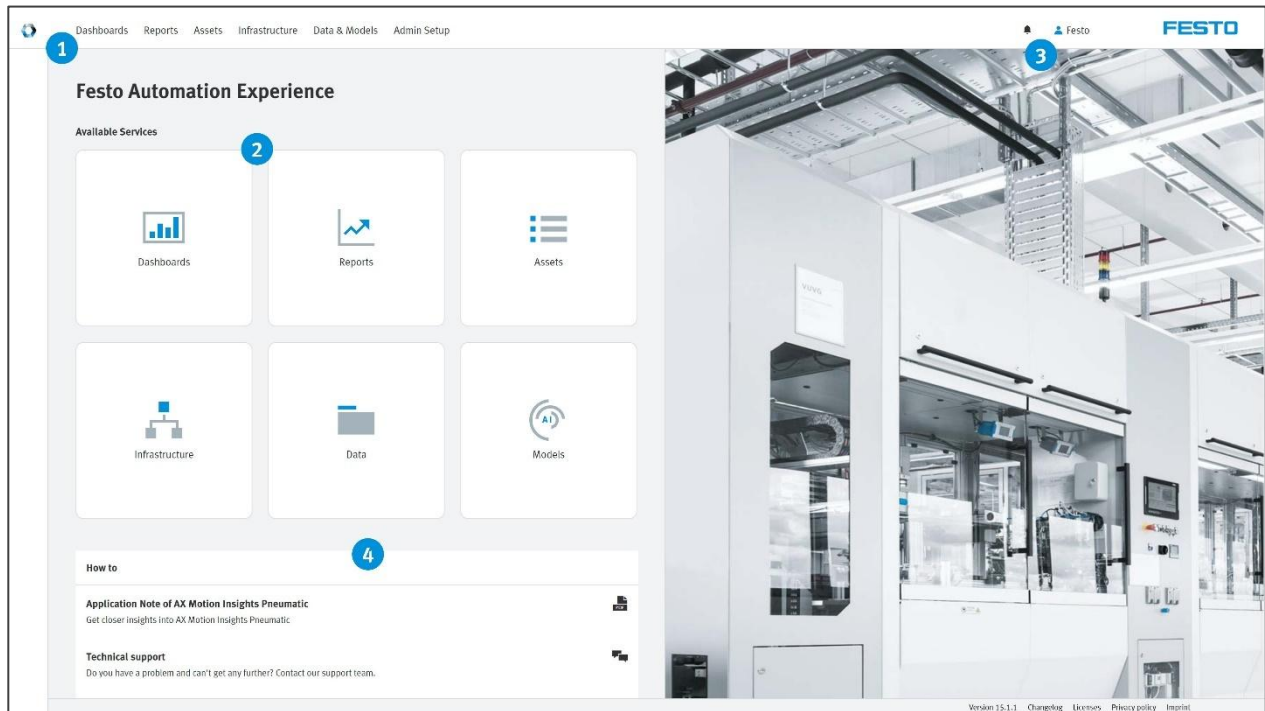


Name	Path	Infrastructure	Asset Type	Anomaly detection	Classification	Last update	Actions
Test-Zylinder	/MIP/CPX-CEC-C1-V3/CPX-CEC-C1-V3/CPE18-M1H-SL-1_4	Field	AssetType-MIP (v4)	On	On	5/22/26, 17:01	Rename Scheduled training Confirm maintenance Configure Delete

5 When the application is running

5.1 UI Walkthrough

After logging into the application, the user is greeted with the app's start screen. As user with the role "ADMIN", the start screen looks as following:



When the application is running

5.1.1 Main Menu (1)

On the top you'll find the main menu starting from the left, that will bring you to the sub sections of the app. It includes:

Menu point	Description	Remark
Dashboards	Access to build customized dashboards from a selection of widgets with the data coming from onboarded assets with their data points/features.	Only users with ADMIN role
Reports	Access to reports to get dedicated views on events and data in retrospective. First report is "Hierarchical Report" to gain overview of anomalies that have occurred in a specific time range.	All users
Assets	Access to all onboarded assets (here: pneumatic cylinders) with their dedicated dashboards for each asset for live view on the asset state. An asset tree allows for easy navigation in hierarchical structure.	All users
Infrastructure	Expert setting screen to adjust inbound and outbound MQTT broker and other settings.	Only users with ADMIN role
Data&Models	Expert setting screen to work with data sets and trigger new trainings on models.	Only users with ADMIN role
Admin Setup	Access to event log, onboarding settings, general tenant settings, user management and system settings. Furthermore access to license settings to activate new licenses and gain overview about existing license setting.	Only users with ADMIN role

Table 5.1: Menu options

5.1.2 Quick Access Buttons (2)

The buttons copy the functionality from the main menu for fast access.

5.1.3 Notifications and User Profile (3)

The bell icon gives you access to the notification dialog. Here users will be notified about two types of events:

