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TIA Portal Openness: Generating a Modular Machine with S7-1500

TIA Portal Openness V15

<https://support.industry.siemens.com/cs/ww/en/view/109739678>

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Table of Contents

	Legal information	2
1	Task	4
2	Solution	5
	2.1 Overview.....	5
	2.2 Hardware and software components	7
	2.2.1 Validity	7
	2.2.2 Components used	7
3	Basics	10
	3.1 Basics on TIA Portal Openness	10
	3.2 Basics on the "option handling" configuration control	10
	3.3 Basics on "Apache Tomcat" web server	11
4	Mode of Operation	12
	4.1 General overview	12
	4.2 Modular project.....	13
	4.2.1 Organization block "Main" [OB 1].....	14
	4.2.2 "Conveyor" [FB 1] function block.....	15
	4.2.3 "Drive" [FB 2] function block.....	17
	4.3 Initial project	18
	4.3.1 "MainOptionHandling" [OB 125] organization block.....	18
	4.3.2 "ActDeactDrive" [FB 15] function block	19
	4.3.3 "PlantConfigData" [DB 7] global data block	20
	4.3.4 "SpeedAxisData" [DB 114] global data block.....	20
5	Installation and Commissioning	21
	5.1 Installing the software (download).....	21
	5.2 Installation of the "Apache Tomcat" web server optional.....	22
	5.2.1 Installation of the "Apache Tomcat" web server.....	22
	5.2.2 Setting the Windows Firewall	24
	5.2.3 Installing the openness web application "WebAppOpenness"	27
	5.2.4 Security setting in the "Apache Tomcat" directory	28
	5.3 Creating the configuration file	29
	5.4 Installation of the OpennessApplication "TIA Openness Project"	29
	5.5 Managing the user rights.....	32
	5.6 Granting access	33
6	Operating the Application Example	34
	6.1 Scenario A	35
	6.2 Scenario B.....	41
7	Links & Literature	43
8	History	43

1 Task

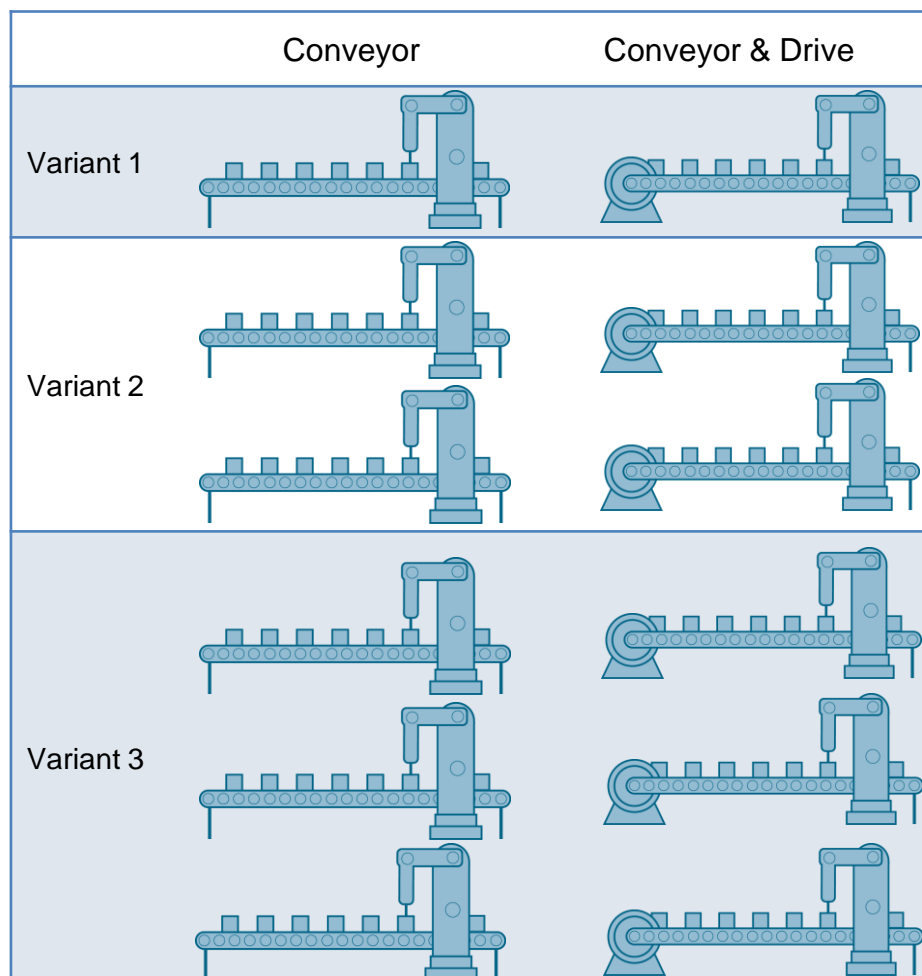
Introduction

TIA Portal Openness V15 is an open interface to TIA Portal V15. With TIA Portal Openness you can automatize and remote control your engineering tasks in the TIA Portal Openness with independent scripts or programs.

Overview of the application example

The following figure gives you an overview of the application example. In the right column the modular system "Conveyor" is supplemented by a "Drive". In the variants the quantity is supplemented by identical systems.

Figure 1-1



Description of the application example

The aim of the application example is to start the TIA Portal via a remote control and to configure and generate a STEP 7 project for a modular machine. All variants of the system are automatized with the same STEP 7 project and without reconfiguration.

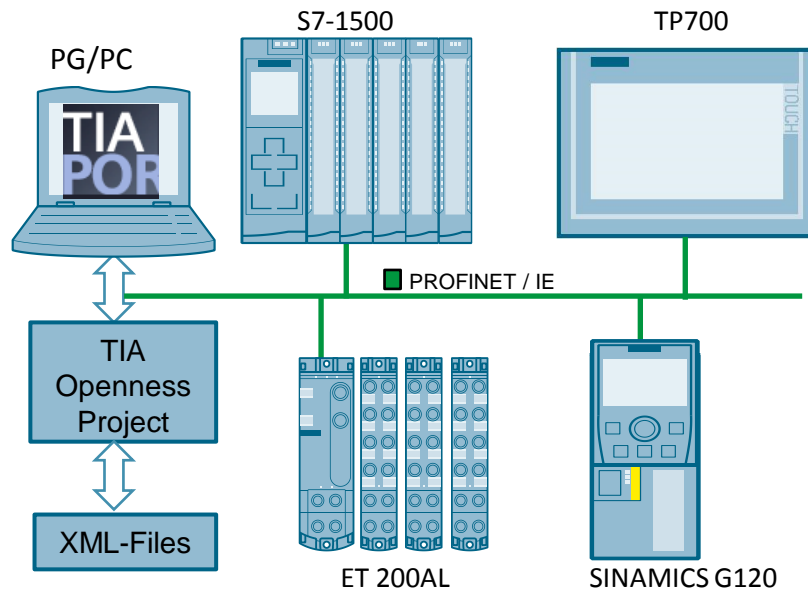
2 Solution

2.1 Overview

Schematic layout

The diagrammatic representation below shows what components are involved in the maximum configuration of the solution:

Figure 2-1



Configuration

The "TIA Openness Project" starts the TIA Portal and opens the initial project. This project consists of a pre-configured maximum configuration, which includes all variants of the machine. Depending on variant the "TIA Openness Project" changes the previously created XML files (program blocks) and imports this in the project. The optional operator panel visualizes the plant.

Advantages

- Remote control of the TIA Portal in order to create projects.
- Provision of project data of the TIA Portal for external applications.
- Easy project development due to the use of a single STEP 7 project for all variants.
- Small engineering effort for configuration, construction and wiring.
- Standardization of hardware and software for the various variants of a machine.

Assumed knowledge

Basic knowledge for the following issues is assumed:

- STEP 7 (TIA Portal)
- Programming environment, for example, Microsoft Visual Studio
- Object-oriented programming, for example, C# and JSP (JavaServer Pages)

2.2 Hardware and software components

2.2.1 Validity

The application example was tested with

- STEP 7 (TIA Portal) V15

2.2.2 Components used

The hardware configuration can be carried out with the TIA Selection Tool:

<http://www.siemens-en/tia-selection-tool>.

The application example has been created with the following components:

Hardware components

Table 2-1

Component	Qty.	Article number	Note
CPU 1511C-1 PN	1	6ES7511-1CK00-0AB0	-
MEMORY CARD, 24 MB	-	6ES7954-8LF02-0AA0	-
DI16/DQ16X24VDC	2	6ES7523-1BL00-0AA0	-
SCALANCE X208	1	GK5 208-0BA10-2AA3	-
TP700 COMFORT	1	6AV2124-0GC01-0AX0	-
ET 200AL IM157-1 PN	1	6ES7157-1AB00-0AB0	-
ET 200AL, DI 4+DQ 4X24VDC/0.5A, 8XM8	3	6ES7143-5BF00-0BA0	-
SINAMICS G120 CU240E-2 PN-F E-TYP	1	6SL3244-0BB13-1FA0	-
SINAMICS POWER MODULE PM240-2	1	6SL3210-1PB13-0AL0	-
DIN RAIL 245MM (9.6")	1	6ES7590-1AC40-0AA0	-
POWER SUPPLY S7-1500 PM1507	1	6EP1332-4BA00	-
BUS CABLE ET CONNECTION, 0.19M	1	6ES7194-2LH02-0AA0	-
POWER LINE M8, 0.19M	1	6ES7194-2LH02-1AA0	-
SINAMICS G120 INTELLIGENT OPERATOR PANEL(IOP)	1	6SL3 255-0AA00-4JA0	-

Software components

Table 2-2

Component	Qty.	Article number	Note
STEP 7 Professional V15	1	6ES7822-1..05-..	-
WinCC Advanced V15	1	6AV210.-....5-0	-
SINAMICS Startdrive V15	1	6SL3072-4FA02-0XG0	-
TIA Portal Openness V15	1		Included in the scope of delivery of STEP 7 Professional V15 or WinCC Advanced V15
Microsoft Visual Studio 2015	1	-	.NET Framework 4.6.1

Example files and projects

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

Table 2-3

No.	Component	Note
1	109739678_TIAV15_OpennessModularMachine_CODE_v11.zip	This zip file includes:
	TIA_OpennessModularMachine_Project_V15	The TIA Portal STEP 7 project
	TIA_OpennessModularMachine_Library_V15	The TIA Portal library
	SourceCode OpennessApp	The Microsoft Visual Studio "OpennessApplication" project
	WebAppOpenness	The openness web application "WebAppOpenness"
	XML	The XML files for the configuration of individual variants
	config.xml	The paths for the web application, the STEP 7 project and TIA Portal library
	TIA_OpennessModularMachine.exe	The executable file for OpennessApplication "TIA Openness Project"
2	109739678_TIA_OpennessModularMachine_PRODUCTS_v10.zip	The zipped file includes the TIA Selection Tool file with hardware and software products.
3	109739678_TIAV15_OpennessModularMachine_DOC_v11_en.pdf	This document

Note

The XML structure has been changed in TIA Portal V14 SP1. For this reason the project "TIA_OpennessModularMachine_Project" of V13 and V14 is not the same project in V14 SP1.

