Manual

PLC Lib: Tc2_EtherCAT

TwinCAT 3

Version: 1.2
Date: 2019-06-25
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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 the 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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Other designations used in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owners.

Patent Pending

The EtherCAT Technology is covered, including but not limited to the following patent applications and patents:
EP1590927, EP1789857, DE102004044764, DE102007017835
with corresponding applications or registrations in various other countries.

The TwinCAT Technology is covered, including but not limited to the following patent applications and patents:
EP0851348, US6167425 with corresponding applications or registrations in various other countries.

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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!

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DANGER</strong></td>
<td>Serious risk of injury! Failure to follow the safety instructions associated with this symbol directly endangers the life and health of persons.</td>
</tr>
<tr>
<td><strong>WARNING</strong></td>
<td>Risk of injury! Failure to follow the safety instructions associated with this symbol endangers the life and health of persons.</td>
</tr>
<tr>
<td><strong>CAUTION</strong></td>
<td>Personal injuries! Failure to follow the safety instructions associated with this symbol can lead to injuries to persons.</td>
</tr>
<tr>
<td><strong>NOTE</strong></td>
<td>Damage to the environment or devices Failure to follow the instructions associated with this symbol can lead to damage to the environment or equipment.</td>
</tr>
</tbody>
</table>

Tip or pointer
This symbol indicates information that contributes to better understanding.
2 Overview

The PLC library Tc2_EtherCAT contains function blocks for executing services or functions on an EtherCAT master device and/or its slave devices.

Sample project and sample configuration for diagnostics

See https://infosys.beckhoff.com/content/1033/tcplclib_tc2_ethercat/Resources/zip/2364613387.zip
3  CoE interface

3.1  FB_EcCoeSdoRead

The FB_EcCoeSdoRead function block allows data to be read from an object dictionary of an EtherCAT slave through an SDO (Service Data Object) access. This requires the slave to have a mailbox and to support the “CANopen over EtherCAT” (CoE) protocol. The nSubIndex and nIndex parameters allow the object that is to be read to be selected. The function block FB_EcCoeSdoReadEx [11] must be used for access to the complete parameter, including subelements.

**VAR_INPUT**

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>sNetId</td>
<td>T_AmsNetId;</td>
</tr>
<tr>
<td>nSlaveAddr</td>
<td>UINT;</td>
</tr>
<tr>
<td>nSubIndex</td>
<td>BYTE;</td>
</tr>
<tr>
<td>nIndex</td>
<td>WORD;</td>
</tr>
<tr>
<td>pDstBuf</td>
<td>PVOID;</td>
</tr>
<tr>
<td>cbBufLen</td>
<td>UDINT;</td>
</tr>
<tr>
<td>bExecute</td>
<td>BOOL;</td>
</tr>
<tr>
<td>tTimeout</td>
<td>TIME := DEFAULT_ADS_TIMEOUT;</td>
</tr>
</tbody>
</table>

**sNetId**: String containing the AMS network ID of the EtherCAT master device. (type: T_AmsNetId)

**nSlaveAddr**: Fixed address of the EtherCAT slave to which the SDO upload command should be sent.

**nSubIndex**: Subindex of the object that is to be read.

**nIndex**: Index of the object that is to be read.

**pDstBuf**: Address (pointer) to the receive buffer.

**cbBufLen**: Maximum available buffer size (in bytes) for the data to be read.

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

**tTimeout**: Maximum time allowed for the execution of the function block.

**VAR_OUTPUT**

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>bBusy</td>
<td>BOOL;</td>
</tr>
<tr>
<td>bError</td>
<td>BOOL;</td>
</tr>
<tr>
<td>nErrId</td>
<td>UDINT;</td>
</tr>
</tbody>
</table>

**bBusy**: This output is set when the function block is activated, and remains set until an acknowledgement is received.

**bError**: This output is set after the bBusy output has been reset when an error occurs in the transmission of the command.

**nErrId**: Supplies the ADS error code associated with the most recently executed command if the bError output is set.
Example of an implementation in ST:

```plaintext
PROGRAM TEST_SdoRead
VAR
  fbSdoRead : FB_EcCoESdoRead;
  sNetId : T_AmsNetId := '172.16.2.131.2.1';
  bExecute : BOOL;
  nSlaveAddr : UINT := 1006;
  nIndex : WORD := 16#1018;
  nSubIndex : BYTE := 1;
  vendorId : UDINT;
  bError : BOOL;
  nErrId : UDINT;
END_VAR

fbSdoRead(sNetId:= sNetId,nSlaveAddr :=nSlaveAddr, nIndex:=nIndex, nSubIndex :=nSubIndex, pDstBuf:=ADR(vendorId), cbBufLen:= SIZEOF(vendorId), bExecute:=bExecute);

bError:=fbSdoRead.bError;

nErrId:=fbSdoRead.nErrId;
```

Requirements

<table>
<thead>
<tr>
<th>Development environment</th>
<th>Target platform</th>
<th>PLC libraries to include</th>
</tr>
</thead>
<tbody>
<tr>
<td>TwinCAT v3.1.0</td>
<td>PC or CX (x86, x64, ARM)</td>
<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>

### 3.2 FB_EcCoESdoReadEx

The **FB_EcCoESdoReadEx** function block allows data to be read from an object dictionary of an EtherCAT slave through an SDO (Service Data Object) access. This requires the slave to have a mailbox and to support the “CANopen over EtherCAT” (CoE) protocol. The nSubIndex and nIndex parameters allow the object that is to be read to be selected. The parameter with subelements can be read via `bCompleteAccess := TRUE`.

**VAR_INPUT**

```plaintext
VAR_INPUT
  sNetId : T_AmsNetId; (* AmsNetId of the EtherCAT master device.*)
  nSlaveAddr : UINT; (* Address of the slave device.*)
  nSubIndex : BYTE; (* CANopen Sdo subindex.*)
  nIndex : WORD; (* CANopen Sdo index.*)
  pDstBuf : PVOID; (* Contains the address of the buffer for the received data. *)
  cbBufLen : UDINT; (* Contains the max. number of bytes to be received. *)
  bExecute : BOOL; (* Function block execution is triggered by a rising edge at this input.*)
  tTimeout : TIME := DEFAULT_ADS_TIMEOUT; (* States the time before the function is cancelled. *)
  bCompleteAccess : BOOL; (* access complete object*)
END_VAR
```

- **sNetId**: String containing the AMS network ID of the EtherCAT master device. (type: T_AmsNetId)
- **nSlaveAddr**: Fixed address of the EtherCAT slave to which the SDO upload command should be sent.
- **nSubIndex**: Subindex of the object that is to be read.
- **nIndex**: Index of the object that is to be read.
- **pDstBuf**: Address (pointer) to the receive buffer.
cbBufLen: Maximum available buffer size (in bytes) for the data to be read.

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

tTimeout: Maximum time allowed for the execution of the function block.

bCompleteAccess: If bCompleteAccess is set, the whole parameter can be read in a single access.

```plaintext
VAR_OUTPUT
VAR_OUTPUT
  bBusy : BOOL;
  bError : BOOL;
  nErrId : UDINT;
END_VAR
```

bBusy: This output is set when the function block is activated, and remains set until an acknowledgement is received.

bError: This output is set after the bBusy output has been reset when an error occurs in the transmission of the command.

nErrId: Supplies the ADS error code associated with the most recently executed command if the bError output is set.

Requirements

<table>
<thead>
<tr>
<th>Development environment</th>
<th>Target platform</th>
<th>PLC libraries to include</th>
</tr>
</thead>
<tbody>
<tr>
<td>TwinCat v3.1.0</td>
<td>PC or CX (x86, x64, ARM)</td>
<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>

### 3.3 FB_EcCoeSdoWrite

The FB_EcCoeSdoWrite function block permits an object from the object directory of an EtherCAT slave to be written by means of an SDO download. This requires the slave to have a mailbox and to support the “CANopen over EtherCAT” (CoE) protocol. The nSubIndex and nIndex parameters allow the object that is to be written to be selected. The function block FB_EcCoeSdoWriteEx [14] must be used for access to the complete parameter, including subelements.

```plaintext
VAR_INPUT
VAR_INPUT
  sNetId : T_AmsNetId;
  nSlaveAddr : UINT;
  nSubIndex : BYTE;
  nIndex : WORD;
  pSrcBuf : PVOID;
  cb BufLen : UDINT;
  bExecute : BOOL;
  tTimeout : TIME := DEFAULT_ADS_TIMEOUT;
END_VAR
```

sNetId: String containing the AMS network ID of the EtherCAT master device. (type: T_AmsNetId)

nSlaveAddr: Fixed address of the EtherCAT slave to which the SDO download command should be sent.

nSubIndex: Subindex of the object that is supposed to be written.
**nIndex**: Index of the object that is supposed to be written.

**pSrcBuf**: Address (pointer) to the send buffer.

**cbBufLen**: Number of date to be sent in bytes.

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

**tTimeout**: Maximum time allowed for the execution of the function block.

### VAR_OUTPUT

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>bBusy</td>
<td>This output is set when the function block is activated, and remains set until an acknowledgement is received.</td>
</tr>
<tr>
<td>bError</td>
<td>This output is set after the bBusy output has been reset when an error occurs in the transmission of the command.</td>
</tr>
<tr>
<td>nErrId</td>
<td>Supplies the ADS error code associated with the most recently executed command if the bError output is set.</td>
</tr>
</tbody>
</table>

### Example of an implementation in ST:

```st
PROGRAM TEST_SdoWrite

VAR
  fbSdoWrite : FB_EcCoESdoWrite;
  sNetId : T_AmsNetId := '172.16.2.131.2.1'; (* NetId of EtherCAT Master *)
  nSlaveAddr : UINT := 1005; (* Port Number of EtherCAT Slave *)
  nIndex : WORD := 16#4062; (* CoE Object Index *)
  nSubIndex : BYTE := 1; (* Subindex of CoE Object *)
  nValue : UINT := 2; (* variable to be written to the CoE Object *)
  bExecute : BOOL; (* rising edge starts writing to the CoE Object *)
  bError : BOOL;
  nErrId : UDINT;
END_VAR

fbSdoWrite(
  sNetId := sNetId,
  nSlaveAddr := nSlaveAddr,
  nIndex := nIndex,
  nSubIndex := nSubIndex,
  pSrcBuf := ADR(nValue),
  cbBufLen := SIZEOF(nValue),
  bExecute := bExecute
);

IF NOT fbSdoWrite.bBusy THEN
  bExecute := FALSE;
ELSE
  bError := FALSE;
  nErrId := 0;
ENDIF

fbSdoWrite(bExecute := FALSE);
END_IF
```

### Requirements

<table>
<thead>
<tr>
<th>Development environment</th>
<th>Target platform</th>
<th>PLC libraries to include</th>
</tr>
</thead>
<tbody>
<tr>
<td>TwinCAT v3.1.0</td>
<td>PC or CX (x86, x64, ARM)</td>
<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>
3.4 FB_EcCoeSdoWriteEx

The FB_EcCoeSdoWriteEx function block permits an object from the object directory of an EtherCAT slave to be written by means of an SDO download. This requires the slave to have a mailbox and to support the “CANopen over EtherCAT” (CoE) protocol. The nSubIndex and nIndex parameters allow the object that is to be written to be selected. Via bCompleteAccess := TRUE the parameter can be written with sub-elements.

VAR_INPUT

VAR_INPUT
sNetId : T_AmsNetId; (* AmsNetId of the EtherCAT master device.*)
nSlaveAddr : UINT; (* Address of the slave device.*)
nSubIndex : BYTE; (* CANopen Sdo subindex.*)
 nIndex : WORD; (*CANopen Sdo index.*)
pSrcBuf : PVOID; (* Contains the address of the buffer containing the data to be send. *)
 cbBufLen : UDINT; (* Contains the max. number of bytes to be received. *)
 bExecute : BOOL; (* Function block execution is triggered by a rising edge at this input.*)
 tTimeout : TIME := DEFAULT_ADS_TIMEOUT; (* States the time before the function is cancelled.*)
bCompleteAccess : BOOL; (* access complete object*)
END_VAR

sNetId: String containing the AMS network ID of the EtherCAT master device. (type: T_AmsNetId)
nSlaveAddr: Fixed address of the EtherCAT slave to which the SDO download command should be sent.
nSubIndex: Subindex of the object that is supposed to be written.
nIndex: Index of the object that is supposed to be written.
pSrcBuf: Address (pointer) to the send buffer.
cbBufLen: Number of data to be sent in bytes.
bExecute: The function block is activated by a positive edge at this input.
tTimeout: Maximum time allowed for the execution of the function block.
bCompleteAccess: If bCompleteAccess is set, the whole parameter can be written in a single access.

VAR_OUTPUT

VAR_OUTPUT
bBusy : BOOL;
bError : BOOL;
nErrId : UDINT;
END_VAR

bBusy: This output is set when the function block is activated, and remains set until an acknowledgement is received.
bError: This output is set after the bBusy output has been reset when an error occurs in the transmission of the command.
nErrId: Supplies the ADS error code associated with the most recently executed command if the bError output is set.
Requirements

<table>
<thead>
<tr>
<th>Development environment</th>
<th>Target platform</th>
<th>PLC libraries to include</th>
</tr>
</thead>
<tbody>
<tr>
<td>TwinCAT v3.1.0</td>
<td>PC or CX (x86, x64, ARM)</td>
<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>

3.5 **FB_CoERead_ByDriveRef**

The function block **FB_CoERead_ByDriveRef** can be used to read drive parameters by means of the “CANopen over EtherCAT (CoE)” protocol. This requires the slave to have a mailbox and to support the “CANopen over EtherCAT” (CoE) protocol. The nSubIndex and nIndex parameters allow the object that is to be read to be selected. Via bCompleteAccess := TRUE the parameter can be read with sub-elements.

```
VAR_INPUT
  stDriveRef            : ST_DriveRef; (*Contains sNetID of EcMaster, nSlaveAddr of EcDrive, nDriveNo of EcDrive, either preset or read from NC*)
  nIndex               : WORD; (*SoE IDN: e.g. “S_0_IDN+1” for S-0-0001 or “P_0_IDN+23” for P-0-0023*)
  nSubIndex            : BYTE; (*Contains the address of the buffer for the received data*)
  pDstBuf              : PVOID; (*Contains the max. number of bytes to be received*)
  bExecute             : BOOL; (*Function block execution is triggered by a rising edge at this input*)
  tTimeout             : TIME; (*States the time before the function is cancelled*)
  bCompleteAccess      : BOOL;
END_VAR
```

**stDriveRef**: Structure containing the AMS network ID of the EtherCAT master device and the address of the slave device. The reference to the drive can be linked directly to the PLC in the System Manager. To this end an instance of ST_PlcDriveRef must be used and the NETID of the Byte array converted to a string.

**nIndex**: Index of the object that is to be read.

**nSubIndex**: Subindex of the object that is to be read.

**pDestBuf**: Address (pointer) to the receive buffer.

**cbBufLen**: Maximum available buffer size (in bytes) for the data to be read.

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

**tTimeout**: Maximum time allowed for the execution of the function block.

**bCompleteAccess**: If bCompleteAccess is set, the whole parameter can be read in a single access.

```
VAR_OUTPUT
  bBusy         : BOOL;
  bError        : BOOL;
  iAdsErrId     : UINT;
  iCANopenErrId : UINT;
END_VAR
```

**bBusy**: This output is set when the function block is activated, and remains set until an acknowledgement is received.

**bError**: This output is set after the bBusy output has been reset when an error occurs in the transmission of the command.

**iAdsErrId**: In the case of a set bError output returns the ADS error code of the last executed command.
CoE interface

**iCANopenErrId**: Returns the CANopen error code if the bError output is set.

**Example of an implementation in ST:**

```plaintext
PROGRAM MAIN
VAR
  fbCoERead       : FB_CoERead_ByDriveRef;
  stDriveRef      : ST_DriveRef;
  nIndex          : WORD := 16#1018;
  nSubIndex       : BYTE := 1;
  bExecute        : BOOL := TRUE;
  tTimeout        : TIME := T#5S;
  bCompleteAccess : BOOL := TRUE;
  vendorId        : UDINT;
  bError          : BOOL;
  nAdsErrId       : UDINT;
  nCANopenErrId   : UDINT;
END_VAR

fbCoERead(
  stDriveRef:= stDriveRef,
  nIndex:= nIndex,
  nSubIndex:= nSubIndex,
  pDstBuf:= ADR(vendorId),
  cbBufLen:= SIZEOF(vendorId),
  bExecute:= bExecute,
  tTimeout:= tTimeout,
  bCompleteAccess:= bCompleteAccess,
);

IF NOT fbCoERead.bBusy THEN
  bError:=fbCoERead.bError;
  nAdsErrId:=fbCoERead.iAdsErrId;
  nCANopenErrId:=fbCoERead.iCANopenErrId;
  bExecute := FALSE;
  fbCoERead(bExecute := bExecute);
END_IF

Requirements

<table>
<thead>
<tr>
<th>Development environment</th>
<th>Target platform</th>
<th>PLC libraries to include</th>
</tr>
</thead>
<tbody>
<tr>
<td>TwinCAT v3.1.0</td>
<td>PC or CX (x86, x64, ARM)</td>
<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>

### 3.6 FB_CoEWrite_ByDriveRef

The function block `FB_CoEWrite_ByDriveRef` can be used to write drive parameters based on the “CANopen over EtherCAT (CoE)” protocol. This requires the slave to have a mailbox and to support the “CANopen over EtherCAT” (CoE) protocol. The `nSubIndex` and `nIndex` parameters allow the object that is to be written to be selected. Via `bCompleteAccess := TRUE` the parameter can be written with sub-elements.

```plaintext
VAR_INPUT
  stDriveRef        : ST_DriveRef; (*Contains sNetID of EcMaster, nSlaveAddr EcDrive, nDriveNo of EcDrive, either preset or read from NC*)
  nIndex            : WORD; (*SoE IDN: e.g. “S_0_IDN+1” for S-0-0001 or “P_0_IDN+23” for P-0-0023*)
  nSubIndex         : BYTE; (*SoE element*)
  pSrcBuf           : PVOID; (*Contains the address of the buffer containing the data to be sent*)
  cbBufLen          : UDINT; (*Contains the max. number of bytes to be received*)
```
CoE interface

PLC Lib: Tc2_EtherCAT
Version: 1.2

---

**bExecute**: BOOL; (*Function block execution is triggered by a rising edge at this input*)

**tTimeout**: TIME; (*States the time before the function is cancelled*)

**bCompleteAccess**: BOOL;

---

**stDriveRef**: Structure containing the AMS network ID of the EtherCAT master device and the address of the slave device. The reference to the drive can be linked directly to the PLC in the System Manager. To this end an instance of ST_PlcDriveRef must be used and the NETID of the Byte array converted to a string.

**nIndex**: Index of the object that is supposed to be written.

**nSubIndex**: Subindex of the object that is supposed to be written.

**pSrcBuf**: Address (pointer) to the send buffer.

**cbBUFLen**: Maximum available buffer size for the data to be sent in bytes.

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

**tTimeout**: Maximum time allowed for the execution of the function block.

**bCompleteAccess**: If bCompleteAccess is set, the whole parameter can be read in a single access.

---

**VAR_OUTPUT**

**bBusy**: BOOL;

**bError**: BOOL;

**iAdsErrId**: UINT;

**iCANopenErrId**: UINT;

---

**bBusy**: This output is set when the function block is activated, and remains set until an acknowledgement is received.

**bError**: This output is set after the bBusy output has been reset when an error occurs in the transmission of the command.

**iAdsErrId**: In the case of a set bError output returns the ADS error code of the last executed command.

**iCANopenErrId**: Returns the CANopen error code if the bError output is set.

---

**Example of an implementation in ST:**

PROGRAM MAIN
VAR
  fbCoEWrite : FB_CoEWrite_ByDriveRef;
  stDriveRef : ST_DriveRef;
  nIndex : WORD := #16#1018;
  nSubIndex : BYTE := #1;
  bExecute : BOOL := TRUE;
  tTimeout : TIME := T#5S;
  bCompleteAccess : BOOL := TRUE;
  vendorId : UDINT := #2;
  bError : BOOL;
  nAdsErrId : UDINT;
  nCANopenErrId : UDINT;
END_VAR

fbCoEWrite(
  stDriveRef := stDriveRef,
  nIndex := nIndex,
  nSubIndex := nSubIndex,
  pSrcBuf := ADR(vendorId),
  cbBUFLen := SIZEOF(vendorId),
  bExecute := bExecute,
  tTimeout := tTimeout,
  bCompleteAccess := bCompleteAccess,
);

IF NOT fbCoEWrite.bBusy THEN
  bError := fbCoEWrite.bError;
  nAdsErrId := fbCoEWrite.iAdsErrId;
  nCANopenErrId := fbCoEWrite.iCANopenErrId;
  bExecute := FALSE;
  fbCoEWrite(bExecute := bExecute);
END_IF
## Requirements

<table>
<thead>
<tr>
<th>Development environment</th>
<th>Target platform</th>
<th>PLC libraries to include</th>
</tr>
</thead>
<tbody>
<tr>
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<td>PC or CX (x86, x64, ARM)</td>
<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>
4 EtherCAT Commands

4.1 FB_EcPhysicalReadCmd

The function block FB_EcPhysicalReadCmd can be used to send an EtherCAT read command (FPRD, APRD, BRD) to a particular EtherCAT slave or to all EtherCAT slaves. This command can be used by the PLC to read a register or the DPRAM of the EtherCAT slave controller.

VAR_INPUT

VAR_INPUT
  sNetId : T_AmsNetId;
  adp : UINT;
  ado : UINT;
  len : UDINT;
  eType : E_EcAdressingType := eAdressingType_Fixed;
  pDstBuf : PVOID;
  bExecute : BOOL;
  tTimeout : TIME := DEFAULT_ADS_TIMEOUT;
END_VAR

* sNetId: String containing the AMS network ID of the EtherCAT master device. (type: T_AmsNetId)
* adp: This value determines which EtherCAT slave is to be addressed with this command. The meaning of this value depends on the addressing mode selected with eType:

<table>
<thead>
<tr>
<th>eType</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>eAdressingType_Fixed</td>
<td>The slave is addressed by means of its configured EtherCAT address. These EtherCAT addresses can be read via the function block FB_EcGetAllSlaveAddr.</td>
</tr>
</tbody>
</table>
| eAdressingType_AutoInc | The slave is addressed based on its position in the ring. The first device has the address 0 (adp=0); adp is decremented by one for all subsequent slaves:  
1. Slave adp = 0  
2. Slave adp = 16#ffff (-1)  
3. Slave adp = 16#ffe(-2)  
4. Slave adp = 16#ff(-3)  
etc. |
| eAdressingType_BroadCAST | All slaves are addressed by this command. adp can be set to 0.               |

* ado: Physical memory (DPRAM) or register to be read.
* len: Number of bytes to be read.

* eType: Different EtherCAT commands are sent, depending on value of eType:

<table>
<thead>
<tr>
<th>eType</th>
<th>Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>eAdressingType_Fixed</td>
<td>Configured Address Physical Read (FPRD)</td>
</tr>
<tr>
<td>eAdressingType_AutoInc</td>
<td>Auto Increment Physical Read (APRD)</td>
</tr>
<tr>
<td>eAdressingType_BroadCAST</td>
<td>Broadcast Read (BRD)</td>
</tr>
</tbody>
</table>
The individual commands differ in terms of addressing mode (see adp).

**pDstBuf**: The address (pointer) of the receive buffer.

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

**tTimeout**: Maximum time allowed for the execution of the function block.

<table>
<thead>
<tr>
<th>VAR_OUTPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>bBusy</strong> : BOOL;</td>
</tr>
<tr>
<td><strong>wkc</strong> : UINT;</td>
</tr>
</tbody>
</table>

**bBusy**: This output is set when the function block is activated, and remains set until an acknowledgement is received.

**bError**: This output is set after the bBusy output has been reset when an error occurs in the transmission of the command.

**nErrId**: Supplies the ADS error code associated with the most recently executed command if the bError output is set.

**wkc**: The working counter is incremented by each EtherCAT slave that has processed this command successfully. If only one EtherCAT slave was addressed by this command, this value should therefore be 1.

**Example of an implementation in ST:**

