Weighing technology

FAQs
SIWAREX WP241

How do I calibrate SIWAREX WP241 with SIWATOOL V7?

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How do I calibrate SIWAREX WP241 with SIWATOOL V7?

The SIWAREX WP241 belt scale integrator can be commissioned with the software SIWATOOL V7. The software is included in the configuration package 7MH4960-4AK01.

Introduction

SIWAREX WP241 is a versatile and very compact belt scale integrator. It can be used in stand-alone operation or seamless integrated into the SIEMENS S7-1200 automation system.

Purpose of this document

This quick guide illustrates how to perform a fast commissioning of a WP241 belt scale integrator with the service and commissioning tool “SIWATOOL V7”. For further detailed information about the integrator please refer to the device manual. The latest version can be found online:
http://support.automation.siemens.com/WW/view/de/90229063/0/en
All steps in the following document describe the commissioning by using metric weight units (kg, m, t). The module itself provides imperial weight units (lbs, ft, T, TL) as well.

Warranty notes

The contents of this programming manual shall not become part of or modify any prior or existing agreement, commitment or legal relationship. All obligations on the part of Siemens AG are contained in the respective sales contract, which also contains the complete and solely applicable warranty conditions. Any statements on the device versions described in the programming manual do not create new warranties or modify the existing warranty.

The content reflects the technical status at the time of printing. We reserve the right to make technical changes in the course of further development.

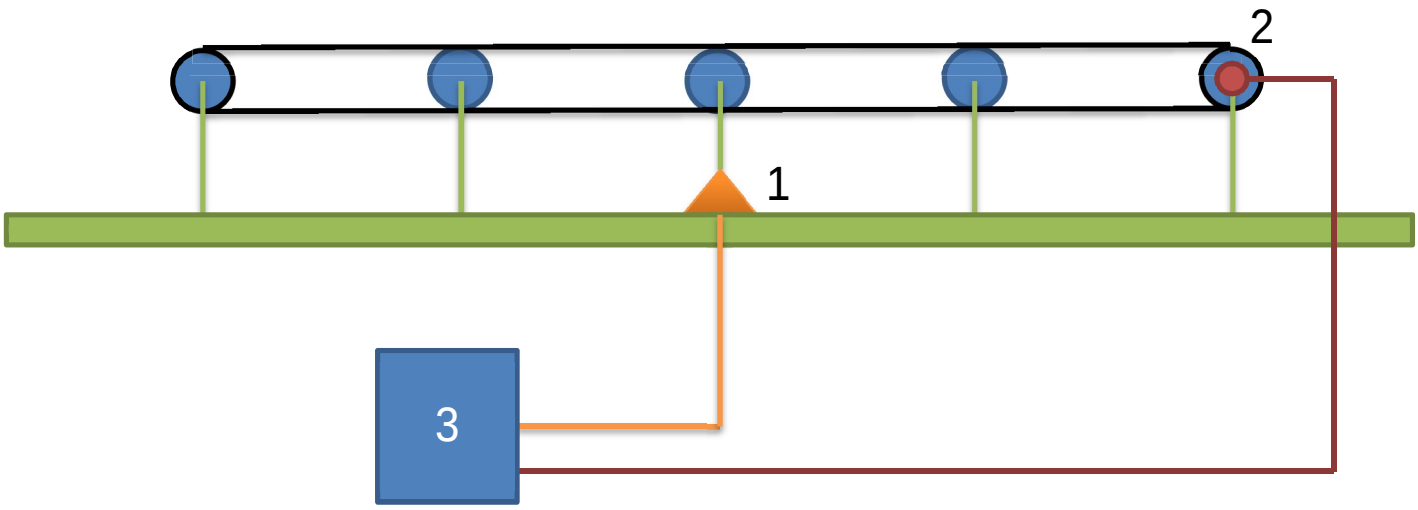
Validation of this document

This documentation is valid in conjunction with the SIWAREX WP241 manual only. The manual can be found online on: http://support.automation.siemens.com/WW/view/de/90229063/0/en

Contents

Required components of a standard belt scale system

A belt scale system typically consists of three components: a weigh bridge with load cells mounted below an idler [1], a shaft [2] or belt mounted speed sensor and a belt scale integrator [3].



The integrator collects the load cells signal and the speed sensor pulses. With this information the actual belt load and belt speed can be calculated and multiplied with each other in order to get the current material flow rate on the belt. This flow rate is internally integrated in order to totalize the quantity of material conveyed over the belt.

$$FLOW\ RATE\ \left[\frac{kg}{s}\right] = BELT\ LOAD\ \left[\frac{kg}{m}\right] x\ BELT\ SPEED\ \left[\frac{m}{s}\right]$$

The connected load cells are fed by a DC voltage from the integrator. The signal coming back from the load cells is a DC mV signal.

Most speed sensors provide a defined number of pulses per revolution.

SIEMENS offers a huge range of belt scales and speed sensors for all type of applications. For more information please check the WT10 weighing catalogue online on www.siemens.com/weighing

But also retrofitting of old systems by using the existing scale and speed sensor in combination with a SIWAREX WP241 is possible in most cases. Please get in touch with our support (see chapter “contact”) to check the compatibility.

Required components for using this commissioning guide

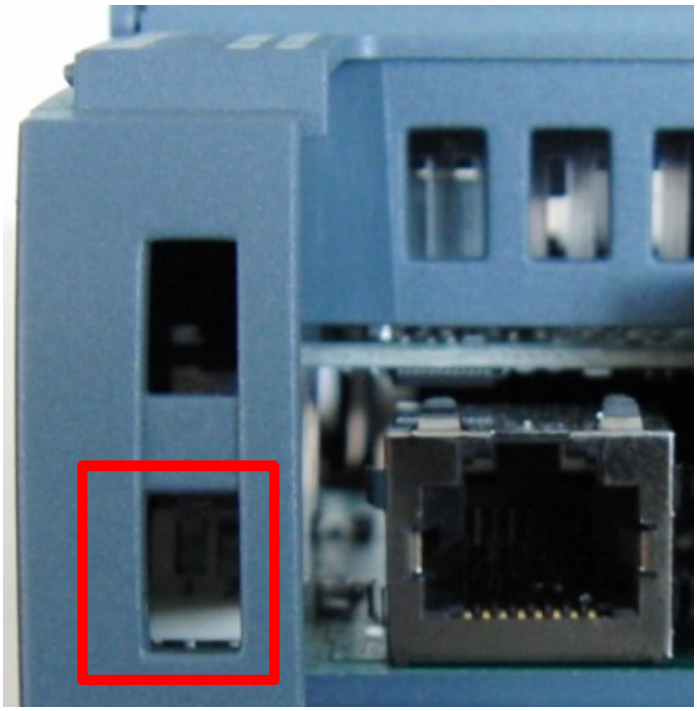
- SIWATOOL V7 → part of software package 7MH4960-4AK01
- SIWAREX WP241 belt scale integrator → 7MH4960-4AA01
- Belt scale connected properly to the WP241
- Speed sensor connected properly to the WP241 (optional)

For the right connection of the belt scale and the speed sensor please refer to the WP241 device manual to chapter 6. Please check the mechanical setup of your system intensively. A correct mechanical setup of the belt scale is a basic requirement for a high accuracy system. In the SIEMENS MSI belt scale manual a lot of information regarding mechanics of a belt scale can be found.

http://support.automation.siemens.com/WW/view/en/56772398

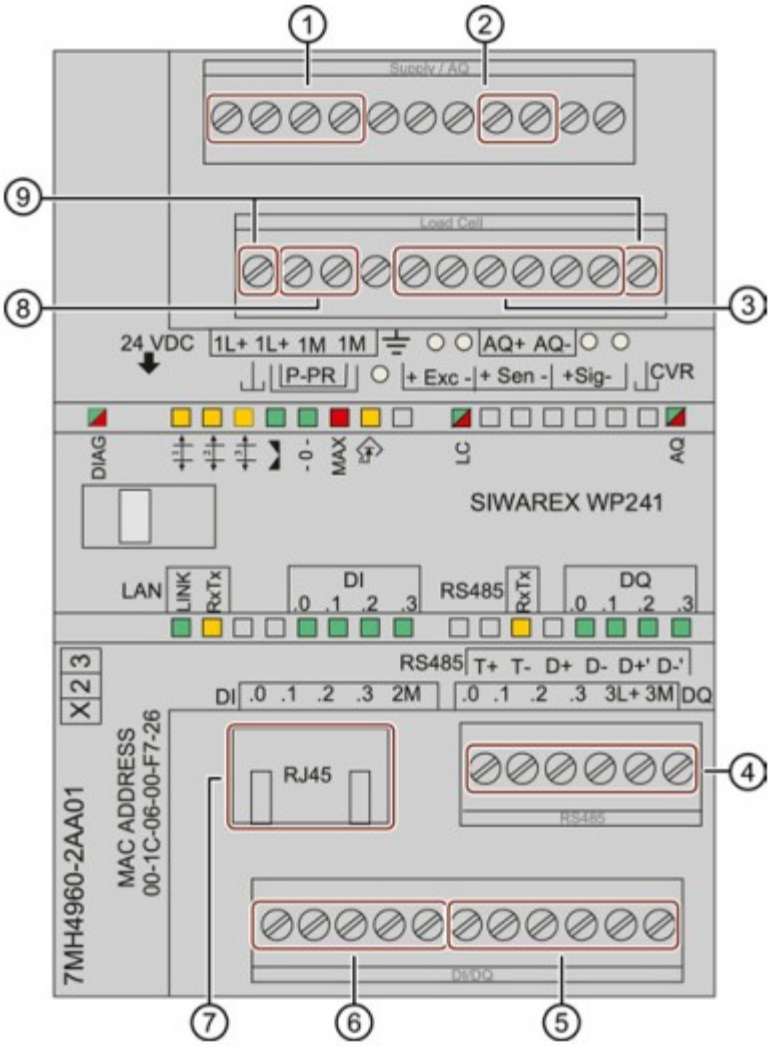
Setting up the WP241 for stand-alone operation

The SIWAREX WP241 can be seamless integrated into SIEMENS Simatic S7-1200 automation systems. Therefore the module is prepared for this integrated operation by factory default. In order to use the device without the use of a S7-1200 CPU (= stand-alone operation) a DIP switch needs to be set to the stand-alone position:



The DIP switches are located left beside the Ethernet port of the WP241. By using a small screw driver, the device can be set to stand-alone operation. As factory default the right DIP switch (DIP no. 2) is in upper position (= integrated S7-1200 mode). Set this switch to the lower position for stand-alone operation. After that the 24V can be connected to start up the WP241.

Connectivity



① 24V DC power supply

② Analog output

③ Load cell interface

④ RS485 interface

⑤ Digital inputs

⑥ Digital outputs

⑦ RJ45 Ethernet port

⑧ + ⑨ not used - prepared for future functions

For detailed wiring instructions please refer chapter 6 of the WP241 device manual.

