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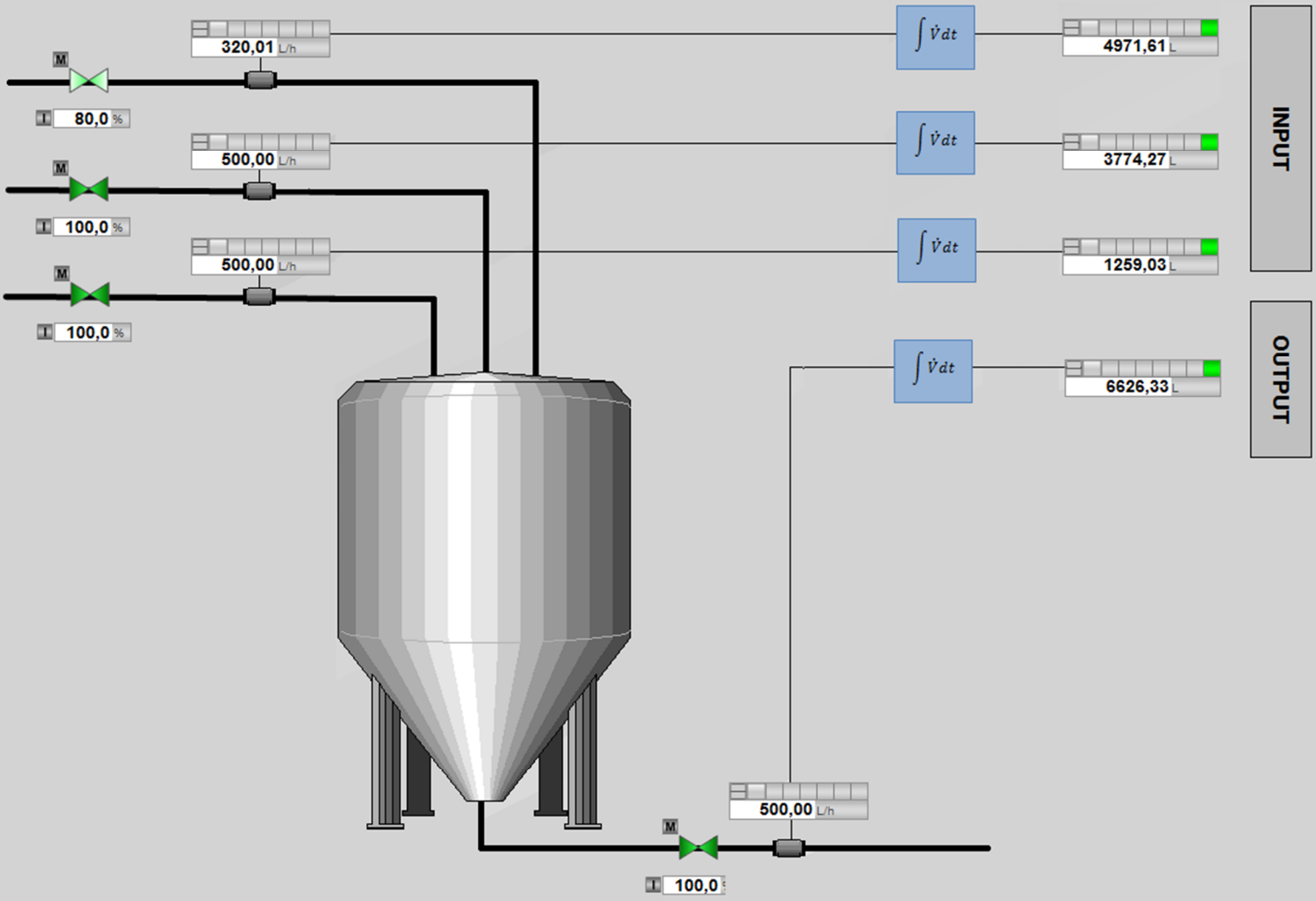

Application description • 10/2014

Integral calculation in PCS 7 with "Integral" FB or "TotalL" FB

PCS 7 V8.0 SP2

http://support.automation.siemens.com/WW/view/de/102052080

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1 Task description and solution

1.1 Task

In automation technology, material flows (e.g. volume flows) are commonly monitored and controlled in order to, for example, achieve a constant level or a continuous material output. During the process, the current values of the specified material flows are recorded.

