3D Motion Controller User's Manual

xDriver

Unix SGI, HP, SUN, DEC, IBM

WWW.3DCONNEXION.COM

Copyright

3Dconnexion Inc. - A Logitech Company
6505 Kaiser Drive
Fremont, CA94555
Web: www.3Dconnexion.com

NOTICE:
The use of the 3D Motion Controller is primarily intended for graphical applications only. The company 3Dconnexion is not liable for any damages (including all kinds of damage from lost profit, operating breakdown, loss of business information, data or other kinds of monetary loss) that are due to either proper or improper use of this 3Dconnexion product. In any case, 3Dconnexion's liability is restricted to the amount of money paid for the product. This exclusion does not hold for damages caused by 3Dconnexion intentionally or grossly negligent. In the same way, claims based on general laws and rules of product liability remain untouched. For other applications 3Dconnexion declines any liability or claims for damages.

This device uses one or more patents held by the Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR).

Edited 12/2002 by 3Dconnexion - A Logitech Company.

NOTE: For optimal viewing of this document, it is recommended to use the latest version of Adobe Acrobat Reader, available on the 3DxWare driver CD-ROM or at www.adobe.com/acrobat.

Contents

Introduction to 3D Motion Controllers

This document is describing 3Dconnexion's 3D input devices, the 3D motion controllers, designed for moving objects or viewpoint in the virtual space.

True 3D Input for Intuitive Control

A 3D Motion Controller is a true three-dimensional input device that translates the slightest fingertip pressure into X, Y, and Z translations and rotations, moving 3D images instantaneously and simultaneously. This provides intuitive, interactive six degrees-of-freedom control of graphical models.

Two World-Class Technologies

There are two product lines each based on different technologies:

- ***SpaceBall***
- ***SpaceMouse***

SpaceBall 4000 FLX

SpaceMouse Plus/XT

How 3D Motion Controller Controls Six Degrees of Freedom

Moving the onscreen object is as easy as moving the 3D Motion Controllers handle. Shift the handle right or left to move the onscreen object horizontally through space. Pull the handle up or press it down to move the object vertically through space. Pull the handle toward the user or press it away to zoom in and out. Rotate the handle about the desired axis to rotate the onscreen object.

Note that the values input by 3D Motion Controllers are not interpreted as absolute position commands but as velocity commands. The magnitude of the handle's displacement determines the magnitude of the onscreen object's velocity.

Two Hands for Intuitive Control

3D Motion Controller allows for simultaneous control of six degrees of freedom with only one hand. When used in conjunction with a 3D CAD application, it takes over the functions of the viewing and supply hand (e.g. for a right-handed person this is the left hand). The working hand (e.g. the right hand) operates the conventional 2D mouse. This corresponds to the natural way of working with real objects and therefore supports intuitive creativity when generating and manipulating 3D objects in a CAD application.

How to Optimally Handle 3D Motion Controller

Spread three or four fingertips around the handle and gently shift and twist it. Apply only light fingertip pressure to the handle. DO NOT grasp the entire handle in your hand. It does not matter whether the right or left hand is used. No shoulder or wrist movement is necessary. The ergonomic design allows the hand to rest on the device without fatigue.

Installation

The following information will help you to install the 3D Motion Controller device and driver software on UNIX systems. For help with installation problems see Troubleshooting.

Package Contents

The product package contains:

- a 3D Motion Controller device (SpaceBall/SpaceMouse);
- a CD-ROM containing the driver software;
- the product documentation; and
- a serial port adapter (if required for the system specified at the time of order).

Hardware Installation

The SpaceBall/SpaceMouse has a serial interface cable with a 9-pin female connector, which must be connected to the proper serial port (RS232 or V24) of your UNIX workstation. The SpaceBall/SpaceMouse cable either plugs directly into the serial port at the back of the workstation or may require a separate adapter cable, which has been included if required. TURN OFF the workstation before connecting the SpaceBall/SpaceMouse. Once the connections have been made, you can restore power to the workstation. For further information see the related appendices listed below.

Related Sections

Connecting to the Serial Port
Connecting to IBM RS6000 Workstations
Connecting to SGI Workstations
Connecting to SUN Workstations

Supported Platforms

The SpaceBall/SpaceMouse X-Window driver is supported on the following platforms:

- DEC — *Digital Equipment Corporation with OSF1*
- HP — *Hewlett-Packard Company with HP-UX*
- IBM — *International Business Machines Corporation with AIX*
- SGI 53 — *Silicon Graphics Inc. with IRIX 5.3*
- SGI 62/32 — *Silicon Graphics Inc. with IRIX 6.2/32 bit (R4000, R5000, ...)*
- SGI 62/64 — *Silicon Graphics Inc. with IRIX 6.2/64 bit (R10000, ...)*
- SGI 63/32 — *Silicon Graphics Inc. with IRIX 6.3/32 bit (R10000, ...)*
- SGI 64/64 — *Silicon Graphics Inc. with IRIX 6.4/64 bit (R10000, ...)*
- SGI 65/64 — *Silicon Graphics Inc. with IRIX 6.5/64 bit (R10000, ...)*
- SUN — *Sun Microsystems with Solaris*

Locate your application in the following pages of this manual. The appropriate global installation commands and other important installation instructions are listed for each supported platform.

NOTE: This list was last updated 12/2002. (For the most current application list, please see www.3Dconnexion.com/software/drivers.) If the list indicates that an appropriate driver is included with your application, you should consult the application manual for the appropriate SpaceBall/SpaceMouse installation procedure.

Application List & Driver Installation Instructions

Locate your application in the Application List and note the important installation instructions. Then proceed to Driver Installation Procedure. A complete list of all supported applications and installation instructions for 3Dconnexion's 3D Motion Controller's can be found on our website.

Visit www.3dconnexion.com /software/drivers for the most current information.

NOTE: If the list indicates that an appropriate driver is included with your application, you should consult the application manual for the appropriate 3D Motion Controller installation procedure. If the list indicates a file to copy, there is no installation tool program for your application. Instead you must manually copy the specified file to your system.

Driver Installation Procedures

Follow the instructions below for either global installation (with "root" privileges) or local installation (without "root" privileges).

Related Sections

Troubleshooting
SGI Workstations With IRIX 6.2 or Higher
Additional Command Line Options

Global Installation

1 Mount the CD-ROM (replace the # symbol with the number of your CD-ROM drive).

DEC:
```
mkdir /CDROM
mount –rt cdfs –o noversion /dev/rz#c
    /CDROM
cd /CDROM
```

HP:
```
mkdir /CDROM
mount –F cdfs –o ro,cdcase
    /dev/dsk/c0t#d0 /CDROM
cd /CDROM
```

IBM:
```
mkdir /cdrom
mount –v cdrfs –r /dev/cd0 /cdrom
cd /cdrom
```

SGI:
```
mkdir /CDROM
mount –rt iso9660 /dev/scsi/sc0d#10
    /CDROM
cd /CDROM
```

SUN:
```
mkdir /cdrom
mount –F hsfs –r /dev/dsk/c0c6d#s0
    /cdrom
cd /cdrom/cdrom0
```

2 Install and configure the driver. (Note that your system may require a different command line. See Application List & Driver Installation Instructions.)

```
./xinstall
```

Select your application and the serial port to which the SpaceBall/SpaceMouse is connected. Press *Install* and *Exit*.

3 (OPTIONAL) Set the user-defined configurations. Set the environment variable MagellanConfig to the name of the configuration file

setenv MagellanConfig $HOME/xdriver.ini (e.g.)

Copy the global configuration file to this directory.

cp *cp /usr/magellan/xdriver.ini $HOME/xdriver.ini* (e.g.)

