BECKHOFF New Automation Technology

Manual | EN

TX1200

TwinCAT 2 | PLC Library: TcTwinSAFE

PLC Libraries
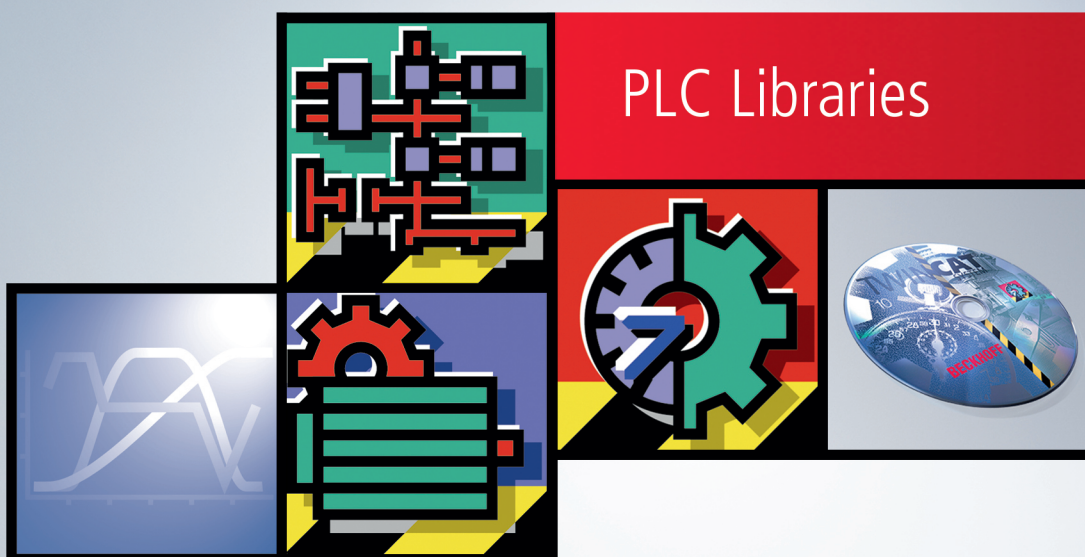
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1 Foreword

1.1 Notes on the documentation

This description is only intended for the use of trained specialists in control and automation engineering who are familiar with applicable national standards.
It is essential that the documentation and the following notes and explanations are followed when installing and commissioning the components.
It is the duty of the technical personnel to use the documentation published at the respective time of each installation and commissioning.

The responsible staff must ensure that the application or use of the products described satisfy all the requirements for safety, including all the relevant laws, regulations, guidelines and standards.

Disclaimer

The documentation has been prepared with care. The products described are, however, constantly under development.
We reserve the right to revise and change the documentation 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 this documentation.

Trademarks

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Patent Pending

The EtherCAT Technology is covered, including but not limited to the following patent applications and patents:
EP1590927, EP1789857, EP1456722, EP2137893, DE102015105702
with corresponding applications or registrations in various other countries.

EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany

Copyright

1.2 Safety instructions

Safety regulations

Please note the following safety instructions and explanations!
Product-specific safety instructions can be found on following pages or in the areas mounting, wiring, commissioning etc.

Exclusion of liability

All the components are supplied in particular hardware and software configurations appropriate for the application. Modifications to hardware or software configurations other than those described in the documentation are not permitted, and nullify the liability of Beckhoff Automation GmbH & Co. KG.

Personnel qualification

This description is only intended for trained specialists in control, automation and drive engineering who are familiar with the applicable national standards.

Description of symbols

In this documentation the following symbols are used with an accompanying safety instruction or note. The safety instructions must be read carefully and followed without fail!

⚠ **DANGER**
Serious risk of injury!
Failure to follow the safety instructions associated with this symbol directly endangers the life and health of persons.

⚠ **WARNING**
Risk of injury!
Failure to follow the safety instructions associated with this symbol endangers the life and health of persons.

⚠ **CAUTION**
Personal injuries!
Failure to follow the safety instructions associated with this symbol can lead to injuries to persons.

