Application example • 03/2017

Plant-wide automation with SIMATIC PCS 7 in the glass industry

SIMATIC PCS 7

https://support.industry.siemens.com/cs/ww/de/view/109744990
Warranty and liability

Note

The Application Examples are not binding and do not claim to be complete regarding the circuits shown, equipping and any eventuality. The Application Examples do not represent customer-specific solutions. They are only intended to provide support for typical applications. You are responsible for ensuring that the described products are used correctly. These Application Examples do not relieve you of the responsibility to use safe practices in application, installation, operation and maintenance. When using these Application Examples, you recognize that we cannot be made liable for any damage/claims beyond the liability clause described. We reserve the right to make changes to these Application Examples at any time without prior notice. If there are any deviations between the recommendations provided in these Application Examples and other Siemens publications – e.g. Catalogs – the contents of the other documents have priority.

We do not accept any liability for the information contained in this document. Any claims against us – based on whatever legal reason – resulting from the use of the examples, information, programs, engineering and performance data etc., described in this Application Example shall be excluded. Such an exclusion shall not apply in the case of mandatory liability, e.g. under the German Product Liability Act (“Produkthaftungsgesetz”), in case of intent, gross negligence, or injury of life, body or health, guarantee for the quality of a product, fraudulent concealment of a deficiency or breach of a condition which goes to the root of the contract (“wesentliche Vertragspflichten”). The damages for a breach of a substantial contractual obligation are, however, limited to the foreseeable damage, typical for the type of contract, except in the event of intent or gross negligence or injury to life, body or health. The above provisions do not imply a change of the burden of proof to your detriment.

Any form of duplication or distribution of these Application Examples or excerpts hereof is prohibited without the expressed consent of the Siemens AG.

Security information

Siemens provides products and solutions with industrial security functions that support the secure operation of plants, systems, machines and networks. In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art industrial security concept. Siemens’ products and solutions only form one element of such a concept.

Customers are responsible for preventing unauthorized access to their plants, systems, machines and networks. Systems, machines and components should be connected to the enterprise network or the Internet only where necessary, only to the extent needed and only with appropriate security measures (e.g. use of firewalls and network segmentation) in place.

Additionally, Siemens’ guidance on appropriate security measures must be taken into account. For more information about industrial security, please visit http://www.siemens.com/industrialsecurity.

Siemens’ products and solutions undergo continuous development to make them even more secure. Siemens strongly recommends applying product updates as soon as available and to always use the latest product versions. Using versions that are obsolete or are no longer supported can increase the risk of cyber threats.

To stay informed about product updates, subscribe to the Siemens Industrial Security RSS Feed under http://www.siemens.com/industrialsecurity.
# Table of contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warranty and liability</td>
<td>2</td>
</tr>
<tr>
<td>1 Introduction</td>
<td>4</td>
</tr>
<tr>
<td>1.1 Plant-wide automation in the glass industry</td>
<td>4</td>
</tr>
<tr>
<td>1.2 Benefits from the glass manufacturer’s perspective</td>
<td>5</td>
</tr>
<tr>
<td>1.3 Benefits from the OEMs’ perspective</td>
<td>6</td>
</tr>
<tr>
<td>2 Introduction to automation in glass production</td>
<td>7</td>
</tr>
<tr>
<td>2.1 Introduction</td>
<td>7</td>
</tr>
<tr>
<td>2.2 Production steps in the glass production process</td>
<td>7</td>
</tr>
<tr>
<td>2.3 Various automation concepts</td>
<td>8</td>
</tr>
<tr>
<td>2.4 Automation of individual production steps</td>
<td>11</td>
</tr>
<tr>
<td>2.5 Automation, example plant</td>
<td>12</td>
</tr>
<tr>
<td>3 Plant-wide automation with Siemens solutions</td>
<td>13</td>
</tr>
<tr>
<td>3.1 General project settings</td>
<td>13</td>
</tr>
<tr>
<td>3.2 Controller S7-410</td>
<td>14</td>
</tr>
<tr>
<td>3.3 PCS 7 libraries Advanced Process Library and Industry Library</td>
<td>14</td>
</tr>
<tr>
<td>3.4 Network components</td>
<td>16</td>
</tr>
<tr>
<td>3.5 SIMATIC Panels</td>
<td>17</td>
</tr>
<tr>
<td>3.6 Process instrumentation</td>
<td>18</td>
</tr>
<tr>
<td>3.7 Archiving</td>
<td>20</td>
</tr>
<tr>
<td>3.8 Lifecycle management as a service</td>
<td>20</td>
</tr>
<tr>
<td>3.9 Siemens Support</td>
<td>21</td>
</tr>
<tr>
<td>4 Links and Literature</td>
<td>22</td>
</tr>
<tr>
<td>5 Documentation of changes</td>
<td>22</td>
</tr>
</tbody>
</table>
1 Introduction

