Pinebox

User Manual

Pinetek Networks

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0 Introduction

Thanks for purchasing the Pinebox, a versatile smart gateway designed to simplify the collection, processing, and forwarding of data in industrial applications. With its intuitive web interface and integrated Node-RED environment, the pinebox enables rapid development of monitoring, reporting, and process control solutions, even for users without prior industrial communication experience.

This manual provides comprehensive guidance on setting up, configuring, and utilizing the pinebox to enhance your industrial IoT applications. Please read this information carefully to ensure safe and hassle-free operation of the device. The application of this product is intended for users, that have experience with electronic devices and programming.

The following symbols will guide you for dedicated areas of interest. The content is relevant for safe operation of the Pinebox.

This symbol is used to show information that is relevant for the operation of the Pinebox.

This symbol is used to show areas of special attention that need to be considered for the safe operation of the Pinebox.

0.1 Principle of operation

Pinebox is a smart gateway for IO-Link® sensors and devices. It can process the acquired data directly on the device with the integrated Node-RED® with Node-RED flows and JavaScript . The **Pinebox** forwards the pre-processed data to

- **Databases** (e.g., MySQL®, Amazon S3, InfluxDB®, PostgreSQL®, MongoDB®, MS SQL and others) through Node-RED connectors or to the integrated SQLite database,
- **Messages** (e.g., email, Signal® message, SMS, WhatsApp®) through Node-RED connectors,
- **Dashboads** as integrated Node-RED dashboards,
- **Communication** (e.g., MQTT, HTTP, Websocket, TCP, UDP, Modbus TCP, OPC/UA) through Node-RED connectors.

A SQLite database including a web interface is pre-installed on the device.

Alternatively the **Pinebox** works as an IO-Link interface and provides the data via the Ethernet interface using JSON.

The **Pinebox** is versatile tool for the fast and easy creation of various appications, like Smart Metering (using IO-Link current sensors), machine commisioning (using e.g., distance sensors), machine smartification for parameters like up-time or output rate.

Trademark	Owner	Website
MySQL®	Oracle Corporation	https://www.oracle.com
Amazon S3	Amazon Web Services, Inc.	https://aws.amazon.com
InfluxDB®	InfluxData Inc.	https://www.influxdata.com
PostgreSQL®	PostgreSQL Global Development Group	https://www.postgresql.org
MongoDB®	MongoDB, Inc.	https://www.mongodb.com
Signal®	Signal Messenger LLC	https://signal.org
WhatsApp®	WhatsApp LLC	https://www.whatsapp.com
Node-RED	OpenJS Foundation	https://nodered.org
IO-Link	PROFIBUS Nutzerorganisation e.V.	https://www.io-link.com

0.2 Important user information

Please note that the information and procedures described in this manual are subject to change without prior notice. We continuously strive to improve our products and services, which may result in updates and modifications to the content provided herein.

As a user of our product, it is important to acknowledge that you are responsible for following all relevant local laws, standards, and regulations applicable to your usage. These laws, standards, and regulations may vary depending on your location and the intended use of the product. It is your responsibility to ensure compliance with such requirements.

While we make every effort to provide accurate and up-to-date information, we cannot guarantee that the content of this manual will always reflect the latest developments or changes. Therefore, we encourage you to regularly check for updates and revisions to ensure that you have the most current information available.

By using our product and following the procedures outlined in this manual, you agree to accept responsibility for your actions and to comply with all applicable laws, standards, and regulations. Please carefully read the following safety instructions. If you have any questions or concerns regarding the information provided in this manual, please contact our customer support team for assistance.

General Safety

- Read this manual carefully before installing or operating the device. Keep the manual accessible for future reference.
- Only trained personnel should install and operate this device. Unauthorized handling may result in injury or damage to the equipment.
- Follow all safety labels and symbols on the device and in this manual.

Electrical Safety

- Ensure the device is connected to a properly rated power source, as specified (24V DC ±20%). Improper voltage can cause device failure or fire hazards.
- Avoid operating the device in wet or damp environments to prevent electric shock or short-circuiting.
- Disconnect the power supply before cleaning, servicing, or opening the device enclosure. Never attempt to repair internal components without authorization.

Device Environment

- Operate the device only within the specified temperature range (-25°C to 55°C). Exceeding this range may reduce performance or cause permanent damage.
- Install the device in a location that allows adequate ventilation and prevents overheating. Avoid placing it near heat sources.
- Mount the device securely on a DIN rail to prevent accidental disconnection or damage.

Protection Against Device Overload

- Avoid exceeding the maximum power supply current of 2.8A and port output limits (450mA per port on L+ and 350mA on C/Q).
- If the device shows any signs of overheating, smoke, or abnormal noise, immediately disconnect it from the power source and contact customer support.

Limitations on Use

- This device is intended for industrial applications and is unsuitable for fail-safe or life-support applications. It should not be used in environments where device failure could lead to severe injury, loss of life, or significant environmental damage.
- Always consider the specific use case and ensure the device is adequately tested within the intended application.

Not for Critical Applications

The Pinebox as device described in this manual (printed and online version), including all associated hardware and software components, shall not be used for fail-safe, life-supporting, or other critical applications where the failure of the device could result in significant harm, injury, loss of life, or catastrophic damage.

While every effort has been made to design and manufacture the device to high standards of reliability and performance, it is not intended for use in situations where its failure could have severe consequences. Such critical applications may include, but are not limited to, medical devices, transportation systems, industrial control systems, and emergency response systems.

Using the device in critical applications could lead to unpredictable outcomes, including system failures, data loss, or malfunction, which may pose serious risks to safety, health, or property. Therefore, it is imperative that the device is only employed in non-critical applications where the potential impact of its failure is minimal.

By using the device, you acknowledge and accept this warning, and you agree to indemnify and hold harmless the manufacturer and its affiliates from any liabilities,

damages, or losses arising from the improper use of the device in critical applications.

Handling and Disposal

Dispose of the device in accordance with WEEE regulations (see Disposal section).

Handle the device with care to avoid physical damage, particularly to connectors and ports.

1 Getting started

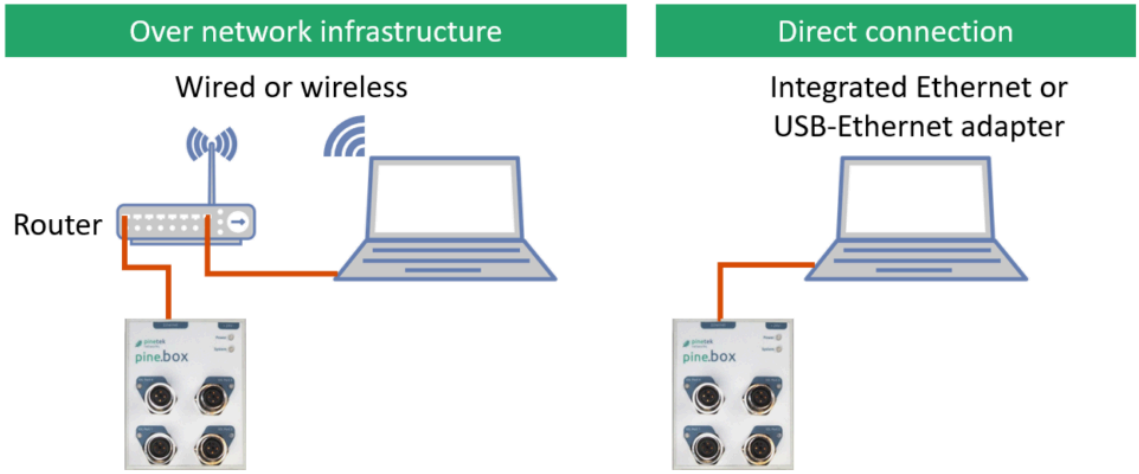
This section describes how to get started with the pinebox, connecting to the web interface, configuring a distance sensor and transferring the nodes to Node RED. In Node-RED we will create flows to forward the data to dashboards and to the internal database.

1.1 Initial connection to the Pinebox

This section describes how to access the web interface of the pine.box over ther Ethernet connection.

Ethernet connection

For the Ethernet connection, there are different options on how to establish the connection. The following image shows the most common configurations:



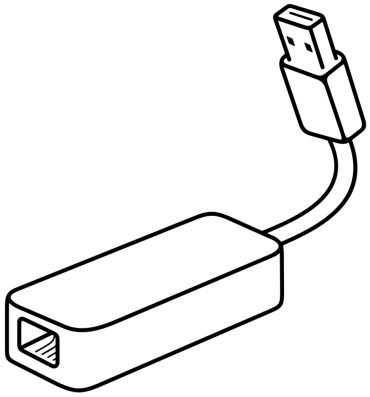
Network infrastructure/DHCP

If the connection is established over an existing network infrastructure (router), the IP address for the Pinebox is usually assigned by the DHCP server in the network from a pre-defined IP range. In this case, the user needs to determine the IP address on the configuration page of the router.

The web interface of the Pinebox can be accessed by typing http://aaa.bbb.ccc.ddd into the address line of your web browser, where aaa.bbb.ccc.ddd is the assigned IP address. Alternatively, the devicename of the Pinebox can be used. The devicename is compiled from the serial number, a device with serial number 12345 will have the devicename **pinebox-12345**. The connection from the PC to the router can be either wired or wireless.

Direct connection

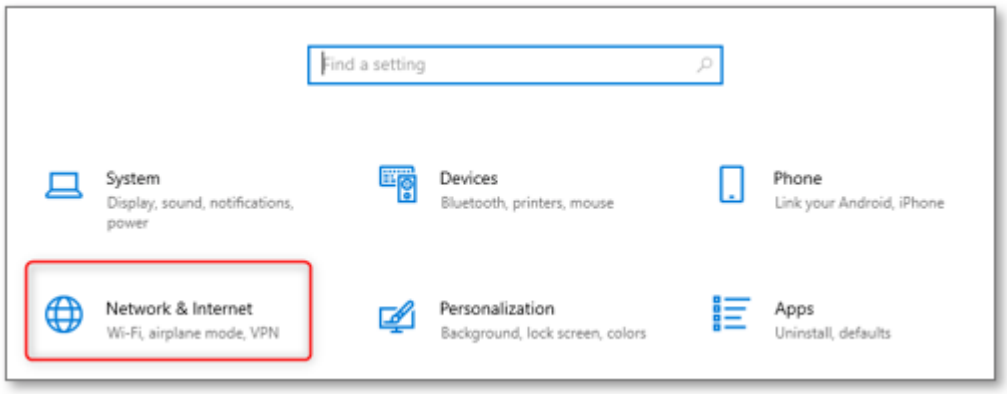
The direct connection can be established either via the PC's build-in Ethernet connection or via a USB-to-Ethernet adapter:



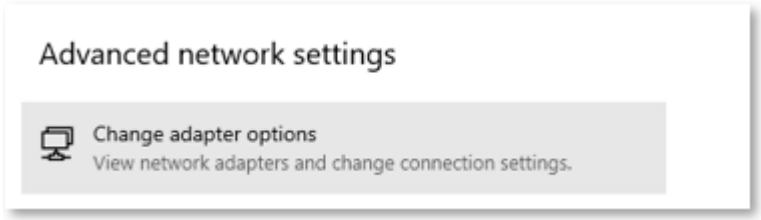
After establishing the connection, the adapter needs to be configured. The following images show how this is done in the Windows operating system.

1. Choose Start  > Settings

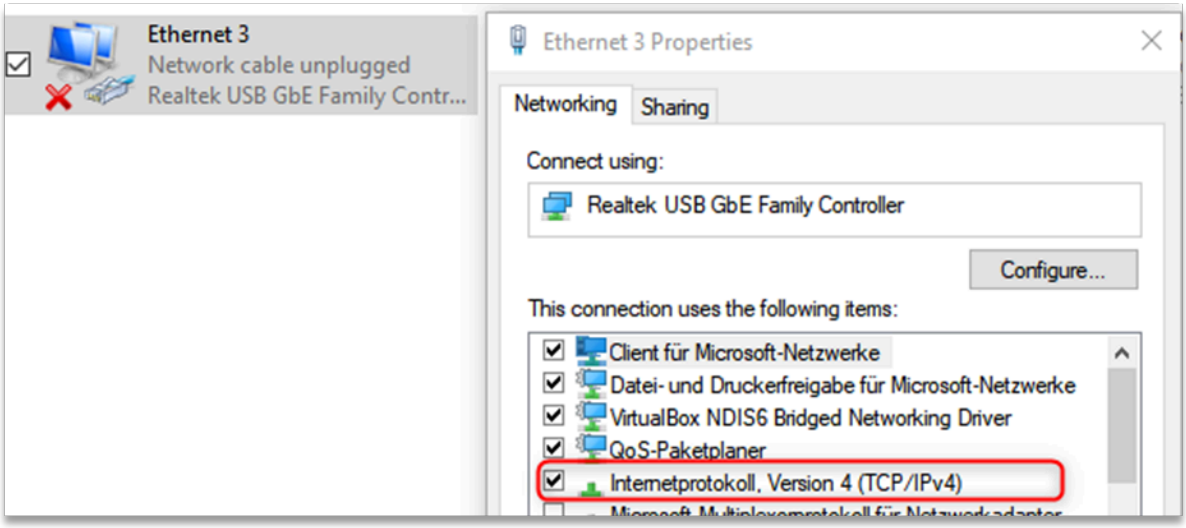
2. Select “Network & Internet” :



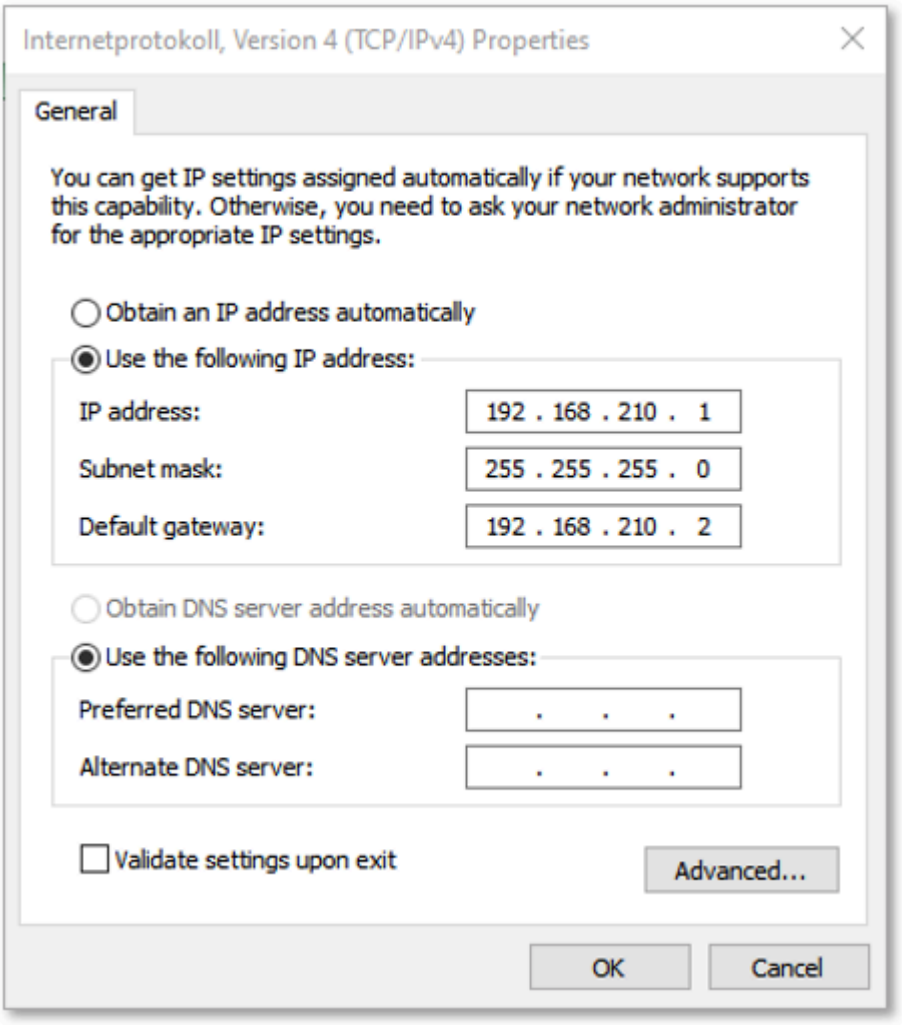
3. Go to “Advanced Networks Settings” and select “Change Adapter Options”:



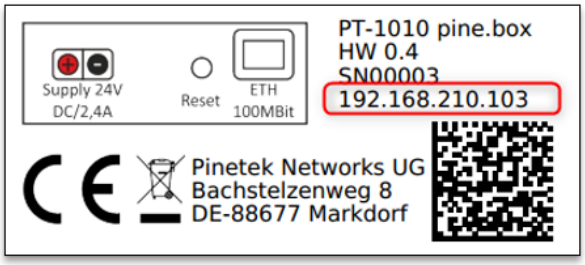
4. Select the Ethernet adapter that was used for the connection by double-clicking and select “Internet Protocol, Version 4 (TCP/IPv4)”:



5. Enter the following values for configuration:



6. Now you can access the pine.box by typing http://aaa.bbb.ccc.ddd into the address line of your web browser, where aaa.bbb.ccc.ddd the assigned IP address on the label.



1.2 Web interface and pine.box configuration

Access the web interface

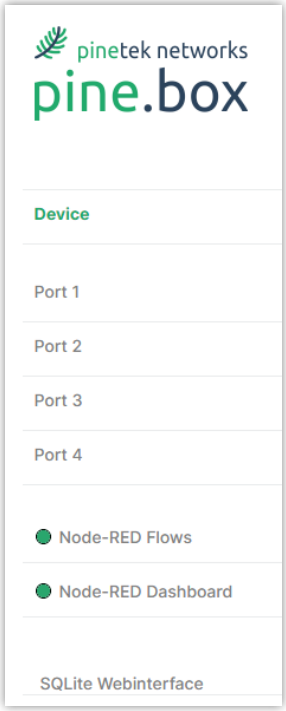
Once the Pinebox has started (“System”-LED solid green), you can access the Pinebox by entering the IP-Address or, if supported by the network, the devicename (in the format pinebox-XXXXX) into your webbrowsers address page:

You will be redirected to the web interface which is available on port 18080.

Web interface sub-pages

The web interface has different sub-pages:

- Device: Setting for the device like network settings, device configuration, store+restore configuration
- Port 1-4: Configuration of the 4 ports
- Node-RED Flows: Indicates if Node-RED is running, clicking leads to the Node-RED configuration page (opens in new window)
- Node-RED Dashboard: Indicates if Node-RED is running, clicking leads to the Node-RED dashboard (opens in new window)
- SQLite Webinterface: Link to the SQLite database web interface for viewing and editing the SQLite data (opens in a new window)



Pinebox Settings

As you are already connected to the pine.box, you do not need to adjust the Network settings. If you anyways wish to do so, please check the corresponding section in the manual. Node-RED and Node-RED dashboards are enabled by default, so you will see a green circle left of the link, indicating that the service is running.

You can now connect and configure the first device!

1.3. Connect and configure a device

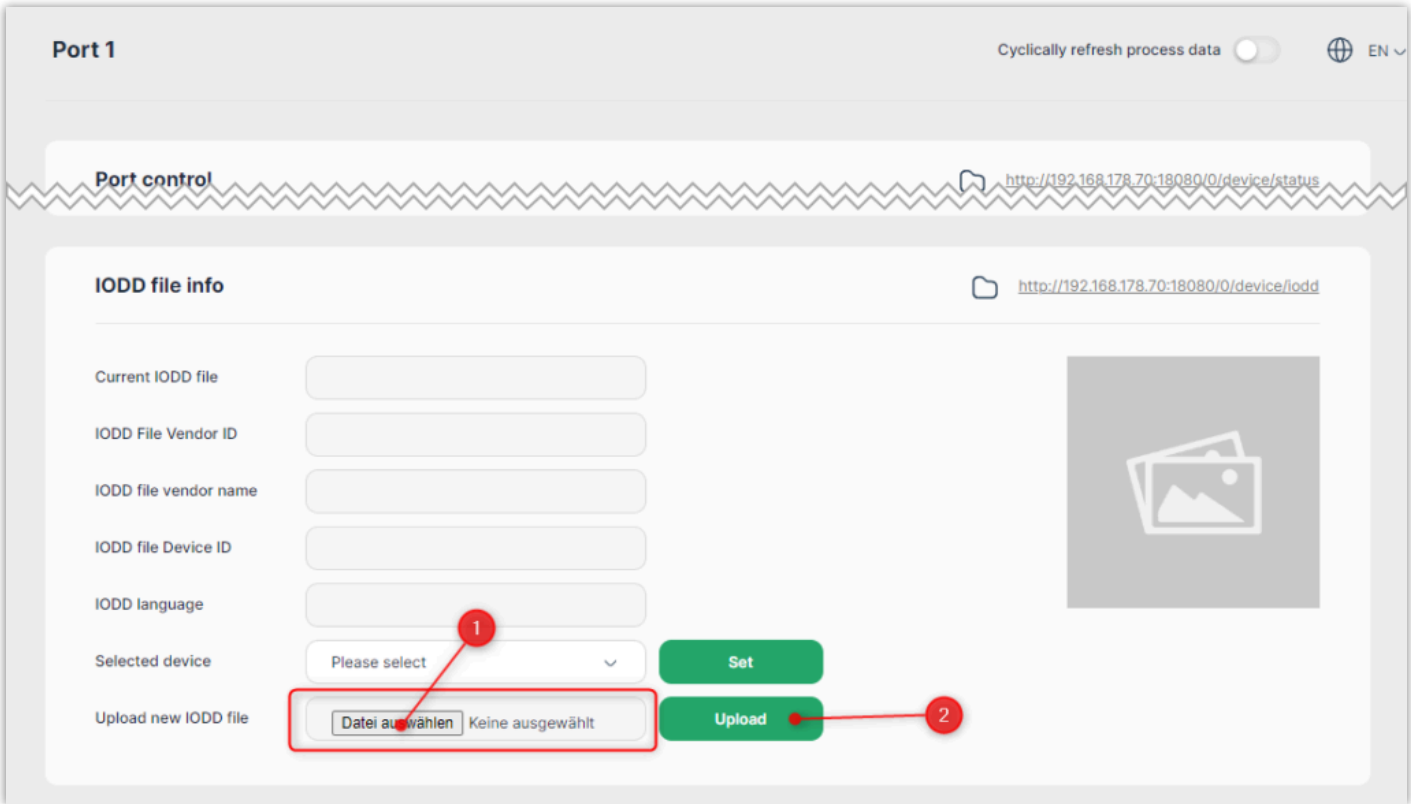
Connect an IO-Link® device

IO-Link devices are connected with an standard M12 connector to the Pinebox. In our example we will use a distance sensor. Anyhow, the configuration principle is the same for all device types and all available ports on the Pinebox.