NOTE
Damage to the environment or devices
Failure to follow the instructions associated with this symbol can lead to damage to the environment or equipment.

Tip or pointer

This symbol indicates information that contributes to better understanding.

1.3   Notes on information security

The products of Beckhoff Automation GmbH & Co. KG (Beckhoff), insofar as they can be accessed online, are equipped with security functions that support the secure operation of plants, systems, machines and networks. Despite the security functions, the creation, implementation and constant updating of a holistic security concept for the operation are necessary to protect the respective plant, system, machine and networks against cyber threats. The products sold by Beckhoff are only part of the overall security concept. The customer is responsible for preventing unauthorized access by third parties to its equipment, systems, machines and networks. The latter should be connected to the corporate network or the Internet only if appropriate protective measures have been set up.

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Beckhoff products and solutions undergo continuous further development. This also applies to security functions. In light of this continuous further development, Beckhoff expressly recommends that the products are kept up to date at all times and that updates are installed for the products once they have been made available. Using outdated or unsupported product versions can increase the risk of cyber threats.

To stay informed about information security for Beckhoff products, subscribe to the RSS feed at https://www.beckhoff.com/secinfo.

2   Overview

The TwinSAFE library contains function blocks with which services/functions can be carried out belonging to the TwinSAFE terminals KL1904, KL2904 and KL6904.

TwinSAFE functions

Name	Description
F_GetVersionTcTwinSAFE [▶ 9]	Library version number
FB_TwinSAFE_connection [▶ 9]	Evaluating the TwinSAFE data which is tranfered from one TwinSAFE terminal to another TwinSAFE terminal, which are inside the same system manager configuration or connected by RT Ethernet.

Example

Name	Description
https://infosys.beckhoff.com/content/1033/tctwinsafe/Resources/zip/11939233419.zip	TwinCAT PLC project including the execution of FB instances of the FB *FB_TwinSAFE_connection* and TwinCAT System Manager configuration which shows the linkage to the TwinSAFE terminals.

PLC Control export file

Requirements

Name	Description
https://infosys.beckhoff.com/content/1033/tctwinsafe/Resources/zip/11939234827.zip	TwinCAT PLC Control export file which contains the data type ST_TWINSAFE_MESSAGE. This data type can be used to map TwinSAFE data to a PLC variable of that type. This feature can be used with TwinCAT version 2.10 Build 1334.
https://infosys.beckhoff.com/content/1033/tctwinsafe/Resources/zip/11939236235.zip	TwinCAT PLC Control export file, which contains the data types FSoE_xxBytes. These data types can be addressed in the PLC control and then used in the System Manager. The variables of that data type can be used to create a TwinSAFE connection between two EL6900 which contains more than 1 byte of safety data.

3 TwinSAFE functions

3.1 F_GetVersionTcTwinSAFE

```
        F_GETVERSIONTCTWINSAFE

nVersionElement : INT F_GetVersionTcTwinSAFE : UINT
```
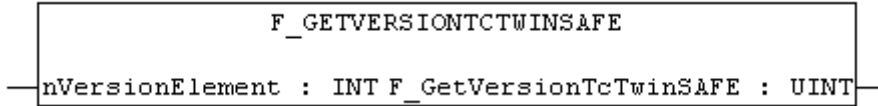
The function returns library version info.

FUNCTION F_GetVersionTcTwinSAFE : UINT

```
VAR_INPUT
    nVersionElement : INT;
END_VAR
```
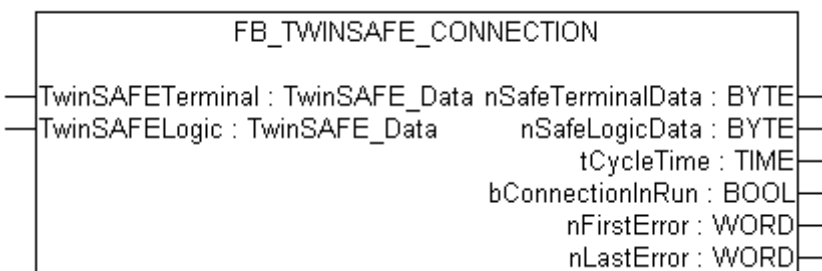
nVersionElement: Version parameter:

