Documentation EtherCAT Slave PC LabVIEW 1.4

This document describes the installation and usage of the “EtherCAT Slave PC LabVIEW“ version 1.4.

1 General Information

The „EtherCAT Slave PC LabVIEW“ turns a Windows PC with LabVIEW application into an EtherCAT slave, which can easily be integrated into automation systems, that use EtherCAT as automation bus. As EtherCAT slave hardware layer a Beckhoff EtherCAT slave PCI card (FC1100 or FC1121) is used.

In LabVIEW an API for exchanging process data and accessing CoE objects is provided. The following functionality is supported:

- Read and write process data
- LabVIEW User Event for new process data
- Read and write CoE objects
- LabVIEW User Event for change of CoE objects by master
- File data excjange bei File over EtherCAT (FoE)

The process data interface for input and output data is configurable by the master and can have 256 bytes respectively.

2 System Requirements

2.1 Operating System

The library can be used on 7, 8 and 10 in 32 and 64 bit.

2.2 Software

All required software is installed by the installer.

2.3 LabVIEW

The library can be used with LabVIEW 2010 to 2017 in 32 bit only(!).

2.4 Required Hardware

The library makes use of a Beckhoff FC1100 PCI or FC1121 PCIe card, which needs to be installed in the system.

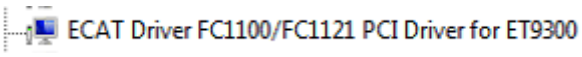
3 Installation

3.1 Beckhoff FC1100 PCI and FC1121 PCIe card

After inserting the PCI card into the PC system, the driver for the hardware needs to be installed. If the hardware dialog does not open automatically, select the card in the hardware manager and select manual selection of the driver.
The driver files are located in:
..\Program Files\Ackermann Automation\EtherCAT Slave PC\FC11xx Drivers

For using the card in Windows mode, the driver EcatDrvFC11xx.inf needs to be installed.

After driver installation, the hardware manager should show the card under system Devices like this:

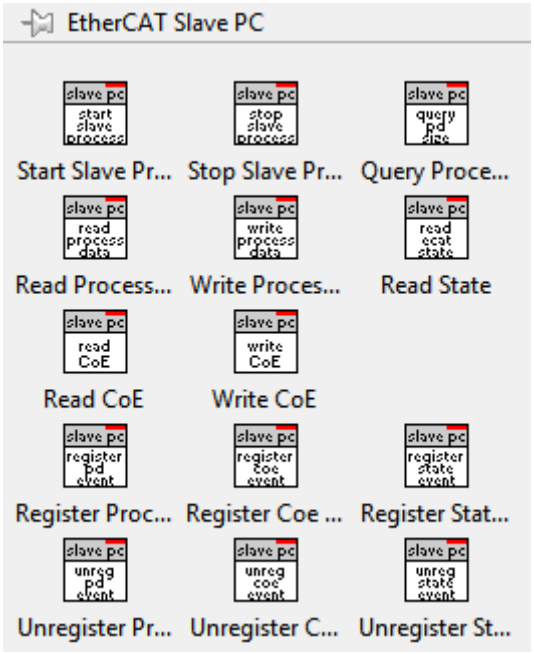


3.2 LabVIEW Library

The installer installs files directly to the LabVIEW directory (..\program files\National Instruments\LabVIEW xx\..)

The library is installed into the intr.lib folder in the subfolder "_Ackermann Automation\Canon EOS Control".

The functions palette is installed under Instrument Drivers.



A shortcut to examples and documents is installed in the Start Menu in Programs -> Ackermann Automation -> EtherCAT Slave PC LabVIEW

3.3 LabVIEW Examples

The examples are installed in the LabVIEW examples folder "..\Program Files\National Instruments\LabVIEW xx\examples\Ackermann Automation\ EtherCAT Slave PC ".

3.4 ESI File

The ESI file for the EtherCAT Slave has to be transferred manually to the corresponding ESI folder of the EtherCAT Master. In case of TwinCAT 2.x, it is the folder "C:\TwinCAT\IO\EtherCAT". In case of TwinCAT 3.x, it is the folder "C:\TwinCAT\3.1\Config\Io\EtherCAT".

The Slave ESI file can be found in
"..\Program Files\Ackermann Automation\ EtherCAT Slave PC LabVIEW\ESI"

The process data objects are generated dynamically in the slave and are not described in the ESI file.

