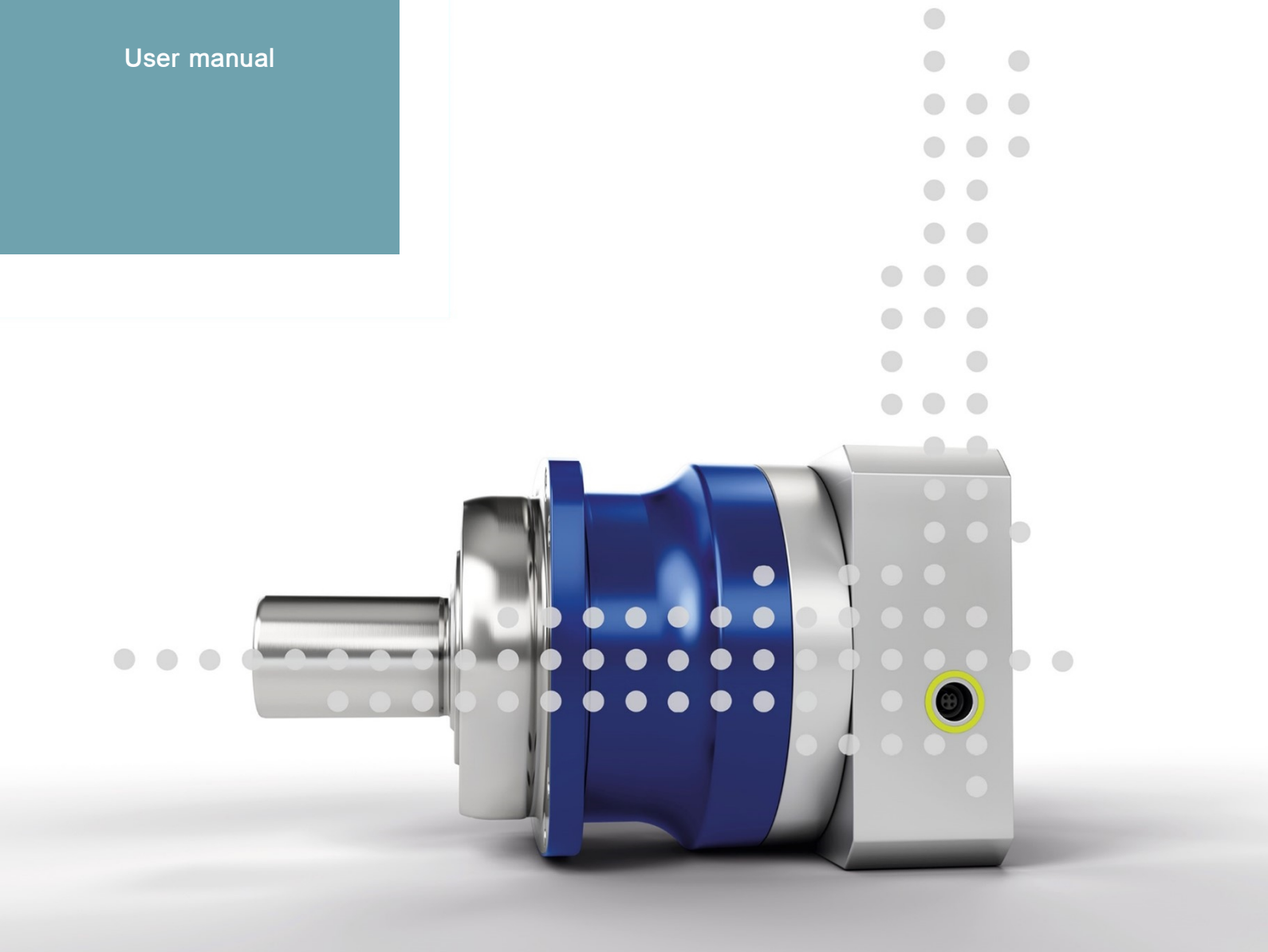
WITTENSTEIN

Smart Service
cynapse® Connect

User manual



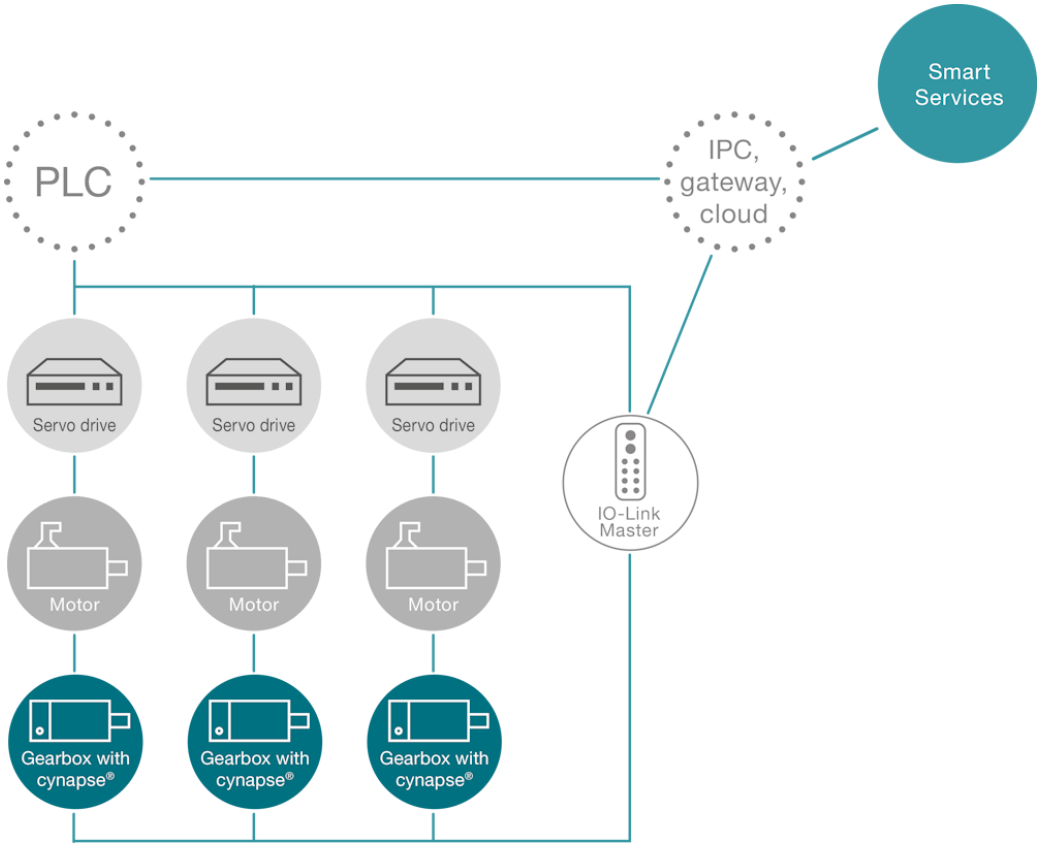
This document describes the features of the Smart Service **cynapse® Connect** in the version **2.1.0**.

For older versions, please contact cybertronic-support@wittenstein.de

System requirements

The WITTENSTEIN Smart Services are based on the hardware abstraction via the container virtualization and support various daten sources and manufacturers.

We recommend a system setup with an IPC as a Docker host or the use of the Bosch Rexroth ctrlX CORE as well as systems with ctrlX OS in combination with cynapse® sensor cubes as data sources and an IO-Link master as part of the infrastructure.



Using this system as an example, the gearboxes with cynapse® are connected to an IPC/gateway via an IO-Link master in addition to the PLC via a separate network connection. This IPC serves as a Docker host and offers the option of integrating additional machine data from the PLC or sending data to the cloud using WITTENSTEIN's Smart Services.

Data sources

The following sources are supported for communication between WITTENSTEIN Smart Services and the cynapse® Sensor Cube:

- IO-Link master with integrated OPC-UA server according to Companion Specification "OPC-UA for IO-Link"
- ifm IO-Link master (e.g.: AL13xx, AL19xx)
- Pepperl+Fuchs or Comtrol with integrated OPC-UA server (e.g.: IEC2-8IOL or IEC3-8IOL)

Furthermore, OPC-UA servers (e.g.: SIMATIC S7-1500 OPC-UA server) are supported as a data source to integrate machine data.

