

## TECH NOTE :: DSE\_Filler\_S7-PLC(TIA-Portal)

Version: 2022-06-06

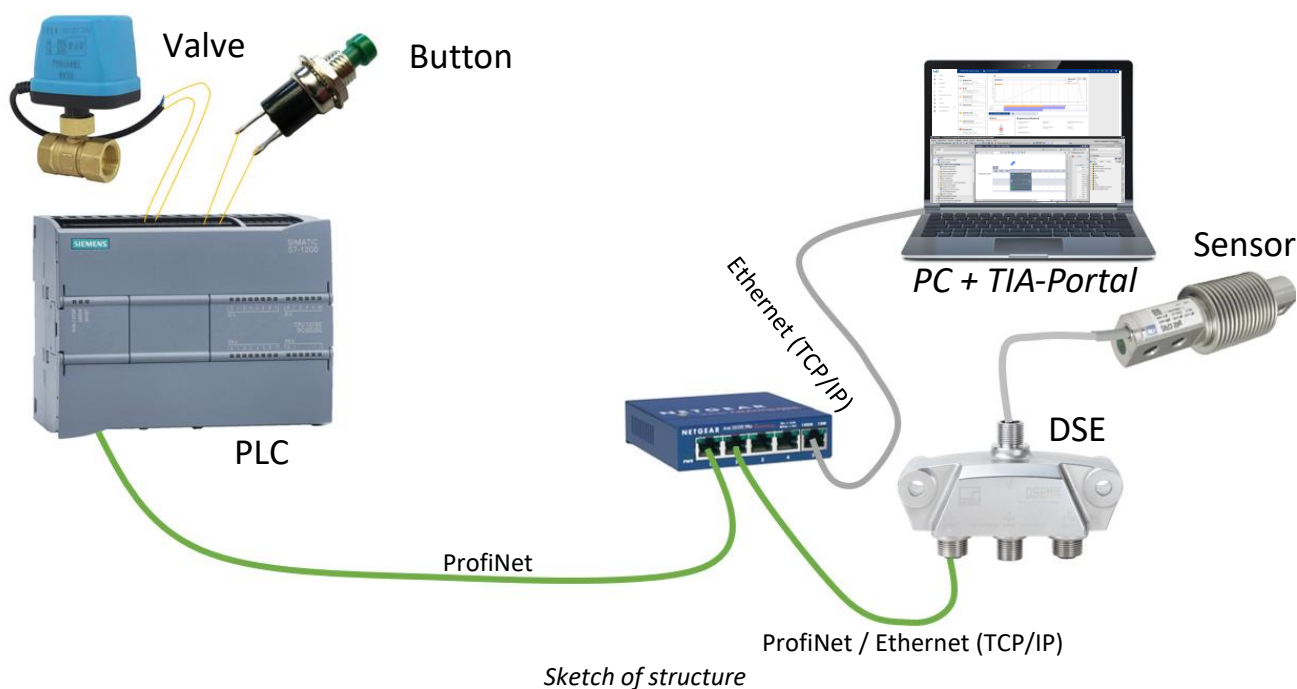
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Status: HBM: Public

### Brief description

This is a quick start guide to operating the filler function of a DSE. This function is used to optimise and monitor processes. By means of a user-friendly interface, complicated control technology becomes operable for everyone. For a first start-up, all that is needed is a computer, sensor and a DSE. This can be extended by a PLC, which takes over the values set in the DSE for fast and accurate control. In this example, an S7-1200 is used with PROFINET interface. The functionality of the filler is available in the DSE from FW V2.0.

