

Application description • 08/2014

## Gravimetric level measurement with SIWAREX U in the PCS 7 environment

SIMATIC PCS 7 and SIWAREX U Advanced Process Library

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# 1 Taskdescription and solution

## 1.1 Task

Dosing and weighing operations are often required in process automation. Different types of electronic weighing systems are used depending on the requirements of the process. The SIWAREX FTA and SIWAREX U have been approved for use in the PCS 7 environment as an electronic weighing system. The following table shows both modules with respect to different areas of application.

Table 1-1

	SIWAREX U	SIWAREX FTA
<b>Order number</b>	7MH4950-1AA01 (single channel version)  7MH4950-2AA01 (two-channel version)	7MH4900-2AA01
<b>Typical areas of application</b>	Simple weighing and force measuring tasks such as platform weighing machines or level measurement in silos and bunkers	Automatic and non-automatic weighing operation for the production of mixtures, filling, loading, monitoring, weighing checks and bagging
<b>Integration into automation systems</b>	<ul style="list-style-type: none"> <li>S7-300 (directly or via ET 200M)</li> <li>S7-400 (H), PCS 7 (H) (via ET 200M)</li> </ul>	<ul style="list-style-type: none"> <li>S7-300 (directly or via ET 200M)</li> <li>S7-400 (H), PCS 7 (H) (via ET 200M)</li> </ul>
<b>Resolution</b>	65,000 parts	16 million parts
<b>Permitted</b>	ATEX 95, FM, $cUL_{US}$	ATEX 95, FM, $uCL_{US}$ , EU type examination according to MID (CE, OIML R76), EU type examination according to MID (OIML R51, R61, R107) for custody transfer applications.

### Note

The following descriptions only relate to the SIWAREX U.

You can find an Application Example for the SIWAREX FTA in the Siemens Industry Online Support portal under the Entry ID 98754978

In the process industry, a common use of the electronic weighing system is the gravimetric level measurement of a storage silo. The gravimetric level measurement should be:

- precise enough
- fast
- reliable
- integrated seamlessly in the process control system

## 1.2 Solution

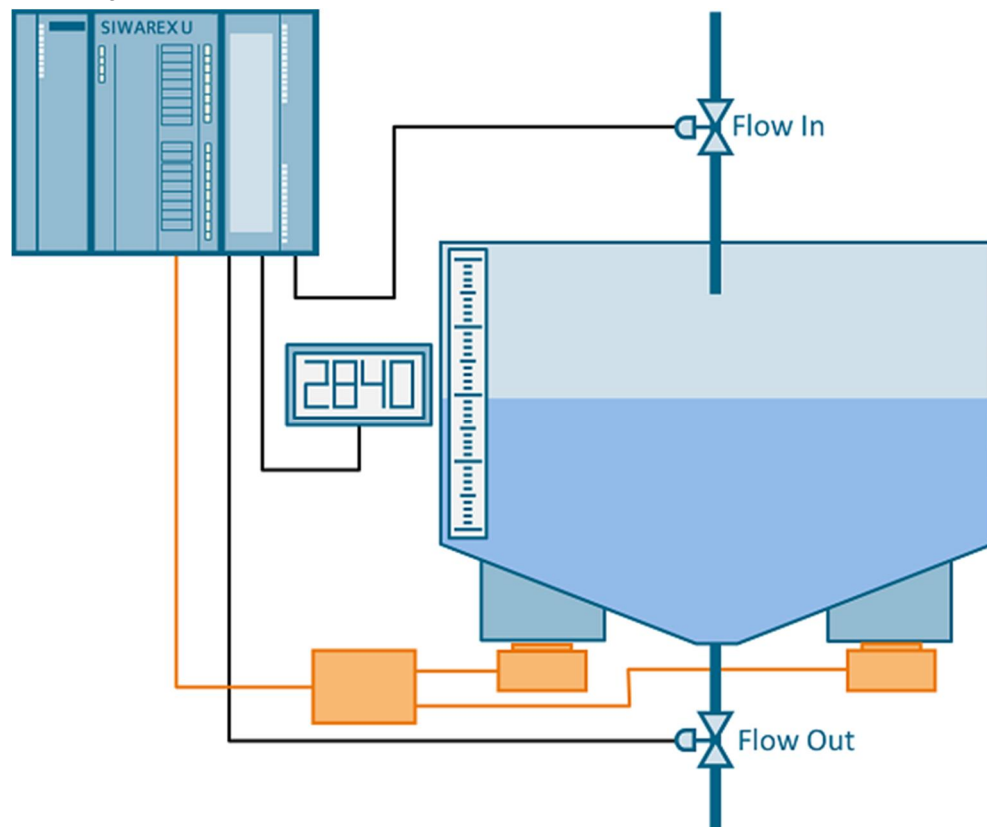
The following Application Example describes the application of a gravimetric level measurement in the PCS 7 environment. The level of a storage silo should be monitored during the process. The following requirements are imposed on the solution:

- The level of the storage silo is detected gravimetrically (by weight), and transmitted to the control system
- The HIGH and LOW limits are defined in the AS and are evaluated
- Display of the current level locally by means of a simple display
- Zero setting of the scale when needed, e.g. in case of contamination

The Application Example provides a template that comprises all typical components, their control system, the necessary logic as well as the visualization.

The figure below describes the schematic structure of the solution:

Abbildung 1-1



### Customer benefits

The following configuration example enables you to significantly reduce your engineering effort when using PCS 7 standard agents while improving performance. You can use the solution for both new configurations as well as for integration into existing projects.

The required hardware and software products are all made by Siemens and guarantee the compatibility, actuality and upgrade options you are accustomed to.

When using the SIWAREX U - Advanced Process Library you also get the following benefits

- A reduction of the required knowledge to develop applications
- A decrease in the configuration effort
- Flexible installation and customization through reusability of the program structures used
- Guaranteed Siemens support
- Standardized and tested solutions
- Engineering in a familiar PCS 7 environment
- Library module with online help (F1) in German and English
- Setup in German and English

### **Core contents of the application description**

- Advantages
- Required hardware and software
- Installation and assembly
- Adjustment
- Configuring of functions

### **Validity**

The SIWAREX U – Advanced Process Library modules used in this application description have been approved for use with all PCS 7 versions starting from PCS 7 V8.0 Update 1.