```plaintext
PROGRAM TEST_PhysicalReadCmd
VAR
    fbReadCmd : FB_EcPhysicalReadCmd;
    bExecute : BOOL;
    value : UINT;
    adp : UINT:=16#3E9;
    ado : UINT:=16#1100;
    eType : E_EcAdressingType := eAdressingType_Fixed;
    sNetId : T_AmsNetId:='192.168.1.5.3.1';
    wkc : UINT;
    bError : BOOL;
    nErrId : UDINT;
END_VAR

fbReadCmd (sNetId:=sNetID, ado:=ado, adp:=adp, eType:=eType, LEN := SIZEOF(value), pDstBuf:=ADR(value), bExecute:=bExecute);
wkc := fbReadCmd.wkc;
bError:= fbReadCmd.bError;
nErrId:= fbReadCmd.nErrId;
```

**Requirements**

<table>
<thead>
<tr>
<th>Development environment</th>
<th>Target platform</th>
<th>PLC libraries to include</th>
</tr>
</thead>
<tbody>
<tr>
<td>TwinCAT v3.1.0</td>
<td>PC or CX (x86, x64, ARM)</td>
<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>

**4.2 FB_EcPhysicalWriteCmd**
The function block FB_EcPhysicalWriteCmd can be used to send an EtherCAT write command (FPWR, APWR, BWR) to a particular EtherCAT slave or to all EtherCAT slaves. This command can be used by the PLC to write to a register or the DPRAM of the EtherCAT slave controller.

**VAR_INPUT**

<table>
<thead>
<tr>
<th>VAR_INPUT</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>sNetId    : T_AmsNetId;</td>
<td>String containing the AMS network ID of the EtherCAT master device. (type: T_AmsNetId)</td>
</tr>
<tr>
<td>adp       : UINT;</td>
<td>This value determines which EtherCAT slave is to be addressed with this command. The meaning of this value depends on the addressing mode selected with eType:</td>
</tr>
<tr>
<td>ado       : UINT;</td>
<td>Physical memory (DPRAM) or register to be read.</td>
</tr>
<tr>
<td>len       : UDINT;</td>
<td>Number of bytes to be written.</td>
</tr>
<tr>
<td>eType     : E_EcAdressingType := eAdressingType_Fixed;</td>
<td>Different EtherCAT commands are sent, depending on the value of eType:</td>
</tr>
<tr>
<td>pSrcBuf   : PVOID;</td>
<td>Address (pointer) of the transmit buffer.</td>
</tr>
<tr>
<td>bExecute  : BOOL;</td>
<td>The function block is activated by a positive edge at this input.</td>
</tr>
<tr>
<td>tTimeout  : TIME := DEFAULT_ADS_TIMEOUT;</td>
<td>Maximum time allowed for the execution of the function block.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>eType</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>eAdressingType_Fixed</td>
<td>The slave is addressed by means of its configured EtherCAT address. These EtherCAT addresses can be read via the function block FB_EcGetAllSlaveAddr.</td>
</tr>
<tr>
<td>eAdressingType_AutoInc</td>
<td>The slave is addressed based on its position in the ring. The first device has the address 0 (adp=0); adp is decremented by one for all subsequent slaves: 1. Slave adp = 0 2. Slave adp = 16#ffff (-1) 3. Slave adp = 16#ffe(-2) 4. Slave adp = 16#fffd(-3) etc.</td>
</tr>
<tr>
<td>eAdressingType_BroadCAST</td>
<td>All slaves are addressed by this command. adp should be set to 0.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>eType</th>
<th>Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>eAdressingType_Fixed</td>
<td>Configured Address Physical Write ( FPWR)</td>
</tr>
<tr>
<td>eAdressingType_AutoInc</td>
<td>Auto Increment Physical Write ( APWR)</td>
</tr>
<tr>
<td>eAdressingType_BroadCAST</td>
<td>Broadcast Write ( BWR)</td>
</tr>
</tbody>
</table>

The individual commands differ in terms of addressing mode (see adp).

<table>
<thead>
<tr>
<th>pSrcBuf</th>
<th>Address (pointer) of the transmit buffer.</th>
</tr>
</thead>
<tbody>
<tr>
<td>bExecute</td>
<td>The function block is activated by a positive edge at this input.</td>
</tr>
<tr>
<td>tTimeout</td>
<td>Maximum time allowed for the execution of the function block.</td>
</tr>
</tbody>
</table>

**VAR_OUTPUT**

<table>
<thead>
<tr>
<th>VAR_OUTPUT</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>bBusy : BOOL;</td>
<td>This output is set when the function block is activated, and remains set until an acknowledgement is received.</td>
</tr>
<tr>
<td>bError : BOOL;</td>
<td></td>
</tr>
<tr>
<td>nErrId : UDINT;</td>
<td></td>
</tr>
<tr>
<td>wkc : UINT;</td>
<td></td>
</tr>
</tbody>
</table>

bBusy: This output is set when the function block is activated, and remains set until an acknowledgement is received.
EtherCAT Commands

**bError:** This output is set after the bBusy output has been reset when an error occurs in the transmission of the command.

**nErrId:** Supplies the ADS error code associated with the most recently executed command if the bError output is set.

**wkc:** The working counter is incremented by each EtherCAT slave that has processed this command successfully. If only one EtherCAT slave was addressed by this command, this value should therefore be 1.

**Example of an implementation in ST:**

```plaintext
PROGRAM Test_PhysicalWriteCmd
VAR
  fbWriteCmd : FB_EcPhysicalWriteCmd;
  bExecute   : BOOL;
  value      : UINT :=16#5555;
  ado         : UINT :=16#1100;
  eType       : E_EcAdressingType := eAdressingType_Fixed;
  sNetId      : T_AmsNetId :='192.168.1.5.3.1';
  wkc         : UINT;
  bError      : BOOL;
  nErrId      : UDINT;
END_VAR

fbWriteCmd (sNetId:=sNetId, ado:=ado, adp:=adp, eType:=eType, LEN := SIZEOF(value), pSrcBuf:=ADR(value), bExecute:=bExecute);

wkc := fbWriteCmd.wkc;
bError:= fbWriteCmd.bError;
nErrId:= fbWriteCmd.nErrId;
```

**Requirements**

<table>
<thead>
<tr>
<th>Development environment</th>
<th>Target platform</th>
<th>PLC libraries to include</th>
</tr>
</thead>
<tbody>
<tr>
<td>TwinCAT v3.1.0</td>
<td>PC or CX (x86, x64, ARM)</td>
<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>

**4.3 FB_EcLogicalReadCmd**

The master sends a logical EtherCAT read command (LRD) with the function block FB_EcLogicalReadCmd. In each slave, local address ranges (DPRAM) can be mapped to global logical address ranges. This command therefore addresses all EtherCAT slaves, which have mapping configured for the selected logical address range.

**VAR_INPUT**

```plaintext
VAR_INPUT
  sNetId       : T_AmsNetId;
  logAddr      : UDINT;
  len          : UDINT;
  pDstBuf      : PVOID;
  bExecute     : BOOL;
  tTimeout     : TIME := DEFAULT_ADS_TIMEOUT;
END_VAR
```

**sNetId:** String containing the AMS network ID of the EtherCAT master device. (type: T_AmsNetId)

**logAddr:** Logical address.

**len:** Number of bytes to be read.
**EtherCAT Commands**

**pDstBuf**: Address (pointer) to the receive buffer.

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

**tTimeout**: Maximum time allowed for the execution of the function block.

**VAR_OUTPUT**

```plaintext
VAR_OUTPUT
   bBusy : BOOL;
   bError : BOOL;
   nErrId : UDINT;
   wkc : UINT;
END_VAR
```

**bBusy**: This output is set when the function block is activated, and remains set until an acknowledgement is received.

**bError**: This output is set after the bBusy output has been reset when an error occurs in the transmission of the command.

**nErrId**: Supplies the ADS error code associated with the most recently executed command if the bError output is set.

**wkc**: The working counter is incremented by each EtherCAT slave that has processed this command successfully. If only one EtherCAT slave was addressed by this command, this value should therefore be 1.

**Example of an implementation in ST:**

```plaintext
PROGRAM Test_LogicalReadCmd
VAR
   fbReadCmd : FB_EcLogicalReadCmd;
   bExecute : BOOL;
   value : USINT;
   logAddr : UDINT := 16#10000;
   sNetId : T_AmsNetId := '192.168.1.5.3.1';
   wkc : UINT;
   bError : BOOL;
   nErrId : UDINT;
END_VAR

   fbReadCmd (sNetId:=sNetID, logAddr:=logAddr, LEN := SIZEOF(value), pDstBuf:=ADR(value), bExecute:=bExecute);
   wkc := fbReadCmd.wkc;
   bError:= fbReadCmd.bError;
   nErrId:= fbReadCmd.nErrId;
```

**Requirements**

<table>
<thead>
<tr>
<th>Development environment</th>
<th>Target platform</th>
<th>PLC libraries to include</th>
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</thead>
<tbody>
<tr>
<td>TwinCAT v3.1.0</td>
<td>PC or CX (x86, x64, ARM)</td>
<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>

**4.4 FB_EcLogicalWriteCmd**

The master sends a logical EtherCAT write command (LWR) with the function block `FB_EcLogicalWriteCmd`. In each slave, local address ranges (DPRAM) can be mapped to global logical address ranges. This command therefore addresses all EtherCAT slaves, which have mapping configured for the selected logical address range.
VAR_INPUT

VAR_INPUT
sNetId : T_AmsNetId;
logAddr : UDINT;
len : UDINT;
pSrcBuf : PVOID;
bExecute : BOOL;
tTimeout : TIME := DEFAULT_ADS_TIMEOUT;
END_VAR

sNetId: String containing the AMS network ID of the EtherCAT master device. (type: T_AmsNetId)

logAddr: Logical address.

len: Number of bytes to be written.

pSrcBuf: Address (pointer) to the send buffer.

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

tTimeout: Maximum time allowed for the execution of the function block.

VAR_OUTPUT

VAR_OUTPUT
bBusy : BOOL;
bError : BOOL;
nErrId : UDINT;
wkc : UINT;
END_VAR

bBusy: This output is set when the function block is activated, and remains set until an acknowledgement is received.

bError: This output is set after the bBusy output has been reset when an error occurs in the transmission of the command.

nErrId: Supplies the ADS error code associated with the most recently executed command if the bError output is set.

wkc: The working counter is incremented by each EtherCAT slave that has processed this command successfully. If only one EtherCAT slave was addressed by this command, this value should therefore be 1.

Example of an implementation in ST:

PROGRAM Test_LogicalWriteCmd
VAR
 fbWriteCmd : FB_EcLogicalWriteCmd;
bExecute : BOOL;
value : USINT :=16#55;
logAddr : UDINT :=16#10000;
sNetId : T_AmsNetId:='192.168.1.5.3.1';
wkc : UINT;
bError : BOOL;
nErrId : UDINT;
END_VAR

fbWriteCmd (sNetId:=sNetID, logAddr:=logAddr, LEN := SIZEOF(value), pSrcBuf:=ADR(value), bExecute:=bExecute);
wkc := fbWriteCmd.wkc;
bError :=fbWriteCmd.bError;
nErrId :=fbWriteCmd.nErrId;

Requirements

<table>
<thead>
<tr>
<th>Development environment</th>
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<th>PLC libraries to include</th>
</tr>
</thead>
<tbody>
<tr>
<td>TwinCAT v3.1.0</td>
<td>PC or CX (x86, x64, ARM)</td>
<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>
5 EtherCAT Diagnostic

5.1 FB_EcGetAllSlaveAbnormalStateChanges

The function block FB_EcGetAllSlaveAbnormalStateChanges can be used to read the unexpected EtherCAT state changes of all the slaves connected to the master. If the call is successful, the buffer transferred in the parameter pBufAddr contains the number of unexpected state changes of all slaves as an array of UDINTs. EtherCAT state changes are unexpected if they were not requested by the EtherCAT master, e.g. if an EtherCAT slave spontaneously switches from OP state to SAFEOP state.

VAR_INPUT

VAR_INPUT

\begin{tabular}{|l|}
\hline
sNetId & T_AmsNetId; (*AmsNetId of the EtherCAT master device*) \tabularnewline
pAddrBuf & POINTER TO ARRAY [0..EC_MAX_SLAVES] OF UDINT; (*Contains the address of the buffer the counters for the state changes f.i. Op to SafeOp-Err are copied to.*) \tabularnewline
cbBufLen & UDINT; (*Size of the buffer pAddrBuf. The size of the buffer must be at least nSlave *4 Bytes.*) \tabularnewline
bExecute & BOOL; (*Function Block execution is triggered by a rising edge at this input*) \tabularnewline
tTimeout & TIME; (*States the time before the function is cancelled.*) \tabularnewline
\hline
\end{tabular}

sNetId: String containing the AMS network ID of the EtherCAT master device. (type: T_AmsNetId)
pAddrBuf: Address of an array of UDINTs, into which the number of unexpected state changes of the individual slaves is to be written.
cbBufLen: Maximum available buffer size (in bytes) for the data to be read.
bExecute: Maximum available buffer size (in bytes) for the data to be read.
tTimeout: The function block is activated by a positive edge at this input.

VAR_OUTPUT

VAR_OUTPUT

\begin{tabular}{|l|}
\hline
bBusy & BOOL; \tabularnewline
bError & BOOL; \tabularnewline
nErrId & UDINT; \tabularnewline
nSlaves & UINT; \tabularnewline
\hline
\end{tabular}

bBusy: This output is set when the function block is activated, and remains set until an acknowledgement is received.
bError: This output is set after the bBusy output has been reset when an error occurs in the transmission of the command.
nErrId: Supplies the ADS error code associated with the most recently executed command if the bError output is set. Error 1798 (0x706) indicates a null pointer at the buffer address. Error 1797 (0x705) indicates inadequate buffer size.
nSlaves: The number of slaves connected to the master.

Requirements

\begin{tabular}{|l|l|l|}
\hline
Development environment & Target platform & PLC libraries to include \\
\hline
TwinCAT v3.1.0 & PC or CX (x86, x64, ARM) & Tc2_EtherCAT \\
\hline
\end{tabular}
5.2 FB_EcGetAllSlaveAddr

The `FB_EcGetAllSlaveAddr` function block allows the addresses of all the slaves connected to the master to be read. When the call is successful, the buffer passed in the parameter `pAddrBuf` contains the addresses of all the slaves as an array of UINTs.

**VAR_INPUT**

```plaintext
VAR_INPUT
  sNetId   : T_AmsNetId;
pAddrBuf : POINTER TO ARRAY[0..EC_MAX_SLAVES] OF UINT;
  cbBufLen  : UDINT
  bExecute : BOOL;
  tTimeout : TIME := DEFAULT_ADS_TIMEOUT;
END_VAR
```

- **sNetId**: String containing the AMS network ID of the EtherCAT master device. (type: T_AmsNetId)
- **pAddrBuf**: Address of an array of UINTs into which the addresses of the individual slaves are to be written.
- **cbBufLen**: Maximum available buffer size (in bytes) for the data to be read.
- **bExecute**: The function block is activated by a positive edge at this input.
- **tTimeout**: Maximum time allowed for the execution of the function block.

**VAR_OUTPUT**

```plaintext
VAR_OUTPUT
  bBusy   : BOOL;
  bError  : BOOL;
  nErrId  : UDINT;
  nSlaves : UINT;
END_VAR
```

- **bBusy**: This output is set when the function block is activated, and remains set until an acknowledgement is received.
- **bError**: This output is set after the bBusy output has been reset when an error occurs in the transmission of the command.
- **nErrId**: Supplies the ADS error code associated with the most recently executed command if the bError output is set. Error 1798 (0x706) indicates a null pointer at the buffer address. Error 1797 (0x705) indicates inadequate buffer size.
- **nSlaves**: The number of slaves connected to the master.

**Example of an implementation in ST:**

```plaintext
PROGRAM TEST_GetAllSlaveAddresses
VAR
  fbGetAllSlaveAddr : FB_EcGetAllSlaveAddr;
  sNetId           : T_AmsNetId := '172.16.2.131.2.1';
  bExecute         : BOOL;
  slaveAddresses   : ARRAY[0..255] OF UINT;
  nSlaves          : UINT := 0;
  bError           : BOOL;
  nErrId           : UDINT;
END_VAR

fbGetAllSlaveAddr(sNetId:= sNetId,pAddrBuf := ADR(slaveAddresses), cbBufLen:= SIZEOF(slaveAddresses), bExecute:=bExecute);
```

Version: 1.2 PLC Lib: Tc2_EtherCAT
nSlaves := fbGetAllSlaveAddr.nSlaves;
bError := fbGetAllSlaveAddr.bError;
nErrId := fbGetAllSlaveAddr.nErrId;

Requirements

<table>
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</tr>
</thead>
<tbody>
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<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>

5.3 FB_EcGetAllCrcErrors

The FB_EcGetAllSlaveCrcErrors function block allows the CRC error counters of all the slaves connected to the master to be read. The CRC errors at the individual ports of a slave are added.

In order to read the CRC errors of the individual ports (A, B and C) of a slave, it is necessary to call the FB_EcGetSlaveCrcError function block.

In order to read the CRC errors of the individual ports (A, B, C and D) of a slave, it is necessary to call the FB_EcGetSlaveCrcErrorEx function block.

**VAR_INPUT**

<table>
<thead>
<tr>
<th>sNetId : T_AmsNetId;</th>
</tr>
</thead>
<tbody>
<tr>
<td>pCrcErrorBuf : POINTER TO ARRAY[0..EC_MAX_SLAVES] OF DWORD;</td>
</tr>
<tr>
<td>cbBufLen : UDINT;</td>
</tr>
<tr>
<td>bExecute : BOOL;</td>
</tr>
<tr>
<td>tTimeout : TIME := DEFAULT_ADS_TIMEOUT;</td>
</tr>
</tbody>
</table>

**VAR_OUTPUT**

<table>
<thead>
<tr>
<th>bBusy : BOOL;</th>
</tr>
</thead>
<tbody>
<tr>
<td>bError : BOOL;</td>
</tr>
<tr>
<td>nErrId : UDINT;</td>
</tr>
<tr>
<td>nSlaves : UINT;</td>
</tr>
</tbody>
</table>

**sNetId**: String containing the AMS network ID of the EtherCAT master device. (type: T_AmsNetId)

**pCrcErrorBuf**: The address of an array of DWORDs into which the CRC error counter is to be written.

**cbBufLen**: Maximum available buffer size (in bytes) for the data to be read.

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

**tTimeout**: Maximum time allowed for the execution of the function block.

**bBusy**: This output is set when the function block is activated, and remains set until an acknowledgement is received.

**bError**: This output is set after the bBusy output has been reset when an error occurs in the transmission of the command.

**nErrId**: Supplies the ADS error code associated with the most recently executed command if the bError output is set. Error 1798 (0x706) indicates a null pointer at the buffer address. Error 1797 (0x705) indicates inadequate buffer size.

**nSlaves**: The number of slaves connected to the master.
Example of an implementation in ST:

PROGRAM TEST_GetAllSlaveCrcErrors
VAR
    fbGetAllSlaveCrcErrors : FB_EcGetAllSlaveCrcErrors;
    sNetId : T_AmsNetId := '172.16.2.131.2.1';
    bExecute : BOOL;
    crcErrors : ARRAY[0..255] OF DWORD;
    nSlaves : UINT := 0;
    bError : BOOL;
    nErrId : UDINT;
END_VAR

fbGetAllSlaveCrcErrors(sNetId:= sNetId, pCrcErrorBuf := ADR(crcErrors), cbBufLen:= SIZEOF(crcErrors)
, bExecute:=bExecute);

nSlaves := fbGetAllSlaveCrcErrors.nSlaves;
bError := fbGetAllSlaveCrcErrors.bError;
nErrId := fbGetAllSlaveCrcErrors.nErrId;

Requirements

<table>
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</thead>
<tbody>
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<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>

5.4 FB_EcGetAllSlavePresentStateChanges

The function block FB_EcGetAllSlavePresentStateChanges can be used to read the EtherCAT state changes from state “slave is present” to “INIT_NO_COMM” of all slaves connected to the master. If the call is successful, the buffer transferred in the parameter pAddrBuf contains the number of state changes of all slaves as an array of UDINTs. The EtherCAT state change from state “slave is present” to “INIT_NO_COMM” means that the connection to the slave has been interrupted. For example by disconnecting the EtherCAT cable.

VAR_INPUT

VAR_INPUT

sNetId : T_AmsNetId; (*AmsNetId of the EtherCAT master device*)
pAddrBuf : POINTER TO ARRAY [0..EC_MAX_SLAVES]OF UDINT; (*Contains the address of the buffer the counters for the state changes from INIT_NO_COMM to Present are copied to.*)
cbBufLen : UDINT; (*Size of the buffer pAddrBuf. The size of the buffer must be at least nSlave *4 Bytes.*)
bExecute : BOOL; (*Function Block execution is triggered by a rising edge at this input*)
tTimeout : TIME; (*States the time before the function is cancelled.*)
END_VAR

sNetId: String containing the AMS network ID of the EtherCAT master device. (type: T_AmsNetId)
pAddrBuf: Address of an array of UDINTs, into which the number of state changes from INIT_NO_COMM to “slave is present” for the individual slaves is to be written.
cbBufLen: Maximum available buffer size (in bytes) for the data to be read.
bExecute: The function block is activated by a positive edge at this input.
tTimeout: Maximum time allowed for the execution of the function block.

VAR_OUTPUT

VAR_OUTPUT

bBusy : BOOL;
bError : BOOL;
bBusy: This output is set when the function block is activated, and remains set until an acknowledgement is received.

bError: This output is set after the bBusy output has been reset when an error occurs in the transmission of the command.

nErrId: Supplies the ADS error code associated with the most recently executed command if the bError output is set. Error 1798 (0x706) indicates a null pointer at the buffer address. Error 1797 (0x705) indicates inadequate buffer size.

nSlaves: The number of slaves connected to the master.

Requirements

<table>
<thead>
<tr>
<th>Development environment</th>
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</tr>
</thead>
<tbody>
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<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>

5.5 FB_EcGetConfSlaves

The function block FB_EcGetConfSlaves can be used to read a list of configured slaves from the EtherCAT master object directory.

VAR_INPUT

VAR_INPUT
- sNetId : T_AmsNetId;
- pArrEcConfSlaveInfo : POINTER TO ARRAY[0..EC_MAX_SLAVES] OF ST_EcSlaveConfigData;
- cbBufLen : UDINT;
- bExecute : BOOL;
- tTimeout : TIME := DEFAULT_ADS_TIMEOUT;

sNetId: String containing the AMS network ID of the EtherCAT master device. (type: T_AmsNetId)

pArrEcConfSlaveInfo: Address of an array of structures of type ST_EcSlaveConfigData [99], into which data of each configured slave are to be written.

cbBufLen: Maximum available buffer size (in bytes) for the data to be read.

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

tTimeout: Maximum time allowed for the execution of the function block.

VAR_OUTPUT

VAR_OUTPUT
- bBusy : BOOL;
- bError : BOOL;
- nErrId : UDINT;
- nSlaves : UINT;

bBusy: This output is set when the function block is activated, and remains set until an acknowledgement is received.

bError: This output is set after the bBusy output has been reset when an error occurs in the transmission of the command.
nErrId: Supplies the ADS error code associated with the most recently executed command if the bError output is set. Error 1798 (0x706) indicates a null pointer at the buffer address. Error 1797 (0x705) indicates inadequate buffer size.

nSlaves: Returns the number of configured slaves.

Requirements

<table>
<thead>
<tr>
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</thead>
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</tr>
</tbody>
</table>

5.6  FB_EcGetLastProtErrInfo

The function block FB_EcGetLastProtErrInfo can be used to read additional error information relating to the most recent mailbox protocol error. An error-free mailbox command resets the last error every time.

VAR_INPUT

VAR_INPUT

- sNetId : T_AmsNetId;
- nSlaveAddr : UINT;
- eProtocol : E_EcMbxProtType := eEcMbxProt_FoE;
- bExecute : BOOL;
- tTimeout : TIME := DEFAULT_ADS_TIMEOUT;
END_VAR

sNetId: String containing the AMS network ID of the EtherCAT master device. (type: T_AmsNetId)

nSlaveAddr: Fixed address of the EtherCAT slave, whose error information is to be read.

eProtocol: EtherCAT mailbox protocol type [97].

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

tTimeout: Maximum time allowed for the execution of the function block.

VAR_OUTPUT

VAR_OUTPUT

- bBusy : BOOL;
- bError : BOOL;
- nErrId : UDINT;
- info : ST_EcLastProtErrInfo;
END_VAR

bBusy: This output is set when the function block is activated, and remains set until an acknowledgement is received.

bError: This output is set after the bBusy output has been reset when an error occurs in the transmission of the command.

nErrId: Supplies the ADS error code associated with the most recently executed command if the bError output is set.

info: Structure with additional error information [98].
Sample in ST:

A rising edge at bGet triggers reading of additional error information relating to the most recent mailbox protocol error.