Host

- IPC for running Smart Services using Docker from version 2.5.0.1.
- Bosch Rexroth ctrlX CORE or systems with ctrlX OS.

The requirements for running WITTENSTEIN Smart Services using Docker are:

- 64-bit kernel and CPU support for virtualization
- KVM virtualization
- QEMU in version 5.2 or later
- systemd init system
- At least 4 GB of RAM

(Source: https://docs.docker.com/desktop/install/linux-install/)

This manual aims to help you understand and configure the WITTENSTEIN Smart Service **cynapse® Connect**.

Overview

Receiving, processing and integrating data from cynapse® Sensor Cube and higher level systems

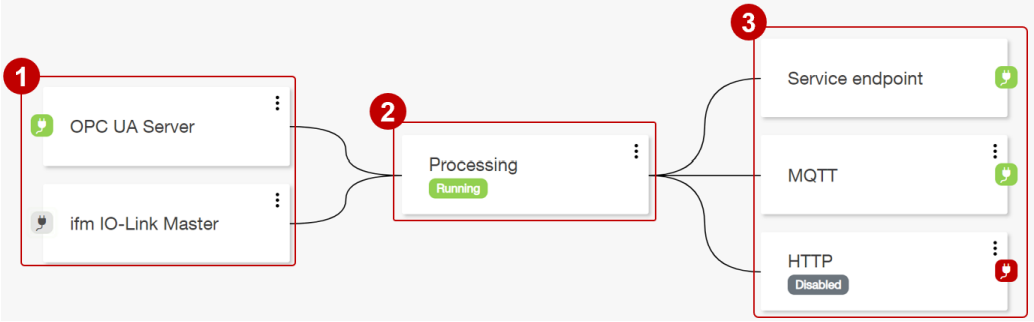
The Smart Service UI visualizes the data flow from left to right.

1. **Data sources**
   Allow the connection of various data sources for use within Smart Services or for forwarding to the supported target systems. Currently, there exist two kinds of data sources:
   - *IO-Link Master*: Provides data from cynapse® Sensor Cube using IO-Link.
   - *Higher level system*: Provides individual, application-specific data points.
2. **Processing node**
   Integrates all data from the data sources and translates it into a structured format. Also, it interacts with cynapse® Sensor Cube and, if applicable, other data sources.
3. **Data targets**
   cynapse® Connect sends the processed data to the other WITTENSTEIN Smart Services, by default. Additionally, custom data targets can be configured in order to send data and events to other systems such as an MQTT broker or a database as required by the specific application.

> ***Please note**: Custom data targets such as a MQTT broker, InfluxDB or HTTP REST endpoint can only be configured when having a **cynapse® Connect Advanced** license which can be purchased separately.*

The current connection state of each data source and data target is indicated via the color of the connector next to the respective tile:

- *green* represents a working connection
- *yellow* represents a working connection but no data is transmitted
- *gray with a pulsating border* represents that cynapse® Connect currently attempts to establish a connection.
- *red* means not connected or disabled



Processing node

1. Using the processing node, the following actions can be performed:

Adding new data sources and data targets

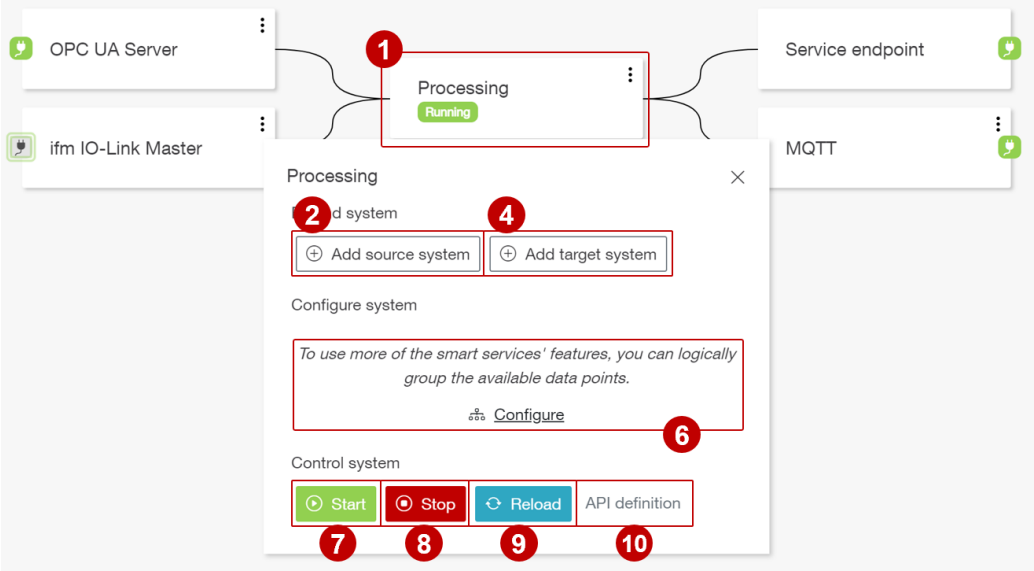
2. Add a new **data source** such as an IO-Link master or an OPC-UA server.
3. Select one of the available data sources. The categories on the left side can be used to filter the data sources.
4. Add a new **data target** such as an MQTT broker or database (requires the previously mentioned *Advanced* license).
5. Select one of the available data targets. The categories on the left side can be used to filter the data targets.

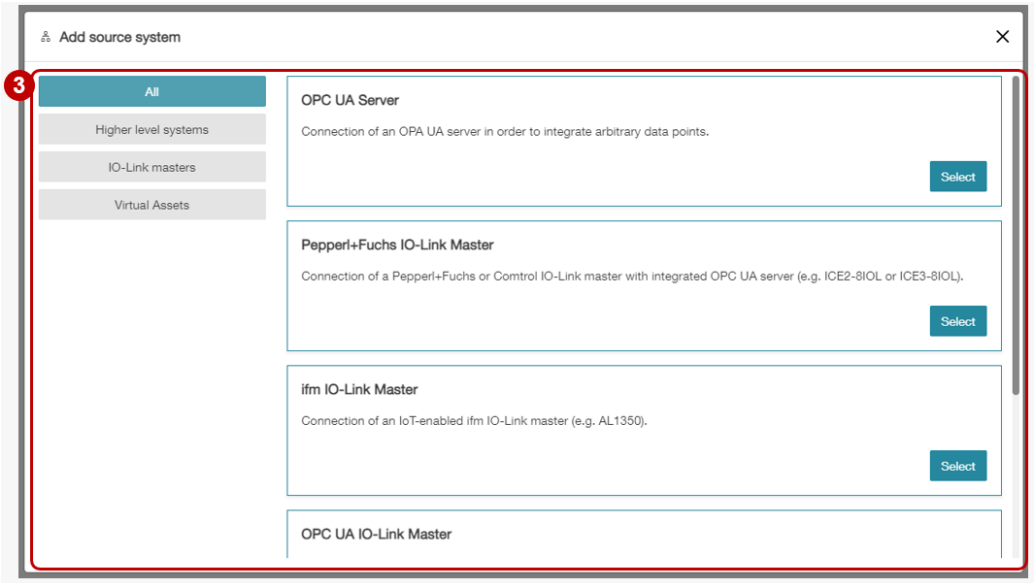
Configure drive trains and machine

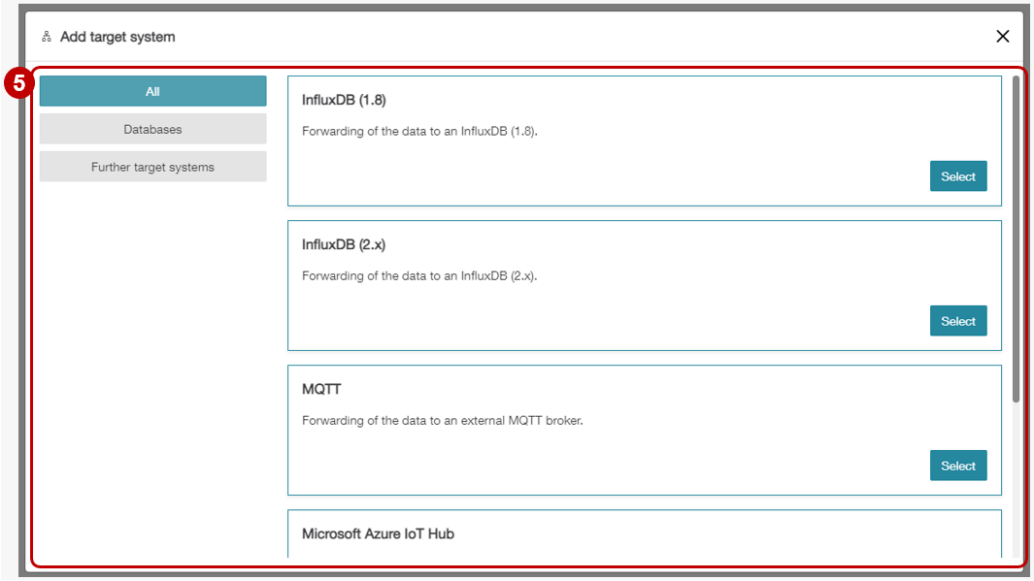
6. Using the "configure" button, drive trains can be configured and gearboxes can be assigned to them. This is further explained in chapter **e)**.

