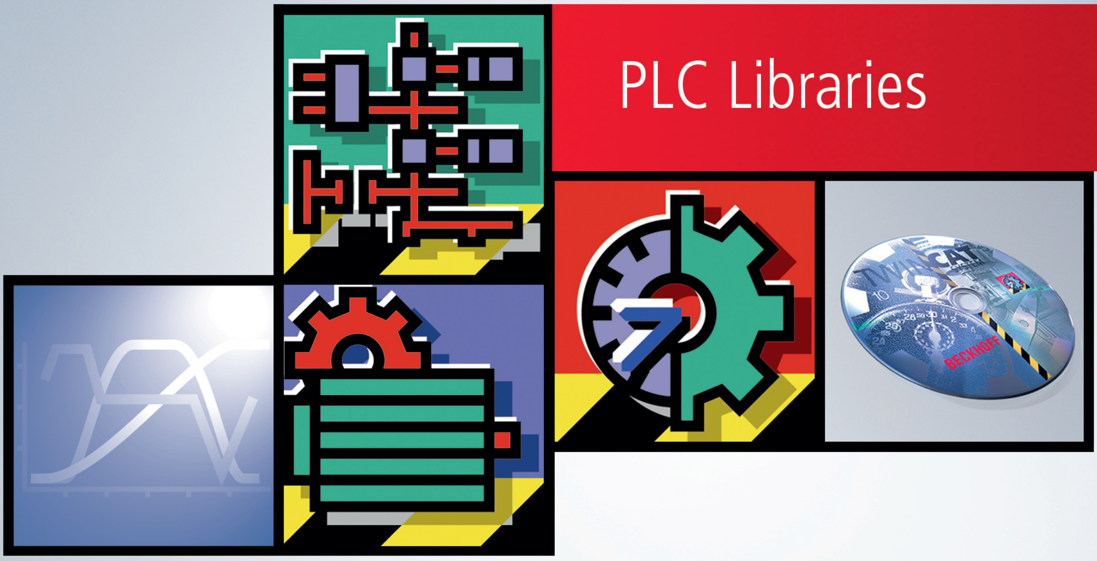
BECKHOFF New Automation Technology

Manual | EN

TX1200

TwinCAT 2 | PLC Library: TcPlcCoupler



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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

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.

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.

In addition, the recommendations from Beckhoff regarding appropriate protective measures should be observed. Further information regarding information security and industrial security can be found in our https://www.beckhoff.com/secguide.

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 TcPlcCoupler.Lib library contains function blocks that provide convenient access to registers in the terminals via the terminal's control/status byte (register communication) and for communication with the Beckhoff couplers via the 2-byte PLC interface. The function blocks can, for instance, be used for parameterization of the terminals by way of the fieldbus.

Only the intelligent terminals have a register structure. The intelligent terminals include, for example, all the analog input and output terminals. The terminal's status/control byte is only visible in the process image if the terminal has been mapped as a complex terminal. Each terminal channel has its own register structure with a maximum of 64 registers. Under a compact mapping the control/status bytes are not visible in the process image.

For register access via the 2-byte PLC interface it is also necessary for the status and control word variables of the PLC interface to be mapped into the process image. In some fieldbusses (Lightbus, Profibus) this can be configured for the particular coupler in the TwinCAT System Manager, but in others (e.g. Interbus S) special configuration software is required for the job (e.g. KS2000). The status and control variables are linked to the function block's corresponding input and output variables.

If any changes made to the registers are to be stored permanently, the power supply to the coupler must be interrupted.

NOTE

Risk of EEPROM damage using cyclic write access

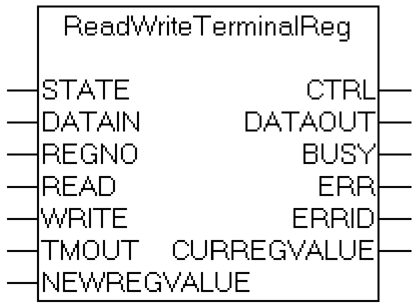
When called, the function blocks of the library carry out write/read access to the registers in the terminals or in the couplers. If they are called cyclically, the EEPROM memory may be destroyed. The function blocks were basically developed to facilitate configuration of the terminals/couplers or fault diagnosis from within the PLC program.