SIWATOOL V7

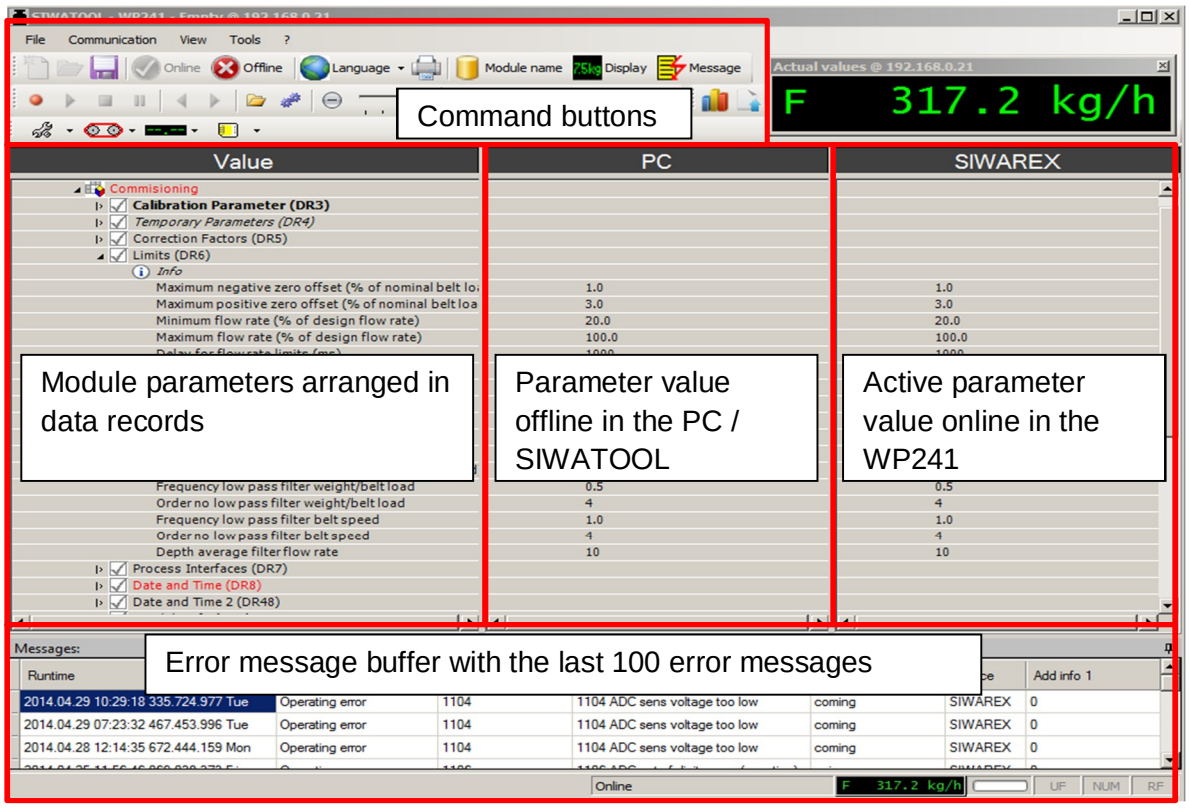
SIWATOOL V7 communicates via a standard Ethernet connection. Therefore a PC with an Ethernet port is required. A correct parameterization of the IP address of the PC and the WP241 is required to establish the communication. The default IP address of a SIWAREX WP241 module is 192.168.0.21.

Attention

The IP address of the PC needs to be in the same IP range and Subnet-Mask like the WP241 module. (e.g. WP241=192.168.0.21 (=factory default) → PC IP must be 192.168.0.XXX, but not 192.168.0.21).

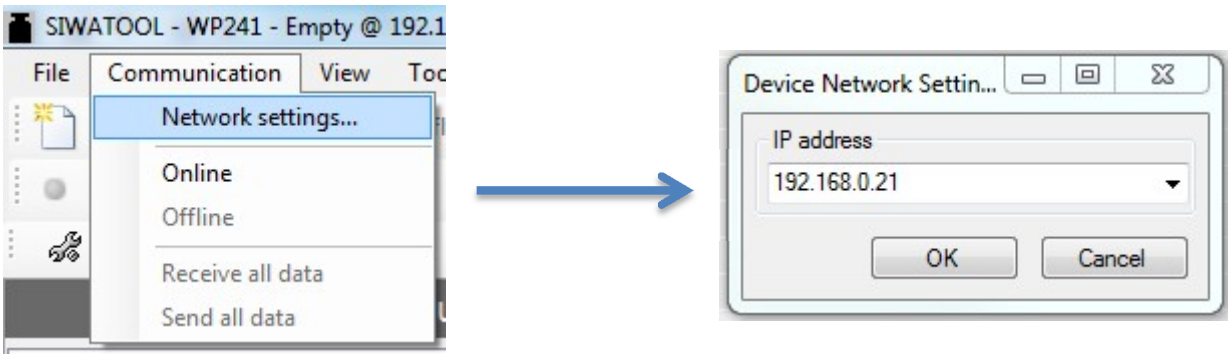
The IP address of the WP241 can then be changed with SIWATOOL V7 or with the "Primary setup tool" (PST). The PST tool can be downloaded online:
http://support.automation.siemens.com/WW/view/en/19440762

SIWATOOL V7 - overview



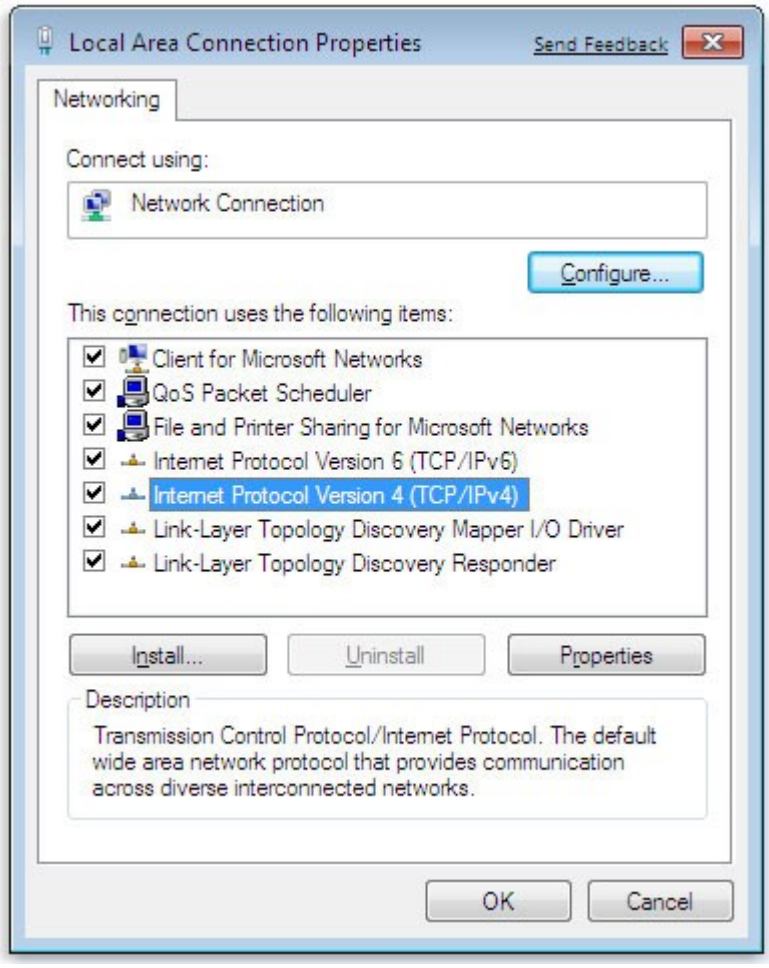
All parameters of a SIWAREX weighing module are grouped into packages called “data records” (DR). These data records can be read out of the module or written into the module only as a complete package. Even in case of editing only one single parameter inside a data record, the whole data record is written to the SIWAREX module!

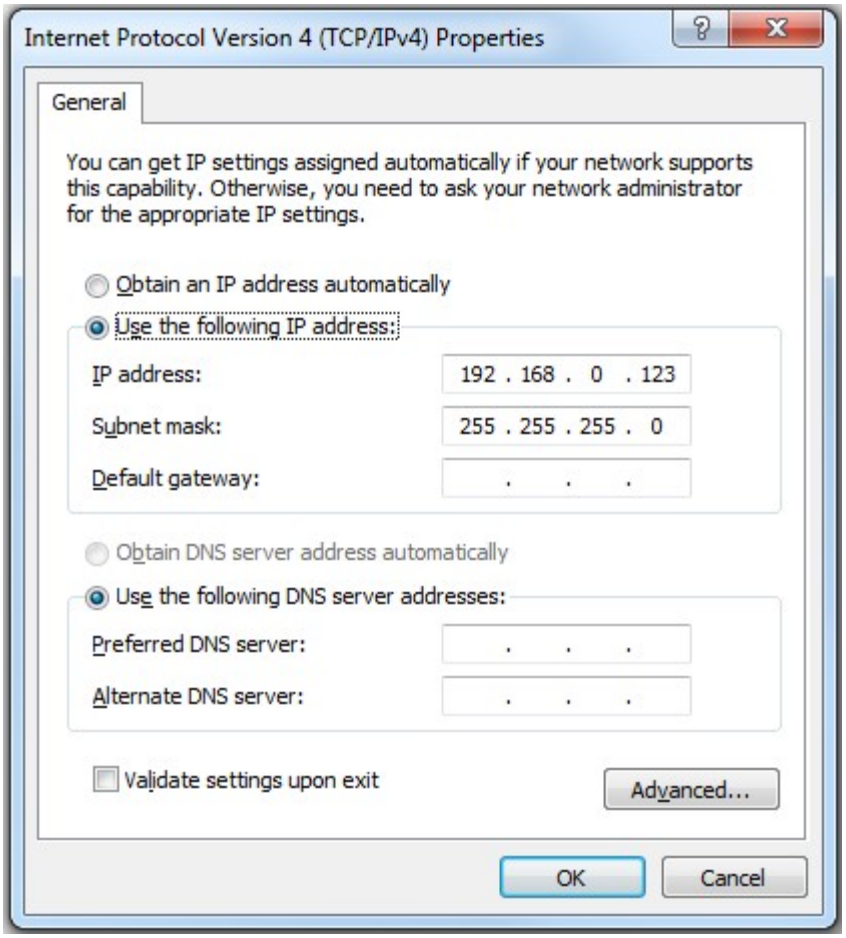
To go online with SIWATOOL, please check the IP address settings in SIWATOOL first:



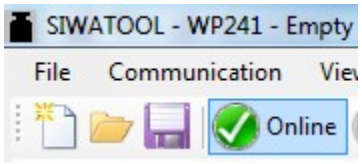
Factory default IP address of a SIWAREX WP241 is 192.168.0.21. The IP address of the PC Ethernet port needs to be in the same IP range like the WP241! As the WP module supports auto negotiation, a basic Ethernet patch cable can be used for a direct connect from PC to the WP module.