Controlling cynapse® Connect

7. Start data processing.
8. Stop data processing. This results in cynapse® Connect stopping to request any new input data from the data sources. Also, no data will be sent to any of the data targets.
9. Every change in the configuration requires reloading the configuration in order to take effect.
10. The API definition provides an overview over all available REST endpoints provided by cynapse® Connect. These can be used by custom systems in order to communicate with cynapse® Connect.




Add source system
3
All
Higher level systems
IO-Link masters
Virtual Assets
OPC UA Server
Connection of an OPA UA server in order to integrate arbitrary data points.
Select
Pepperl+Fuchs IO-Link Master
Connection of a Pepperl+Fuchs or Comtrol IO-Link master with integrated OPC UA server (e.g. ICE2-8IOL or ICE3-8IOL).
Select
ifm IO-Link Master
Connection of an IoT-enabled ifm IO-Link master (e.g. AL1350).
Select
OPC UA IO-Link Master


Add target system
5
All
Databases
Further target systems
InfluxDB (1.8)
Forwarding of the data to an InfluxDB (1.8).
Select
InfluxDB (2.x)
Forwarding of the data to an InfluxDB (2.x).
Select
MQTT
Forwarding of the data to an external MQTT broker.
Select
Microsoft Azure IoT Hub

Data sources

When adding a new **data source** or when clicking the tile of an existing **data source**, the configuration dialog is opened which is explained in the following.

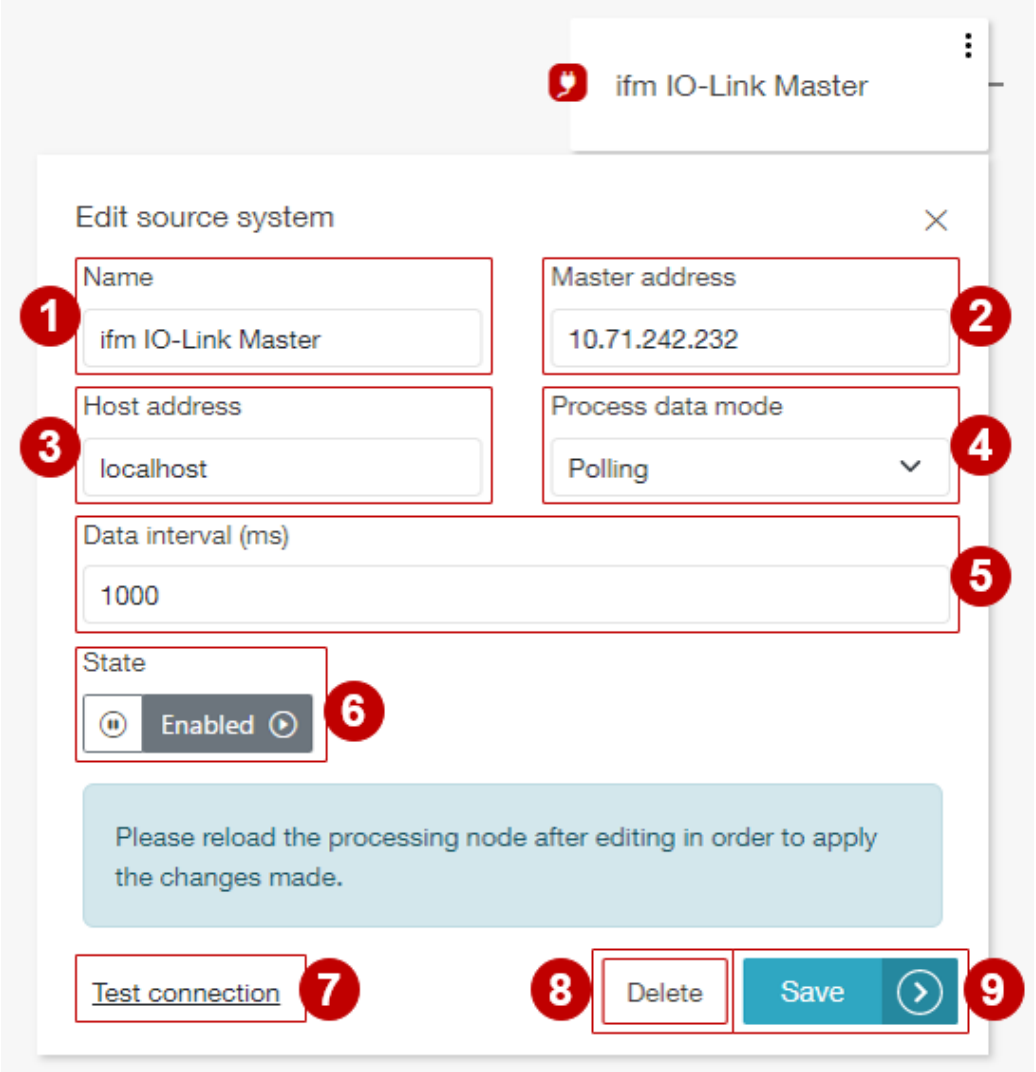
> ***Please note**: Any changes to any of the data sources are only applied once the "Reload" button is pressed in the processing section (see chapter **b**).*

IO-Link master

1. Custom display name used in the user interface.
2. IP address or host name of the IO-Link master.
3. IP address or host name of the IPC / host system onto which the Smart Service cynapse® Connect is installed.
4. Configure the process data reading and processing mode.
    - **Auto** chooses between **Publish & Subscribe** and **Polling** depending on the set interval.
    - **Publish & Subscribe** configures the IO-Link Master to send the process data to the cynapse® Connect at the set interval.
    - **Polling** cyclically requests the process data at the set interval.
    - In **Disabled** mode, no process data is read.
5. Configure the interval (specified in milliseconds) for the process data cycle.
6. Activate or suspend the connection to the device.
7. Validate the configuration and attempt to connect to the device.
8. Permanently delete the data source.
9. Save the changes to the data source.

