

SIEMENS

Ingenuity for life



Test Suite Advanced: Example for the Application Test of Code Blocks

TIA Portal / V16 / Test Suite Advanced

<https://support.industry.siemens.com/cs/ww/en/view/109779805>

Siemens
Industry
Online
Support



Legal information

Use of application examples

Application examples illustrate the solution of automation tasks through an interaction of several components in the form of text, graphics and/or software modules. The application examples are a free service by Siemens AG and/or a subsidiary of Siemens AG ("Siemens"). They are non-binding and make no claim to completeness or functionality regarding configuration and equipment. The application examples merely offer help with typical tasks; they do not constitute customer-specific solutions. You yourself are responsible for the proper and safe operation of the products in accordance with applicable regulations and must also check the function of the respective application example and customize it for your system.

Siemens grants you the non-exclusive, non-sublicensable and non-transferable right to have the application examples used by technically trained personnel. Any change to the application examples is your responsibility. Sharing the application examples with third parties or copying the application examples or excerpts thereof is permitted only in combination with your own products. The application examples are not required to undergo the customary tests and quality inspections of a chargeable product; they may have functional and performance defects as well as errors. It is your responsibility to use them in such a manner that any malfunctions that may occur do not result in property damage or injury to persons.

Disclaimer of liability

Siemens shall not assume any liability, for any legal reason whatsoever, including, without limitation, liability for the usability, availability, completeness and freedom from defects of the application examples as well as for related information, configuration and performance data and any damage caused thereby. This shall not apply in cases of mandatory liability, for example under the German Product Liability Act, or in cases of intent, gross negligence, or culpable loss of life, bodily injury or damage to health, non-compliance with a guarantee, fraudulent non-disclosure of a defect, or culpable breach of material contractual obligations. Claims for damages arising from a breach of material contractual obligations shall however be limited to the foreseeable damage typical of the type of agreement, unless liability arises from intent or gross negligence or is based on loss of life, bodily injury or damage to health. The foregoing provisions do not imply any change in the burden of proof to your detriment. You shall indemnify Siemens against existing or future claims of third parties in this connection except where Siemens is mandatorily liable.

By using the application examples you acknowledge that Siemens cannot be held liable for any damage beyond the liability provisions described.

Other information

Siemens reserves the right to make changes to the application examples at any time without notice. In case of discrepancies between the suggestions in the application examples and other Siemens publications such as catalogs, the content of the other documentation shall have precedence.

The Siemens terms of use (<https://support.industry.siemens.com>) shall also apply.

Security information

Siemens provides products and solutions with industrial security functions that support the secure operation of plants, systems, machines and networks.

In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art industrial security concept. Siemens' products and solutions constitute one element of such a concept.

Customers are responsible for preventing unauthorized access to their plants, systems, machines and networks. Such systems, machines and components should only be connected to an enterprise network or the Internet if and to the extent such a connection is necessary and only when appropriate security measures (e.g. firewalls and/or network segmentation) are in place. For additional information on industrial security measures that may be implemented, please visit <https://www.siemens.com/industrialsecurity>.

Siemens' products and solutions undergo continuous development to make them more secure. Siemens strongly recommends that product updates are applied as soon as they are available and that the latest product versions are used. Use of product versions that are no longer supported, and failure to apply the latest updates may increase customer's exposure to cyber threats.

To stay informed about product updates, subscribe to the Siemens Industrial Security RSS Feed at: <https://www.siemens.com/industrialsecurity>.

Table of Contents

Legal information	2
1 Introduction	4
1.1 Overview	4
1.2 Requirements	4
1.3 Components Used.....	4
2 Useful Information	5
2.1 Structure of the Test Environment	6
2.2 Definition of a Test Case	8
3 Executing an Application Test	10
3.1 Executing a Test Case	10
3.2 Evaluation of the Test Results	11
4 Appendix	13
4.1 Service and support	13
4.2 Links and literature	14
4.3 Change documentation	14

1 Introduction

1.1 Overview

In this demo project, the application test of the TIA Portal Test Suite is explained by means of examples, and the structure of the testing environment is also shown. This is done using an example function, which is checked or validated by several test cases.

1.2 Requirements

To perform an application test, the following requirements must be met.

