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Vectorizing

Vectorizing tools are used to create vector data from scanned drawings or images. Combined with the display speed of Image Manager, these tools provide an efficient environment for data conversion projects.

Overview

Vectorizing and raster to vector line conversion are achieved with a set of tools and function keys, together with special features to control the automatic line conversion: the nodes. This chapter explains all of these features and their properties, as well as the behavior of the vector data which is generated.

The conversion functions can work with gray scale or color images, as well as with binary or two-color images. When gray scale or color images are digitized, a color filter has to be used in order to determine the lines to be converted.

Automatic line conversion consists of following lines and outlines, or following the boundaries between a mass of pixels belonging to a given color filter and the rest of the image.

When you convert or interpret raster objects into design elements, you can define the characteristics and meaning of this element by using a theme. A theme is a set of parameters that defines the element symbology, such as line weight, line style, pattern, hatch, color, name (road, street, pipe, etc.), and so forth.

This chapter first presents the new concepts or features utilized in heads-up digitizing or line conversion operations, and then describes a set of enhanced MicroStation line editing tools, with

integrated automatic line conversion and raster snap functions and zoom capabilities:

- Place Element (Stream, Point or Arc mode)
- Continue Element (Stream, Point or Arc mode)
- Insert Element (Stream, Point or Arc mode)
- Convert Lines
- Convert All Connected Lines
- Convert Contour Lines
- Convert Circle
- Place Nodes
- Delete Nodes
- Vectorize Settings
- Auto Convert
- Raster Snap
- Spy Window
- Undo/Redo Vertices
- Snap Vector
- Center on Cursor/Last point
- Close Element

Concepts

The following sections present the new concepts and features involved in vectorizing, such as nodes and other break points, generalization, raster lines or outlines.

Nodes

Nodes are features allowing the operator to control the Vectorize functions by stopping or constraining automatic line conversion. They are manually placed with the *Place Nodes* tool and they can be removed with the *Delete Nodes* tool. They can also be automatically placed at specific points with the Auto Place Nodes toggle on.

Nodes can be created, displayed, deleted, or saved into files and restored for later use.

The main property of a node, which is a point surrounded by a control area, is to stop all automatic line conversion functions and to force the generated vector element to snap to it. The automatic line conversion functions are: Auto Convert in Place Element or Continue Element, Convert Lines, Convert All Connected Lines, and Convert Contour Lines.

Besides the above, nodes govern all of the Vectorize functions according to the following rules:

- All points are to be placed inside the control area of a node snap to this node.
- When a snap to a node occurs, all functions stop or pause for a decision (automatic or from the operator).
- A node cannot be placed inside the control area of another node.
- When a point is to be entered where the control areas of two or more nodes overlap, it snaps to the closest node.

Other Break Points

Break points are where the automatic line conversion stops or pauses for a decision. In addition to nodes, which are managed

by the operator, there are two kinds of break points which belong to the raster image and are not managed by the operator:

- Raster Intersection Points are where three or more raster lines intersect.
- Raster End Points are the ends of raster lines, or where the automatic line conversion algorithm cannot go further on a raster line.

The results of the Vectorize functions with Raster Intersection Points and Raster End Points are:

- When a Raster Intersection Point or a Raster End Point is hit, all automatic line conversion functions stop or pause for a decision (automatic or from the operator). The automatic line conversion functions are: Auto Convert in Place Element or Continue Element, Convert Lines, Convert All Connected Lines, and Convert Contour Lines.
- When two vector lines generated by automatic line conversion hit the same Raster Intersection Point, they have exactly the same end point.
- When a function is going to hit either a Raster Intersection Point or a Raster End Point inside of the control area of a node, the node always wins and its rules apply.

Generalization

After a vector line is generated by automatic line conversion, it is passed through a generalization process. This process removes points from the original result to keep only those considered as necessary to characterize the original pathway of the vector line.

The first and the last points produced by automatic line conversion are kept unchanged by generalization. It may happen that only those points remain after the generalization process, and the result is then a straight two-point segment.

Raster Lines or Outlines

For all Vectorize functions, there is no difference between a raster line and the outline of raster objects, which is the boundary

between a mass of pixels (for a given color filter) and the rest of the image. Let's look at a few examples.

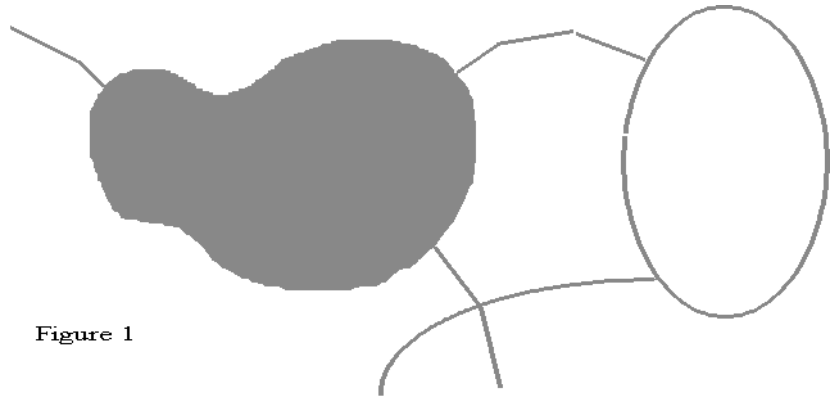


Figure 1

In the diagram above, all raster objects belong to the same color filter, including the outer contour of the ellipse as well as the “body” of the pear-shaped object on the left. This object has no outer contour as such, as opposed to the situation shown in Figure 2 below. In Figure 2, the body of this shape is filled with a lighter gray and does not belong to the given color filter, but it has a contour line belonging to this filter. In both situations, the Vectorize functions yield the same result.

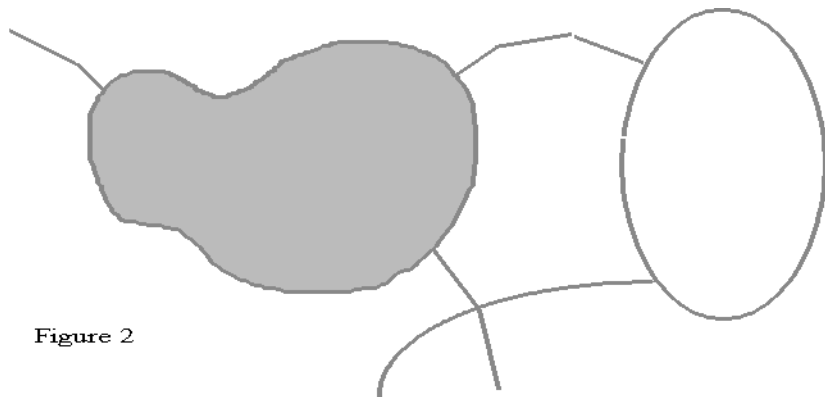


Figure 2

With the following functions, you can convert either lines or outlines:

- Place Element, with Auto Convert (see “Place Element tool” on page 13-8)

- Continue Element, with Auto Convert (see “Continue Element tool” on page 13-12)
- Convert Lines

Before using any of these tools, you have to specify whether you want to vectorize lines or outlines. To do so, choose Line or Outline in the Entity option menu in the tool settings windows.

For example, the following procedure shows how to convert all lines or outlines of Figure 3.

