PID control with PID_Compact

SIMATIC S7-1200 / S7-1500 + TIA Portal V15.1

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1 Task

1.1 Overview

Introduction
For the targeted influencing of certain quantities in a technical system, these quantities must be controlled. Controllers are also used in a wide variety of applications in automation technology, for instance speed control.
For the SIMATIC S7-1200/S7-1500, the technology object "PID_Compact" is provided for proportional actuators.

Description of the automation task
The automation task consists of setting up a control loop to influence physical variables in a technical process.
The control loop should consist of the following elements:
- "PID_Compact" as controller
- Simulated technical processes as a controlled system

Figure 1-1

The following points are described in the application example
- Configuration and parameter assignment of the software controller ("PID_Compact")
- Tuning options for "PID_Compact"
- Operation and monitoring of the control process via HMI
2 Solution

2.1 Overview

Diagram

The following diagram shows the most important components of the solution:

Figure 2-1

The "PID_Compact" technology object reads the measured process value and compares it with the setpoint (in this example, the setpoint is set via HMI). From the resulting control deviation, the controller calculates an output value in order to adjust the setpoint deviation or the disturbance variable if necessary. The output value of the PID controller consists of three components:

- **P component**
  The P component of the output value is proportional to the control deviation.

- **I component**
  The I component of the output value is the integral component. This increases as long as there is a control deviation.

- **D component**
  The D component is the differential component and increases as the rate of change of the control deviation increases.

The "PID_Compact" technology object has the "tuning" commissioning functionality with which the P, I and D parameters can be calculated automatically depending on the controlled system. However, you can also specify the control parameters manually.

The automatic tuning is divided into tuning types:
1. Pretuning and
2. Fine tuning

Both types of tuning are described below.
2.2 Description of the core functionality

The core functionality of the application example lies in the operation of the technology object "PID_Compact" via the HMI.

Overview and description of the interface

Figure 2-2

The operation of the application example consists of the following 6 screens:
- Trend view
- Tuning
- Monitoring
- Alarm messages
- Configuration
- Simulation

The operation of the interfaces is described in more detail in the chapter Operation of the application example.

Advantages of this solution

The application example allows you to use all configuration options and commissioning features via an operator panel or HMI simulation.

This application example offers you the following advantages:
- Switchover between automatic and manual mode
- Trend view of setpoint, process and manipulated value via HMI
- Switchover between real controlled system and simulation
- Disturbance compensation in simulated operation
- Specification of the behavior in the event of an error and its simulation
- Manual controller parameter setting and automatic tuning
- Online monitoring of the "PID_Compact" controller module
- Configuration change at runtime
2 Solution

2.3 Hardware and software components

Delimitation
This application example provides an overview of the "PID_Compact" technology object for commissioning with the SIMATIC S7-1200/S7-1500. You can use the application example to conveniently operate your control system via an operator panel and adapt it to your automation task.

The application example was tested by simulating the controlled system. For real operation, you must adapt the application example to the actuator and process value sensor you are using:
- Analog control or control via a digital output using the pulse width modulated signal?
- Required voltage and power for control?
- What are the signal characteristics of the process value sensor used?

Note
The application example is not a replacement for the configuration mask of the PID_Compact Assistant, as it is used to define the start values in the instance data block, which are decisive for restarting after a power failure.

In addition to the "PID_Compact" control block, STEP 7 (TIA Portal) also provides the following compact controllers with automatic tuning for the SIMATIC S7-1200/S7-1500:
- Modulating controller "PID_3Step" for valves or actuators with integrating behavior (10)
- Temperature controller "PID_Temp" for pure heating or heating/cooling applications (4, 5)

Note
You can find more information on the technology objects
- in the STEP 7 Professional manual (6) → chapter on "PID Control"
- in the function manual on PID control (13)

Required knowledge
Basic knowledge of control engineering is required.

2.3 Hardware and software components

2.3.1 Validity
This application example was created and tested with
- STEP 7 V15.1 Update 1 and higher
- S7-1200 CPU Firmware V4.3 and higher / S7-1500 CPU Firmware 2.6 and higher
- Technology object "PID_Compact" V2.3 for S7-1200 / V2.4 for S7-1500

Note
The version differences of the controller can be found in the chapter "New features of PID_Compact" in the function manual for PID control (13).
2 Solution

2.3 Hardware and software components

2.3.2 Components used

This application example was created using the following components:

**Hardware components**

<table>
<thead>
<tr>
<th>Components</th>
<th>Qty.</th>
<th>Article number</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIMATIC HMI KTP900 BASIC</td>
<td>1</td>
<td>6AV2123-2JB03-0AX0</td>
<td>Optional (can also be simulated in WinCC)</td>
</tr>
<tr>
<td>COMPACT SWITCH MODULE CSM 1277</td>
<td>1</td>
<td>6GK7277-1AA10-0AA0</td>
<td></td>
</tr>
<tr>
<td>POWER SUPPLY S7-1200 PM1207</td>
<td>1</td>
<td>6EP1332-1SH71</td>
<td></td>
</tr>
<tr>
<td>CPU 1211C, DC/DC/DC, 6DI/4DO/2AI</td>
<td>1</td>
<td>6ES7211-1AE40-0XB0</td>
<td>Firmware V4.3</td>
</tr>
<tr>
<td>Fan/motor with analog speed control (0 to 10V / 0 to 20mA)</td>
<td>1</td>
<td>Fan/motor manufacturer</td>
<td>- Without integrated speed control electronics</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Optionally with integrated actual speed feedback</td>
</tr>
<tr>
<td>HTL INCREMENTAL ENCODER 1000 I/U, OP. VOLT. 10-30V CLAMPING FLANGE, SHAFT 10 MM FLANGE SOCKET RADIAL</td>
<td>1</td>
<td>e.g. 6FX2001-4QB00</td>
<td>Optional if fan/motor does not provide integrated actual speed feedback</td>
</tr>
<tr>
<td>SIGNAL BOARD SB 1232, 1 AQ, (12 bit resolution)</td>
<td>1</td>
<td>6ES7232-4HA30-0XB0</td>
<td>Optional (for fan/motor control with 0 to 20 mA current output)</td>
</tr>
<tr>
<td>Programming device</td>
<td>1</td>
<td></td>
<td>With Ethernet connection</td>
</tr>
<tr>
<td>CPU 1511C-1 PN, 175 KB prog., 1 MB data</td>
<td>1</td>
<td>6ES7511-1CK01-0AB0</td>
<td>Firmware V2.6</td>
</tr>
<tr>
<td>SIMATIC S7 Memory Card, 24 MB</td>
<td>1</td>
<td>6ES7954-8LF03-0AA0</td>
<td>Can be plugged into the S7-1500 as load memory</td>
</tr>
</tbody>
</table>
3 Principle of operation