1.1 Plant-wide automation in the glass industry

Challenges
Due to the different production steps in the glass production process, each of which demands a specific procedure and a very high standard of technological expertise, suppliers have become specialized in the individual plant sections (process OEM, hereinafter referred to as “OEM”), for which they have built up and refined their own know-how.

The challenge for the general contractor, who in the glass industry is typically also the final customer, consists in the coordination of the individual OEMs in the project management, and in particular in the specification of the technologies and interfaces to be used.

Solution
Plant-wide automation (PWA) is the basis for a smooth, uniform, standardized solution for plant-encompassing automation. Siemens supports both the general contractor and OEMs in this, e.g. working out specifications, with the components and assemblies used, and in project support and further-reaching services.

Purpose of this documentation
This documentation provides you with a guideline for glass projects and describes the advantages of plant-wide automation for both suppliers of automation solutions and end customers. In addition, production and maintenance are also considered, up to and including Siemens Services for the glass industry.

Notes on the different glass production processes
The facts and examples described in this application example refer principally to flat glass production. The technology used and the automation proposals made do not differ in principle in terms of the type of product, and can be applied for the automation of production systems for hollow glass or other kinds of glass as well.
Individual production steps and plant sections in these systems may differ from the descriptions given in this document, but in principle they can be integrated in a master control system with the same approaches towards plant-wide automation.
1.2 Benefits from the glass manufacturer’s perspective

The objective of an overarching master control system is uniform operation and data management across all the automation stations in the production process. This unification produces long-term benefits for the plant operator which outweigh any additional effort which might be caused by projecting the automation process itself.

Requiring the OEM to standardize and use the same hard- and software means that the OEM solutions can be integrated seamlessly and without any additional effort in the superordinate process control system.

Uniform procedures and process control systems create advantages for the glass manufacturer:

- Plant-wide and uniform data storage is made possible
  - an overview of all your system’s data
  - access to the data of all Operator Stations
- A uniform operating and monitoring philosophy of the Operation Station is made possible
  - a lower effort in the engineering and commissioning phase
  - lower training costs for operating personnel
  - swifter training for the system’s operating personnel
- Sustainable profitability through system-wide data and information base, e.g. optimization of material flow
- Higher productivity thanks to plant-wide data and information base, optimization of procedures, swifter processing times
- Greater energy efficiency thanks to plant-wide data and information base, e.g. better use of energy through coordination with the production steps
- Shorter time-to-market thanks to simpler commissioning and system start-up
- Greater flexibility thanks to the use of uniform and compatible automation products
- Greater transparency of all production steps since the plant-wide production data are filed over long periods of time
- Consistency in the plant thanks to use of unified hard- and software
- Innovative lead thanks to periodic uniform updates of the automation solutions
- The opportunities of the digitalization can only be realized by plant-wide data and information

When implementing plant-wide automation, Siemens can support you with technological solutions and expertise. The services provided are not restricted to configuration and project development; Siemens is at your disposal as a service partner for the entire useful life cycle of the system.
1.3 Benefits from the OEMs’ perspective