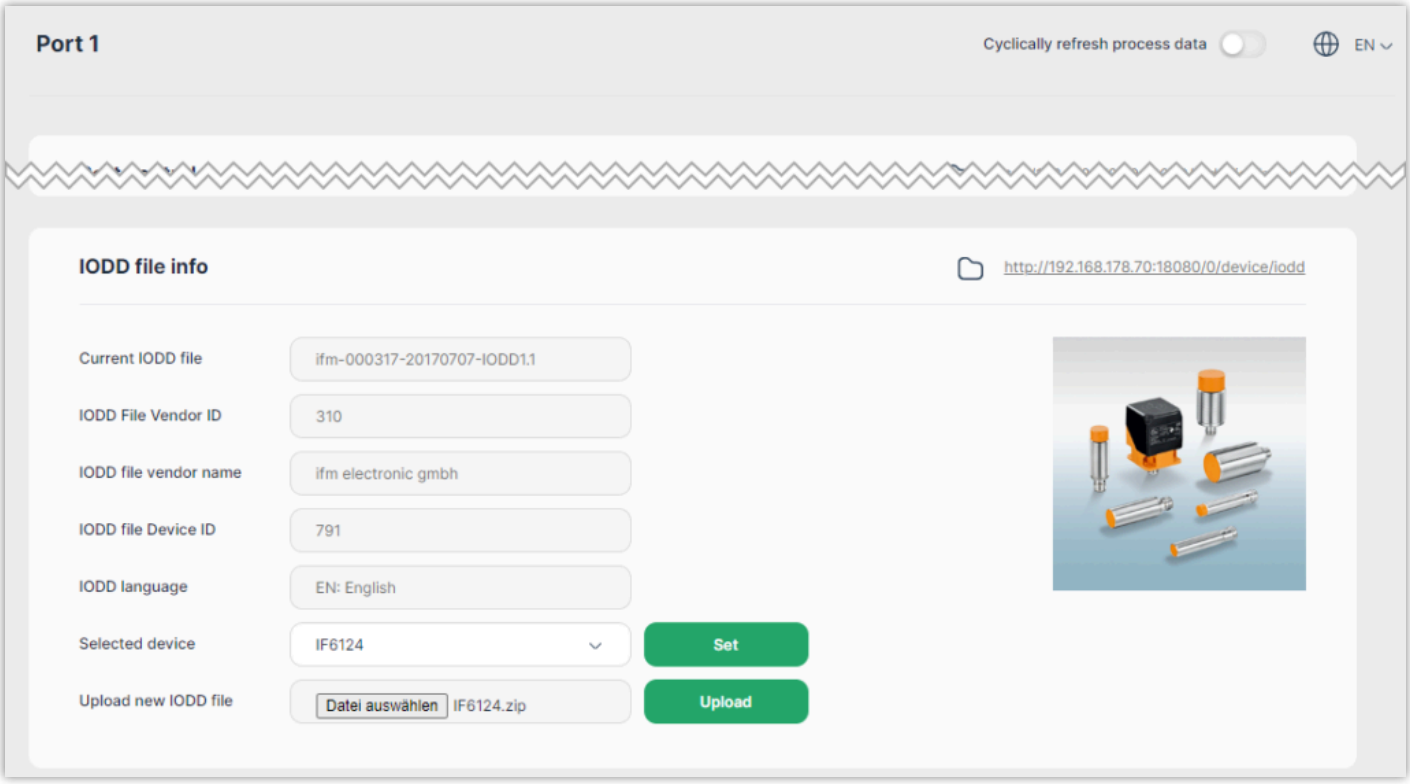
In case your device does not have a M12 connector, you will need an adaptor or open-connections cable.

Configure an IO-Link device

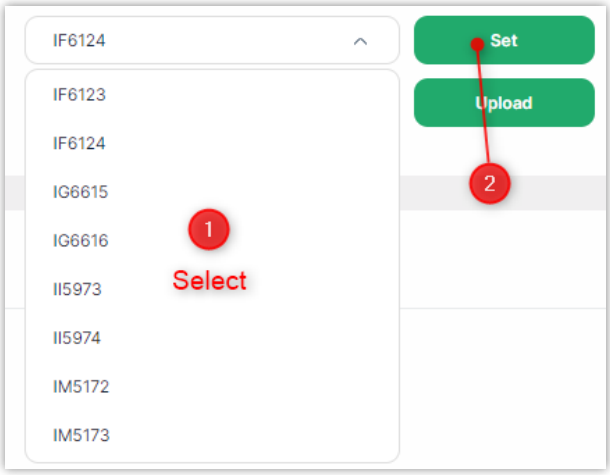
First, the IODD needs to be loaded. Download the file from your device manufacturer and upload it over the web interface (Step 1: Select file, step 2: upload). The Pinebox accepts zip-Files and plain .iodd files (in xml-Format):



Now you see the device information in the info section:



If the device is applicable to more than one device type, you can select the connected device via the dropdown menu. The selection however does not have a functional impact, it just changes the image of the device:

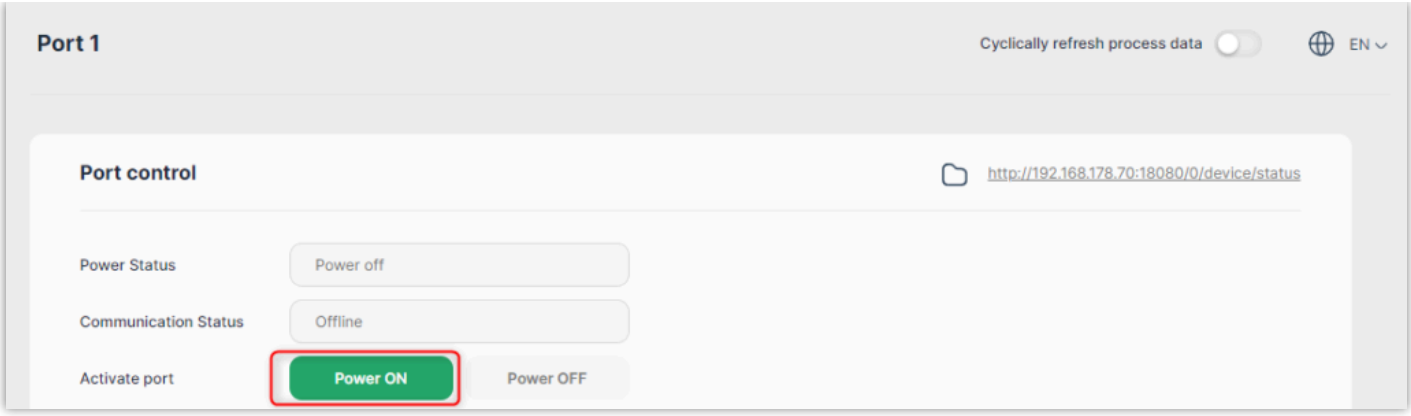


The device data is seperated in the following sections:

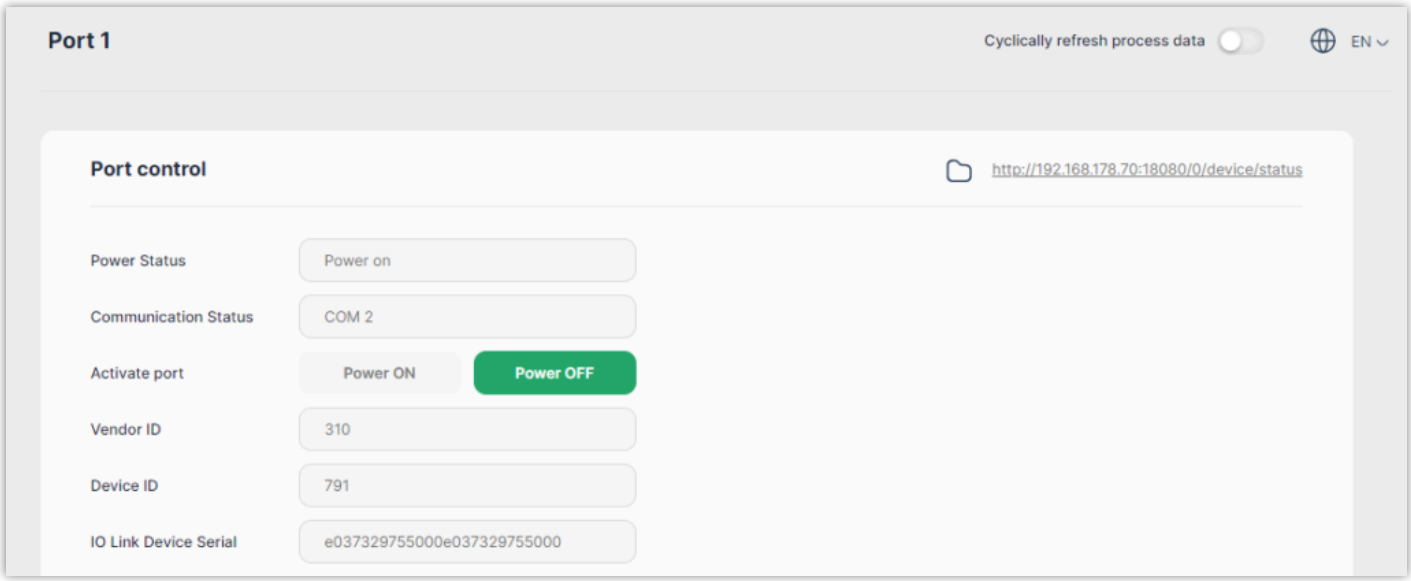
- Process data: This is data that is cyclically exchanged, like distance values for a distance sensor
- Parameters: This is data that is used to check and configure the device, e.g., with serial number, or threshold values

Enable power

To communicate with the device, you need to apply port power by clicking the “Power ON” button. Please not that this activity will take a short time to be completed.

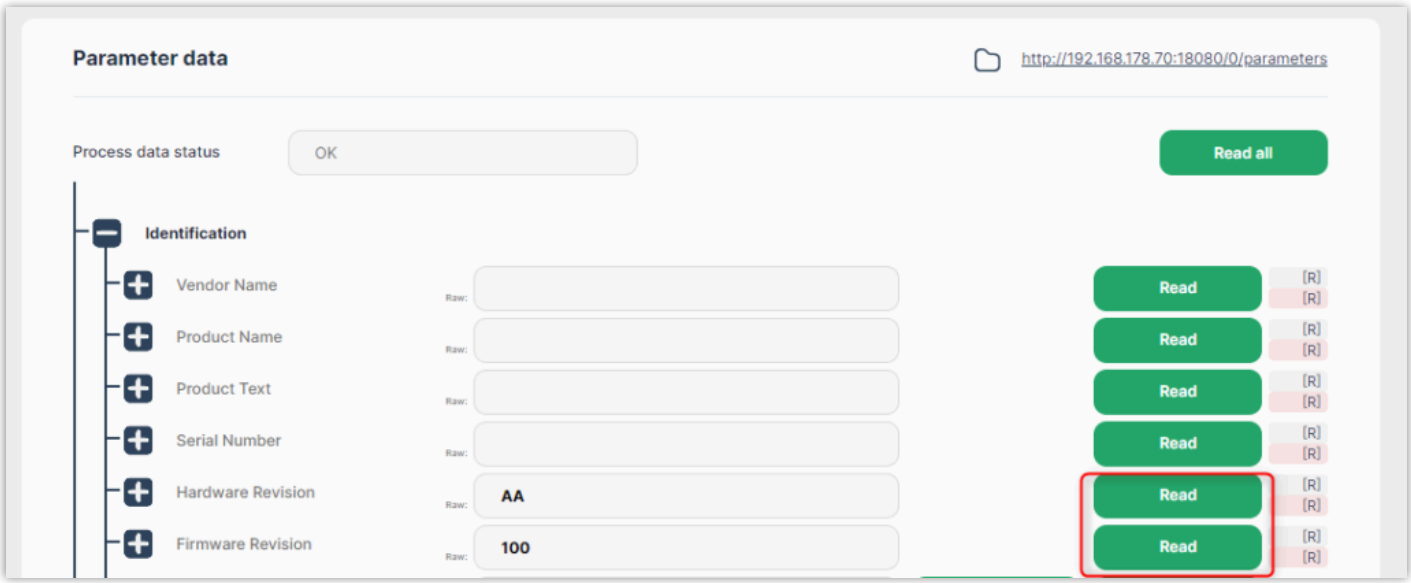


When power is emabled, the information of the connected device is visible:

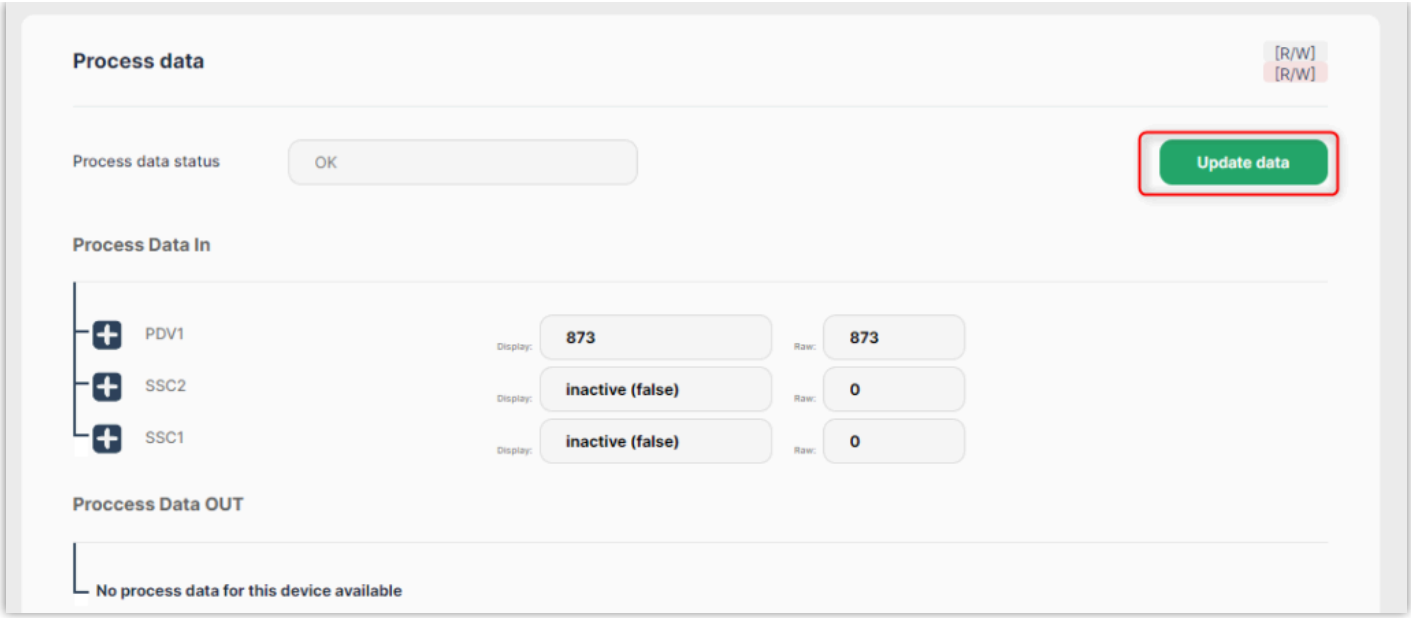


Test the device

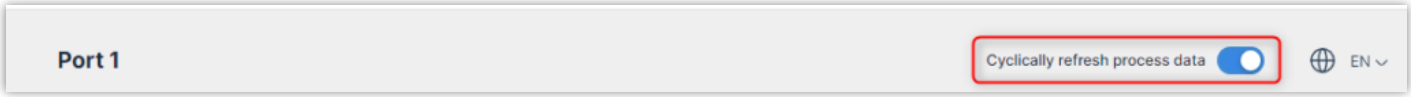
After enabling power, you can test the device by reading and writing information in the parameter section, e.g. the hardware and firmware revision:



You can also exchange process data (the data might be not complete on the first click):



If the device has process data OUT (data from the Pinebox to the device), the values can be set in the corresponding section. You can also auto-update the process data cyclically with the switch on the top of the page:



Congratulations, you just finished configuring the first device on the Pinebox!

1.4 Add device process data to Node-RED

After ensuring that your device is properly connected, you can add the device specific node to Node-RED.

Node-RED is an open-source visual programming tool used for wiring together hardware devices, APIs, and online services. It provides a browser-based flow editor, which allows users to create flows using nodes (blocks) and connect them together to define the logic of their application or automation task. Each node represents a function or service, and they can be dragged and dropped onto the editor canvas and connected together to create a flow. Node-RED is pre-installed on the Pinebox.

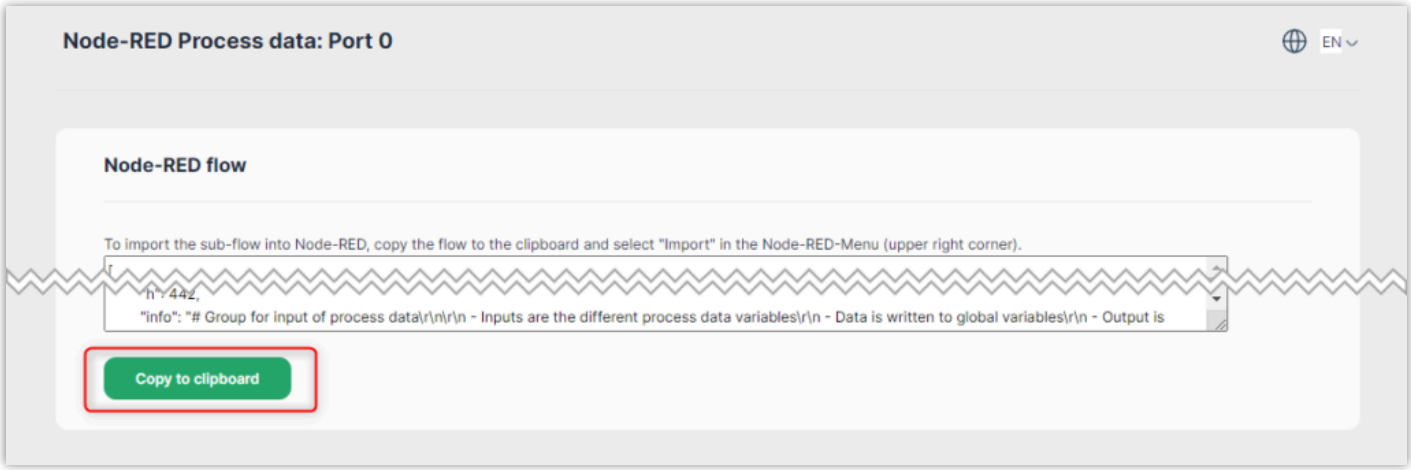
Export the node data from the web interface

To integrate the IO-Link device data in Node-RED, a device specific node needs to be exported from the web interface and later imported into Node-RED. In this example, we are using the process data from our distance sensor.

In the “Process Data” section of the port sub-page of the web interface, select the lower link (red background) labeled “[R/W] “. The upper (grey background) link is used for raw JSON access.

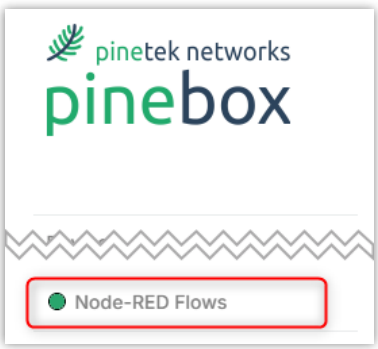
A new tab in your browser will open. The box contains the text description of the node. No worries: You do not need to understand this section.