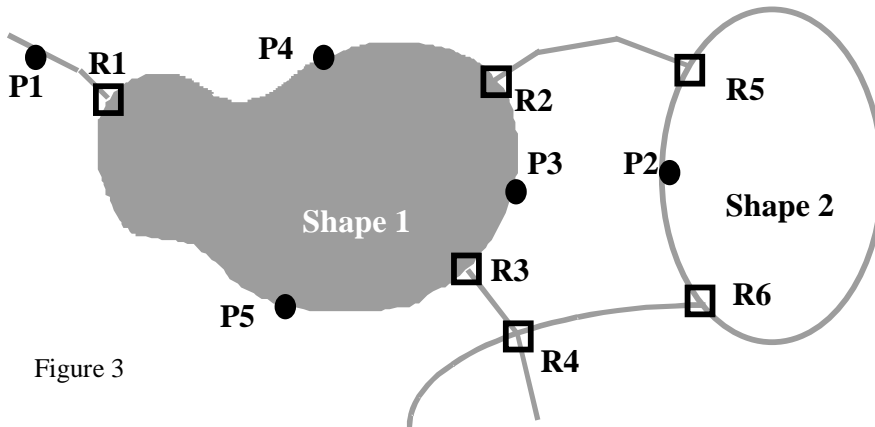


Figure 3

Line to outline intersections such as R1, R2 and R3 will be detected with the Line option, but not with Outline. Taking that into account, it is suggested that you convert lines before outlines.

► To convert all lines and outlines in Figure 3

1. Turn on the Auto Place Nodes toggle on the Nodes page of the Vectorize Settings dialog box (see “Auto Place Nodes” on page 13-38).
This automatically places nodes at positions R1, R2, R3, etc., when appropriate.
2. Select *Convert Lines*, and then choose Line in the Entity option menu in the tool settings window.
3. Choose the appropriate Filter and Theme options.
4. Enter a data point at P1.
This automatically places a node at R1 and converts the branch going off Shape 1.
5. Choose *Convert All Connected Lines* (and the same Filter and Theme options).

6. Enter a data point at P2.
This converts all of the network of lines to the right of shape 1, including the ellipse, and automatically places nodes at R2 and R3.
7. Select *Convert Lines* again, and choose Outline in the Entity option menu in the tool settings window.
Keep the same Filter and Theme options.
8. Enter data points at P3, P4, and P5.
This converts the outlines between R2 and R3, between R1 and R2, and between R1 and R3, and completes all line conversion in Figure 3.

Vectorize tool box

The Vectorize tool box includes a set of enhanced editing tools that support extraction of feature information from images.

Vectorize tool box



All elements digitized with the Vectorize tools are added to the active design file as “complex chains,” which consist of one or more line string elements, as well as arcs. The tool box comprises several vectorizing or line conversion tools and one extra button for settings.

The first three tools, *Place Element*, *Continue Element* and *Insert Element* are for placing a new element or continuing or editing an existing one. They are manual and directly controlled by the operator when raster data is not present or not used. They are more or less automatic when raster data is present and used.

The next tools are for controlling automatic line conversion from raster to vector. These functions cannot work without raster data. They are organized in such a manner that any number of raster lines or circles can be automatically converted in a row.

Additionally, a set of special functions or parameters supplements the Vectorize tools. They can be accessed through user-defined function keys, or they can be set on the appropriate tool settings windows when the context permits. The remainder are set in the Vectorize Settings dialog box, which is accessed from the last button of the Vectorize tool box.

Any element drawn with a Vectorize tool is given the tag of the current theme. The element is created with all graphical attributes related to the theme specified such as color, line style, line weight, fill, hatch, or pattern. The theme is selected with the Theme option menu in the tool settings window of each tool. If “None” (the default) is selected, the MicroStation graphical attributes chosen from the Element menu are used for the display and no tag is given to the element.

- ☞ Most of the Vectorize tools use the MicroStation locate tolerance to begin, especially when Raster Snap is on (Raster Snap is automatically on with the *Convert Lines*, *Convert All Connected Lines*, *Convert Contour Lines* and *Convert Circle* tools). To change the size of the locate tolerance, use the following key-in:

Key-in: SET LOCATE <value>

Value is a number between 1 and 100, given in screen pixels.

The Vectorize tools or functions can be used with the following MicroStation element types:

Use	With element types
Continue Element	Line, Line String, Complex Chain, Arc
Insert Element	Line, Line String, Complex Chain
Snap/Insert Vector	Line, Line String, Complex Chain
Snap/Break Vector	Line, Line String, (Complex Chain)
Auto Snap Vector (Insert)	Line, Line String, Complex Chain
Auto Snap Vector (Break)	Line, Line String, (Complex Chain)

- ☞ The open/closed status of the Vectorize tool box is saved with a project.

Place Element tool

Accepts the previous vector element and starts a new vector element with the selected theme.

Place Element tool



There are several ways of using this tool. When raster data is not present or is not used, it can be a straight heads-up digitizing tool,

directly controlled by the operator. If raster data is correctly defined with a color filter, this tool can be used for automatic line conversion.

Here are a few procedures with various settings or selections. The first two are purely manual.

► **To create a new line string manually**

1. Select the *Place Element* tool.
2. Turn off Erase Raster, Raster Snap and Auto Convert.
3. Choose Stream or Point mode.
4. Select the appropriate theme.
5. Enter a data point to define the beginning of the line string.
6. In Point mode, continue to enter data points to define other vertices. In Stream mode, move the tablet cursor or mouse without pressing the data button.
7. Reset to end the line string.

► **To place an arc manually**

1. Select the *Place Element* tool.
2. Turn off Erase Raster, Raster Snap and Auto Convert.
3. Choose Arc from the Mode option menu.
4. Select the appropriate theme.
5. Enter a data point to define the beginning of the arc.
6. Enter a second data point to anchor a point along the arc.
7. Enter a third data point to define the end of the arc.
8. Reset to end the arc.

☞ After defining one arc, you can continue the present complex chain with more arcs, or you can switch to Point mode or Stream mode and continue the complex chain with line strings. If you define more than one arc in a row, the second and the next arcs require only two points. The last point of the previous arc is the first point of the next arc. See “Arc Recognition” on page 13-31 for more settings.

The next procedure shows how to use the raster snap to digitize a raster line.

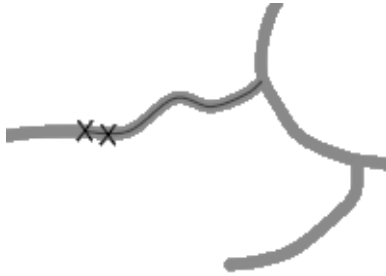
► To digitize a line with Raster Snap

1. Select the *Place Element* tool.
2. Turn on Raster Snap.
3. Select the appropriate color filter.
4. Choose Point Mode (or Stream Mode).
5. Select the appropriate theme.
6. Choose Line in the Entity option menu.
7. Enter data points approximately on the raster line to be digitized (in Stream mode, move the cursor approximately along the raster line without pressing the data button). Each point snaps on the center of the raster line, where vertices will be defined.
8. Reset to end the line string.

► To digitize the border of a raster body with Raster Snap

1. Select the *Place Element* tool.
2. Turn on Raster Snap.
3. Select the appropriate color filter.
4. Choose Point Mode (or Stream Mode).
5. Select the appropriate theme.
6. Choose Outline in the Entity option menu.
7. Enter data points approximately on the border to be digitized (in Stream mode, move the cursor approximately along the border line without pressing the data button). Each point snaps on the exact border, where vertices will be defined.
8. Reset to end the line string.