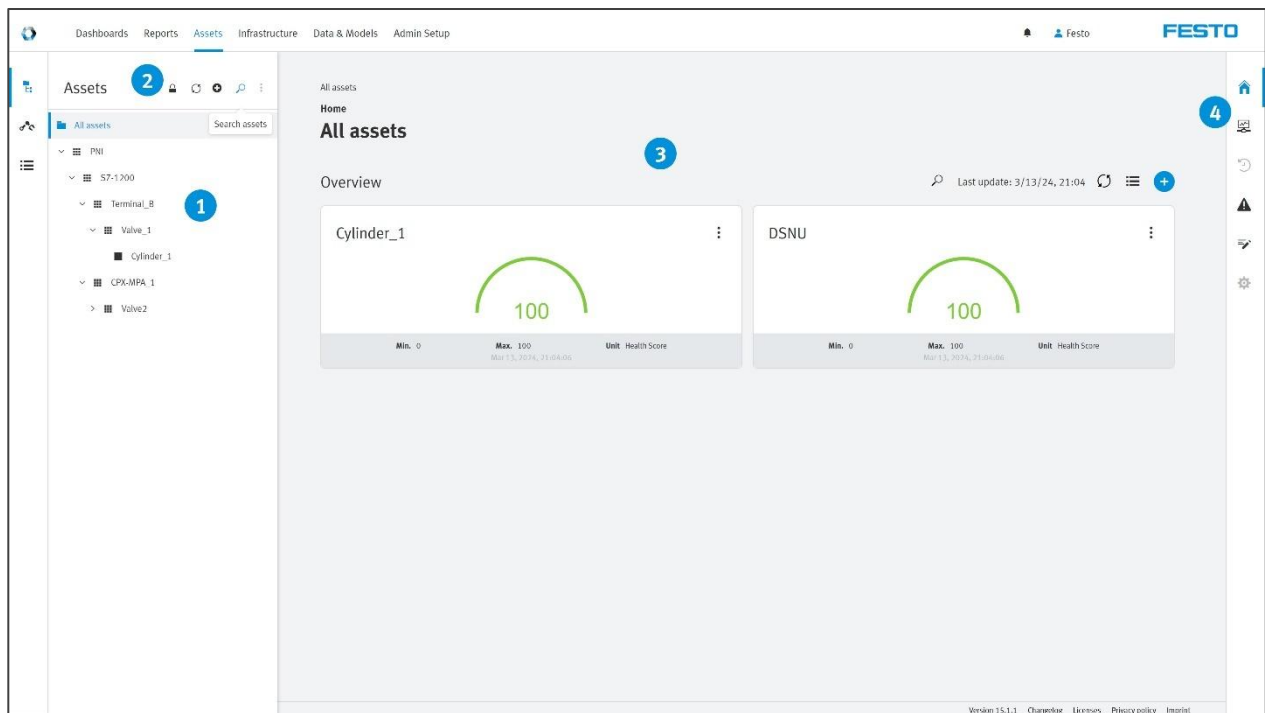
1. Anomaly events
2. Onboarding events

Anomaly events: All anomaly events that occur on the onboarded assets are being triggered as a notification and shown here for direct access.

Onboarding events: Once a new asset has been onboarded to the application, a notification is triggered and shown here. This is especially helpful in the onboarding process.

5.2 Asset Dashboard Walkthrough

Clicking on “Assets” guides you to the assets section that represents one of the core parts of the application. This section gives you structured access to the live data for all onboarded assets.

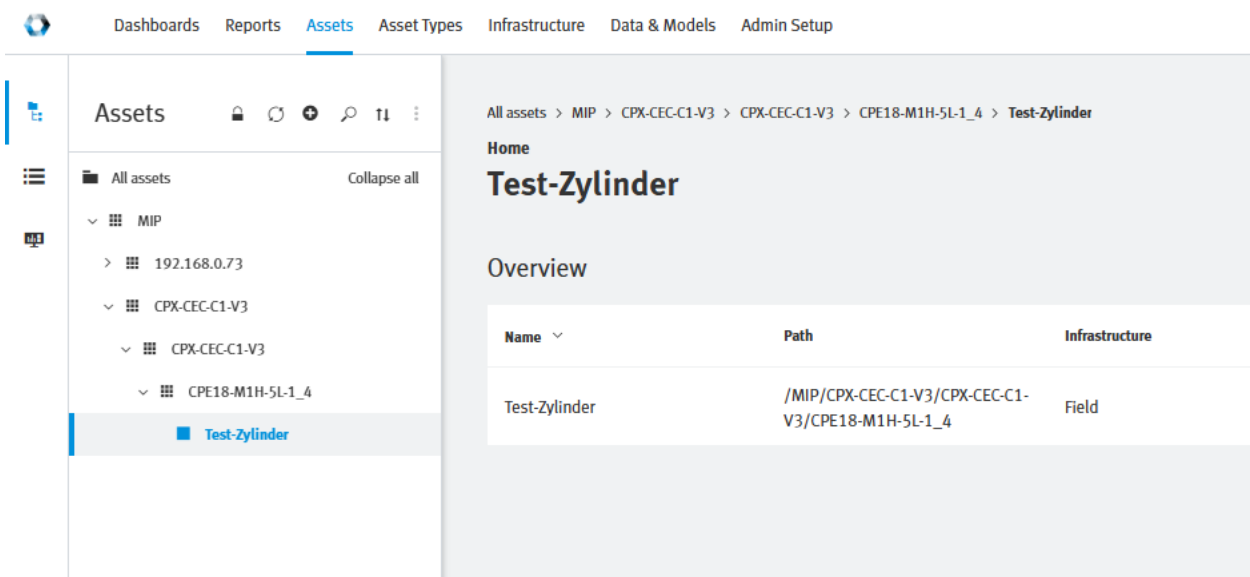


5.2.1 Asset Tree (1)

The asset tree represents the hierarchical structure of your monitored machine or subsystem. Its branch's root is the PLC that has been onboarded. Further down the nodes mirror the configuration that has been done in the function block in the PLC.

