BECKHOFF New Automation Technology

Documentation | EN

TwinSAFE Loader

Tool to load and adapt a TwinSAFE project

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Table of contents

1 Documentation notes

1.1 Disclaimer

Beckhoff products are subject to continuous further development. We reserve the right to revise the operating instructions at any time and without prior announcement. No claims for the modification of products that have already been supplied may be made on the basis of the data, diagrams and descriptions in these operating instructions.

In these operating instructions we define all permissible use cases whose properties and operating conditions we can guarantee. The use cases we define are fully tested and certified. Use cases beyond this, which are not described in these operating instructions, require the approval of Beckhoff Automation GmbH & Co KG.

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- EP1590927
- EP1789857
- EP1456722
- EP2137893
- DE102015105702

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1.1.3 Limitation of liability

All components in this product as described in the operating instructions are delivered in a specific configuration of hardware and software, depending on the application regulations. Modifications and changes to the hardware and/or software configuration that go beyond the documented options are prohibited and nullify the liability of Beckhoff Automation GmbH & Co. KG.

The following is excluded from the liability:

- Failure to observe these operating instructions
- Improper use
- Use of untrained personnel
- Use of unauthorized spare parts

1.1.4 Copyright

1.2 Documentation issue status

Version	Comment
4.0.0	• Chapter Safety and instruction [▶ 9] revised • TwinSAFE Loader version v9 added • Chapter Target system [▶ 15] revised and extended • In chapter Loading a safety project [▶ 21] and Customizing of a safety project [▶ 25] Edition updated • Chapter TwinCAT/BSD [▶ 15] and Number of permitted read retries [▶ 24] added • Chapter List of all available parameters [▶ 34] extended • Chapter Error codes [▶ 35] revised
3.1.0	• In chapter EtherCAT Mailbox Gateway [▶ 38] Description extended
3.0.0	• Editorially revised • TwinSAFE Loader version v8 added • Description of the EtherCAT Mailbox Gateway extended • Chapter Communication [▶ 19] extended • New chapters: Incremental loading of safe parameters [▶ 29] and Loading the safe address [▶ 33] • Chapter Customizing of a safety project [▶ 25] extended • Chapter List of all available parameters [▶ 34] extended • FMEA modified • Error codes extended
2.4.0	• Semicolons in csv tables removed • Note on the different indexing in the Loader compared to the Safety Editor regarding the groups • Another example of customizing added • Description of the executing system extended • Hint text to Mailbox Gateway added
2.3.0	• Description target system extended • TwinSAFE Loader version v7 added
2.2.0	• TwinSAFE Loader version v6 added
2.1.1	• Note text to the Virtual Ethernet Adapter added • Parameter --localams added
2.1.0	• Extensions for TwinSAFE Loader, version v5 added
2.0.0	• Migration • List of released hardware updated
1.2.0	• EtherCAT Mailbox Gateway setup added
1.1.0	• Extension of the system requirements • Foreword updated
1.0.0	• First released version
0.0.7	• Functions *Delete* and *Customize* added
0.0.6	• Note added to FMEDA chapter • Graphic added to Chapter 2.1
0.0.5	• Addition of the FMEDA • Exchange of Chapters 3.2 and 3.3
0.0.4	• Resorting of chapters
0.0.3	• Chapter 3.7, CSV format added

Version	Comment
0.0.2	• Revision of the call parameters
0.0.1	• First draft

Currentness

Please check whether you are using the current and valid version of this document. The current version can be downloaded from the Beckhoff homepage at http://www.beckhoff.de/twinsafe. In case of doubt, please contact Technical Support (see Beckhoff Support and Service [▶ 10]).

Origin of the document

The original documentation is written in German. All other languages are derived from the German original.

Product features

Only the product properties specified in the current operating instructions are valid. Further information given on the product pages of the Beckhoff homepage, in emails or in other publications is not authoritative.

1.3 References

No.	Version	Title / description
[1] - [5]	/	Not used.
[6]	2006/42/EC	**Directive 2006/42/EC of the European Parliament and of the Council of 17 May 2006 on machinery, and amending Directive 95/16-7/EC (recast) of 29 June 2006** This directive, also known as the Machinery Directive, defines requirements for the placing on the market of machines and machine-like components, such as safety components.

1.4 Staff qualification

These operating instructions are intended exclusively for trained specialists in control technology and automation with the relevant knowledge.

The trained specialist personnel must ensure that the applications and use of the described product meet all safety requirements. This includes all applicable and valid laws, regulations, provisions and standards.

Trained specialists

Trained specialists have extensive technical knowledge from studies, apprenticeships or technical training. Understanding of control technology and automation is available. Trained specialists can:

- Independently identify, avoid and eliminate sources of hazard.
- Apply relevant standards and directives.
- Implement specifications from accident prevention regulations.
- Evaluate, prepare and set up the workplaces.
- Evaluate, optimize and execute work independently.

1.5 Safety and instruction

Read the contents that refer to the activities you have to perform with the product. Always read the chapter For your safety in the operating instructions.

Observe the warnings in the chapters so that you can handle and work with the product as intended and safely.

Explanation of symbols

Various symbols are used for a clear arrangement:

1. The numbering indicates an action that should be taken.
• The bullet point indicates an enumeration.
[…] The square brackets indicate cross-references to other text passages in the document.
[1] The number in square brackets indicates the numbering of a referenced document.

The signal words used in the documentation are classified below.

Signal words

Warning of personal injuries

⚠ DANGER

Hazard with high risk of death or serious injury.

⚠ WARNING

Hazard with medium risk of death or serious injury.

⚠ CAUTION

There is a low-risk hazard that could result in medium or minor injury.

Warning of damage to property or environment

NOTICE

Notes

The environment, equipment, or data may be damaged.

Information on handling the product

This information includes, for example:
Recommendations for action, assistance or further information on the product.

1.6 Beckhoff Support and Service

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Beckhoff Support offers technical advice on the use of individual Beckhoff products and system planning. The employees support you in the programming and commissioning of sophisticated automation systems.

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Download area

In the download area you can obtain product information, software updates, the TwinCAT automation software, documentation and much more.

Web:	www.beckhoff.com/download

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For the addresses of our worldwide locations, please visit our website at Global Presence.

2 For your safety

Read this chapter containing general safety information. In addition, always observe the safety instructions and warnings in these operating instructions for your own safety, the safety of other persons and the safety of the product.

When working with control and automation products, many dangers can result from careless or incorrect use. Work particularly thoroughly, not under time pressure and responsibly towards other people.

2.1 Duty of care

The operator must comply with all the requirements and notes specified in these operating instructions in order to fulfill his duty of care. This includes in particular that you

- read the entire documentation of the TwinSAFE component
- comply with the provisions defined in the chapter Limitation of liability [▶ 6].
- only operate the TwinSAFE component when it is in perfect working order.
- provide the operating instructions in a legible condition and complete at the place of use of the TwinSAFE component.

2.2 General safety instructions

Use in machines according to the Machinery Directive

Only use the TwinSAFE component in machines that comply with the Machinery Directive. This is how you ensure safe operation.

For more information, see document [6] at References [▶ 8].

Intended use

Any use of the TwinSAFE components that goes beyond the intended use described is not permitted.

Check safety functions

Perform a new acceptance of the safety functions each time you make a change to your safety project. This also includes reading out and checking the parameters and customizing settings currently active on the TwinSAFE safety controller.

Specify workflow

Specify a workflow for loading and customizing a safety project. This is how you ensure that the correct safety project for the application is activated on the TwinSAFE logic component.

3 System description

3.1 General

The TwinSAFE Loader is software that enables you to use the following functions on a safety controller independently of the TwinCAT development environment:

- Loading, activating and deleting a safety project
- Customizing
- Incremental loading of safe parameters
- Loading the safe address

For a list of the supported TwinSAFE logic components, refer to chapter Target system [▶ 15]. The starting point of a loading procedure is a binary file, which you export from the TwinCAT development environment in advance.