Contents of the Library

Name	Description
ReadWriteTerminalReg [▶ 9]	Access registers in the terminal via the terminal's control/status byte (register communication)
CouplerReset [▶ 11]	Reset the coupler via the 2-byte PLC interface
FB_ReadCouplerDiag [▶ 13]	Read coupler diagnosis (flash code)
FB_ReadCouplerRegs [▶ 14]	Read coupler registers
FB_WriteCouplerRegs [▶ 15]	Write coupler registers
F_GetVersionTcPlcCoupler [▶ 17]	Returns library version info

3 Function blocks

3.1 ReadWriteTerminalReg



The "ReadWriteTerminalReg" function block permits convenient access to the registers of the terminal via the terminal channel's status/control byte (register communication). In the standard operating mode, the data inputs and outputs of the intelligent terminal (e.g. an analog output terminal) are used to exchange the analog output data. A handshake via the status/control byte permits register access. The data input and output variables are used here to transfer the register values. A rising edge at the READ or WRITE input causes the register with number REGNO to be read or written to. Write protection of the register is disabled by the function block for a write access and enabled once more afterwards. When a register is written to, the new register value is read, and is available at the CURRREGVALUE output. If changes made to the register values are to be stored permanently, the power supply to the coupler must be interrupted. The variables STATE, DATAIN, CTRL and DATAOUT must be linked in the TwinCAT System Manager to the corresponding I/O variables in the terminal channel.

VAR_INPUT

```
VAR_INPUT
   STATE              : BYTE;
   DATAIN             : WORD;
   REGNO              : BYTE;
   READ               : BOOL;
   WRITE              : BOOL;
   TMOUT              : TIME;
   NEWREGVALUE        : WORD;
END_VAR
```

STATE: Terminal channel status byte.

DATAIN: Terminal channel data input word.

REGNO: Number of the register that is to be written to or read.

READ: A rising edge at this input activates the block, and the current register value is read. If successful, the register value is available in the output variable CURRREGVALUE.

WRITE: A rising edge at this input activates the block, and the value in the input variable NEWREGVALUE is written into the register REGNO. After this, the current value of the register is read, and, if successful, is made available in the output variable CURREGVALUE.

TMOUT: States the length of the timeout that may not be exceeded during execution of the function.

NEWREGVALUE: Data word that is to be written into the register with number REGNO by a write access.

VAR_OUTPUT

```
VAR_OUTPUT
   CTRL              : BYTE;
   DATAOUT           : WORD;
   BUSY              : BOOL;
   ERR               : BOOL;
   ERRID            : UDINT;
   CURREGVALUE      : WORD;
END_VAR
```

CONTROL: Terminal channel control byte.

DATAOUT: Terminal channel data output word.

BUSY: This output is set when the block is activated and remains set until execution of the function has been completed.

ERR: If an error should occur during the execution of the function, then this output is set, after the BUSY output has been reset.

ERRID: Supplies the error number when the ERR output is set.

CURREGVALUE: This variable provides the current register value after a successful read or write access.

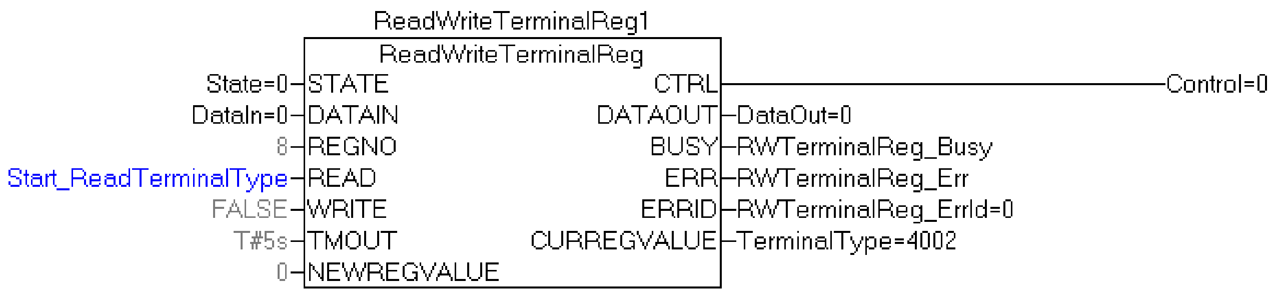
Error descriptions:

Error number	Error descriptions
0	no error
0x100	Timeout error. The time permitted for execution has been exceeded.
0x200	Parameter error (e.g. an invalid register number).
0x300	The read value differs from the written value (writing not allowed)

Examples of calls in FBD:

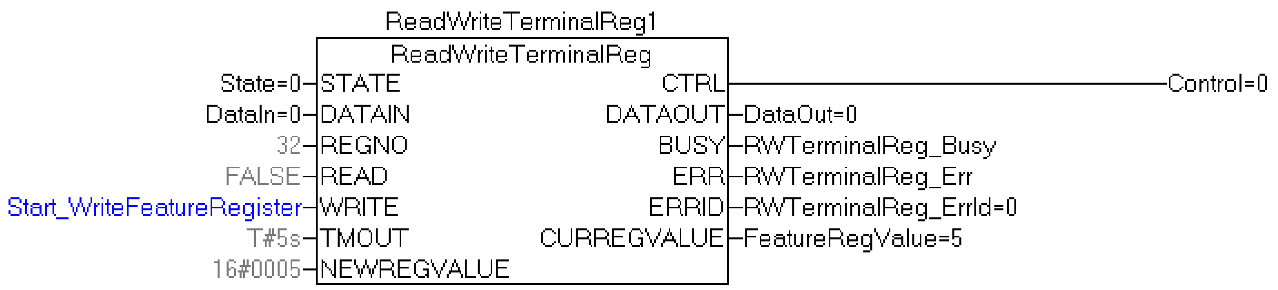
```
VAR
   ReadWriteTerminalReg1                      : ReadWriteTerminalReg;
   State                      AT%IB0          : BYTE;
   Control                    AT%QB0          : BYTE;
   DataIn                     AT%IW1          : WORD;
   DataOut                    AT%QW1          : WORD;
   Start_ReadTerminalType                     : BOOL;
   Start_WriteFeatureRegister                 : BOOL;
   RWTerminalReg_Busy                         : BOOL;
   RWTerminalReg_Err                          : BOOL;
   RWTerminalReg_ErrId                        : UDINT;
   TerminalType                               : WORD;
   FeatureRegValue                            : WORD;
END_VAR
```

Example 1



In Example 1 the terminal identifier is read from register 8 of an analog output terminal. The variables *State*, *Control*, *DataIn* and *DataOut* are linked to the terminal's corresponding I/O variables in the TwinCAT System Manager. The terminal identifier is KL**4002**..

Example 2

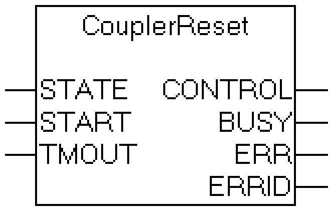


In Example 2 the user-scaling is activated in the feature register (register 32) of a KL4002 analog output terminal. The new value in the feature register is then read by the function block, and can be checked through the output variable **CURREGVALUE**.

Requirements

Development environ-ment	Target system type	IO hardware	PLC libraries to include
TwinCAT version >= 2.7.0	PC (i386)	All terminals with State/ Control bytes (intelligent terminals)	Standard.Lib; TcPlcCoupler.Lib

3.2 CouplerReset



The "CouplerReset" function block can be used to execute a reset of the coupler via the 2-byte PLC interface. In a coupler reset the current terminal configuration, for example, is read in again by the coupler via the K-bus (the terminal bus), and communication on the K-bus is reinitialized. Existing K-bus error messages for the coupler are reset. The **STATE** and **CONTROL** variables are used to perform a handshake with the coupler while the function block is being executed. These variables must therefore be linked with the status/control I/O variables of the 2-byte PLC interface in the TwinCAT System Manager.

