

# User Manual **NanoLib**

## Java

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## 1 Document aim and conventions

This document describes the setup and use of the *NanoLib* library and contains a reference to all classes and functions for programming your own control software for Nanotec controllers. We use the following typefaces:

Underlined text marks a cross reference or hyperlink.

- Example 1: For exact instructions on the NanoLibAccessor, see Setup.
- Example 2: Install the lxxat driver and connect the CAN-to-USB adapter.

*Italic text* means: This is a *named object*, a *menu path / item*, a *tab / file name* or (if necessary) a *foreign-language* expression.

- Example 1: Select *File > New > Blank Document*. Open the *Tool* tab and select *Comment*.
- Example 2: This document divides users (= *Nutzer; usuario; utente; utilisateur; utente* etc.) from:
  - Third-party user (= *Drittnutzer; tercero usuario; terceiro utente; tiers utilisateur; terzo utente* etc.).
  - End user (= *Endnutzer; usuario final; utente final; utilisateur final; utente finale* etc.).

Courier marks code blocks or programming commands.

- Example 1: Via Bash, call `sudo make install` to copy shared objects; then call `ldconfig`.
- Example 2: Use the following NanoLibAccessor function to change the logging level in NanoLib:

```
//
    ***** C++ variant *****
void setLoggingLevel(LogLevel level);
```

**Bold text** emphasizes individual words of **critical** importance. Alternatively, bracketed exclamation marks emphasize the critical(!) importance.

- Example 1: Protect yourself, others and your equipment. Follow our **general** safety notes that are generally applicable to **all** Nanotec products.
- Example 2: For your own protection, also follow **specific** safety notes that apply to **this** specific product.

The verb *to co-click* means a click via secondary mouse key to open a context menu etc.

- Example 1: Co-click on the file, select *Rename*, and rename the file.
- Example 2: To check the properties, co-click on the file and select *Properties*.

## 2 Before you start

Before you start using *NanoLib*, do prepare your PC and inform yourself about the intended use and the library limitations.

### 2.1 System and hardware requirements

#### NOTICE



#### Malfunction from 32-bit operation!

- ▶ Use, and consistently maintain, a 64-bit system.
- ▶ Follow valid OEM instructions.

*NanoLib 1.2.0* supports all Nanotec products with CANopen, Modbus RTU (also USB on virtual *com* port), Modbus TCP, EtherCat, and Profinet. For **older** NanoLibs: See changelog in the imprint. At **your** risk only: legacy-system use. **Note:** Follow valid OEM instructions to set the latency as low as possible if you face problems when using an FTDI-based USB adapter.

#### Requirements (64-bit system mandatory)

Windows 10 or 11 w/ *Visual Studio*

- CANopen: *Ixxat* VCI driver (optional)
- EtherCat module / Profinet DCP: *Npcap* or *WinPcap*
- RESTful module: *Npcap*, *WinPcap*, or admin permission to communicate w/ Ethernet bootloaders

Linux w/ *Ubuntu 18 to 24* (all x64 and arm64)

- Kernel headers and *libpopt-dev* packet
- Profinet DCP: `CAP_NET_ADMIN` and `CAP_NET_RAW` abilities
- CANopen: *Ixxat* ECI driver or *Peak* PCAN-USB adapter
- EtherCat: `CAP_NET_ADMIN`, `CAP_NET_RAW` and `CAP_SYS_NICE` abilities
- RESTful: `CAP_NET_ADMIN` ability to communicate w/ Ethernet bootloaders (also recommended: `CAP_NET_RAW`)

#### Language, fieldbus adapters, cables

Java JRE / JDK 11 or higher

- EtherCAT: *Ethernet cable*
- VCP / USB hub: *now uniform USB*
- USB mass storage: *USB cable*
- REST: *Ethernet cable*
- CANopen: *Ixxat USB-to-CAN V2*; *Nanotec ZK-USB-CAN-1*. **No** *Ixxat* support for *Ubuntu* on *arm64*
- Modbus RTU: *Nanotec ZK-USB-RS-485-1* or equivalent adapter; USB cable on virtual *com* port (VCP)
- Modbus TCP: *Ethernet cable as per product datasheet*

### 2.2 Intended use and audience

*NanoLib* is a program library and software component for the operation of, and communication with, Nanotec controllers in a wide range of industrial applications – and for duly skilled programmers only.

Due to real-time incapable hardware (PC) and operating system, *NanoLib* is not for use in applications that need synchronous multi-axis movement or are generally time-sensitive.

In no case may you integrate *NanoLib* as a safety component into a product or system. On delivery to end users, you must add corresponding warning notices and instructions for safe use and safe operation to each product with a Nanotec-manufactured component. You must pass all Nanotec-issued warning notices right to the end user.

### 2.3 Scope of delivery and warranty

*NanoLib* comes as a \*.zip folder from our download website for either EMEA / APAC or AMERICA. Duly store and unzip your download before setup. The *NanoLib* package contains:

- Interface classes as source code (API)
- Core functions as library in binary format: *\_nanolib\_java.dll*

- Libraries that facilitate communication: *nanolibm\_* ■ Example code: *nanolib-nanolibexample-x.x.x.jar [yourfieldbus].dll* etc.

For scope of warranty, please observe a) our terms and conditions for either EMEA / APAC or AMERICA and b) all license terms. **Note:** Nanotec is not liable for faulty or undue quality, handling, installation, operation, use, and maintenance of third-party equipment! For due safety, always follow valid OEM instructions.

### 3 The *NanoLib* architecture

*NanoLib*'s modular software structure lets you arrange freely customizable motor controller / fieldbus functions around a strictly pre-built core. *NanoLib* contains the following modules:

User interface (API)	NanoLib core	Communication libraries
Interface and helper classes which	Libraries which	Fieldbus-specific libraries which
<ul style="list-style-type: none"> <li>■ access you to your controller's OD (object dictionary)</li> <li>■ base on the <i>NanoLib</i> core functionalities.</li> </ul>	<ul style="list-style-type: none"> <li>■ implement the API functionality</li> <li>■ interact with bus libraries.</li> </ul>	<ul style="list-style-type: none"> <li>■ do interface between <i>NanoLib</i> core and bus hardware.</li> </ul>

#### 3.1 User interface

The user interface consists of header interface files you can use to access the controller parameters. The user interface classes as described in the [Classes / functions reference](#) allow you to:

- Connect to both the hardware (fieldbus adapter) and the controller device.
- Access the OD of the device, to read/write the controller parameters.

#### 3.2 *NanoLib* core

The *NanoLib* core comes with the library . It implements the user interface functionality and is responsible for:

- Loading and managing the communication libraries.
- Providing the user interface functionalities in the [NanoLibAccessor](#). This communication entry point defines a set of operations you can execute on the *NanoLib* core and communication libraries.

#### 3.3 Communication libraries

In addition to *nanotec.services.nanolib.dll* (useful for your optional *Plug & Drive Studio*), *NanoLib* offers the following communication libraries:

- |                               |                                   |                                |
|-------------------------------|-----------------------------------|--------------------------------|
| ■ <i>nanolibm_canopen.dll</i> | ■ <i>nanolibm_ethernetcat.dll</i> | ■ <i>nanolibm_usbmmisc.dll</i> |
| ■ <i>nanolibm_modbus.dll</i>  | ■ <i>nanolibm_restful-api.dll</i> | ■ <i>nanolibm_profinet.dll</i> |

All libraries lay a hardware abstraction layer between core and controller. The core loads them at startup from the designated project folder and uses them to establish communication with the controller by corresponding protocol.

## 4 Getting started

Read how to set up *NanoLib* for your operating system duly and how to connect hardware as needed.

### 4.1 Prepare your system

Before installing the adapter drivers, do prepare your PC along the operating system first. To prepare the PC along your Windows OS, install Java JRE / JDK 11 or higher. To install *make* and *gcc* by *Linux Bash*, call `sudo apt install build-essentials`. Do then enable `CAP_NET_ADMIN`, `CAP_NET_RAW`, and `CAP_SYS_NICE` capabilities for the application that uses NanoLib:

1. Call `sudo setcap 'cap_net_admin,cap_net_raw,cap_sys_nice+eip' <application_name>`.
2. Only then, install your adapter drivers.

### 4.2 Install the *Ixxat* adapter driver for Windows

Only after due driver installation, you may use Ixxat's *USB-to-CAN V2* adapter. Read the USB drives' product manual, to learn if / how to activate the virtual comport (VCP).

1. Download and install Ixxat's VCI 4 driver for Windows from [www.ixxat.com](http://www.ixxat.com).
2. Connect Ixxat's USB-to-CAN V2 compact adapter to the PC via USB.
3. By Device Manager: Check if both driver and adapter are duly installed/recognized.

### 4.3 Install the *Peak* adapter driver for Windows

Only after due driver installation, you may use Peak's *PCAN-USB* adapter. Read the USB drives' product manual, to learn if / how to activate the virtual comport (VCP).

1. Download and install the Windows device driver setup (= installation package w/ device drivers, tools, and APIs) from <http://www.peak-system.com>.
2. Connect Peak's PCAN-USB adapter to the PC via USB.
3. By Device Manager: Check if both driver and adapter are duly installed/recognized.

### 4.4 Install the *Ixxat* adapter driver for Linux

Only after due driver installation, you may use Ixxat's *USB-to-CAN V2* adapter. **Note:** Other supported adapters need your permissions by `sudo chmod +777/dev/ttyACM* (* device number)`. Read the USB drives' product manual, to learn if / how to activate the virtual comport (VCP).

1. Install the software needed for the ECI driver and demo application:

```
sudo apt-get update
apt-get install libusb-1.0-0-dev libusb-0.1-4 libc6 libstdc++6 libgcc1 build-essential
```

2. Download the ECI-for-Linux driver from [www.ixxat.com](http://www.ixxat.com). Unzip it via:

```
unzip eci_driver_linux_amd64.zip
```

3. Install the driver via:

```
cd /EciLinux_amd/src/KernelModule
sudo make install-usb
```

4. Check for successful driver installation by compiling and starting the demo application:

```
cd /EciLinux_amd/src/EciDemos/
sudo make
cd /EciLinux_amd/bin/release/
./LinuxEciDemo
```



## 4.5 Install the *Peak* adapter driver for Linux

Only after due driver installation, you may use Peak's *PCAN-USB* adapter. **Note:** Other supported adapters need your permissions by `sudo chmod +777/dev/ttyACM* (* device number)`. Read the USB drives' product manual, to learn if / how to activate the virtual comport (VCP).

1. Check if your Linux has kernel headers: `ls /usr/src/linux-headers-`uname -r``. **If not**, install them:

```
sudo apt-get install linux-headers-`uname -r`
```

2. Only now, install the *libpopt-dev* packet:

```
sudo apt-get install libpopt-dev
```

3. Download the needed driver package (*peak-linux-driver-xxx.tar.gz*) from [www.peak-system.com](http://www.peak-system.com).

4. To unpack it, use:

```
tar xzf peak-linux-driver-xxx.tar.gz
```

5. In the unpacked folder: Compile and install the drivers, PCAN base library, etc.:

```
make all
```

```
sudo make install
```

6. To check the function, plug the PCAN-USB adapter in.

- a) Check the kernel module:

```
lsmod | grep pcan
```

- b) ... and the shared library:

```
ls -l /usr/lib/libpcan*
```

**Note:** If USB3 problems occur, use a USB2 port.

## 4.6 Connect your hardware

To be able to run a NanoLib project, connect a compatible Nanotec controller to the PC using your adapter.