Click on the “Copy to clipboard” button to copy the content of the box (you will need it in the Node-RED environment).

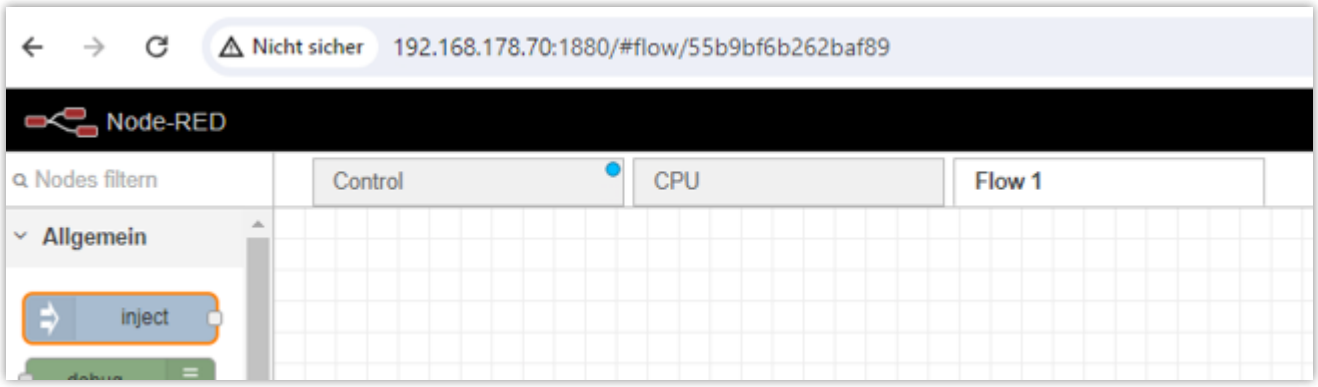


Import the node data into Node-RED

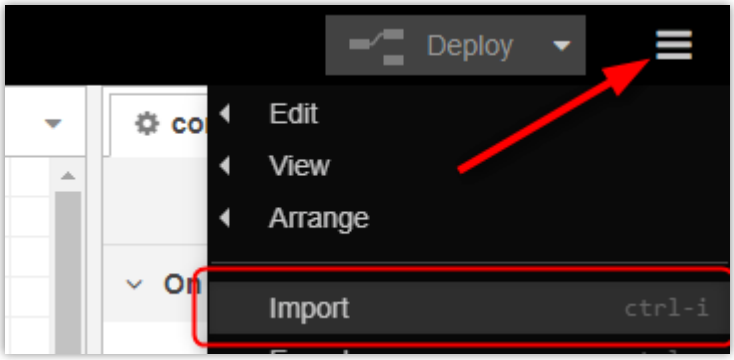
Now switch to the Node-RED Flows page by clicking on “Node-RED Flows” menu item:



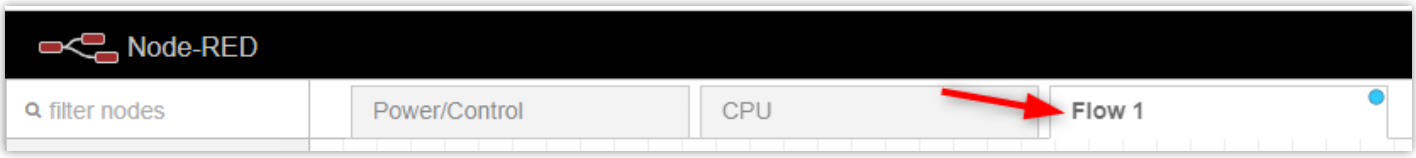
The Node-RED Flow editor opens in a new tab of your browser. The Node-RED environment is available under the same IP-Address as the web interface, only on port 1880:

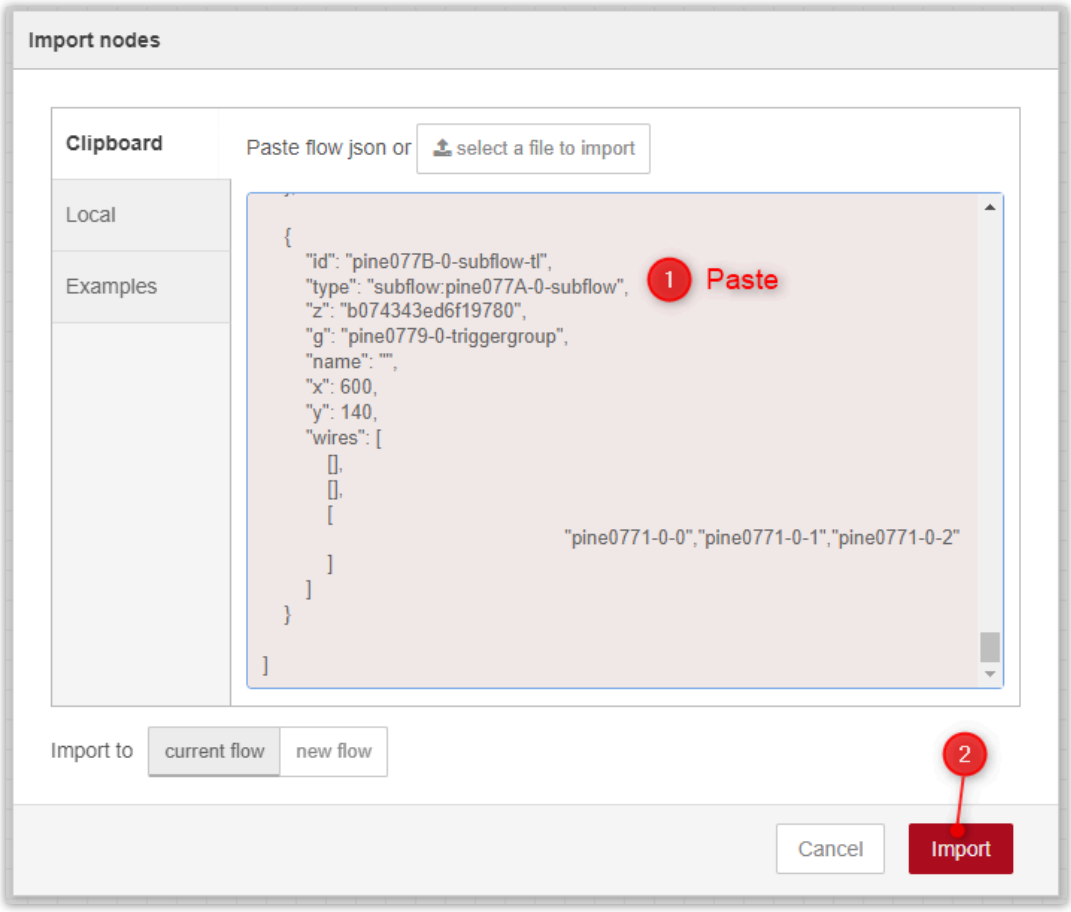


Import the flow from the clipboard by selecting “Import” from the top-right menu:

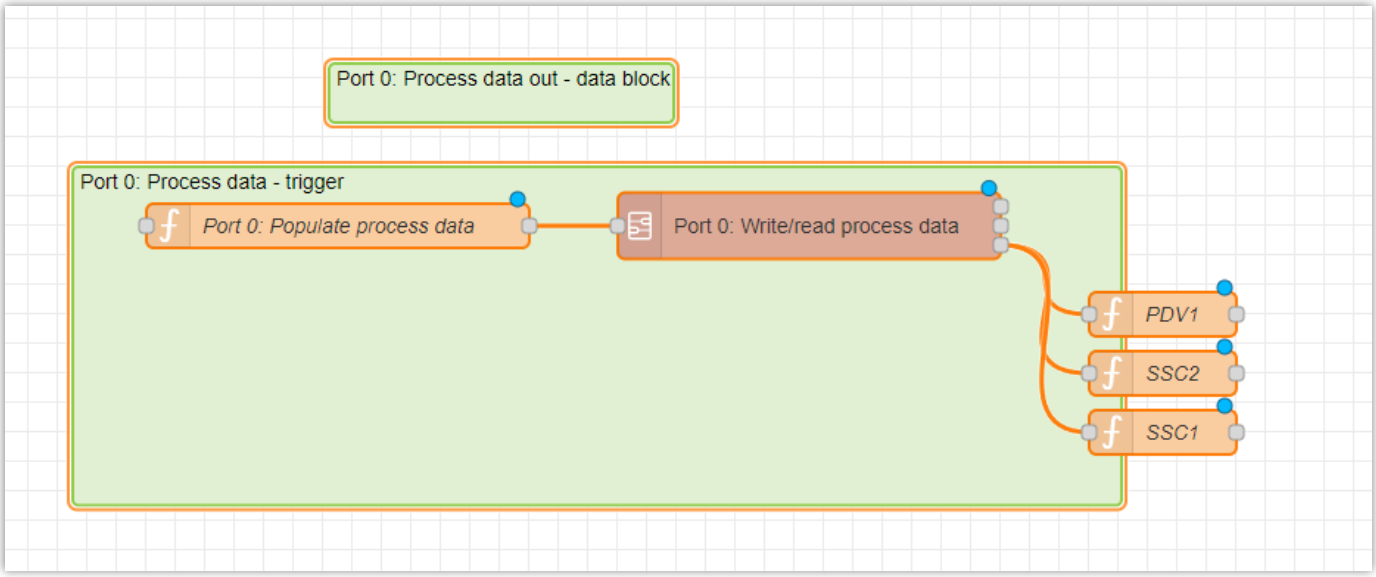


Select the tab “Flow1” and paste the text from the clipboard (1) (Ctrl-v or right-click and select “paste”)and press “Import” (2):





Place the blocks on the canvas. The dimensions of the blocks are adjusted after placing.

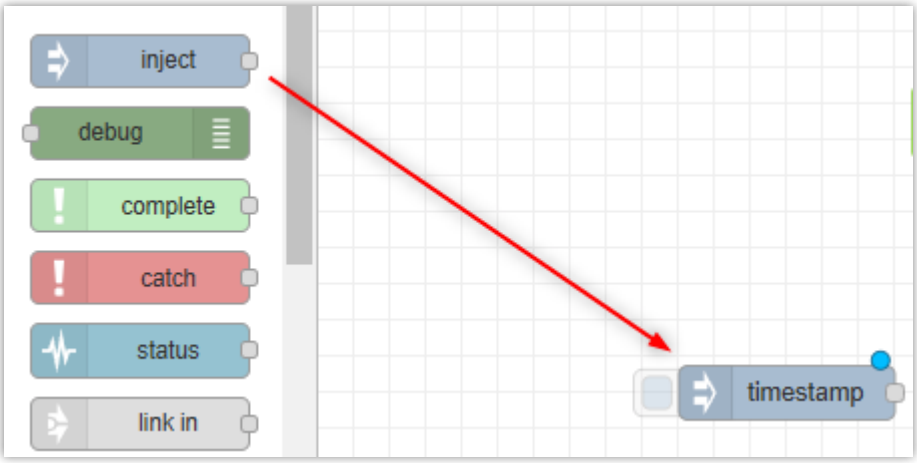


Done! You created a device specific node for the connected IO-Link device in Node-RED.

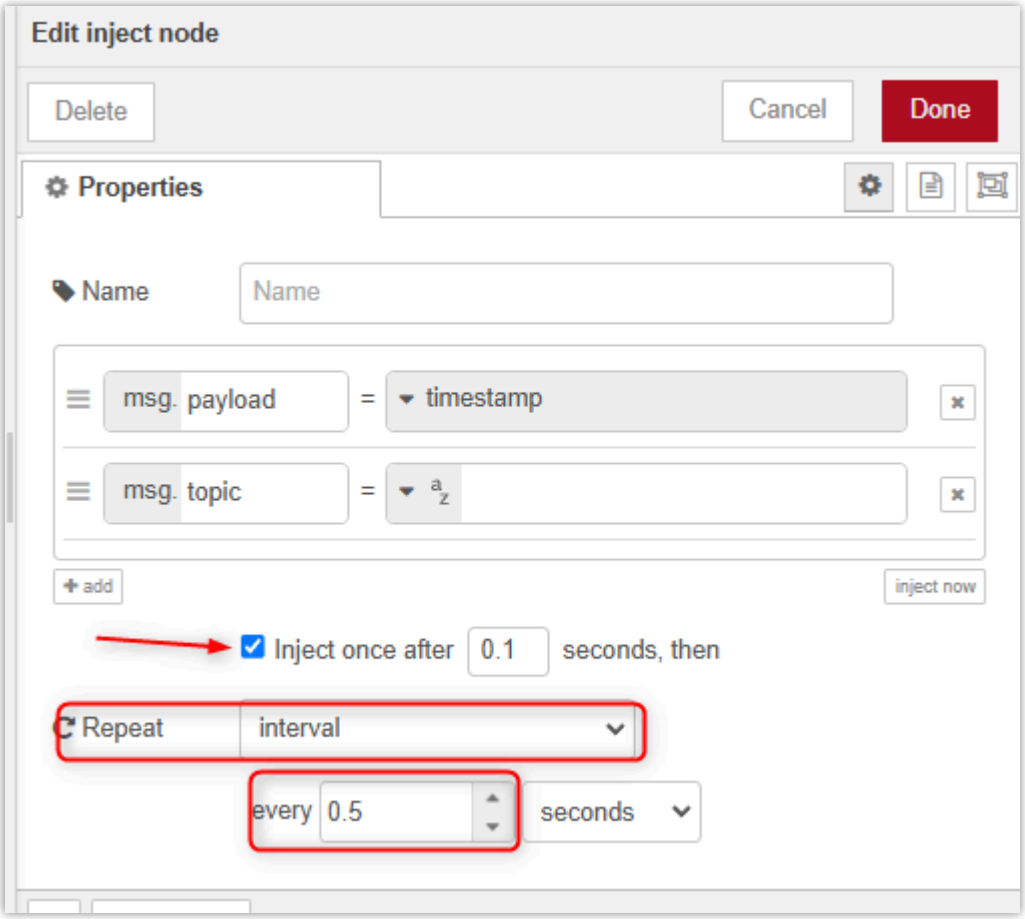
1.5 Create your first Node-RED flow

Once the nodes for the device have been created, we can now add create a simple Node-RED flow. This flow will cyclically get the process data from the connected distance sensor and display the data on a dashboard.

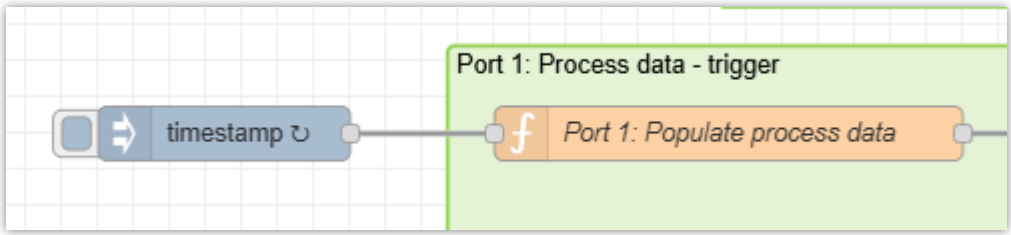
For the first step, we use our imported process data node. To trigger the data exchange, we need to create a trigger. The inject node is selected for this purpose:



The inject node need so to be configured (double-click) to execute cyclically:

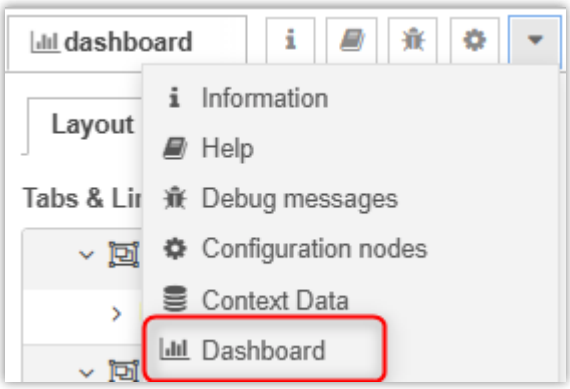


Now, connect the inject node with the process data node:



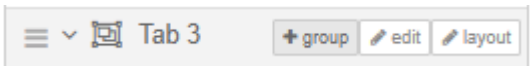
Please note that this direct connection is only valid for devices without output data (data from the Pinebox to the device). If there is output data, the inject node needs to be connected to the node that compiles the output data.

To place an output gauge, a new tab for the dashboard needs to be created:

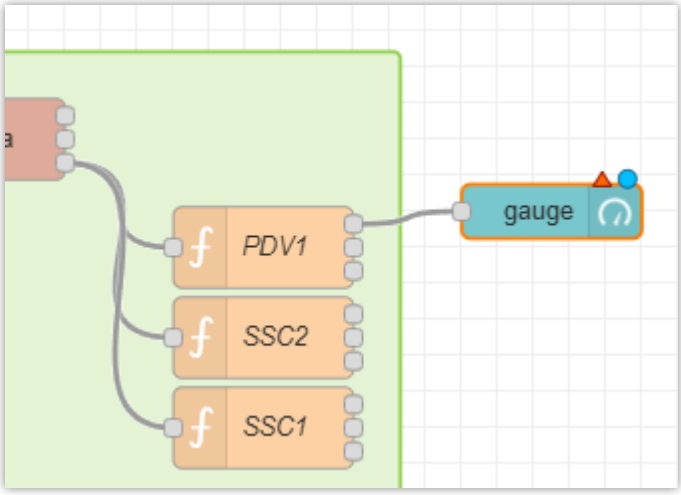


Create a new tab:

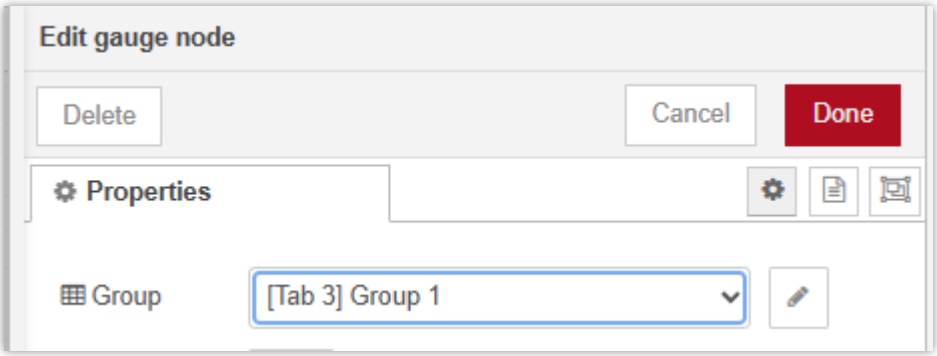
Within the new tab, create a new group:



The output distance data now can be connected to a gauge node:

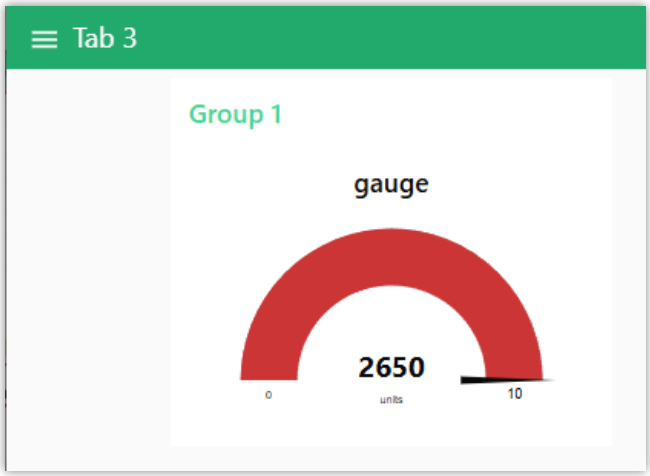


The upper output of the PDV1 is the actual value, the other two outputs are Min and Max values. The gauge needs to be assigned to a dashboard group to be visible in the dashboard. To use the previously created dashboard, select the following:

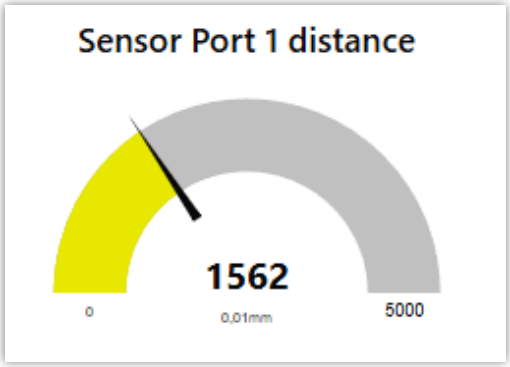


Now, you need to deploy your changes:

If you now go to the dasboard page (e.g. over the Pinebox web interface), you will see the gauge:



You may now set the colors, labels and thresholds to match with the distance sensor’s parameters:

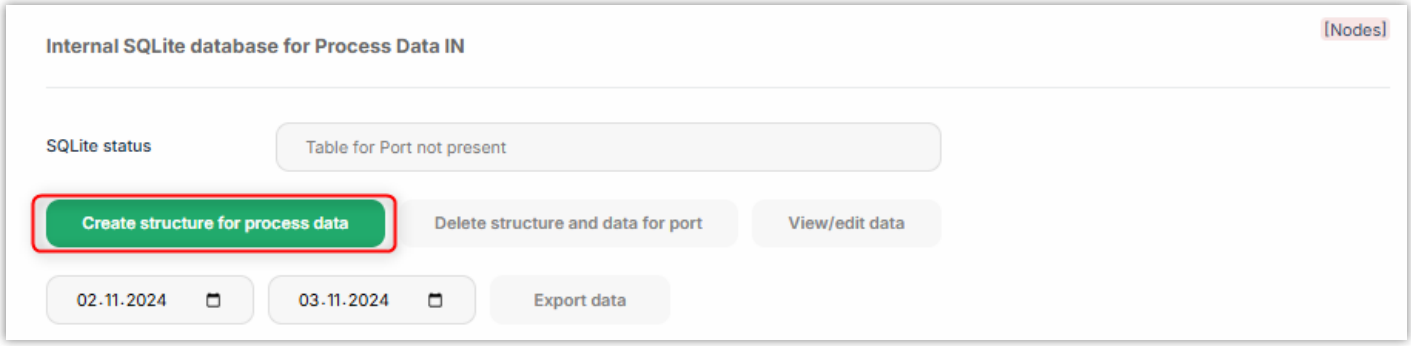


Congrats! You have created your first dashboard using live data from a sensor with the Pinebox.