The description and screenshots of the described configuration example have been made with PCS 7 V8.0 SP1.

## 2 General library information

### Mode of operation

The library is used to connect the SIWAREX U to PCS 7 via APL-compliant (Advanced Process Library) blocks.

The library consists of these three modules:

- "SiwaU08" for scale functionality
- "CMD\_SU08" to control commands in automatic mode
- "MOD\_SU08" for maintenance

### Channel and function block

The "SiwaU08" module serves as a channel and Function Block. This allows data to be transferred cyclically via the peripheral interface and the various data records to be read from or written to the module acyclically.

The block icon and the corresponding faceplate allow the scale to be adjusted and, for example, to reset it to zero due to contamination.

### Command block

The "CMD\_SU08" block serves as an upstream block for the automatic commands of the "SiwaU08".

### Maintenance block

This is not used in this Application Example.

### Text library

In addition to the blocks, the library also contains a text library with the message texts and block icons for operation via the Operator Station (hereinafter abbreviated to OS).



## 2.1 Requirements

### 2.1.1 Hardware requirements

The conditions of STEP 7 and WinCC apply for installation.

In addition, the relevant requirements, e.g. the ones for the PCS 7 Basic Library V8.0, also apply.

The library supports the functions of the SIWAREX U-1 (7MH4950-1AA01) or SIWAREX U-2 (7MH4950-2AA01) modules.

The following table lists the hardware components used in the Application Example:

Table 2-1

Type	Order number	Firmware version
CPU 417-4H	6ES7 417-4HT14-0AB0	V4.5
CP 443-5 Ext	6GK7 443-5DX04-0XE0	V6.6
IM 153-2, redundant	6ES7 153-2BA02-0XB0	
SIWAREX U	7MH4950-1AA01 (single-channel SIWAREX U) 7MH4950-2AA01 (dual-channel SIWAREX U)	
"SIWAREX U APL" configuration package	7MH4950-3AK65	

### 2.1.2 Software requirement

The following software components are required for the gravimetric level measurement presented in this Application Example:

- SIWAREX U - Advanced Process Library
- SIMATIC PCS 7 from Version 8.0 Update 1

## 2.2 Ordering and scope of delivery

The SIWAREX-U APL for SIMATIC PCS 7 V8.0 Update 1 configuration package can be purchased from the Siemens Industry Mall.

Scope of delivery:

- Function and channel blocks for CFC
- Block icon and faceplate for WinCC
- Online help (F1)
- SIWATOOL U PC software
- Manual (PDF format) in German and English

<https://mall.industry.siemens.com/mall/en/oms/Catalog/Product/7MH4900-2AK65>

## 2.3 Installation

### Installing the SIWAREX software

The installation CD includes the "SIWAREX U - Advanced Process Library", sample project and the manuals in German and English.

While installing the software, follow the instructions in the readme file under Chapter 4 "Installation and uninstallation" of the software.

After running the setup program, you will find these components in the following paths:

- Library  
  \Program Files (x86)\SIEMENS\STEP7\S7LIBS
- PCS 7 faceplates  
  \Program Files (x86)\SIEMENS\WINCC\Options\PDL\APL
- Sample project  
  \Program Files (x86)\SIEMENS\STEP7\EXAMPLES

When you open the "SIWAREX U - Advanced Process Library" for the first time, use the "Browse" function from the "Open" dialog to access the "SFT\_U08\_APL" library in the "S7Libs" Siemens folder.

## 3 Configuration and start-up

### User text libraries

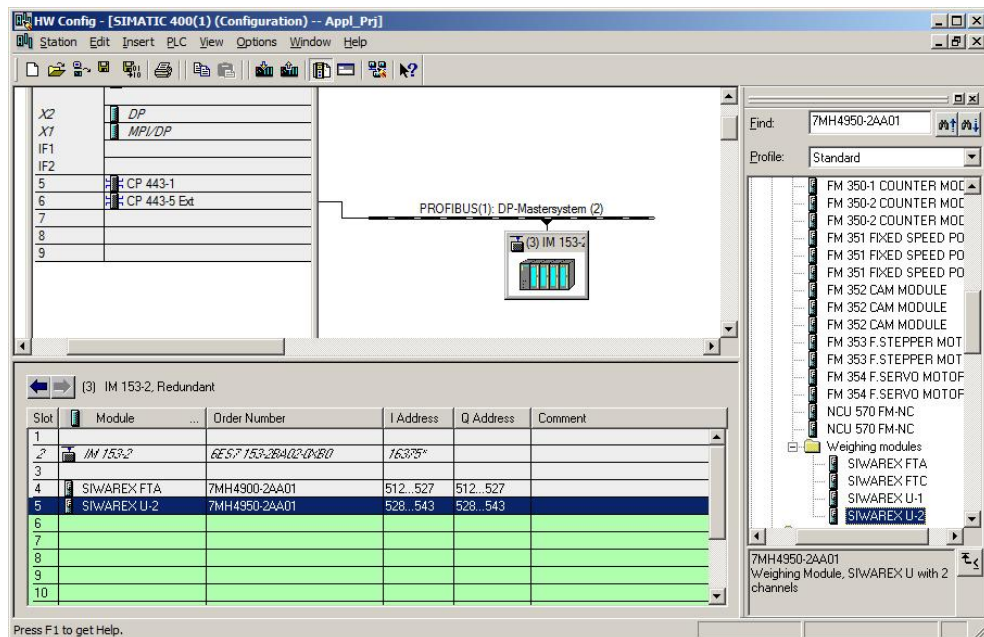
In addition to the error number, various messages in WinCC also contain error text from the user text library. The user text library must be copied by the user from the "SiwaU08" block library to the relevant project.

1. To do this, open the "SiwaU08" block library in SIMATIC Manager
2. Select the "Text Libraries" folder and copy it into your project. If your project already contains a folder for user text libraries, copy the user text library "SIWA\_U08\_DAT\_OP" from that folder to this folder.