In order to determine the amount of supplied material or the amount of output material over a specified period, the material flow must be integrated. Based on the obtained results, the quality of the process can be assessed and appropriate measures can be taken when needed to increase productivity.

1.2 Solution

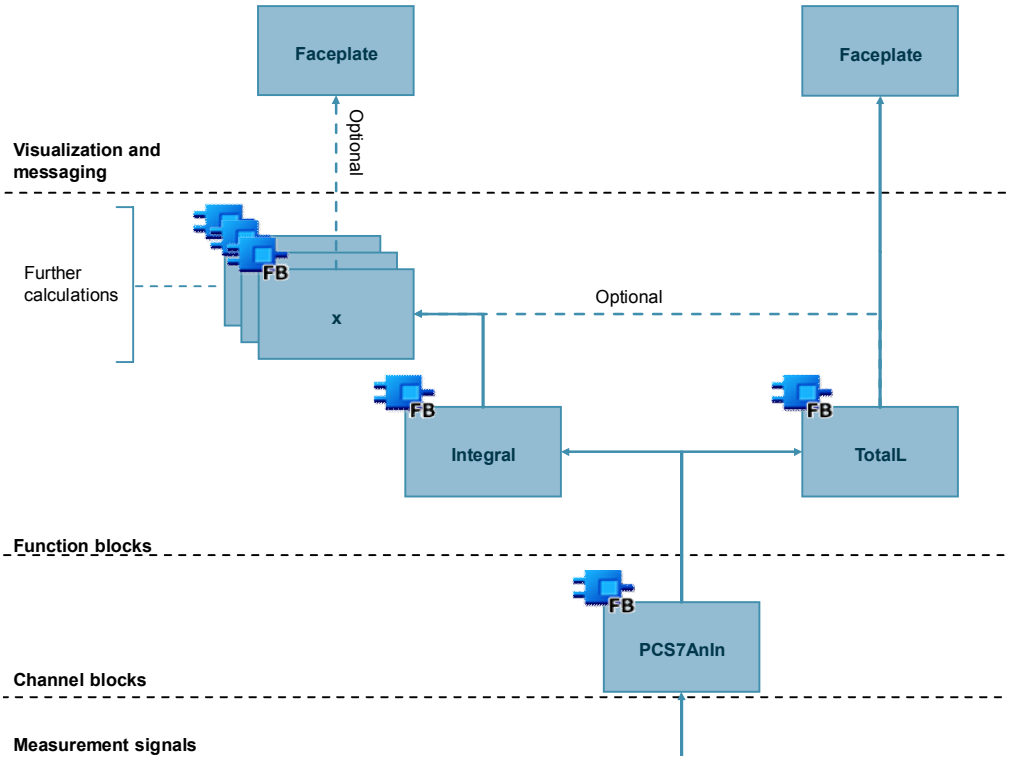
This Application Example describes how to calculate material quantities by using PCS 7 standard blocks from the APL (Advanced Process Library).

Two different solution possibilities with the "Integral" and "TotalL" APL function blocks shall be shown to you.

The description is based on the integration of a flow (measured signal) and contains the necessary configuration steps for the "Integral" FB and the "TotalL" FB. Furthermore, the individual functions and properties of the FBs, used to establish the quantities of material, are also presented.

The figure below describes the basic structure of the presented solutions:

Figure 1–1



Benefits

- Guaranteed Siemens support
- Rapid determination of the appropriate solution for the automation sub-task

Core contents of the Application Example

- Configuring the integral function
- Description of the block functions for the implementation of the automation sub-task

Scope

The blocks used in this Application Example are included in the APL version V7.1 SP5 and upwards.

The description and the screenshots of the described Application Example were made with PCS 7 V8.0 SP2 and APL V8.0 SP2 Upd 2.

1.2.1 Solution with "Integral" FB

A measured value is integrated with the "Integral" FB, and is then available for further processing in the FB output of the AS. The FB is not able to generate messages and cannot be controlled or monitored during operation.

This solution is particularly suitable when the integral value in the AS is required for further calculations. No runtime POs are issued for this FB during licensing.

The integration can be made controllable and monitorable from the available control and monitoring modules available in the APL.

Note

You can find a description of the functions and modes of operation of the control and monitoring modules in the Function Manual "SIMATIC Process Control System PCS 7 Advanced Process Library (V8.0 SP2)".

When using the control and monitoring modules, runtime POs are issued during licensing.