```plaintext
PROGRAM MAIN
VAR
  fbGetInfo : FB_EcGetLastProtErrInfo := ( sNetID := '172.16.6.195.2.1',
  nSlaveAddr := 1004,
  eProtocol := eEcMbxProt_FoE,
  tTimeout := DEFAULT_ADS_TIMEOUT );
  bGet : BOOL;
  bBusy : BOOL;
  bError : BOOL;
  nErrID : UDINT;
  sInfo : T_MaxString;
END_VAR

fbGetInfo( bExecute:= bGet,
  bBusy=>bBusy,
  bError=>bError,
  nErrId=>nErrId );

sInfo := BYTEARR_TO_MAXSTRING( fbGetInfo.info.binDesc );
```

Requirements

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<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>

5.7 FB_EcGetMasterDevState

The function block FB_EcGetMasterDevState can be used to read the current state of the EtherCAT master.

VAR_INPUT

```plaintext
VAR_INPUT
  sNetId   : T_AmsNetId;
  bExecute : BOOL;
  tTimeout : TIME := DEFAULT_ADS_TIMEOUT;
END_VAR
```

- **sNetId**: String containing the AMS network ID of the EtherCAT master device. (type: T_AmsNetId)
- **bExecute**: The function block is activated by a positive edge at this input.
- **tTimeout**: Maximum time allowed for the execution of the function block.

VAR_OUTPUT

```plaintext
VAR_OUTPUT
  bBusy   : BOOL;
  bError  : BOOL;
  nErrId  : UDINT;
  nDevState : WORD;
END_VAR
```

- **bBusy**: This output is set when the function block is activated, and remains set until an acknowledgement is received.
- **bError**: This output is set after the bBusy output has been reset when an error occurs in the transmission of the command.
nErrId: Supplies the ADS error code associated with the most recently executed command if the bError output is set.

nDevState: Current state of the master device.

Requirements

<table>
<thead>
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</tr>
</thead>
<tbody>
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<td>PC or CX (x86, x64, ARM)</td>
<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>

5.8 FB_EcGetScannedSlaves

The function block FB_EcGetScannedSlaves can be used to read a list of the currently available (scanned) slaves from the EtherCAT master object directory. To this end an online scan is executed, during which the EEPROMs of the EtherCAT slaves are read. The scanning process may take some time, depending on the number of connected slaves.

VAR_INPUT

<table>
<thead>
<tr>
<th>VAR_INPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>bExecute  : BOOL;</td>
</tr>
<tr>
<td>sNetId    : T_AmsNetId;</td>
</tr>
<tr>
<td>pArrEcScannedSlaveInfo : POINTER TO ARRAY[0..EC_MAX_SLAVES] OF ST_EcSlaveScannedData;</td>
</tr>
<tr>
<td>cbBufLen  : UDINT;</td>
</tr>
<tr>
<td>tTimeout  : TIME := DEFAULT_ADS_TIMEOUT;</td>
</tr>
</tbody>
</table>

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

sNetId: String containing the AMS network ID of the EtherCAT master device. (type: T_AmsNetId)

pArrEcScannedSlaveInfo: Address of an array of structures of type ST_EcSlaveScannedData[], to which the data for each scanned slave are to be written.

cbBufLen: Maximum available buffer size (in bytes) for the data to be read.

tTimeout: Maximum time allowed for the execution of the function block.

VAR_OUTPUT

<table>
<thead>
<tr>
<th>VAR_OUTPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>bBusy      : BOOL;</td>
</tr>
<tr>
<td>bError     : BOOL;</td>
</tr>
<tr>
<td>nErrId     : UDINT;</td>
</tr>
<tr>
<td>nSlaves    : UINT;</td>
</tr>
</tbody>
</table>

bBusy: This output is set when the function block is activated, and remains set until an acknowledgement is received.

bError: This output is set after the bBusy output has been reset when an error occurs in the transmission of the command.

nErrId: Supplies the ADS error code associated with the most recently executed command if the bError output is set. Error 1798 (0x706) indicates a null pointer at the buffer address. Error 1797 (0x705) indicates inadequate buffer size.

nSlaves: Returns the number of scanned slaves.
Requirements

<table>
<thead>
<tr>
<th>Development environment</th>
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</tr>
</thead>
<tbody>
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</tr>
</tbody>
</table>

5.9 **FB_EcGetSlaveCount**

The function block **FB_EcGetSlaveCount** can be used to determine the number of slaves that are connected to the master.

**VAR_INPUT**

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>sNetId : T_AmsNetId;</td>
<td>String containing the AMS network ID of the EtherCAT master device.</td>
</tr>
<tr>
<td>bExecute : BOOL;</td>
<td>The function block is activated by a positive edge at this input.</td>
</tr>
<tr>
<td>tTimeout : TIME := DEFAULT_ADS_TIMEOUT;</td>
<td>Maximum time allowed for the execution of the function block.</td>
</tr>
</tbody>
</table>

**VAR_OUTPUT**

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>bBusy : BOOL;</td>
<td>This output is set when the function block is activated, and remains set until an acknowledgement is received.</td>
</tr>
<tr>
<td>bError : BOOL;</td>
<td>This output is set after the bBusy output has been reset when an error occurs in the transmission of the command.</td>
</tr>
<tr>
<td>nErrId : UDINT;</td>
<td>Supplies the ADS error code associated with the most recently executed command if the bError output is set.</td>
</tr>
<tr>
<td>nSlaves : UINT;</td>
<td>The number of slaves connected to the master.</td>
</tr>
</tbody>
</table>

**Example of an implementation in ST:**

```st
PROGRAM TEST_GetSlaveCount
VAR
  fbGetSlaveCount : FB_EcGetSlaveCount;
  sNetId : T_AmsNetId := '172.16.2.131.2.1';
  bExecute : BOOL;
  nSlaves : UINT;
  bError : BOOL;
  nErrId : UDINT;
END_VAR

fbGetSlaveCount(sNetId:= sNetId, bExecute:= bExecute);
nSlaves := fbGetSlaveCount.nSlaves;
bError := fbGetSlaveCount.bError;
nErrId := fbGetSlaveCount.nErrId;
```
5.10 FB_EcGetSlaveCrcError

The function block FB_EcGetSlaveCrcError allows the CRC error counters of the individual ports (A, B and C) of a slave to be read. If the call is successful, the output variable crcError, whose type is ST_EcCrcError, contains the requested CRC error counter.

The function block FB_EcGetSlaveCrcError can only be used with slaves with up to 3 ports (e.g. EK1100). The function block FB_EcGetSlaveCrcErrorEx can also be used with slaves with up to 4 ports (e.g. EK1122).

VAR_INPUT

VAR_INPUT
sNetId : T_AmsNetId;
nSlaveAddr : UINT;
bExecute : BOOL;
tTimeout : TIME := DEFAULT_ADS_TIMEOUT;
END_VAR

sNetId: String containing the AMS network ID of the EtherCAT master device. (type: T_AmsNetId)
nSlaveAddr: Fixed address of the EtherCAT slave whose CRC error counter is to be read
bExecute: The function block is activated by a positive edge at this input.
tTimeout: Maximum time allowed for the execution of the function block.

VAR_OUTPUT

VAR_OUTPUT
bBusy : BOOL;
bError : BOOL;
nErrId : UDINT;
crcError : ST_EcCrcError;
END_VAR

bBusy: This output is set when the function block is activated, and remains set until an acknowledgement is received.
bError: This output is set after the bBusy output has been reset when an error occurs in the transmission of the command.
nErrId: Supplies the ADS error code associated with the most recently executed command if the bError output is set.
crcError: CRC error [98] counters for the individual ports.

Example of an implementation in ST:

PROGRAM TEST_GetSlaveCrcError
VAR
  fbGetSlaveCrcError : FB_EcGetSlaveCrcError;
sNetId : T_AmsNetId := '172.16.2.131.2.1';
bExecute : BOOL;
crcError : ST_EcCrcError;
END_VAR
nSlaveAddr := 1001;
bError := FALSE;
nErrId := 0;
END_VAR

fbGetSlaveCrcError(sNetId:= sNetId, nSlaveAddr:= nSlaveAddr, bExecute:=bExecute);
crcError := fbGetSlaveCrcError.crcError;
bError := fbGetSlaveCrcError.bError;
nErrId := fbGetSlaveCrcError.nErrId;

Requirements

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
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<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>

5.11 FB_EcGetSlaveCrcErrorEx

The function block FB_EcGetSlaveCrcErrorEx allows the CRC error counters of the individual ports (A, D, B and C) of a slave to be read. If the call is successful, the output variable crcError, whose type is ST_EcCrcErrorEx, contains the requested CRC error counter.

The function block FB_EcGetSlaveCrcErrorEx can also be used with slaves with up to 4 ports (e.g. EK1122). The function block FB_EcGetSlaveCrcError cannot only be used with slaves with up to 3 ports (e.g. EK1100).

VAR_INPUT

sNetId : T_AmsNetId; (*AmsNetId of the EtherCAT master device*)
nSlaveAddr : UINT; (*Address of the slave device*)
bExecute : BOOL; (*Function block execution is triggered by a rising edge at this input.*)
tTimeout : TIME; (*States the time before the function is cancelled.*)
END_VAR

sNetId: String containing the AMS network ID of the EtherCAT master device (type: T_AmsNetID).
nSlaveAddr: Fixed address of the EtherCAT slave whose CRC error counter is to be read.
bExecute: The function block is activated by a positive edge at this input.
tTimeout: Maximum time allowed for the execution of the function block.

VAR_OUTPUT

bBusy : BOOL;
bError : BOOL;
nErrId : UDINT;
CrcError : ST_EcCrcErrorEx; (*Crc error of the EtherCAT slave device*)
END_VAR

bBusy: This output is set when the function block is activated, and remains set until an acknowledgement is received.
bError: This output is set after the bBusy output has been reset when an error occurs in the transmission of the command.
nErrId: Supplies the ADS error code associated with the most recently executed command if the bError output is set.
CrcError: CRC error counters for the individual ports. (type: ST_EcCrcErrorEx [98])
## Requirements

<table>
<thead>
<tr>
<th>Development environment</th>
<th>Target platform</th>
<th>PLC libraries to include</th>
</tr>
</thead>
<tbody>
<tr>
<td>TwinCAT v3.1.0</td>
<td>PC or CX (x86, x64, ARM)</td>
<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>

### 5.12 FB_EcGetSlaveIdentity

The function block **FB_EcGetSlaveIdentity** can be used to read the CANopen identity of an individual EtherCAT slave device. If the call is successful, the output variable `identity`, whose type is **ST_EcSlaveIdentity**, contains the requested identity information.

#### VAR_INPUT

- **sNetId**: String containing the AMS network ID of the EtherCAT master device. (type **T_AmsNetId**)
- **nSlaveAddr**: Fixed address of the EtherCAT slave.
- **bExecute**: The function block is activated by a positive edge at this input.
- **tTimeout**: Maximum time allowed for the execution of the function block.

#### VAR_OUTPUT

- **bBusy**: This output is set when the function block is activated, and remains set until an acknowledgement is received.
- **bError**: This output is set after the bBusy output has been reset when an error occurs in the transmission of the command.
- **nErrId**: Supplies the ADS error code associated with the most recently executed command if the bError output is set.
- **identity**: CANopen identity [100] of the EtherCAT device.

Example of an implementation in ST:

```st
PROGRAM TEST_GetSlaveIdentity
VAR
  fbGetSlaveIdentity : FB_EcGetSlaveIdentity;
  sNetId : T_AmsNetId := '172.16.2.131.2.1';
  bExecute : BOOL;
  nSlaveAddr : UINT := 1001;
  identity : ST_EcSlaveIdentity;
END_VAR

fbGetSlaveIdentity(sNetId:= sNetId, nSlaveAddr:= nSlaveAddr, bExecute:=bExecute);
```
Requirements

<table>
<thead>
<tr>
<th>Development environment</th>
<th>Target platform</th>
<th>PLC libraries to include</th>
</tr>
</thead>
<tbody>
<tr>
<td>TwinCAT v3.1.0</td>
<td>PC or CX (x86, x64, ARM)</td>
<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>

5.13 FB_EcGetSlaveTopologyInfo

The function block FB_EcGetSlaveTopologyInfo can be used to determine topology information.

VAR_INPUT

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>sNetId</td>
<td>String containing the AMS network ID of the EtherCAT master device. (type: T_AmsNetId)</td>
</tr>
<tr>
<td>pAddrBuf</td>
<td>Address of an array of structures of type ST_TopologyDataEx[104], which contains the topology data.</td>
</tr>
<tr>
<td>cbBufLen</td>
<td>Maximum available buffer size (in bytes) for the data to be read.</td>
</tr>
<tr>
<td>bExecute</td>
<td>The function block is activated by a positive edge at this input.</td>
</tr>
<tr>
<td>tTimeout</td>
<td>Maximum time allowed for the execution of the function block.</td>
</tr>
</tbody>
</table>

VAR_OUTPUT

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>bBusy</td>
<td>This output is set when the function block is activated, and remains set until an acknowledgement is received.</td>
</tr>
<tr>
<td>bError</td>
<td>This output is set after the bBusy output has been reset when an error occurs in the transmission of the command.</td>
</tr>
<tr>
<td>nErrId</td>
<td>Supplies the ADS error code associated with the most recently executed command if the bError output is set. Error 1798 (0x706) indicates a null pointer at the buffer address. Error 1797 (0x705) indicates inadequate buffer size.</td>
</tr>
<tr>
<td>nSlaves</td>
<td>The number of slaves connected to the master.</td>
</tr>
</tbody>
</table>

Requirements

<table>
<thead>
<tr>
<th>Development environment</th>
<th>Target platform</th>
<th>PLC libraries to include</th>
</tr>
</thead>
<tbody>
<tr>
<td>TwinCAT v3.1.0</td>
<td>PC or CX (x86, x64, ARM)</td>
<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>
5.14 FB_EcMasterFrameCount

The function block FB_EcMasterFrameCount can be used to determine the number of EtherCAT frames configured in the master.

**VAR_INPUT**

```
VAR_INPUT
  sNetId : T_AmsNetId;
  bExecute : BOOL;
  tTimeout : TIME := DEFAULT_ADS_TIMEOUT;
END_VAR
```

- **sNetId**: String containing the AMS network ID of the EtherCAT master device. (type: T_AmsNetId)
- **bExecute**: The function block is activated by a positive edge at this input.
- **tTimeout**: Maximum time allowed for the execution of the function block.

**VAR_OUTPUT**

```
VAR_INPUT
  bBusy : BOOL;
  bError : BOOL;
  nErrId : UDINT;
  nFrames : UDINT;
END_VAR
```

- **bBusy**: This output is set when the function block is activated, and remains set until an acknowledgement is received.
- **bError**: This output is set after the bBusy output has been reset when an error occurs in the transmission of the command.
- **nErrId**: Supplies the ADS error code associated with the most recently executed command if the bError output is set.
- **nFrames**: Number of EtherCAT frames.

**Requirements**

<table>
<thead>
<tr>
<th>Development environment</th>
<th>Target platform</th>
<th>PLC libraries to include</th>
</tr>
</thead>
<tbody>
<tr>
<td>TwinCAT v3.1.0</td>
<td>PC or CX (x86, x64, ARM)</td>
<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>

5.15 FB_EcMasterFrameStatistic

The function block FB_EcMasterFrameStatistic can be used to read the frame statistics of the EtherCAT master. A distinction is made between cyclic and acyclic (queued) frames. Acyclic frames are used for the initialization or for parameter access to EtherCAT slaves. Frames are regarded as lost if they fail
to return to the master or are invalid.
The number of lost frames (i.e. lost or invalid cyclic frames), the number of cyclic frames per second, the
number of lost queued frames (i.e. lost or invalid acyclic frames) and the number of queued frames per
second is provided at the function block output.

VAR_INPUT

VAR_INPUT
  sNetId : T_AmsNetId;
  bExecute : BOOL;
  tTimeout : TIME := DEFAULT_ADS_TIMEOUT;
END_VAR

sNetId: String containing the AMS network ID of the EtherCAT master device. (type: T_AmsNetId)
bExecute: The function block is activated by a positive edge at this input.
tTimeout: Maximum time allowed for the execution of the function block.

VAR_OUTPUT

VAR_OUTPUT
  bBusy : BOOL;
  bError : BOOL;
  nErrId : UDINT;
  nLostFrames : UDINT;
  fFramesPerSecond : LREAL;
  nLostQueuedFrames : UDINT;
  fQueuedFramesPerSecond : LREAL;
END_VAR

bBusy: This output is set when the function block is activated, and remains set until an acknowledgement is
received.
bError: This output is set after the bBusy output has been reset when an error occurs in the transmission of
the command.
nErrId: Supplies the ADS error code associated with the most recently executed command if the bError
output is set.
nLostFrames: Returns the current number of lost or invalid cyclic frames.
fFramesPerSecond: Returns the current number of cyclic frames per second.
nLostQueuedFrames: Returns the current number of lost or invalid queued (acyclic) frames.
fQueuedFramesPerSecond: Returns the current number of queued (acyclic) frames per second.

Requirements

<table>
<thead>
<tr>
<th>Development environment</th>
<th>Target platform</th>
<th>PLC libraries to include</th>
</tr>
</thead>
<tbody>
<tr>
<td>TwinCAT v3.1.0</td>
<td>PC or CX (x86, x64, ARM)</td>
<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>

5.16 **FB_EcMasterFrameStatisticClearCRC**

The function block **FB_EcMasterFrameStatisticClearCRC** can be used to delete the CRC error
counters of all EtherCAT slaves.
VAR_INPUT

VAR_INPUT
  sNetId : T_AmsNetId;
  bExecute : BOOL;
  tTimeout : TIME := DEFAULT_ADS_TIMEOUT;
END_VAR

sNetId: String containing the AMS network ID of the EtherCAT master device. (type: T_AmsNetId)

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

tTimeout: Maximum time allowed for the execution of the function block.

VAR_OUTPUT

VAR_OUTPUT
  bBusy : BOOL;
  bError : BOOL;
  nErrId : UDINT;
END_VAR

bBusy: This output is set when the function block is activated, and remains set until an acknowledgement is received.

bError: This output is set after the bBusy output has been reset when an error occurs in the transmission of the command.

nErrId: Supplies the ADS error code associated with the most recently executed command if the bError output is set.

Requirements

<table>
<thead>
<tr>
<th>Development environment</th>
<th>Target platform</th>
<th>PLC libraries to include</th>
</tr>
</thead>
<tbody>
<tr>
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<td>PC or CX (x86, x64, ARM)</td>
<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>

5.17  FB_EcMasterFrameStatisticClearFrames

FB_EcMasterFrameStatisticClearFrames

sNetId : T_AmsNetId
bExecute : BOOL
bBusy : BOOL
bError : BOOL
tTimeout : TIME := DEFAULT_ADS_TIMEOUT
nErrId : UDINT

The function block FB_EcMasterFrameStatisticClearFrames can be used to delete the lost frame counters.

VAR_INPUT

VAR_INPUT
  sNetId : T_AmsNetId;
  bExecute : BOOL;
  tTimeout : TIME := DEFAULT_ADS_TIMEOUT;
END_VAR

sNetId: String containing the AMS network ID of the EtherCAT master device. (type: T_AmsNetId)

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

tTimeout: Maximum time allowed for the execution of the function block.

VAR_OUTPUT

VAR_OUTPUT
  bBusy : BOOL;
  bError : BOOL;
  nErrId : UDINT;
END_VAR
bBusy: This output is set when the function block is activated, and remains set until an acknowledgement is received.

bError: This output is set after the bBusy output has been reset when an error occurs in the transmission of the command.

nErrId: Supplies the ADS error code associated with the most recently executed command if the bError output is set.

Requirements

<table>
<thead>
<tr>
<th>Development environment</th>
<th>Target platform</th>
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</tr>
</thead>
<tbody>
<tr>
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<td>PC or CX (x86, x64, ARM)</td>
<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>

5.18 FB_EcMasterFrameStatisticClearTxRxErr

The function block FB_EcMasterFrameStatisticClearTxRxErr can be used to delete the error counters of the miniport driver of the network card.

VAR_INPUT

VAR_INPUT
sNetId : T_AmsNetId;
nEcMasterDevID : INT;
bExecute : BOOL;
tTimeout : TIME := DEFAULT_ADS_TIMEOUT;
END_VAR

sNetId: String containing the AMS network ID of the CPU (PC). (type: T_AMSNetId)

nEcMasterDevID: Device ID of the EtherCAT master.

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

tTimeout: Maximum time allowed for the execution of the function block.

VAR_OUTPUT

VAR_OUTPUT
  bBusy : BOOL;
  bError : BOOL;
  nErrId : UDINT;
END_VAR

bBusy: This output is set when the function block is activated, and remains set until an acknowledgement is received.

bError: This output is set after the bBusy output has been reset when an error occurs in the transmission of the command.

nErrId: Supplies the ADS error code associated with the most recently executed command if the bError output is set.

Requirements

<table>
<thead>
<tr>
<th>Development environment</th>
<th>Target platform</th>
<th>PLC libraries to include</th>
</tr>
</thead>
<tbody>
<tr>
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<td>PC or CX (x86, x64, ARM)</td>
<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>
5.19 F_CheckVendorId

The function F_CheckVendorId returns TRUE, if the VendorID is Beckhoff, otherwise FALSE.

VAR_INPUT

VAR_INPUT

<table>
<thead>
<tr>
<th>Development environment</th>
<th>Target platform</th>
<th>PLC libraries to include</th>
</tr>
</thead>
<tbody>
<tr>
<td>TwinCAT v3.1.0</td>
<td>PC or CX (x86, x64, ARM)</td>
<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>
6 EtherCAT State Machine

6.1 FB_EcGetAllSlaveStates

The FB_EcGetAllSlaveStates function block allows the EtherCAT status and the Link status of all the slaves connected to the master to be read. When the call is successful, the buffer passed in the parameter pStateBuf contains the requested status information as an array of ST_EcSlaveState.

VAR_INPUT

VAR_INPUT
sNetId : T_AmsNetId;
pStateBuf : POINTER TO ARRAY[0..EC_MAX_SLAVES] OF ST_EcSlaveState;
cbBufLen : UDINT;
bExecute : BOOL;
tTimeout : TIME := DEFAULT_ADS_TIMEOUT;
END_VAR

sNetId: String containing the AMS network ID of the EtherCAT master device. (type: T_AmsNetId)

pStateBuf: The address of an array of ST_EcSlaveStates into which the slave states are to be written.

cbBufLen: Maximum available buffer size (in bytes) for the data to be read.

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

tTimeout: Maximum time allowed for the execution of the function block.

VAR_OUTPUT

VAR_OUTPUT
bBusy : BOOL;
bError : BOOL;
nErrId : UDINT;
nSlaves : UINT;
END_VAR

bBusy: This output is set when the function block is activated, and remains set until an acknowledgement is received.

bError: This output is set after the bBusy output has been reset when an error occurs in the transmission of the command.

nErrId: Supplies the ADS error code associated with the most recently executed command if the bError output is set. Error 1798 (0x706) indicates a null pointer at the buffer address. Error 1797 (0x705) indicates inadequate buffer size.

nSlaves: The number of slaves connected to the master.

Example of an implementation in ST:

PROGRAM TEST_GetAllSlaveStates
VAR
  fbGetAllSlaveStates : FB_EcGetAllSlaveStates;
sNetId : T_AmsNetId := '172.16.2.131.2.1';
bExecute : BOOL;
devStates : ARRAY[0..255] OF ST_EcSlaveState;
nSlaves : UINT := 0;
bError : BOOL;
nErrId : UDINT;
END_VAR
EtherCAT State Machine

fbGetAllSlaveStates(sNetId:= sNetId, pStateBuf := ADR(devStates), cbBufLen:=SIZEOF(devStates), bExecute:=bExecute);
nSlaves := fbGetAllSlaveStates.nSlaves;
bError := fbGetAllSlaveStates.bError;
nErrId := fbGetAllSlaveStates.nErrId;

Requirements

<table>
<thead>
<tr>
<th>Development environment</th>
<th>Target platform</th>
<th>PLC libraries to include</th>
</tr>
</thead>
<tbody>
<tr>
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<td>PC or CX (x86, x64, ARM)</td>
<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>

6.2 FB_EcGetMasterState

The function block FB_EcGetMasterState can be used to read the EtherCAT state of the master. If the call is successful, the State output variable of type WORD contains the requested status information.

VAR_INPUT

VAR_INPUT

sNetId : T_AmsNetId;
bExecute : BOOL;
tTimeout : TIME := DEFAULT_ADS_TIMEOUT;
END_VAR

sNetId: String containing the AMS network ID of the EtherCAT master device. (type: T_AmsNetId)

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

tTimeout: Maximum time allowed for the execution of the function block.

VAR_OUTPUT

VAR_OUTPUT

bBusy : BOOL;
bError : BOOL;
nErrId : UDINT;
state : WORD;
END_VAR

bBusy: This output is set when the function block is activated, and remains set until an acknowledgement is received.

bError: This output is set after the bBusy output has been reset when an error occurs in the transmission of the command.

nErrId: Supplies the ADS error code associated with the most recently executed command if the bError output is set.

state: Current EtherCAT state of the master. The possible values are:

<table>
<thead>
<tr>
<th>Constant</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EC_DEVICE_STATE_INIT</td>
<td>0x01</td>
<td>Master is in Init state</td>
</tr>
<tr>
<td>EC_DEVICE_STATE_PREOP</td>
<td>0x02</td>
<td>Master is in Pre-operational state</td>
</tr>
<tr>
<td>EC_DEVICE_STATE_SAFEOP</td>
<td>0x04</td>
<td>Master is Safe-operational state</td>
</tr>
<tr>
<td>EC_DEVICE_STATE_OP</td>
<td>0x08</td>
<td>Master is Operational state</td>
</tr>
</tbody>
</table>
Example of an implementation in ST:

```plaintext
PROGRAM TEST_GetMasterState
VAR
  fbGetMasterState : FB_EcGetMasterState;
  sNetId           : T_AmsNetId := '172.16.2.131.2.1';
  bExecute         : BOOL;
  state            : WORD;
  bError           : BOOL;
  nErrId           : UDINT;
END_VAR

fbGetMasterState(sNetId:= sNetId, bExecute:=bExecute);
state := fbGetMasterState.state;
bError := fbGetMasterState.bError;
nErrId := fbGetMasterState.nErrId;
```

### Requirements

<table>
<thead>
<tr>
<th>Development environment</th>
<th>Target platform</th>
<th>PLC libraries to include</th>
</tr>
</thead>
<tbody>
<tr>
<td>TwinCAT v3.1.0</td>
<td>PC or CX (x86, x64, ARM)</td>
<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>

### 6.3 FB_EcGetSlaveState

The function block FB_EcGetSlaveState allows the EtherCAT status and the Link status of an individual EtherCAT slave to be read. If the call is successful, the output variable state, whose type is ST_EcSlaveState, contains the requested status information.

#### VAR_INPUT

```plaintext
VAR_INPUT
  sNetId      : T_AmsNetId;
  nSlaveAddr  : UINT;
  bExecute    : BOOL;
  tTimeout    : TIME := DEFAULT_ADS_TIMEOUT;
END_VAR
```

- **sNetId**: String containing the AMS network ID of the EtherCAT master device. (type: T_AmsNetId)
- **nSlaveAddr**: Fixed address of the EtherCAT slave whose status is to be read
- **bExecute**: The function block is activated by a positive edge at this input.
- **tTimeout**: Maximum time allowed for the execution of the function block.

#### VAR_OUTPUT

```plaintext
VAR_OUTPUT
  bBusy    : BOOL;
  bError   : BOOL;
  nErrId   : UDINT;
  state    : ST_EcSlaveState;
END_VAR
```

- **bBusy**: This output is set when the function block is activated, and remains set until an acknowledgement is received.
- **bError**: This output is set after the bBusy output has been reset when an error occurs in the transmission of the command.
- **nErrId**: Supplies the ADS error code associated with the most recently executed command if the bError output is set.
**EtherCAT State Machine**

**state**: Structure that contains the EtherCAT status and the Link status of the slave. (type: ST_EcSlaveState)

**Example of an implementation in ST:**

```st
PROGRAM TEST_GetSlaveState
VAR
    fbGetSlaveState : FB_EcGetSlaveState;
    sNetId           : T_AmsNetId := '172.16.2.131.2.1';
    bExecute         : BOOL;
    state            : ST_EcSlaveState;
    nSlaveAddr       : UINT := 1001;
    bError           : BOOL;
    nErrId           : UDINT;
END_VAR

fbGetSlaveState(sNetId:= sNetId, nSlaveAddr:= nSlaveAddr, bExecute:=bExecute);
state := fbGetSlaveState.state;
bError := fbGetSlaveState.bError;
nErrId := fbGetSlaveState.nErrId;
```

**Requirements**

<table>
<thead>
<tr>
<th>Development environment</th>
<th>Target platform</th>
<th>PLC libraries to include</th>
</tr>
</thead>
<tbody>
<tr>
<td>TwinCAT v3.1.0</td>
<td>PC or CX (x86, x64, ARM)</td>
<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>

### 6.4 FB_EcReqMasterState

With this function block the EtherCAT state of a master device can be requested and set. The requested EtherCAT state is transferred in the state variable. The function block becomes inactive as soon as it has requested the EtherCAT state. Unlike the function block FB_EcSetMasterState it does not wait until the new state is set.

**See also:** [FB_EcSetMasterState](#) [49]

**VAR_INPUT**

```st
VAR_INPUT
    sNetId : T_AmsNetId;
    bExecute : BOOL;
    tTimeout : TIME := DEFAULT_ADS_TIMEOUT;
    state : WORD;
END_VAR
```

- **sNetId**: String containing the AMS network ID of the EtherCAT master device. (type: T_AmsNetId)
- **bExecute**: The function block is activated by a positive edge at this input.
- **tTimeout**: Maximum time allowed for the execution of the function block.
- **state**: EtherCAT state requested from the master. The possible State values are:
### EtherCAT State Machine

#### PLC Lib: Tc2_EtherCAT

#### Version: 1.2

<table>
<thead>
<tr>
<th>Constant</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EC_DEVICE_STATE_INIT</td>
<td>0x01</td>
<td>Request Init state from master</td>
</tr>
<tr>
<td>EC_DEVICE_STATE_PREOP</td>
<td>0x02</td>
<td>Request Pre-operational state from master</td>
</tr>
<tr>
<td>EC_DEVICE_STATE_SAFEOP</td>
<td>0x04</td>
<td>Request Safe-operational state from master</td>
</tr>
<tr>
<td>EC_DEVICE_STATE_OP</td>
<td>0x08</td>
<td>Request Operational state from master</td>
</tr>
</tbody>
</table>

#### VAR_OUTPUT

```plaintext
VAR_OUTPUT
  bBusy  : BOOL;
  bError : BOOL;
  nErrId : UDINT;
END_VAR
```

**bBusy**: This output is set when the function block is activated, and remains set until an acknowledgement is received.

**bError**: This output is set after the bBusy output has been reset when an error occurs in the transmission of the command.

**nErrId**: Supplies the ADS error code associated with the most recently executed command if the bError output is set.

#### Example of an implementation in ST:

```plaintext
PROGRAM TEST_ReqMasterState
VAR
  fbReqMasterState : FB_EcReqMasterState;
  sNetId           : T_AmsNetId:= '172.16.2.131.2.1';
  bExecute         : BOOL;
  state            : WORD :=EC_DEVICE_STATE_INIT;
  bError           : BOOL;
  nErrId           : UDINT;
END_VAR

fbReqMasterState(sNetId:= sNetId, bExecute:=bExecute, state:=state);
  bError := fbGetMasterState.bError;
  nErrId := fbGetMasterState.nErrId;
```

#### Requirements

<table>
<thead>
<tr>
<th>Development environment</th>
<th>Target platform</th>
<th>PLC libraries to include</th>
</tr>
</thead>
<tbody>
<tr>
<td>TwinCAT v3.1.0</td>
<td>PC or CX (x86, x64, ARM)</td>
<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>

#### 6.5 FB_EcReqSlaveState

With this function block a slave can be set to a specified EtherCAT state. The requested EtherCAT state is transferred in the state variable. The function block becomes inactive as soon as it has sent the command to change state. Unlike the function block FB_EcSetSlaveState it does not wait until the EtherCAT slave has attained the new state.

See also: FB_EcSetSlaveState [50]
VAR_INPUT
VAR_INPUT
  sNetId : T_AmsNetId;
  nSlaveAddr : UINT;
  bExecute : BOOL;
  tTimeout : TIME := DEFAULT_ADS_TIMEOUT;
  state : WORD;
END_VAR

sNetId: String containing the AMS network ID of the EtherCAT master device. (type: T_AmsNetId)
nSlaveAddr: Fixed address of the EtherCAT slave whose EtherCAT state is to be set.
bExecute: The function block is activated by a positive edge at this input.
tTimeout: Maximum time allowed for the execution of the function block.

state: EtherCAT state to which the slave is to be set. The possible State values are:

<table>
<thead>
<tr>
<th>Constant</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EC_DEVICE_STATE_INIT</td>
<td>0x01</td>
<td>Set slave to Init state</td>
</tr>
<tr>
<td>EC_DEVICE_STATE_PREOP</td>
<td>0x02</td>
<td>Set slave to Pre-operational state</td>
</tr>
<tr>
<td>EC_DEVICE_STATE_BOOTSTRAP</td>
<td>0x03</td>
<td>Set slave to Bootstrap state. This state is used for firmware downloads.</td>
</tr>
<tr>
<td>EC_DEVICE_STATE_SAFEOP</td>
<td>0x04</td>
<td>Set slave to Safe-operational state</td>
</tr>
<tr>
<td>EC_DEVICE_STATE_OP</td>
<td>0x08</td>
<td>Set slave to Operational state</td>
</tr>
<tr>
<td>EC_DEVICE_STATE_ERROR</td>
<td>0x10</td>
<td>If the error bit in the status byte is set in the EtherCAT slave (state.deviceState &amp; EC_DEVICE_STATE_ERROR = TRUE), the error bit can be reset by setting EC_DEVICE_STATE_ERROR.</td>
</tr>
</tbody>
</table>

VAR_OUTPUT
VAR_OUTPUT
  bBusy : BOOL;
  bError : BOOL;
  nErrId : UDINT;
END_VAR

bBusy: This output is set when the function block is activated, and remains set until an acknowledgement is received.
bError: This output is set after the bBusy output has been reset when an error occurs in the transmission of the command.
nErrId: Supplies the ADS error code associated with the most recently executed command if the bError output is set.

Example of an implementation in ST:

PROGRAM TEST_ReqSlaveState
VAR
  fbGetSlaveState : FB_EcReqSlaveState;
  sNetId : T_AmsNetId:= '172.16.2.131.2.1';
  bExecute : BOOL;
  state : WORD := EC_DEVICE_STATE_INIT;
  nSlaveAddr : UINT := 1001;
  bError : BOOL;
  nErrId : UDINT;
END_VAR

fbGetSlaveState(sNetId:= sNetId, nSlaveAddr:= nSlaveAddr, bExecute:=bExecute, state:=state);
bError := fbGetSlaveState.bError;
nErrId := fbGetSlaveState.nErrId;
Requirements

<table>
<thead>
<tr>
<th>Development environment</th>
<th>Target platform</th>
<th>PLC libraries to include</th>
</tr>
</thead>
<tbody>
<tr>
<td>TwinCAT v3.1.0</td>
<td>PC or CX (x86, x64, ARM)</td>
<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>

6.6 FB_EcSetMasterState

With this function block the EtherCAT state of a master device can be requested and set. The requested EtherCAT state is transferred with the reqState variable. The function block requests the EtherCAT state and, unlike the function block FB_EcReqMasterState, remains active until the new state is set or the maximum time tTimeout is exceeded. The current state is output in the currState variable.

See also: FB_EcReqMasterState [46]

VAR_INPUT

<table>
<thead>
<tr>
<th>VAR_INPUT</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>sNetId</td>
<td>T_AmsNetId; String containing the AMS network ID of the EtherCAT master device. (type: T_AmsNetId)</td>
</tr>
<tr>
<td>bExecute</td>
<td>Boolean; The function block is activated by a positive edge at this input.</td>
</tr>
<tr>
<td>tTimeout</td>
<td>TIME := T#10s; Maximum time allowed for the execution of the function block.</td>
</tr>
<tr>
<td>reqState</td>
<td>WORD; EtherCAT state requested from the master. The possible values for reqState are:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Constant</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECDEVICESTATE_INIT</td>
<td>0x01</td>
<td>Request Init state from master</td>
</tr>
<tr>
<td>ECDEVICESTATE_PREOP</td>
<td>0x02</td>
<td>Request Pre-operational state from master</td>
</tr>
<tr>
<td>ECDEVICESTATESAFEOP</td>
<td>0x04</td>
<td>Request Safe-operational state from master</td>
</tr>
<tr>
<td>ECDEVICESTATEOP</td>
<td>0x08</td>
<td>Request Operational state from master</td>
</tr>
</tbody>
</table>

VAR_OUTPUT

<table>
<thead>
<tr>
<th>VAR_OUTPUT</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>bBusy</td>
<td>Boolean; This output is set when the function block is activated, and remains set until an acknowledgement is received.</td>
</tr>
<tr>
<td>bError</td>
<td>Boolean; This output is set after the bBusy output has been reset when an error occurs in the transmission of the command.</td>
</tr>
<tr>
<td>nErrId</td>
<td>UDINT; Supplies the ADS error code associated with the most recently executed command if the bError output is set.</td>
</tr>
<tr>
<td>currState</td>
<td>WORD;</td>
</tr>
</tbody>
</table>

sNetId: String containing the AMS network ID of the EtherCAT master device. (type: T_AmsNetId)
bExecute: The function block is activated by a positive edge at this input.
tTimeout: Maximum time allowed for the execution of the function block.
reqState: EtherCAT state requested from the master. The possible values for reqState are:
currState: Current EtherCAT state of the master.

Requirements

<table>
<thead>
<tr>
<th>Development environment</th>
<th>Target platform</th>
<th>PLC libraries to include</th>
</tr>
</thead>
<tbody>
<tr>
<td>TwinCAT v3.1.0</td>
<td>PC or CX (x86, x64, ARM)</td>
<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>

6.7 FB_EcSetSlaveState

With this function block a slave can be set to a specified EtherCAT state. The requested EtherCAT state is transferred with the reqState variable. The function block sends the command to change state and, unlike the function block FB_EcRegSlaveState, remains active until the EtherCAT slave has attained the new state or the maximum time tTimeout is exceeded. The current state is output in the currState variable.

See also: FB_EcReqSlaveState [47]

VAR_INPUT

VAR_INPUT
sNetId : T_AmsNetId;
nSlaveAddr : UINT;
bExecute : BOOL;
tTimeout : TIME := T#10s;
reqState : WORD;

sNetId: String containing the AMS network ID of the EtherCAT master device. (type: T_AmsNetId)
nSlaveAddr: Fixed address of the EtherCAT slave whose EtherCAT state is to be set.
bExecute: The function block is activated by a positive edge at this input.
tTimeout: Maximum time allowed for the execution of the function block.

reqState: EtherCAT state to which the slave is to be set. The possible values for reqState are:

<table>
<thead>
<tr>
<th>Constant</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EC_DEVICE_STATE_INIT</td>
<td>0x01</td>
<td>Set slave to Init state</td>
</tr>
<tr>
<td>EC_DEVICE_STATE_PREOP</td>
<td>0x02</td>
<td>Set slave to Pre-operational state</td>
</tr>
<tr>
<td>ECDEVICE_STATE_BOOTSTRAP</td>
<td>0x03</td>
<td>Set slave to Bootstrap state. This state is used for firmware downloads.</td>
</tr>
<tr>
<td>ECDEVICE_STATE_SAFEOP</td>
<td>0x04</td>
<td>Set slave to Safe-operational state</td>
</tr>
<tr>
<td>ECDEVICE_STATE_OP</td>
<td>0x08</td>
<td>Set slave to Operational state</td>
</tr>
<tr>
<td>ECDEVICE_STATE_ERROR</td>
<td>0x10</td>
<td>If the error bit in the status byte is set in the EtherCAT slave (currState.deviceState AND ECDEVICE_STATE_ERROR = TRUE), the error bit can be reset by setting ECDEVICE_STATE_ERROR.</td>
</tr>
</tbody>
</table>
VAR_OUTPUT

VAR_OUTPUT
bBusy : BOOL;
bError : BOOL;
nErrId : UDINT;
currState : ST_ecSlaveState;
END_VAR

bBusy: This output is set when the function block is activated, and remains set until an acknowledgement is received.

bError: This output is set after the bBusy output has been reset when an error occurs in the transmission of the command.

nErrId: Supplies the ADS error code associated with the most recently executed command if the bError output is set.

currState: Current EtherCAT state [101] of the slave.

Requirements

<table>
<thead>
<tr>
<th>Development environment</th>
<th>Target platform</th>
<th>PLC libraries to include</th>
</tr>
</thead>
<tbody>
<tr>
<td>TwinCAT v3.1.0</td>
<td>PC or CX (x86, x64, ARM)</td>
<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>
7 FoE interface

7.1 FB_EcFoeAccess

This function block writes or reads data via the communication port of the “File access over EtherCAT” mailbox protocol.

VAR_INPUT

| hFoe     | T_HFoe;   |
| pBuffer  | DWORD;    |
| cbBuffer | UDINT;    |
| bExecute | BOOL;     |
| tTimeout | TIME := DEFAULT_ADS_TIMEOUT; |

hFoe: “File access over EtherCAT” handle [p. 107].

pBuffer: Contains the address of the buffer into which the data are to be read (read access) or the address of buffer containing the data to be written (write access). The buffer can be a single variable, an array or a structure, whose address can be found with the ADR operator.

cbBuffer: Contains the number of data bytes to be written or read.

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

tTimeout: Maximum time allowed for the execution of the function block.

VAR_OUTPUT

| bBusy   | BOOL; |
| bError  | BOOL; |
| nErrId  | UDINT; |
| cbDone  | UDINT; |
| bEOF    | BOOL; |

bBusy: This output is set when the function block is activated, and remains set until an acknowledgement is received.

bError: This output is set after the bBusy output has been reset when an error occurs in the transmission of the command.

nErrId: Supplies the ADS error code associated with the most recently executed command if the bError output is set.

cbDone: Number of the most recent successfully written or read data bytes.

bEOF: End of File. This variable becomes TRUE if the end of the file is reached during read access. For write access this variable has no purpose.

Requirements

<table>
<thead>
<tr>
<th>Development environment</th>
<th>Target platform</th>
<th>PLC libraries to include</th>
</tr>
</thead>
<tbody>
<tr>
<td>TwinCAT v3.1.0</td>
<td>PC or CX (x86, x64, ARM)</td>
<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>
### 7.2 FB_EcFoeClose

This function block closes the communication port for the “File access over EtherCAT” mailbox protocol.

**VAR_INPUT**

```plaintext
VAR_INPUT
  hFoe : T_HFoe;
  bExecute : BOOL;
  tTimeout : TIME := DEFAULT_ADS_TIMEOUT;
END_VAR
```

- **hFoe**: “File access over EtherCAT” handle [107].
- **bExecute**: The function block is activated by a positive edge at this input.
- **tTimeout**: Maximum time allowed for the execution of the function block.

**VAR_OUTPUT**

```plaintext
VAR_OUTPUT
  bBusy : BOOL;
  bError : BOOL;
  nErrId : UDINT;
END_VAR
```

- **bBusy**: This output is set when the function block is activated, and remains set until an acknowledgement is received.
- **bError**: This output is set after the bBusy output has been reset when an error occurs in the transmission of the command.
- **nErrId**: Supplies the ADS error code associated with the most recently executed command if the bError output is set.

**Requirements**

<table>
<thead>
<tr>
<th>Development environment</th>
<th>Target platform</th>
<th>PLC libraries to include</th>
</tr>
</thead>
<tbody>
<tr>
<td>TwinCAT v3.1.0</td>
<td>PC or CX (x86, x64, ARM)</td>
<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>

### 7.3 FB_EcFoeLoad

The function block **FB_EcFoeLoad** can be used to download or upload files to or from an EtherCAT device via the “File access over EtherCAT” mailbox protocol.
The path can only point to the local file system on the computer. This means that network paths cannot be used here! To upload or download files via the FoE protocol, the function block automatically resets the EtherCAT device to BOOTSTRAP mode. Finally, the function block tries to reset the device to the original state.

VAR_INPUT

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>sNetId</td>
<td>T_AmsNetId</td>
</tr>
<tr>
<td>nSlaveAddr</td>
<td>UINT</td>
</tr>
<tr>
<td>sPathName</td>
<td>T_MxString</td>
</tr>
<tr>
<td>dwPass</td>
<td>DWORD</td>
</tr>
<tr>
<td>eMode</td>
<td>E_EcFoeMode</td>
</tr>
<tr>
<td>bExecute</td>
<td>BOOL</td>
</tr>
<tr>
<td>tTimeout</td>
<td>TIME</td>
</tr>
</tbody>
</table>

VAR_OUTPUT

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>bBusy</td>
<td>BOOL</td>
</tr>
<tr>
<td>bError</td>
<td>BOOL</td>
</tr>
<tr>
<td>nErrId</td>
<td>UDINT</td>
</tr>
<tr>
<td>cbLoad</td>
<td>UDINT</td>
</tr>
<tr>
<td>nProgress</td>
<td>UDINT</td>
</tr>
<tr>
<td>sInfo</td>
<td>T_MxString</td>
</tr>
</tbody>
</table>

Sample in ST:

A rising edge at the bLoad variable triggers the firmware download via the “File access over EtherCAT” mailbox protocol.

PROGRAM MAIN

VAR

    fbDownload : FB_EcFoeLoad := ( sNetId := '5.0.34.3.1', nSlaveAddr := 3004, sPathName := 'C:\FOE_Test\EL6751\ECATFW__EL6751_C6_V0030.efw', dwPass := 0, eMode := eFoeMode_Write );
Requirements

<table>
<thead>
<tr>
<th>Development environment</th>
<th>Target platform</th>
<th>PLC libraries to include</th>
</tr>
</thead>
<tbody>
<tr>
<td>TwinCAT v3.1.0</td>
<td>PC or CX (x86, x64, ARM)</td>
<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>

7.4 FB_EcFoeOpen

This function block is used to open the communication port for the “File access over EtherCAT” mailbox protocol.

VAR_INPUT

```
VAR_INPUT
    sNetId    : T_AmsNetId;
    nPort     : UINT;
    sPathName : T_MaxString;
    dwPass    : DWORD;
    eMode     : E_EcFoeMode;
    bExecute  : BOOL;
    tTimeout  : TIME := DEFAULT_ADS_TIMEOUT;
END_VAR
```

sNetId: String containing the AMS network ID of the EtherCAT master device. (type: T_AmsNetId)

nPort: Fixed address of the EtherCAT device.

sPathName: Path name (e.g.: ‘c:\TwinCAT\FOE\Data.fwp’). By default, only the file name (without file name extension) is extracted from the file path that was entered and used as the file name for the FoE protocol (in our example: ‘Data’). From library version 3.3.12.0, file names including the file name extension can also be used (in our example: ‘Data.fwp’).

The use of the file name extension for all instances of the FB_EcFoeOpen function block can be enabled or disabled via the global Boolean variable Tc2_EtherCAT.bEcFoeOpenFileNameWithFileExt. By default, the variable has the value FALSE (no file name extension). If you set the value to TRUE, the use of the file name extensions is enabled.

Note that the FoE function blocks were originally used for firmware updates for which no file name extension was used. If you want to update the firmware, you may have to make sure that the global variable has its original default value, i.e. FALSE.

dwPass: Password.
eMode: Access mode \[^{97}\] (write/read access).

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

tTimeout: Maximum time allowed for the execution of the function block.

VAR_OUTPUT