- TIA Portal V16 Update1 is installed
- The TIA Portal Test Suite option package is installed
- SIMATIC S7-PLCSIM Advanced V3.0 Update 1 is installed

1.3 Components Used

This application example was created using these software components:

Table 1-1

Component	Quantity	Article number	Notes
STEP 7 Professional V16 Update 1	1	6ES7822-1A.06-..	-
TIA Portal Test Suite Advanced	1	6ES7823-1TE0.-A..	-
SIMATIC S7-PLCSIM Advanced V3.0 Update 1	1	6ES7823-1FA00-2Y..	-

Notes

The exclusive execution of application tests does not require any other SIMATIC S7-PLCSIM Advanced license, besides a valid Test Suite license.

This application example consists of the following components:

Table 1-2

Component	File name	Notes
Documentation	109779805_TestSuite_ApplicationTest_DOC_v10_en.pdf	-
Demo project	109779805_TestSuite_ApplicationTest_CODE_v10.zip	-

2 Useful Information

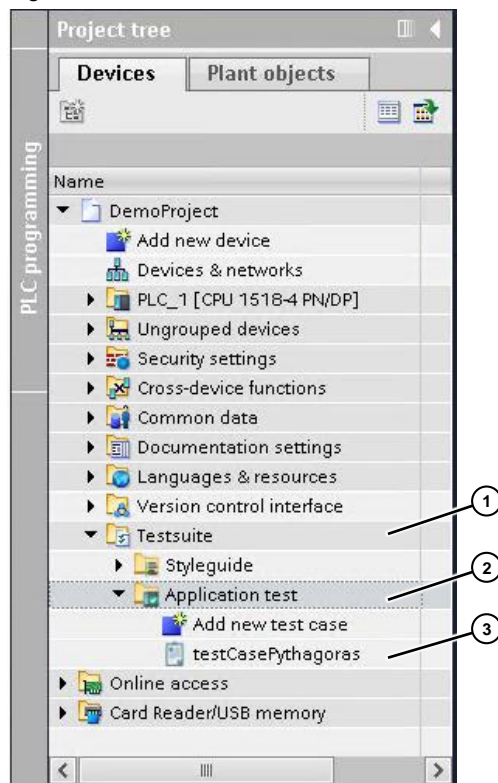
Application tests are generally used to check the program code for errors. Errors that are already found during the creation of the program can be corrected without much effort. For this purpose, the program must be checked at regular intervals. Since this process itself is error-prone and time-consuming, application testing has become increasingly automated.

The Test Suite, available as of TIA Portal V16 Update 1, allows the user to configure and run automatic application tests in the TIA Portal.

After installing the "Test Suite Advanced V16" option package, the Test Suite is available in the project directory.

1. The "Testsuite" folder in the project directory.
2. The "Application test" folder under "Testsuite".
3. User-specific test case for this example.

Figure 2-1



2.1 Structure of the Test Environment

In the demo project, the following blocks and a test case definition have been created for executing an application test:

- "Pythagoras" function block to be tested.
- Test organization block in which the function block is called.
- "InstPythagoras" instance data block
- "testCasePythagoras" test case definition

In principle, the application test consists of the following three functional steps:

- Creation of test cases with the Test Case Editor.
- Creation of a test organization block (OB) and calling of the block to be tested.
- Execution of the test with subsequent evaluation.

Test Case Editor

Test cases are created in the test case editor to test the program blocks. The following test case definition shows an example with basic commands for testing the "Pythagoras" function block.

