

SP7 LabVIEW Toolkit Quick Reference Guide V1.8



DATA AHEAD **SP7** is a toolkit that allows communication with Siemens PLCs from LabVIEW. Use **SP7** to read and write different data blocks, memory blocks, digital input/output modules as well as analog input modules. **SP7** can also be used on NI LabVIEW Real-Time systems.

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What is SP7?

SP7 is an API ("Application Programming Interface") for NI LabVIEW™ that offers read and write functionality for Siemens SIMATIC S7 PLCs („Programmable Logic Controllers“) over Ethernet. It can be used in typical test & measurement applications, to quickly transfer data between a computer and a PLC. **SP7** provides a selection of functions to transfer data in different data types supported by the PLC.

Although **SP7** uses a well-established protocol to transfer data, DATA AHEAD cannot guarantee complete compatibility with all PLCs. When developing programs, careful use of **SP7** and regular backing up of user data is advised, to avoid any possible loss of data. In general, DATA AHEAD cannot be held liable for any loss of data that occurred whilst using **SP7**.

Supported functionality

- Open Connection
- Close Connection
- Read/Write DB
 - o (data type: Array of BOOL, BYTE, INT, DINT, REAL, STRING, WORD, DATE, DATE and TIME, TIME of DAY, S5TIME)
- Read/Write Memory Storage
 - o (data type: Array of BIT, BYTE, WORD, INT, DINT and REAL)
- Read Digital Input
 - o (data type: Array of BIT)
- Read/Write Digital Output
 - o (data type: Array of BIT)
- Read/Write Analog Input/Output
 - o (data type: Array of WORD)
- Auto-reconnect functionality in every "Read/Write function" to ensure a more stable network flow in unstable networks

