



Quantis User Guide

Version 2.7

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Chapter 1. Introduction

Thank you for purchasing a Quantis Random Number Generator.

A random number generator is a device that produces sequences of numbers whose outcome is unpredictable and which cannot subsequently be reliably reproduced. There exist two main classes of random number generators: software and physical generators. In general, software generators produce so-called pseudo random numbers. Although they may be useful in some applications, they should not be used in most applications where true randomness is required.

Quantis is a physical random number generator exploiting an elementary quantum optics process. Photons - light particles - are sent one by one onto a semi-transparent mirror and detected. The exclusive events (reflection - transmission) are associated to "0" - "1" bit values. The operation of Quantis is continuously monitored. If a failure is detected, the random bit stream is immediately stopped.

Quantum random number generators have the advantage over conventional randomness sources of being invulnerable to environmental perturbations and of allowing live status verification.

1.1. What You Need

To use your Quantis, you need:

- A PC with a supported operating system installed (see Table 1.1, "Supported operating systems.") and one of the following slots/ports available:
 - A PCI 32-bit slot (for Quantis PCI).
 - A PCI Express x1 slot (for Quantis PCI Express).
 - A USB 2.0 port (for Quantis USB).
- A USB 2.0 port for the USB Flash drive.
- 50MB hard drive space.

Operating System	Quantis PCI/PCIe	Quantis USB
Microsoft Windows XP (32-bit)		
Microsoft Windows XP (64-bit)		
Microsoft Windows Server 2003		
Microsoft Windows Vista (32-bit and 64-bit)		
Microsoft Windows Server 2008 (32-bit and 64-bit)		
Microsoft Windows 7 (32-bit and 64-bit)		
Linux 2.6 (32-bit and 64-bit)		

Table 1.1. Supported operating systems.

1.1.1. Additional Requirements

1.1.1.1. Linux

On Linux systems, you additionally need:

- Xorg 1.0 or higher (only required to use the EasyQuantis application).

Chapter 2. Hardware Installation

This chapter provides unpacking and installation information for Quantis.

2.1. Quantis PCI and PCI Express Installation



Caution

Under ordinary circumstances, the Quantis PCI and Quantis PCI Express (PCIe) cards will not be affected by static charge as may be received through your body during handling of the unit. However, there are special circumstances where you may carry an extraordinarily high static charge and possibly damage the card and/or your computer. To avoid any damage from static electricity, you should follow some precautions whenever you work on your computer.

1. Turn off your computer and unplug power supply.
2. Use a grounded wrist strap before handling computer components. If you don't have one, touch with both of your hands a safely grounded object or a metal object, such as the power supply case.
3. Place components on a grounded anti-static pad or on the bag that came with the components whenever the components are separated from the system.

The card contains sensitive electric components, which can be easily damaged by static electricity, so the card should be left in its original packing until it is installed.

Unpacking and installation should be done on a grounded anti-static mat. The operator should be wearing an anti-static wristband, grounded at the same point as the anti-static mat.

Inspect the card carton for obvious damage. Shipping and handling may cause damage to your card. Be sure there are no shipping and handling damages on the card before proceeding.

DO NOT POWER YOUR SYSTEM IF THE QUANTIS CARD IS DAMAGED.

2.1.1. Unpacking

Open the shipping carton and carefully remove all items, and ascertain that you have:

- a Quantis PCI or Quantis PCIe card;
- a Quick Install Guide;
- a USB Flash Drive with Manual, Drivers and Samples.

If any item is found to be missing or damaged, please contact your local reseller for replacement.

2.1.2. Installing the Card

1. Shut down the computer, unplug its power cord and remove the chassis cover.
2. Locate the PCI 32-bits slot (for Quantis PCI) or the PCI Express x1 slot (for Quantis PCIe). If necessary, remove the metal cover from this slot, then align your Quantis card with the PCI or PCIe slot respectively and press it in firmly until the card is fully inserted.

3. Install the bracket screw and secure the card to the computer chassis.
4. Cover the computer's chassis.
5. Switch the computer power on.
6. Install the driver (see next Chapter).

2.2. Quantis USB Installation

2.2.1. Unpacking

Open the shipping carton and carefully remove all items, and ascertain that you have:

- a Quantis USB;
- a USB cable;
- a Quick Install Guide;
- a USB Flash Drive with Manual, Drivers and Samples.

If any item is found to be missing or damaged, please contact your local reseller for replacement.

2.2.2. Installing the Device

1. Connect the Quantis device to a USB 2.0 port on your PC using the cable that came with the Quantis device.
2. Install the driver (see next Chapter).

Chapter 3. Driver Installation

To be able to access your Quantis device, you need to install a driver. This chapter contains instructions on how to install the driver on your operating system.



Important

Quantis PCI Express is software-compatible with Quantis PCI. This means that any software capable of communicating with a Quantis PCI device (e.g driver) is also able to communicate with the Quantis PCI Express. More specifically:

- Quantis PCIe uses the Quantis PCI driver.
- Quantis PCIe is considered by the software (driver, application) as a Quantis PCI device.

3.1. Windows Operating Systems

This section contains instructions on how to install a Quantis device on Windows Operating Systems.

Insert the USB flash drive into an available USB port. This drive contains the Quantis drivers as well as software for your device.



Important

In this section, we assume that the letter of the USB flash drive provided by IDQ is drive D:. If this is different on your machine, substitute your corresponding drive name for D: in the appropriate places in this instruction.

3.1.1. Windows XP

When a Quantis RNG is inserted into your computer for the first time, the operating system will detect the device automatically and display a *New Hardware Found* message. The following are step-by-step installation instructions.

3.1.1.1. Found New Hardware Wizard: Welcome

Windows will search for a driver on your computer, on removable media (e.g. CD-ROM) and on the Windows Update Web site.

The Quantis driver is not available on the Windows Update Web site. If asked, deny access to the Windows Update Web site and click the **Next** button.

**Note**

It is harmless to allow the wizard to connect to the Windows Update Web site. The only effect is that the installation process will take a little longer.

3.1.1.2. Found New Hardware Wizard: Quantis

When the wizard asks you what to do to install Quantis software, select *Install from a list or specific location* and click the **Next** button.

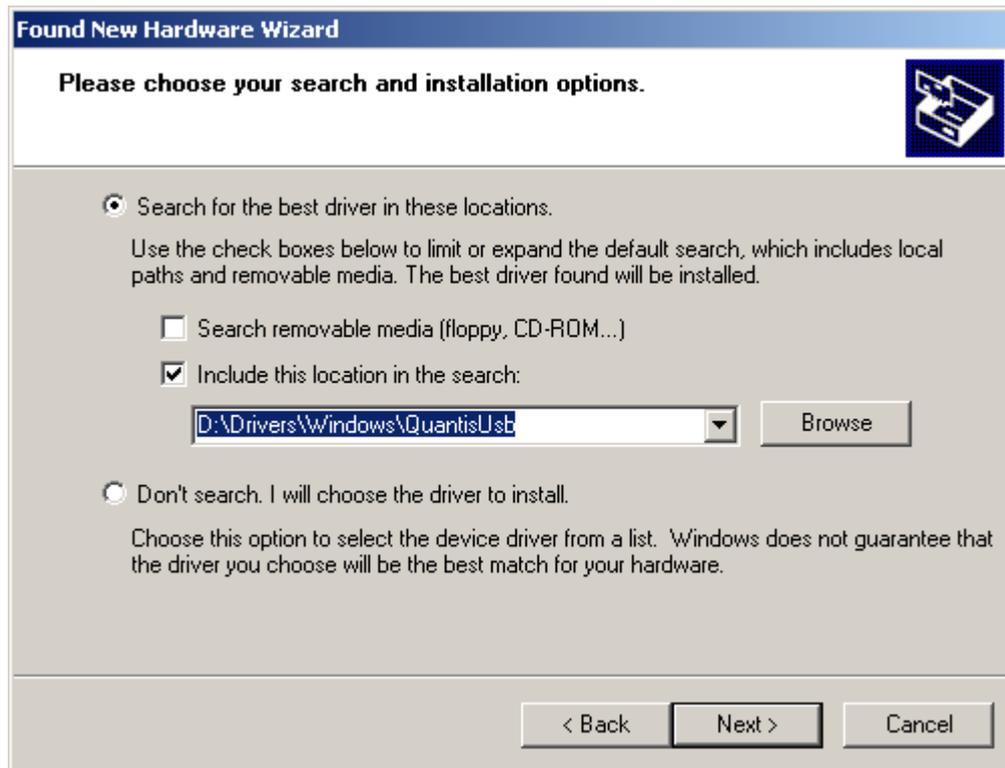


3.1.1.3. Found New Hardware Wizard: Search Location

First select *Search for the best driver in these locations*. Then activate the option *Include this location in the search*. Click the *Browse* button and select the directory containing the right driver for your device:

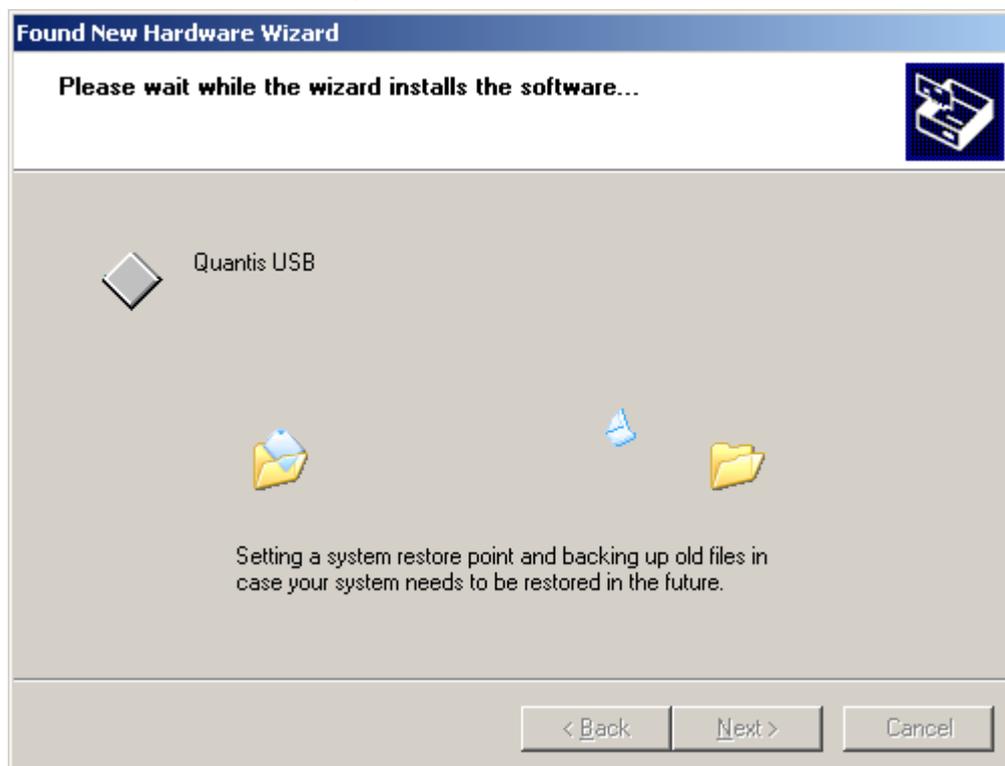
- For the Quantis PCI and Quantis PCIe select `D:\Drivers\Windows\QuantisPci`.
- For the Quantis USB select `D:\Drivers\Windows\QuantisUsb`.

Click the **Next** button to validate.



3.1.1.4. Found New Hardware Wizard: Installation

Wait while the wizard installs the Quantis driver.



3.1.1.5. Found New Hardware Wizard: Completed

When the wizard has finished installing the Quantis driver, click the **Finish** button to exit the installation. Reboot the computer if asked.



Your Quantis device is now installed. You can go to the next Chapter and install the application software.

3.1.2. Windows Vista

When the Quantis RNG is inserted into your computer for the first time, the operating system will detect the device automatically and display a *New Hardware Found* message. The following are step-by-step installation instructions.



