

SIEMENS

Insights Hub

Insights Hub Edge Analytics

System Manual

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Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

DANGER

indicates that death or severe personal injury **will** result if proper precautions are not taken.

WARNING

indicates that death or severe personal injury **may** result if proper precautions are not taken.

CAUTION

indicates that minor personal injury can result if proper precautions are not taken.

NOTICE

indicates that property damage can result if proper precautions are not taken.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

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WARNING

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We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

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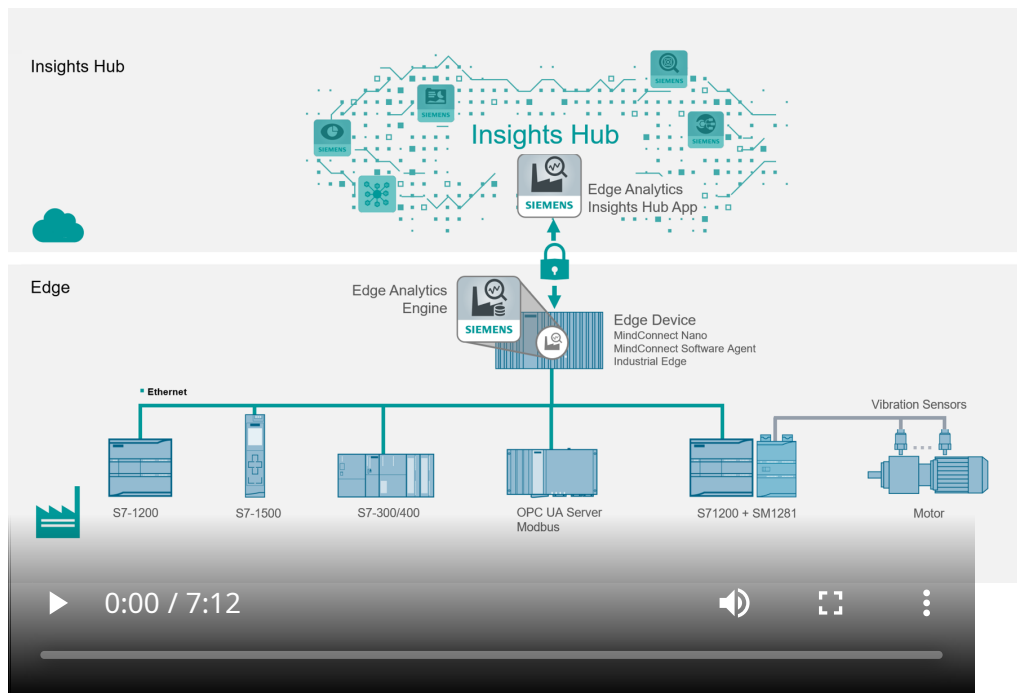
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Introduction

1.1 Introduction

Insights Hub Edge Analytics offers condition monitoring, predictive maintenance, and edge-based, high and low frequent data pre-processing with out-of-the-box and custom KPI calculations.



Insights Hub Edge Analytics is an edge application to collect and preprocess high and low frequency data, correlate them and perform out of the box analysis. It also helps to receive valuable information like the health status of machines or about the performance of a production process. The calculated data can be sent directly to the Insights Hub.

The analysis of the data takes place in an application on an Edge Device. With these calculation results it is possible to perform condition monitoring of assets. The configuration of the Edge Device is done via Insights Hub app.

The analysis packages of Edge Analytics determine the relevant information and send it to Insights Hub. It provides an insight about the condition of an asset. It is also possible to define and manage your own "Custom Analysis" packages.

Insights Hub Edge Analytics offers the following options:

- Edge Analytics allows the data preprocessing.
- Collection, recording and archiving of high dynamic signals from a variety of data sources.
- Sampling rates up to 50 kHz per second.
- Local data buffering in memory for analysis then send it to Insights Hub for long term
- archiving.
- Vibration analysis with a highly scalable system.
- Improved asset availability through predictive maintenance.
- Intuitive creation of common KPIs.
- Usage of seven predefined KPI calculations:
 - RMS Velocity
 - Peak-Peak Velocity
 - Zero-Peak Velocity
 - RMS Acceleration
 - Peak-Peak Acceleration
 - Zero-Peak Acceleration
 - Crest Factor
- Availability for a wide range of industries.
- Calculate vibration characteristic values:
 - RMS Acceleration
 - Peak-Peak Acceleration
 - Zero-Peak Acceleration
 - RMS Velocity
 - Peak-Peak Velocity
 - Zero-Peak Velocity
- Calculate vibration frequency spectra:
 - Spectrum Acceleration
 - Spectrum Acceleration Envelope
 - Spectrum Velocity
- Calculate mathematical statistics: Average, Minimum, Maximum, Peak-Peak and Dynamic.
- MindConnect Databus:

- Access to S7 PLCs with Put / Get
- Access to OPC UA servers
- Read Modbus TCP data
- Read Modbus RTU (RS232, RS485, RS422)
- Access to Rockwell Protocol
- Advanced Driver protocols as supported by MindConnect agents
- PLC Streaming Interface
 - Read data from S71200 and 1500 with up to 1kHz
- MQTT Data Source
 - Read data Industrial Edge Databus for SIMATIC S7 Adapter
- It will detect the defined machine state and execute analysis with Trigger Rules.
 - You can use the collected data and visualize it with Insights Hub Monitor.



Subtenant function

The subtenant function is currently not supported for Insights Hub Edge Analytics.

Purchase Insights Hub Edge Analytics

You can buy Insights Hub Edge Analytics App from the [Industrial IoT Store](#).

Supported browsers

Following are the supported browsers for Edge Analytics application and the tested versions are given in brackets:

- Google Chrome (V119)
- Mozilla Firefox (V115)
- Microsoft Edge (V119)

Insights Hub Edge Analytics is also supported for Local Private Cloud.

Basics of vibration monitoring

2

2.1 Mechanical vibrations

Insights Hub Edge Analytics provides information about the condition of your assets. The condition monitoring of your assets is based on the monitoring and analysis of mechanical vibrations.

Mechanical vibrations can be measured and felt on surfaces of objects. In asset monitoring these include surfaces of machines, components and foundations. Mechanical vibrations are also known as "impact sound", because they propagate exclusively in solid objects. In contrast, the audible "airborne sound" moves in gaseous media, for example, air.

Mechanical vibrations always occur when masses are moving. These masses include:

- Rotating or oscillating parts of machines
- Gases or liquids that impinge on solid surfaces

2.2 Vibration diagnosis

Mechanical vibrations show high information content in several respects:

- Indicator for asset condition
- Reference to dynamic loads of machines, foundations, close-by machine parts
- Reference to operational safety, service life and economy of machines
- Basis of machine diagnosis and vibration damping

Vibration diagnosis is the basis for mechanical condition monitoring of an asset. Based on the vibration diagnosis the following errors can be detected:

- Changes in the airborne sound can be detected
- Displacements of machine parts can be detected
- Altered mechanical vibration behavior can be detected
- Mechanical wear can be detected

Vibration diagnosis also offers the following opportunities:

- Individually planning of maintenance intervals

- Increased machine availability
- Increased productivity of machines

In a detailed analysis, the vibrations in the frequency range are examined. A Fast Fourier Transform (FFT) is used to transform a time signal to the frequency range. This FFT separates the total vibration into sine and cosine components with corresponding amplitudes and frequencies. The time signal is either the vibration signal itself, or the envelope of the vibration signal. This depends on the problem definition and which machine part is monitored.

With the vibration signal, the following errors can be detected:

- Unbalance
- Misalignment
- Soft Foot

With the envelope of the vibration signal, the following errors can be detected:

- Damage to rolling bearing
- Damage to gears

The frequency components generated by individual machine parts are usually known. If they are not known, they must be calculated. If a particular frequency component is over represented, a fault can be assumed. The frequency components in a vibration can therefore be used to identify a large number of faults. For example, vibrations may be caused by the following faults:

- Changes to balance condition
- Changes to alignment
- Wear or damage to journals or rolling bearing
- Damage to gears (meshing) and couplings
- Fissures in critical components
- Operating faults
- Disruptions to the flow in hydroelectric machines
- Transient excitations in electric machines
- Friction
- Mechanical loosening

For example, an imbalance causes a higher amplitude at single speed, whereas a misalignment is characterized by single and double speed in the frequency range. In the case of damage to rolling bearing, the damage frequencies in the vibration signal are not directly visible. Shock pulses are generated as the rolling elements move over the location of the fault. These must be used to create an envelope of the vibration signal. This signal is then transformed into the frequency range.

2.3 General Condition Monitoring

Condition Monitoring is used for a condition-based maintenance of machines, processes and complete plants. The intention is to avoid unplanned downtimes to increase availability of a plant. Therefore, a cyclic or permanent measurement and analysis of data is performed. Physical quantities can be, for example, temperature, speed, torque, vibration, pressure or current. As a result, requirements regarding sensors and connectivity in general are very high. Depending on the data acquired of different sensors which are used for the measurement. In particular, for rotating equipment, mechanical vibrations are used to determine the condition. They provide information about the load of a machine and evolving faults.

Condition Monitoring is one of the main benefits of connected devices and data, offered by be uploaded to Industrial IoT. Streaming data from manufacturing machines, industrial equipment, and other devices connected to be uploaded to Industrial IoT create a massive amount of data. The handling and managing of these data can be difficult and expensive.

Required hardware

3.1 Required hardware

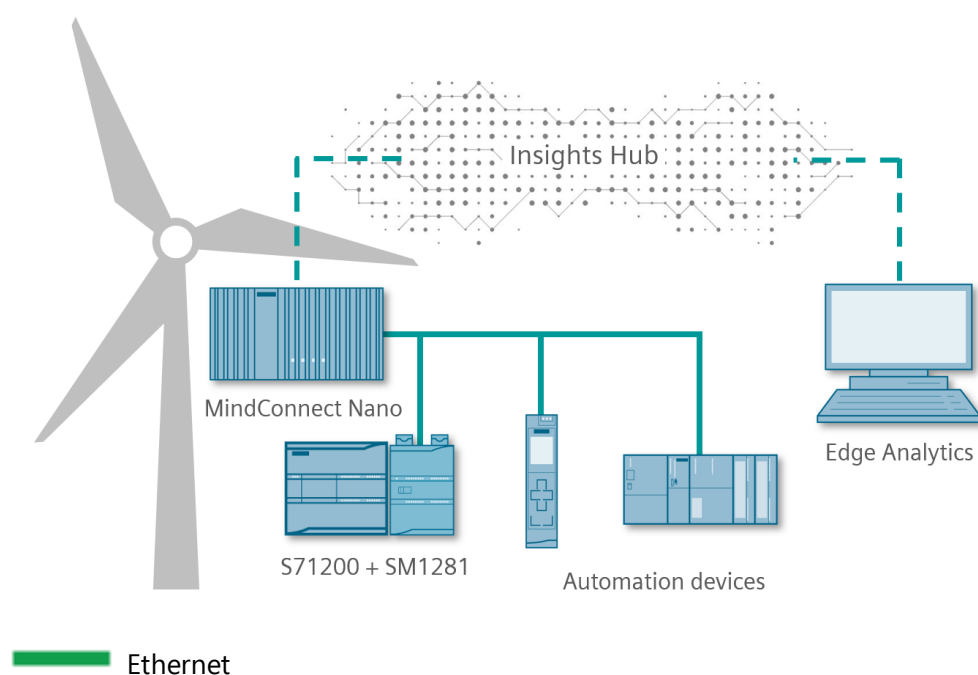
To enable data transfer from your asset to Edge Analytics, you need a supported Edge Device.

- MindConnect Nano
- MindConnect Software Agent (HyperV and Docker)
- MindConnect IoT2050
- [Industrial Edge](#)

You can expand the configuration with the following devices to take full advantage of Edge Analytics:

- SIPLUS CMS1200 SM 1281
- SIMATIC S7 1200 PLC
- ifm ves devices

The following graphic shows an example of the data exchange between the asset and Edge Analytics:



Commissioning

To ensure that simple-KPI Edge Analytics runs correctly, commission the individual hardware components as specified.

You find the instruction in the following manuals:

- SIPLUS CMS 1200 SM 1281 operating manual
- SIMATIC S7 1200 PLC operating manual
- MindConnect Nano
- MindConnect Software Agent (HyperV and Docker)
- MindConnect IoT2050

User rights

4

4.1 User rights

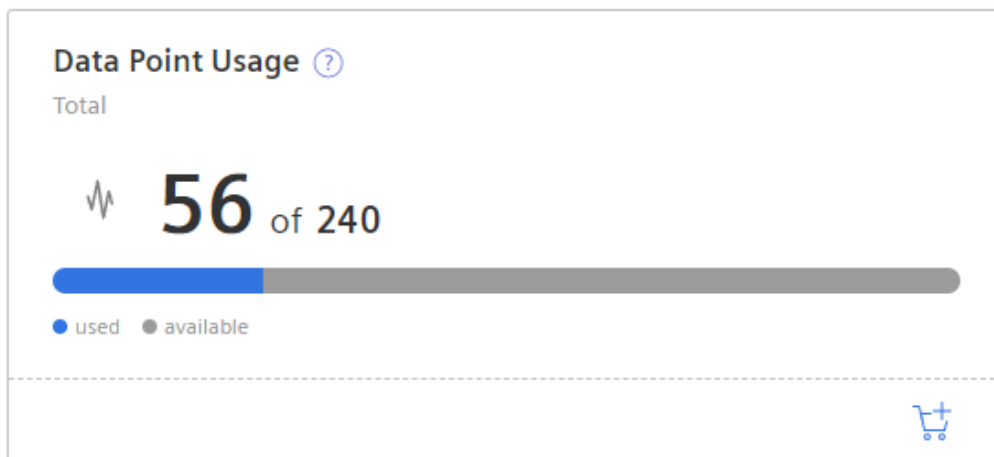
Insights Hub Edge Analytics adopts user rights from Settings. To access and work with Insights Hub Edge Analytics, you need the `eas (mdsp: core)` admin role.

To access and use the Custom Analysis feature, the `mdsp:core:eas.engineer` role or a higher role (`mdsp:core:eas.admin` or `mdsp:core:eas.developer`) needs to be assigned. For more information on roles, see [Settings](#) documentation.

5.1 Data Point Quota

For a tenant, Edge Analytics has a central Data Point Quota that limits the number of Data Points read by Data Source configurations. When creating a Data Source configuration, the number of Data Points configured in the Data Source is directly consumed from the tenant Quota. If the Quota is exceeded, no further configurations can be deployed on the Edge device. The Data Point Quota for the tenant can be filled up with the [5 Data Point Offering](#). Each purchased 5 Data Point offering adds 5 Data Points to the overall number of allowed Data Points for the tenant.

The current Data Point usage can be seen on the "Home" screen of Edge Analytics or on the update tab of a selected Edge Device.



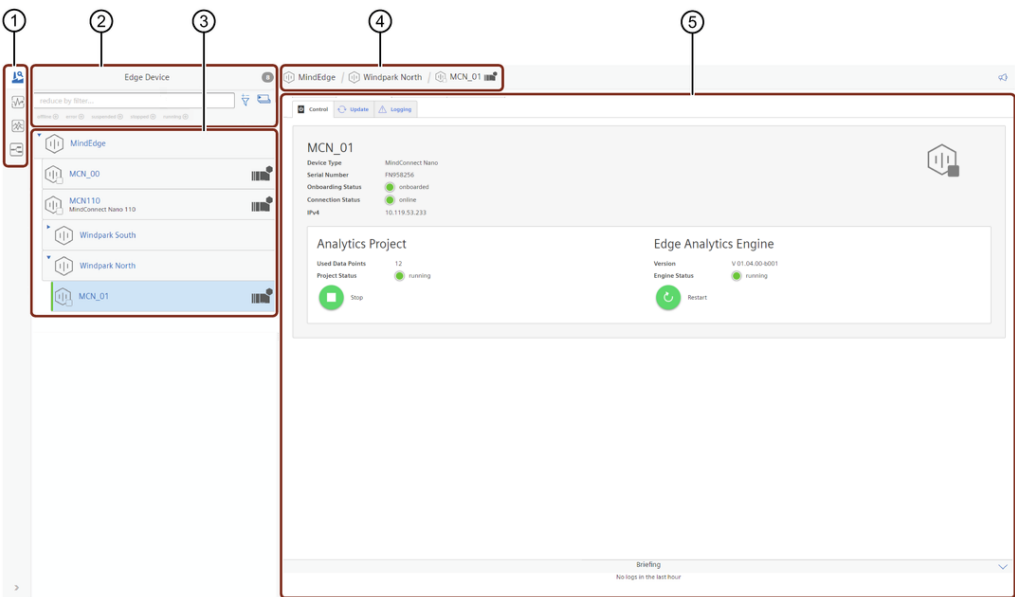
!!! note **Migration** If you already own Edge Analytics licenses of an old type, they will be automatically converted to the Data Point Quota accordingly.

User Interface

6

6.1 User interface

The following graphic shows the user interface of Insights Hub Edge Analytics:



- ① Main selection
- ② Filter and Expand/Collapse operations
- ③ Tree View of Asset structure
- ④ Hierarchy path of the asset
- ⑤ Configuration area

Symbols

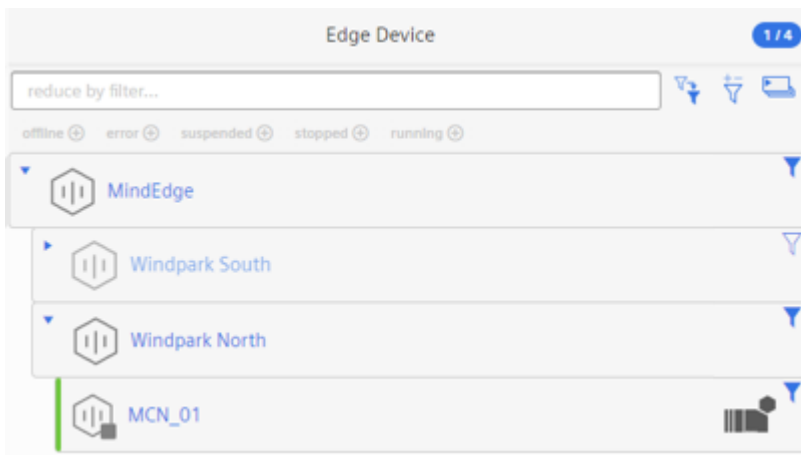
The following section shows the icons that may appear in the user interface:

Symbol	Description
	Shows that you need to update your configuration. A new version of the application requires your configuration to be migrated.
	Shows that configurations are available for upload.

With the node filter it is possible to configure the shown nodes within the Tree View.



After activation of the filtering selection by clicking on the filter button, to be shown or not shown nodes can be selected by clicking on the filter icon directly at the node. The filter icon is shown bold for selected nodes, which shall be shown in the filtered view. All child nodes of a filtered node will receive the same filter status.



In case the filter selection is active and all nodes are selected to be shown, below icon can be used to deselect all nodes.



In case all nodes are deselected, below icon can be used to select all nodes.



The filter selection can be again left by clicking.



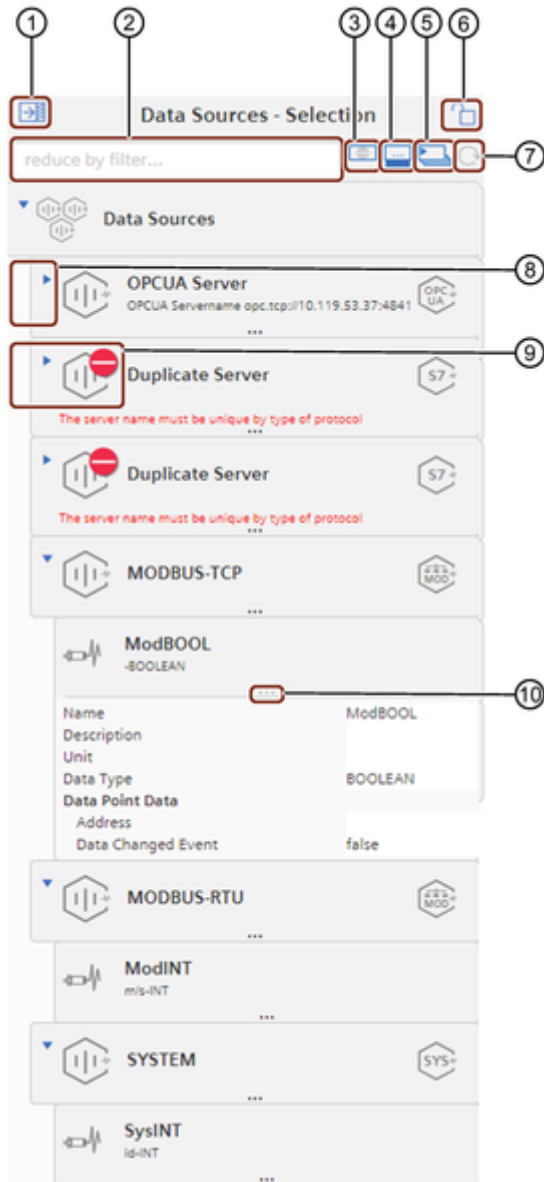
In case the filter selection has been left and a filtering is active, below icon will be still shown.