3.1 Complete overview

Software components

Table 2-2

<table>
<thead>
<tr>
<th>Components</th>
<th>Qty.</th>
<th>Article number</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIMATIC STEP 7 Professional V15.1</td>
<td>1</td>
<td>6ES7822-1AA05-0YA5</td>
<td>• Contains WinCC Basic V15.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• With update 1 ([8]) and</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>HSP0276 ([12]) for S7-1200 and S7-1500</td>
</tr>
<tr>
<td>SIMATIC STEP 7 Basic V15.1</td>
<td>1</td>
<td>6ES7822-0AA05-0YA5</td>
<td>• Contains WinCC Basic V15.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• With update 1 ([8]) and</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>HSP0276 ([12]) for S7-1200 and S7-1500</td>
</tr>
</tbody>
</table>

Example files and projects

The following list contains all files and projects used in this example.

Table 2-3

<table>
<thead>
<tr>
<th>Components</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>100746401_S71200_PidCompact_TiaV15.1_PROJ_V2.0.zip</td>
<td>TIA Portal project for S7-1200</td>
</tr>
<tr>
<td>100746401_S71500_PidCompact_TiaV15.1_PROJ_V2.0.zip</td>
<td>TIA Portal project for S7-1500</td>
</tr>
<tr>
<td>100746401_S71x00_PidCompact_DOC_V2.0_de.pdf</td>
<td>this document.</td>
</tr>
</tbody>
</table>

3 Principle of operation

3.1 Complete overview

Figure 3-1 shows the chronological sequence of the block calls in the control part of the TIA Portal project.

Figure 3-1

The example program is called in the following OBs:
- OB "Main", from which the FB is called for the HMI transfer.
- Cyclic interrupt OB "CyclicInterrupt", which cyclically calls the compact controller and the simulation blocks every 100 milliseconds.

The tag transfer between the functions takes place via the data block DB "Tags" and the instance data block of the controller DB "InstPidCompact".

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3.2 OB "Main"

The function block for the HMI transfer is called from the organization block "Main".

3.2.1 FB "Hmi"

Figure 3-2

Table 3-1

<table>
<thead>
<tr>
<th>Name</th>
<th>Data type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>simulate</td>
<td>Bool</td>
<td>Enabling simulation</td>
</tr>
<tr>
<td>errorSimulation</td>
<td>Bool</td>
<td>Simulation of a sensor error</td>
</tr>
<tr>
<td>tuningMode</td>
<td>Int</td>
<td>Tuning type selection (1=pre-/2=fine tuning)</td>
</tr>
<tr>
<td>errorAckint</td>
<td>Int</td>
<td>Acknowledgment tag for HMI bit messages</td>
</tr>
<tr>
<td>errorAck</td>
<td>Bool</td>
<td>HMI request to clear error messages</td>
</tr>
<tr>
<td>tuningVisible</td>
<td>Bool</td>
<td>Visibility of the tuning</td>
</tr>
<tr>
<td>sutVisible</td>
<td>Bool</td>
<td>Visibility of the pre-tuning</td>
</tr>
<tr>
<td>tirVisible</td>
<td>Bool</td>
<td>Visibility of the fine tuning</td>
</tr>
<tr>
<td>manualModeVisible</td>
<td>Bool</td>
<td>Visibility of the switch to manual mode.</td>
</tr>
<tr>
<td>setpointLimited</td>
<td>Bool</td>
<td>Violation of setpoint limit specifications</td>
</tr>
<tr>
<td>acknowledgeVisible</td>
<td>Bool</td>
<td>Visibility of HMI request to clear error messages</td>
</tr>
<tr>
<td>errorSimulationVisible</td>
<td>Bool</td>
<td>Visibility of the simulation of a sensor error</td>
</tr>
</tbody>
</table>
3 Principle of operation

3.3 OB "CyclicInterrupt"

<table>
<thead>
<tr>
<th>Name</th>
<th>Data type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>pidErrorAck</td>
<td>Bool</td>
<td>Deleting error messages (PID controller)</td>
</tr>
<tr>
<td>outputPwmUsint</td>
<td>USInt</td>
<td>PWM signal as data type &quot;USInt&quot; for HMI display</td>
</tr>
<tr>
<td>errorBitsInt</td>
<td>Int</td>
<td>Error message as data type &quot;Int&quot; for HMI display</td>
</tr>
<tr>
<td>warningInt</td>
<td>Int</td>
<td>Warnings as data type &quot;Int&quot; for HMI display</td>
</tr>
<tr>
<td>InOut pidCompact</td>
<td>PID_Compact</td>
<td>Transfer of the instance data block of the FB &quot;PID_Comact&quot;.</td>
</tr>
</tbody>
</table>

Tags that the HMI requires for the visibility animation of objects and elements are defined in the "Hmi" function block.
More detailed descriptions can be found in the network headings.

3.3 OB "CyclicInterrupt"

The actual program (the call of the compact controller "PID_Comact") takes place in the cyclic interrupt OB, since discrete software controls must be called at a defined time interval.
100ms was selected as the constant time interval of the sampling time of the OB "CyclicInterrupt".