### Hardware configuration

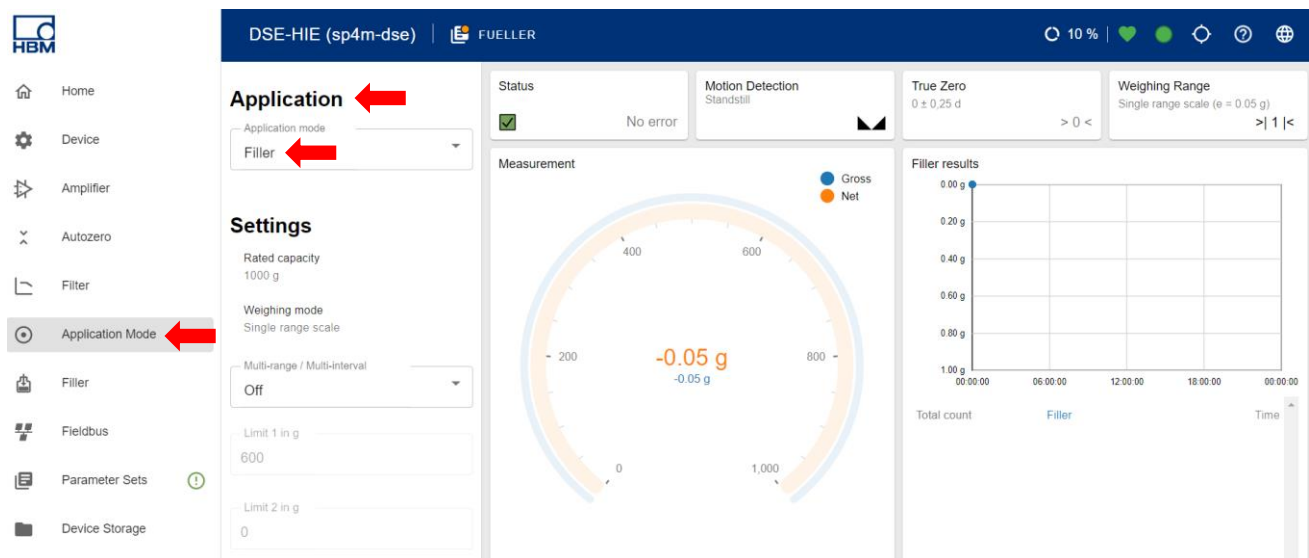


### Components required

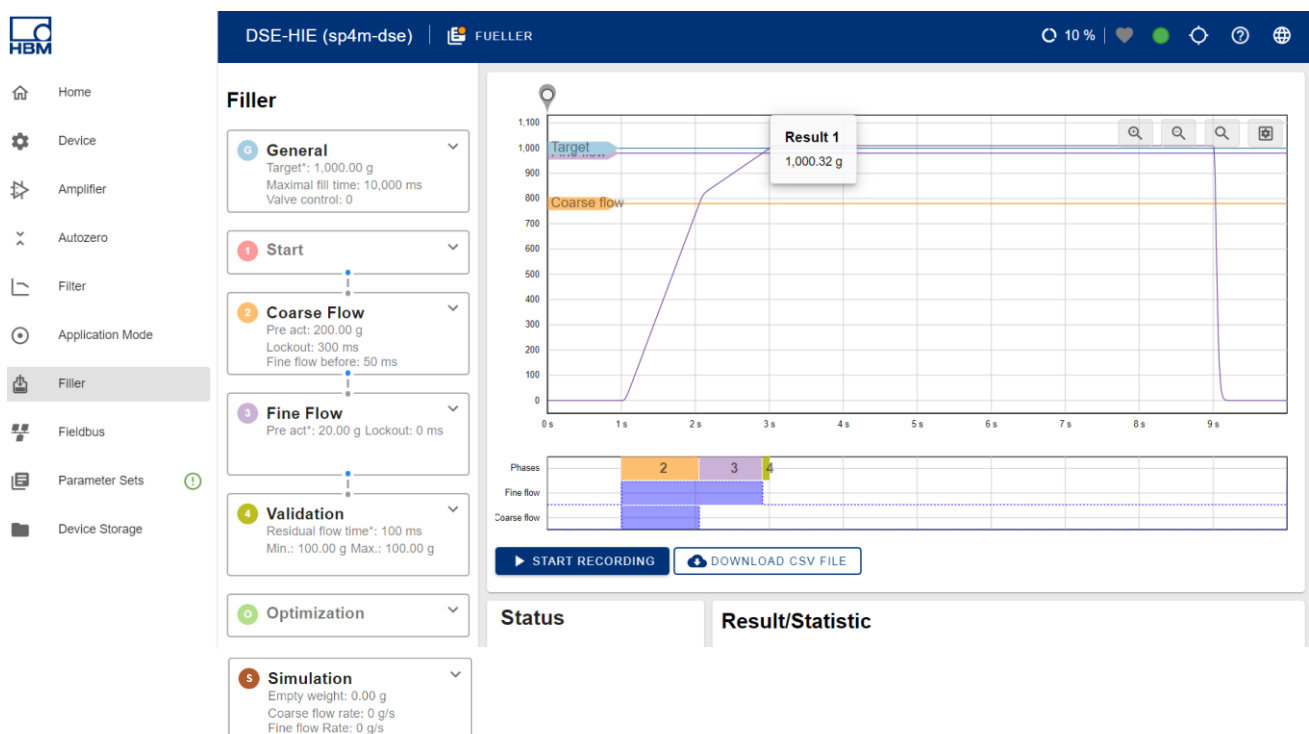
- 1 x DSE system (incl. power supply unit and Ethernet cable)
  - 1 x Ethernet switch
  - 1 x load cell
  - 1 x TIA portal
  - 1 x PLC, S7-1200
- Optional:
- 3 x push-buttons
  - 2 x valves
  -

## Level control web interface

With the help of the DSE, different parameters of a level can be recorded and processed.

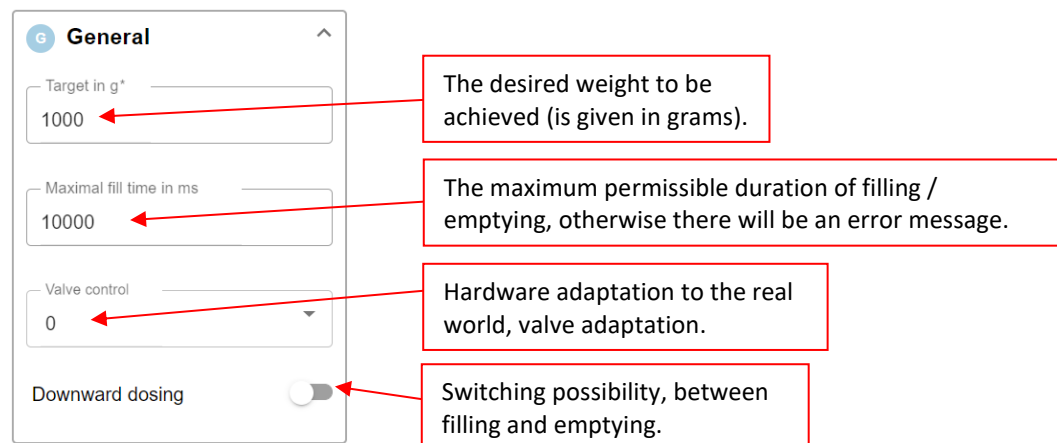


Now switch to the pen. This has various adjustment options in order to capture the different applications of a filling system as well as possible. Many settings are optional, but 3 parameters must be given to the DSE for it to work. Namely **(G) target weight, (3) reserve, (4) post-flow time**. These and all other settings are discussed in the following chapters. The purple curve is a simulation and is intended to facilitate the determination of the correct parameters by visualising the possible result.



For all settings, 0 = function inactive.

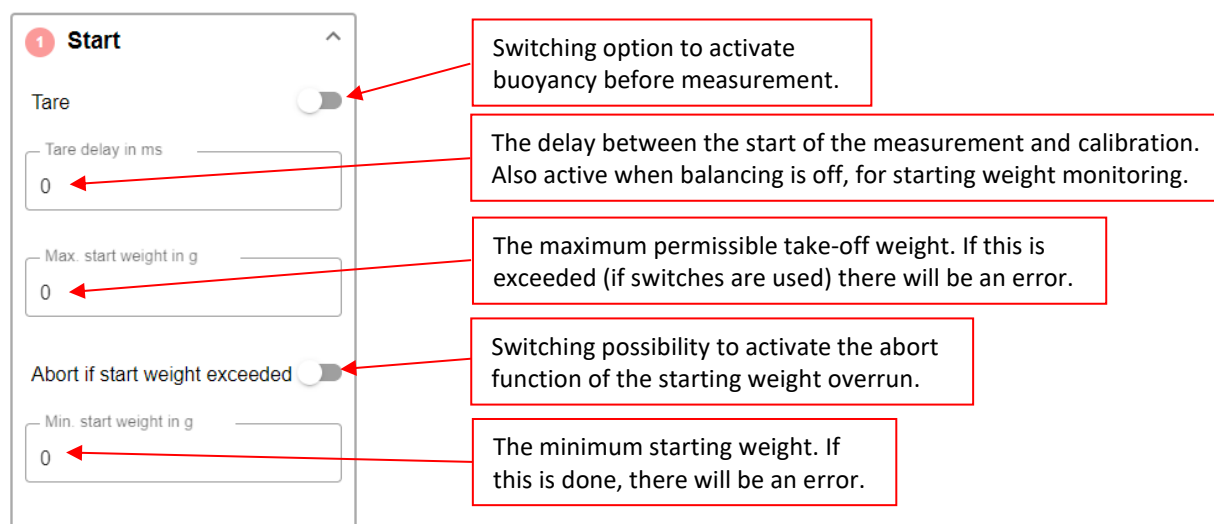
## G General



**G General**

- Target in g\***: 1000. The desired weight to be achieved (is given in grams).
- Maximal fill time in ms**: 10000. The maximum permissible duration of filling / emptying, otherwise there will be an error message.
- Valve control**: 0. Hardware adaptation to the real world, valve adaptation.
- Downward dosing**: ☐. Switching possibility, between filling and emptying.

