

PHANTOM<sup>®</sup> Device Drivers  
and OpenHaptics<sup>®</sup>  
INSTALLATION GUIDE  
FOR LINUX<sup>®</sup>

COMPANION TO THE  
PHANTOM USER'S GUIDE



## **PHANTOM Device Drivers (PDD)**

version 4.3

## **OpenHaptics Toolkit**

version 3.0

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PHANTOM® Device Drivers	PHANTOM Device Drivers or PDD
PHANTOM Omni® haptic device	PHANTOM Omni

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## Introduction

The PHANTOM® Device Drivers and OpenHaptics Installation Guide for Linux® is a companion to the *PHANTOM User's Guide* that is shipped with the PHANTOM device. This guide describes the process of installing the required device drivers, setting up your PHANTOM device on a Linux machine, how to specify the PHANTOM configuration and describes the installed directory structure. Additionally, this guide describes the installation process for the OpenHaptics Toolkit for haptics developers.

For instructions on connecting the hardware and information on how to use the device, see the *PHANTOM User's Guide*.

## Typographical Conventions

This guide uses the following typographical conventions:

Convention	Description	Example
<i>Italics</i>	First use of a new term; reference to another document or file.	See the <i>User's Guide</i> .
< <i>Italics</i> >	A variable.	< <i>Installed Directory</i> >/files.
Courier	Identifies code.	The following must be run as root user: # /sbin/modprobe
<b>Note, Warning, Important</b>	Calls out important information.	<b>Note</b> If you have a previous...

## System Requirements

The following are the requirements to run the PHANTOM device and device drivers. If you are using your PHANTOM device with haptically enabled software, check the documentation for that software for additional system requirements.

### Supported PHANTOM Devices

Supported	NOT Supported
Omni	High Force devices
Desktop	PHANTOM Communication Converter (PCC)
Premium 1.0, 1.5 1.5/6DOF	Dual PHANTOM Configurations
Premium 3.0, 3.0/6DOF	

### Hardware

- Intel® Pentium® 4 or higher. To interface with the SensAble Desktop or Premium devices, EPP mode parallel-port built into the motherboard is required.
- 512 MB disk space and 1 GB RAM.

### Software

- Most Linux® distributions are supported
- Kernel 2.6.30 or higher
- raw1394 kernel module
- Mesa—OpenGL® with GLX interface to the X Window System®  
Make sure that “*glxgears*” runs on your system
- GLUT—OpenGL Utility Toolkit
- MesaGLw—Mesa Widget Library  
Requires the Motif bindings (built with `./configure --enable-motif`)
- FreeType2—Portable font engine (<http://www.freetype.org>)

## Installing the PHANTOM Device Drivers.

### Command entry

Lines starting with # indicate that the following commands must be run as root user. Lines starting with > can be run as a regular user.

Example:

The following must be run as root user:

```
# /sbin/modprobe
```

The following can be run as a regular user or root:

```
> cat /proc/interrupts
```

Actual installation procedures may vary slightly from the instructions given here depending on which version of the PDD you are installing and which distribution of Linux you are running.

**Note** If you have a previous installation of PDD, you must remove it before installing a newer version.

To install the device drivers:

- 1 Insert the software product CD into the CD-ROM drive, or download the installation file from the SensAble Developer Support Center (DSC). The PHANTOM device drivers file will be located in the top level directory.
- 2 To install the PDD package:

```
# rpm -ivh phantomdevicedrivers-4.2-x.i686.rpm
```

## Setting-up PHANTOM Haptic Interface Devices

Depending on the type of interface of your haptic device, select from one of the following, then continue to “Setting-up for Non-Root Users” on page 6.

- If you are using an haptic interface device that utilizes the parallel port interface, such as the PHANTOM Desktop or 1.5/6DOF models, then you must manually configure the parallel port, read the section “Setting-up a parallel port PHANTOM device” below.
- If you are using the PHANTOM Omni haptic device that utilizes a IEEE-1394 compliant FireWire port, read the next Section on “Setting-up an IEEE-1394 compliant FireWire port PHANTOM device” on page 5.

### Setting-up a parallel port PHANTOM device

The PHANTOM haptic devices work by setting up a high-speed synchronous communication channel with the host computer. Regular interrupt requests are generated by the haptic devices and these are passed through the parallel controller to be serviced in the PDD servo loop. EPP mode communication is required to support this high-speed channel.