Note

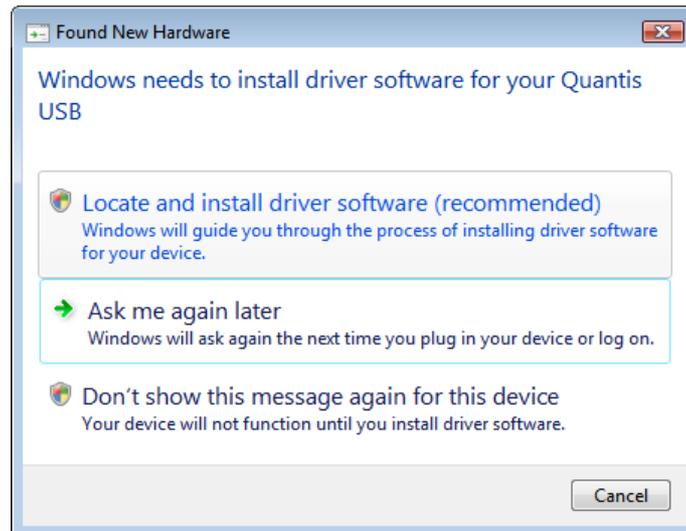
One or more intermediate dialog boxes may appear during the process stating *Windows needs your permission to continue*. Click *Continue* to proceed.



3.1.2.1. Found New Hardware Wizard: Welcome

Windows will search for a driver on your computer, on removable media (e.g CD-ROM) and on the Windows Update Web site.

Let Windows try to locate the driver by clicking on *Locate and install driver software*.



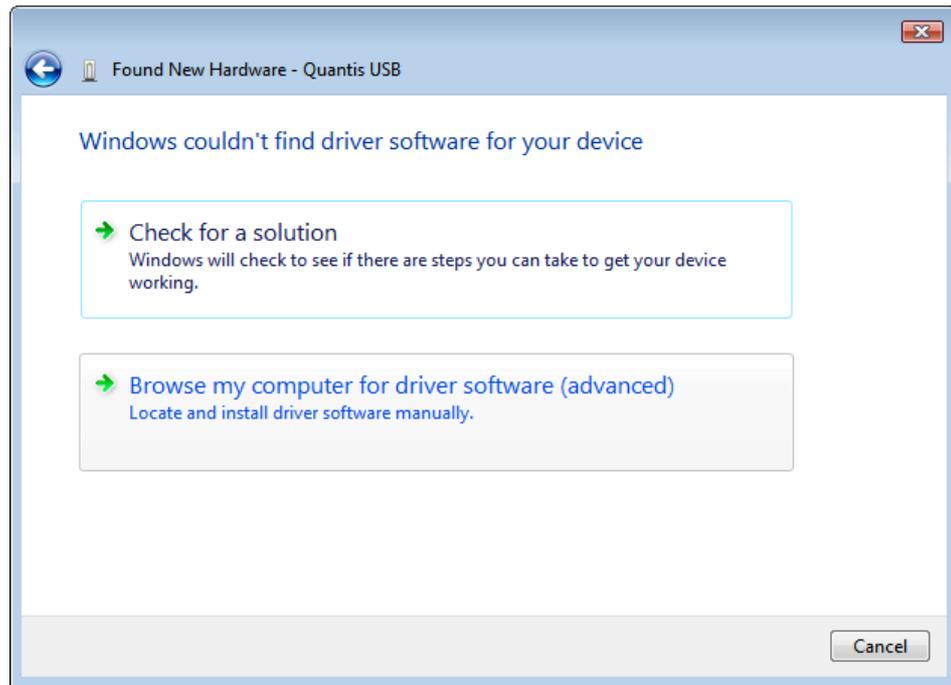
3.1.2.2. Found New Hardware Wizard: Insert Disc

When the wizard asks you to insert the disc that came with your Quantis USB, choose *I don't have the disc. Show me other options.* This allows you to specify the location of the driver available on the USB flash drive.

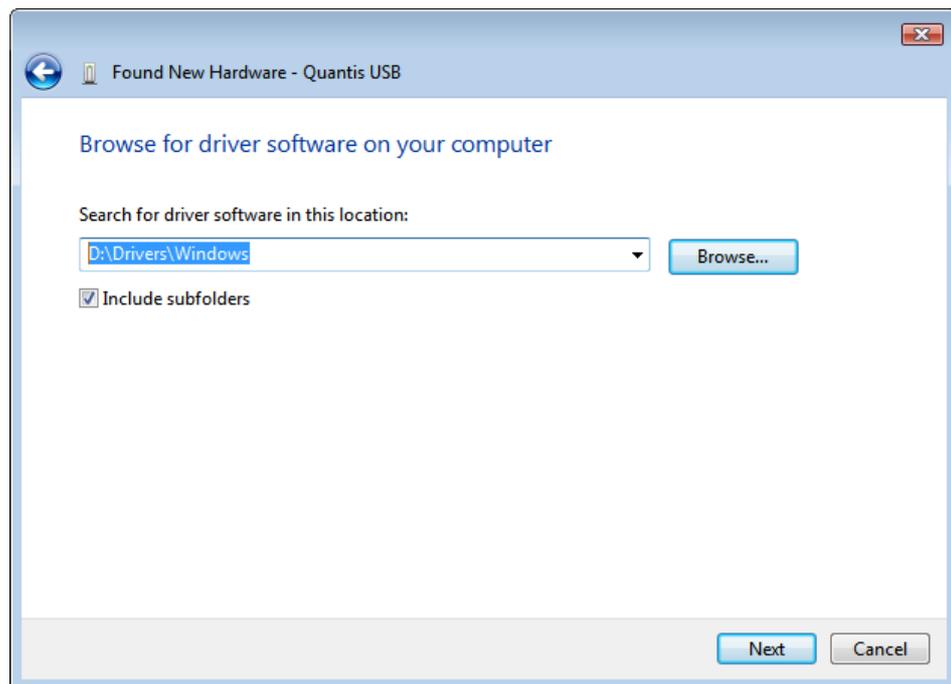


3.1.2.3. Found New Hardware Wizard: Search Location

Select *Browse my computer for driver software.*

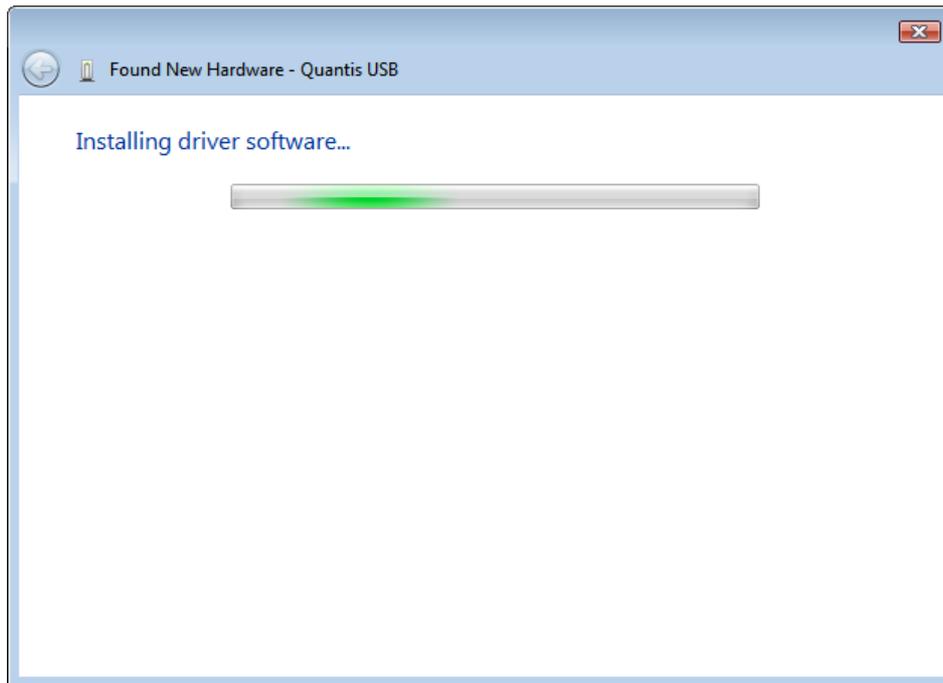


On the next dialog, click the **Browse** button and select the directory `D:\Drivers\Windows`. This directory contains all drivers for Windows. Activate the option *Include subfolders* and validate your choices by clicking the **Next** button.



3.1.2.4. Found New Hardware Wizard: Installation

Wait while the wizard installs the Quantis driver.



3.1.2.5. Found New Hardware Wizard: Install

If asked, validate the installation by clicking the **Install** button.

You can select *Always trust software from "ID Quantique SA"*, to avoid this question in future. All software with a valid digital signature from ID Quantique will be automatically accepted and will be installed without prompting.



3.1.2.6. Found New Hardware Wizard: Completed

When the wizard has finished installing the Quantis driver, click the **Close** button to exit the installation. Reboot the computer if asked.



Your Quantis device is now installed. You can go to the next Chapter and install the application software.

3.1.3. Windows 7

When the Quantis RNG is inserted into your computer for the first time, the operating system will detect the device automatically and search the Windows Update Web site for a driver.

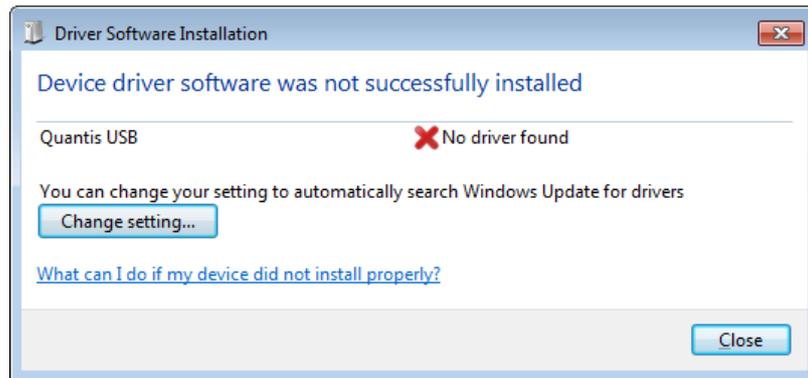


Note

One or more intermediate dialog boxes may appear during the process stating *Windows needs your permission to continue*. Click *Continue* to proceed.

A screenshot of a User Account Control dialog box. The title bar says "User Account Control". The main text reads: "Windows needs your permission to continue". Below this, it says "If you started this action, continue." followed by a small icon of a USB device and the text "Device driver software installation" and "Microsoft Windows". At the bottom, there is a "Details" link, a "Continue" button, and a "Cancel" button. At the very bottom, it says "User Account Control helps stop unauthorized changes to your computer."

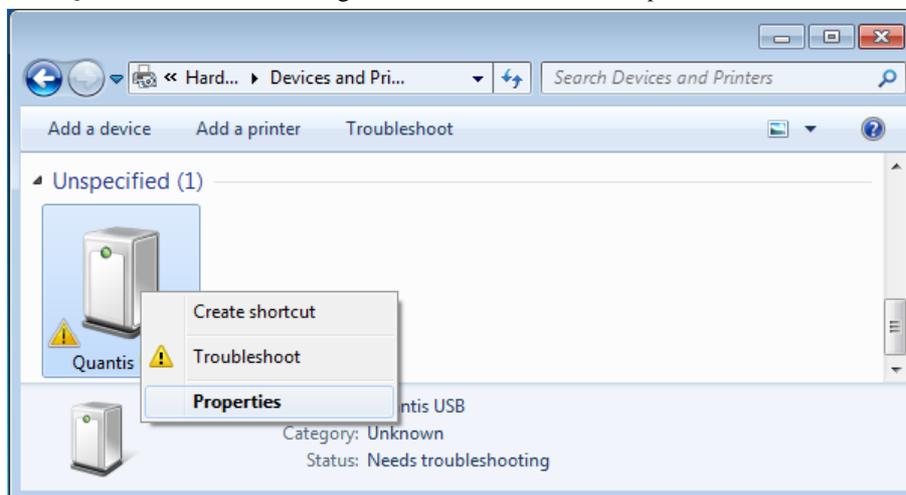
Since the driver for your Quantis device is not available on this site, this search will fail, and you will have to manually point Windows to the driver.