3.5 Tools And Documents

All further tools and documents can be found in:

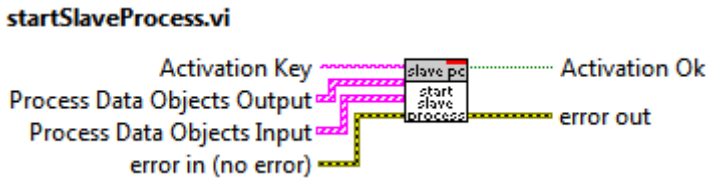
"..\Program Files\Ackermann Automation\ EtherCAT Slave PC LabVIEW"

4 Programming

This chapter describes the principals of programming with the library. The detailed VI information can be found in the help file.

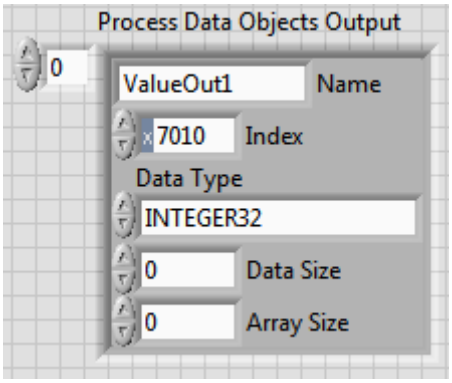
4.1 Start and stop the slave process

The program that contains the EtherCAT slave functionality runs as an own process and can be started and stopped from LabVIEW. So the first step in a LabVIEW application is to start the slave process. In this (and only this) step the process data objects are defined.



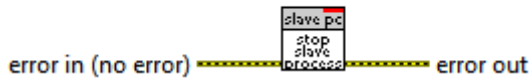
The process data objects (PDO) are created from an array of PDO information for inputs and outputs respectively. The output data (master to slave) has an object index range from 0x7010 to 0x70FF.
The inputs data (slave to master) has an object index range from 0x6010 to 0x60FF.
The PDO information cluster has the following elements:

- **Name**
  String for PDO name
- **Index**
  Object index in the 0x6010 to 0x60FF or 0x7010 to 0x70FF range. Object indices must be unique, but have no rules regarding incremental step size or order.
- **Data Type**
  Data type of the object. Currently no mixed data types in one object are supported. So the object can be a single value or array of the same data type.
- **Data Size**
  This input is used for string types. For all other data types this input is ignored.
- **Array Size**
  If this input is >1, an array is created. For single values, the input can be 0 or 1.



For proper cleanup, the function stop process has to be called.

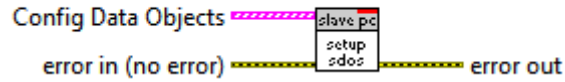
stopSlaveProcess.vi



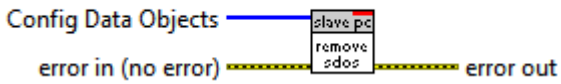
4.2 Create and remove SDOs

Configuration data objects can be added to the slave object dictionary in the configuration section 0x8000 to 0x8FFF. These objects can be created and removed anytime.

setupSdos.vi



removeSdos.vi

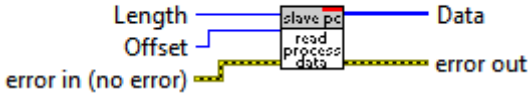


4.3 Read and write process data

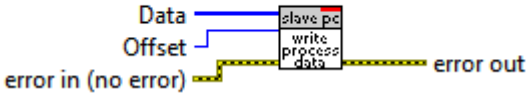
The process data is created from the defined data objects. The data is represented by a continuous byte array. If the first data object represents an int16 and the second PDO an int32, then the first 2 bytes of the array belong to PDO one and bytes 3 to 6 belong to PDO 2. The byte order of numerical types are little endian on the EtherCAT bus and have to be converted to big endian for LabVIEW.

The EtherCAT slave contains 2 standard PDOs status word and control word. The status word informs the master, that process data was received by the slave application. The 2 PDOs are handled internally and are not to be written by user. The write and read functions only handle the additional user defined PDOs.

readProcessData.vi



writeProcessData.vi



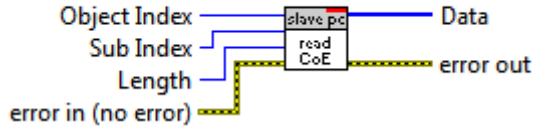
The size of input and output process data is defined by the PDO mapping. The size can be queried.

queryProcessDataSize.vi

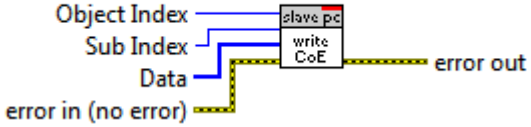
4.4 Read and write CoE data

The access of CoE objects is done by object index and sub index. Data is read and written via byte array. Numerical values have to be converted to little or big endian format when writing and reading. This means the byte order has to be swapped.

readCoE.vi



writeCoE.vi

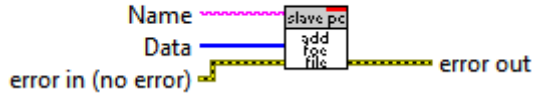


4.5 File over EtherCAT (FoE)

With FoE file data can be transported over the EtherCAT bus. Data can be uploaded from the slave and downloaded to the slave.