The IP address of the PC can be defined in the Windows control panel in the network settings of the used Ethernet connection:





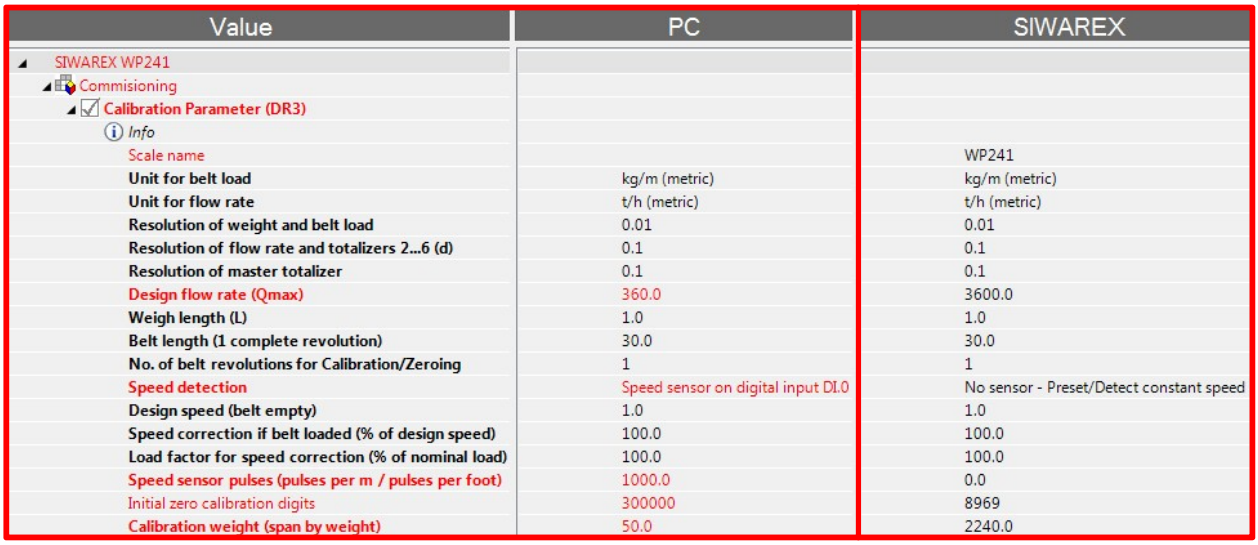
If these settings are correct, hit the “Online” button in SIWATOOL in order to establish the connection:



Once the connection was established, SIWATOOL V7 shows the connection status on the bottom on the right side (“Online” und a moving green bar):

SIWATOOL V7 - Online / offline data

SIWATOOL shows 3 different columns in the main view named “Value” / “PC” / “SIWAREX”. The “Value” column contains all parameters grouped into data records. The “PC” column shows the current parameter value offline in the PC / SIWATOOL file and the “SIWAREX” column shows the current active parameter value online in the WP241. Differences between offline / online values are marked in red:



Value	PC	SIWAREX
SIWAREX WP241		
Commisioning		
Calibration Parameter (DR3)		
Info		
Scale name		WP241
Unit for belt load	kg/m (metric)	kg/m (metric)
Unit for flow rate	t/h (metric)	t/h (metric)
Resolution of weight and belt load	0.01	0.01
Resolution of flow rate and totalizers 2...6 (d)	0.1	0.1
Resolution of master totalizer	0.1	0.1
Design flow rate (Qmax)	360.0	3600.0
Weigh length (L)	1.0	1.0
Belt length (1 complete revolution)	30.0	30.0
No. of belt revolutions for Calibration/Zeroing	1	1
Speed detection	Speed sensor on digital input DI.0	No sensor - Preset/Detect constant speed
Design speed (belt empty)	1.0	1.0
Speed correction if belt loaded (% of design speed)	100.0	100.0
Load factor for speed correction (% of nominal load)	100.0	100.0
Speed sensor pulses (pulses per m / pulses per foot)	1000.0	0.0
Initial zero calibration digits	300000	8969
Calibration weight (span by weight)	50.0	2240.0

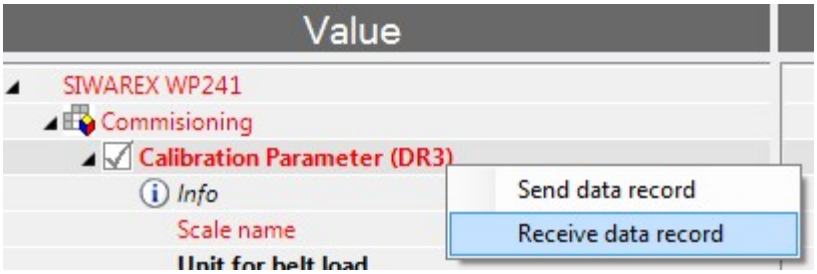
Parameter name and offline value

Online value

Differences between the offline / PC data and the active “SIWAREX” data are marked in red.

SIWATOOL V7 – Receiving data records from SIWAREX WP241 into SIWATOOL

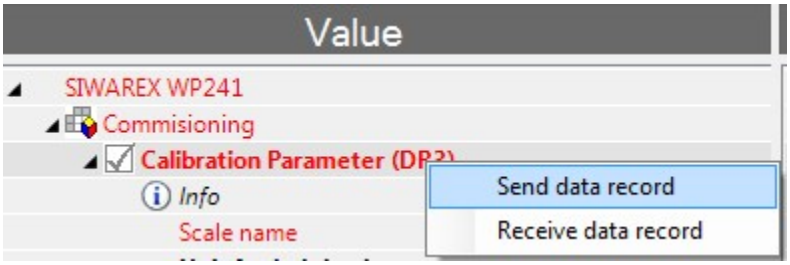
In order to read a data record from the WP241 into SIWATOOL V7 it's required to do a right click on the data records name in the "Value" column. A pop-up menu will appear with the options to send / receive the corresponding data record:



After that, all parameters of the corresponding data record are read into the "PC" column and therefore all parameters should be marked black afterwards, as there are no differences between online and offline data in the corresponding data record anymore.

SIWATOOL V7 – Sending data records from SIWATOOL V7 into SIWAREX WP241

In order to write a data record from SIWATOOL V7 into the SIWAREX WP241 module, it's required to do a right click on the data records name in the "Value" column. A pop-up menu will appear with the options to send / receive the corresponding data record:



After that, all parameters of the corresponding data record are written from the "PC" column into the WP241 (= into the "SIWAREX" column) and therefore all parameters should be marked black afterwards, as there are no differences between online and offline data in the corresponding data record anymore.

Commissioning

The commission of the belt scale system needs to be done step by step and requires up to seven different steps:

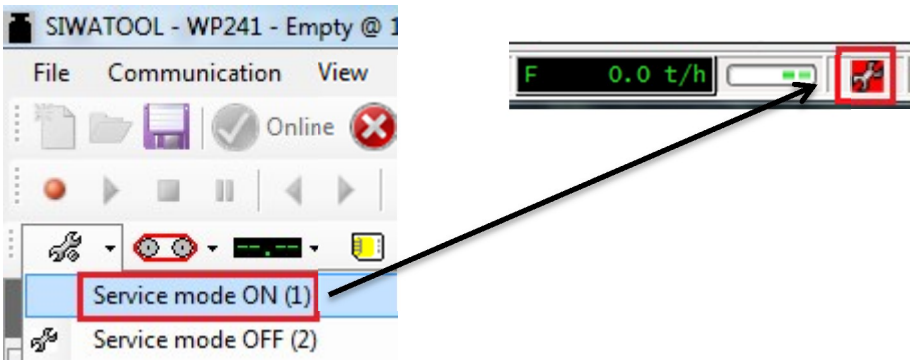
1. Step: Loading factory settings
2. Step: Definition of the basic system parameters in DR3
3. Step: Belt speed commissioning
4. Step: Initial zero calibration with an empty belt
5. Step: Span calibration by using a test weight / test chain
6. Step: Performing a material test for calculating a correction factor
7. Step: Defining limit values and I/O interfaces like analogue output, digital in- and outputs, etc.

1st step: Loading factory settings

The document is based on loaded factory settings in the WP241 module. Therefore please load factory settings first, before performing the following steps:
Loading factory settings requires activated “Service mode”.

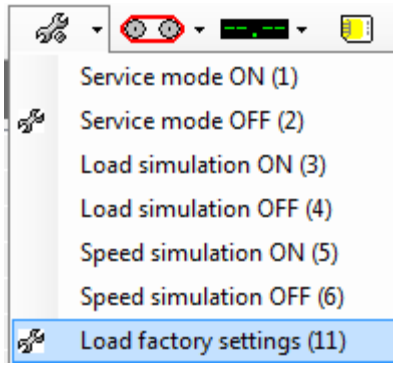
Attention

The service mode can be activated in the service command tab. All commands marked with a *symbol require active service mode. Editing the “Calibration parameters (DR3)” is possible in service mode only as well.*

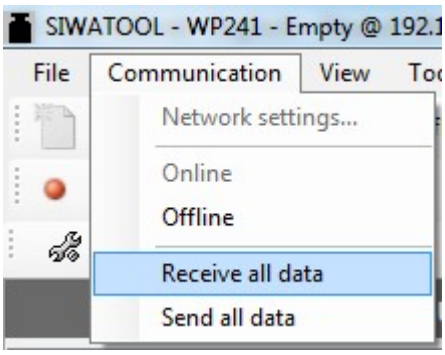


A red symbol on the right bottom side of SIWATOOL V7 indicates the “Service mode”.

After that the factory defaults can be loaded via “Load factory settings (11)”:



Concluding the factory defaults should be read in into SIWATOOL V7 via “Receive all data”:



Please proceed to the next step “Definition of the basic system parameters” now.

2nd step: Definition of the basic system parameters

All important system parameters are grouped in data record 3. Following parameters need to be defined now:

Scale Name

A name of the scale (e.g. location, type of material, etc.) can be defined with up to 12 characters. If there are multiple WP241 in one cabinet, the name directly show, on which scale SIWATOOL V7 is connected.

Unit for belt load

The options are “kg/m” for metric systems or “lbs/ft” for imperial systems.

Unit for flow rate

The options are “t/h” (tons per hour) and “kg/h” (kilograms per hour) for metric systems or “T/h” (short tons per hour), “TL/h” (long tons per hour) or “lbs/h” (pounds per hour) for imperial systems.

Following parameter combinations of “Unit for belt load” and “Unit for flow rate” are possible:

	t/h (tons per hour)	**kg/h** (kilograms per hour)	**T/h** (short tons per hour)	**TL/h** (long tons per hour)	**lbs/h** (pond per hour)
kg/m	ok	ok	not supported	not supported	not supported
lbs/ft	Not supported	Not supported	ok	ok	ok

Resolution of weight and belt load

Examples:

0.01 -> the weight and the belt load is displayed in steps of 0.01 kg/m resp. 0.01 lbs/ft

1.0 -> the weight and the belt load is displayed in steps of 1.0 kg/m resp.1.0 lbs/ft

Resolution of flow rate and totalizers (S2 ... S6)

Examples:

0.01 -> flow rate resolution = 4.79 t/h and totalizers S2 … S6 resolution = 8.21 t (= 10kg steps)

1.0 -> flow rate resolution = 5 t/h and totalizers S2 … S6 resolution = 8 t (= 1 ton steps)

Resolution of master totalizer (S1)

Defines the resolution of the master totalizer S1 (see “Resolution of flow rate and totalizers S2 … S6)

Note: The master totalizer can only be reset by loading factory defaults!