Local Installation

1 Create a subdirectory for the SpaceBall/SpaceMouse driver.

```
mkdir ./magellan
chmod 777 ./ magellan
cd ./ magellan
```

2 Copy the driver from the CD-ROM (replace the # symbol with the number of your CD-ROM drive).

DEC:
```
mkdir /CDROM
mount –rt cdfs –o noversion /dev/rz#c
    /CDROM
cp /CDROM/unix/dec/xdriver xdriver
```

HP:
```
mkdir /CDROM
mount –F cdfs –o ro,cdcase
    /dev/dsk/c0t#d0 /CDROM
cp /CDROM/unix/hp/xdriver xdriver
```

IBM:
```
mkdir /cdrom
mount –v cdrfs –r /dev/cd0 /cdrom
cp /cdrom/unix/ibm/xdriver xdriver
```

SGI:
```
mkdir /CDROM
mount –rt iso9660 /dev/scsi/sc0d#10
    /CDROM
cp /CDROM/unix/sgi/xdriver xdriver
```

SUN:
```
mkdir /cdrom
mount –F hsfs –r /dev/dsk/c0t6d#s0
    /cdrom
cp /cdrom/cdrom0/unix/sun/xdriver xdriver
```

3 Install and configure the driver.

```
chmod 555 xdriver
./xdriver -new
```

Select your application and the serial port to which the SpaceBall/SpaceMouse is connected. Press *Install* and *Exit*.

4 The driver must be active before you launch your application. This can be achieved in several ways, e.g. enter the call of the xdriver in the application startup file, in a login startup file (.cshrc) or in the Xstartup file (as root). The call of the xdriver is: <path>/xdriver &

Starting the Driver for the First Time

After the system has copied the X-Window driver, the driver must be started for the first time and configured. The driver demands sequential information in procedure, which it then stores in a fixed configuration table. The file name of the configuration table is *xdriver.ini*. It is saved in the directory */usr/magellan* (the same directory in which the X-Window driver is installed). While activating the X-Window driver, it searches for the configuration table and uses the information stored there.

Uninstalling the X-Window Driver

To uninstall a global installation, use the following command:

```
/usr/ magellan /xdriver –disableinit
```

To uninstall a local installation, simply remove the *xdriver* entry from the start-up file.

SpaceBall/SpaceMouse Keyboard

The keyboard of the SpaceBall/SpaceMouse operates on two levels: the so-called "standard" or top-level keyboard and the second-level keyboard (SpaceMouse Only).

Common Functions

Several functions that are common to these two levels are described below.

Translation ON/OFF
Turns the translational degrees of freedom (inputs X, Y and Z) on or off. Turning translation off fixes the "screen position" of the onscreen object. The default is ON.

Rotation ON/OFF
Turns the rotational degrees of freedom (inputs A, B and C) on or off. Turning rotation off fixes the orientation of the onscreen object. The default is ON.

Dominant Mode ON/OFF;
When dominant mode is on, only the input of the greatest magnitude is registered, i.e. the onscreen object moves in only one direction at a time. This can be a translational or rotational direction. Dominant mode is especially helpful when learning how to use the SpaceBall/SpaceMouse. The default is OFF.

Gain Down; Decrease Sensitivity
Decreases the sensitivity of the SpaceBall/SpaceMouse. The same movements of the handle will produce a slower movement of the object. Each time the key is pressed, the sensitivity decreases by one half.

Gain Up; Increase Sensitivity
Increases the sensitivity of the SpaceBall/SpaceMouse. The same movements of the handle will produce a faster movement of the object. Each time the key is pressed, the sensitivity doubles.

Gain Default; Default Sensitivity
Returns the SpaceBall/SpaceMouse back to the standard sensitivity.

Standard Keyboards of Common Applications

Functions of the standard keyboard are executed simply by pressing and releasing any one of the buttons of the SpaceBall/SpaceMouse. The default function assigned to each button varies with the application used. Standard keyboards for some common CAD applications are listed below. Note that the functions of the standard keyboard may be customized by the user via the SpaceBall/SpaceMouse driver. See Button Mapping Window.

CADDS5 (v.8.3 or higher)

1	Translation ON/OFF
2	Rotation ON/OFF
3	Dominant Mode ON/OFF
4	Model Space Filter ON/OFF. Toggles the CADDS5 Model Space Filter.
5	Decrease Sensitivity
6	Increase Sensitivity
7	Default Sensitivity

NOTE: See also the CADDS5 user's manual under the cross reference *Working With DynamicView* or *Using Dynamics Manipulation on the View Display*.

CATIA (v.4)

1	Movement About Rotation Axis. With animation turned off in CATIA's 3D menu, the object onscreen performs a rotation about the selected axis (the angle through which it rotates can be changed with the sensitivity adjustment in the 3D menu). When animation is on, the object rotates at a constant speed about the selected axis. The rotation speed doubles each time the key is pressed. Pressing the SpaceMouse star key/SpaceBall key #9 stops the rotation and resets the screen.
2	Translation ON/OFF
3	Rotation ON/OFF
4	Select Rotation Axis. Pressing and holding this key displays the current rotation axis. While still holding the button, a new rotation axis may be selected with the 2D computer mouse.
5	Dominant Mode ON/OFF
6/+	Yes. Activates the Yes button.
7/-	No. Activates the No button.
8	Dialmode. Toggles between standard mode and dialmode (when Enable is checked in the Single Axis Dial section of the SpaceBall/SpaceMouse Motion Control Center main window). The default is STANDARD mode. See Dialmode Keyboard.
/9	Reset Screen. Resets the onscreen object to its stored starting position.

CATIA (v.5.x)

2	Translation ON/OFF
3	Rotation ON/OFF
5	Dominant Mode ON/OFF
6	Increase Sensitivity
7	Decrease Sensitivity

Pro/ENGINEER (v.20 or higher)

1	Repaint. Repaints the current screen.
2	Shade. The object onscreen is shaded.
3	Previous View. Resets the object to the previous view.
4	Default View. Resets the object to the default view.
5	Gain Up
6	Gain Down
7	Gain Default
8	Refit. Resizes the view of the object while maintaining the current orientation.

NOTE: See also the Pro/ENGINEER user's manual under the cross reference *View Point Function* or *Spaceball.*

Unigraphics (v.11 or higher)

1	Translation ON/OFF
2	Rotation ON/OFF
3	Dominant Mode ON/OFF
4	Rotate About Attention Point When this mode is active, the model rotates about the rotation center (set with button 7)
5	Gain Down
6	Gain Up
7	New Rotation Center Sets the new rotation center at the center of the current screen.
8	Menu. Brings up the Unigraphics menu.

NOTE: See also the Unigraphics user's manual under the cross reference *View Point Function* or *Magellan*.

Second-Level Keyboard (SpaceMouse Only)

Functions of the second-level keyboard are executed by pressing one of the first four numerical keys in combination with the star key of SpaceMouse. The keys must be pressed *simultaneously*. Press and hold the star key followed by the desired numerical key. Note that the functions are not application-dependent and are not programmable.

** 1*	Translation ON/OFF
** 2*	Rotation ON/OFF
** 3*	Dominant Mode ON/OFF
** 4*	Zeroing. The SpaceMouse is zeroed at the current position of the handle. All subsequent inputs are relative to this position.

Quicktip (SpaceMouse Only)

A Quicktip is executed by pressing downward on the handle of SpaceMouse with a quick tipping motion of your finger. The Quicktip function is a "virtual" button that may be

programmed just like the normal hardware buttons. The default function assigned to Quicktip toggles the driver window. Note that for the SpaceMouse Classic and some of the Plus, the translation and rotation must be turned ON and the dominant mode turned OFF for the Quicktip function to work.

Dialmode Keyboard

Dialmode functions like a manual dialbox. Press one of the keys listed below to select one of the six degrees of freedom. Twist the handle about the Y-axis (i.e. in the horizontal plane of the base of the SpaceBall/SpaceMouse) to move the onscreen object in the selected direction. See also Single Axis Dial.

1	Input X Twist the handle for horizontal translation.
2	Input Y Twist the handle for vertical translation.
3	Input Z Twist the handle to zoom in or out.
5	Input A Twist the handle to rotate about the x-axis.
6	Input B Twist the handle to rotate about the y-axis.
7	Input C Twist the cap to rotate about the z-axis.

SpaceBall/SpaceMouse Motion Control Center

The SpaceBall/SpaceMouse Motion Control Center (MCC) can be used both to directly configure the hardware settings and to program the standard keyboard.