- 1 Your BIOS settings may also need to be adjusted. For example, on one tested machine, choosing ECP+EPP for the parallel port mode in the BIOS would lead Linux to configure it for ECP mode. EPP mode is required.

- 2 Make sure the parallel port module is installed with

```
> /sbin/lsmmod | grep parport
parport_pc      31205  1
parport         40841  2 parport_pc,lp
```

Or try to re-install the module with the sequence

```
# /sbin/modprobe -r parport_pc
# /sbin/modprobe parport_pc
```

If you get a message that the device is busy, then reboot the system and continue from here.

- 3 **Check Settings.** To check whether the settings were enabled correctly, check the output of the following commands:

## Setting-up PHANTOM Haptic Interface Devices

```
> grep parport /proc/interrupts
7: 0 XT-PIC parport0

> grep parport /proc/ioports
0378-037a : parport0
037b-037f : parport0

> cat /proc/sys/dev/parport/parport0/modes
PCSPP,TRISTATE,EPP
```

If the output is similar to that shown (with appropriate changes for your configuration), then the device has been correctly configured. Again, EPP mode communication must be supported for proper operation with the parallel port PHANTOM devices.

**Note** The PHANTOM parallel port driver uses the `/dev/phnepp` file to access the hardware device. This is installed as a symbolic link to `/dev/parport0`. To control a PHANTOM attached to a different port, change this symbolic link to point to the appropriate device entry.

Additionally, the “modes” file should be linked to `/dev/phnepp_modes` so that the selected port can be opened with the proper settings.

```
# ln -s /proc/sys/dev/parport/parport0/modes /dev/phnepp_modes
```

- 4 Continue to “Setting-up for Non-Root Users” on page 6.

### Setting-up an IEEE-1394 compliant FireWire port PHANTOM device

The 1394 kernel module must be loaded before using your PHANTOM device.

- 1 To check if the 1394 module has been loaded issue the following command

```
# cat /proc/modules | grep raw1394
```

If you see `raw1394` in the output then the module is loaded. Your Omni device is ready to use. If you do not see this output, you need to load the module. Continue to the next step.

- 2 To load the module issue the following command:

```
# /sbin/modprobe raw1394
```

### Setting-up for Non-Root Users

- 3 If there is no output, verify that the module is loaded by repeating step 1.
- 4 If you get a message that there is no such module, then your kernel does not have the proper 1394 support. You can obtain a different kernel using the package installation utility included with your distribution of Linux. Newer Fedora *distros* include an updated `firewire_core` module. See the Appendix for specific instructions on using `raw1394` instead.

**Note** Please refer to your Linux distribution documentation on how to automatically load modules during boot.

- 5 Continue to “Setting-up for Non-Root Users” below.

---

## Setting-up for Non-Root Users

To allow regular users access to the PHANTOM device, you may need to change file permissions on the device that the PHANTOM is connected to.

To allow regular users read/write access to the device issue the following commands. In the example, suppose that the actual device the PHANTOM is connected to is `parport0`.

```
# chmod a+rw /dev/parport0
# ln -s /dev/parport0 /dev/phnepp
# ln -s /proc/sys/dev/parport/parport0/modes /dev/phnepp_modes

# chmod a+rw /dev/raw1394
```

For PHANTOM devices connected to a parallel port a symbolic link points to the device that the PDD will open.

These lines can be added to the `rc.local` file (`boot.local` in some distros) so that the symbolic link and permissions are set each time the system is rebooted.

---

## Specifying the PHANTOM Configuration

- 1 Before you can use any haptic application, you will need to specify which PHANTOM model is being used. Run the following

```
> /usr/sbin/PHANTOMConfiguration
```

- 6 *PHANTOM Installation Guide for Linux*

- 2 Configure the settings appropriate for your model.
- 3 If you have not already done so, reboot your computer to ensure that the parallel port driver configuration changes are updated correctly.
- 4 Run the PHANToMTest program to verify that the installation is correct and to complete configuration for Desktop and Omni models:

```
> /usr/sbin/PHANToMTest
```
- 5 These PHANToM utility programs create files and provide a User Interface assuming LANG=EN. If this does not match your system settings, please use the following two shell scripts instead:

```
> /usr/sbin/runPHANToMConfiguration
> /usr/sbin/runPHANToMTest
```

---

## **PHANTOM Device Drivers Installed Directory Structure**

The PHANTOM Device Driver library is built as a shared object and is installed in `/usr/lib/libPHANToMIO.so`

Administrative applications are installed in `/usr/sbin`. These include:

- PHANToMConfiguration
- PHANToMTest
- runPHANToMConfiguration
- runPHANToMTest
- hostIDutility—returns the MAC address for the selected network interface. Used for generating the OpenHaptics license file.

