ssheet

This syntax is specific to...
Silicon Graphics workstations

keys:	**[from]**	*<number>*	source picture
	to	*<number>*	start picture number for saving displayed images
	with	*<number>*	picture containing an image specifying the surface colour values for the colour map rendering mode
	emission	*<number>*	display look-up table number defining the colours to be used in the emission contour mode
	colour	*<number>*	display look-up table number defining the colours to be used in the colour contour mode
	map	*<number>*	display look-up table number for mapping the colours to be used in the colour map mode
	vfrom	*<number>*	picture containing initial view parameter settings
	vto	*<number>*	picture for saving viewing parameters

Use the **ssheet** command to display 3D surfaces using the Silicon Graphics workstation's 3D graphics capability. The source picture intensity values are interpreted as Z or height information and the resulting surface is rendered into a separate display window. You control the viewing, lighting and clipping parameters as well as the way in which the surface is rendered by manipulating sliders and menus with the workstation's mouse.

Examples

```
ssheet 2:1
```

This command displays the surface described by the intensity values in picture 2:1.

```
ssheet from 4 to 5
```

This command displays picture 4 as a 3D surface and allows you to save displayed images in pictures 5, 6, 7, etc.

```
ssheet 9 colour 2 emission 5
```

This command displays picture 9, using display look-up table 2 for the colour contoured rendering mode and look-up table 5 for the emission contour mode.

```
ssheet 34 vfrom 999 vto 998
```

This command displays picture 34 according to the viewing parameters saved in picture 999. The modified viewing parameters on exit from **ssheet** are saved in picture 998.

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Description

The command **ssheet** interprets the source picture intensity values as Z or height information and displays the surface in one of five ways:

- wireframe
- smooth shaded surface
- emission contoured surface
- colour contoured surface
- colour mapped surface

A control panel is displayed in a second window, allowing you to modify the viewing parameters, data sampling interval and rendering mode, and to save/restore all these settings. You may also save the displayed view as a Semper picture. Separate control panels can be selected to control the lighting conditions and set the clipping limits. All of these controls are driven by the workstation's mouse.

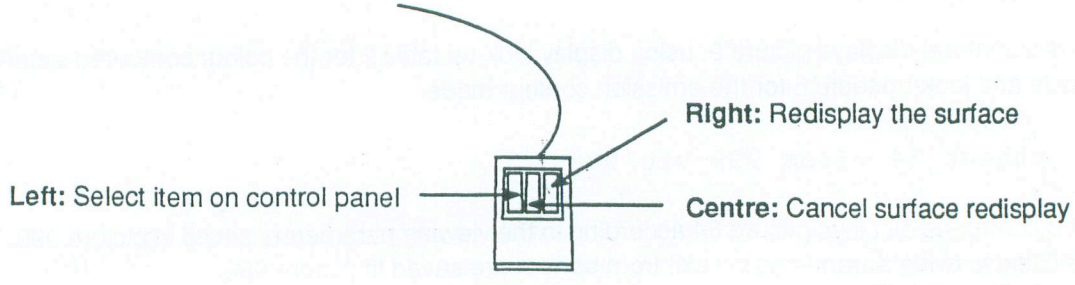
When the command starts up, the source picture data is copied into an array in virtual memory (4 bytes per pixel). For very large images (1K by 1K or larger), this will take some time and there may also be a time penalty when rendering the image, if the available amount of physical memory is such that much of the image data is paged from disc.

How to use the mouse

All of the normal window controls may be accessed with the mouse. You may reposition any of the control panels but not resize them. The surface display window may be repositioned and also resized at any time. Selecting the **Close** or **Quit** option in a window's pop-up menu will cause the **ssheet** command to be abandoned. The normal way to exit the **ssheet** command is to select the **QUIT** option on the main control panel.

When the cursor lies within the display window, or any of the control panels, you can press the right mouse button to cause the surface to be redisplayed. Pressing the middle mouse button will cancel this operation.

When the cursor is positioned inside any of the control panels, you can adjust sliders or select menu options by pointing to the relevant object with the mouse and the pressing the left mouse button.



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To move a slider, you must must place the cursor on or near the slider's pointer before pressing the the left mouse button. As long as you hold down the mouse button, the pointer will track any movement of the mouse. There are three types of sliders:

- circular sliders, for setting angular values
- linear sliders
- logarithmic sliders

Only the field-of-view and vertical scaling parameters are controled by logarithmic sliders.

When you select a menu option, the option is highlighted in red. Only when you release the left mouse button does the menu option take effect. This means that you can slide the cursor up and down the menu, over different options, until you are satisfied with the selection. If you move the cursor right out of the menu box, the menu is restored to its original state, allowing you to cancel the selection of any menu option.

When the image is being redisplayed and the single redraw mode is selected, the appearance of the cursor changes to an hourglass. This does not happen when the continuous redraw mode is selected because it would cause the cursor to switch rapidly between the hourglass cursor and the default arrow cursor.