Motion Control Center Main Window

The main window of the MCC contains basic features for configuring the SpaceBall/SpaceMouse.

3D Modes

Translation ON/OFF. Turns the translational degrees of freedom (inputs X, Y and Z) on or off. Turning translation off fixes the "screen position" of the onscreen object. The default is ON.

Rotation ON/OFF. Turns the rotational degrees of freedom (inputs A, B and C) on or off. Turning rotation off fixes the orientation of the onscreen object. The default is ON.

Dominant ON/OFF. Turns dominant mode on or off. When dominant mode is on, only the input of the greatest magnitude is registered, i.e. the onscreen object moves in only one direction at a time. This can be a translational or rotational direction. Dominant mode is especially helpful when learning how to use the SpaceBall/SpaceMouse. The default is OFF.

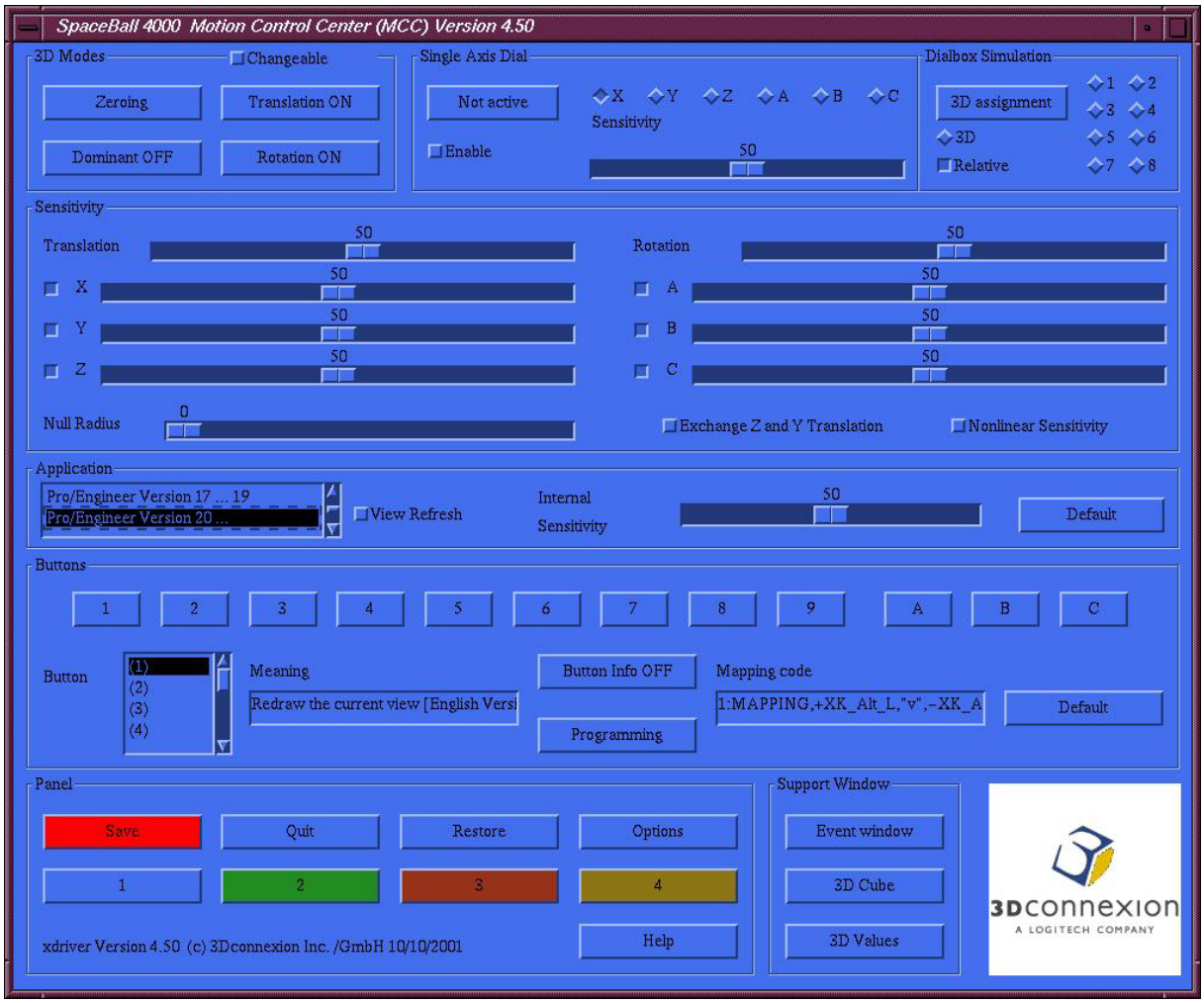
Zeroing. The device is zeroed at the current position of the handle. All subsequent inputs are relative to this position (same as *4 at the SpaceMouse)

Changeable [tickbox]. Fixes or unfixes the current translation, rotation and dominant mode settings.

Sensitivity

Translation [slider bar]. Adjusts the overall translational sensitivity (inputs X, Y and Z).

Rotation [slider bar]. Adjusts the overall rotational sensitivity (inputs A, B and C).



X, Y, Z, A, B, C [slider bars]. Adjust the sensitivities of the individual degrees of freedom. For example, it may be useful to have faster zoom response (Z-sensitivity) than pan response (X- and Y-sensitivities). Untick the boxes next to each slider bar to turn off the corresponding degree of freedom.

Null Radius [slider bar]. Controls the minimum displacement of the handle necessary to cause movement of the onscreen object. Increasing the null radius may be helpful in work environments prone to vibrations (e.g. industrial environments), which may cause the SpaceBall/SpaceMouse to register unintentional movements.

Exchange Y and Z Translation [tickbox]. Swaps the Y- and Z-inputs, which may be necessary for some applications.

Nonlinear Sensitivity [tickbox]. Activates the nonlinear sensitivity feature. See Options Window.

Application

Application [scroll bar]. The application selected during installation is highlighted. To use SpaceBall/SpaceMouse with a different application, select the new application from the scroll bar menu and click Save (in the Panel section of the MCC window). To use SpaceBall/SpaceMouse with more than one application, select a different panel in the Panel section before choosing the application and clicking Save. The MCC automatically switches to the panel settings of the active application. Customized MCC settings may be saved for up to four different applications; see Panel.

Default. Returns the settings in the 3D Modes, Sensitivity and Single Axis Dial sections of the MCC main window to their defaults.

Internal Sensitivity [slider bar]. Adjusts the overall sensitivity of the SpaceBall/SpaceMouse device (not present for all applications).

Buttons

Holding the 2D mouse cursor over one of these software buttons displays two lines of information text. The first line shows the function that is currently mapped to the corresponding hardware button. The second line shows the default function.

Buttons [scroll bar]. Select a button to program (i.e. "map").

Meaning [field]. Displays the current function of the selected button. After mapping a button, the user should enter a new description in the Meaning field.

Button Info. Opens a small window that displays the key sequence mapped to the hardware buttons whenever they are pressed.

Programming. Opens the Button Mapping Window, which is used to program or "map" buttons of the SpaceBall/SpaceMouse.

Mapping Code [field]. Displays the current mapping code of the selected button.

Default. Resets all button mappings to their defaults.

Panel

Save. Saves the current MCC configuration. Anytime changes are made anywhere in the MCC window, the Save button is highlighted red, indicating that the current changes have not been saved.

Quit. Quits the MCC (note that quitting the MCC does NOT stop the X-Window driver).

Restore. Appears when unsaved changes have been made, which can be used to undo any unwanted changes.

1, 2, 3, 4 [colored buttons]. Can be used to save up to four independent configurations or "panels". Panels can be used for different settings within the same CAD application or they can be associated with different applications (see also Application). The background color of the MCC window changes to match the color of the numbered button of the active panel.

Help. Opens a small window for launching the xdriver.htm help file.

Options. Opens the Options Window.

Support Window

3D Cube. Opens a demo program for interactively testing the MCC configuration settings. (Note that it is not possible to test the default functions of the standard keyboard with the 3D Cube demo program.)

3D Values. Opens a small window that displays both the analog values of all six degree-of-freedom inputs as well as the events corresponding to each pressed key.

