

14 Configuring PEX

This chapter introduces PEX and describes configuring terminals for using PEX applications. The following topics are covered in this chapter:

- ❑ “PEX Overview” on page 14-1
- ❑ “PEX Requirements” on page 14-3
- ❑ “Setting PEX Configuration Parameters” on page 14-3
- ❑ “Specifying the Input Device for PEX” on page 14-13
- ❑ “Troubleshooting PEX” on page 14-14

PEX is supported on HMX and Explora 700 terminals only.

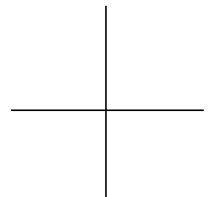
PEX Overview

The PEX extension to the X protocol provides support for 3D graphics applications. Using the PEX X server module, NCD terminals can display 3D drawing applications written for PEX. 3D applications provide such features as 3D objects, transformations, floating-point color, and lighting.

Applications that use PEX include 3D drawing programs, CAD (computer-aided design) programs, and scientific visualization programs. When considering 3D clients to be run on NCD X terminals, make sure they are based on PEX. Only applications that generate the PEX protocol can access the PEX functional extensions in the PEX server.

As with the core X protocol, software for running PEX applications is required on the terminal and on the host computer where the application is running.

The PEX acronym stands for PHIGS Extension to X. PHIGS was the original API (application programming interface) for PEX. Since the origin of PEX, other APIs have been implemented and PEX is no longer based solely on PHIGS.



The PEX X Server Module

The PEX X server module allows you to display PEX images along with standard X images on your NCD terminal.

The PEX module supports PEX protocol versions 5.0 and 5.1. The PEX module supports all of the subsets of PEX: immediate mode (the Renderer Subset), structure mode (the Structure Subset), and workstation mode (the PHIGS Workstation Subset). These subsets provide a variety of 3D and 2D graphics capabilities.

Data can be rendered immediately as it is transmitted to the terminal (immediate mode rendering) or it can be stored as data in the terminal (structure mode), where it can be quickly updated and re-rendered. Workstation mode is similar to structure mode and provides additional control of scene updating.

The PEX module includes two other X extensions:

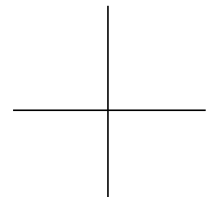
- ❑ MBX (the MultiBuffer Extension to X)—Provides an invisible drawing buffer for rendering one scene while another scene is displayed. This enables clients to provide smooth animation with little effort.
- ❑ XInput (the Input Extension to X)—Provides support for the sophisticated input devices required by some PEX clients. In NCDware, Summagraphics-compatible digitizing tablets and the Logitech 3D mouse are supported.

The PEX module provides both terminal configuration parameters and user preference parameters for PEX. “Setting PEX Configuration Parameters” on page 14-3 describes the parameters in detail.

PEX Fonts

The PEX module uses stroke fonts, which are scalable fonts defined as coordinates of line segments. The fonts required by PEX are built into the X server, so no additional font paths or font definitions are required. The PEX fonts available in NCDware are roman (a proportionally spaced font) and roman_m (a monospaced font).

The same two fonts are supplied on NCDware distribution media as downloadable font files. All fonts in the NCD PEX font format have filenames with the **.phont** suffix. The two font files available in NCDware are named **Roman.phont** and **Roman_M.phont**. These fonts are normally installed in the **/usr/lib/X11/ncd/fonts/PEX** directory during software installation.



PEX Requirements

Using PEX requires a valid license. To add a PEX node license, use the **unit-license-key** parameter (Setup ⇒ Change Setup Parameters ⇒ Licenses ⇒ License Key). If the terminal has more than one node license, include one instance of this parameter for each license key. The parameter is saved in NVRAM.

After adding the PEX license, reboot the terminal so that the X server can read the PostScript resource file.

If you are using site licensing or floating licenses, see the *NCDware System Administrator's Guide for UNIX Systems* for instructions.