The default directory for configuration files is

`/etc/SensAble/PHANToMDeviceDrivers`

This document is in:

`/usr/share/PHANTOM/doc/HW_userguide_Linux.pdf`

*PHANTOM Device Drivers Installed Directory Structure*

**Parallel port driver** The parallel port driver uses the `/dev/phnepp` device special file to access the hardware device. This is installed as a symbolic link to `/dev/parport0`. To control a PHANTOM attached to a different port, change this symbolic link to point to the appropriate device entry.

## Installing the OpenHaptics Toolkit

Once the installation of the PDD has been completed, verify the proper working operation of the PHANTOM device with `PHANTOMTest`.

Then install OpenHaptics using

```
> sudo rpm -ivh openhaptics-3.0-x.i686.rpm
```

Please note that the developer version of the OpenGL Utility Toolkit (GLUT) must also be available (e.g. package `freeglut-devel`) in order to compile the OpenHaptics examples.

Header files are installed into sub-directories of `/usr/include`:

- `/usr/include/HD`
- `/usr/include/HDU`
- `/usr/include/HL`
- `/usr/include/HLU`
- `/usr/include/QH`
- `/usr/include/SnapConstraints`

Library files are installed into `/usr/lib` or `/usr/lib64` for 64-bit systems

- `/usr/lib/libHD.so`
- `/usr/lib/libHDU.a`
- `/usr/lib/libHL.so`
- `/usr/lib/libHLU.a`
- `/usr/lib/libQH.so`
- `/usr/lib/libQHGLUTWrapper.so`
- `/usr/lib/libSnapConstraints.a`

Finally, source code for example haptics applications; source code for the HDU, HLU and SnapConstraints libraries; 3D model files; and documentation and license files are all installed into the directory:

- `/usr/share/3DTouch`

## OpenHaptics Licensing

Before running the example OpenHaptics applications, the environment variable `3DTOUCH_BASE` should be set to point to this primary install directory.

```
setenv 3DTOUCH_BASE /usr/share/3DTouch
```

We recommend that each developer put this line into their `.cshrc` file for shell start-up.

To access the OpenHaptics example source code, either change the permissions on `/usr/share/3DTouch` or copy the C files to your home directory. Then to compile the examples run `make` in:

- `/usr/share/3DTouch/examples/HL/console`
- `/usr/share/3DTouch/examples/HL/graphics`
- `/usr/share/3DTouch/examples/HD/console`
- `/usr/share/3DTouch/examples/HD/graphics`
- `/usr/share/3DTouch/QuickHaptics/examples`

---

## OpenHaptics Licensing

The OpenHaptics software toolkit for commercial developers requires a license file to run the HDAPI and the HLAPI programs.

Two kinds of licensing are supported, either a “temporary” license that you will receive along with the initial product CD, or a permanent “node-locked” license that is tied to a particular computer. A permanent license can be requested from the Support page on the SensAble website. For host identification, the *MAC address* of the network interface card (`eth0`) is used. This can be easily found using the provided utility function `/usr/sbin/hostIDutility`.

Once you have received your license file, it is recommended that you place it in a local directory (e.g. `/etc/SensAble`). You should then create an environment variable named

```
OH_SDK_LICENSE_PATH
```

and set the value as the location of the license file. Note that the OpenHaptics toolkit license file should be named either:

- *OHlicense.lic*
- or *license.lic*

As an alternative, you can place the license file in the same folder as your OpenHaptics program's executable file. However, using the default `/etc/SensAble` path or setting the environment variable is the recommended method for managing your licensing.

## Appendix: Tips and Tricks for Different Linux Distros

### OpenSuse 11.1

Yast can be used to easily install the necessary packages.