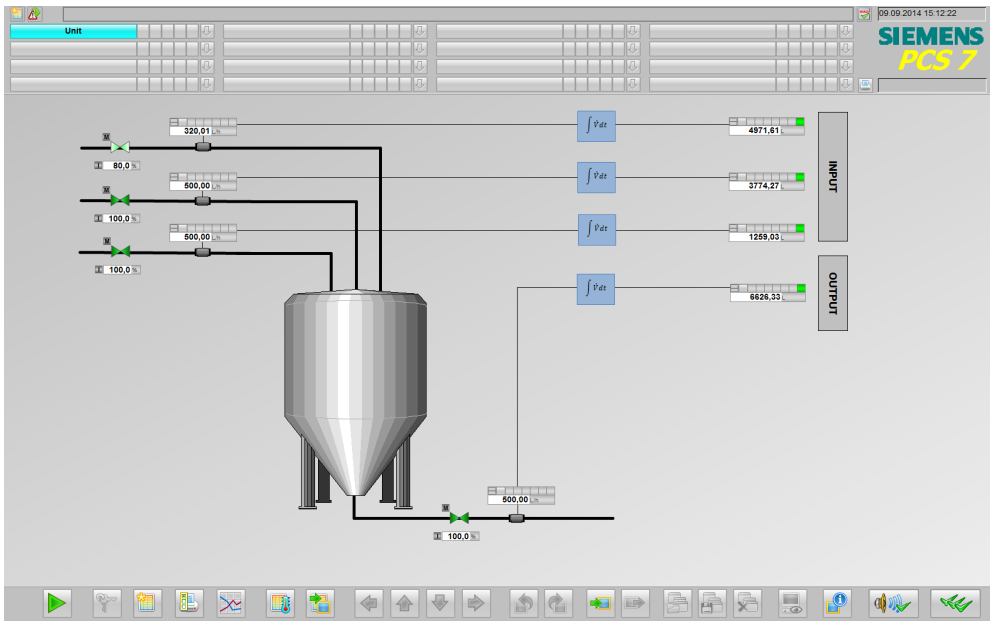
1.2.2 Solution with "TotalL"

The measured value is integrated with the "TotalL" FB, and is then available for further processing in the FB output of the AS. The FB is able to generate messages and can be controlled or monitored in WinCC via the included block icon and faceplate. The block is able to generate messages, meaning that alarms are triggered when, for example, a defined limiting value is exceeded.

This solution is particularly suitable when the integral value or the integration is supposed to be controllable and monitorable, and when monitoring for limit violation is required. Since the FB is controllable and monitorable and also able to generate messages, POs are issued during licensing.

The following figure shows a possible visualization of the solution with the "totalL" FB:

Figure 1–2



2 Function mechanisms

The core functionalities of both the "Integral" and "TotalL" function blocks are described below.

2.1 "Integral" function block

The "Integral" function block is used to form a time integral over a connected input signal. It can also be used to form the integral component for the installation of the controller.

The function block integrates the "In" input signal according to the trapezoidal rule, and outputs the result to the "Out" output.

Limit monitoring

Limiting values for the integrated value "Out" can be predefined at the function block. If the limiting values are reached or exceeded, the preset limit is set and the "Out" output is given out.

When a limit is reached or exceeded/underranged, the outputs "OutHiAct" and "OutLoAct" are set to 1. An evaluation of the upper limit violation is therefore possible in the AS.

Track values

The "OutTrkOn" block input allows the "Track values" function to be activated. As a result of which, the value you set at the "OutTrk" input is given out at the "Out" output. The value is output as long as the "Track values" function remains active.

If the tracking is exited, the function block uses the current value at the output "Out" as the first to be integrated. This corresponds to the value "OutTrk".

In this way, the integral value can be set, for example, back to 0.

Hold integration

The input parameter "Hold" allows the integration to be put on hold. Once the integration is continued, the current value at output "Out" is used for the integration process.

Startup characteristics

The feature bit 0 allows the determination of whether the last saved value should be given out at output "Out" during startup or whether the "Out" output is reset to 0.

Note A detailed description of the functions and the mode of operation of the "integral" function block can be found in chapter 11.8 "Integral - Generating a time integral" of the Function Manual "SIMATIC Process Control System PCS 7 Advanced Process Library (V8.0 SP2)".