VAR_INPUT

```
VAR_INPUT
    STATE     : PLCINTFSTRUCT;
    START     : BOOL;
    TMOUT     : TIME;
END_VAR
```

STATE: Status [▶ 18] word of the 2-byte PLC interface.

START: The function block is activated by a positive edge at this input.

TMOUT: States the length of the timeout that may not be exceeded during execution of the function.

VAR_OUTPUT

```
VAR_OUTPUT
    CONTROL   : PLCINTFSTRUCT;
    BUSY      : BOOL;
    ERR       : BOOL;
    ERRID     : UDINT;
END_VAR
```

CONTROL: Control word of the 2-byte PLC interface.

BUSY: This output is set when the block is activated and remains set until execution of the function has been completed.

ERR: If an error should occur during the execution of the function, then this output is set, after the BUSY output has been reset.

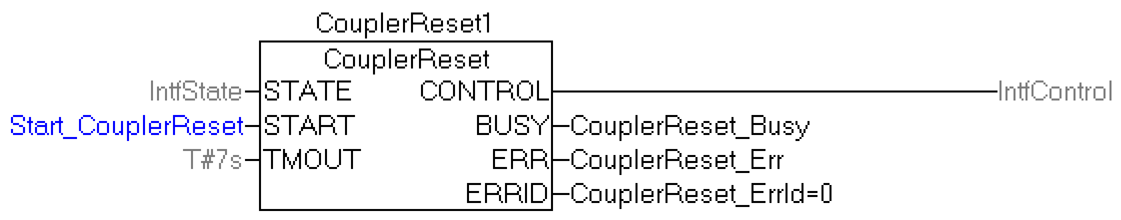
ERRID: Supplies the error number when the ERR output is set.

Error descriptions:

Error number	Error descriptions
0	no error
0x100	Error in initialization of the communication
0x200	Error during communication
0x300	Timeout error. The time permitted for execution has been exceeded.

Example of a call in FBD:

```
VAR
    IntfState       AT%IW10    : PLCINTFSTRUCT;
    IntfControl     AT%QW10    : PLCINTFSTRUCT;
    CouplerReset1              : CouplerReset;
    Start_CouplerReset         : BOOL;
    CouplerReset_Busy          : BOOL;
    CouplerReset_Err           : BOOL;
    CouplerReset_ErrId         : UDINT;
END_VAR
```



The variables *IntfState* and *IntfControl* are linked with corresponding I/O variables in the TwinCAT System Manager.

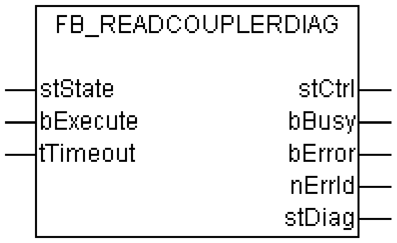
Requirements

Development environ-ment	Target system type	IO hardware	PLC libraries to include
TwinCAT version >= 2.7.0	PC (i386)	All coupler with 2 byte PLC interface	Standard.Lib; TcPlcCoupler.Lib

Also see about this

- Error codes:2 byte PLC interface [21]

3.3 FB_ReadCouplerDiag



The FB_ReadCouplerDiag function block allows reading of the first and second flashing sequences of the error LED on the coupler when a terminal bus or coupler error occurs. The data is transferred to the PLC via the 2-byte PLC interface. This, however, only functions if communication over the fieldbus is maintained. It must be possible for the data to be transferred without error from the coupler to the PLC via the fieldbus. In order to detect that a coupler error has occurred, the status byte for the coupler in the PLC can be interrogated cyclically, and the function block activated when an error occurs.

VAR_INPUT

```
VAR_INPUT
    stState          : PLCINTFSTRUCT;
    bExecute         : BOOL;
    tTimeout         : TIME;
END_VAR
```

stState : Status [▸ 18] word of the 2-byte PLC interface.

bExecute: The function block is activated by a positive edge at this input.

tTimeout: States the length of the timeout that may not be exceeded during execution of the function.