- 1 : major number;
- 2 : minor number;
- 3 : revision number;

Requirements

Development environment	Target system type	IO-Hardware	PLC libraries to include
TwinCAT v2.10.0 Build > 914	PC (i386)	---	TcTwinSAFE.Lib (Standard.Lib, TcBase.Lib and TcSystem.Lib are included automatically)

3.2 FB_TwinSAFE_connection

```
            FB_TWINSAFE_CONNECTION

TwinSAFETerminal : TwinSAFE_Data nSafeTerminalData : BYTE
TwinSAFELogic : TwinSAFE_Data        nSafeLogicData : BYTE
                                         tCycleTime : TIME
                                  bConnectionInRun : BOOL
                                        nFirstError : WORD
                                         nLastError : WORD
```

The function block *FB_TwinSAFE_connection* is made for evaluating the TwinSAFE data which is transferred from one TwinSAFE communication partner to another TwinSAFE communication partner. The input parameters have to be linked to the SafetyQBx or SafetyIn signal of the corresponding TwinSAFE terminal. Please assure that the new linkage does not remove the already existing linkage. When RT Ethernet is used to transfer the TwinSAFE data, one parameter must be linked to SafetyQBx the other parameter has to be linked to Vardata of the network variable subscriber.

VAR_INPUT

```
VAR_INPUT
    TwinSAFETerminal AT%I* : TwinSAFE_Data; (* Additional link to "SafetyIn" e.g. KL1904, KL2904 or
networkvariable subscriber *)
    TwinSAFELogic    AT%I* : TwinSAFE_Data; (* Additional link to "SafetyQBx" e.g. KL6904 *)
END_VAR
```

TwinSAFETerminal: TwinSAFE telegram [▶ 16] which is transferred from one TwinSAFE communication partner to another TwinSAFE communication partner. This parameter has to be linked to SafetyIn (output data of a KL1904 or KL2904 or network variable subscriber).

TwinSAFELogic: TwinSAFE telegram which is transferred from one TwinSAFE communication partner to another TwinSAFE communication partner. This parameter must be linked to SafetyQBx (output data of a KL6904).

VAR_OUTPUT

```
VAR_OUTPUT
    nSafeTerminalData   : BYTE;
    nSafeLogicData      : BYTE;
    tCycleTime          : TIME;
    bConnectionInRun    : BOOL;
    nFirstError         : WORD;
    nLastError          : WORD;
END_VAR
```

nSafeTerminalData: TwinSAFE data of TwinSAFETerminal.

nSafeTerminalData	description
.0	Channel 1 of TwinSAFE data (KL1904 Input 1, KL6904 Channel 1)
.1	Channel 2 of TwinSAFE data (KL1904 Input 2, KL6904 Channel 2)
.2	Channel 3 of TwinSAFE data (KL1904 Input 3, KL6904 Channel 3)
.3	Channel 4 of TwinSAFE data (KL1904 Input 4, KL6904 Channel 4)
.4	Channel 5 of TwinSAFE data (KL6904 Channel 5)
.5	Channel 6 of TwinSAFE data (KL6904 Channel 6)
.6	Channel 7 of TwinSAFE data (KL6904 Channel 7)
.7	Channel 8 of TwinSAFE data (KL6904 Channel 8)

nSafeLogicData: TwinSAFE data of TwinSAFELogic.