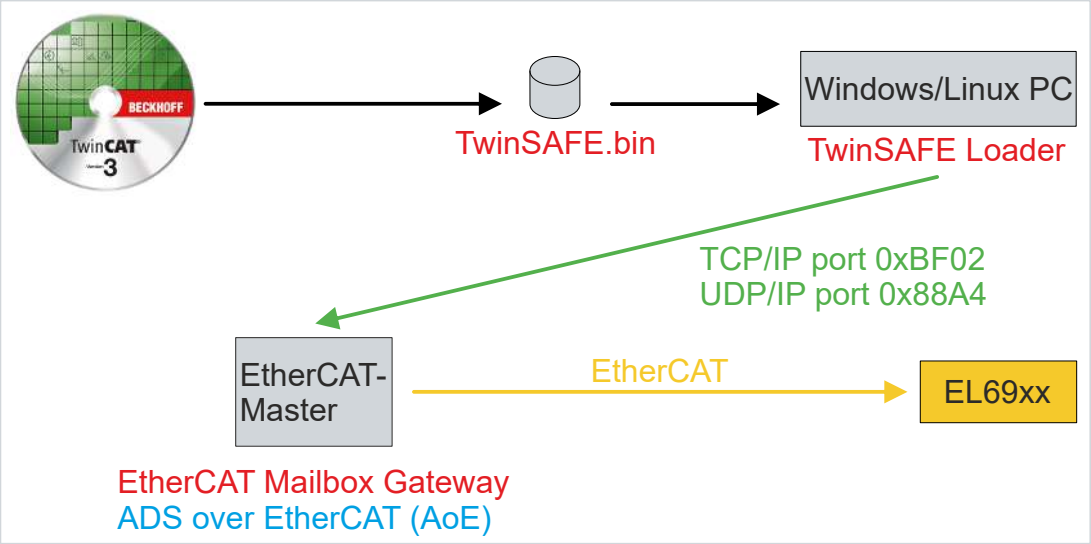


Fig. 1: System description

After the actual loading process, you have the option of customizing the safety project, performing incremental loading of safe parameters and loading a safe address. In order to perform an adaptation, a corresponding configuration of the safety project in the TwinCAT development environment is required. The TwinSAFE groups, which you can activate, deactivate or passivate, must be parameterized accordingly. You must also define the safe replacement values for the outputs of the groups during development. These replacement values are also part of the binary file you created after completing the security program.

3.2 System limits

NOTICE

Valid for v9

This documentation applies exclusively to TwinSAFE Loader version 9.

The TwinSAFE Loader software is delivered as an executable program library and is available for the Windows and Linux operating systems. You can include this library in applications. The control of the different functions of the program library is done by appropriate command line parameters.

For the EL6900 TwinSAFE logic terminal, you can only load the safety project. It is not possible to customize the safety project here.
For the other TwinSAFE logic components according to the chapter Target system [▶ 15] and, if necessary, future TwinSAFE logic components, you can load and customize the safety project.

Operating states

Ensure the operating states "OP" and
"SAFEOP" for the TwinSAFE Loader functionalities.

For the creation of a corresponding safety project, the incremental loading or the writing of a safe address you need a TwinCAT version 3.1 or higher.

4 Product description

This chapter first describes the system requirements and then goes into detail about how the product works.

4.1 Intended use

The TwinSAFE Loader is a program library for loading and customizing a safety project for TwinSAFE logic components as well as for incrementally loading safe parameters and writing a safe address.

Operate the TwinSAFE Loader exclusively for the intended activities defined in this documentation, taking into account the prescribed values.

⚠ WARNING

Improper use

Any use which exceeds the permissible written values or which does not observe other specifications from these operating instructions or other documents of the overall documentation is considered to be not in accordance with the intended use and is therefore prohibited.

This applies in particular to the use cases defined by Beckhoff Automation, which have been fully tested and certified and whose properties and operating conditions can be guaranteed. Use cases beyond this are regarded as inappropriate and require the approval of Beckhoff Automation.

Improper use will result in loss of safety and invalidation of certifications and approval.

4.2 System requirements

4.2.1 Operating System

To run the TwinSAFE Loader, the following system requirements must be met depending on the operating system.

4.2.1.1 Windows

You do not need any additional components for the Windows 10 operating system (32/64-bit).

The following table lists the different versions of the TwinSAFE loader and the corresponding SHA checksums.

File name	Operating system	Version	SHA checksum
TwinSAFE_Loader.exe	Win32	v1	SHA1: 3dfc76aca223f04a0e91677f2c6452df8a39a8f9
		v5	SHA256: 970a4ee096e181d20cea42d700c6ded1253a61a34c9ea00a5db6cc9ee99693f6
		v6	SHA256: 177f74ae6ce036ecc0f747f1f1324cfd890c627be91c111429a4bf124a3a1a1d
		v7	SHA256: e8287a0c23229cedb821e3a5b56459101ca45aabadaa185e4313bd7ad3a92d47
		v8	SHA256: aa2781a916c769d24c6c57b92a80b378943f5fae038efbd589c31fed8a414506
		v9	SHA256: bd63c3542bd318a5419c18657f295fa11b5873d2a775412dca0cfe7e95735412

4.2.1.2 Linux

You do not need any other components for the Debian 11 distribution.

The following table lists the different versions of the TwinSAFE loader and the corresponding SHA checksums.

File name	Operating system	Version	SHA checksum
TwinSAFE_Loader.bin	Linux x86 64-bit	v1	SHA1: c37f52a2fb8e3609346671feb2f60c9cba2bd2f9
		v5	SHA256: 462a9f652eab4ad43fb0dbf487bb3db9fa71a596ce339fb9fd5990f544d0a808
		v6	SHA256: 972391f4aa88322dc8ffad415919ae814095ab7349f059ffcb03e8a8c5d0f8a5
		v7	SHA256: b184816a9a17caeb1d7baca2395d30207cac463b63638930de0dc4f20539bedf
		v8	SHA256: ad6fa0edb3464e76ad8367955c12d84fa19a61a31e1ff85f2279ca435e356488
		v9	SHA256: e2a5973f2f7fd2aefe6127418cbcea77f8b6d2ab5152f93668f35cb36e17660e
TwinSAFE_Loader-i386.bin	Linux x86 32-bit	v5	SHA256: 4b25dbd486cd56a3da411e7b1643be6834b7db51c3cb58bfb9caecdd36bdc9e1
		v6	SHA256: 11ed882fd06dd28f19ec3a7c458fdebf87b8fdd269bec930a145056ece4dc835
		v7	SHA256: 3af9a3a22fffa7a399c9aa5c1763ba588bc2680beb8d3cadfd165739f4dca099
		v8	SHA256: 55a806f77976e82af486b710915bc2f4a72a7d84b64d47f0a0866aa0bcc23360
		v9	SHA256: fcf3a616e33cb1367b11029b34107ade3fca752fcd83731b6486a056784b5eb5

4.2.1.3 TwinCAT/BSD

You do not need any additional components for the TwinCAT/BSD operating system.

The following table lists the different versions of the TwinSAFE loader and the corresponding SHA checksums.

File name	Operating system	Version	SHA checksum
TwinSAFE_Loader	TC/BSD	v9	5dcd4f137d3f701a8cb1480425e8f33411769f05cf2bc4c56c5739deecbeeadb

4.2.2 Target system

The following table shows the supported TwinSAFE logic components:

Product designation	SW version
EL6900	05 or newer (production as of week 02/2014)
EL/EK/EJ/EPx9yx with y>0	01 or newer
AX8xxx-xyxx-xxxx with y in (1, 2)	01 or newer
AMP8xxx-xxyx-xxxx with y in (1, 2, 3, 4)	01 or newer
AMI8xxx-xyxx-xxxx with y=1	01 or newer
ELM7xxx-yxxx-xxxx with y=9	01 or newer

The listed components are directly supported in the current version of the TwinSAFE Loader.

Currently, all TwinSAFE logic components are based on the EL6910, with the exception of the EL6900, which forms its own basis.

4.2.2.1 Implementation of new components

If a new TwinSAFE logic component is available, which is not directly supported in the current version of the TwinSAFE Loader, you have the possibility to include this component by an additional configuration file.

The configuration file is structured as follows:

The first line contains an unsigned integer, which is interpreted as the version number of the format:

"1"

The second line contains the header:

class;type

1st column: specifies the class on which the TwinSAFE logic component is based. See the table below for more information.

Component	Based on the class
EL6900	EL6900
All other TwinSAFE logic components	EL6910

2nd column: specifies the type of the TwinSAFE component.

Proceed as follows to include a new TwinSAFE logic component:

1. Create an additional file "custom_terminals.csv" in the directory of the TwinSAFE Loader execution file
2. Fill the new file with the syntax as shown in the example of an ELx9xx

Using the example of a new ELx9xx logic component based on the EL6910 TwinSAFE Logic, expand the file as shown in line 5. Lines 1 and 2 are fixed.

For TwinSAFE logic components with long type designations, use only the first 15 digits of the designation.

File: custom_terminals.csv

```
1
class;type
EL6910;EL6910
EL6910;EP1957-0022
EL6910;ELx9xx
```

4.2.3 Communication with the TwinSAFE logic component

The TwinSAFE Loader supports the following protocols for the loading and customizing of a safety project to a TwinSAFE logic component:

- ADS over EtherCAT (AoE)
- EtherCAT Mailbox Gateway

For successful communication with the TwinSAFE logic component, the TwinSAFE Loader must be able to establish a connection with the EtherCAT master existing in the system. To do this, meet the following system requirements.

4.2.3.1 ADS over EtherCAT (AoE)

Configure the EtherCAT master to accept AoE connections (according to ETG.1020) on port 0xBF02 (TCP/IP).

4.2.3.2 EtherCAT Mailbox Gateway

Configure the EtherCAT master to accept packets from the EtherCAT Mailbox Gateway (according to ETG.8200) on port 0x88A4 (UDP/IP).