2.2 "TotalL" function block

The "TotalL" function block allows the upward or downward integration of an analog input value. It can also be used for triggered or continuous summing (upwards or downwards).

Depending on the set counting, the function block integrates the "in" input signal according to the trapezoidal rule, and outputs the result to the "Out" output.

Note This Application Example only deals with the integral function and the necessary functions of the "TotalL" block.

Counting limit monitoring

The "TotalL" function block allows the function for the monitoring of the upper and lower alarm, warning and tolerance limiting values to be activated (each limit separately). The limiting value monitoring of the integral direction depends on this. The upper limiting values are monitored during the upward integration and the lower ones are monitored during downward integration.

If a limiting value is reached or exceeded, a corresponding message is generated.

Startup characteristics

The feature bit 0 allows the determination of whether the last saved value should be given out at output "Out" during startup or whether the "Out" output is reset to 0.

Setting the integral value to preset

The "Setting the integral value to preset" function is similar to the "Track values" function of the "Integral" function block.

Presetting is done via the "PresetVal" input parameter. The value can be set by an interconnection or from the faceplate by the operator. If the "PresetVal" input parameter is not interconnected, presetting can be done from the faceplate.

Switching the integrator on and off

Integration can be put on hold or its direction can be changed from the faceplate or via the UpOp, OffOp and DnOp input parameters.

After a change of direction or continuation of the integration, the current value at the "Out" output is used for the integration process.

Message behavior

The function block generates messages depending on the configured limiting values. These messages can be suppressed from the appropriate settings "MsgEn" and "MsgLock".

HMI

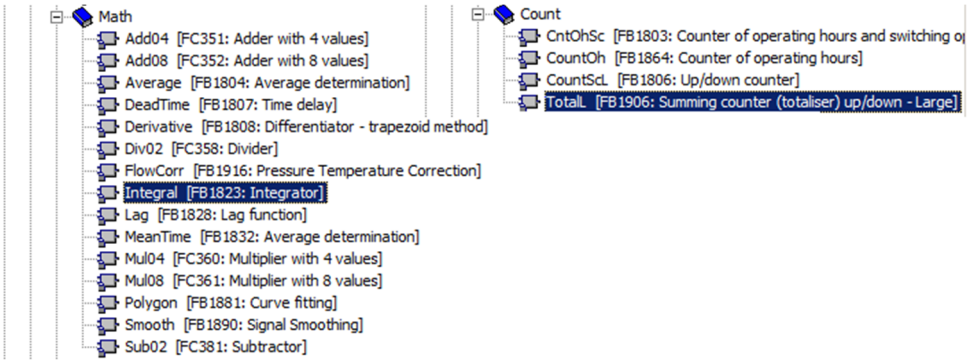
The function block is controllable and monitorable. Various block icons are available. The faceplate allows, among other things, the display of messages (Message view), calling reports (Trend view), changing limiting values and changing parameters such as, for example, the integral time (Parameters view). The integral direction, integral value and the value of the input signal to be integrated are among the values shown in the standard view. The "InUnit" and "OutUnit" input parameters allow the units to be predefined by the input signal and integral value. These parameters are displayed in the Standard view.

Note A detailed description of the functions and the mode of operation of the "integral" function block can be found in chapter 9.3 "TotalL - Additive counter with upward or downward counting direction (totalizer)" of the Function Manual "SIMATIC Process Control System PCS 7 Advanced Process Library (V8.0 SP2)".

3 Configuring of functions

The APL contains the "Integral" and "TotalL" function blocks. The "Integral" FB forms part of the "Math" block family. The "TotalL" FB forms part of the "Count" block family. Adding in a CFC chart is done by drag and drop.

Figure 3–1



In the "TotalL" FB, the mode of operation of the block must still be configured as integrator via the „Feature“ (Bit6) input parameter.