Additional terminal memory may be required. For information on the amount of terminal memory required to use PEX, see the *Release Notes*.

Setting PEX Configuration Parameters

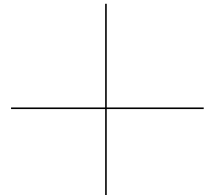
This section describes the PEX remote configuration parameters. In the Setup menus, some PEX parameters are in Change Setup Parameters (in the PEX and PEX Colors hide boxes), and some are in Change User Preferences (in the PEX hide box). PEX parameters are not saved in NVRAM.

Setting the Parameters Listed in Change Setup Parameters

The PEX parameters in Change Setup Parameters take effect after rebooting, so they must be set in a remote configuration file.

The parameters described in this section control the maximum number of half-spaces for model clipping, the maximum number of name set identifiers, and the maximum number of non-ambient light sources. The default values of these parameters are the defaults specified by the PHIGS standard and should work for most applications.

The recommended terminal memory listed in the *Release Notes* is based on the default values of these parameters. Increasing the values of these parameters places increased demands on terminal memory.



Specifying the Number of Clipping Planes

The `pex-max-model-clip-planes` parameter specifies the maximum number of half-spaces that can be defined for the purpose of model clipping. Half-spaces are defined by the clipping plane. A half-space is an infinite region of modeling coordinate space bounded on one side by the clipping plane.

Table 14-1 `pex-max-model-clip-planes` Parameter

Possible Values	Result
default	64
<i>integer</i>	The maximum number of model clipping half-spaces that can be defined. Range: 6 to 65535.

Specifying the Number of Name Sets

The `pex-max-nameset-names` parameter specifies the maximum number of name set identifiers that can be defined. This value must be a power of two. Setting this parameter to an integer that is not a power of two causes the parameter setting to be ignored.

A name set provides an identifier (unique name) for an individual primitive or a group of primitives. The identifier can then be used to pick or highlight all the primitives in the group or make them invisible.

Table 14-2 `pex-max-nameset-names` Parameter

Possible Values	Result
default	256
64, 128, 256, 512, 1024, 2048, 4096, 8192, 16384, or 32768	The maximum number of identifiers that can be defined.

Specifying the Number of Non-Ambient Light Sources

The `pex-max-non-ambient-lights` parameter specifies the maximum number of non-ambient light sources that can be defined.

The non-ambient light source types are directional light, positional light, and spot light.

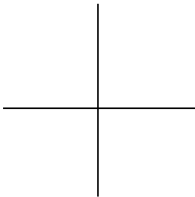


Table 14-3 pex-max-non-ambient-lights Parameter

Possible Values	Result
default	64
<i>integer</i>	The maximum number of non-ambient lights that can be defined. Range: 0 to 65535.

PEX Color Parameters

You may need to adjust PEX color parameters if:

- ☐ You are not using a monitor supplied by NCD.
- ☐ The factory setting of the monitor's brightness control is changed.
- ☐ The natural aging of the monitor causes its color display to change.

Color parameters specify the color components of the properly adjusted display monitor according to the CIE (Commission Internationale de l'Eclairage) color space definition. The three color components (red, green, and blue) and the reference white value each consist of three coordinates (values). Each value is a floating point number ranging from a minimum of 0.0 to a maximum of 1.0. The three values are:

- ☐ Y—the luminance value
- ☐ u' —the chromaticity value on the u' axis
- ☐ v' —the chromaticity value on the v' axis

Color parameters do not directly affect colors displayed on the terminal. A client can use these values (for example, to set up a colormap to send to the server), but it is not required to use them.

Blue Color Component

The following parameters specify the three values that make up the blue color component of the properly adjusted display monitor. Each value can range from 0.0 to 1.0.