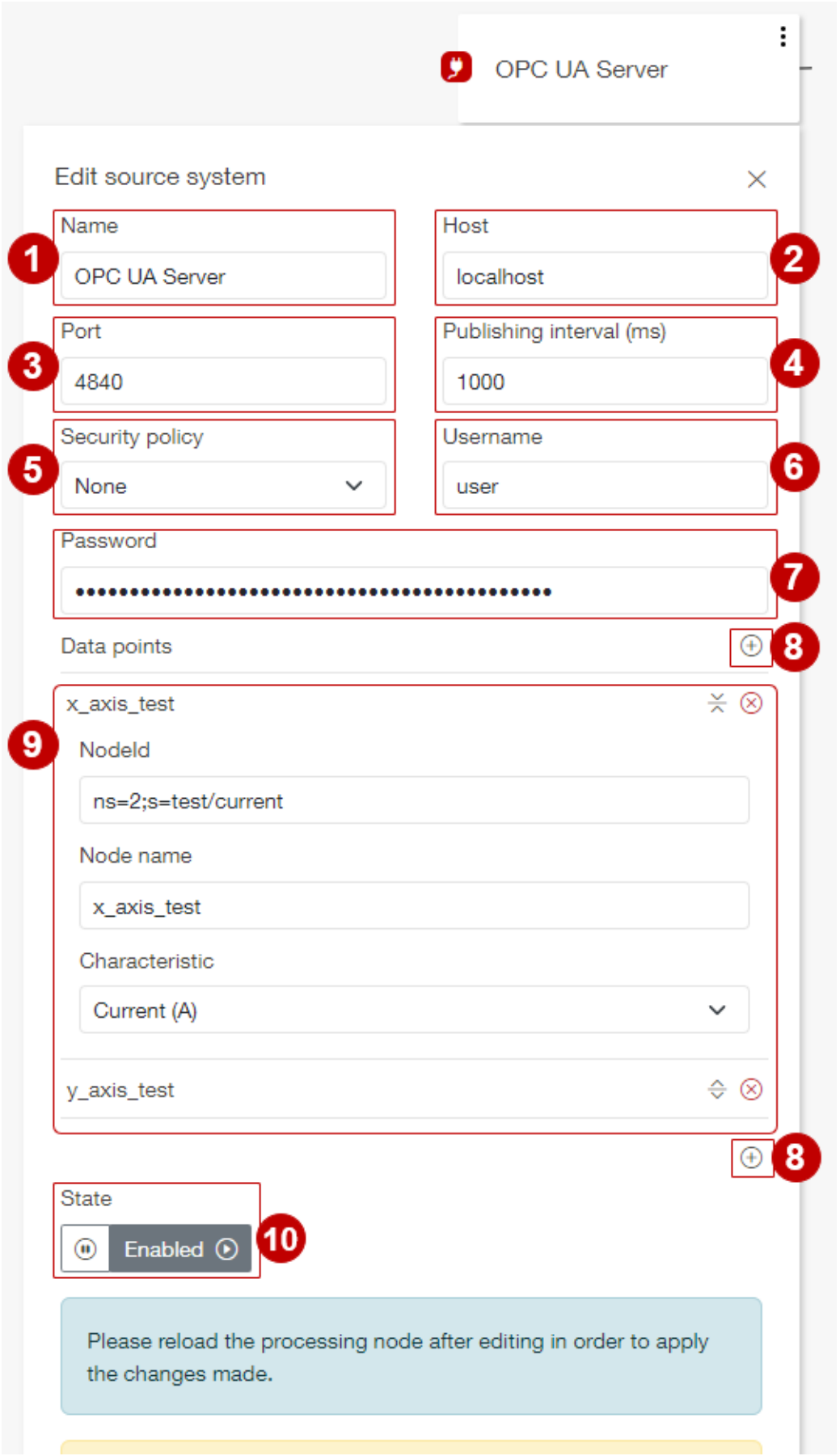
> ***Please note**: Depending on the selected IO-Link master the configurable parameters may vary.*

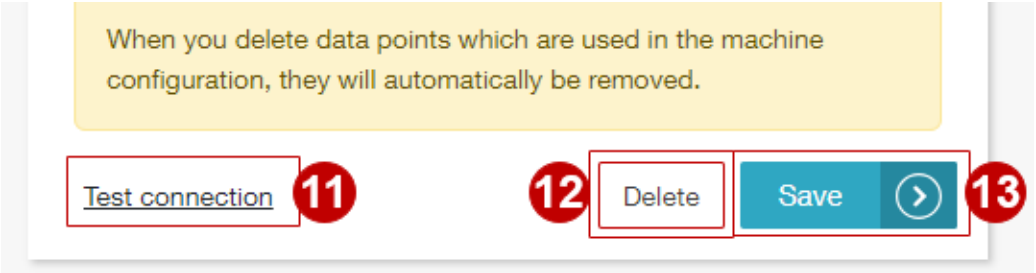
> ***Please note**: In case of ifm IO-Link masters, the HTTP communication from the IO-Link master to cynapse® Connect must be permitted in the firewall and no proxy server may be present.*



OPC-UA server

1. Custom display name used in the user interface.
2. IP address or host name of the OPC-UA server.
3. Port of the OPC-UA server (default: 4840).
4. Configure the preferred *publishing interval* (specified in milliseconds) for communication with the OPC-UA server. If the specified value is not supported by the server, cynapse® Connect will automatically try to select an alternative publishing interval which is supported by the server.
5. Select the security policy for communication with the server. Currently, the only available option is *None*.
6. Username for authentication with the server.
7. Password for authentication with the server.
8. Add a new data point. Each data point can be used to subscribe to one node provided by the OPC-UA server.
9. Edit or delete existing data points. Each datapoint is defined by an arbitrary display name, the OPC-UA node id as well as an assignment of one characteristic (e.g. current or rotational speed, see chapter **f**).
10. Activate or suspend the connection to the device.
11. Validate the configuration (and if applicable, the specified authentication) and attempt to connect to the device. In addition, cynapse® Connect will check whether all specified nodes actually exist on the server.
12. Permanently delete the data source.
13. Save the changes to the data source.

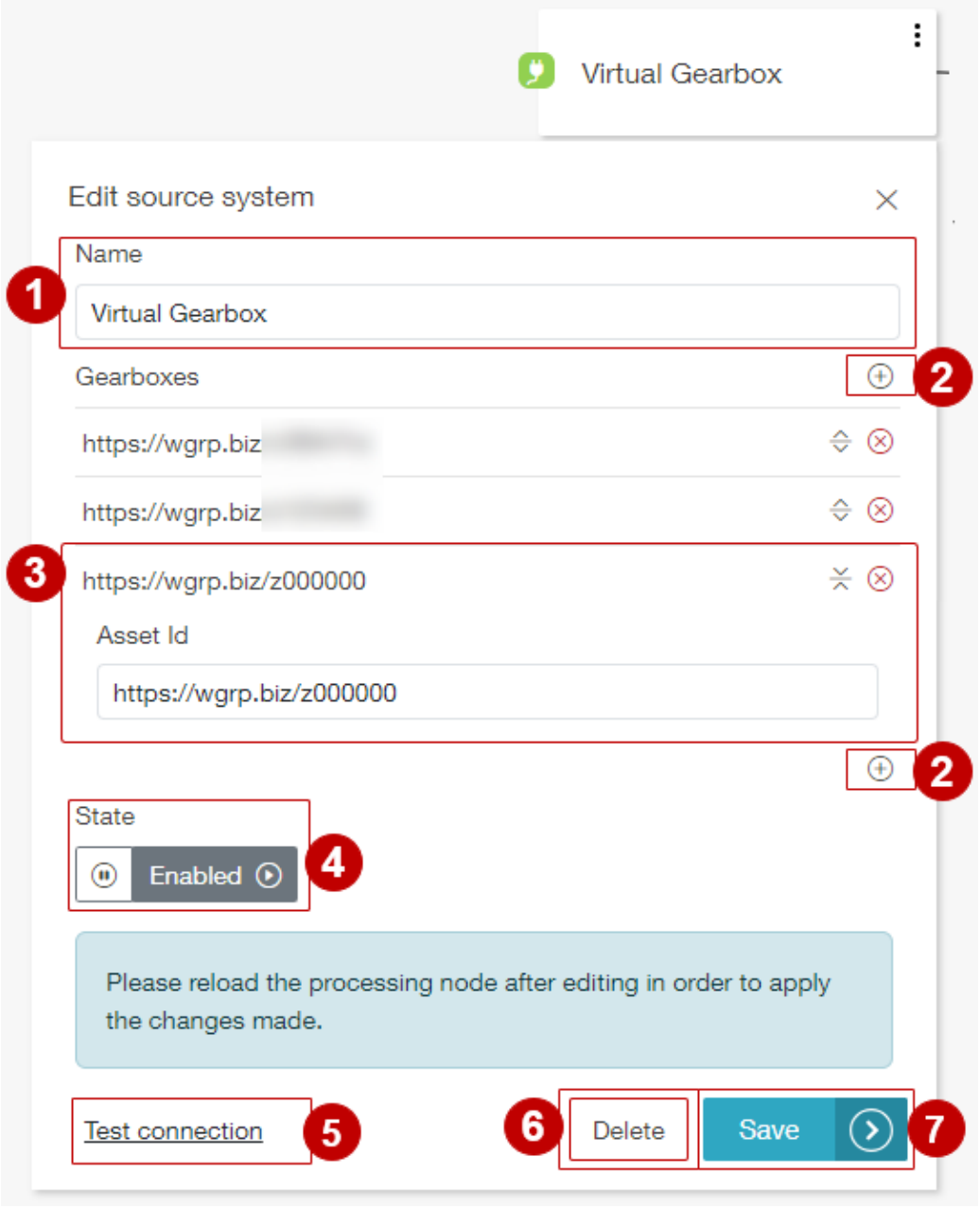

OPC UA Server
Edit source system
Name
OPC UA Server
Host
localhost
Port
4840
Publishing interval (ms)
1000
Security policy
None
Username
user
Password
Data points
x_axis_test
NodeId
ns=2;s=test/current
Node name
x_axis_test
Characteristic
Current (A)
y_axis_test
State
Enabled
Please reload the processing node after editing in order to apply the changes made.
1
2
3
4
5
6
7
8
9
10