```plaintext
VAR_OUTPUT
  bBusy : BOOL;
  bError : BOOL;
  nErrId : UDINT;
  hFoe : T_HFoe;
END_VAR
```

bBusy: This output is set when the function block is activated, and remains set until an acknowledgement is received.

bError: This output is set after the bBusy output has been reset when an error occurs in the transmission of the command.

nErrId: Supplies the ADS error code associated with the most recently executed command if the bError output is set.

hFoe: “File access over EtherCAT” handle \[^{107}\].

Requirements

<table>
<thead>
<tr>
<th>Development environment</th>
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<th>PLC libraries to include</th>
</tr>
</thead>
<tbody>
<tr>
<td>TwinCAT v3.1.0</td>
<td>PC or CX (x86, x64, ARM)</td>
<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>
8 SoE interface

8.1 FB_EcSoeRead

The function block FB_EcSoeRead can be used to read drive parameters by means of the “Servo drive profile over EtherCAT (SoE)” protocol. To this end the slave must have a mailbox and support the SoE protocol. The drive parameter to be read is specified with the parameters nIdn (identification number), nElement and nDriveNo.

VAR_INPUT

sNetId : T_AmsNetId;
nSlaveAddr : UINT;
nSubIndex : BYTE;
nIdn : WORD;
nElement : BYTE;
nDriveNo : BYTE;
bCommand : BOOL
pDstBuf : PVOID;
cbBufLen : UDINT;
bExecute : BOOL;
tTimeout : TIME := DEFAULT_ADS_TIMEOUT;

sNetId: String containing the AMS network ID of the EtherCAT master device. (type: T_AmsNetId)

nSlaveAddr: Fixed address of the EtherCAT slave to which the SoE read command is to be sent.

nIdn: Identification number of the parameter to be read.

nElement: Element number of the parameter to be read. The following values are permitted:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x01</td>
<td>Data status</td>
</tr>
<tr>
<td>0x02</td>
<td>Name (read only)</td>
</tr>
<tr>
<td>0x04</td>
<td>Attribute</td>
</tr>
<tr>
<td>0x08</td>
<td>Unit</td>
</tr>
<tr>
<td>0x10</td>
<td>Minimum</td>
</tr>
<tr>
<td>0x20</td>
<td>Maximum</td>
</tr>
<tr>
<td>0x40</td>
<td>Value</td>
</tr>
<tr>
<td>0x80</td>
<td>Default</td>
</tr>
</tbody>
</table>

nDriveNo: Drive number.

bCommand: This parameter should be set if internal command execution is to be used.

pDstBuf: Address (pointer) to the receive buffer.

cbBufLen: Maximum available buffer size (in bytes) for the data to be read.

bExecute: The function block is activated by a positive edge at this input.
**tTimeout**: Maximum time allowed for the execution of the function block.

**VAR_OUTPUT**

```plaintext
VAR_OUTPUT
  bBusy : BOOL;
  bError : BOOL;
  nErrId : UDINT;
END_VAR
```

**bBusy**: This output is set when the function block is activated, and remains set until an acknowledgement is received.

**bError**: This output is set after the bBusy output has been reset when an error occurs in the transmission of the command.

**nErrId**: Supplies the ADS error code associated with the most recently executed command if the bError output is set.

**Example of an implementation in ST:**

```plaintext
PROGRAM TEST_SoERead
VAR
  fbSoERead   : FB_EcSoERead;
  sNetId      : T_AmsNetId:= '172.16.2.131.2.1';
  bExecute    : BOOL;
  nSlaveAddr  : UINT := 1006;
  nIdn        : WORD := 15;
  nElement    : BYTE := 0;
  nDriveNo    : BYTE := 0;
  bCommand    : BOOL := FALSE;
  val         : UINT;
  bError      : BOOL;
  nErrId      : UDINT;
END_VAR

fbSoERead(sNetId:= sNetId,nSlaveAddr :=nSlaveAddr, nIdn := nIdn, nElement:=nElement, nDriveNo := nDriveNo, bCommand:=bCommand, pDstBuf:= ADR(val), cbBufLen:=SIZEOF(val),bExecute:=bExecute);

bError := fbSoERead.bError;

nErrId := fbSoERead.nErrId;
```

**Requirements**

<table>
<thead>
<tr>
<th>Development environment</th>
<th>Target platform</th>
<th>PLC libraries to include</th>
</tr>
</thead>
<tbody>
<tr>
<td>TwinCAT v3.1.0</td>
<td>PC or CX (x86, x64, ARM)</td>
<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>

### 8.2 **FB_EcSoeWrite**

The function block **FB_EcSoeWrite** can be used to write drive parameters by means of the “Servo drive profile over EtherCAT (SoE)” protocol. To this end the slave must have a mailbox and support the SoE protocol. The drive parameter to be written is specified with the parameters nIdn (identification number), nElement and nDriveNo.
VAR_INPUT

VAR_INPUT
sNetId : T_AmsNetId;
nSlaveAddr : UINT;
Idn : WORD;
Element : BYTE;
DriveNo : BYTE;
pCommand : BOOL;
pSrcBuf : PVOID;
BufLen : UDINT;
bExecute : BOOL;
tTimeout : TIME := DEFAULT_ADS_TIMEOUT;
END_VAR

sNetId: String containing the AMS network ID of the EtherCAT master device. (type: T_AmsNetId)

nSlaveAddr: Fixed address of the EtherCAT slave to which the SoE write command is to be sent.

Idn: Identification number of the parameter to be written.

Element: Element number of the parameter to be written. The following values are permitted:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x01</td>
<td>Data status</td>
</tr>
<tr>
<td>0x02</td>
<td>Name (read only)</td>
</tr>
<tr>
<td>0x04</td>
<td>Attribute</td>
</tr>
<tr>
<td>0x08</td>
<td>Unit</td>
</tr>
<tr>
<td>0x10</td>
<td>Minimum</td>
</tr>
<tr>
<td>0x20</td>
<td>Maximum</td>
</tr>
<tr>
<td>0x40</td>
<td>Value</td>
</tr>
<tr>
<td>0x80</td>
<td>Default</td>
</tr>
</tbody>
</table>

DriveNo: Drive number.

pCommand: This parameter must be set if internal command execution is to be used.

pSrcBuf: Address (pointer) to the send buffer.

cbBufLEN: Number of date to be sent in bytes.

bExecute: Number of date to be sent in bytes.

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

VAR_OUTPUT

VAR_OUTPUT
bBusy : BOOL;
bError : BOOL;
Err : UDINT;
END_VAR

bBusy: This output is set when the function block is activated, and remains set until an acknowledgement is received.

bError: This output is set after the bBusy output has been reset when an error occurs in the transmission of the command.

Err: Supplies the ADS error code associated with the most recently executed command if the bError output is set.

Example of an implementation in ST:

PROGRAM TEST_SoEWrite
VAR
  fbSoeWrite : FB_EcSoEWrite;
sNetId : T_AmsNetId := '172.16.2.131.2.1';
bExecute : BOOL;
nSlaveAddr : UINT := 1006;
END_VAR
Requirements

<table>
<thead>
<tr>
<th>Development environment</th>
<th>Target platform</th>
<th>PLC libraries to include</th>
</tr>
</thead>
<tbody>
<tr>
<td>TwinCAT v3.1.0</td>
<td>PC or CX (x86, x64, ARM)</td>
<td>Tc2EtherCAT</td>
</tr>
</tbody>
</table>

8.3 FB_SoERead_ByDriveRef

The FB_SoERead_ByDriveRef function block can be used to read drive parameters by means of the “Servo drive profile over EtherCAT (SoE)” protocol. To this end the slave must have a mailbox and support the SoE protocol. The drive parameter to be read is specified with the parameters nIdn (identification number), nElement and stDriveRef.

The global variable bSeqReadDrvAttrAndValue := TRUE from the Tc2EtherCAT library can be used to enforce sequential access to attribute and value. The default value of this variable is FALSE. Devices of the AX5xxx series enable parallel and sequential access to attribute and value. For third-party devices it may be necessary to separate access to attribute and value, which overall slows down access by several cycles.

VAR_INPUT

VAR_INPUT

stDriveRef : ST_DriveRef; (* contains sNetID of EcMaster, nSlaveAddr of EcDrive, nDriveNo of EcDrive, either preset or read from NC *)

VAR_INPUT

nIdn : WORD; (* SoE IDN: e.g. "S_0_IDN + 1" for S-0-0001 or "P_0_IDN + 23" for P-0-0023*)
nElement : BYTE; (* SoE element.*)
pDestBuf : PVOID; (* Contains the address of the buffer for the received data. *)
chBufLen : UDINT; (* Contains the max. number of bytes to be received. *)
bExecute : BOOL; (* Function block execution is triggered by a rising edge at this input.*)
tTimeout : TIME := DEFAULT_ADS_TIMEOUT; (* States the time before the function is cancelled.*)

END_VAR

stDriveRef: The reference to the drive can be linked directly to the PLC in the System Manager. To this end an instance of ST_PlcDriveRef must be used and the NetID of the Byte array converted to a string. (type: ST_DriveRef)

nIdn: Identification number of the parameter to be read.

nElement: Element number of the parameter to be read. The following values are permitted:
### Value | Description
--- | ---
0x01 | Data status
0x02 | Name (read only)
0x04 | Attribute
0x08 | Unit
0x10 | Minimum
0x20 | Maximum
0x40 | Value
0x80 | Default

**pDstBuf**: Address (pointer) to the read buffer.

**cbBufLen**: Maximum available buffer size (in bytes) for the data to be read.

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

**tTimeout**: Maximum time allowed for the execution of the function block.

### VAR_OUTPUT
```
VAR_OUTPUT
    bBusy     : BOOL;
    bError    : BOOL;
    iAdsErrId : UINT;
    iSercosErrId : UINT;
    dwAttribute : DWORD;
END_VAR
```

**bBusy**: This output is set when the function block is activated, and remains set until an acknowledgement is received.

**bError**: This output is set after the bBusy output has been reset when an error occurs in the transmission of the command.

**iAdsErrId**: In the case of a set bError output returns the ADS error code of the last executed command.

**iSercosErrId**: In the case of a set bError output returns the Sercos error of the last executed command.

**dwAttribute**: Returns the attributes of the Sercos parameter.

### Requirements

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<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>TwinCAT v3.1.0</td>
<td>PC or CX (x86, x64, ARM)</td>
<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>

### 8.4 FB_SoEWrite_ByDriveRef

The function block **FB_SoeWrite_ByRef** can be used to write drive parameters by means of the “Servo drive profile over EtherCAT (SoE)” protocol. To this end the slave must have a mailbox and support the SoE protocol. The drive parameter to be written is specified with the parameters nIdn (identification number), nElement and stDriveRef.
The global variable `bSeqReadDrvAttrAndValue := TRUE` from the Tc2_EtherCAT library can be used to enforce sequential access to attribute and value. The default value of this variable is FALSE. Devices of the AX5xxx series enable parallel and sequential access to attribute and value. For third-party devices it may be necessary to separate access to attribute and value, which overall slows down access by several cycles.

### VAR_INPUT
```
VAR_INPUT
  stDriveRef : ST_DriveRef; (* contains sNetID of EcMaster, nSlaveAddr of EcDrive, nDriveNo of EcDrive, either preset or read from NC *)
  nIdn       : WORD; (* SoE IDN: e.g. "S_0_IDN + 1" for S-0-0001 or "P_0_IDN + 23" for P-0-0023*)
  nElement   : DWORD; (* SoE element.*)
  pSrcBuf    : PVOID; (* Contains the address of the buffer containing the data to be send. *)
  cbBufLen   : UDINT; (* Contains the max. number of bytes to be received. *)
  bExecute   : BOOL; (* Function block execution is triggered by a rising edge at this input.*)
  tTimeout   : TIME := DEFAULT_ADS_TIMEOUT;(* States the time before the function is cancelled.*)
END_VAR
```

*stDriveRef*: The reference to the drive can be linked directly to the PLC in the System Manager. To this end an instance of `ST_PlcDriveRef` must be used and the NetID of the Byte array converted to a string. (type: `ST_DriveRef`)

*nIdn*: Identification number of the parameter to be read.

*nElement*: Element number of the parameter to be read. The following values are permitted:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x01</td>
<td>Data status</td>
</tr>
<tr>
<td>0x02</td>
<td>Name (read only)</td>
</tr>
<tr>
<td>0x04</td>
<td>Attribute</td>
</tr>
<tr>
<td>0x08</td>
<td>Unit</td>
</tr>
<tr>
<td>0x10</td>
<td>Minimum</td>
</tr>
<tr>
<td>0x20</td>
<td>Maximum</td>
</tr>
<tr>
<td>0x40</td>
<td>Value</td>
</tr>
<tr>
<td>0x80</td>
<td>Default</td>
</tr>
</tbody>
</table>

*pSrcBuf*: Address (pointer) to the send buffer.

*cbBufLen*: Maximum available buffer size (in bytes) for the data to be read.

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

*tTimeout*: Maximum time allowed for the execution of the function block.

### VAR_OUTPUT
```
VAR_OUTPUT
  bBusy        : BOOL;
  bError       : BOOL;
  iAdsErrId    : UINT;
  iSercosErrId : UINT;
END_VAR
```

*bBusy*: This output is set when the function block is activated, and remains set until an acknowledgement is received.

*bError*: This output is set after the bBusy output has been reset when an error occurs in the transmission of the command.

*iAdsErrId*: In the case of a set bError output returns the ADS error code of the last executed command.

*iSercosErrId*: In the case of a set bError output returns the Sercos error of the last executed command:

### Requirements

<table>
<thead>
<tr>
<th>Development environment</th>
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</thead>
<tbody>
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</tr>
</tbody>
</table>
Conversion Functions

9.1 F_ConvBK1120CouplerStateToString

The function F_ConvBK1120CouplerStateToString returns the coupler state of the BK1120/BK1150/BK1250 as string. For nState = 0 'No error' is returned, otherwise 'K-bus error' is returned, e.g. for nState = 1. If several errors are pending, they are separated by commas.

VAR_INPUT

VAR_INPUT
  nState : WORD;
END_VAR

nState: Coupler state; can be linked in the System Manager from the inputs of the BK1120/BK1250 to the PLC.

0x0000 = 'No error'
0x0001 = 'K-Bus error'
0x0002 = 'Configuration error'
0x0010 = 'Outputs disabled'
0x0020 = 'K-Bus overrun'
0x0040 = 'Communication error (Inputs)'
0x0080 = 'Communication error (Outputs)'

Requirements

<table>
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<tr>
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</thead>
<tbody>
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<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>

9.2 F_ConvMasterDevStateToString

The function F_ConvMasterDevStateToString converts the device status of the EtherCAT master to string.

For nState = 0 'OK' is returned, otherwise, 'Not OK – Link error', e.g. for nState = 1. If several errors are pending, they are separated by hyphens.

VAR_INPUT

VAR_INPUT
  nState : WORD;
END_VAR

nState: Device status of the EtherCAT master; can be linked as DevState in the System Manager from the inputs of the EtherCAT master to the PLC.

0x0001 = 'Link error'
0x0002 = 'I/O locked after link error (I/O reset required)'
0x0004 = 'Link error (redundancy adapter)'
0x0008 = 'Missing one frame (redundancy mode)'
0x0010 = 'Out of send resources (I/O reset required)'
0x0020 = 'Watchdog triggered'
0x0040 = 'Ethernet driver (miniport) not found'
Conversion Functions

| 0x0080 = 'I/O reset active' |
| 0x0100 = 'At least one device in 'INIT' state' |
| 0x0200 = 'At least one device in 'PRE-OP' state' |
| 0x0400 = 'At least one device in 'SAFE-OP' state' |
| 0x0800 = 'At least one device indicates an error state' |
| 0x1000 = 'DC not in sync' |

Requirements

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</tr>
</tbody>
</table>

### 9.3 F_ConvProductCodeToString

The function `F_ConvProductCodeToString` returns the product code as string, e.g. 'EL6731-0000-0017'. From version 3.3.8.0 of the Tc2_EtherCAT library this function also supports ELM and EPP slaves such as 'EPP4374-0002-0018' and 'ELM3704-0001-0016'.

**VAR_INPUT**

```plaintext
VAR_INPUT
stSlaveIdentity : ST_EcSlaveIdentity;
END_VAR
```

`stSlaveIdentity`: Slave identity, which can be read with `FB_EcGetSlaveIdentity` [36].

Requirements

<table>
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<tbody>
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</tr>
</tbody>
</table>

### 9.4 F_ConvSlaveStateToString

The function `F_ConvSlaveStateToString` returns the EtherCAT slave state as string. For conversion to the string see `F_ConvStateToString` [65].

**VAR_INPUT**

```plaintext
VAR_INPUT
state : ST_EcSlaveState;
END_VAR
```

`state`: EtherCAT slave state structure (consisting of: deviceState : BYTE; linkState : BYTE;)

Requirements

<table>
<thead>
<tr>
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</thead>
<tbody>
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<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>
9.5  F_ConvSlaveStateToBits

The function \texttt{F_ConvSlaveStateToBits} returns the EtherCAT slave state as structure \texttt{TYPE ST EcSlaveStateBits [\ref{102}]}.\par

**VAR_INPUT**\par

\begin{verbatim}
VAR_INPUT
    stEcSlaveState : ST_EcSlaveState;
END_VAR
\end{verbatim}\par

\texttt{stEcSlaveState}: EtherCAT slave state structure (consisting of: deviceState : BYTE; linkState : BYTE;)

**Requirements**\par

<table>
<thead>
<tr>
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</table>

9.6  F_ConvSlaveStateToBitsEx

The function \texttt{F_ConvSlaveStateToBitsEx} returns the EtherCAT slave state as structure \texttt{ST EcSlaveStateBitsEx [\ref{103}]}.

**VAR_INPUT**\par

\begin{verbatim}
VAR_INPUT
    stEcSlaveState : ST_EcSlaveState;
END_VAR
\end{verbatim}\par

\texttt{stEcSlaveState}: EtherCAT slave state structure (consisting of: deviceState : BYTE; linkState : BYTE;)

**Requirements**\par

<table>
<thead>
<tr>
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</thead>
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<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>

9.7  F_ConvStateToString

The function \texttt{F_ConvStateToString} returns the EtherCAT slave state as string. For \texttt{nState} = 0 \textquote{\textquote{"\textquote{" is returned, otherwise, \textquote{"INIT \textquote{\textquote{" is returned, e.g. for \texttt{nState} = 1. If several messages are pending, they are separated by spaces.}
VAR_INPUT

VAR_INPUT

  nState : WORD;

END_VAR

nState: EtherCAT slave state as WORD

0x__1 = 'INIT'
0x__2 = 'PREOP'
0x__3 = 'BOOT'
0x__4 = 'SAFEOP'
0x__8 = 'OP'
0x001_ = 'Slave signals error'
0x002_ = 'Invalid vendorId, productCode... read'
0x004_ = 'Initialization error occurred'
0x008_ = 'Slave disabled'
0x010_ = 'Slave not present'
0x020_ = 'Slave signals link error'
0x040_ = 'Slave signals missing link'
0x080_ = 'Slave signals unexpected link'
0x100_ = 'Communication port A'
0x200_ = 'Communication port B'
0x400_ = 'Communication port C'
0x800_ = 'Communication port D'

Requirements

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</tr>
</tbody>
</table>
10 Distributed Clocks

10.1 DCTIME32

10.1.1 ConvertDcTimeToPos

This function block converts a 32-bit distributed clock system time variable of type T_DCTIME32 \[105\] to a corresponding NC axis position (i.e. the NC axis position at precisely this time).

**VAR_INPUT**

```
VAR_INPUT
    nAxisId   : UDINT;
    nSubIdx   : UDINT;
    dcTime    : T_DCTIME32; (* 32 bit distributed clock time *)
END_VAR
```

**nAxisId:** ID of the NC axis

**nSubIdx:** This 32-bit input variable contains two different items of information, and is therefore divided into two 16-bit values:

- The low word (the 16 bits with the lowest value) contains the subindex for relative addressing of an encoder subelement at an axis. The subindex is counted upwards from zero. For the typical case of an axis that has just one encoder, the null subindex is correct.
- The high word (the 16 bits with the highest value) contains a control word (bit mask) that affects the way in which the position is calculated (e.g. the type of interpolation or extrapolation). A bit mask value of 0x0001 means that the set acceleration of the axis is to be included in the calculation.

**dcTime:** 32-bit distributed clock system time variable. This input magnitude is converted through calculation into the corresponding NC axis position.

**NOTE**

The 32-bit time may only be used in the narrow range of ± 2,147 seconds around the current system time, to ensure that it is unambiguous. Within the function block this prerequisite cannot be checked.

**VAR_OUTPUT**

```
VAR_OUTPUT
    fPosition : LREAL;
    iErr      : UDINT;
END_VAR
```

**fPosition:** Supplies the NC axis position corresponding to dcTime. This is an NC axis position that has been scaled and provided with an offset, having, for instance, physical units of degrees or of millimetres.

**iErr:** Returns the error number if an error occurs, e.g. error 0x4012 (axis ID is not allowed, or axis does not exist within the system).

**Requirements**

<table>
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</tr>
</tbody>
</table>
10.1.2 ConvertPosToDcTime

This function block converts an NC axis position to a corresponding 32-bit distributed clock system time variable of type T_DCTIME32 (i.e. the time which precisely this NC axis position was or will be reached).

**VAR_INPUT**

```plaintext
VAR_INPUT
  nAxisId : UDINT;
  nSubIdx : UDINT;
  fPosition : LREAL;
END_VAR
```

- **nAxisId**: ID of the NC axis.
- **nSubIdx**: This 32-bit input magnitude is composed of two different items of information, and is divided into two 16-bit values:
  - The low word (the 16 bits with the lowest value) contains the subindex for relative addressing of an encoder subelement at an axis. The subindex is counted upwards from zero. For the typical case of an axis that has just one encoder, the null subindex is correct.
  - The high word (the 16 bits with the highest value) contains a control word (bit mask) that affects the way in which the position is calculated (e.g. the type of interpolation or extrapolation). A bit mask value of 0x0001 means that the set acceleration of the axis is to be included in the calculation.
- **fPosition**: NC axis position that is converted to the corresponding 32-bit distributed clock system time variable.

If the distributed clock system time that corresponds to the position is outside the expected time window of ±2,147 seconds, this conversion is rejected with an error number.

**VAR_OUTPUT**