VAR_OUTPUT

```
VAR_OUTPUT
    stCtrl           : PLCINTFSTRUCT;
    bBusy            : BOOL;
    bError           : BOOL;
    nErrId           : UDINT;
    stDiag           : ST_CouplerDiag;
END_VAR
```

stCtrl : Control word of the 2-byte PLC interface.

bBusy: This output is set when the block is activated, and remains set until execution of the function has been completed.

bError: If an error should occur during the execution of the function, then this output is set, after the bBusy output has been reset.

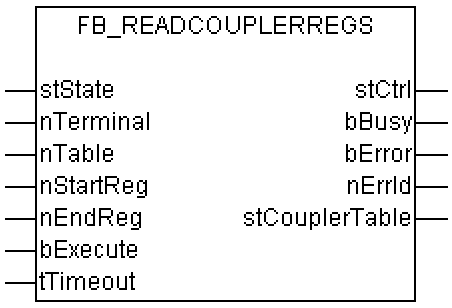
nErrId : Supplies the error number when the bError output is set. (Table of possible error codes [▸ 21].)

stDiag : Structure [▸ 18] containing the coupler's diagnostic information (error type, and the first and second coupler flashing sequences).

Requirements

Development environ-ment	Target system type	IO-Hardware	PLC libraires to include
TwinCAT Version 2.7.0 Build > 517 TwinCAT Version 2.8.0 Build > 735	PC (i386)	All couplers with 2- byte PLC interfaces	Standard.Lib; TcPlcCoupler.Lib

3.4 FB_ReadCouplerRegs



This function block provides read access to the table register in the coupler and the registers of the intelligent terminals. The coupler itself is referred to as terminal 0 (null). All the other terminals in the terminal block, except for passive terminals (such as power feed terminals), are counted in ascending sequence (beginning with 1). It is possible either to read all registers, or only a partial region (between *nStartReg* and *nEndReg*). Several seconds are required to read all the registers (0...255) in a table. Register values that have been successfully read are found in the structure *stCouplerTable*.The structure is an array of high and low bytes. Each array element corresponds to a register value (e.g.: stCouplerTable[5] == Register 5).

VAR_INPUT

```
VAR_INPUT
    stState      : PLCINTFSTRUCT;
    nTerminal    : BYTE := TERM_COUPLER;
    nTable       : BYTE;
    nStartReg    : BYTE;
    nEndReg      : BYTE;
    bExecute     : BOOL;
    tTimeout     : TIME;
END_VAR
```

stState : Status [▶ 18] word of the 2-byte PLC interface.

nTerminal : Terminal number, to whose table register access is to be made. The coupler has terminal number null. Passive terminals are not to be counted.

nTable : Table number whose register values are to be read. Intelligent terminals only have one table for each terminal channel. A 4-channel terminal has the following table numbers: 0-3. An intelligent terminal, however, only possesses a maximum of 64 register values for each terminal channel!

nStartReg : The number of the first register that is to be read.

nEndReg : The number of the last register that is to be read.

bExecute: The function block is activated by a positive edge at this input.

tTimeout: States the length of the timeout that may not be exceeded during execution of the function.

VAR_OUTPUT

```
VAR_OUTPUT
    stCtrl            : PLCINTFSTRUCT;
    bBusy             : BOOL;
    bError            : BOOL;
    nErrId            : UDINT;
    stCouplerTable    : ST_CouplerTable;
END_VAR
```

stCtrl : Control word of the 2-byte PLC interface.

bBusy: This output is set when the block is activated and remains set until execution of the function has been completed.

bError: If an error should occur during the execution of the function, then this output is set, after the bBusy output has been reset.

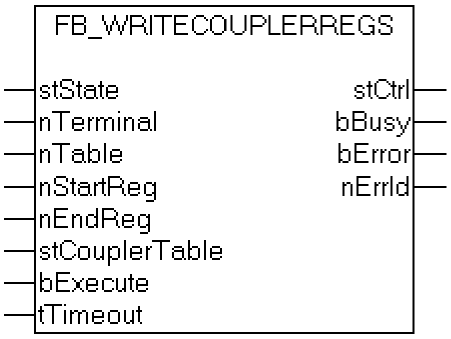
nErrId : Supplies the error number when the bError output is set. (Table of possible error codes [▶ 21]).

stCouplerTable : Structure [▶ 19] containing the register values of the terminal or coupler that have been read.