Close the dialog and read the following for the step-by-step installation instructions.

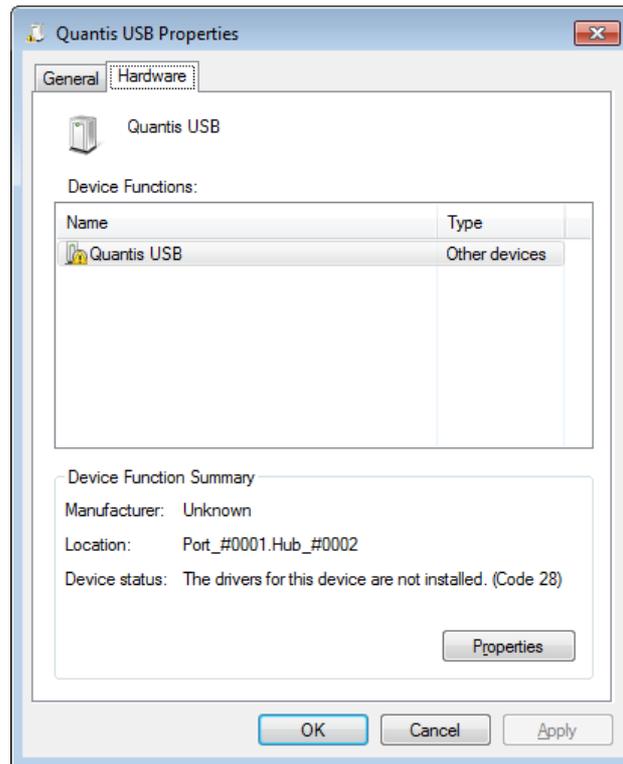
3.1.3.1. Devices and Printers

Open the *Start Menu* and select *Devices and Printers*. Scroll down until the Quantis device appears. Click on the Quantis device with the right mouse button. Select *Properties* on the menu.



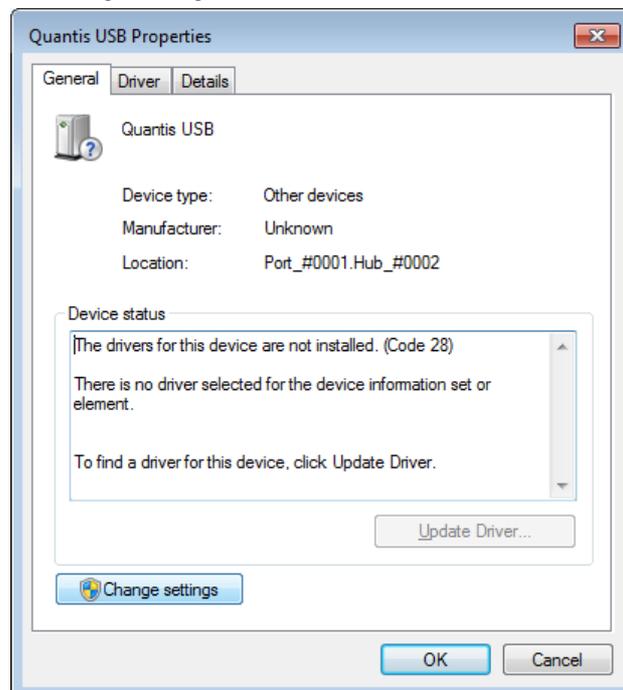
3.1.3.2. Quantis Properties: Hardware

In the Quantis Properties dialog, click on the *Hardware* tab and then on the *Properties* button.

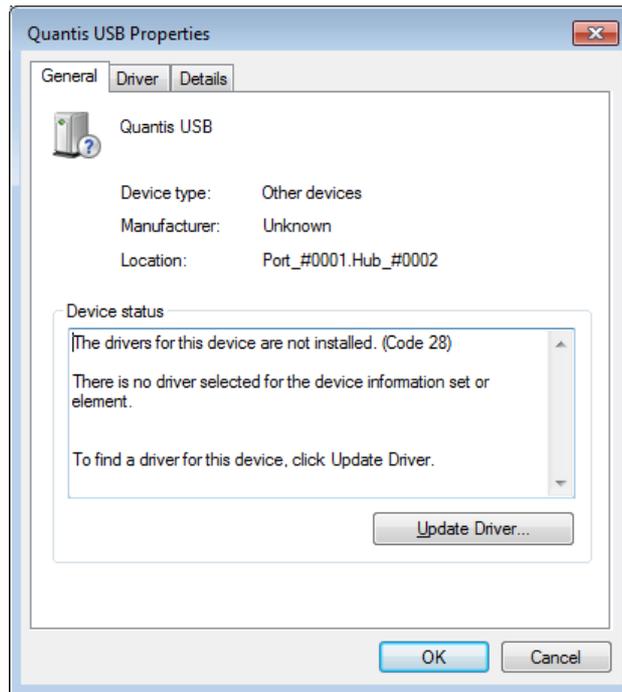


3.1.3.3. Quantis Properties: Update Driver

First click on the button *Change settings*.

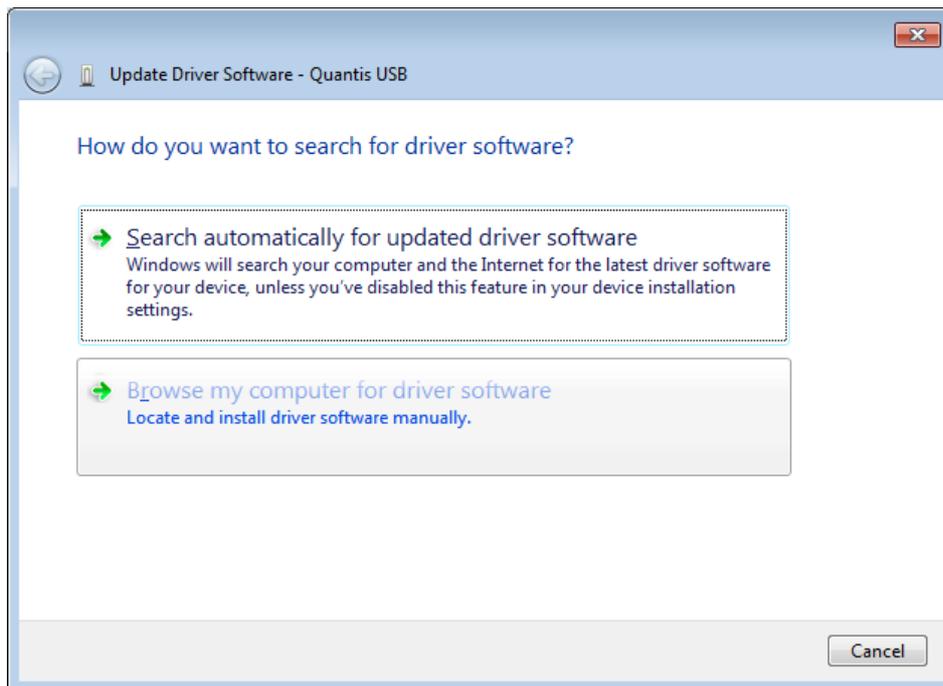


This will enable the *Update Driver* button. Click on it.



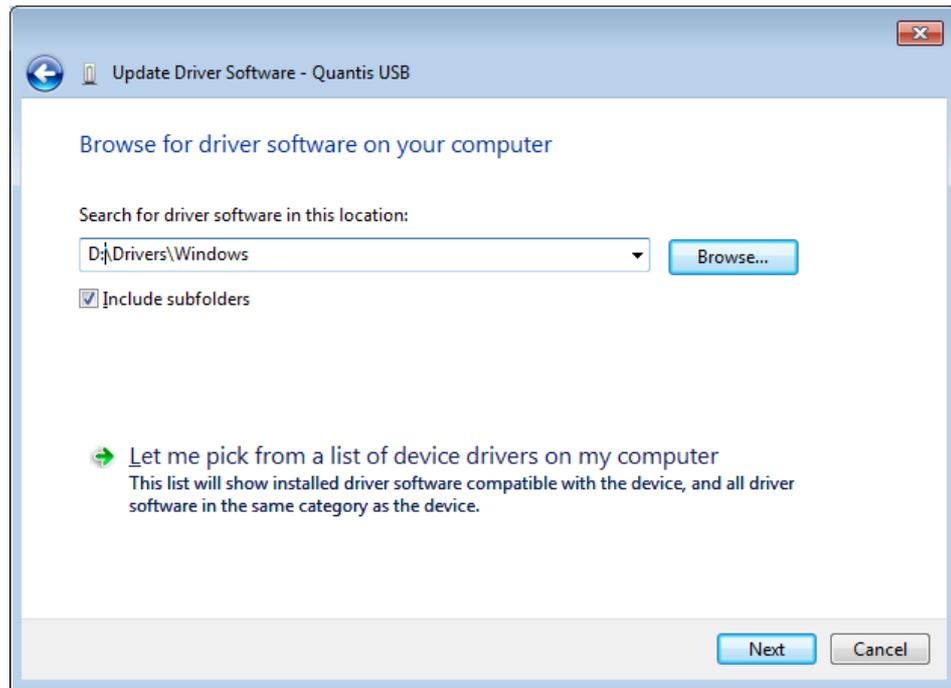
3.1.3.4. Update Driver Software: Search Driver

Driver is available on the USB flash drive provided. Select *Browse my computer for driver software*.



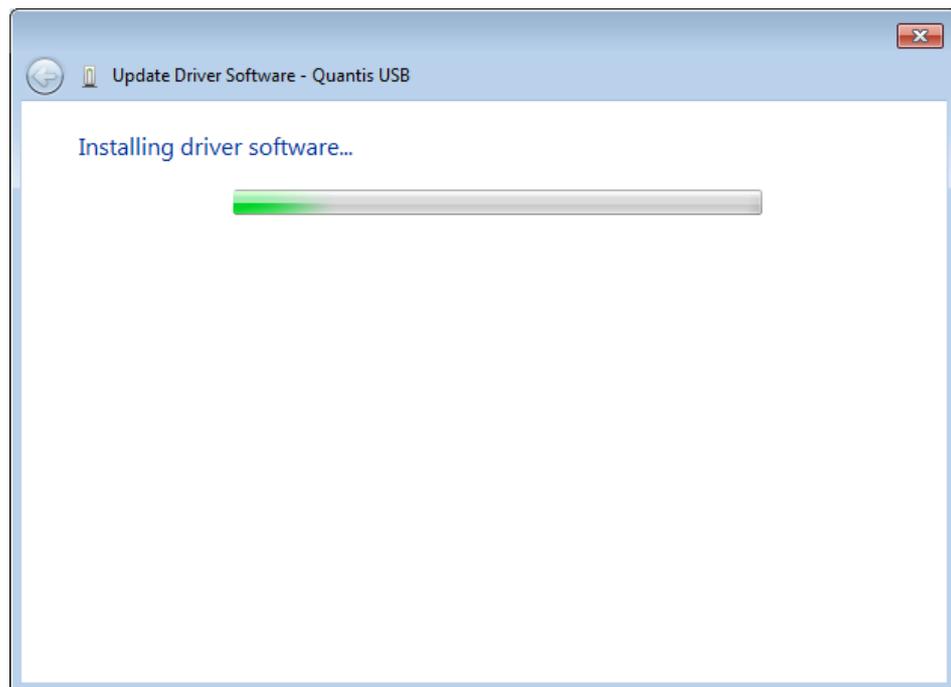
3.1.3.5. Update Driver Software: Search Location

Click the button **Browse** and select the directory `D:\Drivers\Windows`. This directory contains all drivers for Windows. Activate the option *Include subfolders* and validate your choices by clicking the **Next** button.