```plaintext
VAR_OUTPUT
  dcTime : T_DCTIME32;(* 32 bit distributed clock time *)
  iErr : UDINT;
END_VAR
```

- **dcTime**: Returns the 32-bit distributed clock system time variable that corresponds to input fPosition.
- **iErr**: Supplies an error number if an error occurs, e.g.
  - Error 0x4012: axis ID is not allowed, or axis is not present in the system,
  - Error 0x4361: time window exceeded (future),
  - Error 0x4362: time window exceeded (past),
  - Error 0x4363: position cannot be found mathematically.

**Requirements**

<table>
<thead>
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</thead>
<tbody>
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<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>
10.1.3 ConvertDcTimeToPathPos

This function block converts a 32-bit distributed clock system time variable of type T_DCTIME32 [105] to a relative Nci path distance on the contour of the currently active Nci program (i.e. the function block returns a positive or negative relative interval, depending on the timing).

VAR_INPUT

VAR_INPUT
nGrpId : UDINT;
SubIdx : UDINT;
dcTime : T_DCTIME32;(* 32 bit distributed clock time *)
END_VAR

nGrpId: Group ID of the corresponding Nci channel

nSubIdx: This 32-bit input variable contains two different items of information, and is therefore divided into two 16-bit values:

- The low word (the 16 bits with the lowest value) contains the subindex for relative addressing of an encoder subelement at an axis. The subindex is counted upwards from zero. For the typical case of an axis that has just one encoder, the null subindex is correct.

- The high word (the 16 bits with the highest value) contains a control word (bit mask) that affects the way in which the position is calculated (e.g. the type of interpolation or extrapolation).

A bit mask value of 0x0001 means that the set acceleration of the axis is to be included in the calculation.

Bit mask 0x0010 means that the calculation is relative and currently compulsory. Otherwise the call is rejected with an error.

dcTime: 32-bit distributed clock system time variable. This input variable is converted to the corresponding relative Nci path distance on the contour.

NOTE
The 32-bit time may only be used in the narrow range of ±2,147 seconds around the current system time, to ensure that it is unambiguous. Within the function block this prerequisite cannot be checked.

VAR_OUTPUT

VAR_OUTPUT
fPosition : LREAL;
iErr : UDINT;
END_VAR

fPosition: Returns the relative Nci path distance on the contour that corresponds to the dcTime.

iErr: Returns an error number in the event of an error.

Requirements

<table>
<thead>
<tr>
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</thead>
<tbody>
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<td>Tc2EtherCAT</td>
</tr>
</tbody>
</table>
10.1.4 ConvertPathPosToDcTime

This function block converts a relative Nci path distance to a corresponding 32-bit distributed clock system time variable of type \( T \_DCTIME32 \) (i.e. the time that corresponds or corresponded to the relative Nci path distance).

### VAR_INPUT

```plaintext
VAR_INPUT
   nGrpId   : UDINT;
   nSubIdx  : UDINT;
   fPosition: LREAL;
END_VAR
```

- **nGrpId**: Group ID of the corresponding Nci channel
- **nSubIdx**: This 32-bit input variable contains two different items of information, and is therefore divided into two 16-bit values:
  - The low word (the 16 bits with the lowest value) contains the subindex for relative addressing of an encoder subelement at an axis. The subindex is counted upwards from zero. For the typical case of an axis that has just one encoder, the null subindex is correct.
  - The high word (the 16 bits with the highest value) contains a control word (bit mask) that affects the way in which the position is calculated (e.g. the type of interpolation or extrapolation). A bit mask value of 0x0001 means that the set acceleration of the axis is to be included in the calculation. Bit mask 0x0010 means that the calculation is relative and currently compulsory. Otherwise the call is rejected with an error.

- **fPosition**: Relative Nci path distance, which is converted to the corresponding 32-bit distributed clock system time.

If the distributed clock system time that corresponds to the relative Nci path distance is outside the expected time window of \( \pm 2,147 \) seconds, this conversion is rejected with an error number.

### VAR_OUTPUT

```plaintext
VAR_OUTPUT
   dcTime : T\_DCTIME32;(* 32 bit distributed clock time *)
   iErr   : UDINT;
END_VAR
```

- **dcTime**: Returns the 32-bit distributed clock system time variable that corresponds to input fPosition.
- **iErr**: Supplies an error number if an error occurs, e.g.
  - Error 0x4361: time window exceeded (future),
  - Error 0x4362: time window exceeded (past),
  - Error 0x4363: position cannot be found mathematically.

### Requirements

<table>
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</tr>
</tbody>
</table>
10.2 DCTIME64

10.2.1 DCTIME_TO_DCTIME64

The function converts a distributed clock system time variable of type \texttt{T\_DCTIME} \[\text{106}\] to a 64-bit distributed clock system time variable of type \texttt{T\_DCTIME64} \[\text{105}\].

\textbf{FUNCTION DCTIME\_TO\_DCTIME64: T\_DCTIME64}

\textbf{VAR\_INPUT}

\texttt{in : T\_DCTIME;}

\textbf{END\_VAR}

\texttt{in: The distributed clock system time variable to be converted}

\textbf{Requirements}

\begin{tabular}{|l|l|l|}
\hline
Development environment & Target platform & PLC libraries to include \\
\hline
TwinCAT v3.1.0 & PC or CX (x86, x64, ARM) & Tc2\_EtherCAT \\
\hline
\end{tabular}

10.2.2 DCTIME64\_TO\_DCTIME

The function converts a distributed clock system time variable of type \texttt{T\_DCTIME} \[\text{105}\] to a 64-bit distributed clock system time variable of type \texttt{T\_DCTIME64} \[\text{106}\].

\textbf{FUNCTION DCTIME64\_TO\_DCTIME: T\_DCTIME}

\textbf{VAR\_INPUT}

\texttt{in : T\_DCTIME64;}

\textbf{END\_VAR}

\texttt{in: The distributed clock system time variable to be converted}

\textbf{Requirements}

\begin{tabular}{|l|l|l|}
\hline
Development environment & Target platform & PLC libraries to include \\
\hline
TwinCAT v3.1.0 & PC or CX (x86, x64, ARM) & Tc2\_EtherCAT \\
\hline
\end{tabular}

10.2.3 DCTIME64\_TO\_DCTIMESTRUCT

The function converts a 64-bit distributed clock system time variable of type \texttt{T\_DCTIME64} \[\text{105}\] to a structured variable of type \texttt{DCTIMESTRUCT} \[\text{104}\].

\textbf{FUNCTION DCTIME64\_TO\_DCTIMESTRUCT}

\textbf{VAR\_INPUT}

\texttt{in : T\_DCTIME64;}

\textbf{END\_VAR}
**Distributed Clocks**

**Example:**

```pascal
PROGRAM P_TEST
VAR
  dcStruct : DCTIMESTRUCT;
  dcTime : T_DCTIME64;
END_VAR

dcTime : F_GetCurDcTickTime64();
dcStruct := DCTIME64_TO_DCTIMESTRUCT (dcTime);
```

**Requirements**

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</tbody>
</table>

**10.2.4 DCTIME64_TO_FILETIME**

The function converts a 64-bit distributed clock system time variable of type `T_DCTIME64` to a 64-bit Windows file time variable of type `T_FILETIME`.

**FUNCTION DCTIME64_TO_FILETIME: T_FILETIME**

```pascal
VAR_INPUT
  in : T_DCTIME64;
END_VAR;

in: The distributed clock system time variable to be converted

**Example:**

```pascal
PROGRAM P_TEST
VAR
  ft : T_FILETIME;
  dct : T_DCTIME64;
END_VAR

dct := F_GetCurDcTickTime64();
ft := DCTIME64_TO_FILETIME(dct);
```

**Requirements**

<table>
<thead>
<tr>
<th>Development environment</th>
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</tr>
</thead>
<tbody>
<tr>
<td>TwinCAT v3.1.0</td>
<td>PC or CX (x86, x64, ARM)</td>
<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>

**10.2.5 DCTIME64_TO_STRING**

The function converts a 64-bit distributed clock system time variable of type `T_DCTIME64` to a string. The string resulting the conversion has the following format:

- `YYYY-MM-DD-hh:mm:ss.nnnnnnnnn`

  - `YYYY`: year;
  - `MM`: month;
  - `DD`: day;
• hh: hour;
• mm: minute;
• ss: second;
• nnnnnnnn: nanoseconds

FUNCTION DCTIME64_TO_STRING: STRING (29)

VAR_INPUT
in : T_DCTIME64; (*Distributed Clock Time*)
END_VAR

in: The distributed clock system time variable to be converted

Example:
See description of the function F_GetCurDcTickTime64 [79].

Requirements

<table>
<thead>
<tr>
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</thead>
<tbody>
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</tr>
</tbody>
</table>

10.2.6 DCTIME64_TO_SYSTEMTIME

The function converts a 64-bit distributed clock system time variable of type T_DCTIME64 to a structured Windows system time variable of type TIMESTRUCT.

DCTIME64_TO_SYSTEMTIME: TIMESTRUCT

VAR_INPUT
in : T_DCTIME64;
END_VAR

in: The distributed clock system time variable to be converted.

Example:

PROGRAM P_TEST
VAR
  syst : TIMESTRUCT
END_VAR

syst := DCTIME64_TO_SYSTEMTIME ( F_GetCurDcTickTime64() )

Requirements

<table>
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</tr>
</thead>
<tbody>
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</tr>
</tbody>
</table>

10.2.7 DCTIMESTRUCT_TO_DCTIME64

The function converts a structured variable of type of type DCTIMESTRUCT to a 64-bit distributed clock system time variable T_DCTIME64. The structure components wDayOfWeek is ignored in the conversion. The structure components wYear must be greater than or equal to 2000 and less than 2584. For invalid values of the structure components the function returns the value zero.
FUNCTION DCTIMESTRUCT_TO_DCTIME64: T_DCTIME64

VAR_INPUT
  in : DCTIMESTRUCT;
END_VAR

in: The structured variable to be converted

Example:

PROGRAM P_TEST
VAR
  dcStruct : DCTIMESTRUCT := (
    wYear := 2008, wMonth := 3, wDay := 13,
    wHour := 1, wMinute := 2, wSecond := 3,
    wMilliseconds := 123, wMicroseconds := 456, wNanoseconds := 789
  );
  dc64 : T_DCTIME64;
END_VAR

dc64 := DCTIMESTRUCT_TO_DCTIME64( dcStruct );

Requirements

<table>
<thead>
<tr>
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</thead>
<tbody>
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</tr>
</tbody>
</table>

10.2.8 FILETIME_TO_DCTIME64

The function converts a 64-bit Windows file time variable of type T_FILETIME to a 64-bit distributed clock system time variable of type T_DCTIME64. In the event of a conversion error the function returns the value zero.

FUNCTION FILETIME_TO_DCTIME64: T_DCTIME64

VAR_INPUT
  in : T_FILETIME;
END_VAR

in: The Windows file time variable to be converted.

Example:

PROGRAM P_TEST
VAR
  fbSysFileTime : GETSYSTEMTIME;
  ft : T_FILETIME;
  dct : T_DCTIME64;
END_VAR

fbSysFileTime(timeLoDW=>ft.dwLowDateTime, timeHiDW=>ft.dwHighDateTime);
dct := FILETIME_TO_DCTIME64(ft);

Requirements

<table>
<thead>
<tr>
<th>Development environment</th>
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</tr>
</thead>
<tbody>
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</tr>
</tbody>
</table>

10.2.9 STRING_TO_DCTIME64

The function converts a string to a distributed clock system time variable of type T_DCTIME64.
FUNCTION STRING_TO_DCTIME64: T_DCTIME64

VAR_INPUT
  in : STRING(29);
END_VAR

in: The string to be converted.

The string must have the following format: ‘YYYY-MM-DD-hh:mm:ss:nnnnnnnnn’

• YYYY: year;
• MM: month;
• DD: day;
• hh: hour;
• mm: minute;
• ss: second;
• nnnnnnnn: nanoseconds

Example:
See description of the function F_GetCurDcTickTime64 [79].

Requirements

<table>
<thead>
<tr>
<th>Development environment</th>
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</thead>
<tbody>
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<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>

10.2.10 SYSTEMTIME_TO_DCTIME64

FUNCTION SYSTEMTIME_TO_DCTIME64: T_DCTIME64

VAR_INPUT
  in : TIMESTRUCT;
  micro : WORD(0..999); (* Microseconds: 0..999 *)
  nano : WORD(0..999); (* Nanoseconds: 0..999 *)
END_VAR

in: The Windows system time variable to be converted

micro: microseconds

nano: nanoseconds

Example:

PROGRAM P_TEST
VAR
  syst : TIMESTRUCT := ( wYear := 2009, wMonth := 9, wDay := 16, wHour := 12, wMinute := 22, wSecond := 44, wMilliseconds := 123 );
END_VAR

dct := SYSTEMTIME_TO_DCTIME64( syst, 456, 789 );
### Requirements

<table>
<thead>
<tr>
<th>Development environment</th>
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</thead>
<tbody>
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</tr>
</tbody>
</table>

---

#### 10.2.11 FB_EcDcTimeCtrl64

![FB_EcDcTimeCtrl64](image)

This function block can be used to read the individual components such as year, month, day etc. of a 64-bit distributed clock system time variable of type `T_DCTIME64` [105]. The function block has several `A_GETXYZ` actions. Once the required action has been called, the value of the XYZ component is available in the "get" output variable. The "put" input variable is currently not used.

The function block features the following tasks:

- A_GetYear
- A_GetMonth
- A_GetDay
- A_GetDayOfWeek
- A_GetHour
- A_GetMinute
- A_GetSecond
- A_GetMilli
- A_GetMicro
- A_GetNano

**VAR_IN_OUT**

```plaintext
VAR_IN_OUT
in : T_DCTIME64;
END_VAR
```

**in**: TwinCAT distributed clock system time variable

**VAR_INPUT**

```plaintext
VAR_INPUT
put : WORD;
END_VAR
```

**put**: Input parameter (currently not used)

**VAR_OUTPUT**

```plaintext
VAR_OUTPUT
bError : BOOL;
get    : WORD;
END_VAR
```

**bError**: This output is set if an error has occurred during the action call.

**get**: Output parameter (year, month, day, etc.)

**Example of an implementation in ST:**

```plaintext
PROGRAM P_TEST
VAR
    dcStruct : DCTIMESTRUCT;
    dcTime   : T_DCTIME64;
    fbCtrl   : FB_EcDcTimeCtrl;
```

Distributed Clocks

PLC Lib: Tc2_EtherCAT
Version: 1.2

10.3 DCTIME64 and ULINT

10.3.1 F_ConvExtTimeToDcTime64

The function F_ConvExtTimeToDcTime64 converts an external time to the TwinCAT distributed clock system time.

FUNCTION F_ConvExtTimeToDcTime64: T_DCTIME64
VAR_INPUT
  ExtTime : T_DCTIME64;
  DcToExtTimeOffset : ULINT;
END_VAR

ExtTime: External time in TwinCAT distributed clock system time format
DcToExtTimeOffset: Time offset between the TwinCAT distributed clock system time and an external time.

Requirements

<table>
<thead>
<tr>
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<tbody>
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</tr>
</tbody>
</table>

10.3.2 F_ConvTcTimeToDcTime64

The function F_ConvTcTimeToDcTime64 converts the TwinCAT system time to the TwinCAT distributed clock system time.

Requirements

<table>
<thead>
<tr>
<th>Development environment</th>
<th>Target platform</th>
<th>PLC libraries to include</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>
Distributed Clocks

FUNCTION F_ConvTcTimeToDcTime64: T_DCTIME64

VAR_INPUT
    TcTime : T_DCTIME64;
    DcToTcTimeOffset : ULINT;
END_VAR

TcTime: TwinCAT system time in TwinCAT distributed clock system time format
DcToTcTimeOffset: Time offset between the TwinCAT distributed clock system time and the TwinCAT system time

Requirements

<table>
<thead>
<tr>
<th>Development environment</th>
<th>Target platform</th>
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</tr>
</thead>
<tbody>
<tr>
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<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>

10.3.3 F_ConvTcTimeToExtTime64

The function `F_ConvTcTimeToExtTime64` converts the TwinCAT distributed clock system time to an external time.

FUNCTION F_ConvTcTimeToExtTime64: T_DCTIME64

VAR_INPUT
    TcTime : T_DCTIME64;
    DcToTcTimeOffset : ULINT;
    DcToExtTimeOffset : ULINT;
END_VAR

TcTime: TwinCAT system time in distributed clock format
DcToTcTimeOffset: Time offset between the TwinCAT distributed clock system time and the TwinCAT system time
DcToExtTimeOffset: Time offset between the TwinCAT distributed clock system time and an external time

Requirements

<table>
<thead>
<tr>
<th>Development environment</th>
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</thead>
<tbody>
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</tr>
</tbody>
</table>

10.3.4 F_GetActualDcTime64

This function returns the current time in TwinCAT distributed clock system time format (T_DCTIME64 [105]).

FUNCTION F_GetActualDcTime: T_DCTIME64

VAR_INPUT
    (*none*)
END_VAR

Sample in ST:
PROGRAM MAIN
VAR
  actDC : T_DCTIME64;
  sAct  : STRING;
END_VAR

actDC := F_GetActualDcTime64();
sAct  := DCTIME64_TO_STRING( actDC );

Requirements

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
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</tr>
</tbody>
</table>

10.3.5  F_GetCurDcTaskTime64

This function returns the task start time (time at which the task should start) in TwinCAT distributed clock system time format (T_DCTIME64). The function always returns the start time of the task in which it was called.

FUNCTION F_GetCurDcTaskTime64: T_DCTIME64

VAR_INPUT
{"none"}
END_VAR

Requirements

<table>
<thead>
<tr>
<th>Development environment</th>
<th>Target platform</th>
<th>PLC libraries to include</th>
</tr>
</thead>
<tbody>
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</tr>
</tbody>
</table>

10.3.6  F_GetCurDcTickTime64

The function returns the time of the current (last) tick in TwinCAT distributed clock system time format (T_DCTIME64).

FUNCTION F_GetCurDcTickTime64: T_DCTIME64

VAR_INPUT
{"none"}
END_VAR

Example:

PROGRAM MAIN
VAR
  tDC  : T_DCTIME64;
  sDC  : STRING;
  tDCBack : T_DCTIME64;

  sDCZero : STRING;(* DCTIME64 = zero time starts on 01.01.2000 *)
  tDCBackFromZero : T_DCTIME64;
  tDCFromString : T_DCTIME64;
  sDCBackFromString : STRING;
END_VAR

  tDC := F_GetCurDcTickTime64();
DcToExtTimeOffset: Time offset between the TwinCAT distributed clock system time and an external time

DcToTcTimeOffset: Time offset between the TwinCAT distributed clock system time and the TwinCAT system time

Requirements

<table>
<thead>
<tr>
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</tr>
</tbody>
</table>

The function block FB_EcExtSyncCalcTimeDiff64 calculates the difference between external and internal time, taking into account the time offsets.

VAR_IN_OUT

VAR_IN_OUT

DcToTcTimeOffset : ULIINT;
DcToExtTimeOffset : ULIINT;
ExtTime : T_DCTIME64;
IntTime : T_DCTIME64;
END_VAR

DcToTcTimeOffset: Time offset between the TwinCAT distributed clock system time and the TwinCAT system time

DcToExtTimeOffset: Time offset between the TwinCAT distributed clock system time and an external time
**ExtTime**: External time in TwinCAT distributed clock system time format

**IntTime**: Internal time in TwinCAT distributed clock system time format

**VAR_OUTPUT**

<table>
<thead>
<tr>
<th></th>
<th>VAR_OUTPUT</th>
</tr>
</thead>
</table>
| nTimeDiff | UDINT; (*with difference greater than 32 bit timeDiff = 0xffffffff*)
| nOffsetFromSyncMaster | DINT; (*less than 32 bit int Offset = 0x80000000, greater than 32 bit int Offset = 0x7FFFFFFF*)

**nTimeDiff**: If the difference is less than 32 bit, the time difference is returned. If the difference is greater than 32 bit, 16#FFFFFFFF is returned.

**nOffsetFromSyncMaster**: If the difference is greater than 32 bit and the offset between internal and DC time is less than 32 bit, 16#80000000 is returned. If the difference is greater than 32 bit and the offset between internal and DC time is greater than 32 bit, 16#7FFFFFFF is returned.

**Requirements**

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</tbody>
</table>

**10.3.9 FB_EcExtSyncCheck64**

The function block **FB_EcExtSyncCheck64** checks whether the internal and external clocks are synchronous. See function block **FB_EcExtSyncCalcTimeDiff64** [80].

**VAR_INPUT**

<table>
<thead>
<tr>
<th></th>
<th>VAR_INPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>nSyncWindow</td>
<td>UDINT;</td>
</tr>
<tr>
<td>bNotConnected</td>
<td>BOOL;</td>
</tr>
</tbody>
</table>

**nSyncWindow**: Time window within which the internal and external clock are regarded as synchronous.

**bNotConnected**: TRUE = connection to external clock is interrupted.

**VAR_IN_OUT**

<table>
<thead>
<tr>
<th></th>
<th>VAR_IN_OUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>DcToTcTimeOffset</td>
<td>T_LARGE_INTEGER;</td>
</tr>
<tr>
<td>DcToExtTimeOffset</td>
<td>T_LARGE_INTEGER;</td>
</tr>
<tr>
<td>ExtTime</td>
<td>T_DCTIME64;</td>
</tr>
<tr>
<td>IntTime</td>
<td>T_DCTIME64;</td>
</tr>
</tbody>
</table>

**DcToTcTimeOffset**: Time offset between the TwinCAT distributed clock system time and the TwinCAT system time

**DcToExtTimeOffset**: Time offset between the TwinCAT distributed clock system time and an external time

**ExtTime**: External time in TwinCAT distributed clock system time format

**IntTime**: Internal time in TwinCAT distributed clock system time format
**VAR_OUTPUT**

```plaintext
VAR_OUTPUT
  bSynchronized : BOOL;
  nTimeDiff : UDINT;
  nOffsetFromSyncMaster : DINT;
END_VAR
```

- **bSynchronized**: TRUE = external and internal clock are synchronous
- **nTimeDiff**: Current time difference between the two clocks
- **nOffsetFromSyncMaster**: Offset to sync master

**Requirements**

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</tbody>
</table>

### 10.4 [outdated DCTIME]

#### 10.4.1 DCTIME_TO_DCTIMESTRUCT

The function converts a 64-bit distributed clock system time variable of type `{T_DCTIME}` to a structured variable of type `{DCTIMESTRUCT}`.

**FUNCTION DCTIME_TO_DCTIMESTRUCT: DCTIMESTRUCT**

```plaintext
FUNCTION DCTIME_TO_DCTIMESTRUCT: DCTIMESTRUCT
  VAR_INPUT
    in : T_DCTIME;
  END_VAR
  in: The distributed clock system time variable to be converted.

Example:

```plaintext
PROGRAM P_TEST
VAR
  dcStruct : DCTIMESTRUCT;
  dcTime : T_DCTIME;
END_VAR

dcTime := F_GetCurDcTickTime();
dcStruct := DCTIME_TO_DCTIMESTRUCT(dcTime);
```

**Requirements**

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</tr>
</tbody>
</table>
10.4.2 DCTIME_TO_FILETIME

Outdated function
This function is outdated. Use the function DCTIME64_TO_FILETIME [72] instead.

The function converts a 64-bit distributed clock system time variable of type T_DCTIME [106] to a 64-bit Windows file time variable of type T_FILETIME.

FUNCTION DCTIME_TO_FILETIME: T_FILETIME
VAR_INPUT
  in : T_DCTIME;
END_VAR

in: The distributed clock system time variable to be converted.

Example:

PROGRAM P_TEST
VAR
  ft : T_FILETIME;
  dct : T_DCTIME;
END_VAR

dct := F_GetCurDcTickTime();
ft := DCTIME_TO_FILETIME(dct);

Requirements

<table>
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</tbody>
</table>

10.4.3 DCTIME_TO_STRING

Outdated function
This function is outdated. Use the function DCTIME64_TO_STRING [72] instead.

The function converts a string to a distributed clock system time variable of type T_DCTIME [106].

The string resulting the conversion has the following format: 'YYYY-MM-DD-hh:mm:ss.nnnnnnnnnn'

- YYYY: year;
- MM: month;
- DD: day;
- hh: hour;
- mm: minute;
- ss: second;
- nnnnnnnnnn: nanoseconds;
FUNCTION DCTIME_TO_STRING: STRING(29)

VAR_INPUT
  in: T_DCTIME;
END_VAR

in: The distributed clock system time variable to be converted.

Example:

See description of the function $F\_GetCurDcTickTime$ [§ 91].

Requirements

<table>
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</tr>
</tbody>
</table>

10.4.4 DCTIME_TO_SYSTEMTIME

FUNCTION DCTIME_TO_SYSTEMTIME: TIMESTRUCT

VAR_INPUT
  in: T_DCTIME;
END_VAR

in: The distributed clock system time variable to be converted.

Example:

PROGRAM P_TEST
VAR
  syst : TIMESTRUCT;
END_VAR

syst := DCTIME_TO_SYSTEMTIME(F_GetCurDcTickTime());

Requirements

<table>
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</tr>
</tbody>
</table>

10.4.5 DCTIMESTRUCT_TO_DCTIME

FUNCTION DCTIMESTRUCT_TO_DCTIME

VAR_INPUT
  in: T_DCTIME;
END_VAR

in: The distributed clock system time variable to be converted.

Example:

PROGRAM P_TEST
VAR
  syst : TIMESTRUCT;
END_VAR

syst := DCTIME_TO_SYSTEMTIME(F_GetCurDcTickTime());

Requirements

<table>
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</tr>
</tbody>
</table>
Outdated function
This function is outdated. Use the function DCTIMESTRUCT_TO_DCTIME64 [73] instead.

The function converts a structured variable of type DCTIMESTRUCT [104] to a 64-bit distributed clock system time variable of type T_DCTIME [106]. The structure components wDayofWeek is ignored in the conversion. The structure components wYear must be greater than or equal to 2000 and less than 2584. For invalid values of the structure components the function returns the value zero.

FUNCTION DCTIMESTRUCT_TO_DCTIME: T_DCTIME
VAR_INPUT
  in : DCTIMESTRUCT;
END_VAR
in: The structured variable to be converted.

Example:
PROGRAM P_TEST
VAR
  dcStruct : DCTIMESTRUCT := ( wYear := 2008, wMonth := 3, wDay := 13,
    wHour := 1, wMinute := 2, wSecond := 3,
    wMilliseconds := 123, wMicroseconds := 456, wNanoseconds := 789 );
  dc64 : T_DCTIME;
END_VAR
dc64 := DCTIMESTRUCT_TO_DCTIME( dcStruct );

Requirements

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<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>

10.4.6 FILETIME_TO_DCTIME

Outdated function
The function is outdated. Use the function FILETIME_TO_DCTIME64 [74] instead.

The function converts a 64-bit Windows file time variable of type T_FILETIME to a 64-bit distributed clock system time variable of type T_DCTIME [106]. In the event of a conversion error the function returns the value zero.

FUNCTION FILETIME_TO_DCTIME: T_DCTIME
VAR_INPUT
  in : T_FILETIME;
END_VAR
in: The Windows file time variable to be converted.

Example:
PROGRAM P_TEST
VAR
  fbSysFileTime : GETSYSTEMTIME;
  ft : T_FILETIME;
  dct : T_DCTIME;
END_VAR
Distributed Clocks

```c
fbSysFileTime(timeLoDW=>ft.dwLowDateTime, timeHiDW=>ft.dwHighDateTime);
dct := FILETIME_TO_DCTIME(ft);
```

**Requirements**

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</table>

### 10.4.7 STRING_TO_DCTIME

**Outdated function**

This function is outdated. Use the function `STRING_TO_DCTIME64` instead.

The function converts a string to a distributed clock system time variable of type `T_DCTIME`.

**FUNCTION STRING_TO_DCTIME: T_DCTIME**

```c
FUNCTION STRING_TO_DCTIME: T_DCTIME
VAR_INPUT
    in : STRING(29);
END_VAR

in: The string to be converted.