1. By a suitable cable, connect your adapter to the controller.
2. Connect the adapter to the PC according to the adapter data sheet.
3. Power on the controller using a suitable power supply.
4. If needed, change the Nanotec controller's communication settings as instructed in its product manual.

## 4.7 Load *NanoLib*

For a first start with quick-and-easy basics, you may (but must not) use our example project.

1. Depending on your region: Download NanoLib from our website for either [EMEA / APAC](#) or [AMERICA](#).
2. Unzip the package's files / folders and do select one option:
  - **For quick-and easy basics:** See [Starting the example project](#).

## 5 Starting the example project

With NanoLib duly loaded, the example project shows you through NanoLib usage with a Nanotec controller. **Note:** For each step, comments in the provided example code explain the functions used. The example code provided is:

- *NanolibExample.java* (main file)
- *NanolibHelper.java* (helper class for wrapping the NanoLib accessor)
- *NanolibProfinetExample.java* (optional example for PROFINET devices)
- *NanolibSamplerExample.java* (optional example for sampler use)

An example to demonstrate the logging function is in the *loggingcallbackexample* folder and usable in Windows or Linux.

### In Windows via powershell etc.

1. In the command prompt: Change to the NanoLib directory:

```

` `` cmd
  cd <desired directory>\example
` ``

```

2. With *N.N.N* as current NanoLib version: Start the java example program containing the example jar:

```

` `` cmd
  java -jar nanolib-<example name>-N.N.N.jar
` ``

```

### In Linux via Bash

1. In the bash: Change to the NanoLib directory `` `cmd cd <desired directory>/example ` ``

```

` `` cmd
  cd <desired directory>/example
` ``

```

2. With *N.N.N* as current NanoLib version: Start the java example program containing the example jar

```

` `` cmd
  java -jar nanolib-<example name>-N.N.N.jar
` ``

```

The main example demonstrates the typical workflow for handling a controller:

1. Check the PC for connected hardware (adapters) and list them.
2. Establish connection to an adapter.
3. Scan the bus for connected controller devices.
4. Connect to a device.
5. Read/write from/to the controller's object dictionary (examples provided in code ).
6. Close the connection *first* to the device, *then* to the adapter.

## 6 Classes / functions reference

Find here a list of *NanoLib*'s user interface classes and their member functions. The typical description of a function includes a short introduction, the function definition and a parameter / return list:

### ExampleFunction ()

Tells you briefly what the function does.

Parameters	<i>param_a</i>	Additional comment if needed.
	<i>param_b</i>	
Returns	<i>ResultVoid</i>	Additional comment if needed.

### 6.1 NanoLibAccessor

Interface class used as entry point to the *NanoLib*. A typical workflow looks like this:

1. Start by scanning for hardware with `NanoLibAccessor.listAvailableBusHardware ()`.
2. Set the communication settings with `BusHardwareOptions ()`.
3. Open the hardware connection with `NanoLibAccessor.openBusHardwareWithProtocol ()`.
4. Scan the bus for connected devices with `NanoLibAccessor.scanDevices ()`.
5. Add a device with `NanoLibAccessor.addDevice ()`.
6. Connect to the device with `NanoLibAccessor.connectDevice ()`.
7. After finishing the operation, disconnect the device with `NanoLibAccessor.disconnectDevice ()`.
8. Remove the device with `NanoLibAccessor.removeDevice ()`.
9. Close the hardware connection with `NanoLibAccessor.closeBusHardware ()`.

NanoLibAccessor has the following public member functions:

#### listAvailableBusHardware ()

Use this function to list available fieldbus hardware.

```
ResultBusHwIds listAvailableBusHardware ()
```

Returns	<i>ResultBusHwIds</i>	Delivers a <u>fieldbus ID array</u> .
---------	-----------------------	---------------------------------------

#### openBusHardwareWithProtocol ()

Use this function to connect bus hardware.

```
ResultVoid openBusHardwareWithProtocol (BusHardwareId busHwId,  
BusHardwareOptions busHwOpt)
```

Parameters	<i>busHwId</i>	Specifies the <u>fieldbus</u> to open.
	<i>busHwOpt</i>	Specifies <u>fieldbus opening options</u> .
Returns	<i>ResultVoid</i>	Confirms that a <u>void function</u> has run.

#### isBusHardwareOpen ()

Use this function to check if your fieldbus hardware connection is open.

```
boolean isBusHardwareOpen (BusHardwareId busHardwareId)
```

Parameters	<i>BusHardwareId</i>	Specifies each <u>fieldbus</u> to open.
Returns	<i>true</i>	Hardware is open.
	<i>false</i>	Hardware is closed.

### getProtocolSpecificAccessor ()

Use this function to get the protocol-specific accessor object.

```
ResultVoid getProtocolSpecificAccessor (BusHardwareId busHwId)
```

Parameters	<i>busHwId</i>	Specifies the <u>fieldbus</u> to get the accessor for.
Returns	<i>ResultVoid</i>	Confirms that a <u>void function</u> has run.

### getProfinetDCP ()

Use this function to return a reference to Profinet DCP interface.

```
ProfinetDCP getProfinetDCP ()
```

Returns	<u>ProfinetDCP</u>
---------	--------------------

### getSamplerInterface ()

Use this function to get a reference to the sampler interface.

```
SamplerInterface getSamplerInterface ()
```

Returns	<i>SamplerInterface</i>	Refers to the <u>sampler interface</u> class.
---------	-------------------------	---

### setBusState ()

Use this function to set the bus-protocol-specific state.

```
ResultVoid setBusState (BusHardwareId busHwId, String state)
```

Parameters	<i>busHwId</i>	Specifies the <u>fieldbus</u> to open.
	<i>state</i>	Assigns a bus-specific state as a string value.
Returns	<i>ResultVoid</i>	Confirms that a <u>void function</u> has run.

### scanDevices ()

Use this function to scan for devices in the network.

```
ResultDeviceIds scanDevices (BusHardwareId busHwId, NlcScanBusCallback callback)
```

Parameters	<i>busHwId</i>	Specifies the <u>fieldbus</u> to scan.
	<i>callback</i>	<u>NlcScanBusCallback</u> progress tracer.
Returns	<i>ResultDeviceIds</i>	Delivers a <u>device ID</u> array.
	<i>IOError</i>	Informs that a device is not found.

### addDevice ()

Use this function to add a bus device described by *deviceId* to *NanoLib*'s internal device list, and to return *deviceHandle* for it.

```
ResultDeviceHandle addDevice (DeviceId deviceId)
```

Parameters	<i>deviceId</i>	Specifies the device to add to the list.
Returns	<i>ResultDeviceHandle</i>	Delivers a <u>device handle</u> .

**connectDevice ()**

Use this function to connect a device by *deviceHandle*.

```
ResultVoid connectDevice (DeviceHandle deviceHandle)
```

Parameters	<i>deviceHandle</i>	Specifies what bus device NanoLib connects to.
Returns	<i>ResultVoid</i>	Confirms that a <u>void function</u> has run.
	<i>IOError</i>	Informs that a device is not found.

**getDeviceName ()**

Use this function to get a device's name by *deviceHandle*.

```
ResultString getDeviceName (DeviceHandle deviceHandle)
```

Parameters	<i>deviceHandle</i>	Specifies what bus device NanoLib gets the name for.
Returns	<i>ResultString</i>	Delivers device names as a <u>string</u> .

**getDeviceProductCode ()**

Use this function to get a device's product code by *deviceHandle*.

```
ResultInt getDeviceProductCode (DeviceHandle deviceHandle)
```

Parameters	<i>deviceHandle</i>	Specifies what bus device NanoLib gets the product code for.
Returns	<i>ResultInt</i>	Delivers product codes as an <u>integer</u> .

**getDeviceVendorId ()**

Use this function to get the device vendor ID by *deviceHandle*.

```
ResultInt getDeviceVendorId (DeviceHandle deviceHandle)
```

Parameters	<i>deviceHandle</i>	Specifies what bus device NanoLib gets the vendor ID for.
Returns	<i>ResultInt</i>	Delivers vendor ID's as an <u>integer</u> .
	<i>ResourceUnavailable</i>	Informs that <u>no data</u> is found.

**getDeviceId ()**

Use this function to get a specific device's ID from the *NanoLib* internal list.

```
ResultDeviceId getDeviceId (DeviceHandle deviceHandle)
```

Parameters	<i>deviceHandle</i>	Specifies what bus device NanoLib gets the device ID for.
Returns	<i>ResultDeviceId</i>	Delivers a <u>device ID</u> .

**getDeviceIds ()**

Use this function to get all devices' ID from the *NanoLib* internal list.

```
ResultDeviceIds getDeviceIds ()
```

Returns	<i>ResultDeviceIds</i>	Delivers a <u>device ID list</u> .
---------	------------------------	------------------------------------

**getDeviceUid ()**

Use this function to get a device's unique ID (96 bit / 12 bytes) by *deviceHandle*.

```
ResultArrayByte getDeviceUid (DeviceHandle deviceHandle)
```

Parameters	<i>deviceHandle</i>	Specifies what bus device NanoLib gets the unique ID for.
Returns	<i>ResultArrayByte</i>	Delivers unique ID's as a <u>byte array</u> .
	<i>ResourceUnavailable</i>	Informs that <u>no data</u> is found.

**getDeviceSerialNumber ()**

Use this function to get a device's serial number by *deviceHandle*.

```
ResultString getDeviceSerialNumber (DeviceHandle deviceHandle)
```

Parameters	<i>deviceHandle</i>	Specifies what bus device NanoLib gets the serial number for.
Returns	<i>ResultString</i>	Delivers serial numbers as a <u>string</u> .
	<i>ResourceUnavailable</i>	Informs that <u>no data</u> is found.

**getDeviceHardwareGroup ()**

Use this function to get a bus device's hardware group by *deviceHandle*.

```
ResultInt getDeviceHardwareGroup (DeviceHandle deviceHandle)
```

Parameters	<i>deviceHandle</i>	Specifies what bus device NanoLib gets the hardware group for.
Returns	<i>ResultInt</i>	Delivers hardware groups as an <u>integer</u> .

**getDeviceHardwareVersion ()**

Use this function to get a bus device's hardware version by *deviceHandle*.

```
ResultString getDeviceHardwareVersion (DeviceHandle deviceHandle)
```

Parameters	<i>deviceHandle</i>	Specifies what bus device NanoLib gets the hardware version for.
Returns	<i>ResultString</i>	Delivers device names as a <u>string</u> .
	<i>ResourceUnavailable</i>	Informs that <u>no data</u> is found.

**getDeviceFirmwareBuildId ()**

Use this function to get a bus device's firmware build ID by *deviceHandle*.

```
ResultString getDeviceFirmwareBuildId (DeviceHandle deviceHandle)
```

Parameters	<i>deviceHandle</i>	Specifies what bus device NanoLib gets the firmware build ID for.
Returns	<i>ResultString</i>	Delivers device names as a <u>string</u> .

**getDeviceBootloaderVersion ()**

Use this function to get a bus device's bootloader version by *deviceHandle*.

```
ResultInt getDeviceBootloaderVersion (DeviceHandle deviceHandle)
```

Parameters	<i>deviceHandle</i>	Specifies what bus device NanoLib gets the bootloader version for.
Returns	<i>ResultInt</i> <i>ResourceUnavailable</i>	Delivers bootloader versions as an <u>integer</u> . Informs that <u>no data</u> is found.