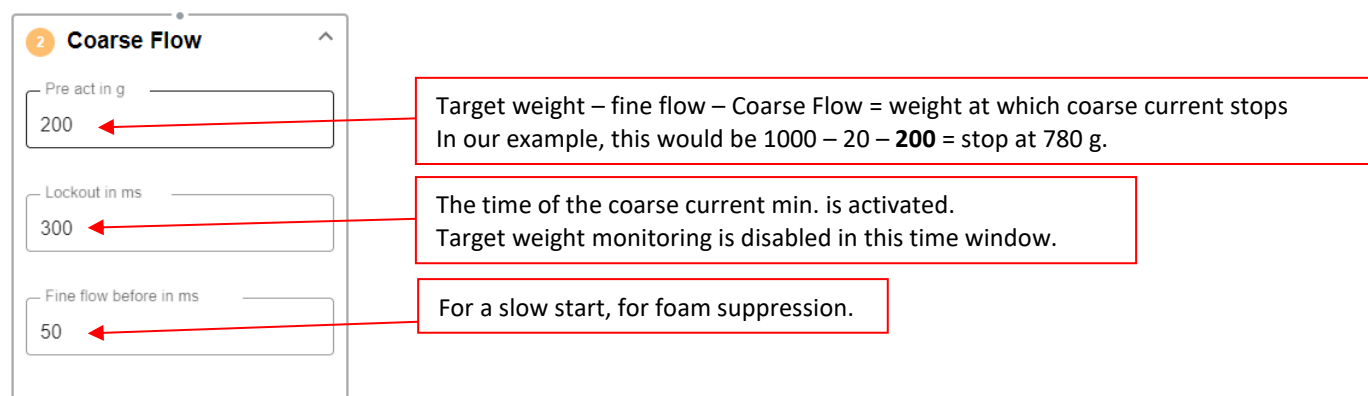
## 1 Start



**1 Start**

- Tare**: ☐. Switching option to activate buoyancy before measurement.
- Tare delay in ms**: 0. The delay between the start of the measurement and calibration. Also active when balancing is off, for starting weight monitoring.
- Max. start weight in g**: 0. The maximum permissible take-off weight. If this is exceeded (if switches are used) there will be an error.
- Abort if start weight exceeded**: ☐. Switching possibility to activate the abort function of the starting weight overrun.
- Min. start weight in g**: 0. The minimum starting weight. If this is done, there will be an error.

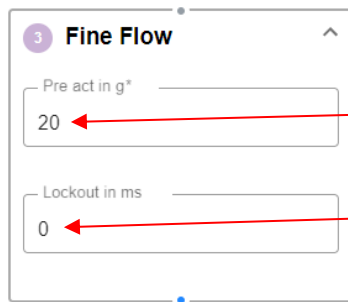
## 2 Coarse Flow



**2 Coarse Flow**

- Pre act in g**: 200. Target weight – fine flow – Coarse Flow = weight at which coarse current stops. In our example, this would be 1000 – 20 – **200** = stop at 780 g.
- Lockout in ms**: 300. The time of the coarse current min. is activated. Target weight monitoring is disabled in this time window.
- Fine flow before in ms**: 50. For a slow start, for foam suppression.

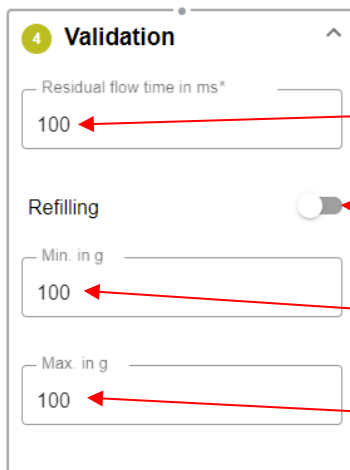
### 3 Fine Flow



Target weight – reserve = weight at which the fine current stops.  
In our example, this would be:  $1000 - 20 = \text{Stop at } 980 \text{ g}$ .

The time of the fine current min. is activated. Target weight monitoring is disabled in this time.

### 4 Validation



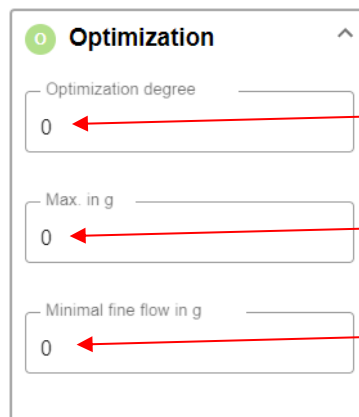
The time that the residual flow still needs before the measured value comes to a standstill.

Activate refilling to limit residual fluid.

Min. Residual flow. Meaning:  $1000 - 100 = 900$   
If this value is lower there is an error.

Min. Residual flow. Meaning:  $1000 + 100 = 1100$   
If this value is exceeded there is an error.

### 0 Optimization



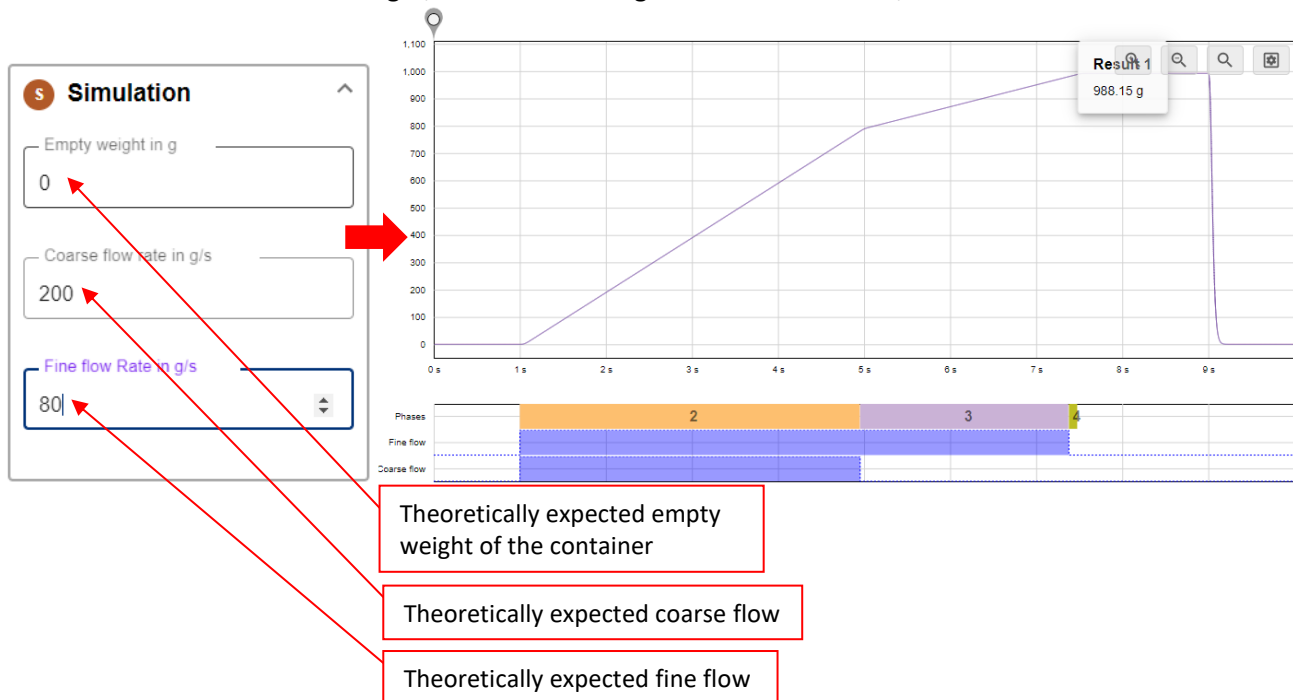
Adjustment possibility for tracking, in 3 speed levels.

Maximum change of the cut-off points by the correction.

The divergence between coarse current and fine current.

