



phantom®
HAPTIC DEVICES

Omni Device Guide

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Sensable Technologies does not warrant that this publication is error free. This publication could include technical or typographical errors or other inaccuracies. Sensable may make changes to the product described in this publication or to this publication at any time, without notice.

Hardware usage guidelines are provided to assist the user in protecting the effectiveness and life of the device. They are not intended as recommendations for the prevention of repetitive stress injury, carpal tunnel syndrome or any other conditions, injuries or disorders; users should consult their own physicians. By using the Phantom device, the user acknowledges and agrees that Sensable shall have no liability for any disorder, condition or injury arising from any use of the device.

Warning Do NOT open the Phantom device. Attempting to open or repair the device by anyone other than a certified authorized service center voids the manufacturer warranty and hardware maintenance contract.

Questions or Comments

If you have any questions for our technical support staff, please contact us at support@sensable.com. You can also phone 1-888-SENSABL (U.S.A. only) or 1-781-939-7444 (International).

If you have any questions or comments about the documentation, please contact us at documentation@sensable.com.



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Contents

	Preface.....	i
	About this Guide	i
	Typographical Conventions	i
Chapter 1	Getting Started	1-1
	Contents of the Shipping Box	1-1
	The Phantom Omni Haptic Device	1-2
	System Requirements	1-2
	Proper Handling and Positioning of the Phantom Omni Device	1-3
Chapter 2	Installing the Phantom Omni Device	2-1
	Installing the Phantom Device Drivers	2-1
	Connecting the Phantom Omni Device	2-1
	Run Phantom Test to Verify Setup	2-4
Chapter 3	Using the Phantom Omni Device	3-1
	Working in 3D Space	3-1
	Physical Limits of the Device	3-1
Appendix	Troubleshooting	A-1
Appendix	Customer Support	B-1
Appendix	Regulatory Notices	C-1
Appendix	Configuring Multiple Devices	D-1
Appendix	Phantom Omni Re-Packaging Instructions	E-1
Appendix	Device Specifications	F-1

Preface

About this Guide

The Phantom Omni® Device Guide describes the process of installing the required device drivers for your new Phantom Omni haptic device and connecting the hardware device to your computer. You will also find information on how to use the device and other information about the device.

For the most current device information please visit the Sensable website at www.sensable.com.

We've worked extensively to ensure that the Phantom Omni device and device drivers install and work smoothly. If you experience any problems in the installation or use of your device, please contact Sensable support (see inside cover for contact information).

Please note, if you are installing your device on a supported non-Microsoft® Windows OS, you will find additional information in a separate document that shipped with your software product.

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.	A <i>Voxel</i> is...; see the <i>User Manual</i> .
Bold	Keywords, actual user input, or examples.	Click Ok .
Greater Than (>)	Indicates a menu pick, as in “select Options from the Tools menu”.	Tools>Options

1

Getting Started

This guide covers the currently shipping Phantom Omni haptic device. The information contained in this manual was current at the time of publication. Visit www.sensable.com for the latest information.

This chapter describes the following:

- The contents of the shipping box
- The Phantom Omni haptic device
- System Requirements
- The proper handling of the Phantom Omni haptic device

Contents of the Shipping Box

If you are purchasing a Phantom Omni device for the first time, in your shipping box you should find the following:

- **The Phantom Omni haptic device and detachable stylus:** The Phantom device uses high-fidelity force feedback to make it possible to touch and manipulate virtual objects.
- **The Phantom Omni Device Guide:** Describes the process of connecting the haptic device as well as how to work with the device including proper handling, troubleshooting, and device specifications.
- **The Phantom Device Driver Installation Guide:** Describes the process of installing the device drivers.
- **FireWire® Cable:** This IEEE-1394a compliant six pin to six pin FireWire cable is used to connect the Phantom Omni device to the IEEE-1394a compliant six pin FireWire port on your computer.
- **Universal Power Supply:** The power supply can be used on any standard circuit, using the supplied power cord.
- **Power Cord:** The power cord connects the Universal Power Supply to the wall outlet.