1.6 Forward data to the SQLite database

Now, we can forward the data to the integrated SQLite database.

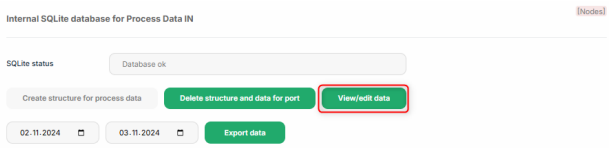
First the structure for the process data needs to be created in the internal SQLite database. This can be easily done over the port page in the process data section:



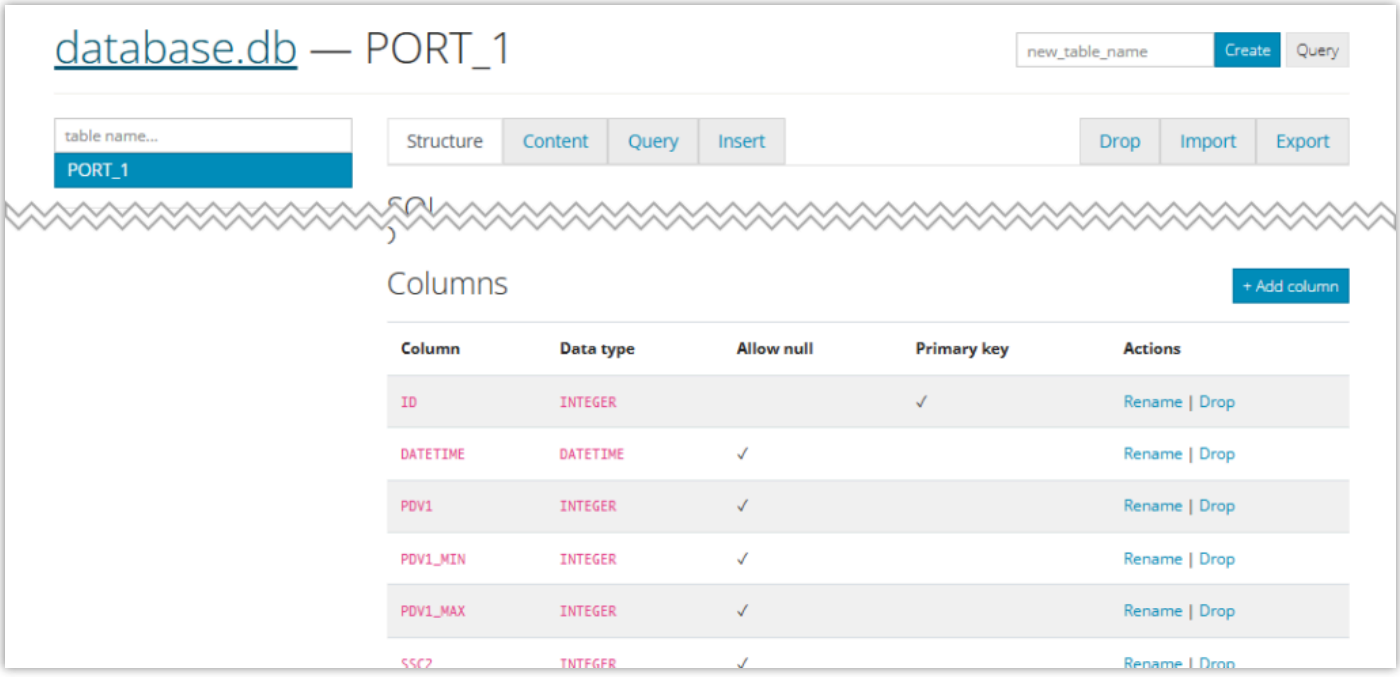
After this, the structure can be verified in the integrated SQLite frontend. The frontend can be accessed via the page menu on the left or the "View/edit data" button at the process data:

Page menu

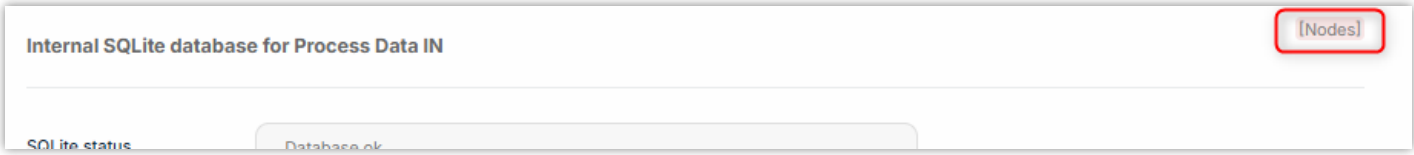
Process data section



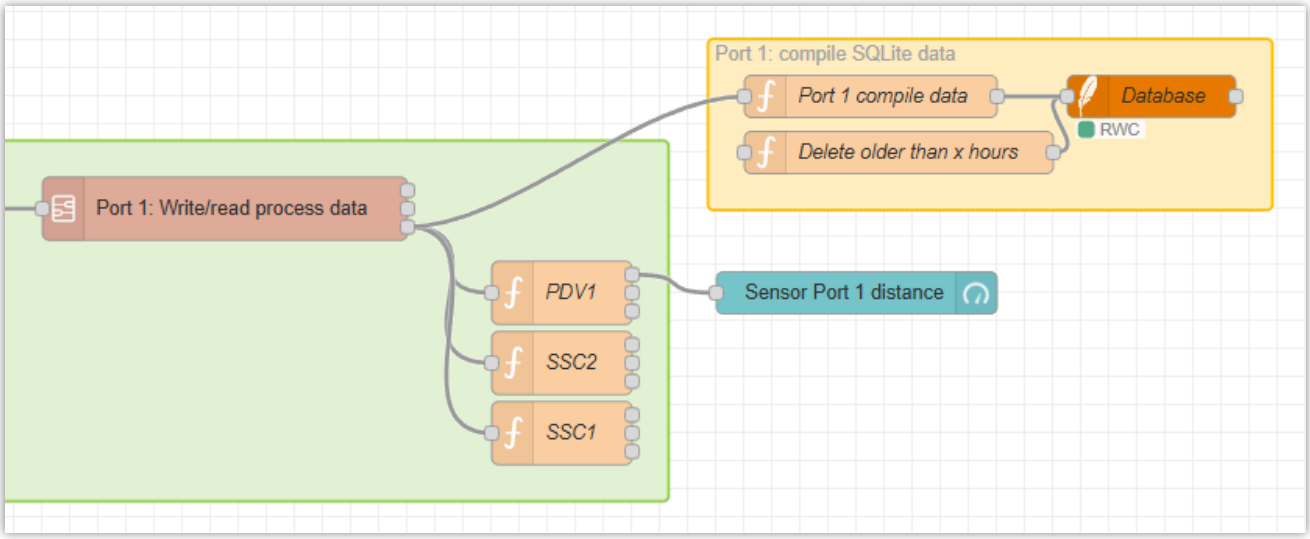
In the front end, the data structure is shown as columns:



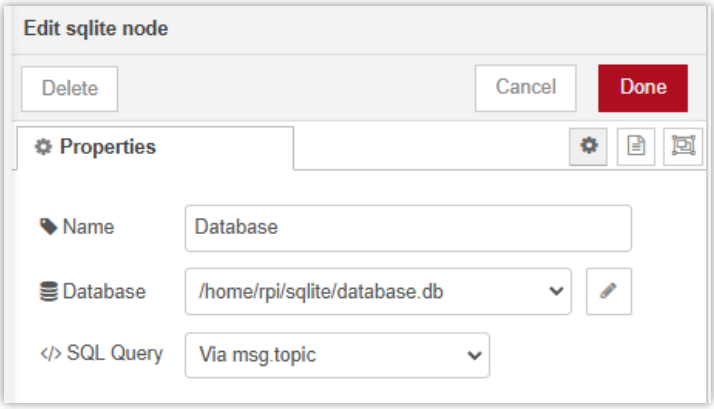
For the access via Node-RED, the corresponding node needs to be imported:



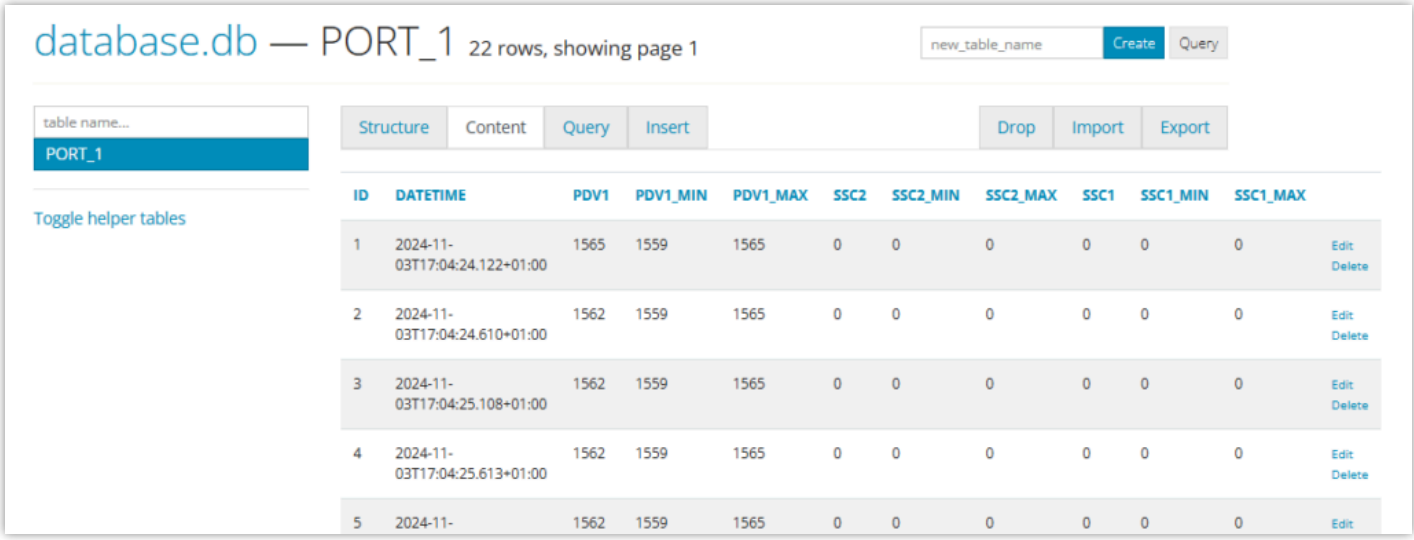
Copy the contet (as stated in 1.4 1.4 Add device process data to Node-RED) and import it to Node-RED. The result will be a node group from SQLite data, that needs to be directly connected to the "value" output of the "Write/read process data" flow:



The SQLite database requires to be confirmed before deploy. Double-click on the "Database" node and confirm by "Done":



Hit "Deploy" and you can view the data in the SQLite frontend. Select "Content" to view the data:



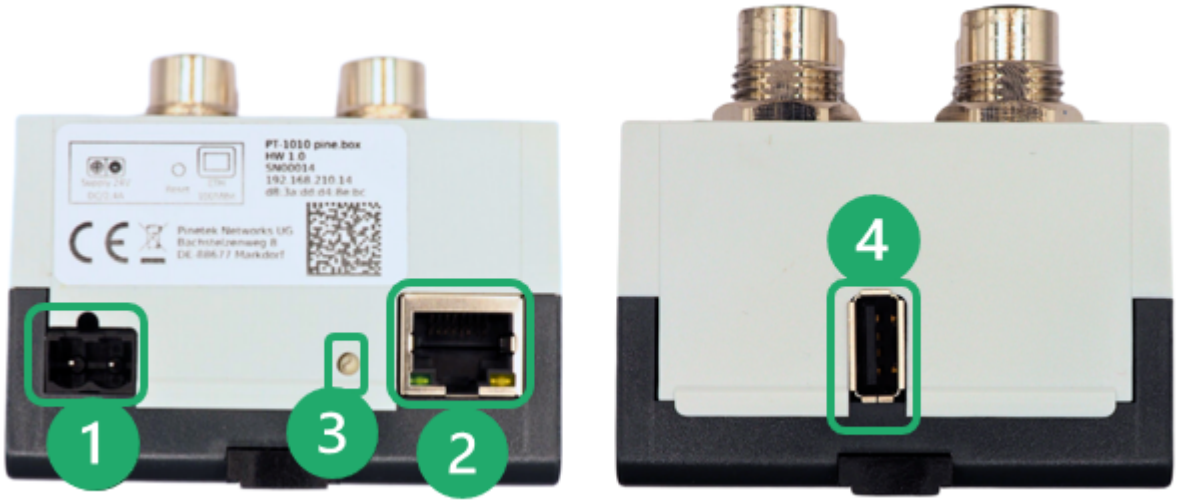
Well done! Your data is now stored in the internal database for further processing.

2 Connections and user interface

This section describes the hardware connection and the physical user interface of the Pinebox.

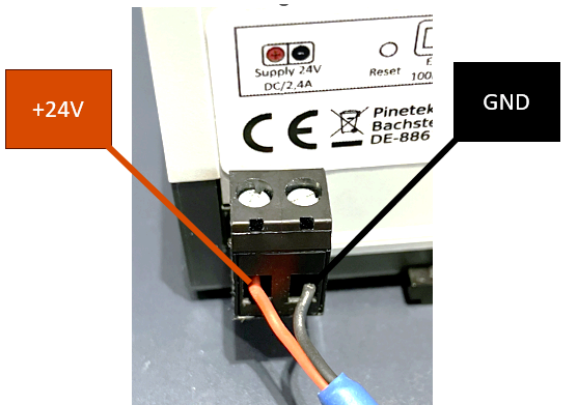
2.1 Power and network connections, Reset button

The pine.box has several connections that need to be connected to operate and access the device.



1. Power connection

The power connection is located on the top of the device. The used plug-in connector is an MSTBA2 type with 5,08mm spacing. The polarity is as shown in the following image:



The pine.box operates on 24V DC with a max. deviation for +/- 20% (i.e. 20,2V-26,8V). At maximum load, the device has a current consumption of 2,8A (at nominal voltage of 24V). The user shall ensure that the limits for safe operation of the device are maintained at power input.

> Operating the device outside of these boundaries can damage the pine.box (e.g., by overheating). Use only voltage sources that ensure that the above limits are kept.

Please note that the GND potential at the 24V input connector and the GND potential at the port connectors differ due to internal filters.

2. Ethernet

The Ethernet connection established through a standard RJ45 connector with operations modes for 10/100/1000 MBIt/s. The configuration of the Ethernet settings is done via the “Device” page on the web configuration page. The standard operation mode is DHCP client. If no DHCP server is present in the network, the fallback address printed on the label is used by the device.

The link status and activity of the Ethernet network is indicated over two LEDs located at the RJ45-connector:

- Link LED (green): Indicates an Ethernet Link on the port
- Activitiy LED (yellow): Indicates data activity on the Ethernet port

3. Reset button

To reset the device to the original Ethernet settings, please press the Reset-button for minimum 5 seconds. A successful reset is indicated with a red System LED. After the reset and a device restart has been performed, the default Ethernet settings are applied (DHCP client, if no DHCP client is available, fallback address is used).

4. USB

The USB connection is currently not used on the device and reserved for future applications.

2.2 User interface and device ports

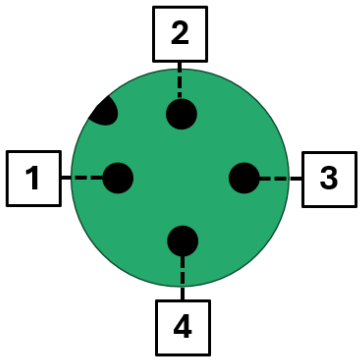
Device LEDs

The pine.box has two LED indicators for the device status

- Power LED:
  - OFF: No power supply, power supply out of specified range, internal power supply malfunction
  - Green: Power supply good
- System LED:
  - Off: System not running
  - Blinking green: System starting (e.g. after initial power on, or reset of device)
  - Solid green: System running
  - Red: Restart of system ongoing
  - Blinking Red/Green: Software update

Device Ports

The pine.box has four ports that can connect to IO-Link compatible (SDCI) devices. The connection is established via a 4-pin M12 (female) connector with the follwing pin assignments (as per connector on the pine.box):



Pin	Signal	Description
1	L+	24 Volt power supply to device (will be switched by pine.box). The pine.box can deliver max. 0,5A per port on this pin. The pin is overload protected.
2	I/Q	Digital Input/Output – not supported by pine.box
3	L-	Device GND Please note that the GND potential at the 24V input connector and the GND potential at the port connectors differ due to internal filters.
4	C/Q	Communication signal (SIO- Standard Input/Output). The pine.box can deliver max. 150mA per port on this pin. The pin is overload protected.

The pine.box supports communication speeds COM1, COM2 and COM3. The speed is auto-detected.

Device Port Indicators

Each port has one LED indicator located at the port.

- Off: Port power not enabled
- Green: Port power enabled, communication to connected device ok
- Blinking Red/Green: Port power enabled, no device detected at port
- Blinking Green: Port enabled, device detected but device configuration faulty (e.g., wrong IODD file loaded)

The device port indicator perform a flashing circle at the start of the application software to indicate the Pinebox is ready for operation.

3 Pinebox configuration

This section describes how the the Pinebox and the ports are configured through the integrated web interface.

3.1 Device configuration and update

This section covers the "Device" page of the web interface. The web interface can be reached:

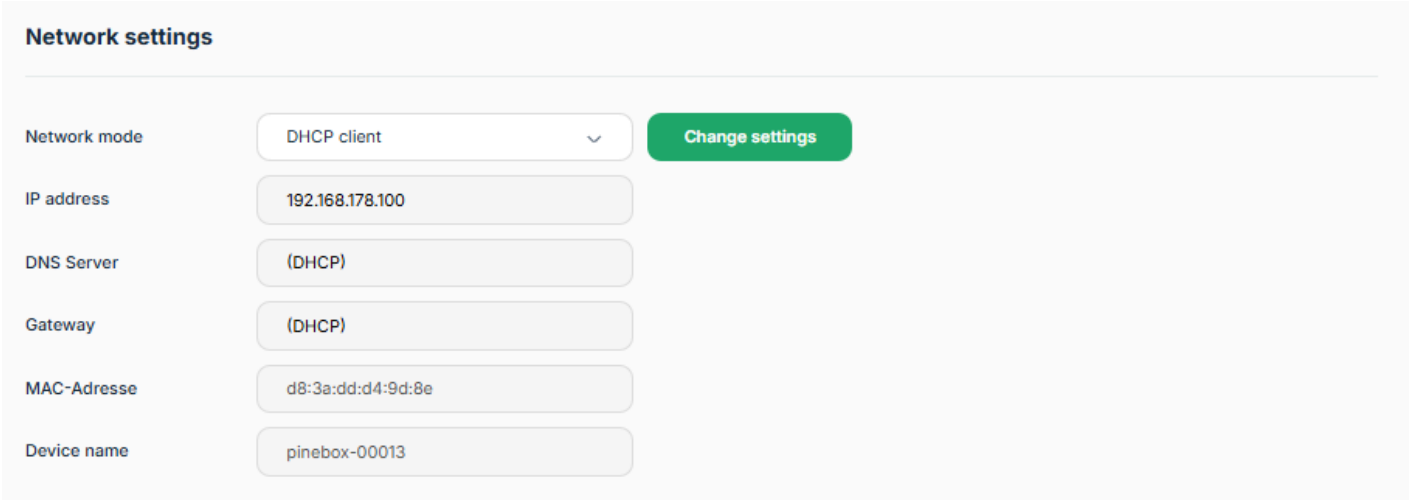
- with the IP-Address
- with the devicename in the format pinebox-XXXXX. For this, the name must be known to the network's name server, which is usually the case if the IP was assigned by DHCP

Status

This section holds the following information:

- Device status: Operational or error state
- Software version: The installed device software, can be updated (see "Update" section)
- Hardware version: The hardware version of the Pinebox
- Device serial: Serial number of the Pinebox.
- Log: "Show log" will open another tab with log information. In case of issues with the Pinebox, the Pinetek Networks support may ask to provide information from this output

Network settings



The network setings allow you to set the Ethernet IP-Address. There are two options:

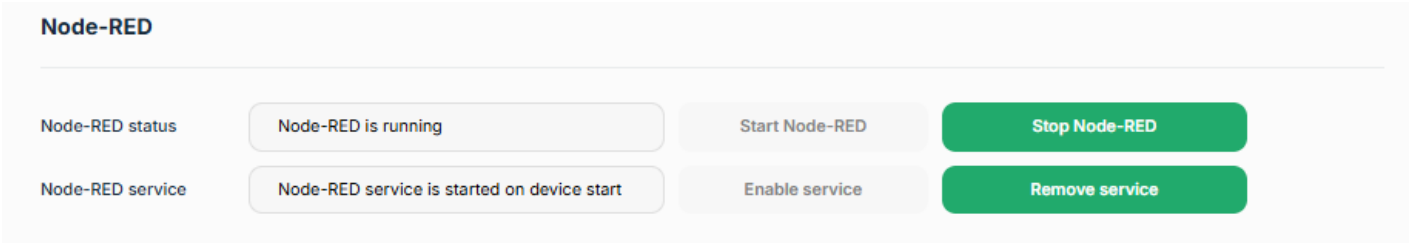
1. **Network mode "DHCP client"**
   This is the default setting (factory default). In the network, a DHCP server needs to be present to assign an IP address. The address can then be looked up in the DHCP server's client list. Typically, the DHCP server also acts as DNS, so the web interface also can be accessed with the device name.
   In DHCP client mode, the fields for IP address, DNS server and gateway are read-only as the data is assigend from the server.
   Fallback mode for DHCP: if no DHCP server can be detected by the Pinebox, the IP address falls back to the static fallback IP that is marked on the Pinebox's label on the backside of the device. As the DHCP mode is factory default, the static fallback IP can be set with the reset button.
2. **Network mode "Manual IP address"**
   In this setting, the IPs for the device ("IP address") and the network's DNS Server and gateway

need to be set manually.