For further information about the configuration of the EtherCAT Mailbox Gateway refer to chapter EtherCAT Mailbox Gateway [▶ 38].

4.3 Safety parameters

The product is classified in accordance with IEC 61508:2010 as a T2 tool.

The confirmation of conformity of the TwinSAFE Loader can be found at https://www.beckhoff.com/en-en/support/download-finder/certificates-approvals/.

5 Functioning

The TwinSAFE Loader enables the following functions:

- Loading, activating and deleting a safety project
- Customizing
- Incremental loading of safe parameters
- Loading the safe address

The data packets necessary for this are transmitted via the EtherCAT master existing in the system to the corresponding component. The TwinSAFE Loader functions are controlled via command line parameters.

5.1 Communication

For information on FMEA, refer to chapter To control communication, use the following parameters:

Command line parameters	Description
`--gw <IPv4 address>`	Specification of the IPv4 address of the EtherCAT Mailbox Gateway or, in AoE mode, the IPv4 address of the EtherCAT master. Starting with version v5 you can also address the EtherCAT master in AoE mode via the host name. For more information, see EtherCAT Mailbox Gateway [▶ 38].
`--ams <NetId>`	Specification of the AMSNetID if you want to use ADS over EtherCAT (AoE). This parameter does not work on a local computer.
`--localams <NetId>`	When using --ams, you can use this to specify the local AMSNetID. If you do not use the parameter, the AMSNetID is formed from own IP address + ".1.1".

For information on FMEA, see chapter General [▶ 36].

5.1.1 Testing the communication connection

To test the communication connection, use the following parameter:

Command line parameters	Description
`--list <file path>`	Specification of the path of the file in which the available communication connections are listed

For example, testing the communication connection is done as shown in the following calls:

Sample with AMS:

```
TwinSAFELoader.exe --gw  172.17.42.29 --ams 172.17.42.29.2.1 --localams 172.17.100.7.1.1 --list
testLoader.csv
```

Sample with EtherCAT Mailbox Gateway:

```
TwinSAFE_Loader.exe --gw 192.168.67.254 --list testLoader.csv
```

5.1.2 Parameterizing a timeout

The "--timeout" parameter defines the waiting time for network packets. The default value is 10,000 ms.

To parameterize the timeout parameter use the following parameter:

Command line parameters	Description
`--timeout <time in ms>`	Specification of the EtherCAT slave address of the TwinSAFE component

If the specified value in the timeout parameter is not sufficient, error code (5) appears. For more information, see the chapter Error codes [▶ 35].

5.2 Authentication

⚠ WARNING

Use only by authorized persons

Make sure that only authorized persons can load and customize the safety project.

Failure to comply may result in loss of safety.

User management

Each TwinSAFE logic component has its own user administration. Only users registered in the TwinSAFE logic component can perform certain functions.

To authenticate a user on the TwinSAFE logic component, use the following parameters:

Command line parameters	Description
`--user <username>`	Name of the user with the appropriate rights to perform the desired function
`--pass <password>`	User password

For information on FMEA, see chapter General [▶ 36].

5.3 Loading a safety project

To load a safety project, use the following parameters:

Command line parameters	Description
`--slave <EtherCAT Adresse des EtherCAT Slaves>`	Specification of the EtherCAT slave address of the TwinSAFE logic component
`--proj <Pfad zur Binärdatei>`	Specification of the path to the binary file of the safety project

Loading a safety project consists of a two-step process:

1. Loading the safety project onto the TwinSAFE logic component
2. Activating the safety project

Splitting the process allows you to take measures to ensure that the correct safety project for the application is switched active on the TwinSAFE logic component. The user shall bear full responsibility for demonstrating the accuracy and efficacy of these measures. Please also refer to chapter FMEA [▶ 36].

Loading a safety project, for example, is done as shown in the following call:

```
TwinSAFE_Loader.exe --gw 192.168.67.254 --user Administrator --pass TwinSAFE --slave 1004 --proj
example_el6910.bin
```

For example, the output looks like this:

```
2023-11-02T18:43:27 Info: TwinSAFE Loader - v9
2023-11-02T18:43:27 Info: 'Administrator' is downloading 'example_el6910' to EL6910 @3 (Serial
Number: 1106135)
2023-11-02T18:43:27 Info: Safe Logic Data CRC:  Online: 0xa649; Offline: 0xa649; Verification: ok
2023-11-02T18:43:27 Info: Mapping Data CRC:     Online: 0x696e; Offline: 0x696e; Verification: ok
2023-11-02T18:43:27 Info: Parameter Data CRC:   Online: 0xa8d6; Offline: 0xa8d6; Verification: ok
2023-11-02T18:43:27 Info: Info Data CRC:        Online: 0x0629; Offline: 0x0629; Verification: ok
2023-11-02T18:43:27 Info: Customizing Data CRC: Online: 0x0000; Offline: 0x0000; Verification: ok
2023-11-02T18:43:27 Info: Download of 'example_el6910' (0x2d63) to EL6910 @3 (Serial Number:
1106135) completed
```

For information on FMEA, see chapter Loading and activating a safety project [▶ 36].

5.4 Activating a safety project

To activate a safety project, use the following parameters:

Command line parameters	Description
`--slave <EtherCAT-Adresse des EtherCAT-Slaves>`	Specification of the EtherCAT slave address of the TwinSAFE logic component
`--proj <Pfad zur Binärdatei>`	Specification of the path to the binary file of the safety project to be activated
`--crc <Projekt-CRC des zu aktivierenden Safety-Projekts>`	Specification of the project CRC of the safety project to be activated

For example, activating a safety project is done as shown in the following call:

```
TwinSAFE_Loader.exe --gw 192.168.67.254 --user Administrator --pass TwinSAFE --slave 1004 --proj example_el6910.bin --crc 0x2d63
```

For example, the output looks like this:

```
2022-01-06T13:50:12 Info: TwinSAFE Loader - v9
2022-01-06T13:50:13 Info: Project successfully activated on EL6910 @3 (Serial Number: 1106135)
```

For information on FMEA, see chapter Loading and activating a safety project [▶ 36].

5.5 Deleting a safety project

To delete a safety project, use the following parameters:

Command line parameters	Description
`--slave <EtherCAT-Adresse des EtherCAT-Slaves>`	Specification of the EtherCAT slave address of the TwinSAFE logic component
`--delete`	Command to delete the safety project

Deleting a safety project, for example, is done as shown in the following call:

```
TwinSAFE_Loader.exe --gw 192.168.67.254 --user Administrator --pass TwinSAFE --slave 1004 --delete
```

For example, the output looks like this:

```
2022-01-06T13:47:13 Info: TwinSAFE Loader - v9
2022-01-06T13:47:13 Info: 'Administrator' is deleting project from EL6910 @3 (Serial Number: 1106135)
2022-01-06T13:47:14 Info: Project successfully deleted from EL6910 @3 (Serial Number: 1106135)
```

For information on FMEA, see chapter General [▶ 36].

5.6 Listing of the TwinSAFE logic components

For scanning and returning all available TwinSAFE logic components in an EtherCAT network use the following parameter:

Command line parameters	Description
`--list <Dateiname>`	Saves the list of all available slaves as a list in the specified file

The logic terminal listing is done for example as shown in the following call:

```
TwinSAFE_Loader.exe --gw 192.168.67.254 --list safetyterminals.csv
```

For example, the output looks like this:

```
2022-01-06T13:46:06 Info: TwinSAFE Loader - v9
2022-01-06T13:46:06 Info: Reading slave list completed
```

The result is in the file *safetyterminals.csv*.

For information on FMEA, see chapter General [▶ 36].

5.6.1 Component listing file format

The file for listing the TwinSAFE logic components consists of several lines of ASCII text whose columns are separated by semicolons.

The 1st line contains the text:

"Upload: TwinSAFE Logic Devices"

The 2nd line contains the column description:

"EtherCAT address;FSoE address;type;project crc;name;serial number"

The column order is fixed and includes the following information:

1st column: indicates the EtherCAT address of the slave.
2nd column: indicates the FSoE address of the slave.
3rd column: indicates the terminal type of the slave.
4th column: indicates the project CRC of the slave's currently active project.
5th column: indicates the name of the EtherCAT slave in TwinCAT.
6th column: indicates the serial number of the slave.

The (2+n)th row contains the configuration of the nth EtherCAT slave in the format:

<EtherCAT address>;<FSoE address>;<type>;<projekt crc>;<name>;<serial number>

Example: Component listing (table form)

EtherCAT address	FSoE address	type	projekt crc	name	serial number
1001	1	EL6900	0x0	Term 2 (EL6900)	968063
1004	3	EL6910	0x0	Term 4 (EL6910	1106135
1022	1000	AX8206-0210-010	0x56af	Drive 22 (AX8206-0210-0104)	2628377
1024	200	AMP8000-0030-01	0xc035	Drive 48 (AMP8000-0030-0104)	2249750

For TwinSAFE logic components with long type designations, only the first 15 digits of the designation are displayed.