The upload works with an internal file archive in the slave. This has to be filled, before the master can request a file from the slave. The upload request is done by file name. Files are organized with the add function to add or replace a file and delete to erase a file.

addFoeStorageFile.vi



deleteFoeStorageFile.vi

The files that are downloaded by the master from the slave are received by event. An event is fired, when new data is available. See chapter on registering events.

Passwords are currently not supported.

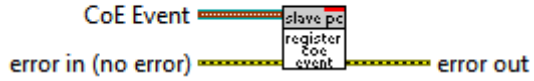
4.6 Registering events

For better performance by avoiding polling, LabVIEW events can be registered for receiving new output process data, change of CoE data by the master and change of EtherCAT bus state.

registerEthercatStateEvent.vi

registerProcessDataEvent.vi

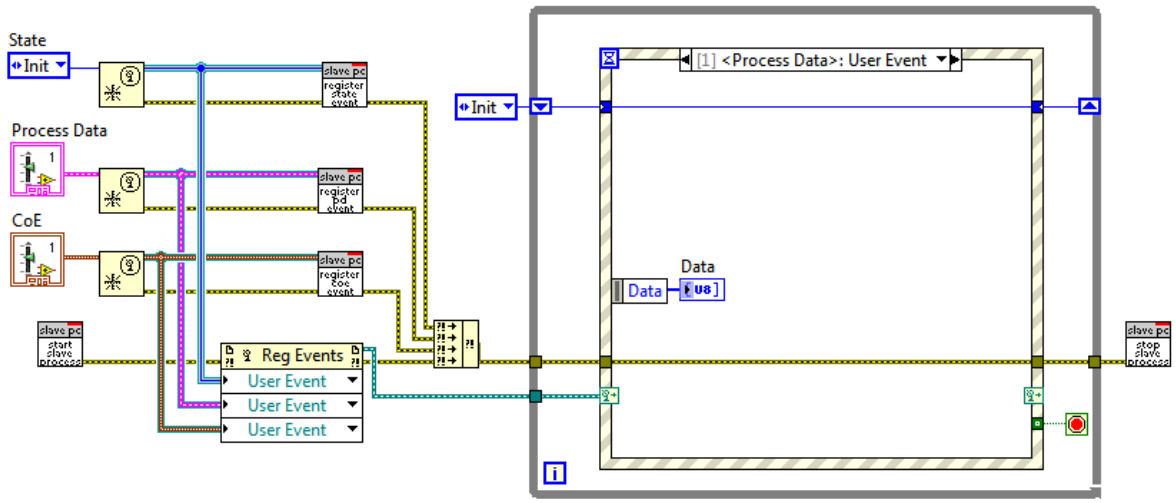
registerCoeEvent.vi



An FoE Event is fired, when the master downloaded a file to the slave.

registerFoeEvent.vi

The events can be caught in a LabVIEW User Event structure.



5 Write ESI file to EEPROM of PCI card

The PCI slave card comes configured as a FC card EtherCAT slave. This configuration has to be updated to be an “EtherCAT Slave PC” Device. Therefore the ESI file has to be written to the EEPROM of the card. This is done using an EtherCAT master like TwinCAT.