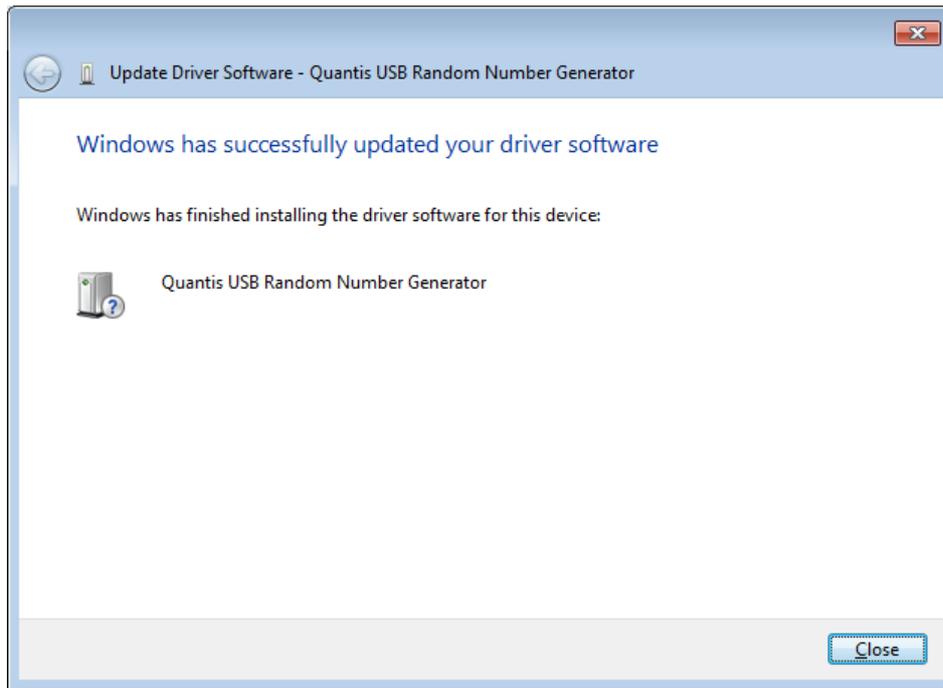
3.1.3.6. Update Driver Software: Installation

Wait while the Windows installs the driver.



3.1.3.7. Update Driver Software: Completed

When the wizard has finished installing the Quantis driver, click the **Close** button to exit the installation. Reboot the computer if asked.



Your Quantis device is now installed. You can go to the next Chapter and install the application software.

3.2. Linux Operating System

This section contains instructions on how to install Quantis devices on Linux Operating Systems.



Note

In this section, we assume that the USB flash drive with the software is mounted on `/media/USB_FLASH`. If this is different on your machine, substitute your corresponding drive name in the appropriate places in this instruction.



Important note for Ubuntu users

Ubuntu does not include the `root` user. Instead, administrative access is given to individual users, who may use the **sudo** application to perform administrative tasks. To use **sudo** on the command line, preface your command with **sudo**:

```
$ sudo my_command_requiring_administrative_access
```

In this document, when a command must be executed as `root` on Ubuntu, preface the command with **sudo**.

Please refer to the Ubuntu guide for more details about the command **sudo**.

3.2.1. Quantis PCI and Quantis PCI Express

The Quantis PCI and Quantis PCIe cards require a kernel module to be compiled and installed to work correctly. The following are step-by-step installation instructions.

3.2.1.1. Install Pre-Requirements

Before being able to compile a Quantis PCI kernel module, you must install a compiler and the Linux kernel sources.



Note

Generally, you do not need the full source tree in order to build a module against the running kernel. Most of the time you just need the kernel headers.

3.2.1.1.1. Debian-based Distributions

Debian-based distributions have a powerful tool for building kernel modules: **module-assistant**. **module-assistant** aims to facilitate the process of building kernel modules from source. Type following command as root to install module assistant:

```
# apt-get install module-assistant
```

To download the headers corresponding to the current kernel and other mandatory tools, simply run (as root):

```
# m-a prepare
```

This command determines the name of the required kernel-headers package, installs it if needed and creates the `/usr/src/linux` symlink if needed. Also installs the **build-essential** package to ensure that the same compiler environment is established.

All required software has been installed. You can skip to Section 3.2.1.2, “Compile and Install Driver”.

3.2.1.1.2. Red Hat Enterprise Linux and CentOS Distributions

To build kernel modules on Red Hat Enterprise Linux and CentOS distributions it is not necessary to download the entire kernel. To build a module for the currently running kernel, only the matching **kernel-devel** package is required. Run the following command to install the **kernel-devel** package using **yum**:

```
# yum install kernel-devel
```



Important

The previous command installs the kernel headers for the latest kernel available in the repository. If your system is not up-to-date you need first to update the kernel and then boot the new kernel before installing the **kernel-devel** package:

```
# yum update kernel*
# reboot
# yum install kernel-devel
```

To compile the kernel driver you also need to install the developer tools such as GNU GCC C/C++ compilers, make and others. You can install them with the following command (as root):

```
# yum groupinstall "Development Tools"
```

All required software has been installed. You can skip to Section 3.2.1.2, “Compile and Install Driver”.

3.2.1.1.3. Other Distributions

Install the GNU GCC compiler and the header corresponding to the current kernel (or the whole source kernel). Please refer to the guide of your distribution for help on installing packages.

3.2.1.2. Compile and Install Driver

Now that all pre-requirements have been installed you can compile and install the driver.

First copy the source code of the driver to /tmp:

```
$ cp -R /media/USB_FLASH/Drivers/Unix /tmp/
```

Change to the directory which contains the driver and compile the driver:

```
$ cd /tmp/Unix/QuantisPci/  
$ make
```

When compilation finish, install and load the driver with following commands (as root):

```
# make install  
# modprobe quantis_pci
```

You can verify that the driver has been successfully loaded and all your Quantis PCI and PCIe cards have been detected with the command **dmesg**:

```
$ dmesg | grep quantis_pci  
quantis_pci: Initializing Quantis PCI RNG driver version 2.0  
quantis_pci: driver build Feb 12 2010 14:26:14  
quantis_pci: support enabled up to 10 PCI card(s)  
quantis_pci: Found card #0  
quantis_pci: core version 0x040a1201  
quantis_pci: device registered at /dev/grandom0  
quantis_pci: Driver loaded. Found 1 card(s)
```



Important

If you update your kernel, you must recompile and reinstall the driver!

3.2.1.3. Auto-load the Driver on Boot-up

Instead of using the **modprobe** command each time you want to load the driver, you can let the system load the driver automatically on boot-up.



Note

Some distributions already load the driver on boot for each detected device (if available).

To check if your system does this for you, reboot your computer and run the command **dmesg** as explained in previous section. If the driver has been loaded and all Quantis devices have been detected, you can skip this section.

3.2.1.3.1. Debian-based Distributions

To automatically load the driver on boot, simply add the driver's name at the end of `/etc/modules`. You can type the following command (as `root`) to add the entry:

```
# echo "quantis_pci" >> /etc/modules
```

3.2.1.3.2. Red Hat Enterprise Linux and CentOS Distributions

Red Hat Enterprise Linux checks for the existence of the `/etc/rc.modules` file at boot time, which contains various commands to load modules. The following commands configure the loading of the `quantis_pci` module at boot time (as `root`):

```
# echo modprobe quantis_pci >> /etc/rc.modules
# chmod +x /etc/rc.modules
```

3.2.1.3.3. Other Distribution

Please consult your distribution's guide to know how to auto-load a driver on boot-up.

3.2.1.4. Modify the Device's Permissions

Depending on the distribution, the Quantis PCI device might be accessible only to user `root`. UDEV (the device manager for the Linux 2.6 kernel series) must be instructed to allow other users to access the Quantis.

3.2.1.4.1. The `plugdev` group

IDQ provides a rule for UDEV that allows all users in group `plugdev` to access the Quantis device. The group `plugdev` is generally created on all modern distributions.

First check if your system already has the group `plugdev`:

```
$ grep plugdev /etc/group
```

If the previous command displays a line beginning with:

```
plugdev:x:
```

then your system has the group `plugdev`. When the **grep** command does not display any message, then the `plugdev` group doesn't exist on your system. Type following command (as `root`) to create the `plugdev` group:

```
# groupadd --gid 46 plugdev
```

3.2.1.4.2. Adding users to the `plugdev` group

Every user who is a member of the `plugdev` group can access hot-pluggable devices (digital cameras, USB drives etc.).

You can use the command **groups** to display the groups your user is in:

```
$ groups
users adm dialout cdrom plugdev lpadmin admin sambashare
```

If your user is not in the group `plugdev`, use the **usermod** command (as `root`) to add the user `LOGIN` to the group `plugdev` (substitute your own login name for `LOGIN`):

```
# usermod -G plugdev -a LOGIN
```

3.2.1.4.3. UDEV rules

In the directory `Drivers/Unix/` on the USB flash there are two files with UDEV rules:

- `idq-quantis-rhel.rules` for Red Hat Enterprise Linux and CentOS distributions.

- `idq-quantis.rules` for all other distributions.

Copy (as root) the right file into `/etc/udev/rules.d/` directory:

- On Red Hat Enterprise Linux and CentOS distributions:

```
# cp /media/USB_FLASH/Drivers/Unix/idq-quantis-rhel.rules
  /etc/udev/rules.d/
```

- On all other distributions:

```
# cp /media/USB_FLASH/Drivers/Unix/idq-quantis.rules
  /etc/udev/rules.d/
```



Note

The files `idq-quantis-rhel.rules` and `idq-quantis.rules` contain UDEV rules for both Quantis PCI and Quantis USB devices.

The udev daemon must now reload the rules. Type following command (as root) to reload the rules:

```
# udevadm control --reload-rules
```



Note

On Red Hat Enterprise Linux and CentOS distributions the `udevadm` command does not exist. Use following command to reload the rules instead:

```
# udevcontrol reload_rules
```



Note

The udev daemon only apply rules when creating the device's node (when the drivers loads). If the Quantis PCI driver is already loaded you need thus to unload and reload it to have the right permissions on the device:

```
# rmmod quantis_pci
# modprobe quantis_pci
```

3.2.1.5. Check Your Device

The driver has been installed and the system configured. You can now check if your device works correctly by reading some random bytes from the device. The following command reads 100 bytes from the first Quantis PCI device found on the system (not as root):

```
$ head -c 100 /dev/qrandom0
```



Important

It is important not to run the `head` command as `root` but as the standard user who will use the Quantis PCI device. Otherwise you won't be verifying that permission has been granted to you to access the device.

The above command will display some random characters on the console.



Important

If you get one or more *Operation not permitted* messages, you don't have the right permissions to access the Quantis device. In such a case:

- Verify that `/etc/udev/rules.d/idq-quantis.rules` exists and has the same content as the one provided on the USB flash drive.
- Verify that your user is in the `plugdev` group.
- Reboot the system to ensure that the new rules are loaded by the `udev` daemon.

Your Quantis device is now installed. You can go to the next Chapter to install the application software.

3.2.2. Quantis USB

Quantis USB only requires USB support enabled in the kernel¹. The Quantis USB device is accessed through the open source library `libusb-1.0`.

The following are step-by-step installation instructions.

3.2.2.1. libusb-1.0 Installation

Quantis USB device is accessed through the library `libusb-1.0`². This library is available on all recent distributions and can be installed using the package manager of the distribution.



Warning

Do not confuse `libusb-0.1` with `libusb-1.0`! `libusb-0.1` is the legacy release and is not developed any more. As of December 2008, `libusb-1.0` is the current stable branch. This new branch, used to access the Quantis USB, adds features missing in the first release.

3.2.2.1.1. Debian-based Distributions



Note for Debian users

`libusb-1.0` is only available on Debian Squeeze and newer releases. It is also available on Debian lenny-backports. Please refer to the Debian help on how to enable backports packages. On all other Debian releases, you need to manually install `libusb-1.0`. Please refer to Section 3.2.2.1.4, “Manually Compile `libusb-1.0`”.



Note for Ubuntu users

`libusb-1.0` is only available on Ubuntu Jaunty (9.04) and newer releases. On previous Ubuntu releases you need to manually install `libusb-1.0`. Please refer to Section 3.2.2.1.4, “Manually Compile `libusb-1.0`”.