## Simulation

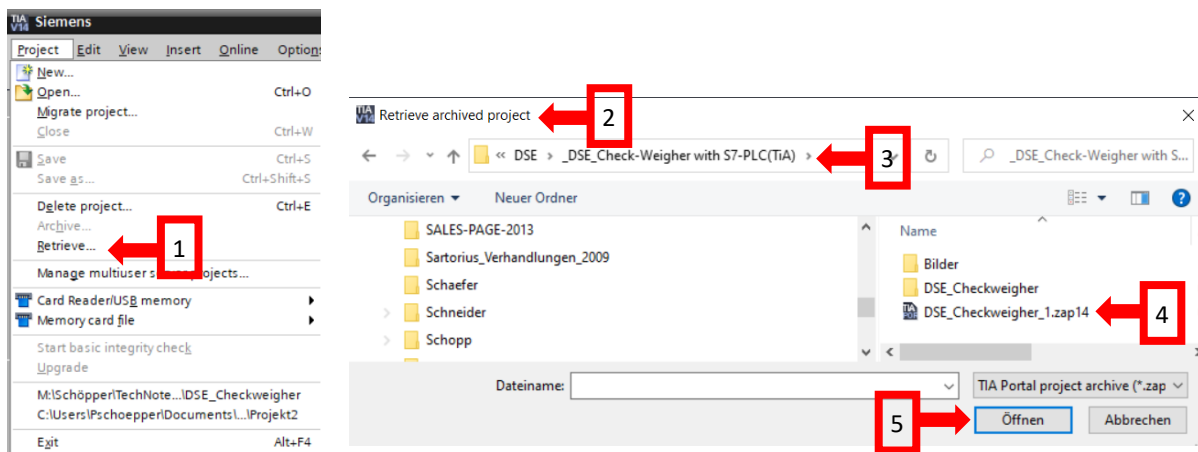
The Simulation setting is used for the theoretical testing of the previously entered parameters. These are checked to see if the desired target, in our case 1000g and 10 sec. duration, can be reached.



## Import project (necessary once)

The project contains all necessary libraries, including the device description file (GSDML V2.0) of the DSE and only needs to be imported once. This can be updated as follows, if necessary.

Open the TIA portal on your computer.



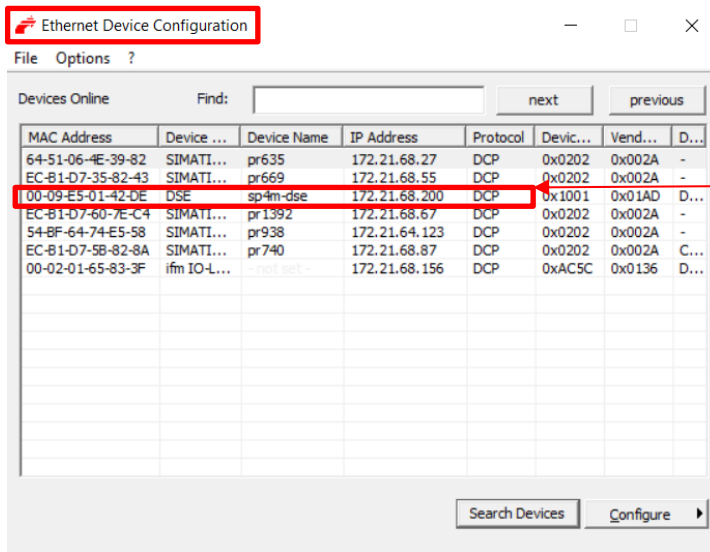
After clicking Open, the project with all libraries and devices is imported into the TIA Portal.

## Level control Codesys

How to prepare Codesys to capture the values of the DSE is explained in the TechNote "TECH-NOTE\_DSE\_Checkweigher\_with\_PLC (R-PI) \_en". All essential steps are explained there.

## Network configurations

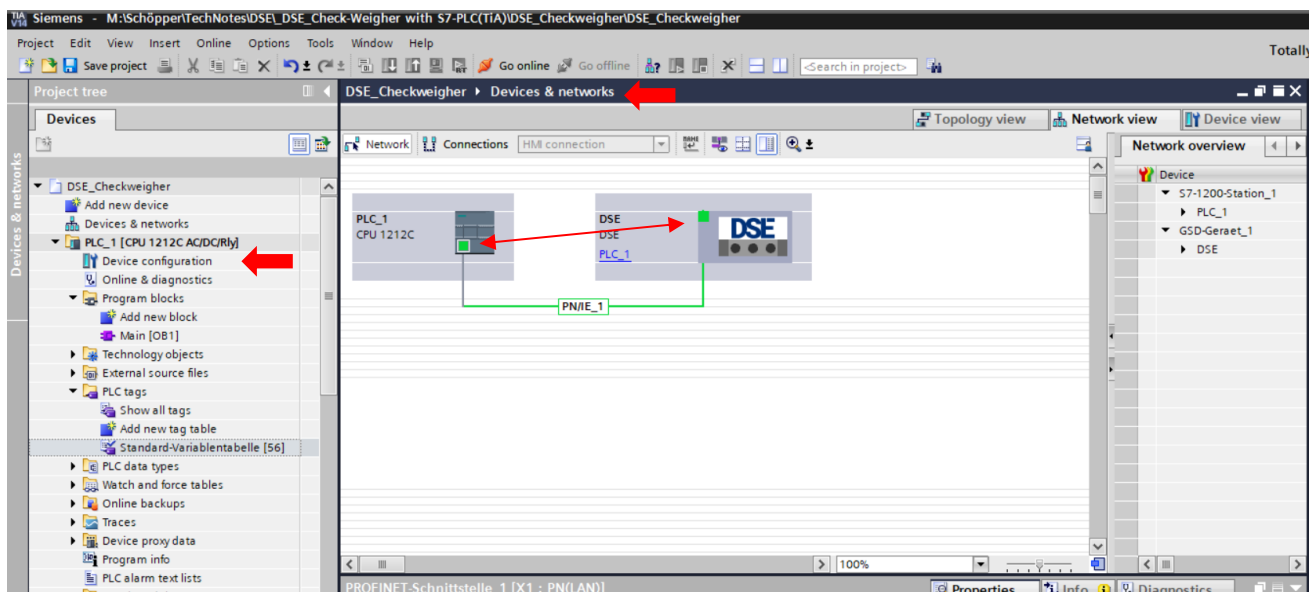
**Note:** The IP address as well as the device name of the DSE can be configured using "Ethernet Device Setup".