“PLC Name” > “Valve Terminal ID” > Valve ID > “Cylinder ID”/Asset name

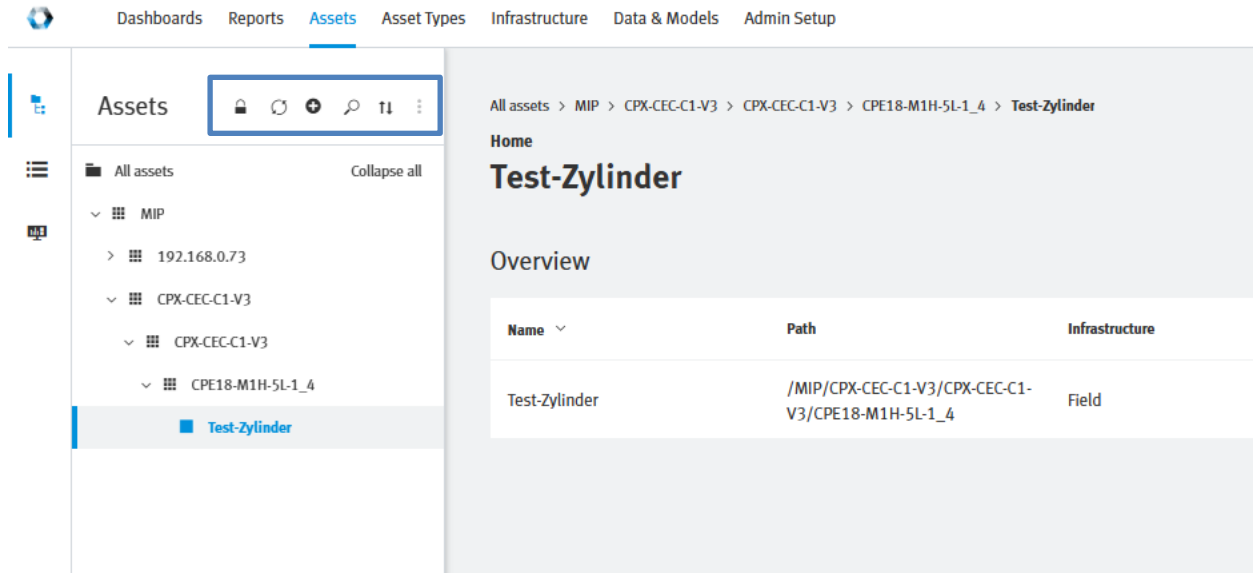
Clicking on the asset name will bring you to the detail screen for the asset.



When the application is running

5.2.2 Asset Tree Controls (2)

These buttons allow you to turn on the edit mode for the asset tree (to modify it), to reload its structure (can be helpful in onboarding phase), to create new assets or to search for a specific one (helpful in scenarios with many assets).



Note

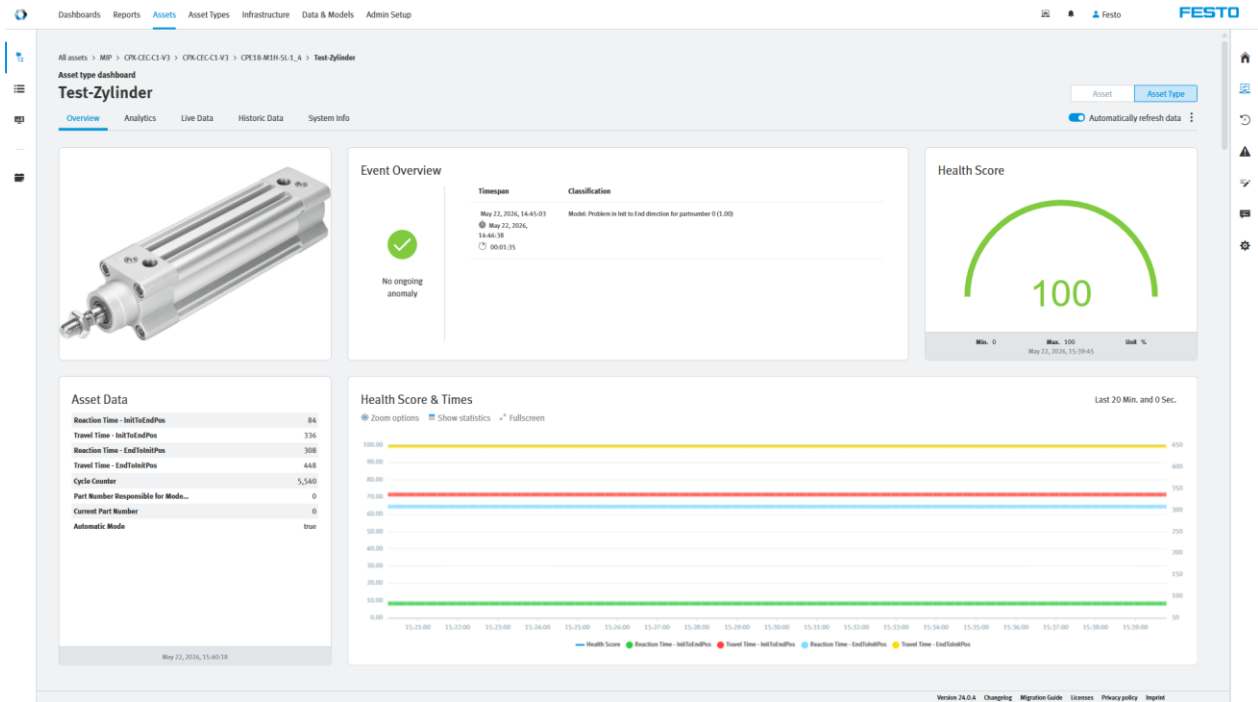
- For versions > 22.x.x the asset tree is in read-only mode by default. To make it editable, deactivate the feature toggle “Asset Tree Read Only” when logged in with the superadmin account (see chapter 3.4)
- For Energy Insights assets, any change in the hierarchy is not permitted!

5.2.3 Asset Main Screen (3)

The main screen section displays the respective sub menu content that is selected through the sub menu on the right side. For example: it contains the dashboard section for an asset when “Dashboard” is selected on the right side.