Example: Component listing (plain text)

```
Upload: TwinSAFE Logic Devices
EtherCAT address;FSoE address;type;project crc;name;serial number
1001;1;EL6900;0x0;Term 2 (EL6900);968063
1004;3;EL6910;0x0;Term 4 (EL6910);1106135
1022;1000;AX8206-0210-010;0x56af;Drive 22 (AX8206-0210-0104);2628377
1024;200;AMP8000-0030-01;0xc035;Drive 48 (AMP8000-0030-0104);2249750
```

The file contains a listing of 4 TwinSAFE logic components:

1. The first logic component can be reached via the EtherCAT address "1001", has the FSoE address "1", is of type "EL6900", no project is currently active on it ("0x0"), it has the designation "Term 2 (EL6900)" and has the serial number "968063"
2. The second logic component can be reached via the EtherCAT address "1004", has the FSoE address "3", is of the type "EL6910", no project is currently active on it ("0x0"), it has the designation "Term 4 (EL6910)" and the serial number "1106135"
3. The third logic component can be reached via the EtherCAT address "1022", has the FSoE address "1000", is of the type "AX8206-0210-010", a project is currently active on it ("0x56af "), it has the designation "Drive 22 (AX8206-0210-0104)" and the serial number "2628377"
4. The fourth logic component can be reached via the EtherCAT address "1024", has the FSoE address "200", is of type " AMP8000-0030-01", a project is currently active on it ("0xc035 "), it has the designation "Drive 48 (AMP8000-0030-0104)" and has the serial number "2249750"

5.6.2 Number of permitted read retries

Use the following parameter to set the number of permitted read retries for scanning and returning all available TwinSAFE logic components:

Command line parameters	Description
`--retryattemps`	Command for the number of permitted read retries for scanning and returning all available TwinSAFE logic components in an EtherCAT network

The number of permitted read retries is set as shown in the following call, for example:

```
TwinSAFE_Loader.exe --gw 192.168.67.254 --list safetyterminals.csv --retryattemps 2
```

For example, the output looks like this:

```
2023-10-15T12:46:32+0000 Info: TwinSAFE Loader - v9
2023-10-15T12:46:46+0000 Error: select() timeout
2023-10-15T12:46:46+0000 Warning: Retry scanning slave 23
2023-10-15T12:47:02+0000 Error: select() timeout
2023-10-15T12:47:02+0000 Warning: Retry getting information of slave
2023-10-15T12:47:03+0000 Info: Reading slave list completed
```

For information on FMEA, see chapter General [▶ 36].

5.7 Customizing of a safety project

To customize a safety project, use the following parameters:

Command line parameters	Description
`--slave <EtherCAT Adresse des EtherCAT Slaves>`	Specification of the EtherCAT slave address of the TwinSAFE logic component
`--customize <Pfad zur Datei, die die Gruppenkonfiguration enthält>`	Specification of the path to the file for the group configuration

For example, customizing a safety project is done as shown in the following call:

```
TwinSAFE_Loader.exe --gw 192.168.67.254 --user Administrator --pass TwinSAFE --slave 1004 --
customize groupconfig.csv
```

For example, the output looks like this:

```
2023-11-02T18:44:54 Info: TwinSAFE Loader - v9
2023-11-02T18:44:54 Info: 'Administrator' is customizing EL6910 @3 (Serial Number: 1106135)
2023-11-02T18:44:54 Info: Customizing Data CRC: Online: 0x42e4; Offline: 0x42e4; Verification: ok
2023-11-02T18:44:54 Info: Customization of EL6910 @3 (Serial Number: 1106135) completed
2023-11-02T18:44:54 Info: Customizing parameter on EL6910 @3 (Serial Number: 1106135):
2
Upload: Customizing Parameter
Serial Number: 1106135
id;activate;passivate;temporarily;permanent
1;A;E;E;E
2;A;E;D;D
```

For information on the structure of the CSV file, see the chapter File format for customizing [▶ 26].

Customizing using the log call

With the help of the log call, the read-back of the customizing settings on the TwinSAFE logic component is redirected to a file directly after downloading the customizing.

To customize using the log call, use the following additional parameter:

Command line parameters	Description
`--log <Dateipfad>`	Specification of the path to the file for the customizing settings

Customizing a safety project with the log call is done, for example, as shown in the following call:

```
TwinSAFE_Loader.exe --gw 192.168.67.254 --user Administrator --pass TwinSAFE --slave 1004 --
customize groupconfig.csv --log logging.txt
```

For example, the output looks like this:

```
2022-01-06T14:01:13 Info: TwinSAFE Loader - v9
2022-01-06T14:01:13 Info: 'Administrator' is customizing EL6910 @3 (Serial Number: 1106135)
2022-01-06T14:01:14 Info: Customization of EL6910 @3 (Serial Number: 1106135) completed
```

Customizing via PLC

With the aid of the NT_StartProcess function block from the Tc2_Utilities library, you can also start customizing via the PLC, for example:

```
NT_StartProcess_Customizing : NT_StartProcess;
NT_StartProcess_NetId       : T_AmsNetID:='';
NT_StartProcess_Err         : BOOL;
NT_StartProcess_ErrId       : UDINT;
NT_StartProcess_Start       : BOOL;
NT_StartProcess_Tmout       : TIME;
NT_StartProcess_Busy        : BOOL;
```

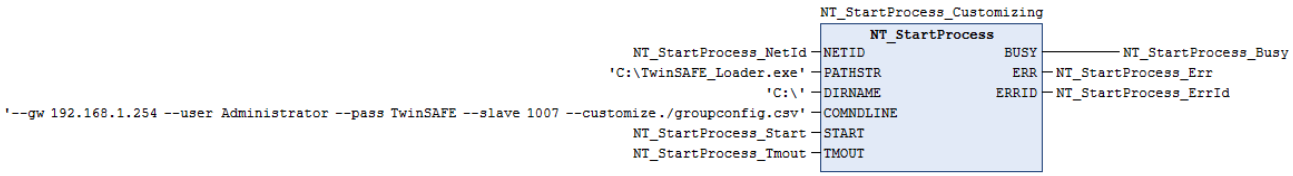


Fig. 2: Calling the NT_StartProcess function block for customizing

⚠ WARNING

Avoid unauthorized access

The figure shows only an exemplary procedure. Make sure that the password is not visible in plain text to avoid unauthorized access.

Unauthorized access may compromise security.

For information on FMEA, see chapter Customizing of a safety project [▶ 36].

5.7.1 File format for customizing

The file for the customization consists of several lines of ASCII text, whose columns are separated by semicolons.

The 1st line contains an unsigned integer, which is interpreted as the version number of the format:

"1"

The 2nd line contains the column labels:

"id;activate;passivate;temporarily;permanent"

The column order is fixed and includes the following information:

1st column: indicates the ID of the TwinSAFE group.
2nd column: indicates whether the group should be activated.
3rd column: indicates whether the group can and should be passivated.
4th column: indicates whether the group can and should be temporarily disabled.
5th column: indicates whether the group can and should be permanently disabled.

The (2+n)th line contains the configuration of the nth TwinSAFE group in the format:

<id>;[AE];[ADE]; [ADE]; [ADE]

A: Active; active
D: Disabled; cannot be activated
E: Enabled; can be activated, but currently not active

Example: TwinSAFE group configuration (tabular form)

1				
id	**activate**	**passivate**	**temporarily**	**permanent**
1	E	E	E	A
2	E	A	D	D

Example of TwinSAFE group configuration (plain text)

```
1
id;activate;passivate;temporarily;permanent
1;E;E;E;A
2;E;A;D;D
```

This is a version 1 CSV format.

The file contains a configuration for a TwinSAFE project with two groups:

1. The first group can be activated, passivated, temporarily disabled and permanently disabled. Its current state is permanently disabled.
2. The second group can only be activated or passivated. Its current state is passivated.

5.8 List of the current group configuration

For listing the groups of a safety project use the following parameters:

Command line parameters	Description
`--slave <EtherCAT Adresse des EtherCAT Slaves>`	Specification of the EtherCAT slave address of the TwinSAFE logic component
`--list <Dateiname>`	Saves the list of the group configuration as a list in the specified file

The listing of the groups of a safety project takes place, for example, as shown in the following call:

```
TwinSAFE_Loader.exe --gw 192.168.67.254 --slave 1004 --list groupconfig.csv
```

For example, the output looks like this:

```
2022-01-06T14:01:13 Info: TwinSAFE Loader - v9
2022-01-06T14:01:13 Info: Reading customizing parameter from EL6910 @3 (Serial Number: 1106135)
completed
```

The result is in the file *groupconfig.csv*.

For information on FMEA, see chapter General [▶ 36].

5.8.1 Group configuration file format

The group configuration file consists of several lines of ASCII text whose columns are separated by semicolons.