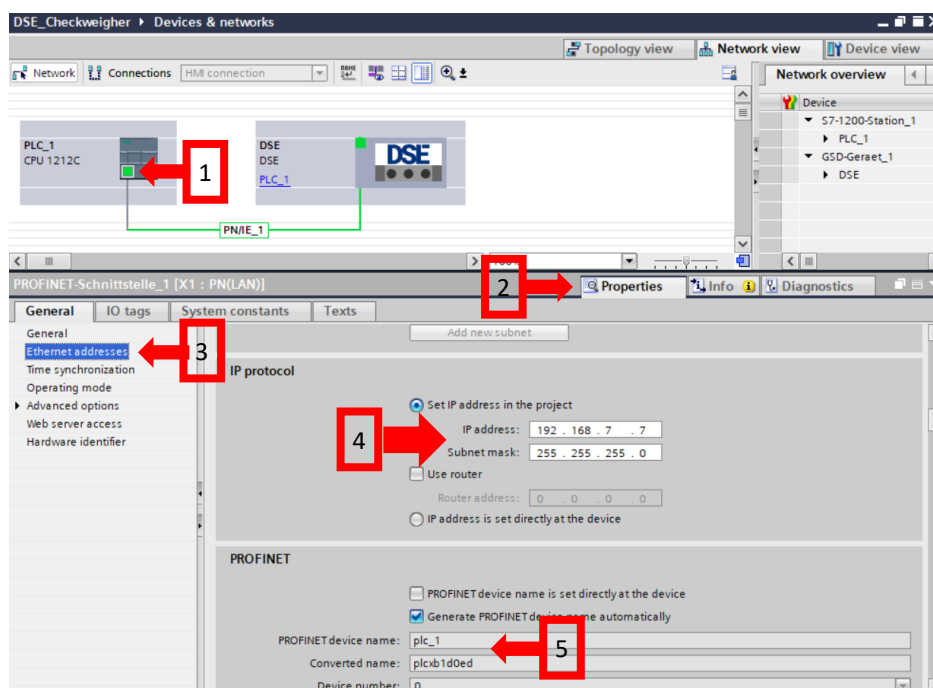
Right click -> Set IP/Device Name to configure.

**Note:** The IP must match the IP address of the R-Pis, i.e. the first 3 blocks must be the same, the last different.

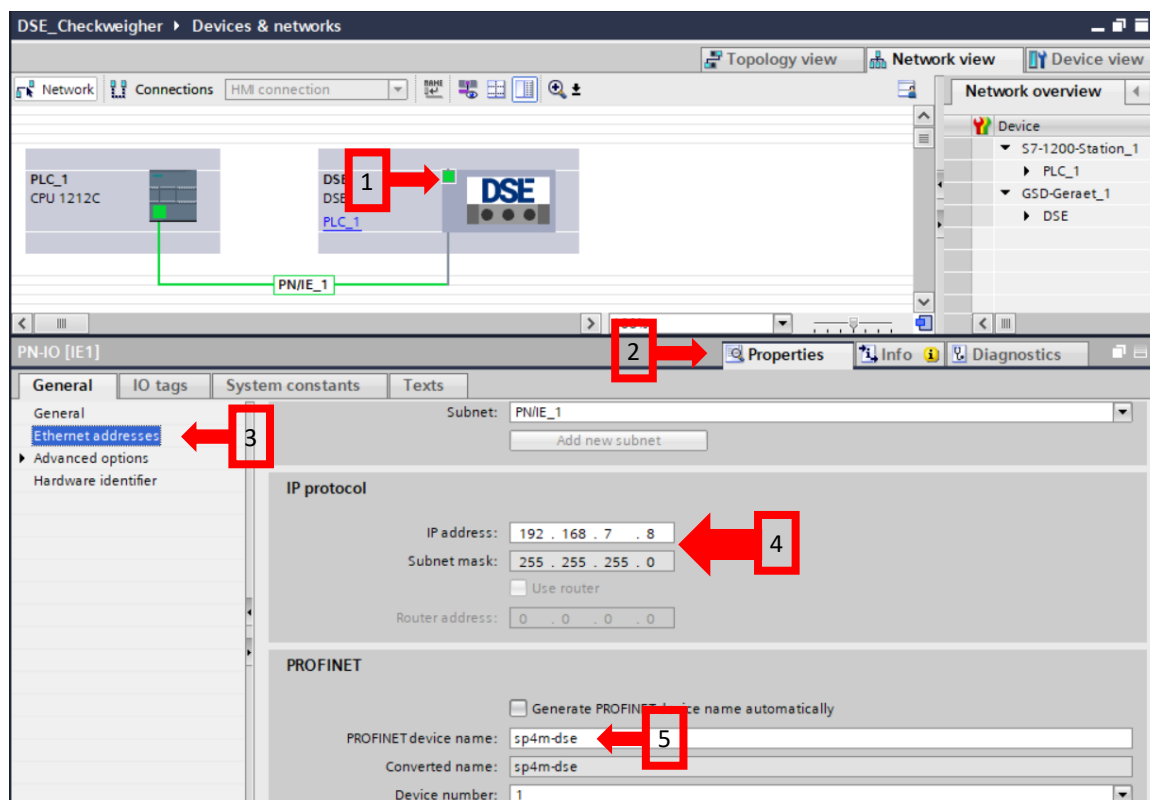
Due to the prefabricated project, the DSE is already inserted and the connection is already established. Now only the IP addresses, network masks and device names have to be adapted to the local network.



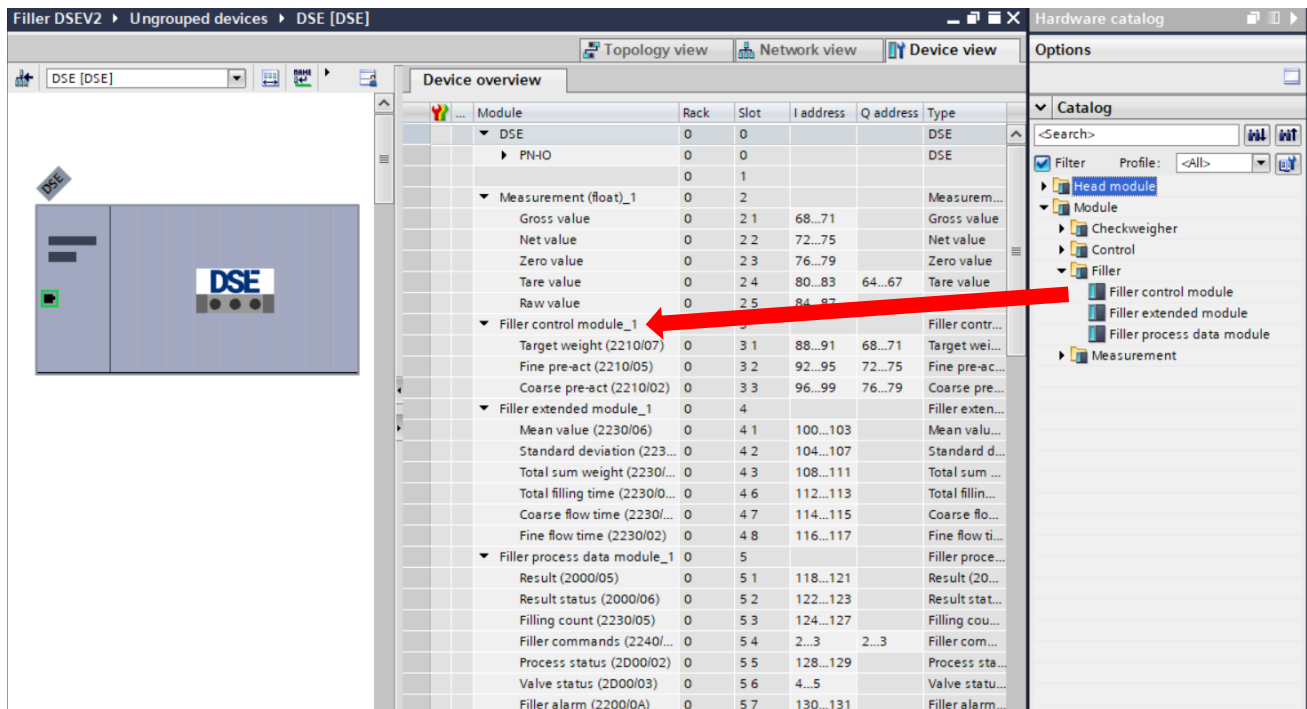
- Select the green input of the PLC
- Select the item "Ethernet addresses" in the "Properties" tab.
- Enter the IP address of the control unit



- Now select the green input of the DSE
- Select the item "Ethernet addresses" in the "Properties" tab.
- Enter the IP address of the DSE and (if different) the station name of the DSE.