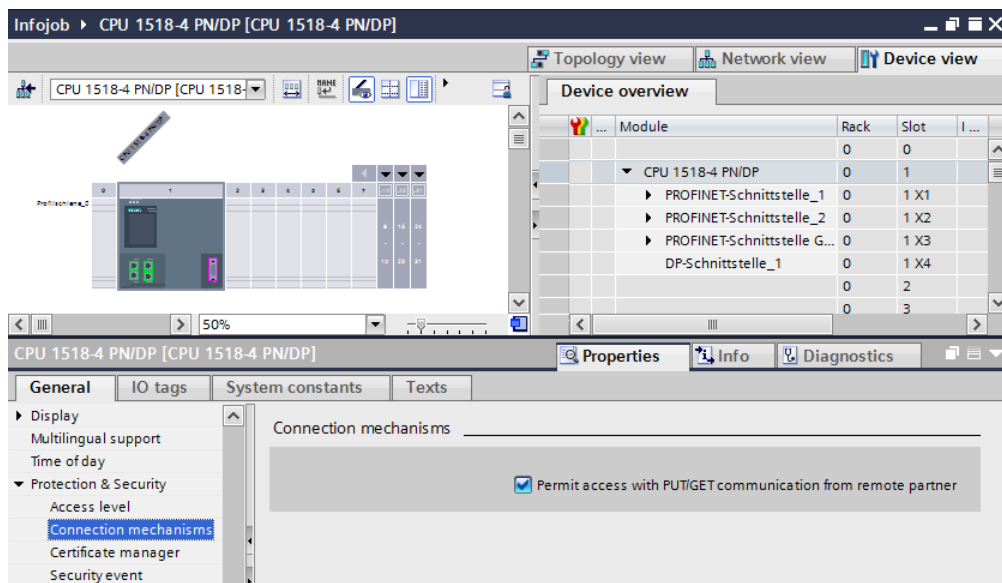
Supported controllers

Siemens SIMATIC S7 controllers with an Ethernet interface, such as

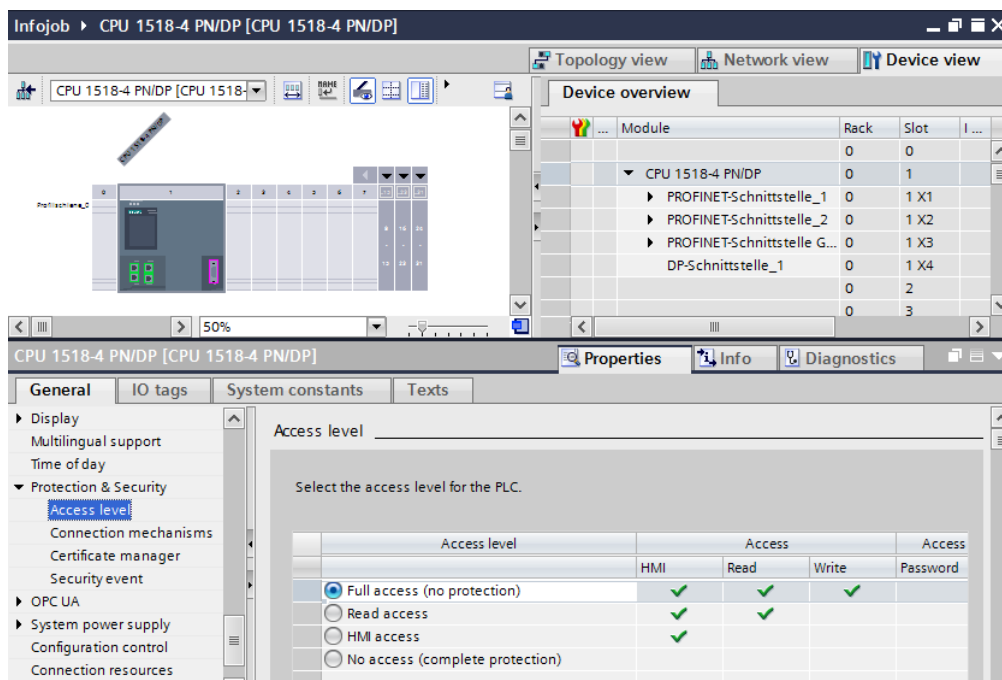
- S7-200
- S7-300
- S7-400
- S7-1200
- S7-1500

Usage with S7-1200/1500

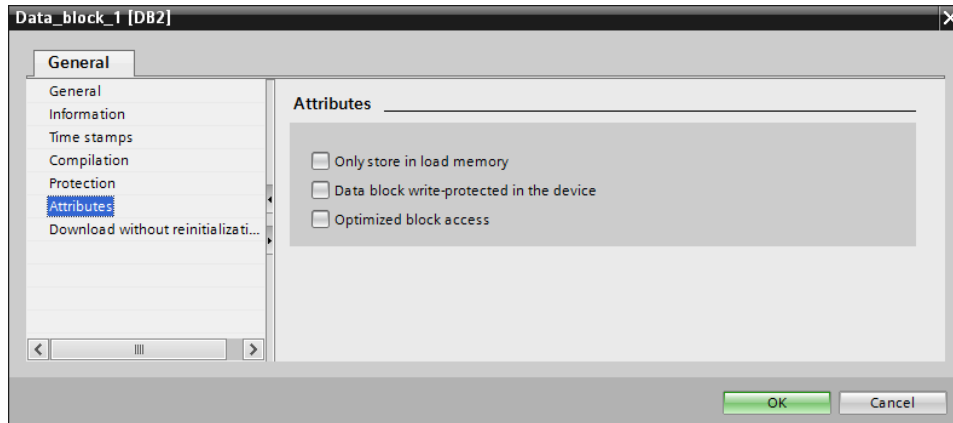
- Allow PUT/GET communication in Siemens project settings



- Accessibility of the PLC has to be "full access/no protection"



- DB's have to be global accessible and the offset has to be static ("Optimized block access" unchecked)



Deployment

Requirements

SP7 does not require any additional software to be deployed.

Building an Executable Application

SP7 does not require any additional software to be used in an executable. It relies on LabVIEW functions only; therefore it can also be deployed on any Real-Time target.

Warning



While the functionality of **SP7** has been tested extensively, DATA AHEAD cannot guarantee flawless communication with specific PLCs. Taking precautions, such as implementing buffering in your application, is highly recommended. Incorrect usage of the **SP7** API can potentially lead to a loss of data.



PLCs often control industrial automation equipment. Manipulation and incorrect usage of PLCs can lead to serious hazards and possibly have harmful consequences. Only authorized and qualified personnel may implement interfaces to a PLC that controls and automates machines and processes.

DATA AHEAD GmbH cannot be held liable for errors, for damage to property or pecuniary damages caused during the usage of the **SP7** API.

Installing SP7

LabVIEW 2010 or newer is required to install **SP7**.

The easiest way to install **SP7** is to use the National Instruments Tools Network or the JKI VI Package Manager (Image 1). Search for "SP7" and select „Install & Upgrade Packages" to install SP7 to your LabVIEW installation.

SP7 requires the JKI VI Package Manager 2014.0.0 or newer.

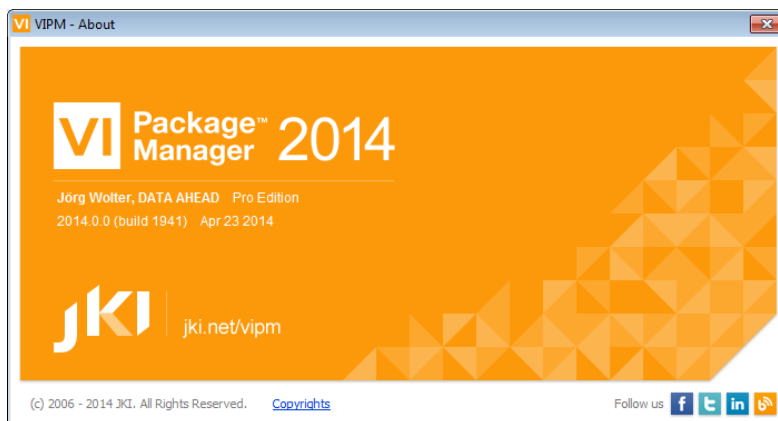


Image 1: JKI Package Manager to find and install SP7

Upon successful installation, a new palette will be installed in LabVIEW that can be found in the "data communication" function palette of the block diagram (image 2).