By clicking on this button, the complete filtering can be removed and all nodes will be shown again. Afterwards this button will also disappear.

6.2 Context bar

The following graphic shows the context bar:



- ① Expand or collapse the context bar
- ② Search field
- ③ Hide or show entries which are not applicable
- ④ Expand or collapse all property panels
- ⑤ Expand or collapse all items
- ⑥ Lock or unlock the expand or collapse of the context bar
- ⑦ Refresh context bar
- ⑧ Expand or collapse data source

- ⑨ Shows that the data source is not applicable
- ⑩ Expand or collapse the property panel

7.1 Workflow for using Edge Analytics

With Edge Analytics, it is possible to configure a data streaming from certain data sources as well as to be applied analysis packages for streamed data. These configurations can be deployed to an Edge Device. An active configuration on an Edge Device can be monitored, started, and stopped. In order to get started with Edge Analytics, a MindConnect Nano, MindConnect IoT2050, MindConnect Software Agent or Industrial Edge has to be onboarded to the tenant. To get an Edge Analytics project deployed to an Edge Device, follow these steps:

[Onboarding of Edge Device](#)

[Initialize Edge Analytics Engine](#)

[Create resources structure](#)

[Configure Data Sources](#)

[Configure Analysis Packages](#)

[Configure Trigger Rules](#)

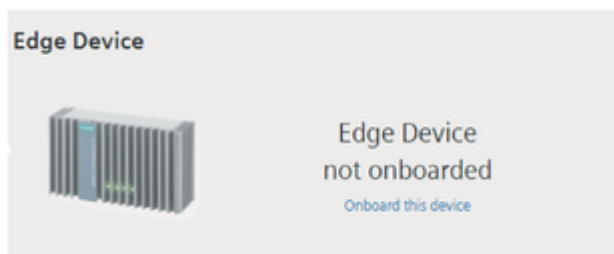
[Create Project](#)

[Update configuration to Edge Device](#)

After the upload is successful, you can start and pause the uploaded configuration within "Control". For more details, refer to [Edge Device - Control](#).

7.2 Onboarding Edge device

If the edge device, for example MindConnect Nano, is not onboarded, the following is displayed:



To onboard the device in Asset Manager, click on "Onboard this device".

You will get redirected to Asset Manager. You find the information for onboarding the device in the documentation of [MindConnect-Hardware-general-description](#).

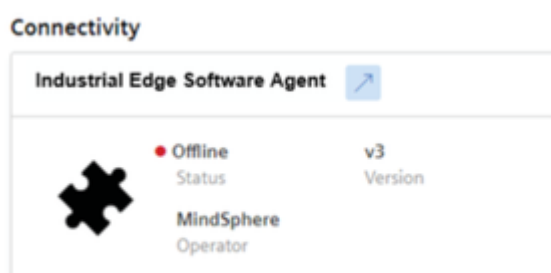
Onboarding an Industrial Edge device with Insights Hub Edge Analytics

To onboard an Industrial Edge, ensure that the Edge Analytics application is installed on the target device from the Industrial Edge Management Hub. For information about Industrial Management Hub and how to manage Industrial Edge devices, see [Industrial Edge Management](#) documentation.

To onboard an Industrial Edge, proceed as follows:

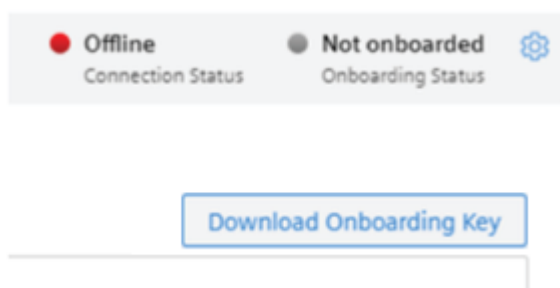
Within the Asset Manager application, create a new Asset of type `core.industrialedge`

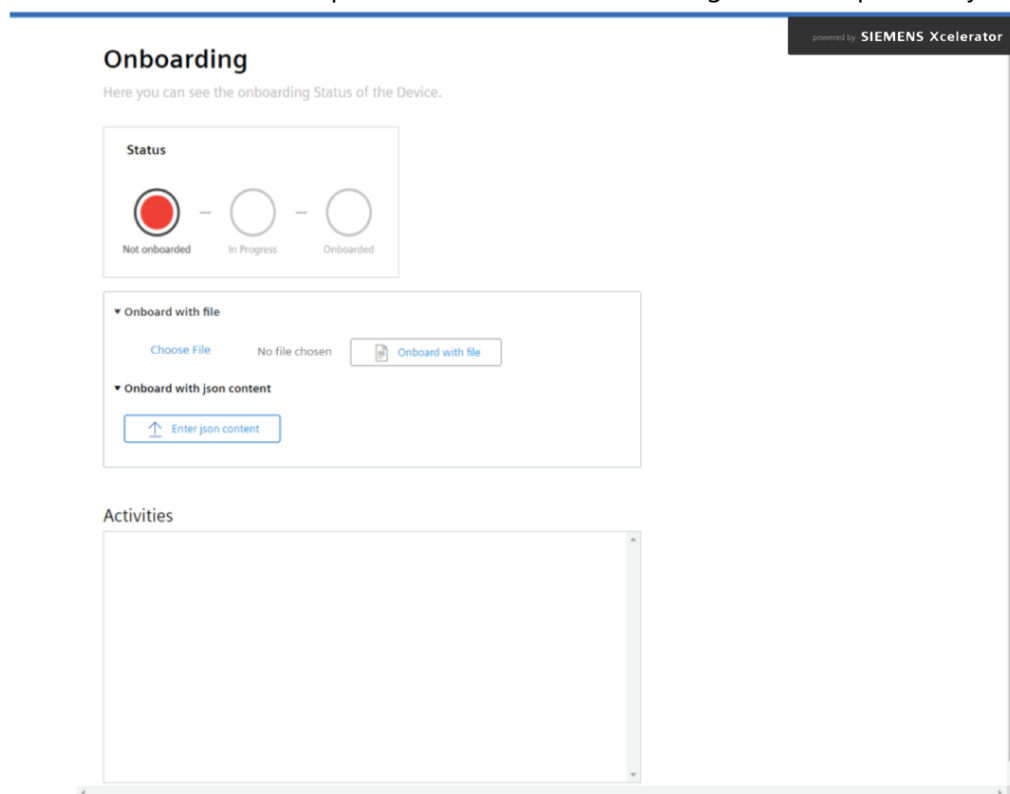
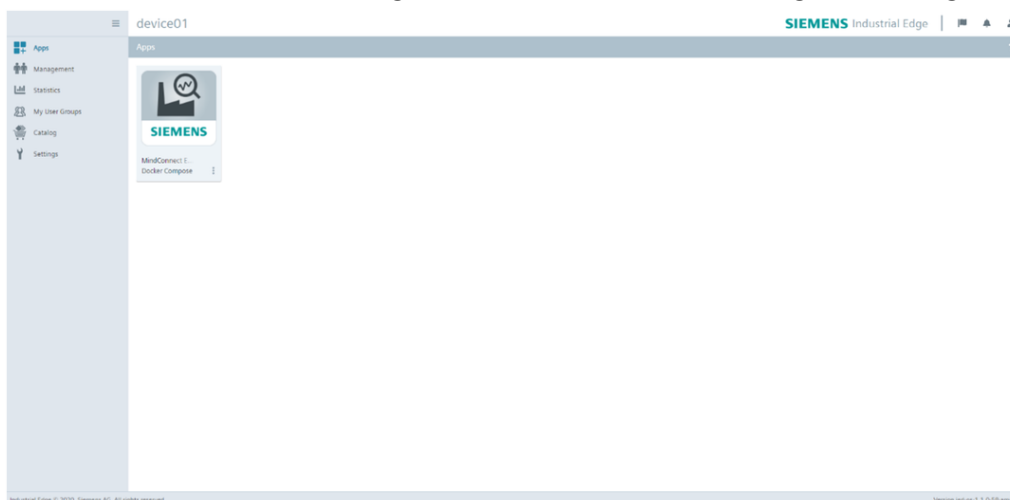
1. `softwareagent` and enter the Industrial Edge Software Agent Plugin.



- Within the Industrial Edge Software Agent Plugin, edit the connection settings using the
2. "Settings" button, if required.

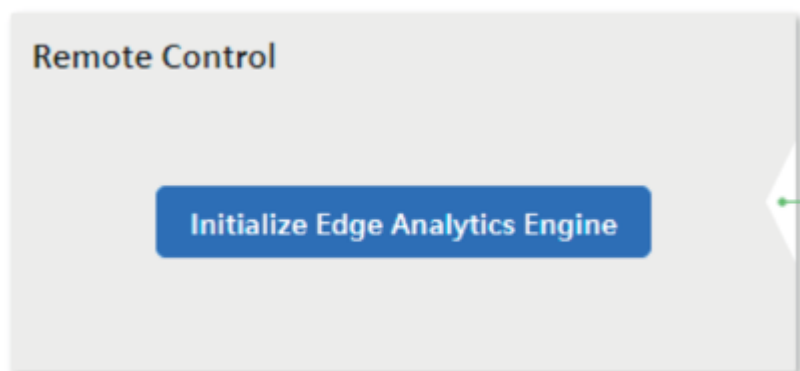
3. Click the "Download Onboarding Key" button.





7.3 Initializing Insights Hub Edge Analytics Engine

By default, the Insights Hub Edge Analytics Engine is deactivated on your edge device. The following message is displayed:



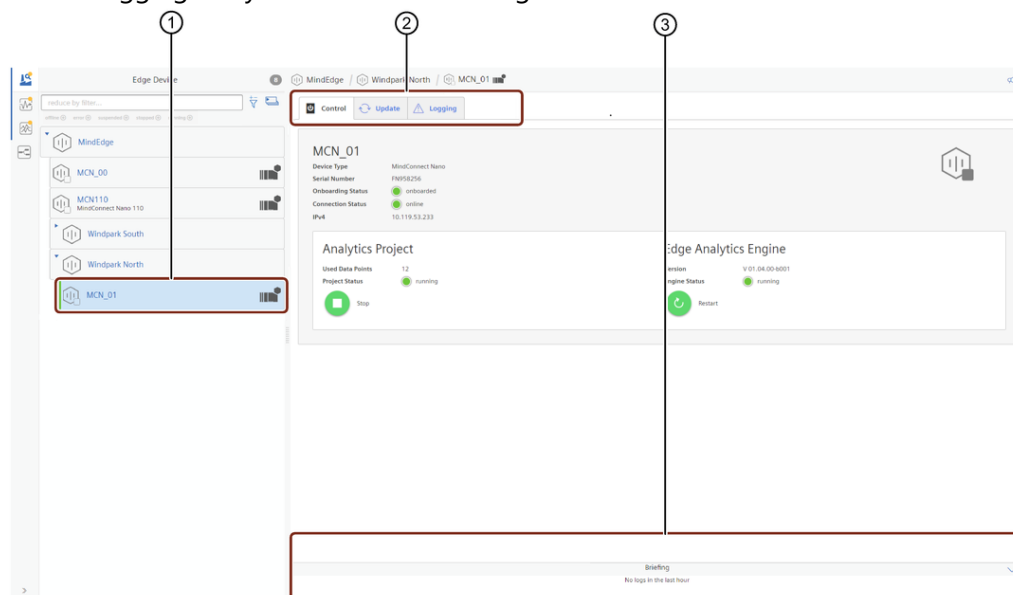
To activate the Insights Hub Edge Analytics Engine on the device, click on "Initialize Insights Hub Edge Analytics Engine".

After confirmation The Edge Analytics Engine runs on your device.

An initialized Insights Hub Edge Analytics Engine runs until the next factory reset.

8.1 Edge Device Overview

The following graphic shows the selection of an Edge Device. Within the tree view, the asset structure of the tenant is shown. Available Edge Devices can be selected for further configuration. A selected Edge Device provides the feature tabs Control, Update and Logging. The Control tab provides general information about the device and allows you to control the Edge Device as well as the deployed project (#using-control)). In the Update tab you can update new or changed configurations to the Edge Device (#uploading-configuration-to-edge-device)). In the Logging tab you can view all the log information.



- ① Selected Edge Device
- ② Feature Tabs for Edge Device
- ③ Brief log info

Adding and editing entries is not always possible

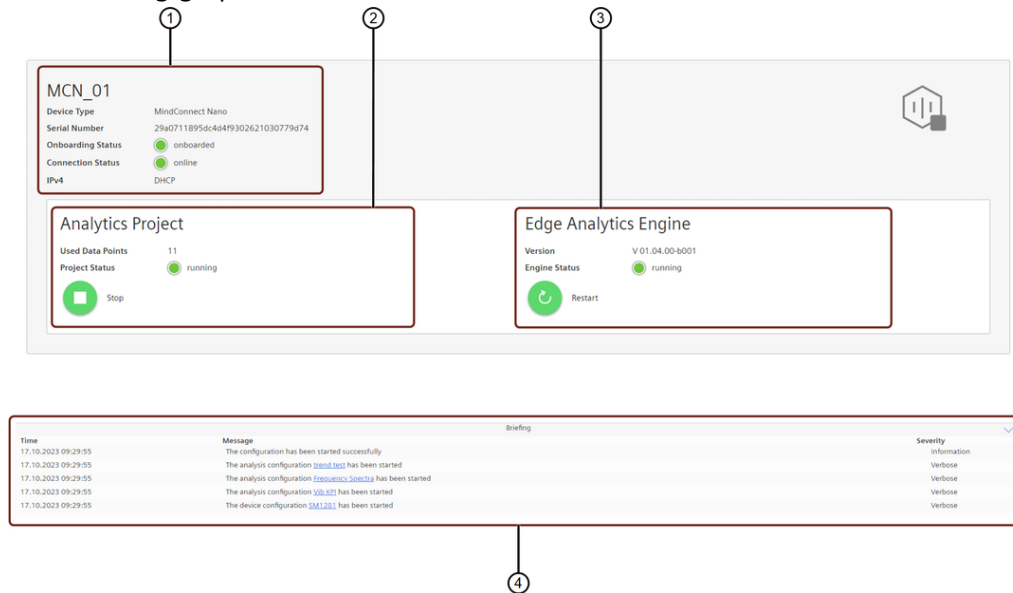
When opening Edge Analytics for the first time, an asset structure is shown in the navigation. Within this asset structure it is not possible to add, rename or delete entries. These entries were created in Asset Manager.

To create individual entries follow the procedure described in chapter [Creating individual structure](#).

8.2 Control

The "Control" page provides information about the connection status between Edge Analytics, Insights Hub and the Edge Device. Additionally it shows the status the Edge Analytics Engine and the Analytics Project.

The following graphic shows the "Remote Control" user interface:



- ① Device Information
- ② Analytics Project control and status
- ③ Edge Analytics Engine control and status
- ④ Brief logs of the last hour

8.3 Logging

On the Logging tab for the selected Edge Device, corresponding log information of the device and the project can be examined.

Log entries are displayed with different levels of severity and can therefore have different meanings.

The following table shows the different severity levels, starting with the worst in descending order and an exemplary message.

Severity	Description	Example Message
Critical	An error has occurred that you cannot resolve yourself. Please contact the support.	<p>The device configuration could not be created.</p> <p>The analysis configuration could not be created.</p> <p>The configuration could not be started.</p>

Severity	Description	Example Message
Error	An error has occurred that you can resolve yourself. Please adjust your configuration to resolve the error.	The configuration has been started with suspends. The device configuration has been suspended. The analysis configuration has been suspended.
Warning	A temporary issue has occurred, which may disappears after some time.	The CPU usage is too high.
Info	Information about current system activities.	The configuration has been started successfully. The device configuration has resumed: <device configuration reference> The analysis configuration has resumed: <analysis configuration reference>
Verbose	Shows all present messages.	The device configuration has been started: <device configuration reference> The analysis configuration has started: <analysis configuration reference>

Date and Time picker

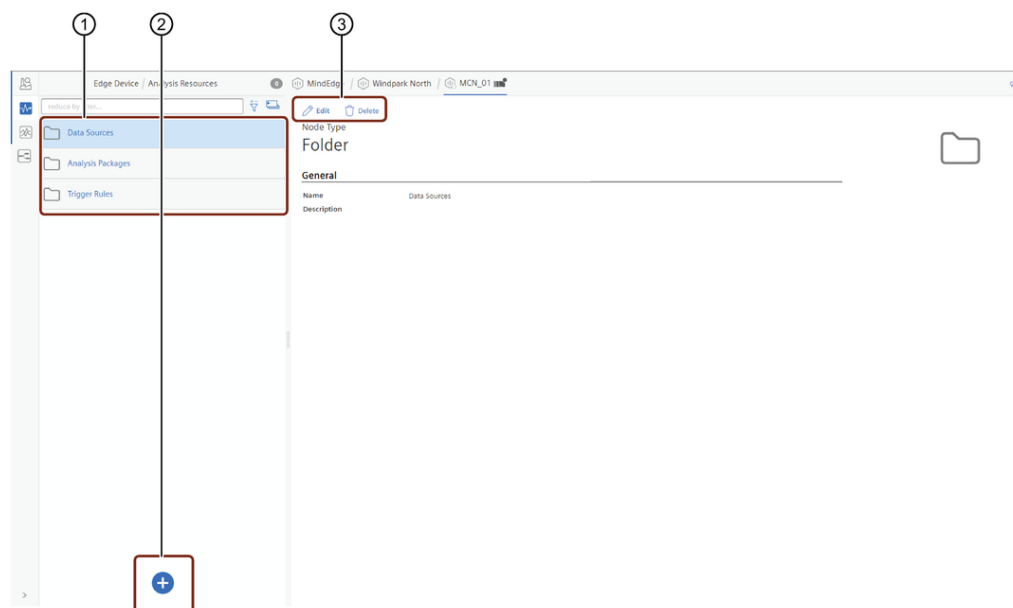
With the Date and Time picker, you can select a specific time range for which the available messages are to be displayed.



- ① Previous month
- ② Select the time interval to specify your search.
- ③ Next month
- ④ Shows the selected end date of the search
- ⑤ Displays the current day
- ⑥ Input box to add the exact time for specifying the search
- ⑦ Click "Confirm" to apply the selected search parameters or "Cancel" to return without applying the search parameters.
- ⑧ Shows the selected start date of the search

8.4 Resources

The following screenshot displays the configuration section, which is used for the creation of configuration items like data sources, analysis packages and trigger rules. Created resource items are in general templates which can be applied to a project multiple times, within the project section.



- ① Structure of resources
- ② Buttons to create new resource items
- ③ Buttons to edit or delete existing items

8.5 Resource structure creation

For the Resources and Project section the structure will depend on your individual configuration. In the "Resources" section, at least one folder has to be created to insert an Analysis Package, Data Sources or Trigger Rules. The created folders can be used to structure your configuration

items. In the Project section, the existing configuration items that have been created in the Resources section will be utilized to create a project. The Project structure will represent the upload path of the resulting data.

Procedure

To create a new structure for your Data Sources, Analysis Package and Trigger Rule configuration within the Resources, proceed as follows:

1. In the "Edge Device" tab, select an edge device in the navigation.

Select "Resources" in the main selection.

The Asset structure disappears and a new tree view representing the resource structure is

2. displayed.

3. To create a new entry in the navigation, click on "Root Folder". In the case when there is no existing structure.

4. Type the appropriate name and press <Enter>.

5. To create another subsection, select the new created entry, and click on "Sub Folder".

6. Type the appropriate name and press <Enter>.

Proceed in the same way with the remaining entries. If you want to create a root entry at the first level again, select a folder on the first level, and click "Parallel Folder".