The TIA Portal projects in V13, V14 and V14 SP1 are different in their structures to the TIA Portal project in V14 SP1.

3 Basics

3.1 Basics on TIA Portal Openness

In STEP 7 V15 and WinCC V15, TIA Portal Openness V15 is available for free on the respective product DVDs. For you to be able to use TIA Portal Openness V15, STEP 7 or WinCC V15 has to be installed.

TIA Portal Openness V15 provides DLLs via which you can access the TIA Portal platform. These DLLs are based on .NET Framework 4.6.1

With TIA Portal Openness you automatize engineering by controlling the TIA Portal from a program created by you.

With TIA Portal Openness you can perform the following actions:

- Create project data
- Modify project data
- Delete project data
- Read project data
- Provide projects and project data for other applications.

Note

More information on TIA Portal Openness can be found in the manual "Automating SIMATIC Projects via Scripts" and in the application example "TIA Portal Openness Introduction and Demo Application".

<https://support.industry.siemens.com/cs/de/en/view/109477163/99477079435>

<https://support.industry.siemens.com/cs/de/en/view/108716692>

3.2 Basics on the "option handling" configuration control

The "option handling" configuration control enables flexible configuration steps for several stations within in a project and can be adjusted to customer requirements.

In a single STEP 7 project the maximum configuration of the stations is configured that comprises all module variants of a machine. This project can be used for several configuration steps of I/O stations.

To be able to use configuration control, the following steps are required:

1. Enable configuration control in the module.
2. Configure maximum configuration or program and write control data record that is valid as basis for the configuration control.

Note

More information on configuration control "option handling" can be found in the application example "Variants Management with SIMATIC S7".

<https://support.industry.siemens.com/cs/ww/en/view/29430270>

3.3 Basics on "Apache Tomcat" web server

Apache Tomcat is an open source web server that consists of Java Servlets of the JSP engine (JavaServer pages). With Apache Tomcat, web applications that are written with Java can be executed.

Apache Tomcat can be operated as independent web server with the HTTP connector or integrated with AJP connector in other web servers, for example, Microsoft IIS (Internet Information Services) or Apache web server.

Note

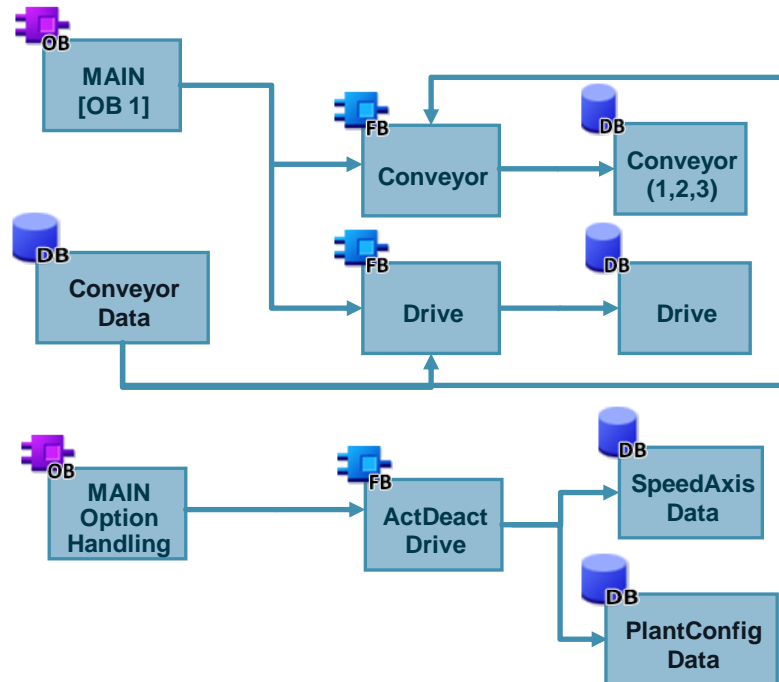
More information on the "Apache Tomcat" web server can be found on the Apache Tomcat website <http://tomcat.apache.org/>.

4 Mode of Operation

4.1 General overview

The figure below shows the program structure of the entire STEP 7 project.

Figure 4-1



Description of the core functionality

- The control with the modules for the maximum configuration is configured in the STEP 7 project.
- For all variants of the machine an independent data structure has been created in a database (XML files).
- To be able to display the selected variant, the user program transfers the required data record into the controller.

This application example consists of the following blocks:

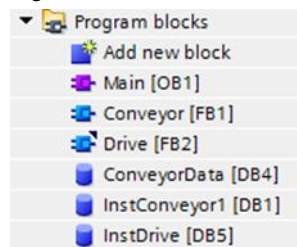
Table 4-1

Symbolic name	Description
Modular project	
Main [OB 1]	The OB 1 block contains the cyclic program. For the variant change the modules are created from the hardware catalog and for the drive the option handling is used.
Conveyor [FB 1]	The function block FB 1 includes the configuration of the "Conveyor".
ConveyorData [DB 4]	Data block DB 4 includes the tags for the maximum configuration.
Drive [FB 2]	The function block FB 2 includes the configuration of the "Drive".
Initial project	
MainOptionHandling [OB 125]	Block OB 125 creates a defined initial state for configuration of the "Drive".
ActDeactDrive [FB 15]	Function block FB 15 defines the states of the drive.
PlantConfigData [DB 7]	Data block DB 7 includes the status information of the "Conveyor" and the "Drive".
SpeedAxisData [DB 114]	Data block DB 114 includes the database of the "Drive".

4.2 Modular project

The initial configuration for this display is variant 1 "Conveyor & Drive".

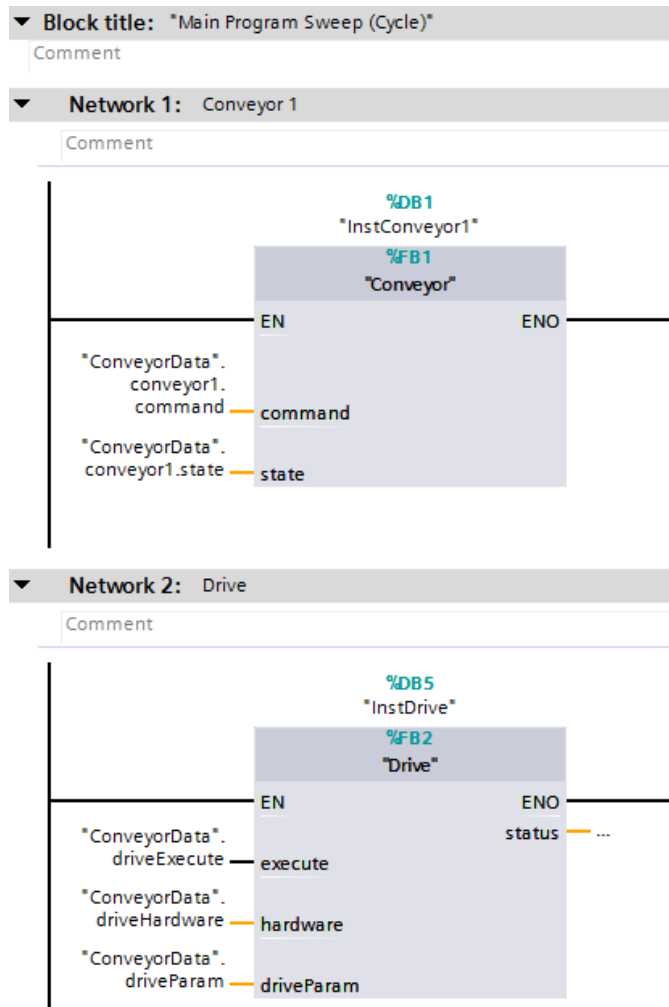
Figure 4-2



4.2.1 Organization block "Main" [OB 1]

OB 1 block contains the cyclic program and is used to operate the application. If the variant is changed, the hardware configuration of the modules is created from the hardware catalog via Openness and for the drive the "OptionHandling" is used. The configuration basis for OB 1 is the "XML > Main.xml" file.

Figure 4-3



4.2.2 "Conveyor" [FB 1] function block

The function block "conveyor" includes the parameters "velocity and direction" as well as the status information of the "conveyor". The configuration basis for FB 1 is the "XML > Conveyor.xml" file.

Figure 4-4



The following table includes all tags that are used with function block FB 1.

Table 4-2

Typ	Name	Parameter	Datentyp	Beschreibung
Input	command		PLC-data types	Struktur "ConveyorCommands"
		enable	BOOL	Activate/deactivate
		setMode	BOOL	
		conveyorID	INT	Hardware ID module (conveyor number)
		hardware	HW_SUBMODULE	Hardware ID sub module
		setDirection	BOOL	Direction conveyor
	setVelocity	REAL	Velocity conveyor	

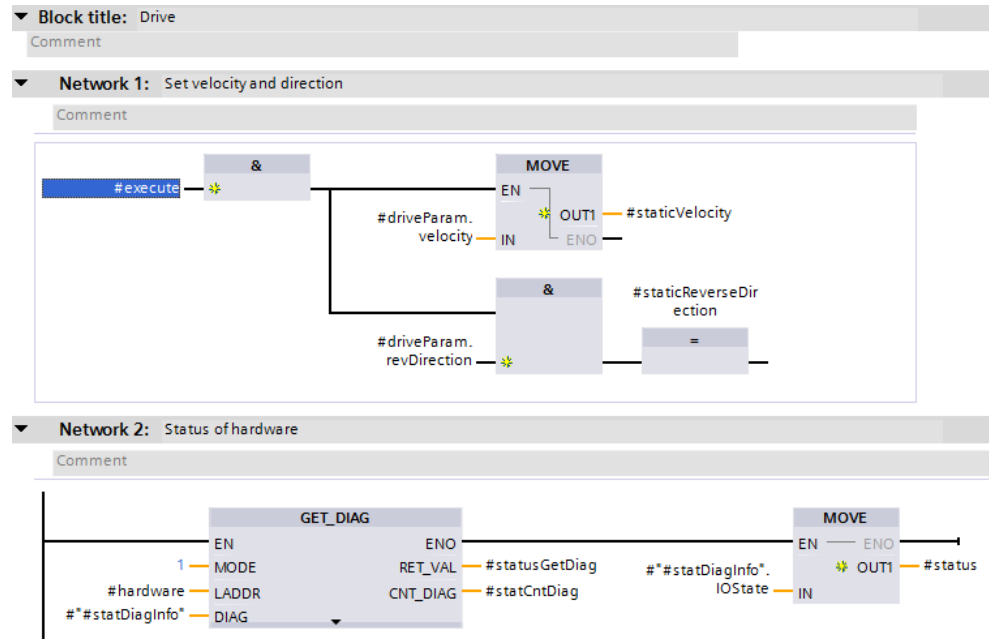
4 Mode of Operation

InOut	state		PLC-data types	Structure "ConveyorState"
		enabled	BOOL	Activate
		actState	INT	State activate
		actMode	BOOL	Mode activate
		actDirection	BOOL	Direction conveyor activate
		actVelocity	REAL	Velocity conveyor activate

4.2.3 "Drive" [FB 2] function block

The "drive" function block includes the parameters "velocity and direction" as well as the status information of the "Drive". The configuration basis for FB 2 is the "TIA_OpennessModularMachine_Library_V15" library.