3.1 Configuring the SampleTime and integral time

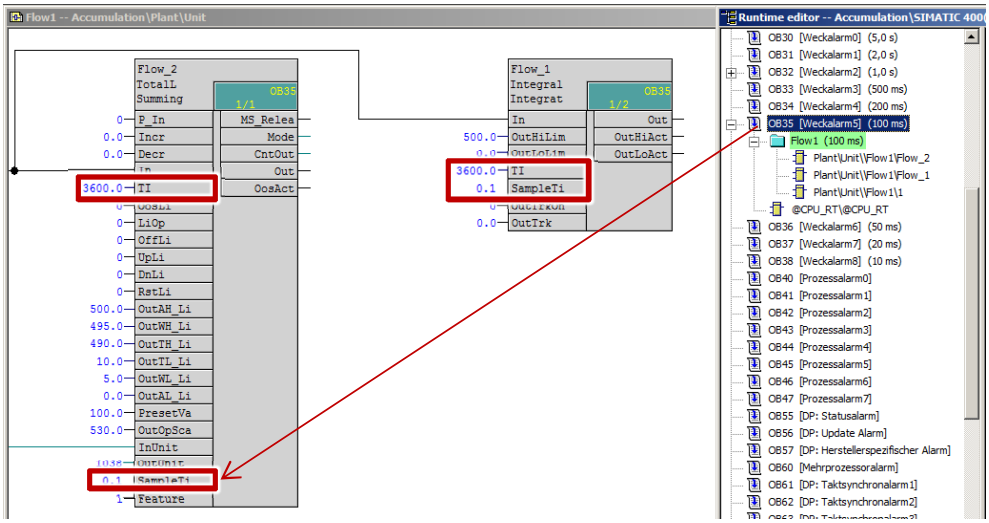
The "SampleTime" and the integral time must be configured in the same way on both function blocks via the "SampleTime" and "Ti" input parameters.

The value of the "SampleTime" parameter is determined automatically from the called cyclic interrupt (OBxx). Changing this value is only possible by switching to another cyclic interrupt.

The integral time must be configured according to the input signal. The integral time is measured in seconds. The preset value is 1. If the physical unit of the input signal is in the "unit/second" form (e.g. B. L/s), the preset value should be kept.
If the physical unit of the input signal is in the "unit/minute" form (e.g. L/min), the value of the "Ti" input parameter must be changed to 60 (60 seconds = 1 minute). The situation is analogous to all other time units.

In this Application Example, the physical unit of the input signal is L/h. Accordingly, the value of the "Ti" input parameter is 3600. The following figure shows the configuration of the "SampleTime" and "Ti" input parameters of the "Integral" and "totalL" function blocks in the CFC.

Figure 3–2



When configuring "SampleTime" and "Ti", one has to ensure that the value for "Ti" is not within the following range:

$$-\frac{SampleTime}{2} < TI < \frac{SampleTime}{2}$$

3.2 Resetting the integral value

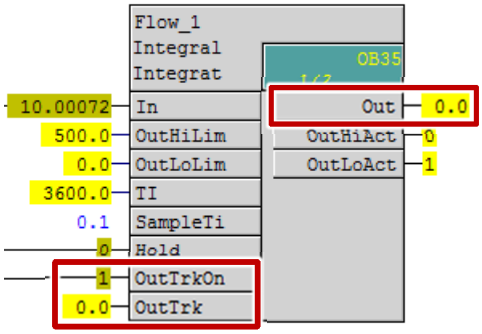
The integral value of both function blocks can be reset to 0 by configuring a preset integral value.

"Integral" function block

The integral value in the "Integral" function block is reset to 0 via the "OutTrk" and "OutTrkOn" input parameters.

The value 0 is to be entered in the "OutTrk" input parameter. If the "OutTrkOn" input parameter is set to 1, the value 0 is given out at the "Out" output parameter (Out.Value = OutTrk.Value).

Figure 3–3



The integral value can be reset from an interconnection or through the Online view in the CFC chart. If the reset is to be done via the user interface in WinCC, the "OutTrkOn" input parameter can be interconnected to the "Out" output parameter of a block from the "Operate" family (e.g. "OpTrig"). It is then possible to perform the reset via the faceplate of the connected block from the "Operate" family.