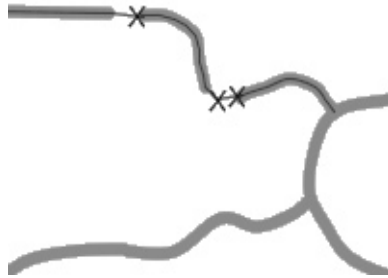
The next procedure shows how to start automatic line conversion along a raster line or at one end of a raster line.



► **To start automatic line conversion along a raster line**

1. Select the *Place Element* tool.
2. Turn on Raster Snap and Auto Convert.
Erase Raster should be turned OFF.
3. Select the appropriate color filter.
4. Choose Point or Stream mode.
5. Select the appropriate theme.
6. Choose Line in the Entity option menu.
7. Enter a data point along the raster line, approximately where you want to begin the line string. The point snaps on the center of the raster line (use the Spy Window with Raster Snap off if you want to define the starting point more precisely).
8. Enter another data point to determine in which direction you want to go. The automatic line conversion starts automatically from there and continues until a break point (a node, an intersection or an end point) is encountered.
9. Reset to end the line string (or continue the same line string in the same mode by entering one or more data points).

The next procedure shows how to bridge gaps in raster lines.



► To bridge gaps along a raster line

1. Follow either of the above procedures until the automatic line conversion hits a gap. A rubber band is then attached to the last point of the line string.
2. By stretching the rubber band over the gap, enter one or several data points until you reach the other side. The automatic line conversion resumes automatically from there and continues until a break point (a node, an intersection or an end point) is encountered.

If you use the Arc mode, enter a data point in the center of the gap and another on the other side. The automatic line conversion resumes automatically from there.

3. Repeat the same until all gaps are bridged.
4. Reset to end the line string.



- ☞ You may have to turn off Raster Snap and/or Auto Convert while entering data points to bridge the gap, especially if there raster data that “disturbs” the operation, such as text, in the gap.

Continue Element tool

Selects a vector element and continues placing line strings or arcs from the chosen end with the same theme. This tool works exactly like Place Element, except it allows you to select an existing element before continuing it.

Continue Element tool



► **To resume the placement of an existing element**

1. Select the *Continue Element* tool.
2. Identify the element.
3. Enter a data point near the end of the element at the location where you want to resume (or reset and retry).

After you select the element to resume, follow any of the Place Element procedures described above (except the first step).

Insert Element tool

Edits an existing element by removing a portion of it between two points that you specify and by placing new line strings or arcs between these points. After you specified the portion to be removed, this tool works like Place Element and it has the same settings except Auto Convert which is not present. The resulting element, made of two former portions and the new one, will be a complex chain.

Insert Element tool



You can place the new part of the element with any of the three modes:

- Point,
- Stream
- Arc

► **To edit an existing element in Point mode**

1. Select the *Insert Element* tool.
2. Select Point from the Mode option menu.
3. Specify the portion of the element to be changed by entering two data points.

The former line string is removed and a double rubber band is attached to both points specified. The solid rubber band tells where the new line string will be entered.

4. Enter data points to define all vertices of the new line string.

5. Reset to end the line string.

A line is drawn between the last point entered and the point where the dashed rubber band was connected. The modified element is then placed as a complex chain.

► **To edit an existing element in Stream mode**

1. Select the *Insert Element* tool.
2. Select Stream from the Mode option menu.
3. Specify the portion of the element to be changed by entering two data points.

The former line string is removed and a double rubber band is attached to both points specified. The solid rubber band tells where the new line string is to be entered.

4. Enter a data point to start drawing the new line string in Stream mode. Then move the table cursor or mouse without pressing the data button.

5. Reset to pause the stream.

A dashed rubber band displays between the last point entered and the second point specified in step 3.

6. Enter a data point to resume drawing the new line string in stream mode as in step 4.

or

Reset to end the line string.

A line is drawn between the last point entered and the point where the dashed rubber band was connected. The modified element is then placed as a complex chain.

► **To edit an existing element in Arc mode**

1. Select the *Insert Element* tool.
2. Select Arc from the Mode option menu.
3. Specify the portion of the element to be changed by entering two data points.

The former line string is removed and a double rubber band is attached to both points specified. The solid rubber band tells where new arcs are to be defined.

4. Enter two data points to define one arc.

The arc will be defined by the first point entered in step 3 and the two points entered in step 4.

If you press Reset after one data point, step 4 is started again. After one arc is defined, a dashed rubber band displays between the end of the arc and the second point specified in step 3.

5. Define other arcs by entering two data points as in step 4.
or

Reset to stop defining arcs.

A line is drawn between the end of the last arc and the point where the dashed rubber band was connected. The modified element is then placed as a complex chain.

Convert Lines tool

Used to automatically convert one or more raster lines and to place a line string with the selected theme for each raster line which is converted.

Convert Lines tool



The behavior of this function depends upon where it is started.

- If it is started along a raster line, this raster line is converted in both directions until a break point (raster intersection point, raster end point, or node) is hit. Only one line string is generated.
- If it is started at a free end of a raster line (on a raster end point), this raster line is converted in the only possible direction until a break point is hit. Only one line string is generated.
- If it is started at a raster intersection (on a raster intersection point), all raster branches are converted until a break point is hit. A line string is generated for each raster branch.
- If it is started from a node, a raster line is converted in every possible direction until a break point (raster intersection point, raster end point, or node) is hit. A line string is generated for each possible direction (that excludes a branch that is already converted).

Auto Continue

If on, the *Continue Element* tool is automatically selected after using the *Convert Lines* tool. That allows conversion to continue of a raster line or all raster branches connected at the same intersection.

If you use the *Convert Lines* tool to convert one raster line, use the *Continue Element* tool to continue this line from one end and then from the other end. Press the Reset button to switch from one end to the next. After both ends have been continued, press Reset to return to the *Convert Lines* tool.

If you use the *Convert Lines* tool to convert all raster branches from the same intersection, you can continue each branch from its far end. Use the Reset button to switch from one branch to the next. After all branches have been continued, press Reset to return to the *Convert Lines* tool.

- ☞ In either situation, any end that hits an existing node will not be offered for continuation. Temporary nodes shown at other ends will be removed if you continue from there.
- ☞ If all ends snapped to existing nodes, the *Continue Element* tool is not automatically selected and you stay with the *Convert Lines* tool.

► To convert one raster line

1. Select the *Convert Lines* tool.
2. Select the appropriate color filter.
3. Select the appropriate theme.
4. Choose Line in the Entity option menu.
5. Turn on or off Auto Continue.
6. Identify the raster line to be converted by entering a data point along it or at a free end.

The resulting vector element follows the center of the raster line that is converted, and it is now constrained between two break points.

If Auto Continue is off, the procedure is complete.

If Auto Continue is on, the *Continue Element* tool is automatically selected and a rubber band is drawn from one end of the resulting vector element. Continue with the next steps.

7. Use the *Continue Element* tool to continue converting the line as far as you wish and then press Reset.
You are switched to the other end and a rubber band is drawn from there.
8. Use the *Continue Element* tool to continue converting the line from the other end as far as you wish and then press Reset.
You are switched back to the *Convert Lines* tool.

► **To convert the side of a raster line or the outline of a raster object**

1. Select the *Convert Lines* tool.
2. Select the appropriate color filter.
3. Select the appropriate theme.
4. Choose Outline in the Entity option menu.
5. Identify the side of the raster line or object to be converted by entering a data point on the side (or just outside) of it.
The resulting vector element follows the edge of the raster line or object in both directions from the starting point. Only existing nodes stop this automatic conversion.

W Since it is the only way to control the Outline mode, it is recommended that you place nodes in the appropriate positions prior to start.