Requirements

Development environment	Target system type	IO-Hardware	PLC libraries to include
TwinCAT Version 2.7.0 Build > 517 TwinCAT Version 2.8.0 Build > 735	PC (i386)	All couplers with 2- byte PLC interfaces	Standard.Lib; TcPlcCoupler.Lib

3.5 FB_WriteCouplerRegs



This function block provides write access to the table register in the coupler and the registers of the intelligent terminals. The coupler itself is referred to as terminal 0 (null). All the other terminals in the terminal block, with the exception of passive terminals (such as power feed terminals), are counted in ascending sequence (beginning with 1) . It is possible either to write all registers, or only a partial region (between *nStartReg* and *nEndReg*). Several seconds are required to write all the registers (0.255) of a table of the coupler. The register values to be written are in the structure *stCouplerTable.*The structure is an array of high and low bytes. Each array element corresponds to a register value (e.g.: *stCouplerTable*[5] == Register 5).

VAR_INPUT

```
VAR_INPUT
    stState          : PLCINTFSTRUCT;
    nTerminal        : BYTE := TERM_COUPLER;
    nTable           : BYTE;
    nStartReg        : BYTE;
    nEndReg          : BYTE;
    bExecute         : BOOL;
    stCouplerTable   : ST_CouplerTable;
    tTimeout         : TIME;
END_VAR
```

stState : Status [▶ 18] word of the 2-byte PLC interface.

nTerminal : Terminal number, to whose table register access is to be made. The coupler has terminal number null. Passive terminals are not to be counted.

nTable : Table number whose register values are to be written. Intelligent terminals only have one table for each terminal channel. A 4-channel terminal has the following table numbers: 0-3. An intelligent terminal, however, only possesses a maximum of 64 register values for each terminal channel!

nStartReg : The number of the first register that is to be written.

nEndReg : The number of the last register that is to be written.

stCouplerTable : Register value array [▸ 19] to be written.

bExecute: The function block is activated by a positive edge at this input.

tTimeout: States the length of the timeout that may not be exceeded during execution of the function.

VAR_OUTPUT

```
VAR_OUTPUT
    stCtrl      : PLCINTFSTRUCT;
    bBusy       : BOOL;
    bError      : BOOL;
    nErrId      : UDINT;
END_VAR
```

stCtrl : Control word of the 2-byte PLC interface.

bBusy: This output is set when the block is activated, and remains set until execution of the function has been completed.

bError: If an error should occur during the execution of the function, then this output is set, after the bBusy output has been reset.

nErrId : Supplies the error number when the bError output is set. (Table of possible error codes [▸ 21]).

Requirements

Development environ-ment	Target system type	IO Hardware	PLC libraries to include
TwinCAT Version 2.7.0 Build > 518 TwinCAT Version 2.8.0 Build > 737	PC (i386)	All couplers with 2- byte PLC interfaces	Standard.Lib; TcPlcCoupler.Lib

4 Functions

4.1 F_GetVersionTcPlcCoupler

F_GetVersionTcPlcCoupler
nVersionElement

This function reads version information from the plc library.

FUNCTION F_GetVersionTcPlcCoupler : UINT

```
VAR_INPUT
    nVersionElement : INT;
END_VAR
```

nVersionElement : Version element, that is to be read. Possible parameters:

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

Requirements

Development environ-ment	Target system type	IO hardware	PLC libraries to include
TwinCAT v2.9.0 Build > 1033 TwinCAT v2.10.0 Build > 1257	PC (i386)	All coupler with 2 byte PLC interface	Standard.Lib; TcPlcCoupler.Lib