Event Window. Select this button, then select the window of a target application. All subsequent SpaceBall/SpaceMouse events are sent to the target application, no matter which application is active.

Single Axis Dial ("Dialmode")

Enable [tickbox]. Maps the Dialmode ON/OFF function onto SpaceBall/SpaceMouse button 8. Press button 8 to activate Dialmode, or select Active/Not Active. See also Dialmode Keyboard.

Active/Not Active. Activates Dialmode (same as SpaceBall/SpaceMouse button 8).

X, Y, Z, A, B, C [tickboxes]. Selects the active degree of freedom for Dialmode.

Sensitivity [slider bar]. Adjusts the sensitivity of the single axis dial.

Dialbox Simulation

Unlike the single axis dial ("Dialmode") feature, a real dialbox is simulated using the dialbox simulation mode. This is only necessary for some applications that do not support SpaceBall/SpaceMouse but that do support dialboxes. Note that some IBM and SGI systems may require a separate installation procedure to activate the dialbox simulation mode. See LPFK and Dialbox Driver Installation.

1, 2, 3, 4, 5, 6, 7, 8 [tickboxes]. The functions of these numbered tickboxes correspond to the default functions that your CAD application would normally assign the eight wheels of a dialbox. Select a degree of freedom by ticking one of the eight tickboxes or by pressing the

corresponding hardware button. Twist the handle about the Y-axis (i.e. in the plane of the base of the SpaceBall/SpaceMouse). This executes the same motion as that obtained by turning the corresponding wheel on a real dialbox.

3D [tickbox]. Makes it possible to move the onscreen object in more than one degree of freedom at a time. The handle must then be moved and twisted in the normal, intuitive directions (i.e. not only about the Y-axis).

3D Assignment. Opens a small window for reassigning the six degrees of freedom to the wheels of the dialbox. By correctly assigning the six inputs, SpaceBall/SpaceMouse can be used as normal with applications that do not support its use.

Relative [tickbox]. Causes all values generated by SpaceBall/SpaceMouse to be interpreted by the application as relative values.

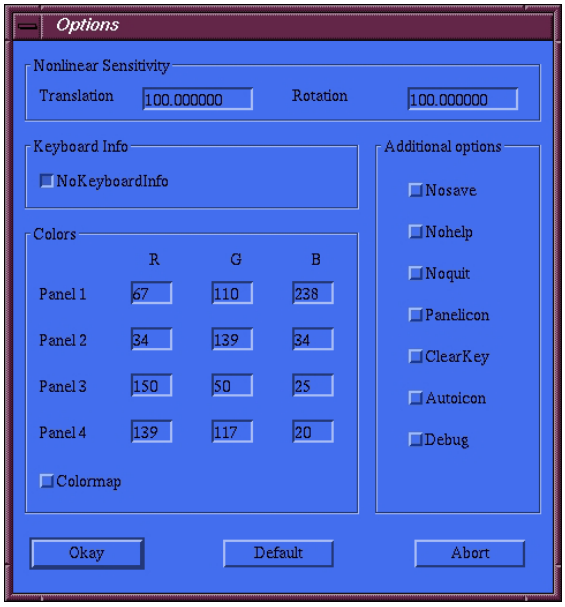
Options Window

Click *Options* in the *Panel* section of the MCC main window to open the Options window. This window contains additional features for controlling various functions and appearances of the MCC.

Okay. Saves the current changes.

Default. Restores the default settings.

Abort. Cancels the current changes.



Nonlinear Sensitivity

Translation, Rotation [fields]. The values entered in these fields determine the nonlinear behavior of the translational and rotational sensitivity. Nonlinear sensitivity is characterized by increasing sensitivity with increasingly large deflections of the SpaceMouse/SpaceBall handle. Values of 0 or higher may be entered, with 0 having no effect and higher values giving stronger nonlinear behavior. The default for both parameters is 100. (Note that Nonlinear Sensitivity must be ticked in the Sensitivity section of the MCC main window for these values to take affect.)

Keyboard Info

No Keyboard Info [tickbox]. Tick this box to disable the Button Info Window.

Catia Config. Imports the configuration information for the function buttons at the bottom of the CATIA window (for use with CATIA V4 only).

Colors

Panel 1, 2, 3, 4 / R, G, B [fields]. Used to change the color of each MCC panel. Values from 0 to 255 may be entered.

Colormap [tickbox]. Tick this box to prevent the X-Window driver from creating new colors within the colormap.

Additional Options

No Save, No Help, No Quit [tickboxes]. Hide the corresponding buttons in the Panel section of the MCC main window.

Panel Icon [tickbox]. When activated, a small colored dot corresponding to the color of the active MCC panel appears in the desktop icon of the minimized MCC window.

Clear Key [tickbox]. Ensures that all keys pressed in the button mapping codes are released after the mapping is executed.

Auto Icon [tickbox]. Causes the xdriver's desktop icon to always appear in front of other open windows.

Debug [tickbox]. Reports debug information on the command line.

Quicktip [tickbox]. Toggles on and off the Quicktip function. (SpaceMouse only)

Button Mapping Window

To program or "map" a new command onto a SpaceBall/SpaceMouse button, select the button number from the scroll bar menu in the *Buttons* section of the MCC main window. Then click *Programming*, which opens the Button Mapping window. Clicking the buttons in this window adds commands to the mapping code of the selected SpaceBall/SpaceMouse button.

Okay. Saves the current changes.

Abort. Cancels the current changes.

Press a Key

[field]. Single keys entered in a button's mapping sequence are displayed and stored here.

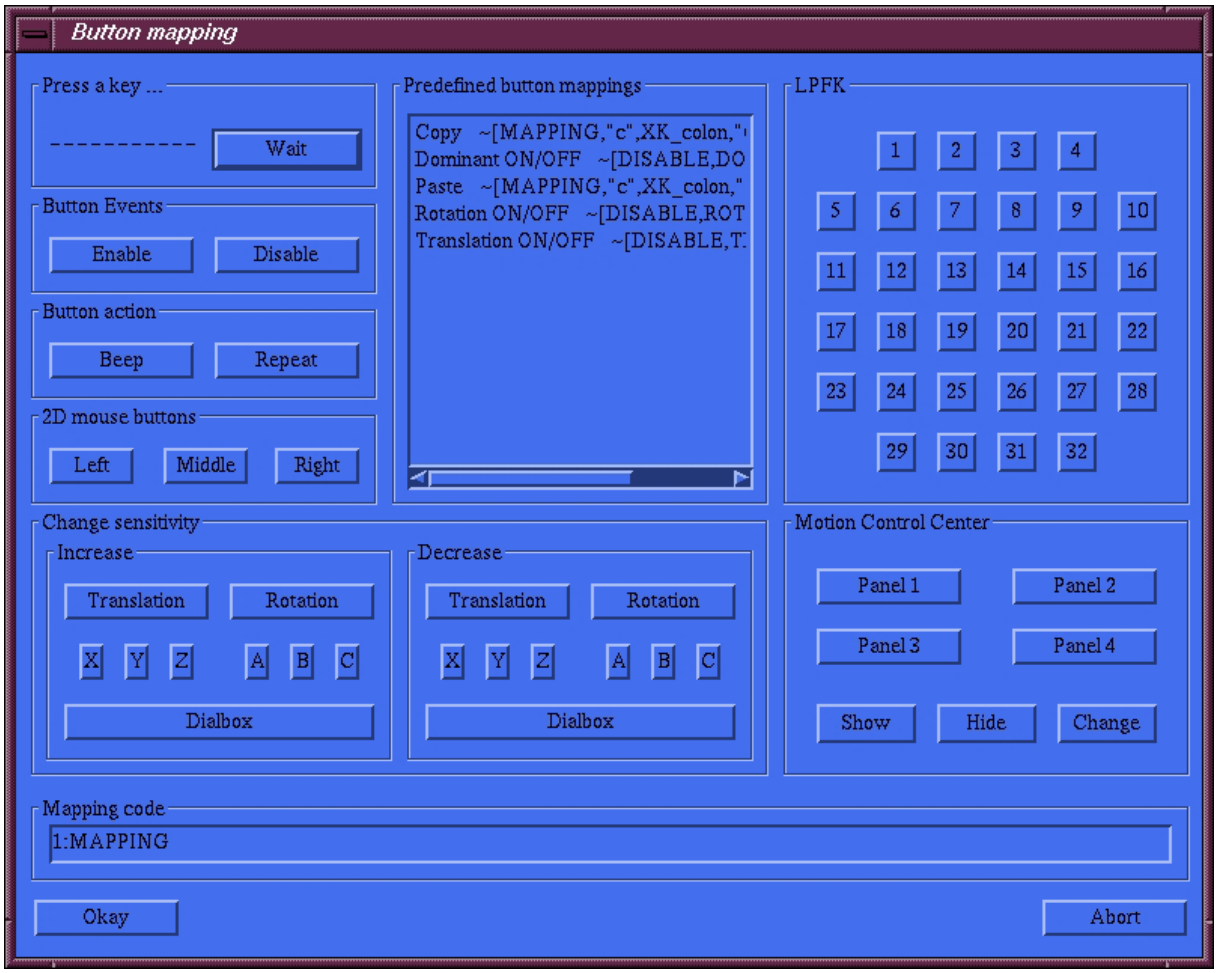
Wait. Enter in mapping sequences that require a window to be opened or a menu to be pulled down.