Long-term benefits for the OEM arise from the consistent implementation of the definition and specifications of hard- and software by the contractor. These benefits extend from the project and planning phase to the commissioning and to the maintenance of their own OEM solution. At the same time, the highly important protection of the OEM’s own know-how is upheld during the project implementation thanks to the uniform procedure:

- OEM know-how protected through the customary safety measures of PCS 7, e.g. know-how protection of the PCS 7 modules.
- Standardized interfaces make cooperation with other suppliers easier
- The feasibility of a central Engineering Station simplifies commissioning and maintenance of the OEM automation solution
- The OEM automation solution can easily be integrated in the superordinate PCS 7 process control system, which guarantees a swifter commissioning
- Safe, simple and cost-effective remote maintenance thanks to unified access to the OEM plant section
- Flexible expandability thanks to the use of uniform soft- and hardware
2 Introduction to automation in glass production

In the following the production line for the manufacturing of plate glass and the Siemens solutions for the automation of such systems will be described as explanation and introduction into plant-wide automation in glass production.

2.1 Introduction

Almost all the plate glass produced in the world is manufactured using the so-called float process. The production of glass using the float process is an endless continuous process. Molten glass at a temperature of around 1500 degrees Centigrade flows continuously onto a long liquid tin bath on which the glass floats and spreads evenly. At the cooler far end of the bath, the solidified glass - still at a temperature of around 600 ºC - is drawn out continuously and passes through a lehr, where it cools down tension-free.

The so-called “cold end” of the glass production process begins with a camera-based quality inspection for imperfections and the subsequent optimized cutting (longitudinal and transversal), depending on the result of the preceding inspection. The glass sheets are then distributed onto various transport belts, then taken down and stacked, and may be subjected to further treatment, e.g. coating, bending, perforating, grinding.

2.2 Production steps in the glass production process

The stages in a glass production line can be broadly grouped into the following process steps:

- **Mixture preparation:**
  Mixing, weighing and preparation of the raw materials

- **Melting furnace:**
  Melting the mixture, removal of gases, basin for homogenization and cooling to a moldable temperature

- **Shaping:**
  Float process for plate glass, IS machine for hollow glass, Tel process for glass wool, rotating Danner Pipe for glass tubing

- **Cooling:**
  Slow cooling in annealing lehr to remove tension

- **Quality control:**
  Check for impurities and material defects

- **Packaging and storage:**
  Picking of customer orders, storage, preparation for transport
2.3 Various automation concepts

Individual solutions

A production plant consists of plant sections from different OEMs. There is no uniform automation concept, each plant section is independently automated in itself.

Short-term benefits for the OEM:
- Individual configuration of the plant section independently of the overall concept

Long-term disadvantages for the plant operator:
- No system-wide data management and information display
- Complex care and maintenance due to different manufacturers and contact persons
- Difficult commissioning of the overall plant due to the different solutions and procedures of the component plant sections
- Communication between the plant sections is only possible by means of workarounds
- Complex operation of the entire system due to different operating concepts
Individual solutions with single products

A production plant consists of plant sections from different OEMs. There is a uniform concept for the automation of the plant units; however, all the plant sections continue to be automated in an isolated, self-sufficient manner.

Short-term benefits for the OEM:
- Individual configuration of the plant sections independently of the overall concept based on the standard components of a manufacturer.

Long-term disadvantages for the plant operator:
- System-wide data management and information display is not possible
- Medium-level effort for care and maintenance due to non-uniform implementation of plant sections
- Complex commissioning of complete plant due to non-uniform configuration
- Complex communication between plant sections due to non-uniform parameterization of communication
- Medium-level complexity of operation of entire system due to uniform operating concept, but different Operator Stations.
Overall solution with single products and plant-wide automation

A production plant consists of plant sections from different OEMs. There is a uniform concept for the automation of the complete plant. All the plant sections comply with unified automation specifications and are integrated in a plant-wide process control system.

