

Application Note FC1100/FC1121 (EtherCAT Slave Card)

EtherCAT[®] 

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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.

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

2 Hardware

The hardware design focused to create an easy communication interface to an EtherCAT network.

The complete local memory area of the ESC (EtherCAT Slave Controller) is mapped to the memory range of the slave card. In case of the FC1100 the AL Event Interrupt is mapped to the PCI bus on interrupt line INTA.

2.1 FC1100 | PCI EtherCAT slave card

The PCI ID values of the FC1100 are listed in Table 2. 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

The AL Event (PDI IRQ) is mapped to INTA of the PCI bus.

Table 2: FC1100 PCI values

Parameter	Value
DeviceID	0x1100
VendorID	0x15ec

Figure 1 shows the hardware structure of the FC1100 slave card.

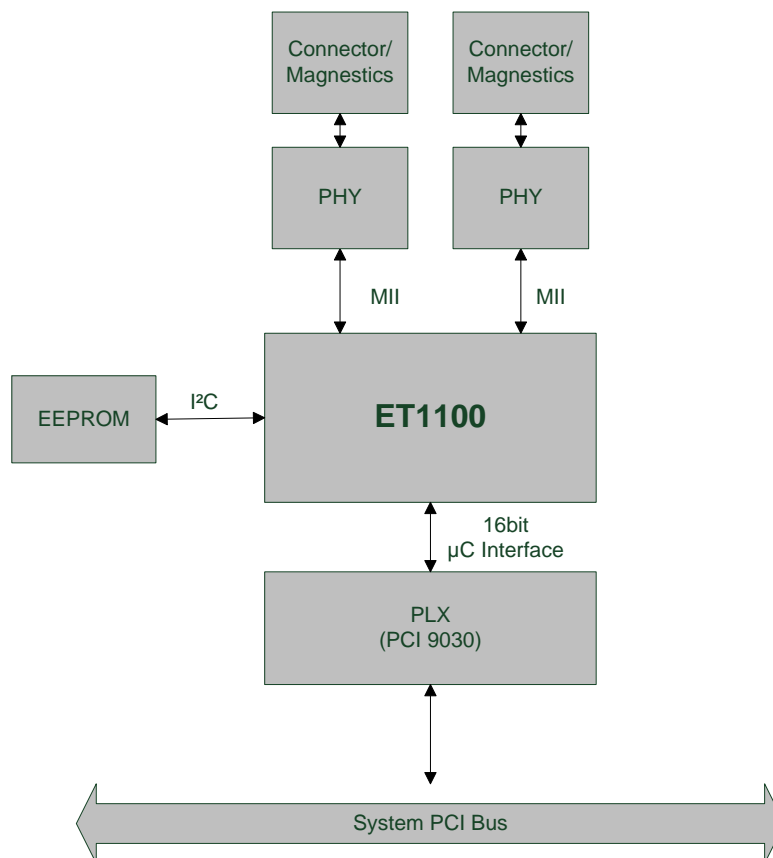


Figure 1: Hardware Schema

2.2 FC1121 | PCIe EtherCAT slave card

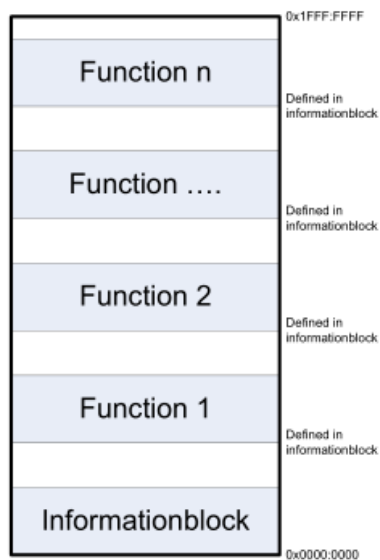
The PCIe ID values of the FC1121 are listed in Table 3. An FPGA based EtherCAT Slave Controller (ESC) is used to access the EtherCAT network. For ESC specific information (e.g. type and revision) see the corresponding ESC registers readout by an EtherCAT master or configuration tool.

