BECKHOFF New Automation Technology

Documentation | EN

FC1100 and FC1121

Application Note (EtherCAT Slave Card)

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1 Foreword

1.1 Notes on the documentation

Intended audience

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 these 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.

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Patent Pending

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

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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 instructions

In this documentation the following instructions are used.
These instructions must be read carefully and followed without fail!

⚠ DANGER

Serious risk of injury!

Failure to follow this safety instruction directly endangers the life and health of persons.

⚠ WARNING

Risk of injury!

Failure to follow this safety instruction endangers the life and health of persons.

⚠ CAUTION

Personal injuries!

Failure to follow this safety instruction can lead to injuries to persons.

NOTE

Damage to environment/equipment or data loss

Failure to follow this instruction can lead to environmental damage, equipment damage or data loss.

Tip or pointer

This symbol indicates information that contributes to better understanding.

1.3 Documentation Issue Status

Version	Comment
2.0	• Migration • Update structure

2 Product overview

2.1 Introduction

This document contains a software installation and configuration guideline for the fieldbus cards FC1100 and FC1121 with TwinCAT and the SlaveStackCode.
Furthermore all required information are provided to develop a new driver for these fieldbus cards.

The basic information about the fieldbus cards are listed in Table 1 [▶ 8].

Table 1: FC11xx comparison

Technical data	FC1100	FC1121
Link	http://www.beckhoff.com/FC1100/	http://www.beckhoff.com/FC1121/
Interface to the PC	PCI	PCIe
EtherCAT Slave Controller	ET1100	FPGA-based
RAM	8	8
SYNC manager	8	4
FMMUs	8	3

3 Hardware

3.1 FC1100 | PCI EtherCAT slave card

The PCI ID values of the FC1100 are listed in Table 2 [▶ 9]. The ET1100 (see type and revision register for detailed information) chip is used to access the EtherCAT network. The address range of the ET1100 is mapped to the memory specified by Base Address Registers 2 (BAR2) of the PCI device.
NOTE: The low nibble of BAR2 contains configuration bits

Table 2: FC1100 PCI values

Parameter	Value
DeviceID	0x1100
VendorID	0x15ec

Figure 1 [▶ 9] shows the hardware structure of the FC1100 slave card.