### getDeviceBootloaderBuildId ()

Use this function to get a bus device's bootloader build ID by *deviceHandle*.

```
ResultString getDeviceBootloaderBuildId (DeviceHandle deviceHandle)
```

Parameters	<i>deviceHandle</i>	Specifies what bus device NanoLib gets the bootloader build ID for.
Returns	<i>ResultString</i>	Delivers device names as a <u>string</u> .

### rebootDevice ()

Use this function to reboot the device by *deviceHandle*.

```
ResultVoid rebootDevice (DeviceHandle deviceHandle)
```

Parameters	<i>deviceHandle</i>	Specifies the <u>fieldbus</u> to reboot.
Returns	<i>ResultVoid</i>	Confirms that a <u>void function</u> has run.

### getDeviceState ()

Use this function to get the device-protocol-specific state.

```
ResultString getDeviceState (DeviceHandle deviceHandle)
```

Parameters	<i>deviceHandle</i>	Specifies what bus device NanoLib gets the state for.
Returns	<i>ResultString</i>	Delivers device names as a <u>string</u> .

### setDeviceState ()

Use this function to set the device-protocol-specific state.

```
ResultVoid setDeviceState (DeviceHandle deviceHandle, String state)
```

Parameters	<i>deviceHandle</i> <i>state</i>	Specifies what bus device NanoLib sets the state for. Assigns a bus-specific state as a string value.
Returns	<i>ResultVoid</i>	Confirms that a <u>void function</u> has run.

### getConnectionState ()

Use this function to get a specific device's last known connection state by *deviceHandle* (= *Disconnected*, *Connected*, *ConnectedBootloader*)

```
ResultConnectionState getConnectionState (DeviceHandle deviceHandle)
```

Parameters	<i>deviceHandle</i>	Specifies what bus device NanoLib gets the connection state for.
Returns	<i>ResultConnectionState</i>	Delivers a <u>connection state</u> (= <i>Disconnected</i> , <i>Connected</i> , <i>ConnectedBootloader</i> ).

### checkConnectionState ()

Only if the last known state was not *Disconnected*: Use this function to check and possibly update a specific device's connection state by *deviceHandle* and by testing several mode-specific operations.

```
ResultConnectionState checkConnectionState (DeviceHandle deviceHandle)
```

Parameters	<i>deviceHandle</i>	Specifies what bus device NanoLib checks the connection state for.
Returns	<i>ResultConnectionState</i>	Delivers a <u>connection state</u> (= not <i>Disconnected</i> ).

### assignObjectDictionary ()

Use this **manual** function to assign an object dictionary (OD) to *deviceHandle* on your **own**.

```
ResultObjectDictionary assignObjectDictionary (DeviceHandle deviceHandle,  
ObjectDictionary objectDictionary)
```

Parameters	<i>deviceHandle</i> <i>objectDictionary</i>	Specifies what bus device NanoLib assigns the OD to.
Returns	<i>ResultObjectDictionary</i>	Shows the <u>properties of an object dictionary</u> .

### autoAssignObjectDictionary ()

Use this **automatism** to let **NanoLib** assign an object dictionary (OD) to *deviceHandle*. On finding and loading a suitable OD, NanoLib automatically assigns it to the device. **Note:** If a compatible OD is already loaded in the object library, NanoLib will automatically use it without scanning the submitted directory.

```
ResultObjectDictionary autoAssignObjectDictionary (DeviceHandle deviceHandle,  
String dictionariesLocationPath)
```

Parameters	<i>deviceHandle</i> <i>dictionariesLocationPath</i>	Specifies for which bus device NanoLib shall automatically scan for suitable OD's. Specifies the path to the OD directory.
Returns	<i>ResultObjectDictionary</i>	Shows the <u>properties of an object dictionary</u> .

### getAssignedObjectDictionary ()

Use this function to get the object dictionary assigned to a device by *deviceHandle*.

```
ResultObjectDictionary getAssignedObjectDictionary (DeviceHandle  
deviceHandle)
```

Parameters	<i>deviceHandle</i>	Specifies what bus device NanoLib gets the assigned OD for.
Returns	<i>ResultObjectDictionary</i>	Shows the <u>properties of an object dictionary</u> .

### getObjectDictionaryLibrary ()

This function returns an OdLibrary reference.

```
OdLibrary getObjectDictionaryLibrary ()
```

Returns	<i>OdLibrary</i> &	Opens the entire OD library and its object dictionaries.
---------	--------------------	--



### setLoggingLevel ()

Use this function to set the needed log detailing (and log file size). Default level is *Info*.

```
void setLoggingLevel (LogLevel level)
```

Parameters *level*

The following log detailings are possible:

- 0 = *Trace*    Lowest level (largest log file); logs any feasible detail, plus software start / stop.
- 1 = *Debug*    Logs debug information (= interim results, content sent or received, etc.)
- 2 = *Info*      Default level; logs informational messages.
- 3 = *Warn*     Logs problems that did occur but **won't** stop the current algorithm.
- 4 = *Error*     Logs just severe trouble that **did** stop the algorithm.
- 5 = *Critical*   Highest level (smallest log file); turns logging **off**; no further log at all.
- 6 = *Off*        No logging at all.

### setLoggingCallback ()

Use this function to set a logging callback pointer and log module (= library) for that callback (not for the logger itself).

```
public void setLoggingCallback(NlcLoggingCallback callback, LogModule logModule)
```

Parameters *\*callback*  
*logModule*

Sets a callback pointer.  
Tunes the callback (not logger!) to your library.

- 0 = *NanolibCore*      Activates a callback for NanoLib's core only.
- 1 = *NanolibCANopen*    Activates a CANopen-only callback.
- 2 = *NanolibModbus*     Activates a Modbus-only callback.
- 3 = *NanolibEtherCAT*    Activates an EtherCAT-only callback.
- 4 = *NanolibRest*        Activates a REST-only callback.
- 5 = *NanolibUSB*        Activates a USB-only callback.

### unsetLoggingCallback ()

Use this function to cancel a logging callback pointer.

```
void unsetLoggingCallback ()
```

### readNumber ()

Use this function to read a numeric value from the object dictionary.

```
ResultInt readNumber (DeviceHandle deviceHandle, OdIndex odIndex)
```

Parameters *deviceHandle*  
*odIndex*

Specifies what bus device NanoLib reads from.  
Specifies the (sub-) index to read from.

Returns *ResultInt*

Delivers an uninterpreted numeric value (can be signed, unsigned, fix16.16 bit values).

**readNumberArray ()**

Use this function to read numeric arrays from the object dictionary.

```
ResultArrayInt readNumberArray (DeviceHandle deviceHandle, int index)
```

Parameters	<i>deviceHandle</i>	Specifies what bus device NanoLib reads from.
	<i>index</i>	Array object index.
Returns	<i>ResultArrayInt</i>	Delivers an <u>integer array</u> .

**readBytes ()**

Use this function to read arbitrary bytes (domain object data) from the object dictionary.

```
ResultArrayByte readBytes (DeviceHandle deviceHandle, OdIndex odIndex)
```

Parameters	<i>deviceHandle</i>	Specifies what bus device NanoLib reads from.
	<i>odIndex</i>	Specifies the <u>(sub-) index</u> to read from.
Returns	<i>ResultArrayByte</i>	Delivers a <u>byte array</u> .

**readString ()**

Use this function to read strings from the object directory.

```
ResultString readString (DeviceHandle deviceHandle, OdIndex odIndex)
```

Parameters	<i>deviceHandle</i>	Specifies what bus device NanoLib reads from.
	<i>odIndex</i>	Specifies the <u>(sub-) index</u> to read from.
Returns	<i>ResultString</i>	Delivers device names as a <u>string</u> .

**writeNumber ()**

Use this function to write numeric values to the object directory.

```
ResultVoid writeNumber (DeviceHandle deviceHandle, long value, OdIndex odIndex, long bitLength)
```

Parameters	<i>deviceHandle</i>	Specifies what bus device NanoLib writes to.
	<i>value</i>	The uninterpreted value (can be signed, unsigned, fix 16.16).
	<i>odIndex</i>	Specifies the <u>(sub-) index</u> to read from.
	<i>bitLength</i>	Length in bit.
Returns	<i>ResultVoid</i>	Confirms that a <u>void function</u> has run.

**writeBytes ()**

Use this function to write arbitrary bytes (domain object data) to the object directory.

```
ResultVoid writeBytes (DeviceHandle deviceHandle, ByteVector data, OdIndex odIndex)
```

Parameters	<i>deviceHandle</i>	Specifies what bus device NanoLib writes to.
	<i>data</i>	Byte vector / array.
	<i>odIndex</i>	Specifies the <u>(sub-) index</u> to read from.
Returns	<i>ResultVoid</i>	Confirms that a <u>void function</u> has run.

### uploadFirmware ()

Use this function to update your controller firmware.

```
ResultVoid uploadFirmware (DeviceHandle deviceHandle, ByteVector fwData,
  NlcDataTransferCallback callback)
```

Parameters	<i>deviceHandle</i>	Specifies what bus device NanoLib updates.
	<i>fwData</i>	Array containing firmware data.
	<i>NlcDataTransferCallback</i>	A <a href="#">data progress</a> tracer.
Returns	<i>ResultVoid</i>	Confirms that a <a href="#">void function</a> has run.

### uploadFirmwareFromFile ()

Use this function to update your controller firmware by uploading its file.

```
ResultVoid uploadFirmwareFromFile (DeviceHandle deviceHandle, String
  absoluteFilePath, NlcDataTransferCallback callback)
```

Parameters	<i>deviceHandle</i>	Specifies what bus device NanoLib updates.
	<i>absoluteFilePath</i>	Path to file containing firmware data (string).
	<i>NlcDataTransferCallback</i>	A <a href="#">data progress</a> tracer.
Returns	<i>ResultVoid</i>	Confirms that a <a href="#">void function</a> has run.

### uploadBootloader ()

Use this function to update your controller bootloader.

```
ResultVoid uploadBootloader (DeviceHandle deviceHandle, ByteVector btData,
  NlcDataTransferCallback callback)
```

Parameters	<i>deviceHandle</i>	Specifies what bus device NanoLib updates.
	<i>btData</i>	Array containing bootloader data.
	<i>NlcDataTransferCallback</i>	A <a href="#">data progress</a> tracer.
Returns	<i>ResultVoid</i>	Confirms that a <a href="#">void function</a> has run.

### uploadBootloaderFromFile ()

Use this function to update your controller bootloader by uploading its file.

```
ResultVoid uploadBootloaderFromFile (DeviceHandle deviceHandle, String
  bootloaderAbsolutePath, NlcDataTransferCallback callback)
```

Parameters	<i>deviceHandle</i>	Specifies what bus device NanoLib updates.
	<i>bootloaderAbsolutePath</i>	Path to file containing bootloader data (string).
	<i>NlcDataTransferCallback</i>	A <a href="#">data progress</a> tracer.
Returns	<i>ResultVoid</i>	Confirms that a <a href="#">void function</a> has run.

### uploadBootloaderFirmware ()

Use this function to update your controller bootloader and firmware.

```
ResultVoid uploadBootloaderFirmware (DeviceHandle deviceHandle, ByteVector
  btData, ByteVector fwData, NlcDataTransferCallback callback)
```

Parameters	<i>deviceHandle</i>	Specifies what bus device NanoLib updates.
------------	---------------------	--

	<i>btData</i>	Array containing bootloader data.
	<i>fwData</i>	Array containing firmware data.
	<i>NlcDataTransferCallback</i>	A <a href="#">data progress</a> tracer.
Returns	<i>ResultVoid</i>	Confirms that a <a href="#">void function</a> has run.