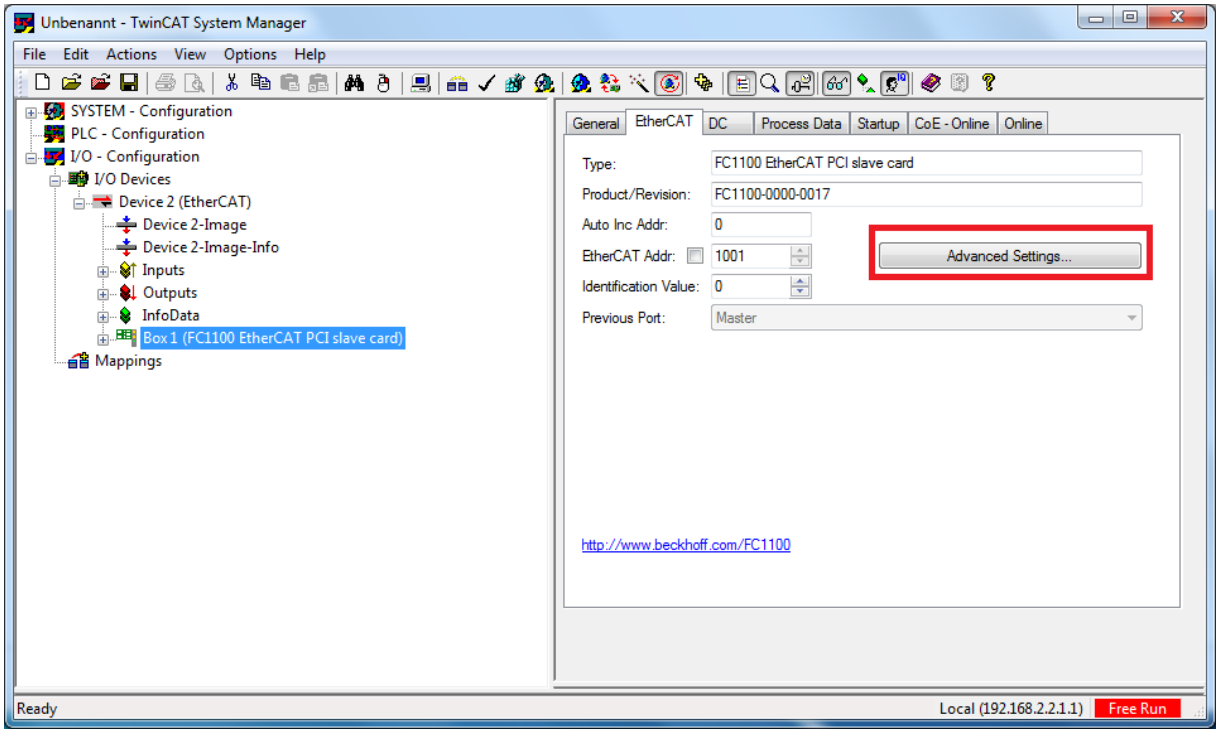
The ESI file for the EtherCAT Slave has to be transferred manually to the corresponding ESI folder of the EtherCAT Master. In case of TwinCAT, it is the fodler “C:\TwinCAT\IO\EtherCAT”.

The Slave ESI file can be found in
“..\Program Files\Ackermann Automation\ EtherCAT Slave PC LabVIEW\ESI“

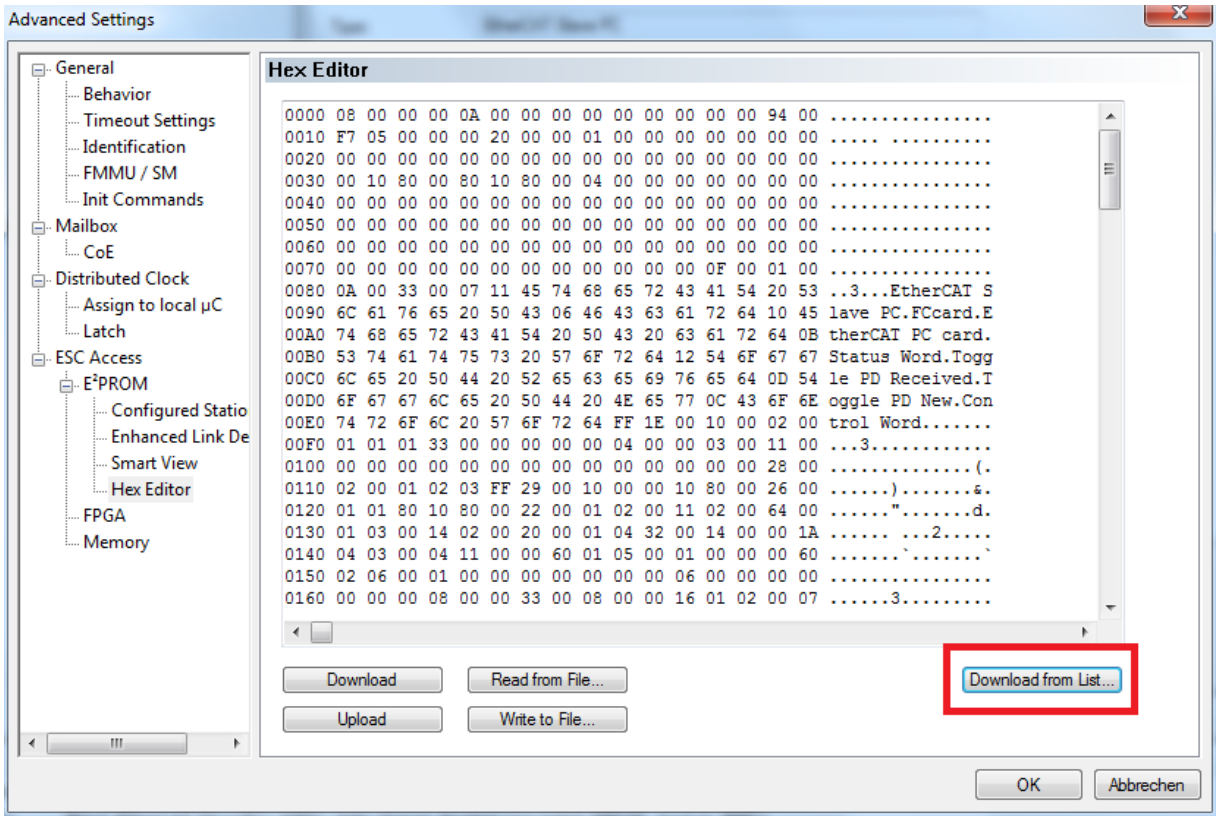
The steps are shown in TwinCAT.