Figure 2-2

```

DemoProject ▶ Testsuite ▶ Application test ▶ testCasePythagoras
Scope PLC_1
1 VAR //The area to instantiate variables starts with 'VAR'
2 //To reduce characters, placeholders can be used as shown below
3 a: InstPythagoras.a := 0.0; //Instantiate a and set it 0.0
4 b: InstPythagoras.b := 0.0; //Instantiate b and set it 0.0
5 c: InstPythagoras.c; //Instantiate c
6 valid: InstPythagoras.valid; //Instantiate 'valid'
7 END_VAR //The area to instantiate variables ends with 'END_VAR'
8
9 STEP: Check_for_negative_a_and_b //A test case starts with 'STEP:' following the name of the test case
10 a := -1.0; //Set a and b < 0
11 b := -1.0;
12 RUN(CYCLES := 1); //Run the FB once
13 ASSERT.Equal(c, -1.0); //Check if c = -1.0
14 ASSERT.Equal(valid, false); //Check if 'valid' = false
15 END_STEP //A test case ends with 'END_STEP'
16
17 STEP: Check_for_a_and_b_equal_to_zero //Set a and b = 0.0
18 a := 0.0; //Set a and b = 0.0
19 b := 0.0;
20 RUN(CYCLES := 1); //Run the FB once
21 ASSERT.Equal(c, 0.0); //Check if c = 0.0
22 ASSERT.Equal(valid, true); //Check if 'valid' = true
23 END_STEP
24
25 STEP: Check_a_equal_to_3_and_b_equal_to_4 //Set a = 3.0
26 a := 3.0; //Set a = 3.0
27 b := 4.0; //Set b = 4.0
28 RUN(CYCLES := 1); //Run the FB once
29 ASSERT.Equal(c, 5.0); //Check if c = 5.0
30 ASSERT.Equal(valid, true); //Check if 'valid' = true
31 END_STEP
32
33 STEP: Check_a_equal_to_0_and_b_equal_to_1 //Set a = 0.0;
34 a := 0.0; //Set a = 0.0;
35 b := 1.0; //Set b = 1.0;
36 RUN(TIME := t#5s); //Run the FB for 5 seconds
37 ASSERT.GreaterThanOrEqual(c, 1.0); //Check if c >= 1.0;
38 ASSERT.NotEqual(valid, true); //Check if 'valid' != true
39 END_STEP
40

```

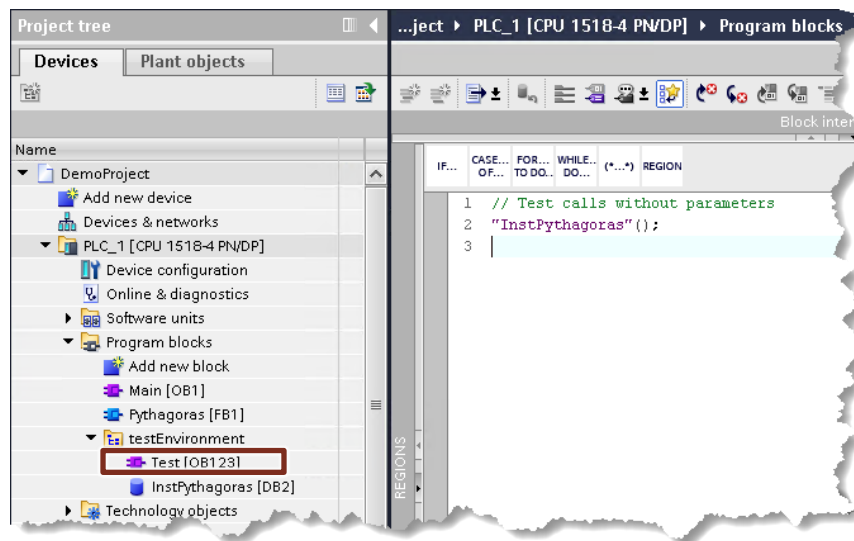
Test organization block (OB)

If a function (FC) or a function block (FB) is to be tested, it must be called in an OB. It is advisable to create a new OB for this purpose (e.g. OB123).

The inputs and outputs of the FB should not be interconnected, as the test procedure is executed with the associated instance data block (DB).

If a function (FC) is to be tested, the interface data must be exchanged via a global data block (DB). To do this, the user must create a global DB and define tags that represent the interfaces of the function. When instantiating the function in the test OB, the inputs and outputs must be connected to the tags in the global DB. The test is then executed via the DB tags as with the FB.

Figure 2-3



Besides single FCs or FBs, it is also possible to test complete sections of the program, in which blocks call each other. This can be used to validate a finished project, for example.

If, for example, this project is upgraded automatically for a new TIA Portal version at a later date, the functionality can be ensured with an additional test without having to delve into the details first.