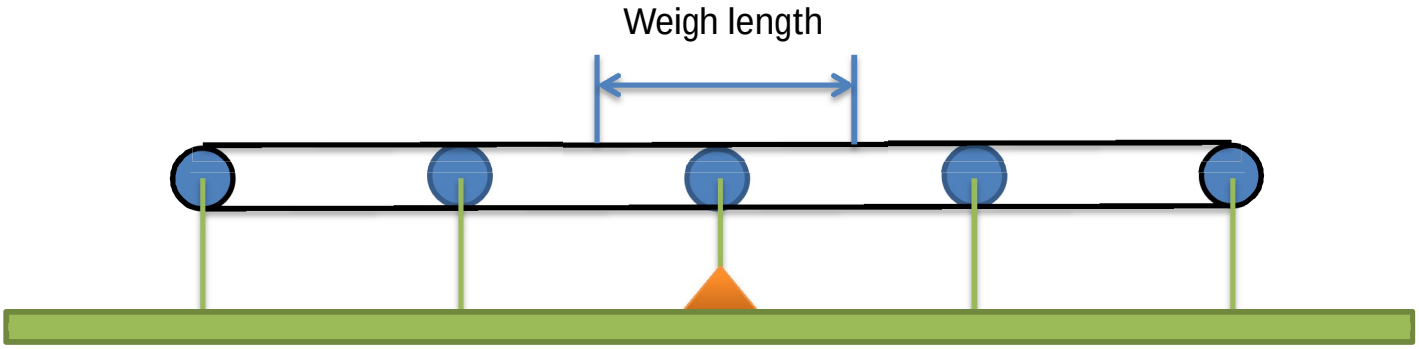
Design flow rate

The design flow rate is a fix defined parameter of the belt scale system and depended on different parameters like load cell capacity, weigh length, max. belt speed. This parameter is defined during the dimensioning of the belt scale.

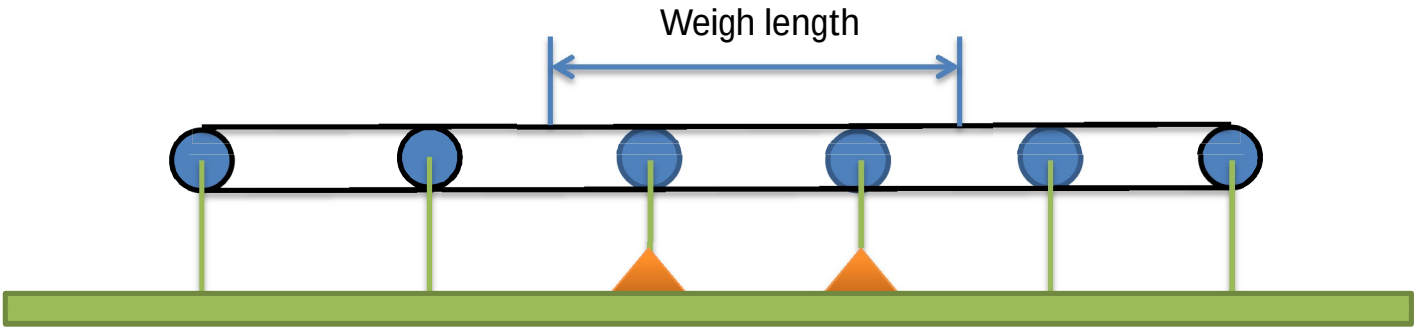
The unit for this parameter always needs to be same like chosen in parameter “Unit for flow rate”.

Weigh length

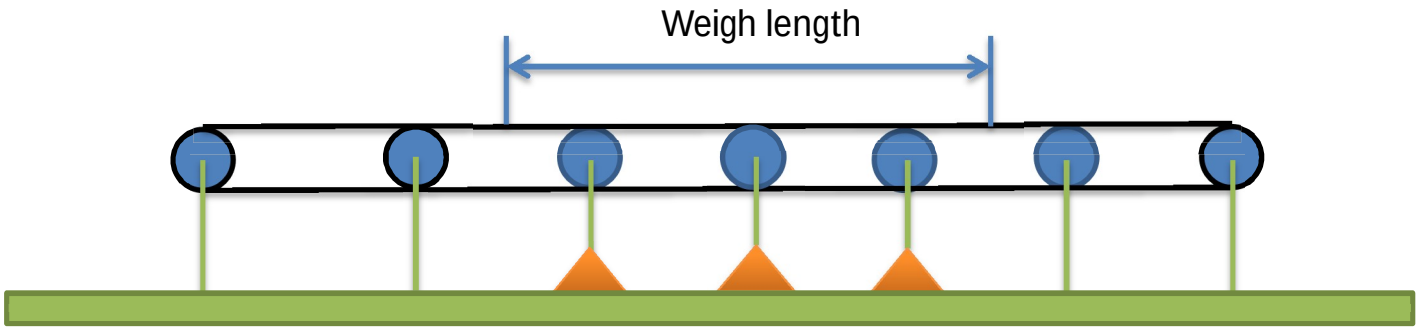
The weigh length is calculated by half the distance to the next idler before the weigh bridge plus half the distance to the next idler behind the weigh bridge:



In case of two weigh bridges the weigh length is defined as follows:



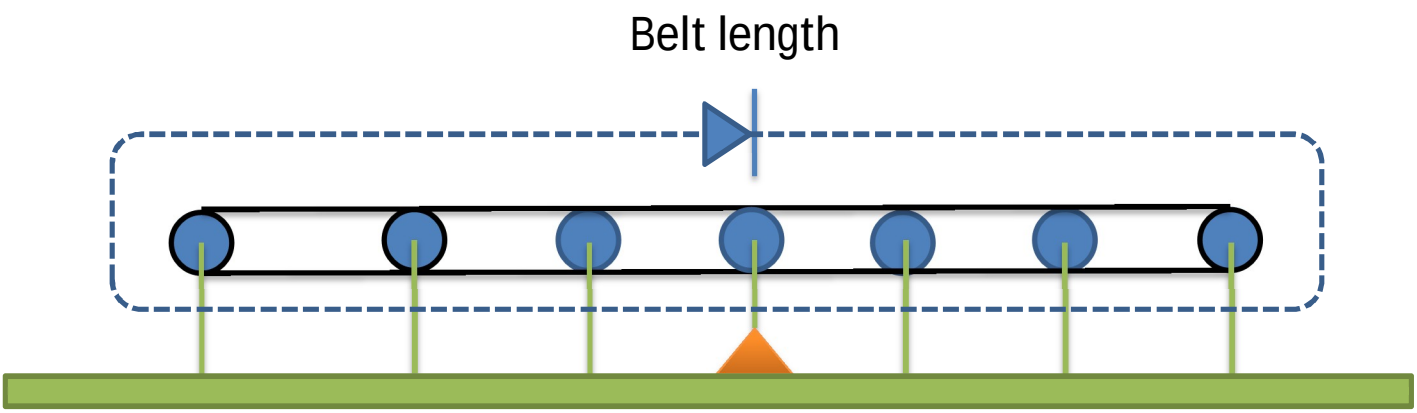
In case of three weigh bridges the weigh length is defined as follows:



The unit for the weigh length depends on the “Unit for belt load”. In case of “kg/m” it needs to be entered in meters, in case of “lbs/ft” it needs to be entered in feet.

Belt length

Complete length of the belt (one complete revolution).



The unit for the belt length depends on the “Unit for belt load”. In case of “kg/m” it needs to be entered in meters, in case of “lbs/ft” it needs to be entered in feet.

No. of belt revolutions for calibration/zeroing

Defines the number of belt revolutions for calibration commands (initial zero, span), or for zero setting function (auto zero and zero tracking) during operation.

Speed detection

The SIWAREX offers three different ways of detecting the current belt speed.

In case of using a speed sensor connected to digital input DI.0 please select
“Speed sensor on digital input DI.0”

In case of using a known constant speed value please select
“No Sensor – Preset/Detect constant speed”

In case of using a speed values from an external CPU please select
“External speed value from CPU (via DR19)”

Warm-up timer (minutes)

To have good results with high accuracy a belt needs to warm-up before starting the weighing process. This warm-up time depends on the belt length and environmental conditions. Therefore a time can be entered and the status bit “warm-up” be linked to a digital output. By doing this, the output indicates when the warm-up time is completed. The satus-bit itself has absolutely no influence on the weighing system itself. It’s information only!

3rd step: Belt speed commissioning

Please select the next step accordingly your system environment.

Using a speed sensor with a known pulse constant

In case of using a speed sensor, it must be connected to digital input DI.0 of the WP241. For detailed wiring information please check the WP241 device manual.

Following parameters needs to be defined in data record 3:

Speed detection	Speed sensor on digital input DI.0
Design speed (belt empty)	1.0
Speed correction if belt loaded (% of design speed)	100.0
Load factor for speed correction (% of nominal load)	100.0
Speed sensor pulses (pulses per m / pulses per foot)	1000.0

"Design speed (belt empty)" defines the maximum belt speed. The minimum and maximum limits for speed are related to this parameter.

The "Speed sensor pulses (pulses per m / pulses per foot)" is a parameter based on the connected speed sensor. Most belt mounted speed sensors (like SIEMENS RBSS (150.4 pulses/m) or SIEMENS TASS (9.947 pulses/m)) provide this parameter in the datasheet.
In case of a shaft mounted speed sensor the pulses per meter resp. pulses per foot need to be calculated by following formula:

$$Pulses\ per\ meter\ = \frac{(Pulses\ per\ revolution)}{(\pi\ x\ d)}$$

Pulses per revolution: see data sheet of the speed sensor / encoder

π = 3,1416

d = diameter of guide pulley in meter

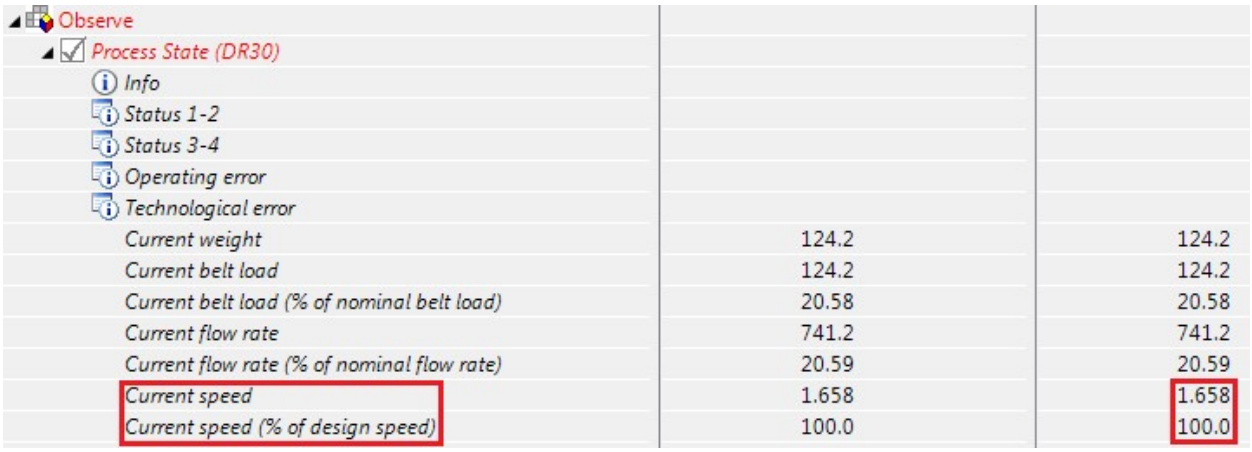
$$Pulses\ per\ feet\ = \frac{(Pulses\ per\ revolution)}{(\pi\ x\ d)}$$

Pulses per revolution: see data sheet of the speed sensor / encoder

π = 3,1416

d = diameter of guide pulley in feet

After defining all mentioned parameters, please check the belt speed in DR30:



Observe		
Process State (DR30)		
Info		
Status 1-2		
Status 3-4		
Operating error		
Technological error		
Current weight	124.2	124.2
Current belt load	124.2	124.2
Current belt load (% of nominal belt load)	20.58	20.58
Current flow rate	741.2	741.2
Current flow rate (% of nominal flow rate)	20.59	20.59
Current speed	1.658	1.658
Current speed (% of design speed)	100.0	100.0

To verify the speed, a tachometer can be used.
Alternatively the length of one complete belt revolution can be divided by the time for one complete belt revolution. This time can be measured by the WP241 internal stop watch function, the calculation can be done by the WP241 internal calculator function.