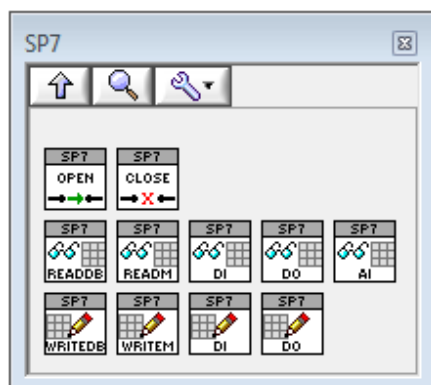


Image 2: SP7 palette in "data communication"

Furthermore, examples will be added to the LabVIEW Example Finder. To search for examples open the help tab and choose „Example Finder“ (Image 3). In the Example Finder, search for „**SP7**“

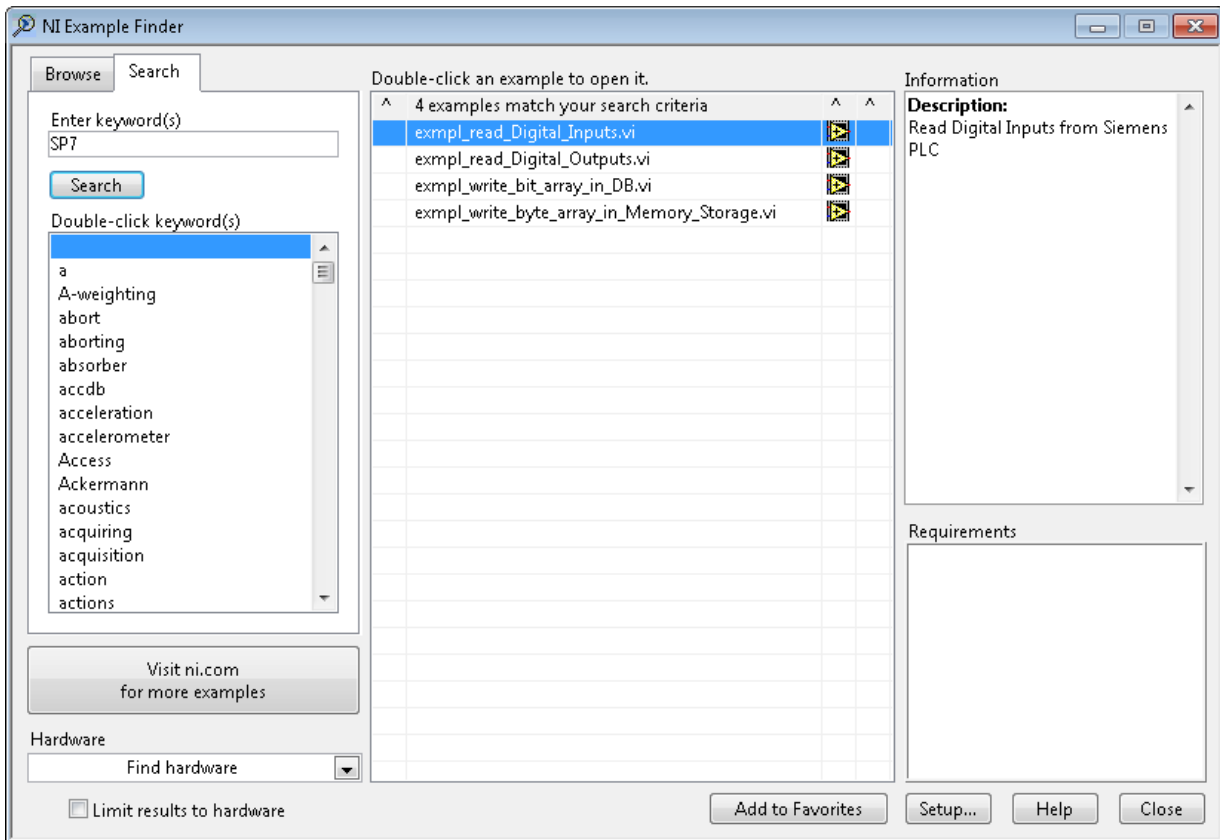


Image 3: SP7 examples in the NI Example Finder

License explanations

Developer license:

The developer license is needed in order to use the SP7 API. Upon purchasing a license from NI, you will receive an email titled *"Activation Information for your ni.com purchase: **SP7** - DATA AHEAD GMBH"* that contains your **License ID** and **Password** for the developer suite. With this information you can activate SP7 which is described in "Activating SP7".