► **To convert all raster branches from an intersection**

1. Select the *Convert Lines* tool.
2. Select the appropriate color filter.
3. Select the appropriate theme.
4. Choose Line in the Entity option menu.
5. Turn on or off Auto Continue.
6. Identify the branches to be converted by entering a data point at the intersection.

All branches are converted from the intersection to the next break point in each direction. Resulting vector elements follow the center of the raster lines that are converted.

If Auto Continue is off, the procedure is complete.

If Auto Continue is on, the *Continue Element* tool is automatically selected and a rubber band is drawn from the end of one branch. Continue with the next steps.

7. Use the *Continue Element* tool to continue converting the first branch as far as you wish and then press Reset.
You are switched to the end of the next branch and a rubber band is drawn from there.
8. Use the *Continue Element* tool to continue converting the other branches. Press Reset to switch from one branch to the next. When all branches are done, press Reset.
You are switched back to the *Convert Lines* tool.

Convert All Connected Lines tool

Used to convert all raster branches forming a network of lines connected at intersections and to place a vector string with the selected theme for each raster line which is converted.

Convert All Connected Lines tool



This tool can start conversion from anywhere on the network of lines to be converted: along a line, on an intersection, at the end of a line, or even on a node.

Line strings are then placed by converting raster in all possible directions from the starting point to the next break point (raster intersection points, raster end points, or nodes). When a break point is hit, the following conditions apply:

- If the break point is a raster intersection, all other branches from there will be processed. This progressively converts all lines connected at intersections.
- If the break point is the end of a line, obviously there is no attempt to process other branches from this point.
- If the break point is a node, there is no attempt to process any other branch from this point.

If the starting point is on a node, the conversion process starts in every possible direction (excluding a branch that is already converted).

You will be prompted to identify the raster line or lines to be converted by entering a data point where conversion is to be started.

► **To convert one network of raster lines**

1. Select the *Convert All Connected Lines* tool.
2. Select the appropriate color filter.
3. Select the appropriate theme.
4. Identify the network of raster lines to be converted by entering a data point anywhere on the network.

Convert Contour Lines tool

Used to automatically convert one or more raster contour lines and to place a line string with the selected theme for each raster line which is converted.

Convert Contour Lines tool



This tool is used only with 3D design files.

You will be prompted to identify the raster line to be converted by entering a data point where conversion is to be started.

Active Z and Interval

When the first contour line of a series is converted, it is given the active Z that you specified in the Active Z text box in the tool settings window. The second one is given an active Z incremented with the Interval value. The increment will be positive if Up is selected, negative if Down is chosen.

If all contour lines to be converted happen to be at the same elevation, set the Active Z and lock it. Then, the Interval and the Up/Down options are not used.


Auto Continue

If on, the *Continue Element* tool will be automatically selected after a part of a contour line is converted. That allows continuation of converting this contour line from one end, and then from the other end. Use the Reset button to switch from one end to the other. After both ends have been continued, press Reset to return to the *Convert Contour Lines* tool.

If the whole loop of a contour line is converted and a closed shape results, this mechanism does not apply.

- ☞ If one end hits an existing node, it will not be offered for continuation. If both ends are snapped to existing nodes, the

Continue Element tool is not automatically selected and you stay with the *Convert Contour Lines* tool.

 Temporary nodes shown at the ends will be removed if you continue from there.

► **To convert one raster contour line**

1. Select the *Convert Contour Lines* tool.
2. Select the appropriate color filter.
3. Select the appropriate theme.
4. Set the active Z for this contour line (ignore the other parameters).
5. Turn on Auto Continue.
6. Identify the raster line to be converted.
If the result is a closed shape, the procedure is complete. If not, the *Continue Element* tool is automatically selected and a rubber band is drawn from one end of the resulting vector element. Continue with the next steps.
7. Use the *Continue Element* tool to continue converting the contour line as far as you can and then press Reset.
You are switched to the other end and a rubber band is drawn from there.
8. Use the *Continue Element* tool to continue converting the contour line from the other end as far as you can and then press Reset.
You are switched back to the *Convert Contour Lines* tool.

► **To convert a series of raster contour lines**

1. Select the *Convert Contour Lines* tool.
2. Select the appropriate color filter.
3. Select the appropriate theme.
4. Set the active Z for the first contour line.
5. Set the interval between two consecutive contour lines (positive number).
6. Select Up or Down to tell how you will progress from one line to the next.
7. Turn on Auto Continue.

8. Proceed to the conversion of the first raster line.
Identify this line with a data point. If the raster contour line is not completely converted, use the *Continue Element* tool, which is automatically selected, to complete it.
When you finish converting this line, the active Z is incremented accordingly.
9. Proceed to the conversion of the second raster line, and so on.

Convert Circle tool

Used to automatically convert one raster circle and to place a circle with the selected theme.

Convert Circle tool



► To convert one raster circle

1. Select the *Convert Circle* tool.
2. Select the appropriate color filter.
3. Select the appropriate theme.
4. Choose Line in the Entity option menu if only the circumference of the circle is drawn with the color (or colors) of the filter.
or
Choose Outline in the Entity option menu if the circle is filled with the color (or colors) of the filter.
5. Make sure the Round Off field is set to zero and the lock at the left of the Diameter/Radius option menu is off.
6. Identify the raster circle to be converted by entering a data point along its circumference.
The resulting vector circle follows the center of the raster circumference that is converted (or the circumference of the solid raster circle).
7. Enter a data point to accept the circle.
or
Adjust the size of the resulting circle by editing the Diameter/Radius field and enter a data point to accept the circle.

- ☞ Use the Round Off field to round off the resulting circle to specific increments. See “Circle Recognition” on page 13-32.

Place Nodes tool

Used to place nodes and to add them to the current Node file.

Place Nodes tool



The Boundary option menu controls the way positions are identified. Four options are supported:

- Use None to place nodes interactively one by one with data points.
- Use Block to place nodes where the boundary of a block crosses raster lines or outlines.
- Use Element to place nodes where the boundary of an existing closed vector element crosses raster lines or outlines.
- Use Fence to place nodes where the boundary of a fence crosses raster lines or outlines.

The Entity option menu lets you choose whether to place the nodes at the center of the raster lines (Line), or on the edges of the raster objects or lines (Outline).

► To place one node interactively at the position of a data point

1. Select the *Place Nodes* tool.
2. Select None as the Boundary option.
3. Turn off both Raster Snap and Vector Snap.
4. Identify the exact position of the node by entering a data point.
The node is placed without attempting to adjust to raster or vector data.

► To place one node interactively at the center of a line

1. Select the *Place Nodes* tool.
2. Turn on Raster Snap.
3. Turn off Vector Snap.

4. Select the appropriate color filter.
5. Select None as the Boundary option.
6. Choose Line in the Entity option menu.
7. Identify the approximate position of the node by entering a data point.

The actual position of the node is adjusted to the center of the line by the raster snap.

☞ If both Raster Snap and Vector Snap are on, the raster snap is applied first and then the vector snap.

► **To place one node interactively on the edge of a raster object or line**

1. Select the *Place Nodes* tool.
2. Turn on Raster Snap.
3. Turn off Vector Snap.
4. Select the appropriate color filter.
5. Select None as the Boundary option.
6. Choose Outline in the Entity option menu.
7. Identify the approximate position of the node by entering a data point.

The raster snap adjusts the actual position of the node and places it precisely on the edge of the raster object, or on either or both sides of a raster line.

☞ If both Raster Snap and Vector Snap are on, the raster snap is applied first, and then the vector snap.