Figure 4-5



The following table includes all tags that are used with function block FB 7.

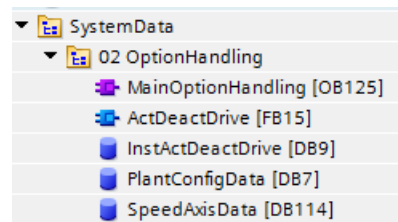
Table 4-3

Type	Parameter	Data type	Description
Input	excute	BOOL	Executing in the TRUE cycle
	hardware	HW_SUBMODULE	Hardware ID of the module (drive)
Output	status	WORD	I/O status of the module
InOut	driveParam	typeDriveParam	Velocity and direction (drive)
Static	staticVelocity	REAL	Velocity status interim result
	staticReverseDirection	BOOL	Changing direction
	#statDiagInfo	DIS	Diagnostic information at Mode = 1
	statusGetDiag	WORD	Status of instruction
	statCntDiag	WORD	Reserved (always "0")

4.3 Initial project

The initial project includes the system data "SystemData" that serves as basis for the configuration of the "Drive". The structure is specified for all variants.

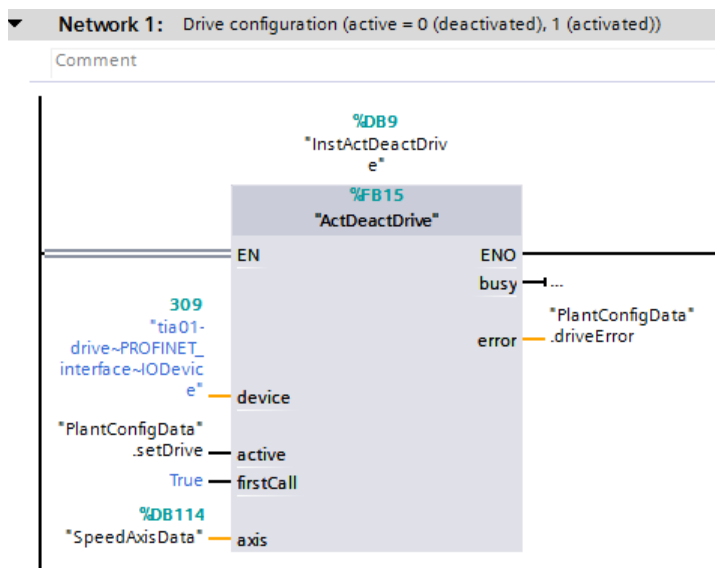
Figure 4-6



4.3.1 "MainOptionHandling" [OB 125] organization block

The "MainOptionHandling" block creates a defined initial state for configuration of the "Drive". In the user interface of the "TIA Openness Project" application or the "WebAppOpenness" web application, the various variants of the machine can be selected.

Figure 4-7



Note

More information on the configuration control "option handling" can be found in the application example "Variants Management with SIMATIC S7".
<https://support.industry.siemens.com/cs/ww/en/view/29430270>

4.3.2 "ActDeactDrive" [FB 15] function block

The "ActDeactDrive" function block includes all status information of the drive.

Figure 4-8

ActDeactDrive							
Name	Data type	Default value	Retain	Accessible from HMI	Visible in HMI	Comment	
▼ Input				<input type="checkbox"/>	<input type="checkbox"/>		
device	HW_DEVICE	16#0	Non-retain	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	HWID of the device	
active	Bool	false	Non-retain	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	1 = available // 0 = not available	
firstCall	Bool	false	Non-retain	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
▼ Output				<input type="checkbox"/>	<input type="checkbox"/>		
busy	Bool	false	Non-retain	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
error	Int	0	Non-retain	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
▼ InOut				<input type="checkbox"/>	<input type="checkbox"/>		
<Add new>				<input type="checkbox"/>	<input type="checkbox"/>		
▼ Static				<input type="checkbox"/>	<input type="checkbox"/>		
statStateOld	Bool	false	Non-retain	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
statBusyOld	Bool	false	Non-retain	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
▼ Temp				<input type="checkbox"/>	<input type="checkbox"/>		
tempMode	Int			<input type="checkbox"/>	<input type="checkbox"/>		
req	Bool			<input type="checkbox"/>	<input type="checkbox"/>		

The following table includes all tags that are used with function block FB 15.

Table 4-4

Type	Parameter	Data type	Description
Input	device	HW_DEVICE	Hardware ID device
	active	Bool	Activation: 1 = available 0 = not available
	firstCall	Bool	First call
Output	busy	Bool	Busy = 1: Job is still active Busy = 0: Job was completed
	error	Int	Device activate/deactivate
Static	statStateOld	Bool	Saving status interim result
	statBusyOld	Bool	
Temp	tempMode	Int	1 = activate 2 = deactivate
	req	Bool	Carrying out activation or deactivation

4.3.3 "PlantConfigData" [DB 7] global data block

The following figure shows the structure of the global "PlantConfigData" data block. Data block DB 7 includes the status information of the conveyor (conveyor 1, 2 and 3) and the drive (drive 0 and 1).

Figure 4-9

PlantConfigData							
Name	Data type	Start value	Retain	Accessible from HMI	Visible in HMI	Comment	
Static							
setConveyor	Int	1	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	1 = 1 conveyor; 2 = 1,2 conveyor; 3 = 1,2,3 conveyor	
conveyorStatus	DWord	16#0	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
setDrive	Bool	0	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	0 = inactive; 1 = active	
driveError	Word	16#0	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		

4.3.4 "SpeedAxisData" [DB 114] global data block

The "SpeedAxisData" data block includes the database of the drive.

Figure 4-10

SpeedAxisData			
	Name	Data type	Start value
1	Static		
2	Power	Struct	
3	Reset	Struct	
4	Halt	Struct	
5	MoveVelocity	Struct	
6	MoveJog	Struct	
7	acceleration	LReal	0.0
8	velocity	LReal	0.0
9	setVelocity	LReal	500.0
10	minVelocity	LReal	-1500.0
11	maxVelocity	LReal	1500.0
12	McRelease	Bool	false
13	errorDetail	UDInt	0
14	enable_X0	Bool	false
15	error_X1	Bool	false
16	controlPanelActive_X4	Bool	false
17	standstill_X7	Bool	false
18	ackAxis	Bool	false
19	powerOnAxis	Bool	false

5 Installation and Commissioning

This chapter shows you how to install and commission the application example.

5.1 Installing the software (download)

Load the following download file in a directory of your choice and unzip the zipped folder.

"109739678_TIAV15_OpennessModularMachine_CODE_v11.zip"

The zipped download file includes:

- SourceCode OpennessApp
- TIA_OpennessModularMachine_Library_V15
- TIA_OpennessModularMachine_Project_V15
- WebAppOpenness
- XML
- config.xml
- TIA_OpennessModularMachine.exe

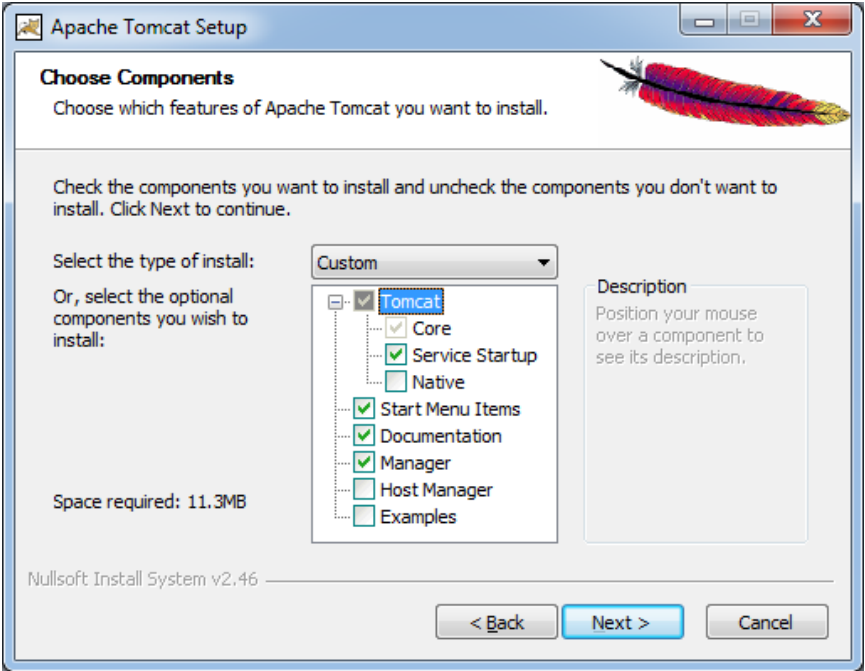
5.2 Installation of the "Apache Tomcat" web server optional