The string must have the following format: 'YYYY-MM-DD-hh:mm:ss.nnnnnnnnnn'

- YYYY: year;
- MM: month;
- DD: day;
- hh: hour;
- mm: minute;
- ss: second;
- nnnnnnnnn: nanoseconds;

**Example:**

See description of the function `F_GetCurDcTickTime`.

**Requirements**

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</table>

### 10.4.8 SYSTEMTIME_TO_DCTIME

```c

```
Outdated function

This function is outdated. Use the function `SYSTEMTIME_TO_DCTIME64` instead.

The function converts a structured Windows system time variable of type TIMESTRUCT to a 64-bit distributed clock system time variable of type `T_DCTIME`. In the event of a conversion error the function returns the value zero.

**FUNCTION SYSTEMTIME_TO_DCTIME: T_DCTIME**

```
VAR_INPUT
  in : TIMESTRUCT;
  micro : WORD(0..999); (* Microseconds: 0..999 *)
  nano : WORD(0..999); (* Nanoseconds: 0..999 *)
END_VAR

in: The Windows system time variable to be converted.

micro: Microseconds.
nano: Nanoseconds.
```

**Example:**

```
PROGRAM P_TEST
VAR
  syst : TIMESTRUCT := ( wYear := 2009, wMonth := 9, wDay := 16, wHour := 12, wMinute := 22, wSecond := 44, wMilliseconds := 123 );
END_VAR

dct := SYSTEMTIME_TO_DCTIME( syst, 456, 789 );
```

**Requirements**

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**10.4.9 FB_EcDcTimeCtrl**

Outdated function

This function is outdated. Use the function block `FB_EcDcTimeCtrl64` instead.

This function block can be used to read the individual components such as year, month, day etc. of a 64-bit distributed clock system time variable of type `T_DCTIME`. The function block has several A_GetXYZ actions. Once the required action has been called, the value of the XYZ component is available in the “get” output variable. The “put” input variable is currently not used.

The function block currently has the following actions:

- A_GetYear;
- A_GetMonth;
- A_GetDay;
- A_GetDayOfWeek;
- A_GetHour;
- A_GetMinute;
- A_GetSecond;
Distributed Clocks

- A_GetMilli;
- A_GetMicro;
- A_GetNano;

**VAR IN/OUT**

```plaintext
VAR_IN_OUT
   in : T_DCTIME;
END_VAR
```
in: TwinCAT distributed clock system time variable

**VAR INPUT**

```plaintext
VAR_INPUT
   put : WORD;
END_VAR
```
put: Input parameter (currently not used)

**VAR OUTPUT**

```plaintext
VAR_OUTPUT
   bError : BOOL;
   get : WORD;
END_VAR
```
bError: This output is set if an error has occurred during the action call.
get: Output parameter (year, month, day, etc.)

Example of an implementation in ST:

```plaintext
PROGRAM P_TEST
VAR
   dcStruct : DCTIMESTRUCT;
   dcTime   : T_DCTIME;
   fbCtrl   : FB_EcDcTimeCtrl;
   wYear    : WORD;
   wMonth   : WORD;
   wDay     : WORD;
   wDayOfWeek : WORD;
   wHour    : WORD;
   wMinute  : WORD;
   wSecond  : WORD;
   wMilli   : WORD;
   wMicro   : WORD;
   wNano    : WORD;
END_VAR

dcTime := F_GetCurDcTickTime();

fbCtrl.A_GetYear( in := dcTime, get => wYear );
fbCtrl.A_GetMonth( in := dcTime, get => wMonth );
fbCtrl.A_GetDay( in := dcTime, get => wDay );
fbCtrl.A_GetDayOfWeek( in := dcTime, get => wDayOfWeek );
fbCtrl.A_GetHour( in := dcTime, get => wHour );
fbCtrl.A_GetMinute( in := dcTime, get => wMinute );
fbCtrl.A_GetSecond( in := dcTime, get => wSecond );
fbCtrl.A_GetMilli( in := dcTime, get => wMilli );
fbCtrl.A_GetMicro( in := dcTime, get => wMicro );
fbCtrl.A_GetNano( in := dcTime, get => wNano );
```

Requirements

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</table>

Version: 1.2  PLC Lib: Tc2_EtherCAT
10.5 [outdated DCTIME and T_LARGE_INTEGER]

10.5.1 F_ConvExtTimeToDcTime

The function F_ConvExtTimeToDcTime converts an external time to the TwinCAT distributed clock system time.

**FUNCTION F_ConvExtTimeToDcTime: T_DCTIME**

VAR_INPUT

| ExtTime       : T_DCTIME; |
| DcToExtTimeOffset : T_LARGE_INTEGER; |

END_VAR

**Requirements**

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</table>

10.5.2 F_ConvTcTimeToDcTime

The function F_ConvTcTimeToDcTime64 converts the TwinCAT system time to the TwinCAT distributed clock system time.

**FUNCTION F_ConvTcTimeToDcTime: T_DCTIME**

VAR_INPUT

| TcTime       : T_DCTIME; |
| DcToTcTimeOffset : T_LARGE_INTEGER; |

END_VAR

**Requirements**

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</tbody>
</table>
The function `F_ConvTcTimeToExtTime` converts the TwinCAT distributed clock system time to an external time.

**FUNCTION F_ConvTcTimeToExtTime: T_DCTIME**

```plaintext
VAR_INPUT
  TcTime : T_DCTIME;
  DcToTcTimeOffset : T_LARGE_INTEGER;
  DcToExtTimeOffset : T_LARGE_INTEGER;
END_VAR

TcTime: TwinCAT system time in distributed clock format
DcToTcTimeOffset: Time offset between the TwinCAT distributed clock system time and the TwinCAT system time
DcToExtTimeOffset: Time offset between the TwinCAT distributed clock system time and an external time
```

Requirements

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</table>

This function returns the current time in TwinCAT distributed clock system time format (T_DCTIME [106]).

**FUNCTION F_GetActualDcTime: T_DCTIME**

```plaintext
VAR_INPUT
  (*none*)
END_VAR

Example:

```plaintext
PROGRAM MAIN
VAR
  actDC : T_DCTIME;
  sAct : STRING;
END_VAR

actDC := F_GetActualDcTime();
sAct := DCTIME_TO_STRING( actDC );
```
Requirements

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</table>

10.5.5  F_GetCurDcTaskTime

Outdated function

This function is outdated. Use the function `F_GetCurDcTaskTime64` instead.

This function returns the task start time (time at which the task should start) in TwinCAT distributed clock system time format (`T_DCTIME`). The function always returns the start time of the task in which it was called.

```plaintext
FUNCTION F_GetCurDcTaskTime: T_DCTIME
VAR_INPUT
{"none")
END_VAR
```

10.5.6  F_GetCurDcTickTime

Outdated function

The function is outdated. Use the function `F_GetCurDcTickTime64` instead.

The function returns the time of the current (last) tick in TwinCAT distributed clock system time format (`T_DCTIME`).

```plaintext
FUNCTION F_GetCurDcTickTime: T_DCTIME
VAR_INPUT
{"none")
END_VAR
```

Example:

```plaintext
PROGRAM MAIN
VAR
  tDC : T_DCTIME;
  sDC : STRING;
  tDCBack : T_DCTIME;
  sDCZero : STRING;(* DCTIME = zero time starts on 01.01.2000 *)
  tDCBackFromZero : T_DCTIME;
```
Distributed Clocks

\[
tDCFromString : T_DCTIME; \\
sDCBackFromString : STRING;
\]

END_VAR

\[
tDC := F_GetCurDcTickTime(); \\
sDC := DCTIME_TO_STRING( tDC ); \\
tDCBack := STRING_TO_DCTIME( sDC );
\]

\[
sDCZero := DCTIME_TO_STRING( ULARGE_INTEGER(0, 0) ); \\
tDCBackFromZero := STRING_TO_DCTIME( sDCZero );
\]

\[
tDCFromString := STRING_TO_DCTIME( '2007-03-09-11:31:09.223456789' ); \\
sDCBackFromString := DCTIME_TO_STRING( tDCFromString );
\]

Requirements

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</table>

### 10.5.7 F_GetCurExtTime

![F_GetCurExtTime](image)

**Outdated function**
This function is outdated. Use the function F_GetCurExtTime64 [80] instead.

The function returns the external time in TwinCAT distributed clock system time format (T_DCTIME [106]).

**FUNCTION F_GetCurExtTime: T_DCTIME**

\[
VAR_INPUT \\
DcToExtTimeOffset : T_LARGE_INTEGER; \\
DcToTcTimeOffset : T_LARGE_INTEGER; \\
END_VAR
\]

**DcToExtTimeOffset**: Time offset between the TwinCAT distributed clock system time and an external time

**DcToTcTimeOffset**: Time offset between the TwinCAT distributed clock system time and the TwinCAT system time

Requirements

<table>
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</table>

### 10.5.8 FB_EcExtSyncCalcTimeDiff

![FB_EcExtSyncCalcTimeDiff](image)

**Outdated function block**
This function block is outdated. Use the function block FB_EcExtSyncCalcTimeDiff64 [80] instead.

The function block FB_EcExtSyncCalcTimeDiff calculates the difference between external and internal time, taking into account the time offsets.
DcToTcTimeOffset: Time offset between the TwinCAT distributed clock system time and the TwinCAT system time

DcToExtTimeOffset: Time offset between the TwinCAT distributed clock system time and an external time

ExtTime: External time in TwinCAT distributed clock system time format

IntTime: Internal time in TwinCAT distributed clock system time format

nTimeDiff: If the difference is less than 32 bit, the time difference is returned. If the difference is greater than 32 bit, 16#FFFFFFFF is returned.

nOffsetFromSyncMaster: If the difference is greater than 32 bit and the offset between internal and DC time is less than 32 bit, 16#80000000 is returned.
If the difference is greater than 32 bit and the offset between internal and DC time is greater than 32 bit, 16#7FFFFFFF is returned.

Requirements

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10.5.9 FB_EcExtSyncCheck

Outdated function block
This function block is outdated. Use the function block FB_EcExtSyncCheck64 instead.

The function block FB_EcExtSyncCheck checks whether the internal and external clocks are synchronous. See function block FB_EcExtSyncCalcTimeDiff.

VAR_INPUT

nSyncWindow : UDINT;
bNotConnected : BOOL;
END_VAR

nSyncWindow: Time window within which the internal and external clock are regarded as synchronous.
bNotConnected: TRUE = connection to external clock is interrupted.
VAR_IN_OUT

VAR_IN_OUT

DcToTcTimeOffset : T_LARGE_INTEGER;
DcToExtTimeOffset : T_LARGE_INTEGER;
ExtTime : T_DCTIME;
IntTime : T_DCTIME;

END_VAR

DcToTcTimeOffset: Time offset between the TwinCAT distributed clock system time and the TwinCAT system time

DcToExtTimeOffset: Time offset between the TwinCAT distributed clock system time and an external time

ExtTime: External time in TwinCAT distributed clock system time format

IntTime: Internal time in TwinCAT distributed clock system time format

VAR_OUTPUT

VAR_OUTPUT

bSynchronized : BOOL;
nTimeDiff : UDINT;
nOffsetFromSyncMaster : DINT;

END_VAR

bSynchronized: TRUE = external and internal clock are synchronous

nTimeDiff: Current time difference between the two clocks

nOffsetFromSyncMaster: Offset to sync master

Requirements

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</table>
11  F_CheckVendorId

The function `F_CheckVendorId` returns TRUE, if the VendorID is Beckhoff, otherwise FALSE.

```
VAR_INPUT
  stSlaveIdentity : ST_EcSlaveIdentity;
END_VAR
```

`stSlaveIdentity`: Slave identity, which can be read with `FB_EcGetSlaveIdentity` [36].

**Requirements**

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12 [Obsolete]

12.1 F_GetVersionTcEtherCAT

Outdated function

This function is outdated. Use the global structure instance stLibVersion_Tc2EtherCAT instead.

This function can be used to read PLC library version information.

FUNCTION F_GetVersionTcEtherCAT : UINT
VAR_INPUT
  nVersionElement : INT;
END_VAR

nVersionElement: Version element to be read. Possible parameters:
  • 1: major number;
  • 2: minor number;
  • 3: revision number;

Requirements

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13 Data types

13.1 E_EcAdressingType

Addressing in EtherCAT is either position-dependent (eAdressingType_AutoInc), based on a fixed, configured address (eAdressingType_Fixed) or applies to all slaves (eAdressingType_Broadcast).

```plaintext
TYPE E_EcAdressingType :
    { eAdressingType_AutoInc:=1, (* Adress slave by it’s position. (adp = 1-position, 1.Slave = 0, 2.Slave = 0xffff(-1) etc) *)
    (* EtherCAT commands: APRD, APWR, APRW *)
    eAdressingType_Fixed, (* Address slave by configured ethercat slave address (adp = configured address *)
    (* EtherCAT commands: FPRD, FPWR, FPFW *)
    eAdressingType_Broadcast (* Address all slaves. *)
    (* EtherCAT commands: BRD, BWR, BRW *)
};
END_TYPE
```

Requirements

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13.2 E_EcFoeMode

Access mode for the “File access over EtherCAT” mailbox protocol.

```plaintext
TYPE E_EcFoeMode :
    { eFoeMode_Write := 1,
    eFoeMode_Read
};
END_TYPE
```

Requirements

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13.3 E_EcMbxProtType

Supported EtherCAT mailbox protocol types.

```plaintext
TYPE E_EcMbxProtType:
    { eEcMbxProt_CoE := 3, (* CANopen over EtherCAT *)
    eEcMbxProt_FoE := 4,(* File over EtherCAT *)
    eEcMbxProt_SoE := 5 (* Servo Drive Profile over EtherCAT *)
};
END_TYPE
```

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</table>
13.4 **ST_EcCrcError**

Structure containing the CRC error counters of the individual ports (A, B and C) of an EtherCAT slave device.

```plaintext
TYPE ST_EcCrcError :
STRUCT
  portA : UDINT;
  portB : UDINT;
  portC : UDINT;
END_STRUCT
END_TYPE
```

- **portA**: CRC error counter of Port A
- **portB**: CRC error counter of Port B
- **portC**: CRC error counter of Port C

### Requirements

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13.5 **ST_EcCrcErrorEx**

Structure containing the CRC error counters of the individual ports (A, B, C and D) of an EtherCAT slave device.

```plaintext
TYPE ST_EcCrcErrorEx :
STRUCT
  portA : UDINT;
  portB : UDINT;
  portC : UDINT;
  portD : UDINT;
END_STRUCT
END_TYPE
```

- **portA**: CRC error counter of Port A
- **portB**: CRC error counter of Port B
- **portC**: CRC error counter of Port C
- **portD**: CRC error counter of Port D

### Requirements

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13.6 **ST_EcLastProtErrInfo**

The structure ST_EcLastProtErrInfo contains additional error information relating to the most recent EtherCAT mailbox protocol error.

```plaintext
TYPE ST_EcSlaveState:
STRUCT
  ownAddr : ST_AmsAddr;
  orgAddr : ST_AmsAddr;
  errCode : UDINT;
  binDesc : ARRAY[0..MAX_STRING_LENGTH] OF BYTE;
END_STRUCT
END_TYPE
```

- **ownAddr**: Own AMS address (address of the communication device that queries the error information).
Data types

**orgAddr**: AMS address of the error originator (address of communication device that has triggered or caused the protocol error).

**errCode**: Mailbox protocol error number (SoE, CoE, FoE error code).

**binDesc**: Additional error information as binary data. The additional error information is device-specific and can include a string or binary data, for example.

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### 13.7 ST_EcMasterStatistic

The structure `ST_EcMasterStatistic` contains the EtherCAT configuration data for an EtherCAT slave device.

```plaintext
TYPE ST_EcMasterStatistic :
  STRUCT
    nSysTime       : UDINT;
    nCycFrameCnt   : UDINT;
    nCycFrameMissedCnt : UDINT;
    nQueuedFrameCnt : UDINT;
    nQueuedFrameMissedCnt : UDINT;
  END_STRUCT
END_TYPE
```

- **nSysTime**: System time in µs
- **nCycFrameCnt**: Number of cyclic EtherCAT frames
- **nCycFrameMissedCnt**: Number of lost cyclic EtherCAT frames
- **nQueuedFrameCnt**: Number of acyclic EtherCAT frames
- **nQueuedFrameMissedCnt**: Number of lost acyclic EtherCAT frames

Requirements

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### 13.8 ST_EcSlaveConfigData

The structure `ST_EcSlaveConfigData` contains the EtherCAT configuration data for an EtherCAT slave device.

```plaintext
TYPE ST_EcSlaveConfigData:
  STRUCT
    nEntries    : WORD;
    nAddr       : WORD;
    sType       : STRING[15];
    sName       : STRING[31];
    nDevType    : DWORD;
    stSlaveIdentity : ST_EcSlaveIdentity;
    nMailboxOutSize : WORD;
    nMailboxInSize : WORD;
    nLinkStatus  : BYTE;
  END_STRUCT
END_TYPE
```

- **nEntries**: used internally
- **nAddr**: Address of an EtherCAT slave
- **sType**: EtherCAT type of a slave
- **sName**: Name of an EtherCAT slave
nDevType: EtherCAT device type of a slave

stSlavIdentity: Identity of an EtherCAT slave (see ST_EcSlaveIdentity [100])

nMailboxOutSize: Mailbox OutSize of an EtherCAT slave.

nMailboxInSize: Mailbox InSize of an EtherCAT slave.

nLinkStatus: Link status of an EtherCAT slave.

Requirements

<table>
<thead>
<tr>
<th>Development environment</th>
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<th>PLC libraries to include</th>
</tr>
</thead>
<tbody>
<tr>
<td>TwinCAT v3.1.0</td>
<td>PC or CX (x86, x64, ARM)</td>
<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>

### 13.9 ST_EcSlaveIdentity

The structure ST_EcSlaveIdentity contains the EtherCAT identity data of an EtherCAT slave device.

```plaintext
TYPE ST_EcSlaveIdentity :
STRUCT
    vendorId : UDINT;
    productCode : UDINT;
    revisionNo : UDINT;
    serialNo : UDINT;
END_STRUCT
END_TYPE
```

**vendorId**: Vendor-ID of the slave device.

**productCode**: Product code of the slave device.

**revisionNo**: Indicates the revision number of the slave device.

**serialNo**: Indicates the serial number of the slave device.

Requirements

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</tr>
</tbody>
</table>

### 13.10 ST_EcSlaveScannedData

The structure ST_EcSlaveScannedData contains the EtherCAT configuration data of a scanned EtherCAT slave device.

```plaintext
TYPE ST_EcSlaveConfigData:
STRUCT
    nEntries : WORD;
    nAddr : WORD;
    stSlaveIdentity : ST_EcSlaveIdentity;
    nd1StatusReg : WORD;
END_STRUCT
END_TYPE
```

**nEntries**: used internally

**nAddr**: Address of an EtherCAT slave

**stSlavIdentity**: Identity of an EtherCAT slave (see ST_EcSlaveIdentity [100])
**ndlStatusReg**: Link status of an EtherCAT slave from ESC register 0110/0111\textsubscript{hex}, or 272/273\textsubscript{dec}. Status 0 is displayed if the slave cannot be reached or is offline. The port number \(\leftrightarrow\) socket/Ebus contact assignment can be found in the respective device documentation. Unless described otherwise, port 0 is the left-hand Ebus contact of an EL/ES terminal or the RJ45 socket of an EP box, port 1 is the right-hand outgoing Ebus contact/RJ45 socket.

The bit meanings are:

<table>
<thead>
<tr>
<th>Bit</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>internal use</td>
</tr>
<tr>
<td>2</td>
<td>internal use</td>
</tr>
<tr>
<td>3</td>
<td>internal use</td>
</tr>
</tbody>
</table>
| 4   | physical link on Port 0  
0: no link, 1: Link detected |
| 5   | physical link on Port 1  
0: no link, 1: Link detected |
| 6   | physical link on Port 2  
0: no link, 1: Link detected |
| 7   | physical link on Port 3  
0: no link, 1: Link detected |
| 8   | Loop Port 0  
0: Open, 1: Closed |
| 9   | Communication on Port 0  
0: no stable communication, 1: Communication established |
| 10  | Loop Port 1  
0: Open, 1: Closed |
| 11  | Communication on Port 1  
0: no stable communication, 1: Communication established |
| 12  | Loop Port 2  
0: Open, 1: Closed |
| 13  | Communication on Port 2  
0: no stable communication, 1: Communication established |
| 14  | Loop Port 3  
0: Open, 1: Closed |
| 15  | Communication on Port 3  
0: no stable communication, 1: Communication established |

**Requirements**

<table>
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</tr>
</tbody>
</table>

13.11 **ST_EcSlaveState**

The structure **ST_EcSlaveState** contains the EtherCAT status and the link status of an EtherCAT slave device.