► **To place nodes along the boundary of a block**

1. Select the *Place Nodes* tool.
2. Select the appropriate color filter.
3. From the Entity option menu, choose Line or Outline.
4. Select Block as the Boundary option.

This option is not accessible when there is no active image.

5. Define the block to be used as a boundary by entering two opposite corners.

If Line is chosen, nodes are placed everywhere the boundary of the block crosses raster lines. Outlines or edges are not considered.

If Outline is chosen, nodes are placed everywhere the boundary of the block crosses the edge of raster objects or lines. Both sides of raster lines are considered.

Both Raster Snap and Vector Snap toggles are disabled with this option.

► **To place nodes along the boundary of a closed shape**

1. Select the *Place Nodes* tool.
2. Select the appropriate color filter.
3. From the Entity option menu, choose Line or Outline.
4. Select Element as the Boundary option.

This option is not accessible when there is no active image.

5. Identify the vector element to be used as a boundary. The element must be a closed shape.

If Line is chosen, nodes are placed everywhere the boundary of the element crosses raster lines. Outlines or edges are not considered.

If Outline is chosen, nodes are placed everywhere the boundary of the element crosses the edge of raster objects or lines. Both sides of raster lines are considered.

Both Raster Snap and Vector Snap toggles are disabled with this option.

► **To place nodes along the boundary of a fence**

1. Select the *Place Nodes* tool.
2. Select the appropriate color filter.
3. From the Entity option menu, choose Line or Outline.
4. Select Fence as the Boundary option. You cannot access this option when a fence is not present.

5. If there is a fence, you are prompted to accept it by entering a data point.

If Line is chosen, nodes are placed everywhere the boundary of the fence crosses raster lines. Outlines or edges are not considered.

If Outline is chosen, nodes are placed everywhere the boundary of the fence crosses the edge of raster objects or lines. Both sides of raster lines are considered.

Both Raster Snap and Vector Snap toggles are disabled with this option.

Delete Nodes tool

Used to delete nodes from the current Node file.

Delete Nodes tool



You are prompted to identify the nodes to be deleted or the area inside which all nodes will be deleted. This is controlled by the Area option menu. Six options are supported:

- Use None to delete nodes interactively one by one with data points.
- Use Block to delete nodes inside a block.
- Use Element to delete nodes inside an existing closed vector element.
- Use Fence to delete nodes inside a fence.
- Use Image to delete nodes inside the extent of the active image.
- Use Unlimited to delete all nodes.

► To delete one node interactively

1. Select the *Delete Nodes* tool.
2. Select None as the Area option.
3. Identify the node to be deleted.
4. Enter a data point to accept.

► To delete nodes inside a block

1. Select the *Delete Nodes* tool.
2. Select Block as the Area option.
3. Define the block to be used by entering two opposite corners.

All nodes inside the block are deleted.

► To delete nodes inside a closed shape

1. Select the *Delete Nodes* tool.
2. Select Element as the Area option.
3. Identify the vector element to be used as an area. The element must be a closed shape.
4. Enter a data point to accept.

All nodes inside the shape are deleted.

► To delete nodes inside a fence

1. Select the *Delete Nodes* tool.
2. Select Fence as the Area option. This option is not accessible when a fence is not present.
3. If there is a fence, you are prompted to accept it by entering a data point.

All nodes inside the fence are deleted.

► To delete nodes inside the extent of the active image

1. Select the *Delete Nodes* tool.
2. Select Image as the Area option.
This option is not accessible when there is no active image.
3. Enter a data point to accept.

All nodes inside the extent of the active image are deleted.

► To delete all nodes

1. Select the *Delete Nodes* tool.
2. Select Unlimited as the Area option.
3. Enter a data point to accept.

All nodes are deleted.

Vectorize Settings tool

Select the *Vectorize Settings* tool from the Vectorize tool box to open the Vectorize Settings dialog box (See “Vectorize Settings dialog box” on page 13-30).

Vectorize Settings tool



Erasing Raster while Vectorizing

The *Erase Raster* option is found under the tool settings window. The Erase Raster option allows the erasure of converted raster elements. On non-binary images the eraser color can be specified. Choosing a different color than the background color of the image can be useful if revision marks are required before completely erasing the converted raster elements.

Erase Raster Option Button

From the tool settings window, if the Entity option is available:

- The Erase Raster feature is enabled only when the Entity option button is set to Line.
- The color of the eraser is set from the color picker or keyed in the eraser color field.
- The image is binary, the eraser color is automatically set to the background color.

Erase Raster Behavior

The following are considered true for all the tools using the Erase Raster feature. Exceptions are described under the specific tool section described below.

If the Erase Raster is on;

- the raster under all the vector placed in a complete *tool* function execution, stopped by a reset button or the start of a new or same function, is erased with the chosen eraser color.
- the erasure of the raster element is based upon the vector raster line width associated with the current selected filter.
- the Auto Convert and/or Raster Snap options are not considered.

Undo/Redo Behavior

The following are considered true for all tools using the Erase Raster feature. Exceptions are described under the specific tool section described below.

- The Undo/Redo functions will undo and redo all previously erased raster from a complete *Tool* function execution.

Vectorize Tools Supporting Raster Erase

Below is a list of the Vectorize tools using the Erase Raster feature. When applicable, a description of behavior exceptions for the *Erase Raster* feature and/or the *Undo/Redo* feature can be found.

Place Element

No specific behaviors apply to the *Erase Raster* feature or the *Undo/Redo* feature.

Continue Element

Since the continued element is considered a new element, the raster is erased under all this continued element.

Insert Element

Since the inserted element is considered a new element then the raster is erased under all this inserted element.

Convert Lines

When *Erase Raster* and *Auto Continue* are ON, the Erase Raster rules applied are the ones from the *Continue Element* tool.

Convert All Connected Lines

When Erase Raster is on the raster for the converted elements, is erased after the conversion process has ended either by the user (<ESC>) or by normal completion of the tool.

Convert Contour Lines

When Erase Raster and Auto Continue are ON, the Erase Raster rules are the ones for the Continue Element tool.

Convert Circle

The erased raster is always the one under the original first circle found, regardless if the Lock toggle or the round off values are used. New key-ins can be found in the Appendix A.

The Node File tool box



Node File tool box

The Node File tool box includes all necessary tools to manage Node files.

A Node file is used to save nodes for later use. When it is given a name, it is saved with the project. Any time unsaved nodes are going to be lost, a warning message displays and you are given the option to save the file.

New Node File tool

Used to create a new Node file.



New Node File tool

► To create a new Node file

1. Select the *New Node File* tool.

If a Node file is already open, it will close. The new file is not given a name until it is saved with the Save Node File tool.

Open Node File tool

Used to open a Node file.



Open Node File tool

► To open an existing Node file

1. Select the *Open Node File* tool.
2. Use the File Navigation dialog box to choose an existing file.
If a Node file is already open, it first closes.

Save Node File tool

Used to save a Node file.



Save Node File tool

► To save an unnamed Node file

1. Select the *Save Node File* tool.
2. Use the File Navigation dialog box to name the file.

► To save a Node file already named

1. Select the *Save Node File* tool.
The file is saved with the same name.

Save Node File As tool

Used to save a Node file with a new name.



Save Node File As tool

► To save a Node file with a new name

1. Select the *Save Node File As* tool.
2. Use the File Navigation dialog box to save the Node file with a new name.

Vectorize Settings dialog box

Use the Vectorize Settings dialog box to set specific Vectorize parameters for various editing and view management functions.