nSafeLogicData	description
.0	Channel 1 of TwinSAFE data (KL2904 Output 1, KL6904 Channel 1)
.1	Channel 2 of TwinSAFE data (KL2904 Output 2, KL6904 Channel 2)
.2	Channel 3 of TwinSAFE data (KL2904 Output 3, KL6904 Channel 3)
.3	Channel 4 of TwinSAFE data (KL2904 Output 4, KL6904 Channel 4)
.4	Channel 5 of TwinSAFE data (KL6904 Channel 5)
.5	Channel 6 of TwinSAFE data (KL6904 Channel 6)
.6	Channel 7 of TwinSAFE data (KL6904 Channel 7)
.7	Channel 8 of TwinSAFE data (KL6904 Channel 8)

tCycleTime: Cycle time in ms which is needed to exchange the TwinSAFE telegram between the TwinSAFE communication partner of this connection.

bConnectionInRun: When there is no error in the TwinSAFE connection the value is set to TRUE. When the value is FALSE the parameter nSafeTerminalData and nSafeLogicData are set to 0.

nFirstError: Gives an error code for the first error in the connection. The error is resetted as soon as bConnectionInRun is TRUE again.

nLastError: Gives an error code for the last error in the connection. The error is resetted as soon as bConnectionInRun is TRUE again.

errorvalue	description for nFirstError and nLastError
0x0001	Watchdog in TwinSAFETerminal
0x0002	Watchdog in TwinSAFELogic
0x0004	CRC Error in TwinSAFETerminal
0x0008	CRC Error in TwinSAFELogic
0x0010	Slave Error in TwinSAFETerminal
0x0020	Slave Error in TwinSAFELogic
0x4000	not specified error in TwinSAFETerminal
0x8000	not specified error in TwinSAFELogic

Example for the FB call in FBD:

```
PROGRAM MAIN
VAR
    fbTwinSAFE_connection   : FB_TwinSAFE_connection;
    nSafeKL1904_data        : BYTE;
    nSafeKL6904_ata         : BYTE;
    CycleTime               : TIME;
    bConnectioninRun        : BOOL;
    nFirstErr               : WORD;
    nLastErr                : WORD;
    KL1904_input_1          : BOOL;
END_VAR
```
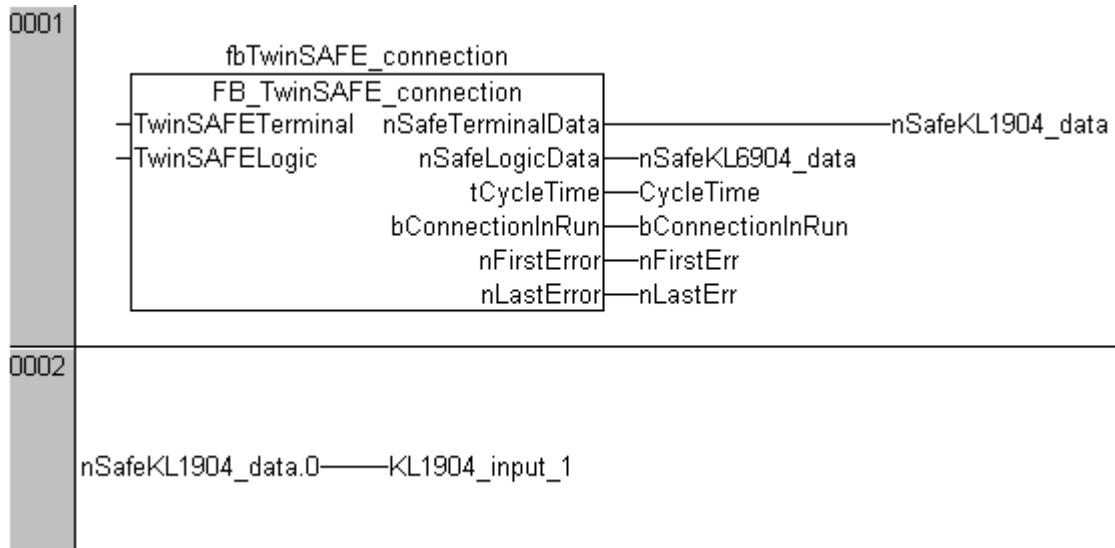

In the above example data of a TwinSAFE connection are written to the connected variables. When the output bConnectionInRun is FALSE the outputs nSafeTerminalData and nSafeLogicData are set to 0.