Type the following command (as `root`) to install `libusb-1.0` and the development package (needed if you want to write your own application using the Quantis libraries):

```
# apt-get install libusb-1.0-0 libusb-1.0-0-dev
```

¹USB support in the kernel is generally enabled on all modern Linux distributions.

²<http://libusb.org/wiki/Libusb1.0>

3.2.2.1.2. Red Hat Enterprise Linux and CentOS Distributions

libusb-1.0 is currently not available on Red Hat Enterprise Linux nor CentOS distributions. You need to manually install libusb-1.0. Please refer to Section 3.2.2.1.4, “Manually Compile libusb-1.0”.

3.2.2.1.3. Other Distributions

Use the package manager of your distribution to install the library libusb-1.0. If the package is not available, please refer to Section 3.2.2.1.4, “Manually Compile libusb-1.0”.

3.2.2.1.4. Manually Compile libusb-1.0

If library libusb-1.0 can not is not available on the list of packages in the package manager of your distribution, you can easily compile it by hand.

First you need to download the library's sources. Go to the address <http://sourceforge.net/projects/libusb/files/libusb-1.0/> and download the latest version.

Open the **Terminal** application and change the working directory to the one containing the downloaded libusb-1.0 archive. Unpack the archive and compile the library (replace *x* with your version number):

```
$ tar xvjf libusb-1.0.x.tar.bz2
$ cd libusb-1.0.x/
$ ./configure --prefix=/usr
$ make
```

When the library has been compiled, install it with the following command (as `root`):

```
# make install
```

3.2.2.2. Modify the Device's Permissions

By default, the Quantis USB device is accessible only to user `root`. UDEV (the device manager for the Linux 2.6 kernel series) must be instructed to allow other users to access the Quantis. Please follow instructions on Section 3.2.1.4, “Modify the Device's Permissions”.



Important

If the Quantis USB device was already plugged in before the reloading of the udev rules, please unplug and replug the Quantis device, otherwise it will have the wrong permissions.

3.2.2.3. Check Your Device

All requirements have been installed. You can now plug your Quantis USB device into your computer.

You can now check if your device works correctly with the `lsusb` command as following (not as `root`):

```
$ lsusb -d 0aba:0102 -v
```



Important

It is important not to run the `lsusb` command as `root` but as the standard user who will use the Quantis USB device. Otherwise you won't be verifying that permission has been granted to you to access the device.



Note

If above command returns the message:

```
lsusb: command not found
```

then the command **lsusb** is not installed. Install the **usbutils** package to fix the problem.

The output of above command should be similar to the following:

```
Bus 002 Device 035: ID 0aba:0102 Ellisys
Device Descriptor:
  bLength                18
  bDescriptorType        1
  bcdUSB                  2.00
  bDeviceClass            255 Vendor Specific Class
  bDeviceSubClass        0
  bDeviceProtocol         0
  bMaxPacketSize0        64
  idVendor                 0x0aba Ellisys
  idProduct                0x0102
  bcdDevice                2.00
  iManufacturer           1 id Quantique
  iProduct                 2 Quantis USB
  iSerial                  3 070001A410
  bNumConfigurations      1
Configuration Descriptor:
  bLength                9
  bDescriptorType        2
  wTotalLength           25
  bNumInterfaces         1
  bConfigurationValue    1
  iConfiguration         0
  bmAttributes           0x80
    (Bus Powered)
  MaxPower                300mA
Interface Descriptor:
  bLength                9
  bDescriptorType        4
  bInterfaceNumber       0
  bAlternateSetting      0
  bNumEndpoints          1
  bInterfaceClass        255 Vendor Specific Class
  bInterfaceSubClass     0
  bInterfaceProtocol     0
  iInterface              0
Endpoint Descriptor:
  bLength                7
  bDescriptorType        5
  bEndpointAddress       0x86 EP 6 IN
  bmAttributes           2
    Transfer Type         Bulk
    Synchronizer Type     None
    Usage Type            Data
  wMaxPacketSize         0x0200 1x 512 bytes
  bInterval              0
Device Qualifier (for other device speed):
```

```

bLength          10
bDescriptorType   6
bcdUSB           2.00
bDeviceClass     255 Vendor Specific Class
bDeviceSubClass   0
bDeviceProtocol   0
bMaxPacketSize0  64
bNumConfigurations 1
Device Status:    0x0000
(Bus Powered)

```



Important

Please verify that you have the *Device Qualifier* and *Device Status* information sections and not messages such as:

```

can't get device qualifier: Operation not permitted
can't get debug descriptor: Operation not permitted
cannot read device status, Operation not permitted

```

If you get one or more *Operation not permitted* messages, you don't have the right permissions to access the Quantis device. In such a case:

- Verify that `/etc/udev/rules.d/idq-quantis.rules` or `/etc/udev/rules.d/idq-quantis-rhel.rules` exists and has the same content as the one provided on the USB flash drive.
- Verify that your user is in the `plugdev` group.
- Reboot the system to ensure that the new rules are loaded by the `udev` daemon.

You Quantis device is now installed. You can go to the next Chapter to install the application software.

3.3. Mac OS X Operating System

This section contains instructions on how to install and operate Quantis devices on Mac OS X Operating Systems. The binaries are only supported from Mac OS X 10.6 (Snow Leopard). In order to use the driver with earlier versions of the OS, the sources should be recompiled.

3.3.1. QuantisPCI and QuantisPCI Express

The Quantis PCI is not yet supported on Mac OS X.

3.3.2. Quantis USB

The binary distribution is contained in the file `EasyQuantis.dmg` and is composed of:

- the **EasyQuantis** application which allow the immediate use of the Quantis;
- the `QuantisRNG-2.7.0-Darwin-i386.pkg` which is a standard package for the Mac OS X installer and which contain all the SDK to use the Quantis from the C/C++ programming language.
- the `Readme` describing briefly how to install the software.

3.3.3. Installation

To access the content of the file `EasyQuantis.dmg` simply double click on its icon (in the **Finder**). Once the disk opened, simply drag the icon of the **EasyQuantis** application in the Applications folder (or in any other convenient folder).

To install the SDK, double click on its icon and follow the instructions of the package manager. Once the license is accepted, the different files (headers, library and binaries) will be available in the directory `/opt/IDQQuantis`.

This directory is deliberately chosen in order to avoid interferences with the standard system. The directory name should normally only be used to add search paths for headers files (`/opt/IDQQuantis/include`) or libraries (`/opt/IDQQuantis/lib`) to the compiler command line or to the **XCode** projects.



Note

The directory `/opt/IDQQuantis` is a perfectly standard Unix path and is accessible without problem from the **Terminal**. Since it is not a standard Mac OS X path, it is not available directly in the **Finder**. It is however possible to reach it by choosing the menu Go to Folder (Shift+Command+g).

3.3.4. Implementation details

Like on Linux (see the paragraph Section 3.2.2.1, “libusb-1.0 Installation”), the Quantis USB is available by using the `libusb 1.0`. This software is not included in Mac OS X and should be installed manually. The two projects

1. MacPorts [<http://www.macports.org>]
2. Fink [<http://www.finkproject.org/>]

provide an easy solution for installing additional Unix software on Mac OS X.

The MacPorts `libusb 1.0` package has been chosen for the use with the distributed driver. To facilitate the distribution of the software, the library `libusb 1.0` has been statically linked inside the library `Quantis`.

The application **EasyQuantis** needs the libraries `qt`, `boost` and `png`. All these libraries are statically linked inside the application. Unfortunately none of the `qt` provided by the two projects has static libraries. The `qt` library has then been compiled statically directly from the sources provided on the official site [<http://qt.nokia.com/products/>].

Even if the **EasyQuantis** use graphical Mac OS X widgets, it is not fully recognized by the system as a Cocoa application. To bypass this problem, a small Cocoa program has been written to load the actual **EasyQuantis** program.

Since all the Cocoa applications are Mac OS X bundles,³ the actual program is located inside the subdirectory `libexec` of the application bundle with the name **EasyQuantis** (the Cocoa wrapper is located in the subdirectory `MacOS` with the name **EasyQuantis**).

By using this trick, the **EasyQuantis** has the standard behaviour of a Cocoa application. It would have perhaps been possible to modify the main source of the **EasyQuantis** application, but this solution would have made the portability across platforms more complicated and the wrapper solution has been preferred.

³A bundle is a directory with a specific organisation containing all what is needed to run the application (icons, resources, menu, documentation and naturally the program itself).

It is generally not possible to link statically all the libraries on Mac OS X since most of the standard system libraries are provided only as dynamic libraries. To achieve a static linking as complete as possible one has to do:

- add explicitly the name of the library (i.e. `/opt/local/lib/libusb-1.0.a`) to the list of objects (otherwise the Mac linker, when static and dynamic libraries are available, prefers dynamic libraries);
- add the correct parameters to the linker which otherwise do not link with the system dynamic libraries. For instance, the following parameters⁴ have been added (when invoking the compiler on command line) in order to link the Quantis library: `-framework IOKit -framework CoreFoundation -lSystem`

3.3.5. Known problems

The following problems have been noticed:

- the progress bar do not work while the application **EasyQuantis** acquires random data from the Quantis device;
- the actual **EasyQuantis** command (located in `/opt/IDQQuantis/bin`) do not work correctly in graphical mode.

This problem arise only when the **qt** library is statically linked in the program. It is caused while some additional files for displaying graphic widgets are not found. The problem do not exist when the application is used inside an application bundle or if a framework (containing the necessary resources) for the **qt** library is installed in the system.

Chapter 4. The EasyQuantis application

Quantis is delivered with the EasyQuantis application. This application allows you to quickly and easily generate random data.



Important

Quantis PCI Express is software-compatible with Quantis PCI. EasyQuantis considers Quantis PCIe devices as Quantis PCI devices.

4.1. Installation

4.1.1. Windows Operating Systems

EasyQuantis is provided as a Microsoft Installer (MSI) package for easy installation. Just double-click on `EasyQuantis.msi` file and follow on-screen instructions.

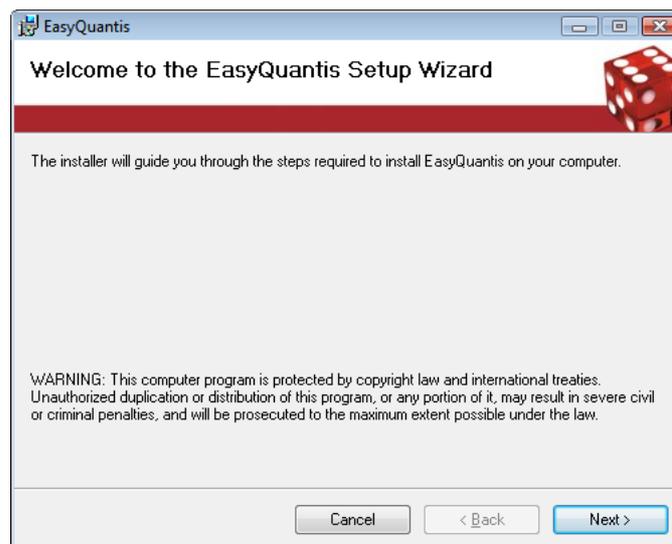


Figure 4.1. EasyQuantis Setup Wizard welcome

To launch the application click on the `EasyQuantis` icon in `Start -> Program`.

4.1.2. Linux Operating Systems

4.1.2.1. Install Requirements

EasyQuantis requires the `libusb-1` and `Qt4` libraries (`qt4-core` and `qt4-gui`) to work.

If you have a Quantis PCI card, please follow instructions in Section 3.2.2.1, “`libusb-1.0` Installation”. If you have a Quantis USB device, `libusb-1` has already been installed on your system.

Qt libraries are available on all major Linux distributions and they can be installed using the package manager of the distribution.

4.1.2.1.1. Debian-based Distributions

Open a terminal and install `libqt4-core` and `libqt4-gui` using the following command (as root):

```
# apt-get install libqt4-core libqt4-gui
```

4.1.2.1.2. Other Distributions

Install `libqt4-core` and `libqt4-gui` using the package manager of your distribution.