Button Events

Enable. Causes the application's default command to be executed whenever the selected button is pressed, regardless of other commands included in the button mapping. For example, if Enable is entered and the mapping code for an additional function is included in

the button mapping, the default function and the additional function are simultaneously executed.

Disable. Prevents the default command from being sent.



Button Action

Beep. Causes a single beep to sound.

Repeat. Causes the mapped command to be repeatedly executed as long as the button is held down. Note that the beep command cannot be repeated.

2D Mouse Buttons

Left, Middle, Right. Map the functions of the three 2D mouse buttons.

Change Sensitivity (Increase/Decrease)

Translation. Maps a function for increasing/decreasing the translational sensitivity.

Rotation. Maps a function for increasing/decreasing the rotational sensitivity.

X, Y, Z, A, B, C. Map functions for increasing/ decreasing the sensitivity of individual degrees of freedom.

Dialbox. Maps a function for increasing/decreasing the sensitivity in Dialmode.

Predefined Button Mappings

A list of the predefined mapping codes available for the current application is displayed here. Click a mapping code to map the function to the selected SpaceBall/SpaceMouse button.

Motion Control Center

Panel 1, 2, 3, 4. Switch the MCC to the selected panel number.

Show. Brings the MCC window to the front of the screen.

Hide. Sends the MCC window to the back of the screen.

Change. Toggles the MCC window between the front and back of the screen.

LPFK

1 – 32. The functions of the 32 buttons correspond to the default functions that your CAD application normally assigns the buttons of an LPFK. Use these buttons to map the corresponding LPFK functions. Note that some IBM and SGI systems may require a separate installation procedure to activate the LPFK simulation mode. See LPFK and Dialbox Driver Installation.

Mapping Code

[field]. Displays changes made to the mapping code of the selected SpaceBall/SpaceMouse button.

Troubleshooting

Problem/Error	*Possible Explanations*	*Recommended Actions*
SpaceBall/SpaceMouse not found on TTY.	➢ Access rights on TTY ports are wrong.	✓ Check access rights on the TTY ports and change if necessary.
	➢ The correct adapter is not being used.	✓ Make sure you use the correct adapter.
	➢ Another driver is running on the TTY port (e.g. getty).	✓ Verify that the port is available and not in use by another device or driver.
xdriver already running. You must kill (XXXX) PID and restart xdriver using xdriver –new.	➢ The user may have quit the MCC and tried to restart the X-Window driver without first stopping the X-Window driver processes from running.	✓ Kill the running X-Window driver process ID and restart the X-Window driver, unless the driver was installed globally, in which case it will automatically be re-launched a few seconds after being killed.
Cannot copy xdriver.	➢ Access rights incorrect or not logged on as ROOT.	✓ Try copying the files manually.
Dialbox installation failed.	➢ Some of the system files that support LPFK and Dialbox may not be installed on the system.	✓ Contact your system administrator (see also comments below).
MCC does not start.	➢ Access rights to Xserver are incorrect.	✓ Use xhost + localhost.

NOTE: Troubleshooting on UNIX requires editing of critical startup files and therefore some knowledge of UNIX commands. Your system administrator should help you with it. If the X-Window driver installation fails, an email message is automatically generated, saved in the */tmp* directory and (if the workstation is connected to the internet) sent to our technical support at

supportUS@3Dconnexion.com
(US/Asia/Americas)
supportEU@3Dconnexion.com
(Europe/EMEA)
We send responses to these emails with suggestions on how to resolve the problem. You can also contact our technical support by phone. Please call the numbers listed for your area (see 3Dconnexion Support).

3Dconnexion Support

If you have any questions or comments about your 3D Motion Controller, please contact the appropriate regional support center listed for your area.

When you call technical support, please be at your computer so that we can assist you. Please have the following information available when you call:

- Your name, company name, and telephone number
- Product name and version number
- Your computer configuration: CPU type, speed, memory, pointing device, video card (its memory and resolution)
- The platform and operating system you are running
- Your application name and version
- The version of 3d motion controller driver you are using

You can also send an email or a detailed fax. Clearly state your problem and include the information listed above.

Various information about 3Dconnexion's 3D Motion Controllers, including the latest driver versions, can be found at:
http://3Dconnexion.com

US / Asia / Americas

3Dconnexion
30600 Telegraph Road, Suite 4290
Bingham Farms, MI 48025
U.S.A.
Tel: + 1-248-331-1999
Fax: + 1-248-331-1399
Email: supportUS@3dconnexion.com
Web: www.3Dconnexion.com

Online Support
www.3Dconnexion.com/support/

Technical Support Hotline
+1 (888) 247 9545
(English Only)

Europe / EMEA

3Dconnexion GmbH
An der Hartmuehle 8
D-82229 Seefeld
Germany
Tel: + 49 (0) 8152-9919-0
Fax: + 49 (0) 8152-9919-50
Email: supportEU@3dconnexion.com
Web: www.3Dconnexion.com

Online Support
www.3Dconnexion.com/support/

Technical Support Hotline
+49 (8152) 9919 44
(English & German Only)

3Dconnexion Services

Please visit our website www.3Dconnexion.com for any of the following services.

New Integration
To find out details about integrating 3D motion controllers into your application you can contact one of the offices listed on the website.

Software Development Kit (SDK)
Is a documented C-based library available online for add-in development. Please visit our website for the latest information on our SDK at: http://www.3Dconnexion.com/software/sdk

Implementation support
To get help in your implementation efforts you can find support information on the website.

Application Support
At www.3Dconnexion.com/software/drivers/ there is list of applications supported.

If a particular application is not on the list, please contact the software company producing that application to find out more about 3D motion controller support.

Connecting to the Serial Port

The SpaceBall/SpaceMouse is equipped with a 9-pin D-Sub female connector. The wiring of this connector matches any IBM-compatible PC with a 9-pin serial connector. To use the SpaceBall/SpaceMouse with other computers, check the pin functions against the list shown below and verify whether the SpaceBall/SpaceMouse connector wiring matches your system. If not, you must use an appropriate adapter cable to connect the SpaceBall/SpaceMouse wiring to that of your computer.

Pin	*Meaning*	*Connection to Computer*
Case	Shield	Case
2	TxD	RxD
3	RxD	TxD
4	Supply	DTR
5	GND	GND
7	CTS	RTS
8	RTS	CTS

The use of the handshake signals (CTS, DTR and RTS) is absolutely necessary for the safe operation of the SpaceBall/SpaceMouse. Without these handshake signals, loss of data will occur. Additionally, the signal lines (DTR and RTS) are used to supply power to the SpaceBall/SpaceMouse. Thus no external power supply is required. The minimum output voltage has to be 5 V, providing a output current of 9 mA on both signal lines.