The linkage of the input data of the connection must be done by marking the parameter TwinSAFETerminal and chossing "Change Link..." from the context menu

and choosing the correct SafetyIn variable in the upcoming dialog.
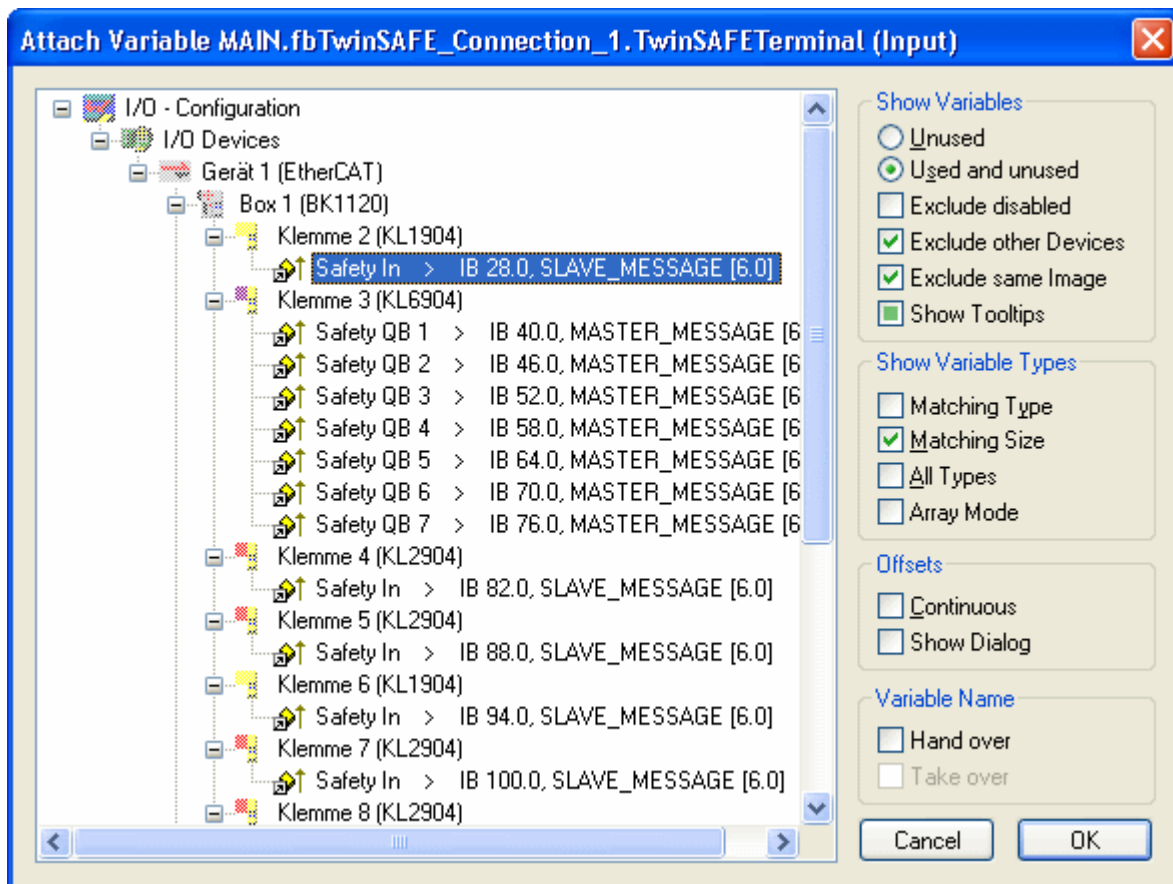
When using RT Ethernet for the TwinSAFE communication