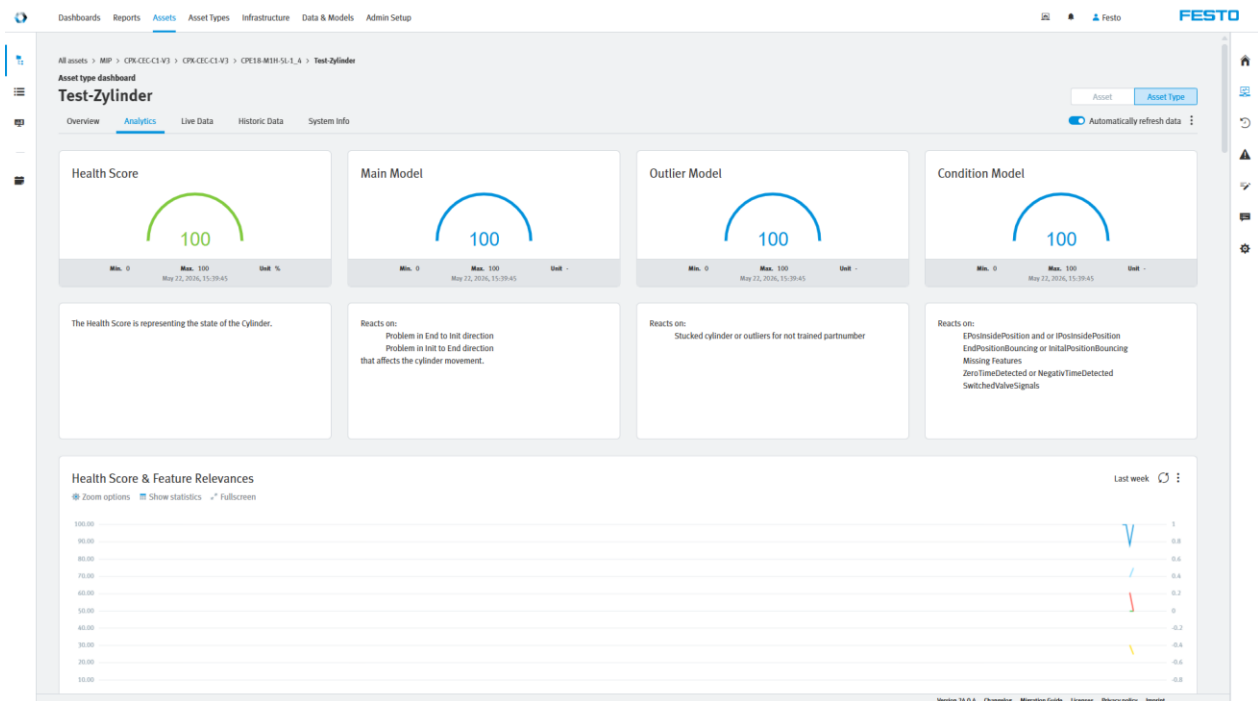
5.2.3.1 Overview

The Overview tab displays information about the health score and classification, along with the primary measurement data. It provides a summary of all critical information related to the current condition of the cylinder.



5.2.3.2 Analytics

The Analytics tab contains all relevant information regarding the health score. It also includes a historical data view that displays the health score trend over the past week.



To detect different kinds of issues that can occur related to the cylinder, multiple models are used to identify specific errors. The results of all models are rated and combined to the Health Score which shows the condition of the asset. There is also a classification which provides detailed information about the detected error. The part number with the worst condition result dominates the Health Score. Therefore a chart showing the part number which is responsible for the model-detected anomaly is provided.

The Analytics tab gives insights into the current and historical results of the 3 anomaly detection models as well as the Health Score. The purpose of these models is listed below:

When the application is running

Main Model:

Analyses the reaction and travel times of the cylinder and detects deviations in the cylinder movement. This model also handles different part numbers to enable accurate analysis results.

The possible classifications are:

- Problem in End to Init direction
- Problem in Init to End direction

Outlier Model:

Detects strong deviations from the normal behaviour even if the cylinder is running with a new part number that has not been trained in the main model yet.

The possible classification is:

- Stucked cylinder or outliers for not trained partnumber

Condition Model:

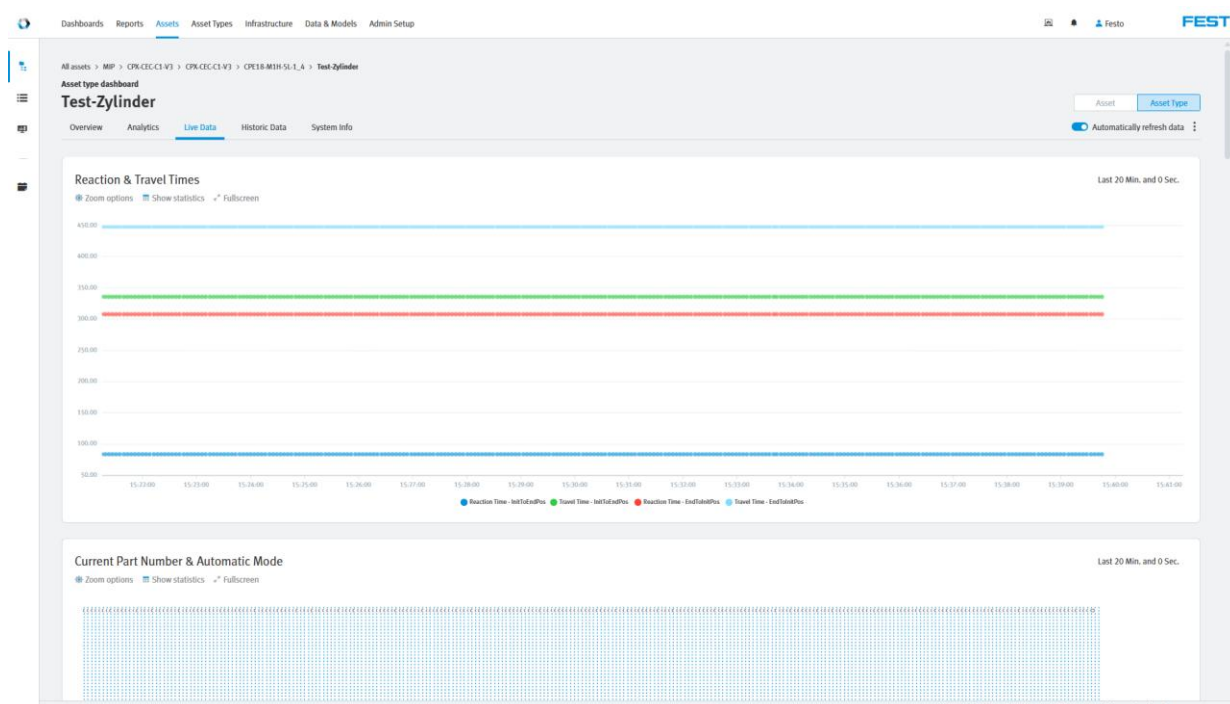
Monitors the order of the signal edges and validates the calculation results of the travel and reaction times to identify anomalies in the motion sequence of the cylinder.