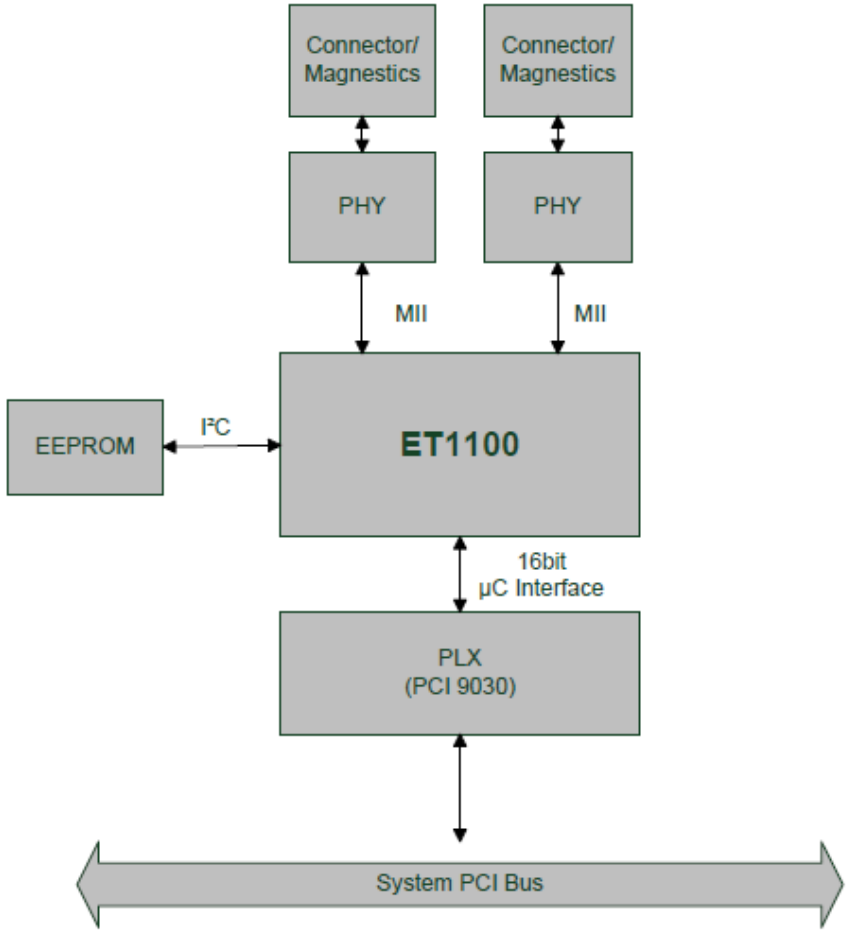

Fig. 1: Hardware Schema

3.2 FC1121 | PCIe EtherCAT slave card

The PCIe ID values of the FC1121 are listed in Table 3 [▶ 9]. An FPGA based EtherCAT Slave Controller (ESC) is used to access the EtherCAT network. For ESC specific information (e.g. type and revision) see the corresponding ESC registers readout by an EtherCAT master or configuration tool.

The address range of the IPCore need to be determined by the information and function description located at the beginning of BAR0 (Figure 2: FC1121 BAR0 memory mapping [▶ 9]). The address is BAR0 plus the offset specified in the EtherCAT slave function block (Function type 0x0002).

Table 3: FC1121 PCIe values

Parameter	Value
DeviceID	0x5000
VendorID	0x15ec

The content of FC1121 BAR0 is shown in Figure 2 [▶ 9].

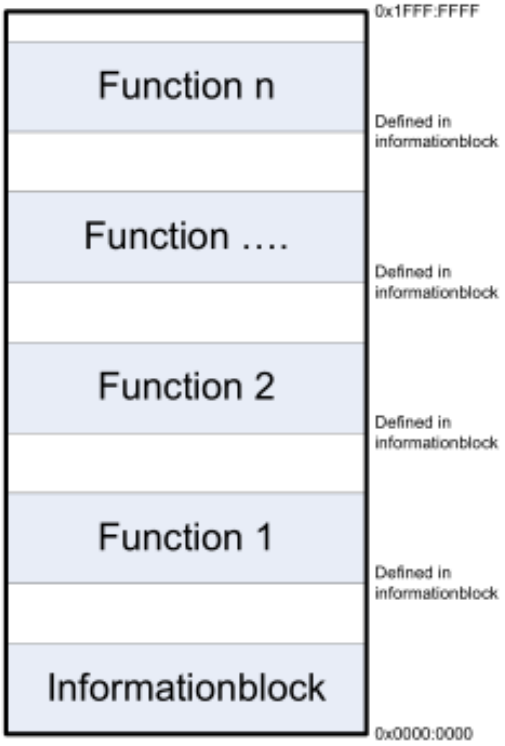

Fig. 2: FC1121 BAR0 memory mapping

The information block content of the FC1121 is shown in Table 4 [▶ 9].

Table 4: FC1121 information block values

Address	Description	Value
0x01:0x00	Type of function	0x0001
0x03:0x02	Revision of function	0x0001
0x04	Number of function blocks	Depends Configuration
0x05	Creation day	Depends on creation date
0x06	Creation month	Depends on creation date
0x07	Creation year	Depends on creation date
0x0b:0x08	Identifier 1	0x0000:88a4
0x0f:0x0c	Identifier 2	“CCAT”

The function block content of the FC1121 is shown in Table 5 [▶ 9].