please choose the corresponding subscriber variable.
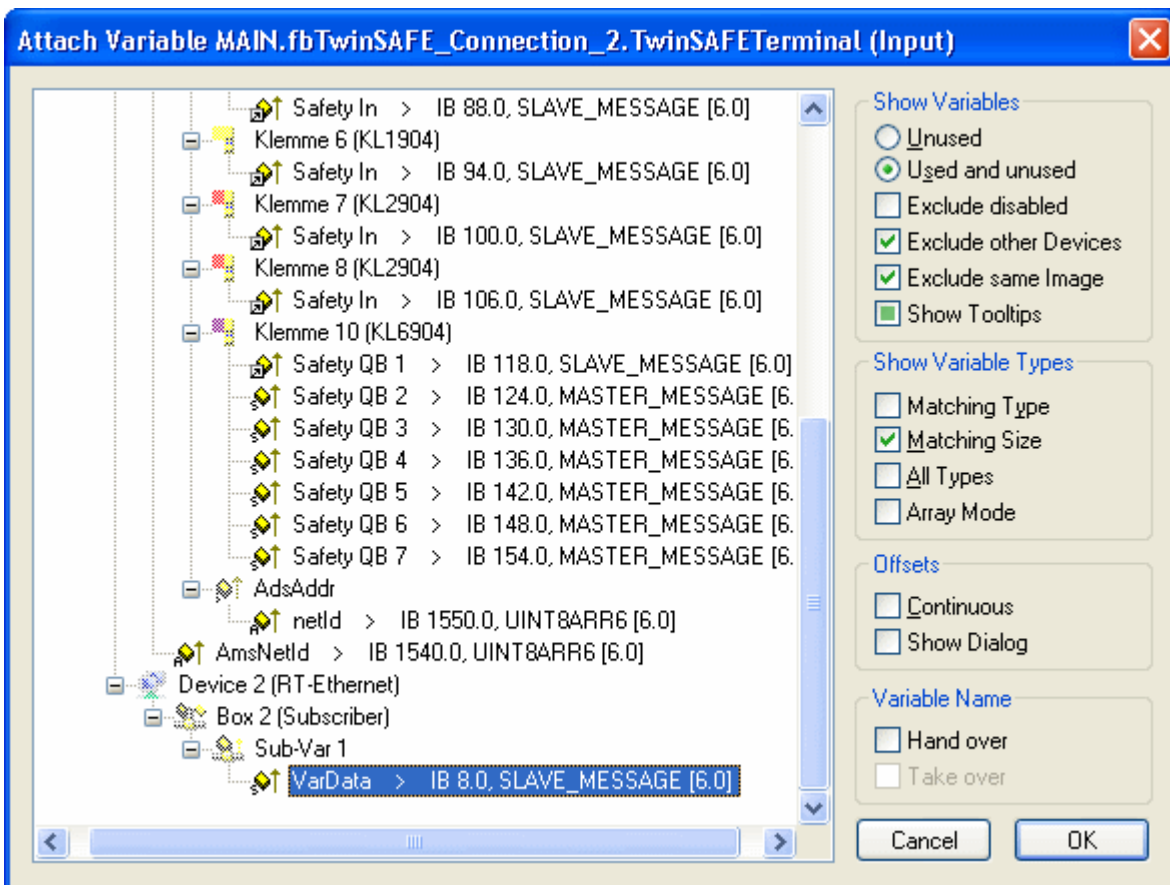
The linkage of the output data of the connection must be done by marking the parameter TwinSAFELogic and choosing "Change Link..." from the context menu and choosing the correct SafetyQBx variable in the upcoming dialog.