The possible classifications are:

- EPosInsidePosition and/or IPosInsidePosition
- EndPositionBouncing or InitalPositionBouncing
- Missing Features
- ZeroTimeDetected
- NegativTimeDetected
- SwitchedValveSignals

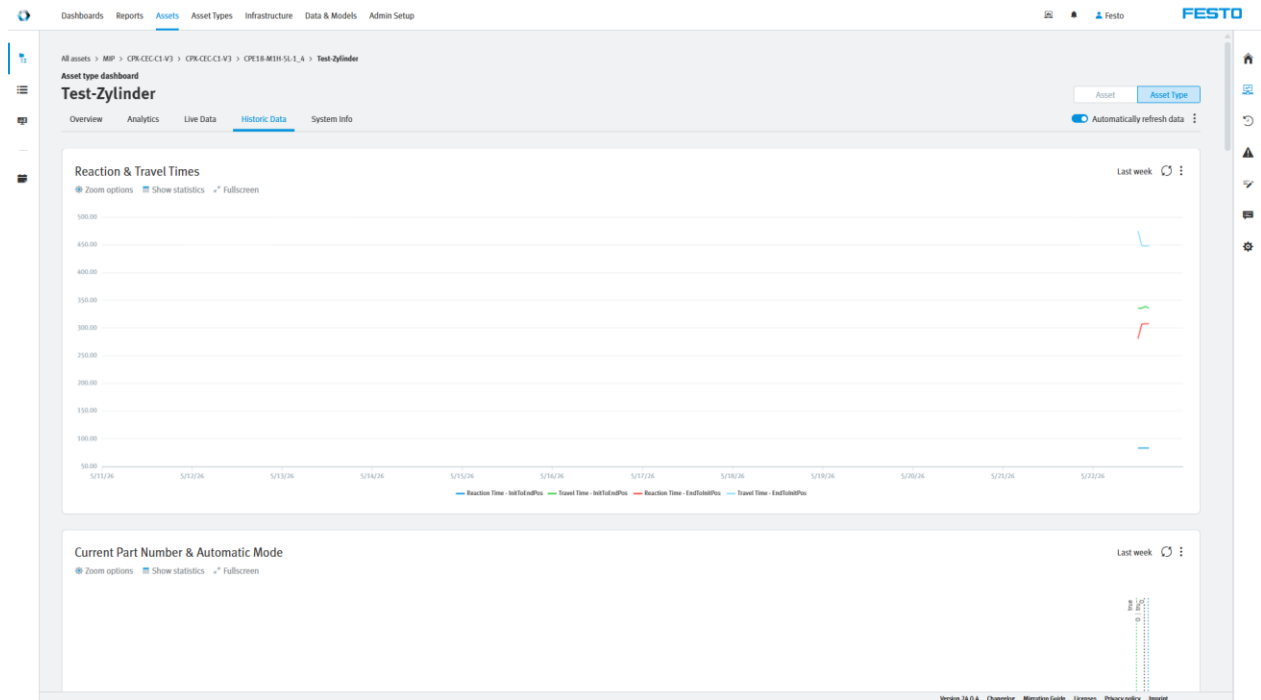
5.2.3.3 Live Data

The live data view displays the measurement data from the last 20 minutes.



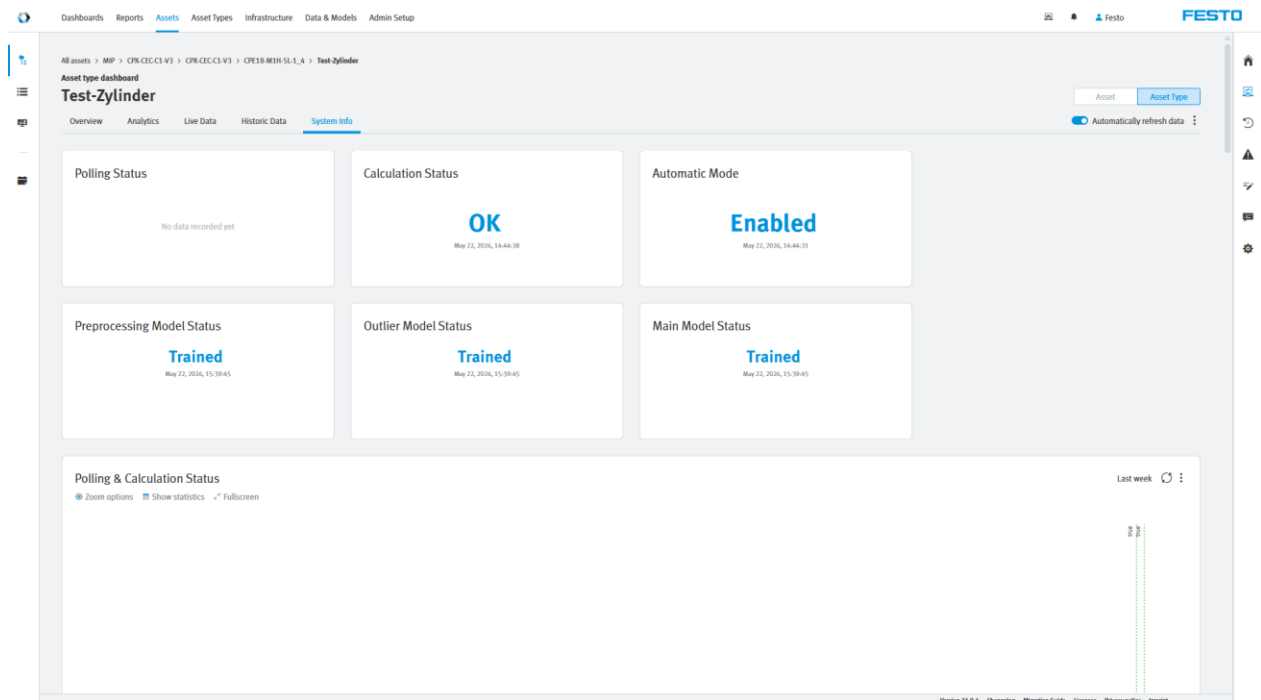
5.2.3.4 Historic Data

The historic data from the past week displays all measurement data, aggregated as mean values over one-hour intervals.