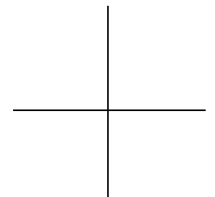


Table 14-4 pex-monitor-reference-blue-u Parameter

Possible Values	Result
default	0.1756
<i>floating point number</i>	The u' CIE-chromaticity coordinate for the blue color component of the properly adjusted display monitor.

Table 14-5 pex-monitor-reference-blue-v Parameter

Possible Values	Result
default	0.1785
<i>floating point number</i>	The v' CIE-chromaticity coordinate for the blue color component of the properly adjusted display monitor.

Table 14-6 pex-monitor-reference-blue-y Parameter

Possible Values	Result
default	1.0
<i>floating point number</i>	The Y CIE-luminance coordinate for the blue color component of the properly adjusted display monitor.

Green Color Component

The following parameters specify the three values that make up the green color component of the properly adjusted display monitor. Each value can range from 0.0 to 1.0.

Table 14-7 pex-monitor-reference-green-u Parameter

Possible Values	Result
default	0.1169
<i>floating point number</i>	The u' CIE-chromaticity coordinate for the green color component of the properly adjusted display monitor.

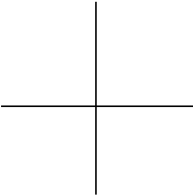


Table 14-8 pex-monitor-reference-green-v Parameter

Possible Values	Result
default	0.559
<i>floating point number</i>	The v' CIE-chromaticity coordinate for the green color component of the properly adjusted display monitor.

Table 14-9 pex-monitor-reference-green-y Parameter

Possible Values	Result
default	1.0
<i>floating point number</i>	The Y CIE-luminance coordinate for the green color component of the properly adjusted display monitor.

Red Color Component

The following parameters specify the three values that make up the red color component of the properly adjusted display monitor. Each value can range from 0.0 to 1.0.

Table 14-10 pex-monitor-reference-red-u Parameter

Possible Values	Result
default	0.4288
<i>floating point number</i>	The u' CIE-chromaticity coordinate for the red color component of the properly adjusted display monitor.

Table 14-11 pex-monitor-reference-red-v Parameter

Possible Values	Result
default	0.5249
<i>floating point number</i>	The v' CIE-chromaticity coordinate for the red color component of the properly adjusted display monitor.

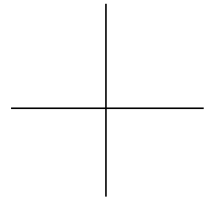


Table 14-12 pex-monitor-reference-red-y Parameter

Possible Values	Result
default	1.0
<i>floating point number</i>	The Y CIE-luminance coordinate for the red color component of the properly adjusted display monitor.

Reference White Value

The following parameters specify the three values that make up the reference white value of the properly adjusted display monitor. Each value can range from 0.0 to 1.0.

Table 14-13 pex-monitor-reference-white-u Parameter

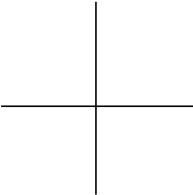
Possible Values	Result
default	0.1884
<i>floating point number</i>	The u' CIE-chromaticity coordinate for the reference white value of the properly adjusted display monitor.

Table 14-14 pex-monitor-reference-white-v Parameter

Possible Values	Result
default	0.4463
<i>floating point number</i>	The v' CIE-chromaticity coordinate for the reference white value of the properly adjusted display monitor.

Table 14-15 pex-monitor-reference-white-y Parameter

Possible Values	Result
default	1.0
<i>floating point number</i>	The Y CIE-luminance coordinate for the reference white value of the properly adjusted display monitor.



Setting the Parameters Listed in Change User Preferences

PEX user preference parameters allow users to manipulate PEX rendering by setting attributes such as shading, dithering, and light sources.

When set through Change User Preferences (Setup \Rightarrow Change User Preferences), these parameters offer dynamic control over the client. All of the PEX preference parameters take effect immediately after they are applied.