Program Overview

The entire simulated control loop is calculated in the cyclic interrupt OB.

Figure 3-3

The following peripheral connection for controlling a real system is made in the example project:

<table>
<thead>
<tr>
<th>Tag</th>
<th>S7-1200</th>
<th>S7-1500</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;PID_Comact&quot;.Input_PER</td>
<td>IW64</td>
<td>IW0</td>
</tr>
<tr>
<td>&quot;PID_Comact&quot;.Output_PER</td>
<td>QW80</td>
<td>QW0</td>
</tr>
<tr>
<td>&quot;PID_Comact&quot;.Output_PWM</td>
<td>Q0.0</td>
<td>Q4.0</td>
</tr>
</tbody>
</table>
3 Principle of operation

3.3 OB "CyclicInterrupt"

Description
In the example project, the compact controller "PID_Compact" accesses the peripheral signals from Table 3-2. This calculates the manipulated variable from the control deviation = setpoint - process value as a function of the PID parameters. The manipulated variable can be output either as an analog or digital pulse width modulated signal to the peripheral control outputs. For simulation, the manipulated variable is transferred to the function block "LSim_PT1" as a floating point number. The FB "LSim_PT1" simulates a controlled system with PT1 behavior and thus outputs the simulated process value as a floating point number. This is converted into an analog value via the FC "Scale". When the "Error simulation" is activated, the analog process value is overwritten with the erroneous value (-32768). In addition, the simulated analog process value is converted via the FC "Scale" into the corresponding floating point number for the "Input" input of the FB "PID_Compact".

By deactivating the FB "Simulation" you can switch off the plant simulation and control a real controlled system (signal evaluation via the control periphery) with the FB "PID_Compact".

3.3.1 FB "PID_Compact"

STEP 7 V15.1 supplies the technology object "PID_Compact" in version 2.3 for the S7-1200 or version 2.4 for the S7-1500 with the installation. This function block was specially developed for the control of proportional actuators.
3 Principle of operation

3.3 OB "CyclicInterrupt"

Figure 3-4

Table 3-3

<table>
<thead>
<tr>
<th>Name</th>
<th>Data type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Setpoint</td>
<td>Real</td>
<td>Setpoint input</td>
</tr>
<tr>
<td>Input</td>
<td>Real</td>
<td>Process value in REAL format</td>
</tr>
<tr>
<td>Input_PER</td>
<td>Int</td>
<td>Analog process value</td>
</tr>
<tr>
<td>Disturbance</td>
<td>Real</td>
<td>Disturbance selection</td>
</tr>
<tr>
<td>ManualEnable</td>
<td>Bool</td>
<td>Activating the &quot;Manual mode&quot; operating mode</td>
</tr>
<tr>
<td>ManualValue</td>
<td>Real</td>
<td>Manual value</td>
</tr>
<tr>
<td>errorAck</td>
<td>Bool</td>
<td>Deletion of error messages / warnings</td>
</tr>
<tr>
<td>Reset</td>
<td>Bool</td>
<td>Resetting, restarting of the controller</td>
</tr>
</tbody>
</table>
3 Principle of operation

3.3 OB "CyclicInterrupt"

<table>
<thead>
<tr>
<th>Name</th>
<th>Data type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ModeActivate</td>
<td>Bool</td>
<td>Enable &quot;Mode&quot; operating mode</td>
</tr>
<tr>
<td>ScaledInput</td>
<td>Real</td>
<td>Scaled process value</td>
</tr>
<tr>
<td>Output</td>
<td>Real</td>
<td>Output value in REAL format</td>
</tr>
<tr>
<td>Output.PER</td>
<td>Int</td>
<td>Analog output value</td>
</tr>
<tr>
<td>Output_PWM</td>
<td>Bool</td>
<td>Pulse width modulated output value</td>
</tr>
<tr>
<td>SetpointLimit_H</td>
<td>Bool</td>
<td>Setpoint is fixed at the upper limit</td>
</tr>
<tr>
<td>SetpointLimit_L</td>
<td>Bool</td>
<td>Setpoint is fixed at the lower limit</td>
</tr>
<tr>
<td>InputWarning_H</td>
<td>Bool</td>
<td>Process value has exceeded upper warning limit</td>
</tr>
<tr>
<td>InputWarning_L</td>
<td>Bool</td>
<td>Process value has undershot lower warning limit</td>
</tr>
<tr>
<td>State</td>
<td>Int</td>
<td>Display of the current operating mode of the PID controller (0=Inactive, 1=SUT, 2=TIR, 3=Automatic, 4=Manual)</td>
</tr>
<tr>
<td>Error</td>
<td>Bool</td>
<td>At least one error message present</td>
</tr>
<tr>
<td>ErrorBits</td>
<td>DWord</td>
<td>Error message</td>
</tr>
<tr>
<td>InOut</td>
<td>Mode</td>
<td>Operating mode default (see &quot;State&quot;)</td>
</tr>
</tbody>
</table>

The FB "PID_Compact" is called in the alarm OB "CyclicInterrupt". You can find the "InstPidCompact" instance data block in the "Technology Objects" folder: This can be opened by right-clicking -> "Open DB editor".

Note

A more detailed description of the compact controller can be found in the STEP 7 V15.1 online help. Select the function block "PID_Compact" in the program call (see Figure 3-4) and press F1.

3.3.2 FB "Simulation"

Figure 3-5

The FB "Simulation" simulates the system to be controlled as a PT1 element. In addition, the conversion to the process value as an analog value or floating point
number takes place within the block. The FB "Simulation" writes directly to the selected peripheral input of the technology object "PID_Compact". When the FB "Simulation" is deactivated, the controller uses the process value of a connected sensor. The FB "Simulation" calls the following blocks:

- FB "LSim_PT1"
- FC "Scale"

The FB "Simulation" is called in the same cyclic interrupt as the compact controller "PID_Compact".

For more information, refer to the network headings and the following description.