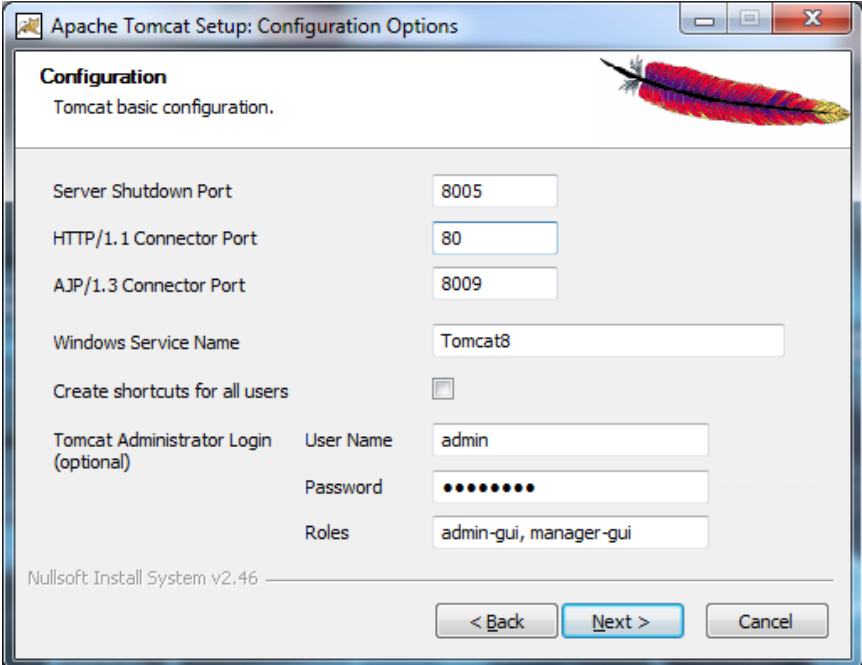
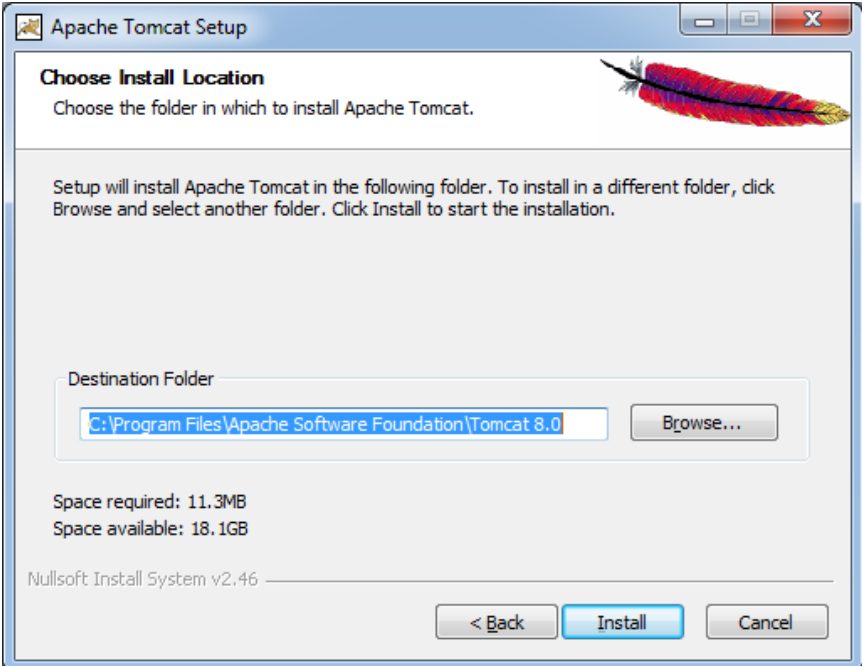
This chapter shows you the steps to be able to work with the "Apache Tomcat" web server.

5.2.1 Installation of the "Apache Tomcat" web server

You can use the "Apache Tomcat" web server for dynamic web applications.

Table 5-1

No.	Action
1.	Open the Apache Tomcat website http://tomcat.apache.org/
2.	Select the "32-bit/64-bit Windows Service Installer" in "Download > Tomcat 8 > Binary Distributions".
3.	Load the executable file "apache-tomcat-8.5.5.exe" onto your device.
4.	Open the storage folder of the downloaded file and start the Apache Tomcat setup. Follow the instructions of the installation setup.
5.	<p>Select the functions of the web server that you want to install by ticking or unticking "Choose Components".</p> 

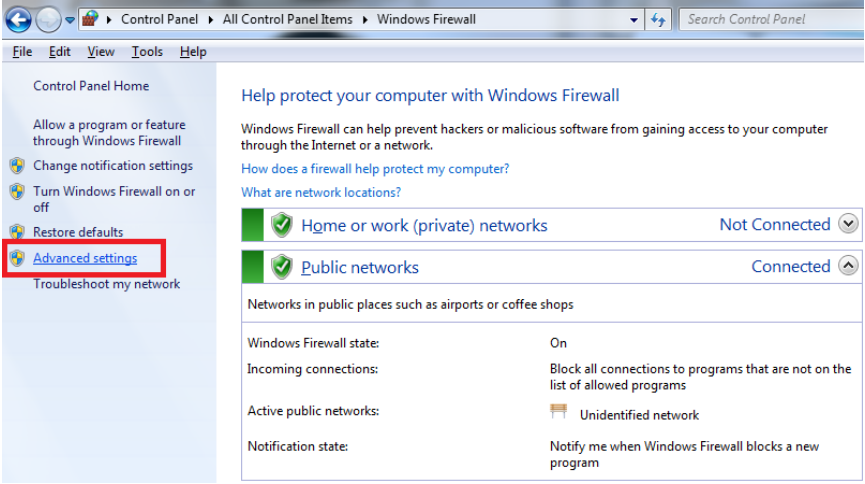
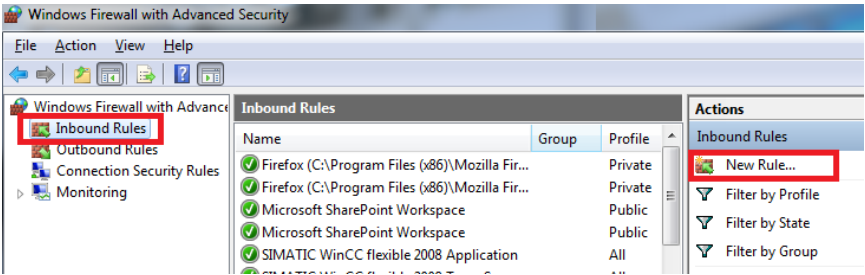
No.	Action
6.	<p>Set the entries in the configuration settings "Configuration Options" as shown in the following figure. Enter a user name and password.</p> 
7.	<p>Select the folder in which you want to install "Apache Tomcat". Then click the "Install" button.</p> 

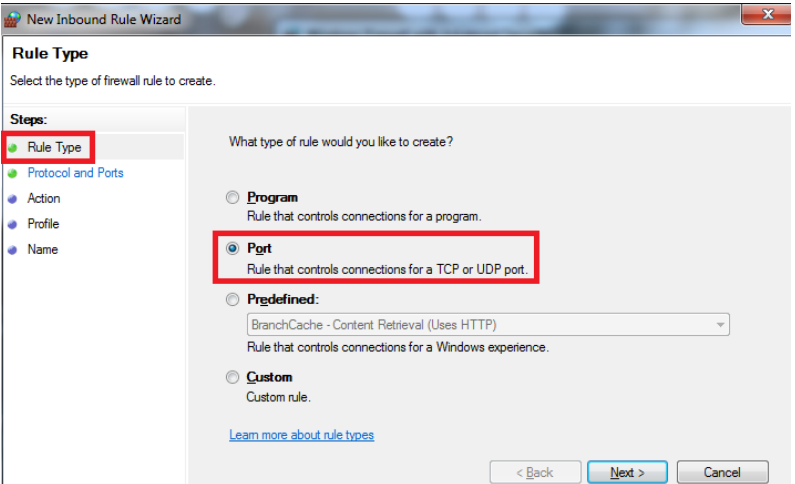
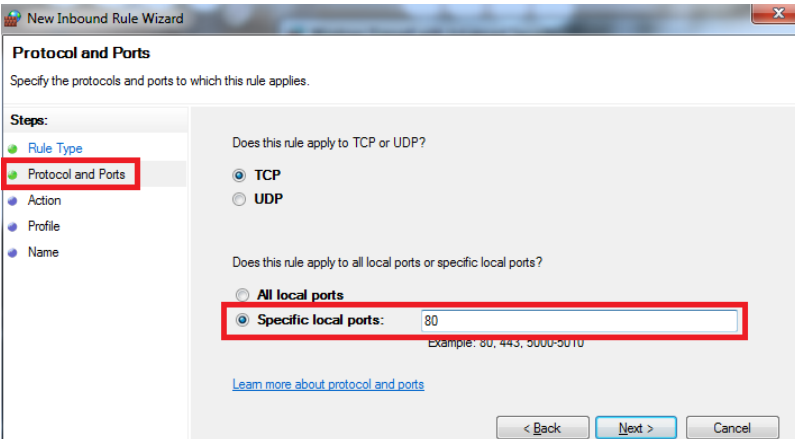
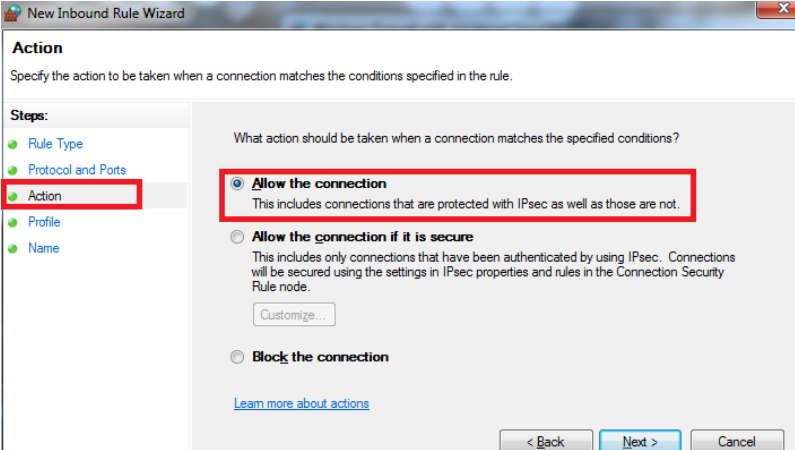
5.2.2 Setting the Windows Firewall

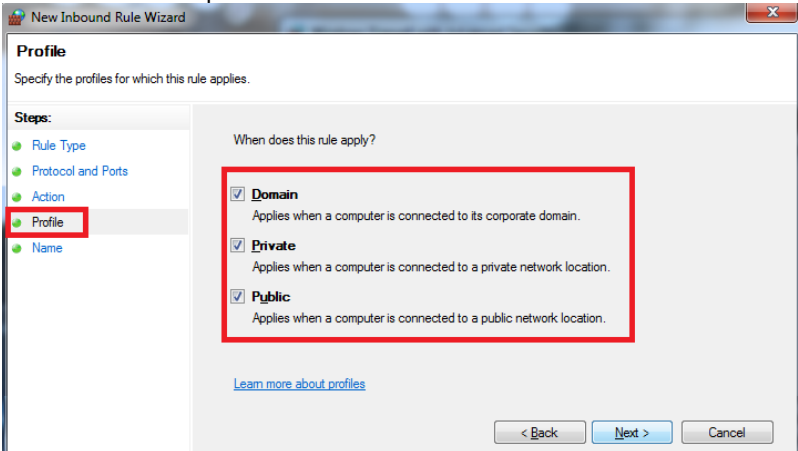
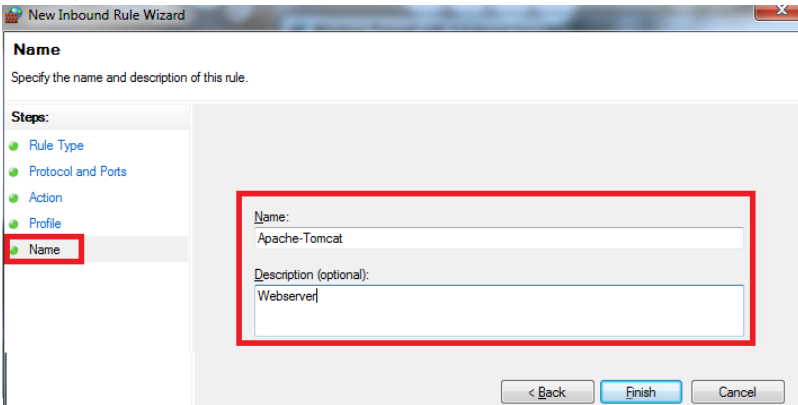
If the network connection between the individual components is blocked by a firewall, there may be problems with the data transmission.