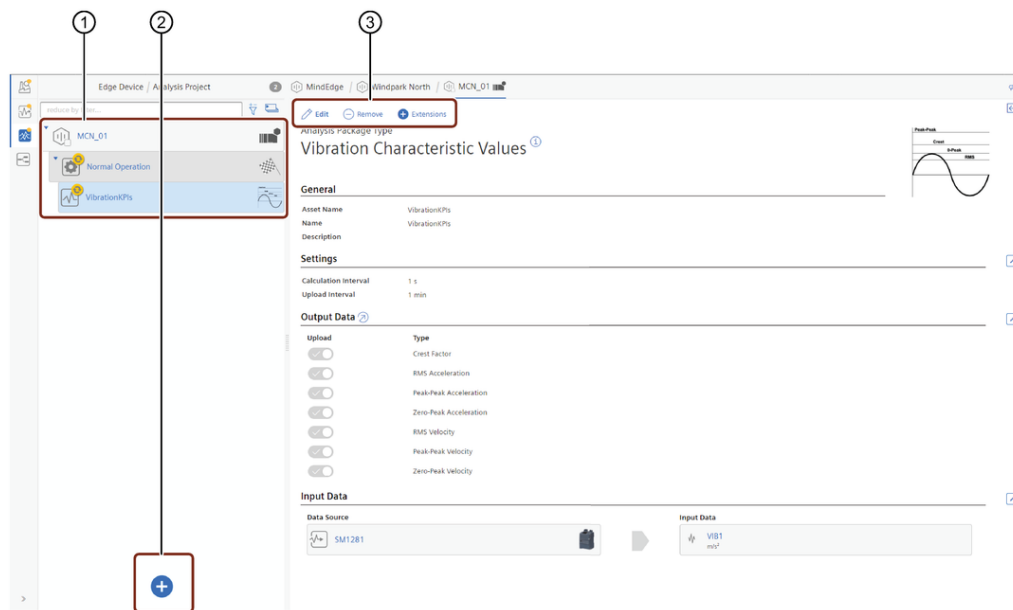
Result

You have created a new individual resource structure and can continue to create the Data Source, Analysis Package and Trigger Rule configurations according to your needs.

8.6 Project

The project section is used to compose a project with the existing items from the resource section. You can build the project structure and define the execution for a specific analysis. You can also define the asset structure, where the calculation result is to be uploaded.

The following screenshot displays the user interface of the "Project" section:



- ① Items that are inserted in the project structure
- ② Add new items in the project structure
- ③ Buttons to edit and remove items in the project structure

The project structure starts with a root asset, which can be selected from the asset structure of the tenant. Additional sub assets can also be inserted in the project structure. Trigger Rule items have to be inserted to define the execution of an analysis. Analysis Packages can be inserted below Trigger Rules, to execute them based on the Trigger Rule state.

8.7 Create a Project

Within the Project section, a final Analytics Project is assembled from the resource configuration in the Resource section. It can be defined where the calculation results shall be uploaded within the asset structure of the tenant. Available assets can be inserted into the tree structure to build the desired structure. Below an asset in the tree structure, Trigger Rules and Analysis Packages can be inserted from the resource section, and as their input data, data from Data Sources needs to be linked. For each Analysis Package an asset will be automatically created on the tenant, containing the uploaded calculation results of the Analytics Project. The asset name for each inserted configuration can be adapted if needed. Alternatively, a Data Mapping extension can be used to map the to be uploaded data to an existing structure, if no automatic asset creation is wanted.

The following steps will lead you through the process of creating a project.

Requirements

Prepare edge device within Edge Analytics:

- [Individual structure](#) has been created within the "Resource".

- Activated edge device.

Procedure

To create a project, proceed as follows:

1. In the "Edge Device" window, select an edge device.
2. Select "Project".
3. Click on the button to add a "Root Asset" and select a root asset.
4. Select the inserted asset.
5. Click on the button to add a Trigger Rule and select an existing Trigger Rule.
 - In case of a Trigger Rule with a condition value range, click the edit button and drag and drop a desired data from the context bar, and click "Save".
6. Click on the button to add an Analysis Package and select an existing Analysis Package.
7. Click on the edit button and drag and drop the data onto the input data area.
8. Click "Save".

Result

You have successfully created a new project.

8.8 Data Upload Options

By default, the composed project structure defines the target upload assets.

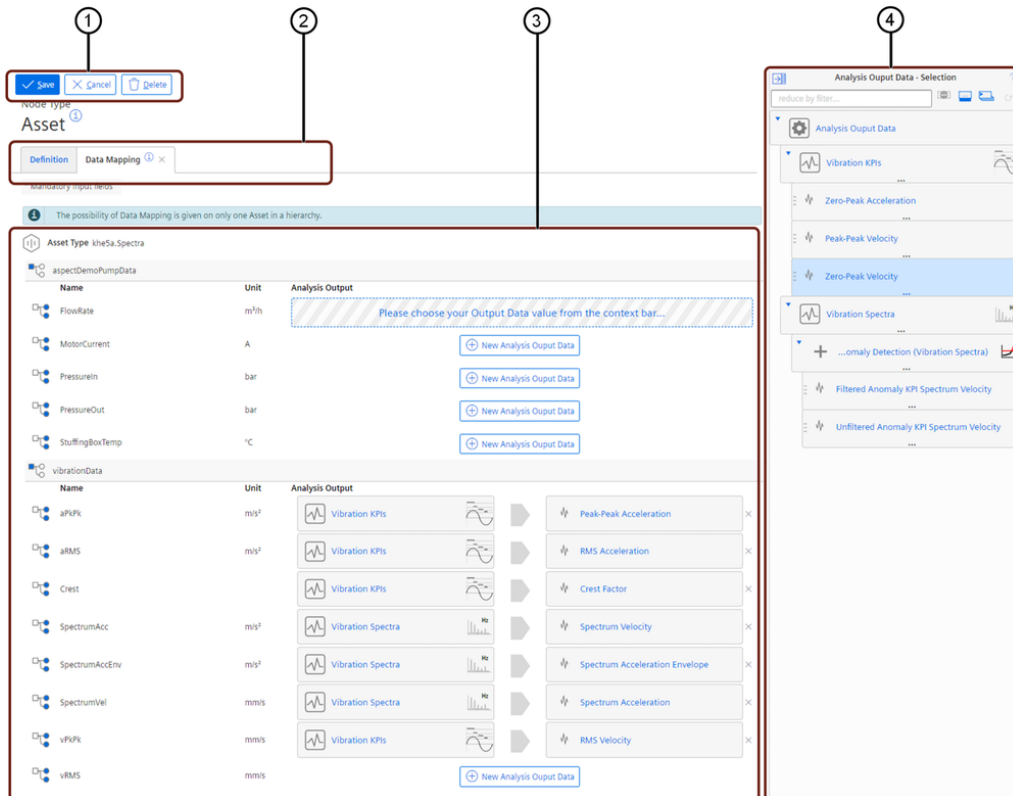
Edge Analytics will create an asset for each inserted Trigger Rule and Analysis Package, with the name "Trigger Rule.Analysis Package". For these assets, the output data of the Analysis Packages will be uploaded.

In case you would like to use your own asset, aspect, and variable structure, to which the output data of an analysis shall be uploaded, you can use the data mapping extension.

Data Mapping

Output data from Analysis Packages can be mapped to variables of existing aspects and assets. To do so, you can add the extension "Data Mapping" to an asset that you have inserted to your project structure in Edge Analytics. The extension will recognize all underlying Analysis Packages and their output data, and you can link the output data to the available variables of the target asset.

The following screenshot shows the data mapping extension:



- ① Save or cancel changes
- ② Configuration tabs
- ③ Overview of the asset type, showing available aspects and variables that can be used for mapping
- ④ Context Bar containing available output data, which can be dragged and dropped to variables



Each output data can only be mapped to one variable at a time.

8.9 Update

On the "Update" tab, the analysis and data source configuration can be updated to the Edge Device. "Update" also provides information about the active configuration of the Edge Device. After the upgrade, your device starts to execute the configuration.

The configuration can only be updated to the Edge Device if the "Data Point" Quota is not exceeded. Each read data from a Data Source configuration consumes one Data Point of the Quota. The Quota can be filled up with additional [Data Points](#) for the whole tenant.

The following graphic shows the "Update" user interface:



- ① Overview about Data Point Quota
- ② "Active" list provides information about all configurations that have already been deployed.
- ③ "Pending" list provides information about available configurations.
- ④ Update button:
 - Start the update.
 - Individual steps executed during the update.

Parameter of "Pending" area

The following table shows the different parameters of the "Pending" area:

Parameter	Description
Type	Shows the type of the configuration: - Analysis configuration - Device configuration
Modified	Shows date and time when the configuration was last edited. After editing a configuration, the update icon appears in the selection list related to the corresponding configuration.
Name	Shows the individual given name for the configuration.
Description	Shows the individual description added in the analysis configuration or device configuration.
Version	Shows the number of changes to the configuration.

Parameter of "Active" area

The following table shows the different parameters of the "Active" area:

Parameter	Description
-----------	-------------

Parameter	Description
Type	Shows the type of the configuration: - Analysis configuration - Device configuration
Modified	Shows date and time when the configuration was last edited.
Name	Shows the individual given name for the configuration.
Description	Shows the individual description added in the analysis configuration or device configuration.
Version	Shows the number of changes to the configuration.

8.10 Configuration Update steps

The following table shows the individual steps during the update:

Individual Update Steps	Description
Start/Retry	Start the upload.
Prepare Configuration	All individually designed configurations are prepared for the upload to MindConnect Nano.
Download to Box	Individually designed configuration is downloaded to edge device with Edge Analytics Engine.
Prepare Environment	Edge Analytics Engine is stopped.
Update Configuration	Transmitting the configuration files to edge device. Edge Analytics Engine receives the configuration files.
Start Configuration	The configuration files have successfully been transmitted and Edge Analytics Engine is started again after finishing the update.

8.11 Uploading configuration to Edge Device

Configurations which have been created within the resources section and composed to a project within the project section, can be deployed to the selected Edge Device. Items which are to be


downloaded to the device, are listed up in the "Pending" list. The already active configurations are listed up in the "Active" list.

Following steps will guide you through an update procedure.

Requirements

- The target Edge Device is onboarded and initialized
- You do have enough Data Points available from your Data Point Quota
- You have created a Data Source
- You have created a Trigger Rule
- You have created an Analysis Package

Procedure

1. Select the edge device in the navigation.
 - The edge device appears in the selection list.
2. Select the next edge device in the selection list.
3. Select "Update" tab in the main selection.
 - The "Update" edit window opens in the configuration area.
4. To start the upload process, click  in the "Update" edit window.
 - The configuration upload starts. After finishing, all configurations switch from "Pending" to "Active".

Result

The configuration is uploaded to the device:

Configuration Update



* Pressing the Retry button will resend the active configurations on the device again.

Pending

No pending items (An update will send the current and active configuration on the device again)

Active

Type	Modified	Name	Description	Version
	2018-07-24 10:25	SM1281		1
	2018-07-24 10:26	Vibration Analysis		1

The analysis package now retrieves the data.

Data Source and Interface configuration

9

9.1 "Data Source and Interface" configuration

9.2 Data Sources

Data Sources are used to directly connected devices, which are providing data, to Edge Analytics Engine, so that this data can be streamed.

Usually, each data source addresses a single device from which data is read.

[SIPLUS SM1281](#)

[Configure a SM1281 Data Source](#)

[MindConnect Data Sources](#)

[Configure a new MindConnect Data Source](#)

[Supported protocols for MindConnect Data Source](#)

[PLC Streaming Interface](#)

[Configure a new PLC Streaming Interface Data Source](#)

[MQTT Data Sources](#)

[Configure a new MQTT Data Source](#)

9.3 Data Interfaces

Data Interfaces are used to define generic templates for a data reading.

They can be used in combination with Analysis Models, to create a generic data reading and processing job.

[SIPLUS SM1281 WAV](#)

[Configure a SM1281 WAV Data Interface](#)

9.4 Data Source - SIPLUS SM1281

Within the "Data Source SIPLUS SM 1281" tab you configure the data source of a SIPLUS SM1281 device.

The following graphic shows the different areas of the "Data Source SIPLUS SM1281" window:

The screenshot shows the configuration interface for a SIPLUS SM1281 device. The interface is divided into several sections, each highlighted with a red box and a numbered callout:

- 1**: Save or Cancel buttons at the top left.
- 2**: Device Type dropdown menu.
- 3**: General section containing Name, Description, and a link to the user manual.
- 4**: Settings section containing IP, Command Port, and Data Port fields.
- 5**: Data section containing a table for configuring data sources.
- 6**: Characteristics section containing a table for configuring device characteristics.

The Data section table is as follows:

Enabled	Reference	Unit	Data Name	Sample Rate [Hz]	Sensor Sensitivity [mV/g]
<input checked="" type="checkbox"/>	VIB1	m/s²	Data Source1	44,875 kHz	100
<input checked="" type="checkbox"/>	VIB2	m/s²	Data Source2	44,875 kHz	100
<input checked="" type="checkbox"/>	VIB3	m/s²	Data Source3	44,875 kHz	100
<input checked="" type="checkbox"/>	VIB4	m/s²	Data Source4	44,875 kHz	100
<input checked="" type="checkbox"/>	Speed	rpm	Data Source5	44,875 kHz	100

The Characteristics section table is as follows:

Unit	Characteristic Name	VIB1	VIB2	VIB3	VIB4
m/s²	(Data Name) aRMS	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
m/s	(Data Name) aRMS	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
rpm	(Data Name) SDC	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

- ① Save or cancel
- ② Device Type
- ③ General
- ④ Settings
- ⑤ Data
- ⑥ Characteristics

Parameter table SIPLUS SM 1281

The following table shows the individual areas and parameters of the "Devices" window:

Area	Parameter	Description
Device type	-	Shows from which device type the configuration is created.
General	Device Name	Add an individual name for your device.
	Description	Add an individual description (optional).
Settings	IP	Add the IP address of the device.
	Command Port	Add the command port of the device.
	Data Port	Add the data port of the device.
Data	Enabled	Put a tick in the box to activate the channel.
	Reference	Displays the source which provides this data.

Area	Parameter	Description
	Unit	Shows the unit in which the value is given.
	Data Name	Field to add an individual signal name. Subsequent the individual signal name is put together with the Data Name Prefix to create clear terms.
	Sample Rate	Select the preferred sample rate.
	Sensor Sensibility [mV/g]	Add a value for the sensor sensibility.
Characteristics	RMS Acceleration	Enable or disable the streaming of a pre-calculated RMS Acceleration. The RMS Acceleration is an indicator about the energy contained in the higher frequency range of the component.
	RMS Velocity	Enable or disable the streaming of a pre-calculated RMS Velocity. The RMS Velocity is an indicator about the energy contained in the lower frequency range of the component.
	Diagnostics	Enable or disable the streaming of a pre-calculated DKW. The DKW is an indicator for bearing damages

9.5 Configure a SM1281 Data Source

To be able to use Edge Analytics, it is necessary to configure the data source and add key parameters. The following steps will lead you through the process of configuring the data source in Edge Analytics and exemplarily use the SM 1281.

Requirements

- A SM 1281 device configuration is including the following settings:
 - IP address of the SM 1281 is assigned
 - Command port has been set via SM 1281 web interface
 - Data port has been set via SM 1281 web interface
 - Vibration values have been configured via SM 1281 web interface
 - Set SM1281 to "RUN:X-Tools Mode"
- Prepared edge device within Edge Analytics:
 - [Individual structure](#) was created within the "Resources" section

- Activated edge device


Procedure

To configure the data source, proceed as follows:

1. Open the "Edge Device" section and select the edge device.
2. Select "Resources" in the main selection.
 - The individual created structure within the navigation appears.
3. Select a folder within the navigation.
4. Click on the button to add a new data source.
 - In the configuration area the available choice of data sources appears.
5. Select the data source, for example "SIPLUS SM1281".
 - In the configuration area the new edit window appears.
6. Enter a name and description in the "General" area.
7. In the area "Settings" add the following entries as needed:
 - IP address
 - Command Port
 - Data Port
8. In the "Data" area select the vibration data which shall be streamed from the device.
 - You can find detailed information about the parameter in chapter [User interface "Data Source SIPLUS SM1281"](#).
 - Add individual name for the vibration data channels.
 - Select individual sample rate.
 - Add individual sensor sensibility according to the sensor data sheet.
9. In order to save the configuration, click "Save".

Result

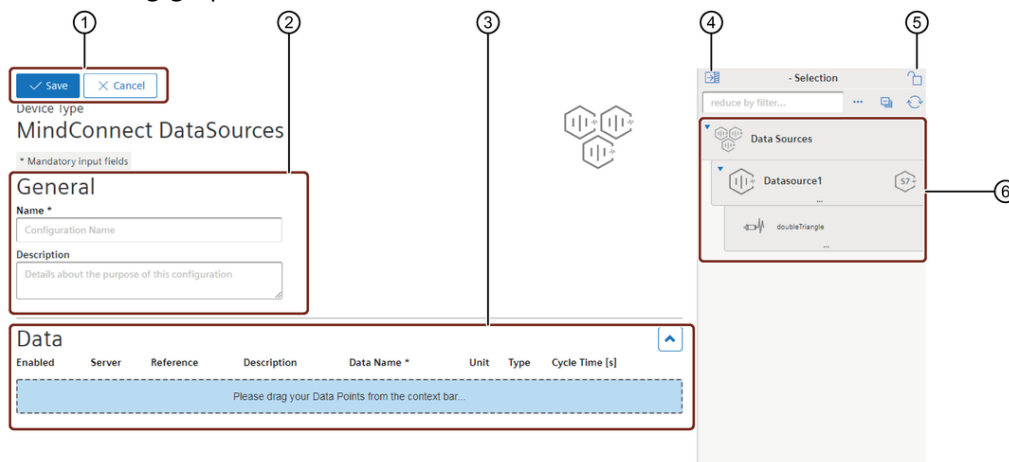
You have created a new configuration for a data source.

If you want to edit the configuration again, select the newly created entry in the selection list and click  Edit in the configuration area.

9.6 Data Source - MindConnect Data Sources

With the MindConnect Data Source configuration you can receive data, which is read out by MindConnect Nano data adapters (e.g. S7, OPC UA, Modbus). You have to configure the readings for these adapters in the corresponding MindConnect Nano asset within the Asset Manager.

The following graphic shows the different areas of the "Data Source" window:



- ① Save or cancel settings
- ② General
- ③ Data configuration
- ④ Expand or collapse the context bar
- ⑤ Lock or unlock the expand or collapse of the context bar
- ⑥ Context bar

Parameter table

The following table shows the individual areas and parameters of the "MindConnect Data Sources" window:

Area	Parameter	Description
General	Name	Add an individual name for the data source.
	Description	Add an individual description (optional).
Context Bar	Data sources selection	The context bar shows all available MindConnect Data Sources and its containing data points, which can be added to the configuration. You can assign complete data sources or single data points to the data table via drag-and-drop.
Data	Data Table	The data table shows all data points which have been assigned from the context bar.

9.7 Configure a new MindConnect Data Source

To be able to use Edge Analytics, it is necessary to configure the data source and add key parameters. The following steps will lead you through the process of configuring the data source in Edge Analytics and exemplarily use a MindConnect Nano.

Requirements

- The MindConnect Nano device is configured in Asset Manager as an asset with data points.
- Prepared edge device within Edge Analytics:
 - [Individual structure](#) has been created within the "Resource" section.
 - Activated edge device.



Changes in Asset Manager configuration

If you change the adapter configuration in the MindConnect Nano asset, you have to adjust the data source configuration in Edge Analytics manually.

Procedure

To configure the data source, proceed as follows:

1. Open the "Edge Device" section and select the edge device.
2. Select "Configuration" in the main selection.
 - The individual created structure within the navigation appears.
3. Select a folder within the navigation.
4. Click on the button to create a new data source.
 - In the configuration area the available analytics data sources appear.
5. Select the data source, for example "MindConnect Data Source".
 - In the configuration area the new edit window appears.
6. Enter a name and description in the "General" area.
7. Select a data point from the context bar and add it to the data table via drag-and-drop.
8. In the "Data" area you can activate or deactivate the data points to be monitored.
9. In order to save the configuration, click "Save".

Result

You have created a new configuration for a data source.

✓ Save ✕ Cancel

Device Type

MindConnect DataSources

* Mandatory input fields

General

Name *
NewDataSourceTest e.g.: Configuration Name

Description
Details about the purpose of this configuration

Data

Enabled	Server	Reference	Description	Data Name *	Unit Type	Cycle Time [s]
<input checked="" type="checkbox"/>	MyS7	double	NewDataSource	double	A DOUBLE	1 s
<input checked="" type="checkbox"/>	S7OPCUA	signedInt64	NewDataSource	signedInt64	W LONG	10 s
<input checked="" type="checkbox"/>	X7POPCUA	doubleTriangle	NewDataSource	doubleTriangle	A DOUBLE	1 s

Please drag your Data Points from the context bar...