The 1st line contains an unsigned integer, which is interpreted as the version number of the format:

"2"

The 2nd line contains the name of the file format:

"Upload: Customizing parameters"

The 3rd line contains the serial number:

"Serial Number: …"

The 4th line contains the column labels:

"id;activate;passivate;temporarily;permanent"

The column order is fixed and includes the following information:

1st column: indicates the ID of the TwinSAFE group.
2nd column: indicates whether the group should be activated.
3rd column: indicates whether the group can and should be passivated.
4th column: indicates whether the group can and should be temporarily disabled.
5th column: indicates whether the group can and should be permanently disabled.

The (2+n)th line contains the configuration of the nth TwinSAFE group in the format:

<id>;[AE];[ADE]; [ADE]; [ADE]

A: Active; active
D: Disabled; cannot be activated
E: Enabled; can be activated, but currently not active

5.9 Incremental loading of safe parameters

In addition to the information regarding the actual functionality of the safety application, a safety project has so-called safe parameters. You can use these to configure the target system and the secure communication devices.

You have the possibility to overwrite a part of these safe parameters by the function "Incremental loading of safe parameters". For this purpose, the TwinSAFE Loader provides functions to read out the safe parameters of the safety project and to download and upload an incremental parameter set. Incrementally downloaded parameters are not automatically transferred to the safety project. You have to customize this manually.

Incremental loading limited

Incremental loading of the safe parameters is only possible if you use a suitable TwinSAFE logic component and have activated downloading in your safety project. You can find out whether your TwinSAFE logic component supports this function in the documentation for your TwinSAFE logic component. These can be found on the Beckhoff website at https://www.beckhoff.com/en-en/support/download-finder/certificates-approvals/.

The TwinSAFE Loader supports the "Incremental loading of safe parameters" function for EL6910-based TwinSAFE logic components. Refer to the table in section Implementation of new components [▶ 16] for information on which TwinSAFE logic components are EL6910 based.

For information on FMEA, see chapter Incremental loading of safe parameters [▶ 37].

5.9.1 Upload the safe parameters

To upload the safe parameters of the logic project currently active on the TwinSAFE logic component, use the following parameters:

Command line parameters	Description
`--slave <EtherCAT Adresse des EtherCAT Slaves>`	Specification of the EtherCAT slave address of the TwinSAFE logic component
`--rdpara <Pfad zu einer neu zu erstellenden Datei>`	Command to upload the safe parameters

For example, uploading the safe parameters is done as shown in the following call:

```
TwinSAFE_Loader.exe --gw 192.168.67.254 --slave 1022 --rdpara safeParameters.txt
```

For example, the output looks like this:

```
2022-01-06T14:01:13 Info: TwinSAFE Loader - v9
2022-01-06T14:01:13 Info: Reading safe parameters from AX8206-0210-010 @1000 (Serial Number: 2628377) completed
```

The result is in the file *safeParameters.txt*.

5.9.1.1 File format for uploading the safe parameters

The file for uploading the safe parameters consists of several lines of ASCII text whose columns are separated by semicolons.

The 1st line contains an unsigned integer, which is interpreted as the version number of the format:

"1"

The 2nd line contains the name of the file format:

"Upload: Safe Parameter (Logic Project)"

The 3rd line contains the serial number:

"Serial Number: …"

The 4th line contains the heading:

"DATA:"

The 5th line contains the uploaded data with 512 digits, which can be interpreted as 256 bytes.

- Byte 0, 1, 2 are 0.
- Byte 3 contains the length (n) of the safe parameters.
- Byte 4 to (4+n-1) contains the safe parameters.
- Byte (4+n) to 255 are filled with 0.

Sample: Uploading the safe parameters of the safety project:

```
1
Upload: Safe Parameter (Logic Project)
Serial Number: 2628377
DATA:
000000d8c42200800000000000000006401020064010200000000001c00000000001c00000000000000001c0000000000
1c00000000002000200034120000e0d300002000000000000002000000000000000000000000000000000000000000000
0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
000000000000
```

5.9.2 Incremental download of the safe parameters

To download the safe parameters incrementally, use the following parameters:

Command line parameters	Description
`--slave <EtherCAT Adresse des EtherCAT Slaves>`	Specification of the EtherCAT slave address of the TwinSAFE logic component
`--wrincpara <Pfad zu einer Datei, die die inkrementell heruntergeladenen sicheren Parameter enthält>`	Command for incremental download of safe parameters

For example, the incremental download of the safe parameters is done as shown in the following call:

```
TwinSAFE_Loader.exe --gw 192.168.67.254 --user Administrator --pass TwinSAFE --slave 1022 --
wrincpara safeParameters.txt
```

The output shows a comparison between the safe parameters and the incrementally downloaded safe parameters.

For example, the output looks like this:

```
2022-01-06T13:34:10 Info: TwinSAFE Loader - v9
2022-01-06T13:34:14 Info: 'Administrator' is incrementally downloading safe parameters to
AX8206-0210-010 @1000 (Serial Number: 2628377)
2022-01-06T13:34:14 Info: Incremental download of safe parameters to AX8206-0210-010 @1000 (Serial
Number: 2628377) completed
1
Differences between safe project parameters and incrementally downloaded safe parameters on
AX8206-0210-010 @1000 (Serial Number: 2628377):
Changed safe parameter: OFFSET: 40; Project Parameter: 1c; Incr. downloaded parameter: 34
Changed safe parameter: OFFSET: 56; Project Parameter: 34; Incr. downloaded parameter: 63
Changed safe parameter: OFFSET: 57; Project Parameter: 12; Incr. downloaded parameter: e6
```

Incremental download of safe parameters using the log call

Using the log call, the differences between the safe parameters of the safety project and the currently incrementally downloaded safe parameters are redirected to a file immediately after the download.

To write using the log call, use the following additional parameter:

Command line parameters	Description
`--log <Pfad zur Datei>`	Specifying the path to the file for the safe parameters

For example, downloading using the log call is done as shown in the following call:

```
TwinSAFE_Loader.exe --gw 192.168.67.254 --user Administrator --pass TwinSAFE --slave 1022 --
wrincpara safeParameters.txt --log logging.txt
```

For example, the output looks like this:

```
2022-01-06T13:34:10 Info: TwinSAFE Loader - v9
2022-01-06T13:34:14 Info: 'Administrator' is incrementally downloading safe parameters to
AX8206-0210-010 @1000 (Serial Number: 2628377)
2022-01-06T13:34:14 Info: Incremental download of safe parameters to AX8206-0210-010 @1000 (Serial
Number: 2628377) completed
```

All further information of the output can be found in the file *logging.txt*.

5.9.2.1 Incremental download file format

The file for incremental download of safe parameters consists of several lines of ASCII text whose columns are separated by semicolons.

The 1st line contains an unsigned integer, which is interpreted as the version number of the format:

"1"

The 2nd line contains the heading:

"DATA:"

The 3rd line contains the uploaded data with 512 digits, which can be interpreted as 256 bytes.

- Byte 0, 1, 2 are 0.
- Byte 3 contains the length (n) of the safe parameters.
- Byte 4 to (4+n-1) contains the safe parameters.
- Byte (4+n) to 255 are filled with 0.

Sample: Incremental download of the safe parameters

```
1
DATA:
000000d8c42200800000000000000006401020064010200000000001c00000000001c0000000000000000001c0000000000
1c00000000000200020034120000e0d300002000000000000000200000000000000000000000000000000000000000000000
0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
000000000000
```

5.9.3 Uploading the incrementally downloaded safe parameters

To upload the incrementally downloaded safe parameters, use the following parameters:

Command line parameters	Description
`--slave <EtherCAT Adresse des EtherCAT Slaves>`	Specification of the EtherCAT slave address of the TwinSAFE logic component
`--rdincpara <Pfad zu einer neu zu erstellenden Datei>`	Command for uploading the incrementally downloaded safe parameters

For example, reading the incrementally downloaded safe parameters is done as shown in the following call:

```
TwinSAFE_Loader.exe --gw 192.168.67.254 --slave 1022 --rdincpara incrementalSafeParameters.txt
```

For example, the output looks like this:

```
2022-01-06T13:34:10 Info: TwinSAFE Loader - v9
2022-01-06T13:34:14 Info: Reading incrementally downloaded safe parameters from AX8206-0210-010
@1000 (Serial Number: 2628377) completed
```

The result is in the file *incrementalSafeParameters.txt*.

5.9.3.1 File format for uploading the incrementally downloaded safe parameters

The file for uploading the incrementally downloaded safe parameters consists of several lines of ASCII text whose columns are separated by semicolons.

The 1st line contains an unsigned integer, which is interpreted as the version number of the format:

"1"

The 2nd line contains the name of the file format:

"Upload: Safe Parameter (Incremental Download)"

The 3rd line contains the serial number:

"Serial Number: …"

The 4th line contains the heading:

"DATA:"

The 5th line contains the uploaded data with 512 digits, which can be interpreted as 256 bytes.