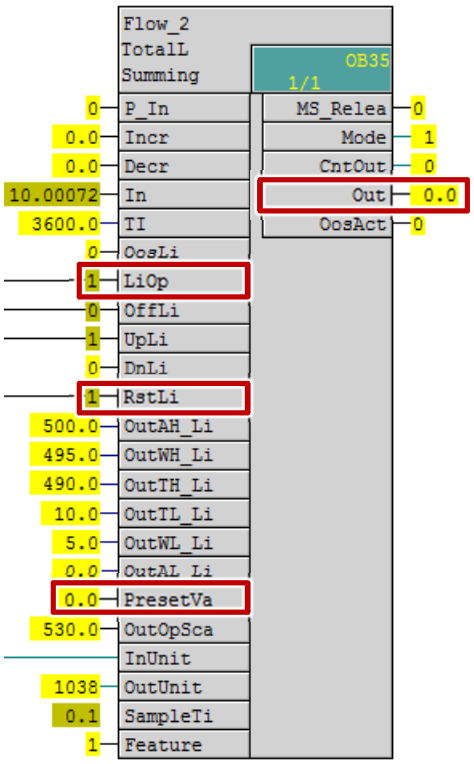
"TotalL" function block

The integral value is reset to 0 at the function block "TotalL" via the input parameters "PresetValue", "RstLi" (input parameter "LiOp" = 1) and "RstOp" (input parameter "LiOp" = 0). The "RstOp" input parameter is controlled from the faceplate.

The value 0 is to be entered in the "PresetValue" input parameter. This can be done in the CFC directly from the block or in the parameter view of the faceplate. An interconnection to another block is not necessary for setting the preset value in WinCC.

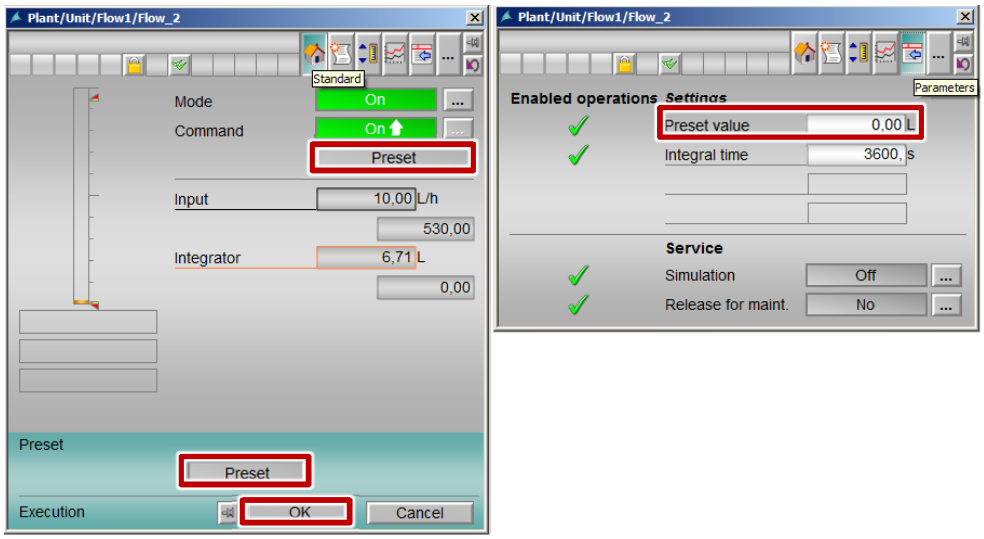
If the value 1 is set during a reset via an interconnection to the input parameter RstLi, the value 0 is given out at the "Out" output (Out.Value = Preset.Value).

Figure 3–4 Reset via interconnection



When performing a reset from the faceplate, the "RstOp" input parameter is set to 1. The reset is done from the "Preset" button in the "standard" view of the faceplate.

Figure 3–5 resetting



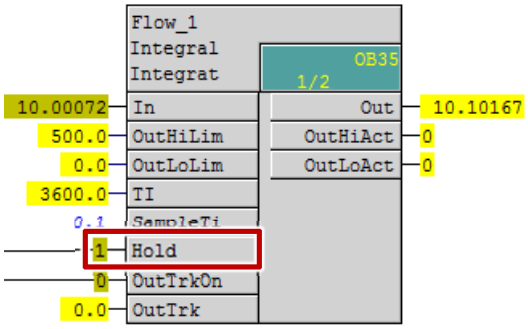
3.3 Putting the integration on hold

The integration of both function blocks can be put on hold. The final integral value is then written permanently to the "Out" output of the function blocks.

"Integral" function block

The integration of the "Integral" function block can be put on hold from the "Hold" input parameter. If this value is set to 1, the integration is put on hold. Once it is set back to 0, the integration is resumed.