Table 5: FC1121 function block description

Address	Description	Value
0x01:0x00	Type of function	0x0002
0x03:0x02	Revision of function	
0x05:0x04	Parameter of function	
0x07:0x06	reserved	
0x0b:0x08	Base address offset of function	Offset to BAR0
0x0f:0x0c	Size of function on bytes	

3.2.1 Interrupt

To enable the interrupt of the FC1121 the following settings need to be done.

Enable BAR2 register 0x50 bit 7. The interrupt state is shown in BAR2 register 0x40 bit 7.

Enable interrupt mask for **slot1** in the interrupt control function block. The interrupt function block is described in Table 6 [▶ 11], Table 7 [▶ 11] and Table 8 [▶ 11].

Table 6: Interrupt Controller function block description

Address	Description	Value
0x01:0x00	Type of function	0x0011
0x03:0x02	Revision of function	
0x07:0x04	reserved	
0x0b:0x08	Base address offset of function	Offset to BAR0
0x0f:0x0c	Size of function on bytes	

Table 7: Interrupt State Register (0x00) description

Bit	Description	Reset value
0	Interrupt state of Slot 0	0
1	Interrupt state of Slot 1	0
…	…	…
15	Interrupt state of Slot 15	0

Table 8: Interrupt Mask Register (0x08) description

Bit	Description	Reset value
0	Interrupt mask of Slot 0	0
1	Interrupt mask of Slot 1	0
…	…	…
15	Interrupt mask of Slot 15	0

4 Software

4.1 TwinCAT

Since TwinCAT version 2.11 R2 it is possible to make PLC data accessible by an EtherCAT master via the EtherCAT network. The available process data size depends on the used ESC (see 2 Hardware).

4.1.1 Configure Slave System

The following steps describe how to configure the slave system with TwinCAT and the slave card installed in PCI or PCIe port.

Start TwinCAT software, scan for new “I/O Devices” and select “EtherCAT Slave” (see Select EtherCAT Slave [▶ 12]).

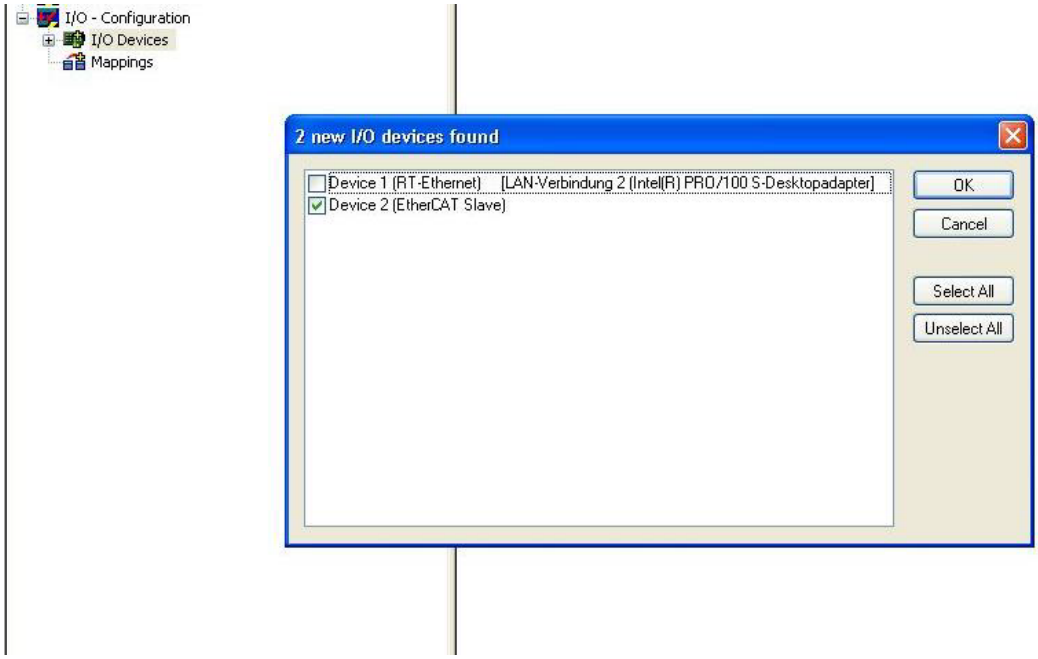

Fig. 3: Select EtherCAT Slave

The process data can be added by right mouse click on the corresponding node (see Add Process Data Manually [▶ 12]). If a PLC project is already added to the System Manger project which contains user defined structs these are also selectable.