If any items are missing, please call Sensable at 1-888-SENSABL.

The Phantom Omni Haptic Device

The Phantom Omni enhances productivity and efficiency by enabling the most intuitive human/computer interaction possible, the ability to solve problems by touch.

The Phantom Omni model is the most cost-effective haptic device available today. The Phantom Omni system's high fidelity force feedback senses motion in 6 degrees of freedom providing the best, most realistic 3D Touch sensation for any application. You can feel the point of the stylus in all axes, and track its orientation (pitch, roll and yaw). The Phantom Omni's portable design, compact footprint, and IEEE-1394a FireWire port interface ensure quick installation and ease-of-use.

Features

- Dexterous Serial manipulator design
- Six degree-of-freedom positional sensing
- Portable design and compact footprint for workplace flexibility
- Compact workspace for ease-of-use
- Comfortable molded-rubber stylus with textured paint for long term use and secure grip
- Removable stylus for end-user customization
- Two integrated momentary switches on the stylus for ease of use and end-user customization
- Stylus-docking inkwell for automatic workspace calibration
- Constructed of metal components and injection-molded plastics
- FCC, CE and RoHS Certified

System Requirements

The Phantom Omni requires certain hardware and software components to be able to function properly as a real-time streaming device. This section describes the requirements for operating the Phantom Omni haptic device.

Note Visit www.sensable.com to get the latest and most complete system requirements information.

- An Intel® processor based personal computer (A minimum of Pentium® IV class processor is recommended) or select personal computer.
- IEEE-1394a-2000 compliant FireWire® port.
- Windows XP, Vista or Windows 7.
- A hard drive with 512 MB of disk space.

- There are no specific memory requirements to run the haptic device; however, a minimum of 1 GB RAM is recommended for overall system performance. Any haptic application that uses the Omni device will have additional memory requirements.
- The most current version of the Phantom Device driver (PDD). See the document *Installing Phantom Device Drivers* for specific PDD requirements.
- A Sensable supplied 6-6 pin FireWire cable. Laptop Users please note that Sensable recommends using a 6-6 pin cable and add-in card instead of 6-4 pin cable. See www.sensable.com for the latest information.

Proper Handling and Positioning of the Phantom Omni Device

Warning Gripping and lifting the Phantom Omni device improperly may damage it. To reduce the risk of damage, please follow the instructions below.

Handling the Phantom Omni Device

Calibrating the device: The Phantom Omni may need to be recalibrated from time to time, particularly if it has lost power. To calibrate the device, place the stylus in the inkwell and start your haptically enabled application. The indicator light in the inkwell of the Phantom Omni device will be lit a steady blue when the device is properly calibrated. Alternatively, you can use the Phantom Test application (Start>All Programs>Sensable.)

Lifting the device To properly lift the device grasp the base of the Phantom Omni unit on both sides and lift as shown in the image below. DO NOT lift by grasping the stylus or arm. The stylus is detachable by design. Lifting the unit by the stylus or arm could result in severe damage to the device.

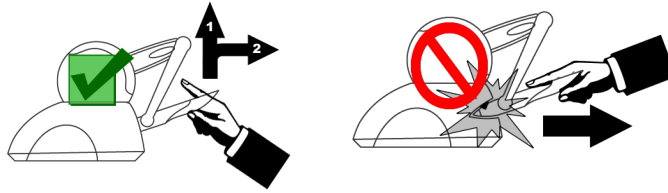


Position hands to securely fit the device.

1 GETTING STARTED

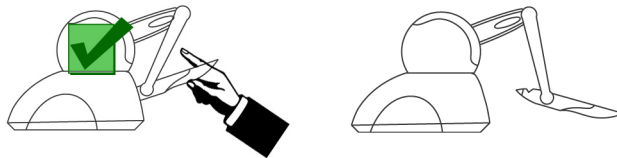
Proper Handling and Positioning of the Phantom Omni Device

Lifting the stylus out of the inkwell Grasp the end of the stylus and lift UP, to disengage, and then OUT as show below in the image on the left. Do NOT attempt to pull the stylus straight out as shown on the right.