Figure 3–6



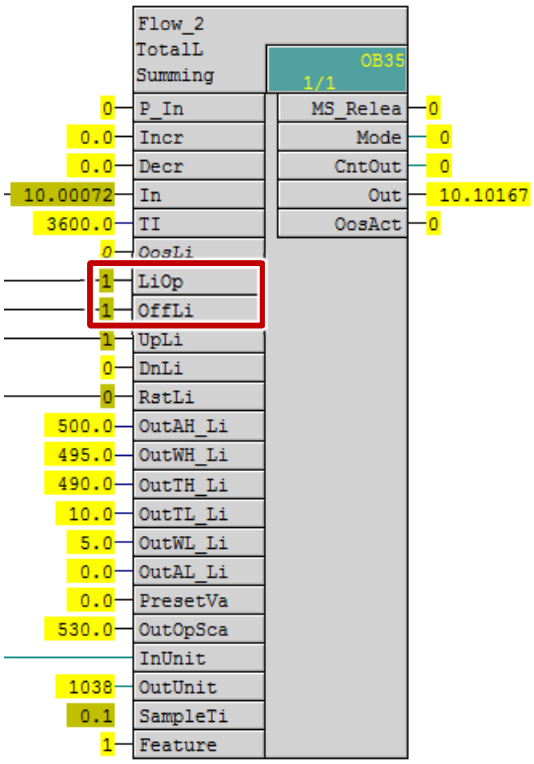
The integration can be only put on hold from an interconnection or through the Online view in the CFC chart. If the integration is to be put on hold from the user interface, the "Hold" input parameter can be interconnected to the "Out" output parameter of a block from the "Operate" family (e.g. "OpTrig"). It is then possible to put on hold via the faceplate of the connected block from the "Operate" family.

"TotalL" function block

The integration of the "TotalL" function block is put on hold via the input parameters "OffLi" (input parameter "LiOp" = 1) or "OffOp" (input parameter "LiOp" = 0).
The "OffOp" input parameter is controlled from the faceplate.

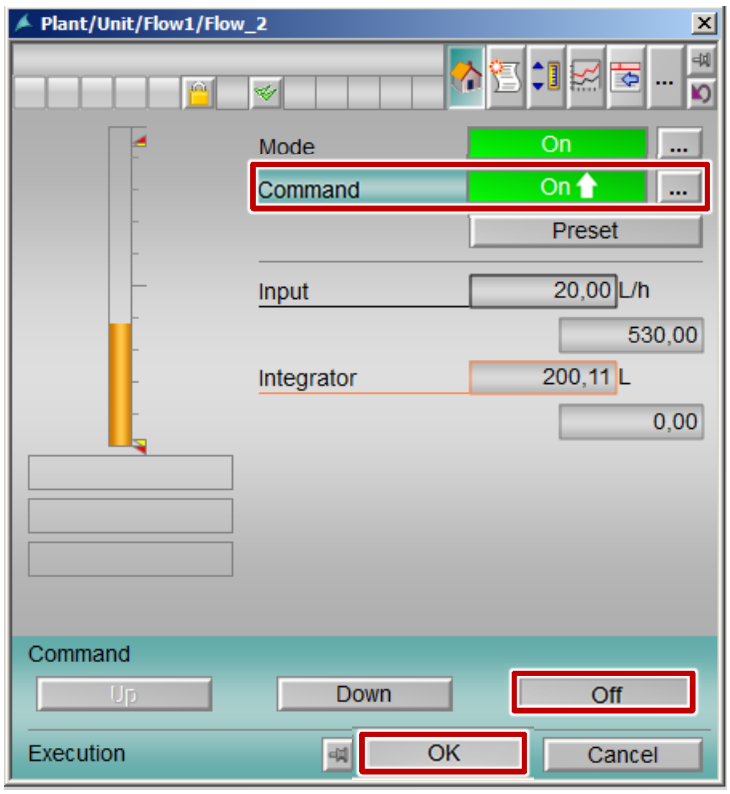
If this value of the "OffLi" input parameter is set to 1, the integration is put on hold. The last integral value is written permanently at the "Out" output. If the "OffLi" input parameter is reset to 0, the integration resumes with the recent integral value, as long as one of the two input parameters "UPLI" (upward integration) or "DnLi" (downward integration) and the "LiOp" input parameter is set to 1.

Figure 3–7 Putting the integration on hold from the interconnection



The input parameters "OffOp", "UpOp" and "DnOp" are written out from the faceplate. The integration can be put on hold from the "Command" section in the "Standard" view. The integration can be also resumed from the "Command" section in the "Standard" view.