When you delete data points which are used in the machine configuration, they will automatically be removed.
Test connection
11
12
Delete
Save
13

Virtuelle Getriebe

> ***Please note**: The virtual gearbox data source can only be configured when having a **cynapse® Connect Advanced** license which can be purchased separately.*

1. Custom display name used in the user interface.
2. Add a new virtual gearbox.
3. Edit or delete an existing virtual gearbox. Each entry contains an asset id in the format `https://wgrp.biz/x_____` .
4. Activate or suspend the virtual gearboxes.
5. Validate the specified data.
6. Permanently delete the data source.
7. Save the changes to the data source.



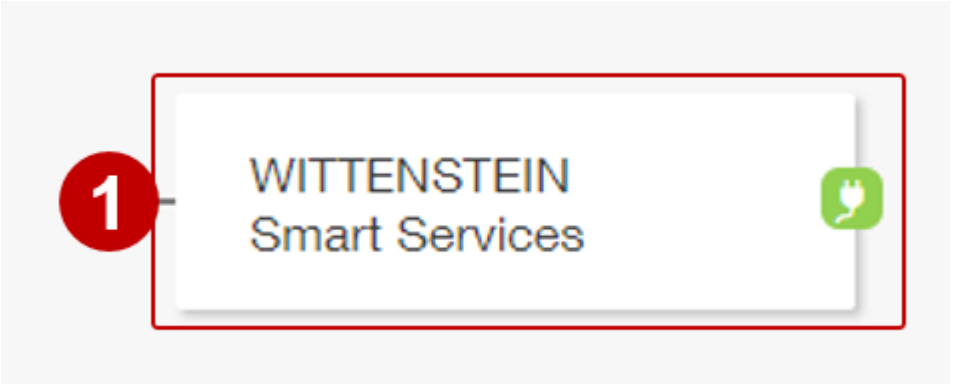
Data targets

When adding a new **data target** or when clicking the tile of an existing **data target**, the configuration dialog is opened which is explained in the following.

> ***Please note**: Any changes to any of the data targets are only applied once the "Reload" button is pressed in the processing section (see chapter **b**).*

WITTENSTEIN Smart Services

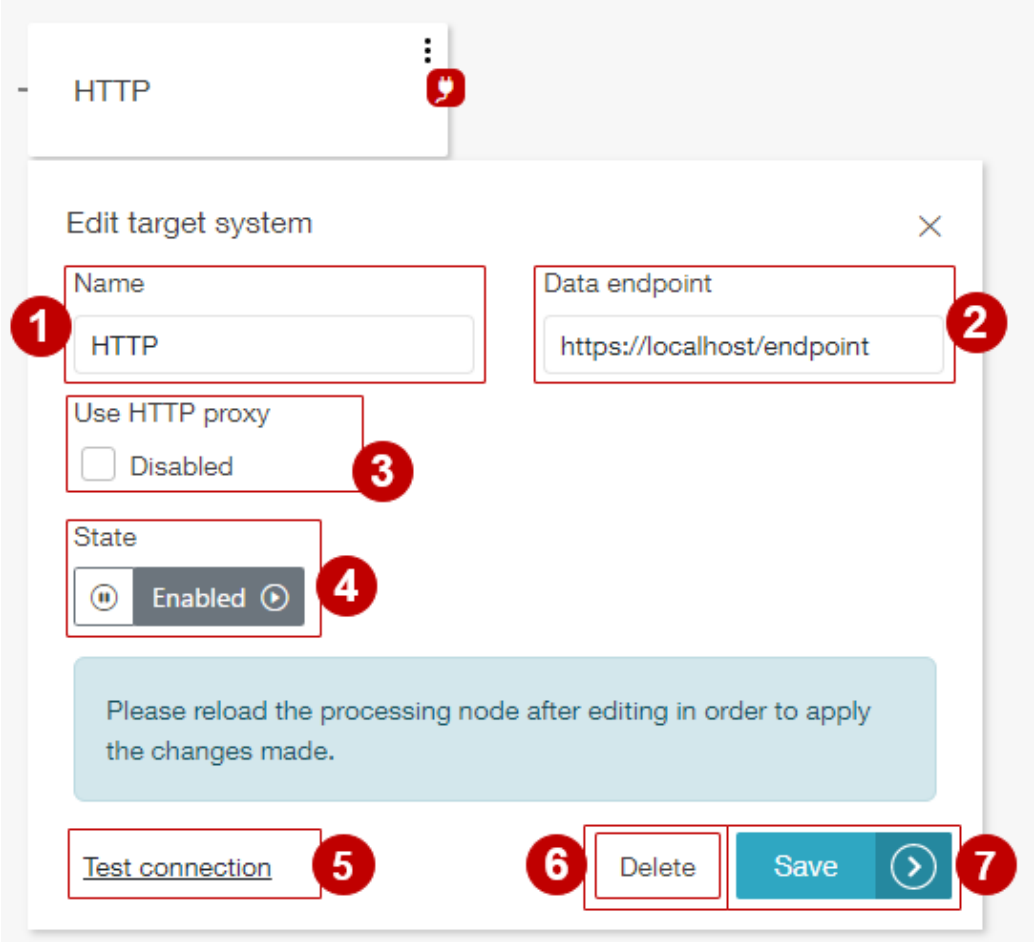
The data target *WITTENSTEIN Smart Services* is the default data target which is always preconfigured and forwards all data to the other installed Smart Services. This data target can not be deleted and does not offer any configuration options.



HTTP

The *HTTP* data target allows the configuration of an HTTP endpoint to which cynapse® Connect shall send the data. It offers the following configuration options:

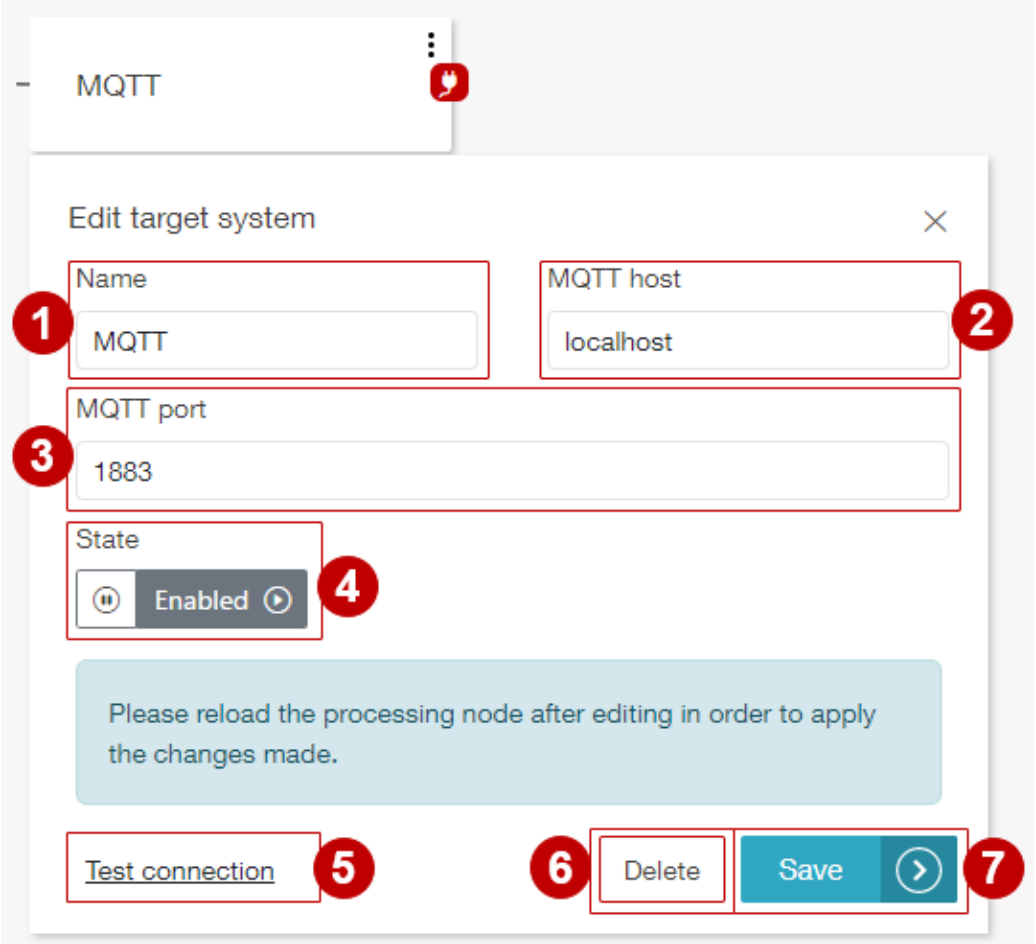
1. Custom display name used in the user interface.
2. HTTP or HTTPS endpoint, to which data shall be sent.
3. Whether to use the configured proxy server for sending HTTP requests.
4. Activate or suspend data transmission to the data target.
5. Validate the configuration by sending a `HEAD` request to the specified endpoint. The configuration is considered valid when the server returns a `1xx`, `2xx` or `3xxx` status code.
6. Permanently delete the data source.
7. Save the changes to the data source.



MQTT

The *MQTT* data target allows the configuration of an MQTT broker to which cynapse® Connect shall send the data and certain events. It offers the following configuration options:

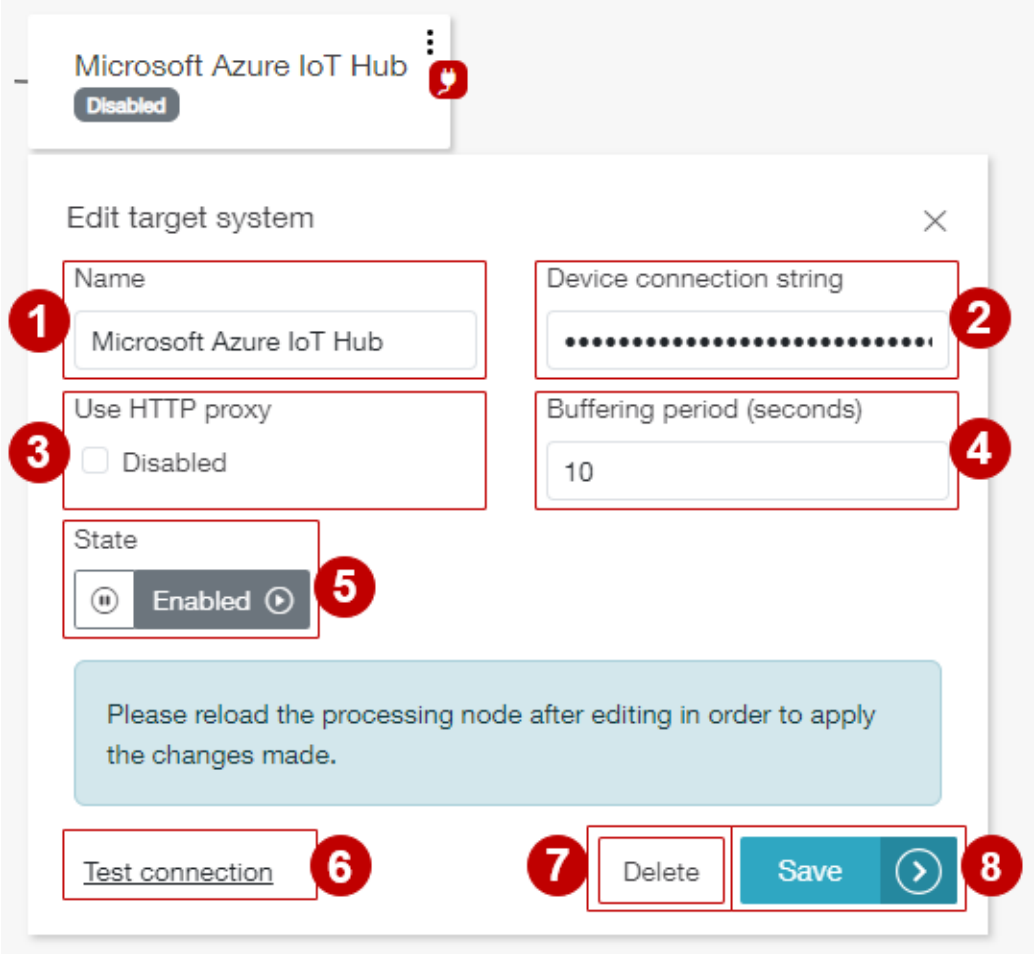
1. Custom display name used in the user interface.
2. IP address or host name of the MQTT broker.
3. Port of the MQTT broker (default: 1883)
4. Activate or suspend data transmission to the data target.
5. Validate the configuration (and if applicable, the specified authentication) and attempt to connect to the device.
6. Permanently delete the data target.
7. Save the changes to the data target.



Azure IoT Hub

The *Azure IoT Hub* data target provides the option to send data to a device in the Azure IoT Hub. It offers the following configuration options:

1. Custom display name used in the user interface.
2. *Connection string* for connecting to the Azure IoT hub.
3. Whether to use the configured proxy server for sending HTTP requests.
4. Specify, how often data shall be sent to Azure IoT hub.
5. Activate or suspend data transmission to the data target.
6. Validate the configuration (and if applicable, the specified authentication) and attempt to connect to the device.
7. Permanently delete the data target.
8. Save the changes to the data target.