If you want to edit the configuration again, select the newly created entry in the selection list and click Edit in the configuration area.

9.8 Supported protocols for MindConnect Data Source

With different MindConnect devices, different protocols can be used. Following table gives an overview about the supported protocols for each device, which can be used with Edge Analytics.

Protocols	MindConnect Nano	MindConnect Software Agent	MindConnect IoT2050
S7	Yes	Yes	Yes
OPC UA	Yes	Yes	Yes
Modbus TCP IP	Yes	Yes	Yes
Modbus RTU	Yes	No	Yes
SIMATIC I/O	No	No	Yes
System	Yes	Yes	Yes
Rockwell	Yes	Yes	Yes
S7 +	No	Yes	Yes

Protocols	MindConnect Nano	MindConnect Software Agent	MindConnect IoT2050
Fanuc Focas	No	Yes	No
Sinumerik	No	Yes	Yes
IEC61850	No	Yes	Yes
MTConnect	No	Yes	Yes

9.9 Data Source - PLC Streaming Interface

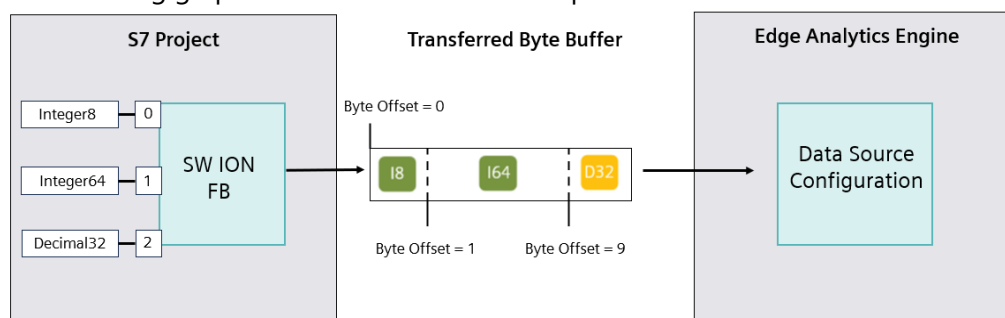
Within the "PLC Streaming Interface" data source, a connection to an S71200 or S71500 can be established. For this purpose, a library needs to be included in the S7 project, which allows transferring chosen data via TCP/IP to the Edge Analytics Engine.

Within the S7 project, the data which is supposed to be transferred to the Edge Analytics Engine needs to be configured. All data points are transferred within a one-byte buffer from the S7 FB to the Edge Analytics Engine. Within Edge Analytics, the single data points are retrieved by the reading of the corresponding bytes from the received buffer.

Overview of data type sizes:

- Boolean: 1 byte
- Signed/Unsigned Integer 8: 1 byte
- Signed/Unsigned Integer 16: 2 bytes
- Signed/Unsigned Integer 32: 4 bytes
- Signed/Unsigned Integer 64: 8 bytes
- Decimal 32: 4 bytes
- Decimal 64: 8 bytes
- String: One character = 1 byte

The following graphic shows a schematic example of the data transmission:

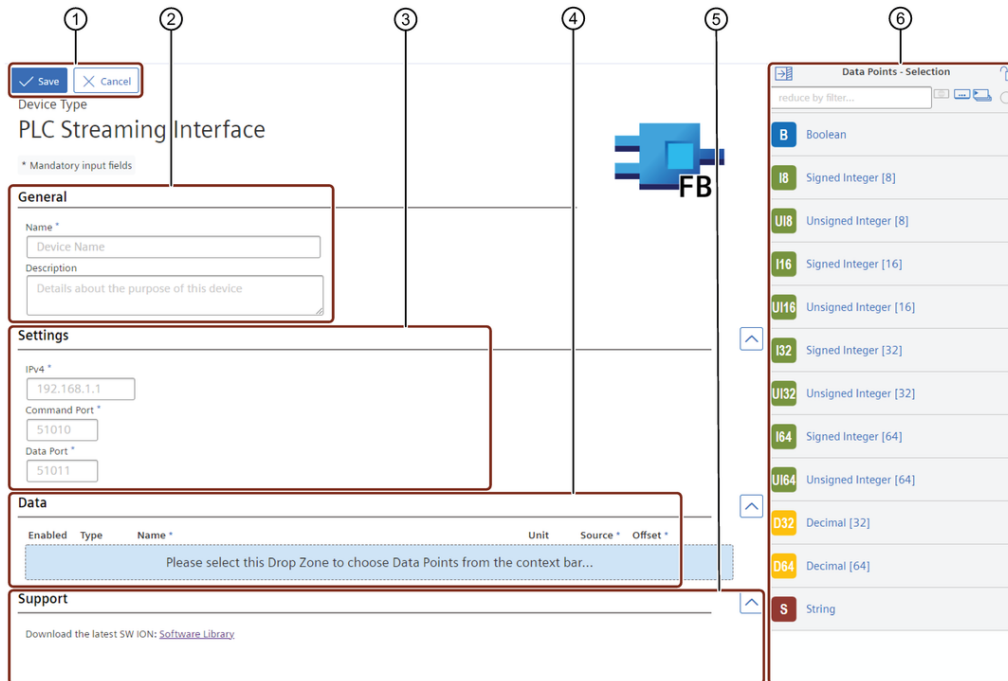


To download the SW ION library, a detailed description of the configuration is given in the [SIOS entry](#).

Currently, the supported SW IONs are:

- ION SIMATIC S7-1200
- ION SIMATIC S7-1500

The following graphic shows the user interface of the PLC Streaming interface:



- ① Save or cancel settings
- ② General
- ③ Settings
- ④ Data
- ⑤ Support
- ⑥ Context bar

Parameter table

The following table shows the individual areas and parameters of the "PLC Streaming Interface" window:

Area	Parameter	Description
General	Name	Add an individual name for the data source
	Description	Add an individual description (optional)
Settings	IP	Add the IP address of the device
	Command Port	Add the command port of the device
	Data Port	Add the data port of the device

Area	Parameter	Description
Data	Enabled	Enable or disable the data point reading
	Type	Data format type, which shall be used for the read data within Edge Analytics
	Name	Name of the data point
	Unit	Unit of the data point
	Source	Data source type, which is used for the data within the S7
	Offset	Byte offset – Is needed to determine the to be read bytes from the received byte buffer containing the data values Bit offset – For certain cases needed to determine the to be read bit within a defined byte, for example, in case of multiple Boolean data transferred as array.
Data (Additional Settings)	Data Format	Options to define the endianness for the reading of the received bytes are: - BigEndian (MSB) - LittleEndian (LSB)
Support	Software Library	Link to the download page of the SW ION Library

9.10 Configure a new PLC Streaming Interface Data Source

The following steps will lead you through the process of configuring the data source “PLC Streaming Interface”.

Requirements

- An S71200 or S71500 with a configured SW ION library and FB
 - The needed SW ION can be downloaded from: [Software IONs for CMS X-Tools V 5.0 and Insights Hub Edge Analytics](#).
 - For a detailed description of how to configure the SW ION library for an S7 project, refer the manuals available on the page link given above.
- Prepared edge device within Edge Analytics:
 - [Individual structure](#) has been created within the "Configuration" section
 - Activated edge device

Procedure

To configure the data source, proceed as follows:

1. Open the "Edge Device" section and select the edge device.
2. Select "Resources" in the main selection.
 - The individual created structure within the navigation appears.
3. Select a folder within the navigation.
4. Click on the button to add a new data source.
 - In the configuration area, the available data sources appear.
5. Select the data source "PLC Streaming Interface".
 - In the configuration area, the new edit window appears.
6. Enter a name and description in the "General" area.
7. In the area "Settings" add the following entries as needed:
 - IP address
 - Command Port
 - Data Port

In the "Data" for each data that is transferred from the S7 Project within a byte buffer, drag and drop the needed data source type from the Context Bar.

Define the name, unit, and byte offset to determine from which bytes in the receiving buffer the values shall be read for this particular data.

Note:

8. In case the byte offset is chosen wrong, this can lead to a wrong data reading.

Select the data entry within the table of data and within the context, bar defines the data

9. reading format (endianness) and the source data type, if needed.

10. To save the configuration, click "Save".

Result

You have created a new configuration for a PLC Streaming Interface data source.

If you want to edit the configuration again, select the newly created entry in the selection list and click "Edit" in the configuration area.

9.11 Data Source - MQTT Data Sources

Within the "MQTT Data Source", a connection to an MQTT Broker can be established in order to subscribe to MQTT Topics.

It is possible to define the data reading from MQTT Topics with predefined data models. The currently supported model is "IE Databus - SIMATIC S7", which allows to read data from an Industrial Edge Databus published by an SIMATIC S7 adapter.

The following graphic shows the user interface of the MQTT Data Source:

The screenshot shows the 'MQTT Data Sources' configuration window. It has a title bar with 'Save' and 'Cancel' buttons (callout 1). The window is divided into several sections: 'General' (callout 2) with 'Name *' and 'Description' fields; 'Settings' (callout 3) with 'Host', 'Port', 'User Name *', and 'Password *' fields; and 'Data' (callout 4) with a dashed box containing the text 'Drop a Data Source from the Context Bar...'. On the right, there is a 'MQTT Data Source - Selection' panel (callout 5) showing a list of available data sources, including 'IE Databus - SIMATIC S7'. A central MQTT logo is also visible.

- ① Save or cancel settings
- ② General
- ③ Settings
- ④ Data
- ⑤ Context bar

Parameter table

The following table shows the individual areas and parameters of the "MQTT Data Source" window:

Area	Parameter	Description
General	Name	Add an individual name for the data source
	Description	Add an individual description (optional)
Settings	Host	Define the host name of the to be connected MQTT Broker
	Port	Define the port of the to be connected MQTT Broker
	User Name	Add the username used to connect to the MQTT Broker

Area	Parameter	Description
	Password	Add the password used to connect to the MQTT Broker
Data	Enabled	Enable or disable the data point reading
	Type	Data format type, which shall be used for the read data within Edge Analytics
	Data Name	Display name for configurations in Edge Analytics
	Tag Name	Name of the Tag as defined within the Industrial Edge Adapter
	Unit	Unit of the data point
	Acquisition Cycle	Acquisition cycle as defined within the Industrial Edge Adapter

9.12 Configure a new MQTT data source

The following steps will lead you through the process of configuring the "MQTT data source".

Requirements

- Prepared Industrial Edge device within Edge Analytics:
 - An individual structure was created within the "Configuration" section. See [Creating individual structure](#).
 - Activated the edge device.
 - Industrial Edge Data Bus App has been installed and configured for usage.
 - Industrial Edge SIMATIC S7 Adapter has been installed and configured with data.

Procedure

To configure the data source, proceed as follows:

1. Open the "Edge Device" section and select the edge device.
Select "Resources" in the main selection.
2. The individual created structure within the navigation appears.
3. Select a folder within the navigation.

Click on the button to add a new data source.

4. The available data sources appears in the configuration area.

Select the data source "MQTT Data Source".

5. The new edit window appears in the configuration area.

6. Enter a name and description in the "General" area.

7. Select a Data Model and drag-drop from the Context Bar to the Data Source Drop Zone.

8. In the area "Settings", add the following entries as needed:

- Host
- Port

In the "Data" section for each data which shall be read, drag-drop the needed data source

9. type from the Context Bar.

10. Define the data name, tag name, unit, and acquisition cycle.

11. Click the "Save" button in order to save the configuration.

Result

You have created a new configuration for a MQTT Data Source.

If you want to edit the configuration again, select the newly created entry in the selection list and Click "Edit" in the configuration area.

9.13 Data Source - Ifm vse

With the ifm vse Data Source you can receive object KPIs, as well as vibration raw data from ifm vse devices.

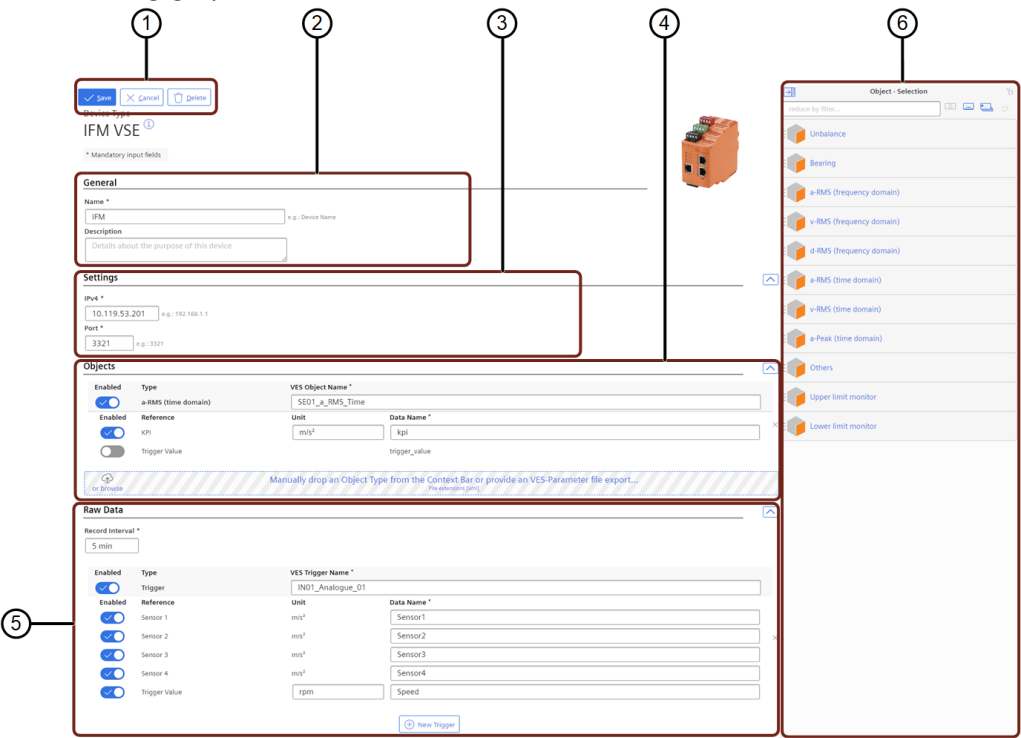
It is possible to load an ves parameter export from the ifm device, to quickly import all available object and trigger configurations. Otherwise the different objects and triggers can also be configured manually.

Supported device types are:

- VSE002
- VSE003
- VSE100
- VSE101
- VSE150
- VSE151

- VSE152
- VSE153
- VSE903
- VSE950
- VSE951
- VSE953

The following graphic shows the different areas of the "Data Interfave SIPLUS SM1281 WAV" UI:



- ① Save or cancel
- ② General
- ③ Settings
- ④ Objects
- ⑤ Raw Data
- ⑥ Context Bar

Parameter table ifm vse

The following table shows the individual areas and parameters of the device UI:

Area	Parameter	Description
General	Name	Add an individual name for your data source.
	Description	Add an individual description (optional).
Settings	IPv4	Add the IP address of the device

Area	Parameter	Description
	Port	Add the Port of the device
Objects	Enabled	Enable or disable the reading for object or data.
	Type	Type of the ves object. The type must match the type of configured object within the ves project
	VES Object Name	Enter the name of the vse object which shall be read. The name must match the name configured within the ves project
	Data Name	Enter a name for the data, which will be shown within the Edge Analytics application
	Unit	Shows the unit of the data.
	Reference	Reference information about the provided data.
Raw Data	Enabled	Enable or disable the reading for object or data.
	Type	Type of the ves trigger.
	VES Trigger Name	Enter the name of the vse trigger which shall used for raw data recording. The name must match the name configured within the ves project
	Data Name	Enter a name for the data, which will be shown within the Edge Analytics application
	Unit	Shows the unit of the data.
	Reference	Reference information about the provided data.
Context Bar	Object Selection	Shows the available vse object types, which can be used for configuration.
	Trigger Selection	Shows the available vse trigger types, which can be used for configuration.

9.14 Configure a SM1281 WAV Data Interface

The following steps will lead you through the process of configuring an ifm vse Data Source.

Requirements

- Prepared edge device within Edge Analytics:


- [Individual structure](#) was created within the "Resources" section
- Activated edge device

Procedure

To configure the data source, proceed as follows:

1. Open the "Edge Device" section and select the edge device.
2. Select "Resources" in the main selection.
 - The individual created structure within the navigation appears.
3. Select a folder within the navigation.
4. Click on the button to add a new Data Source.
 - In the configuration area, the available choice of Data Sources appears.
5. Select the Data Source "ifm vse".
 - In the configuration area the new edit window appears.
6. Enter a name and description in the "General" area.
7. In the "Settings" area add the following entries as needed:
 - IP address
 - Port
8. In the "Object" area configure the object KPIs which shall be streamed from the device.
 - Add the object types according to the ifm project configuration.
 - Enter the object names according to the ifm project configuration.
Optional: You can load all information from an ifm ves parameters export in XML format.
9. In the "Raw Data" area configure the ifm triggers for which you would like to receive the vibration raw data for an analysis.
 - Add a trigger from the context bar.
 - Enter the trigger names according to the ifm project configuration.
 - Enable/Disable the sensors according to your needs. Optional: You can load all information from an ifm ves parameters export in XML format.
10. In order to save the configuration, click "Save".

Result

You have created a new configuration for an ifm vse Data Source.
If you want to edit the configuration again, select the newly created entry in the selection list and click  **Edit** in the configuration area.

9.15 Data Interface - SIPLUS SM1281 WAV

With the SIPLUS SM1281 WAV Interface you can receive vibration raw data from wave files for usage with Analysis Models.

The wave files can be exported from the SM1281 Device and dropped into a network share folder of the MindConnect Software Agent (HyperV).

For information about how to export wave files from a SM1281 Device, please refer to its manual at the chapter [export wave files](#).

To be able to import wave files to Edge Analytics, the file transfer feature of the MindConnect Software Agent needs to be enabled.

For detailed information about how to do so, please follow the instructions to enable the [file transfer](#).

As soon as a SIPLUS SM1281 WAV Interface configuration has been downloaded to the Edge Device, a folder named "EdgeAnalyticsFileInput" is created in the file transfer folder of the Software Agent.

This folder is dedicated for to be imported files by Edge Analytics.

To be imported wave files need to be dropped into this folder and will then be processed by Edge Analytics.

Later on, when using the Data Interface within an Analysis Model, it is important to define unique File References for each file within the corresponding Data Source Extension of the Analysis Model.

These File References are used to identify the different files.

After processing, the files will be deleted.

The following graphic shows the different areas of the "Data Interface SIPLUS SM1281 WAV" UI:

The screenshot shows the configuration interface for the SIPLUS SM1281 WAV data source. It is divided into four main sections, each indicated by a numbered callout:

- 1. Save or cancel:** Located at the top left, containing 'Save' and 'Cancel' buttons.
- 2. General:** Contains fields for 'Name' (with a hint 'Wave File Readings' and 'e.g.: Device Name') and 'Description' (with a hint 'Details about the purpose of this device').
- 3. Settings:** Contains a 'Max number of different file references' field, currently set to 3.
- 4. Interface:** A table with columns: Enabled, Reference, Unit, Data Name, and Sample Rate. It lists five channels: VIB1, VIB2, VIB3, VIB4, and Speed, each with a toggle switch, a reference dropdown, a unit dropdown, a data name input field, and a sample rate dropdown.

At the top right, there is a 'WAV' icon and the text '4 Vibration Channels + Speed'.

- ① Save or cancel
- ② General
- ③ Settings
- ④ Interface

Parameter table SIPLUS SM 1281 WAV

The following table shows the individual areas and parameters of the "Devices" UI:

Area	Parameter	Description
General	Name	Add an individual name for your interface.
	Description	Add an individual description (optional).
Settings	Max number of different file references	Define the maximum number of different files, which are supposed to be read
Interface	Enabled	Enable or disable the reading for this channel.
	Reference	Displays the source channel which provides this data.
	Unit	Shows the unit in which the value is given.
	Data Name	Field to add an individual signal name.
	Sample Rate	Shows the sample rate of the data.

!!! note **MCSA file import** For the wave file import the MCSA File Share Feature is mandatory. Therefore this feature is restricted to MCSA Edge Devices only.

!!! note **File Deletion** Files which have been processed by Edge Analytics within the "EdgeAnalyticsFileInput" folder will be deleted. If you want to keep the original file, make sure to only drop a copy into this folder.

9.16 Configure a SM1281 WAV Data Interface

The following steps will lead you through the process of configuring a SIPLUS SM1281 WAV Data Interface.