Category list box

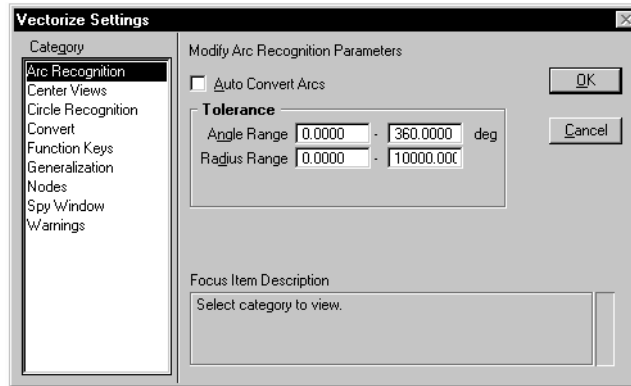
Use the Category list box to select the group of parameters you want to set. The options are:

- “Arc Recognition” on page 13-31
- “Center Views” on page 13-32
- “Circle Recognition” on page 13-32
- “Convert” on page 13-33
- “Function Keys” on page 13-34
- “Generalization” on page 13-36
- “Nodes” on page 13-37
- “Spy Window” on page 13-40
- “Warnings” on page 13-43

Arc Recognition

Use this page to turn the Arc Recognition process on or off and to set the relevant parameters.

*Vectorize Settings dialog box
showing the Arc
Recognition settings*



Auto Convert Arcs

If on, this feature tries to recognize arcs along the line strings generated with the following tools:

- *Place Element* (Stream or Point Mode)
- *Continue Element* (Stream or Point Mode)
- *Convert Lines*
- *Convert All Connected Lines*
- *Convert Contour Lines*

Tolerance

This group is used to control the automatic arc recognition mechanism. A potential arc whose angle or radius is outside the specified ranges is ignored (it remains a line string).

Angle Range

Used to specify the minimum and maximum angle of a potential arc to be recognized.

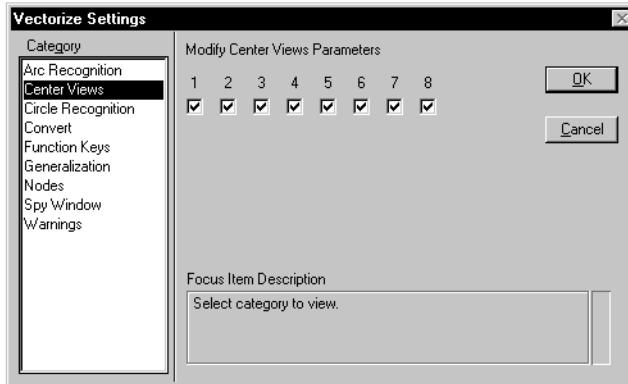
Radius Range

Used to specify the minimum and maximum radius of a potential arc to be recognized.

Center Views

Center Views is used to specify which of the eight MicroStation views are to be centered with the Center on Cursor (see page 13-44) and Center on Last Point keys (see page 13-44).

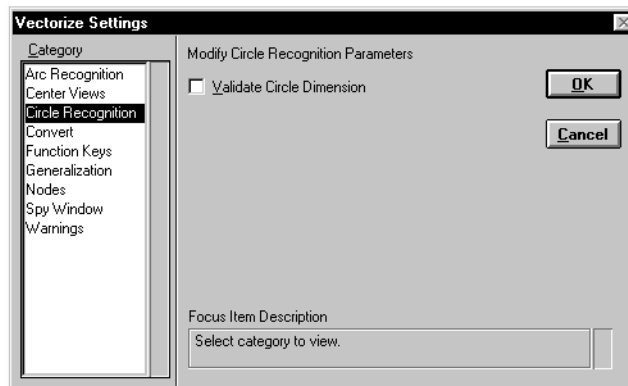
Vectorize Settings dialog box showing the Center Views settings



Circle Recognition

Use this page to control the validation of the converted circles.

Vectorize Settings dialog box showing the Circle Recognition settings



Validate Circle Dimension

If on, the resulting vector circle is compared with the raster circle for validation.

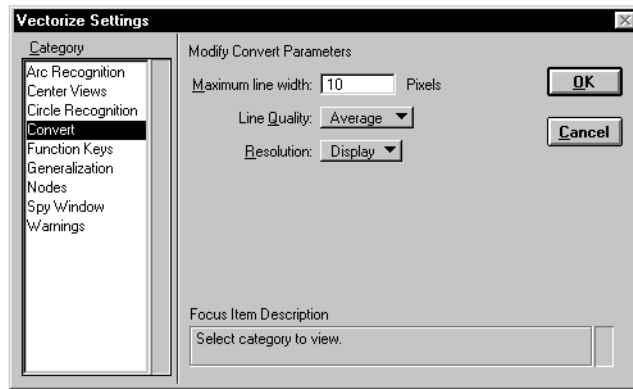
If the proposed circumference is inside a ring within two times the raster line width, the resulting circle is accepted.

If the proposed circumference is outside this raster tolerance, the circle is rejected.

Convert


Use this page to optimize automatic line conversion.

Vectorize Settings dialog box showing the Convert settings



Maximum Line Width

Used to determine what a raster line is. All lines, or parts of lines, or any raster object wider than this value will not be considered as a raster line. There will be no attempt to apply automatic line conversion with the Line mode (as opposed to Outline, which is not affected by this parameter). This value is given in pixels.

 It is suggested that you use the *Measure Speckle* tool from the Clean Up tool box to measure the width of the larger lines you want to convert.

Line Quality

Used to declare the quality of the lines to be converted. The options are:

- Excellent
- Good
- Average
- Poor
- Bad

Many factors can affect the quality of the raster lines on an image, such as the drawing itself before it is scanned, the scanning process, or the color filter you apply.

To assess the quality of the lines, display a few samples with a 1:1 resolution. If you see smooth, solid lines, the quality is excellent. Jagged lines have a lesser quality. The more speckles or notches

or holes in the lines, the poorer the quality. If there are repeated gaps, the quality is bad.

Declaring the appropriate line quality optimizes the efficiency of the automatic line conversion. The better the line quality, the faster the processing, since fewer tests are conducted during conversion.

Resolution

Used to specify the resolution at which automatic line conversion is performed. There are two options:

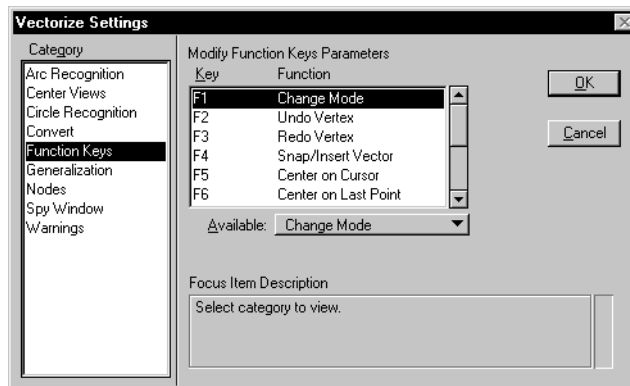
- File — uses the full resolution of the image, which yields better results but takes more time.
- Display — uses an image resolution similar to the one at which the active image is displayed in the view where you work. If the active image is zoomed out, the process is faster.

☞ When Display is chosen, if you do not see the lines clearly, the automatic line conversion will not work correctly.

Function Keys

Use Function Keys to assign a function key (F1, F2, F3, etc.) to a function working with the Vectorize tool box.


Vectorize Settings dialog box showing the Function Keys settings



A list box displays a two-column table showing which function is assigned to each of the Function keys.