Run one of the LabVIEW examples or any other LabVIEW slave application! The slave process needs to be running for the EEPROM download. It does not matter, which LabVIEW application is running.

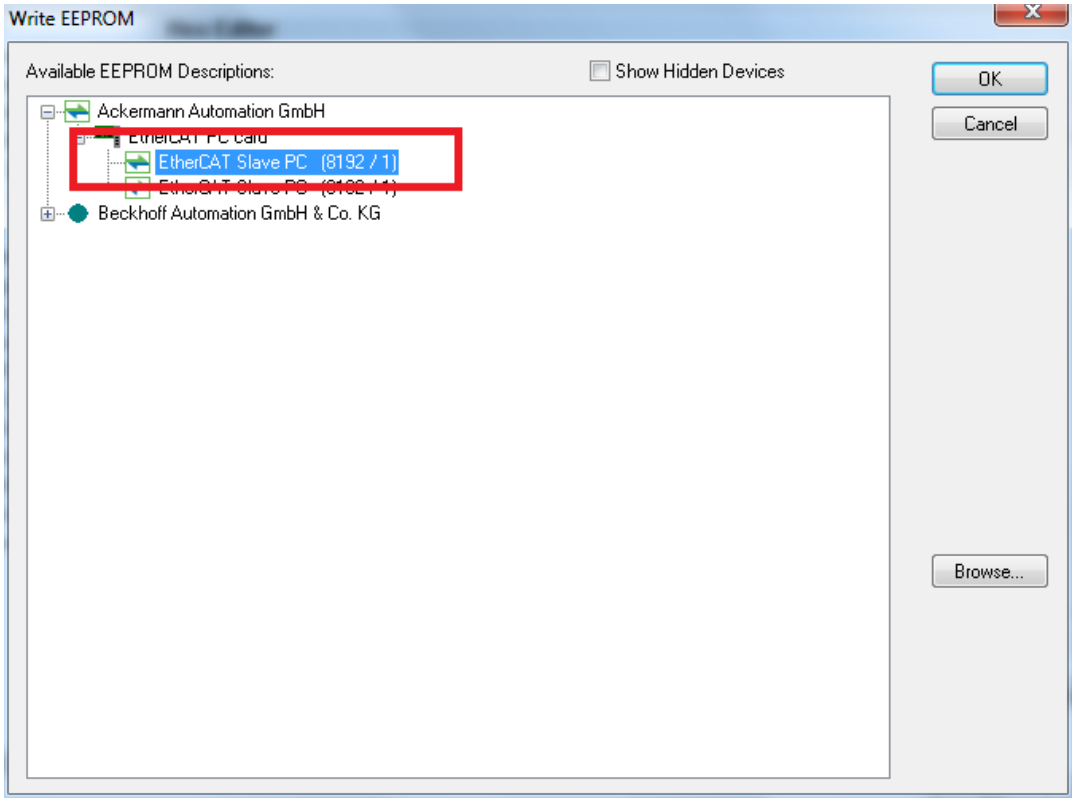
Scan the EtherCAT bus in TwinCAT. Go to the detected slave card and open the advanced options.



Open the EEPROM Hex view section and select Download from List to choose a slave from the ESI files.



Select Ackermann Automation -> EtherCAT Slave PC and press OK.