### uploadBootloaderFirmwareFromFile ()

Use this function to update your controller bootloader and firmware by uploading the files.

```
ResultVoid uploadBootloaderFirmwareFromFile (DeviceHandle deviceHandle, String
bootloaderAbsolutePath, String absoluteFilePath, NlcDataTransferCallback
callback)
```

Parameters	<i>deviceHandle</i>	Specifies what bus device NanoLib updates.
	<i>bootloaderAbsolutePath</i>	Path to file containing bootloader data (string).
	<i>absoluteFilePath</i>	Path to file containing firmware data (uint8_t).
	<i>NlcDataTransferCallback</i>	A <a href="#">data progress</a> tracer.
Returns	<i>ResultVoid</i>	Confirms that a <a href="#">void function</a> has run.

### uploadNanoJ ()

Use this public function to upload the NanoJ program to your controller.

```
ResultVoid uploadNanoJ(DeviceHandle deviceHandle, ByteVector vmmData,
NlcDataTransferCallback callback)
```

Parameters	<i>deviceHandle</i>	Specifies what bus device NanoLib uploads to.
	<i>vmmData</i>	Array containing NanoJ data.
	<i>NlcDataTransferCallback</i>	A <a href="#">data progress</a> tracer.
Returns	<i>ResultVoid</i>	Confirms that a <a href="#">void function</a> has run.

### uploadNanoJFromFile ()

Use this public function to upload the NanoJ program to your controller by uploading the file.

```
ResultVoid uploadNanoJFromFile (DeviceHandle deviceHandle, String
absoluteFilePath, NlcDataTransferCallback callback)
```

Parameters	<i>deviceHandle</i>	Specifies what bus device NanoLib uploads to.
	<i>absoluteFilePath</i>	Path to file containing NanoJ data (string).
	<i>NlcDataTransferCallback</i>	A <a href="#">data progress</a> tracer.
Returns	<i>ResultVoid</i>	Confirms that a <a href="#">void function</a> has run.

### disconnectDevice ()

Use this function to disconnect your device by *deviceHandle*.

```
ResultVoid disconnectDevice (DeviceHandle deviceHandle)
```

Parameters	<i>deviceHandle</i>	Specifies what bus device NanoLib disconnects from.
Returns	<i>ResultVoid</i>	Confirms that a <a href="#">void function</a> has run.

**removeDevice ()**

Use this function to remove your device from *NanoLib*'s internal device list.

```
ResultVoid removeDevice (DeviceHandle deviceHandle)
```

Parameters	<i>deviceHandle</i>	Specifies what bus device NanoLib delists.
Returns	<i>ResultVoid</i>	Confirms that a <u>void function</u> has run.

**closeBusHardware ()**

Use this function to disconnect from your fieldbus hardware.

```
ResultVoid closeBusHardware (BusHardwareId busHwId)
```

Parameters	<i>busHwId</i>	Specifies the <u>fieldbus</u> to disconnect from.
Returns	<i>ResultVoid</i>	Confirms that a <u>void function</u> has run.

**6.2 BusHardwareId**

Use this class to identify a bus hardware one-to-one or to distinguish different bus hardware from each other. This class (without setter functions to be immutable from creation on) also holds information on:

- Hardware (= adapter name, network adapter etc.)
- Bus hardware specifier (= serial port name, MAC address etc.)
- Protocol to use (= Modbus TCP, CANopen etc.)
- Friendly name

**BusHardwareId () [1/3]**

Constructor that creates a new bus hardware ID object.

```
BusHardwareId (String busHardware_, String protocol_, String hardwareSpecifier_, String name_)
```

Parameters	<i>busHardware_</i>	Hardware type (= ZK-USB-CAN-1 etc.).
	<i>protocol_</i>	Bus communication protocol (= CANopen etc.).
	<i>hardwareSpecifier_</i>	The specifier of a hardware (= COM3 etc.).
	<i>extraHardwareSpecifier_</i>	The extra specifier of the hardware (say, USB location info).
	<i>name_</i>	A friendly name (= <i>AdapterName (Port)</i> etc. ).

**BusHardwareId () [2/3]**

Constructor that creates a new bus hardware ID object, with the option for an extra hardware specifier.

```
BusHardwareId (String busHardware_, String protocol_, String hardwareSpecifier_, String extraHardwareSpecifier_, String name_)
```

Parameters	<i>busHardware_</i>	Hardware type (= ZK-USB-CAN-1 etc.).
	<i>protocol_</i>	Bus communication protocol (= CANopen etc.).
	<i>hardwareSpecifier_</i>	The specifier of a hardware (= COM3 etc.).
	<i>extraHardwareSpecifier_</i>	The extra specifier of the hardware (say, USB location info).
	<i>name_</i>	A friendly name (= <i>AdapterName (Port)</i> etc. ).

**BusHardwareId () [3/3]**

Constructor that copies an existing *busHardwareId*.

```
nlc::BusHardwareId::BusHardwareId (BusHardwareId const &)
```

```
BusHardwareId (BusHardwareId arg0)
```

Parameters *busHardwareId* Names the bus hardware ID to copy from.

**equals ()**

Compares a new bus hardware ID to existing ones.

```
boolean equals (BusHardwareId other)
```

Parameters *other* Another object of the same class.  
 Returns *true* If both are equal in all values.  
*false* If the values differ.

**getBusHardware ()**

Reads out the bus hardware string.

```
String getBusHardware ()
```

Returns *string*

**getHardwareSpecifier ()**

Reads out the bus hardware's specifier string (= network name etc.).

```
String getBusHardware ()
```

Returns *string*

**getExtraHardwareSpecifier ()**

Reads out the bus extra hardware's specifier string (= MAC address etc.).

```
String getExtraHardwareSpecifier ()
```

Returns *string*

**getName ()**

Reads out the bus hardware's friendly name.

```
String getName ()
```

Returns *string*

**getProtocol ()**

Reads out the bus protocol string.

```
String getProtocol ()
```

Returns *string*

### toString ()

Returns the bus hardware ID as a string.

```
String toString ()
```

Returns *string*

## 6.3 BusHardwareOptions

Find in this class, in a key-value list of strings, all options needed to open a bus hardware.

### BusHardwareOptions () [1/2]

Constructs a new bus hardware option object.

```
BusHardwareOptions ()
```

Use the function [addOption \(\)](#) to add key-value pairs.

### BusHardwareOptions () [2/2]

Constructs a new bus hardware options object with the key-value map already in place.

```
BusHardwareOptions (StringStringMap options)
```

Parameters *options* A map with options for the bus hardware to operate.

### addOption ()

Creates additional keys and values.

```
void addOption (String key, String value)
```

Parameters *key* Example: BAUD\_RATE\_OPTIONS\_NAME, see *bus\_hw\_options\_defaults*  
*value* Example: BAUD\_RATE\_1000K, see *bus\_hw\_options\_defaults*

### equals ()

Compares the BusHardwareOptions to existing ones.

```
boolean equals (BusHardwareOptions other)
```

Parameters *other* Another object of the same class.  
 Returns *true* If the other object has all of the exact same options.  
*false* If the other object has different keys or values.

### getOptions ()

Reads out all added key-value pairs.

```
StringStringMap getOptions ()
```

Returns *string map*

**toString ()**

Returns all keys / values as a string.

```
String toString ()
```

Returns *string*

**6.4 BusHwOptionsDefault**

This default configuration options class has the following public attributes:

```
const CanBus           canBus = CanBus ()
const Serial          serial = Serial ()
const RESTfulBus      restfulBus = RESTfulBus()
const EtherCATBus    ethercatBus = EtherCATBus()
```

**6.5 CanBaudRate**

Struct that contains CAN bus baudrates in the following public attributes:

```
string           BAUD_RATE_1000K = "1000k"
string           BAUD_RATE_800K  = "800k"
string           BAUD_RATE_500K  = "500k"
string           BAUD_RATE_250K  = "250k"
string           BAUD_RATE_125K  = "125k"
string           BAUD_RATE_100K  = "100k"
string           BAUD_RATE_50K   = "50k"
string           BAUD_RATE_20K   = "20k"
string           BAUD_RATE_10K   = "10k"
string           BAUD_RATE_5K    = "5k"
```

**6.6 CanBus**

Default configuration options class with the following public attributes:

```
string           BAUD_RATE_OPTIONS_NAME = "can adapter baud rate"
const CanBaudRate baudRate = CanBaudRate ()
const lxxat      lxxat = lxxat ()
```

**6.7 CanOpenNmtService**

For the NMT service, this struct contains the CANopen NMT states as string values in the following public attributes:

```
string           START = "START"
string           STOP  = "STOP"
string           PRE_OPERATIONAL = "PRE_OPERATIONAL"
string           RESET = "RESET"
string           RESET_COMMUNICATION = "RESET_COMMUNICATION"
```

**6.8 CanOpenNmtState**

This struct contains the CANopen NMT states as string values in the following public attributes:



```

string          STOPPED = "STOPPED"
string          PRE_OPERATIONAL = "PRE_OPERATIONAL"
string          OPERATIONAL = "OPERATIONAL"
string          INITIALIZATION = "INITIALIZATION"
string          UNKNOWN = "UNKNOWN"

```

## 6.9 EtherCATBus struct

This struct contains the EtherCAT communication configuration options in the following public attributes:

```

string NETWORK_FIRMWARE_STATE_OPTION_NAME = "Network Firmware State"
Network state treated as firmware mode. Acceptable values (default = PRE_OPERATIONAL):
    ■ EtherCATState::PRE_OPERATIONAL
    ■ EtherCATState::SAFE_OPERATIONAL
    ■ EtherCATState::OPERATIONAL

string DEFAULT_NETWORK_FIRMWARE_STATE = "PRE_OPERATIONAL"

string EXCLUSIVE_LOCK_TIMEOUT_OPTION_NAME = "Shared Lock Timeout"
Timeout in milliseconds to acquire exclusive lock on the network (default = 500 ms).

const unsigned int DEFAULT_EXCLUSIVE_LOCK_TIMEOUT = "500"

string SHARED_LOCK_TIMEOUT_OPTION_NAME = "Shared Lock Timeout"
Timeout in milliseconds to acquire shared lock on the network (default = 250 ms).

const unsigned int DEFAULT_SHARED_LOCK_TIMEOUT = "250"

string READ_TIMEOUT_OPTION_NAME = "Read Timeout"
Timeout in milliseconds for a read operation (default = 700 ms).

const unsigned int DEFAULT_READ_TIMEOUT = "700"

string WRITE_TIMEOUT_OPTION_NAME = "Write Timeout"
Timeout in milliseconds for a write operation (default = 200 ms).

const unsigned int DEFAULT_WRITE_TIMEOUT = "200"

string READ_WRITE_ATTEMPTS_OPTION_NAME = "Read/Write Attempts"
Maximum read or write attempts (non-zero values only; default = 5).

const unsigned int DEFAULT_READ_WRITE_ATTEMPTS = "5"

string CHANGE_NETWORK_STATE_ATTEMPTS_OPTION_NAME = "Change Network State Attempts"
Maximum number of attempts to alter the network state (non-zero values only; default = 10).

const unsigned int DEFAULT_CHANGE_NETWORK_STATE_ATTEMPTS = "10"

string PDO_IO_ENABLED_OPTION_NAME = "PDO IO Enabled"
Enables or disables PDO processing for digital in- / outputs ("True" or "False" only; default = "True").

string DEFAULT_PDO_IO_ENABLED = "True"

```

## 6.10 EtherCATState struct

This struct contains the EtherCAT slave / network states as string values in the following public attributes.