**FB "LSim_PT1"**

The function block "LSim_PT1" simulates the continuous behavior of a PT1 system. This block comes from the library for controlled system simulation ([7](#)). You can also find a detailed description of the FB "LSim_PT1" here. In this application example, the "LSim_PT1" system simulation module is designed with a delay time of 3 seconds.

**Note**

Please note that changes of the system parameters are only accepted after activation of the input "calcParam" (implemented in the example project as restart of the CPU).

**FC "Scale"**

The "Scale" function is used for linear conversion according to the following formula:

\[
output = \frac{outputRef2 - outputRef1}{inputRef2 - inputRef1} \cdot (input - inputRef1) + outputRef1
\]

Figure 3-6
### 3 Principle of operation

#### 3.3 OB "CyclicInterrupt"

By selecting the data type "LReal", the correct conversion of or into the attached actual parameters is ensured.

The FC "Scale" converts the process output into an analog value in order to simulate the behavior of the controller in the event of an error.

The fault occurs in a real system due to the failure of the process value sensor (e.g. due to wire breakage).

In the simulation, this is achieved by overwriting the analog process value with a value outside the measuring range (-32768) (see Figure 3-3).

Then FC "Scale" converts the resulting analog value into a floating point value for the process value selection "Input" of the FB "PID_Compact".

**Table 3-5**

<table>
<thead>
<tr>
<th>Name</th>
<th>Data type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input</td>
<td></td>
<td></td>
</tr>
<tr>
<td>input</td>
<td>LReal</td>
<td>Value to be converted</td>
</tr>
<tr>
<td>inputRef1</td>
<td>LReal</td>
<td>Input value of reference point 1</td>
</tr>
<tr>
<td>inputRef2</td>
<td>LReal</td>
<td>Input value of reference point 2</td>
</tr>
<tr>
<td>outputRef1</td>
<td>LReal</td>
<td>Output value of reference point 1</td>
</tr>
<tr>
<td>outputRef2</td>
<td>LReal</td>
<td>Output value of reference point 2</td>
</tr>
<tr>
<td>Output</td>
<td></td>
<td></td>
</tr>
<tr>
<td>output</td>
<td>LReal</td>
<td>Output value</td>
</tr>
</tbody>
</table>

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Installation and commissioning

4.1 Hardware adaptation

The following table provides information on the controllers used and the connection options to a real controlled system.

Table 4-1

<table>
<thead>
<tr>
<th>Signal</th>
<th>CPU 1211C</th>
<th>CPU 1511C-1 PN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog process value (0-10V)</td>
<td>IW64</td>
<td>IW0</td>
</tr>
<tr>
<td>Analog manipulated value (0-10V)</td>
<td>QW80 (with SB 1232 AQ)</td>
<td>QW0</td>
</tr>
<tr>
<td>Digital PWM signal</td>
<td>Q0.0</td>
<td>Q4.0</td>
</tr>
<tr>
<td>Digital recording of the speed (A-B track)</td>
<td>DI 0.0</td>
<td>DI 10.0</td>
</tr>
<tr>
<td>of the incremental encoder via fast counters</td>
<td>DI 0.1</td>
<td>DI 10.1</td>
</tr>
</tbody>
</table>

Depending on the version of your selected actuator, you may have to adjust the hardware configuration.

The configuration options for operating the "PID_Compact" compact controller are presented below.

Input signal

The controlled variable is recorded by the peripheral "Input_PER" as a processed floating point number "Input" or as an analog value. The "PID_Compact" offers the conversion of the analog value into the physical unit in the configuration mask.

For controlled variable acquisition, modules are offered for analog value recording as well as for temperature recording via thermocouples or resistance thermometers.

Output signal

The "PID_Compact" offers the control of the actuator via an analog output or via a digital pulse width modulated transistor output.

Note

Further information on the selection of your peripherals or their wiring can be found in the hardware catalog in the TIA Portal or:

- in Section A "Technical data" in the S7-1200 manual (3)
- in the manual "SIMATIC S7-1500/ET 200MP Manual Collection" (9)
- via the TIA selection tool (111)
Hardware installation

The following figure shows the hardware structure of the application example with a SIMATIC S7-1200.

Figure 4-1

The following figure shows the hardware structure of the application example with a SIMATIC S7-1500.
4 Installation and commissioning

4.1 Hardware adaptation

Figure 4-2

Installing the hardware

<table>
<thead>
<tr>
<th>No.</th>
<th>Action</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Adapt the peripherals of the S7-1200/S7-1500 to the actuator you are using.</td>
<td>See Chapter 4.1.</td>
</tr>
<tr>
<td>2</td>
<td>Mount all required components on a DIN rail (S7-1200) or S7-1500 profile rail.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Wire and connect all required components as described.</td>
<td>S7-1200 Manual (3) Section A &quot;Technical data&quot; or S7-1500 Manual Collection (9)</td>
</tr>
<tr>
<td>4</td>
<td>Finally, activate the power supply for the SIMATIC PM 1207.</td>
<td></td>
</tr>
</tbody>
</table>
### 4.2 Configuration

#### 4.2.1 Transferring I/O addresses

Depending on the changed configuration, the input or output addresses of the added hardware must be transferred to the program. This is shown using the example of a signal board 1232 AQ 1x12 bit for the SIMATIC S7-1200:

<table>
<thead>
<tr>
<th>No.</th>
<th>Action</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Open the device configuration of the controller &quot;PID_CPU&quot;.</td>
<td><img src="image1.png" alt="Image of device configuration" /></td>
</tr>
</tbody>
</table>
| 2.  | Mark the signal board 1232 AQ 1x12 Bit in the device view of the CPU. Read the output address of the signal board under the menu item "I/O addresses":  
  - Start address: 80  
  - End address: 81  
  This means that:  
  The address via which the analog value of the SB 1232 AQ 1x12 Bit is output is: **QW80** | ![Image of I/O addresses](image2.png) |
| 3.  | Open the OB "CyclicInterrupt" in the control part of the project. | ![Image of OB CyclicInterrupt](image3.png) |
| 4.  | Since the analog manipulated variable is output to the actuator via the signal board, transfer the output "Output_PER" of the FB "PID_Compact" to the output word **QW80** in network 2:  
  - To do this, select the linked tag "sbAq" and right-click to select "Rewire tag...".  
  - Change the address of the tag: %QW80  
  Accordingly, you can also adapt the other peripheral links from **Table 4-1** to your signal selection. | ![Image of peripheral links](image4.png) |
4.2 Configuration

4.2.2 Configure PID controller

The configuration of the technology object "PID_Compact" determines the functionality of the compact controller.