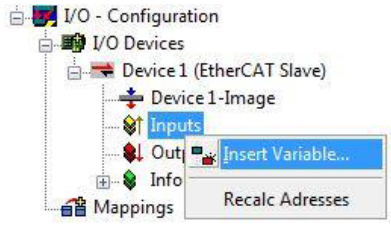

Fig. 4: Add Process Data Manually

If the PLC project is available the linking between the PLC data and the defined process data is done by right mouse click on the variable and select “Change Link” (see Create Variable Link [▶ 12]).

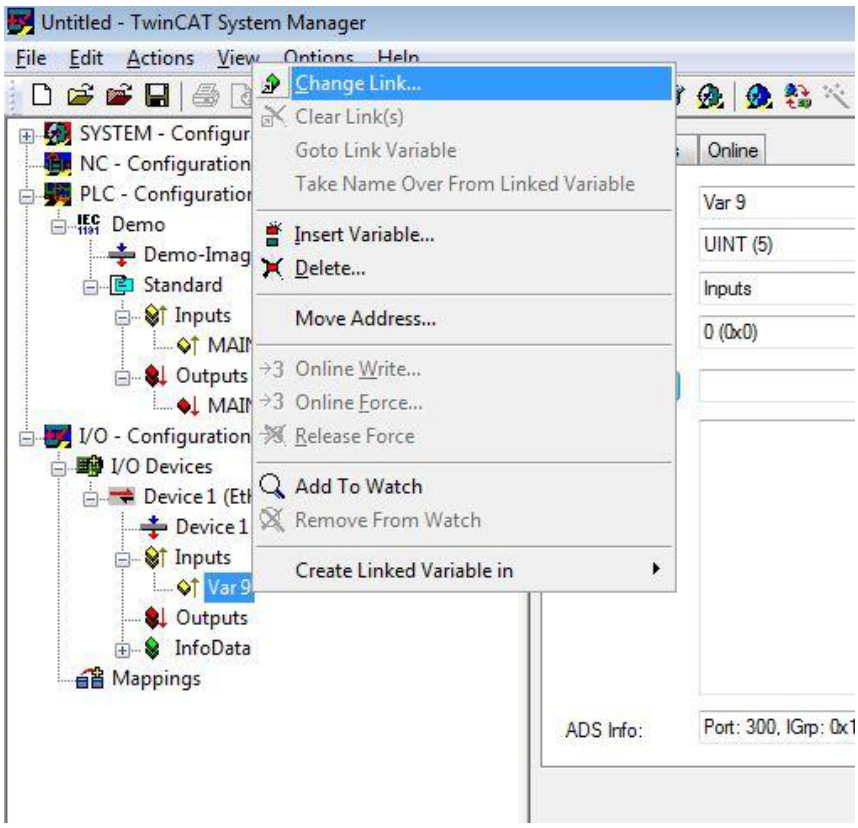

Fig. 5: Create Variable Link

Save the configuration in a tsm-file. This file can be used to provide the PDO setup to the Master configuration.

4.1.2 Configure Master System

In this description the FC1100 is referenced, the configuration for the FC1121 is equal.
Create a new TwinCAT System Manager configuration. Append a new FC1100 EtherCAT Slave (see Add FC1100 EtherCAT Slave [▶ 13]).