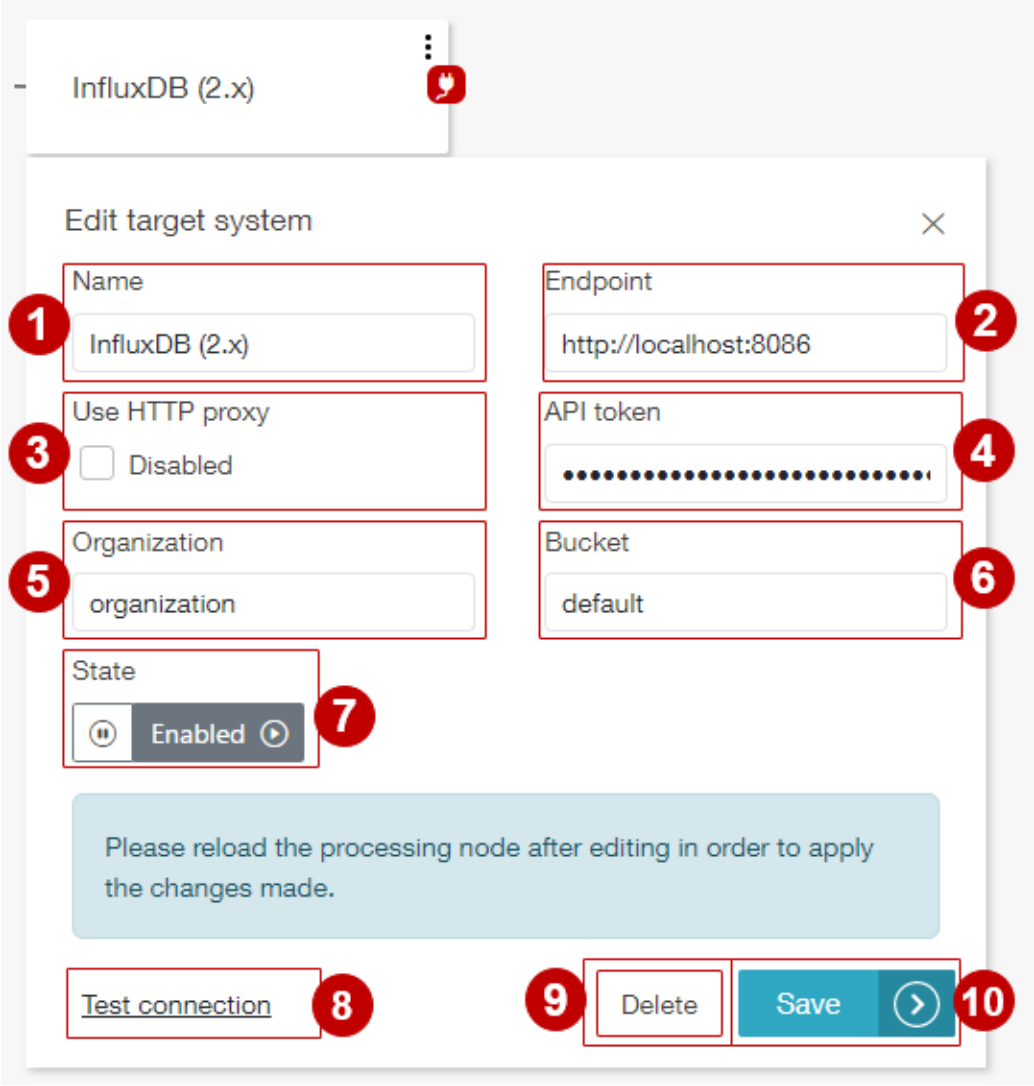
InfluxDB

The *InfluxDB* data target provides the option to send data to an InfluxDB time series database. It offers the following configuration options:

1. Custom display name used in the cynapse® Connect UI.
2. HTTP endpoint of the InfluxDB instance.
3. Whether to use the configured proxy server for sending HTTP requests.
4. API token used to authenticate with the InfluxDB.
5. Organization within InfluxDB to which the data should be assigned to.
6. Bucket within InfluxDB to which the data should be assigned to.
7. Activate or suspend data transmission to the data target.
8. Validate the configuration (and if applicable, the specified authentication) and attempt to connect to the device.
9. Permanently delete the data target.
10. Save the changes to the data target.

For each data point, a corresponding time series will be created in the InfluxDB. Each time series will be tagged by certain metadata including the asset Id and the semantic Id of the data point.

> ***Please note**: Histories and histograms from cynapse® Sensor Cube are not supported by this data target.*



Machine configuration

Specifying a machine configuration allows cynapse® Connect to correctly correlate data from various data sources for further processing in other Smart Services. This is done by distributing the available gearboxes among multiple drive trains and by assigning data points such as motor torque or rotational speed from external systems to the drive trains. The configuration dialog is opened via the processing node (see section **b**) and offers the following settings:

1. The machine configuration can be given a custom display name.
2. Add a new drive train.
3. A list of all currently existing drive trains. They can be expanded to view and configure the individual components.
4. The detail view shows all available components. The structure of the drive train can currently not be changed. All drive trains consist of a gearbox, a motor and five measurement connectors. When clicking a component (such as gearbox `5` or motor `7`), it can be configured in the following ways (not all options are available for all component types):
   - Assignment of a physical asset by its asset ID (in the format `https://vendor/x123456`).
   - Specifying numeric constants.
   - Assignment of data points from external data sources such as an OPC-UA server.

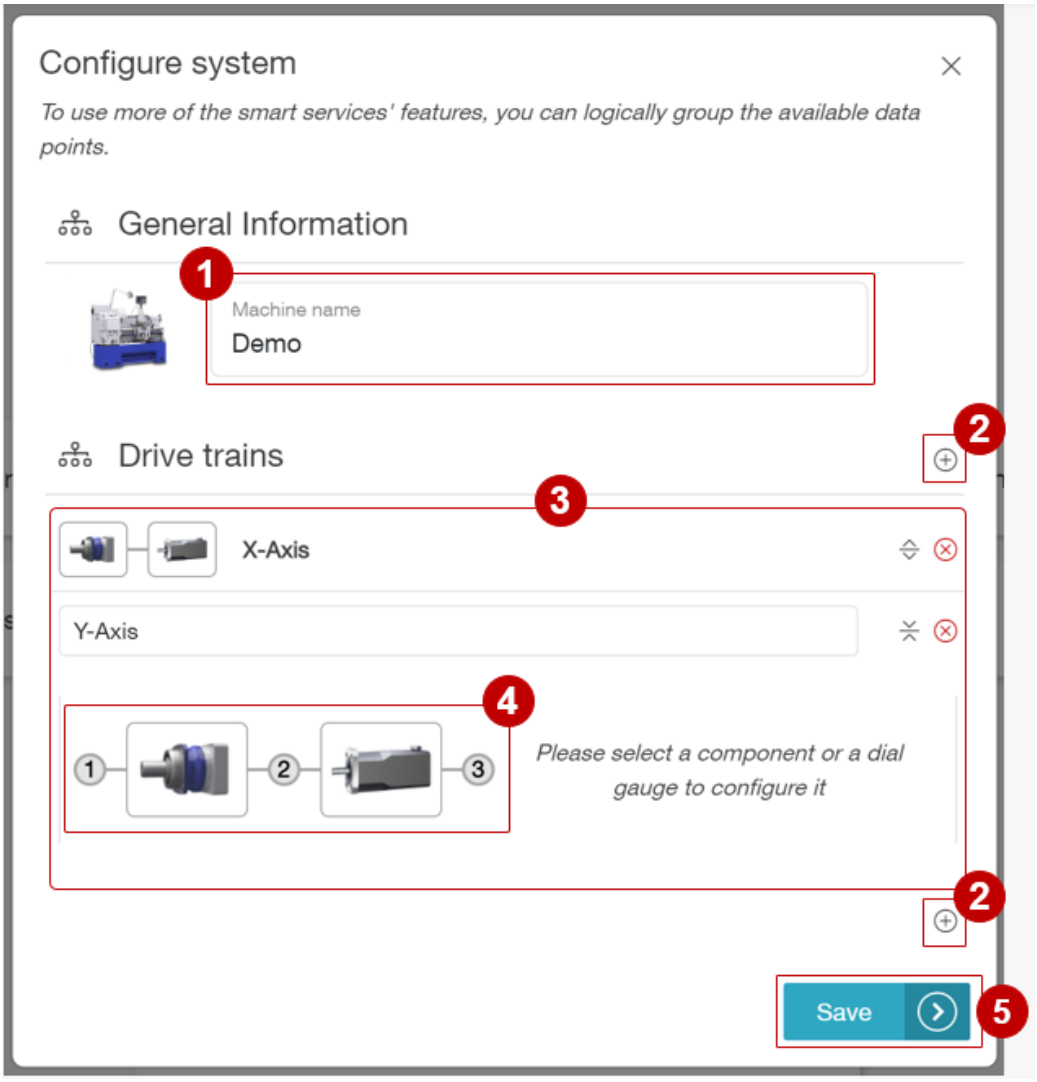
   In contrast to components, you can only assign external data points to connectors (`6`).