Attach Variable MAIN.fbTwinSAFE_Connection_1.TwinSAFELogic (Input)

```
I/O - Configuration
  I/O Devices
    Gerät 1 (EtherCAT)
      Box 1 (BK1120)
        Klemme 2 (KL1904)
          Safety In   >   IB 28.0, SLAVE_MESSAGE [6.0]
        Klemme 3 (KL6904)
          Safety QB 1   >   IB 40.0, MASTER_MESSAGE [6.0]
          Safety QB 2   >   IB 46.0, MASTER_MESSAGE [6.0]
          Safety QB 3   >   IB 52.0, MASTER_MESSAGE [6.0]
          Safety QB 4   >   IB 58.0, MASTER_MESSAGE [6.0]
          Safety QB 5   >   IB 64.0, MASTER_MESSAGE [6.0]
          Safety QB 6   >   IB 70.0, MASTER_MESSAGE [6.0]
          Safety QB 7   >   IB 76.0, MASTER_MESSAGE [6.0]
        Klemme 4 (KL2904)
          Safety In   >   IB 82.0, SLAVE_MESSAGE [6.0]
        Klemme 5 (KL2904)
          Safety In   >   IB 88.0, SLAVE_MESSAGE [6.0]
        Klemme 6 (KL1904)
          Safety In   >   IB 94.0, SLAVE_MESSAGE [6.0]
        Klemme 7 (KL2904)
          Safety In   >   IB 100.0, SLAVE_MESSAGE [6.0]
        Klemme 8 (KL2904)
```
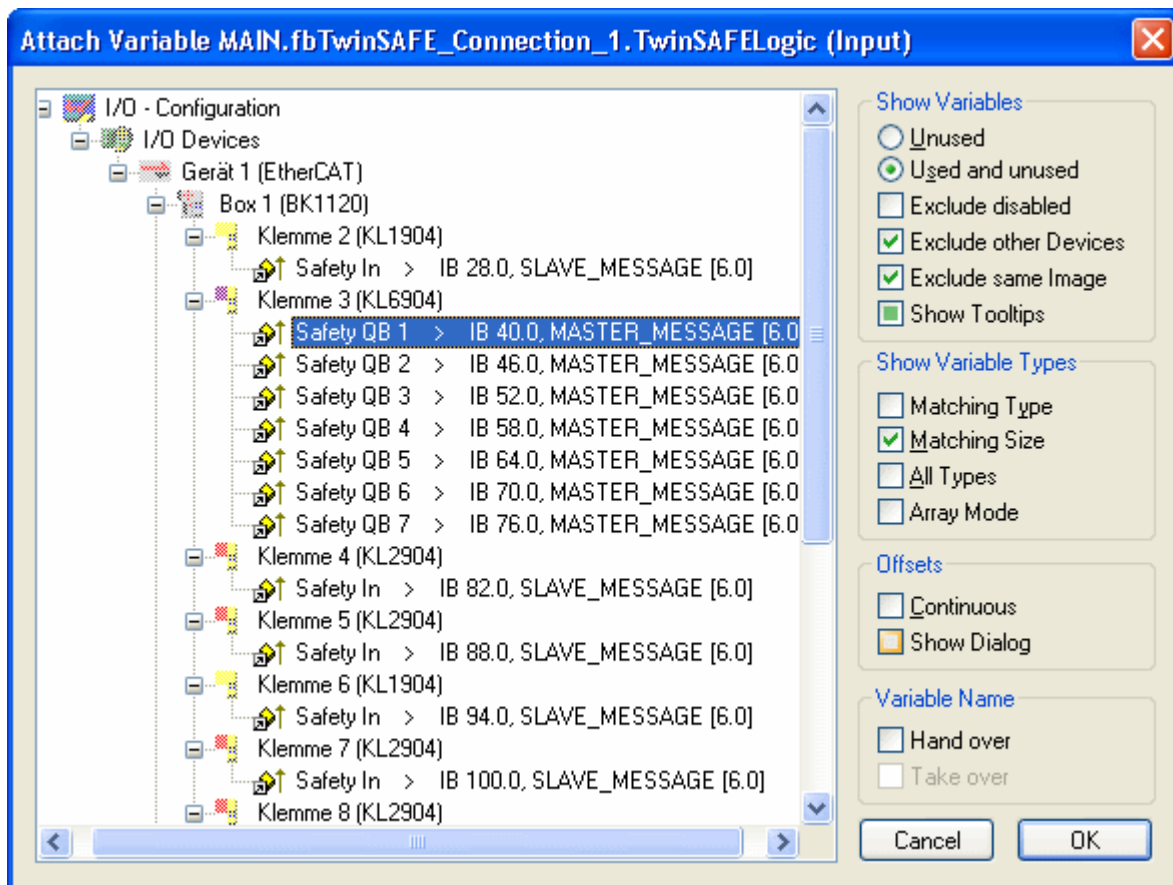
Show Variables
- ○ Unused
- ● Used and unused
- ☐ Exclude disabled
- ☑ Exclude other Devices
- ☑ Exclude same Image
- ☐ Show Tooltips