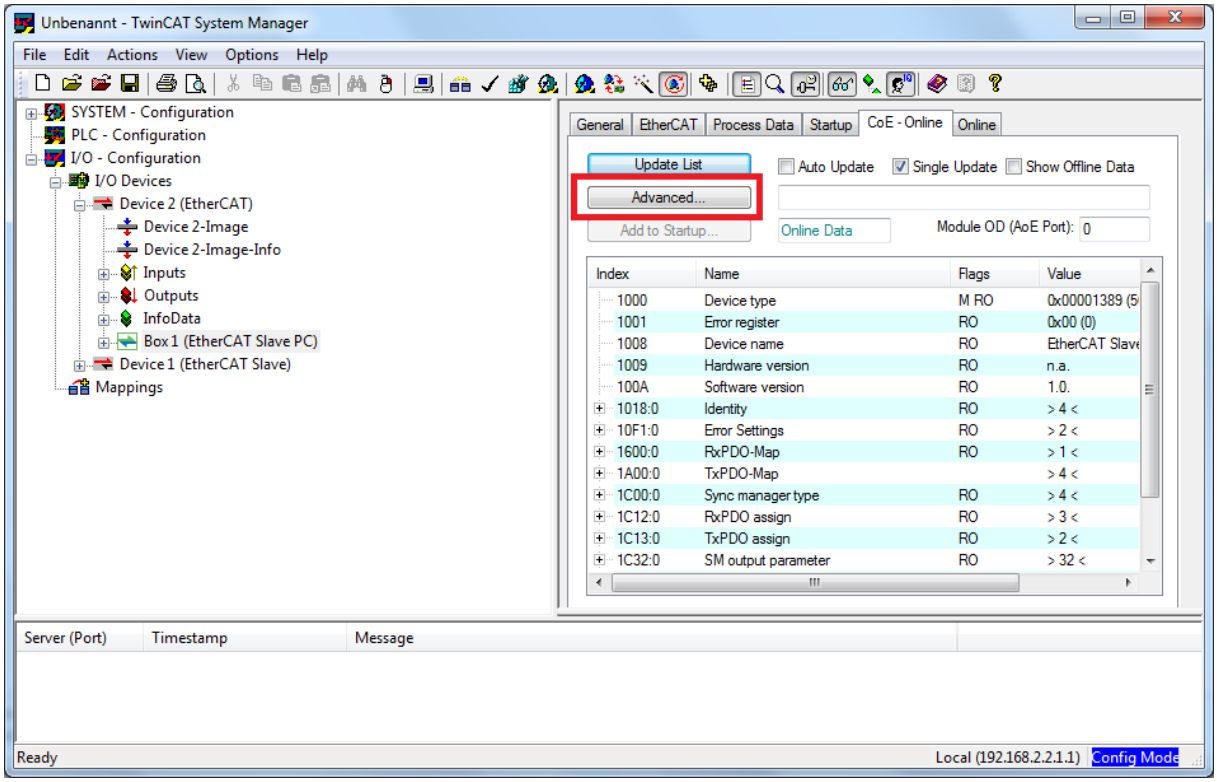
The data is then downloaded to the slave. After a rescan of the EtherCAT bus, the card should be recognized as EtherCAT Slave PC device.

6 Starting an Example

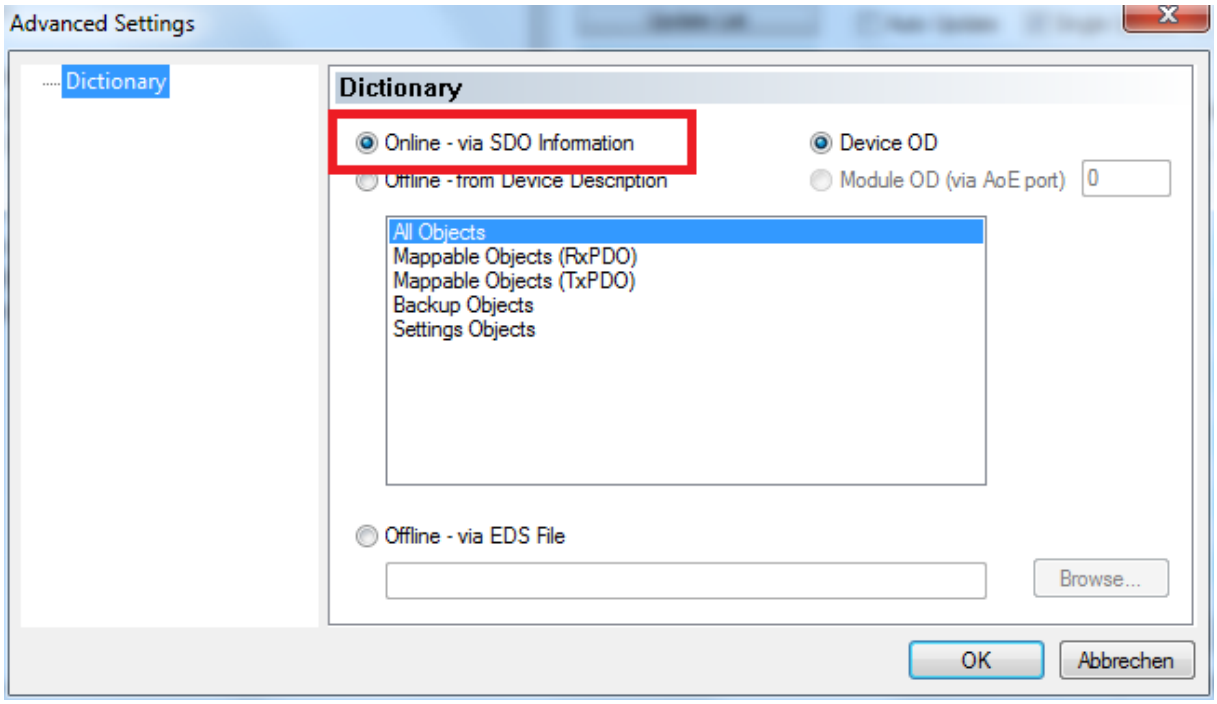
The steps are shown in TwinCAT.