**Note:** Default state at power on is `PRE_OPERATIONAL`; *NanoLib* can provide no reliable "OPERATIONAL" state in a non-realtime operating system:

```

string          NONE = "NONE"

```

```

string          INIT = "INIT"
string          PRE_OPERATIONAL = "PRE_OPERATIONAL"
string          BOOT = "BOOT"
string          SAFE_OPERATIONAL = "SAFE_OPERATIONAL"
string          OPERATIONAL = "OPERATIONAL"

```

## 6.11 Ixxat

This struct holds all information for the *Ixxat* usb-to-can in the following public attributes:

```

string          ADAPTER_BUS_NUMBER_OPTIONS_NAME = "ixxat adapter bus number"
const IxxatAdapterBusNumber adapterBusNumber = IxxatAdapterBusNumber ()

```

## 6.12 IxxatAdapterBusNumber

This struct holds the bus number for the *Ixxat* usb-to-can in the following public attributes:

```

string          BUS_NUMBER_0_DEFAULT = "0"
string          BUS_NUMBER_1 = "1"
string          BUS_NUMBER_2 = "2"
string          BUS_NUMBER_3 = "3"

```

## 6.13 Peak

This struct holds all information for the *Peak* usb-to-can in the following public attributes:

```

string          ADAPTER_BUS_NUMBER_OPTIONS_NAME = "peak adapter bus number"
const PeakAdapterBusNumber adapterBusNumber = PeakAdapterBusNumber ()

```

## 6.14 PeakAdapterBusNumber

This struct holds the bus number for the *Peak* usb-to-can in the following public attributes:

```

string          BUS_NUMBER_1_DEFAULT = std::to_string (PCAN_USBBUS1)
string          BUS_NUMBER_2 = std::to_string (PCAN_USBBUS2)
string          BUS_NUMBER_3 = std::to_string (PCAN_USBBUS3)
string          BUS_NUMBER_4 = std::to_string (PCAN_USBBUS4)
string          BUS_NUMBER_5 = std::to_string (PCAN_USBBUS5)
string          BUS_NUMBER_6 = std::to_string (PCAN_USBBUS6)
string          BUS_NUMBER_7 = std::to_string (PCAN_USBBUS7)
string          BUS_NUMBER_8 = std::to_string (PCAN_USBBUS8)
string          BUS_NUMBER_9 = std::to_string (PCAN_USBBUS9)
string          BUS_NUMBER_10 = std::to_string (PCAN_USBBUS10)
string          BUS_NUMBER_11 = std::to_string (PCAN_USBBUS11)
string          BUS_NUMBER_12 = std::to_string (PCAN_USBBUS12)
string          BUS_NUMBER_13 = std::to_string (PCAN_USBBUS13)
string          BUS_NUMBER_14 = std::to_string (PCAN_USBBUS14)
string          BUS_NUMBER_15 = std::to_string (PCAN_USBBUS15)
string          BUS_NUMBER_16 = std::to_string (PCAN_USBBUS16)

```

## 6.15 DeviceHandle

This class represents a handle for controlling a device on a bus and has the following public member functions.

### DeviceHandle ()

```
DeviceHandle ()
```

### equals ()

Compares itself to a given device handle.

```
boolean equals (DeviceHandle other)
```

### toString ()

Returns a string representation of the device handle.

```
String toString ()
```

## 6.16 DeviceId

Use this class (not immutable from creation on) to identify and distinguish devices on a bus:

- Hardware adapter identifier
- Device identifier
- Description

The meaning of device ID / description values depends on the bus. For example, a CAN bus may use the integer ID.

### DeviceId () [1/3]

Constructs a new device ID object.

```
DeviceId (BusHardwareId busHardwareId_, long deviceId_, String description_)
```

Parameters	<i>busHardwareId_</i>	Identifier of the bus.
	<i>deviceId_</i>	An index; subject to bus (= CANopen node ID etc.).
	<i>description_</i>	A description (may be empty); subject to bus.

### DeviceId () [2/3]

Constructs a new device ID object with extended ID options.

```
DeviceId (BusHardwareId busHardwareId_, long deviceId_, String description_,  
          ByteVector extraId_, String extraStringId_)
```

Parameters	<i>busHardwareId_</i>	Identifier of the bus.
	<i>deviceId_</i>	An index; subject to bus (= CANopen node ID etc.).
	<i>description_</i>	A description (may be empty); subject to bus.
	<i>extraId_</i>	An additional ID (may be empty); meaning depends on bus.
	<i>extraStringId_</i>	Additional string ID (may be empty); meaning depends on bus.

**DeviceId () [3/3]**

Constructs a copy of a device ID object.

```
DeviceId (DeviceId arg0)
```

Parameters *deviceId\_* Device ID to copy from.

**equals ()**

Compares new to existing objects.

```
boolean equals (DeviceId other)
```

Returns *boolean*

**getBusHardwareId ()**

Reads out the bus hardware ID.

```
BusHardwareId getBusHardwareId ()
```

Returns BusHardwareId

**getDescription ()**

Reads out the device description (maybe unused).

```
String getDescription ()
```

Returns *string*

**getDeviceId ()**

Reads out the device ID (maybe unused).

```
long getDeviceId ()
```

Returns *unsigned int*

**toString ()**

Returns the object as a string.

```
String toString ()
```

Returns *string*

**getExtraId ()**

Reads out the extra ID of the device (may be unused).

```
ByteVector getExtraId ()
```

Returns *vector extrad\_* A vector of the additional extra ID's (may be empty); meaning depends on the bus.

**getExtraStringId ()**

Reads out the extra string ID of the device (may be unused).

```
String getExtraStringId ()
```

Returns *string* The additional string ID (may be empty); meaning depends on the bus.

**6.17 LogLevelConverter**

This class returns your log level as a string.

```
static String toString (LogLevel logLevel)
```

**6.18 ObjectDictionary**

This class represents an object dictionary of a controller and has the following public member functions:

**getDeviceHandle ()**

```
ResultDeviceHandle getDeviceHandle ()
```

Returns ResultDeviceHandle

**getObject ()**

```
ResultObjectSubEntry getObject (OdIndex odIndex)
```

Returns ResultObjectSubEntry

**getObjectEntry ()**

```
ResultObjectEntry getObjectEntry (int index)
```

Returns ResultObjectEntry Informs on an object's properties.

**getXmlFileName ()**

```
getXmlFileName (self)
```

```
ResultString getXmlFileName ()
```

Returns ResultString Returns the XML file name as a string.

**readNumber ()**

```
ResultInt readNumber (OdIndex odIndex)
```

Returns ResultInt

**readNumberArray ()**

```
ResultArrayInt readNumberArray (int index)
```

Returns [ResultArrayInt](#)

### readString ()

```
ResultString readString (OdIndex odIndex)
```

Returns [ResultString](#)

### readBytes ()

```
ResultArrayByte readBytes (OdIndex odIndex)
```

Returns [ResultArrayByte](#)

### writeNumber ()

```
ResultVoid writeNumber (OdIndex odIndex, long value)
```

Returns [ResultVoid](#)

### writeBytes ()

```
ResultVoid writeBytes (OdIndex odIndex, ByteVector data)
```

Returns [ResultVoid](#)

### Related Links

[OdIndex](#)

## 6.19 ObjectEntry

This class represents an object entry of the object dictionary and has the following public member functions:

### getName ()

Reads out the name of the object as a string.

```
String getName ()
```

### getPrivate ()

Checks if the object is private.

```
boolean getPrivate ()
```

### getIndex ()

Reads out the address of the object index.

```
int getIndex ()
```

### getDataType ()

Reads out the data type of the object.

```
ObjectEntryDataType getDataType ()
```

**getObjectCode ()**

Reads out the object code:

<b>Null</b>	0x00
<b>Deftype</b>	0x05
<b>Defstruct</b>	0x06
<b>Var</b>	0x07
<b>Array</b>	0x08
<b>Record</b>	0x09

```
ObjectCode getObjectCode ()
```

**getObjectSaveable ()**

Checks if the object is saveable and it's category (see product manual for more details):

APPLICATION, COMMUNICATION, DRIVE, MISC\_CONFIG, MODBUS\_RTU, NO, TUNING, CUSTOMER, ETHERNET, CANOPEN, VERIFY1020, UNKNOWN\_SAVEABLE\_TYPE

```
ObjectSaveable getObjectSaveable ()
```

**getMaxSubIndex ()**

Reads out the number of subindices supported by this object.

```
short getMaxSubIndex ()
```

**getSubEntry ()**

```
ObjectSubEntry getSubEntry (short subIndex)
```

See also [ObjectSubEntry](#).

**6.20 ObjectSubEntry**

This class represents an object sub-entry (subindex) of the object dictionary and has the following public member functions:

**getName ()**

Reads out the name of the object as a string.

```
String getName ()
```

**getSubIndex ()**

Reads out the address of the subindex.

```
short getSubIndex ()
```

**getDataType ()**

Reads out the data type of the object.

```
ObjectEntryDataType getDataType ()
```

**getSdoAccess ()**

Checks if the subindex is accessible via SDO:

<b>ReadOnly</b>	1
<b>WriteOnly</b>	2
<b>ReadWrite</b>	3
<b>NoAccess</b>	0

```
ObjectSdoAccessAttribute getSdoAccess ()
```

**getPdoAccess ()**

Checks if the subindex is accessible/mappable via PDO:

<b>Tx</b>	1
<b>Rx</b>	2
<b>TxRx</b>	3
<b>No</b>	0

```
ObjectPdoAccessAttribute getPdoAccess ()
```

**getBitLength ()**

Checks the subindex length.

```
long getBitLength ()
```

**getDefaultValueAsNumeric ()**

Reads out the default value of the subindex for numeric data types.

```
ResultInt getDefaultValueAsNumeric (String key)
```

**getDefaultValueAsString ()**

Reads out the default value of the subindex for string data types.

```
ResultString getDefaultValueAsString (String key)
```

**getDefaultValues ()**

Reads out the default values of the subindex.

```
StringStringMap getDefaultValues ()
```

**readNumber ()**

Reads out the numeric actual value of the subindex.

```
ResultInt readNumber ()
```



**readString ()**

Reads out the string actual value of the subindex.

```
ResultString readString ()
```

**readBytes ()**

Reads out the actual value of the subindex in bytes.

```
ResultArrayByte readBytes ()
```

**writeNumber ()**

Writes a numeric value in the subindex.

```
ResultVoid writeNumber (long value)
```

**writeBytes ()**

Writes a value in the subindex in bytes.

```
ResultVoid writeBytes (ByteVector data)
```

**6.21 OdIndex**

Use this class (immutable from creation on) to wrap and locate object directory indices / sub-indices. A device's OD has up to 65535 (0xFFFF) rows and 255 (0xFF) columns; with gaps between the discontinuous rows. See the CANopen standard and your product manual for more detail.

**OdIndex ()**

Constructs a new OdIndex object.

```
OdIndex ()
```

Parameters	<i>index</i>	From 0 to 65535 (0xFFFF) incl.
	<i>subindex</i>	From 0 to 255 (0xFF) incl.