The settings made determine the starting values with which the PID controller restarts after a cold or warm start (e.g. power failure).

You can find a more detailed description in the S7-1200 manual (13) → Chapter 10.2.5 or in the function manual for PID control (13) → Chapter "Configuring PID_Compact V2".

Table 4-4

<table>
<thead>
<tr>
<th>No.</th>
<th>Action</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Open the configuration editor by selecting the CPU -&gt; Technology objects -&gt; InstPidCompact -&gt; Configuration.</td>
<td></td>
</tr>
</tbody>
</table>
| 2.  | Open the "Control mode" submenu in the basic settings: Define  
• which physical unit is to be used for the display of setpoint and process value  
• whether the controller output is to be inverted  
• whether the controller is to remain "inactive" after restarting the CPU or changes to the operating mode stored at "Mode"  
• under "Set mode to:" the operating mode that is to be activated after a complete loading into the device. (The prerequisite for this is that the "Mode" parameter is not linked -> see Figure 3-4) | |
| 3.  | Adjust the "Input/Output parameters" submenu in the basic settings to the sensors/actuators used:  
• Process value as prepared floating point number "Input" or as analog value "Input_PER".  
• Manipulated variable as floating point number "Output", as analog value "Output_PER" or as digital pulse width modulated signal "Output_PWM". | |
### 4.2 Configuration

<table>
<thead>
<tr>
<th>No.</th>
<th>Action</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.</td>
<td>Determine the limits of the scaled process value in the submenu &quot;Process value limits&quot; in the process value settings. <strong>Note:</strong> Make sure that the upper and lower limits of the process value are set correctly, as the controller interprets violation of these limits as an error and reacts according to the settings &quot;Behavior in the event of an error&quot; (see no. 8)!</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>When using the analog process value &quot;Input_PER&quot; in the submenu &quot;Process value scaling&quot; in the process value settings, determine the value pairs for the linear conversion into the scaled process value.</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Open the &quot;Process value monitoring&quot; in the Advanced settings: Here you can specify warning limits where a warning bit is activated if they are exceeded or not reached.</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Open the &quot;PWM Limits&quot; in the Advanced settings: For adaptation to the actuator inertia, you can specify minimum switch-on or switch-off times here. <strong>Note:</strong> These settings are also effective when using another control variable signal (&quot;Output&quot; or &quot;Output_PER&quot;)!</td>
<td></td>
</tr>
</tbody>
</table>
### 4.2 Configuration

<table>
<thead>
<tr>
<th>No.</th>
<th>Action</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.</td>
<td>Open the &quot;Output value&quot; in the Advanced settings:&lt;br&gt;&lt;br&gt;<strong>Output value limits</strong>&lt;br&gt;Determine the percentage limits of the signal to be output to the actuator.&lt;br&gt;&lt;br&gt;<strong>Response to errors</strong>&lt;br&gt;Check whether, in the case of an error,&lt;br&gt;• the controller is switched to the inactive state,&lt;br&gt;• the current manipulated variable is maintained for the duration of the error or&lt;br&gt;• a substitute output value to be specified is to be output permanently as a manipulated variable or for the duration of the error.</td>
<td>Changes to the start values of a data block are not accepted as actual values until the next STOP/RUN transition (for non-retentive data types).</td>
</tr>
<tr>
<td>9.</td>
<td>Open the &quot;PID Parameters&quot; in the Advanced settings:&lt;br&gt;Here you can enter the start values of the controller parameters manually.&lt;br&gt;They are then written as start values in the instance data block of the “PID_Compact” and transferred as actual values after a cold start (load project into the controller).&lt;br&gt;&lt;br&gt;<strong>Rule for tuning</strong>&lt;br&gt;Depending on the selected controller structure, the initial values for the setting rules of the pre- or fine tuning are set to&lt;br&gt;• &quot;PID according to Chien, Hrones and Reswick&quot; or &quot;PID automatic&quot; or&lt;br&gt;• &quot;PID according to Chien, Hrones and Reswick&quot; or &quot;Ziegler-Nichols PI&quot;. Select &quot;PI&quot; as the controller structure for speed control.</td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>Save the project.&lt;br&gt;Mark the program folder of the S7-1x00 and transfer the program to the controller via &quot;Online/PLC program load into device and reset&quot;, so that the settings made are used as start values of the technology object when the CPU is started.</td>
<td></td>
</tr>
</tbody>
</table>
4.3 CPU simulation with PLCSIM

You can simulate the technology object "PID_Compact" V2.x for CPU S7-1500 with PLCSIM. The simulation of PID_Compact V2.x with PLCSIM for CPU S7-1200 is not supported.

The actual timing of a cyclic interrupt OB may vary more with a simulated PLC than with "real" PLCs. In the standard configuration, PID_Compact automatically determines the time between calls and monitors them for fluctuations. When simulating PID_Compact with PLCSIM, a sampling time error (ErrorBits = DW#16#00000800) can therefore be detected. This leads to the abort of ongoing tuning.

To prevent this, you should configure PID_Compact for simulation with PLCSIM as follows:

- CycleTime.EnEstimation = FALSE
- CycleTime.EnMonitoring = FALSE
- CycleTime.Value: Assign the time cycle of the cyclic interrupt OB in seconds to this variable.
4.4 Commissioning the compact controller

Below you will learn how to optimize the PID_Compact with the aid of the commissioning wizard.