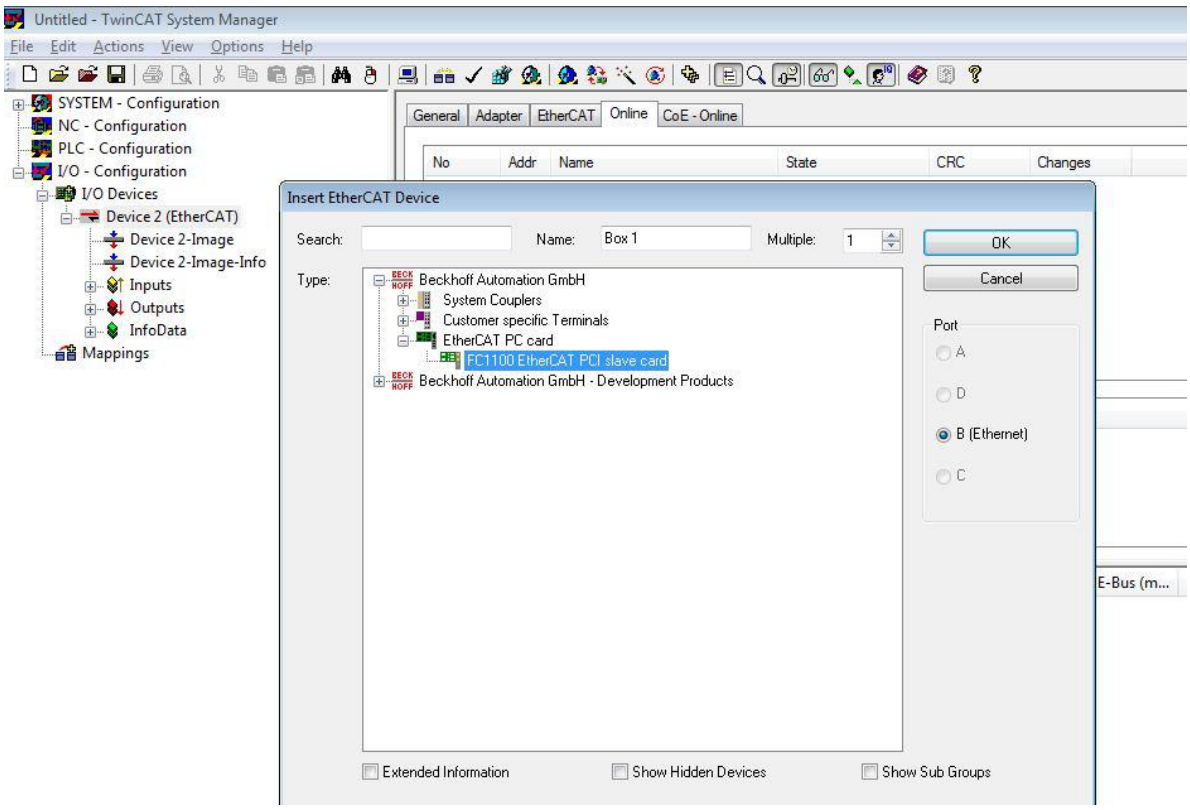

Fig. 6: Add FC1100 EtherCAT Slave

Import the PDO Configuration from the previous stored tsm file (see Import PDO Configuration [▶ 13]).

