SCE Training Curriculum for Integrated Automation Solutions

Totally Integrated Automation (TIA)

Siemens Automation Cooperates with Education

TIA Portal Module 010-080
HMI Panel KTP600 with SIMATIC S7-1200
Matching SCE training packages for these training curriculums

- **SIMATIC S7-1200 AC/DC/RELAY 6er "TIA Portal"**
  Order No.: 6ES7214-1BE30-4AB3
- **SIMATIC S7-1200 DC/DC/DC 6er "TIA Portal"**
  Order No.: 6ES7214-1AE30-4AB3
- **SIMATIC S7-SW for Training STEP 7 BASIC V11 Upgrade (for S7-1200) 6er "TIA Portal"**
  Order No.: 6ES7822-0AA01-4YE0

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1. Preface

Regarding its content, module 010-080 is part of the training unit 'Basics of PLC Programming' and demonstrates how to configure WinCC visualization between the panel KTP600 and the SIMATIC S7-1200 controller.

Training Objective

In this module 010-080 the reader learns how to configure process visualization of a panel by means of WinCC, in connection with the SIMATIC S7-1200.

Prerequisites

To successfully work through this module 010-080, the following knowledge is assumed:

- How to operate Windows
- Basics of PLC programming with the TIA Portal
  (for example, Module 010-010 'Startup' Programming of the SIMATIC S7-1200 with TIA-Portal V11)
- Blocks for the SIMATIC S7-1200
  (for example, Module 010-020 – Block Types for the SIMATIC S7-1200)
- Timer and Counter Blocks for the SIMATIC S7-1200
  (for example, Module 010-030 – Multi-Instances at the SIMATIC S7-1200)
Hardware and Software required

1. PC Pentium 4, 1.7 GHz, 1 (XP) – 2 (Vista) GB RAM, free disk storage approx. 2 GB
   Operating system Windows XP (Home SP3, Professional SP3)/Windows Vista (Home Premium SP1, Business SP1, Ultimate SP1)
2. Software STEP7 Basic V11 SP2 ( Totally Integrated Automation (TIA) Portal V11)
3. Ethernet connection between PC and CPU 1214C and panel
4. PLC SIMATIC S7-1200; for example, CPU 1214C und switch CSM 1277. The inputs have to be brought out to the panel.
5. SIMATIC Panel KTP600 Basic Color PN
2. **Instructions for Programming the SIMATIC S7-1200**

2.1 **Automation System SIMATIC S7-1200**

The automation system SIMATIC S7-1200 is a modular mini-controller system for the lower and medium performance range. An extensive module spectrum is available for optimum adaptation to the automation task. The S7 controller consists of a power supply, a CPU and input/output modules for digital and analog signals. If needed, communication processors and function modules are added for special tasks such as step motor control.

With the S7 program, the programmable logic controller (PLC) monitors and controls a machine or a process; the IO modules are polled in the S7 program by means of the input addresses (%I) and addressed by means of output addresses (%Q).

The system is programmed with the software STEP 7.

2.2 **Programming Software STEP 7 Professional V11 (TIA Portal V11)**

The software STEP 7 Professional V11 (TIA Portal V11) is the programming tool for the following automation systems:
- SIMATIC S7-1200
- SIMATIC S7-300
- SIMATIC S7-400
- SIMATIC WinAC

With STEP 7 Professional V11, the following functions can be used to automate a plant:
- Configuring and parameterizing the hardware
- Specifying communication
- Programming
- Test, commissioning and service with the operational/diagnostic functions
- Training curriculum
- Generating visualizations for the SIMATIC basic panels with the integrated WinCC Basic.
- With additional WinCC packages, visualization solutions for PCs and other panels can be created

All functions are supported with detailed online help.
2.3 Operator Control and Monitoring with WinCC

System Description

Since processes are becoming more and more multi-layered and the demands regarding the functionality of machines and plants are rising, the operator needs a powerful tool to control and monitor production systems. A HMI system (Human Machine Interface) represents the interface between the human being (operator) and the process (machine/system). The controller actually controls the process. That is, there is an interface between the operator and WinCC (at the operator panel) and an interface between WinCC and the controller. WinCC is the software we use to handle all necessary configuring tasks. WinCC Runtime is the software for process visualization. In runtime, the project is executed in the process mode.

WinCC handles the following tasks:

- **Representing the process**
  The process is mapped to the operator panel. If, for example, a state changes in the process, the display is updated on the operator panel.