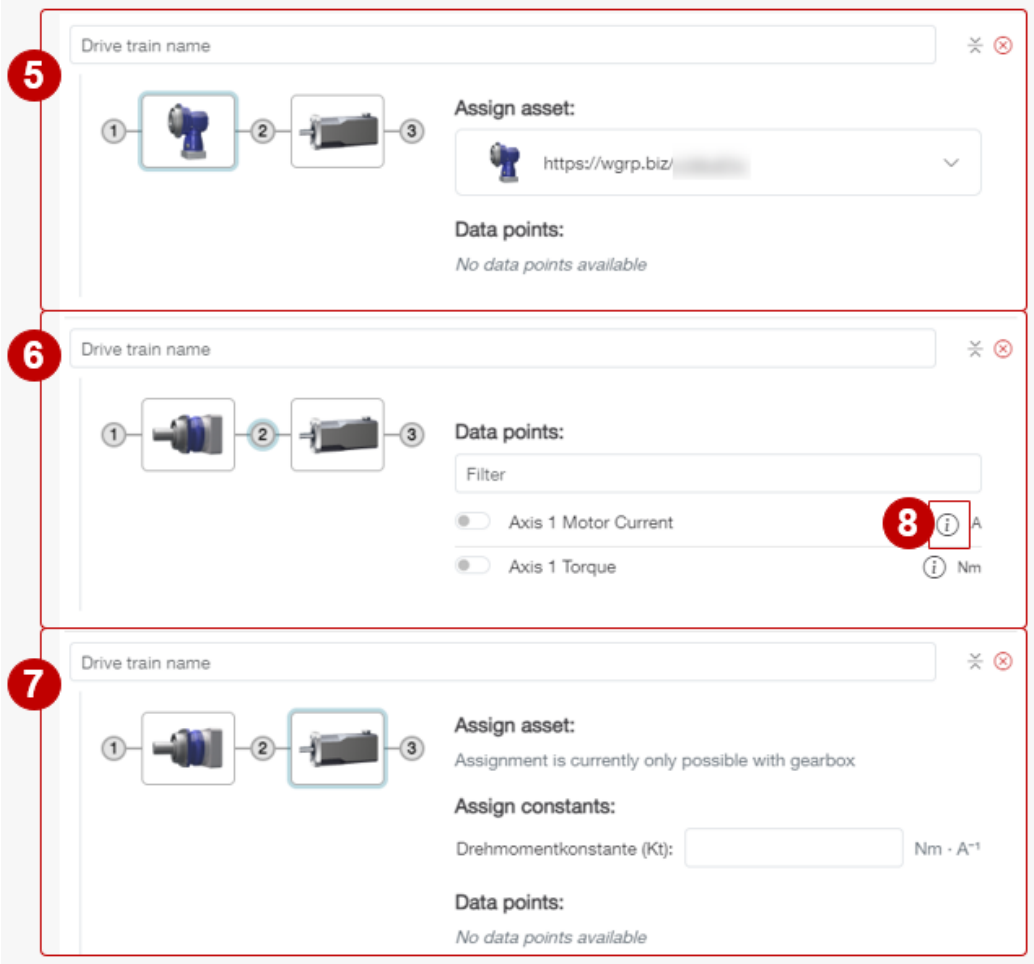
   Information concerning the data points is displayed as a tooltip (`8`), such as whether the value must be on the drive input or output side.

> ***Please note**: For each component or connector, you can assign at most one data point of a certain characteristic.*

> ***Please note**: In the case that a component provides data points by itself (e.g. a cynapse® Sensor Cube connected via IO-Link, which provides adapter plate temperature), no custom data point with the same characteristic can be assigned to that component.*

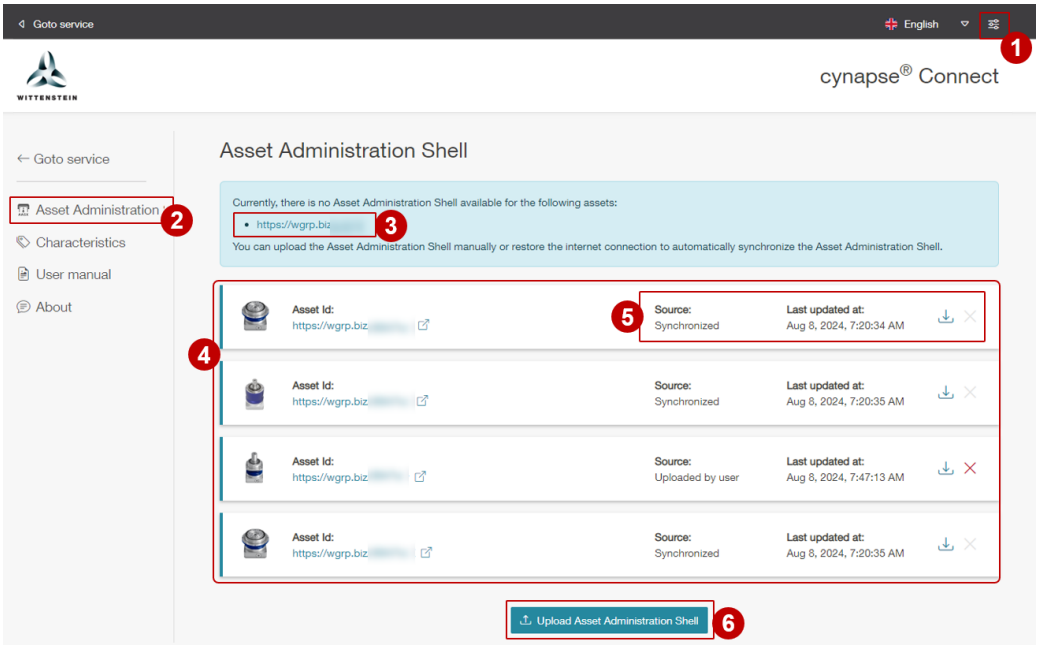
> ***Please note**: In the drive train visualization and gearbox dropdown, a matching gearbox icon for your asset will be displayed, if available.*


Configure system
To use more of the smart services' features, you can logically group the available data points.
General Information
1
Machine name
Demo
Drive trains
2
3
X-Axis
Y-Axis
4
1
2
3
Please select a component or a dial gauge to configure it
2
Save
5


5
Drive train name
1
2
3
Assign asset:
https://wgrp.biz/
Data points:
No data points available
6
Drive train name
1
2
3
Data points:
Filter
Axis 1 Motor Current
8
A
Axis 1 Torque
Nm
7
Drive train name
1
2
3
Assign asset:
Assignment is currently only possible with gearbox
Assign constants:
Drehmomentkonstante (Kt):
Nm · A⁻¹
Data points:
No data points available

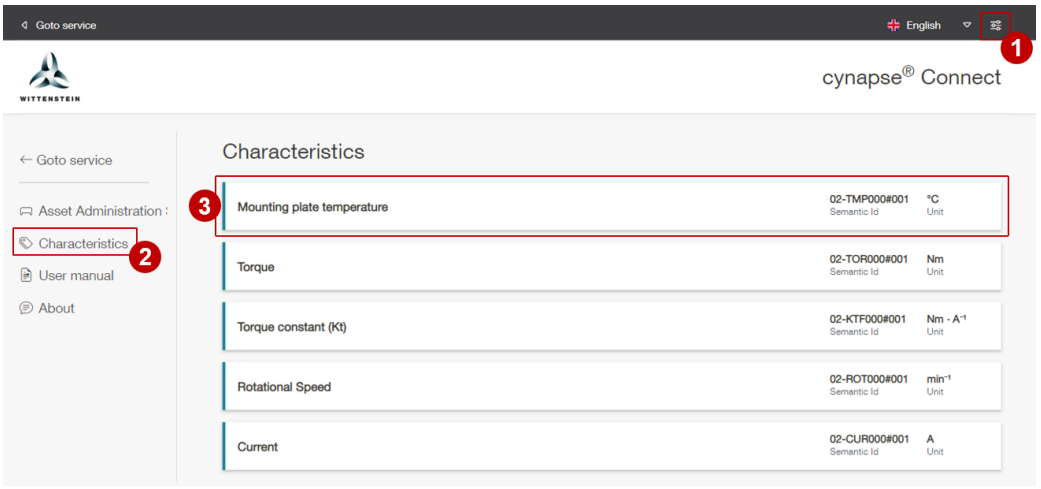
Asset Administration Shell

By opening the *Settings & Information* page (`1`) and then selecting the *Asset Administration Shell* tab (`2`), you can view a list of all missing (`3`) and available (`4`) asset administration shells. As long as an internet connection is available, cynapse® Connect will automatically try to download any missing asset administration shells. The source (*Synchronized* or *Uploaded by user*), the timestamp of the synchronization/upload and an option to download the asset administration shell is given for each asset (`5`). A missing asset administration shell can be uploaded manually (`6`) and only manually uploaded asset administration shells can be deleted.



Characteristics

A list of all available characteristics can be viewed by opening the *Settings & Information* page (`1`) and then selecting the *Characteristics* tab (`2`). Each characteristic (`3`) is defined by its semantic ID and additionally has a display name and a corresponding unit. Using characteristics, data from external data sources can be classified such that the Smart Services can correctly process the data based on the physical quantity.



> ***Please note**: Depending on your installed cynapse® Connect version, the list of characteristics may differ from the one shown in the screenshot.*