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). 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.


Figure 2: FC1121 BAR0 memory mapping

The information block content of the FC1121 is shown in Table 4.

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.

Table 5: FC1121 function block description

Address	Description	ESC 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 Software

By default two software solutions are provided:

- TwinCAT (<http://www.beckhoff.com/TwinCAT>)
- SlaveStackCode (http://www.ethercat.org/memberarea/stack_code.aspx)

Both solutions are Windows-based and don't support any kind of synchronization.

3.1 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).

3.1.1 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 Figure 3: Select EtherCAT Slave).

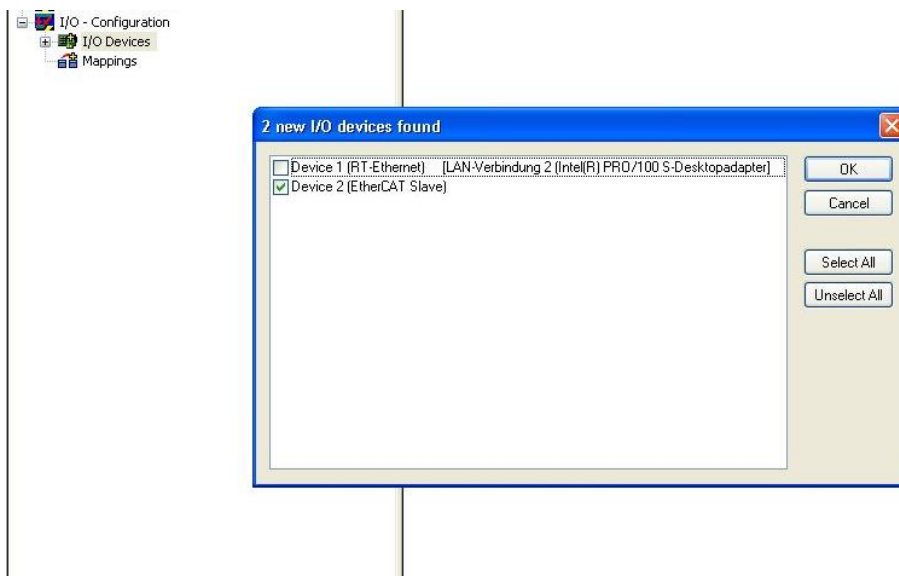


Figure 3: Select EtherCAT Slave

The process data can be added by right mouse click on the corresponding node (see Figure 4: Add Process Data Manually). If a PLC project is already added to the System Manager project which contains user defined structs these are also selectable.



Figure 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 Figure 5: Create Variable Link).

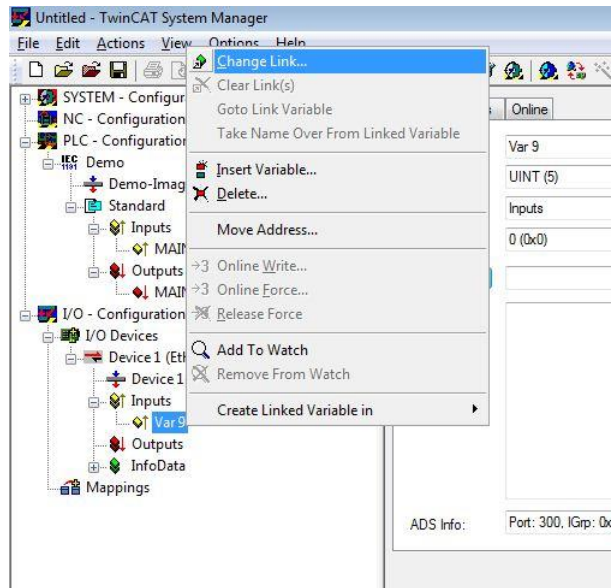


Figure 5: Create Variable Link

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

3.1.2 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 Figure 6: Add FC1100 EtherCAT Slave).