If settings are change, these are applied with the “Change settings” button.

> If IP settings are changed and are not matching with the actual network, this can lead to a situation, where IP traffic can be disturbed in the network or the device is left unreachable. In these cases, a factory reset of the network over the hardware reset button (see 2.1 Power and network) might be necessary to re-establish communications.

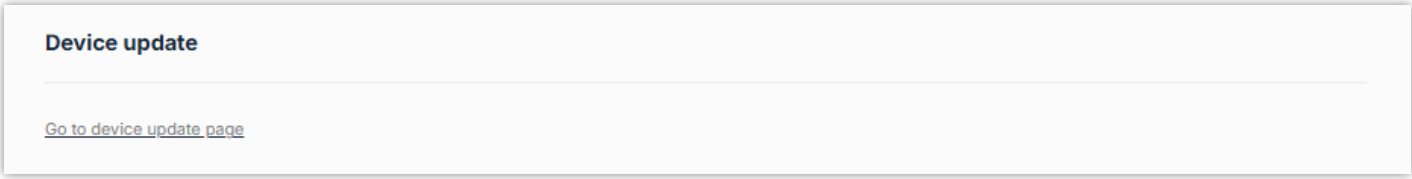
Node-RED



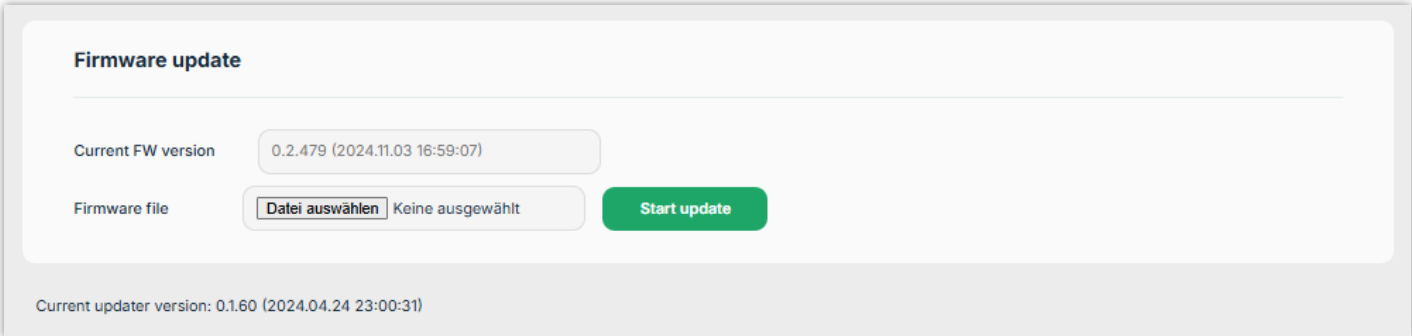
This section controls the Node-RED service. Node-RED can be manually started and stopped (“Start Node-RED” / “Stop Node-RED”). Please not that starting will take some time to complete. If Node-RED is stopped, the Node-RED Flows and Dashboard cannot be accessed, and the configured flows are not executed.

BY default, Node-RED is configured to start as a service on device start. You can disable this be removing the service. In case you want to execute the Node-RED flows, Node-RED requires a manual start (over the web interface or via JSON interface).

Device update



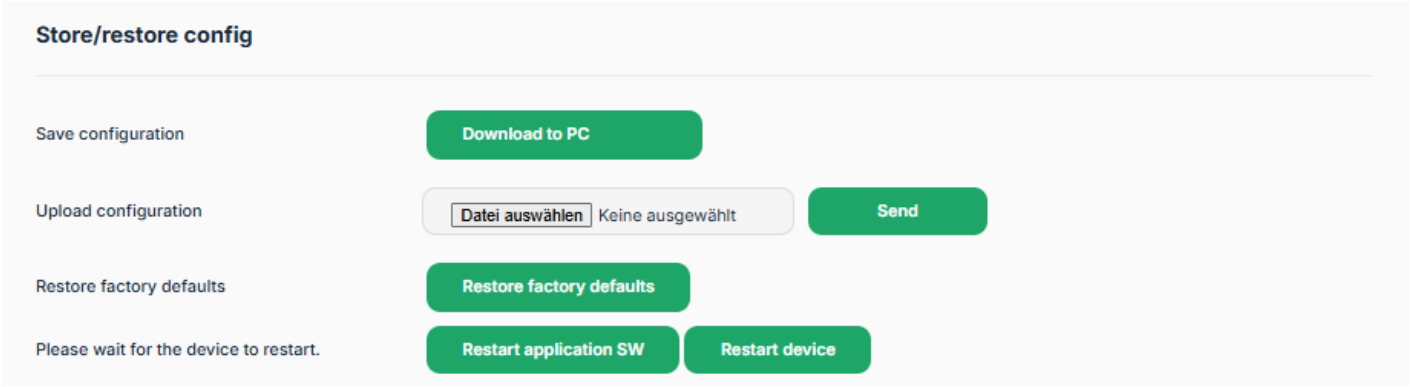
Clicking the link will lead to the device update page (under a different port than the rest of the web interface):



The latest firmware is provided here: download.pinetek-networks.com/pinebox/firmware/. The file needs to be un-zipped, the device update expects a .pfw (Pinebox Firmware) file.

The version of the update is listed for reference.

Store/restore config

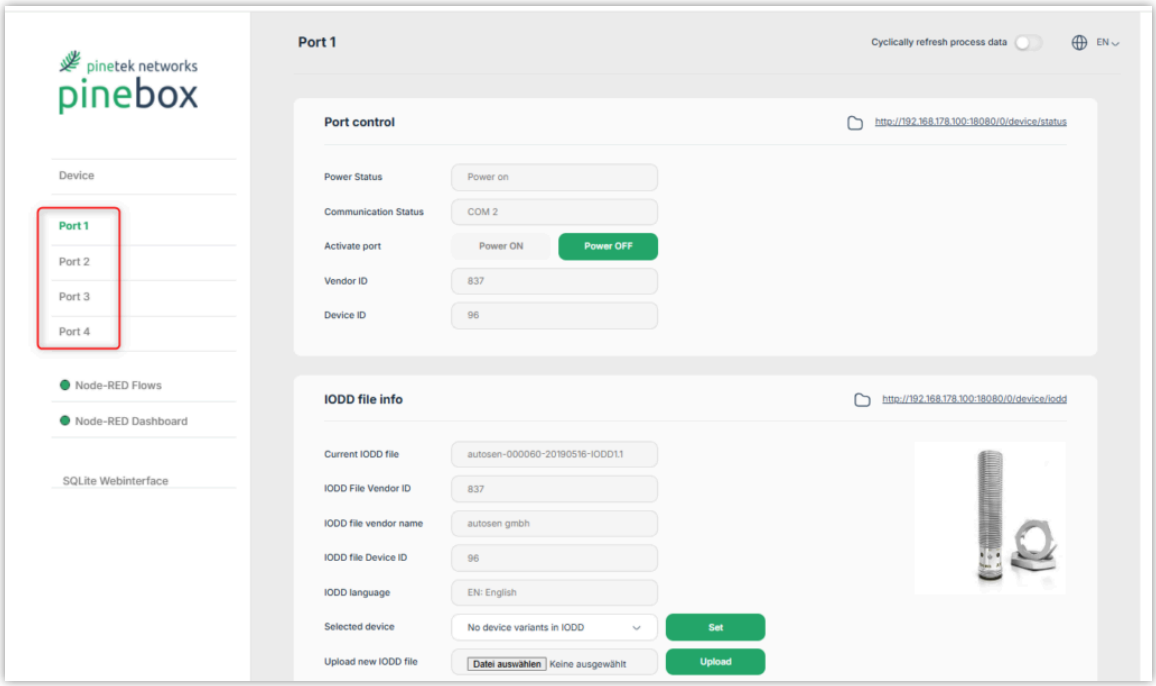


In this section, the user data can be stored and restored and the device and application can be re-started.

- Save/upload configuration: This saves and restores the user data (port configuration and IODDs, Node-RED configuration and nodes). The network configuration (see above) is not stored and restored.
- Restore factory defaults: This erases all user data (port configuration and IODDs, Node-RED configuration and nodes). The network configuration is also set to default (DHCP).
- Restart application SW: This restarts the application software of the Pinebox, the SDCI ports driver remains untouched by this. Can be used if an application error persists.
- Restart device: This does a hard restart of the complete Pinebox. Can be used if an error persists in the device at runtime.

3.2 Port configuration and control

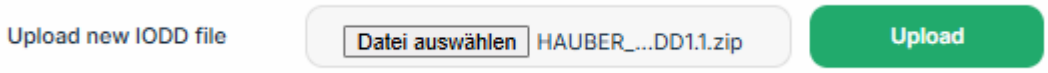
Before you can communicate to a device that is connected to one of the four ports, the device needs to be configured. The configuration is performed over the web interface on the sub-pages for the ports:



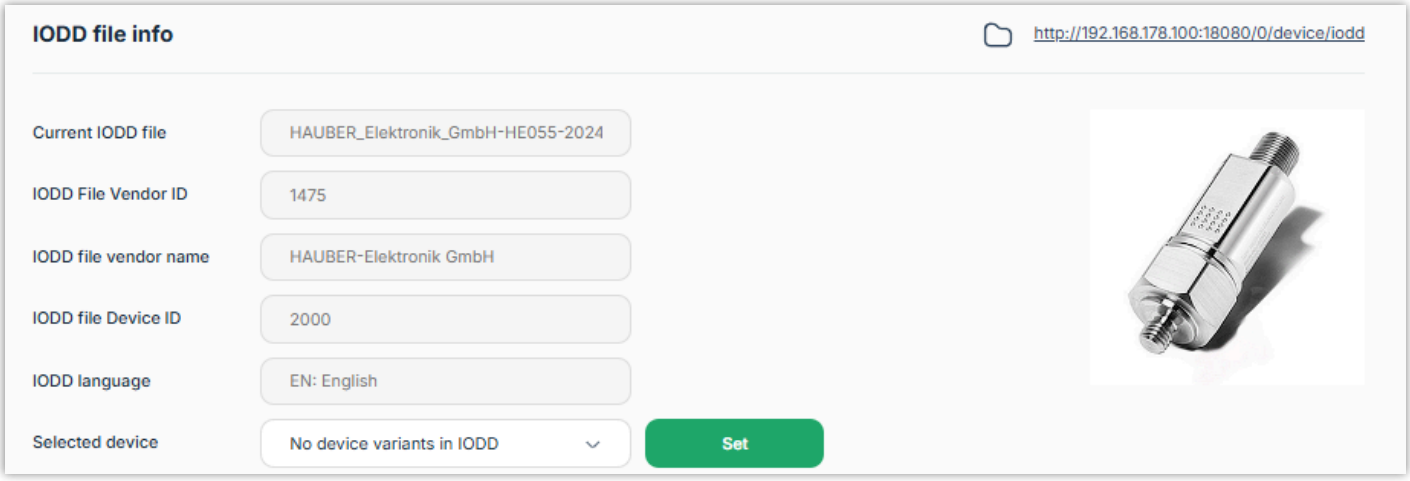
Port configuration

The port is configured using an IODD file that describes the features and functions of the IO-Link device. This file is provided by the IO-Link device manufacturer usually per download on the webpage. You can also use the IODD-Finder webpage: ioddfinder.io-link.com.

The IODD file comes either as single iodd XML-File or as zip file. The configuration interface of the Pinebox accepts both file formats. Use the upload field to select the IODD files from your PC and load the file by pressing the "Upload" button:



After uploading, you can see the selected file, the vendor ID, vendor name and device ID in the information fields:



Languages

In case the IODD supports multiple languages, the web interface language defines the used IODD language. The fallback language will always be English.

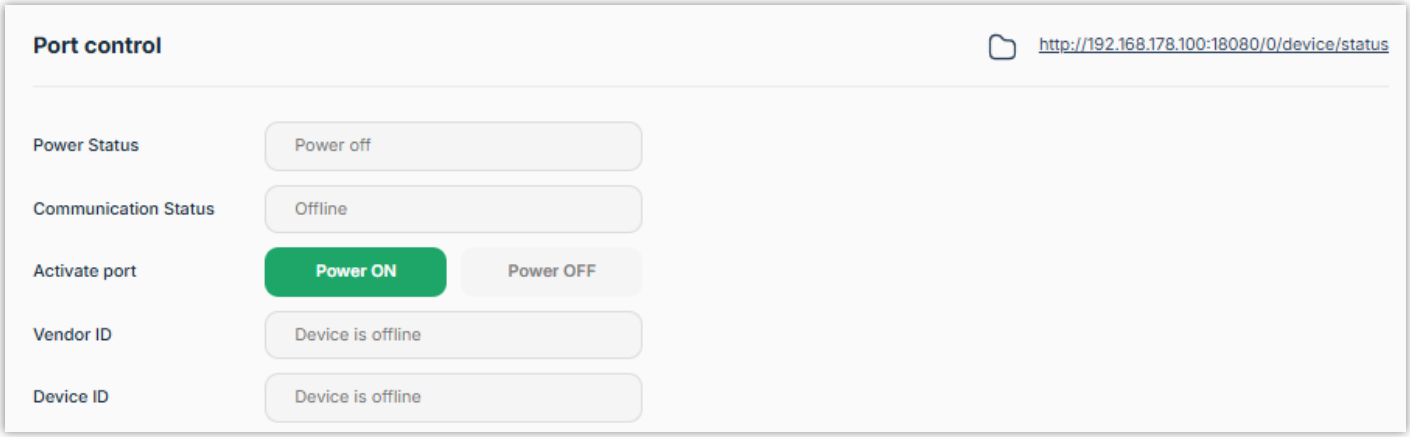
Device variants

IODD files may apply for several device variants. You can select the correct device variant in this case over the dropdown menu. The selection affects the device image shown in the IODD information box. There is no functional impact of the selection

In case only one device variant is included in the IODD file, the selection field is greyed out.

Port control

Initially, the port power is disabled after startup of the device. The power can be enabled and disabled using the buttons on the port subpage of the web interface:

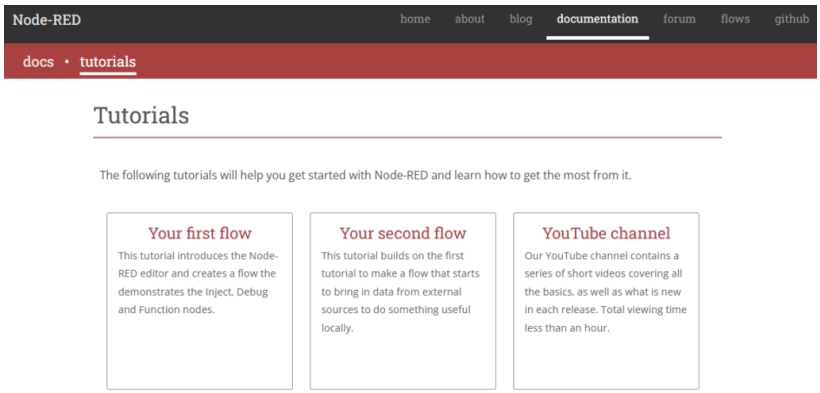


After enabling the port, the detected communication speed and IDs are read and displayed. If vendor ID or device ID do not match with the IODD file used for port configuration, an error is shown and no communication to the device will be possible.

4 Node-RED

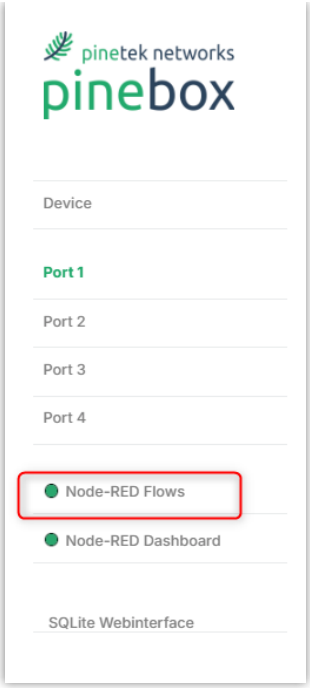
This section describes how the SDCI data can be processed in Node-RED and vice versa. The Pinebox's web interface creates data to import nodes into Node-RED specific to the connected device based on the IODD file.

There are many introduction tutorials available for Node-RED. We recommend you to get familiar with the principles e.g., by starting with the official Node-RED documentation: nodered.org/docs/tutorials/



Node-RED Workspace

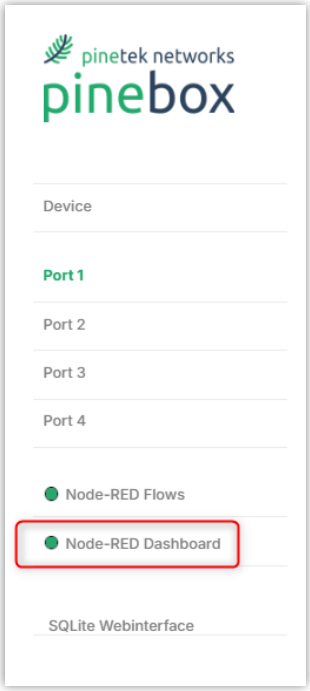
The Node-RED Flows workspace can be accessed over the menu in the Pinebox web interface:



Alternatively, the Flows workspace is available over port :1880 (with IP-address or hostname). If you perform changes in the Node-RED Flows, you need to perform a “Deploy” action to submit the changes:

Node-RED Dashboards

The Node-RED dashboards can be accessed over the menu Pinebox web interface:



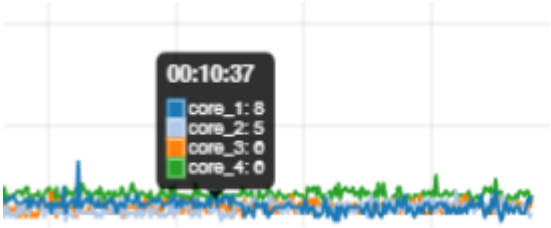
Alternatively, the Flows workspace is available over port :1880/ui (with IP-address or hostname).

Please note that on deploy, the current view is being reset to the first tab.

Default dashboards

There are several tabs in the dashboard. Per default, the first two tabs are the “Node-RED System Info” with current CPU load and CPU load history to determine if the Pinebox is overloaded.

CPU core 3 and core 4 are for SDCI functionality and cannot be utilized for user application.



The second tab is “the port control “Power/Status” to control the port power and receive the status from Node-RED. If not needed, the firt two tabs can be deleted. They will be re-created on factory reset.

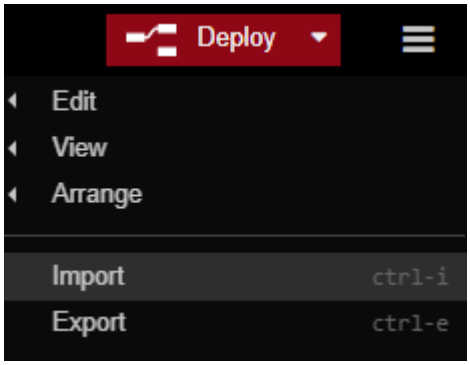
4.1 Node Red – Exchange Process Data

This section is about exchanging process data with an IO-Link device using Node-RED. The target is the creation of a specific Node-RED node for a write-read cycle.