Benefits for the OEM:
- Configuration of plant sections according to customer and automation standards. Adhering to the standards enables digital simulation, virtual commissioning and know-how-protected remote maintenance.

Benefits for the plant operator:
- Optimization of productivity, material usage and energy efficiency through system-wide central data management and information processing and display
- Lower maintenance and care effort thanks to a uniform implementation of the plant units
- Simplified commissioning of the entire system thanks to uniform configuration
- Integral data flow and information exchange thanks to uniform communication between plant sections
- Simplified operation of the entire plant thanks to unified operating concept of the complete system via operation stations of the same type.
- All process data and information can be made available to a Big Data application, e.g. Operations Intelligence Platform XHQ, digital Cloud Services with MindSphere, Energy Monitoring and other data processing systems.
2.4 Automation of individual production steps

The individual production steps in glass production are implemented with the corresponding OEM automation solution. The automation of individual components is functional in itself; however, in order to implement plant-wide automation this has to be integrated in an overall system with all the necessary interfaces for operation and data acquisition.
2.5 Automation, example plant

The following Example Plant is intended to illustrate system-wide automation for glass production under observance of unified guidelines.
3 Plant-wide automation with Siemens solutions

Plant-wide automation requires unified guidelines to be observed for its successful implementation. Compliance with the guidelines means the integration of individual plant sections from different OEMs can be implemented faster and more simply. Further advantages are the ease of maintenance of the different plant sections and a uniform data and operating concept.

The following Section provides a selection of the most important requirements for the implementation of plant-wide automation.

Siemens will provide you with a more detailed specification for your plant-wide automation with additional know-how. The responsible specialist advisor can provide you with further information, or you can contact the Siemens experts specialized in the glass sector directly:

www.siemens.com/glass

Basic procedure for a PWA project

- You and your suppliers (process OEMs) of plant sections have decided to implement plant-wide automation (PWA).
- Siemens presents you with a Technical Guideline.
- Siemens and you draw up a Design Specification working together.
- The Design Specification is presented to all the OEMs involved.
- Siemens supports OEMs in the implementation of the Design Specification.
- The OEMs deliver the respective plant section according to specifications.
- Siemens takes charge of merging the plant areas into a PWA overall system with universal communication and data management.

3.1 General project settings

You implement the automation of your system as a multi-project. The interface as central server operator interface is shared with all the clients. This guarantees uniform operation and user authorization at all operator stations. Thanks to central data storage all the OEMs can make swift modifications during the commissioning.

You will find information about PCS 7 guidelines for the implementation of projects in the PCS 7 compendia in Siemens Industry Online Support:


You will find more information on the engineering of a multi-project under the following link:

Summary

- Uniform use of PCS 7 and use of the same PCS 7 version
- Design and implementation of all projects as a multiproject with a server-client architecture
- Uniform Windows user authorization management
- Uniform name conventions in projects
- Uniform name conventions in programs, variables and user interfaces
- Uniform project storage structure
- Use of a central data server for data storage, archiving and web access to your data

3.2 Controller S7-410

For projects in the glass industry, model series S7-410 controllers are used; these are ideally suited for new installations or for an as-yet unknown performance requirement of your plant. Apart from the usual SIMATIC features such as e.g. great ruggedness and availability, the controller is characterized by its top-level flexibility. The controller is delivered with the maximum computing and storage capacity level; by means of a system expansion card (SEC) it is scaled to the required performance. In addition, as from Version PCS 7 V8.1 the update of individual block types and the incorporation of new expansion modules can be carried out without causing an interruption. This means that at a later date you can expand your plant with flexibility in respect of performance and scope.