Proceed to the next step “Initial zero calibration”.

Using a speed sensor with an unknown pulse constant

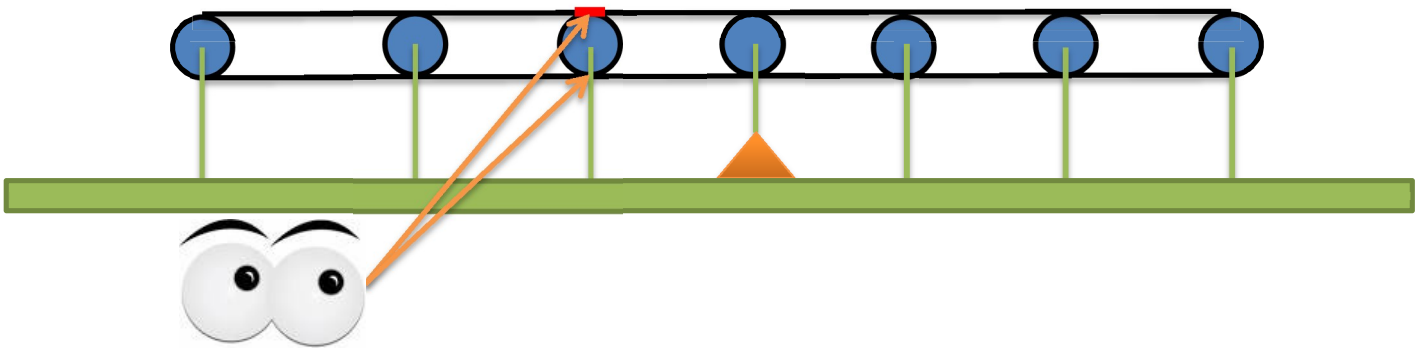
In some applications – especially retrofits – the constant of an old existing speed sensor is quite often unknown. In this case SIWAREX WP241 can calculate the “Pulses per meter” resp. “Pulses per foot” by an integrated system function.

Caution:

By using this feature, be sure that the basic parameter “belt length” was entered with highest accuracy! If the belt length is entered with an error of 10% (110m instead of 100m), the pulse constant will be calculated with an error of 10% and therefore the whole system will work with an error of 10%.
In case of using this function, the belt length needs to be measured by a length measuring device (e.g. tachometer), or measuring tape.

1st step: Stop the belt and place a check mark on the belt. This can be done by chalk or duct tape for instance. The mark should pass an easy to see fixed defined point of the belt scale (e.g. a defined part of the weigh bridge or an idler station).

2nd step: Switch on the belt again. Monitor the mark and execute the command “Start speed-/pulse detection (79)”, when the check mark passes your selected reference point.



Start speed-/pulse detection (70)

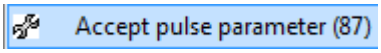
3rd step: Wait for the “number of belt revolutions”, which you defined in the basic parameters by counting the check mark passing by your reference point.
Example:
If two belt revolutions were defined in the basic parameters, the mark needs to pass by three times: first time for “Start speed-/pulse detection”. Second time indicates the first complete revolution. By passing by the third time the command “Stop speed-/pulse detection” need to be executed.

Stop speed-/pulse detection (71)

After that all calculated results are shown in data record 4 and can be verified. The parameters are not directly active in the WP241 in this state:

Temporary Parameters (DR4)		
Info		
Speed (belt empty)	0.0	0.7223665
Speed correction if belt loaded (% of design speed)	0.0	0.0
Load factor for speed correction (% of nominal load)	0.0	0.0
Speed sensor pulses (per m / per foot)	0.0	290.5667
Pulses per belt revolution	0	8717

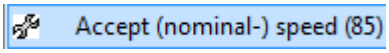
If the results of the calculation seem to be plausible, they can be accepted by following commands:



By using this command, the “Pulses per m” resp. “Pulses per foot” are copied from DR4 into the basic parameters in DR3. From that moment, the speed is calculated by the WP241 with the new parameters and can be verified in DR30:

Value	PC	
SIWAREX WP241		
Commisioning		
Additional Parameters		
Observe		
Process State (DR30)		
Info		
Status 1-2		
Status 3-4		
Operating error		
Technological error		
Current weight	2.63	2.63
Current belt load	2.63	2.63
Current belt load (% of nominal belt load)	2.62	2.62
Current flow rate	6.8	6.8
Current flow rate (% of nominal flow rate)	1.89	1.89
Current speed	0.720764	0.720804
Current speed (% of design speed)	72.0764	72.0804

In addition the WP241 calculates the average belt speed during the pulse detection. The result of this calculation is shown in DR4 “Speed (belt empty)”. This parameter can be copied into DR3 as “Design belt speed” by executing the command “Accept (nominal-) speed”, if desired.



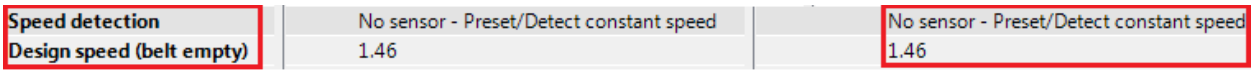
Caution:

If the pulse detection was not performed at maximum belt speed, the calculated “Speed (belt empty)” in DR4 might not be the real design speed of the belt. Therefore it shouldn’t be copied in DR3. In that case, please set the belt speed to maximum and check in DR30 the real maximum / design speed of your belt and enter this value manually in DR3 into the parameter “Design belt speed”.

Proceed to the next step “Initial zero calibration”.

Using a known constant default speed value

Following parameters needs to be defined in data record 3:



The value in “Design speed (belt empty)” is then used as default speed value for all calculations.

Caution

As the WP241 cannot know if the belt is really turning, an external signal / information is required. This can be realized in two different ways:

- The digital input DI.0 and an external 24V signal can be used to tell the WP241 that the belt is turning. In this case the function of the digital input DI.0 needs to be changed in DR7 as follows:

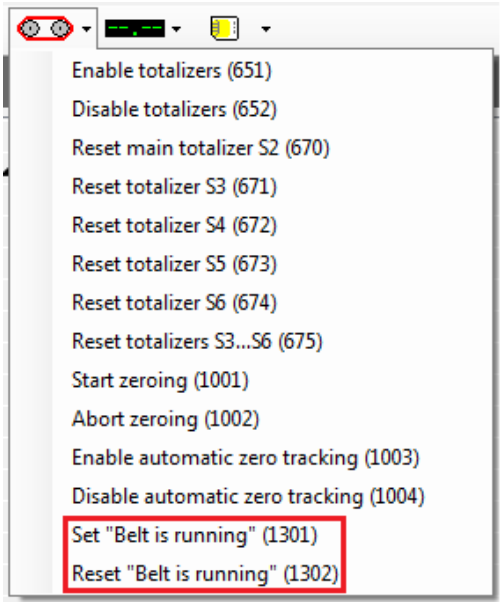
  According the default speed value of the screen shot above:

  +24V -> 1.46 m/s resp. 1.46 ft/s is used as constant speed

  +0V -> belt is not running -> no flow rate calculation, no totalizing.

- Alternatively the SIMATIC CPU or an external CPU (via Modbus TCP or Modbus RTU) can send a command code (1301 / 1302), that the belt is turning or not. Please refer to the WP241 device manual for further instructions on how to send commands to the WP241 from SIMATIC S7-1200 or via Modbus.

  For testing purposes these commands can be executed in SIWATOOL as well:



Proceed to the next step “Initial zero calibration”.

Detecting an unknown constant belt speed

In case of a system without speed sensor and an unknown belt speed, the speed can be detected by the WP241 by a special procedure.

Following parameters needs to be defined in data record 3:

Speed detection	No sensor - Preset/Detect constant speed	No sensor - Preset/Detect constant speed

As the WP241 cannot know if the belt is really turning, an external signal / information is required.
This can be realized in two different ways:

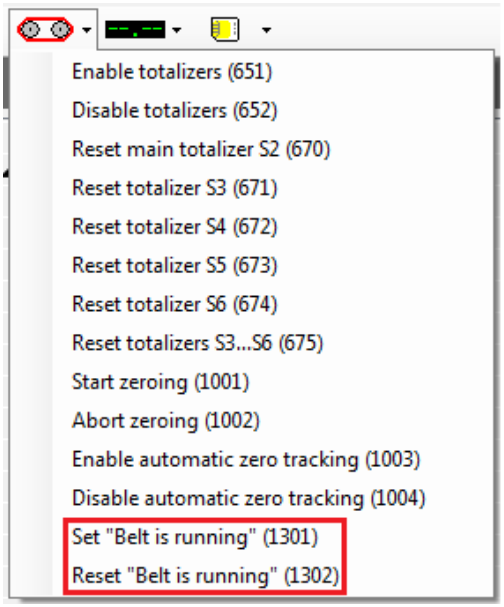
- The digital input DI.0 and an external 24V signal can be used to tell the WP241 that the belt is turning. In this case the function of the digital input DI.0 needs to be changed in DR7 as follows:

<u>According the default speed value of the screen shot above:</u>

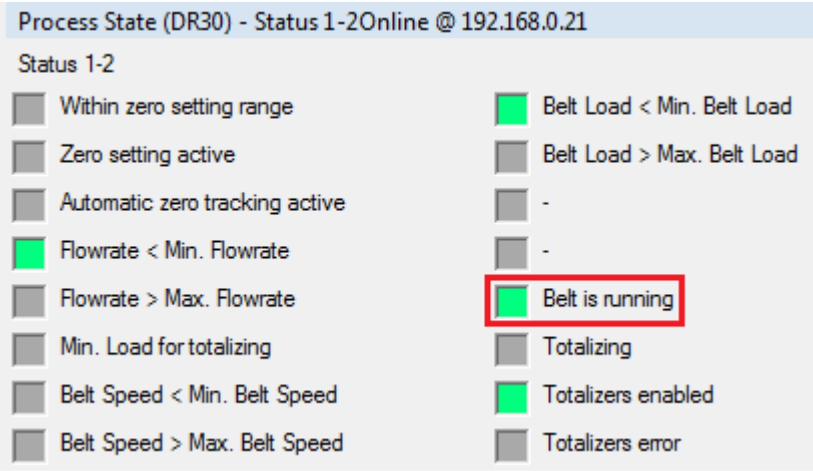
+24V -> 1.46 m/s resp. 1.46 ft/s is used as constant speed

+0V -> belt is not running -> no flow rate calculation, no totalizing.