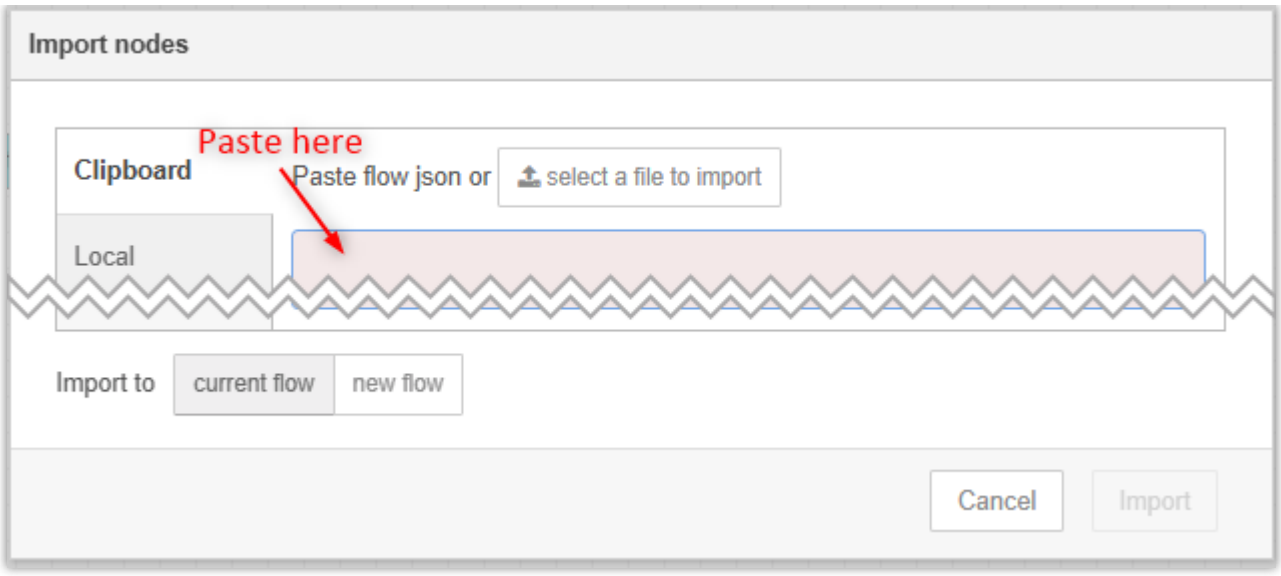
Starting point is the configuration web interface. If a parameter is readable (Read only, Read/Write), the Node-RED node creation link is shown at the variable in the "Parameter section:

In the new tab that opens, click on "Copy to clipboard":

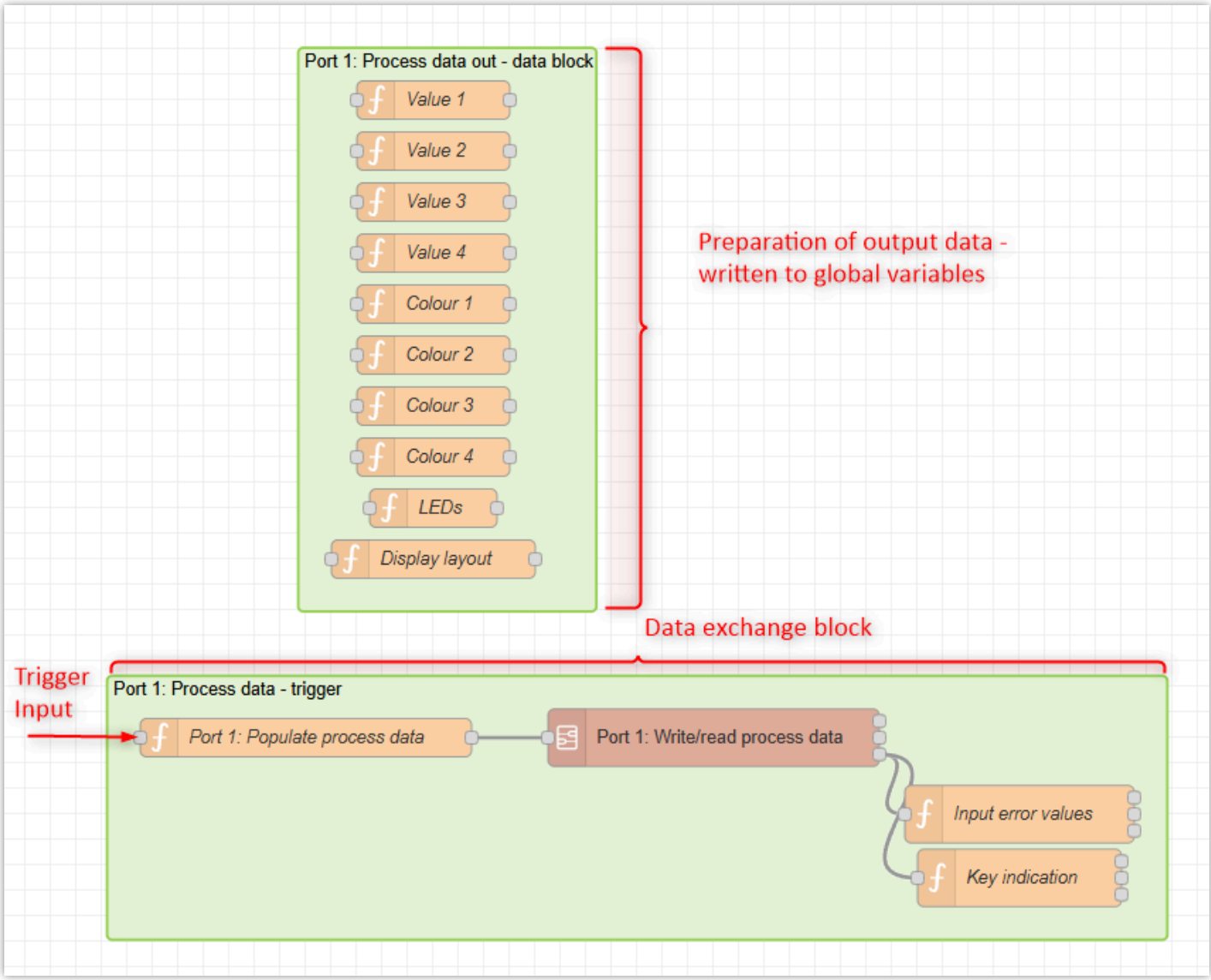
In the Node-RED Flows Workspace, import the node (ether with the menu or CTRL-I).



Paste the content of the clipboard to the node/flow JSON box:

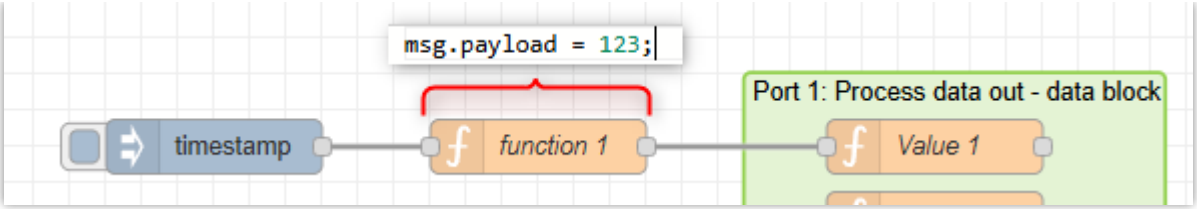


The specific node is the imported into Node-RED. It splits into two sections:



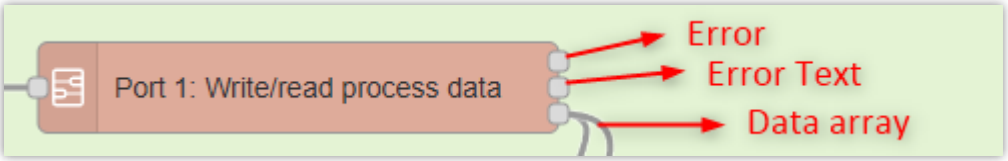
Preparation of output data

This block holds data that is written to the connected device. The data is stored in global variables. It can be set at any time by writing a message with the payload value to the single nodes:

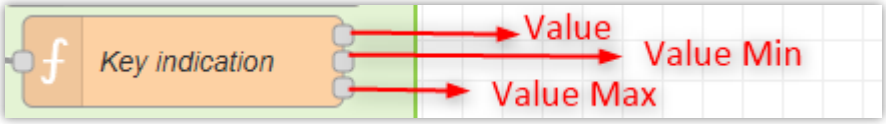


Data exchange block

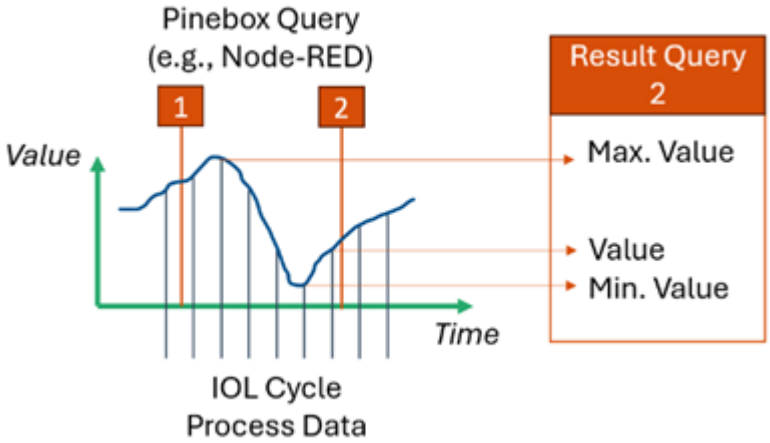
This block is triggered by the trigger input. The trigger input does not require a specific payload. The data to transfer is populated from the global data in the "Populate process data" node. The Write/read process data node provides the following output:



- The Error Number and Error Text hold the error number (see https://www.pinetek-networks.com/knowledge-base/pinebox/10-appendix/appendix-error-codes/)
- The data is a data array with all read data from the device. It will be processed for each input variable. The output of the single process data variables is structured as follows for each variable:



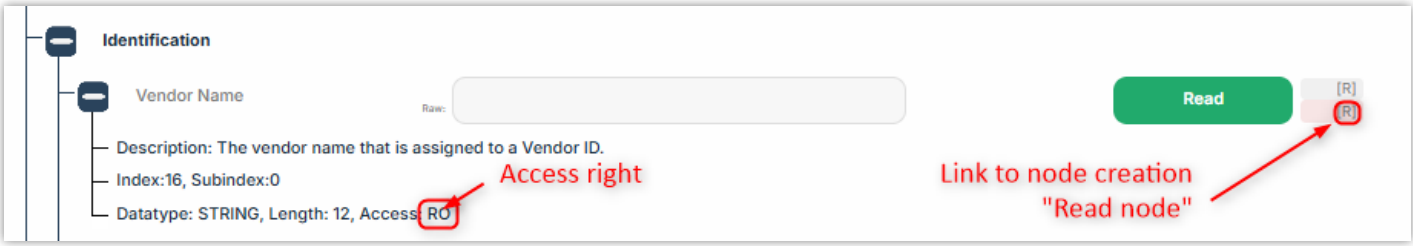
- The Value is the last read value from the device
- The Min./Max. values are the values received by the Pinebox since the last Write/Read process data block execution. Note that the Pinebox can hold up to 255 cycle data values.



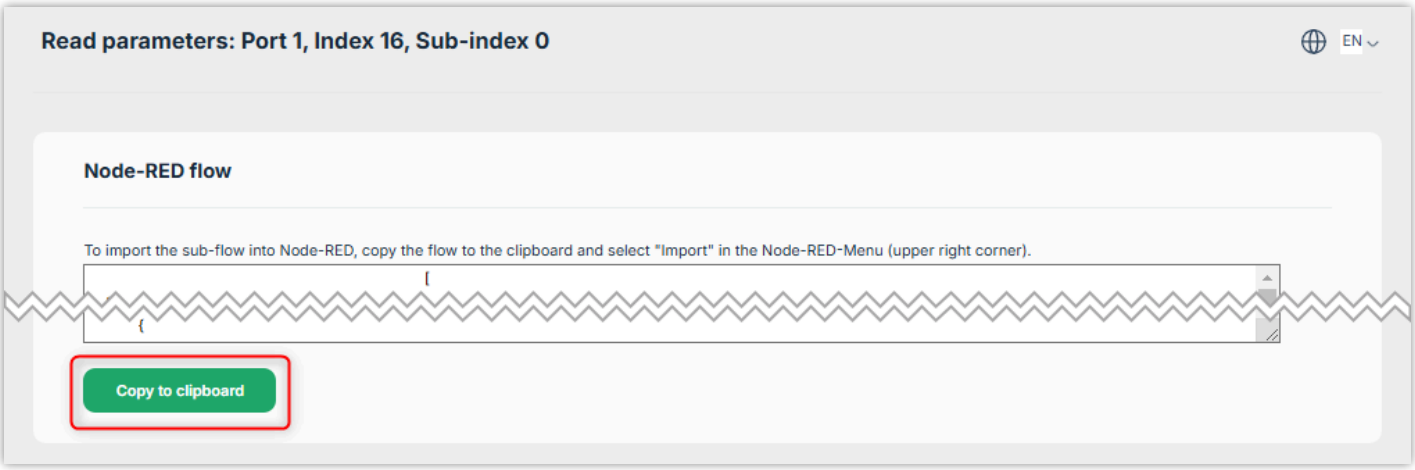
4.2 Node Red – Reading Parameters

This section is about reading parameter data from an IO-Link device using Node-RED. The target is the creation of a specific Node-RED node for the write read of the parameter's index and sub-index.

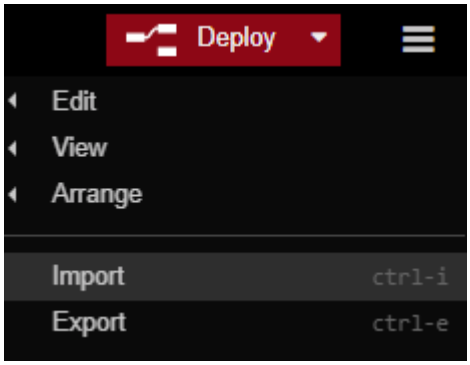
Starting point is the configuration web interface. If a parameter is readable (Read only, Read/Write), the Node-RED node creation link is shown at the variable in the "Parameter section:



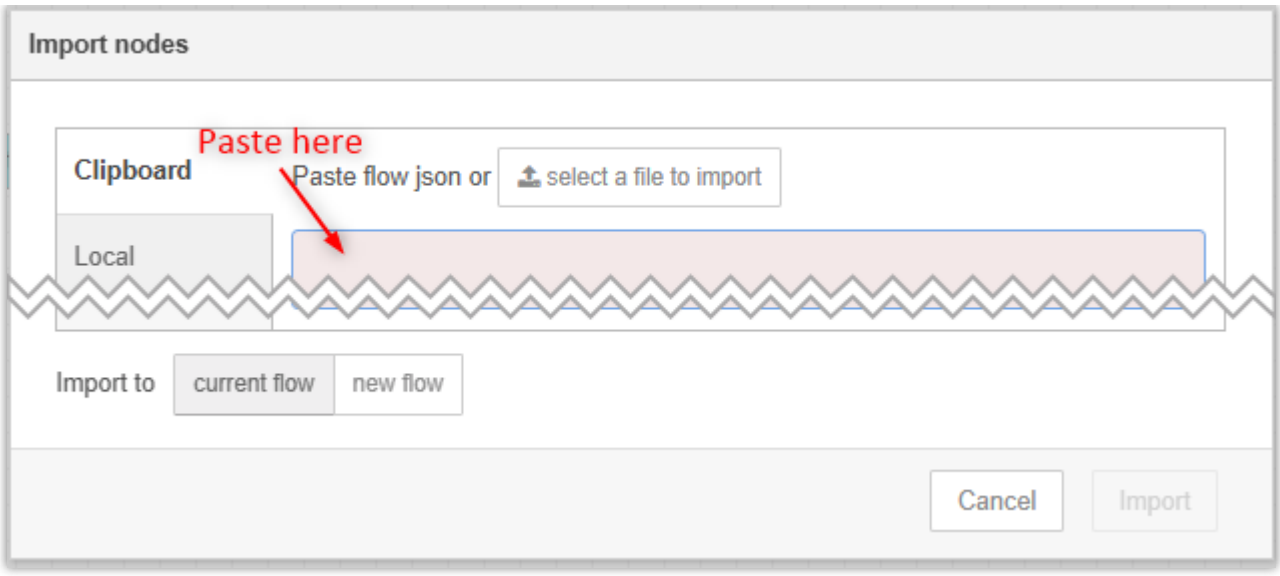
In the new tab that opens, click on "Copy to clipboard":



In the Node-RED Flows Workspace, import the node (ether with the menu or CTRL-I).



Paste the content of the clipboard to the node/flow JSON box:



The specific node is the imported into Node-RED:

- The Read Trigger Input starts the data read action. No specific data needs to be written to the port.
- The Error Number and Error Text hold the error number (see https://www.pinetek-networks.com/knowledge-base/pinebox/10-appendix/appendix-error-codes/)
- Output is the data that is read from the parameter. For datatypes like Numbers or Strings, this is usually the data that was written. For more complex datatypes like BLOB (represented by OctetString data), this might be formatted data.

Numbers (Integers, Bool) and Strings

Numbers and strings are read in the native Javascript format.

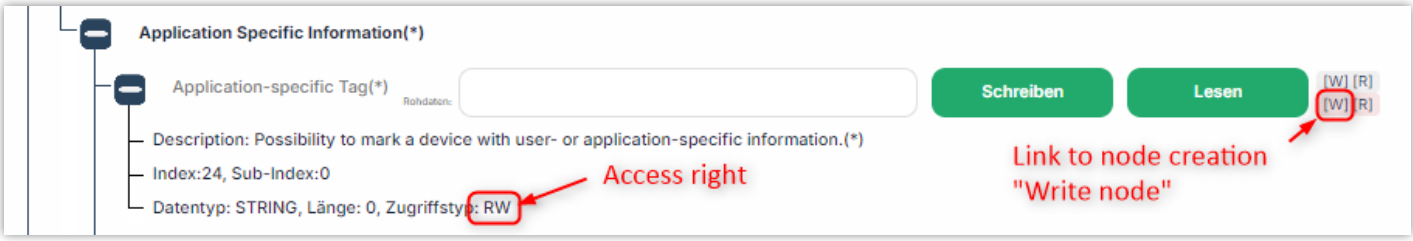
OctetString/Buffers

Octet Stings and buffers are provided in OctetSting format.

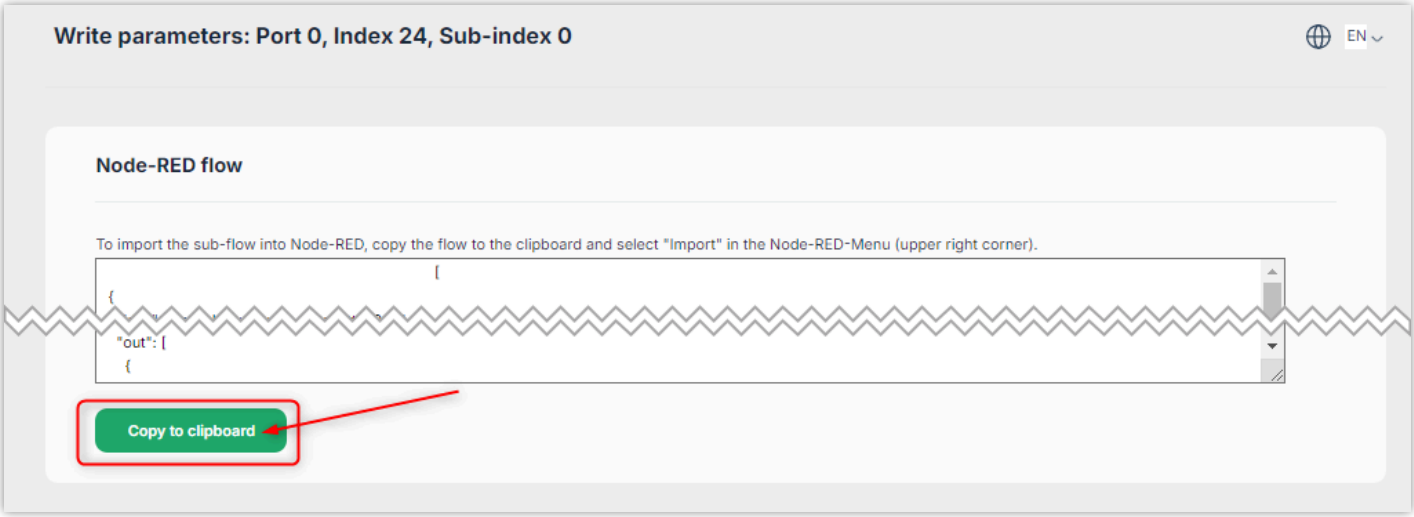
4.3 Node Red – Writing Parameters

This section is about writing parameter data to an IO-Link device using Node-RED. The target is the creation of a specific Node-RED node for the write operation of the parameter's index and sub-index.