- Byte 0, 1, 2 are 0.
- Byte 3 contains the length (n) of the safe parameters.
- Byte 4 to (4+n-1) contains the safe parameters.
- Byte (4+n) to 255 are filled with 0.

Sample: Uploading the incrementally downloaded safe parameters

```
1
Upload: Safe Parameter (Incremental Download)
Serial Number: 2628377
DATA:
000000d8c42200800000000000000006401020064010200000000001c00000000001c00000000000000001c0000000000
1c000000000020002003412000e0d300002000000000000000200000000000000000000000000000000000000000000
0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
000000000000
```

5.10 Loading the safe address

For TwinSAFE logic components without a hardware address switch, the address is set via the software.

The TwinSAFE Loader supports the "Loading the safe address" function for EL6910-based TwinSAFE logic components where the address is set via the software. Refer to the table in chapter Implementation of new components [▶ 16] for information on which components are based on the EL6910.

To load the safe address, use the following parameters:

Command line parameters	Description
`--slave <EtherCAT Adresse des EtherCAT Slaves>`	Specification of the EtherCAT slave address of the TwinSAFE logic component
`--wraddr <Sichere Adresse des Slaves>`	Command to load the safe address The format of the safe address is to be specified in decimal. Value range 1 to 65535.

For example, loading a safe address is done as shown in the following call:

```
TwinSAFE_Loader.exe --gw 192.168.67.254 --user Administrator --pass TwinSAFE --slave 1024 --wraddr
42
```

For example, the output looks like this:

```
2022-01-06T13:43:47 Info: TwinSAFE Loader - v9
2022-01-06T13:43:48 Info: 'Administrator' is writing new safe address '42' to AMP8000-0030-01 @200
(Serial Number: 2249750)
2022-01-06T13:43:48 Info: Changing safe address of AMP8000-0030-01 @200 (Serial Number: 2249750) to
42 succeeded
2022-01-06T13:43:48 Info: Changing safe address requires a power cycle to take effect (please turn
device off and then on again)
```

For information on FMEA, see chapter Loading the safe address [▶ 37].

6 List of all available parameters

Command line parameters	Description
`--gw <IPv4-Adresse>`	Specification of the IPv4 address of the EtherCAT Mailbox Gateway or, in AoE mode, the IPv4 address of the EtherCAT master
`--ams <NetId>`	Specification of the AmsNetID, if ADS over EtherCAT (AoE) is to be used
`--localams <lokale AMS Net ID>`	When using --ams, the local AMS Net ID can be specified via this. If the parameter is not used, the AmsNetID is formed from own IP address + ".1.1".
`--user <Benutzername>`	Name of the user with the appropriate rights to perform the desired function
`--pass <Passwort>`	User password
`--slave <EtherCAT-Adresse des EtherCAT-Slaves>`	Specification of the EtherCAT slave address of the TwinSAFE logic component
`--delete`	Command to delete the safety project
`--timeout <Dezimalwert der Zeit in ms>`	Command for setting the maximum waiting time for network packets
`--retryattemps <Anzahl der zulässigen Lese-Wiederholungen>`	Command for the number of permitted read retries for scanning and returning all available TwinSAFE safety controllers in an EtherCAT network
`--help`	Command to output all possible call parameters
`--proj <Pfad zur Binärdatei>`	Specification of the path to the binary file of the safety project
`--crc <Projekt-CRC des zu aktivierenden Safety-Projekts>`	Specification of the project CRC of the safety project to be activated
`--list <Dateiname>`	Together with the command parameter --gw: Saves the list of all available slaves as a CSV list in the specified file.
`--list <Dateiname>`	Together with the command parameters --gw and --slave: Saves the list of the group configuration as a CSV list in the specified file
`--customize <Pfad zur CSV-Datei, die die Gruppenkonfiguration enthält>`	Changes the group configuration on the TwinSAFE logic component if the CSV file says something different than is active on the TwinSAFE logic component
`--log <Dateipfad>`	When customizing: Lists the customizing parameters read back in the specified file.
`--rdpara <Pfad zu einer neu zu erstellenden Datei>`	Command to upload the safe parameters
`--wrincpara <Pfad zu einer Datei, die die inkrementellen Safety-Parameter enthält>`	Command for incremental download of safe parameters
`--log <Dateipfad>`	When downloading incrementally: Lists the differences between the incrementally downloaded safe parameters of the TwinSAFE logic component and the safe parameters of the currently active safety project in the specified file.
`--rdincpara <Pfad zu einer neu zu erstellenden Datei>`	Command for uploading the incremental safe parameters
`--wraddr <Sichere Adresse des Slaves>`	Command to download the safe address

7 Error codes

The following error codes apply to the TwinSAFE Loader:

Error code	Return value	Meaning	Possible causes
ERR_NONE	(0)	No error.	• The action has been carried out successfully.
ERR_INVALID_PARAMETER	(1)	Invalid call parameter.	• The command line parameter was incorrect.
ERR_CORRUPT_FILE	(2)	The file does not exist or is corrupted.	• The project file is corrupted or the specified path is invalid.
ERR_AUTHENTICATION_ FAILED	(3)	The login has failed.	• The specified user name or password is invalid on the TwinSAFE logic component. • The user does not have the required rights for customizing or incremental download.
ERR_SLAVE_NOT_FOUND	(4)	Unknown EtherCAT slave.	• No slave could be found for the specified EtherCAT address.
ERR_CORRUPT_ COMMUNICATION	(5)	Error during the data transmission.	• The communication connection was disconnected or timeout.
ERR_CUSTOMIZING_FAILED	(6)	Customizing error.	• The TwinSAFE logic component has received invalid data.
ERR_CUSTOMIZING_NOT_ SUPPORTED	(7)	Customizing is not supported.	• EL6900-based devices do not support the function. • No group for the "Customizing" function is activated in the safety project.
ERR_READ_SAFE_PARAM_ NOT_SUPPORTED	(8)	Reading the safety parameters is not supported.	• EL6900-based devices do not support the function.
ERR_INCREMENTAL_ DOWNLOAD_FAILED	(9)	The incremental download failed.	• The parameters are to be changed at an offset that is not supported by the target system.
ERR_INCREMENTAL_ DOWNLOAD_NOT_SUPPORTED	(10)	Incremental download is not supported.	• The TwinSAFE logic component or the loaded project do not support incremental safety parameters.
ERR_READ_INC_PARAM_ FAILED	(11)	Reading the incrementally downloaded safe parameters failed.	• There are no valid parameters on the TwinSAFE logic component and no valid parameters were previously downloaded to the TwinSAFE logic component.
ERR_READ_INC_PARAM_NOT_ SUPPORTED	(12)	Reading the incremental downloaded safe parameters is not supported.	• The TwinSAFE logic component or the loaded project do not support incremental safety parameters.
ERR_WRITE_ADDRESS_NOT_ SUPPORTED	(13)	Writing the safe address is not supported.	• The TwinSAFE logic component does not support this function.

8 FMEA

The following tables contain the user actions derived from the FMEA of the TwinSAFE Loader.

⚠ WARNING

Consider measures

If you use any of these sub-functions, you must consider all measures. Only under this premise is the safety-related confirmation by the notified body valid.

Failure to comply may result in loss of safety.

The user shall bear full responsibility for demonstrating the accuracy and efficacy of these measures.

8.1 General

Measure	FMEA-ID
• Check in your application that the executed function completes without errors with return value ERR_NONE.	FMEA9

8.2 Loading and activating a safety project

Measure	FMEA-ID
• Check in your application that the executed function completes without errors with return value ERR_NONE.	FMEA1, FMEA5, FMEA15, FMEA10,
• Ensure that the CRC for activation comes from a diversified source (for example, deposited list of projects and corresponding expected CRC) and that activation is executed only when the expectation is met.	FMEA2
• Ensure that the serial number of the target system read by the TwinSAFE Loader is compared with its expectation and that the activation is only executed when its expectation is met.	FMEA11
• Ensure that a complete acceptance of the safety application is performed to ensure the correct functionality of the system. • Ensure that the CRC of the project downloaded on the target system meets the expectation.	FMEA3
• Make sure that only authorized users have knowledge of the corresponding access data.	FMEA7

8.3 Customizing of a safety project

Measure	FMEA-ID
• Check in your application that the executed function completes without errors with return value ERR_NONE.	FMEA14, FMEA16, FMEA18, FMEA24, FMEA39
• Make sure that only authorized users have knowledge of the corresponding access data.	FMEA13
• Read and check the current customizing settings to see if they match your expectations. • Check the correctness of the current Customizing settings by performing an acceptance test.	FMEA8, FMEA12

8.4 Incremental loading of safe parameters

Measure	FMEA-ID
• Check in your application that the executed function completes without errors with return value ERR_NONE.	FMEA27, FMEA28, FMEA34, FMEA36
• Evaluate the differences output by the TwinSAFE Loader between the safe parameters of the logic project currently active on the TwinSAFE safety controller and the parameters currently downloaded by the "Incremental loading of safe parameters" function and check whether they match your expectations. • Check the correctness of the currently active parameters downloaded incrementally by performing an acceptance test.	FMEA25, FMEA26
• Make sure that only authorized users have knowledge of the corresponding access data.	FMEA35
• Ensure that the serial number of the target system read by the TwinSAFE Loader is compared with its expectation and that the activation is only executed when its expectation is met.	FMEA40

8.5 Loading the safe address

Measure	FMEA-ID
• Check in your application that the executed function completes without errors with return value ERR_NONE.	FMEA31, FMEA32, FMEA38
• Evaluate the safe address output by the TwinSAFE Loader and check whether it matches its expectation.	FMEA29, FMEA30
• Make sure that only authorized users have knowledge of the corresponding access data.	FMEA37
• Ensure that the serial number of the target system read by the TwinSAFE Loader is compared with its expectation and that the activation is only executed when its expectation is met.	FMEA41

9 EtherCAT Mailbox Gateway

The EtherCAT Mailbox Gateway is required for access to TwinSAFE logic components if ADS cannot be used for communication.