**getIndex ()**

Reads out the index (from 0x0000 to 0xFFFF).

```
int getIndex ()
```

**getSubindex ()**

Reads out the sub-index (from 0x00 to 0xFF)

```
short getSubIndex ()
```

**toString ()**

Returns the index and subindex as a string. The string default *0xIIII:0xSS* reads as follows:

- I = index from 0x0000 to 0xFFFF
- S = sub-index from 0x00 to 0xFF

```
std::string nlc::OdIndex::toString () const
```

```
String toString ()
```

Returns `0xIII:0xSS` Default string representation

## 6.22 OdIndexVector

Helping class that creates a vector of [OdIndex](#) objects, to build an object dictionary.

## 6.23 OdLibrary

Use this programming interface to create instances of the *ObjectDictionary* class from XML. By *assignObjectDictionary*, you can then bind each instance to a specific device due to a uniquely created identifier. *ObjectDictionary* instances thus created are stored in the *OdLibrary* object to be accessed by index. The *ODLibrary* class loads [ObjectDictionary](#) items from file or array, stores them, and has the following public member functions:

### getObjectDictionaryCount ()

```
long getObjectDictionaryCount ()
```

### getObjectDictionary ()

```
ResultObjectDictionary getObjectDictionary (long odIndex)
```

Returns [ResultObjectDictionary](#)

### addObjectDictionaryFromFile ()

```
ResultObjectDictionary addObjectDictionaryFromFile (String  
absoluteXmlFilePath)
```

Returns [ResultObjectDictionary](#)

### addObjectDictionary ()

```
virtual ResultObjectDictionary addObjectDictionary (std::vector <uint8_t>  
const & odXmlData, const std::string &xmlFilePath = std::string ())
```

```
ResultObjectDictionary addObjectDictionary (ByteVector odXmlData, String  
xmlFilePath)
```

Returns [ResultObjectDictionary](#)

## 6.24 OdTypesHelper

### uintToObjectCode ()

Converts unsigned integers to object code:

Null                      0x00

<b>Deftype</b>	0x05
<b>Defstruct</b>	0x06
<b>Var</b>	0x07
<b>Array</b>	0x08
<b>Record</b>	0x09

```
static ObjectCode uintToObjectCode (long objectCode)
```

### **isNumericDataType ()**

Informes if a data type is numeric or not.

```
static boolean isNumericDataType (ObjectEntryDataType dataType)
```

### **isDefstructIndex ()**

Informes if an object is a definition structure index or not.

```
static boolean isDefstructIndex (int typeNum)
```

### **isDeftypeIndex ()**

Informes if an object is a definition type index or not.

```
static boolean isDeftypeIndex (int typeNum)
```

### **isComplexDataType ()**

Informes if a data type is complex or not.

```
static boolean isComplexDataType (ObjectEntryDataType dataType)
```

### **uintToObjectEntryDataType ()**

Converts unsigned integers to OD data type.

```
static ObjectEntryDataType uintToObjectEntryDataType
```

### **objectEntryDataTypeToString ()**

Converts OD data type to string.

```
static String objectEntryDataTypeToString (ObjectEntryDataType odDataType)
```

### **stringToObjectEntryDatatype ()**

Converts string to OD data type if possible. Otherwise, returns UNKNOWN\_DATATYPE.

```
static ObjectEntryDataType stringToObjectEntryDatatype (String dataTypeString)
```

### **objectEntryDataTypeBitLength ()**

Informes on bit length of an object entry data type.

```
static long objectEntryDataTypeBitLength (ObjectEntryDataType dataType)
```

## 6.25 RESTfulBus struct

This struct contains the communication configuration options for the RESTful interface (over Ethernet). It contains the following public attributes:

```

const std::string      CONNECT_TIMEOUT_OPTION_NAME = "RESTful Connect Timeout"
const unsigned long    DEFAULT_CONNECT_TIMEOUT = 200
const std::string      REQUEST_TIMEOUT_OPTION_NAME = "RESTful Request Timeout"
const unsigned long    DEFAULT_REQUEST_TIMEOUT = 200
const std::string      RESPONSE_TIMEOUT_OPTION_NAME = "RESTful Response Timeout"
const unsigned long    DEFAULT_RESPONSE_TIMEOUT = 750

```

## 6.26 ProfinetDCP

Under **Linux**, the calling application needs `CAP_NET_ADMIN` and `CAP_NET_RAW` capabilities. To enable: `sudo setcap 'cap_net_admin,cap_net_raw+eip' ./executable`. In **Windows**, the ProfinetDCP interface uses WinPcap (tested with version 4.1.3) or Npcap (tested with versions 1.60 and 1.30). It thus searches the dynamically loaded `wpcap.dll` library in the following order (**Note**: no current Win10Pcap support):

1. `Nanolib.dll` directory
2. Windows system directory `SystemRoot%\System32`
3. Npcap installation directory `SystemRoot%\System32\Npcap`
4. Environment path

This class represents a Profinet DCP interface and has the following public member functions:

### getScanTimeout ()

Informs on a device scan timeout (default = 2000 ms).

```
long getScanTimeout ()
```

### setScanTimeout ()

Sets a device scan timeout (default = 2000 ms).

```
void setScanTimeout (long timeoutMsec)
```

### getResponseTimeout ()

Informs on a device response timeout for setup, reset and blink operations (default = 1000 ms).

```
long getResponseTimeout ()
```

### setResponseTimeout ()

Informs on a device response timeout for setup, reset and blink operations (default = 1000 ms).

```
void setResponseTimeout (long timeoutMsec)
```

### isServiceAvailable ()

Use this function to check Profinet DCP service availability.

- Network adapter validity / availability
- Windows: WinPcap / Npcap availability

- Linux: CAP\_NET\_ADMIN / CAP\_NET\_RAW capabilities

```
ResultVoid isServiceAvailable (BusHardwareId busHardwareId)
```

Parameters	<i>BusHardwareId</i>	Hardware ID of Profinet DCP service to check.
Returns	<i>true</i>	Service is available.
	<i>false</i>	Service is unavailable.

### scanProfinetDevices ()

Use this function to scan the hardware bus for the presence of Profinet devices.

```
ResultProfinetDevices scanProfinetDevices (BusHardwareId busHardwareId)
```

Parameters	<i>BusHardwareId</i>	Specifies each <u>fieldbus</u> to open.
Returns	<u>ResultProfinetDevices</u>	Hardware is open.

### setupProfinetDevice ()

Establishes the following device settings:

- Device name
- IP address
- Network mask
- Default gateway

```
ResultVoid setupProfinetDevice (BusHardwareId busHardwareId, ProfinetDevice profinetDevice, boolean savePermanent)
```

### resetProfinetDevice ()

Stops the device and resets it to factory defaults.

```
ResultVoid resetProfinetDevice (BusHardwareId busHardwareId, ProfinetDevice profinetDevice)
```

### blinkProfinetDevice ()

Commands the Profinet device to start blinking its Profinet LED.

```
ResultVoid blinkProfinetDevice (BusHardwareId busHardwareId, ProfinetDevice profinetDevice)
```

### validateProfinetDeviceIp ()

Use this function to check device's IP address.

```
ResultVoid validateProfinetDeviceIp (BusHardwareId busHardwareId, ProfinetDevice profinetDevice)
```

Parameters	<i>BusHardwareId</i>	Specifies the hardware ID to check.
	<i>ProfinetDevice</i>	Specifies the <u>Profinet device</u> to validate.
Returns	<i>ResultVoid</i>	

## 6.27 ProfinetDevice struct

The Profinet device data have the following public attributes:

std::string	deviceName
-------------	------------

std::string	deviceVendor
std::array< uint8_t, 6 >	macAddress
uint32_t	ipAddress
uint32_t	netMask
uint32_t	defaultGateway

The MAC address is provided as array in format `macAddress = {xx, xx, xx, xx, xx, xx}`; whereas IP address, network mask and gateway are all interpreted as big endian hex numbers, such as:

IP address: 192.168.0.2	0xC0A80002
Network mask: 255.255.0.0	0xFFFF0000
Gateway: 192.168.0.1	0xC0A80001

## 6.28 Result classes

Use the "optional" return values of these classes to check if a function call had success or not, and also locate the fail reasons. On success, the `hasError ()` function returns `false`. By `getResult ()`, you can read out the result value as per type (`ResultInt` etc.). If a call fails, you read out the reason by `getError ()`.

Protected attributes	<i>string</i>	<code>errorString</code>
	<code>NlcErrorCode</code>	<code>errorCode</code>
	<code>uint32_t</code>	<code>exErrorCode</code>

Also, this class has the following public member functions:

### hasError ()

Reads out a function call's success.

```
boolean hasError ()
```

Returns	<code>true</code>	Failed call. Use <code>getError ()</code> to read out the value.
	<code>false</code>	Successful call. Use <code>getResult ()</code> to read out the value.

### getError ()

Reads out the reason if a function call fails.

```
String getError ()
```

Returns `const string`

### getErrorCode ()

Read the `NlcErrorCode`.

```
NlcErrorCode getErrorCode ()
```

### getExErrorCode ()

```
uint32_t getExErrorCode () const
```

```
long getExErrorCode ()
```

### 6.28.1 ResultVoid

*NanoLib* sends you an instance of this class if the function returns void. The class inherits the public functions and protected attributes from the [result class](#) and has the following public member functions:

#### ResultVoid ()

The following functions aid in defining the exact void result:

```
ResultVoid (String errorString_)
```

```
ResultVoid (NlcErrorCode errCode, String errorString_)
```

```
ResultVoid (NlcErrorCode errCode, long exErrCode, String errorString_)
```

```
ResultVoid (Result result)
```

### 6.28.2 ResultInt

*NanoLib* sends you an instance of this class if the function returns an integer. The class inherits the public functions / protected attributes from the [result class](#) and has the following public member functions:

#### getResult ()

Returns the integer result if a function call had success.

```
long getResult ()
```

Returns *long*

#### ResultInt ()

The following functions aid in defining the exact integer result:

```
ResultInt (long result_)
```

```
ResultInt (String errorString_)
```

```
ResultInt (NlcErrorCode errCode, String errorString_)
```

```
ResultInt (NlcErrorCode errCode, long exErrCode, String errorString_)
```

```
ResultInt (Result result)
```

### 6.28.3 ResultString

*NanoLib* sends you an instance of this class if the function returns a string. The class inherits the public functions / protected attributes from the [result class](#) and has the following public member functions:

#### getResult ()

Reads out the string result if a function call had success.

```
String getResult ()
```

Returns *const string*

## ResultString ()

The following functions aid in defining the exact string result:

```
ResultString (String message, boolean hasError_)
```

```
ResultString (NlcErrorCode errCode, String errorString_)
```

```
ResultString (NlcErrorCode errCode, long exErrCode, String errorString_)
```

```
ResultString (Result result)
```

### 6.28.4 ResultArrayByte

*NanoLib* sends you an instance of this class if the function returns a byte array. The class inherits the public functions / protected attributes from the [result class](#) and has the following public member functions:

#### getResult ()

Reads out the byte vector if a function call had success.

```
ByteVector getResult ()
```

Returns `const vector<uint8_t>`

#### ResultArrayByte ()

The following functions aid in defining the exact byte array result:

```
ResultArrayByte (ByteVector result_)
```

```
ResultArrayByte (String errorString_)
```

```
ResultArrayByte (NlcErrorCode errCode, String errorString_)
```

```
ResultArrayByte (NlcErrorCode errCode, long exErrCode, String errorString_)
```

```
ResultArrayByte (Result result)
```

### 6.28.5 ResultArrayInt

*NanoLib* sends you an instance of this class if the function returns an integer array. The class inherits the public functions / protected attributes from the [result class](#) and has the following public member functions:

#### getResult ()

Reads out the integer vector if a function call had success.

```
IntVector getResult ()
```