### 3.1 Configuring the hardware

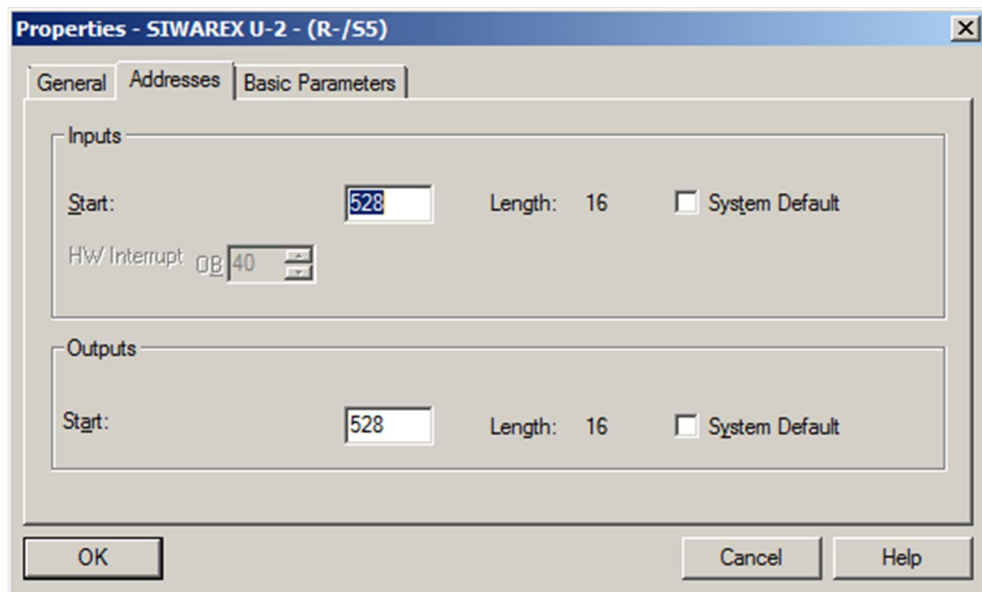
The SIWAREX U is located in the "Standard" catalog profile and it is pulled to the ET 200M via drag and drop.

Figure 3-1



The input and output addresses must lie within the process image of the CPU.

Figure 3-2

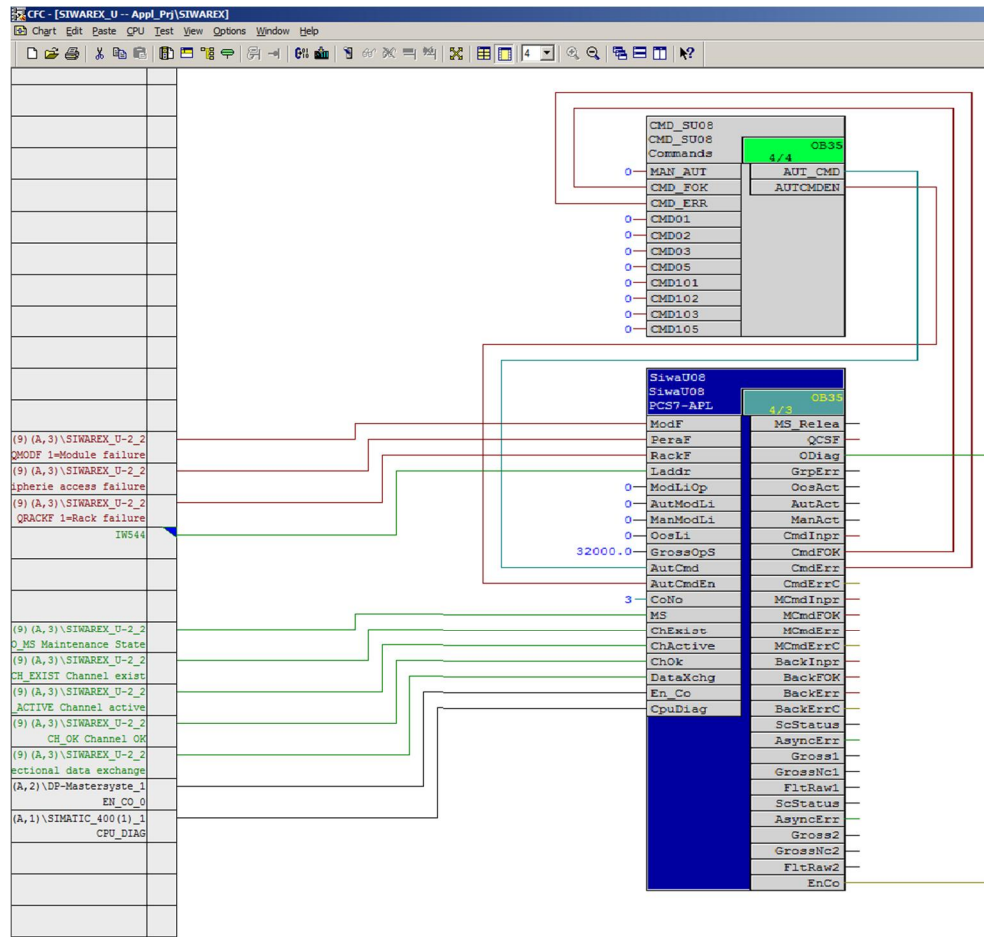


Once you have inserted the SIWAREX U and predefined the address range, save and compile the configuration, and close the hardware configuration.

### 3.2 Configuring the function blocks

The following figure shows the first configuration steps in the Continuous Function Chart.

Figure 3-3



The "Laddr" input of the "SiwaU08" block must be connected with the assigned address in the hardware configuration. The PCS 7 driver wizard then installs all the required driver blocks automatically (the "Create module driver" option must be activated when compiling). The block parameters "Modf", "PeraF", "RackF", "MS", "ChExist", "ChActive", "ChOk", "DataXchg", "CpuDiag", "ODIAG" and "EnCo" are connected by the driver wizard and the parameters of the inputs "Subn1Id", "Subn2Id", "RackNo", "SlotNo", "BasAdr", "Daddr" and "CoNo" are assigned according to the data from the hardware configuration.

**Note**

A sample CFC is available in the sample project for the SIWAREX U, which is included in the "SIWAREX U APL" configuration package. For more information, see the "SIWAREX U PCS 7 Advanced Process Library" Manual (Chapter 6, "Configuration Example").