Summary

- Use of an S7-410 CPU for future flexibility and high availability
- Use of S7-410 redundancy modules if even greater availability is required, and in safety-critical plant sectors

3.3 PCS 7 libraries Advanced Process Library and Industry Library

Advanced Process Library (APL)

Programming the automation is done using the APL’s library blocks, which cover a wide range of functions of the process industry, e.g. channel blocks, regulation blocks, technology blocks and maintenance blocks. Moreover, for the blocks used the APL automatically creates the corresponding data management and enables the automatic generation of uniform image blocks for your operator interface. The automatic process with the engineering making use of the library saves you a great effort when creating your standardized solution. In addition, program standardization makes it easier to update to new versions.

The function blocks of the Advanced Process Library and Industry Library are to be used preferentially. The APL style guide must be observed when creating your own function blocks.

For complex control of a process in your glass production the APL offers standardized model-based predictive control (MPC) control blocks. These control blocks can regulate precisely 4x4 / 10x10 interconnected manipulated variables.
and controlled variables, enabling optimum control of complex processes in your plant.

Further information about MPC and examples of their application can be found at: https://support.industry.siemens.com/cs/ww/en/view/101978659

Industry Library (IL)

For more specific technical solutions, the SIMATIC PCS 7 Industry Library expands the standard functionality of the Advanced Process Library by incorporating characteristic industry functionalities, among others for the glass industry. The Industry Library offers special technology blocks as an extension and is a functional expansion of your automation in the Look&Feel of the APL. The Library also supports operation and monitoring via a multiple observation concept as well as the integration of Panels in your system and the integration of SIMATIC S7 package units into SIMATIC PCS 7 applications.

Summary

- Standardized use of the APL library for the generation of the user interface
- Special individual blocks have to be organized in a library
- Unified programmer style guide for all plant sections
- Unified naming conventions are used for blocks, variables and process tags
- Uniform adjustments for the archiving in all projects
- Model-based predictive control (MPC) for 4x4 / 10x10 interconnected actuating and control variables
- Use of the Industry Library for the standardized application of additional technology blocks
- Multiple observation concept and panel integration
3.4 Network components

The PCS 7 project communication is based on a client/server network architecture. Communication is via optical fiber in a ring topology and industrial ethernet. Siemens offers an extensive range of network components for electronic and optical data transfer. SIMATIC PCS 7 distinguishes between a separate system network and a terminal network in order to guarantee a high level of safety and performance. Configuration of the networks is implemented according to defined ethernet specifications in respect of Mac, IP address and subnet templates.

Communication with the sensors and actuators is generally via PROFIBUS and PROFINET. The connection between the controller and the peripherals is done via the Siemens Interface Module ET 200. The uniform structure of the network communication enables parameterization of the process instruments in the field across all the network structures with the Process Device Manager (PDM) straight from the Engineering Station (ES). Data acquisition and processing from the field during operation is possible on the operator level directly.

Summary

- Use of unified network components
- General client-server architecture
- Separate system and terminal network
- Hardware firewalls for secure web access
- Use of industrial ethernet in a ring topology for system bus
- Redundant design
- Use of PROFIBUS and PROFINET as standardized field buses
- Uniform control of network settings
3 Plant-wide automation with Siemens solutions

3.5 SIMATIC Panels

On-site operation is made possible with the SIMATIC Panel IPC 277D (NANOPANEL PC). Use WinCC flexible Advanced or TIA portal for the configuration of the panels. The panels are integrated into your SIMATIC PCS 7 process control system via the Industry Library (IL) function blocks.