- Alternatively the SIMATIC CPU or an external CPU (via Modbus TCP or Modbus RTU) can send a command code (1301 / 1302), that the belt is turning or not. Please refer to the WP241 device manual for further instructions on how to send commands to the WP241 from SIMATIC S7-1200 or via Modbus.



Before proceeding please check in “Status 1-2” in DR30, if the status “belt is running” is active. This state is basic requirement for the following steps:

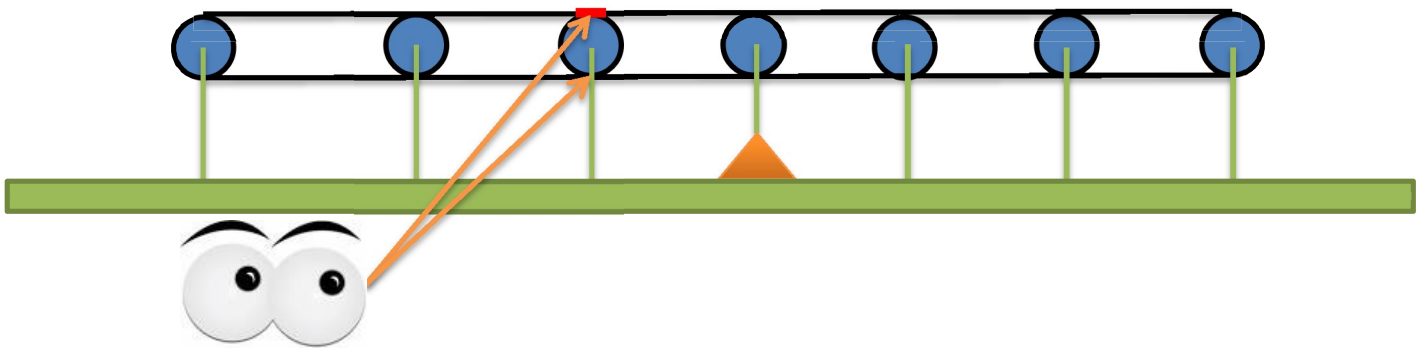


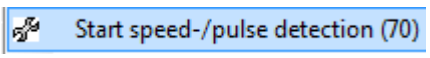
Caution

By using this feature, be sure that the basic parameter “belt length” was entered with highest accuracy! If the belt length is entered with an error of 10% (110m instead of 100m), the pulse constant will be calculated with an error of 10% and therefore the whole system will work with an error of 10%.
In case of using this function, the belt length needs to be measured by a length measuring device (e.g. tachometer), or measuring tape.

1st step: Stop the belt and place a check mark on the belt. This can be done by chalk or duct tape for instance. The mark should pass an easy to see fixed defined point of the belt scale (e.g. a defined part of the weigh bridge or an idler station).

2nd step: Switch on the belt again and run it without material. Monitor the mark and execute the command “Start speed-/pulse detection (70)”, when the check mark passes your selected reference point:

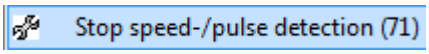




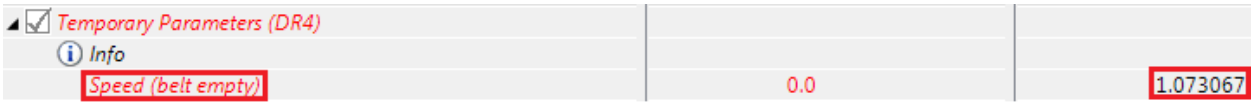
3rd step: Wait for the “number of belt revolutions”, which you defined in the basic parameters by counting the check mark passing by your reference point.

Example:

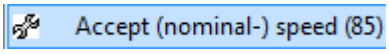
If two belt revolutions were defined in the basic parameters, the mark needs to pass by three times: first time for “Start speed-/pulse detection”. Second time indicates the first complete revolution. By passing by the third time the command “Stop speed-/pulse detection (71)” need to be executed.



After that the calculated speed of the empty belt is shown in data record 4 and can be verified. The parameter is not directly active in the WP241 in this state:



If the detected speed value seems to be plausible, it needs to be accepted by command “Accept (nominal-) speed (85)”. After that the calculated speed value is used for all further calculations in the module:



Proceed to the next step “Initial zero calibration”.

Optional step

(only possible if initial zero and span calibration was performed already!)

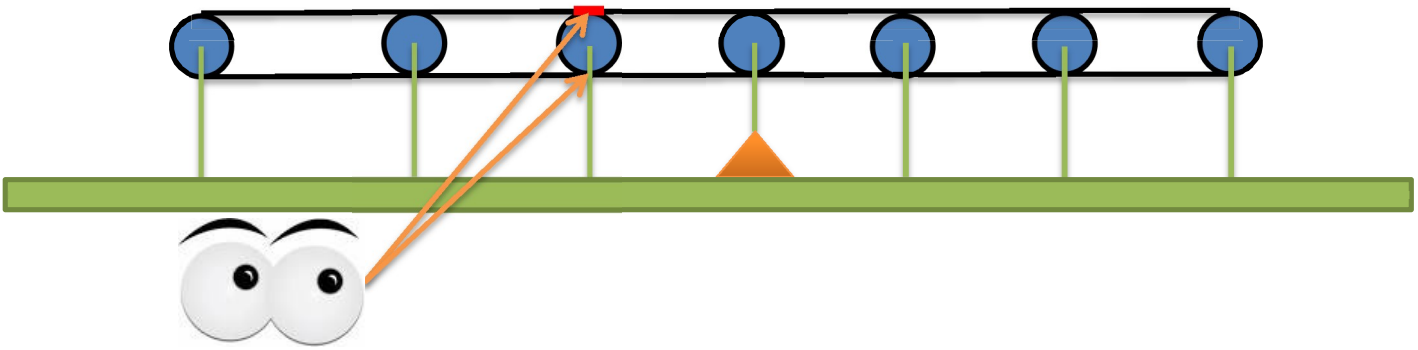
The just calculated speed is based on an empty belt. E.g. in case of a fully loaded belt, the speed of the belt will decrease. Depending on the belt length this decrease can have a not to be scoffed influence on the accuracy of the system. Therefore SIWAREX WP241 offers the possibility to perform a second speed measurement with a loaded belt. With help of this second speed information of the loaded belt, the speed of the system is corrected in relation to the belt load – even without a connected speed sensor.

Caution

By using this feature, be sure that the basic parameter “belt length” was entered with highest accuracy! If the belt length is entered with an error of 10% (110m instead of 100m), the pulse constant will be calculated with an error of 10% and therefore the whole system will work with an error of 10%.
In case of using this function, the belt length needs to be measured by a length measuring device (e.g. tachometer), or measuring tape.

1st step: Stop the belt and place a check mark on the belt. This can be done by chalk or duct tape for instance. The mark should pass an easy to see fixed defined point of the belt scale (e.g. a defined part of the weigh bridge or an idler station) and be visible even with material on the belt.

2nd step: Switch on the belt again and run it with material (as close as possible to the nominal belt load). Monitor the mark and execute the command “Start speed measurement “belt loaded” (72)”, when the check mark passes your selected reference point:



Start speed measurement "belt loaded" (72)

3rd step: Wait for the “number of belt revolutions”, which you defined in the basic parameters by counting the check mark passing by your reference point.

Example:

If two belt revolutions were defined in the basic parameters, the mark needs to pass by three times: first time for “Start speed measurement “belt loaded” (72)”. Second time indicates the first complete revolution. By passing by the third time the command “Stop speed measurement “belt loaded” (73)” need to be executed.

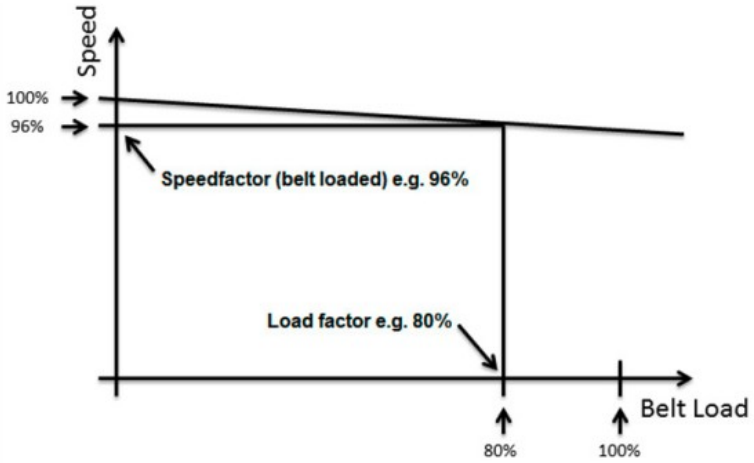
Stop speed measurement "belt loaded" (73)

After that the calculated speed of the loaded belt and the average belt load during the procedure is shown in data record 4 as a percentage deviation of the nominal values and can be verified. The parameters are not directly active in the WP241 in this state:

Temporary Parameters (DR4)		
Info		
Speed (belt empty)	0.0	0.0
Speed correction if belt loaded (% of design speed)	0.0	95.82916
Load factor for speed correction (% of nominal load)	0.0	9.260786

If the detected percentage deviations seem to be plausible, they need to be accepted by command “Accept speed parameters – “belt loaded” (86)”. After that all parameters are copied into DR3 and the “constant” speed of the system is corrected relating to the belt loading:

Accept speed parameters "belt loaded" (86)



Sending a constant belt speed value from an external CPU

In some cases the speed of the belt is already calculated / known in a CPU (e.g. based on VFD data). In this situation it is possible to send this speed value directly to the SIWAREX WP241 via S7-1200 function block, Modbus TCP or Modbus RTU.

Following parameters needs to be defined in data record 3:

Speed detection	External speed value from CPU (via DR19)	External speed value from CPU (via DR19)

After that, every value that is unequal zero and sent to the SIWAREX WP241 via data record 19 is used as the belt speed for all calculations. Sending 0 via DR19 leads to a stop of the flow rate calculation and a stop of the totalizers.

After a power failure, DR19 is automatically reset to 0 and needs to be reinitialized with the actual speed value.

Proceed to the next step “Initial zero calibration”.

4th step: Initial zero calibration

If the basic parameters were defined successfully and the belt speed is detected correctly, the initial zero calibration can be performed.