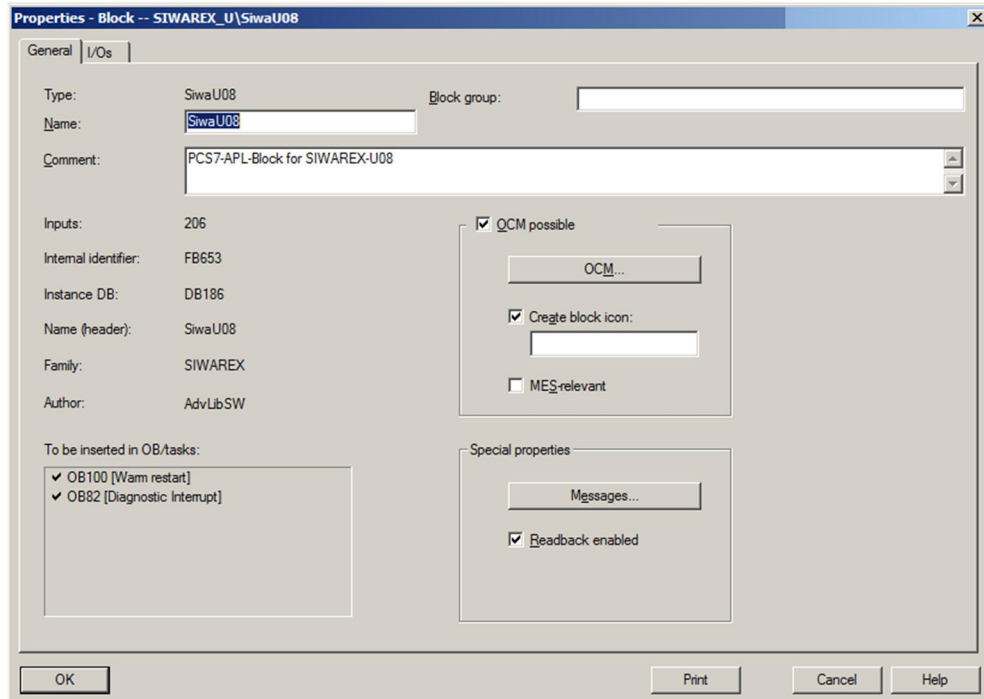
The following table describes the connections between the two function blocks "SiwaU08" and "CMD\_SU08".

Table 3-1

Module	Output		Block	Input
CMD_SU08	AUT_CMD	→	SiwaU08	AutCmd
CMD_SU08	AUTCMDEN	→	SiwaU08	AutCmdEn
SiwaU08	AutAct	→	CMD_SU08	Man_Out
SiwaU08	CmdFOK	→	CMD_SU08	CMD_FOK
SiwaU08	CmdErr	→	CMD_SU08	CMD_ERR

Activate the "Create block icon" option in the object properties of the "SiwaU08" function block. This is necessary to enable adjustment and commissioning via the faceplate.

Figure 3-4



## 3.3 Commissioning / Calibration

Commissioning and calibration are done with the help of the block icon or the faceplate and the "SiwaU08" function block.

In order to perform the commissioning and calibration from the faceplate, the following requirements must be met:

- Hardware is correctly installed and wired
- User program is compiled and loaded
- OS is compiled and has connection to AS

In the following chapters, descriptions only include those data records and their parameters that are required for commissioning and calibration. All other data records and their parameters that are needed for the requirements described for the implementation of the chapter [1.2](#) "solution" are described separately in the chapters belonging to the requirements.

### 3.3.1 Calibration parameters (DR 3)

The adjustment parameters of the SIWAREX U, which are required for the adjustment of the SIWAREX U are summarized in data record 3 (from now on, Data Record shall be abbreviated as DR). The scale is put into operation with these parameters and the adjustment.

#### Note

The adjustment parameters are to be checked for each scale and adapted if needed.

The SIWAREX U is available as a single and dual channel version. The adjustment parameters for channel 2 are summarized in DR 4. The current Application Example only describes channel 1.

General procedure:

- Check all parameters and calibrate if needed
- Send DR 3 to the SIWAREX U
- Perform adjustment
- Read DR 3 from the SIWAREX U  
(in the SIMATIC controller, so that in a fault scenario, the data can be loaded quickly into the module).

Detailed information about the parameters of the DR 3 is available in the "SIWAREX U Device manual", from Chapter 5.2 "DR 3 Adjustment parameters channel 1, DR 4 adjustment parameters channel 2".

### 3.3.2 Adjustment via faceplate

#### General information


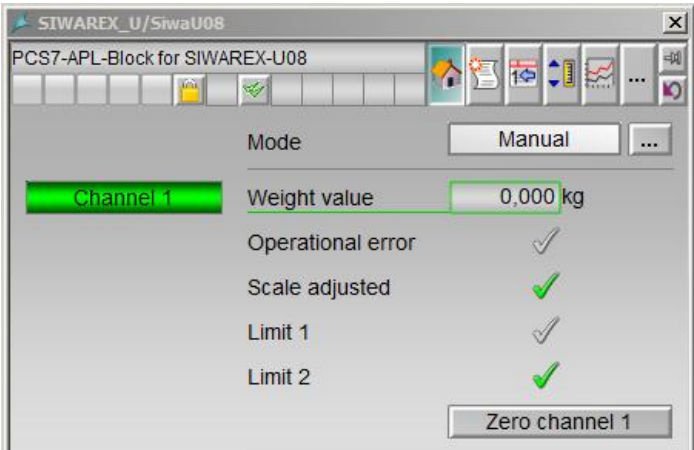
The scale can be adjusted in the following ways:

- SIWATOOL U (by means of a PC and an RS232 connection)
- CFC (via SiwaU block and DR 3 parameters)
- WinCC (via faceplate: writes and reads parameters of DR 3)