4.1.2.2. Install the Application

The EasyQuantis and Quantis libraries are provided in a bz2 archive.

On 32-bit systems, you can install the application using the following commands as root (replace `x.y` with your version number):

```
# cd /mnt/USB_FLASH/  
# tar xvjf QuantisRNG-2.x.y-Linux-i386.tar.bz2 -C /tmp/  
# cd /tmp/QuantisRNG-2.x.y-Linux-i386/  
# mv bin/EasyQuantis /bin/  
# mv lib/libQuantis* /lib/
```

On 64-bit systems, use the following commands as root instead:

```
# cd /mnt/USB_FLASH/  
# tar xvjf QuantisRNG-2.x.y-Linux-amd64.tar.bz2 -C /tmp/  
# cd /tmp/QuantisRNG-2.x.y-Linux-amd64/  
# mv bin/EasyQuantis /bin/  
# mv lib64/libQuantis* /lib64/
```

You can run the EasyQuantis application by typing **EasyQuantis** on a terminal:

```
$ EasyQuantis
```

4.1.2.3. Uninstall the Application

To uninstall, manually remove installed files as follows (as root):

```
# rm -Rf /bin/EasyQuantis  
# rm -Rf /lib/libQuantis* # on 32-bit systems  
# rm -Rf /lib64/libQuantis* # on 64-bit systems
```

4.2. Using EasyQuantis

Figure 4.2, “EasyQuantis main window” shows the main window of the **EasyQuantis** application



Note

On some systems, when the application has been downloaded from Internet, one may have to acknowledge that fact on first use.

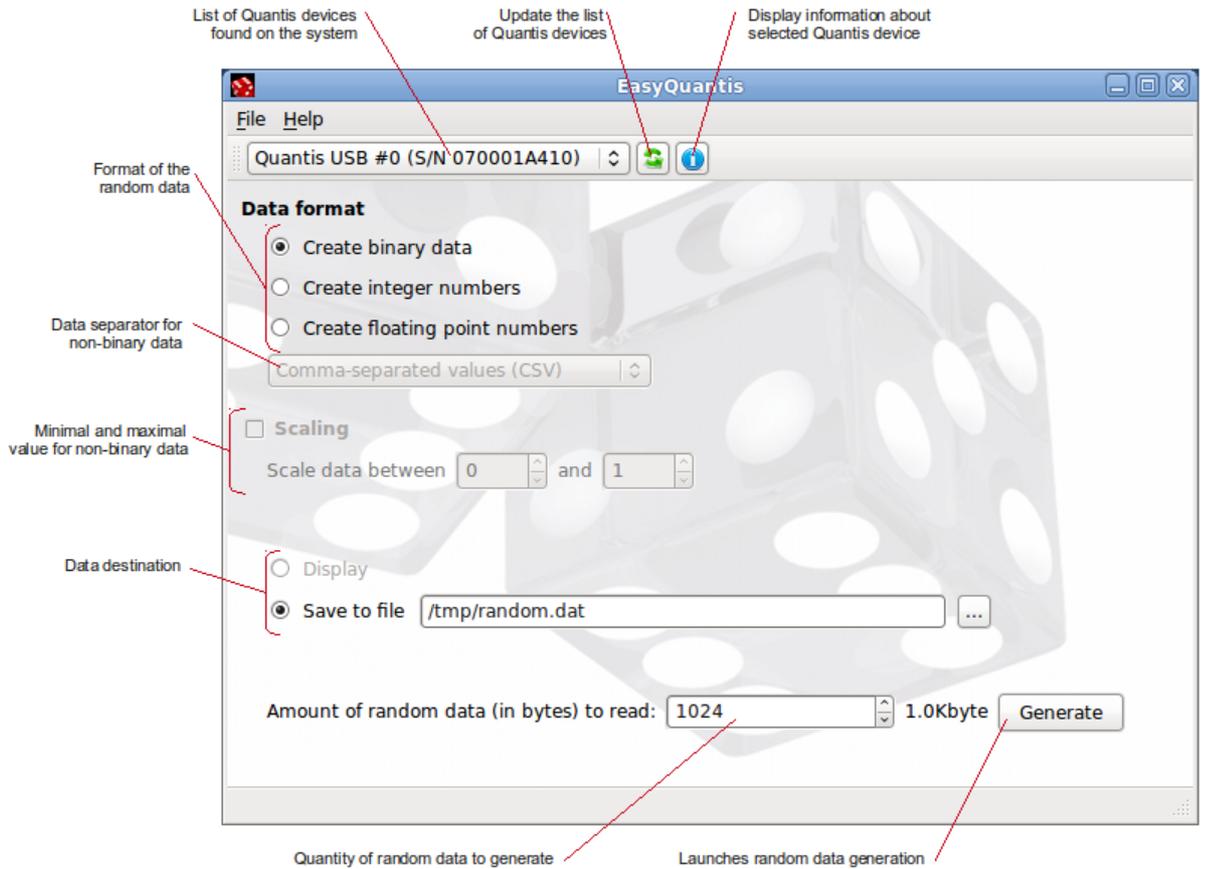


Figure 4.2. EasyQuantis main window

To generate random data using EasyQuantis:

1. Select a Quantis device from the list.
2. Select a data format:
 - **Binary data.** Data is read from the Quantis and returned as bytes.
 - **Integer numbers.** Generates 32-bit random numbers ranging between -2'147'483'648 and 2'147'483'647 (inclusive).
 - **Floating point numbers.** Generates numbers between 0.0 (inclusive) and 1.0 (exclusive).
3. Select a data separator:
 - **Comma-separated values (CSV).** CSV is a type of delimited text data, which uses a comma to separate subsequent values. The benefit of CSV is that they allow for the transfer of data across different applications.

The following is an example of CSV:

```
Value1,Value2,Value3,...,ValueN
```

- **One entry per line.** Each value is on a separate line:

```
Value1
Value2
Value3
```

...
ValueN



Note

When generating binary data you cannot select a data separator.

- If needed, you can scale the random values to be within a smaller range.



Note

For more details about the scaling algorithms, please refer to Section 5.2.7.2.1.1, “Integral Values: The Scaling Algorithm”.

- Select the data destination:

- **Display.** Data is displayed on screen. You can copy-paste the data to your application.

Use this option for *small* amounts of random data that you want to use it right away.



Note

This option is not available for binary data.

- **Save to file.** The data is written to a file. Use this option to generate large amounts of random data or to generate data for later use.



Note

On some systems (Mac OS X, Windows) the temporary default directory is not very convenient and should probably be changed to a better suited one. This will ease the manipulation of the produced file from outside the **EasyQuantis** program.

- Select the amount of data to generate.
- Click the Generate button and wait while the application generates the random data.

4.3. The EasyQuantis Command Line

EasyQuantis v1.1 and newer includes a command line parser, allowing you to use the application from the console or in a script.

4.3.1. Options

4.3.1.1. Generic Options

`-h [--help]` Display a summary of available options.

4.3.1.2. Quantis Options

`-l [--list]` List all devices available on the system.

`-p [--pci] arg` Select the given Quantis PCI device as input device. `arg` is the number of the Quantis PCI device to use.

`-u [--usb] arg` Select the given Quantis USB device as input device. `arg` is the number of the Quantis USB device to use.

4.3.1.3. Acquisition Options

`-n [--size] arg` Set the number of bytes or values that should be read. If nothing is specified 1024 is used.

`-b [--binary] arg` Generates a binary file. `arg` designates the filename.

`-i [--integers] arg` Generates a file of integers numbers. `arg` designates the filename.

`-f [--floats] arg` Generates a file of floating point numbers. `arg` designates the filename.

`-s [--separator] arg` Sets the separator string for non-binary files. The default format is one entry per line.

`--min arg` Specify the minimal value for integers and floats. If specified, requires `--max` to be specified as well.

`--max arg` Specify the maximal value for integers and floats. If specified, requires `--min` to be specified as well.

4.3.2. Usage Examples

In this section you will find some examples of usage of the EasyQuantis command line.

4.3.2.1. Generate Binary Data

```
EasyQuantis -p 0 -b random.dat -n 1073741824
```

Generates a file named `random.dat` containing 1GByte of binary random numbers using the Quantis PCI device number 0.

4.3.2.2. Generate Numbers

```
EasyQuantis -u 0 -i integers.dat -n 1000
```

Generates a file named `integers.dat` with 1000 integer numbers.

4.3.2.3. Generate Scaled Numbers

```
EasyQuantis -u 0 -i integers.dat -n 1000 --min 1 --max 6
```

Generates a file named `integers.dat` with 1000 integer numbers whose values are between 1 and 6.

Chapter 5. The Quantis Library

To easily access the Quantis device from your application, IDQ provides an abstraction library for all supported operating systems. The library allows you to easily write your (multi-platform) application without knowing how the Quantis devices internally works.



Important

API changed with Quantis library version 2.0. If your application uses a previous Quantis library version, please read the Appendix C, *Migrating to the New API*.



Note for C++ users

Each time you request an operation, the Quantis library:

1. Opens the Quantis device;
2. Performs the requested operation;
3. Closes the Quantis device.

The C++ library wrapper has been optimized to open the Quantis device in the class constructor and close it in the class destructor, thereby leaving the connection to the device open throughout the entire execution. If your application is written in C++, it is suggested to use the C++ wrapper rather than the C wrapper. Please read Chapter 6, *Quantis Library Wrappers* for further information.

5.1. Device Type

Almost all Quantis library functions require the device type to be specified. Currently there are two types:

- `QUANTIS_DEVICE_PCI` to specify a Quantis PCI or a Quantis PCI Express.
- `QUANTIS_DEVICE_USB` to specify a Quantis USB.



Important

Quantis PCI Express is software-compatible with Quantis PCI. There is no distinction between Quantis PCI and Quantis PCIe devices within the library and they are both considered as PCI devices.

5.2. Basic Functions

This section introduces a minimal set functions you need to use to read random data from within your application.

5.2.1. QuantisCount

```
int QuantisCount(QuantisDeviceType deviceType);
```

Returns the number of devices that have been detected. It returns 0 when no card is installed and on error.

Parameters:

`deviceType` the type (PCI or USB) of the Quantis device.

5.2.2. QuantisGetDriverVersion

```
float QuantisGetDriverVersion(QuantisDeviceType deviceType);
```

Returns the version of the driver as a number composed of a major and a minor version number. The value before the point represents the major version number, while the value after the point represents the minor version number.

Returns a `QUANTIS_ERROR` code (cast to float) on failure.

Parameters:

`deviceType` the type (PCI or USB) of the Quantis device.

5.2.3. QuantisGetLibVersion

```
float QuantisGetLibVersion();
```

Returns the version of the library as a number composed of a major and a minor version number. The value before the point represents the major version number, while the value after the point represents the minor version number.

5.2.4. QuantisGetManufacturer

```
char* QuantisGetManufacturer(QuantisDeviceType deviceType,  
                             unsigned int deviceNumber);
```

Returns a pointer to the manufacturer name string of the Quantis device. Currently only the USB version supports manufacturer name retrieval. On PCI and PCI Express, the string *"Not available"* is returned.

The string *"Not available"* is returned on failure as well.

Parameters:

`deviceType` the type (PCI or USB) of the Quantis device.

`deviceNumber` the number of the Quantis device. Note that device numbering starts at 0.

5.2.5. QuantisGetModulesDataRate

```
int QuantisGetModulesDataRate(QuantisDeviceType deviceType,  
                              unsigned int deviceNumber);
```

Returns the data rate (in bytes per second) provided by the Quantis device or a `QUANTIS_ERROR` code on failure.

Parameters:

`deviceType` the type (PCI or USB) of the Quantis device.

`deviceNumber` the number of the Quantis device. Note that device numbering starts at 0.

5.2.6. QuantisGetSerialNumber

```
char* QuantisGetSerialNumber(QuantisDeviceType deviceType,
                             unsigned int deviceNumber);
```

Returns a pointer to the serial number string of the Quantis device. Currently only the USB version supports serial number retrieval. On PCI and PCI Express, the string "*S/N not available*" is returned.