NOTICE

Avoid parallel access

Do not access the CoE data and the TwinSAFE Loader in parallel when using the Mailbox Gateway. The data may interfere with each other and errors may occur in the data transmission. The command is canceled.

Check the result and resend the command if necessary.

The following description shows which settings you have to make exemplarily to be able to communicate via the EtherCAT Mailbox Gateway.

For larger EtherCAT networks, it may be necessary to increase the number of permitted connections for the EtherCAT Mailbox Gateway in order to avoid communication problems or timeout messages.

The configuration for using the EtherCAT Mailbox Gateway consists of a TwinSAFE Loader PC, on which the TwinSAFE Loader is installed, and a TwinCAT PC, which serves as a gateway for routing the requests of the TwinSAFE Loader PC into the EtherCAT network and to the TwinSAFE logic components.

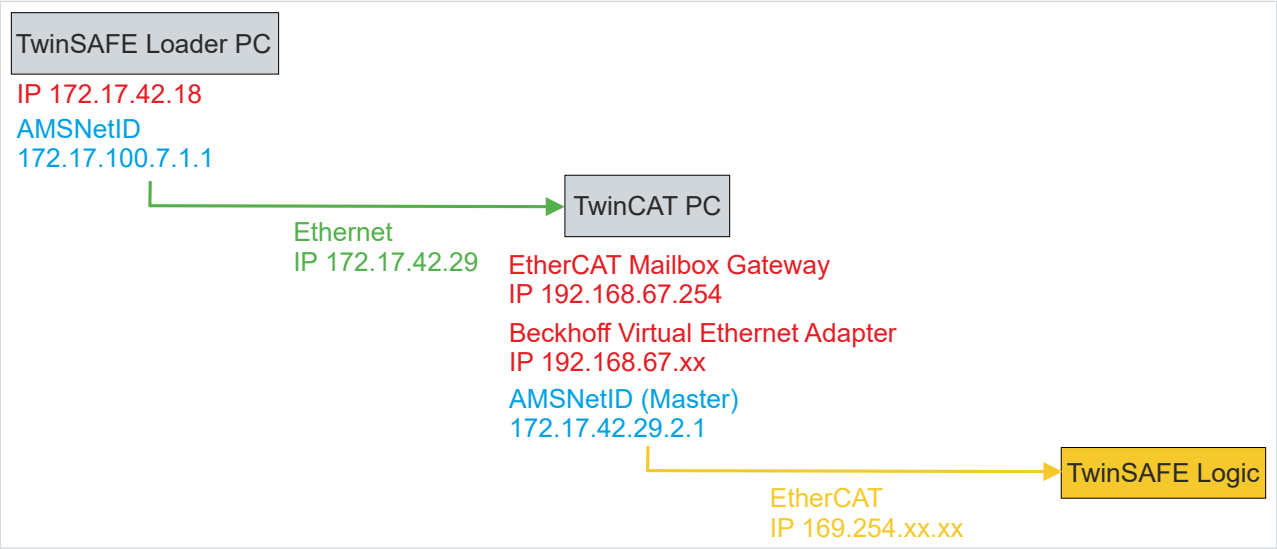


Fig. 3: EtherCAT Mailbox Gateway

9.1 Setting of the EtherCAT Mailbox Gateway

The EtherCAT Mailbox Gateway is activated via the advanced settings of the EtherCAT master. These can be found when selecting the EtherCAT master in the TwinCAT tree structure under the "EtherCAT" tab.

The settings for the EtherCAT Mailbox Gateway are summarized under the entry "EoE Support". Proceed as follows:

1. Enable "Virtual Ethernet Switch"
2. Enable "Connect to TCP/IP Stack"
3. Enable "IP Enable Router"
4. Enable "EtherCAT Mailbox Gateway"
5. Select IP address that is outside the previous networks
6. Restart TwinCAT PC

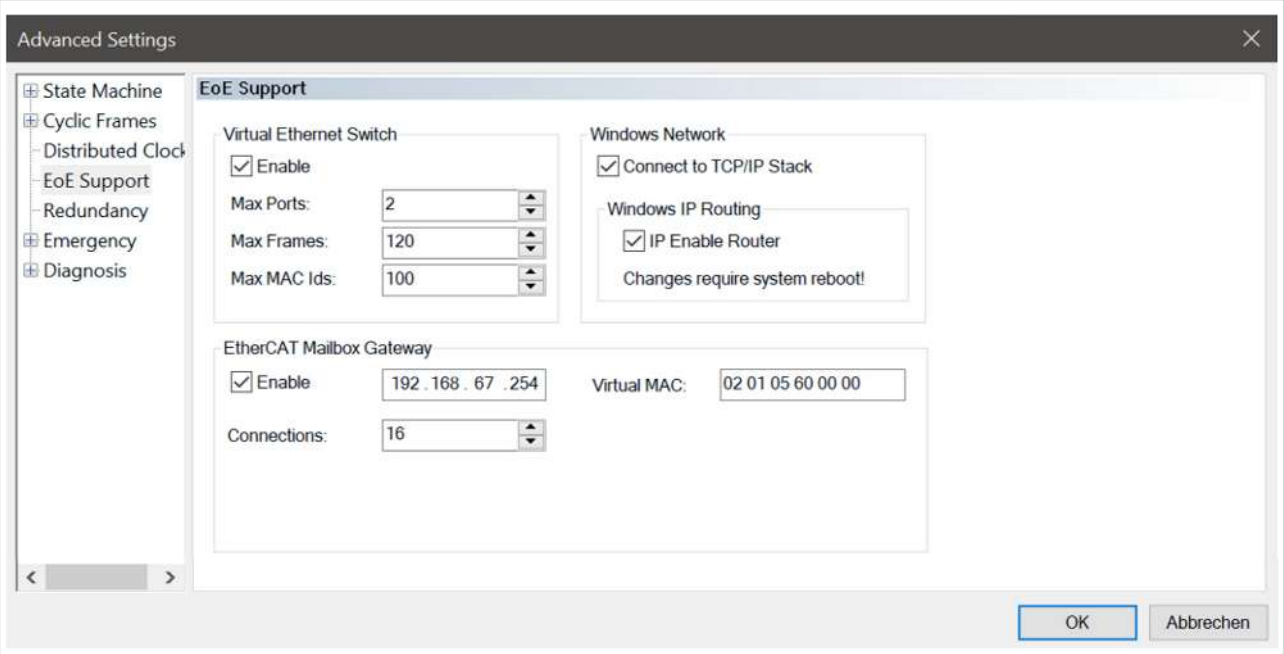


Fig. 4: EoE Support

NOTICE

Increase the number of connections

For larger EtherCAT networks, it may be necessary to increase the number of permitted connections for the EtherCAT Mailbox Gateway in order to avoid communication problems or timeout messages.

You can set the number of connections using the box marked in the following figure.