- **Operating the process**
  The operator can operate the process by means of the graphic operator interface. For example, the operator can enter a setpoint for the controller, or start a motor.

- **Reading out alarms**
  If critical process states occur in the process, an alarm is triggered automatically; for example, if a specified limit is exceeded.

- **Archiving process values and alarms**
  The HMI system is able to archive alarms and process values. Thus, the process can be training curriculumed and older production data can later be accessed.

- **Managing process and machine parameters**
  The HMI system is able to store parameters for processes and machines in recipes. These parameters can, for example, be transferred from the operator panel to the controller in one step in order to change production to another product type.
3. **Conveyor Control with Counter and Multi-Instance**

For our process visualization with WinCC, the example for conveyor control will be expanded with a counter and a multi-instance.

With the conveyor, 20 bottles are always to be transported in a case. When the case is full, the conveyor belt is stopped, and the case has to be exchanged.

With button 'S1' the operating mode 'Manual' and with button 'S2' the operating mode 'Automatic' can be selected.

In the operating mode 'Manual', the motor is switched on as long as button 'S3' is operated; button 'S4' must not be operated.

In the 'Automatic' mode, the conveyor motor is switched on with button 'S3' and switched off with button 'S4' (NC).

In addition, there is a sensor ‘B0’ that counts the bottles into the case. After 20 bottles are counted, the conveyor is stopped...

When a new case is put in place, it has to be confirmed with 'S5'.

### Assignment list

<table>
<thead>
<tr>
<th>Address</th>
<th>Symbol</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>%I 0.0</td>
<td>S1</td>
<td>Button manual mode S1 NO</td>
</tr>
<tr>
<td>%I 0.1</td>
<td>S2</td>
<td>Button automatic mode S2 NO</td>
</tr>
<tr>
<td>%I 0.2</td>
<td>S3</td>
<td>On button S3 NO</td>
</tr>
<tr>
<td>%I 0.3</td>
<td>S4</td>
<td>Off button S4 NC</td>
</tr>
<tr>
<td>%I 0.6</td>
<td>S5</td>
<td>Button S5 NO reset counter/new case</td>
</tr>
<tr>
<td>%I 0.7</td>
<td>B0</td>
<td>Sensor B0 NO bottle counter</td>
</tr>
<tr>
<td>%O 0.2</td>
<td>M01</td>
<td>conveyor motor M01</td>
</tr>
</tbody>
</table>

3.1 **Task**

The conveyor control is to be operated and monitored by means of the panel.

Using the panel, the following requirements are to be met:

The operating mode is switched by means of the panel, and the respective operating mode is to be displayed on the panel.

Starting and stopping the conveyor motor is controlled from the panel.

Case replacement is acknowledged on the panel.

Transport of the bottles and filling the case is to be shown graphically.
3.2 Configuration

With the configuring software STEP7 V11, process visualization for conveyor control is set up, using the integrated WinCC version. The process values are represented with pictures and picture objects. With operating elements, default values are transferred to the controller. By means of the controller, tags handle the communication between the operator panel and the machine or the process. The value of a tag is written to a memory area (address) in the controller where it is read by the operator panel.

The process visualization is stored and loaded to the panel KTP600 Basic color PN. After the panel is powered up, the conveyor control can be monitored and operated.

4. Inserting Panel KTP600 PN in the Project of Conveyor Control

For project management and programming, the software 'Totally Integrated Automation Portal V11' is used.

Here, under a uniform interface, components such as controller, visualization and networking for the automation solution are set up, parameterized and programmed.

Online tools are available for error diagnosis.

In the steps below, the following is done: for the SIMATIC S7-1200 a project is opened, stored under a different name and adapted to the new requirements.

The central tool is the 'TIA Portal V11'. It is called here with a double click.
4.1 Load and Re-Store Existing Project

The project "FB_conveyor_counter" from Module 010-030 will now be opened as the model for this program.
Now, 'First steps' is offered for configuring. Click on 'Open the project view'.

![First steps in TIA Portal](image-url)
First, we are going to store the project under another name. In the menu **Project** click on **"Save As"**.
Now, 'Save' the project under the new name 'conveyor_KTP600'.

![Save as dialog](image)

- Save in: `automation`
- File name: `conveyor_KTP600`
- Save as type: `TIA-Portal-Projects`
To set up a new project, select the list box by double clicking on ‘Add new device’.
Under SIMATIC HMI, select the 6” display panel “KTP600 Basic PN”.
Set the check mark at “Start device wizard”.
Click “OK”.