The string "*S/N not available*" is returned on failure as well.

Parameters:

deviceType	the type (PCI or USB) of the Quantis device.
deviceNumber	the number of the Quantis device. Note that device numbering starts at 0.

5.2.7. QuantisRead

```
int QuantisRead(QuantisDeviceType deviceType,
                unsigned int deviceNumber,
                void* buffer,
                size_t size);
```

Reads random data from the Quantis device.

Returns `QUANTIS_SUCCESS` on success or a `QUANTIS_ERROR` code on failure.

Parameters:

deviceType	the type (PCI or USB) of the Quantis device.
deviceNumber	the number of the Quantis device. Note that device numbering starts at 0.
buffer	a pointer to the destination buffer. The buffer MUST already be allocated. Its size must be at least <code>size</code> bytes.
size	the number of bytes to read (cannot be larger than <code>QUANTIS_MAX_READ_SIZE</code>).



Warning

If `buffer` is not allocated or the allocated size of memory is insufficient to store the data, the library will deliver unexpected results and may even cause a crash of the enclosing application!

5.2.7.1. Reading Large Amounts of Data

`QuantisRead` is not meant to read large amount of data. The maximal size of a request is defined by `QUANTIS_MAX_READ_SIZE`. If you try reading a larger amount, `QuantisRead` will return an error. To read large amount of data you have to use a loop as in following example:

```
/* Chunk size. Recommended values are 2048 or 4096 */
chunkSize = CHUNK_SIZE;

remaining = SIZE;
```

```
while(remaining > 0u)
{
    /* Chunk size */
    if (remaining < chunkSize)
    {
        chunkSize = remaining;
    }

    /* Read data */
    result = QuantisRead(deviceType, 0, buffer, NUM_BYTES);

    /*
     * TODO:
     * 1. Check result (see example at the end of the chapter)
     * 2. Handle buffer (e.g. store data in a file)
     */

    /* Update info */
    remaining -= chunkSize;
}
```

5.2.7.2. Reading Basic Data Types

The function `QuantisRead` is useful to read a high quantity of raw random data. Depending on the application, it can be useful to be able to directly read basic data types. This section introduces functions designed for this purpose.

5.2.7.2.1. Integral Values

```
int QuantisReadShort(QuantisDeviceType deviceType,
                    unsigned int deviceNumber,
                    short* value);

int QuantisReadScaledShort(QuantisDeviceType deviceType,
                          unsigned int deviceNumber,
                          short* value,
                          short min,
                          short max);

int QuantisReadInt(QuantisDeviceType deviceType,
                  unsigned int deviceNumber,
                  int* value);

int QuantisReadScaledInt(QuantisDeviceType deviceType,
                        unsigned int deviceNumber,
                        int* value,
                        int min,
                        int max);
```

Reads a random 16-bit or 32-bit integral value. Returns `QUANTIS_SUCCESS` on success or a `QUANTIS_ERROR` code on failure.

Parameters:

<code>deviceType</code>	the type (PCI or USB) of the Quantis device.
<code>deviceNumber</code>	the number of the Quantis device. Note that device numbering starts at 0.

value	a pointer to the destination value.
min	the minimal value that the returned numbers can take
max	the maximal value that the returned numbers can take.

5.2.7.2.1.1. Integral Values: The Scaling Algorithm

Random numbers required by an application are very often in a range (much) smaller than the (fixed) range of the random number produced by Quantis.

To perform the scaling, the largest permitted multiple of the output range is selected. Random values equal or higher this limit are discarded. Below you will find a simplified version of the C code implementing `QuantisReadScaledInt` which produces an *unbiased* number between `minValue` and `maxValue` (inclusive):

```
int rnd;

/* Output range */
unsigned long long range = maxValue - minValue + 1;

/* Range of the rnd value */
unsigned long long maxRange = 232;

/* Largest multiple of the output range */
unsigned long long limit = maxRange - (maxRange % range);

/* Read raw random number until it is lower the limit */
do
{
    QuantisReadInt(deviceType, deviceNumber, &rnd);
} while (rnd >= limit);

/* Scale value */
value = (rnd % range) + minValue;
```



Note

This scaling algorithm wastes data when Quantis generates random values equalling or exceeding the limit. In the worst case (when $\text{range} = \text{maxRange} / 2 + 1$), the probability to drop a generated value is roughly 50%!



Warning

Raw random values are often scaled using the modulus operator, using something like:

```
minValue + (rawRndValue % (maxValue - minValue + 1))
```

where `%` represents the modulus operator. This formula produces a number between `minValue` and `maxValue` (inclusive), but in certain conditions (when their range is not a multiple of the output range) the distribution of these numbers has a small bias that favours numbers at the lower end of the output range.

5.2.7.2.2. Floating Point Values

```
int QuantisReadFloat_01(QuantisDeviceType deviceType,
    unsigned int deviceNumber,
```

```

float* value);

int QuantisReadScaledFloat(QuantisDeviceType deviceType,
                           unsigned int deviceNumber,
                           float* value,
                           float min,
                           float max);

int QuantisReadDouble_01(QuantisDeviceType deviceType,
                          unsigned int deviceNumber,
                          double* value);

int QuantisReadScaledDouble(QuantisDeviceType deviceType,
                             unsigned int deviceNumber,
                             double* value,
                             double min,
                             double max);

```

Reads a random floating point value between 0.0 (inclusive) and 1.0 (exclusive). The scaled versions read a random floating point value between min (inclusive) and max (exclusive). Returns QUANTIS_SUCCESS on success or a QUANTIS_ERROR code on failure.

Parameters:

deviceType	the type (PCI or USB) of the Quantis device.
deviceNumber	the number of the Quantis device. Note that device numbering starts at 0.
value	a pointer to the destination value.
min	the minimal value that the returned numbers can take.
max	the maximal value that the returned number can take.



Note

Floating point values are computed by dividing a random integral value (32-bit for floats and 64-bit for double) by the integral's value range (2^{32} and 2^{64} respectively).



Warning

In certain conditions, the distribution of numbers produced by the floating point scaling algorithm has a small bias that favours numbers at the lower end of the output range. If you need unbiased random numbers, please consider to use QuantisReadScaledShort or QuantisReadInt instead:

```

/* Example: how to generate a random number between
 * 1.001 and 75.5 (inclusive)
 */

float min = 1.001;
float max = 75.5;
float multiplier = 1000.0;

int rndInt;
if (QuantisReadScaledInt(deviceType,
                        deviceNumber,

```

```

        &rndInt,
        (int)(min * multiplier),
        (int)(max * multiplier)) < 0)
    {
        /* Handle error */
    }

    float randomValue = (float)rndInt / multiplier;

```

5.2.8. QuantisStrError

```
char* QuantisStrError(QuantisError errorNumber);
```

Get a pointer to the error message string. This function interprets the value of `errorNumber` and generates a string describing the error. The returned pointer points to a statically allocated string, which may not be modified by the enclosing application. Further calls to this function will overwrite its content.

Parameters:

`errorNumber` the number assigned to a particular type of error.

5.3. Advanced Functions

This section introduces advanced functions that allow more control over the Quantis device. Most users don't need to use these functions.

5.3.1. QuantisBoardReset

```
int QuantisBoardReset(QuantisDeviceType deviceType,
                     unsigned int deviceNumber);
```

Resets the Quantis board. Returns `QUANTIS_SUCCESS` on success or a `QUANTIS_ERROR` code on failure.

Parameters:

`deviceType` the type (PCI or USB) of the Quantis device.

`deviceNumber` the number of the Quantis device. Note that device numbering starts at 0.



Note

You generally don't need to reset Quantis devices: the Quantis library already resets the device when needed.

5.3.2. QuantisGetBoardVersion

```
int QuantisGetBoardVersion(QuantisDeviceType deviceType,
                          unsigned int deviceNumber);
```

Returns the internal version of the board.

Parameters:

deviceType	the type (PCI or USB) of the Quantis device.
deviceNumber	the number of the Quantis device. Note that device numbering starts at 0.

5.3.3. QuantisGetModulesCount

```
int QuantisGetModulesCount(QuantisDeviceType deviceType,
                           unsigned int deviceNumber);
```

Returns the number of modules that have been detected on a Quantis device or a QUANTIS_ERROR code on failure.

Parameters:

deviceType	the type (PCI or USB) of the Quantis device.
deviceNumber	the number of the Quantis device. Note that device numbering starts at 0.

5.3.4. QuantisGetModulesMask

```
int QuantisGetModulesMask(QuantisDeviceType deviceType,
                           unsigned int deviceNumber);
```

Returns a bitmask of the modules that have been detected on a Quantis device or a QUANTIS_ERROR code on failure.

Bit n is set in the bitmask if module n is present. For instance 5 (1101 in binary) is returned when modules 0, 2 and 3 have been detected.

Parameters:

deviceType	the type (PCI or USB) of the Quantis device.
deviceNumber	the number of the Quantis device. Note that device numbering starts at 0.

5.3.5. QuantisGetModulesPower

```
int QuantisGetModulesPower(QuantisDeviceType deviceType,
                            unsigned int deviceNumber);
```

Returns the power status of the modules on a device. Returns 1 if the modules are powered, 0 if the modules are not powered and a QUANTIS_ERROR code on failure.



Note

This function is useful only for Quantis USB devices. Modules of Quantis PCI devices are always powered, thus the function always returns 1 on such devices.

Parameters:

deviceType	the type (PCI or USB) of the Quantis device.
deviceNumber	the number of the Quantis device. Note that device numbering starts at 0.

5.3.6. QuantisGetModulesStatus

```
int QuantisGetModulesStatus(QuantisDeviceType deviceType,  
                           unsigned int deviceNumber);
```

Returns the status of the modules on the given device as a bitmask or a `QUANTIS_ERROR` code on failure.

Bit `n` is set in the bitmask if module `n` is enabled and functional. For instance 5 (1101 in binary) is returned when modules 0, 2 and 3 are enabled and functional.

Parameters:

<code>deviceType</code>	the type (PCI or USB) of the Quantis device.
<code>deviceNumber</code>	the number of the Quantis device. Note that device numbering starts at 0.

5.3.7. QuantisModulesDisable

```
int QuantisModulesDisable(QuantisDeviceType deviceType,  
                          unsigned int deviceNumber,  
                          int modulesMask);
```

Disable one or more modules. Returns `QUANTIS_SUCCESS` on success or a `QUANTIS_ERROR` code on failure.

Parameters:

<code>deviceType</code>	the type (PCI or USB) of the Quantis device.
<code>deviceNumber</code>	the number of the Quantis device. Note that device numbering starts at 0.
<code>modulesMask</code>	a bitmask of the modules (as specified in the <code>QuantisGetModulesMask</code> function) that are to be disabled.

5.3.8. QuantisModulesEnable

```
int QuantisModulesEnable(QuantisDeviceType deviceType,  
                        unsigned int deviceNumber,  
                        int modulesMask);
```

Enable one or more modules. Returns `QUANTIS_SUCCESS` on success or a `QUANTIS_ERROR` code on failure.

Parameters:

<code>deviceType</code>	the type (PCI or USB) of the Quantis device.
<code>deviceNumber</code>	the number of the Quantis device. Note that device numbering starts at 0.
<code>modulesMask</code>	a bitmask of the modules (as specified in the <code>QuantisGetModulesMask</code> function) that are to be enabled.

5.3.9. QuantisModulesReset

```
int QuantisModulesReset(QuantisDeviceType deviceType,
                        unsigned int deviceNumber,
                        int modulesMask);
```

Reset one or more modules. Returns `QUANTIS_SUCCES` on success or a `QUANTIS_ERROR` code on failure.

Parameters:

<code>deviceType</code>	the type (PCI or USB) of the Quantis device.
<code>deviceNumber</code>	the number of the Quantis device. Note that device numbering starts at 0.
<code>modulesMask</code>	a bitmask of the modules (as specified in the <code>QuantisGetModulesMask</code> function) that are to be reset.



Note

This function executes sequentially `QuantisModuleDisable` and `QuantisModuleEnable` with the given parameters.