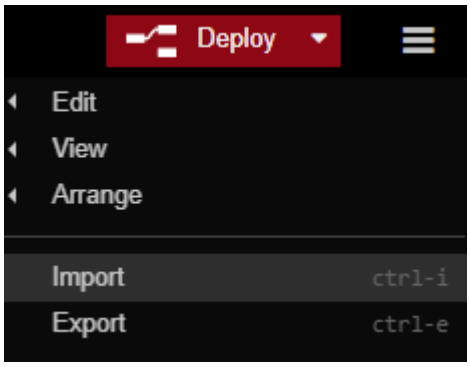
Starting point is the configuration web interface. If a parameter is writeable (Read/Write, Write Only), the Node-RED node creation link is shown at the variable:



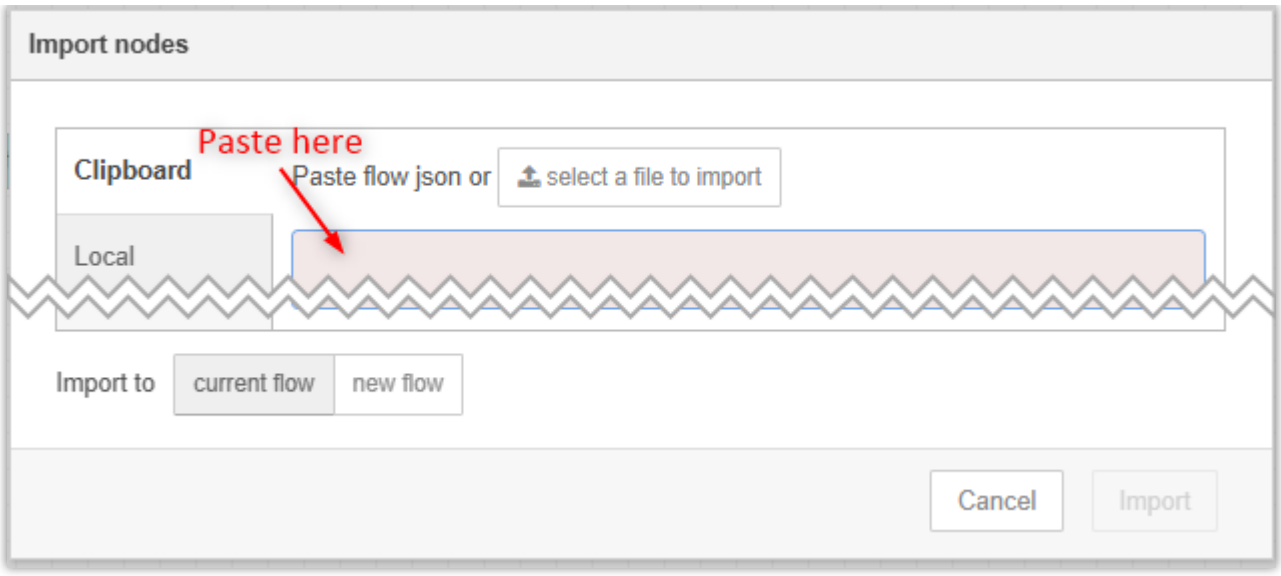
In the new tab that opens, click on "Copy to clipboard":



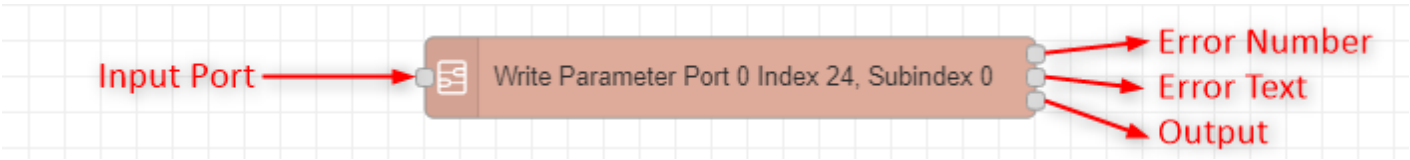
In Node-RED Flows workspace, import the node (ether with the menu or CTRL-I).



Paste the content of the clipboard to the node/flow JSON box:



The specific node is the imported into Node-RED:



- The Input Port receives the input data. This darta needs to be formatted as described in the sections below. The node is triggered by writing data to this port.
- The Error Number and Error Text hold the error number (see https://www.pinetek-networks.com/knowledge-base/pinebox/10-appendix/appendix-error-codes/)
- Output is the data that is read back from the parameter (Write-Read-Verification). For datatypes like Numbers or Strings, this is usually the data that was written. For more complex datatypes like BLOB (represented by OctetString data), this might be formatted data that requires unpacking before further treatment.

Numbers (Integers, Bool) and Strings

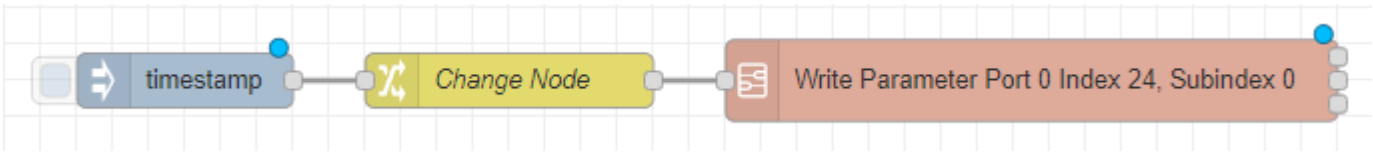
Numbers and strings can be put to the input of the Write Parameter Node in the native Javascript format. The input is expected as payload to the message.

OctetString

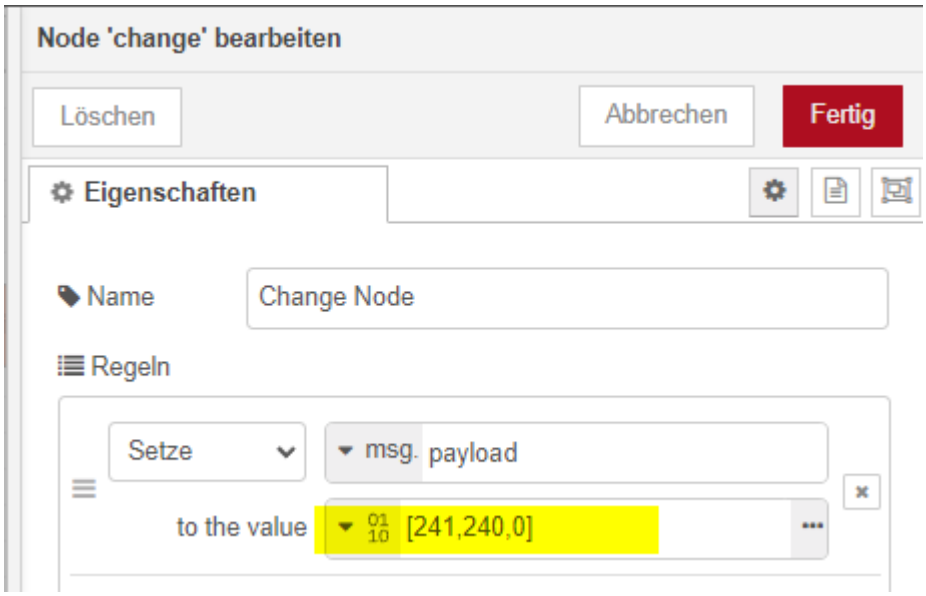
There are two ways to format OctetSting input data:

Format as buffer

Example: Change Node

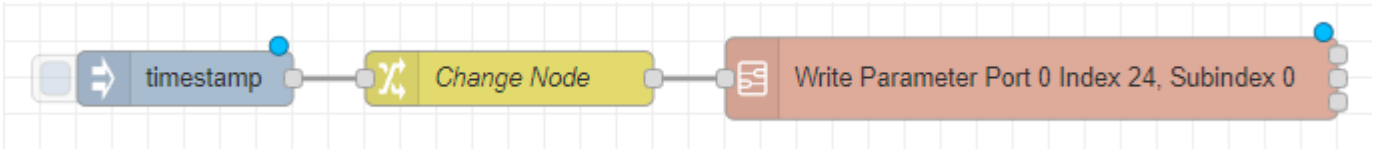


For the buffer, the data needs to be formatted accordingly:

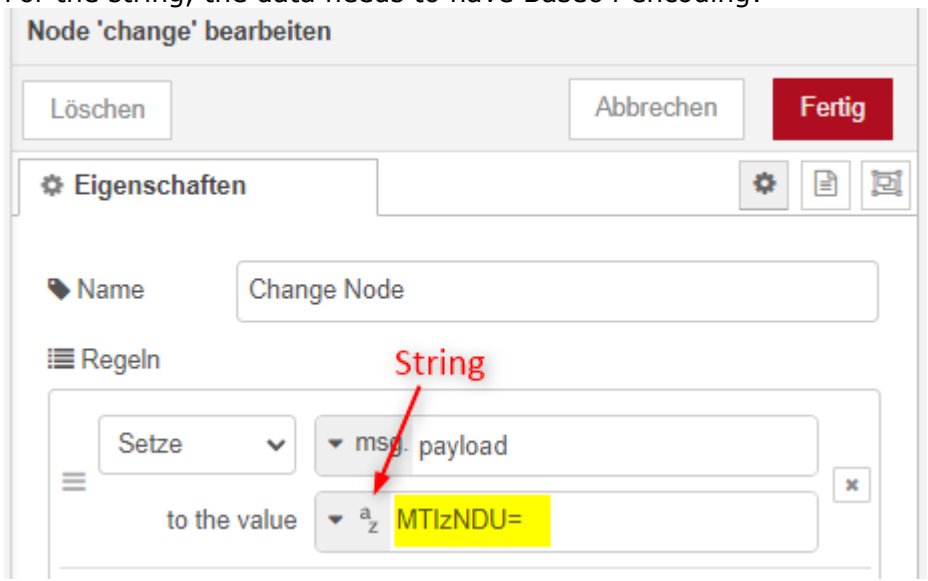


Format as Base64 string

Example: Change Node



For the string, the data needs to have Base64 encoding:



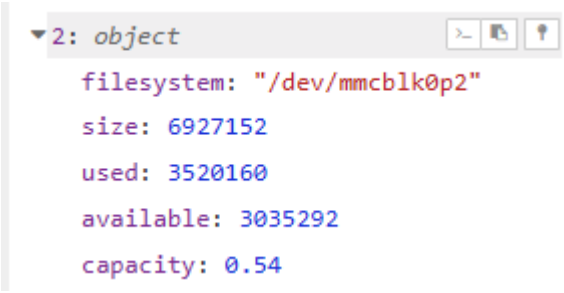
5 SQLite Database

The Pinebox is equiped with a pre-installed SQLite database: www.sqlite.org

This section describes how the SQLite database is accessed from Node-RED and how the frontend can be accessed over the web interface.

Please note that the storage on the Pinebox is limited. The Pinebox is equipped with an internal eMMC, to many write cycles may eventually damage the memory.

You can install the node node-red-contrib-os via the palette manager to get an overview on the consumed disk memory with the “Drives” node:

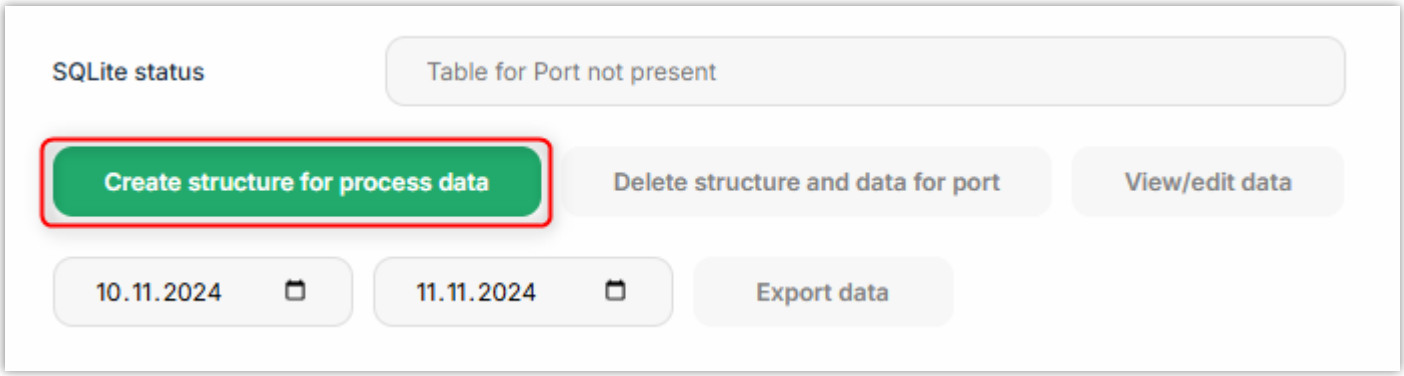


It is recommended to wipe old data from the database, if it is no longer needed.

5.1 SQLite Database – Create, delete and export tables

The Pinebox offers a possibility to create the table structure from the process data.

To create the data, a valid IODD file needs to be present for the port. In the web interface, the section for the database control is in the process data section of the port page. To create a new table structure, hit the “Create structure for process data” button:



The data consists of the elements for the process data and additionally, minimum and maximum values since the last request (numeric values only). It also adds a column for the timestamp.

If data is present, or you wish to delete the existing structure, this can be also performed in this section.

The “View/edit data” button will take you to the database frontend (see chapter 5.1 Database Frontend).

The database control section also offers the possiblilty to export data from the SQLite database for the port in CSV format. The data will be restricted to the date range given in the input boxes.

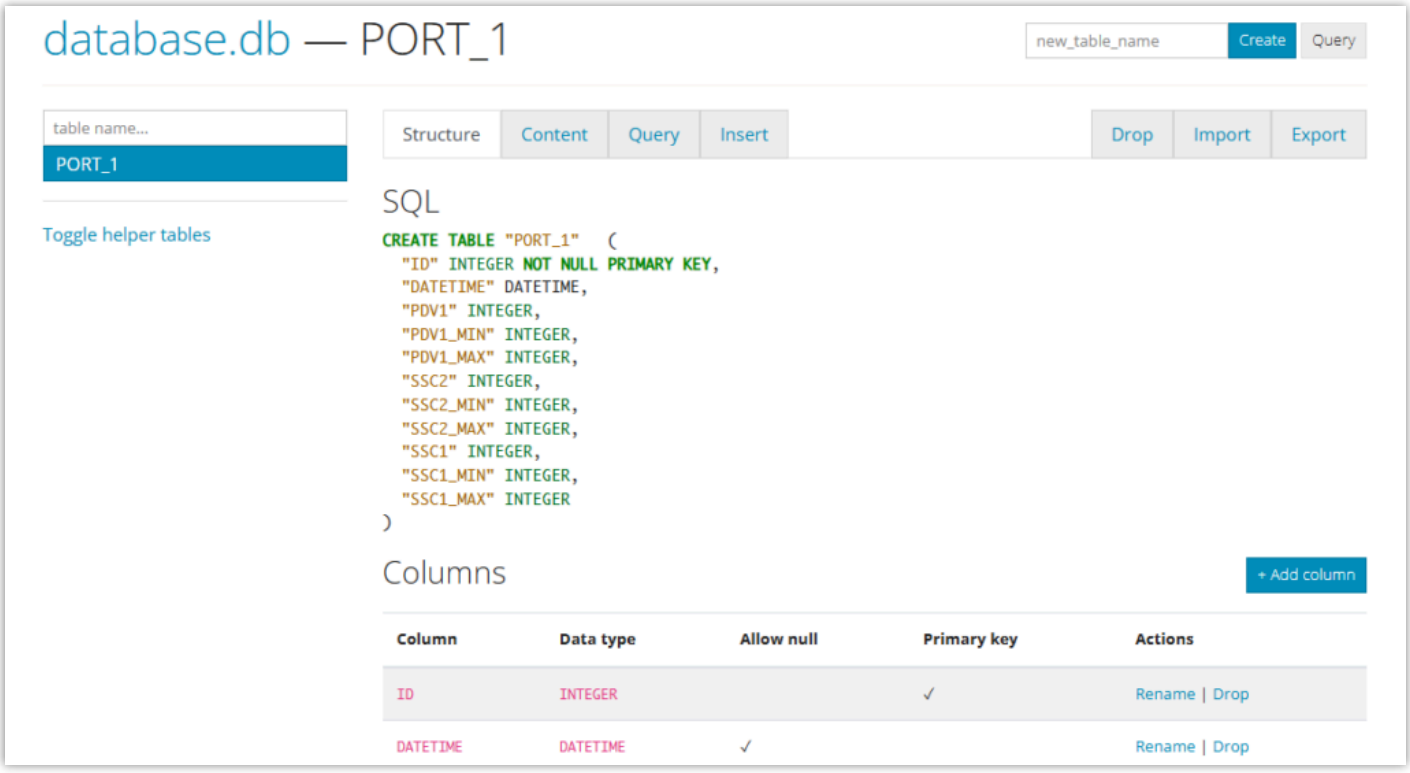
5.2 SQLite Database – Database Frontend

The Pinebox has an integrated web front end for the SQLIte database. The database frontend is based on sqlite-web, and can be accessed on port :8080 of the Pinebox web server or via the link in the Pinebox web interface menu:

On the left side of the database frontend, the tables for the ports are shown. The default table names are PORT_1 to PORT_4:

The default database name is database.db.

The tabs for each table splits into structure, content, query and insert:



Under “Structure”, the table structure of the port can be analysed. Also, additional columns can be added, and columns can be altered and deleted

Please note that altering the structure and adding or deleting colums require that the Node-RED node for the database also needs to be modified. Doing so requires knowledge on database structures and SQL syntax. Deleting columns or dropping databases also will lead to data loss. This applies also for editing the content of the database (see below).

Unter “Content”, the acquired data can be analysed and also modified.

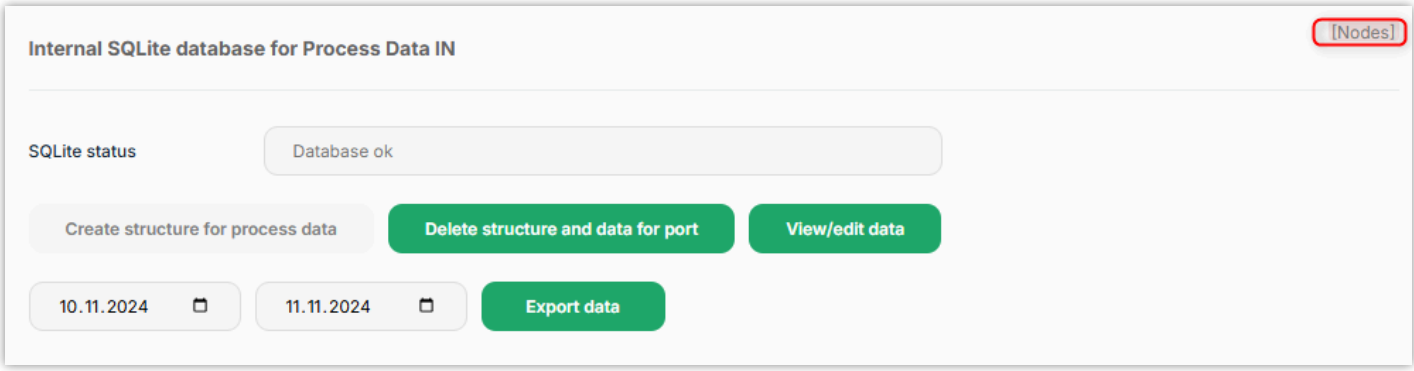
Under “Query”, custom queries can be executed to view and also modify the database structure and content. Knowledge of the SQL syntax is required to do so.

Unter “Insert”, data can be added column-wise.