- Switch to the device view of the DSE (double-click on the device or switch in the tab at the top)
- The filler modules are already added in the device view.



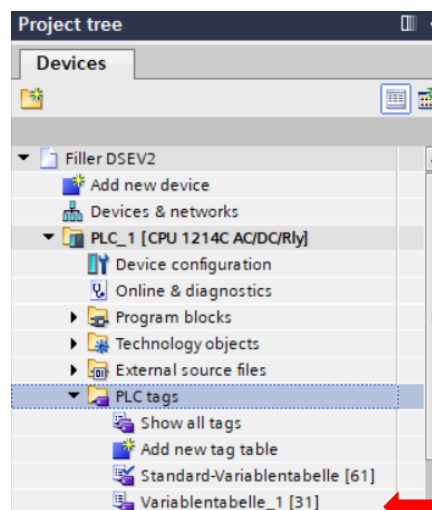
The addresses of the measured values can be taken directly from the list.

## Example valve control

The Codesys control system takes over the parameters entered in the DSE and uses them to control the filling process. Due to the intelligent software of the DSE, only a few steps have to be programmed independently. The variables given here are specifically adapted to our experimental set-up and therefore cannot be copied one-to-one to other systems.

First, variables must be created:

- Unter „PLC-Variablen“ sind in der „Variablentabelle\_1“ alle notwendigen Variablen hinterlegt.

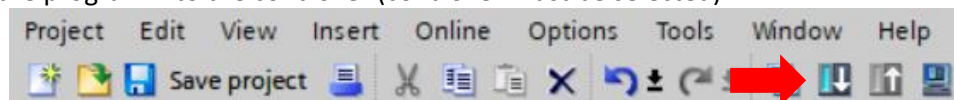




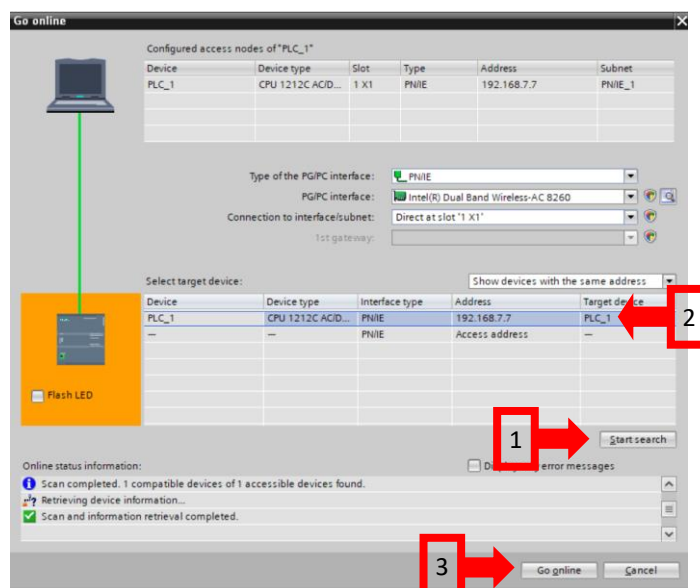
- Add both values as a variable with the specified addresses (start address is specified and the length is determined by the data type).

	Name	Data type	Address	Retain	Acces...	Writa...	Visibl...
1	Start	Bool	%I0.0	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
2	stop	Bool	%I0.1	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
3	Manuel(1)	Bool	%I0.2	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
4	Automatik(1)	Bool	%I0.3	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
5	Leeren(1)	Bool	%I0.5	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
6	Reserve(2)	Bool	%I0.6	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
7	Reserve(3)	Bool	%I0.7	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
8	Pumpe groß	Bool	%Q0.0	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
9	Pumpe klein	Bool	%Q0.1	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
10	P1 Ready	Bool	%Q0.2	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
11	P2 Alarm	Bool	%Q0.3	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
12	Behälter voll	Bool	%M0.0	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
13	MLeeren	Bool	%M0.1	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
14	Füllen	Bool	%M0.2	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
15	Ready LED	Bool	%M0.3	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
16	Alarm LED	Bool	%M0.4	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
17	Initialschritt	Bool	%M0.5	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
18	Gross value	Real	%ID68	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
19	Tare value	Real	%ID80	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
20	Grundstellung	Bool	%M6.0	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
21	M80.1	Bool	%M80.1	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
22	Leeren	Bool	%M0.6	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
23	MFüllen	Bool	%M0.7	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
24	Defekt	Bool	%I0.4	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
25	DSE Filling process	Int	%IW128	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
26	DSE Valve course	Bool	%I5.0	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
27	DSE Valve fine	Bool	%I5.1	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
28	DSE Filler alarm	Word	%IW130	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
29	DSE Start filling	Bool	%Q3.0	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
30	DSE Stop filling	Bool	%Q3.1	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
31	DSE Clear stats	Bool	%Q3.2	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

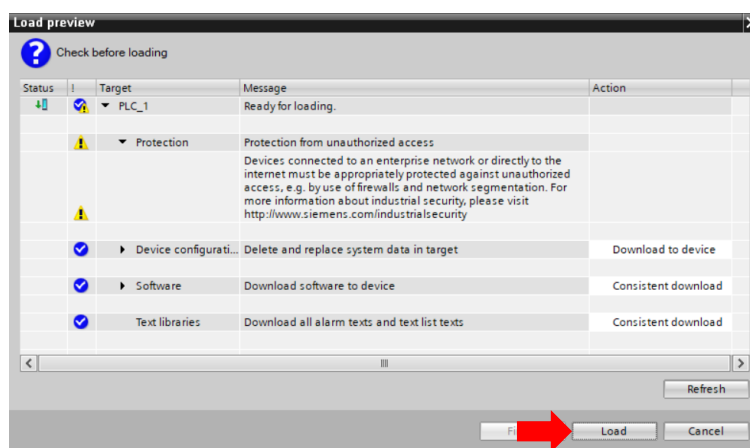
- Load the program into the controller (controller must be selected)