Execution of the test

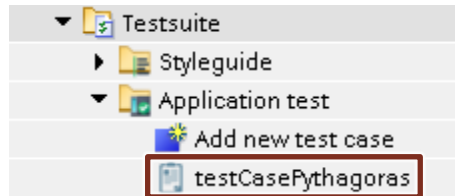
Test execution is started from the test case editor and includes the following steps:

- The PLC program is compiled and checked for consistency.
- A PLCSIM Advanced instance is automatically created and the PLC program is loaded.
- The test case is executed and the created PLCSIM Advanced instance is deleted.
- The test results are displayed in the Inspector window.

2.2 Definition of a Test Case

Open the test case prepared in the demo project by double-clicking on the "testCasePythagoras" test case. In the opened Test Case Editor, the test definition is shown, which is described below.

Figure 2-4



Tag definition (optional)

The section starts with the keyword "VAR" and ends with "END_VAR". First, the tags are defined and initialized. This helps to avoid long variable names and increases readability. An additional advantage is the reusability. If you want to use the test case for additional validations, you need only adjust the tags in one place.

Figure 2-5

```

1  VAR
2
3     a: InstPythagoras.a := 0.0;
4     b: InstPythagoras.b := 0.0;
5     c: InstPythagoras.c;
6     valid: InstPythagoras.valid;
7  END_VAR

```

Define individual test steps

In the example, four test steps with basic commands have been created:

- Check_for_negative_a_and_b (Check for negative values)
- Check_for_a_and_b_equal_to_zero (Check for zero values)
- Check_a_equal_to_3_and_b_equal_to_4 (Check the calculation)
- Check_a_equal_to_0_and_b_equal_to_1 (Check for a zero value)

Basic command "STEP:"

Individual test steps are started with the basic command "STEP:" and the name of the test case. A test step is ended with the command "END_STEP". In between, the inputs are described first. Additional commands follow.

Basic command "RUN()"

The "RUN()" command allows the user to execute the PLC program for a preset number of cycles ("CYCLES") or for a preset time ("TIME"). With the parameter "CYCLES := 1", the PLC program is executed for one cycle. After the run has completed, the outputs of the block are checked for expected values.

Basic command "ASSERT.Equal()"

The ASSERT commands compare the actual value of the PLC tags with the expected value specified by the user (expected values). With the "Equal" parameter, the "ASSERT.Equal (c, -1.0)" command checks whether the actual value of the tag "c" is equal to the expected value "-1.0".

The "ASSERT.Equal (valid, false)" command is used to check whether the actual value of the tag "valid" is equal to the expected value "false".

Figure 2-6

```

9  □ STEP: Check_for_negative_a_and_b
10 |   a := -1.0;
11 |   b := -1.0;
12 |   RUN(CYCLES := 1);
13 |   ASSERT.Equal(c, -1.0);
14 |   ASSERT.Equal(valid, false);
15 | END_STEP

```

Test step "Check_a_equal_to_0_and_b_equal_to_1"

In this test step, the basic commands are called with additional parameters.

RUN (TIME := t#5s)

This command executes the PLC program for this test step for five seconds.

ASSERT.GreaterThanOrEqual()

The "ASSERT.GreaterThanOrEqual(c, 1.0)" command checks if the tag "c" >= the expected value "1.0".

ASSERT.NotEqual()

The "ASSERT.NotEqual(valid, true)" command checks if the "valid" tag is not equal to the expected value "true".

Figure 2-7

```

33 □ STEP: Check_a_equal_to_0_and_b_equal_to_1
34 |   a := 0.0;
35 |   b := 1.0;
36 |   RUN(TIME := t#5s);
37 |   ASSERT.GreaterThanOrEqual(c, 1.0);
38 |   ASSERT.NotEqual(valid, true);
39 | END_STEP

```

Notes

You can find a complete list of basic commands with parameters in the TIA Portal Online Help section and the TIA Portal Test Suite Function Guide.

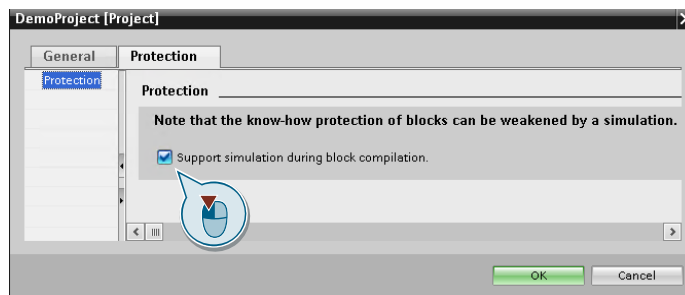
<https://support.industry.siemens.com/cs/ww/en/view/109779356>

3 Executing an Application Test

3.1 Executing a Test Case

Notes Before the application test is executed, check that the blocks can be simulated. The setting can be checked or enabled by right-clicking the project under "Properties > Protection".