Requirements

- Prepared edge device within Edge Analytics:
 - [Individual structure](#) was created within the "Resources" section
 - Activated edge device


Procedure

To configure the data source, proceed as follows:

1. Open the "Edge Device" section and select the edge device.
2. Select "Resources" in the main selection.
 - The individual created structure within the navigation appears.
3. Select a folder within the navigation.
4. Click on the button to add a new Data Interface.
 - In the configuration area the available choice of Data Interfaces appears.
5. Select the Data Interface "SIPLUS SM1281 WAV".
 - In the configuration area the new edit window appears.
6. Enter a name and description in the "General" area.
7. In the area "Settings" add the following entries as needed:
 - Max number of different file readings
8. In the "Interface" area select the vibration data which shall be imported from the wave files.
 - Add individual name for the vibration data channels.
9. In order to save the configuration, click "Save".

Result

You have created a new configuration for a Dta Interface.

If you want to edit the configuration again, select the newly created entry in the selection list and click  **Edit** in the configuration area.

Analysis configuration

10.1 "Analysis" configuration

This chapter contains the following content:

[Introduction analysis packages](#)

[Create a new analysis package](#)

[Analysis packages](#)

[Custom Analysis](#)

[Analysis Package Extensions](#)

[Analysis Models](#)

10.2 Introduction analysis packages

Within the "Analysis" tab you can configure your analysis package before uploading it to your edge device. Edge Analytics supports various analysis packages. It is also possible to define and manage your own "Custom Analysis" packages.



Vote for future analyzing packages

When creating a new analysis, you can use the vote button in the configuration area to vote on the priority of upcoming analyzing packages.

10.3 Create a new Analysis Package

Requirements

- Vibration channels VIB1 to VIB4 are configured within edge device.
- Edge device configuration is created within Edge Analytics.
 - Individual structure is created within "Resources".
 - Edge device activation.

- Establish a connection between edge device and Edge Analytics Engine.

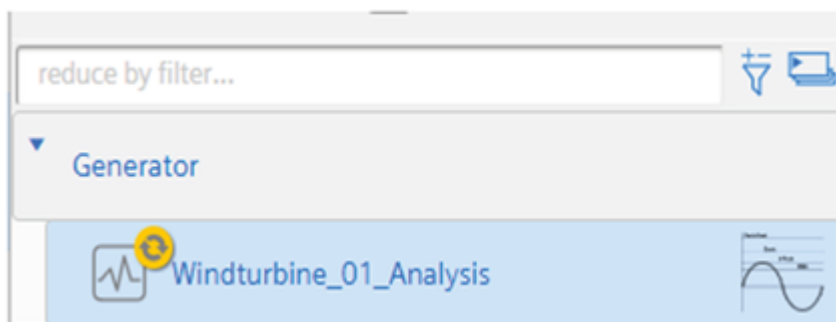
Procedure


To create and configure a new analysis package, follow these steps:

1. Select an edge device from "Edge Device" tab.
2. Select "Resources" in the main selection.
 - The created structure within the navigation appears.
3. Select the folder within the configuration structure.
4. To create a new analysis package, click the button to create a new analysis package.
 - In the configuration area the available analysis packages are displayed.

Result

You have created a new analysis configuration. The new configuration is displayed in the tree structure:



If you want to edit the configuration again, select the analysis package in the selection list and click on  **Edit** in the configuration area.

See also

[Analysis packages](#)

10.4 Analysis package "Vibration Characteristic Values"

With the analysis package "Vibration Characteristic Values" you can create or edit your individual analysis configuration. The following graphic shows the different areas of the "Vibration Characteristic Values" window:

The screenshot shows the configuration interface for the 'Vibration Characteristic Values' analysis package. It includes sections for General, Settings, Output Data, and Project Data. Numbered callouts point to specific elements: 1 points to the Save/Cancel/Delete buttons; 2 points to the Analysis Package Type header; 3 points to the Name and Description input fields; 4 points to the Calculation Interval and Upload Interval input fields; 5 points to the list of output data types with their respective upload toggle switches; and 6 points to the Project Data section at the bottom.

- ① Save, cancel or delete changes
- ② Packages name
- ③ Input fields for name and description of the analysis
- ④ Input fields for the settings of the analysis
- ⑤ Available calculations
- ⑥ Assignments of this Analysis Package is within the Project

Parameter of "Vibration Characteristic Values"

The following table shows the parameters of the "Vibration Characteristic Values" window:

Area	Parameter	Description
General	Analysis Package Name	Add an individual name for your analysis package.
	Description	Add an individual description (optional).
Settings	Calculation Interval [s]	Add the time interval for the calculation of new values.
	Upload Interval [min]	Add the time interval for the upload of the calculated values to Insights Hub

Area	Parameter	Description
.		
Calculations	Data Storage Asset	<ul style="list-style-type: none"> - Select the asset your configuration is related to. - Change to Insights Hub Monitor to see the respective data.
	RMS Velocity	The RMS (Root Means Square) of a velocity signal provides information about the energy content of a vibration. The RMS is calculated from the dominant frequency component. Due to this fact, this quantity provides only information about the general condition of a machine or component. Therefore, it is impossible to detect changing vibration frequencies or new developing frequency components caused by a beginning damage. The velocity RMS value is a crucial quantity in order to detect inappropriate behavior of stationary machine components. In order to receive the velocity signal, the input acceleration signal is converted into a velocity signal automatically. It has to be considered that the amplitudes above 1500 Hz are attenuated because of the integration.
	Peak-Peak Velocity	The peak-peak value of a velocity signal can be calculated as auxiliary quantity to the velocity RMS in order to detect inappropriate behavior of stationary machine components. In order to receive the velocity signal, the input acceleration signal is converted automatically into a velocity signal. It has to be considered that the amplitudes above 1500 Hz are attenuated because of the integration.
	Zero-Peak Velocity	The zero-peak value of a velocity signal can be calculated as auxiliary quantity to the velocity RMS in order to detect inappropriate behavior of stationary machine components. In order to receive the velocity signal, the input acceleration signal is converted automatically into a velocity signal. It has to be considered that the amplitudes above 1500 Hz are attenuated because of the integration.
	RMS Acceleration	The RMS (Root Means Square) of an acceleration signal provides information about the energy content of a vibration. The RMS is calculated from the dominant frequency component. Due to this fact this quantity provides only information about the general condition of a machine or component. Therefore, it is impossible to detect changing vibration frequencies or new developing frequency components caused by beginning damage. The acceleration RMS value is a crucial quantity in order to detect inappropriate behavior of stationary machine components.
	Peak-Peak Acceleration	The peak-peak value of an acceleration signal can be calculated as auxiliary quantity to the acceleration RMS in order to detect inappropriate behavior of stationary machine components.
	Zero-Peak Acceleration	The zero-peak value of an acceleration signal can be calculated as auxiliary quantity to the acceleration RMS in order to detect inappropriate behavior of stationary machine components.

Area	Parameter	Description
	Crest Factor	The crest factor of a signal is the ratio of the zero-peak value to the RMS. A typical acceleration signal from a machine with a large imbalance possesses a crest factor similar to $\sqrt{2}$. But as the bearings begin to wear and impact begins to occur, the crest factor has a higher value than this. Therefore, this quantity is very important for evaluating rolling bearing.

10.5 Analysis package "Vibration Frequency Spectra"

The analysis package "Vibration Frequency Spectra" analyzes vibration signals by calculating selected spectral quantities (Fast Fourier Transformation) such as frequency-based acceleration, acceleration envelope and velocity spectra. These quantities can be used to evaluate the spectral composition of the given input signal considering a fixed frequency range (speed independent) and allows an early detection of mechanical fault of rotating equipment.

- ① Save, cancel or delete changes
 - ② Package name
 - ③ Input fields for name and description of the analysis
 - ④ Available calculations
 - ⑤ Assignments of this Analysis Package is within Project
- Following default parameters are used for the calculation.

Parameter of "Vibration Frequency Spectra"

Area	Parameter	Description
------	-----------	-------------

Area	Parameter	Description
General	Analysis Package Name	Add an individual name for your analysis package.
	Description	Add an individual description (optional).
Calculations	Spectrum Acceleration	<p>In the case of machines and gears running on roller bearings, the calculation of the vibration acceleration $a(t)$ spectrum may be informative regarding the state of the bearings or toothing. In general, it is suitable to get indications about potential error sources within the higher frequency range (>1000 Hz). The following default parameter are used for the calculation:</p> <ul style="list-style-type: none"> - Bandpass Filter (Hz): 10 - 10.000 - NoP (Number of Points): 131.072 - Lap (Overlap): 0,6 - Resolution (Hz): 0,153
	Spectrum Acceleration Envelope	<p>Envelope curve analyses are frequently used as a demodulation method in the investigation of periodic, shock type vibration, such as may be encountered with damaged roller bearings or gears. These extremely short-lived, rapidly decaying shocks are not susceptible to direct frequency analysis to determine their periodicity. For this to be done, the envelope curve which envelopes the time function must be determined. With the resulting spectrum of the envelope, it is possible to determine frequencies of periodic, shock type vibration and their potential root cause. The following default parameter are used for the calculation:</p> <ul style="list-style-type: none"> - Bandpass Filter (Hz): 1.000 - 10.000 - Lowpass Filter (Hz): 1.500 - NoP (Number of Points): 16.384 - Lap (Overlap): 0,6 - Resolution (Hz): 0.183
	Spectrum Velocity	<p>Vibration velocity $v(t)$ is the decisive measured quantity specified in all standards for evaluating vibration in the stationary components of machines with rotating masses. The resulting calculated spectrum of this signal gives indications about potential error sources within the lower frequency range (<1000 Hz). The following default parameter are used for the calculation:</p> <ul style="list-style-type: none"> - Highpass Filter (Hz): 10 - Bandpass Filter (Hz): 10 - 1.000 - NoP (Number of Points): 16.384 - Lap (Overlap): 0,6

You can find more information about extended data types in the [appendix](#).



A fully configured monitoring of the analysis packages "Vibration Characteristic Values" and "Vibration Frequency Spectra" with all channels of one SM1281 and Trigger Rule of type "Continuous", can exceed the CPU performance of the MindConnect Nano. Also, in other scenarios dependent of tasks running in parallel on MindConnect Nano, CPU load can get too high. The recommendation is to use only two fully configured "Vibration Frequency Spectra" analysis packages in parallel, when using a Trigger Rule of type "Continuous".

10.6 Analysis package "Vibration Order Spectra"

The analysis package "Vibration Order Spectra" analyzes vibration signals by calculating selected spectral quantities (Fast Fourier Transformation) such as frequency-based acceleration, acceleration envelope, and velocity spectra. These quantities can be used to evaluate the spectral composition of the given input signal and allow early detection of the mechanical fault of rotating equipment. Besides the vibration data, the speed data is also required as an input, which is used for the order tracking technique, whereby the nonstationary vibration data is resampled to an equal angle-interval at a rate proportional to the shaft rotating speed. As a result, the order Spectrum is calculated. The Order Spectrum can be used for time-varying rotating speed cases where the speed variation may cause smearing of the frequencies in a Frequency Spectrum, for example, during a startup or shutdown process of rotating machinery.

① Save or cancel changes

② Package name

③ Input fields for name and description of the analysis

④ Available calculations

- ① Save or cancel changes
 - ② Package name
 - ③ Input fields for name and description of the analysis
 - ④ Available calculations
- Following default parameters are used for the calculation.

Parameters of "Vibration Order Spectra"

Area	Parameter	Description
General	Analysis Package Name	Add an individual name for your analysis package.
	Description	Add an individual description (optional).
Calculations	Spectrum Acceleration	<p>In the case of machines and gears running on roller bearings, the calculation of the vibration acceleration $a(t)$ spectrum may be informative regarding the state of the bearings or toothing. In general, it is suitable to get indications about potential error sources within the higher frequency range (>1000 Hz). The following default parameter are used for the calculation:</p> <ul style="list-style-type: none"> - Max Order: 128 - NoP (Number of Points): 16384 - Overlap: 0.6 - Min Speed: 15 Hz (900 rpm) - NoSpm for average: 5 - Bandpass Filter: 10 - 10000 Hz
	Spectrum Acceleration Envelope	<p>Envelope curve analyses are frequently used as a demodulation method in the investigation of periodic, shock type vibration, such as may be encountered with damaged roller bearings or gears. These extremely short-lived, rapidly decaying shocks are not susceptible to direct frequency analysis to determine their periodicity. For this to be done, the envelope curve which envelopes the time function must be determined. With the resulting spectrum of the envelope, it is possible to determine frequencies of periodic, shock type vibration and their potential root cause. The following default parameter are used for the calculation:</p> <ul style="list-style-type: none"> - Max Order: 128 - NoP: 16384 - Overlap: 0.6 - Min Speed: 15 Hz (900 rpm) - NoSpm for average: 5 - Lowpass Filter (Hz): 1.500 - Bandpass Filter: 10 - 10000 Hz

Area	Parameter	Description
	Spectrum Velocity	<p>Vibration velocity $v(t)$ is the decisive measured quantity specified in all standards for evaluating vibration in the stationary components of machines with rotating masses. The resulting calculated spectrum of this signal gives indications about potential error sources within the lower frequency range (<1000 Hz).</p> <p>The following default parameter are used for the calculation:</p> <ul style="list-style-type: none"> - Max Order: 64 - NoP: 8192 - Overlap: 0.6 - Min Speed: 15 Hz (900 rpm) - NoSpm for average: 5 - Bandpass Filter: 10 - 1000 Hz



A fully configured monitoring of the analysis packages "Vibration Characteristic Values" and "Vibration Order Spectra" with a Continuous Calculation Mode (Trigger Rule) and all channels of one SM1281 can exceed the CPU performance of the MindConnect Nano. Also, in other scenarios dependent on tasks running in parallel on the MindConnect Nano, CPU load can get too high. The recommendation is to use only two fully configured "Vibration Frequency Spectra" Analysis packages in parallel.

10.7 Analysis package "Statistics"

This package calculates statistics of a given input data.

① Save, cancel or delete changes

② Package name

③ Input fields for name and description of the analysis

④ Available calculation

⑤ Assignments of this Analysis Package is within the Project

- ① Save, cancel or delete changes
- ② Package name
- ③ Input fields for name and description of the analysis
- ④ Available calculation
- ⑤ Assignments of this Analysis Package is within the Project

Parameter of "Statistics"

Area	Parameter	Description
General	Analysis Package Name	Add an individual name for your analysis package.
	Description	Add an individual description (optional).
Settings	Calculation Interval [s]	Add the time interval for the calculation of new values.
	Upload Interval [min]	Add the time interval for the upload of the calculated values to Insights Hub.
Calculations	Average	Calculates the average value of the input data.
	Minimum	Calculates the minimal value of the input data.
	Maximum	Calculates the maximal value of the input data.

Area	Parameter	Description
	Peak-Peak	Calculates the Peak to Peak value, which is the difference between the maximum positive and the maximum negative amplitudes.
	Dynamic	Calculates a dynamic factor, out of the ratio of Peak-Peak to Average, which gives indications about the dynamic changes of the data.

10.8 Analysis package "Event Based Data Upload"

The analysis package "Event Based Data Upload" allows you to upload defined data ranges or data snippets based on events. You can define the events that trigger a data collection. The data is recorded with the defined length and afterwards uploaded to Industrial IoT. You can select whether the data should be uploaded as files or injected as time series to an asset in the common way. The upload as a file offers a higher sampling rate than with a time series injection for example Vibration raw data. The Analysis Package "Event Based Data Upload" currently supports events of type "Time Based".



It is recommended to use an "Event Based Data Upload" analysis package, with 5 data points and 15.625 kHz sampling rate per data point. The maximum sampling rate is 23,438 kHz.

Make sure that all further uploads of the edge device do not exceed the traffic limit of internet connection.

The screenshot shows the configuration interface for the 'Event Based Data Upload' analysis package. It includes sections for General, Settings, Output Data, and Project Data. Numbered callouts point to specific elements: 1 points to the Save/Cancel/Delete buttons; 2 points to the 'Event Based Data Upload' title; 3 points to the Name and Description input fields; 4 points to the Collection Trigger and Duration settings; 5 points to the Storage Type dropdown; and 6 points to the Data Name and Unit input fields.

- ① Save, cancel or delete changes
- ② Package name
- ③ Input fields for name and description of the analysis

- ④ Input field for the settings of the analysis
- ⑤ Data that has to be uploaded
- ⑥ Assignments of this Analysis Package is within the Project

Parameter of "Event Based Data Upload"

The following table shows the parameters of the "Event Based Data Upload" window:

Area	Parameter	Description
General	Name	Add an individual name for the analysis package.
	Description	Add an individual description (optional).
Settings	Collection Trigger (repeated) [min]	Define the periodic time interval in which the data c is collected.
	Collection Duration [s]	Define the length of the data snippets in seconds, which are periodically collected and uploaded.
Data	Storage Type	You can select the following storage types: <ul style="list-style-type: none">- File Upload: Stores the data as files. Provides a higher sampling rate than time series.- Time Series Upload: Uploads the data as time series to the environment structure.- Data Lake Upload: Stores the data as files in a static structure to the Integrated Data Lake.
	Data Storage	Define the target asset, into which the resulting data shall be uploaded to.
	Data Table	The data table shows all data points which have been assigned from the context bar and are used as input data for the analysis package.

10.9 Analysis Package "Data Upload"

The analysis package "Data Upload" allows you to upload defined data to a target asset.



Only low frequency data are supported for this analysis package. High frequent vibration data like the data of SM1281 cannot be configured for a data upload with this analysis package.

1 Save, cancel or delete changes

2 Package name

3 Input fields for name and description of the analysis

4 Input field for the settings of the analysis

5 Data that has to be uploaded

6 Assignments of this Analysis Package is within Project

- ① Save, cancel or delete changes
- ② Package name
- ③ Input fields for name and description of the analysis
- ④ Input field for the settings of the analysis
- ⑤ Data that has to be uploaded
- ⑥ Assignments of this Analysis Package is within Project

Parameter of "Data Upload"

The following table shows the parameters of the "Data Upload" analysis package:

Area	Parameter	Description
General	Name	Add an individual name for the analysis package.
	Description	Add an individual description (optional).
Settings	Upload Interval [min]	Add the time interval for the upload of the data.
Data	Data Storage	Define the target asset, into which the resulting data shall be uploaded to.
	Data Table	The data table shows all data points which have been assigned from the context bar and are used as input data for the analysis package.

10.10 Analysis Package "Range Check"

The analysis package allows to check range of the given input data within the defined range of lower and upper threshold. It also provides the delta value of the input data and the defined thresholds. In case the input data is in range of delta is zero. Also, when the input data is not in range, the delta has the value of the deviation to the corresponding threshold.

The screenshot shows the configuration interface for the 'Range Check' analysis package. It includes a top bar with 'Save', 'Cancel', and 'Delete' buttons. Below is the 'Analysis Package Type' section with the title 'Range Check' and a note about mandatory input fields. The main configuration area is divided into several sections: 'General' with fields for 'Name' and 'Description'; 'Settings' with input fields for 'Calculation Interval [min]' and 'Upload Interval [min]'; 'Output Data' with a table for defining output columns; and 'Project Data' with a table for project assignments. A small scatter plot is visible on the right side of the interface.

Upload	Type	Value *	Unit
<input checked="" type="checkbox"/>	Minimum extent	<input type="text"/>	
<input checked="" type="checkbox"/>	Maximum extent	<input type="text"/>	

Asset	Trigger & Rules	Input Data
This Analysis Definition is actually not in use. All Project usage will be listed here.		

- ① Save, cancel or delete changes
- ② Package name
- ③ Input fields for name and description of the analysis
- ④ Input field for the settings of the analysis
- ⑤ Available calculations
- ⑥ Assignments of this Analysis Package is within Project

Parameter of "Range Check"

The following table shows the parameters of the "Range Check" analysis package:

Area	Parameter	Description
General	Analysis Package Name	Add an individual name for your analysis package.
	Description	Add an individual description.
Settings	Calculation Interval [min]	Add the interval for the calculation of new values.
	Upload Interval [min]	Add the time interval for the upload of the calculated values to Insights Hub.
Calculations	Minimum Extent	The entered value acts as a threshold. The calculation will determine the difference between the minimum threshold and the input data values. In case the input data values are within the range of the minimum and maximum extent the calculation result will be 0.
	Maximum Extent	The entered value acts as a threshold. The calculation will determine the difference between the maximum threshold and the input data values. In case the input data values are within the range of the minimum and maximum extent the calculation result will be 0.