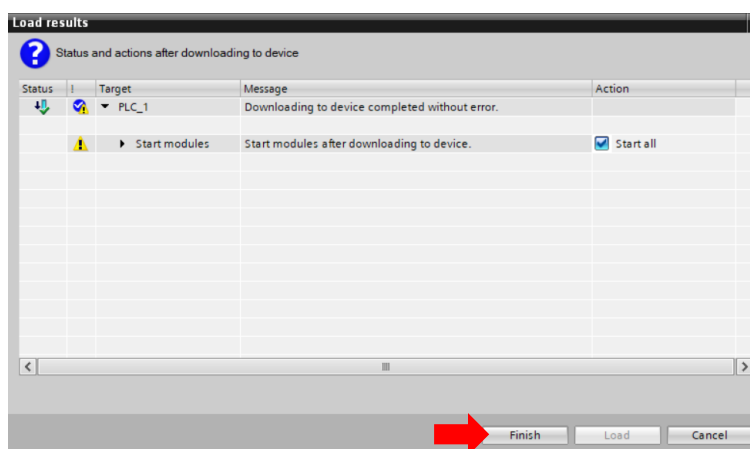
- Search for the control in the dialog



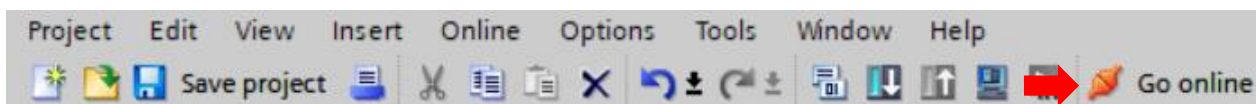
- Select "Load"



- Select "Start assembly"
- Confirm with "Finish"



- Connecting to the control unit online



- Display live values

Filler DSEV2 ▶ PLC\_1 [CPU 1214C AC/DC/Rly] ▶ PLC tags ▶ Variablen-tabelle\_1 [31]

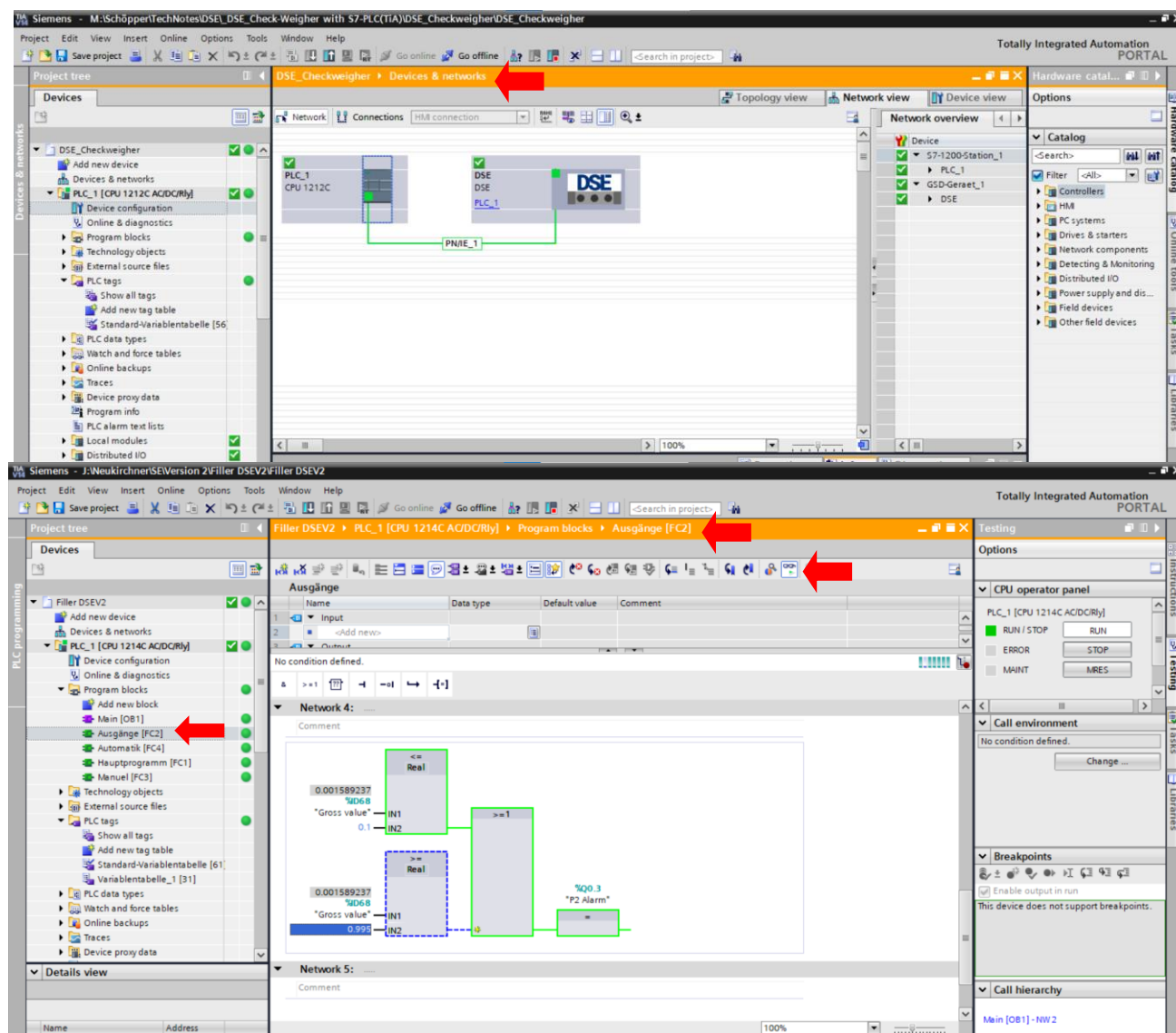
Tags

Variablen-tabelle\_1

	Name	Data type	Address	Retain	Acces...	Writa...	Visibl...	Monitor value
1	Start	Bool	%I0.0	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	FALSE
2	stop	Bool	%I0.1	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	FALSE
3	Manuel(1)	Bool	%I0.2	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	FALSE
4	Automatik(1)	Bool	%I0.3	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	FALSE
5	Leeren(1)	Bool	%I0.5	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	FALSE
6	Reserve(2)	Bool	%I0.6	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	FALSE
7	Reserve(3)	Bool	%I0.7	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	FALSE
8	Pumpe groß	Bool	%Q0.0	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	FALSE
9	Pumpe klein	Bool	%Q0.1	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	FALSE
10	P1 Ready	Bool	%Q0.2	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	FALSE
11	P2 Alarm	Bool	%Q0.3	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	FALSE
12	Behälter voll	Bool	%M0.0	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	FALSE
13	MLeeren	Bool	%M0.1	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	FALSE
14	Füllen	Bool	%M0.2	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	FALSE
15	Ready LED	Bool	%M0.3	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	FALSE
16	Alarm LED	Bool	%M0.4	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	FALSE
17	Initialschritt	Bool	%M0.5	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	FALSE
18	Gross value	Real	%ID68	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	0.6662464
19	Tare value	Real	%ID80	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	0.0
20	Grundstellung	Bool	%M6.0	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	FALSE
21	M80.1	Bool	%M80.1	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	FALSE
22	Leeren	Bool	%M0.6	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	FALSE
23	MFüllen	Bool	%M0.7	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	FALSE
24	Defekt	Bool	%I0.4	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	FALSE
25	DSE Filling process	Int	%IW128	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	0
26	DSE Valve course	Bool	%I5.0	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	FALSE
27	DSE Valve fine	Bool	%I5.1	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	FALSE
28	DSE Filler alarm	Word	%IW130	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	16#0000
29	DSE Start filling	Bool	%Q3.0	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	FALSE
30	DSE Stop filling	Bool	%Q3.1	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	FALSE
31	DSE Clear stats	Bool	%Q3.2	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	FALSE