An option menu allows you to choose a function to be assigned to the selected Function keys. The options are:

- Change Mode (Point/Stream/Arc)
- Undo Vertex
- Redo Vertex
- Snap/Insert Vector
- Center on Cursor
- Center on Last Point
- Close Element
- Spy Window On/Off
- Raster Snap On/Off
- Auto Convert On/Off
- Auto Place Nodes On/Off
- Snap/Break Vector

 See “Vectorize Functions assigned to Function Keys” on page 13-43 for a description of these functions.

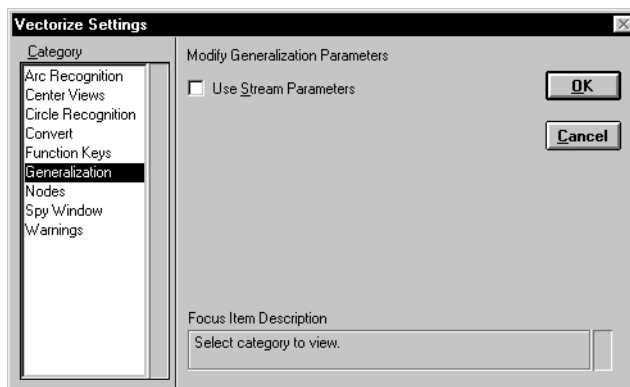
➤ **To assign a Vectorize function to a Function key**

1. Click on the line of the Function keys to be changed in the list box.
2. Choose the function to be assigned to the selected Function keys from the Available option menu.
The list box updates and shows the new assignment table.

Generalization

Used to set the Use Stream Parameters toggle.

Vectorize Settings dialog box showing the Generalization settings



Use Stream Parameters

If on, the four MicroStation stream parameters will be used to perform generalization of all vector data generated with any Vectorize function.

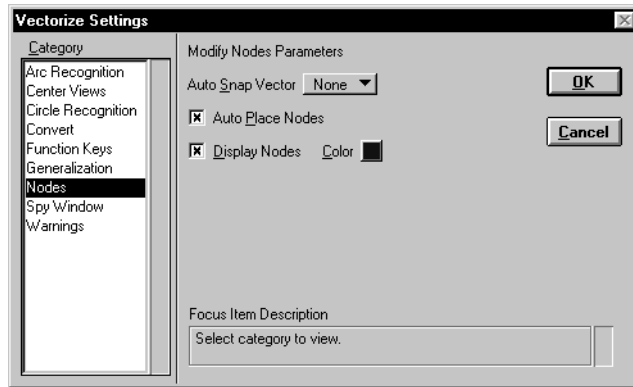
If off, only vector data generated with the Stream mode will still use these parameters. Vector data generated by all other means will be generalized without requiring parameter settings.

- ☞ The MicroStation stream parameters are Delta, Tolerance, Angle, and Area. For a full description of these parameters, see the *MicroStation Reference Guide*.

Nodes

Used to set the parameters controlling the display or the automatic placement of nodes.

Vectorize Settings dialog box showing the Nodes settings



Auto Snap Vector

The Auto Snap Vector option menu controls the automatic vector snap mechanism. Three options are supported:

- Choose None to turn off this mechanism.
- If you choose Insert, a Snap/Insert Vector occurs automatically where and when automatic line conversion finishes.
- If you choose Break, a Snap/Break Vector occurs automatically where and when automatic line conversion finishes.

Conditions are explained in the section on Vector Behavior. Default is None.

Display Nodes and Color

If Display Nodes is on, nodes display with the color chosen with the color picker. Default is on and red.

The size of a node varies with the situation:

- If it is placed on a line with a raster snap, it is a little larger than the line.
- If it is placed where there is no line, or with no raster snap, or with an “outline” snap, it is the size of the locate tolerance set in MicroStation.

☞ To change the size of the locate tolerance, key in the following:

Key-in: SET LOCATE <value>

Value is a number between 1 and 100, given in screen pixels.

Auto Place Nodes

Turning Auto Place Nodes on (default) activates a mechanism with the following effects:

- All “used” break points automatically transform into nodes
- Nodes will be automatically placed on all ends of generated vector lines
- Nodes will be automatically placed at “critical points”

Transforming “used” break points into nodes

This mechanism transforms raster intersection points and raster end points into nodes after they have been visited by automatic line conversion for pausing or stopping, and after the visiting function is finished with them.

Automatic line conversion is found with Auto Convert (in Place Element or Continue Element), Convert Lines, Convert All Connected Lines and Convert Contour Lines. For example, Convert All Connected Lines is finished with a raster intersection point when all branches from this raster intersection point are converted.

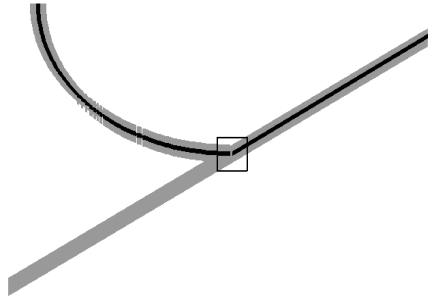
Placing nodes on ends of generated vector

Nodes will be placed at both ends of all linear elements generated with any Vectorize function.

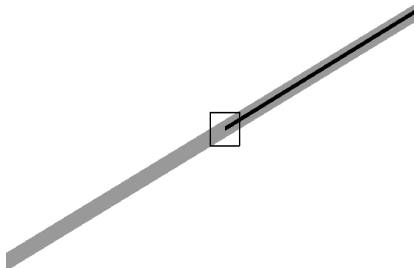
Placing nodes at “critical points”

Critical points are where a Vectorize function has a possibility to again convert a raster line or a part of a raster line already converted. There are three kinds of critical points:

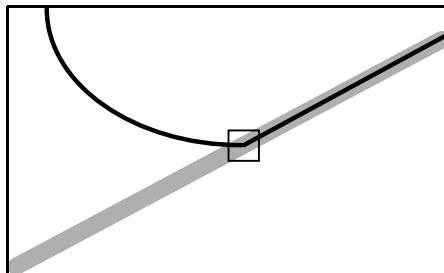
- A raster intersection where at least one branch is not converted. A raster intersection point is shown in this example.



- Where a vector line starts or stops along a raster line.



- At a junction between a vector line and a raster line.



The Auto Place Nodes mechanism is mainly meant to place nodes as firewalls, so as to prevent raster lines from being converted more than once. It stops all access to raster lines already converted and automatic conversion does not spread to them, unless it is “ignited” from inside the firewall. If nodes are placed at critical points, it is still possible for the operator to convert a raster line, but only deliberately.

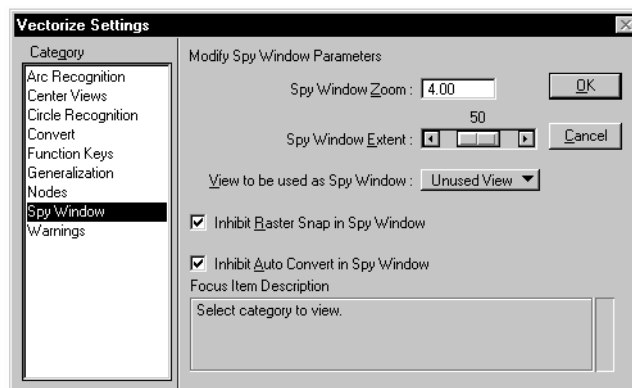
The Auto Place Nodes mechanism is also useful to assure a snap on special points where nodes are placed and to make this process simpler.