Communication via the serial port using the XON/XOFF protocol is supported by the SpaceBall/SpaceMouse, but the handshake signals (CTS, DTR and RTS) are needed for safe operation. Thus the status of the handshake signals has to be carefully checked and treated by the computer. To activate the SpaceBall/SpaceMouse, these signals should have a positive (active) level.

Connecting to IBM RS6000 Workstations

The IBM–SpaceBall/SpaceMouse adapters for 25-pin and 9-pin D-Sub male ports use the wiring schemes shown in the following diagrams.

Pin No. 25-p. D-Sub f.		*Pin No. 9-p. D-Sub m.*
connector shield		connector shield
2	TxD	3
3	RxD	2
4	RTS	7
5	CTS	8
7	GND	5
20	DTR	4
6	DSR	
8	DCD	
(to serial port)		*(to 3d input device)*

Pin No. 9-p. D-Sub f.		*Pin No. 9-p. D-Sub m.*
connector shield		connector shield
1	DCD	1
2	RxD	2
3	TxD	3
4	DTR	4
5	GND	5
6	DSR	6
7	RTS	7
8	CTS	8
(to serial port)		*(to 3d input device)*

Connecting to SGI Workstations

If the 8-pin mini-DIN female connector on an SGI workstation is used, the converter-adapter cable shown in the following diagram is required. The cable changes the mini-DIN connector to that of the SpaceBall/SpaceMouse

Pin No. 8-p. mini-DIN m.		*Pin No. 9-p. D-Sub m.*
1	DTR (4V conv. 7V)	1
2	CTS not used	5
3	TxD	3
4	GND	5
5	RxD	2
6	RTS	7
7	DCD not used	
8	GND	5
connector shield		connector shield
(to serial port)		*(to 3d input device)*

and converts, if necessary, the 4 V output voltage of the SGI port handshake signals to 5 V and 10 mA to supply SpaceBall/SpaceMouse. The input handshake signals CTS and DCD of the workstation are not connected in order to save some current taken from the workstation's output handshake signals DTR and RTS.

Different SGI workstations—despite somewhat similar connector types—show different voltage and current conditions at the serial port. One example is a Personal IRIX workstation, which offers such a low current (and voltage) handshake signal that the SpaceBall/SpaceMouse (as well as any standard mouse) is not able to operate due to a lack of current. In such cases, only an external power supply (min. 5.0 V, max. 11.0 V, 9 mA DC) into the DTR pin of the SpaceBall/SpaceMouse will solve the problem. An appropriate adapter cable with external power supply has been included in the product package based on the system specified at the time of order. However, if an adapter with the external power supply feature has not been included with your SpaceBall/SpaceMouse or should you discover after ordering that your SGI machine requires an external power supply, please contact the 3Dconnexion Support Center listed for your area.

Connecting to SUN Workstations

To install the SpaceBall/SpaceMouse on SUN workstations, make sure that the hardware configuration of the serial port to which you want to connect the SpaceBall/SpaceMouse is set to RS232. *The default is RS422!* The RS232 configuration is required in order to supply control voltages to the SpaceBall/SpaceMouse through the handshake signal lines. To configure the port to RS232, follow the steps in your SUN user handbook. The wiring scheme of the SUN–SpaceBall/SpaceMouse adapter is shown below.

Pin No. ***25-p. D-Sub f.***		***Pin No.*** ***9-p. D-Sub m.***
connector shield		connector shield
2	TxD	3
3	RxD	2
4	RTS	7
5	CTS	8
7	GND	5
20	DTR	4
(to serial port)		*(to 3d input device)*

SGI Workstations With IRIX 6.2 or Higher

Some applications support the driver for the SpaceBall/SpaceMouse that is integrated in SGI systems with IRIX version 6.2 or higher. Follow the procedure below to install the X-Window driver with these applications.

1. Login as *root* and launch the *inst* program.
2. Select the CD-ROM as the source drive (the SpaceBall/SpaceMouse driver is located on the IRIX 6.2 System CD-ROM 1 of 2).
3. Select the step installation menu with the following commands:

   ```
   inst
   install eoe.sw.optinput
   go
   quit
   ```

4. Exit the *inst* program.
5. Using the System Manager Tools, configure the Serial Port Setup to which the SpaceBall/SpaceMouse is connected (Port 2) as *Magellan*. Test the installation with *Run Confidence Test*.
6. For older applications that use the old name (e.g. IRIX Inventor) you must create the file */usr/lib/X11/input/config/magellan* with following contents:

   ```
   x_init  {
   name "spaceball"
   }
   ```

   After creating the file, reboot the system for the new configuration to take effect.

NOTE: Install either the xdriver or the IRIX kernel driver. *Do not install both!* For older R3000 workstations, please contact 3Dconnexion Support and ask if a driver is available. You can also check our homepage at www.3Dconnexion.com.

Additional Command Line Options

The X-Window driver may be launched with the following command line attachments.

-class Class information of all active windows is shown.

-connect To a running xdriver the command is sent to restores the connection to the serial port (see *-disconnect*).

-debug Reports debug information.

-dialsingle Sends all LPFK and Dialbox events separately.

-disableinit Turns off the X-Window driver in the */etc/inittab* file. An X-Window driver launched from */etc/inittab* is terminated immediately.

-disconnect To a running xdriver the command is sent to separate from the serial port. The MotionControlCenter is still there, but there is no functionality of the device (see *-connect*).

-display <xyz> Redirects the output of the xdriver to the given display.

-enableinit Relaunches the X-Window driver from the */etc/inittab* file.

-exit Causes a running xdriver to stop.

-graphics Opens a demo window in which a 3D cube can be moved in six degrees of freedom.

-grab The 2D mouse cursor is blocked if the SpaceBall/SpaceMouse is active.

-help Prints a list of possible command line options.

-hidemcc Hides the MCC so that it is no longer usable. (The *Quit* button in the MCC and the -nomcc option have the same effect.)

-inittab Informs the X-Window driver that it was started from the */etc/inittab*.

-installlpfk Installs the driver necessary for the LPFK simulation.

-installmgl Installs the Magellan XIE driver. (Only for SGI systems with IRIX 6.2 or higher.)

-irixmgl Activates the Magellan XIE driver and functions within the MCC. (Only for SGI systems with IRX 6.2 or higher.)

-lpfkdevice The driver for the LPFK simulation are not installed, only those for the dialbox simulation. (needed if the 3D device and a LPFK device are used.)

-new Set up new local configuration. The configuration file **.ini* is deleted and a new configuration of the driver is asked for.

-new -global Set up new global configuration.

-nocookie xdriver avoids the authorization to the XServer.

-nohelp or **-nohtml** Suppresses the creation of the X-Window HTML files and disables the *Help* button in the MCC.

-nooptions Disables the Options button in the MCC.

-nolpfk Disables the LPFK-Simulation.

-nomcc or **-nomotif** No MCC window comes up with the X-Window driver.

-noquit Ensure that the MCC will never be turned off.

-showmcc Causes the MCC to reappear (after it has been hidden, e.g. with the –*hidemcc* or *-nomcc* commands).

-serialport <serial port> Causes the xdriver to look for the device at the given serial port and not at the one from the configuration file (e.g. xdriver.ini)

-test Test the driver. Opens a window and shows all X-Window driver data received.

-texte Text output. The texts used in the X-Window driver are output in all used languages.

-tty <serial port> Connect information about the SpaceBall/SpaceMouse at the defined serial port with YES or NO.

-turbo The Turbo SpaceBall/SpaceMouse (18ms data rate) is supported.

-ungrab or **-nograb** Ensures that the 2D mouse cursor remains unblocked.

-uninstalllpfk Uninstalls the LPFK simulation driver.

-uninstallmgl Uninstalls the Magellan XIE driver. (Only for SGI systems with IRIX 6.2 or higher.)

-user All logged-in users are shown.

-userdir or **-userid** Creates an *xdriver.ini* file from the user's home directory (so that the configuration file is user-dependent) and saves the configuration file **.ini* with the user-ID and group-ID of the current user. For global installation, the X-Window driver uses the */usr/magellan/xdriver.ini* configuration file as the default. Note that this option will work only if the X-Window driver has been launched using *-inittab*.