This chapter shows you how you have to configure the firewall to ensure smooth communication between the components.

Table 5-2

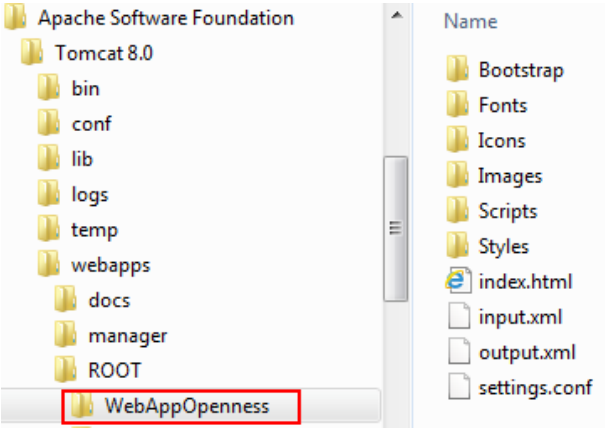
No.	Action
1.	<p>Select "Start > Control Panel > All Control Panel Items > Windows Firewall > Advanced settings".</p> 
2.	<p>First of all create a new "Inbound Rules" in order to open the port for the web server in inbound direction.</p> 

No.	Action
3.	<p>Select the type of rule, by enabling "Port".</p> 
4.	<p>Specify the respective port (80) and in addition select the "TCP" protocol.</p> 
5.	<p>Enable the "Allow the connection" check box.</p> 

No.	Action
6.	<p>Select the network profile for which the created rule is valid.</p>  <p>The screenshot shows the 'New Inbound Rule Wizard' dialog box. The 'Profile' step is selected in the 'Steps' list. The main area is titled 'Profile' and contains the text 'Specify the profiles for which this rule applies.' Below this is a 'Steps' list with 'Profile' highlighted. The main content area is titled 'When does this rule apply?' and contains three checked options: 'Domain', 'Private', and 'Public'. Each option has a brief description. A red box highlights this entire section. At the bottom, there are buttons for '< Back', 'Next >', and 'Cancel'.</p>
7.	<p>Name your rule. The rule is shown in the list of outbound rules.</p>  <p>The screenshot shows the 'New Inbound Rule Wizard' dialog box. The 'Name' step is selected in the 'Steps' list. The main area is titled 'Name' and contains the text 'Specify the name and description of this rule.' Below this is a 'Steps' list with 'Name' highlighted. The main content area contains two input fields: 'Name:' with the value 'Apache-Tomcat' and 'Description (optional):' with the value 'Webserver'. A red box highlights these two input fields. At the bottom, there are buttons for '< Back', 'Finish', and 'Cancel'.</p>

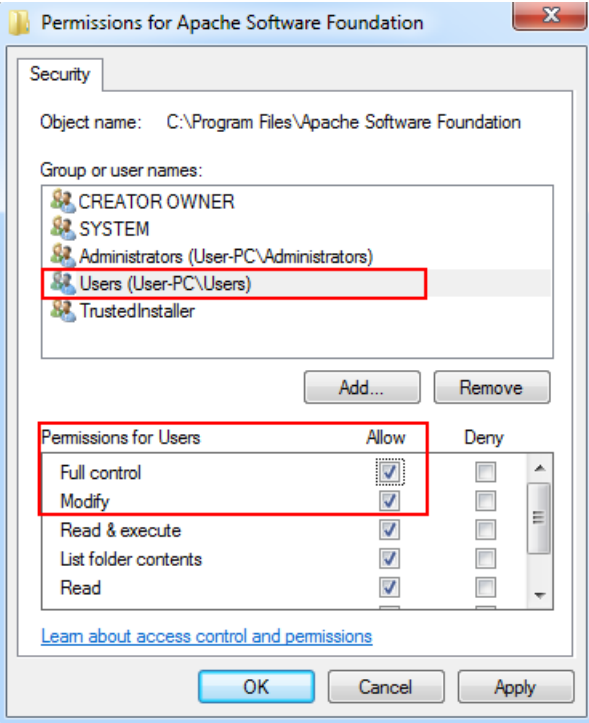
5.2.3 Installing the openness web application "WebAppOpenness"

Table 5-3

No.	Action
1.	Take the "WebAppOpenness" folder from the download file that you have downloaded in chapter 5.1.
2.	<p>Copy the "WebAppOpenness" folder into the following directory: "C: > Program Files > Apache Software Foundation > Tomcat 8.0 > webapps > ROOT".</p>  <p>Note: The storage path for the "WebAppOpenness" web application is specified in the configuration file "config.xml" from chapter 5.3. If you have not installed "Apache Tomcat" locally, you have to change the link in the "config.xml" accordingly.</p>
3.	<p>Once you have installed "Apache Tomcat" you can start the "WebAppOpenness" web application in your browser. Enter "http://localhost/WebAppOpenness/" in the address line to call the web application.</p>

5.2.4 Security setting in the "Apache Tomcat" directory

Table 5-4

No.	Action																		
1.	Open the "C:\Program Files" directory.																		
2.	Right-click the "Apache Software Foundation" folder and select "Properties > Security > Edit".																		
3.	<p>For the "Users" tick "Allow" for "Full control" and "Modify".</p>  <p>The screenshot shows the 'Permissions for Apache Software Foundation' dialog box. The 'Object name' is 'C:\Program Files\Apache Software Foundation'. The 'Group or user names' list includes CREATOR OWNER, SYSTEM, Administrators (User-PC\Administrators), Users (User-PC\Users), and TrustedInstaller. The 'Users (User-PC\Users)' group is highlighted with a red box. Below, the 'Permissions for Users' table shows the following settings:</p> <table border="1"> <thead> <tr> <th>Permissions for Users</th> <th>Allow</th> <th>Deny</th> </tr> </thead> <tbody> <tr> <td>Full control</td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td>Modify</td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td>Read & execute</td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td>List folder contents</td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td>Read</td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </tbody> </table>	Permissions for Users	Allow	Deny	Full control	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Modify	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Read & execute	<input checked="" type="checkbox"/>	<input type="checkbox"/>	List folder contents	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Read	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Permissions for Users	Allow	Deny																	
Full control	<input checked="" type="checkbox"/>	<input type="checkbox"/>																	
Modify	<input checked="" type="checkbox"/>	<input type="checkbox"/>																	
Read & execute	<input checked="" type="checkbox"/>	<input type="checkbox"/>																	
List folder contents	<input checked="" type="checkbox"/>	<input type="checkbox"/>																	
Read	<input checked="" type="checkbox"/>	<input type="checkbox"/>																	

5.3 Creating the configuration file

To determine the path, you can use the configuration file "config.xml" from the download file from chapter [5.1](#).

The "config.xml" includes the paths of:

- TIA Portal STEP 7 project
- TIA Portal STEP 7 library
- XML files
- Web application "WebAppOpenness"

Additionally available are:

- Name of online PLC
- Enabler of webserver

Figure 5-1

```
<?xml version="1.0" encoding="utf-8"?>
<config>
  <project>TIA_OpennessModularMachine_Project_V15\TIA_OpennessModularMachine_Project_V15.ap15</project>
  <library>TIA_OpennessModularMachine_Library_V15\TIA_OpennessModularMachine_Library_V15.al15</library>
  <xml-files>XML</xml-files>
  <web-path>C:\Program Files\Apache Software Foundation\Tomcat 8.0\webapps\ROOT\WebAppOpenness\</web-path>
  <nameOnlinePlc>tia01-plc</nameOnlinePlc>
  <enableWebserver>>false</enableWebserver>
</config>
```

Note

The "config.xml" has to be stored in the same directory as the OpennessApplication "TIA_OpennessModularMachine.exe".

You have to enter the correct path in "config.xml", otherwise the OpennessApplication will not work.

5.4 Installation of the OpennessApplication "TIA Openness Project"

Note

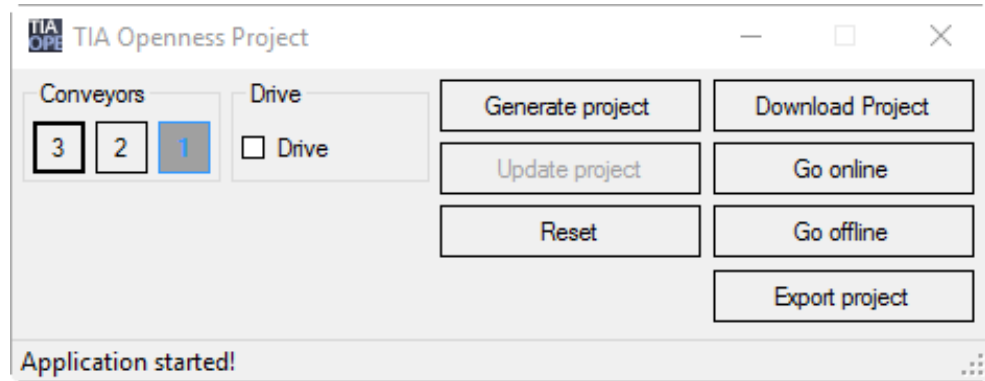
In STEP 7 V15 or WinCC V15, TIA Portal Openness V15 is included in the delivery.

The Microsoft Visual Studio project with fully programmed TIA Portal Openness functions is available in the download file from chapter [5.1](#) in the "SourceCode OpennessApp" folder.

The executable file "TIA_OpennessModularMachine.exe" can be found in the download file.

The following user interface "TIA Openness Project" is shown.

Figure 5-2



The "TIA Openness Project" accesses the "config.xml" file to be able to read the path of the initial project, the library and the XML files and calls the TIA Portal project accordingly.