As a result, all toggles on this page help produce what is called “topologically ready” or “structured” vector data. It consists of vector branches properly connected at intersections and never superimposed. When branches are connected at intersections or end to end, they share strictly the same end points.

Spy Window

Use the Spy Window category to set all parameters that control the spy window.

Vectorize Settings dialog box showing the Spy Window settings



The spy window is like a small rectangular magnifying glass that pops up on top of all images in a view, at the position of the cursor, and displays the space around the cursor with a zoom factor. It is opened or closed with the Spy Window function key.

Spy Window Zoom

Used to specify the zoom factor of the spy window.

Spy Window Extent

Used to specify the extent of the spy window, in terms of the percentage of the view the spy window occupies. The size of the spy window depends on the actual size of each view where it is opened.

View to be Used as Spy Window

Used to specify which view will be used as a spy window. Options are:

- Unused View (default), to open an unused MicroStation view.
- Pop Up, to open a special spy window. This is the only available option if all MicroStation views are used.

When a MicroStation view is chosen as the Spy Window, all functions from the Vectorize tool box or from the Function keys are allowed in this window and will work normally. If Pop Up is chosen, the Spy Window has less functionality.

When a MicroStation view is chosen

When open, the Spy Window is a MicroStation view and behaves as such in most aspects. It differs mainly by the manner in which it is opened, with defaults and automatic features:

- It always opens where the cursor is.
- When opened, it takes the default values Spy Window Zoom Factor and Spy Window Extent given on the Spy Window page of Vectorize Settings.
- When opened, the Spy Window automatically inherits the image contents of the view where the cursor is: list of images, stacking properties, on or off status, transparency status, etc.
- When a MicroStation view is opened as the Spy Window, the corresponding toggle is automatically turned on in the Center Views group of the Vectorize Settings.

After it is opened, the only differences with other views are the following:

- The Inhibit Raster Snap in Spy Window and the Inhibit Auto Convert in Spy Window toggles are exclusive to it.
- When open, the Spy Window can be closed with the same toggle Function keys used to open it (in addition to regular ways to close a view). Nothing else will close the Spy Window.

- When the Center on Cursor or the Center on Last Point Function keys are pressed with the cursor pointing on another view, the Spy Window automatically inherits the image contents of the view where the cursor is (chameleon effect).

A MicroStation view that is used as the Spy Window keeps all other properties or functionality, such as resize, move, zoom, etc. If the zoom factor or the extent has been changed while such a view is open, the equivalent values will be taken from the Spy Window page of Vectorize Settings the next time it is opened.

When Pop Up is chosen

A special view is used, with the following properties or limitations:

- Only raster data and the active vector element are displayed.
- It is always opened where the cursor is and cannot be moved while open.
- The chameleon effect applies when it is opened.
- The Spy Window toggle Function key opens or closes it.
- Only one data point can be entered in the Spy window and then it closes.

Inhibit Raster Snap in Spy Window

If this toggle is on, the raster snap will be inhibited in the Spy Window. Default is on.

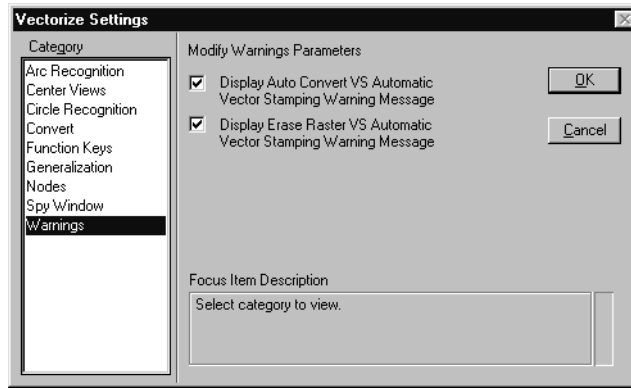
Inhibit Auto Convert in Spy Window

If this toggle is on, automatic line conversion will be inhibited in the Spy Window. Default is on. Automatic line conversion normally occurs when the Auto Convert toggle is on with the *Place Element* or *Continue Element* tools.

Warnings

Use this page to control whether warnings will be displayed.

*Vectorize Settings dialog box
showing the Warnings
settings*



Display Automatic Vector Stamping vs Auto Convert Warning

If Automatic Vector Stamping is on (See “Automatic Vector Stamping” on page 11-19) and automatic line conversion is going to take place, a warning displays.

The warning box allows you to stop receiving the same message again with the Don’t display this message again toggle. When you turn on this toggle, it can be turned off again by using the Display Automatic Vector Stamping Vs Auto Convert Warning toggle, which is synchronized with the above.

Vectorize Functions assigned to Function Keys

This section describes each of the functions you can assign to Function Keys with the Function Keys page of Vectorize Settings (see “Function Keys” on page 13-34).

Change Mode

Use Change Mode to dynamically toggle between Point, Stream and Arc modes.

Undo Vertex

Used to erase the present end point of the active element. Hold this key down to erase vertices, until all vertices of the active element are removed. The first end point is not removed.

Redo Vertex

Used to reinsert the last erased vertex as the present end point of the active element. Hold this key down to reinsert erased vertices, until all former vertices of the active element are reinserted.

Snap/Insert Vector

Use Snap/Insert Vector to snap to an existing design element from the active design file. The following MicroStation element types can be snapped with the Snap function:

- Line
- Line String
- Shape
- Complex Chain
- Complex Shape

When the Snap/Insert Vector key is pressed, the active element is snapped to the nearest existing element supported by the Snap/Insert Vector function. The snap creates a node, which is added as an additional point to the existing elements at the snap location. This implementation ensures that the design file structure is topologically ready.

W The Complex elements (Chain and Shape) can be formed by Line, Line String, Arc, Curve, or B-Spline. You can snap only on a supported element.

Center on Cursor

Use Center on Cursor to center the specified MicroStation views on the present position of the cursor. Views that can be centered are the ones turned on in the Center Views group of the Vectorize Settings dialog box.

Center on Last Point

Use Center on Last Point to center the specified MicroStation views on the end point of the active element. Views that can be centered are the ones turned on in the Center Views group of the Vectorize Settings dialog box.

Close Element

Use Close Element to close the active element into a polygon. The polygon is placed when the Close key is pressed; the current Vectorize tool then resets and is ready to function.

Spy Window On/Off

Use Spy Window On/Off to open or close the spy window (See “Spy Window” on page 13-40).

Raster Snap (On/Off)

Use Raster Snap On/Off to open or close the raster snap capability.

A raster snap is the placement of an accepted data point at a specific location on the closest raster element of an image.

A raster element is defined as a body or as a stream of contiguous pixels of either the foreground color or the color indices that belong to the active color filter.

Use On/Off to turn on or off the raster snap capability.

When on, entering a data point by using a Vectorize tool (such as Place Element or Continue Element) causes a snap, or a shift of the data point, to the closest raster element in the active image. If there is not a raster element close enough, the data point is entered without a raster snap.

Auto Convert On/Off

Used to open or close the Auto Convert capability.

Auto Place Nodes On/Off

Used to turn the Auto Place Nodes on or off.

Snap/Break Vector

Use Snap/Break Vector to snap to an existing design element from the active design file. The following MicroStation element types can be snapped with this function:

- Line
- Line String
- Complex Chain

When the Snap/Break Vector key is pressed, the active element is snapped to the nearest of existing elements supported by the Snap/Break Vector function. The former element is broken into two pieces and an additional end point is added to each of the new elements at the snap location.

W A Complex Chain can be formed with Lines, Line Strings, Arcs, Curves, or B-Splines. You can snap only on a supported component.