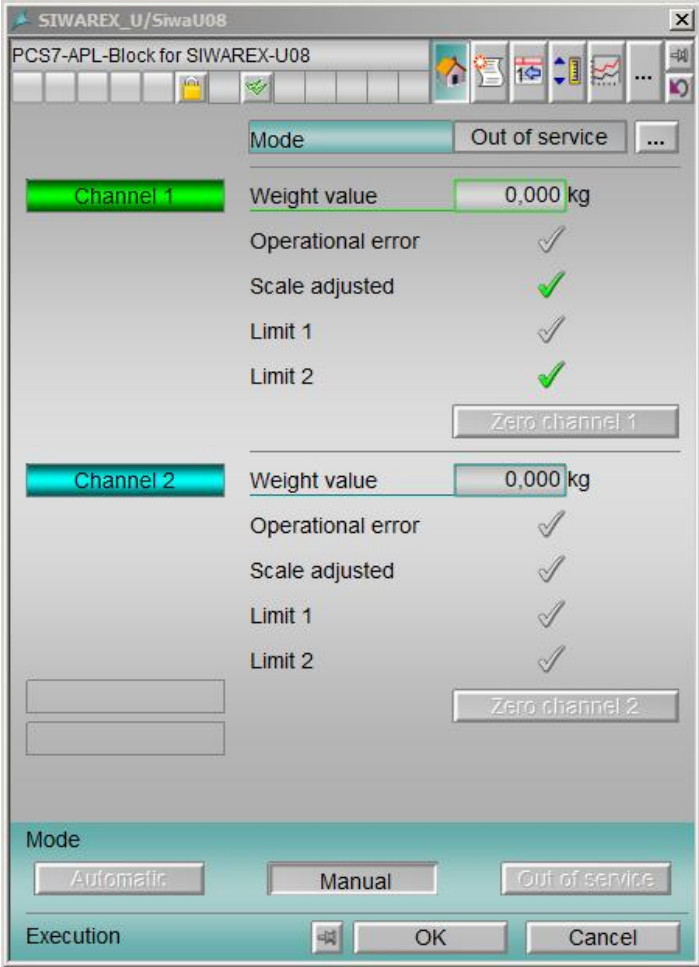
#### Description

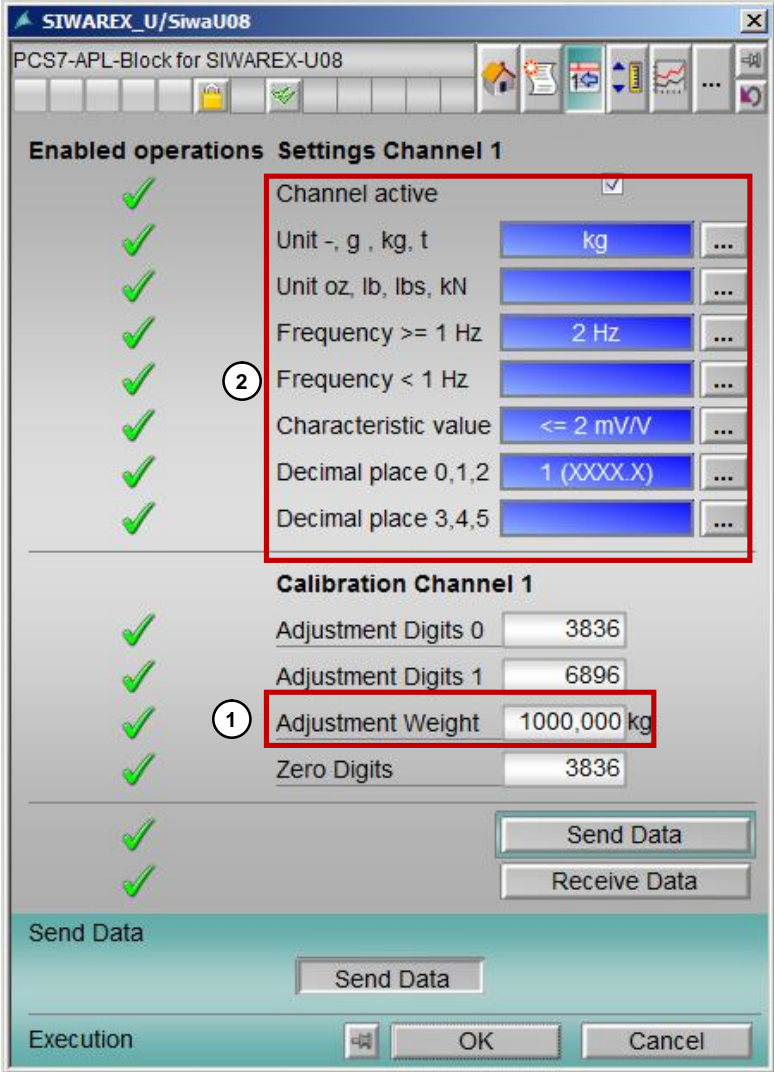
The following table describes the procedure for the adjustment in WinCC via the faceplate:

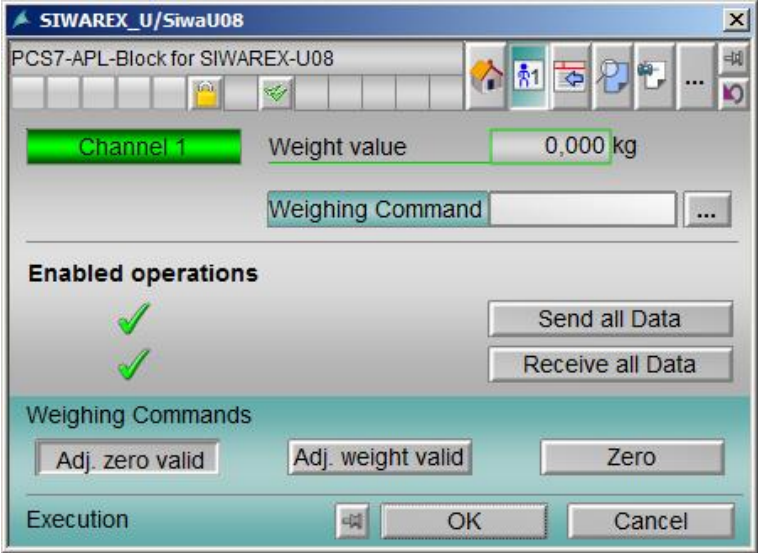
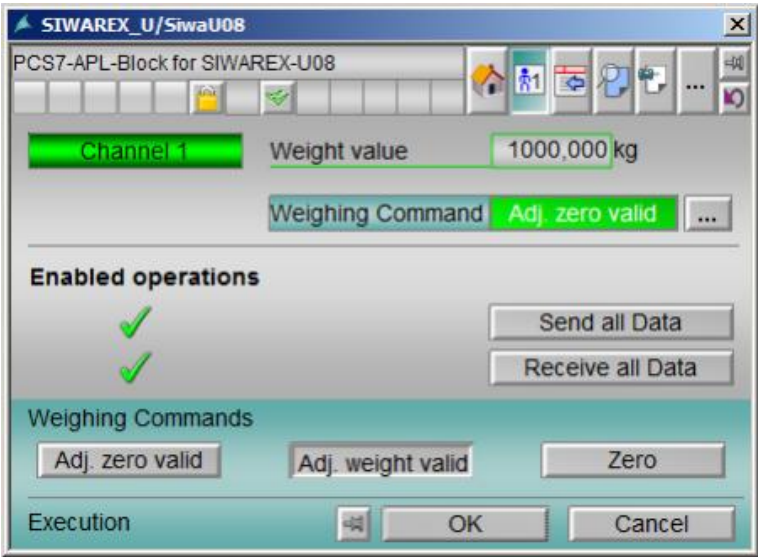
Table 3-2