Figure 3-1



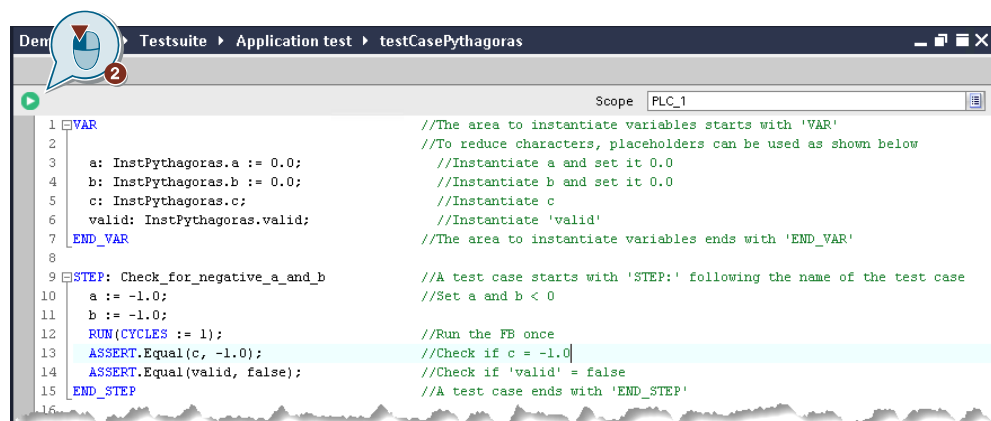
There are two different ways to start the application test. Either from the currently open Test Case Editor or via the project navigation.

Starting from the open Test Case Editor

To test the function block in the project, proceed as follows:

1. Double-click to open the "testCasePythagoras" test case in the project navigation under "Testsuite > Application test".
2. Click "Run test case" in the Test Case Editor.

Figure 3-2

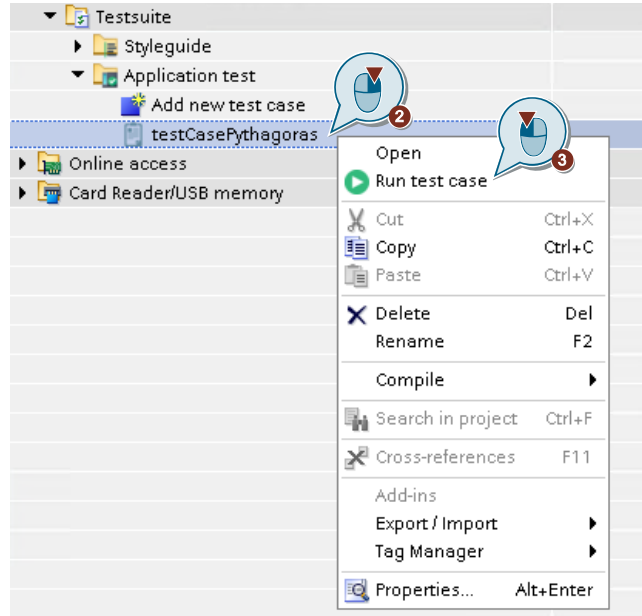


Starting from the project navigation

To execute your test case, proceed as follows:

1. Navigate in the project navigation to "Testsuite > Application test".
2. Right-click the "testCasePythagoras" test case.
3. Click the "Run test case" entry in the context menu.

Figure 3-3



3.2 Evaluation of the Test Results

The results of the individual test steps are displayed in the Inspector Window under "Info > Test results" with the message "Pass" or "Fail".

With the "Go to" option, you can navigate directly to the test step of the respective result.