Extract from the Eula:

The license is a single End-User Pc License you may install and use one copy of the software on a single computer. The SOFTWARE PRODUCT is used on only one computer at any one time. The provided SOFTWARE PRODUCT is not used on more computers than the number of licensed users at any one time.

Runtime license:

The runtime license is needed when your program or executable has to communicate with a PLC. It is only needed once in a life time of the program and it doesn't need to be activated in any way. The runtime licensing system is based on honesty between customer and developer.

Activating SP7

You can evaluate **SP7** for 30 days. After this period you have to activate the **SP7** add-on in LabVIEW. Upon purchasing a license from NI, you will receive an email titled "*Activation Information for your ni.com purchase: SP7 - DATA AHEAD GMBH*" that contains your License ID and Password for the developer suite. In order to activate **SP7**, your target system needs to be connected to the Internet. If there is no Internet connectivity available on the target computer, you can also activate **SP7** through a web browser on a different computer (see step3 – alternative option).

Step 1: Open LabVIEW. Select "Help" in the menu bar and then on the menu point "Activate Add-ons" to carry out the function.

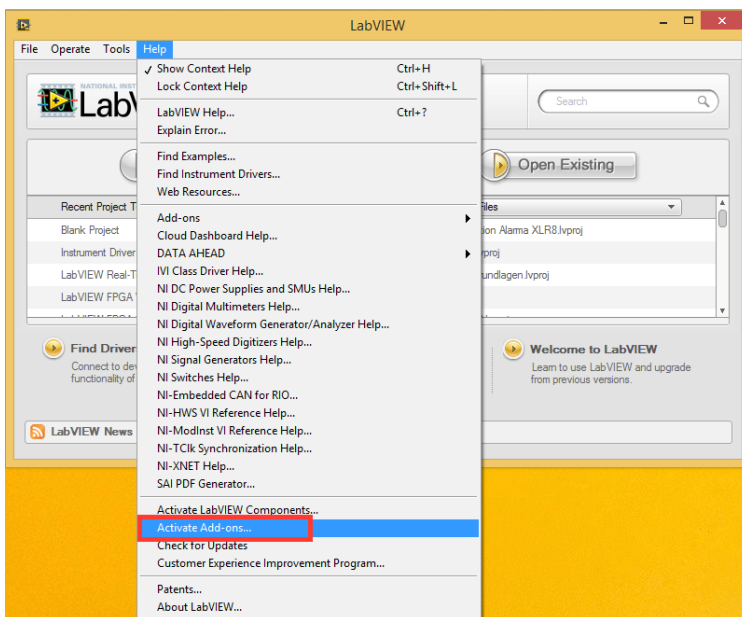


Image 4: Activation Step 1

Step 2: The following pop-up window will appear and display your **SP7** installation and activation status. Select **SP7** "DATA AHEAD SP7 x.x.x.xx" and click "next" or "Activate".

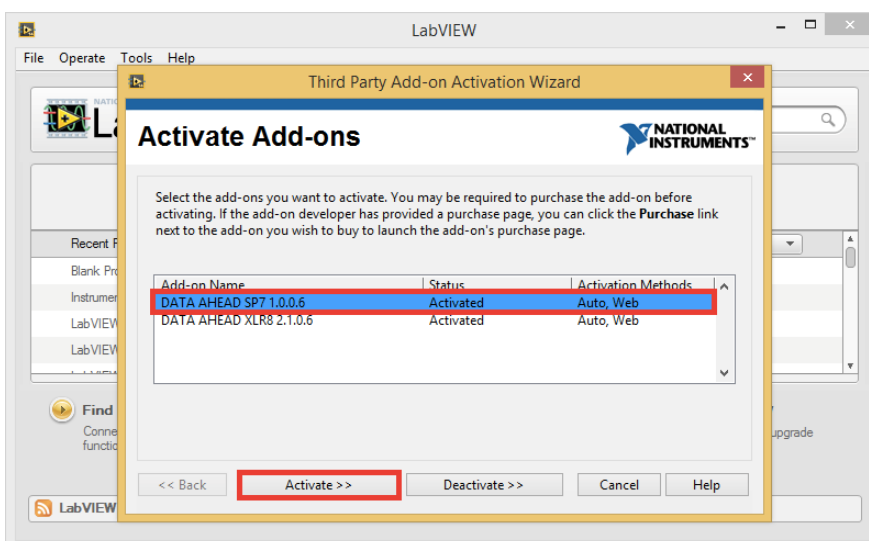


Image 5: Activation Step 2

Step 3: Now select the method of activation. If the computer is connected to the Internet select the first option. If you do not have Internet access, see the alternative option below. To proceed, click "Next".