Before starting the calibration please define the following parameter in DR10:

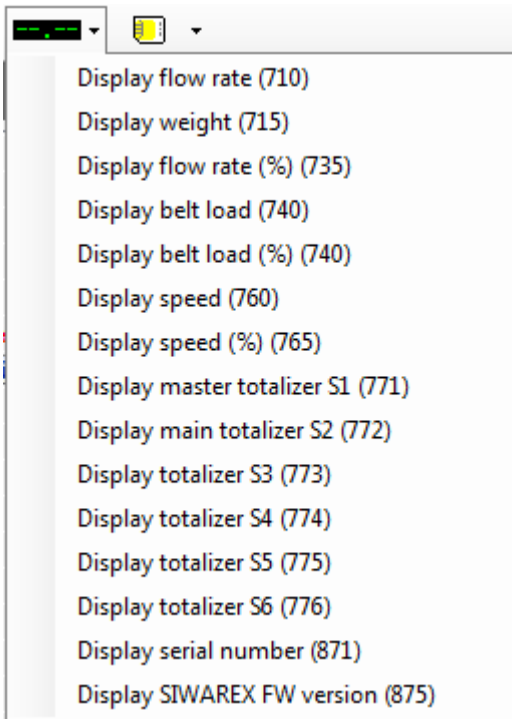
Load Cells Parameter (DR10)		
Info		
No. of load cells	2	2
Switch 50/60Hz	50 Hz	50 Hz

Please select the frequency of your local grid in order to improve the signal filtering of the WP241.

Verify the following conditions before starting the initial zero calibration:

- Belt is warmed-up and turning
- Belt is unloaded
- Service mode is activated

Every process value (load, speed, flow rate) of the WP241 can be displayed in SIWATOOL V7 by using following options:



The command “Start initial zero calibration (60)” needs to be started now:

Start initial zero calibration (60)

After the defined number of belt revolutions, the result of the operation is shown in DR4. The parameters are not directly active in the WP241 in this state:

Temporary Parameters (DR4)		
Info		
Speed (belt empty)	0.0	0.0
Speed correction if belt loaded (% of design speed)	0.0	0.0
Load factor for speed correction (% of nominal load)	0.0	0.0
Speed sensor pulses (per m / per foot)	0.0	0.0
Pulses per belt revolution	0	0
Initial zero calibration digits	0	1094672
Deviation from old initial zero calibration digits (%)	0.0	264.9

If the result seems to be plausible it needs to be accepted and activated by command “Accept initial zero calibration digits (88)”:

Accept initial zero calibration digits (88)

The current belt load should be 0.0 kg/m resp. 0.0 lbs/ft now.

Proceed to the next step “Span calibration”.

5th step: Span calibration

The SIWAREX WP241 offers different ways to perform a span calibration. This document describes the calibration by using test weights, alternatively a test chain or the load cells data. Please jump to the type of span calibration you want to perform.

Using test weights

In case of using test weights for the span calibration, following parameter needs to be defined in DR3:

Calibration weight (span by weight)	28.5	28.5

The unit of this parameter depends on the selected “Unit for belt load”. In case of “kg/m” the calibration weight must be entered in kg, in case of “lbs/ft” in lbs.

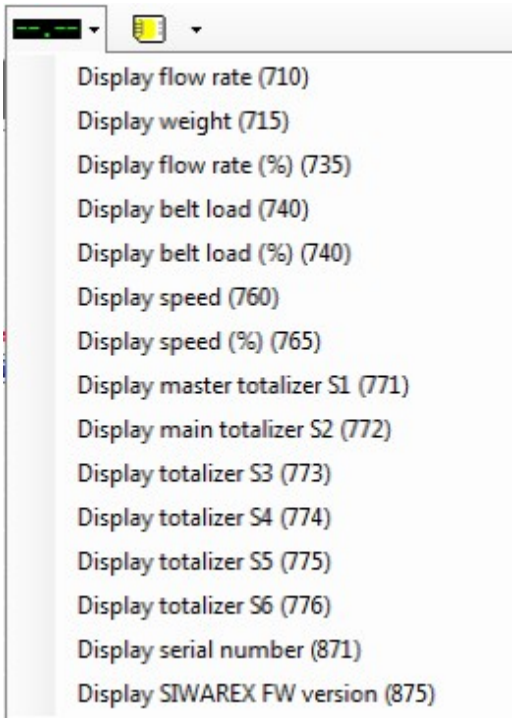
Caution:

Stop the belt before mounting the test weight(s) to the scale!

Verify the following conditions before starting the span calibration with test weights:

- Initial zero calibration was performed successfully
- Belt is warmed-up and turning
- Test weights are mounted on the scale
- The belt is empty
- Service mode is activated

Every process value (e.g. load, speed, flow rate) of the WP241 can be displayed in SIWATOOL V7 by using following options:



The command “Start span calibration with test weight (61)” needs to be started now:

Start span calibration with test weight (61)

After the defined number of belt revolutions, the result of the operation is shown in DR4. The parameters are not directly active in the WP241 in this state:

Calibration weight (calculated)	0.0	28.5
Calibration load (calculated)	0.0	0.0
Span calibration digits	0	1148332
Deviation from old span calibration digits in (%)	0.0	-61.72

If the result seems to be plausible it needs to be accepted and activated by command “Accept span calibration digits (89)”:

Accept span calibration digits (89)

The current belt load in the display should be the result of test weight divided by the weigh length now.

- Stop the belt and dismount the test weights.
- Switch off the “Service mode”
- Create a backup file of your system by “Communication” → “Receive all data” → “File” → “Save as …”

Proceed to the next step “Material test”.

Using a test chain

In case of using a test chain for the span calibration, following parameter needs to be defined in DR3:

Calibration load (span by test chain)	85.6	85.6

The load of a calibration chain is a fix defined parameter of the chain. The parameter must be entered either in “kg/m” or “lbs/ft” depending on the selected “Unit for belt load”.

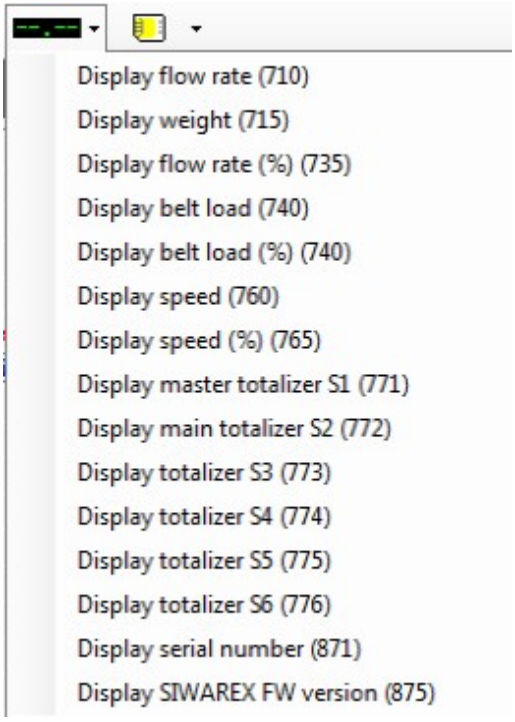
Caution:

Stop the belt before mounting the test chain on the belt!

Verify the following conditions before starting the span calibration with test weights:

- Initial zero calibration was performed successfully
- Belt is warmed-up and turning
- Test chain is mounted on the belt in a centered position
- Service mode is activated

Every process value (e.g. load, speed, flow rate) of the WP241 can be displayed in SIWATOOL V7 by using following options:



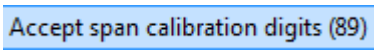
The command “Start span calibration with test chain (65)” needs to be started now:

Start span calibration with test chain (65)

After the defined number of belt revolutions, the result of the operation is shown in DR4. The parameters are not directly active in the WP241 in this state:

Calibration weight (calculated)	0.0	28.5
Calibration load (calculated)	0.0	0.0
Span calibration digits	0	1148332
Deviation from old span calibration digits in (%)	0.0	-61.72

If the result seems to be plausible it needs to be accepted and activated by command “Accept span calibration digits (89)”:



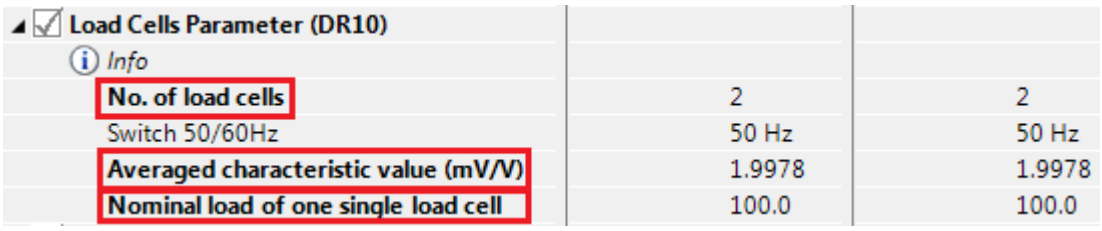
The entered “Calibration load” should be displayed as belt load now.

- Stop the belt and dismount the test chain.
- Switch off the “Service mode”
- Create a backup file of your system by “Communication” → “Receive all data” → “File” → “Save as …”

Proceed to the next step “Material test”.

Using load cell data (automatic calibration)

In case of performing an automatic calibration, following parameters needs to be defined in DR10:



"No. of loadcells"

Defines the number of connected load cells. In case of using a SIEMENS MSI belt scale, the number of load cells would be two, for an MMI-2 four.

"Averaged characteristic value (mV/V)"

In case of using two or more load cells, the characteristic value needs to be averaged:

LC1 : 1,998 mV/V
LC2 : 1,997 mV/V
LC3 : 1,999 mV/V
LC4 : 2,001 mV/V
_____

7,995 mV/V / 4 = 1,99875 mV/V = averaged characteristic value

The exact characteristic values can be found directly on the load cells or in the load cells data sheet. If it's not possible to use the exact value, a value of 1.0mV/V, 2.0mV/V or 4mV/V (depending on the load cell) can be assumed and entered.

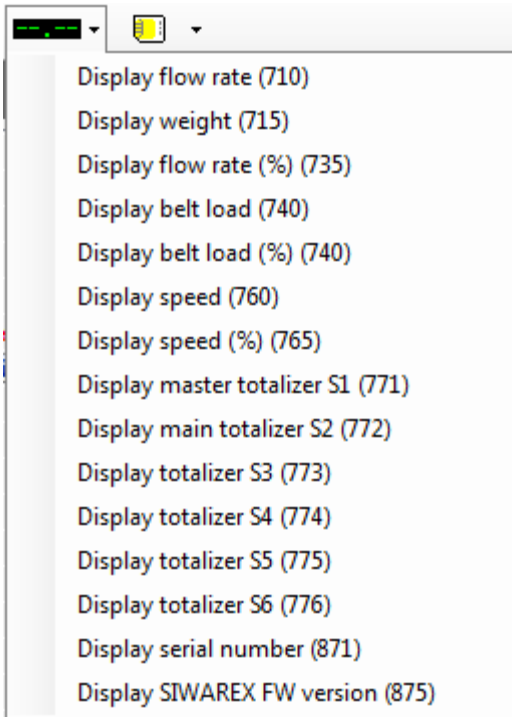
"Nominal load of one single load cell"

Defines the nominal load (= rated capacity) of one single load cell of the belt scale. The unit of the parameter must be either "kg" or "lbs" depending on the selected unit for belt load.