Step	Action
1.	<p>Open the faceplate of the SIWAREX U by clicking the mouse on the block icon.</p>  <p>The faceplate opens in the "Standard" view.</p> 



Step	Action
2.	<p>Check if the "Manual" operating mode is activated. If not, activate the "Manual" operating mode.</p>  <p>The screenshot shows the SIWAREX U software interface for PCS7-APL-Block for SIWAREX-U08. It displays two channels, Channel 1 and Channel 2. Channel 1 has a weight value of 0,000 kg and is marked as 'Scale adjusted' with a green checkmark. Channel 2 also has a weight value of 0,000 kg and is marked as 'Scale adjusted' with a green checkmark. Both channels have 'Operational error', 'Limit 1', and 'Limit 2' status indicators, all of which are checked. At the bottom, the 'Mode' section shows 'Automatic', 'Manual', and 'Out of service' buttons, with 'Manual' being the active mode. The 'Execution' section at the very bottom has 'OK' and 'Cancel' buttons.</p>

Step	Action
3.	<p>Switch to "Scale parameters channel 1" view and enter the weight of the adjustment weights in the "Adjustment weight 1" (1) field.</p>  <p>If necessary, carry out the channel-specific settings (2) and then send the new values to the SIWAREX U via "Send Data".</p>

Step	Action
4.	<p>Switch back to the view "Operator input channel 1". Make sure that the scale is not loaded (empty scale or empty container) and run the scale command "adjustment point 0 valid".</p> 
5.	<p>Load the scale with the "Adjustment weight 1" entered in step 3. Run the scale command "Adjustment point 1 valid".</p>  <p>The scale is now adjusted. Finally, the determined adjustment parameter must be still read using "Receive all Data" in the control system. This concludes the adjustment.</p>

## 4 Configuring requirements

The following chapters describe the configurations that are necessary to meet the requirements described in chapter 1.2 "Solution".

### 4.1 Requirements

To meet the requirements, you must fulfill the following conditions:

- SIWAREX U is adjusted and put in operation
- Current data and states of the SIWAREX U are known

#### 4.1.1 Process value and state

##### Note

The described state and the described process value relate to channel 1 of the SIWAREX U.

The current weight and the current state of the SIWAREX U can be observed with the aid of the process value "Gross1" (Gross weight value channel 1) and the status "ScStatus1" (Status channel 1). Both values are transferred directly through the peripherals of the SIWAREX. This means that both values are read automatically into the controller without requesting a data record.

The status information is combined to form a BYTE. The weight value is present as a REAL type value.

The following table describes the information (bits) that can be used from the "ScStatus1" status for further processing.

Table 4-1

Bit no.	Name	Range of values / meaning
0.	Operating fault	1 = an operational fault exists
1.	Data, operation fault	1 = a data or operation fault has occurred during the last action.
2.	Limit 1 active	1 = Limit value 1 active
3.	Limit 2 active	1 = limit value 2 active
4.	Adjusted	1 = the scale has already been adjusted
5.	Measured value toggle bit	Measured value toggle bit is inverted with each new measured value
6.	Life bit	Live bit is set or reset according to specification (I/O communication only)

### 4.1.2 Access to status-bits of "ScStatus1"

The status of "Channel 1" of the SIWAREX U is summarized in a BYTE variable. These in turn form part of structural variables (consisting of value and signal status).

To access the individual status bits, the structure must be first resolved. Then, a type conversion must be also performed from BYTE to BIT.

No direct function is provided by PCS 7 to resolve the structure. A function has to be created to resolve the structure with SCL.

The "DW\_DO" function can be used for the type conversion from BYTE to BIT. However, this has the disadvantage that the outputs for the individual bits have no meaningful names (Out0 ... Out7).

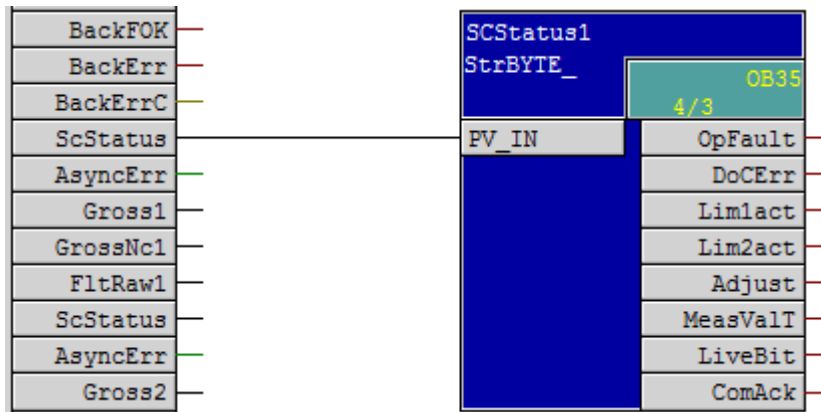
For this reason, we recommend you create a function that resolves the structure and outputs the individual status bits. Meaningful names can then be assigned to the outputs. This clearly facilitates the subsequent processing of the status bits.

In the present Application Example, a function has been created for the "Channel 1" status. The source can be found in the supplied example project.

**Note**

The source for the function that resolves the structure of the "ScStatus" can be found in the supplied sample project.