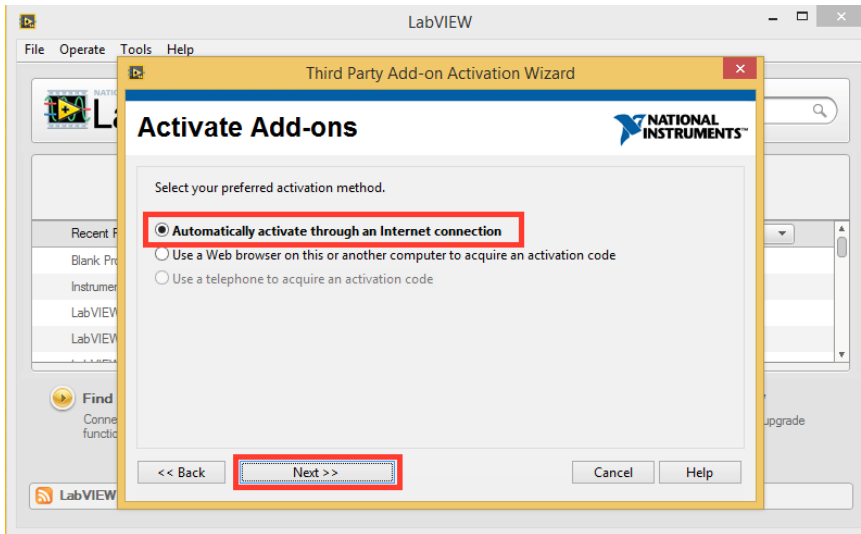


Image 6: Activation Step 3

Step 4: To complete the activation, enter the provided License ID and Password that you received in the email from NI. Please mind capital letters. After entering the License ID and Password click "Activate".

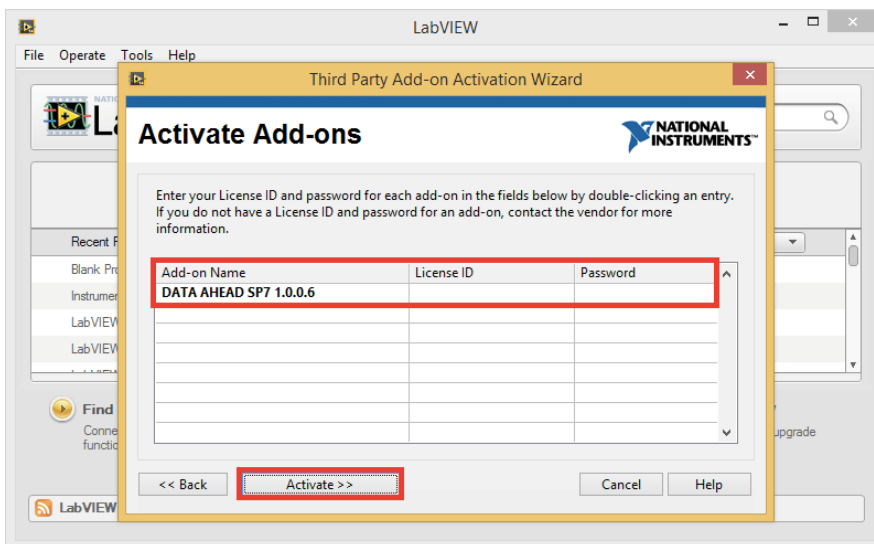


Image 7: Activation Step 4

Step 3 (alternative): If no Internet connection is available, selecting the second option will direct you to National Instruments activation website where you will have to enter the user codes displayed in the dialog as well as your License ID and Password. This option allows you to activate the toolkit from another computer that is connected to the Internet.

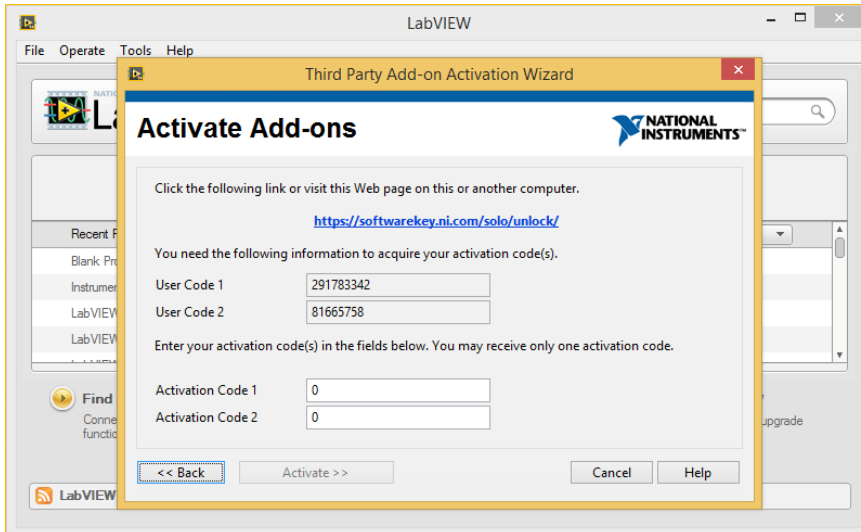


Image 8: Activation Step 3, option 2: activate through a web browser – LabVIEW dialog