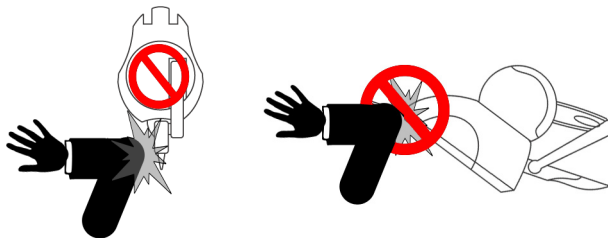
Be sure to lift the stylus in a two step motion.

Storing the stylus After the device is calibrated, the stylus may be kept in the inkwell or left resting on the desk. Keep in mind that storing the stylus in the inkwell increases the risk that the device will be knocked over or that the stylus will be damaged.



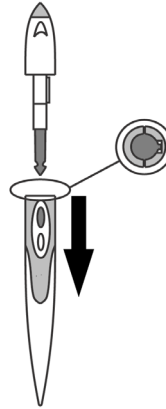
Stylus does not need to be stored in the inkwell.

Protecting the device from damage It is best to place the unit firmly on the desktop and away from edges to reduce the risk of damage to the device from a direct, unintentional elbow hit. The stylus is particularly vulnerable to sustaining damage when it is in the inkwell.



To reduce the risk of damage, keep the device out of harms way. Pay extra attention if the stylus is stored in the inkwell.

Reassembling the detachable stylus The stylus is detachable by design and comes unassembled. Reassemble it by aligning the blade on the shaft with the slot in the stylus and inserting it till it snaps in place as shown in the image below.



Align the blade and shaft to reassemble the stylus.

**Positioning the
Phantom Omni Device**

The correct placement of the device will vary from one user to another. You may want to experiment to find a placement that feels right for you.

- The device should be positioned so that you are comfortable when working with it.
- You should not feel any strain on your wrist or forearm when working with the device.
- If you are left-handed, you may find it easier to work with the Omni placed to the left of the keyboard.
- Remember to take breaks often to stretch your hands, wrists, and elbows.

1 GETTING STARTED

Proper Handling and Positioning of the Phantom Omni Device

2

Installing the Phantom Omni Device

This chapter will describe, step by step, how to install the Phantom Omni haptic device. The installation is done in two steps.

- Install the software, the Phantom Device Driver, that allows your computer to communicate with the Phantom Omni device.
- Connect the hardware, the Phantom Omni device, to your computer and power source.

Installing the Phantom Device Drivers

The Phantom Omni device communicates with the computer through the FireWire port. To enable this, you must install a software driver, called the Phantom Device Drivers (PDD), to control the communication.

Specific instructions for installing the PDD on Windows XP, Vista and Windows 7 systems can be found in the *Phantom Device Driver Installation Guide*. For installation instructions for other operating systems, see the additional documentation shipped with your device or software product, or contact customer support

Note As with most other software packages, you must have administrator privileges on the machine in order to install the system. If you are unfamiliar with installing software or do not have administrator privileges, please have your System Administrator execute these steps for you.