Figure 4-1 Function for access to status bits for ScStatus



## 4.2 Gravimetric level detection

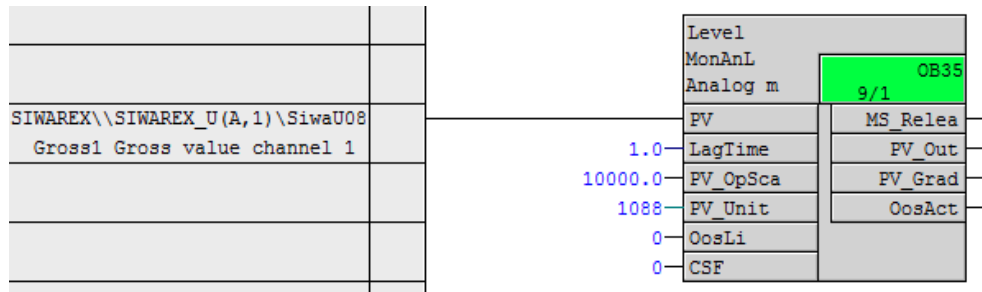
The level of a storage silo should be detected gravimetrically and transmitted to the control system.

After commissioning and adjustment as described in chapter 3 "Configuring and Commissioning", the current level is also provided as a weight value at the "Gross1" output of the "SiwaU08" block for further processing in the AS.

The current level is also shown in the block icon or in the faceplate of the OS.

In this Application Example, the "Gross1" value is connected to the "MonAnL" block. This enables the level to be monitored for its rate of change and for limit values that are important for the process. The monitoring is carried out independently of the limits that are also stored in the SIWAREX U and that are monitored there.

Figure 4-2



The current weight value is additionally displayed in the OS (block icon of the MonAnL).

### 4.3 Defining the limit values for HIGH and LOW

A HIGH and LOW limit should always be defined and monitored in the AS.

The definition of limit values for HIGH and LOW limit can be made via the faceplate of SIWAREX U.

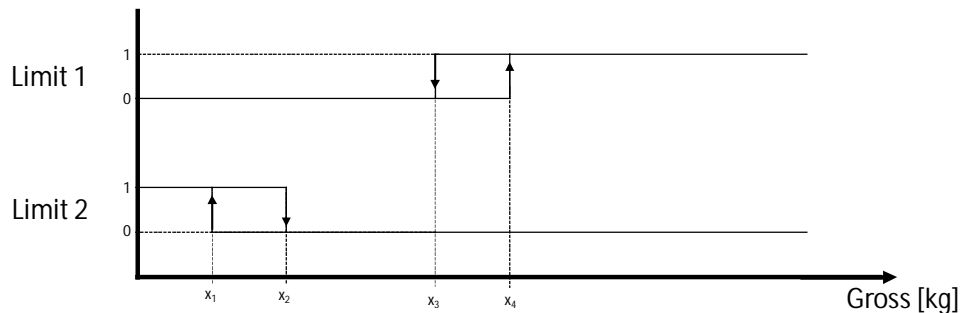
The following table describes the definition of the limit values via the faceplate.

Table 4-2

Step	Action
1.	Open the faceplate of SIWAREX U by clicking the mouse on the block icon and turn on the "Manual" operating mode.
2.	Switch back to the view "Limit values channel 1"
3.	Assign appropriate switch-on and cut-off limit values for Limit 1 and Limit 2. <div> </div> <p>In this Application Example, Limit 1 is used as the high limit and Limit 2 as the low limit.</p>
4.	Then, send the data to the SIWAREX U.
5.	Read the data from the SIWAREX U.

The following figure shows at which weights the status bits for Limit 1 and Limit 2 are set and reset.

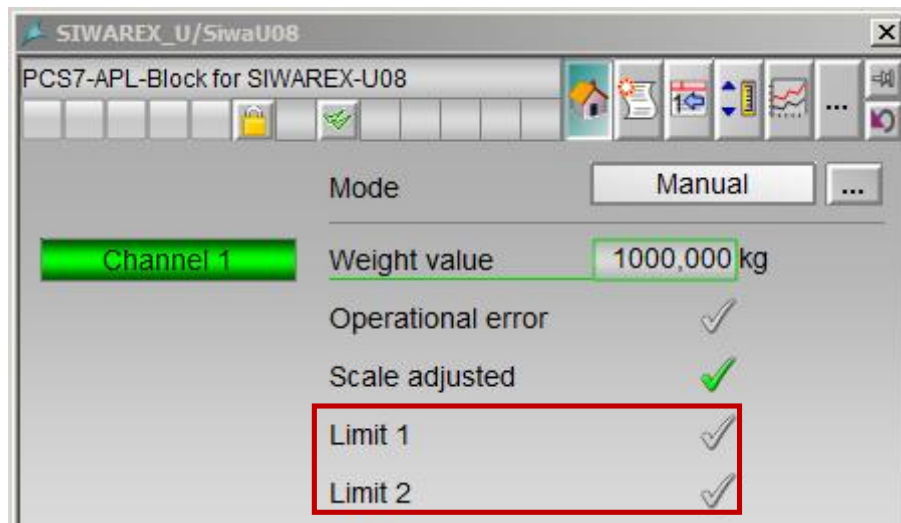
Figure 4-3



$x_1 = 0,000 \text{ kg}$	$x_3 = 10000,000 \text{ kg}$
$x_2 = 5,000 \text{ kg}$	$x_4 = 10100,000 \text{ kg}$

Whether one of the two limits is active, this is shown in the faceplate, in the "standard" view.

Figure 4-4



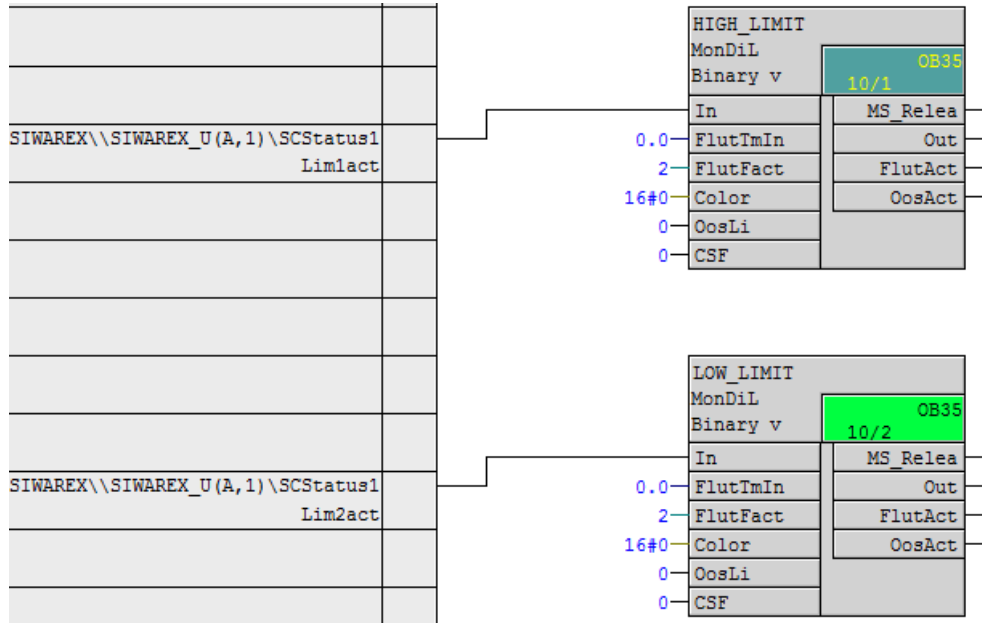
Furthermore, from the "ScStatus" one can also check whether the limits are active. For this purpose, the present Application Example uses the function "StrBYTE\_TO\_BIT\_ScStatus" (see chapter 4.1.2). The function module allows the current status of both limits to be connected to the AS for further processing/analysis.