Figure 5-3

```
// initialize form
InitializeComponent();

// folder path of application (exe)
string debugFolderPath = @"Z:\Shared_Folder_VM_Win10_TIAP_V15_SafetySD\189739678_TIAV14SPI_OpennessModularMachine_CODE_v10\";

string debugFolderPath = "";

// load config file
XElement root = XElement.Load(Path.Combine(debugFolderPath, "config.xml"));

XElement xEnableWebserver = root.Element("enableWebserver");
EnableWebserver = "false";
EnableWebserver = xEnableWebserver.Value;
XElement xWebPath = root.Element("web-path");

// use available input and output files in webserver folder
if (EnableWebserver.Equals("true")){...}
else{...}

// read project path from config
XElement xProject = root.Element("project");
string temp = Path.Combine(debugFolderPath,xProject.Value);
if (xProject != null && File.Exists(Path.Combine(debugFolderPath, xProject.Value))) ProjectPath = Path.Combine(debugFolderPath,xProject.Value);
else throw new Exception("Can't finde configured project. Please check <config.xml>!");

// read library path from config
XElement xLibrary = root.Element("library");
if (xLibrary != null && File.Exists(Path.Combine(debugFolderPath, xLibrary.Value))) LibraryPath = debugFolderPath + xLibrary.Value;
else throw new Exception("Can't find configured library. Please check <config.xml>!");

// read path for XML files for generating blocks
XElement xXml = root.Element("xml-files");
if (xXml != null && Directory.Exists(Path.Combine(debugFolderPath, xXml.Value))) XmlPath = debugFolderPath + xXml.Value;
else throw new Exception("Can't find directory for XML files. Please check <config.xml>!");

//read plc name used to go online
XElement xNameOnlinePlc = root.Element("nameOnlinePlc");
if (xNameOnlinePlc != null && xNameOnlinePlc.Value != null) NameOnlinePlc = xNameOnlinePlc.Value;
else throw new Exception("Configure Plc name in <config.xml>!");
```

The project is updated by the "TIA_OpennessModularMachine_Library_V15" library (update project)

The configuration data of the machine variants are imported from the XML folder via XML files in the TIA Portal. Afterwards the program blocks are generated and configured.

Figure 5-4

```

public void Generate(ushort conveyors, ushort drive, string xmlPath, string process, string result, bool compile = false)
{
    if (conveyors < 1 || conveyors > 3 || drive > 1)
        throw new RecoverableException("Can't generate project. Wrong number of conveyors and drives!");
    Disconnect();
    using (var exclusiveAccess = _tiaInstance.ExclusiveAccess(process))
    using (var transaction = exclusiveAccess.Transaction(_tiaProject, result))
    {
        // delete devices
        deleteET_200AL(_tiaProject);
        createET_200AL(_tiaProject, conveyors);

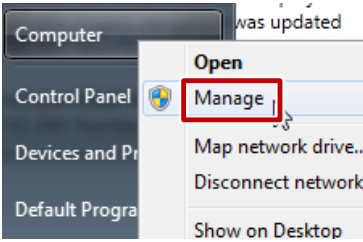
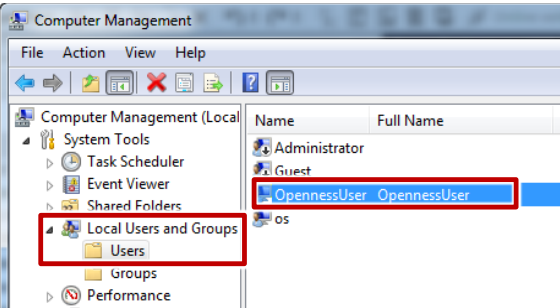
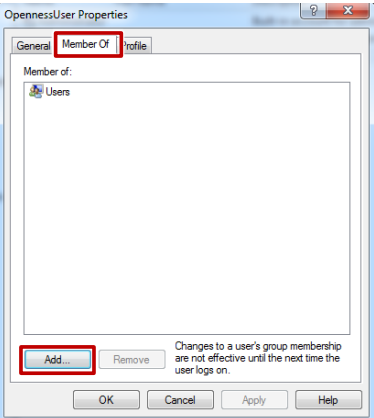
        _xmlPath = xmlPath;
        if (drive > 0)
        {
            InstantiateBlock("Drive", 1, 0, 0);
        }
        else
        {
            DeleteBlock("Drive");
            DeleteBlock("InstDrive");
        }
        GenerateBlock("Conveyor");
        var conveyorData = ModifyConveyorData(Path.Combine(xmlPath, "ConveyorData.xml"), conveyors, drive);
        GenerateBlock("ConveyorData", conveyorData);
        File.Delete(conveyorData);
        GenerateBlock("InstConveyor1");
        GenerateBlock("InstConveyor2", conveyors > 1);
        GenerateBlock("InstConveyor3", conveyors > 2);
        GenerateBlock("InstDrive", drive > 0);
        //Main
        var main = ModifyMain(Path.Combine(xmlPath, "Main.xml"), conveyors, drive);
        GenerateBlock("Main", main);
        File.Delete(main);
        string plantConfig = ModifyPlantConfig(Path.Combine(xmlPath, "PlantConfigData.xml"), conveyors, drive);
        GenerateBlock("PlantConfigData", plantConfig, FindBlock("PlantConfigData").Folder.Blocks);
        File.Delete(plantConfig);
        transaction.CommitOnDispose();
    }
    //Compile software
    _controller.GetService<ICompilable>().Compile();
}

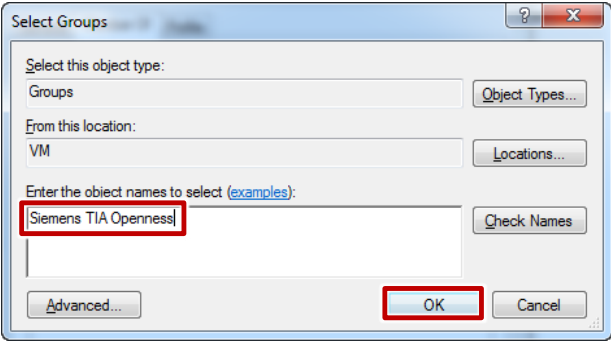
```

5.5 Managing the user rights

In order to use the application example, the user has to be added to the "Siemens TIA Openness" user group.

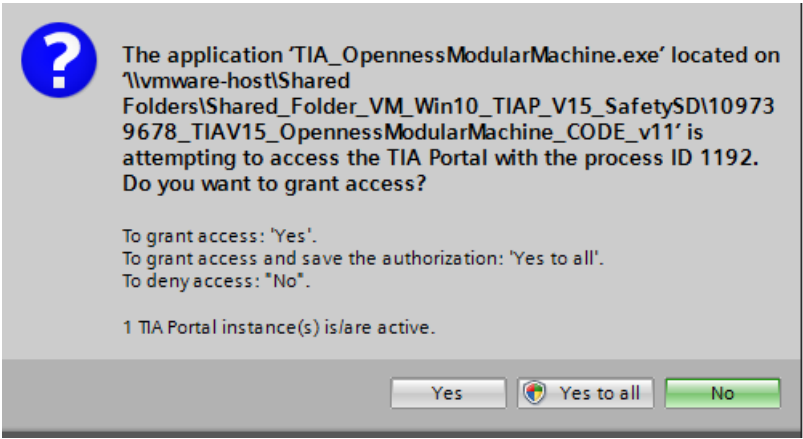
Table 5-5

No.	Action
1.	<p>Right-click on "Computer" in the windows taskbar and select "Manage".</p> 
2.	<p>Open "Local Users and Groups > Users" and double click the user.</p> 
3.	<p>Go to the "Member Of" tab and click the "Add" button.</p> 

No.	Action
4.	<p>Enter "Siemens TIA Openness" and confirm by pressing "OK".</p> 
5.	<p>Close the opened dialog boxes and log in again.</p> <p>Note: When the dialog is not closed and is reopened, the changes are not validly accepted.</p>

5.6 Granting access

Table 5-6

No.	Action
1.	<p>Double-click on the "TIA_OpennessModularMachine.exe" application. When you start the application for the first time, the following security message appears.</p> 
2.	<p>Confirm the message with "Yes" to allow the access once and with "Yes to all" to always permit access to this application.</p>

Note

If you are working with Microsoft Visual Studio, it can happen that you will receive the message, although you have already clicked "Yes to all". To avoid this, follow the instructions in the FAQ "Tips for TIA Portal Openness".
<https://support.industry.siemens.com/cs/ww/en/view/109251656>

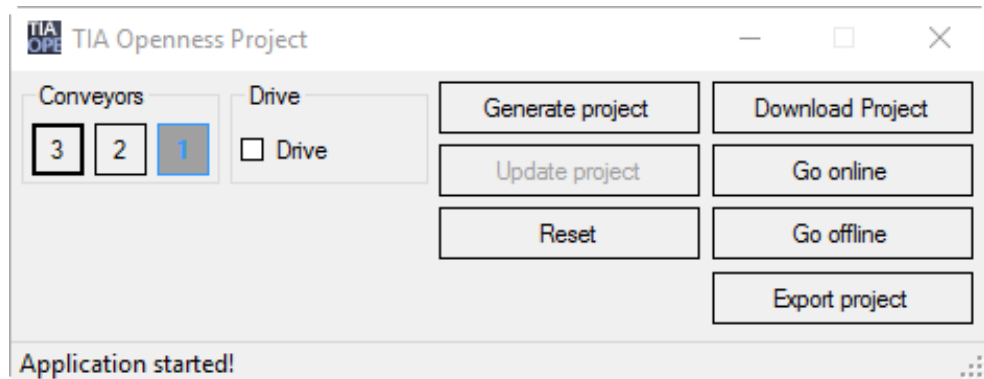
6 Operating the Application Example

At this point, it is assumed that the necessary software from chapter 5.1 has been installed on your computer and that you are familiar with the software.

To start "OpennessApplication", double-click on the following "TIA_OpennessModularMachine.exe" file.

First of all a TIA Portal instance is opened and then a default project. The following user interface "TIA Openness Project" is shown.

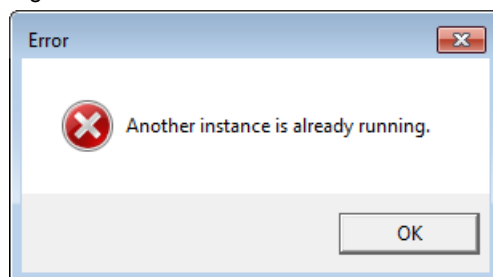
Figure 6-1



Note

When the "TIA_OpennessModularMachine.exe" is running in the background it cannot be restarted. The following error message is displayed "Another instance is already running".