Fig. 5: EtherCAT Mailbox Gateway Connections

Check the correctness of the settings with the ping command locally on the TwinCAT computer. In this sample, the command is as follows:

```
ping 192.168.67.254
```

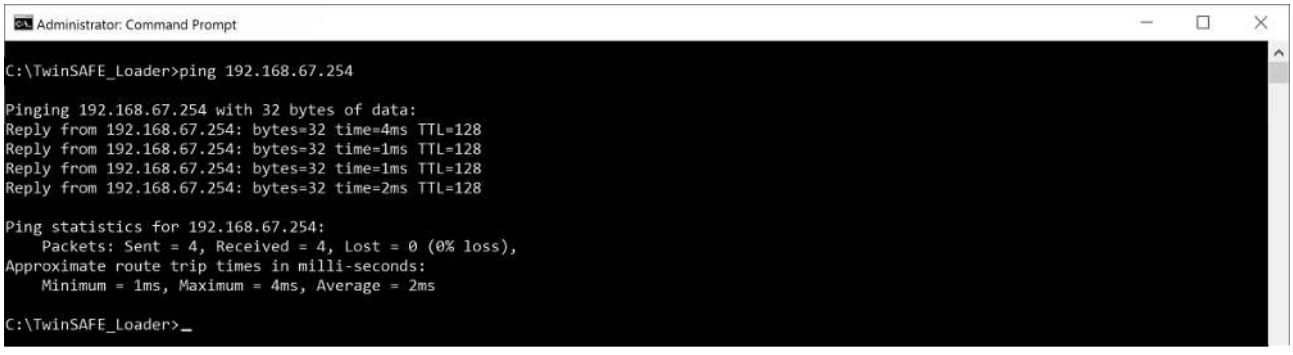
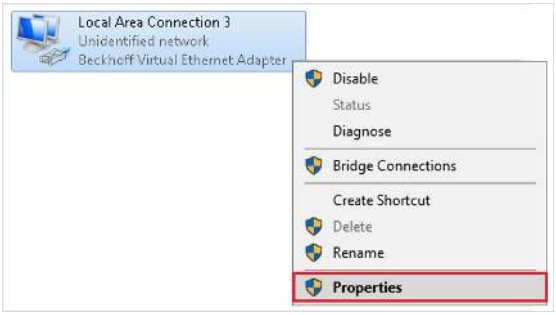


Fig. 6: Command "ping 192.168.67.254"

9.2 Beckhoff Virtual Ethernet Adapter

If the "ping" command has not yet returned a positive result, it is possible that configuration of the Beckhoff Virtual Ethernet Adapter is required first.

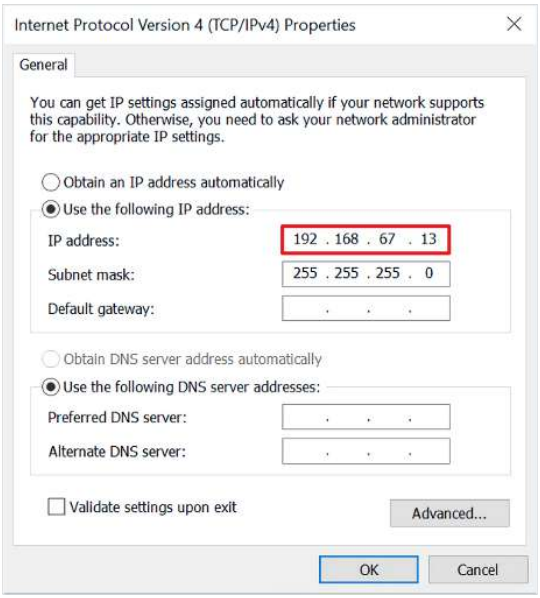
Proceed as follows:



1. Open network settings
2. Open context menu of the Beckhoff Virtual Ehternet Adapter
3. Select "Properties"

Virtual Ethernet Adapter

If there is no Virtual Ethernet Adapter in the system, you have the possibility to add an EoE device under TwinCAT, such as EL6601. Under the extended EtherCAT settings of this device you activate the Virtual Ethernet Port via EoE.



4. Select "Internet Protocol Version 4 (TCP/IPv4)"
5. Open "Properties"

In the properties of this network adapter you set a fixed IP address that is within the network range of the EtherCAT Mailbox Gateway.

In the figure, the IP address 192.168.67.13 with the subnet mask 255.255.255.0 is set as an example.

```
ping 192.168.67.254
```

6. Execute the ping command locally on the TwinCAT computer

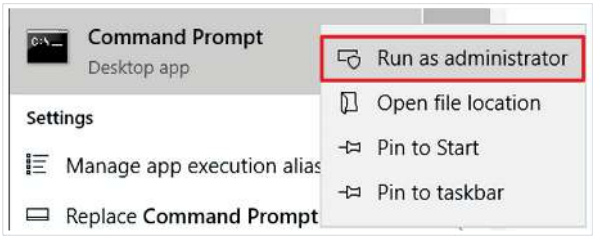
Use the "ping" command to check whether the settings you made earlier are correct.

9.3 Adding a route

After all settings have been made on the TwinCAT PC and the local execution of the "ping" command has been successful, add an IP route on the TwinSAFE Loader PC.

Adding the route is done using the "route add" command in the command line of a Windows command prompt.

Proceed as follows:



1. Start Windows command prompt as administrator

2. Add route using the following command

```
route add 192.168.67.0 mask 255.255.255.0 172.17.42.29
```

Fig. 7: Command "route add"

If the route creation was successful, the command returns an "OK!".

You can call up the current routes using the command "route print 192.168.*".

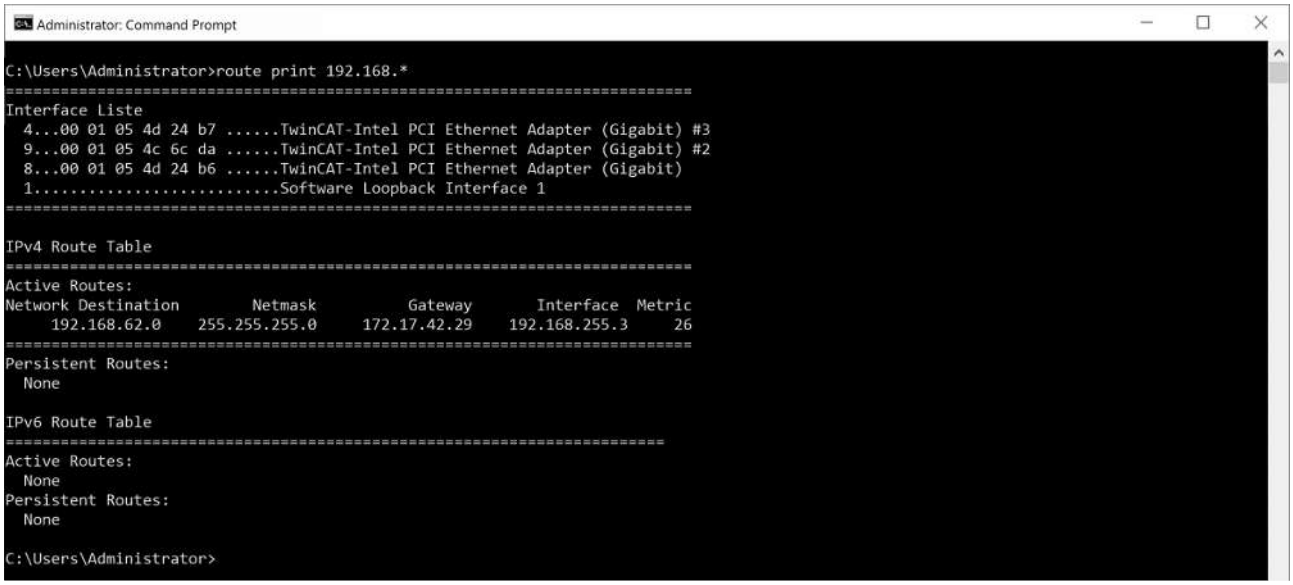


Fig. 8: Output of the "route print" command

To check whether the route was added successfully, send a ping command on the TwinSAFE Loader PC to the IP address of the EtherCAT Mailbox Gateway.

```
ping 192.168.67.254
```

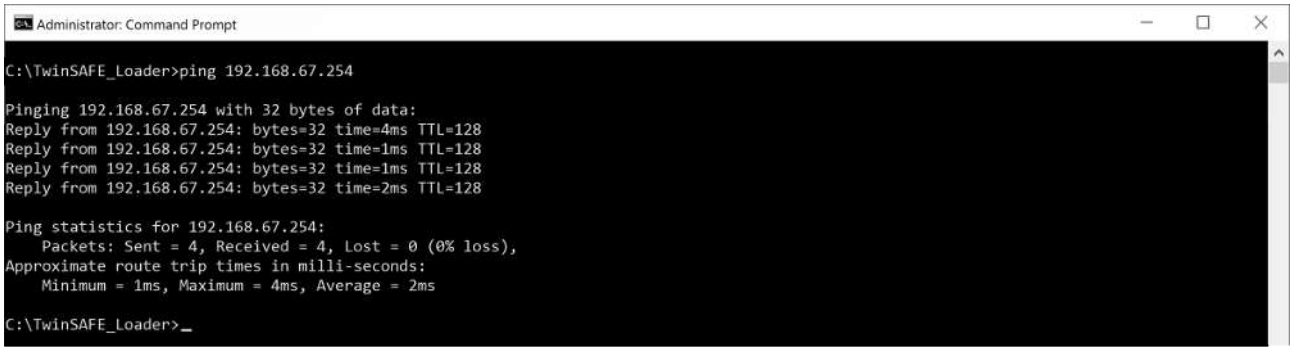


Fig. 9: Command "ping 192.168.67.254"

A positive response of the ping command is a requirement for using the Mailbox Gateway in the TwinSAFE Loader.

Table of figures

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