![Image of Siemens TIA Portal Module 010-080, Edition 09/2012 with HMI Panel KTP600 with SIMATIC S7-1200]
Under Select PLC, first select "controller_conveyor".

Then, click on "Next".
Under Screen layout, change the background color to "White". And remove the check mark at "Header".

Then click on "Next".
Remove all check marks at Alarms.

Then click on “Next”.
Under Screen navigation, a screen menu structure could be set up. For our example, the “Root screen” is sufficient for the time being.

Then click on "Next".
As System screen, select the switch-over “Operating modes” and “Stop Runtime”.

Then click on “Next”.
Finally, predefined system buttons can be added. Remove all checkmarks.

Then click on “Finish”.
The WinCC interface is now opened with the root screen.
5. WinCC Operator Interface

- Project Navigation
- Menu bar and buttons
- Work area
- Tools

- Detail view
- Property window
5.1 Project Navigation

The project navigation window is the central connection point for project editing. All components and all available editors for a project are displayed in a project window in a tree structure, and can be opened from there. Each editor is assigned a symbol with which the associated objects can be identified. Only those elements are displayed in the project window that the selected operator panel supports. In the project window, you can access the basic settings of the operator panel.

![Project tree](image)

5.2 Menu Bar and Buttons

The menus and the symbol bars provide all functions needed to program the operator panel. If a corresponding editor is active, editor-specific menu commands or symbol bars are displayed. If you point to a command with the mouse pointer, a corresponding QuickInfo is provided for each function.

![Menu bar](image)
5.3 Work Area

In the work area, we edit objects of the project. All WinCC elements are arranged around the work area. In the work area, we edit the project data either in table form (for example, tags), or graphically (for example, a process display).

A symbol bar is located on the upper part of the work area. Here, fonts, colors or functions such as Rotate, Align, etc. can be selected.

5.4 Tools

In the tool window, a selection of objects is provided that can be inserted in pictures, such as graphic objects and operating elements. In addition, the tool window includes libraries with preassembled library objects and collections of picture blocks. Objects are moved to the work area with drag&drop.
5.5 Property Window

In the property window, we edit the properties of objects; for example, the color of picture objects. The property window is available only in certain editors. In the property window, the properties of the selected object are displayed arranged according to categories. As soon as you exit an input field, the value changes become effective. If you enter an invalid value, its background is colored. Via the QuickInfo, you are then provided with information regarding the valid value range, for example.

In addition, animations and events of the selected object are configured in the property window; here, for example, a display change when releasing the button.

5.6 Detail View

In the Details view, additional information is displayed regarding the object marked in project navigation.
6. **Operating Screens and Connections**

A screen can consist of static and dynamic elements...
Static elements such as text and graphics are not updated by the controller.
Dynamic elements are connected to the controller and visualize current values from the controller’s memory. Visualization can be in the form of alpha-numerical displays, curves and bars. Dynamic elements are also inputs on the operator panel that are written to the controller’s memory. Tags provide for the interfacing with the controller.

First, we are going to create a screen for our conveyor control.

6.1 **Root Screen or Start Screen**

This screen is already set up automatically and defined as start screen.
Here, the entire system is represented.
Buttons are provided for switching between the manual and the automatic mode, for starting and stopping the conveyor motor and for exchanging the case.
The movement of the bottle on the conveyor belt and the number of bottles in the case are shown graphically.

By operating the F6 key, we are jumping to the system screen.
6.2 Connections to S7 Controllers

For operating elements and display objects that access the process values of a controller, first a connection to the controller has to be configured. Here, we specify how and over which interface the panel communicates with the controller. In Project navigation, click on Connections. Through the settings in the hardware configuration, all parameters are already set.

The IP address still has to be assigned to the panel. With Accessible devices, read out the panel's MAC address. Then click on the button "Show".
### 6.3 Assigning the IP Address

After the MAC address is entered, the IP address can be assigned under **Online & Diagnostics.** The panel has to be in the transfer mode in that case.

**Note**

The IP address can also be checked or entered on the panel in the system control under **Control Panel** at **Profinet.**
7. Configuring the Root Screen

The system screen is called using the button "System screens". The function of the button "System screens" is to be transferred to the function key "F6".

Select the button "System screens" and below, in the property window, copy the function "ActivateScreen" at "Events" "Release".
7.1 Function Key F6

Select function key “F6” and below, in the Properties window, insert the function “ActivateScreen” at “Events” “Release key”.