5.4. Example

The following is a simple example of usage of the Quantis library:

```
/* Global includes */
#include <stdio.h>
#include <stdlib.h>

/* Includes Quantis library's header */
#include "Quantis.h"

/* Define the number of bytes that should be read */
#define NUM_BYTES 100

int main()
{
    QuantisDeviceType deviceType;
    unsigned char* buffer;
    int result;
    int i;

    /* Select device type */
    if (QuantisCount(QUANTIS_DEVICE_PCI) > 0)
    {
        /* There is one ore more Quantis PCI device... */
        deviceType = QUANTIS_DEVICE_PCI;
    }
    else if (QuantisCount(QUANTIS_DEVICE_USB) > 0)
    {
        /* There is one ore more Quantis USB device... */
        deviceType = QUANTIS_DEVICE_USB;
    }
}
```

```
else
{
    /* No Quantis device has been found on the system */
    printf("No Quantis device found\n");
    return -1;
}

/* Allocate buffer's memory */
buffer = (unsigned char*)malloc(NUM_BYTES);
if (!buffer)
{
    fprintf(stderr, "Unable to allocate memory\n");
    return -1;
}

/* Read random data from the Quantis*/
result = QuantisRead(deviceType, 0, buffer, NUM_BYTES);
/* Check if there are some errors */
if (result < 0)
{
    /* An error occurred. Print the error message */
    fprintf(stderr,
            "An error occurred when reading random bytes: %s\n",
            QuantisStrError(result));
    goto cleanup;
}
else if (result != NUM_BYTES)
{
    /* Quantis did not return the number of bytes asked */
    fprintf(stderr,
            "Asked to read %d bytes but received %d bytes\n",
            NUM_BYTES,
            result);
    goto cleanup;
}

/* Display buffer in HEX format */
printf("Displaying %d random bytes in HEX format:\n",
        NUM_BYTES);
for(i = 0; i < NUM_BYTES; i++)
{
    printf("%02x ", buffer[i]);
}
printf("\n");

/* Cleanup */
cleanup:

if(buffer)
{
    free(buffer);
}

return 0;
}
```

A more detailed example is available on the USB flash drive in the Samples directory.

Chapter 6. Quantis Library Wrappers

IDQ provides several wrappers to allow you to use the Quantis device with your preferred programming language.

Currently wrappers for the following languages are available:

- C++
- C#
- Java
- VB.NET

The wrappers are for Object-oriented programming languages and they all have the same structure:

- The class is named `Quantis`.
- On class instantiation, you must provide the `deviceType` and the `deviceNumber`.
- The names of public functions in the Wrappers are the same as those in the Quantis C library but without the prefix *Quantis*, for instance `QuantisCount` is named `Count` in the wrapper. Functions other than the constructors do not require providing values for `deviceType` and `deviceNumber` since these are defined globally within the class. The only exception to this rule are static functions which have the same definition in both the C- and the Wrapper code.

Please refer to the sample available with each wrapper for further details.



Note for the C++ Wrapper

Since the Quantis device is kept open until the Quantis class is destroyed, it is highly recommended to reduce the scope of the Quantis variable as much as possible. In particular it is discouraged to make the Quantis variable.

6.1. Example

Here is the example presented in the previous chapter modified to use the C++ Wrapper:

```
/* Global includes */
#include <iostream>
#include <cstdlib>
#include <string>

/* Includes Quantis library's header */
/* Note the hpp extension! */
#include "Quantis.hpp"

/* Define the number of bytes that should be read */
#define NUM_BYTES 100

using namespace std;

int main()
{
    QuantisDeviceType deviceType;
    int result;
```

```
/* Select device type */
if (Quantis::Count(QUANTIS_DEVICE_PCI) > 0)
{
    /* There is one ore more Quantis PCI device... */
    deviceType = QUANTIS_DEVICE_PCI;
}
else if (Quantis::Count(QUANTIS_DEVICE_USB) > 0)
{
    /* There is one ore more Quantis USB device... */
    deviceType = QUANTIS_DEVICE_USB;
}
else
{
    /* No Quantis device has been found on the system */
    cout << "No Quantis device found" << endl;
    return -1;
}

try
{
    /* Creates a quantis object */
    Quantis quantis(deviceType, 0);

    /* Read random data from the Quantis*/
    string buffer = quantis.Read(NUM_BYTES);
    if (buffer.length() != NUM_BYTES)
    {
        /* Quantis did not return the number of bytes asked */
        cerr << "Asked to read " << NUM_BYTES
            << " byts but received " << buffer.length()
            << " bytes" << endl;
        return -1;
    }

    // Display buffer in HEX format
    cout << "Displaying " << NUM_BYTES
        << " random bytes in HEX format:" << endl;
    string::iterator it = buffer.begin();

    while (it != buffer.end())
    {
        cout << setw(2) << setfill('0') << hex
            << static_cast<int>(static_cast<unsigned char>(*it++))
            << " ";
    }
    cout << endl;

    catch (runtime_error &ex)
    {
        cerr << "Error while accessing Quantis device: "
            << ex.what() << endl;
        return -1;
    }

    return 0;
}
```

Appendix A. Troubleshooting

A.1. EasyQuantis

A.1.1. EasyQuantis crashes on Linux, with one of the following errors:

- *Segmentation fault.*
- *symbol lookup error: EasyQuantis: undefined symbol: _ZN14QPlainTextEditC1EP7QWidget.*

Such errors are generally caused by an incompatible Qt library binary. The binary of EasyQuantis provided by ID Quantique has been linked against Qt version 4.3.4. Since Qt libraries are only backward compatible, to solve this issue you need to install Qt4 version 4.3.4 or newer.

If Qt version 4.3.4 (or newer) is not available on your system, you can still use EasyQuantis in command line mode, which is not affected by this issue. Please refer to Section 4.3, “The EasyQuantis Command Line”.

This issue can also be solved by recompiling the Quantis library and EasyQuantis on your system.

Appendix B. Frequently Asked Questions (FAQ)

B.1. Quantis Library

B.1.1. Can I use the 32-bit Quantis library on a 64-bit system?

Yes, you can use the 32-bit Quantis library within a 32-bit application on 64-bit systems. Note however that you can neither use the 32-bit Quantis library within a 64-bit application nor the 64-bit Quantis library within a 32-bit application.

B.1.2. On Microsoft Windows, is it necessary to copy the `Quantis.dll` library to the system directory (`C:\Windows\System32`)?

No, this is not mandatory. IDQ recommends to install the `Quantis.dll` library in the directory in which your application resides.

B.1.3. On Microsoft Windows, when I use `Quantis.dll` within my application I get the error "*The application has failed to start because WINUSB.DLL was not found. Re-installing the application may fix this problem*". What should I do?

This problem occurs with `Quantis.dll` v2.1 (and older) when the Quantis USB driver is not installed. This issue has been fixed in `Quantis.dll` v2.2. Please update your `Quantis.dll` to the latest available version.

B.2. EasyQuantis

B.2.1. On Microsoft Windows, when I launch EasyQuantis I have the error "*The application has failed to start because WINUSB.DLL was not found. Re-installing the application may fix this problem*". What should I do?

This problem occurs with EasyQuantis 1.0 when the Quantis USB driver is not installed. This issue has been fixed in EasyQuantis 1.1. Please update EasyQuantis to the latest available version.

B.2.2. When I launch EasyQuantis on Microsoft Windows a console appears for a few seconds. Why does that happen?

EasyQuantis integrates a command line interface and a graphical interface. However, on Microsoft Windows it is not possible to build an hybrid Windows/Console application. EasyQuantis has been built as a Console application. When launched, the system automatically creates a console window. If no argument has been provided to the application (giving arguments would invoke the console version), the console window is hidden and the graphical interface is displayed. Avoiding this issue is very difficult.

Appendix C. Migrating to the New API

The Quantis library version 2.0 has a slightly different API than its predecessors. This is mainly due to the merge of the old Quantis library (used to access Quantis PCI devices) and Quantis-USB library (used to access Quantis USB devices) into a single library.

The main difference between versions 1.x and 2.0 is the addition of the parameter `deviceType`, which allows you to specify the type of device to use (PCI/PCIe or USB). Additionally, function names have been modified when ambiguous. See Table C.1, “API 1.x and 2.0 functions equivalences.” for equivalences between API 1.x and 2.0.

API 1.x functions	API 2.0 functions
<code>int quantisBoardReset(int cardNumber);</code>	<code>int QuantisBoardReset(QuantisDeviceType deviceType, unsigned int deviceNumber);</code>
<code>int quantisBoardVersion(int cardNumber);</code>	<code>int QuantisGetBoardVersion(QuantisDeviceType deviceType, unsigned int deviceNumber);</code>
<code>int quantisCount();</code>	<code>int QuantisCount(QuantisDeviceType deviceType);</code>
<code>int quantisDriverVersion();</code>	<code>float QuantisGetDriverVersion(QuantisDeviceType deviceType);</code>
<code>int quantisGetModules(int cardNumber);</code>	<code>int QuantisGetModulesMask(QuantisDeviceType deviceType, unsigned int deviceNumber);</code>
<code>char* quantisGetSerialNumber(int cardNumber);</code>	<code>char* QuantisGetSerialNumber(QuantisDeviceType deviceType, unsigned int deviceNumber);</code>
<code>int quantisLibVersion();</code>	<code>float QuantisGetLibVersion();</code>
<code>int quantisModuleDataRate(int cardNumber);</code>	<code>int QuantisGetModulesDataRate(QuantisDeviceType deviceType, unsigned int deviceNumber);</code>
<code>int quantisModulesDisable(int cardNumber, int moduleMask);</code>	<code>int QuantisModulesDisable(QuantisDeviceType deviceType, unsigned int deviceNumber, int modulesMask);</code>
<code>int quantisModulesEnable(int cardNumber, int moduleMask);</code>	<code>int QuantisModulesEnable(QuantisDeviceType deviceType, unsigned int deviceNumber, int modulesMask);</code>
<code>int quantisModulesPower(int cardNumber);</code>	<code>int QuantisGetModulesPower(QuantisDeviceType deviceType, unsigned int deviceNumber);</code>
<code>int quantisModulesReset(int cardNumber, int moduleMask);</code>	<code>int QuantisModulesReset(QuantisDeviceType deviceType, unsigned int deviceNumber, int modulesMask);</code>

API 1.x functions	API 2.0 functions
<pre>int quantisModulesStatus(int cardNumber);</pre>	<pre>int QuantisGetModulesStatus(QuantisDeviceType deviceType, unsigned int deviceNumber);</pre>
<pre>int quantisRead(int cardNumber, void* buffer, unsigned int size);</pre>	<pre>int QuantisRead(QuantisDeviceType deviceType, unsigned int deviceNumber, void* buffer, size_t size);</pre>

Table C.1. API 1.x and 2.0 functions equivalences.

C.1. Compatibility Wrapper

IDQ provides a compatibility wrapper that allows you to use the old API with the new library. This is meant to facilitate the migration of your application to the new API.



Important

It is highly recommended to update your application to the new API as soon as possible.

To use the compatibility wrapper, define `QUANTIS_DEVICE_TYPE` and then include `Quantis-Compat.h` instead of `quantis.h` and recompile your application:

```
/*
 * Define Quantis type:
 * - set QUANTIS_DEVICE_TYPE to 1 for Quantis PCI/PCIe
 * - set QUANTIS_DEVICE_TYPE to 2 for Quantis USB
 */
#define QUANTIS_DEVICE_TYPE 1

/* Includes compatibility wrapper */
#include "Quantis-Compat.h"
```



Note

On Microsoft Windows systems, you can try to rename `QuantisPci-Compat.dll` to `Quantis.dll` or `QuantisUsb-Compat.dll` to `Quantis-Usb.dll` and replace your old library with the renamed one. This way you normally do not need to recompile your application.

Appendix D. Notes

D.1. Images

Some images used in this manual and in the Quantis software are from VistaICO.com.

Bibliography

Websites

[USB] *Official USB website.* <http://www.usb.org/>.