Connecting the Phantom Omni Device

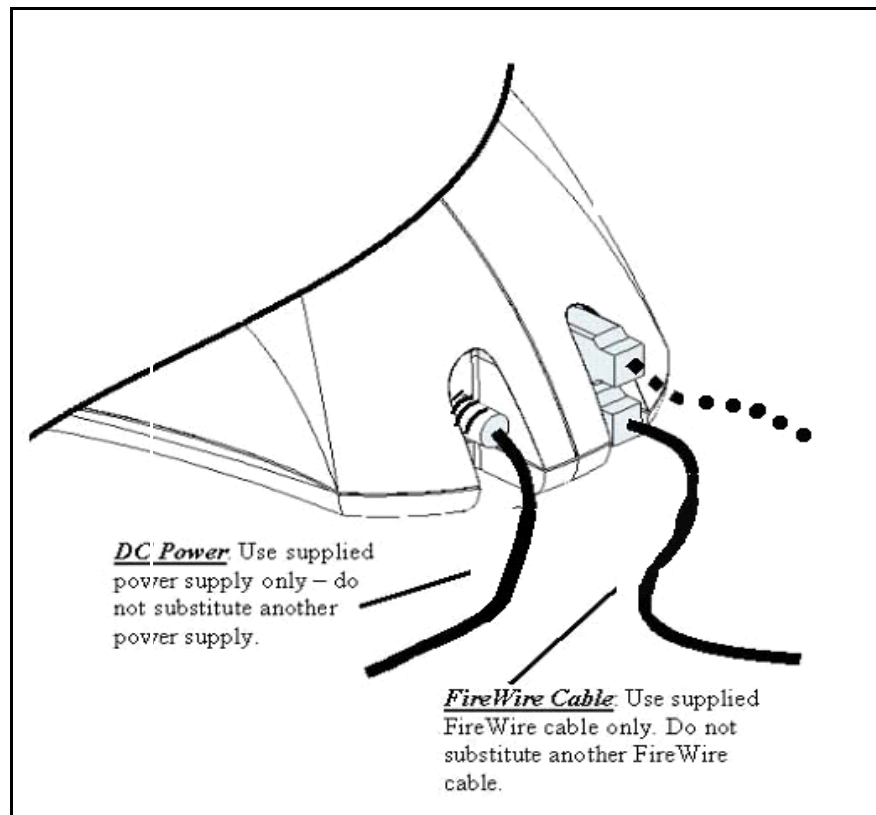
In this section you will setup the Phantom Omni device and plug in all of the cables.

Note Exact appearance of your equipment may vary from that shown in the figures.

- 1 Restart your computer after installing the PDD if you have not already done so.
- 2 Position the Phantom Omni device in your workspace, using both hands to grasp the base of the device. See “Proper Handling and Positioning of the Phantom Omni” on page 1-3 for instructions on how to handle the device to reduce the risk of damage.

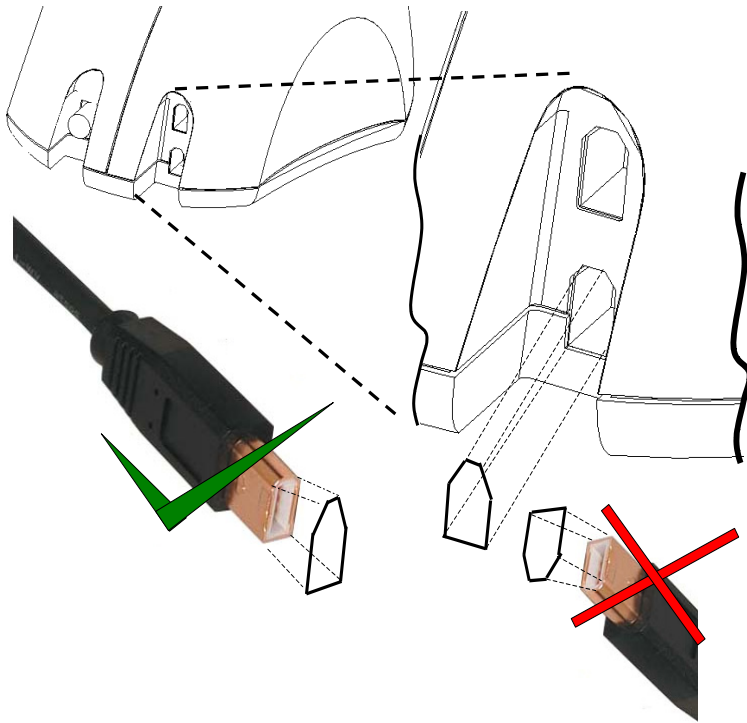
1 INSTALLING THE PHANTOM OMNI DEVICE
Connecting the Phantom Omni Device

- 3 Attach the stylus. See “Reassembling the detachable stylus” on page 1-5 for instructions.
- 4 Connect the FireWire cable.
- 5 Connect the power supply as follows:
 - a Insert the round pin from the Sensable-supplied power supply into the back of the Phantom Omni device, as shown in the image below.