Figure 6-2



You have two options to operate the application:

- Scenario A: Operation via the user interface "TIA Openness Project"
- Scenario B: Operation via the "WebAppOpenness" web browser

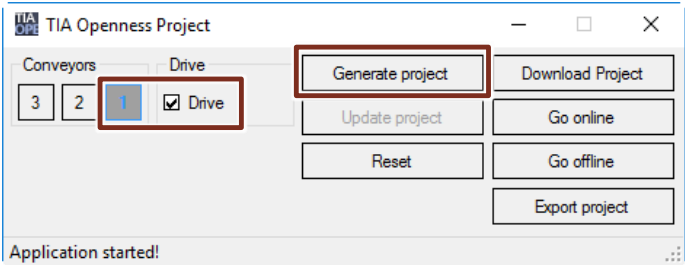
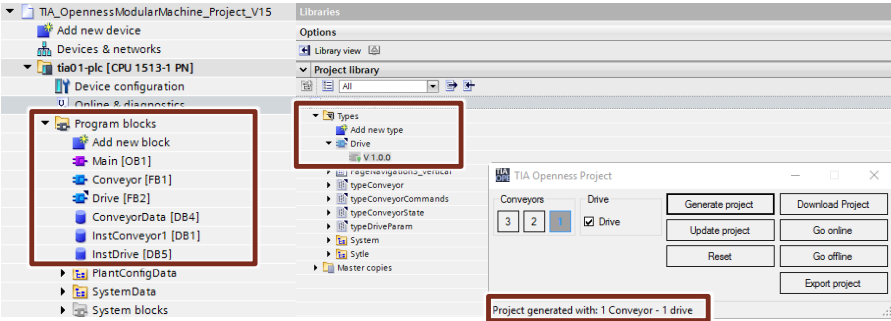
6.1 Scenario A

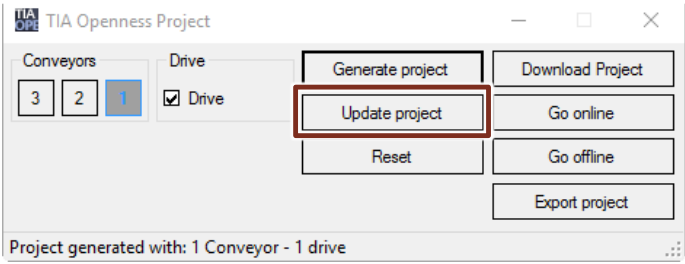
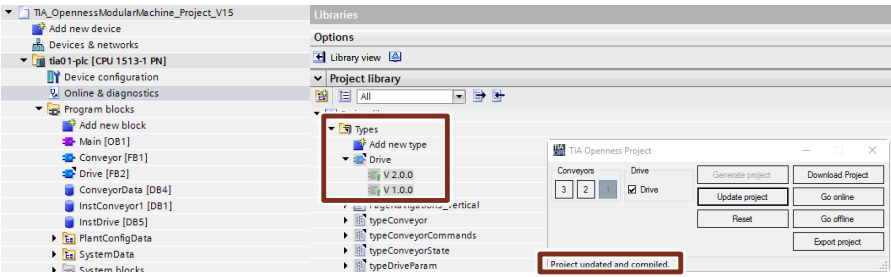
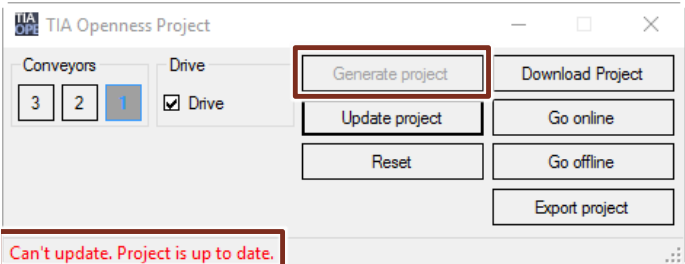
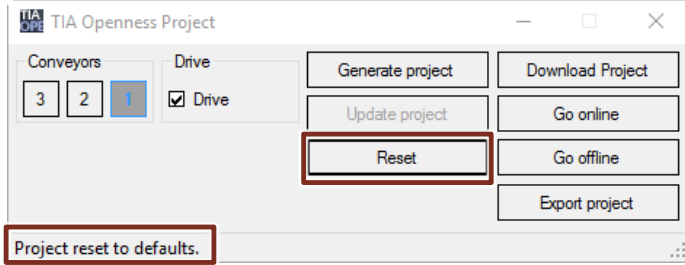
In scenario A you operate the application via the user interface "TIA Openness Project".

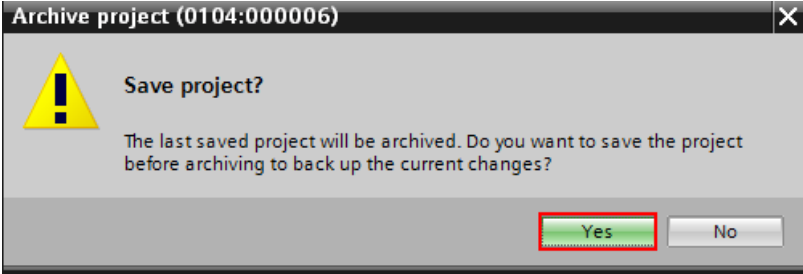
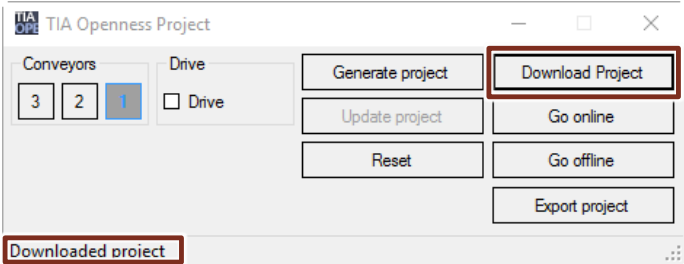
Note

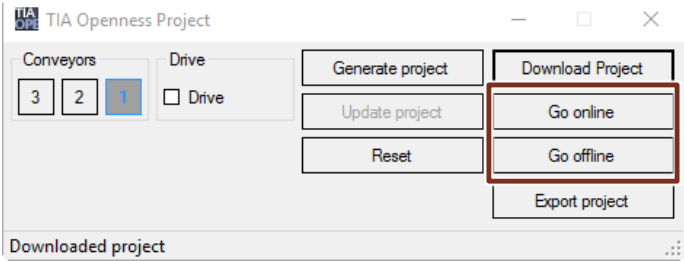
In order to save your changes permanently, you have to archive the project. This is also valid when the project is saved under a different name, since the project is reset to default after closing.

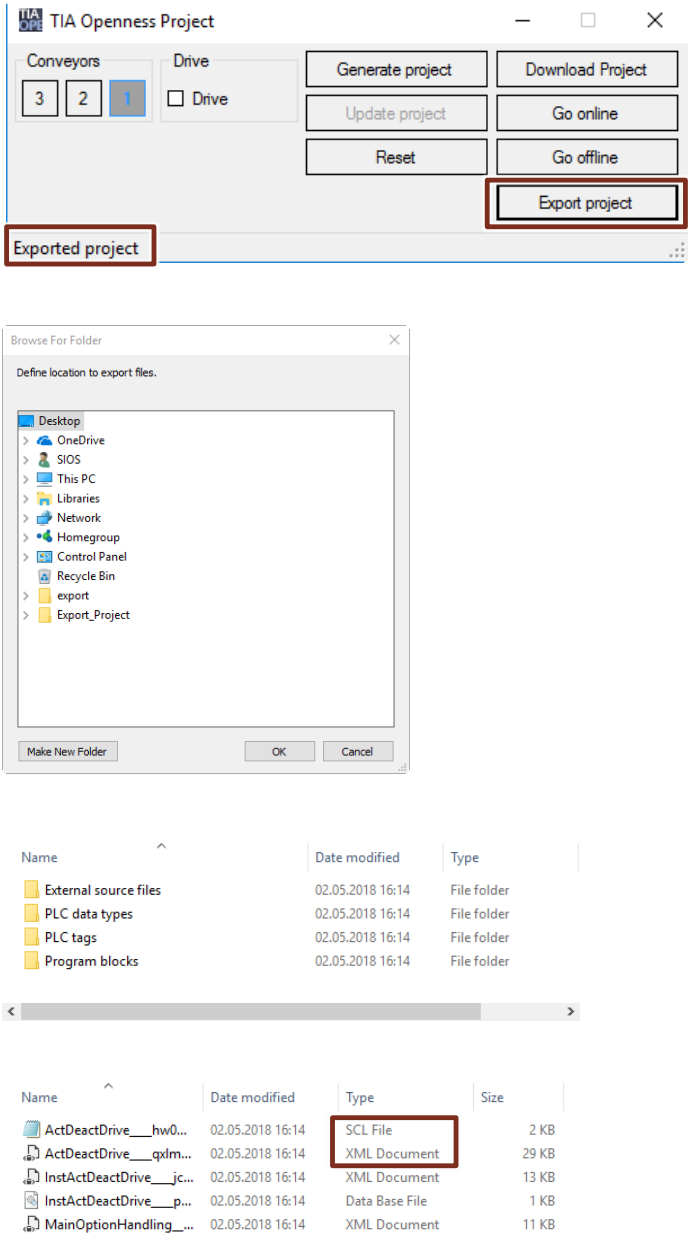
Table 6-1

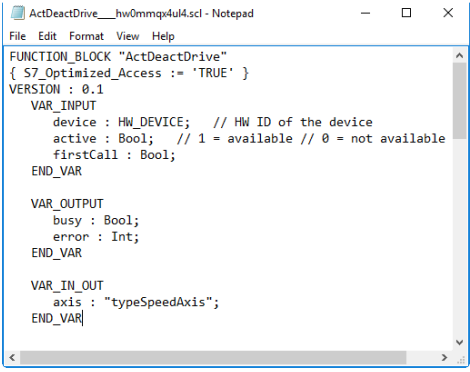
No.	Action
1.	<p>Select the desired variant of your machine and then click on "Generate project". In the example variant 1 with drive (Conveyor & Drive) is shown.</p> 
2.	<p>As initial configuration, the hardware in the plant is setup according to variant 1. The program blocks of the selected modules are generated (generating) and the configuration is compiled (Compiling). The version of the drive (Drive V1.0.0) can be seen in the project library.</p>  <p>The variant of the machine can be changed as often as desired when you click onto the desired variant and the "Generate project" button.</p>

No.	Action
3.	<p>To update the variant of your machine, click on "Update project". The libraries are loaded and the project is updated.</p> 
4.	<p>The update of the project can be seen based on the version of the drive (Drive V 2.0.0) in the project library.</p> 
5.	<p>After updating the project (Update project) no generation or renewed update is possible.</p> 
6.	<p>Reset the project to default to be able to allow another generation. Click the "Reset" box.</p> <p>After the reset, the following message appears: "Project reset to defaults".</p> 