Returns `const vector<uint64_t>`



## ResultArrayInt ()

The following functions aid in defining the exact integer array result:

```
ResultArrayInt (IntVector result_)
```

```
ResultArrayInt (String errorString_)
```

```
ResultArrayInt (NlcErrorCode errCode, String errorString_)
```

```
ResultArrayInt (NlcErrorCode errCode, long exErrCode, String errorString_)
```

```
ResultArrayInt (Result result)
```

### 6.28.6 ResultBusHwIds

*NanoLib* sends you an instance of this class if the function returns a bus hardware ID array. The class inherits the public functions / protected attributes from the result class and has the following public member functions:

#### getResult ()

Reads out the bus-hardware-ID vector if a function call had success.

```
BusHWIdVector getResult ()
```

Parameters *const*  
*vector<BusHardwareId>*

#### ResultBusHwIds ()

The following functions aid in defining the exact bus-hardware-ID-array result:

```
ResultBusHwIds (BusHWIdVector result_)
```

```
ResultBusHwIds (String errorString_)
```

```
ResultBusHwIds (NlcErrorCode errCode, String errorString_)
```

```
ResultBusHwIds (NlcErrorCode errCode, long exErrCode, String errorString_)
```

```
ResultBusHwIds (Result result)
```

### 6.28.7 ResultDeviceId

*NanoLib* sends you an instance of this class if the function returns a device ID. The class inherits the public functions / protected attributes from the result class and has the following public member functions:

#### getResult ()

Reads out the device ID vector if a function call had success.

```
DeviceId getResult ()
```

Returns *const vector<DeviceId>*

## ResultDeviceId ()

The following functions aid in defining the exact device ID result:

```
ResultDeviceId (DeviceId result_)
```

```
ResultDeviceId (String errorString_)
```

```
ResultDeviceId (NlcErrorCode errCode, String errorString_)
```

```
ResultDeviceId (NlcErrorCode errCode, long exErrCode, String errorString_)
```

```
ResultDeviceId (Result result)
```

### 6.28.8 ResultDeviceIds

*NanoLib* sends you an instance of this class if the function returns a device ID array. The class inherits the public functions / protected attributes from the result class and has the following public member functions:

#### getResult ()

Returns the device ID vector if a function call had success.

```
DeviceIdVector getResult ()
```

Returns *const vector<DeviceId>*

## ResultDeviceIds ()

The following functions aid in defining the exact device-ID-array result:

```
ResultDeviceIds (DeviceIdVector result_)
```

```
ResultDeviceIds (String errorString_)
```

```
ResultDeviceIds (NlcErrorCode errCode, String errorString_)
```

```
ResultDeviceIds (NlcErrorCode errCode, long exErrCode, String errorString_)
```

```
ResultDeviceIds (Result result)
```

### 6.28.9 ResultDeviceHandle

*NanoLib* sends you an instance of this class if the function returns the value of a device handle. The class inherits the public functions / protected attributes from the result class and has the following public member functions:

#### getResult ()

Reads out the device handle if a function call had success.

```
DeviceHandle getResult ()
```

Returns *DeviceHandle*

## ResultDeviceHandle ()

The following functions aid in defining the exact device handle result:

```
ResultDeviceHandle (DeviceHandle result_)
```

```
ResultDeviceHandle (String errorString_)
```

```
ResultDeviceHandle (NlcErrorCode errCode, String errorString_)
```

```
ResultDeviceHandle (NlcErrorCode errCode, long exErrCode, String errorString_)
```

```
ResultDeviceHandle (Result result)
```

### 6.28.10 ResultObjectDictionary

*NanoLib* sends you an instance of this class if the function returns the content of an object dictionary. The class inherits the public functions / protected attributes from the result class and has the following public member functions:

#### getResult ()

Reads out the device ID vector if a function call had success.

```
ObjectDictionary getResult ()
```

Returns     *const*  
              *vector<ObjectDictionary>*

## ResultObjectDictionary ()

The following functions aid in defining the exact object dictionary result:

```
ResultObjectDictionary (ObjectDictionary result_)
```

```
ResultObjectDictionary (String errorString_)
```

```
ResultObjectDictionary (NlcErrorCode errCode, String errorString_)
```

```
ResultObjectDictionary (NlcErrorCode errCode, long exErrCode, String  
errorString_)
```

```
ResultObjectDictionary (Result result)
```

### 6.28.11 ResultConnectionState

*NanoLib* sends you an instance of this class if the function returns a device-connection-state info. The class inherits the public functions / protected attributes from the result class and has the following public member functions:

#### getResult ()

Reads out the device handle if a function call had success.

```
DeviceConnectionStateInfo getResult ()
```

Returns     *DeviceConnectionStateInfo*    Connected / Disconnected / ConnectedBootloader

### ResultConnectionState ()

The following functions aid in defining the exact connection state result:

```
ResultConnectionState (DeviceConnectionStateInfo result_)
```

```
ResultConnectionState (String errorString_)
```

```
ResultConnectionState (NlcErrorCode errCode, String errorString_)
```

```
ResultConnectionState (NlcErrorCode errCode, long exErrCode, String  
errorString_)
```

```
ResultConnectionState (Result result)
```

### 6.28.12 ResultObjectEntry

*NanoLib* sends you an instance of this class if the function returns an object entry. The class inherits the public functions / protected attributes from the result class and has the following public member functions:

#### getResult ()

Returns the device ID vector if a function call had success.

```
ObjectEntry getResult ()
```

Returns *const ObjectEntry*

### ResultObjectEntry ()

The following functions aid in defining the exact object entry result:

```
ResultObjectEntry (ObjectEntry result_)
```

```
ResultObjectEntry (String errorString_)
```

```
ResultObjectEntry (NlcErrorCode errCode, String errorString_)
```

```
ResultObjectEntry (NlcErrorCode errCode, long exErrCode, String errorString_)
```

```
ResultObjectEntry (Result result)
```

### 6.28.13 ResultObjectSubEntry

*NanoLib* sends you an instance of this class if the function returns an object sub-entry. The class inherits the public functions / protected attributes from the result class and has the following public member functions:

#### getResult ()

Returns the device ID vector if a function call had success.

```
ObjectSubEntry getResult ()
```

Returns *const ObjectSubEntry*

### ResultObjectSubEntry ()

The following functions aid in defining the exact object sub-entry result:

```
ResultObjectSubEntry (ObjectSubEntry result_)
```

```
ResultObjectSubEntry (String errorString_)
```

```
ResultObjectSubEntry (NlcErrorCode errCode, String errorString_)
```

```
ResultObjectSubEntry (NlcErrorCode errCode, long exErrCode, String  
errorString_)
```

```
ResultObjectSubEntry (Result result)
```

### 6.28.14 ResultProfinetDevices

*NanoLib* sends you an instance of this class if the function returns a [Profinet device](#). The class inherits the public functions / protected attributes from the [result class](#) and has the following public member functions:

#### getResult ()

Reads out the Profinet device vector if a function call had success.

```
ProfinetDeviceVector getResult ()
```

### ResultProfinetDevices ()

The following functions aid in defining the exact Profinet devices.

```
ResultProfinetDevices (ProfinetDeviceVector profinetDevices)
```

```
ResultProfinetDevices (Result result)
```

```
ResultProfinetDevices (string errorText, NlcErrorCode errorCode)
```

### 6.28.15 ResultSampleDataArray

*NanoLib* sends you an instance of this class if the function returns a [sample data](#) array. The class inherits the public functions / protected attributes from the [result class](#) and has the following public member functions:

#### getResult ()

Reads out the data array if a function call had success.

```
SampleDataVector getResult ()
```

## ResultSampleDataArray ()

The following functions aid in defining the exact Profinet devices.

```
ResultSampleDataArray (SampleDataVector dataArray)
```

```
ResultSampleDataArray (string errorDesc, NlcErrorCode errorCode, uint
  extendedErrorCode)
```

```
ResultSampleDataArray (string errorDesc, NlcErrorCode errorCode)
```

```
ResultSampleDataArray (Result result)
```

### 6.28.16 ResultSamplerState

*NanoLib* sends you an instance of this class if the function returns a [sampler state](#). This class inherits the public functions / protected attributes from the [result class](#) and has the following public member functions:

#### getResult ()

Reads out the sampler state vector if a function call had success.

```
SamplerState getResult ()
```

Returns *SamplerState*> Unconfigured / Configured / Ready / Running / Completed / Failed / Cancelled

## ResultSamplerState ()

The following functions aid in defining the exact sampler state.

```
ResultSamplerState (SamplerState state)
```

```
ResultSamplerState (String errorDesc, NlcErrorCode errorCode, long
  extendedErrorCode) de)
```

```
ResultSamplerState (ResultSamplerState other)
```

```
ResultSamplerState (Result result)
```

## 6.29 NlcErrorCode

If something goes wrong, the [result classes](#) report one of the error codes listed in this enumeration.

Error code	C: Category   D: Description   R: Reason
Success	<b>C:</b> None. <b>D:</b> No error. <b>R:</b> The operation completed successfully.
GeneralError	<b>C:</b> Unspecified. <b>D:</b> Unspecified error. <b>R:</b> Failure that fits no other category.
BusUnavailable	<b>C:</b> Bus. <b>D:</b> Hardware bus not available. <b>R:</b> Bus inexistent, cut-off or defect.
CommunicationError	<b>C:</b> Communication. <b>D:</b> Communication unreliable. <b>R:</b> Unexpected data, wrong CRC, frame or parity errors, etc.
ProtocolError	<b>C:</b> Protocol. <b>D:</b> Protocol error. <b>R:</b> Response after unsupported protocol option, device report unsupported protocol, error in the protocol (say, SDO segment sync bit), etc. <b>R:</b> A response or device report to unsupported protocol (options) or to errors in protocol (say, SDO segment sync bit), etc. <b>R:</b> Unsupported protocol (options) or error in protocol (say, SDO segment sync bit), etc.

<b>Error code</b>	<b>C: Category   D: Description   R: Reason</b>
ODDoesNotExist	<b>C:</b> Object dictionary. <b>D:</b> OD address inexistent. <b>R:</b> No such address in the object dictionary.
ODInvalidAccess	<b>C:</b> Object dictionary. <b>D:</b> Access to OD address invalid. <b>R:</b> Attempt to write a read-only, or to read from a write-only, address.
ODTypeMismatch	<b>C:</b> Object dictionary. <b>D:</b> Type mismatch. <b>R:</b> Value unconverted to specified type, say, in an attempt to treat a string as a number.
OperationAborted	<b>C:</b> Application. <b>D:</b> Process aborted. <b>R:</b> Process cut by application request. Returns only on operation interrupt by callback function, say, from bus-scanning.
OperationNotSupported	<b>C:</b> Common. <b>D:</b> Process unsupported. <b>R:</b> No hardware bus / device support.
InvalidOperation	<b>C:</b> Common. <b>D:</b> Process incorrect in current context, or invalid with current argument. <b>R:</b> A reconnect attempt to already connected buses / devices. A disconnect attempt to already disconnected ones. A bootloader operation attempt in firmware mode or vice versa.
InvalidArguments	<b>C:</b> Common. <b>D:</b> Argument invalid. <b>R:</b> Wrong logic or syntax.
AccessDenied	<b>C:</b> Common. <b>D:</b> Access is denied. <b>R:</b> Lack of rights or capabilities to perform the requested operation.
ResourceNotFound	<b>C:</b> Common. <b>D:</b> Specified item not found. <b>R:</b> Hardware bus, protocol, device, OD address on device, or file was not found.
ResourceUnavailable	<b>C:</b> Common. <b>D:</b> Specified item not found. <b>R:</b> busy, inexistent, cut-off or defect.
OutOfMemory	<b>C:</b> Common. <b>D:</b> Insufficient memory. <b>R:</b> Too little memory to process this command.
TimeOutError	<b>C:</b> Common. <b>D:</b> Process timed out. <b>R:</b> Return after time-out expired. Timeout may be a device response time, a time to gain shared or exclusive resource access, or a time to switch the bus / device to a suitable state.