10.11 Custom Analysis

Using the “Custom Analysis” feature, you can define and manage your own Analysis Packages which at the edge shall be applied onto data and upload the results. The desired calculation can be graphically programmed with the help of a NodeRed based Editor Known as “Analysis Flow Editor (AFE)” and an expanding library of all kinds of functions blocks. The created Custom Analysis Packages can be published for other Edge Analytics users within the environment. To access and use the Custom Analysis feature, the `mdsp:core:eas.engineer` role or a higher role (`mdsp:core:eas.admin` or `mdsp:core:eas.developer`) needs to be assigned.

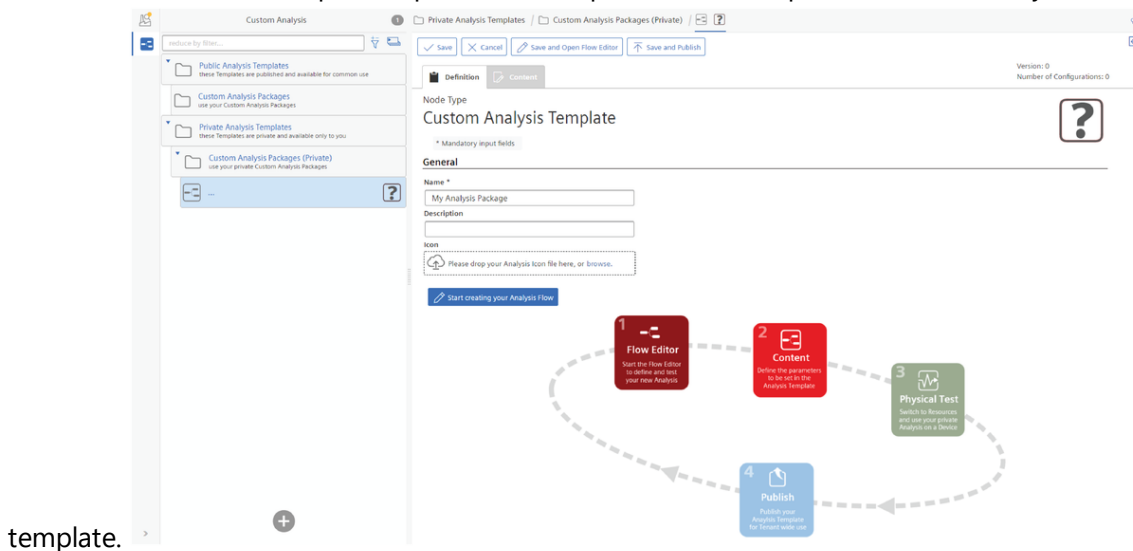


Edge Analytics performs basic monitoring of the hardware resources of the Edge Device and during runtime warns if they are exceeded. However, the user is responsible to avoid overloading the Edge Device with too many resource-intense calculations.

10.12 Creating new Custom Analysis definition

To create a new Custom Analysis definition, proceed as follows:

1. Open the Edge Analytics application and navigate to the “Custom Analysis” tab in the main selection.
2. Expand the main folder “Private Analysis Templates” and select the “Custom Analysis Packages (Private)” sub-folder.
3. Click on the “Add Custom Analysis Template” button.
4. Enter the Name, Description (optional), and upload an Icon (optional) for the Analysis



template.

5. Click the “Save” Button.
A new Custom Analysis Template is created.

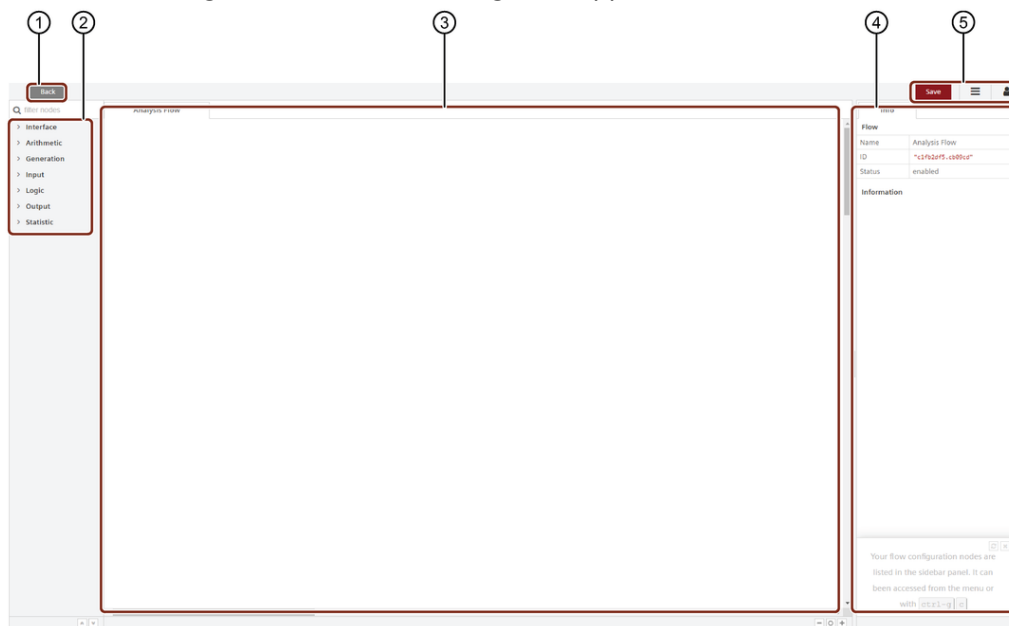
10.13 Creating Analysis Flow

To Create an Analysis Flow behind the mask of the Custom Analysis package, proceed as follows:

Click on the “Start creating your Analysis Flow” while creating the new Analysis Template. In case of an existing definition, click on the “Open Flow Editor”.

The “Analysis Flow” editor page appears. It will be empty for new Analysis Templates and in

1. case of existing definitions, the existing Flow appears.



① Back button to get back to the Analysis Template definition

② Library of Analyzing Functions

③ Flow Workspace

④ Context Bar

⑤ Save button to save the Flow

The following table shows the different categories within the Analyzing Function Library:

Categories	Description
Interface	Contains interface functions to receive a data or parameter which will be selected at the Analysis Package UI, to use this data or parameter within the flow, or to create data which is supposed to be uploaded from the edge to the Insights Hub, e.g. the calculation output of a flow.
Arithmetic	Contains functions to perform arithmetic operations onto data
Generation	Contains functions for simple data generation
Input	Contains functions to read values for a given data name
Logic	Contains functions for logic operations
Output	Contains functions to write values to a new data
Statistic	Contains functions for statistical analysis
Monitoring	Contains functions for data monitoring operations



For more details of a selected Analyzing Function, read the information available within the Context Bar.

2. Perform graphical programming by dragging and dropping Analyzing Functions into the “Analysis Flow” workspace and interconnect their Inputs and Outputs.



Double click the Analysing Function which is already in the workspace to view its detailed properties.

To receive data or parameter which can be used within the Flow, use the interface

- functions “AnalysisFlow Input” or “AnalysisFlow Parameter”.

An “AnalysisFlow Input” will be shown as a field for input data assignment at the final Analysis Package UI. The output of these functions needs to be connected to an input

- function, for example, “InptNmbr”, to read in the single values of the target data.

An “AnalysisFlow Parameter” will be shown as an input field for a constant value at the final Analysis Package UI. The output of this function can be connected to any other

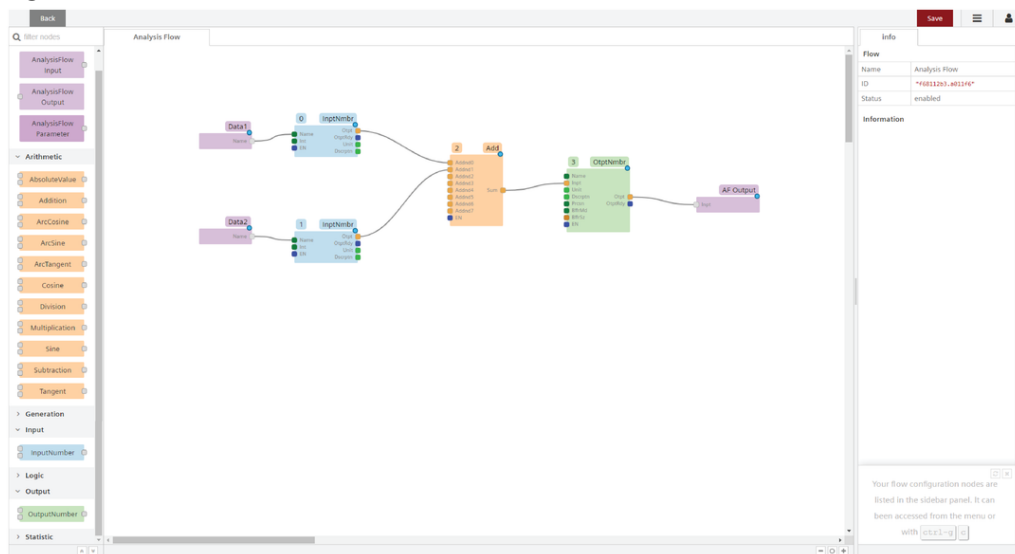
- numeric input.

To upload calculation results, a new output data has to be generated, for example, with “OtpNmbr”.

This function has to be linked with the interface function “AnalysisFlow Output”, which will link and show this data has to be uploaded Output Data on the final Analysis Package UI.

The image given below shows an example flow that performs the addition of two input

- signals.



3. Click the “Save” button to save the Analysis flow. 4. Click the “Back” button to navigate back to the Analysis Template definition.

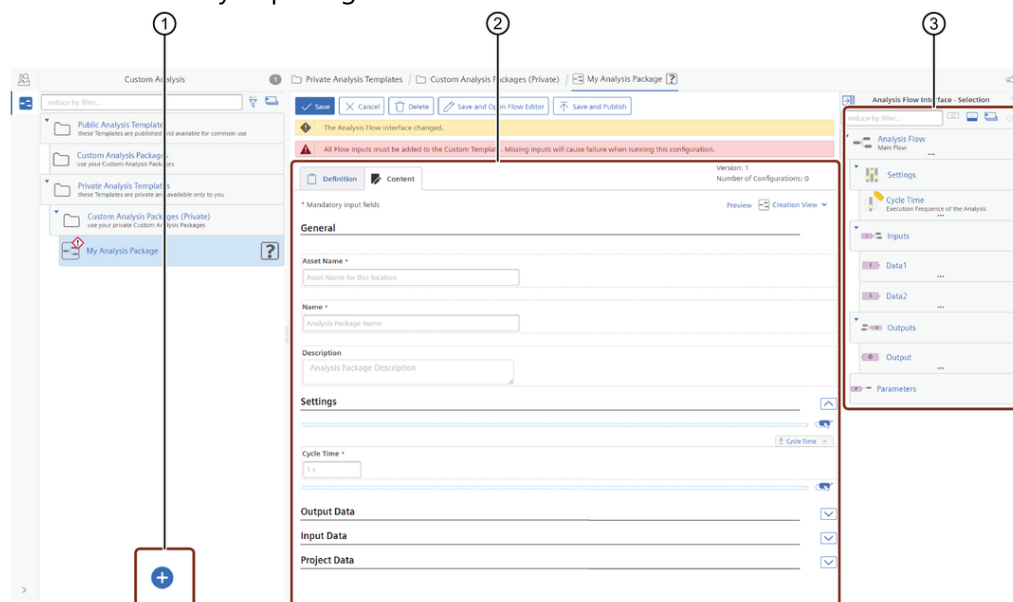


In case the existing Custom Analysis Packages are in use at some places within the project and a breaking change of the interface is done for this Analysis Template definition e.g. by removing interface functions in the Flow, the corresponding Custom Analysis Package instances will get outdated and need to be re-created.

10.14 Custom Analysis Package content definition

Once the Analysis flow has been defined, the Custom Analysis Package layout and how it shall appear to the users can be defined in the “Content” tab of the Analysis Template definition

1. Select the Analysis package and click on the “Content” tab.



- ① Button to create new custom analysis item
- ② Custom Analysis Package UI layout editor
- ③ Context Bar to show the defined flow interface or properties of selected controls

The interface functions (defined within the flow) and the general settings which can be configured for the execution of the flow are shown in the context bar. The following table shows the different categories of the Analysis Flow Interface:

Categories	Description
Settings	Contains settings of the Flow e.g. the Cycle Time
Inputs	Contains all AnalysisFlow Inputs which have been defined within the Flow
Outputs	Contains all AnalysisFlow Outputs which have been defined within the Flow
Parameters	Contains all AnalysisFlow Parameters which have been defined within the Flow

2. Drag and drop the items within the Analysis Flow Interface to the matching drop zones in the UI layout editor, to make them configurable for the final Analysis Package UI.

3. Edit properties of the Items which are inserted into the Layout as necessary.

For inputs, interface settings regarding the allowed sample rate of the input data can be set.

Control Type	Table
Title	<input type="text"/>
Context Data	
Category	<input checked="" type="checkbox"/> Signals (Sample Rate > 1 Hz) <input checked="" type="checkbox"/> Signals (Sample Rate <= 1 Hz) <input checked="" type="checkbox"/> MindConnect DataSources <input type="checkbox"/> Vibration Signals (3 kHz - 46 kHz) <input type="checkbox"/> Data for IOT Time-Series <input type="checkbox"/> Data for File Storage
Max Sample ...	<input type="text" value="46,875 Hz"/>
Drop Zone Text	<input type="text" value="Please select this Drop Zone to drag your Input Data from the context bar..."/>
Empty Notific...	Please switch to Edit mode and select th
Notification T...	Warning
Behavior	
enabled	when open in Project
hidden	

For other interface items and controls, it is possible to adjust settings such as unit, description, layout, and appearance.

4. Use the “Preview” button and different view modes to view the UI layout of the Analysis Package for its appearance in different contexts.

5. Click the “Save” button once the layout is finalized.

The Analysis package is ready for the private use of the creator of this Analysis Package.

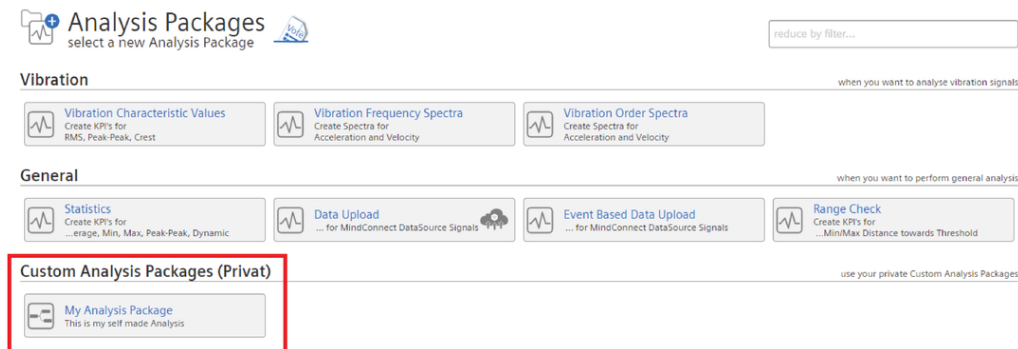
10.15 Using Custom Analysis Packages

Once the Custom Analysis definition is completed, Analysis package instances can be created within the Resources/Project Section for a selected Edge Device.

1. Navigate to the “Resources” tab from the main selection.

Select the “Analysis Packages” folder and create a new package using the “Analysis Package” option available under the “Add Resource Items” section.

2. The available Custom Analysis Packages will appear below the default Analysis Packages.



Select the appropriate Custom Analysis Package.

3. The UI appears as designed in the Customer Analysis Content Editor.

Enter the Name, Description (optional), and click “Save”.

This Custom Analysis Package is now available in the “Project” section, where the data

4. assignment is done.

5. Navigate to the “Project” tab from the main selection.

Select the appropriate Operation type and click on the “Analysis” option available under the

6. “Add Project Items” section.

7. Select the desired Custom analysis definition and click “Edit”.

8. Assign "Input Data" by dragging and dropping from the context bar and click “save”.

9. Download the project to the Edge Device to generate the defined calculation results.

10.16 Publishing and revoking Custom Analysis Packages

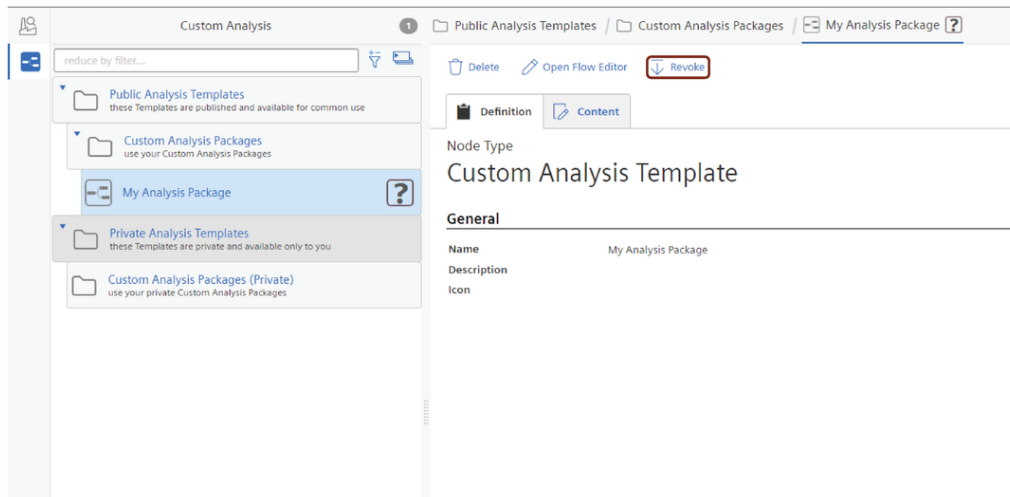
Once the Custom Analysis Package has been created and validated, it can be published for other users within the environment. Proceed as follows to publish and revoke Custom Analysis Packages:

Select the Analysis package and click the “Publish” button.

The analysis package appears under the “Public Analysis Templates” category and it is

1. available for all Edge Analytics users within the environment.

2. Click on the "Revoke" button to revoke the Analysis Package and modify it again.



10.17 Analysis Package Extensions

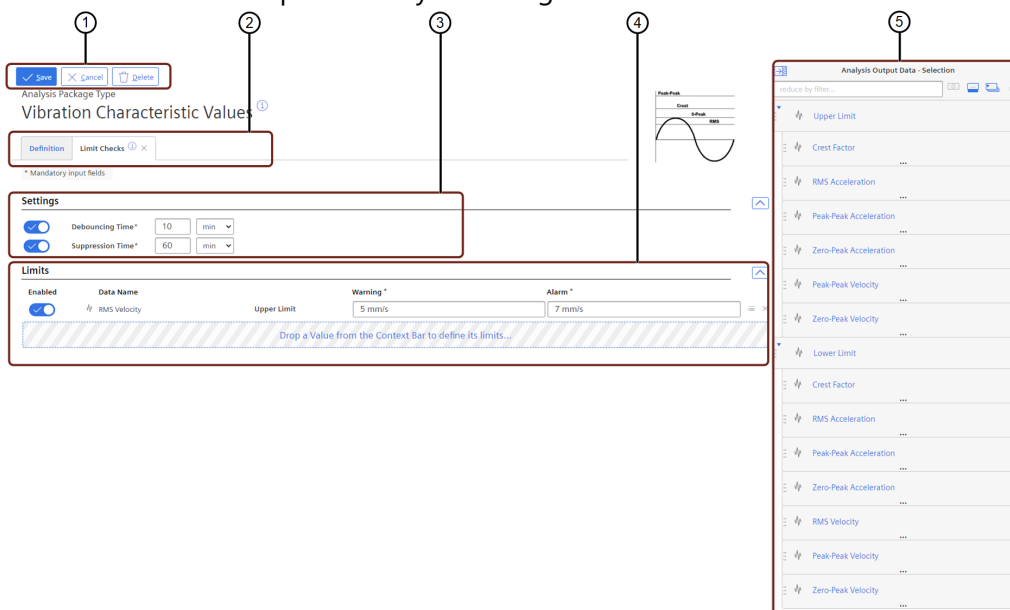
Analysis Packages can be extended with optional functionality by using the



button for a selected Analysis Package.

10.18 Analysis Package Extensions "Limit Check"

The Analysis Package Extension "Limit Check" allows to perform a limit check on calculated timeseries KPIs. It is possible to perform a check against upper and or lower warning and alarm limits. Therefore, the target KPI needs to be chosen from the context bar, which shows the available KPIs for the specific Analysis Packages.