<table>
<thead>
<tr>
<th>No.</th>
<th>Action</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Open the commissioning editor by selecting the CPU -&gt; Technology objects -&gt; InstPidCompact -&gt; Commissioning.</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Start the measurement.</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>The tuning status indicates that no tuning has been started yet and the controller is in the &quot;Deactivated - Inactive&quot; state after the first CPU start (see Table 4-4, No. 2).</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>You get the best PID parameters when you perform pretuning and fine tuning. Requirements for the pretuning are:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• ManualEnable = FALSE, Reset = FALSE</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• PID_Compact is in &quot;Manual&quot;, &quot;Inactive&quot; or &quot;Automatic&quot; mode.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• The setpoint and the process value are within the configured limits (see Table 4-4, No. 4).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• The difference between setpoint and process value is greater than 30% of the difference between upper limit of process value and lower limit of process value.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• The distance between setpoint and process value is &gt; 50% of the setpoint.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>If possible, enter a target value in the middle field of the process value range (e.g. via an observation table; the start value of the target value is already predefined accordingly in the project).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Start the pretuning.</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>The pretuning determines the process response to a jump in the output value and searches for the turning point. The PID parameters are calculated from the maximum gradient and the dead time of the controlled system. You can follow the pretuning and the subsequent adjustment to the setpoint with the found PID parameters via the trend.</td>
<td></td>
</tr>
</tbody>
</table>
4.4 Commissioning the compact controller

<table>
<thead>
<tr>
<th>No.</th>
<th>Action</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.</td>
<td>After successful pretuning, the controller switches to automatic mode. The determined values can be viewed via “Go to PID parameters”. Via “Load PID parameter” the determined values are written to the project as start values in the instance data block of the “PID_Compact”.</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Requirements for fine tuning are:</td>
<td><img src="image" alt="Tuning mode" /></td>
</tr>
<tr>
<td></td>
<td>• ManualEnable = FALSE, Reset = FALSE</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• The setpoint and the process value are within the configured limits.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• The control loop is steady at the operating point. The operating point is reached when the process value corresponds to the setpoint.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• No interference is expected.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• PID_Compact is in Inactive, Automatic or Manual mode.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>If possible, enter a target value in the middle field of the process value range (e.g. via an observation table; the start value of the target value is already predefined accordingly in the project). Now start the fine tuning.</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>The fine tuning generates a constant, limited oscillation of the process value. The amplitude and frequency of this oscillation are used to optimize the PID parameters for the operating point. All PID parameters are recalculated from the results. The PID parameters from fine tuning usually show better command and error behavior than the PID parameters from pretuning. You can track the fine tuning via the trend.</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>After successful completion of the fine tuning you can load the determined PID parameters into the project as start values in the instance data block of the &quot;PID_Compact&quot; in order to load and save the project changes into the CPU afterwards.</td>
<td></td>
</tr>
</tbody>
</table>

You can find a more detailed description in the S7-1200 manual (3 → Chapter 10.2.7) and in the function manual on PID control (13 → Chapter "Commissioning PID_Compact V2").

**Note**
The PID parameters are retentively stored in the instance data module of the "PID_Compact" compact controller. During a warm start (voltage recovery), the last values passed through are retained. The start values are only loaded during a cold start (transfer of the project in the operating state STOP or overall reset of the memory via MRES).
4.5 HMI device

Load HMI project part into KTP900 Basic

Connect your PG/PC directly or via the switch CSM1277 to the HMI.

Table 4-6

<table>
<thead>
<tr>
<th>No.</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>• Mark the HMI folder &quot;PID_HMI [KTP900 Basic PN]&quot;.</td>
</tr>
<tr>
<td></td>
<td>• Click the &quot;Load to device&quot; button to download the HMI project part into the KTP900 Basic.</td>
</tr>
<tr>
<td></td>
<td>• Follow the wizard to &quot;Load into device&quot;.</td>
</tr>
</tbody>
</table>

HMI simulation

If you want to use the PG/PC as an operating device, start the HMI simulation as follows:

Table 4-7

<table>
<thead>
<tr>
<th>No.</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>• Mark the HMI folder &quot;PID_HMI [KTP900 Basic PN]&quot;.</td>
</tr>
<tr>
<td></td>
<td>• Click the &quot;Start simulation&quot; button.</td>
</tr>
</tbody>
</table>
5 Operation of the application example

5.1 Overview

Overview and description of the interface

The user interface is made up of 8 menus:
- Start screen (overview)
- Trend view
- Tuning
- Monitoring
- Alarm view
- Configuration
- Simulation
- Settings

5.1.1 Overview (start screen)

The overview screen provides information on the topic dealt with. The technology object is presented: the compact controller "PID_Compact" available in the controllers:
- SIMATIC S7-1200 CPU with Firmware V4.3 and PID_Compact V2.3
- SIMATIC S7-1500 CPU with Firmware V2.6 and PID_Compact V2.4

Configuration is performed with STEP 7 V15.1 (TIA Portal).

The operation of the right menu bar is also explained. It is available in every screen.
5 Operation of the application example

5.1 Overview

Figure 5-2

| • | takes you to the overview screen (this screen). |
| • | takes you to the trend view (Figure 5-3). |
| • | takes you to the tuning (Figure 5-4). |
| • | takes you to the monitoring (Figure 5-5). |
| • | takes you to the alarm view (Figure 5-6). |
| • | takes you to the configuration (Figure 5-8). |
| • | takes you to the simulation (Figure 5-10). |
| • | takes you to the system functions (Figure 5-11). |

With F8 you can switch between German and English.

The currently selected menu is indicated by the orange background of the symbol:

e.g. (for the overview screen) or the title in the header line (left):

In the middle of the header line you can see which operating mode the controller is currently in:

State: Automatic mode (for automatic mode)

The header line is also visible in each image.
5.1 Overview

5.1.2 Trend view

Figure 5-3

The "Trend view" image shows the time course over 90 seconds.