The power cables connected to the back of the Omni device.

- b Plug the power supply into an available AC outlet. (For 110 V the AC outlet must be rated for at least 2 Amps; for 220 V AC, at least 1 Amp).



Insert the FireWire cable plug correctly into the Phantom Omni device.

- c** Connect the supplied FireWire cable into either of the two 6-pin FireWire ports on the back of the Phantom Omni device.
- d** Connect the other end of the FireWire cable to the FireWire port on your computer.

Warning Make sure the connector is facing in the correct orientation as shown in the image above.

IMPORTANT

Sensable Technologies uses only FireWire components that exceed the IEEE 1394 implementation recommendations. Sensable is not responsible for any damage that may result from using 3rd party cables.

- 6 For Windows® XP Users-** After you have connected the Phantom Omni device to your computer, the Microsoft “Found New Hardware Wizard” dialog will appear. (This may take a few moments).

Continue as appropriate for your operating system:

- 7** Select **Install the software automatically (recommended)** and click **Next**.

- 8 When the **Completing the Found New Hardware Wizard** window opens, click **Finish** to complete the install process.

Run Phantom Test to Verify Setup

In this section you will run the Phantom Test application to confirm that the device is properly connected and installed.

- 1 Select **Start>All Programs>Sensable>Phantom Test**.
- 2 If the device is properly connected and installed, the Phantom Test application will open and you will be in select mode. Gently move the Phantom arm and the Phantom test application will synchronously display the movement in the display window.

If the device is not properly connected, you will receive the following:

“The Phantom device named ‘Default Phantom’
could not initialize properly.”

If you encounter this error message first check to see that the Omni is the selected device in the **Phantom Configuration tool** (via the Control Panel). If you still encounter problems, reconnect the device and try again.

3

Using the Phantom Omni Device

This chapter will introduce you to working with the Phantom Omni haptic device and the physical limits of the device's range of motion. It is important to understand these physical limitations so that you do not inadvertently damage the device by forcing it past its designed limits.

Working in 3D Space

We have become so accustomed to using a mouse to move around a computer monitor that we don't think twice as we move our hand around a desk to move the cursor on the computer screen. But there was a time not long ago when this seemingly simple task was not second nature; some even found it challenging and were often frustrated as they learned. If you are new to working in 3D digital space and haptics, working with the Phantom Omni device may take a little getting used to. Understanding where objects are in 3D space may take some practice before you are able to move and manipulate objects with ease and certainty. Be patient with yourself.

Physical Limits of the Device

The Phantom Omni device has six degrees of motion provided by six axis points. All the degrees of motion have physical limits. When you reach one of these limits you will feel a sudden stop; this is the mechanical stop designed into the device. Forcing the device past any of these stops risks damaging the device.

Take some time to become more familiar with the location of the mechanical stops of the Phantom Omni before using the device by moving the device through its full range of motion at each axis point.

- 1 First make sure the device is not active; the inkwell should not be lit. If the inkwell is lit, close any haptic applications you have open.
- 2 Grasp the rubber grip of the stylus as you would a pen, with the free end of the stylus (the eraser end of a pencil) pointing toward you and the point of the stylus (the end connected to the arm) pointing toward the unit. Using the following illustration as a guide, gently move the stylus in all directions to feel each mechanical stop.

- 3 Now, you will perform macro movements. That is, you will move the device at the "body", "shoulder", and "elbow" of the Phantom Omni device.



Macro movements. Showing movement of the Phantom Omni arm and the body.