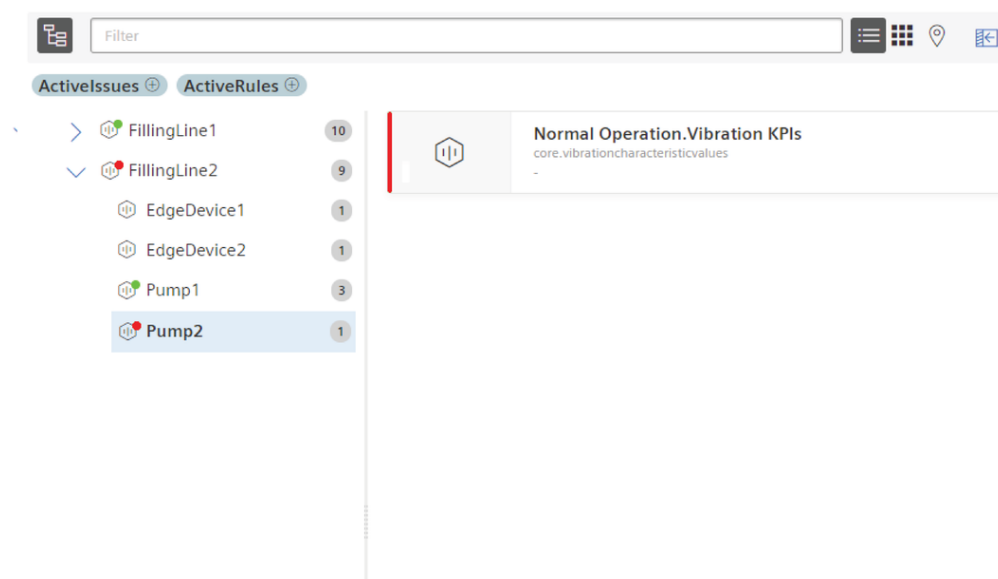
- ① Save or Cancel settings
- ② Extension selection tabs
- ③ Settings definitions
- ④ Limit definitions
- ⑤ Context Bar with available KPIs

Area	Parameter	Description
Settings	Debouncing Time	Define a value for the debouncing time
Settings	Suppression Time	Define a value for the suppression time
Limits	Warning	Define a value for the warning limit
	Alarm	Define a value for the alarm limit
Context Bar	Analysis Output Data	Shows the available data of the Analysis Package, which can be used for an upper or lower limit check

KPIs, which are extended with a limit check option will check each calculation result against the defined limits. On exceeding one of these limits, a corresponding health status is generated, uploaded to Industrial IoT, and can be monitored in Insights Hub Monitor.

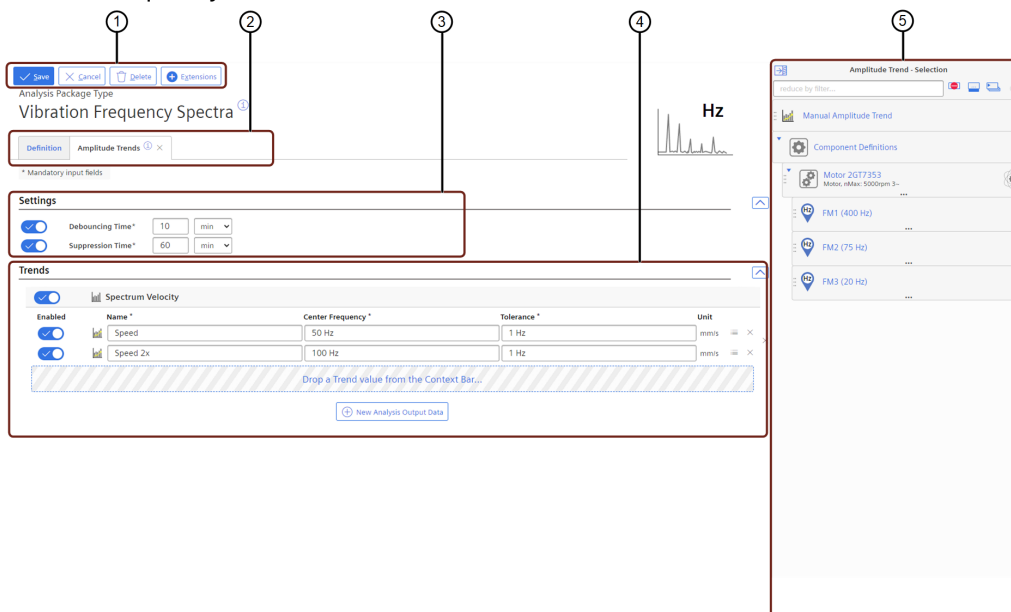
The debouncing time can be used to suppress the event creation on exceeding limits. If the timeseries data settles back below a previously exceeded limit within the defined time, no event is created.

After an event has been created, further events will be dismissed for the defined suppression time if the suppression is enabled.



10.19 Amplitude Trends

The Analysis Package Extension “Amplitude Trends” allows to extract the maximal amplitude of defined frequencies or orders from its calculated spectra and upload it as a timeseries trend. It is also possible to set the center frequencies based on the created components, which already contain frequency definitions.



- ① Save or Cancel settings
- ② Extension selection tabs
- ③ Settings definitions
- ④ Amplitude Trend definitions
- ⑤ Context Bar with available spectrum types, trend type or Components

Area	Parameter	Description
Trends	Name	Define the Amplitude Trend Name
	Center Frequency	Define the Center Frequency from which the maximal amplitude shall be determined
	Tolerance	Define the Tolerance around the Center Frequency, to compensate for minor deviations of the frequency. The maximal Amplitude will be determined in a frequency band of: Center Frequency – Tolerance till Center Frequency + Tolerance
	Limit Check	Enable and define the limit check on the amplitude. If the menu button on the amplitude trend is clicked, a context bar appears, where it is possible to enable and configure warning and alarm limits
Context Bar	Analysis Output Data	Shows the available data of the Analysis Package, which can be used for Amplitude Trend extraction

If the limits are defined for one or more trends, a determination of the health status will be performed, and the settings for debouncing and suppression time are shown and can be set. On

exceeding one of these limits, a corresponding health status is generated, uploaded to Industrial IoT, and can be monitored in Insights Hub Monitor.

The debouncing time can be used to suppress the event creation on exceeding limits. If the timeseries data settles back below a previously exceeded limit within the defined time, no event is created.

After an event has been created, further events will be dismissed for the defined suppression time if the suppression is enabled.

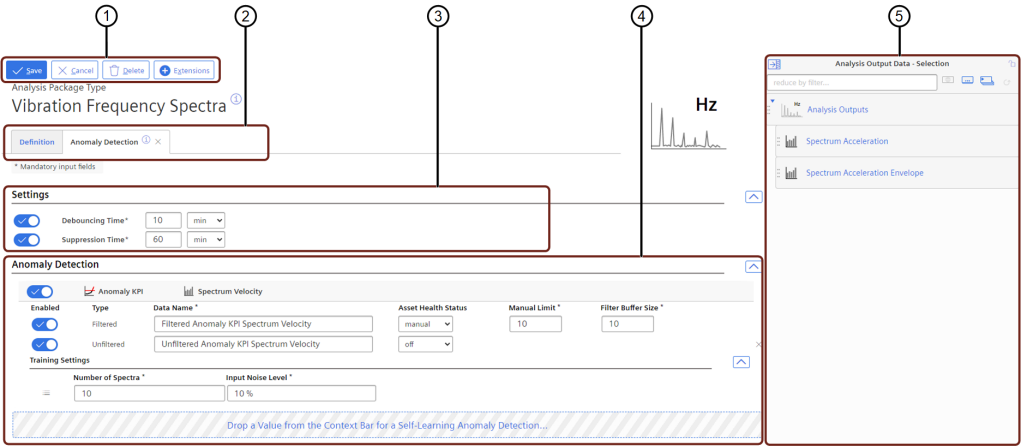
10.20 Anomaly Detection

The Analysis Package Extension “Anomaly Detection” compares a currently calculated spectrum with a set of reference ones and estimates a difference between them. This way it is possible to detect anomalies in all three spectrum types.

The analysis is based on the autoencoder neural network. First, the reference spectra are collected. Then the neural network is trained on the edge device and stored as a model. Finally, every new calculated spectrum is propagated through that neural network and the anomaly measure (anomaly KPI) is calculated as a mean squared error of the prediction.

It is possible to generate a filtered and un-filtered KPI indicating the anomaly level. For the filtered KPI a buffered window method is applied to reduce sudden outliers, to receive a more clear trending.

The smaller the anomaly KPI, the closer the spectrum to the reference data set.



- ① Save or Cancel settings
- ② Extension selection tabs
- ③ Anomaly Detection definitions
- ④ Context Bar with available spectrum types

Area	Parameter	Description
------	-----------	-------------

Area	Parameter	Description
Anomaly Detection	Data Name	Define the anomaly KPI name
	Asset Health Status	Select the asset health status calculation mode
	Asset Health Status Manual Limit	If the asset health status mode is manual, define the limit for the anomaly KPI
	Filter Buffer Size	Define the number calculated KPI probes, which shall be collected and used for the filtering
	Training Settings Number of Spectra	Define the number of reference spectra collected for training
	Training Settings Input Noise Level	Define the level of autoencoder denoising
	Training Settings Extended Settings	Open the context bar with extended settings
Context Bar	Analysis Output Data	Shows the available data of the Analysis Package, which can be used for Anomaly Detection
	Extended Settings Max Iterations	Configure the maximal number of iterations for the training of the neural network
	Extended Settings Learning Finished Tolerance	Select the tolerance to stop training of the neural network
	Extended Settings Update Mode (in Project only)	Select the update mode

The Limit Check can also be configured for the anomaly KPI. Apart from the possibility to specify the limit manually, there is another option to estimate this limit automatically. In the latter case, the anomaly KPI is calculated on the reference spectra, and its mean value and standard deviation (stddev) are calculated. The limit is estimated as **mean + 4 * stddev**.

If a limit is defined, a determination of the health status will be performed, and the settings for debouncing and suppression time are shown and can be set. On exceeding one of these limits, a corresponding health status is generated, uploaded to Industrial IoT, and can be monitored in Insights Hub Monitor.

The debouncing time can be used to suppress the event creation on exceeding limits. If the timeseries data settles back below a previously exceeded limit within the defined time, no event is created.

After an event has been created, further events will be dismissed for the defined suppression time if the suppression is enabled.

When the training process is completed, an optimization report is uploaded as an IoT File to a data asset, where all spectra and anomaly KPIs are stored. The name of the file is built up as <anomaly KPI name>.optimization-report.<version>.txt.

```
Train early stop reached!
Optimization Report
-----

Initial coordinates:
-0.5909 -0.5284 -0.7699 ... 0.9943

Final coordinates:
-0.4488 -0.7846 -1.0365 ... 0.5013

iter      loss      loss change  |gradient|  step size  total time
0          37758363.177  0.000      1632878120.7760  0.001      1.736
223        14370.343    37743992.833  8526026.757    0.001      322.047
446        6812.147      7558.196     3656077.211    0.001      642.238
669        1852.604      4959.543     1083697.791    0.001      964.479
892        326.910       1525.694     493216.577     0.001      1275.900
1115       103.023       223.887     906146.887     0.001      1510.833
1338       35.114        67.910      564559.210     0.001      1738.316
1561       21.508        13.605      290059.362     0.001      1959.964
1784       22.393        -0.884      345698.988     0.001      2193.085
2007       6.272         16.121      18163.151      0.001      2369.018
2230       6.546         -0.275      37022.613      0.001      2519.574
-----
```

Another source of important information about the training process can be found in the [Log information](#) section. Here, more details can be obtained by switching the severity filter to Verbose.



To assess the anomaly detection quality, examine the optimization report.

- If the maximum number of iterations is reached, increase it.
- If the training stopped too early, decrease the tolerance and set it manually if required.
- Then reset or update the model.

The model can be reset by changing the update setting at the analysis extension instance in Project. When the desired option is selected, the project should be downloaded to an edge device again so that the change applies.



Currently, it is not recommended to configure more than 400 spectra for training in total on one edge device. A larger amount may lead to performance and memory issues.

10.21 Analysis Models

Analysis Models can be utilized to reuse a configuration of Trigger Rules and Analysis Packages for multiple different input data.

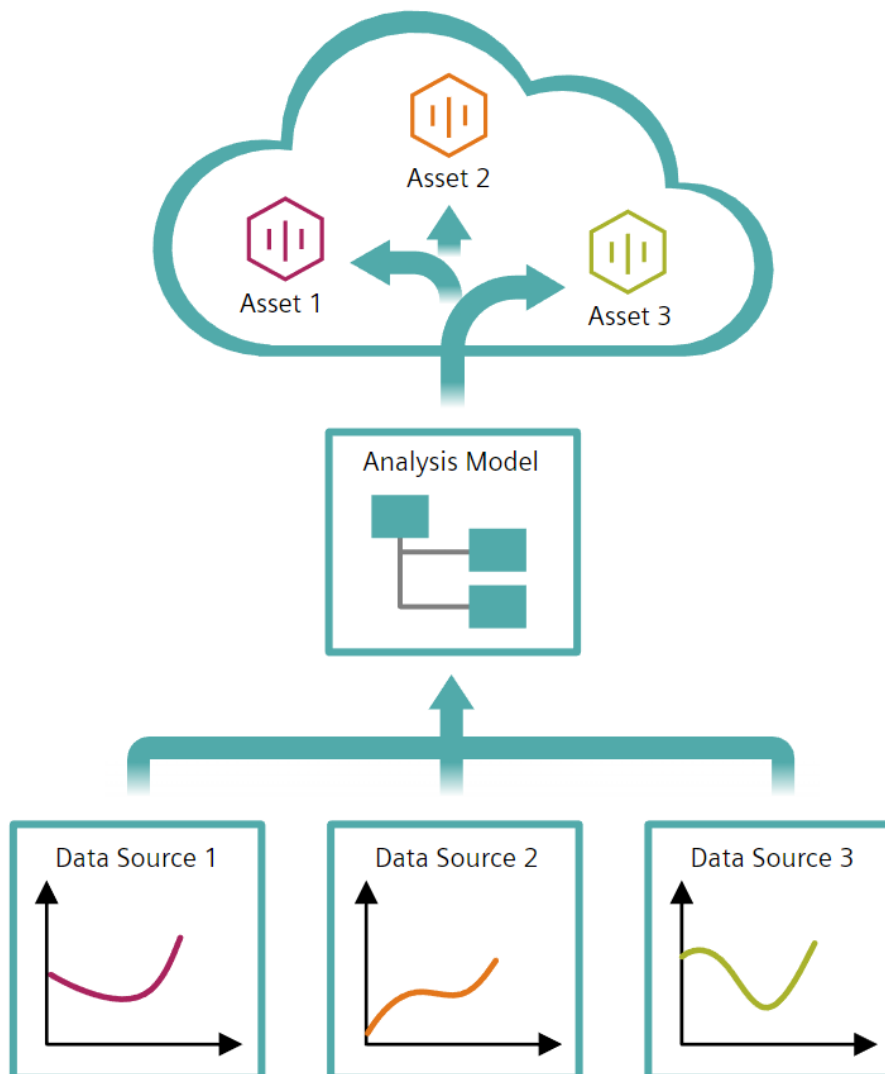
To create and use an Analysis Model, you can build a desired configuration structure with Trigger Rules and Analysis Packages.

Instead of a direct assignment of input data from Data Sources, Data Interfaces are used as input, to create a generic link to the created Trigger Rules and Analysis Packages.

The needed Data Interface items need to be created within the Resource Section.

Within the Data Source Extension of the Analysis Model, multiple input Data Sources can be linked, as well as the target Asset for data upload.

For each Data Source, the defined Analysis will be executed and the results will be uploaded to the target Asset.



10.22 Create a new Analysis Model

Requirements

- Following configurations need to be created upfront within the Resources section of the Edge Device:
 - Data Interface e.g. [SM1281 WAV](#).
 - [Trigger Rule](#).
 - [Analysis Package](#).

Procedure

To create a new Analysis Model, proceed as follows:

1. Open the "Edge Device" section and select the edge device.
2. Select "Project" in the main selection.
3. Within the Project Tree click on the button to add a new Analysis Model Folder.
4. Select the created Analysis Model Folder and enter a name.
5. Click on the button to add a new Analysis Model, enter a name and click save.
6. Insert Trigger Rules and Analysis Packages according to your needs and link the input data of a Data Interface to them.
7. Again select the created Analysis Model item within the Project Tree and click the button to add a Data Source extension.
8. For each device or file, define the target Asset to which the results shall be uploaded, and save the configuration.

Note: Currently the first supported Data Interface is SM1281 WAV and its only supported Trigger Rule is of condition Continuous.

In case of file readings, each file needs to have a unique File Reference, which is used to identify the file.

The File Reference needs to be a part of the target file name.

Following picture shows an example configuration.



In case of File Import Interfaces, the File Reference IDs can be imported from .txt or .csv Files.

A .txt File needs to be in the format:

file_reference_1

file_reference_2

file_reference_3

...

The format of a .csv File can be detected automatically. It is also possible to manually define the delimiter and column Keys or Indexes. A file can be structured in the following way:

file_reference_1;name_1;description_1;


file_reference_2;name_2;description_1;

file_reference_3;name_3;description_2;

...

Result

You have created a new configuration for a Analysis Model with linked Data Sources via Data Interface.

If you want to edit the configuration again, select the newly created entry in the selection list and click  Edit in the configuration area.

11.1 Introduction to Trigger Rules

Trigger Rules are the configuration items, which can be created within the "Resources". Trigger Rules are used to determine the period of analysis execution. With the help of Trigger Rules, operating states of machines and assets can be detected and perform the analysis always in the same state of the machine.

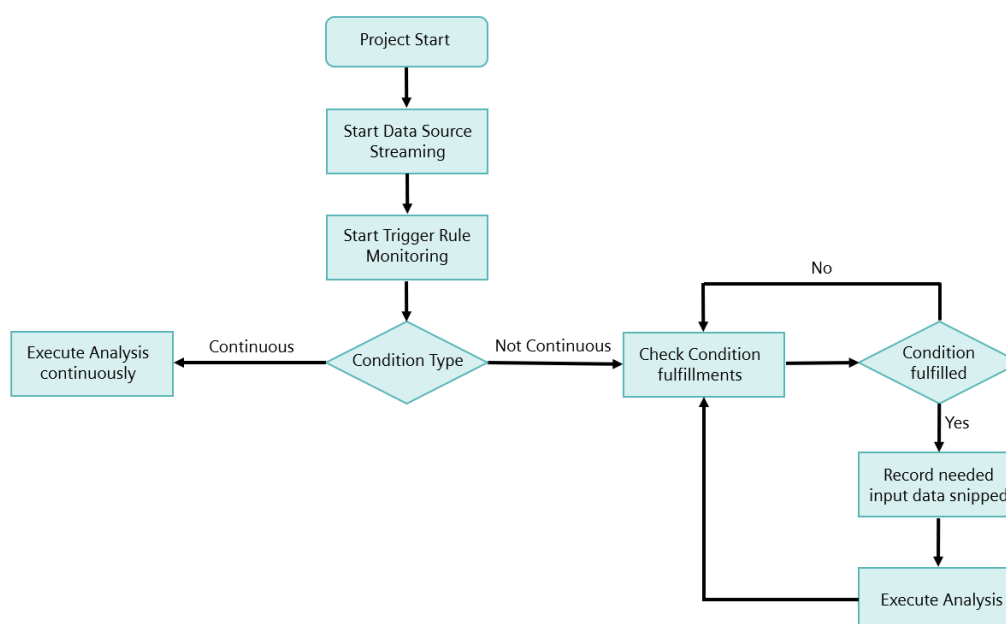
Each Trigger Rule can have one or multiple conditions. Conditions are used to define when a trigger rule will be in active state.

In "Resources", existing Trigger Rule configurations can be inserted to the "Project". After that, Analysis Packages will be assigned to an inserted Trigger Rule. All assigned analysis packages will be executed as soon as the condition of the Trigger Rule is fulfilled.

11.2 Analysis Sequence

The Edge Analytics Engine always executes a project in the following sequence:

- Start the data streaming for all defined data sources
- Start the Trigger Rule Monitoring, to decide on to be executed analysis
 - If the Condition is of type Continuous execute all assigned Analysis Packages
 - If the Condition is of any other type, periodically check the Condition fulfillments. If all Conditions are fulfilled;
 - Record an input data snippet which is long enough to successfully receive one calculation result from it
 - Execute the assigned Analysis Packages
 - Repeat the periodically check the Condition fulfillments to perform the next analysis



11.3 Condition Types

These are the following condition types in Edge Analytics:

Continuous Calculation

Analysis Packages assigned to a Trigger Rule with a condition “Continuous Calculation”, will be applied to the input data stream without interruption. The calculation will be active all the time and will consume high resources.