Open an example and run the LabVIEW code. This will start the slave process, which is necessary for all actions done with the slave.

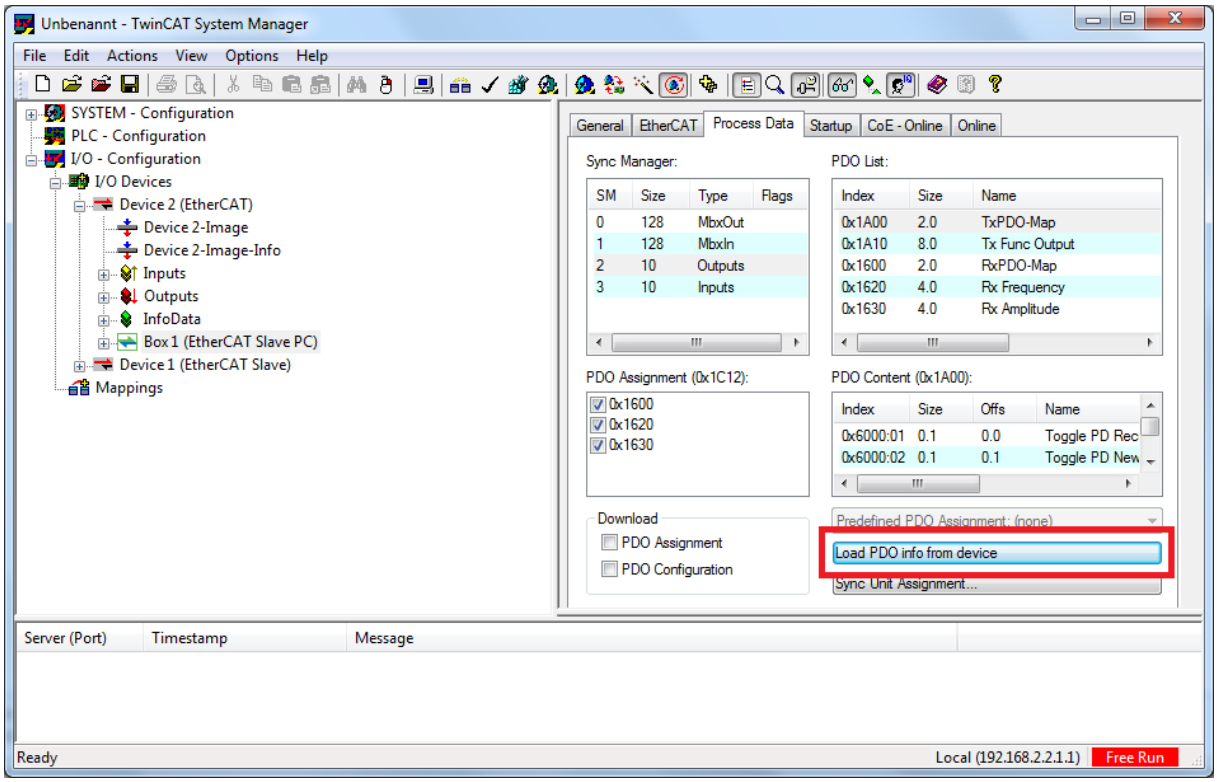
Scan the EtherCAT bus in TwinCAT. Go to CoE-Online tab and open the advanced options.