- a Start with large-but gentle movements. See the Figure above. Beginning at the top, move the arm of the device left/right. The body, sometimes referred to as the turret, of the Phantom Omni device will pivot until it reaches a physical limit. Again, do not try to force the device past any of the mechanical stops.
- b Next, move the stylus up/down. The primary movement will happen in the shoulder of the Phantom Omni device.
- c Next move it in/out with the primary movement happening in the elbow. When you reach a physical limit, you'll feel one of the device's mechanical stops. Don't force the device past any of these stops.



- 4 Next you perform micro movements further down the haptic device, moving the device at the stylus, as in the image above.
 - a Holding the stylus with one hand rotate left/right at the top of the yoke.
 - b Next pivot it up/down at the bottom of the yoke where it joins the stylus.
 - c Finally gently twist the stylus back/forth.

Now you should have an understanding of the range of motion of the Phantom Omni device at each axis point and where its limits are.

Warning ALWAYS work with the connected end of the stylus pointing away from you. NEVER rotate the stylus with the point facing you.

1 USING THE PHANTOM OMNI DEVICE
Physical Limits of the Device

Appendix: Troubleshooting

This section provides tips for correcting some common problems encountered with the Phantom Omni device. If after following these steps, you cannot resolve the problem, please contact customer support (see Appendix B:, "Customer Support").

#1 My Phantom Omni does not seem to be working and the Omni's light (located in the "inkwell") does not come on at all.

The inkwell light on the Phantom Omni device should be on if the following criteria are met:

- It is receiving power. Check that the power supply is plugged into a working outlet. Then check that the connection between the power supply and the Phantom device is made correctly.
- The device is connect to your PC via the FireWire cable connection. Make sure that the FireWire cable is plugged into one of the ports on the back of the Phantom Omni device. You may want to switch ports. Make sure the other end is plugged into the FireWire 1394a port on your computer.
- It is configured as the current haptic device via the Phantom Configuration tool. As Administrator, open the Phantom Configuration tool from the Control Panel. Make sure the Omni is selected in the Phantom Model. You may want to set to another device, such as the Desktop, and reset back to Omni and click Apply.

#2 The Phantom Omni blinks on and off.

Your Phantom Omni device may not be calibrated properly. This can happen if you unplug it. To correct this situation, place your stylus in the inkwell. During this process, the light should turn a solid blue. You can also open the Phantom Configuration Test and select the **Calibrate** tab. The message should read, "The Phantom has already inkwell-calibrated." Then, go to the **Test Forces** tab. If the light does not turn solid blue, see #1 above. If you need further assistance contact Customer Support.

#3 The Phantom Omni stylus and the cursor in my haptic application seem to be out of sync.

Your Phantom Omni device may not be calibrated properly. This can happen if you unplug it. To re-calibrate the device, place the stylus in the inkwell. The light on the Phantom Omni device should be a steady blue once calibrated. If the light does not turn solid blue, see #1 above. If you need further assistance contact Customer Support.

#5 I am able to start an application, but even though the light is lit steadily, the device behaves strangely when I move it around in a scene.

It is possible that there is a defect or a loose connection inside the Phantom Omni device. **DO NOT ATTEMPT TO OPEN THE DEVICE.** Contact Sensable Technical Support. When contacting Support, you may be asked to run the "PHANToM Test" application to help with diagnosis. (**Start>All Programs>Sensable**).

The following describes the basic features of this test application which you should be prepared to run.

- Select the Phantom device which you want to test. Usually this will be “Default Phantom”.
- Read Encoders - The values being sensed for the positions and rotations of the device are dynamically displayed in the window. The stylus switch is ON when the user presses the front, dark gray button. The presence switch is ON when the user presses the second, light gray button. The picture of the Phantom Omni should change dynamically as you move the stylus around.
- Test Forces - IMPORTANT: Hold onto the stylus when executing this test. Move the sliders with your mouse to generate forces which push against your hand. X controls force parallel to the table. Y controls force up and down. Z controls force in and out.
- Box Test - Provides a box which you can feel with your Phantom Omni. The sides of the box should feel flat and the corners sharp.
- Quit - Quits the test application.