5.2.3.5 System Info

The system Info tap contains status information regarding the data connectivity and the model training. Only after all models have been trained, the full range of functions is available.



When the application is running

5.2.4 Asset Controls (4)

The sub menu on the right side controls section to show for the asset selected by the asset tree.

	Home Screen for the asset. Contains an overview including the current health score for the asset (or group of assets when a node is selected in the tree).
	The dashboard for the asset. There is two sections: the general dashboard that is derived from the asset's asset type and a dashboard for the individual asset. The latter can be designed individually by the user. The first one gives a great overview and already contains a lot of information about the current state of the asset as well as a look back for a certain time period.
	Access to historic data of the asset. Further offers to export the data selection as csv or to create a new data set in AX from it to train a model with it.
	Event log for an asset. Here all events for the asset, such as anomalies, are collected.
	Upon anomalies, annotation can be added to an event to use in future events.
	Model overview for an asset. Allows for fine tuning of a model and to schedule new trainings, e.g. after component replacement. Expert section.

5.3 Inviting New Users

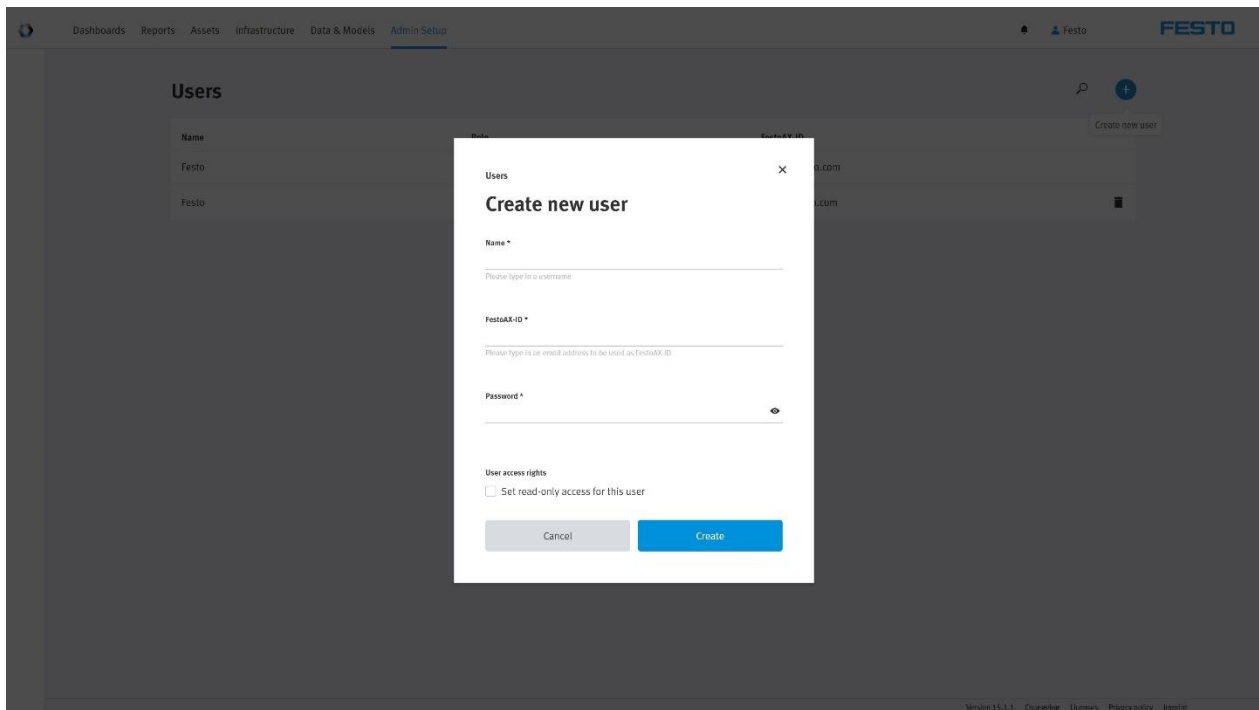
User with role “ADMIN” can invite new users. There is currently no logical limit to users added to the application. New users are added through the “Users” screen. It is reached through

Admin Setup > User Settings > (+) *New User*

Three things are needed for a new user:

- Name: a non-unique name to label the user
- FestoAX-ID: E-Mail address to uniquely identify user (also used for login)
- Password: The password to authenticate the user.

The new user can be set to “read-only”. This allows for accounts that can only view the data but not make amendments.