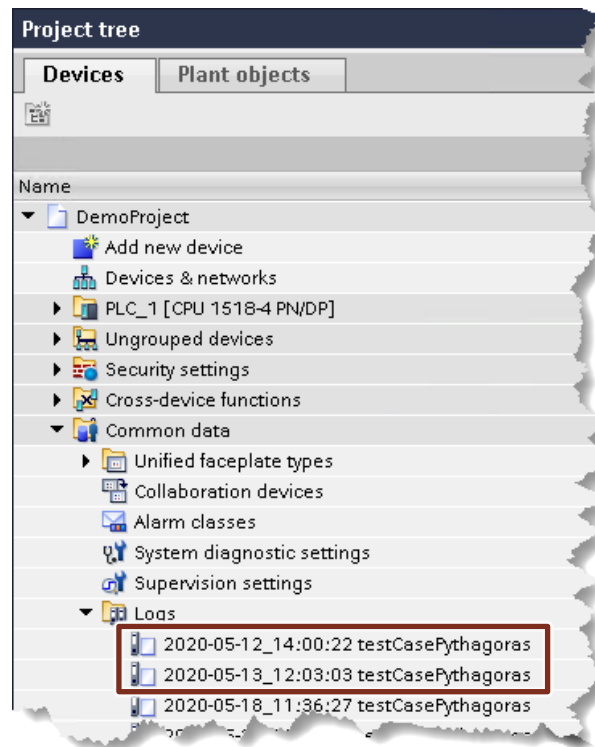
Figure 3-4

!	Path	Description	Go to ?	Errors	Warnings
✖	Application test		↕	3	0
✔	testCasePythagoras: PLC_1		↕	3	0
✔	Check_for_negative_a_and_b	Pass	↕		
✖	Check_for_a_and_b_equal_to_zero	Fail	↕	2	0
✖	InstPythagoras.c	Actual: -1.000000E+000, Expected: 0.000000E+000	↕		
✔	InstPythagoras.valid	Actual: False, Expected: True	↕		
✔	Check_a_equal_to_3_and_b_equal_to_4	Pass	↕		
✖	Check_a_equal_to_0_and_b_equal_to_1	Fail	↕	1	0
✖	InstPythagoras.c	Actual: -1.000000E+000, Expected: 1.000000E+000	↕		
ℹ	Test case(s) execution completed.				

Display of the results in the log file

The results in the "Test results" tab are also stored in a log file. You can find the file in the project navigation under "Common data > Logs".

Figure 3-5



Notes

For additional information about the TIA Portal Test Suite, see the "TIA Portal Test Suite" function manual.

<https://support.industry.siemens.com/cs/ww/en/view/109779356>

You can download the TIA Portal Test Suite here:

<https://support.industry.siemens.com/cs/ww/en/view/109775719>

4 Appendix

4.1 Service and support

Industry Online Support

Do you have any questions or need assistance?

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

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

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

<https://support.industry.siemens.com>

Technical Support

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

www.siemens.com/industry/supportrequest

SITRAIN – Training for Industry

We support you with our globally available training courses for industry with practical experience, innovative learning methods and a concept that's tailored to the customer's specific needs.

For more information on our offered trainings and courses, as well as their locations and dates, refer to our web page:

www.siemens.com/sitrain

Service offer

Our range of services includes the following:

- Plant data services
- Spare parts services
- Repair services
- On-site and maintenance services
- Retrofitting and modernization services
- Service programs and contracts

You can find detailed information on our range of services in the service catalog web page:

<https://support.industry.siemens.com/cs/sc>

Industry Online Support app

You will receive optimum support wherever you are with the "Siemens Industry Online Support" app. The app is available for Apple iOS and Android:

<https://support.industry.siemens.com/cs/ww/en/sc/2067>

4.2 Links and literature

Table 4-1

No.	Subject
\1\	Siemens Industry Online Support https://support.industry.siemens.com
\2\	Link to the article page of the application example https://support.industry.siemens.com/cs/ww/en/view/109779805
\3\	"TIA Portal Test Suite" function manual https://support.industry.siemens.com/cs/ww/en/view/109779356
\4\	Download the TIA Portal Test Suite https://support.industry.siemens.com/cs/ww/en/view/109775719
\5\	Download the SIMATIC S7-PLCSIM Adv. V3.0 PLCSIM V3.0 Advanced Update 1 https://support.industry.siemens.com/cs/ww/en/view/109776014

4.3 Change documentation

Table 4-2

Version	Date	Change
V1.0	06/2020	First version