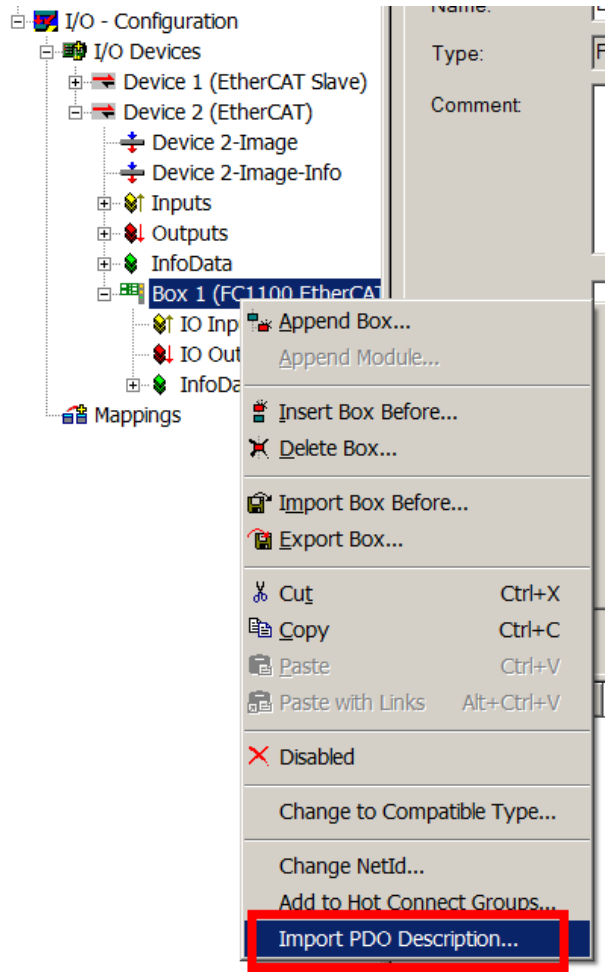

Fig. 7: Import PDO Configuration

The tsm file needs to be loaded to get the required information.

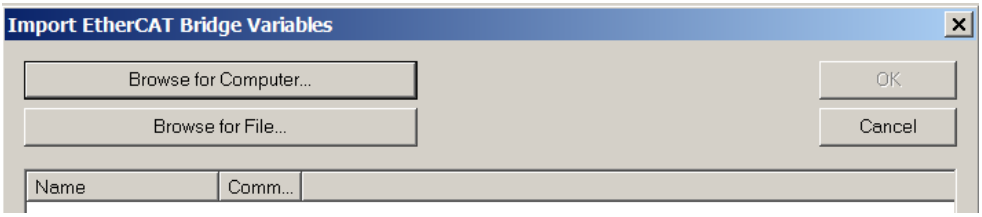

Fig. 8: Import PDO Configuration Dialog

Select FC1100 card with PDOs

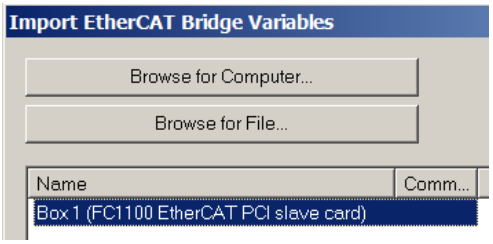

Fig. 9: Select corresponding Slave from tsm file

4.2 Slave Sample Code

The SlaveStackCode since provides the possibility to create a PC-based slave application without the TwinCAT software.
To get this slave application running the FC11xx driver need to be installed (3.2.1 [▶ 16] Driver installation [▶ 16]).
This driver creates a black channel between device memory in kernel layer and the application in the user layer.

4.2.1 Driver installation

After plugin the FC11xx EtherCAT PCI Slave card the driver installation window (see Driver Installation Window [▶ 16]) will be appear. If a driver is already installed, then open this window from the Windows Device Manager dialog.

Fig. 10: Driver Installation Window

Select driver source path from a specific location (see Select Driver Location [▶ 16]) and choose the path where the files “FC11xx.inf” and “TcMM.sys” are located.