#6 My Phantom Omni works fine but the inkwell is never lit.

If your Omni is performing properly, the LED in the inkwell could have simply burned out. You can continue to use your device without risking damage to the device. If you have any questions, contact customer support.

#7 How do I connect multiple Phantom Omni devices, daisy chaining?

To connect more than one Phantom Omni device, it is recommended that you use two separate FireWire controllers. This is to work around kernel issues in the Microsoft operating system. Make sure each controller is available on the Device Manager, then plug in each Omni as before.

IMPORTANT Remember to ensure that the connectors are oriented properly to the ports. See Appendix D: “Configuring Multiple Devices” for more information.

#8 I cannot power on my computer when I have the Phantom Omni connected.

You may not have a compatible FireWire card.

Appendix: Customer Support

Warning DO NOT OPEN THE DEVICE. Attempting to open or repair the device by anyone other than a certified authorized service center voids the manufacturer warranty and hardware maintenance contract. There are no serviceable components in the Phantom Omni device or power supply. Return to Sensable for servicing.

If you encounter any difficulties within your warranty period, you can obtain Technical Support through the three channels listed below. If you are out of warranty and do not have active maintenance, Technical Support is limited.

- If you purchased your Phantom Omni device from a distributor, please contact them first.
- Sensable Technologies Customer Support can be reached via e-mail at support@sensable.com.
- Sensable Technologies Customer Support can also be reached via telephone:
 - In the United States: 1-888-SENSABL (1-888-736-7225)
 - Outside the United States: +1-781-939-7444

Appendix: Regulatory Notices

FCC Notice (U.S. Only)

The Phantom Omni® haptic device is classified by the Federal Communications Commission (FCC) as a Class B digital device.

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment under FCC rules.

The following information is provided on the device covered in this document in compliance with FCC regulations:

Product Name: Phantom Omni

Model Number: 02350

Company Name: Sensable Technologies, Inc.

NOTES

Any changes or modifications to the hardware not expressly approved by Sensable Technologies could void the user's authority to operate this equipment.

This device is to be used with the Sensable-supplied power supply only. Replacement power supplies are available directly from Sensable Technologies.

Canadian Requirements:

Canadian Department of Communications Radio Interference Regulations

This digital apparatus, the Phantom Omni haptic device, does not exceed the Class B limits for radio-noise emissions from digital apparatus as set out in the Radio Interference Regulations of the Canadian Department of Communications.

Règlement sur le brouillage radioélectrique du ministère des Communications.

Cet appareil numérique, the Phantom Omni haptic device, respecte les limites de bruits radioélectriques visant les appareils numériques de classe B prescrites dans le Règlement sur le brouillage radioélectrique du ministère des Communications du Canada.

European Requirements:

EN 55022 Statement

This is to certify that the Sensable Technologies Phantom Omni haptic device is shielded against the generation of radio interference in accordance with the application of Council Directive 89/336/EEC, Article Aa. Conformity is declared by the application of EN 55022 Class B (CISPR 22).

Warning: This is a Class B product. In a domestic environment, this product may cause radio interference, in which case, the user may be required to take appropriate measures.

Achtung: Dieses ist ein Gerät der Funkstörgrenzwertklasse B. In Wohnbereichen können bei Betrieb dieses Gerätes Rundfunkstörungen auftreten, in welchen Fällen der Benutzer für entsprechende Gegenmaßnahmen verantwortlich ist.

Attention: Ceci est un produit de Classe B. Dans un environnement domestique, ce produit risque de créer des interférences radioélectriques, il appartiendra alors à l'utilisateur de prendre les mesures spécifiques appropriées.

Appendix: Configuring Multiple Devices

If you want to use more than one Phantom haptic device with your computer, you can create as many as 20 uniquely named Phantom configurations. Each named Phantom configuration can refer to a particular system configuration that you use frequently. Which device to use is defined by the software application which uses it.

To create a new Phantom configuration use the Phantom Configuration Utility.