Then, delete or remove the text field in the center and the button “System screens”.

The yellow triangle on the function key F6 refers to the key having been configured.
7.2 Configuring the Automatic and Manual Buttons

Drag a button into the work area of the root screen.

As text, enter **Automatic**.

**Caution!** Don’t press the input key; otherwise, a second line is generated.

Under Layout, enter position & size.
Under events, at Press, select the function under bit editing “SetBitWhileKeyPressed”.

Then, click on the field Tag (Input/Output) and open the tag window with the button 

Here, you can also access the interface declaration of data blocks.

As tag, select "automatic" from the conveyor_DB [DB1]

In the automatic mode, the button flashes and changes color. Under Animations, select Add new animation.
Select Appearance and confirm your selection with OK.

As tag, select “memory_automatic” from the conveyor_DB [DB1].

The button changes color in the automatic mode; i.e., when the tag “memory_automatic” has the value 1. For the color change to be visible, at Appearance change the foreground color to white and the background color to green. At Flashing, set to yes.

Copy and add the button “Automatic”. Place the added button below the Automatic button.

As text, enter Manual at Label.
Caution! Don’t press the input key; otherwise, a second line is generated.
Under Events Press, select as tag “manual” from the conveyor_DB [DB1].
The tag has to be selected, because only in this way is a new HMI tag generated.

The button changes color in the manual mode; i.e. when the tag “memory Automatic” has the value 0. For the color change to be visible, at Appearance change the foreground color to white and the background color to blue. At Flashing, set No.

Save the project.
7.3 Changes in the Step7 Program

Before we are testing the visualization, we first have to make a change in the Step7 program. In OB1, remove the assignment S1_conveyor1 and S2_conveyor1 when calling FB1. This is necessary since otherwise, the panel signals are overwritten by the process image of the inputs. Save and load the modified program.
### 7.4 Setting the PG/PC Interface for Runtime Simulation

For a connection to be set up between the runtime simulation on the PG/PC and the S7-1200 CPU, first the PG/PC interface has to be set to TCP/IP.

<table>
<thead>
<tr>
<th>No.</th>
<th>Procedure</th>
</tr>
</thead>
</table>
| 1   | Open the Control Panel  
• with "Start > Control Panel"  
  (Start menu for easy access to programs under Windows XP),  

• or via "Start > Settings > Control Panel"  
  (with class Start menu as is the case in earlier Windows versions). |
| 2   | In the Control Panel, double-click the icon "Set PG/PC Interface". |

Set the following parameters in the "Access Path" tab:  
1. For the access point of the application, select "S7ONLINE [STEP 7]" from the drop-down list.  
2. From the list of interface parameter assignment used, select the interface "TCP/IP(Auto) -> with your network adapter that is connected directly with the Panel and the controller, e.g., 3Com EtherLink XL.  
3. Then click OK and confirm the next message with OK.
7.5 Starting the Configuration in Runtime

In the project window, select the HMI_1 [KTP600 Basic PN] panel

Click in the button “Start simulation”.

Visualization is opened in the RT simulator.

Test the conveyor control project.
Either the automatic or the manual mode is now preselected on the panel.
7.6 Loading the Configuration to the Panel and Testing It

In the project window, select the HMI_1 [KTP600 Basic PN] panel.
Click on the button “Load to device”.

Click on the button “Load”.

If the operating system on the panel is not current, an additional window is displayed for updating the operating system.
Test function key F6 also.
7.7 Start and Stop Button

Now we are going to configure the start and stop buttons. The button "Start" is created in the same manner as the Automatic and Manual buttons. The button "Stop" has a break contact function and has to remove the signal when operated.

Generate the "Start" button.
Set the background color to green.
Under Events Press, select the function SetBitWhileKeyPressed under bit editing.
Select the tag "on" from conveyor_DB [DB1].
Generate the "Stop" button.
Set the background color to red.
Under Events Press, select the function **SetBitWhileKeyPressed** under bit editing.
Select the tag "off" from **conveyor_DB [DB1]**.
Before we test visualization, another change has to be made in the Step7 program.
In OB1, remove the assignment S3_Conveyor1 and S4_Conveyor1 when calling FB1.
Delete the negation at the off input of the block.
Save and load the modified program.

Load the configuration to the panel and test the Start and Stop buttons.
7.8 Adding Graphics from the Graphics Folder

In the tool box under Graphics, open the directory tree **WinCC graphics folder**
Drag the conveyor belt graphic to the root screen and drop it.
In the tool box under Graphics, open the directory tree WinCC Graphics folder. Drag the graphic of the beer bottle to the basic screen and drop it. Change the size and the position of the bottle.