-version Prints out a version string.

-xstartup Informs the X-Window driver that it was started from the Xstartup.

LPFK and Dialbox Driver Installation

In order to use the LPFK and dialbox simulation modes, it may be necessary to install additional operating system files. The following systems normally require additional files:

- SGI (IRIX 5.3 or higher)
- IBM (AIX 4.14 or higher)

For IBM system, consult your AIX user's manual. For SGI systems, follow the installation procedure outlined below. Note that LPFK and dialbox simulation modes are not available on SUN.

1. Insert the IRIX 6.2 System CD-ROM 1 of 2.
2. Start the Software Manager. From the *System* menu select *Software Manager* or double-click on the CD-ROM icon on your desktop.
3. Select the input directory next to the *Available software* window.

   /CDROM/dist

   If you install the operating system from a location other than the CD-ROM drive, change this accordingly.
4. Click *Customize Installation.*
5. A list of all installed and available OS modules appears. Scroll down to *IRIX 6.2 Execution Environment* and expand the folder.
6. Scroll down to *Optional Input Devices*, highlight the entry and click *Start*.
7. This starts the installation process whereby the following file is installed:

   /usr/lib/X11/input/dial.o
8. After rebooting, reinstall the X-Window driver, this time using the *-installlpfk* command.

   ./xdriver -new -global -installlpfk
9. To test the installation, start the X-Window driver and from the *System* menu select *Run Confidence Test*. Click on *Dials and Buttons*. You should now be able to manipulate the dials and the buttons with the SpaceBall/SpaceMouse device.

Product Specifications

Feature/Specification	*SpaceMouse Classic*	*SpaceMouse Plus & Plus XT*	*SpaceBall 4000FLX*
Number of freely programmable buttons	9	11	12
Software-controllable keyboard LEDs	No	Yes (2 yellow, 1 red) XT Only	No
Quicktip virtual button	Yes	Yes	No
Device weight (for stability)	0.660 kg	0.680 kg	0.650 kg
Human Interface Form-Factor	Round Puck	Ergonomic Puck	Soft Touch Ball
Operating humidity (non-condensing)	10 to 98% RH	10 to 98% RH	10 to 98% RH
Operating temperature	+5 to +60 °C	+5 to +60 °C	+10 to +40 °C
Storage humidity	10 to 98% RH	10 to 98% RH	10 to 98% RH
Storage temperature	-40 to +85 °C	-40 to +85 °C	+6 to +60 °C
Supported systems	*UNIX:* DEC, HP, IBM, SGI, SUN *PC:* Win98, ME, WinNT, 2000, XP	*UNIX:* DEC, HP, IBM, SGI, SUN *PC:* Win98, ME, WinNT, 2000, XP	*UNIX:* DEC, HP, IBM, SGI, SUN *PC:* Win98, ME, WinNT, 2000, XP
Power source	5V / 9mA	5V / 9mA	5V / 10mA
Connector	Serial or USB	Serial or USB	Serial or USB
Baud Rate	9600 Baud	9600 Baud	9600 Baud
Standard Data Rate	40 ms	40 ms	50 ms
Compact Size L x W x H (mm)	165 x 112 x 40	188 x 129 x 44	213 x 152 x 76
Converter-adapters available for the following serial port connections	IBM 25-p D-Sub m IBM 9-p D-Sub m SGI 8-p mini-DIN f SGI 8-p DIN f SGI 9-p D-Sub f SUN 25-p D-Sub f	IBM 25-p D-Sub m IBM 9-p D-Sub m SGI 8-p mini-DIN f SGI 8-p DIN f SGI 9-p D-Sub f SUN 25-p D-Sub f	IBM 25-p D-Sub m IBM 9-p D-Sub m SGI 8-p mini-DIN f SGI 8-p DIN f SGI 9-p D-Sub f SUN 25-p D-Sub f
FCC, TUV/GS, VCCI, CSA or UL, & CE - Approved	Yes	Yes	Yes
Length of manufacturer's warranty	3 years	3 years	3 years
Standard driver source freely available	Yes	Yes	Yes
Unix Specific Features			
Dialbox Simulation	Yes	Yes	Yes
LPFK Simulation	Yes	Yes	Yes
Dominant Mode	Yes	Yes	Yes

Product Specifications
Please visit our website to see additional information on our complete line of 3D Motion Controllers at:
http://www.3Dconnexion.com/products.

Warranty Information

3Dconnexion's Limited Lifetime Product Warranty

Limited Warranty

3Dconnexion warrants that any hardware product accompanying this documentation shall be free from significant defects in material and workmanship for a period of three (3) years from the date of purchase. 3Dconnexion's limited warranty is nontransferable and is limited to the original purchaser. This warranty gives you specific legal rights, and you may also have other rights which vary under local laws.

Remedies

3Dconnexion's entire liability and your exclusive remedy for any breach of warranty shall be, at 3Dconnexion's option, to: (a) repair or replace the hardware, provided that the hardware is returned to the point of purchase or such other place as 3Dconnexion may direct, with a copy of the sales receipt, or (b) refund the price paid. Any replacement hardware will be warranted for the remainder of the original warranty period or thirty (30) days, whichever is longer. These remedies are void if failure of the hardware has resulted from accident, abuse, or misapplication.

DISCLAIMER OF WARRANTY

THE WARRANTIES EXPRESSLY SET FORTH IN THIS AGREEMENT REPLACE ALL OTHER WARRANTIES. 3DCONNEXION AND ITS SUPPLIERS EXPRESSLY DISCLAIM ALL OTHER WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT OF THIRD-PARTY RIGHTS WITH RESPECT TO THE HARDWARE. NO 3DCONNEXION DEALER, AGENT, OR EMPLOYEE IS AUTHORIZED TO MAKE ANY MODIFICATION, EXTENSION, OR ADDITION TO THIS WARRANTY. Some jurisdictions do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you.

LIMITATION OF LIABILITY

IN NO EVENT WILL 3DCONNEXION OR ITS SUPPLIERS BE LIABLE FOR ANY COSTS OF PROCUREMENT OF SUBSTITUTE PRODUCTS OR SERVICES, LOST PROFITS, LOSS OF INFORMATION OR DATA, OR ANY OTHER SPECIAL, INDIRECT, CONSEQUENTIAL, OR INCIDENTAL DAMAGES ARISING IN ANY WAY OUT OF THE SALE OF, USE OF, OR INABILITY TO USE ANY 3DCONNEXION PRODUCT OR SERVICE, EVEN IF 3DCONNEXION HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. IN NO CASE SHALL 3DCONNEXION'S AND ITS SUPPLIERS' TOTAL LIABILITY EXCEED THE ACTUAL MONEY PAID FOR THE 3DCONNEXION PRODUCT OR SERVICE GIVING RISE TO THE LIABILITY. Some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you. The above limitations will not apply in case of personal injury where and to the extent that applicable law requires such liability.

FCC Compliance Statement

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1) This device may not cause harmful interference.

2) This device must accept any interference received, including interference that may cause undesired operation.

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.

European Economic Community Declaration of Conformance (CE)

The Magellan/SPACE MOUSE is attested to meet the essential protection requirements against electromagnetic emission, which are established in the regulations of the council for assimilating the rules and regulations of the member states about electromagnetic compatibility 89/336/EEC and changed by regulation 92/31 EEC. This declaration is valid for all samples produced according to the enclosed production drawings, which are part of this declaration. The following standards were used for judging the product concerning electromagnetic capability:

- For trouble emission: EN55022 edition: 05/95
- For trouble security: EN50082-1 edition: 03/93

VCCI Class B Declaration

この装置は，情報処理装置等電波障害自主規制協議会（ＶＣＣＩ）の基準に基づくクラスＢ情報技術装置です。この装置は，家庭環境で使用することを目的としていますが，この装置がラジオやテレビジョン受信機に近接して使用されると，受信障害を引き起こすことがあります。
取扱説明書に従って正しい取り扱いをして下さい。

Korea Class B Declaration

이 기기는 가정용으로 전자파적합등록을 한 기기로서 주거지역에서는 물론 모든 지역에서 사용할 수 있습니다.