Verify the following conditions before starting the automatic span calibration:

- Initial zero calibration was performed successfully
- Belt is empty and not turning
- No test weights / test chains are on the scale
- Service mode is activated

Every process value (e.g. load, speed, flow rate) of the WP241 can be displayed in SIWATOOL V7 by using following options:



The command “Start automatic span calibration (63)” needs to be executed now:

Start automatic span calibration (63)

Directly after executing the command, the result is entered in DR3 and active!

In case of performing an automatic calibration it’s highly recommended to perform a material test afterwards in order to increase the accuracy of the system.

Proceed to the next step “Material test”.

6th step: Material test

The material test is the last step of the belt scale calibration. During this test, a defined quantity of material is conveyed on the belt scale system. The quantity needs either to be pre- or post-weighed – typically by a truck scale.
Totalizer S6 of the SIWAREX WP241 is designed for material tests, as all other totalizers (S1…S5) can be optionally stopped during the test, so that the test does not impact the already totalized values.
Totalizer S6 can't be stopped and therefore totalizes always.

Material test with pre-weighed material

A known quantity of material (truck weighed on a truck scale) is conveyed via the belt scale system. By doing this type of test, the material can be used directly in the process. Following steps need to be done:

1st step :
Belt need to run empty

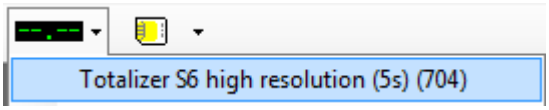
2nd step :
Optionally stop totalizers S1…S5 by command Disable totalizers (652)

3rd step :
Reset totalizer S6 by command Reset totalizer S6 (674)

4th step :
Start conveying constantly the pre-weighed material

5th step :
Wait until the complete material was conveyed and check the value of totalizer S6 in DR33.

Totalizer S6	0.0	22.4

By using command 

the resolution of totalizer S6 will be increased for 5s in DR33. Therefore the calculation of the correction factor (see step 7) gets much more accurate!
Depending on the selected unit for flow rate, the WP241 totalizes either in t (tons), kg (kilograms), T (short tons), TL (long tons) or lb (pound).

6th step :
With the information of totalizer S6 (high resolution) and the weight of the conveyed material a correction factor can be calculated now by following formula:

$$Correction\ factor\ new\ =\ (Correction\ factor\ old)\ x\ \frac{pre-weighed\ material\ quantity}{totalized\ weight\ of\ totalizer\ S6}$$

Correction factor old: *Currently used correction factor in DR5*

The new factor must be entered in DR5 and send to the WP241:

Correction Factors (DR5)		
Info		
Belt load factor 1 (% of nominal belt load)	40.0	40.0
Correction factor 1	1.0	1.0
Belt load factor 2 (% of nominal belt load)	0.0	0.0
Correction factor 2	1.0	1.0

Note

As long as the parameter "Belt load factor 2 (% of nominal belt load)" is set to 0%, only "Correction factor 1" is used constantly.

Material test with post-weighed material

Material is conveyed via the belt scale system directly into a truck. Afterwards the material is weighed and the correction factor can be calculated. Following steps need to be done:

1st step :
Belt need to run empty

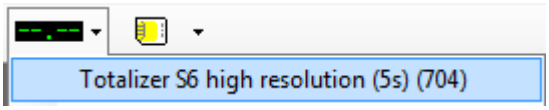
2nd step :
Optionally stop totalizers S1…S5 by command Disable totalizers (652)

3rd step :
Reset totalizer S6 by command Reset totalizer S6 (674)

4th step :
Start conveying constantly material

5th step :
After the material was conveyed, totalizer S6 in DR33 need to be checked:

Totalizer S6	0.0	22.4

By using command 

the resolution of totalizer S6 will be increased for 5s in DR33. Therefore the calculation of the correction factor (see step 7) gets much more accurate!
Depending on the selected unit for flow rate, the WP241 totalizes either in t (tons), kg (kilograms), T (short tons), TL (long tons) or lb (pound).

6th step :
Weigh the conveyed material (e.g. by a truck and a truck scale)

7th step :
With the information of totalizer S6 (high resolution) and the weight of the conveyed material a correction factor can be calculated now by following formula:

$$Correction\ factor\ new\ =\ (Correction\ factor\ old)\ x\ \frac{post-weighed\ material\ quantity}{totalized\ weight\ of\ totalizer\ S6}$$

Option – Second correction factor

Because of a different mechanical behavior of the belt and the belt scale at different belt loadings, the definition of a second correction factor based on a second material test at a higher belt load can increase the accuracy of the system.
In that case, the percentage belt load needs to be monitored during the material test by the operator.

This can be done in SIWATOOL V7 by displaying the percentage belt load:

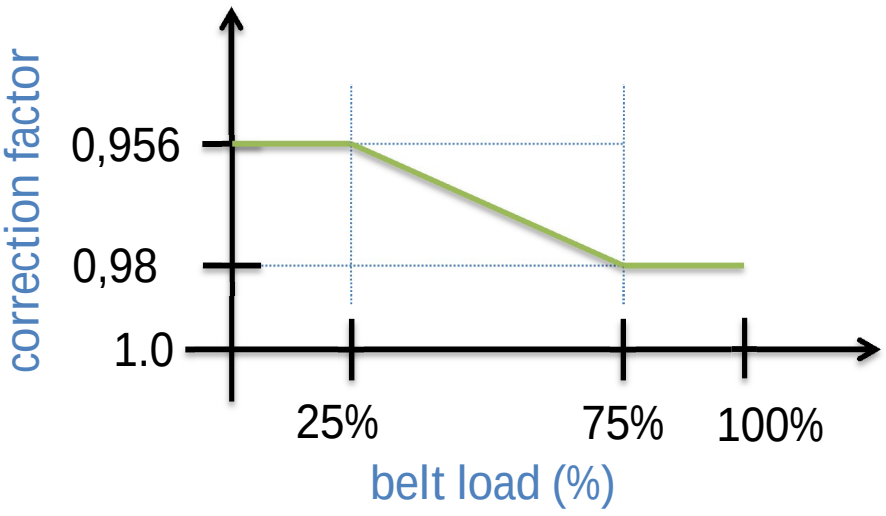
Display belt load (%) (740)

As the belt load will alternate during the material test, the monitored and afterwards entered value does not need to be very exact.

Note

By using two correction factors, it's important to perform the material tests with different belt loadings, for example at 25% and 75% belt load (% of nominal load).

Afterwards the WP241 uses different correction factors depending on the current belt load. The following diagram illustrates this functionality:



According this example the parameters in SIWATOOL in DR5 have to be set as follows:

Correction Factors (DR5)		
Info		
Belt load factor 1 (% of nominal belt load)	25.0	25.0
Correction factor 1	0.956	0.956
Belt load factor 2 (% of nominal belt load)	75.0	75.0
Correction factor 2	0.989	0.989

7th step: Defining limits & I/O interfaces

In the last step of the commissioning, the limits and I/O interfaces need to be defined.
All Limit settings are self-explanatory defined in DR6.

Analog output

The analog output of the WP241 is defined in data record 7 (“Process Interfaces”).
The following parameters need to be defined:

Range analog output	4 .. 20 mA
Source for analog output	Flow rate
State of analog output on error or CPU-Stop	Predefined state
Start value analog output	0.0
End value analog output	180.0
Value for analog output on error or CPU-Stop (mA)	3.5

Range analog output

0-20mA or 4-20mA operation.

Source for analog output

Defines, which process value is linked to the analog signal: flow rate, belt load, belt speed, controlled by SIWATOOL V7 or controlled by SIMATIC S7-1200 function block.

State of analog output on error or CPU-stop

Possible states are:

- OFF → 0/4 mA in case of error / CPU-stop
- Maintain functionality
- Predefined state → The value defined in “Value for analog output on error or CPU-stop (mA)” is used.
- ON → maximum analog value

Start / End value for analog output

Defines the scaling of the analog signal.

Example analog signal for “FLOW RATE”:

Range = 4..20mA
Source = flow rate
State of analog output on error or CPU-Stop = Predefined state
Start value = 0.0 (=4mA)
End value = 180.0 (=20mA)
Value for analog output on error or CPU-Stop = 3.5mA

→ A flow rate of 0.0 t/h equals 4mA output, 90.0 t/h equals 12mA output, 180.0 t/h equals 20mA output.
→ In case of an error (e.g. disconnected load cell), the output gives out 3.5mA

Example analog signal for “BELT SPEED”:

Range = 0..20mA
Source = Belt speed
State of analog output on error or CPU-Stop = OFF
Start value = 0.0 (=0mA)
End value = 2.0 (=20mA)
Value for analog output on error or CPU-Stop = 3.5mA

→ A belt speed of 0.0 m/s equals 0mA output, 1.0 m/s equals 10mA, 2 m/s equals 20mA output.
→ In case of an error (e.g. disconnected load cell), the output gives out 0mA

Example analog signal for “BELT LOAD”:

Range = 4..20mA
Source = Belt load
State of analog output on error or CPU-Stop = Predefined state
Start value = 0.0 (=4mA)
End value = 50.0 (=20mA)
Value for analog output on error or CPU-Stop = 3.5mA

→ A belt load of 0.0kg/m equals 4mA output, 25.0 kg/m equals 12mA output, 50.0 kg/m equals 20mA output.
→ In case of an error (e.g. disconnected load cell), the output gives out 3.5mA

Pulse signal for remote totalizer

A digital output of the WP241 can be used for sending pulse signals according a defined quantity of totalized material. First step is the definition of the quantity of material and the duration of the pulse signal in DR 7:

Load per pulse
Pulse duration

"Load per pulse" defines the quantity of material, after which a pulse signal should be generated (e.g. 0,02t). The unit of the parameter depends on the selected unit of the flow rate (t, kg, T, TL or lbs).

"Pulse duration" defines the duration of the pulse high-signal in milliseconds. The shortest possible duration is 50ms.

The following conditions must be fulfilled:

$$Max.\,Rate \leq \frac{load\ per\ pulse}{(Pulse\ duration + 30ms)}$$

Examples:

Max. Rate = 360 t/h; desired "Load per pulse" = 0,02t; desired "Pulse duration" = 250ms;

$$360\,\frac{t}{h} \leq \frac{0{,}02t}{(250ms + 30ms)} \rightarrow 360\,\frac{t}{h} \leq \frac{0{,}02t}{0{,}28s} \rightarrow 360\,\frac{t}{h} \leq 257{,}14\,\frac{t}{h}$$

➔ Not possible!

Max Rate = 360 t/h; desired "Load per pulse" = 0,1t; desired "Pulse duration" = 500ms;

$$360\,\frac{t}{h} \leq \frac{0{,}1t}{(500ms + 30ms)} \rightarrow 360\,\frac{t}{h} \leq \frac{0{,}1t}{0{,}53s} \rightarrow 360\,\frac{t}{h} \leq 679{,}25\,\frac{t}{h}$$

➔ Possible!

In addition one of the four on board digital outputs needs to be defined in data record 7 as the "Pulse output". In this example, digital output DQ.1 is used:

Assignment digital output DQ.1	Pulse output

→ After each 0,1 tons of totalized material, a 500ms pulse signal is generated on digital output DQ.1.

Contact

If you have any issues or suggestions regarding the related products or documents, please feel free to contact:

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