Specifying the Nominal Line Width

The **pref-pex-nominal-line-width** parameter controls the nominal width (in pixels) of lines and curves. The nominal line width is a default size from which other line sizes are derived by applying a scaling factor (Setup \Rightarrow Change User Preferences \Rightarrow PEX \Rightarrow Nominal Line Width).

This parameter allows you to match the appearance of lines and curves on an NCD terminal to their appearance on other displays.

Table 14-16 pref-pex-nominal-line-width Parameter

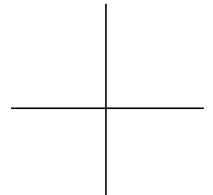
Possible Values	Result
default	1
<i>integer</i>	Standard width of lines and curves (in pixels). Range: 1 to 64.

Specifying the Nominal Edge Width

The **pref-pex-nominal-edge-width** parameter controls the nominal width (in pixels) of edges of surface primitives when such edges are displayed. The nominal edge width is a default width from which other edge sizes are derived by applying a scaling factor (Setup \Rightarrow Change User Preferences \Rightarrow PEX \Rightarrow Nominal Line Width).

Table 14-17 pref-pex-nominal-edge-width Parameter

Possible Values	Result
default	1
<i>integer</i>	Standard width of surface primitive edges (in pixels) when edges are displayed. Range: 1 to 64.



Specifying the Nominal Marker Size

The **pref-pex-nominal-marker-size** parameter controls the nominal size (in pixels) of marker primitives. For example, if a + (plus) marker is 3 pixels wide, a nominal marker size of 2 makes the plus marker 6 pixels wide. Other marker types (except for dot markers) are scaled accordingly (Setup ⇒ Change User Preferences ⇒ PEX ⇒ Nominal Marker Size).

Table 14-18 pref-pex-nominal-marker-size Parameter

Possible Values	Result
default	1
<i>integer</i>	Standard width of marker primitives (in pixels). Range: 1 to 64.

Specifying Surface Dithering

The **pref-pex-dither-flat-shaded-surface** parameter controls flat-shaded surface dithering (Setup ⇒ Change User Preferences ⇒ PEX ⇒ Dither Flat Shaded Surface).

Table 14-19 pref-pex-dither-flat-shaded-surface Parameter

Possible Values	Result
default	by-request
by-request	Flat-shaded surfaces are dithered only when the client requests it.
off	Flat-shaded surfaces are never dithered.
on	Flat-shaded surfaces are always dithered.

The **pref-pex-dither-interpolated-surface** parameter controls Gouraud-shaded surface dithering (half-toning) (Setup ⇒ Change User Preferences ⇒ PEX ⇒ Dither Interpolated Surface).

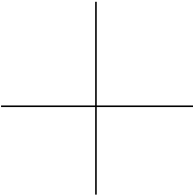


Table 14-20 pref-pex-dither-interpolated-surface Parameter

Possible Values	Result
default	on
on	Gouraud-shaded surfaces are always dithered.
by-request	Gouraud-shaded surfaces are dithered only when the client requests it.
off	Gouraud-shaded surfaces are never dithered.

Specifying Surface Interior Style, Shading, and Lighting

The **pref-pex-surface-interior-style** parameter specifies how to render the interiors of surfaces (Setup ⇒ Change User Preferences ⇒ PEX ⇒ Surface Interior Style).

Table 14-21 pref-pex-surface-interior-style Parameter

Possible Values	Result
default	by-request
by-request	Surface interiors are rendered as requested by the client.
hollow	All surface interiors are rendered hollow.
solid	All surface interiors are rendered solid.
empty	All surface interiors are rendered empty.

The **pref-pex-surface-interp-method** parameter specifies how to shade the interiors of surfaces (Setup ⇒ Change User Preferences ⇒ PEX ⇒ Surface Interpolation Method).

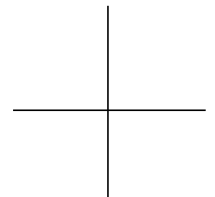


Table 14-22 pref-pex-surface-interp-method Parameter

Possible Values	Result
default	by-request
by-request	Surface interiors are shaded as requested by the client.
none	All surface interiors are flat-shaded.
color	All surface interiors are Gouraud-shaded.