Step 4 (alternative): Open the website <https://softwarekey.ni.com/solo/unlock/> on a computer with Internet connection. Enter the User Code 1 and User Code 2 on the website, as displayed in the dialog on the target computer. Enter License ID and Password from the activation e-Mail. Click "Continue". Activation Code 1 and 2 will now be generated that you can enter in the dialog on the target computer. Finish the dialog by clicking "Activate".

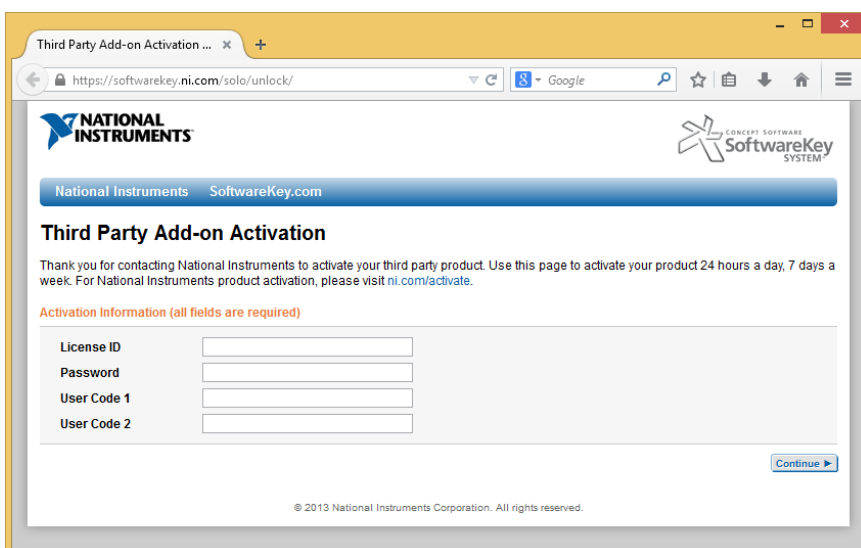


Image 9: Activation Step 3, option 2: activate through a web browser – activation website

Getting Started

To get started, please locate the examples that are shipped with the **SP7** package. All of the examples include a short description in their respective VI documentation and explain the appropriate usage of the API VIs. For instance, open the example "exmpl_read_Digital_Inputs.vi".

To accomplish a successful connection to the PLC, ensure that there are enough connection resources set in the PLC. The number of allowed connections to the PLC can be set in the PLC development environment under CPU settings.

Read digital inputs with an implemented example

To read digital inputs please open example „exmpl_read_Digital_Inputs.vi“ from the LabVIEW example finder.

LabVIEW: Help-> Find Examples... – search for „**SP7**“.

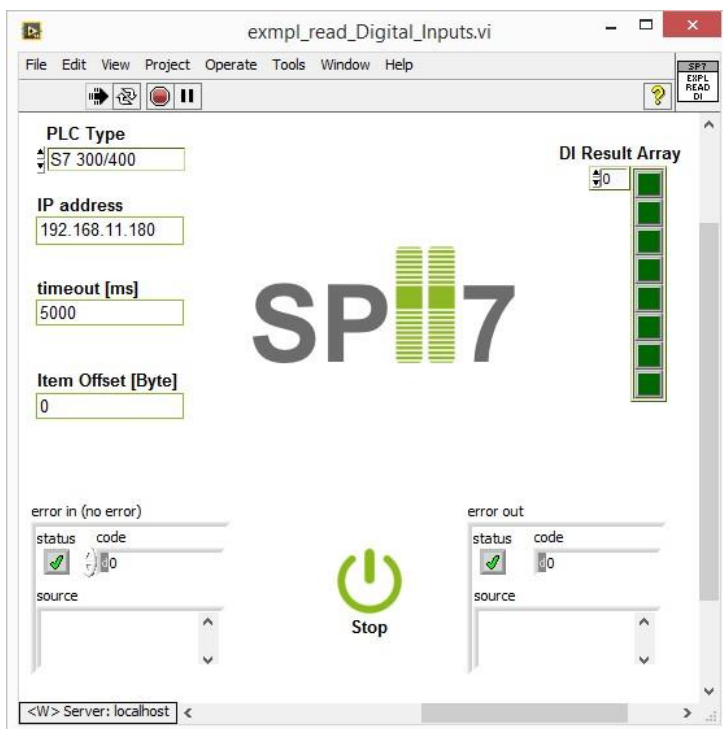


Image 10: front panel of the example „exmpl_read_Digital_Inputs.vi“

You will see three input parameters (image 4) and an output of a Boolean array.