CAUTION: The user is cautioned that changes or modifications to the equipment not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Software License Agreement

3DCONNEXION

SOFTWARE LICENSE AGREEMENT

3DCONNEXION IS WILLING TO LICENSE THIS SOFTWARE TO YOU ONLY ON THE CONDITION THAT YOU ACCEPT ALL OF THE TERMS CONTAINED IN THIS LICENSE AGREEMENT. This is a legal agreement between you (either an individual end-user or an entity) and 3Dconnexion ("Agreement"). By using this software, you are agreeing to be bound by the terms and conditions of this Agreement. If you do not agree to the terms and conditions of this Agreement, promptly return the software and other items that are part of this product in their original package with your sales receipt to your point of purchase for a full refund, or if you have downloaded this software from a 3Dconnexion web site, then you must stop using the software and destroy any copies of the software in your possession or control.

1. Grant of Agreement. Subject to the terms and conditions of this Agreement, 3Dconnexion and its suppliers grant to you a nonexclusive license to use one copy of the software program and any documentation accompanying this Agreement ("Software") on one computer only with the 3Dconnexion product you have purchased. No other rights are granted. The Software is in use if it is loaded on the computer's permanent or temporary memory. For backup purposes only, you may make one copy of the Software. You must include on the backup copy all copyright and other notices included on the Software as supplied by 3Dconnexion. Installation on a network server for the sole purpose of your internal distribution of the Software is permitted only if you have purchased an individual Software license for each networked computer to which the Software is distributed.

2. Restrictions. The Software contains copyrighted material, trade secrets, and other proprietary materials of 3Dconnexion and its licensors. You agree that in order to protect those proprietary materials, except as expressly permitted by applicable law, neither you nor a third party acting on your behalf will: (i) decompile, disassemble or reverse engineer the Software; (ii) modify or create derivative works of the Software; (iii) use the Software in any manner to provide service bureau, commercial time-sharing or other computer services to third parties; (iv) transmit the Software or provide its functionality, in whole or in part, over the Internet or other network (except as expressly permitted above); or (v) sell, distribute, rent, lease, sublicense or otherwise transfer the Software to a third party, except upon a permanent transfer of the 3Dconnexion product using the Software; provided that: (a) all Software updates are included in the transfer, (b) you do not retain a copy of the Software, and (c) the transferee agrees to be bound by the terms and conditions in this Agreement.

3. Ownership. The Software is licensed, not sold, to you for use only under the terms and conditions of this Agreement, and 3Dconnexion reserves all rights not expressly granted to you in this Agreement. 3Dconnexion and/or its licensors retain title to the Software, and all intellectual property rights therein.

4. Termination. This Agreement is effective until terminated. Upon any violation of any of the provisions of this Agreement, rights to use the Software shall automatically terminate and the Software must be returned to 3Dconnexion or all copies of the Software destroyed. You may also terminate this Agreement at any time by destroying all copies of the Software in your possession or control. If 3Dconnexion makes a request via public announcement or press release to stop using the copies of the Software, you will comply immediately with this request. The provisions of paragraphs 3, 7, 8 and 12 will survive any termination of this Agreement.

5. Limited Product Warranty. 3Dconnexion warrants to you that the Software will substantially conform to its published documentation and the media containing the Software shall be free from defects in material, each for a period of ninety (90) days from the date of purchase. 3Dconnexion's limited warranty is nontransferable and is limited to the original purchaser. This warranty gives you specific legal rights, and you may also have other rights which vary under local laws.

6. Remedies. 3Dconnexion's entire liability and your exclusive remedy for any breach of warranty shall be, at 3Dconnexion's option, to: (a) repair or replace the Software or media, provided that the Software or media is returned to the point of purchase or such other place as 3Dconnexion may direct, with a copy of the sales receipt,or (b) refund the price paid. Any replacement Software or media will be warranted for the remainder of the original warranty period or thirty (30) days,whichever is longer. These remedies are void if failure of the Software or media has resulted from accident, abuse, or misapplication.

7. DISCLAIMER OF WARRANTY. THE WARRANTIES EXPRESSLY SET FORTH IN THIS AGREEMENT REPLACE ALL OTHER WARRANTIES. 3DCONNEXION AND ITS SUPPLIERS EXPRESSLY DISCLAIM ALL OTHER WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT OF THIRD-PARTY RIGHTS WITH RESPECT TO THE SOFTWARE OR MEDIA, AND ANY WARRANTIES OF NON-INTERFERENCE OR ACCURACY OF INFORMATIONAL CONTENT. NO 3DCONNEXION DEALER, AGENT, OR EMPLOYEE IS AUTHORIZED TO MAKE ANY MODIFICATION, EXTENSION, OR ADDITION TO THIS WARRANTY. SOME JURISDICTIONS DO NOT ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS, SO THE ABOVE LIMITATION MAY NOT APPLY TO YOU.

8. LIMITATION OF LIABILITY. IN NO EVENT WILL 3DCONNEXION OR ITS SUPPLIERS BE LIABLE FOR ANY COSTS OF PROCUREMENT OF SUBSTITUTE PRODUCTS OR SERVICES, LOST PROFITS, LOSS OF INFORMATION OR DATA, OR ANY OTHER SPECIAL, INDIRECT, CONSEQUENTIAL, OR INCIDENTAL DAMAGES ARISING IN ANY WAY OUT OF THE SALE OF, USE OF, OR INABILITY TO USE ANY 3DCONNEXION PRODUCT OR SERVICE, EVEN IF 3DCONNEXION HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. IN NO CASE SHALL 3DCONNEXION'S AND ITS SUPPLIERS' TOTAL LIABILITY EXCEED THE ACTUAL MONEY PAID FOR THE 3DCONNEXION PRODUCT OR SERVICE GIVING RISE TO THE LIABILITY. Some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you. The above limitations will not apply in case of personal injury where and to the extent that applicable law requires such liability.

9. U.S. Government Restricted Rights. Use, duplication, or disclosure by the U.S. Government is subject to restrictions set forth in this Agreement and as provided in DFARS 227.7202-1(a) and 227.7202-3(a) (1995), DFARS 252.227-7013(c)(1)(ii) (OCT 1988) FAR 12.212(a) (1995), FAR 52.227-19, or FAR 52.227-14 (ALT III), as applicable. 3Dconnexion Inc. 6505 Kaiser Drive, Fremont, CA 94555.

10. Export Law Assurances. You agree and certify that neither the Software nor any other technical data received from 3Dconnexion will be exported outside the United States except as authorized and as permitted by the laws and regulations of the United States. If you have rightfully obtained the Software outside of the United States, you agree that you will not re-export the Software nor any other technical data received from 3Dconnexion, except as permitted by the laws and regulations of the United States and the laws and regulations of the jurisdiction in which you obtained the Software.

11. Agents and Third Party Purchasers. If you are acquiring the Software on behalf of another person or entity, you represent and warrant that you have the authority to bind the party or entity for which you are acquiring the Software to the terms and conditions of this Agreement.

12. General Terms and Conditions. This Agreement will be governed by and construed in accordance with the laws of the United States and the State of California, without regard to or application of its choice of law rules or principles. If for any reason a court of competent jurisdiction finds any provision of this Agreement, or portion thereof, to be unenforceable, that provision of the Agreement shall be enforced to the maximum extent permissible so as to affect the intent of the parties, and the remainder of this Agreement shall continue in full force and effect. This Agreement constitutes the entire agreement between the parties with respect to the use of the Software and supersedes all prior or contemporaneous understandings, communications or agreements, written or oral, regarding such subject matter. 3Dconnexion may, in its sole discretion, modify portions of this Agreement at any time. 3Dconnexion may notify you of any changes by posting notice of such modifications on 3Dconnexion's web site(s) or sending notice via e-mail, postal mail or other means. Your continued use of the Software following notice of such modifications shall be deemed to be your acceptance of any such modifications to the Agreement. If you do not agree to any such modifications, you must immediately stop using the Software and destroy all copies of the Software in your possession or control.

The Software is protected by United States copyright law and international treaty. Unauthorized reproduction or distribution of the Software is subject to civil and criminal penalties.