- of the setpoint \textit{Setpoint} (scale left)
- of the process value \textit{Input} (scale left)
- the manipulated variable \textit{Output} (scale right)

\textbf{Manual mode}

Use \textbf{MAN} to change to manual mode.

In manual mode, you can enter the manipulated variable directly via the manual value \textbf{50 \%} (value range 0 to 100 \%).

\textbf{Note}

Manual mode is activated here via the value setting at the "Mode" parameter in conjunction with activation via "ModeActivate" (not via "ManualEnable").

\textbf{Automatic mode}

Use \textbf{AUTO} to change to automatic mode.

Use \textit{Setpoint: 675 1/min} to set the setpoint in automatic mode.

Use \textit{Disturbance: +100 \%} to specify the disturbance variable which is added directly to the manipulated variable.

In automatic mode, you can follow the regulation of the disturbance variable in the trend view.
5 Operation of the application example

5.1 Overview

Response to errors

If the process value limits are exceeded (e.g. due to sensor failure), you can
predefine the behavior of the controller.

Check whether, in the case of an error,

- the controller should be switched to the inactive state

- or with active troubleshooting
  - the current manipulated variable is maintained for the duration
  - a substitute value should be set via as a

If troubleshooting is active, the manipulated variable (output) is set to the current
value or to the substitute output value for the duration of the error in the event of an
error.
This behavior occurs in the following operating modes:

- Pretuning
- Fine tuning
- Automatic mode

The controller also switches to inactive in manual mode when this behavior is
selected in the event of an error.

In the system simulation mode, the selected behavior in the event of an error can
be simulated (switched on and off) via . If an error is activated, the symbol is
highlighted in red:

Note

These selection fields are highlighted in yellow, since they are non-retentive data
in the instance data block of the “PID_Compact”.
You can change them via the operator interface or its simulation to test the
function.

To save these default settings even in the event of a power loss, this value must
be written as start values in the instance data module of the “PID_Compact”.
The configuration wizard offers this function (Table 4-4) with subsequent transfer
of the instance data block.
5.1.3 Tuning

In the "Tuning" menu you can set the control parameters automatically or manually. Figure 5-4

The tuning screen lets you perform
- pretuning
- or fine tuning
from the inactive controller state, manual or automatic mode.

**Note**
Manual operation must not be selected via the "ManualEnable" input!

For pretuning, you can choose between the following tuning methods:
- Chien, Hrones, Reswick PID
- Chien, Hrones, Reswick PI

For fine tuning, you can choose between the following tuning methods:
- PID automatic
- PID fast
- PID slow
- Ziegler-Nichols PID
- Ziegler-Nichols PI
- Ziegler-Nichols P

Use **Tuning Level** to determine the maximum permitted setpoint change during tuning. If this value is exceeded, the tuning is aborted and, depending on the selected error handling, the controller switches to inactive or returns to the operating mode from which the tuning was started.

The setpoint is frozen during tuning. The limit specifications (frozen setpoint with maximum permitted setpoint change) are displayed: **675 +/- 10 1/min**
5 Operation of the application example

5.1 Overview

Note The parameter "CancelTuningLevel" ensures tuning even with signal noise at the setpoint (e.g. when using a potentiometer).

Use to start the selected tuning.

Note If possible, enter a target value in the middle field of the process value range to avoid aborting the tuning by reaching the limit.

The tuning status and the percentage progress are displayed during tuning.

The saved "BackUp" parameter set can be reloaded into the controller via

Use to cancel the tuning and return to the operating mode from which the tuning was started.

After successful tuning, the determined controller parameters are displayed in the column and the controller parameters are moved to the column before tuning.

The current controller parameters ("Retain.CtrlParams") can also be edited manually (displayed by framing the parameter ).

Note The current controller parameter set ("Retain.CtrlParams") is retentive and remains even after voltage loss. To start with these parameters even after a cold start, they must be written as start values in the instance DB of the "PID_Compact". Der commissioning wizard provides this function (Table 4-5, Step 9).

Use to load the default values of the PLC data type "PID_CompactRetain":

The sampling time of the controller PID_Compact sampling time: 0.1 s
5 Operation of the application example

5.1 Overview

The sampling time of the PID algorithm

**Sampling time of PID algorithm: 0.1 s** corresponds to a multiple of the
sampling time of the controller and depends on the PWM limitation.

After successful tuning, you can calculate the controller parameters using

[Calculate Params]

for other tuning methods without repeating the tuning process, depending on the type of tuning.

Use [OFF] to deactivate the controller. This operating state is particularly
advantageous for pretuning. During pretuning, the control parameters are
determined from the response to a setpoint jump.

The process value must not be too close to the setpoint:

- |Setpoint - Input| > 0.3 * |Config.InputUpperLimit - Config.InputLowerLimit| and
- |Setpoint - Input| > 0.5 * |Setpoint|
5 Operation of the application example

5.1 Overview

5.1.4 Monitoring

The monitoring screen shows the online status of the "PID_Compact" compact controller.

Figure 5-5

You can:

• view all input and output values
• edit the following parameters:
  - Setpoint in automatic mode ("Setpoint")
  - Feedforward control in automatic mode ("Disturbance")
  - On/Off switching of manual operation ("ManualEnable")
  - Manual manipulated variable setting in manual mode ("ManualValue")
  - Acknowledgment (reset) of the messages "ErrorBits" and "Warning" ("Acknowledge Error")
  - Resetting the compact controller ("Reset")
  - Changing the operating mode via the selection at the parameter "Mode" and activation via "ModeActivate".

• Test the process value monitoring configuration
  - Editing the upper ("InputUpperWarning") and lower ("InputLowerWarning") warning limits
  - Direct monitoring at the outputs "InputWarning_H" or "InputWarning_L".

Note In this application example, the reset button restarts the blocks "PID_Compact" and "LSim_PT1". The controller switches to the "Inactive" operating mode. The messages "ErrorBits" and "Warnings" are reset. The controller then starts in the operating mode that is applied to the "Mode" parameter.