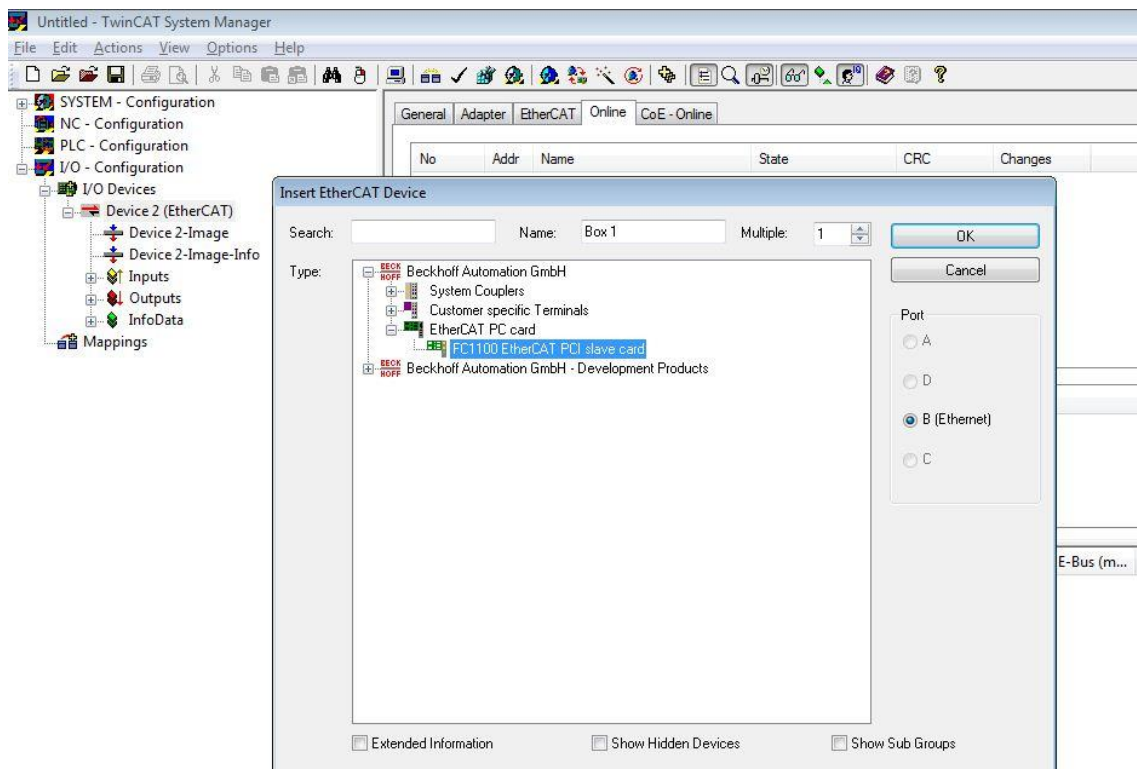


Figure 6: Add FC1100 EtherCAT Slave

Import the PDO Configuration from the previous stored tsm file (see Figure 7: Import PDO Configuration).