- 1 From the **Start** menu, select **Settings>Control Panel>Phantom Configuration**. The Phantom Configuration window opens.
- 2 On the hardware tab, click **Add**.
- 3 Enter a name to call that device, click **OK**.
- 4 From the Phantom model menu, select the **correct model**.
- 5 Click **OK**.

Appendix: Phantom Omni Re-Packaging Instructions

If you need to transport or ship the device, please follow these packaging guidelines to reduce the risk of damage to the device.

Important

Remember the Phantom Omni device is a sensitive piece of electronic equipment and must be handled with care. Lifting the device by any of the moving parts may adversely affect the unit's performance and risks damaging the device. The Phantom Omni device has a limited range of motion. Forcing the device past these limits risks damaging the device. If you have not already done so, please review “Proper Handling and Positioning of the PHANTOM Omni” on page 3.

Shipping Checklist / Packing Materials:

You will need the following items to ship the device safely.

The packaging materials in which the device was originally shipped:

- 1 Medium shipping box
- 1 Set of foam inserts (cradles the device)
- 6 Pieces of foam padding (lines the inside walls of box)
- 2 squares of cardboard (inside bottom and top of box)
- Thin, clear, plastic bag
- Packing tape

Packing the Device and Accessories

First package up the Phantom Omni device:

- If necessary, reassemble the box and arrange the foam inserts..
 - Line the sides and bottom with the foam padding.
 - Place cardboard on the bottom of the box.
 - Fit the bottom foam insert into the bottom of the box.
- Orient the Phantom device to fit neatly inside the foam insert. You may need to grasp the Phantom device by the upper arm—the piece with the oblong cutout— in order to position it properly. DO NOT grab the stylus.
- Gently lower the Phantom device into the insert, while maintaining alignment of the Phantom arm to the cutout.

APPENDIX: PHANTOM OMNI RE-PACKAGING INSTRUCTIONS

- Ensure that the Phantom device is fully seated by pressing firmly on the Phantom Omni label.
- Check to see that the Phantom arm is fully seated by carefully pressing on the elbow joint.
- Ensure that the Phantom device is fully seated by pressing firmly on the Phantom Omni label.
- Check to see that the Phantom arm is fully seated by carefully pressing on the elbow joint.
- Place the top half of foam insert over the Phantom device.
- Place the stylus, power supply, power cord, and FireWire cable into the Shipping Tray on the top of the foam insert.
- Place the Shipping Tray over the foam insert.
- Close the box and tape shut.

Appendix: Device Specifications

Product specifications are subject to change without notice.

Force Feedback Workspace	~ 6.4 W x 4.8 H x 2.8 D in	> 160 W x 120 H x 70 d mm
Footprint (physical area the base of the device occupies on a surface)	~ 6 5/8 W x 8 D in	~ 168 W x 203 D mm
Weight (device only)	3 lbs 15 oz	~1.47 kg
Range of Motion	Hand movement pivoting at wrist	
Nominal Position Resolution	> 450 dpi	~0.055 mm
Backdrive Friction	< 1 oz	< 0.26 N
Maximum Exertable Force (at nominal orthogonal arms position)	0.75 lbf	3.3 N
Continuous Exertable Force	> 0.2 lbf	> 0.88 N
Stiffness	X axis > 7.3 lbs./in Y axis > 13.4 lbs./in Z axis > 5.9 lbs./in	X axis > 1.26 N/ mm Y axis > 2.31 N/mm Z axis > 1.02 N/mm
Inertia (apparent mass at tip)	~ 0.101 lbm	~ 45 g
Force Feedback	x, y, z	
Position Sensing	x, y, z (digital encoders)	
Stylus gimbal	Pitch, roll, yaw (\pm 5% linearity potentiometers)	
Interface	IEEE-1394 FireWire® port 6-pin to 6-pin*	
Supported platforms	Intel or AMD-based PCs	
OpenHaptics® SDK compatibility?	Yes	

* Please visit the Support and Resources section of our website for more information (www.sensable.com/support-overview.htm).