In this application example, the limit values are not regarded as important values from a processing point of view, but serve instead as a protection against overflow or mechanical destruction.



In this application example, the limit values are connected with one "MonDiL" block each. In this way, the upper limit or lower limit violation is reported in the OS.

Figure 4-5



## 4.4 Local level indicator

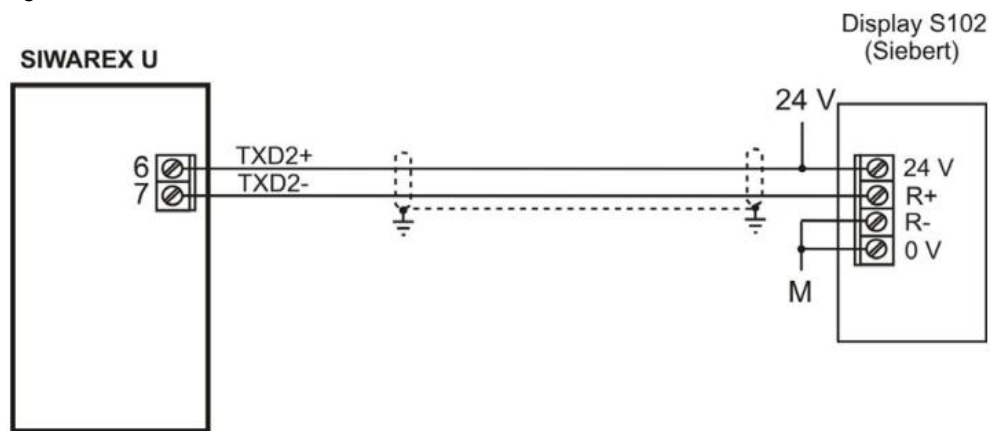
The current level is displayed locally from a simple display.

A Siebert display can be used as a local level indicator. The remote displays "S102" and "S302" can be used for the SIWAREX U.

**Note** For more information about the indicating devices, see [www.siebert.de](http://www.siebert.de).

Wiring is done as described in the following figure (for S102):

Figure 4-6



For the display to always show the current weight value, the display type must be defined in DR 5 (General parameters).

To define the display type without SIWATOOL, proceed as described in the following table:

Table 4-3

Step	Action
1.	Open the CFC chart containing the "SiwaU08" block and switch the block to MANUAL.
2.	Activate the test mode.
3.	Select the "SiwaU08" block and activate the "Monitoring ON" function.
4.	Open the object properties of the block.
5.	Switch to the "Connectors" tab.
6.	Switch the following connections to visible: <ul style="list-style-type: none"> <li>• TRDisp_M</li> <li>• TRDisp_O</li> <li>• ManCmd</li> </ul>
7.	Enter the value "205" (read DR 5) at the "ManCmd" input. The in-out parameter is set back to 0 after a successful read from DR 5.
8.	Check whether the value "16#3" is present at the "TRDisp_O" output.
9.	If this is not the case, then enter the value "16#3" at the "TRDisp_O" input.

Step	Action
10.	Follow this by entering the value 405 at the "ManCmd" input and then check whether the value "16#3" is present at the "TRDisp_O" output by means of "ManCmd" = 205.
11.	If this is not the case, repeat steps 7 to 10.
12.	Then switch the connections mentioned in point 6 back to invisible.
13.	The SIWAREX U is now configured for the local display of the weight value.

Alternatively, the display type can be also set locally by means of a PC and the software SIWATOOL.

## 4.5 Setting to zero when needed

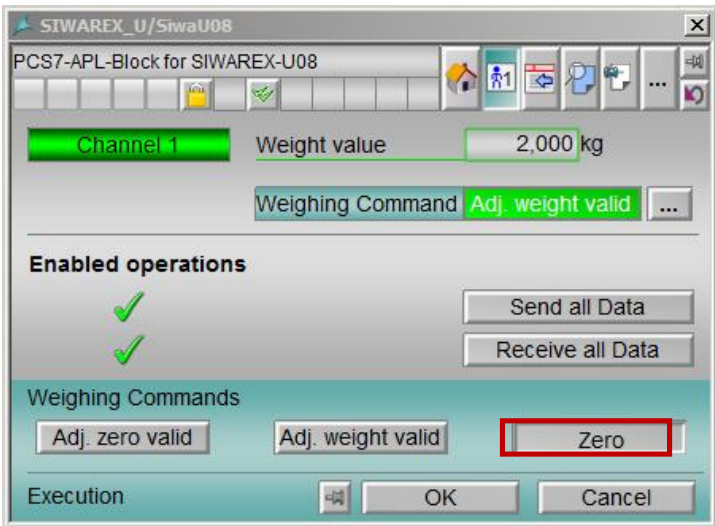
If necessary, the scale (for example, due to contamination) can be set to zero.

The scale can be set to zero via the faceplate.

To do this, the SIWAREX U must be switched to "Manual" operating mode.

The following table describes the procedure:

Table 4-4

Step	Action
1.	Open the faceplate of SIWAREX U by clicking the mouse on the block icon and turn on the "Manual" operating mode.
2.	Switch back to the view "Operator input channel 1".
3.	Run the scale command "Set to zero". 
4.	The scale is now "set to zero". Through this, the limit monitoring values for LOW limit are taken over.

## 5 History

Table 5-1

Version	Date	Change
V1.0	08/2014	First edition