5 Data structures

5.1 PLCINTFSTRUCT

```
TYPE PLCINTFSTRUCT :
STRUCT
    Byte0 :BYTE;
    Byte1 :BYTE;
END_STRUCT
END_TYPE
```

Requirements

Development environ-ment	Target system type	IO hardware	PLC libraries to include
TwinCAT version >= 2.7.0	PC (i386)	All coupler with 2 byte PLC interface	Standard.Lib; TcPlcCoupler.Lib

5.2 E_CouplerErrType

```
TYPE E_CouplerErrType :
(
    CPLERR_NONE      := 0,     (* No error *)
    CPLERR_FIELDBUS  := 1,     (* Fieldbus error *)
    CPLERR_KBUS      := 2,     (* Terminal bus error (KBus)*)
    CPLERR_TERM_IO   := 4,     (* Terminal IO error *)
    CPLERR_COUPLER   := 8      (* Coupler error *)
);
END_TYPE
```

Requirements

Deveplopment environ-ment	Target system type	IO-Hardware	PLC libraries to include
TwinCAT Version 2.7.0 Build > 517 TwinCAT Version 2.8.0 Build > 735	PC (i386)	All Couplers with 2 byte PLC-Interface	Standard.Lib; TcPlcCoupler.Lib

5.3 ST_CouplerDiag

```
TYPE ST_CouplerDiag :
STRUCT
    eErrType    : E_CouplerErrType;
    stFlashCode : ST_FlashCode;
END_STRUCT
END_TYPE
```

eErrType : General Error type [▸ 18]

stFlashCode : The first and second sequence [▸ 20] of the code of flash.

Requirements

Development environment	Target system type	IO-Hardware	PLC libraries to include
TwinCAT Version 2.7.0 Build > 517 TwinCAT Version 2.8.0 Build > 735	PC (i386)	All Coupler with 2 byte PLC interface	Standard.Lib; TcPlcCoupler.Lib

5.4 ST_CouplerReg

```
TYPE ST_CouplerReg
STRUCT
    Lo : BYTE;
    Hi : BYTE;
END_STRUCT
END_TYPE
```

A Coupler register has the size of one word. The parameterization and the configuration of the coupler is discarded in the register.

Requirements

Development environment	Target system type	IO-Hardware	PLC libraries to include
TwinCAT Version 2.7.0 Build > 517 TwinCAT Version 2.8.0 Build > 735	PC (i386)	All Coupler with 2 byte PLC interface	Standard.Lib; TcPlcCoupler.Lib

5.5 ST_CouplerTable

```
TYPE ST_CouplerTable : ARRAY[ 0..255 ] OF ST_CouplerReg;
END_TYPE
```

The parameters and configuration of the coupler are stored in the coupler's EEPROM. The memory is divided into tables. Each table possesses a maximum of 256 registers [▶ 19].

Requirements

Development environment	Target system type	IO Hardware	PLC libraries to include
TwinCAT Version 2.7.0 Build > 517 TwinCAT Version 2.8.0 Build > 735	PC (i386)	All couplers with 2- byte PLC interfaces	Standard.Lib; TcPlcCoupler.Lib

5.6 ST_FlashCode

```
TYPE ST_FlashCode :
STRUCT
    ErrType     : WORD;
    ErrLocation : WORD;
END_STRUCT
END_TYPE
```

ErrType : Error type. Corresponds to the coupler's first flash sequence.

ErrLocation : Error location. Corresponds to the coupler's second flash sequence (the position of the last terminal before the error location - passive terminals are not included in the count!).

Requirements

Development environ-ment	Target system type	IO Hardware	PLC libraries to include
TwinCAT Version 2.7.0 Build > 517 TwinCAT Version 2.8.0 Build > 735	PC (i386)	All couplers with 2- byte PLC interfaces	Standard.Lib; TcPlcCoupler.Lib

6 Appendix

6.1 Error codes:2 byte PLC interface

Error number	Error description
0	no error
0x100	Error at initialisation of the communication via the 2 byte PLC interface.
0x200	error during communication
0x300	Timeout-Error. The permitted execution time was exceeded.
0x400	Wrong parameter value at register number.
0x500	Wrong parameter value at table number.

More Information:
www.beckhoff.de/tx1200

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