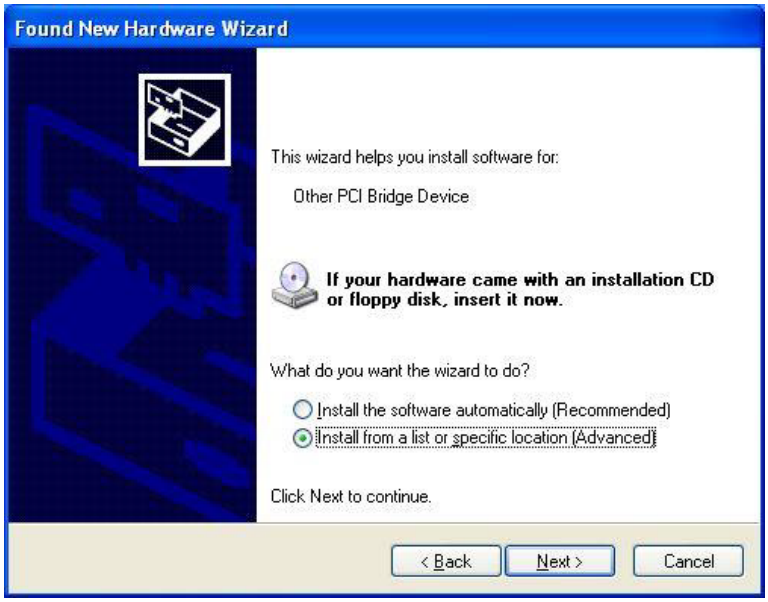

Fig. 11: Select Driver Location

After successful installation the device “FC1100 PCI Driver for ET9300” is listed in the Windows Device Manager (see Windows Device Manager [▶ 16]).
In case of the FC1121 card the name “FC1121 PCI Driver for ET9300” is shown.

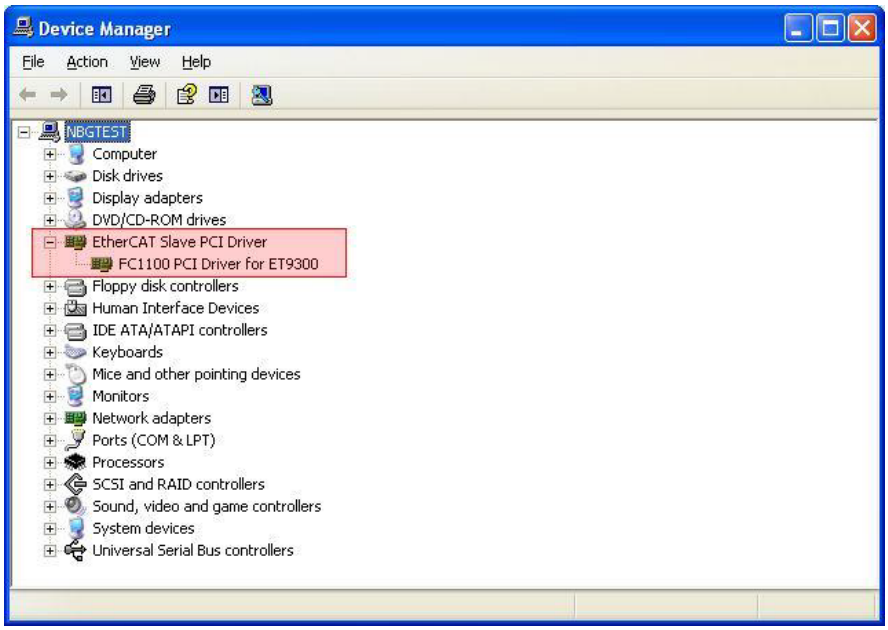

Fig. 12: Windows Device Manager

The EtherCAT Slave Controller (ESC) is now accessible by using the library TcHelper.dll.

4.2.2 Slave Software

In case that the SSC Tool is used create an FC1100 based project (selectable in the “new project dialog”). Otherwise enable “FC1100_HW” in the file ecat_def.h.
Note: When using the FC1121 slave card, the settings for “FC1100” apply as well.

NOTE

Only for Windows 32-Bit operation systems

Only for Windows 32-Bit operation systems the driver and library (provided by default with the SSC) can be used. For all other platforms/operating systems a new driver and library need to be created (refer to Hardware)

5 Appendix

5.1 Support and Service

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List of illustrations

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