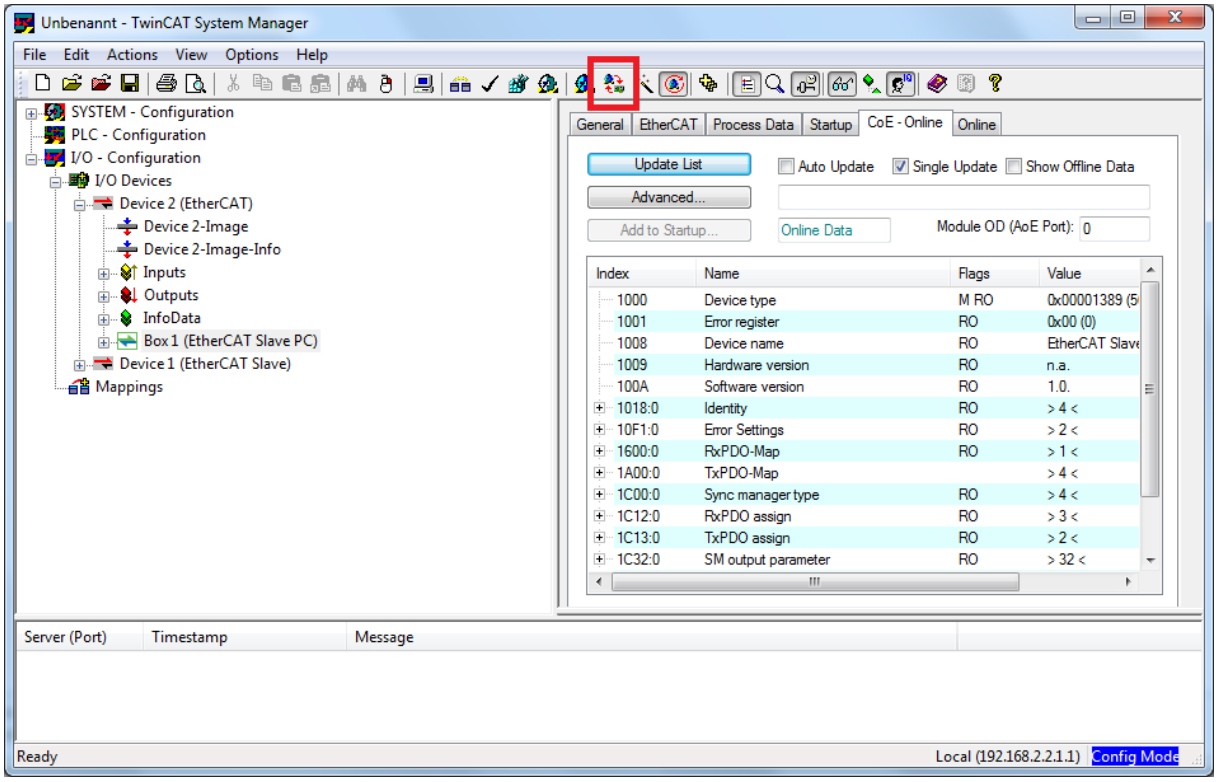
Select the online dictionary download from the slave. This will additionally show all the objects, that were generated from LabVIEW, in the CoE-Online view.



Then go to the Process Data tab and select Load PDO info from device. This will get the PDO configuration made by LabVIEW.



Then press the Reload I/O Devices button. The slave is then ready for Operational mode.

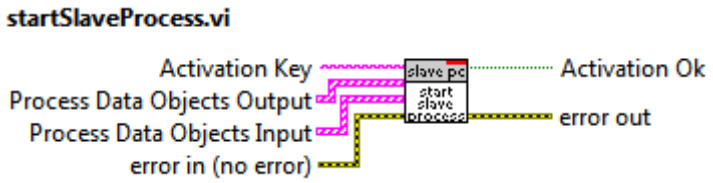


In operational mode the process data can be read and written from LabVIEW.

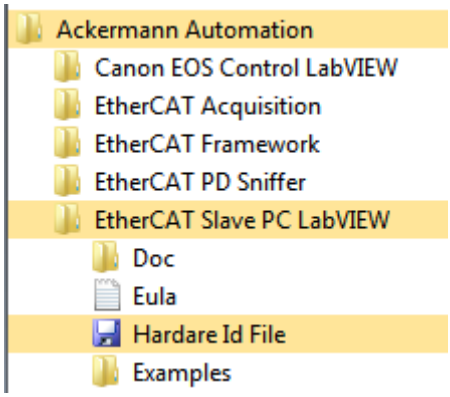
7 License Activation

On each PC the library is used, a runtime license has to be activated. Without activation the library works for 10 minutes in demo mode.

The activation is done by entering the “License Number” and “Activation code” in the startSlaveProcess.vi. The activation state is given at the output of the VI.



To get an activation code, a hardware id file has to be generated on the PC the library is used. This is done with the “Hardware Id File” tool found in the start menu. The requested license number is stated in your license document.



Send the hardware id file to activation@ackermann-automation.de to receive the activation key.

8 Support

For support contact:

Ackermann Automation GmbH
Kelsterbacher Strasse 15-19
60528 Frankfurt am Main
www.ackermann-automation.de

Tel.: +49(0)69-40562742
Fax: +49(0)69-40562816
info@ackermann-automation.de