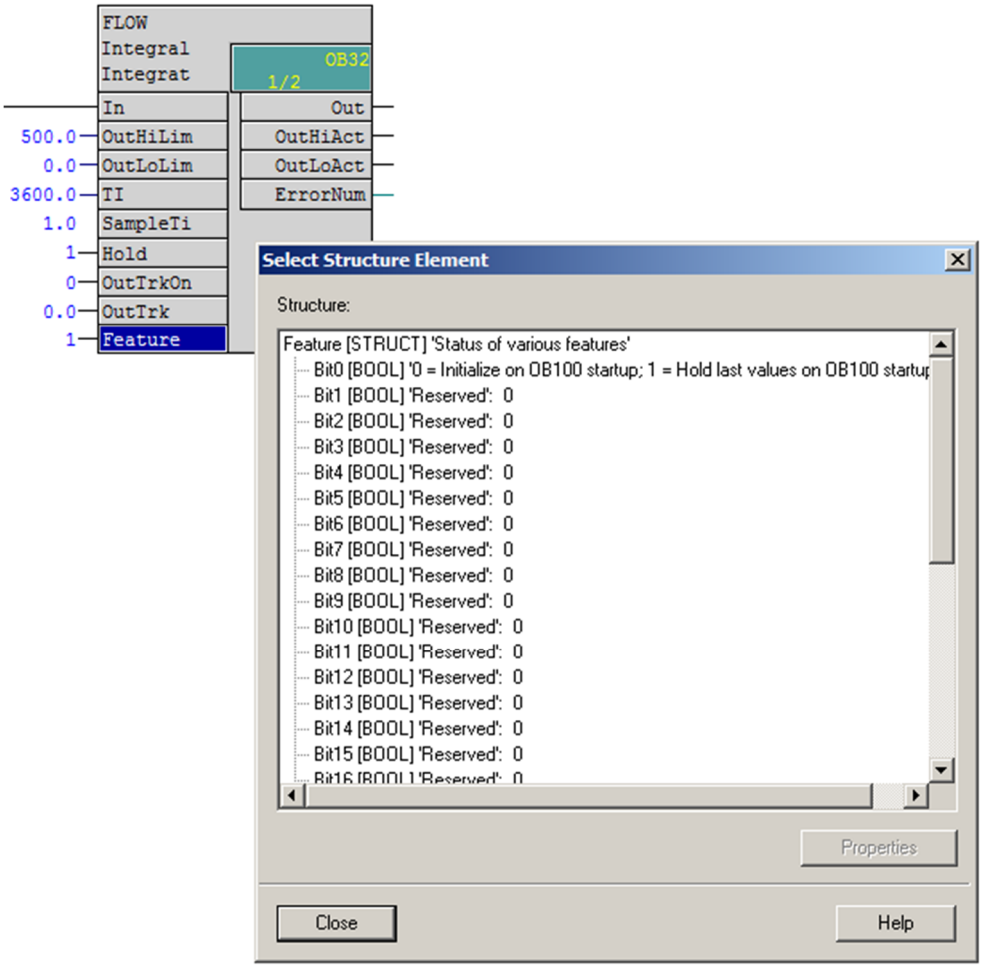
Figure 3–8 Putting the integration on hold from the faceplate



3.4 Retaining the integral value after CPU stop

Whether the integral value is retained when performing a restart of the CPU, is determined by the startup characteristics of the function block. With regard to the function blocks "Integral" and "TotalL", this is done via the bit 0 of the "Feature" input parameter. The configuration is identical for both function blocks.

Figure 3–9



The start-up characteristics differs between the two function modules.

Integral function block

If the Feature Bit 0 = 0, the "Out" output is reset to 0 when starting. If the Feature Bit 0 = 1, the integration is resumed from the last saved value when starting.

TotalL function block

If the Feature Bit 0 = 0, the integration is put on hold and reset to the value predefined in the "PresetValue" input parameter.

If the Feature Bit 0 = 1, the integration is resumed from the last saved value when starting.

4 Literature

Table 4–1

	Subject area	Title
\1\	Siemens Industry Online Support	http://support.automation.siemens.com
\2\	Article download page	http://support.automation.siemens.com/WW/view/de/102052080
\3\	Function manual	SIMATIC Process Control System PCS 7 Advanced Process Library (V8.0 SP2) http://support.automation.siemens.com/WW/view/en/80539207

5 History

Table 5–1

Version	Date	Change
V1.0	10/2014	First edition