The **pref-pex-surface-reflect-model** parameter specifies how to apply lighting effects to all surfaces (Setup ⇒ Change User Preferences ⇒ PEX ⇒ Surface Reflection Model).

Table 14-23 pref-pex-surface-reflect-model Parameter

Possible Values	Result
default	by-request
by-request	Surface lighting effects are applied as requested by the client.
none	Surfaces are not lighted.
ambient	Only ambient lighting is used.
diffuse	Ambient and diffuse lighting are used.
specular	All lighting effects are used.

Specifying the Color Clipping Method

The **pref-pex-color-clipping-method** parameter specifies the method for clipping colors that cannot be displayed because their RGB (red, green, blue) components are outside the displayable range (0.0 through 1.0). Although the display hardware automatically clips values that are out of range, the resulting displayed color is unpredictable (Setup ⇒ Change User Preferences ⇒ PEX ⇒ Color Clipping Method).

Color components may exceed the displayable range, for example, when numerous light sources are applied.

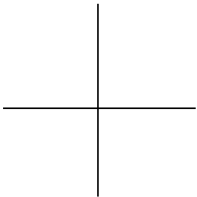


Table 14-24 pref-pex-color-clipping-method Parameter

Possible Values	Result
default	none
none	The RGB components are not corrected.
scale	The RGB components are scaled proportionately if any components exceed 1.0. For example, if the red component has a value of 1.2, it is scaled to 1 and the green and blue components are scaled by the same percentage. Hue and saturation are maintained, while intensity is clipped.
desaturate	The color saturation (contrast) of the RGB components is clipped, while the hue and intensity are maintained.
clamp	The RGB components are set to 0 if they are less than 0.0 or to 1.0 if they are greater than 1.0. Clamping can potentially alter hue, saturation, and intensity.

Specifying the Input Device for PEX

When using the PEX server, you can attach one of the following special input devices to the serial port: a Summagraphics-compatible digitizing tablet or a Logitech 3D mouse. If you are using one of these input devices:

- ❑ Make sure the input device is specified in the **xserver-input-extension-device** parameter (Setup ⇒ Change Setup Parameters ⇒ Input Devices ⇒ Input Extension Device). This parameter is not saved in NVRAM.

Table 14-25 xserver-input-extension-device Parameter

Possible Values	Results
default	tablet
tablet	Specifies a Summagraphics-compatible digitizing tablet.
3d-mouse	Specifies a Logitech 3D mouse.

- ❑ Set the mode of the serial port to “input-device” in the **serial-interfaces-table** parameter (Setup ⇒ Change Setup Parameters ⇒ Serial ⇒ Serial Interfaces Table). This parameter is saved in NVRAM.

For example:

```
serial-interfaces-table = {1 input-device input-device 9600 8 1 none none none}
```

Troubleshooting PEX

The most common problems experienced in running PEX clients are clients that do not run and clients that run but look different on an NCD terminal.

If the PEX Client Does Not Run

If you have trouble running a PEX client and cannot figure out why, check the client documentation. Common conditions that prevent clients from running are:

- ❑ Some clients require that a variable be set in the user’s environment.
- ❑ Some clients require a pre-existing error output file.
- ❑ Occasionally, a client written for a 24-bit display does not set up the proper colormap for 8-bit displays such as the current NCD terminals.

If the PEX Client Looks Different

The PEX protocol defines a full range of graphics functions and allows a server to comply with the protocol without implementing all functions. If the NCD PEX module does not implement the same function subset as another server, the client may look different on the two displays.

For example, the shading methods defined by the PEX protocol are color (Gouraud shading), dot product, and normal (Phong). The NCD PEX module supports Gouraud shading. Clients can run in the absence of the other shading methods because clients default to one of the methods supported by the server.