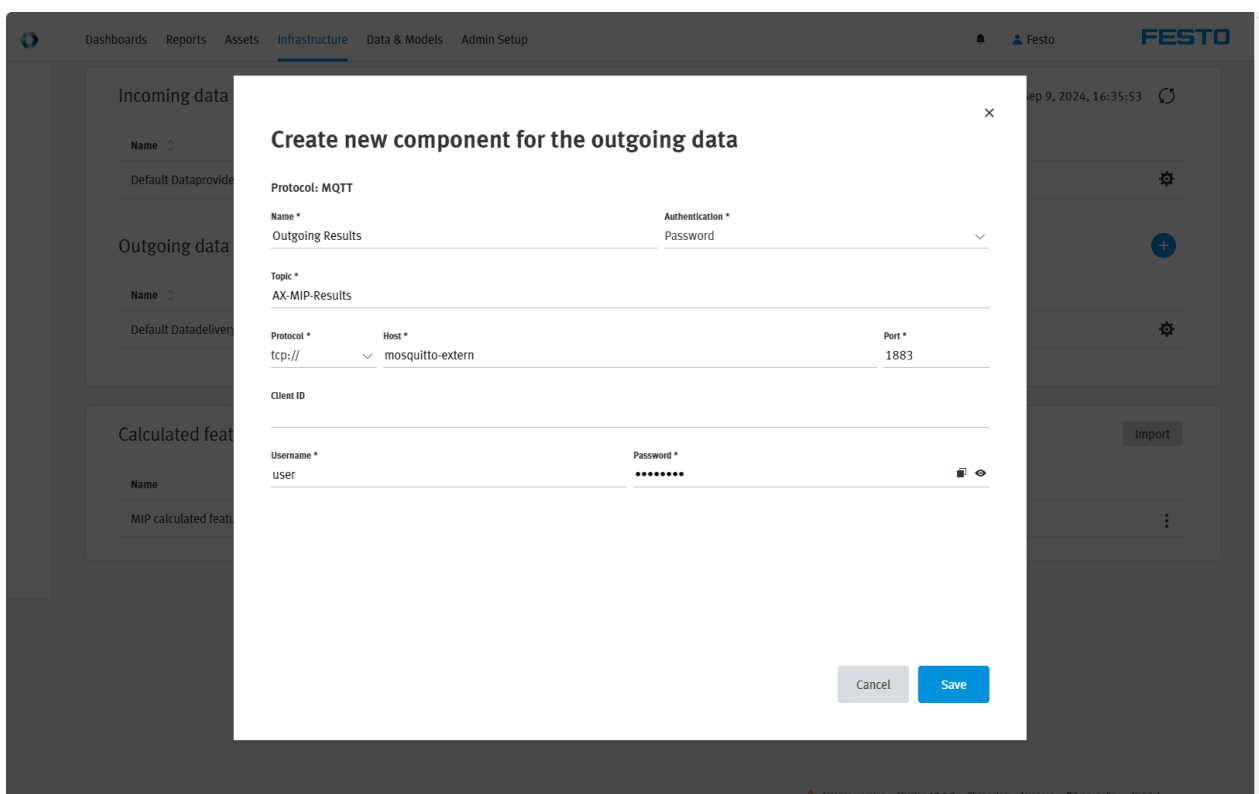


5.4 Outbound MQTT Data Delivery

To use model results like anomaly score or anomaly event in 3rd party systems, an outbound connection via MQTT can be configured. It is reached through

Infrastructure > Field > Outgoing data > Default Datadelivery > (+) *New Component*

The same broker like for the incoming data, which is part of the docker-compose.yml, can be used:



When the application is running

To get results being sent out, the “Field to External (F2E)” forwarding gate has to be activated for the features needed:

- For the according asset, choose the settings and pause the anomaly detection model:

The screenshot shows the Cyl1 configuration page. At the top right, there is a 'Pause & Edit' button highlighted with a red box and a blue circle '1'. Below the 'Models' table, the 'Output features' tab is selected. The table lists features with their information types and data types. The 'Active forwarding gates' column shows a dropdown menu with 'F2E' selected, highlighted with a red box and a blue circle '2'. A blue circle '3' is next to the 'Pause & Edit' button.

No.	Model name	Type	Format	Sample size	Current version	Linked Model	Active	Status
1	MIP_preprocessing	Anomaly detection	Custom Java Model	-	v1 (Jul 15, 2025, 17:13:24)	Cyl1-MIP	On	✓
2	Cyl1-MIP	Anomaly detection	-	-	-	MIP_classification	On	✓

Feature name	Information type	Data type	Active forwarding gates
Anomaly Score	Anomaly score	Numeric	☐
Anomaly Score Raw	Anomaly score (raw)	Numeric	☐
Feature Relevance.reactionTime_EndToInitPos	Feature relevance	Numeric	☐
Feature Relevance.reactionTime_InitToEndPos	Feature relevance	Numeric	☐
Feature Relevance.travelTime_EndToInitPos	Feature relevance	Numeric	☐
Feature Relevance.travelTime_InitToEndPos	Feature relevance	Numeric	☐

- After pausing the model, the forwarding gates can be adjusted and the anomaly detection model can be resumed:

The screenshot shows the Cyl1 configuration page. At the top right, there is a 'Resume' button highlighted with a red box and a blue circle '1'. Below the 'Models' table, the 'Output features' tab is selected. The table lists features with their information types and data types. The 'Active forwarding gates' column shows a dropdown menu with 'F2E' selected, highlighted with a red box and a blue circle '2'. A blue circle '3' is next to the 'Resume' button.

No.	Model name	Type	Format	Sample size	Current version	Linked Model	Active	Status
1	MIP_preprocessing	Anomaly detection	Custom Java Model	-	v1 (Jul 15, 2025, 17:13:24)	Cyl1-MIP	On	✓
2	Cyl1-MIP	Anomaly detection	-	-	-	MIP_classification	On	✓

Feature name	Information type	Data type	Active forwarding gates
Anomaly Score	Anomaly score	Numeric	☐
Anomaly Score Raw	Anomaly score (raw)	Numeric	☐
Feature Relevance.reactionTime_EndToInitPos	Feature relevance	Numeric	☐
Feature Relevance.reactionTime_InitToEndPos	Feature relevance	Numeric	☐

5.5 Connecting Festo AX Smartenance

To be able to trigger incidents for specific assets, a premium account for Festo AX Smartenance is needed. Then the API credentials to connect both systems can be added in Festo AX Motion Insights Pneumatic here:

Admin Setup > Settings > Smartenance

Tenant

SMTP Smartenance

Smartenance Settings Cancel Save

Username *

Password *

Show incident trigger settings for assets ☒

Enable incident creation ☒

Configuration invalid - Last updated at 16:38:05

Test Connection

About Smartenance

Smartenance is the modern, manufacturer-independent solution for maintenance and incident management. Smartenance enables digital and paperless maintenance management.

Maintenance tasks can be scheduled easily and flexibly via a web application and then accessed anywhere via a mobile app. Smartenance increases the efficiency of autonomous and classic maintenance.

[Try Smartenance for free](#)

The free trial period does not include API access. Please contact us via email smartenance@festo.com to have your API access being granted individually.