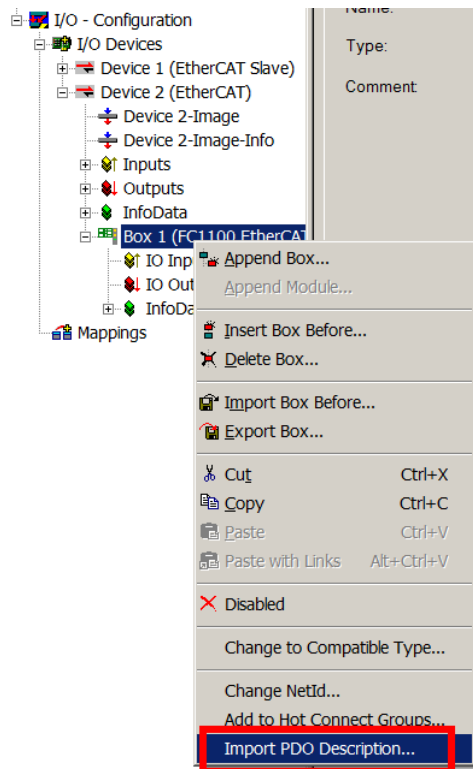


Figure 7: Import PDO Configuration

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

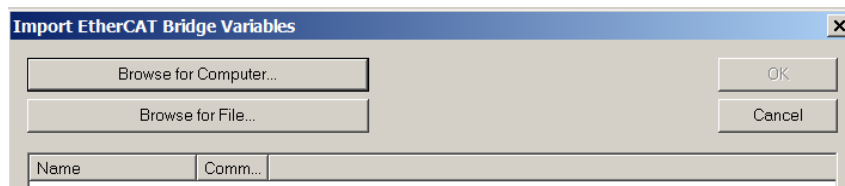


Figure 8: Import PDO Configuration Dialog

Select FC1100 card with PDOs

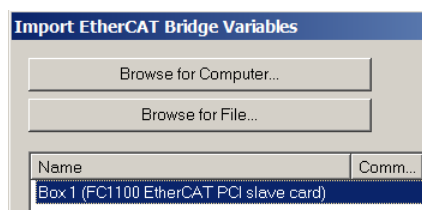


Figure 9: Select corresponding Slave from tsm file

3.2 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 Driver installation). This driver creates a black channel between device memory in kernel layer and the application in the user layer.

3.2.1 Driver installation

After plugin the FC11xx EtherCAT PCI Slave card the driver installation window (see Figure 10: Driver Installation Window) will be appear. If a driver is already installed, then open this window from the Windows Device Manager dialog.



Figure 10: Driver Installation Window

Select driver source path from a specific location (see Figure 11) and choose the path where the files “FC11xx.inf” and “TcMM.sys” are located.



Figure 11: Select Driver Location

After successful installation the device “FC1100 PCI Driver for ET9300” is listed in the Windows Device Manager (see Figure 12).

In case of the FC1121 card the name “FC1121 PCI Driver for ET9300” is shown.

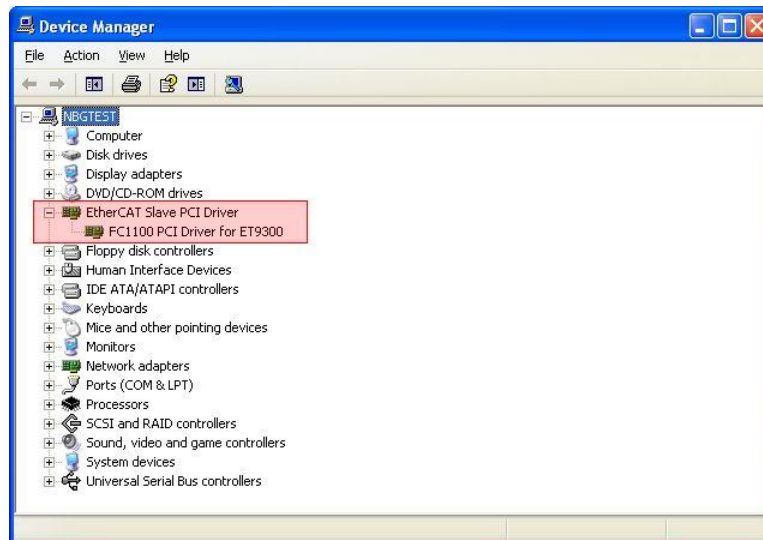


Figure 12: Windows Device Manager

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

3.2.2 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.

If the slave application is executed on a Windows 32-bit platform, then the library “TcHelper” can be used. For all other platforms/operating systems a new library needs to be created (refer to 2 Hardware).

Appendix

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