Please enter the IP address of the PLC in the "IP address" control.

A physical Ethernet connection to the PLC and its IP address are required for **SP7**.

Note: You can use network or IP scanning programs to find an unknown IP address.

The second parameter specifies the timeout in milliseconds.

Setting a higher value here can be useful in unstable or slow networks. At the same time, a high timeout value might cause your programs to respond more slowly.

| Geräteübersicht | | | | | | |
|-----------------|-------------------------|----------|----------|-------------|------------|-------------|
| | Baugruppe | Baugr... | Steck... | E-Adresse | A-Adres... | Typ |
| | PLC_1 | 0 | 2 | | | IM 151-8 PN |
| | PME DC24V_1 | 0 | 4 | 2043* | | PME DC24V |
| | 4DI x DC24V ST_1 | 0 | 5 | 10.0...1... | | 4DI x DC24V |
| | 4DI x DC24V ST_2 | 0 | 6 | 2.0...2.3 | | 4DI x DC24V |
| | 4DO x DC24V / 0,5A ST_1 | 0 | 7 | | 3.0...3.3 | 4DO x DC24 |
| | 2AI x U ST_1 | 0 | 8 | 320...323 | | 2AI x U ST |

Image 11: device overview in Siemens' TIA Portal software

The third parameter is the item offset in byte. These offsets are identical to the addresses specified in the PLC device overview of your PLC configuration software.

Image 11 highlights addresses "2.0...2.3" of a "4DI x DC24V ST_2" digital input module. The address "2.x" here corresponds to an **SP7** item offset of 2.

Depending on your PLC configuration and the modules installed, the addresses available to you may differ.

When the VI is running, a query of the digital input module takes place every 50 ms. The values are visualized in the "DI Result Array".

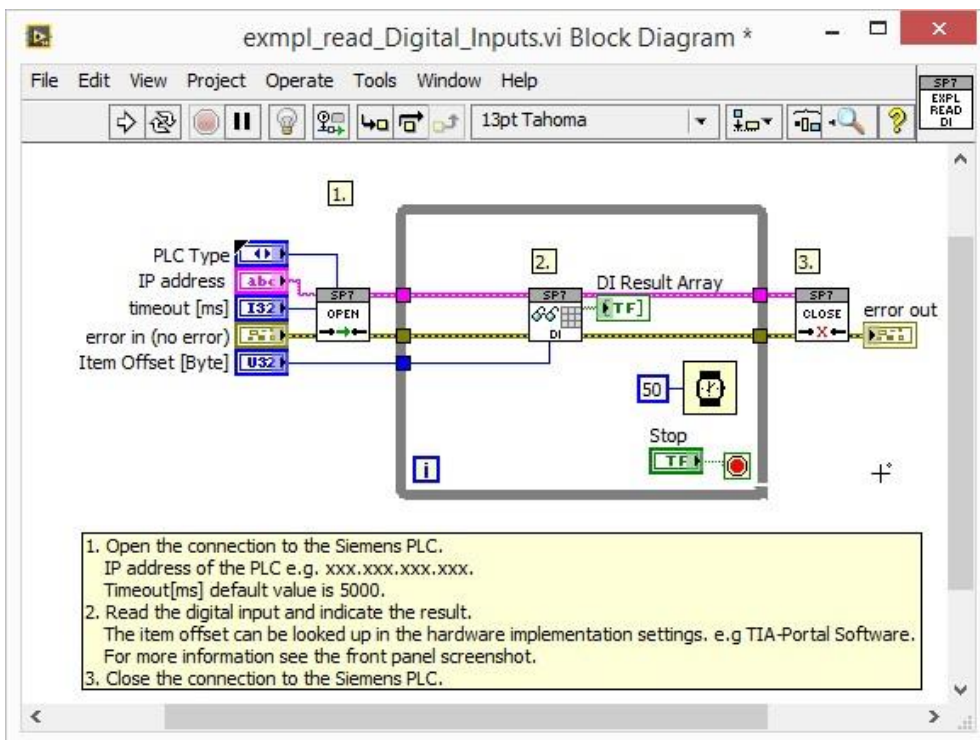


Image 12 example of block diagram „exmpl_read_Digital_Inputs.vi“

The corresponding block diagram is shown in image 12. This image depicts the three **SP7** functions used here: opening a connection, then continuously reading the digital input module until the "Stop" button is pressed. Eventually, the connection is closed.

SP7 API

All VIs can be found in the **SP7** sub-palette of the „Data Communication“ pallet.