After establishing the connection, each asset can be configured to trigger an according incident in Smartenance:

Asset Tree Controls > Asset configuration > Maintenance system triggers > (+) *Add maintenance trigger*

Assets

Additional feature

Add maintenance trigger

Summary template *

cylinder anomaly

Description template *

this is a description

Smartenance machine (number)

Cylinder Monitoring Board 1 (1)

☐ Incident creation for anomalies

Cancel Create

Maintenance system

Version 17.0.7 · [Changelog](#) · [Licenses](#) · [Privacy policy](#) · [Import](#)

When the application is running

5.6 Deletion of data

Recorded data is deleted as soon as 250M features are reached as a default deletion task. This can be changed by adding a new task and deleting the existing default task:

Admin Setup > System Tasks

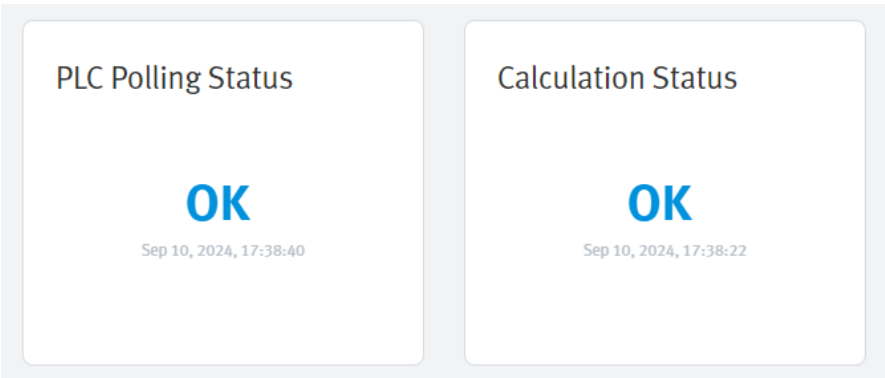
5.7 Debugging: System Info / Status

In case of any unexpected behaviour, the status of connectivity etc. can be checked in the MIP connector as well as in the System Info tab of each asset dashboard.

MIP Connector:

Data Block	Cylinder Id	Valve Id	Valve Terminal Id	Polling Status
1	thisIsMyCylinder	thisIsMyValve	thisIsMyTerminal	✓ HEALTHY

Asset Dashboard:



Polling Status

The polling status is determined by comparing the actual polling rate with the target rate, taking into account a delta value. If there is a deviation, the status is classified as UNHEALTHY.

State in MIP Connector	Description
IN CALCULATION	During the "IN CALCULATION" state, it is determined whether the polling is HEALTHY by counting the individual transmissions from the PLC to MQTT.
HEALTHY	The "HEALTHY" state of the polling status is achieved when the transmissions between the PLC and MQTT fall within the specified delta range. In this state, the actual polling rate closely matches the target polling rate, indicating a healthy polling rate.
UNHEALTHY	The "UNHEALTHY" state of the polling status occurs when the transmissions deviate from the specified delta range, indicating an unstable polling rate.
State in asset dashboard	
OK	Is mapped to the "HEALTHY" status in the MIP Connector, but it only changes when the state transitions from another state.
ERROR	Is mapped to the "UNHEALTHY" status in the MIP Connector, but it only changes when the state transitions from another state.

Table 5.2: MIP connection descriptions

Calculation Status

The "Calculation Status" indicates whether the travel times can be calculated correctly. If the calculation cannot be performed after 8 timestamp value changes, it is assumed that the timestamps are not in the correct order, and the timing is considered to be incorrect.

State in asset dashboard	Description
OK	If the travel times can be calculated, the status is classified as "OK"
ERROR	otherwise "ERROR"

Table 5.3: State in asset dashboard descriptions

6 Frequently Asked Questions

➤ **How many cycles do I need to fine-tune the model initially?**

750 cycles of the cylinder are needed to fine-tune the model. These cycles should include all possible variants of the cylinder (e.g. different weights).

➤ **What actuators does AX Motion Insights Pneumatic work for?**

It works for linear pneumatic actuators with two limit switches attached (to detect end position). So:

- Piston rod cylinders
- Rodless cylinders
- Clamp cylinders
- Pneumatic Grippers

Generally it works for all linear actuators, for which this formula is true:

Travel time actuator <i>GREATER THAN</i> ten times PLC cycle time
--

➤ **Can I install Motion Insights to an existing installation or do all the actuators have to be new at start up?**

Motion Insights can be installed on existing, running installations as well as new ones. Cylinders should be in good condition and running optimally. It is great to onboard cylinders especially after a recent maintenance.

➤ **What happens to the monitoring when an actuator is replaced by a new one?**

You need to retrain the AI for 750 cycles to re-establish norms.

➤ **Does AX Motion Insights Pneumatic work with non-Festo cylinders?**

Yes it does. Generally all pneumatic cylinders that fulfill the criterias defined above.

➤ **My PLC vendor is not yet officially supported by AX MIP. What can I do?**

Festo updates the support for other PLCs continuously. Generally all modern PLCs can be added with slightly more individual effort (lacking the plug'n'play approach described in this document). Please get in contact with Festo through your contact person to discuss individual challenges.

➤ **I have specific questions. How can I get in contact?**

Get in contact with your Festo contact person or through <https://www.festo.com/contact>

➤ **I also have other motion components, e.g. electrical axis. Can I monitor them as well?**

A standardized AX Industrial App for e-axis-monitoring is also available, Motion Insights Electric. Generally the Festo AX Industrial Intelligence suite can be used to tackle various challenges. Find out more here:

<https://www.festo.com/ax>

➤ **The machine is running but I don't see any data or anomaly score calculated. What is the reason?**

There's different reason why no anomaly score is calculated and no data received although everything seems to be set up correctly and machine is running.

- Check for the parameter "ENABLE" in the function block. This must be set to **true**!
- Check for the parameter "bAutomaticMode" in the function block. Only data is taken into account that is generated while this parameter is set to **true**!
- The machine might be running but are the monitored cylinders moving?
- Is everything wired correctly with the function block?
- Have all the models been trained without and error?

➤ **Can I use limit switches with N/C (normally closed) contacts?**

Generally yes, but the signals have to be inverted in the PLC before connecting to the function block. The function block expects N/O (normally open) contacts.