Note In manual mode (activated via "ManualEnable" = "ON"), the operating mode cannot be changed via "Mode" and "ModeActivate".
5 Operation of the application example

5.1 Overview

5.1.5 Alarm view

The "Message display" menu displays the current messages at the "ErrorBits" output and at the "Warning" static parameter of the "PID_Compact" as hexadecimal error codes, as well as in text form with time stamp and status.

Figure 5-6

![Image of alarm view]

The error messages "ErrorBits" are also displayed globally when they occur.

Figure 5-7

![Image of error messages]

You have the option of acknowledging errors that are no longer pending via

This deletes all messages that are no longer present at "ErrorBits" and "Warning" via the "ErrorAck" input.

Within the message display and the other masks, execute this function via

Acknowledgment

The button is only visible for pending messages ("ErrorBits" or "Warning").

Note

The complete description of all error messages can be found in the online help of STEP 7 (TIA Portal). Select the function block "PID_Compact" in the program call (see Figure 3-4) and press F1.
5.1 Overview

5.1.6 Configuration

The configuration mask is based on the basic settings of the configuration wizard (Table 4-4).

Figure 5-8

Here you can change the following settings during runtime:

**Basic settings**

- Control type
  - Specification of the displayed physical unit (limited to 5 characters; not identical to the preselection in the configuration wizard)

  ![Physical unit: 1/min](image)

  - Inversion of the rule sense (see Table 4-4, Step 2)

  ![Invert the control logic: OFF](image)

- Input/output parameters (see Table 4-4, Step 3)
  - Process value signal selection: Floating-point number ("Input") or analog ("Input_PER")

  ![Input_PER (analog)](image)

**Process value settings**

- Process value limits (see Table 4-4, Step 4)
5.1 Overview

- Editing the upper and lower limits of the process value

![Process value limits diagram]

- Process value scaling (see Table 4-4, Step 5)
  - Editing of analog and scaled upper and lower process values

![Process value scaling diagram]

**Note**
The process value scaling serves for linear conversion of the analog value "Input_PER" into the scaled process value "ScaledInput". In simulation mode, however, this conversion is also required when selecting the process value acquisition via the floating point value "Input" (see Figure 3-3).

**Advanced settings**

- PWM limits (see Table 4-4, Step 7)
  - Editing of minimum switch-on and switch-off time for adaptation to possible actuator inertia

![PWM limits diagram]

- Output value limits (see Table 4-4, Step 8)
  - Editing the upper and lower limits of the output value

![Output value limits diagram]

**Setpoint limits**
The compact controller "PID_Compact" automatically limits the setpoint to the "Process value limits". However, you can also limit the setpoint to a smaller range above the setpoint limits.
5 Operation of the application example
5.1 Overview

"PID_Compact" automatically takes the narrower limit.

Figure 5-9

In the event of a limit violation, a corresponding internal restriction takes place. The actual setpoint "CurrentSetpoint" is displayed and the output parameter "SetpointLimit_H" \textit{SLH} or "SetpointLimit_L" \textit{SLL} indicates the limit violation. A corresponding warning message appears (16#0004).

This screen is used to get to know the compact controller settings and their characteristics (especially for simulation mode).

\begin{table}
\centering
\begin{tabular}{|c|c|}
\hline
\textbf{Note} & These input/output fields are highlighted in yellow, since they are non-retentive data in the instance data block of the "PID_Compact". You can change them via the operator interface or its simulation to test the function. To save these default settings even in the event of a power loss, these values must be written as start values in the instance data module of the "PID_Compact". The configuration wizard offers this function (Table 4-4) with subsequent transfer of the instance data block. \\
\hline
\end{tabular}
\end{table}
5 Operation of the application example

5.1 Overview

5.1.7 Simulation

The simulation screen allows you to switch between a real and a simulated control system.

Figure 5-10

The block diagram of the PID control is shown with:

- the setpoint
- the process value display with process value signal selection
  - "Input" as floating-point number or
  - "Input_PER" as analog value with internal conversion ("ScaledInput")
- the disturbance specification "Disturbance".
- the output of the manipulated variable
  - as a percentage floating point number "Output"
  - as analog value "Output_PER"
  - as pulse-width modulated digital signal "Output_PWM"

If the simulation is not switched on, the FB "Simulation" is deactivated and the controller processes the signals via the control peripherals (Table 4-1).

When the simulation is switched on, the figure shows the block diagram structure, how the input signals for the controller are calculated:

The output of the PT1 system simulation block supplies the process value.
5 Operation of the application example

5.1 Overview

5.1.8 Settings

The settings menu consists of the following screens:

- System time / CPU
- Brightness
- User
- System

Figure 5-11

Via [Display Language] you can select "German" as the display language.
Via [Display Language] you can select "English" as the display language.
Via [Exit] you end the HMI runtime.

Time setting/CPU

The application example has a time synchronization between CPU and HMI.

Via [Date] you can edit the date and via [Time] the time.
Via [Write to PLC] you accept these settings and set the CPU system time.

The current CPU operating state is displayed via:

Via [RUN] you put the CPU into the operating state "RUN".
Via [STOP] you put the CPU into the operating state "STOP".

In the CPU operating state the header and sidebar flash alternately orange:
6 Appendix

6.1 Service and support

Industry Online Support

Do you have any questions or need assistance?
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support.industry.siemens.com/cs/ww/en/sc/2067
6.2 Links and Literature

Table 6-1

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<td>1</td>
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</tr>
<tr>
<td>2</td>
<td>Link to the entry page of this application example <a href="https://support.industry.siemens.com/cs/ww/en/view/100746401">https://support.industry.siemens.com/cs/ww/en/view/100746401</a></td>
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6.3 Change documentation

Table 6-2

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<td>V1.0</td>
<td>11/2014</td>
<td>First version</td>
</tr>
<tr>
<td>V2.0</td>
<td>04/2019</td>
<td>Expanded entry on S7-1500 and TIA V15.1</td>
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