Show Variable Types
- ☐ Matching Type
- ☑ Matching Size
- ☐ All Types
- ☐ Array Mode

Offsets
- ☐ Continuous
- ☐ Show Dialog

Variable Name
- ☐ Hand over
- ☐ Take over

Cancel   OK

Requirements

Development environ-ment	Target system type	IO-Hardware	PLC libraries to include
TwinCAT v2.10.0 Build > 914	PC (i386)	KLx904	TcTwinSAFE.Lib (Standard.Lib, TcBase.Lib and TcSystem.Lib are included automatically)

4 Data Types

4.1 ST_FSoE_xxBytes

```
TYPE ST_FSoE_xxBytes :
STRUCT
    CMD       : BYTE;
    SafeData1 : WORD;
    CRC1      : WORD;
    SafeData2 : WORD;
    CRC2      : WORD;
    ...
    SafeData7 : WORD;
    CRC7      : WORD;
    ConnID    : WORD;
END_STRUCT
```

ST_FSoE_xxBytes: Contains the Safety-over-EtherCAT telegram with the length of safe data of 2, 4, 6, 8, 10, 12 or 14 bytes (xx must be replaced by 02 to 14).

Structure element	Description
CMD	Command ID. A detailed description can be found in the Safety-over-EtherCAT specification
SafeData1	Safe data. A detailed description can be found in the Safety-over-EtherCAT specification
CRC1	CRC checksum. A detailed description can be found in the Safety-over-EtherCAT specification
SafeData2	Safe data. A detailed description can be found in the Safety-over-EtherCAT specification
CRC2	CRC checksum. A detailed description can be found in the Safety-over-EtherCAT specification
...	
SafeData7	Safe data. A detailed description can be found in the Safety-over-EtherCAT specification
CRC7	CRC checksum. A detailed description can be found in the Safety-over-EtherCAT specification
ConnID	ID of the TwinSAFE connection. A detailed description can be found in the Safety-over-EtherCAT specification

4.2 ST_TWINSAFE_MESSAGE

```
TYPE ST_TWINSAFE_MESSAGE :
STRUCT
    Data: ARRAY[0..5] OF BYTE;
END_STRUCT
```

ST_TWINSAFE_MESSAGE: Contains the TwinSAFE telegram with a length of 6 bytes.

Bytenummer	Beschreibung
0	A detailed description can be found in the Safety-over-EtherCAT specification
1	A detailed description can be found in the Safety-over-EtherCAT specification
2	A detailed description can be found in the Safety-over-EtherCAT specification
3	A detailed description can be found in the Safety-over-EtherCAT specification
4	A detailed description can be found in the Safety-over-EtherCAT specification
5	A detailed description can be found in the Safety-over-EtherCAT specification

4.3 TwinSAFE_Data

```
TYPE TwinSAFE_Data :
    ARRAY[0..5] OF BYTE;
END_TYPE
```

TwinSAFE_Data   : Contains the TwinSAFE telegram with a length of 6 bytes.

Bytenumber	Description
0	A detailed description can be found in the Safety-over-EtherCAT specification
1	A detailed description can be found in the Safety-over-EtherCAT specification
2	A detailed description can be found in the Safety-over-EtherCAT specification
3	A detailed description can be found in the Safety-over-EtherCAT specification
4	A detailed description can be found in the Safety-over-EtherCAT specification
5	A detailed description can be found in the Safety-over-EtherCAT specification

More Information:
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