```plaintext
TYPE ST_EcSlaveState:
  STRUCT
    deviceState :BYTE;
    linkState   :BYTE;
  END_STRUCT
END_TYPE
```

deviceState: EtherCAT status of a slave. The status can adopt one of the following values:
### Constant Values

<table>
<thead>
<tr>
<th>Constant</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECDEVICESTATEINIT</td>
<td>0x01</td>
<td>Init state</td>
</tr>
<tr>
<td>ECDEVICESTATEPREOP</td>
<td>0x02</td>
<td>Pre-operational state</td>
</tr>
<tr>
<td>ECDEVICESTATEBOOTSTRAP</td>
<td>0x03</td>
<td>Bootstrap state</td>
</tr>
<tr>
<td>ECDEVICESTATESAFEOP</td>
<td>0x04</td>
<td>Safe-operational state</td>
</tr>
<tr>
<td>ECDEVICESTATEOP</td>
<td>0x08</td>
<td>Operational state</td>
</tr>
</tbody>
</table>

In addition, the following bits can be set:

<table>
<thead>
<tr>
<th>Constant</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECDEVICESTATEERROR</td>
<td>0x10</td>
<td>State machine error in the EtherCAT slave</td>
</tr>
<tr>
<td>ECDEVICESTATEINVALID_VENDOR</td>
<td>0x20</td>
<td>Invalid vendor ID, product code, revision number or serial number</td>
</tr>
<tr>
<td>ECDEVICESTATEINITCMDERROR</td>
<td>0x40</td>
<td>Error during sending of initialization commands.</td>
</tr>
<tr>
<td>ECDEVICESTATEDISABLED</td>
<td>0x80</td>
<td>Slave is disabled</td>
</tr>
</tbody>
</table>

**linkState**: Link status of an EtherCAT slave. The Link status can consist of an ORing of the following bits.

<table>
<thead>
<tr>
<th>Constant</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EC_LINKSTATEOK</td>
<td>0x00</td>
<td></td>
</tr>
<tr>
<td>EC_LINKSTATE_NOT_PRESENT</td>
<td>0x01</td>
<td>No EtherCAT communication with the EtherCAT slave</td>
</tr>
<tr>
<td>EC_LINKSTATE_LINK WITHOUT COMM</td>
<td>0x02</td>
<td>Error at port X (specified through EC_LINKSTATE_PORT_A/B/C/D). The port has a link, but no communication is possible via this port.</td>
</tr>
<tr>
<td>EC_LINKSTATE_MISSING_LINK</td>
<td>0x04</td>
<td>Missing link at port X (specified through EC_LINKSTATE_PORT_A/B/C/D).</td>
</tr>
<tr>
<td>EC_LINKSTATE_ADDITIONAL_LINK</td>
<td>0x08</td>
<td>Additional link at port X (specified through EC_LINKSTATE_PORT_A/B/C/D).</td>
</tr>
<tr>
<td>EC_LINKSTATE_PORT_A</td>
<td>0x10</td>
<td>Port 0</td>
</tr>
<tr>
<td>EC_LINKSTATE_PORT_B</td>
<td>0x20</td>
<td>Port 1</td>
</tr>
<tr>
<td>EC_LINKSTATE_PORT_C</td>
<td>0x40</td>
<td>Port 2</td>
</tr>
<tr>
<td>EC_LINKSTATE_PORT_D</td>
<td>0x80</td>
<td>Port 3</td>
</tr>
</tbody>
</table>

### Requirements

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</tr>
</tbody>
</table>

### 13.12 ST_EcSlaveStateBits

The structure **ST_EcSlaveStateBits** contains the EtherCAT status and the link status of an EtherCAT slave device.

```c
TYPE ST_EcSlaveStateBits:
STRUCT
    bInit : BOOL;
    bPreop : BOOL;
    bBootStrap : BOOL;
```

---

102 Version: 1.2 PLC Lib: Tc2_EtherCAT
## Requirements

<table>
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</tbody>
</table>

### 13.13 ST_EcSlaveStateBitsEx

The structure **ST_EcSlaveStateBitsEx** contains the EtherCAT status and the link status of an EtherCAT slave device.

```plaintext
TYPE ST_EcSlaveStateBitsEx:
  STRUCT
    bInit      : BOOL;
    bPreop     : BOOL;
    bBootStrap : BOOL;
    bSafeOp    : BOOL;
    bOp        : BOOL;
    bError     : BOOL;
    bInvVPRS   : BOOL;
    bInitCmdError: BOOL;
    bDisabled  : BOOL;
    bLinkNotPresent : BOOL;
    bLinkWithoutComm : BOOL;
    bLinkMissing : BOOL;
    bAdditionalLink: BOOL;
    bPortA    : BOOL;
    bPortB    : BOOL;
    bPortC    : BOOL;
    bPortD    : BOOL;
  END_STRUCT
END_TYPE
```

### 13.14 ST_PortAddr

The structure **ST_PortAddr** contains EtherCAT topology information for EtherCAT slave device. EtherCAT slave devices typically have 2 to 4 ports.

```plaintext
TYPE ST_PortAddr:
  STRUCT
    portA : UINT;
    portB : UINT;
    portC : UINT;
    portD : UINT;
  END_STRUCT
END_TYPE
```

**portA**: Address of the previous EtherCAT slave at port A of the current EtherCAT slave.
Data types

portB: Address of the optional subsequent EtherCAT slave at port B of the current EtherCAT slave

portC: Address of the optional subsequent EtherCAT slave at port C of the current EtherCAT slave

portD: Address of the optional subsequent EtherCAT slave at port D of the current EtherCAT slave

13.15 ST_TopologyDataEx

The structure ST_TopologyDataEx contains information on EtherCAT topology and hot-connect groups.

```
TYPE ST_TopologyDataEx:
STRUC
  nOwnPhysicalAddr : UINT;
  nOwnAutoIncAddr : UINT;
  stPhysicalAddr : ST_PortAddr;
  stAutoIncAddr : ST_PortAddr;
  aReserved1 : ARRAY [0..3] OF UDINT;
  nStatusBits : DWORD;
  nHCSlaveCountCfg : UINT; (*nStatusBits.0 = TRUE: DcSupprt; .1 = TRUE: DC64Supprt; .2=TRUE: Slave
  Present following hot connect info requires runtime >= TC 2.11 R3 B2246 nStatusBits.3 = TRUE: HotCon
  nnectGroupStart; .4 = HotConnectSlave; .5 = TRUE: HotConnectInvalidB; .6 = TRUE: HotConnectInvalidC;
  .7 = TRUE: HotConnectInvalidD*)
  nHCSlaveCountAct : UINT;
  aReserved2 : ARRAY [0..4] OF UDINT;
END_STRUCT
END_TYPE
```

nOwnPhysicalAddr: Dedicated physical EtherCAT address of the EtherCAT slave device

nOwnAutoInAddr: Dedicated auto-increment EtherCAT address of the EtherCAT slave device

stPhysicalAddr: Physical address information of the EtherCAT slave devices at port A...D

stAutoInAddr: Auto-increment address information of the EtherCAT slave devices at port A...D

aReserved1: reserved

nStatusBits:

nStatusBits.0 = TRUE: Distributed clocks are supported

nStatusBits.1 = TRUE: Distributed clocks are supported (64 bit)

nStatusBits.2 = TRUE: Slave is present

nStatusBits.3 = TRUE: Slave is start node of a Hot Connect group

nStatusBits.4 = TRUE: Slave is in a Hot Connect group

nStatusBits.5 = TRUE: Hot-connect is invalid at port B

nStatusBits.6 = TRUE: Hot-connect is invalid at port C

nStatusBits.7 = TRUE: Hot-connect is invalid at port D

nHCSlaveCountCfg: Configured number of hot-connect group devices

nHCSlaveCountAct: Found number of hot-connect group devices

aReserved2: reserved

Requirements

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</tbody>
</table>

13.16 DCTIMESTRUCT

Structured TwinCAT distributed clock system time format. The smallest unit is a nanosecond. This data type represents the number of nanoseconds since 01.01.2000 (GMT).

```
TYPE DCTIMESTRUCT :
  STRUC
    wYear : WORD;
    wMonth : WORD;
  END_STRUCT
```

Version: 1.2  PLC Lib: Tc2_EtherCAT
Data types

wDayOfWeek : WORD;
wDay : WORD;
wHour : WORD;
wMinute : WORD;
wSecond : WORD;
wMilliseconds : WORD;
wMicroseconds : WORD;
wNanoseconds : WORD;
END_STRUCT
END_TYPE

wYear : Year: 2000 ~ 2584;
wMonth : Month: 1 ~ 12 (January = 1, February = 2 etc.);
wDayOfWeek : Day of the week: 0 ~ 6 (Sunday = 0, Monday = 1 etc.);
wDay : The day of the month: 1 ~ 31;
wHour : Hour: 0 ~ 23;
wMinute : Minute: 0 ~ 59;
wSecond : Second: 0 ~ 59;
wMilliseconds : Millisecond: 0 ~ 999;
wMicroseconds : Microsecond: 0 ~ 999;
wNanoseconds : Nanosecond: 0 ~ 999;

Requirements

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</tr>
</tbody>
</table>

13.17 T_DCTIME32

32-bit TwinCAT distributed clock system time format. The smallest unit is a nanosecond.

This 32-bit DC system time is formed from the full absolute 64-bit DC system time (T_DCTIME [106]) by using only the lowest-order 32 bits. This means the property of an absolute unique time is lost, and it is assumed that this 32-bit time is only used within a narrow time window of ± 2,147 seconds around the current system time, to ensure that it is unambiguous. There are many applications in which this assumption is possible.

If this assumption is violated, errors may occur in the interpretation and further processing of this time.

TYPE T_DCTIME32 : UDINT;
END_TYPE

Requirements

<table>
<thead>
<tr>
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</tr>
</thead>
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</tr>
</tbody>
</table>

13.18 T_DCTIME64

64-bit TwinCAT distributed clock system time format. The smallest unit is a nanosecond.

TYPE T_DCTIME64 : ULIINT;
END_TYPE
### Useful distributed clock system time constants

<table>
<thead>
<tr>
<th>Data Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EC_DCTIME_DELTA_OFFSET64</td>
<td>Number of 100-nanosecond ticks between 01.01.1601 and 01.01.2000. This is the difference between the Windows file time and the distributed clock system time.</td>
</tr>
<tr>
<td>EC_DCTIME_DATEDELTA_OFFSET</td>
<td>Number of days that have passed between the year zero and 1 January 2000</td>
</tr>
<tr>
<td>EC_DCTIME_TICKSPERMSEC64</td>
<td>Number of distributed clock system time nanoseconds per millisecond</td>
</tr>
<tr>
<td>EC_DCTIME_TICKS_PER_SEC64</td>
<td>Number of distributed clock system time nanoseconds per second</td>
</tr>
<tr>
<td>EC_DCTIME_TICKSPER_DAY64</td>
<td>Number of distributed clock system time nanoseconds per day</td>
</tr>
</tbody>
</table>

### Requirements

<table>
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</tbody>
</table>

### T_DCTIME

**Outdated data type**

This data type is outdated. Use the data type T_DCTIME64 instead.

The data type T_DCTIME represents the distributed clock system time (abbreviated as DC time) as a linear 64-bit integer value. The time is expressed in nanoseconds since 1.1.2000 UTC. The data type is represented as two 32-bit DWORD variables, so that it can easily be processed in the PLC. Operations (addition and subtraction of times) can be executed with ui64 functions from the Tc2_Utility library.

```pascal
TYPE T_DCTIME : T_ULARGE_INTEGER;
END_TYPE
```

### Useful distributed clock system time constants

<table>
<thead>
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<th>Data Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EC_DCTIME_DELTA_OFFSET</td>
<td>Number of 100-nanosecond ticks between 01.01.1601 and 01.01.2000. This is the difference between the Windows file time and the distributed clock system time.</td>
</tr>
<tr>
<td>EC_DCTIME_DATEDELTA_OFFSET</td>
<td>Number of days that have passed between the year zero and 1 January 2000</td>
</tr>
<tr>
<td>EC_DCTIME_TICKSPERMSEC</td>
<td>Number of distributed clock system time nanoseconds per millisecond</td>
</tr>
<tr>
<td>EC_DCTIME_TICKS_PER_SEC</td>
<td>Number of distributed clock system time nanoseconds per second</td>
</tr>
<tr>
<td>EC_DCTIME_TICKSPER_DAY</td>
<td>Number of distributed clock system time nanoseconds per day</td>
</tr>
</tbody>
</table>

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</tbody>
</table>
13.20 T_HFoe

“File access over EtherCAT” handle. Before the handle can be used, it must be initialized once with the function block `FB_EcFoeOpen` [55]. The variables of this structured type must not be written directly.

```plaintext
TYPE T_HFoe :
  STRUCT
    sNetID : T_AmsNetId := '';
    nPort : T_AmsPort := 0;
    handle : UDINT := 0;
    eMode : E_EcFoeMode := eFoeMode_Write;
  END_STRUCT
END_TYPE
```

Requirements

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<td>Tc2_EtherCAT</td>
</tr>
</tbody>
</table>
14 Constants

14.1 Global constants

VAR_GLOBAL CONSTANT

EC_AXSPORT_MASTER :UINT :=16#FFFF;
EC_MAX_SLAVES :=UINT :=16#FFFF;

(*ethercat commands*)
EC_CMD_TYPE_APRD :BYTE :=1;
EC_CMD_TYPE_APRW :BYTE :=2;
EC_CMD_TYPE_APRW :BYTE :=3;
EC_CMD_TYPE_FPRD :BYTE :=4;
EC_CMD_TYPE_FPRW :BYTE :=5;
EC_CMD_TYPE_FPRW :BYTE :=6;
EC_CMD_TYPE_BRD :BYTE :=7;
EC_CMD_TYPE_BWR :BYTE :=8;
EC_CMD_TYPE_BRW :BYTE :=9;
EC_CMD_TYPE_LRD :BYTE :=10;
EC_CMD_TYPE_LWR :BYTE :=11;
EC_CMD_TYPE_LRW :BYTE :=12;

(* Device states*)
EC_DEVICE_STATE_MASK :BYTE :=16#0F;
EC_DEVICE_STATE_INIT :BYTE :=16#01;
EC_DEVICE_STATE_PREOP :BYTE :=16#02;
EC_DEVICE_STATE_BOOTSTRAP :BYTE :=16#03;
EC_DEVICE_STATE_SAFEOF :BYTE :=16#04;
EC_DEVICE_STATE_OP :BYTE :=16#08;
EC_DEVICE_STATE_ERROR :BYTE :=16#10;
EC_DEVICE_STATE_INVALID_VPRS :BYTE :=16#20;
EC_DEVICE_STATE_INITCMD_ERROR :BYTE :=16#40;

(* Link states*)
EC_LINK_STATE_OK :BYTE :=16#00;
EC_LINK_STATE_NOT_PRESENT :BYTE :=16#01;
EC_LINK_STATE_MISSING_LINK :BYTE :=16#02;
EC_LINK_STATE_ADDITIONAL_LINK :BYTE :=16#08;
EC_LINK_STATE_PORT_A :BYTE :=16#10;
EC_LINK_STATE_PORT_B :BYTE :=16#20;
EC_LINK_STATE_PORT_C :BYTE :=16#40;
EC_LINK_STATE_PORT_D :BYTE :=16#80;

(* Device/Link state IG/IO*)
EC_ADS_IGRP_MASTER_STATEMACHINE :UDINT :=16#00000003;
EC_ADS_IOFMS_MASTER_CURSTATE :UDINT :=16#00000100;
EC_ADS IOFMS_MASTER_REQSTATE :UDINT :=16#00000101;
EC_ADS IOFMS_MASTER_INTERNALSTATE :UDINT :=16#00000102;
EC_ADS_IGRP_MASTER_COUNT_SLAVE :UDINT :=16#00000006;
EC_ADS_IGRP_MASTER_COUNT_SLAVE :UDINT :=16#00000000;
EC_ADS_IGRP_MASTER_COUNT_PORT :UDINT :=16#00000001;
EC_ADS_IGRP_MASTER_COUNT_ROUTER :UDINT :=16#00000002;
EC_ADS_IGRP_MASTER_SLAVE_ADDRESSES :UDINT :=16#00000007;
EC_ADS_IGRP_MASTER_SENDCMD :UDINT :=16#00000008;
EC_ADS_IGRP_SLAVE_STATEMACHINE :UDINT :=16#00000009;
EC_ADS_IGRP_MASTER_SLAVE_IDENTITY :UDINT :=16#00000011;
EC_ADS_IGRP_MASTER_SLAVE_CRC :UDINT :=16#00000012;
EC_ADS_IGRP_MASTER_SLAVE_ABNORMAL_STATE_CHANGES :UDINT :=16#00000013;
EC_ADS_IGRP_MASTER_SLAVE_SETPRESENT_CHANGES :UDINT :=16#00000016;
EC_ADS_IGRP_MASTER_DEVICESTATE :UDINT :=16#00000045;
EC_ADS_IGRP_MASTER_COUNT_FRAME :UDINT :=16#00000048;

(* SoE IG/IO *)
EC_ADS_IGRP_ECAT_SOE :UDINT :=16#0000F420;
EC_ADS_IGRP_ECAT_SOE_LASTERROR :UDINT :=16#0000F421;
EC_SOE_ELEMENT_DATASTATE :BYTE :=16#01;
EC_SOE_ELEMENT_NAME :BYTE :=16#02;
EC_SOE_ELEMENT_ATTRIBUTE :BYTE :=16#04;
EC_SOE_ELEMENT_UNIT :BYTE :=16#08;
EC_SOE_ELEMENT_MIN :BYTE :=16#10;
EC_SOE_ELEMENT_MAX :BYTE :=16#20;
EC_SOE_ELEMENT_VALUE :BYTE :=16#40;
EC_SOE_ELEMENT_DEFAULT :BYTE :=16#80;

(* FoE IG/IO *)
EC_ADS_IGRP_FOE_FOPENREAD :UDINT :=16#0000F401;
EC_ADS_IGRP_FOE_FOPENWRITE :UDINT :=16#0000F402;
EC_ADS_IGRP_FOE_FCLOSE :UDINT :=16#0000F403;
EC_ADS_IGRP_FOE_FREAD :UDINT :=16#0000F404;
EC_ADS_IGRP_FOE_FWRITE :UDINT :=16#0000F405;
EC_ADS_IGRP_FOE_PROGRESSINFO :UDINT :=16#0000F406;
EC_ADS_IGRP_FOE_LASTERROR :UDINT :=16#0000F407;

(* CoE IG/IO *)
EC_ADS_IGRP_CANOPEN_SDO :UDINT :=16#0000F302;
EC_ADS_IGRP_CANOPEN_SDO_LASTERROR :UDINT :=16#0000F303;

EC_DCTIME_DATEDEDelta_OFFSET : DWORD := 730120; (* Number of past days since year zero until 1 January 2000 *)
EC_DCTIME_DELTA_OFFSET : T_ULARGE_INTEGER := ( dwHighPart := 16#01BF53EB, dwLowPart := 16#256D4000 ) ; (* Number of 100ns ticks between 1.1.1601 and 1.1.2000 *)
EC_DCTIME_TICKSPERMSEC : T_ULARGE_INTEGER := ( dwHighPart := 16#00000000, dwLowPart := 16#000F4240); (* Number of nanosecond ticks per millisecond *)
EC_DCTIME_TICKSPERSEC64 : ULINT := ULINT#16#000F4240;
(* Number of nanosecond ticks per second *)
EC_DCTIME_TICKSPERDAY : T_ULARGE_INTEGER := ( dwHighPart := 16#00000000, dwLowPart := 16#914F0000); (* Number of nanosecond ticks per day *)

All libraries have a certain version. The version is indicated in the PLC library repository, for example. A global constant contains the information about the library version:

Global_Version

VAR_GLOBAL CONSTANT
  stLibVersion_Tc2_EtherCAT : ST_LibVersion;
END_VAR

stLibVersion_Tc2_EtherCAT: Version information of the Tc2_EtherCAT library (type: ST_LibVersion)

To check whether the version you have is the version you need, use the function F_CmpLibVersion (defined in the Tc2_System library).
14.3 EtherCAT mailbox protocol error codes

VAR_GLOBAL CONSTANT

(* FoE mailbox protocol error codes *)
EC_FOE_PROTERR_NOTDEFINED : UDINT := 0;
EC_FOE_PROTERR_NOTFOUND : UDINT := 1;
EC_FOE_PROTERR_ACCESS : UDINT := 2;
EC_FOE_PROTERR_DISKFULL : UDINT := 3;
EC_FOE_PROTERR_ILLEGAL : UDINT := 4;
EC_FOE_PROTERR_PACKENO : UDINT := 5;
EC_FOE_PROTERR_EXISTS : UDINT := 6;
EC_FOE_PROTERR_NOUSER : UDINT := 7;
EC_FOE_PROTERR_BOOTSTRAPONLY : UDINT := 8;
EC_FOE_PROTERR_NOTINBOOTSTRAP : UDINT := 9;
EC_FOE_PROTERR_INVALIDPASSWORD : UDINT := 10;

(* CoE mailbox protocol error codes *)
EC_COE_PROTERR_TOGGLE : UDINT := 16#05030000; (* Toggle bit not alternated. *)
EC_COE_PROTERR_TIMEOUT : UDINT := 16#05040000; (* SDO protocol timed out. *)
EC_COE_PROTERR_CCS_SCS : UDINT := 16#05040001; (* Client/server command specifier not valid or unknown. *)
EC_COE_PROTERR_BLK_SIZE : UDINT := 16#05040002; (* Invalid block size (block mode only). *)
EC_COE_PROTERR_SEQNO : UDINT := 16#05040003; (* Invalid sequence number (block mode only). *)
EC_COE_PROTERR_CRC : UDINT := 16#05040004; (* CRC error (block mode only). *)
EC_COE_PROTERR_ACCESS : UDINT := 16#06010000; (* Unsupported access to an object. *)
EC_COE_PROTERR_WRITEONLY : UDINT := 16#06010001; (* Attempt to read a write only object. *)
EC_COE_PROTERR_INDEX : UDINT := 16#06020000; (* Object does not exist in the object dictionary. *)
EC_COE_PROTERR_PDO_MAP : UDINT := 16#06040041; (* Object cannot be mapped to the PDO. *)
EC_COE_PROTERR_PDO_LEN : UDINT := 16#06040042; (* The number and length of the objects to be mapped would exceed PDO length. *)
EC_COE_PROTERR_P_INCOMP : UDINT := 16#06040043; (* General parameter incompatibility reason. *)
EC_COE_PROTERR_I_INCOMP : UDINT := 16#06040047; (* General internal incompatibility in the device. *)
EC_COE_PROTERR_HARDWARE : UDINT := 16#06060000; (* Access failed due to an hardware error. *)
EC_COE_PROTERR_DATA_SIZE : UDINT := 16#06070010; (* Data type does not match, length of service parameter does not match *)
EC_COE_PROTERR_DATA_SIZE1 : UDINT := 16#06070012; (* Data type does not match, length of service parameter too high *)
EC_COE_PROTERR_DATA_SIZE2 : UDINT := 16#06070013; (* Data type does not match, length of service parameter too low *)
EC_COE_PROTERR_OFFSET : UDINT := 16#06090011; (* Sub-index does not exist. *)
EC_COE_PROTERR_DATA_RANGE : UDINT := 16#06090030; (* Value range of parameter exceeded (only for write access). *)
EC_COE_PROTERR_DATA_RANGE1 : UDINT := 16#06090031; (* Value of parameter written too high. *)
EC_COE_PROTERR_DATA_RANGE2 : UDINT := 16#06090032; (* Value of parameter written too low. *)
EC_COE_PROTERR_MINMAX : UDINT := 16#06090036; (* Maximum value is less than minimum value. *)
EC_COE_PROTERR_GENERAL : UDINT := 16#08000000; (* General error *)
EC_COE_PROTERR_TRANSFER : UDINT := 16#08000020; (* Data cannot be transferred or stored to the application. *)
EC_COE_PROTERR_TRANSFER1 : UDINT := 16#08000021; (* Data cannot be transferred or stored to the application because of local control. *)
EC_COE_PROTERR_TRANSFER2 : UDINT := 16#08000022; (* Data cannot be transferred or stored to the application because of the present device state. *)
EC_COE_PROTERR_DICTIONARY : UDINT := 16#08000023; (* Object dictionary dynamic generation fails or no object dictionary is present (e.g. object dictionary is generated from file and generation fails because of an file error). *)

Requirements

<table>
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<tr>
<th>Development environment</th>
<th>Target platform</th>
<th>PLC libraries to include</th>
</tr>
</thead>
<tbody>
<tr>
<td>TwinCAT v3.1.0</td>
<td>PC or CX (x86, x64, ARM)</td>
<td>Tc2_EtherCAT</td>
</tr>
</tbody>
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Version: 1.2
PLC Lib: Tc2_EtherCAT