5.3 SQLite Database – Node-RED database node

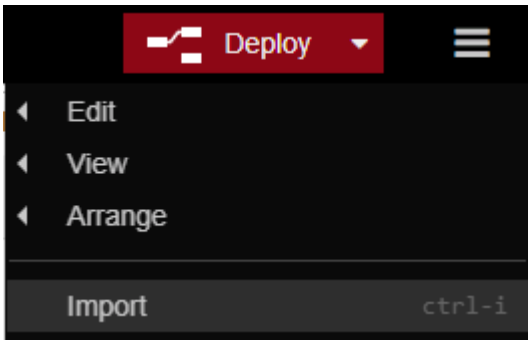
Import node into Node-RED

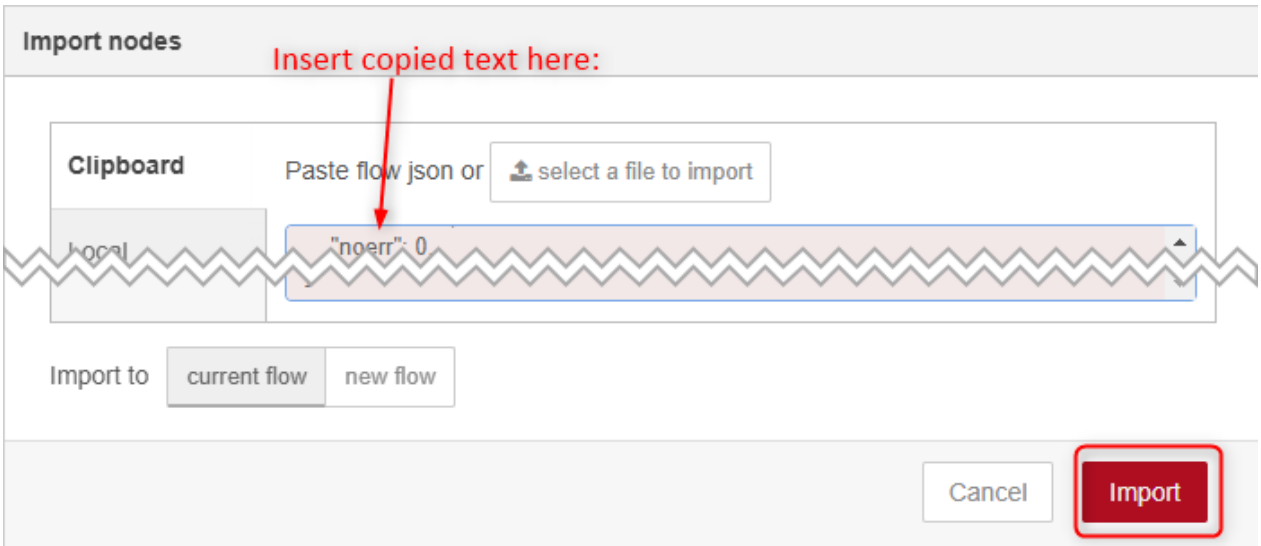
The Node-RED node for the database is generated similar to other nodes and imported into Node-RED:



Copy the content:

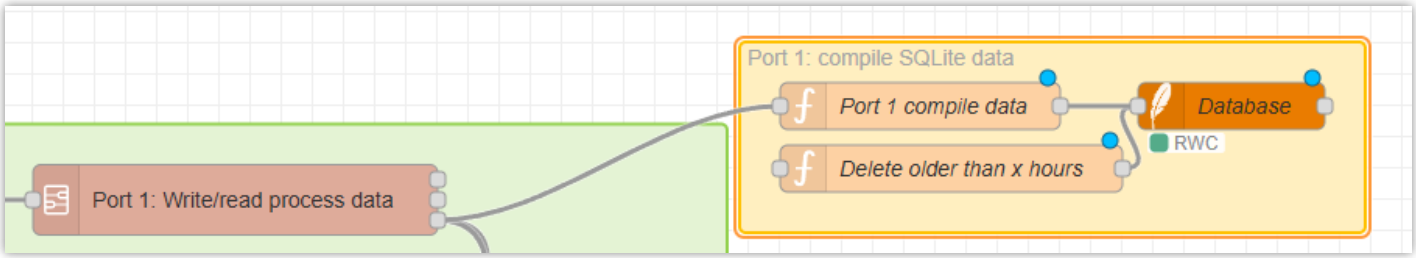
Import into Node-RED:



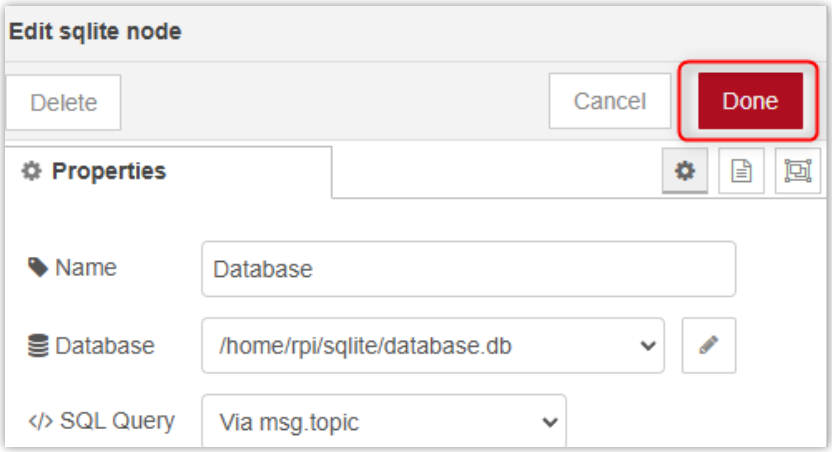


Connect node in Node-RED

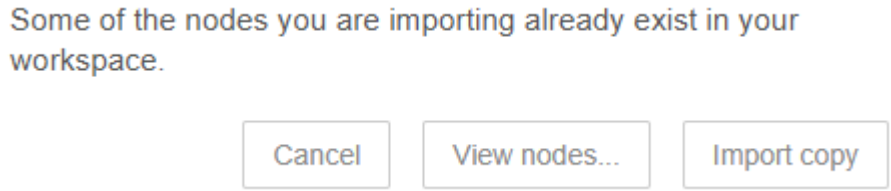
For the resulting node, the output of the Process Data needs to be directly connected to the “Compile Data” node:



To confirm the database settings, the database connection needs to be confirmed. Double-click on the “Database” node and confirm with “Done”:

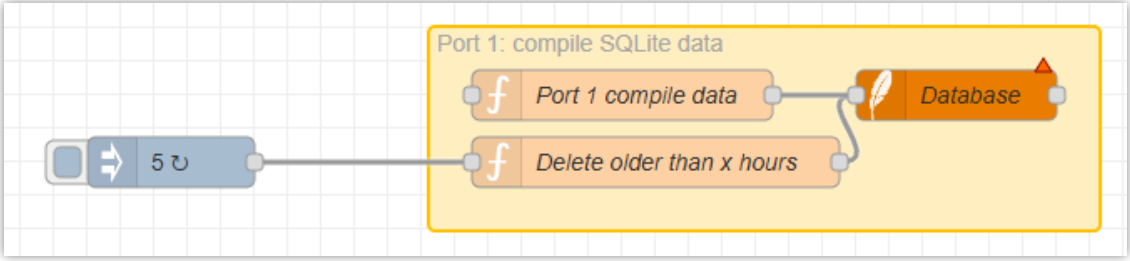


- hen importing more than one database node, a message appears that some of the nodes already exist. Please use “import copy” in this case:

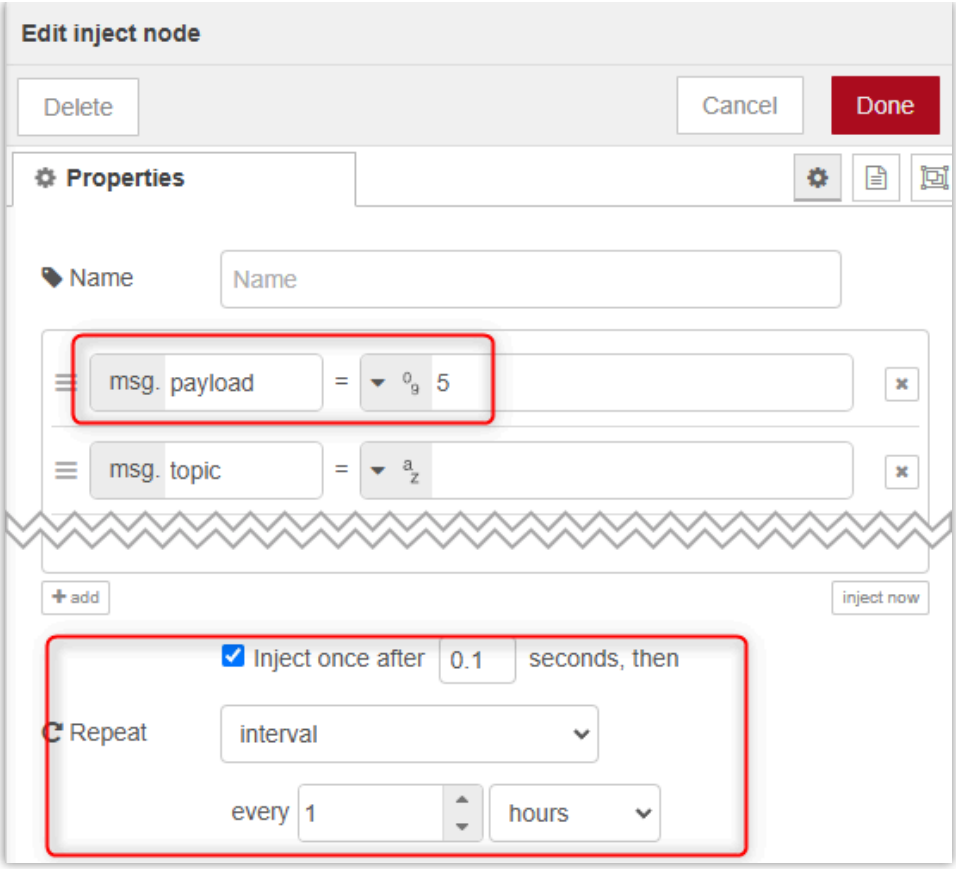


Delete old data

Data can be purged on a regular basis from the database. To do so, connect an “Inject” node with the “Delete older than x hours” input.



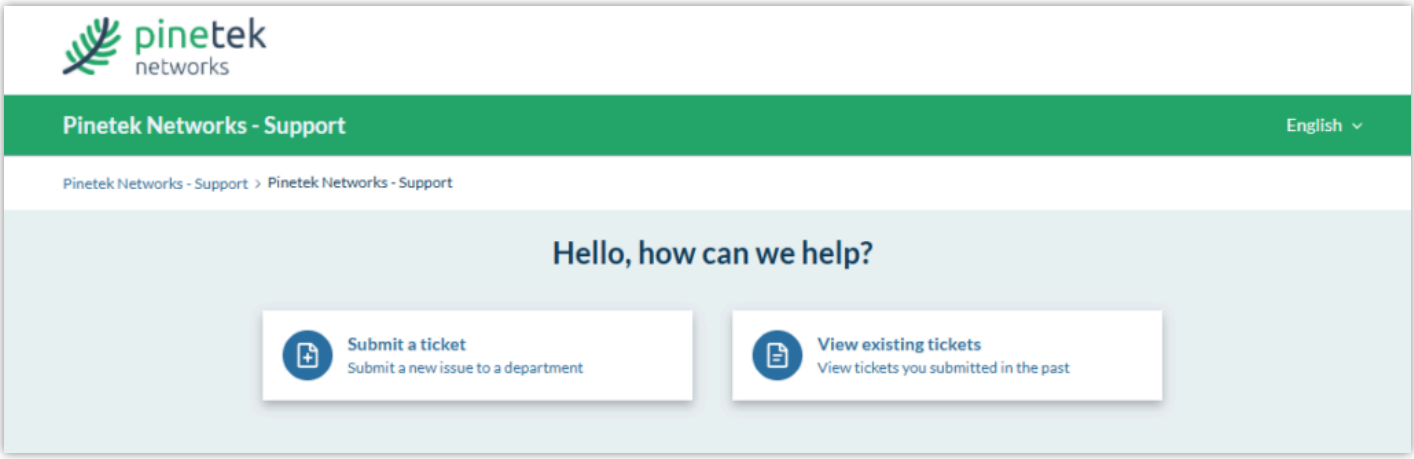
in this example, the node is configured to delete the data older than 5 hours. This operation is executed at Node-RED start (device start if Node-RED service is enabled) and then every hour:


Edit inject node
Delete
Cancel
Done
Properties
Name
Name
msg. payload = 5
msg. topic =
add
inject now
Inject once after 0.1 seconds, then
Repeat
interval
every 1
hours

6 Support

Support can be obtained from the website
www.pinetek-networks.com/support

For specific questions, you can open a support ticket in our ticket system:
support.pinetek-networks.com



7 Technical Data

Mechanical

Dimensions 90 x 72 x 63 mm
Installation DIN-Rail
Protection class IP20
Temperature range (environmental) -25°- 55°C

Please notice that the maximum output current for L+ decreases with rising temperature. The maximum achievable environmental operating temperature is also depending on the CPU load of the device.

The temperature of 55°C environmental was tested with 4 output ports at maximum L+ current per port.

Connections

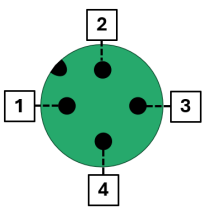
Power supply

- DC Input: 24V DC (+/-20%)
- Power consumption max. 2800mA (SDCI port supply included)

The output voltage on the L+ depends on the input voltage and the internal voltage drop of the device. At room temperature, the voltage drop is approximately 0,3V at room temperature and 1,4V at 55°C ambient @ 900mA load at L+ (two ports enabled at max. load).

SDCI-Ports (IO-Link compatible)

- 4 SDCI-Ports (IO-Link compatible)
- Connector M12 (female)
- Class A (max. 450mA L+ per Port)
- Communication speeds COM1, COM2, COM3 (Auto-Detect)
- Operating mode: IOL (DQ, DI currently not supported)



- 1: L+
- 2: N/C
- 3: L- (GND)
- 4: C/Q

The output current on the L+ and C/Q lines are monitored to not exceed 450mA per port on L+ and 350mA on C/Q (@ 20°C, higher temperatures lead to lower output current). The user, however, shall not install devices that exceed the above current consumption limits (consult device datasheet for reference).

Ethernet

- 1000MBit, RJ45
- IPv4 as DHCP client or with fixed IP address (see Ethernet configuration)

RTC/Battery

The Pinebox is equipped with an Real-Time-Clock that will provide accurate time to the device without network connection. The clock is powered with a CR2032 battery with a lifetime expectation of >1year (the battery is not used while power is applied).

Others

- 1 USB-A port for future extension, max. cable length <1,5m

8 Appendix

The appendix holds additional information on the device.

8.1 Error Codes

JSON/Node Red Error codes

This table shows the error codes for operations, which is returned by the Node-RED nodes or as part of the JSON functions.

Error code	Error type
0x00	noError
0x01	ioddNoPi
0x02	ioddNoPo
0x03	powerOff
0x04	errorIntInit
0x05	errorIntCRC
0x06	errorIntComm
0x07	errorNoIodd
0x08	errorIoddInvalid
0x09	errorIoddMismatch
0x0A	errorPowerSwitch
0x0B	errorNoDevice
0x0C	errorVariableNotAvailable
0x0D	errorTryToReadArrayRecord
0xOE	errorPortError
0x0F	errorParseInputJson
0x10	errorAccesRoVariable
0x11	errorVariableAccess
0x12	errorInputOutOfRange
0x13	errorInputIpMalformed
0x14	errorConfigFile
0x15	errorConfigFileVersion
0x16	errorInputJsonNotBase64orObject

IO-Link error codes

These error codes detail errors on the IO-Link level, e.g. when reading or writing parameters, as part of the IO-Link specification (see IOL-Interface-Spec_10002_V113_Jun19.pdf). The error codes are part of the text field in the JSON response.

Error code	Error type
0x8000	IOLINK_SMI_ERRORTYPE_APP_DEV
0x8011	IOLINK_SMI_ERRORTYPE_IDX_NOTAVAIL
0x8012	IOLINK_SMI_ERRORTYPE_SUBIDX_NOTAVAIL
0x8020	IOLINK_SMI_ERRORTYPE_SERV_NOTAVAIL
0x8021	IOLINK_SMI_ERRORTYPE_SERV_NOTAVAIL_LOCCTRL
0x8022	IOLINK_SMI_ERRORTYPE_SERV_NOTAVAIL_DEVCTRL
0x8023	IOLINK_SMI_ERRORTYPE_IDX_NOT_ACCESSIBLE
0x8030	IOLINK_SMI_ERRORTYPE_PAR_VALOUTOFRNG
0x8031	IOLINK_SMI_ERRORTYPE_PAR_VALGTLIM
0x8032	IOLINK_SMI_ERRORTYPE_PAR_VALLTLIM
0x8033	IOLINK_SMI_ERRORTYPE_VAL_LENOVRRUN
0x8034	IOLINK_SMI_ERRORTYPE_VAL_LENUNDRUN
0x8035	IOLINK_SMI_ERRORTYPE_FUNC_NOTAVAIL
0x8036	IOLINK_SMI_ERRORTYPE_FUNC_UNAVAILTEMP
0x8040	IOLINK_SMI_ERRORTYPE_PAR_SETINVALID
0x8041	IOLINK_SMI_ERRORTYPE_PAR_SETINCONSIST
0x8082	IOLINK_SMI_ERRORTYPE_APP_DEVNOTRDY
0x8100	IOLINK_SMI_ERRORTYPE_UNSPECIFIC
0x1000	IOLINK_SMI_ERRORTYPE_COM_ERR
0x1100	IOLINK_SMI_ERRORTYPE_I_SERVICE_TIMEOUT
0x5600	IOLINK_SMI_ERRORTYPE_M_ISDU_CHECKSUM
0x5700	IOLINK_SMI_ERRORTYPE_M_ISDU_ILLEGAL
0x4001	IOLINK_SMI_ERRORTYPE_ARGBLOCK_NOT_SUPPORTED
0x4002	IOLINK_SMI_ERRORTYPE_ARGBLOCK_INCONSISTENT
0x4003	IOLINK_SMI_ERRORTYPE_DEV_NOT_ACCESSIBLE
0x4004	IOLINK_SMI_ERRORTYPE_SERVICE_NOT_SUPPORTED
0x4005	IOLINK_SMI_ERRORTYPE_DEV_NOT_IN_OPERATE
0x4006	IOLINK_SMI_ERRORTYPE_MEMORY_OVERRUN
0x4011	IOLINK_SMI_ERRORTYPE_PORT_NUM_INVALID

Error code	Error type
0x4034	IOLINK_SMI_ERRORTYPE_ARGBLOCK_LENGTH_INVALID
0x4036	IOLINK_SMI_ERRORTYPE_SERVICE_TEMP_UNAVAILABLE

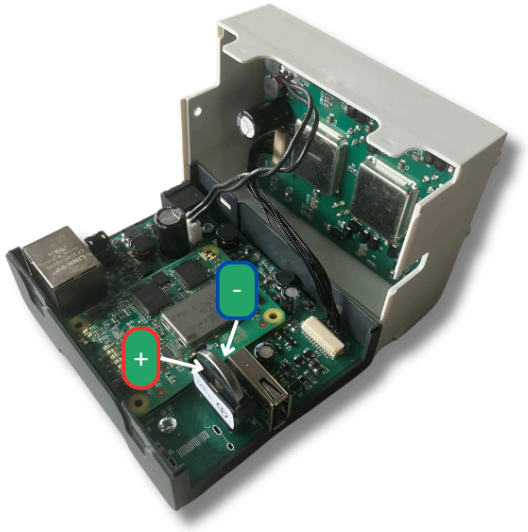
8.2 Real-time-clock

The Pinebox is equipped with a real-time-clock (RTC). This clock is powered by an internal battery in case the Pinebox is not supplied by 24V volts. The RTC is automatically snchronized when the Pinebox is connected to a network that provices access global NTP servers.

The RTC is specifically useful when writing data to a database using timestamps.

Changing the battery

The battery is a CR2032 type 3V lithium battery. To exchange the battery, please open the Pinebox in an ESD safe environment. The location and polarity of the battery is as follows:



8.3 JSON Support and Linux access

JSON Access

The Pinebox provides a JSON interface for access to all SDCI functions and port control. The links for the JSON access are provided in the webinterface if the button “Show JSON links” is activated. The toggle switch is located at the bottom of the Port webpage:

The JSON paths to access the functions are provided in the web interface:

Example: IODD-Information:

Example: Process data:

Please contact Pinetek Networks for a detailed interface description: info@pinetek-networks.com

Linux access

The Pinebox is a Linux®-based product. If you wish to have access to the Linux system for installing own programs directly on the device, please contact Pinetek Networks for further clarification: info@pinetek-networks.com

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8.4 Supplier and device Information, Compliance & Disposal

Supplier information

Pinetek Networks UG (haftungsbeschränkt)
Bachstelzenweg 8
DE-88677 Markdorf

www.pinetek-networks.com
info@pinetek-networks.com

Device information

The device information provided on the label on the back of the device.

The following information is provided:

- CE marking: The device is compliant with applicable EU regulations. Details can be found in the Statement of conformance
- WEEE Symbol: The device complies with the WEEE directive. Details see in the section below.
- Product code: "PT-1010 Pinebox"
- HW: The Hardware version. This information is also available in the device web interface
- The Serial number of the device
- The fallback IP-Address of the device
- The MAC address of the device. This information is also available in the device web interface.

Data privacy

The device does not collect, store, or transmit data unless the user programs the device accordingly.

RoHS and REACH Compliance

All Pinetek Networks products are RoHS and REACH compliant. The statements are available here: www.pinetek-networks.com/quality/

Disposal

The Pinebox device complies with the European Directive 2012/19/EU on Waste Electrical and Electronic Equipment (WEEE). This product is marked with the crossed-out wheelie bin symbol, indicating that it should not be disposed of with household waste.

Pinetek Networks will take back devices that are used in a B2B environment. For devices, that are used in B2C environments, the local disposal through local services, or they can be returned to Pinetek

Networks. If you wish to return used devices, please send them back free of charge to Pinetek Networks.

The WEEE registration number of Pinetek Networks is DE241793280.

Proper disposal and recycling help prevent potential negative consequences for the environment and human health and support the reuse of valuable resources. For further details on disposal, please contact Pinetek Networks or your local waste management authority.