For information on the above please refer to the application example “Integration of Comfort Panels, Operator Panels and S7-300 Package Units in SIMATIC PCS 7 with PCS 7 Industry Library”:


Summary

- Uniform use of machine-oriented control panels
- Integration of panels in process control system with S7-300 and standardized Industry Library
- Uniform panel user interface analogous to Operator Stations
3.6 Process instrumentation

Field devices are an essential component for measurement of pressure, temperature, flow rate or level in every automation. Electrical transmission of the real values is the central function of a field device and enables system regulation and control. The comprehensive Siemens portfolio enables you to implement the entire process instrumentation of your PCS 7 system. The field devices are integrated in your system either centrally or de-centralized via PROFIBUS or PROFINET and can be monitored from all your system’s operating stations. Parameter assignment is carried out with the Process Device Manager (PDM) and then loaded in the field devices via the network after completion. In the following you will find an overview of the possible location of process instruments in a glass production facility.
Further information on process instrumentation and its areas of application can be found at:
3.7 Archiving

Use SIMATIC Process Historian to archive the data of your total system. It archives measured values and messages of the entire system centrally and can make them available for data retrieval and report generation. The Process Historian is operated as a central data server in the terminal network, the data are transferred from the system network via the OS server. The data in the network can additionally be made accessible via a central information server so that you can have selected system data close at hand anywhere and at all times. You can determine with flexibility and according to your own wishes the type of display, quantity and type of data of the web access.

Further information about the Process Historian and Information Server can be found at:

Summary

- Archiving the messages and the measured values with Process Historian
- Uniform archiving settings for all plant sections
- Uniform presentation of data via web interface

3.8 Lifecycle management as a service

In the framework of a lifecycle contract Siemens offers complete service support for the entire useful life of your system. The service is intended to enable your plant to be operated as optimally as possible. This makes possible lower operating and maintenance costs and a consequent reduction of downtime. Siemens’ lifecycle management, which can be adapted to your individual needs, includes the following aspects:

- Advice concerning product choice and system configuration in the event of expansions and updates
- Maintenance and upkeep
- Replacement of defective devices and pre-emptive replacement of devices based on long-term data analysis
- Optimization of energy requirement based on long-term data analysis
- Expansion of the system and upgrading to new versions
- Support with training courses, documentation and operating personnel mentoring

Further information on lifecycle management of PCS 7 systems can be found in the application example “Tool supported lifecycle management of PCS 7 plants”:
3.9 Siemens Support

Industry Online Support

Do you have any questions or need assistance?

Siemens Industry Online Support offers round the clock access to our entire service and support know-how and portfolio.

The Industry Online Support is the central address for information about our products, solutions and services.

Product information, manuals, downloads, FAQs and application examples – all information is accessible with just a few mouse clicks at:

http://www.siemens.com/onlinesupport/pcs7

Technical Support

The Technical Support of Siemens Industry provides you fast and competent support regarding all technical queries with numerous tailor-made offers – ranging from basic support to individual support contracts.

Please send queries to Technical Support via Web form:

https://support.industry.siemens.com/My/ww/en/requests

Industry Online Support app

The “Siemens Industry Online Support” app provides you with optimum support, including while on the road. The app is available for Apple iOS, Android and Windows Phone:

https://support.industry.siemens.com/cs/de/en/sc/2067
4 Links and Literature

Table 4-1

<table>
<thead>
<tr>
<th>No.</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Siemens Industry Online Support</td>
</tr>
<tr>
<td></td>
<td>[<a href="https://support.industry.siemens.com">https://support.industry.siemens.com</a>]</td>
</tr>
<tr>
<td>2</td>
<td>Entry page</td>
</tr>
<tr>
<td></td>
<td>[<a href="https://support.industry.siemens.com/cs/ww/de/view/109744990">https://support.industry.siemens.com/cs/ww/de/view/109744990</a>]</td>
</tr>
<tr>
<td>3</td>
<td>Glass industry web page</td>
</tr>
<tr>
<td></td>
<td>[<a href="http://www.siemens.com/glass">http://www.siemens.com/glass</a>]</td>
</tr>
</tbody>
</table>

5 Documentation of changes

Table 5-1

<table>
<thead>
<tr>
<th>Version</th>
<th>Date</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>V1.0</td>
<td>03/2017</td>
<td>First version</td>
</tr>
</tbody>
</table>

© Siemens AG 2017 All rights reserved