No.	Action
7.	<p>In order to save your changes, you have to archive the project, by confirming the following message.</p> 
8.	<p>In order to download the generated project to the PLC, click the "Download project" button. Please ensure that your PLC is already named according to the specified name in TIA Portal. In addition, this name needs to be set in the field "nameOnlinePLC" in your "config.xml". You hereby allow multiple PLC to be added to the project and still download to a dedicated PLC.</p> <p>Furthermore, please ensure that the PLC and your adapter are in the same ip address band before downloading.</p> <pre style="border: 1px solid #ccc; padding: 5px;"> <?xml version="1.0" encoding="utf-8"?> <config> <project>TIA_OpennessModularMachine_Project_V15\TIA_OpennessModularMachine_Project_V15.ap15</project> <library>TIA_OpennessModularMachine_Library_V15\TIA_OpennessModularMachine_Library_V15.a115</library> <xml-files>XML</xml-files> <web-path>C:\Program Files\Anasoft Software Foundation\Tomcat 8.0\webapps\ROOT\WebAppOpenness\</web-path> <nameOnlinePLC>tia01-plc</nameOnlinePLC> <enablewebserver>false</enablewebserver> </config> </pre>  <p>In case the PLC is secured by a password, this needs to be entered during the download process. The input can be automated by either a deposit hard coded in the program or via entering in an input mask.</p> <pre style="border: 1px solid #ccc; padding: 5px;"> /// <summary> Calls necessary configuration steps to access given plc public void ConfigurePlcAccess(DeviceItem devItem, string downloadpurpose) { DownloadProvider dp = devItem.GetService<DownloadProvider>(); var cfg = dp.Configuration.Modes[0].PcInterfaces[0].TargetInterfaces[0]; OnlineProvider onlineProvider = devItem.GetService<OnlineProvider>(); // Accessing connection configuration object ConnectionConfiguration configuration = onlineProvider.Configuration; // Add your password here //var password = new SecureString(); //"MyPassword".ToList().ForEach(password.AppendChar); //password.MakeReadOnly(); </pre>

No.	Action
9.	<p>Start the online observation by clicking the "Go online" button. By doing so, you go online onto the PLC that has been specified in the "config.xml" via "nameOnlinePlc" and has been loaded with your project previously.</p> <p>By clicking the "Go offline" button, you go offline again.</p>  <p>The screenshot shows a software window titled 'TIA Openness Project'. On the left, there are three buttons labeled '3', '2', and '1' under the heading 'Conveyors', and a 'Drive' checkbox. On the right, there is a vertical stack of buttons: 'Generate project', 'Update project', 'Reset', 'Download Project', 'Go online', 'Go offline', and 'Export project'. The 'Go online' and 'Go offline' buttons are enclosed in a red rectangular box.</p>

No.	Action																																								
10.	<p>In order to export the project, click the "Export project" button.</p> <p>TIA Portal Openness generally supports the export of the entire project, meaning hard- and software. However, in this application example the export is restricted to software components only.</p> <p>After defining a target folder for the export, export data will be stored as follows. Besides "External source files", "PLC data types" and "PLC tags" you'll be presented with the program blocks of the project in the "Program blocks" folder. Depending on the chosen programming language, program blocks will be stored as ".xml" or ".scl" source. A ".scl" source file can be opened via a text editor.</p>  <p>The screenshot shows the 'TIA Openness Project' dialog box with the 'Export project' button highlighted. Below it, a 'Browse For Folder' dialog box shows the export destination. The file explorer below shows the following files:</p> <table border="1"> <thead> <tr> <th>Name</th> <th>Date modified</th> <th>Type</th> <th>Size</th> </tr> </thead> <tbody> <tr> <td>External source files</td> <td>02.05.2018 16:14</td> <td>File folder</td> <td></td> </tr> <tr> <td>PLC data types</td> <td>02.05.2018 16:14</td> <td>File folder</td> <td></td> </tr> <tr> <td>PLC tags</td> <td>02.05.2018 16:14</td> <td>File folder</td> <td></td> </tr> <tr> <td>Program blocks</td> <td>02.05.2018 16:14</td> <td>File folder</td> <td></td> </tr> <tr> <td>ActDeactDrive__hw0...</td> <td>02.05.2018 16:14</td> <td>SCL File</td> <td>2 KB</td> </tr> <tr> <td>ActDeactDrive__qxm...</td> <td>02.05.2018 16:14</td> <td>XML Document</td> <td>29 KB</td> </tr> <tr> <td>InstActDeactDrive__jc...</td> <td>02.05.2018 16:14</td> <td>XML Document</td> <td>13 KB</td> </tr> <tr> <td>InstActDeactDrive__p...</td> <td>02.05.2018 16:14</td> <td>Data Base File</td> <td>1 KB</td> </tr> <tr> <td>MainOptionHandling_...</td> <td>02.05.2018 16:14</td> <td>XML Document</td> <td>11 KB</td> </tr> </tbody> </table>	Name	Date modified	Type	Size	External source files	02.05.2018 16:14	File folder		PLC data types	02.05.2018 16:14	File folder		PLC tags	02.05.2018 16:14	File folder		Program blocks	02.05.2018 16:14	File folder		ActDeactDrive__hw0...	02.05.2018 16:14	SCL File	2 KB	ActDeactDrive__qxm...	02.05.2018 16:14	XML Document	29 KB	InstActDeactDrive__jc...	02.05.2018 16:14	XML Document	13 KB	InstActDeactDrive__p...	02.05.2018 16:14	Data Base File	1 KB	MainOptionHandling_...	02.05.2018 16:14	XML Document	11 KB
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InstActDeactDrive__jc...	02.05.2018 16:14	XML Document	13 KB																																						
InstActDeactDrive__p...	02.05.2018 16:14	Data Base File	1 KB																																						
MainOptionHandling_...	02.05.2018 16:14	XML Document	11 KB																																						

No.	Action
	 <pre>ActDeactDrive__hw0mmq4u4.scl - Notepad File Edit Format View Help FUNCTION_BLOCK "ActDeactDrive" { S7_Optimized_Access := 'TRUE' } VERSION : 0.1 VAR_INPUT device : HW_DEVICE; // HW ID of the device active : Bool; // 1 = available // 0 = not available firstCall : Bool; END_VAR VAR_OUTPUT busy : Bool; error : Int; END_VAR VAR_IN_OUT axis : "typeSpeedAxis"; END_VAR</pre>

6.2 Scenario B

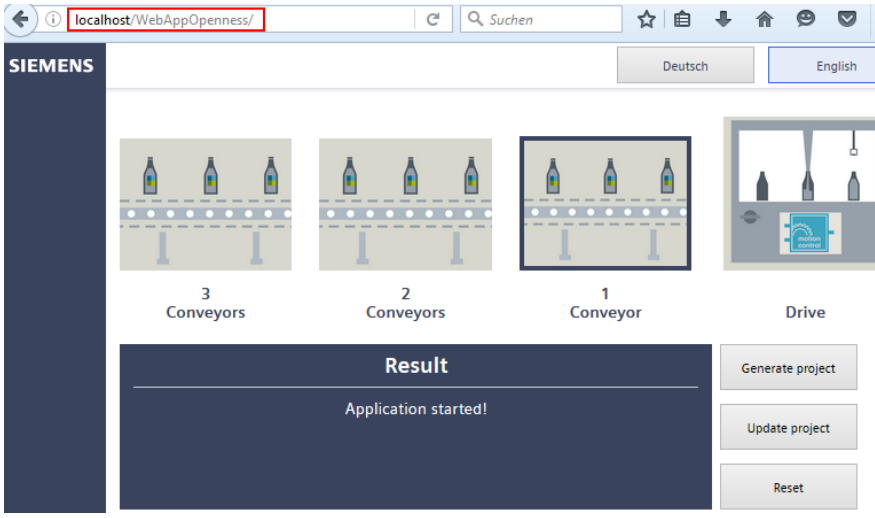
In scenario B you operate the application via the "WebAppOpenness" web browser.

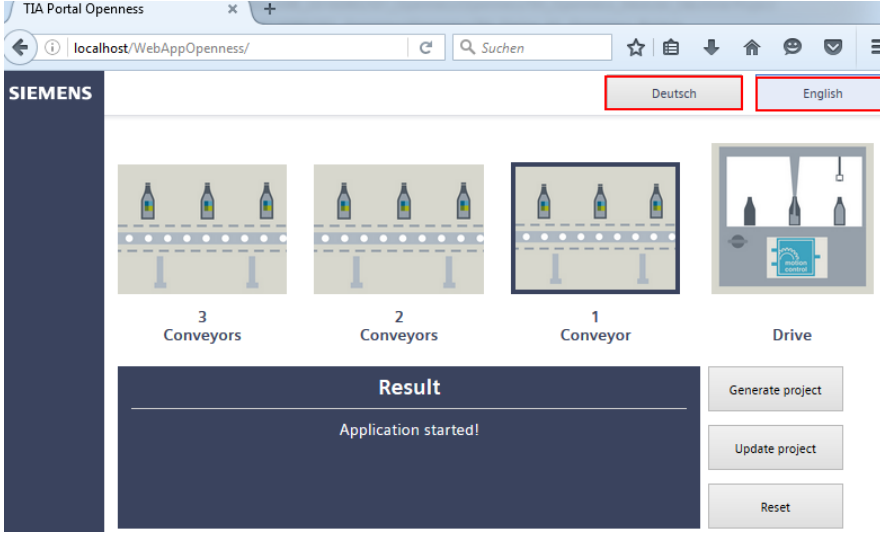
The webserver application only allows a limited set of functions ("Generate", "Update", "Reset").

Note

In order to save your changes permanently, you have to archive the project. This is also valid when the project is saved under a different name, since the project is reset to default after closing.

Table 6-2

No.	Action
1.	Start the "WebAppOpenness" web application in a browser. In this application example the "Firefox" browser it is shown.
2.	<p>Enter "http://localhost/WebAppOpenness/" in the address line and the web application is accessed.</p>  <p>Note: The web application interface can only be operated, when "TIA_OpennessModularMachine.exe" is running in the background and a default project has been created.</p>

No.	Action
3.	<p>Click on German or English, in order to operate the web application interface in the selected language.</p> 
4.	<p>The operation of the web application interface "WebAppOpenness" is identical with the operation of the "TIA Openness Project" user interface. See chapter 6.1.</p>

7 Links & Literature

Table 7-1

	Topic
\1\	Siemens Industry Online Support https://support.industry.siemens.com
\2\	Download page of the entry https://support.industry.siemens.com/cs/ww/en/view/109739678
\3\	Technical Support http://www.siemens.com/automation/support-request
\4\	TIA Selection Tool http://www.siemens.com/tia-selection-tool
\5\	Automating SIMATIC projects via scripts https://support.industry.siemens.com/cs/de/en/view/109477163/72488745483
\6\	TIA Portal Openness: Introduction and Demo Application https://support.industry.siemens.com/cs/de/en/view/108716692
\7\	Variants Management with SIMATIC S7 https://support.industry.siemens.com/cs/ww/en/view/29430270
\8\	Apache Tomcat http://tomcat.apache.org/
\9\	Tips for TIA Portal Openness https://support.industry.siemens.com/cs/en/en/view/109251656

8 History

Table 8-1

Version	Date	Modifications
V1.0	01/2017	First version
V1.0	07/2017	Project upgrade from TIA Portal V14 to V14 SP1
V1.1	05/2018	<ul style="list-style-type: none"> - Project upgrade form TIA Portal V14 SP1 to TIA Portal V15 - Functional extension: Download - Functional extension: Online/ Offline observation - Functional extension: export