### 6.30 NlcCallback

This parent class for callbacks has the following public member function:

#### callback ()

```
ResultVoid callback ()
```

Returns [ResultVoid](#)

### 6.31 NlcDataTransferCallback

Use this callback class for data transfers (firmware update, NanoJ upload etc.).

1. For a firmware upload: Define a "co-class" extending this one with a custom callback method implementation.
2. Use the "co-class's" instances in *NanoLibAccessor.uploadFirmware ()* calls.

The main class itself has the following public member function:

#### callback ()

```
ResultVoid callback (DataTransferInfo info, int data)
```

Returns [ResultVoid](#)

### 6.32 NlcScanBusCallback

Use this callback class for bus scanning.

1. Define a "co-class" extending this one with a custom callback method implementation.
2. Use the "co-class's" instances in *NanoLibAccessor.scanDevices ()* calls.

The main class itself has the following public member function.

#### callback ()

```
ResultVoid callback(BusScanInfo info, DeviceIdVector devicesFound, int data)
```

Returns *ResultVoid*

### 6.33 NlcLoggingCallback

Use this callback class for logging callbacks.

1. Define a class that extends this class with a custom callback method implementation
2. Use a pointer to its instances in order to set a callback by *NanoLibAccessor > setLoggingCallback (...)*.

```
void callback (String payload_str, String formatted_str, String logger_name,
long log_level, java.math.BigInteger time_since_epoch, long thread_id)
```

### 6.34 SamplerInterface

Use this class to configure, start and stop the sampler, or to get sampled data and fetch a sampler's status or last error. The class has the following public member functions.

#### configure ()

Configures a sampler.

```
ResultVoid configure (DeviceHandle deviceHandle, SamplerConfiguration
samplerConfiguration)
```

Parameters	[in] <i>deviceHandle</i>	Specifies what device to configure the sampler for.
	[in] <i>samplerConfiguration</i>	Specifies the values of <u>configuration attributes</u> .
Returns	<i>ResultVoid</i>	Confirms that a <u>void function</u> has run.

#### getData ()

Gets the sampled data.

```
ResultSampleDataArray getData (DeviceHandle deviceHandle)
```

Parameters	[in] <i>deviceHandle</i>	Specifies what device to get the data for.
Returns	<i>ResultSampleDataArray</i>	Delivers the sampled data, which can be an empty array if <u>samplerNotify</u> is active on start.

#### getLastError ()

Gets a sampler's last error.

```
ResultVoid getLastError (DeviceHandle deviceHandle)
```

Returns	<i>ResultVoid</i>	Confirms that a <u>void function</u> has run.
---------	-------------------	---



**getState ()**

Gets a sampler's status.

```
ResultSamplerState getState (DeviceHandle deviceHandle)
```

Returns ResultSamplerState Delivers the sampler state.

**start ()**

Starts a sampler.

```
ResultVoid start (DeviceHandle deviceHandle, SamplerNotify samplerNotify, long applicationData)
```

Parameters [in] *deviceHandle* Specifies what device to start the sampler for.  
 [in] SamplerNotify Specifies what optional info to report (can be *nullptr*).  
 [in] *applicationData* Option: Forwards application-related data (a user-defined 8-bit array of value / device ID / index, or a datetime, a variable's / function's pointer, etc.) to *samplerNotify*.

Returns *ResultVoid* Confirms that a void function has run.

**stop ()**

Stops a sampler.

```
ResultVoid stop (DeviceHandle deviceHandle)
```

Parameters [in] *deviceHandle* Specifies what device to stop the sampler for.  
 Returns *ResultVoid* Confirms that a void function has run.

**6.35 SamplerConfiguration struct**

This struct contains the data sampler's configuration options (static or not).

**Public attributes**

std::vector <OdIndex>	<i>trackedAddresses</i>	Up to 12 OD addresses to be sampled.
uint32_t	<i>version</i>	A structure's version.
uint32_t	<i>durationMilliseconds</i>	Sampling duration in ms, from 1 to 65535
uint16_t	<i>periodMilliseconds</i>	Sampling period in ms.
uint16_t	<i>numberOfSamples</i>	Samples amount.
uint16_t	<i>preTriggerNumberOfSamples</i>	Samples pre-trigger amount.
bool	<i>usingSoftwareImplementation</i>	Use software implementation.
bool	<i>usingNewFWSamplerImplementation</i>	Use FW implementation for devices with a FW version v24xx or newer.
SamplerMode	<i>mode</i>	<i>Normal, repetitive or continuous</i> sampling.
SamplerTriggerCondition	<i>triggerCondition</i>	<b>Start trigger conditions:</b> TC_FALSE = 0x00 TC_TRUE = 0x01 TC_SET = 0x10 TC_CLEAR = 0x11 TC_RISING_EDGE = 0x12 TC_FALLING_EDGE = 0x13 TC_BIT_TOGGLE = 0x14 TC_GREATER = 0x15

```

TC_GREATER_OR_EQUAL = 0x16
TC_LESS = 0x17
TC_LESS_OR_EQUAL = 0x18
TC_EQUAL = 0x19
TC_NOT_EQUAL = 0x1A
TC_ONE_EDGE = 0x1B
TC_MULTI_EDGE = 0x1C, OdIndex, triggerValue

```

SamplerTrigger      *SamplerTrigger*

A trigger to start a sampler?

### Static public attributes

```

static constexpr size_t SAMPLER_CONFIGURATION_VERSION = 0x01000000
static constexpr size_t MAX_TRACKED_ADDRESSES = 12

```

## 6.36 SamplerNotify

Use this class to activate sampler notifications when you start a sampler. The class has the following public member function.

### notify ()

Delivers a notification entry.

```

void notify (ResultVoid lastError, SamplerState samplerState, SampleDataVector
sampleDatas, long applicationData)

```

Parameters	[in] <i>lastError</i>	Reports the last error occurred while sampling.
	[in] <i>samplerState</i>	Reports the sampler status at notification time: Unconfigured / Configured / Ready / Running / Completed / Failed / Cancelled.
	[in] <i>sampleDatas</i>	Reports the sampled-data array.
	[in] <i>applicationData</i>	Reports application-specific data.

## 6.37 SampleData struct

This struct contains the sampled data.

<i>uin64_t iterationNumber</i>	Starts at 0 and only increases in repetitive mode.
<i>std::vector&lt;SampledValues&gt;</i>	Contains the array of sampled values.

## 6.38 SampledValue struct

This struct contains the sampled values.

<i>uin64_t value</i>	Contains the value of a tracked OD address.
<i>uin64_t CollectTimeMsec</i>	Contains the collection time in milliseconds, relative to the sample beginning.

## 6.39 SamplerTrigger struct

This struct contains the trigger settings of the sampler.

<i>SamplerTriggerCondition condition</i>	The trigger condition:TC_FALSE = 0x00 TC_TRUE = 0x01 TC_SET = 0x10 TC_CLEAR = 0x11 TC_RISING_EDGE = 0x12
--	--

```

TC_FALLING_EDGE = 0x13
TC_BIT_TOGGLE = 0x14
TC_GREATER = 0x15
TC_GREATER_OR_EQUAL = 0x16
TC_LESS = 0x17
TC_LESS_OR_EQUAL = 0x18
TC_EQUAL = 0x19
TC_NOT_EQUAL = 0x1A
TC_ONE_EDGE = 0x1B
TC_MULTI_EDGE = 0x1C

```

*OdIndex*

*uin32\_t value*

The trigger's *OdIndex* (address).

Condition value or bit number (starting from bit zero).

## 6.40 Serial struct

Find here your serial communication options and the following public attributes:

:string	BAUD_RATE_OPTIONS_NAME = "serial baud rate"
SerialBaudRate	<i>baudRate</i> = <u>SerialBaudRate struct</u>
string	PARITY_OPTIONS_NAME = "serial parity"
SerialParity	<i>parity</i> = <u>SerialParity struct</u>

## 6.41 SerialBaudRate struct

Find here your serial communication baud rate and the following public attributes:

string	BAUD_RATE_7200 = "7200"
string	BAUD_RATE_9600 = "9600"
string	BAUD_RATE_14400 = "14400"
string	BAUD_RATE_19200 = "19200"
string	BAUD_RATE_38400 = "38400"
string	BAUD_RATE_56000 = "56000"
string	BAUD_RATE_57600 = "57600"
string	BAUD_RATE_115200 = "115200"
string	BAUD_RATE_128000 = "128000"
string	BAUD_RATE_256000 = "256000"

## 6.42 SerialParity struct

Find here your serial parity options and the following public attributes:

string	NONE = "none"
string	ODD = "odd"
string	EVEN = "even"
string	MARK = "mark"
string	SPACE = "space"

## 7 Licenses

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## 8 Imprint, contact, versions

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Document	+ Added   > Changed   # Fixed	Product
1.1.0 <sup>2024.09</sup>	+ NanoLib-CANopen: Support for <i>Peak</i> PCAN-USB adapter (IPEH-002021/002022).	1.2.0
1.0.3 <sup>2024.07</sup>	> NanoLib Core: Changed logging callback interface (LogLevel replaced by LogModule). # NanoLib Logger: Separation between core and modules has been corrected. # Modbus TCP: Fixed firmware update for FW4. # EtherCAT: Fixed NanoJ program upload for Core5. # EtherCAT: Fixed firmware update for Core5.	1.1.3
1.0.2 <sup>2024.05</sup>	# Modbus RTU: Fixed timing issues with low baud rates during firmware update. # RESTful: Fixed NanoJ program upload.	1.1.2
1.0.1 <sup>2024.04</sup>	# NanoLib Modules Sampler: Correct reading of sampled boolean values.	1.1.1
1.0.0 <sup>2024.02</sup>	+ Java 11 support for all platforms. + Python 3.11 /3.12 support for all platforms. + New logging callback interface (see examples). + Callback sinks for NanoLib Logger. > Update logger to version 1.12.0. > NanoLib Modules Sampler: Support now for Nanotec controller firmware v24xx. > NanoLib Modules Sampler: Change in structure used for sampler configuration. > NanoLib Modules Sampler: Continuous mode is synonymous with <i>endless</i> ; the trigger condition is checked once; the number of samples must be 0. > NanoLib Modules Sampler: Normal priority for the thread that collects data in firmware mode. > NanoLib Modules Sampler: Rewritten algorithm to detect transition between <i>Ready &amp; Running state</i> . # NanoLib Core: No more <i>Access Violation (0xC0000005)</i> on closing 2 or more devices using the same bus hardware. # NanoLib Core: No more <i>Segmentation Fault</i> on attaching a PEAK adapter under Linux. # NanoLib Modules Sampler: Correct sampled-values reading in firmware mode. # NanoLib Modules Sampler: Correct configuration of 502X:04. # NanoLib Modules Sampler: Correct mixing of buffers with channels. # NanoLib-Canopen: Increased CAN timeouts for robustness and correct scanning at lower baudrates. # NanoLib-Modbus: VCP detection algorithm for special devices (USB-DA-IO).	1.1.0