The display window

The display window is the second window to appear on the screen after the **ssheet** command starts up. You will have to position and size the window so that it does not obscure the main control panel and any other windows you may also wish to see. The display window may be repositioned and resized at any time. The title of the source picture will appear in the window's title bar.

The 3D surface is rendered in the display window so that, with the default field-of-view of 45 degrees, the image occupies the middle third of the window and should not exceed the limits of the window even with extreme settings for the vertical scaling and view direction. Decreasing the field-of-view zooms the view in towards the surface. Any part of the surface extending beyond the limits of the window will be clipped.

The main control panel

The main control panel appears in the first window to appear on the screen after the **ssheet** command starts up. The window occupies most of the width of the screen so you should position it either at the top or the bottom of the screen. All of the normal viewing controls are to be found on this control panel. Further controls can be displayed up by selecting the **Lighting** and **Clipping** menu options.

The vertical scaling factor for the surface can be varied on a logarithmic scale from 0.01 to 10.0. With unit vertical scaling, the surface Z values are scaled so that the Z range is a quarter of the X or Y dimension, whichever is larger.

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The view is positioned with respect to the surface by means of a 3D cursor. This is red cross-hair which indicates the view centre position. Where the cursor is obscured by the surface, it appears dotted. When the surface is redisplayed, the view centre position will appear at the centre of the display window. The cursor position is controlled by the **Cursor X**, **Cursor Y** and **Cursor Z** sliders. The X and Y slider values are displayed in terms of the source picture coordinates and the Z slider value in terms of the source picture data range. The 3D cursor may be turned on or off.

Circular sliders allow you to set the azimuth and elevation angles for the viewing direction. The surface is displayed so that, as far as possible, the Z axis is projected projected vertically upwards on the screen. The azimuth is the anti-clockwise angle between the positive X axis and the projection of the viewing direction on the X-Y plane. The elevation is the angle between the viewing direction and the X-Y plane.

The surface can be rendered in one of five ways which you select by means of the **Rendering mode** menu:

- wireframe — a grid is drawn joining all adjacent vertices in the X and Y directions
- smooth shaded surface — a smoothly shaded grey surface is rendered, subject to the current lighting conditions
- emission contoured surface — the surface is rendered so that it appears to emit light whose colour varies with the height of the surface
- colour contoured surface — the surface is rendered so that the surface colour varies with the height of the surface, subject to the current lighting conditions
- colour mapped surface — the surface is rendered with the surface colour defined by a separate source image, subject to the current lighting conditions

Note that the **Colour map** option will only appear in the **Rendering mode** menu if the **with** key is specified with the **ssheet** command. The picture specified with this key should be either a single layer picture defining a false colour image or a three layer picture defining a full colour image. The X and Y dimensions of this picture must be the same as the source picture dimensions.

The **emission**, **colour** and **map** keys allow you to specify display look-up tables to define or map the colours used in each of the last three rendering modes. The default is to use the current look-up table (given by Semper variable **clut**) for the colour contour mode and to use linear grey-scale ramps for the emission contour and colour map modes. Each look-up table entry defines the colour for a single contour band for the emission and colour contour modes. The total assemblage of bands spans the entire Z range of the surface. When several adjacent look-up table entries are the same, they will be merged into a single colour band. The time taken to render a contoured surface varies in direct proportion to the number of bands. The **Band coarseness** slider allows you to set an interval for sampling the look-up table data so that the number of bands is reduced. The default band coarseness results in a maximum of 16 contour bands.

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You can also control the source data sampling interval with the **Model coarseness** slider. The coarser the interval, the faster the surface is redisplayed. The wireframe mode is the fastest rendering mode, followed by smooth shading and then the contoured surface or colour map rendering modes, depending on the band coarseness. The default model coarseness setting results in a maximum of 32 sampling points in the X direction. With this sampling interval the wireframe rendering mode is fast enough to allow continuous adjustment of the viewing parameters to be displayed in real time. Note that when the **Continuous** redraw mode is selected, the display is double buffered: the display window switches instantaneously to the new image. In **Single** redraw mode, the old image is erased first and you can then watch the new image being rendered in the display window.

The surface is rendered as a series of square facets with a source pixel at each corner. You can redisplay part of the surface by swithcing on the **Clipping** mode. Any facets which lie entirely outside the clipping limits are skipped over as well as any facets which fall outside the limits of the display window. The Clipping limits themselves are set by means of a separate control panel which you select with the **Clipping** menu option. Reducing the clipping limits reduces the amount of time to redisplay the surface.

The surface is rendered with all hidden surfaces removed by making use of the workstation's Z-buffer facility. The 3D nature of the image can be further enhanced by switching on the **Border** mode. This adds a border surface or "plinth" under the surface which extends down as far as the minimum Z-extent of the surface. The effect is as if the surface is "sculpted" out of a solid block of material. When the **Emission contour** or **Colour contour** rendering mode is selected, the contours extend around the border surface.