Value Range

Analysis Packages assigned to a Trigger Rule with a condition “Value Range”, will be executed when a selected input data is within the defined limits. The condition will define a validation time, which has to be elapsed first before the Trigger Rule gets into an active state. Additionally, it is possible to define a description, a unit, a lower and upper limit for the assigned data.

Simple Timer

Analysis Packages assigned to a Trigger Rule with a condition “Simple Timer”, will be executed periodically after a defined time has elapsed.

11.4 Create a new Trigger Rule

To use Edge Analytics, it is necessary to properly create a Trigger Rule. The following steps will lead you through the process of creating Trigger Rules:

Requirements

Prepare edge device within Edge Analytics:

- [Individual structure](#) has been created within the "Resource".
- Activated edge device.

Procedure

To create a Trigger Rule, proceed as follows:

1. In the "Edge Device" window, select an edge device.
2. Select "Resources".
 - The individual created structure within the navigation is displayed.
3. Select a folder within the navigation area.
4. Click on the button to create a new Trigger Rule.
 - In the configuration area, a new edit window is displayed.
5. Enter a name and description in the "General" area.
6. Drag and drop a condition from the context bar onto the expected area within the settings.
7. Enter the field details and click "Save".

Result

You have successfully created a new Trigger Rule.

Components

12

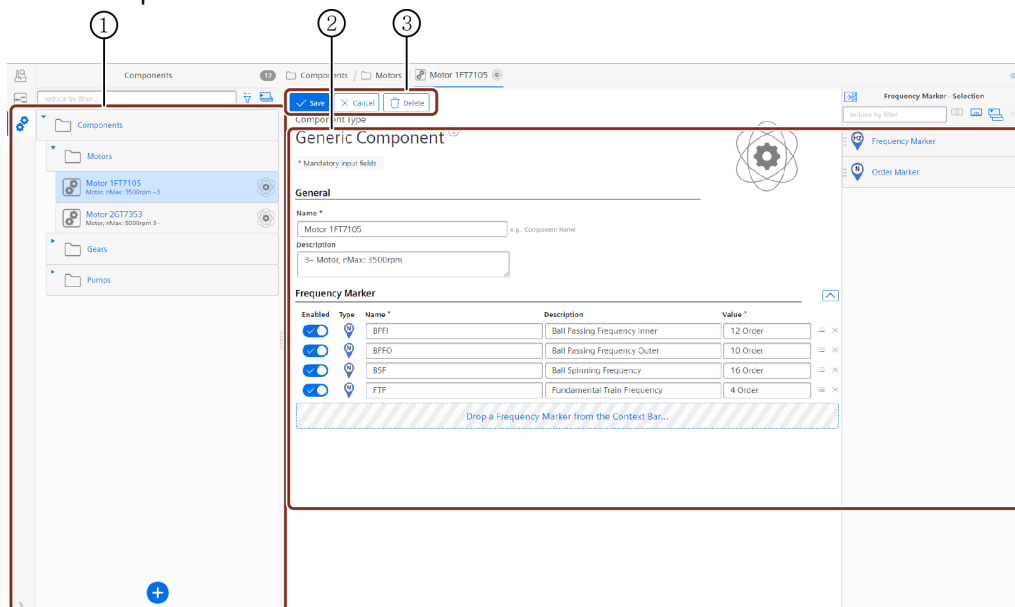
12.1 Introduction to Components

Components are definitions which contain information about Exciter Frequencies of certain mechanical component. These can be Motor, Generators, Gears, Pumps, Bearings, etc. Within a dedicated section in Edge Analytics, such Components can be defined and structured globally for a environment. In a Project, Components then can be assigned to Assets, to inherit the containing frequency information. With the Complex Data Plugin, Frequency Markers can be visualized for a spectrum, based on the available frequency information.

The frequency information can be defined in Order or Frequency(Hz).

Markers of type Frequency are displayed at the target Frequency for a Frequency Spectrum. For an Order Spectrum they are displayed at the corresponding Order, which is calculated with the reference speed.

Markers of type Order are displayed at the target Order for an Order Spectrum. For a Frequency Spectrum they are displayed at the corresponding Frequency, which is calculated with the reference speed.



- ① Components repository.
- ② Component configuration area.
- ③ Edit Save and Delete Buttons.

For the visualization of the Frequency Markers, please refer to Chapter "[Data Visualization](#)".

12.2 Create a new Component

The following steps will lead you through the process of creating a new Component.

Procedure

1. In the "Edge Device" window, select an edge device.
2. Select "Components".
3. Click "+" to create a new folder structure.
4. Select a folder, click "+" and choose "Generic Component".
5. Enter a name and description in the "General" area.
6. Drag and drop Frequency and/or Order Marker items from the Context Bar onto the drop zone of the "Frequency Marker" area.
7. Enter Name, Description and Value for the Marker definitions.
8. Click "Save".

Result

You have successfully created a new Component.

12.3 Usage of a Component in a Project

Requirements

Prepare edge device within Insights Hub Edge Analytics:

- Activated edge device.
- Individual structure has been created within the "Resource".
- A Project has been configured within the "Project" section.
- A Component has been created within the "Components" sections.

Procedure

1. In the "Edge Device" window, select an edge device.

2. Select "Project".
3. Select an item of type "Asset" within the Project Tree and click "Edit".
4. Drag and drop a Component from to Context Bar to the drop zone.
5. Click "Save".
6. In the "Edge Device" window, select an edge device.
7. Click "Update" tab.
8. Click on update button to update the new configuration.

Result

You have successfully assigned a new Component. The Frequency Markers of this Component now can be visualized at the chosen Asset within the Complex Data Plugin of Insights Hub Monitor.

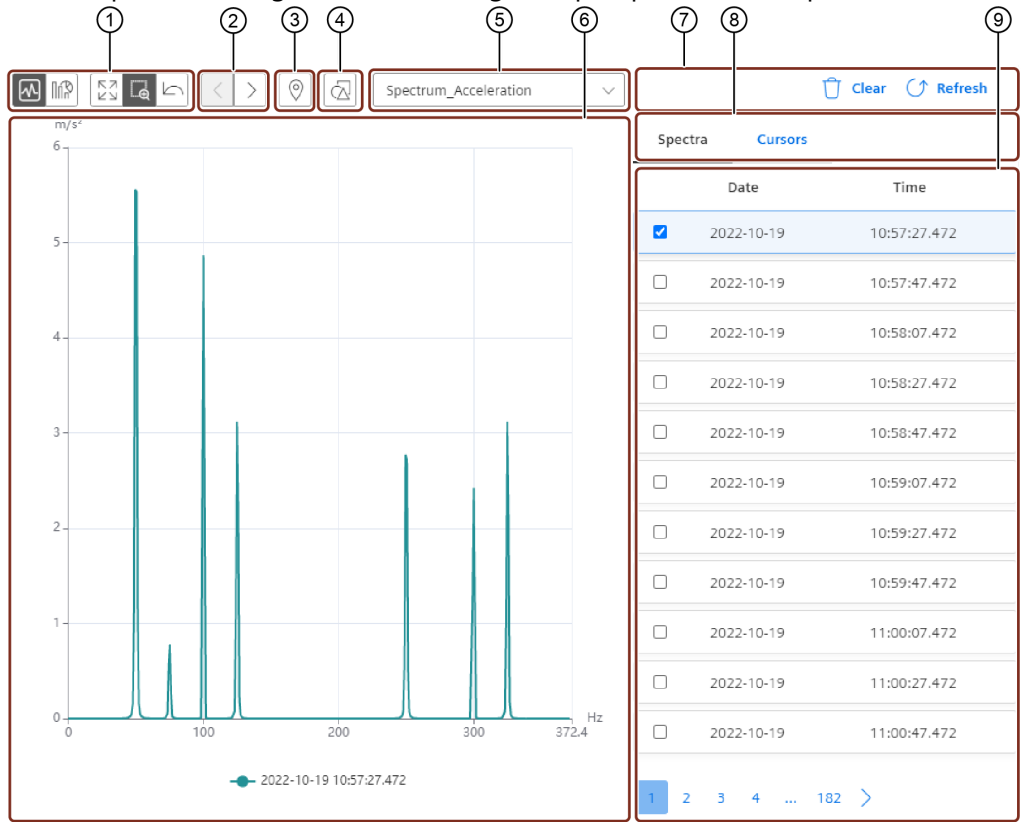
13.1 Data Visualization

To visualize complex data such as Spectra, calculated and uploaded by Analysis Packages, a Complex Data Plugin is provided for Insights Hub Monitor. The plugin will be available as soon as the Insights Hub Edge Analytics application has been enabled for a target environment.

To visualize complex data, the corresponding aspect containing the uploaded data needs to be selected within Insights Hub Monitor and the complex data plugin needs to be opened. Subsequently, the complex data will be listed up for the defined time range and can be selected for visualization.

By assigning Components with containing frequency information to the Asset of the Spectra Analysis Package, Frequency Markers can be displayed to identify single frequency peaks as well as their harmonics. For information about creating and assigning Components, see Chapter [“Components”](#).

The Complex Data Plugin allows selecting multiple spectra, to compare them with each other.



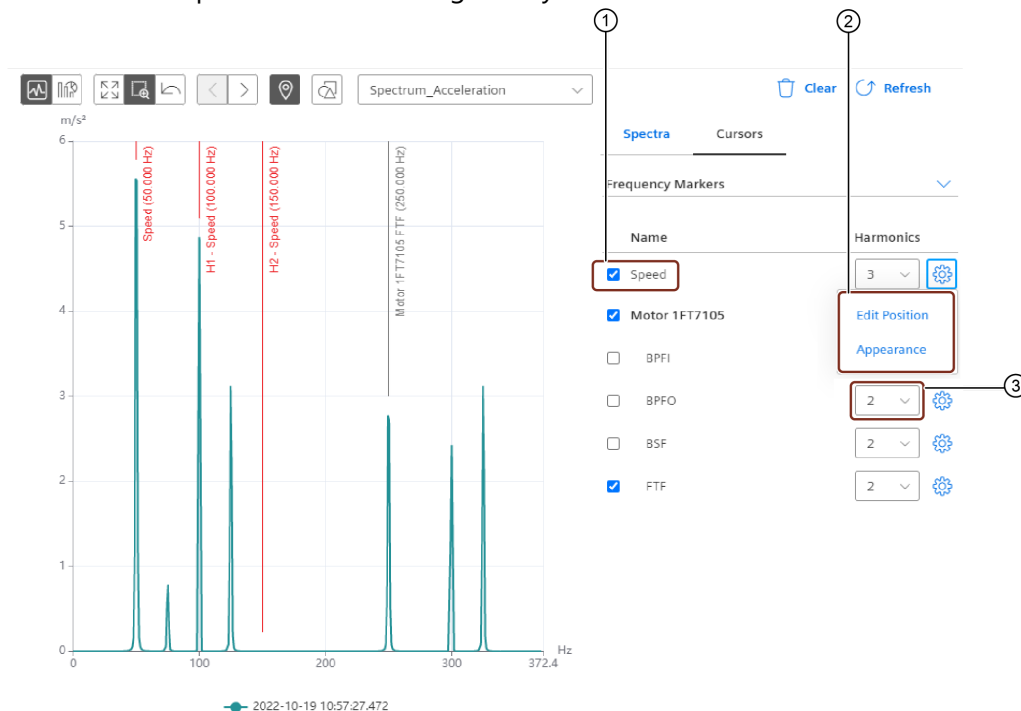
- ① Buttons for zooming/moving, undo zooming/moving, switch between a line or bar interpolation of the shown spectrum
- ② Buttons to select previous or next spectrum

- ③ Button to enable/disable cursors
- ④ Button to enable/disable value markers
- ⑤ Name filter for spectrum selection
- ⑥ Chart area
- ⑦ Buttons to clear spectra selection and to refresh selected time picker range
- ⑧ Tab selection for Spectra and Cursor options
- ⑨ List of available files

In case of assigned Components, the contained Frequency Markers can be displayed within the spectrum. In case the calculated spectrum was linked with a reference speed information in the corresponding Analysis Package, the speed frequency can be displayed as well.

It is possible to edit the position of the Markers, display harmonics and change the appearance. Changing the position can be done by entering a value or dragging the Marker to a new position.

Changed positions and settings are only applied for the selected Asset. If the value of a Frequency Marker needs to be changed centrally for the Components, this needs to be done within the Component Section of Edge Analytics.



- ① Enable Button to show/hide the target Marker
- ② Settings Button to edit position or appearance
- ③ Number of displayed harmonics

14.1 Limits

Edge Analytics offers a wide range of different Analysis Package combinations as well as using Custom Analysis Packages with a possibility of combining up to 200 different types of Analyzing Functions, which all have different effects onto the hardware resources, and to execute the final project on different Edge Devices in regards to the used hardware resources, it is not possible to define strict configuration limits.

Therefore, the user is responsible to verify the load onto the hardware resources of the configured project on his own.

For common use cases following recommendations regarding the project configuration can be given.

Use Case: Vibration Spectra calculation

- Used Edge Device: MindConnect Nano/IoT2050
- Analysis Package
 - Vibration Spectra Frequency or Vibration Spectra Order
 - Enabled calculations
 - Velocity
 - Acceleration
 - Acceleration Envelope
- Trigger Rule
 - Condition
 - Value Range + Timer (1h)

Recommended quantity structure:

MindConnect Nano: A maximum of 5 SM1281 connections with 4 vibration data (46,875kHz) and 1 speed data (3,906kHz) streaming for each device. For each vibration data the Analysis Package is applied, and each speed data is used as input for the Trigger Rules.

MindConnect IoT2050: A maximum of 3 SM1281 connections with 4 vibration data (46,875kHz) and 1 speed data (3,906kHz) streaming for each device. For each vibration data the Analysis

Package is applied, and each speed data is used as input for the Trigger Rules.

Use Case: Rawdata upload

- Used Edge Device: MindConnect Nano/IoT2050
- Analysis Package
 - Event Based Data Upload
 - Collection Trigger (repeated): 60min
 - Collection Duration: 10s
 - Uploaded data
 - 1x Vibration Data
 - 1x Speed
- Trigger Rule
 - Condition
 - Value Range

Recommended quantity structure:

MindConnect Nano: A maximum of 5 SM1281 connections with 4 vibration data (23,438kHz) and 1 speed data (3,906kHz) streaming for each device. Each vibration data and the corresponding speed are uploaded with one Event Based Data Upload Analysis Package and each speed is used as input for the Trigger Rules.

MindConnect IoT2050: A maximum of 3 SM1281 connections with 4 vibration data (23,438kHz) and 1 speed data (3,906kHz) streaming for each device. Each vibration data and the corresponding speed are uploaded with one Event Based Data Upload Analysis Package and each speed is used as input for the Trigger Rules.

15.1 Extended data types

Basic idea

Edge Analytics works with data that have a complex internal structure such as spectra or orbits. One spectrum or orbit may also require significant memory (> 1 Megabyte) and therefore, it is not suitable to store it in the IoT Time Series completely.

The following approach is adapted for storing data:

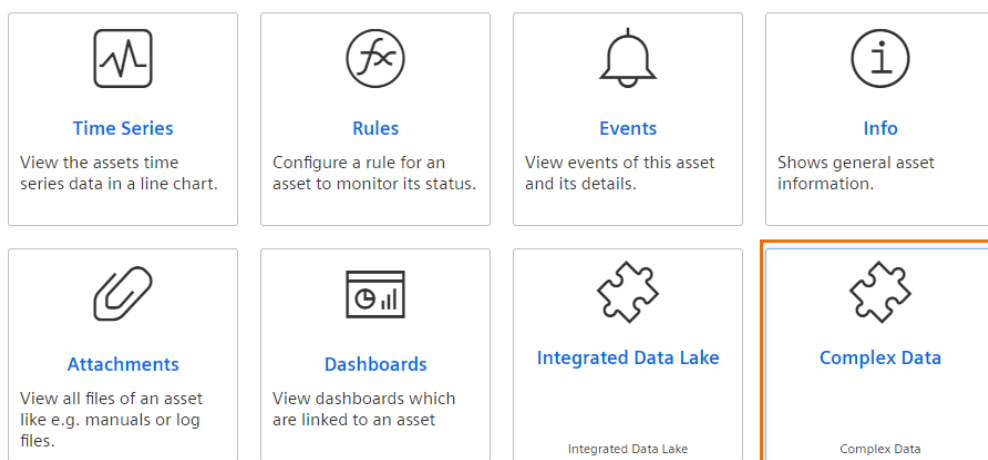
- Only meta-information describing the internal structure of the data is stored as a time series record.
- This meta-information contains a reference to an IoT file, where the payload, for example, amplitudes and phases for a spectrum or the X, Y coordinates for an orbit are stored.

Visualization

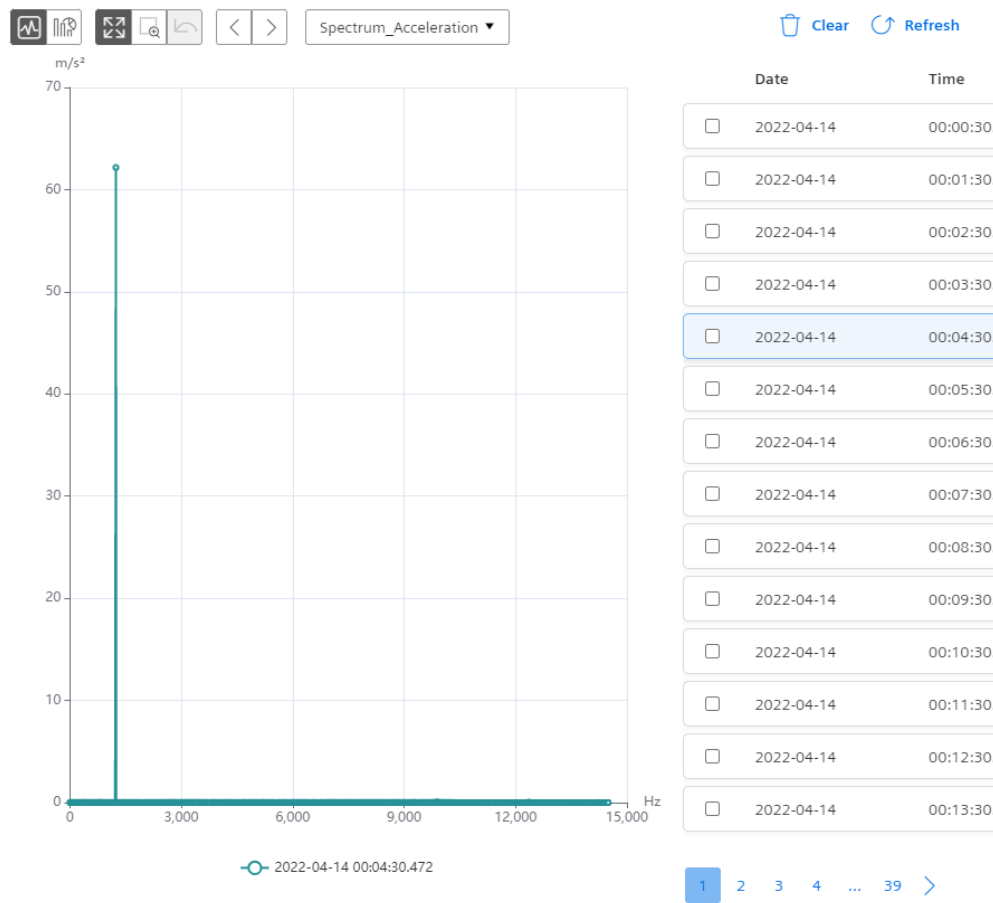
Complex data can be viewed by the Complex Data Plugin available in the Insights Hub Monitor application, as shown in the image below:

Plugin Overview

Select a plugin to get insights about your specific asset.



If supported, complex data that are stored at the selected asset can be visualized from the spectrum.



Data format

Meta information is stored as a JSON string in an IoT Time Series record in the format given below.

The field details is optional.

```
{
  "typeId": "<type_id>",
  "version": "<type_version>",
  "path": "<file path>"
  "details": {
    "<any further useful meta information that can be used for filtering>"
  }
}
```

Example

The meta-information for a frequency spectrum with amplitudes and phases looks like this:


```
{
  "typeId": "mcea.spectrum.frequencyamplitudephases",
  "version": "1.0.0",
  "path": "mceaextendeddata/Spectrum_Acceleration/Spectrum_Acceleratio
n/1649859330472"
  "details": {
    "min": 0,
    "max": 1000,
    "fftBins": 1024
  }
}
```

The corresponding IoT file containing amplitudes and phases in JSON format can be found at the same asset using the following path. The last item in the path is the file name.

mceaextendeddata/Spectrum_Acceleration/Spectrum_Acceleration/1649859330472