- 1 Run Yast->YaST control Center->Software->Software Management
- 2 Search for libraw1394 and install it.
- 3 Search for Mesa and install MesaGLw.
- 4 Search for freeglut and install freeglut-devel.
- 5 Install the PHANTOM Device Drivers and OpenHaptics RPMS as documented above.

### Fedora 11

#### PART 1: Firewire kernel module installation

- 1 Download and install the two packages from the ATrpms repository:
  - a ieee1394-2.6.29.6-9.fc11.i586
  - b ieee1394-kmdl-2.6.29.6-217.2.16.fc11.PAE-2.6.29.6-9.fc11.i686

Here is the link to the repository: <http://atrpms.net/dist/f11/ieee1394/>

- 2 Add the following two lines at the end of the file  
`/etc/modprobe.d/blacklist.conf`  
`blacklist firewire_core`  
`blacklist firewire_ohci`
- 3 Reboot the machine

#### PART 2: PDD installation:

Install the following 3 packages from standard Fedora repositories before trying to install the PDD.

```
freeglut-devel-2.4.0-16.fc11.i586  
mesa-libGLw-6.5.1-7.fc11.i586
```

```
compat-libstdc++-33-3.2.3-66.i586
```

Install the following OpenMotif package from `Motifzone`. You may not find a package for an updated version of Fedora, so just install the latest package available.

For example: `openmotif-2.3.2-1.fc10.i386.rpm` for Fedora 10.

The PDD requires the use of `libraw1394.so.8` so if you have any other version under `/usr/lib`, just create a symbolic link named `libraw1394.so.8` which points to the available version on the disk.

Try installing the PDD package. If it is still giving errors, just force the installation using the following command.

```
rpm --nodeps -ivh phantomdevicedrivers-4.3-4.i686.rpm
```

### **PART 3: OpenHaptics installation:**

Make sure that `freeglut-devel` has been installed.

## **Ubuntu 9.04**

The PDD for Linux requires several libraries for proper functioning. Unfortunately some of these libraries are not available in the Ubuntu distro and should be installed in advance.

- 1** Download and Install required packages
  - a** `configure: error: X11 development libraries needed for dri driver`
  - b** Synaptics --> Search `dri2proto` ----> Install `x11proto-dri2-dev`
  - c** Synaptics --> Search `libdrm` ----> Install `libdrm-dev`
  - d** Synaptics --> Search `x11proto-glx-dev` ----> Install `x11proto-glx-dev`
  - e** Synaptics --> Search `libx11-dev` ----> Install `libx11-dev`
  - f** Synaptics --> Search `xext` ----> Install `libxext-dev`
  - g** Synaptics --> Search `xxf86vm` ----> Install `libxxf86vm-dev`
  - h** Synaptics --> Search `xdamage` ----> Install `libxdamage-dev`
  - i** Synaptics --> Search `expat` ----> Install `libexpat1-dev`

*Appendix: Tips and Tricks for Different Linux Distros*

- j** Synaptics --> Search libxt ----> Install libxt-dev
- k** Synaptics --> Search libmotif ----> Install libmotif-dev
- l** Synaptics --> Search x11proto-print-dev ----> Install x11proto-print-dev
- m** Synaptics --> Search freeglut ----> Install freeglut3-dev
- n** Synaptics --> Search g++ ----> Install g++
- o** Synaptics --> Search tcsh ----> Install tcsh
- p** Synaptics --> Search libncurses ----> Install libncurses5-dev

**2** Download and install MESA

- a** `http://www.mesa3d.org/` -----> Downloading/Unpacking -----> Primary download site -----> MesaLib -----> MesaLib-7.4.2.tar.bz2
- b** `bunzip2 -c MesaLib-7.4.2.tar.bz2 | tar xf -`
- c** Copy the “motif-config” file to `/usr/bin`
- d** `sudo cp motif-config /usr/bin`
- e** From the Mesa extract directory run:
- f** `./configure --enable-motif`
- g** `make`
- h** `sudo make install`

**3** Now install the PDD and OH packages using:

- a** `sudo dpkg -i phantomdevicedrivers_4.3-4_i386.deb`
- b** `sudo dpkg -iopenhaptics_3.0-2_i386.deb`