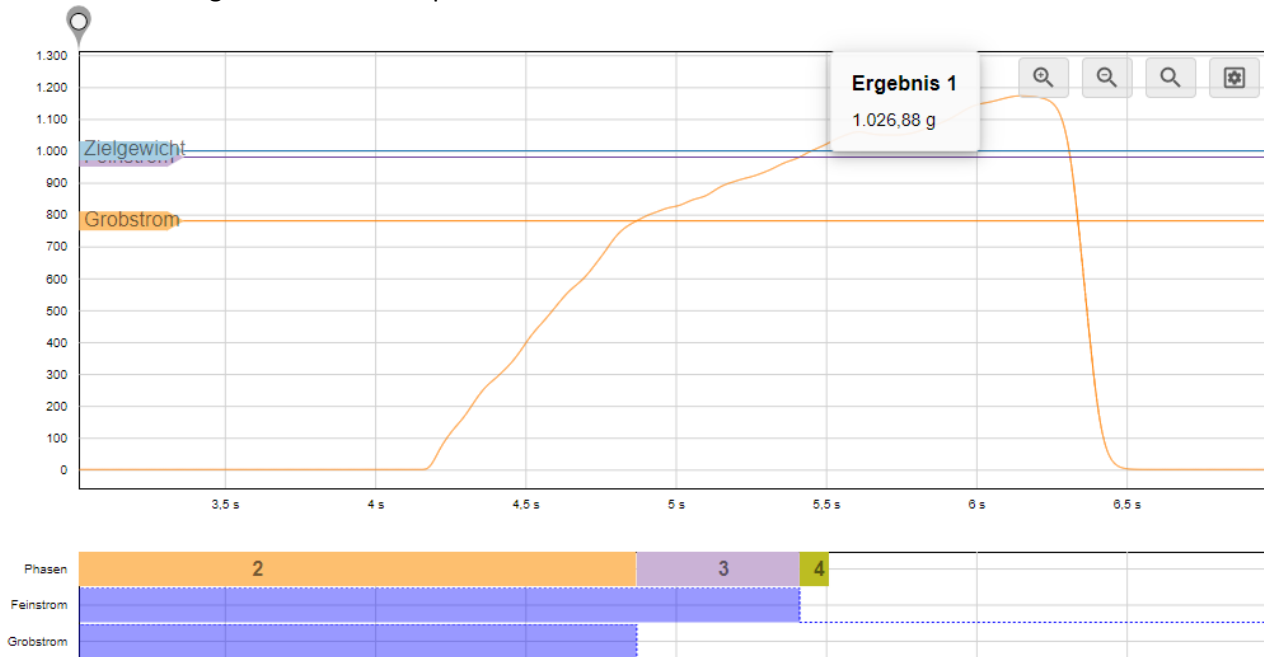
- In the following picture you can see the user interface after a successful connection and a simple programme that transfers data.

You can see that the programme works when there are green circles next to the inserted devices. See picture:



# Result

This orange trace is a real measurement. Now you can see if everything is set correctly. In this example, the coarse flow is set well, but the fine flow is still filling beyond the desired 1000g. Result 1 records the weight after the remaining flow time has elapsed.



## Status

[CSV-DATEI HERUNTERLADEN](#)



Ready

Leerlauf

## Ergebnisse/Statistik

Füller-Ergebnis 1.035,28 g	Mittelwert 632,05 g	Standardabweichung 351,49 g
Feinstromzeit 284 ms	Grobstromzeit 2.644 ms	Füllzeit 3.029 ms
Gesamtanzahl 12		

## Example Optimization

In this concrete example, a filler model was used that only executes Fine Flow. Nevertheless, it is recommended to enter a small value for Course Flow. Otherwise, Course Flow can lead to negative values and thus to strong deviations. **Target weight for this model is 0.20kg.**

The settings before the first run:

### Filler

6

General

Target\*: 0.20 kg

Maximal fill time: 0 ms

Valve control: 0

1

Start

2

Coarse Flow

Pre act: 0.01 kg Lockout: 0 ms

Fine Flow Time Startup: 0 ms

3

Fine Flow

Pre act\*: 0.02 kg Lockout: 0 ms

4

Validation

Residual Flow Time\*: 1,000 ms

Min.: 0.00 kg Max.: 0.00 kg

0

Optimization

Optimization Grade: 1

Max.: 0.25 kg

Minimal fine flow: 0.00 kg

Result first run:

Result/Statistic

Filler result

0.18 kg

Standard deviation

0.00 kg

Coarse time

0 ms

Total count

1

Mean value

0.18 kg

Fine time

9,743 ms

Total time

10,744 ms

The settings after the first optimisation:

### Filler

6

General

Target\*: 0.20 kg

Maximal fill time: 0 ms

Valve control: 0

1

Start

2

Coarse Flow

Pre act: 0.02 kg Lockout: 0 ms

Fine Flow Time Startup: 0 ms

3

Fine Flow

Pre act\*: 0.00 kg Lockout: 0 ms

4

Validation

Residual Flow Time\*: 1,000 ms

Min.: 0.00 kg Max.: 0.00 kg

0

Optimization

Optimization Grade: 1

Max.: 0.25 kg

Minimal fine flow: 0.00 kg

3

Fine Flow

Pre act in kg\*

0,00296

Lockout in ms

0

Internally, the DSE calculates with this optimised value, as input it would be inadmissible.

Result second run:

Result/Statistic

Filler result

0.20 kg

Standard deviation

0.01 kg

Coarse time

0 ms

Total count

2

Mean value

0.19 kg

Fine time

9,587 ms

Total time

10,588 ms

The DSE optimises itself further with each subsequent run. This can also be seen in the results. For speed optimisation in this concrete example, the value for coarse and fine flow becomes smaller and smaller. After the second optimisation:

## Filler

**G General**  
 Target\*: 0.20 kg  
 Maximal fill time: 0 ms  
 Valve control: 0

**1 Start**

**2 Coarse Flow**  
 Pre act: 0.00 kg Lockout: 0 ms  
 Fine Flow Time Startup: 0 ms

**3 Fine Flow**  
 Pre act\*: 0.00 kg Lockout: 0 ms

**4 Validation**  
 Residual Flow Time\*: 1,000 ms  
 Min.: 0.00 kg Max.: 0.00 kg

**O Optimization**  
 Optimization Grade: 1  
 Max.: 0.25 kg  
 Minimal fine flow: 0.00 kg

**2 Coarse Flow**  
 Pre act in kg  
 0,00704  
 Lockout in ms  
 0  
 Fine Flow Time Startup in ms  
 0

**3 Fine Flow**  
 Pre act in kg\*  
 0,00138  
 Lockout in ms  
 0

Result third run:

**Result/Statistic**

Filler result 0.20 kg	Mean value 0.19 kg
Standard deviation 0.01 kg	Fine time 9,095 ms
Coarse time 0 ms	Total time 10,096 ms
Total count 3	

## Legal notice

This example is for illustrative purposes only. It is not subject to any warranties or liability claims.