Connection

These VIs establish and close a connection to a PLC.



| VI | Name and description (more information in the context help) |
|---|---|
|  | connect.vi Opens an Ethernet connection to a given PLC |
|  | disconnect.vi Closes the connection. |

Chart 1: functions to establish a connection

Read operations

These VIs can be used to read data from a PLC. The item offset value must be entered in bytes. (For example: M10.0 -> enter "10").






| | |
|---|--|
|  | Read DB.vi (Polymorph: BOOL, BYTE, INT, DINT, REAL, STRING, WORD, DATE, DATE and TIME, TIME of DAY, S5TIME) Reads data from a specified data block. |
|  | Read M.vi (Polymorphic: BIT, BYTE, INT16, INT32, REAL, WORD) Reads data from a specified memory block |
|  | Read DI.vi Reads the specified digital input as a BIT array |
|  | Read DO.vi Reads the specified digital output as a BIT array |
|  | Read AI.vi Reads the specified analog input value as WORD. |

Chart 2: read operations

Write operations

Use the following VIs to write data to a PLC. Depending on the required data type, polymorphic VIs are available.






| | |
|---|--|
|  | Write DB.vi (Polymorphic: BOOL, BYTE, INT, DINT, REAL, STRING, WORD, DATE, DATE and TIME, TIME of DAY, S5TIME) Writes data to a specified data block. |
|  | Write M.vi (Polymorphic: BIT, BYTE, INT16, INT32, REAL, WORD) Writes data to a specified memory block. |
|  | Write DI.vi Writes a BIT array to a digital input. (simulated DI only) |
|  | Write DO.vi Writes a BIT array to a digital output. |
|  | Write AO.vi Writes a Word-Array to an analogue Output (not scaled). The scale values are different to any output module therefore you have to get the factors from the analogue module description. |

Chart 3: write operations

Applications / Examples

SP7 ships with a number of example programs that can be found using the LabVIEW example finder: Help -> Find Examples – Search for „SP7“





| | |
|---|---|
|  | Exmpl_read_Digital_Inputs.vi This VI demonstrates how to access the digital inputs. |
|  | Exmpl_read_Digital_Outputs.vi This VI demonstrates how to read digital outputs' values. |
|  | Exmpl_write_bit_array.vi This VI demonstrates how to write a BIT array in a data block |
|  | Exmpl_write_byte_array_in_Memory_Storage.vi This VI demonstrates how to write a BYTE array in the memory storage |

Chart 4: applications and examples

Support and Feedback

Please contact us at info@dataahead.de

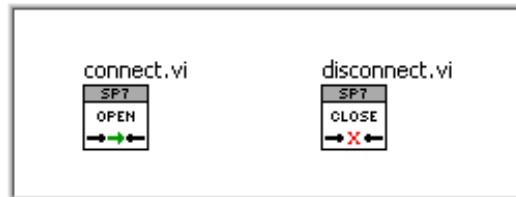
For latest news and support on our toolkits, go to
<https://decibel.ni.com/content/groups/data-ahead-toolkit-support>

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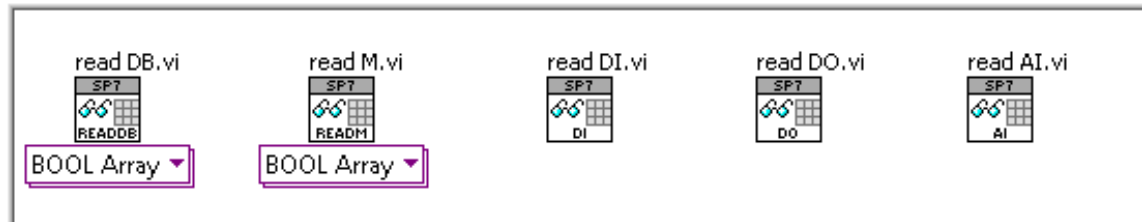
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VI Overview (LabVIEW)

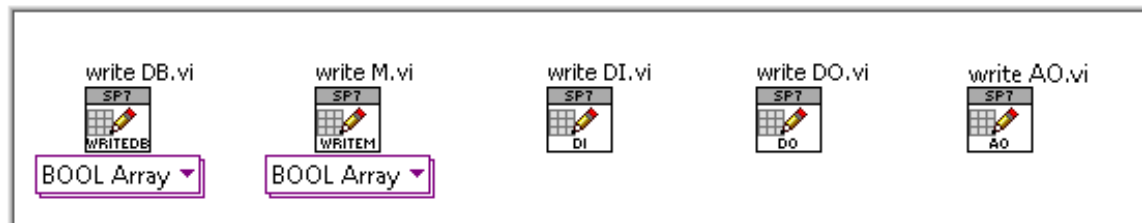
Connection



Read functions



Write functions



Examples