The normal way to cause the surface to be redisplayed after making changes to the viewing parameters is to press the right mouse button. However, if you select the **Continuous** redrawing mode, the surface will be redisplayed each time a viewing parameter is changed. The following events also cause the surface to be redisplayed:

- changing **Rendering mode**
- changing **Redraw mode**
- switching **Clipping** on or off
- switching **Border** on or off
- selecting **Centre view** on the clipping control panel
- repositioning or resizing the display window
- exposing any part of the display window

If the **to** key is specified when starting up the **ssheet** command, the **Save Image** menu option will appear on the main control panel. This allows you to to save the current image into the specified Semper picture. The picture will contain three layers of byte data representing the red, green and blue intensities of the surface image. You can save the current image as often as you like. Each time the output picture number is incremented, up to the maximum of 999. In this way you can save a whole sequence of views.

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You can also save all the current viewing parameters into a buffer and then restore them later on. If you use the key **vfrom** when starting up the **ssheet** command, the buffer is initialised to the values contained in the specified Semper picture, otherwise, the following default values are used:

- Azimuth 315 degrees
- Elevation 45 degrees
- Field of view 45 degrees
- Cursor position centre of X, Y and Z range
- Vertical scale 1.0
- Model coarseness (source picture row length) / 32
- Contour band coarseness (display look-up table length) / 16
- Rendering mode wireframe
- Redraw mode single
- Cursor on/off on
- Border on/off off
- Clipping on/off on
- Autocentring on/off off
- Clipping limits limit of X and Y range
- Front section plane 100 %
- Back section plane –100 %
- Ambient lighting 10 %
- Light source azimuth 0 degrees
- Light source elevation 90 degrees
- Light source colour white (on), black (off), black (off)

The contents of the buffer are used to set the viewing parameters when you start up **ssheet** and whenever you select the **Restore View** menu option. If you specify the **vto** key, the contents of the buffer are copied into the specified Semper picture when you quit from **ssheet**.

The lighting control canel

All the controls to set the lighting parameters are contained in a separate control panel which will appear if you select the **Lighting** menu option on the main control panel. You may position this control panel anywhere you like on the screen. When you have finished adjusting the lighting parameters, you can clear away the window by selecting the **HIDE WINDOW** menu option.

The lighting parameters affect the appearance of the surface (border surface as well as the top surface) when rendered in the smooth shaded, colour contour or colour map mode. There is ambient lighting and three separate point light sources. You can control the orientation, colour and brightness of each light source. If you set the red, green and blue intensity of a light source to zero, the light source is turned off. This bypasses the small time overhead associated with each light source when rendering the surface. The default lighting consists of 10% red, green and blue ambient light and one white light source positioned vertically above the surface. The orientation of the light sources is specified in the same way as the viewing direction, that is, with an azimuth and elevation defined with respect to the source picture axes.

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The clipping control panel

Controls to set the clipping limits and the front and back sectioning planes are located in a separate control panel which will appear if you select the **Clipping** menu option on the main control panel. You may position this control panel anywhere you like on the screen. When you have finished adjusting the clipping parameters, you can clear away the window by selecting the **HIDE WINDOW** menu option.

The clipping limits determine which surface facets are rendered. Any facet which falls completely outside the clipping limits is not rendered, together with any facets falling outside the limits of the display window. You can use the clipping facility to expose parts of a surface which would not otherwise be visible. You can also speed up the display of small sections of the surface, so that rendering modes other than the wireframe mode can also be used when the **Continuous** redraw mode is selected.

The **Centre view** menu option causes the view centre position to be set mid-way between the X and Y clipping limits. This is useful when the clipping limits get too far away from the view centre position so that the part of the surface that is not clipped disappears off the edge of the display window. Turning on the **Autocentring** mode causes the view centre position to be centred on the clipping limits whenever these are adjusted.

The front and back sectioning planes allow you to set clipping planes perpendicular to the view direction. The slider value for each plane is arranged so that zero intersects the view centre position and 100% is guaranteed to lie beyond the limits of the surface.

The clipping parameters are not allowed to cross over: the slider controls are interlocked so that, for example, if the minimum X clipping limit is moved to the right of the maximum X limit, the pointer for maximum X slider will also move to maintain the correct relationship with the minimum X slider. The sliders for the Y clipping limits and the sliders for the front and back sectioning planes are similarly interlocked.

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Defaults and Ranges

keys/options	defaults	range
[from]	current picture, held in the variable *select*	valid picture number
to	*none*	valid picture number
with	*none*	valid picture number
emission	linear grey-scale look-up table	valid look-up table number
colour	current look-up table, held in the variable *clut*	valid look-up table number
map	linear grey-scale look-up table	valid look-up table number
vfrom	*none*	valid picture number
vto	*none*	valid picture number