Note

All graphic objects have to be located within the work area (320x240 pixels).
7.9 Control Program for Simulating Bottle Movement

To simulate bottle movement and the bottle sensor, we are creating a new block. The FB2 (simulation) below with tag declaration and network consists of a counter that, activated by a start signal, always counts up from 1 to 51.

In Network 1, the CTU (up counter) is added as multi-instance.
In Network 2, a bottle sensor pulse signal is read out when the count reaches 50.
This simulates when a bottle leaves the conveyor.
Program in ladder diagram (LAD):

**Network 1:** counter for position of the bottle

**Network 2:** simulation sensor bottle
7.10 Activating the Clock Memory and Assigning the MB100

As clock memory, an internal CPU clock memory bit is used. Activate the clock memory bits, and assign MB100 as address.
7.11 Calling FB2 (Simulation) in OB1

Before calling FB1 (conveyor), add a new network.

Call the simulation block (FB2) before the conveyor block (FB1).

In OB1, set up the "Temp tag" "bottle" and wire the blocks.

Then, save the project and load it to the controller.
Program in ladder diagram (LAD):

**Block title:** Main Program Sweep (Cycle)

**Network 1:** call program simulation bottle move

```
EN    ENO
"simulation_DB"
"Simulation"

"M1_CONVEYOR1" — start bottle_sensor  #bottle
"Clock_10Hz" — pulse
```

**Network 2:** call program conveyor 1

```
EN    ENO
"conveyor_DB"
"conveyor"

false — manual
false — automatic
false — on
false — off

#bottle — sensor_bottle
false — reset_counter
```
7.12 Configuring the Bottle Movement

Select the bottle and under the tab “Properties/Animations”, select under Movements “Add new animation”.

![Diagram showing the configuration process]

Select the bottle and under the tab “Properties/Animations”, select under Movements “Add new animation”.

![Diagram showing the configuration process]
As tag, select "CV" of IEC_Counter_1 in the simulation_DB (DB2).
Under range, enter 0 to 50.
Change the target position to the end of the conveyor X150.
In the project window, select the **HMI tags**.

Drag the slider in the window towards the right to get to the column **Acquisition cycle**. Set the acquisition cycle of the **HMI tags** to **100ms**.
Then, save the project, load it to the panel and test it.

After 20 bottles, the conveyor motor stops. To restart, the bottle counter has to be reset.
7.13 Resetting the Bottle Counter

Drag a button into the basic screen.

As text, enter "Change beer case" and adjust the color, position and size of the button.
Under Events Press, select under bit editing the function “SetBitWhileKeyPressed”. Select the tag “reset_counter” from conveyor_DB [DB1].

Set the acquisition cycle of the new HMI tag to 100ms. In OB1, remove the wiring reset_counter when calling the conveyor_FB. Then save the project, load it to the CPU and the panel, and test it.
7.14 Drawing the Beer Case

Draw a rectangle with a transparent background. Enter the frame width, the position and the size.
Draw a vertical line with a spacing of 30 pixels.
Draw a horizontal line with a spacing of 30 pixels.

With copying and inserting, add the remaining lines with a spacing of 30 pixels.
Select the beer case by drawing a frame around the case with the mouse.

In the menu “Edit”, select the function “Group”.
The rectangle and the lines are not to be displayed when the beer case is replaced.
At Rectangle_1 and at the lines, create the animation "Visibility" with the tag "conveyor_DB_reset_counter" at Value 1 Invisible.
At the lines, the animation can also be copied and inserted.

Then, save the project, load it to the panel and test it.
7.15 Drawing the Bottles in the Case

Enlarge the view and draw a circle in the lower right field of the case.
Draw a second circle.

Group the two inserted circles.
At Circle_1 and Circle_2, generate the animation “Visibility” with the tag "Conveyor_DB_IEC_Counter_0_Instance.CV" value range 0 to 19 Visible.
Copy and insert the bottle.
At the two circles under Visibility, change the value range of the tag
"Conveyor_DB_IEC_Counter_0_Instance_CV" to 0 to 18 Visible.
Copy and insert the individual bottles.

At the animation "Visibility" of the two circles, decrease the value at "to" by 1.

The last bottle has the value range 0 to 0.

Set the acquisition cycle of the new HMI tag to 100ms.

Then save the project, load it to the panel and test it.