

Lavenir CAM Software User's Guide



CAMMaster



ViewMaster PRO



ViewMaster



ViewMate

This Lavenir CAM Software User's Guide provides information about Version 6.1 of CAMMaster, ViewMaster PRO, ViewMaster and ViewMate. Every effort has been made to make it as complete and accurate as possible, however the information contained in it is subject to change without notice and does not represent a commitment on the part of Global MAINTECH Corporation. No part of this document may be reproduced by any means without the prior written consent of Lavenir, a subsidiary of Global MAINTECH Corporation, 2440 Estand Way, Pleasant Hill, CA 94523.

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Chapter 1

Welcome to Lavenir CAM Software

Lavenir produces a complete line of accurate, high-speed CAM software for PCB data. This CAM Software User's Guide documents the features of the entire Lavenir CAM software product line.

Lavenir CAM Software Feature Comparison

Whatever your requirements, Lavenir has a CAM package to meet your needs. This chart compares the features of ViewMate, ViewMaster, ViewMaster PRO, and CAMMaster.

	ViewMate	ViewMaster	ViewMaster PRO	CAMMaster
PCB Data Import	✓	✓	✓	✓
PCB Data Export	—	✓	✓	✓
PCB Data Viewing	✓	✓	✓	✓
PCB Data Editing	✓	✓	✓	✓
Aperture File Conversion Wizard	✓	✓	✓	✓
Printing	✓	✓	✓	✓
Vector DRC	—	✓	✓	✓
Raster DRC	—	—	—	✓
Fill Polygons	—	—	✓	✓
Add Venting Patterns	—	—	✓	✓
Calculate Copper Area	—	—	✓	✓
Delete Non-Functional Pads	—	—	✓	✓
Snap Data to Padmaster	—	—	✓	✓
Clip Silkscreen Traces	—	—	✓	✓
Generate Soldermask Data	—	—	✓	✓
Generate Filleting	—	—	✓	✓
Generate Outlines	—	—	✓	✓
Generate Polygon Contours	—	—	✓	✓
Generate Centroid Data	—	—	✓	✓
Compare Layers	—	—	✓	✓
Correct Trace/Pad Overlap	—	—	✓	✓
Convert Drawn Pads to Flashed	—	—	✓	✓
Vector Netlist Extraction	—	—	✓	✓
Raster Netlist Extraction	—	—	—	✓
Netlist Conversion	—	—	—	✓
Netlist Comparison	—	—	—	✓
Sax Basic Scripting	—	—	—	✓
Automatic Panelization	—	—	—	✓

ViewMate

ViewMate is Lavenir's free Gerber viewer. ViewMate allows you to import, view and print PCB and aperture data. ViewMate also allows you to experiment with editing features. ViewMate does not save or export data, but it is an excellent viewer, and the printing feature is useful. You are welcome to keep and use ViewMate as you wish. Make as many copies as you want, spread it around to others in your company, and give it to the people you do business with. You can download free copies of ViewMate from the Lavenir Web Site at <http://www.lavenir.com>.

ViewMaster

ViewMaster is Lavenir's basic PCB editing program. With ViewMaster, you can import, export, view, and edit PCB and aperture data. You can also print a plot and run a Vector Design Rule Check.

Importing PCB Files

You set language and format options for importing data:

- Gerber data of multiple formats.
- NC Drill data specified as Excellon, Wessel, or Sieb & Meyer.
- HPGL

Once the format is specified, you can import up to 99 layers of incoming data.

Importing Aperture and Tool Code Information

You can import an aperture list from over 100 CAD/CAM systems, or you can manually set up a new aperture list.

The Aperture File Wizard allows you to show ViewMaster how to interpret and import a previously unsupported aperture list type and save a method for importing that same type in the future.

ViewMaster supports up to 2000 D Code definitions within the range of D10 to D9999 and supports 255 Tool Code definitions. You can design and use custom apertures, combine aperture lists automatically and save D Code and Tool Code information in Lavenir environment files.

Exporting Data

ViewMaster exports PCB files in several formats:

- Basic Gerber
- Gerber Extended
- MDA Autoplot
- NC Drill

Visible layers can be output as individual files or combined into one.

The program can also export a text Report file with statistical information about the loaded files.

Viewing and Inspecting Data

ViewMaster presents a graphical view of any combination of the 99 layers for your inspection.

- Control which layers are visible to work with at any given time. Layers can be positive or negative, paint, or scratch. You control the colors and visibility.
- Traces and pads can be shown true to width and filled or as zero-width or outlined. Turn pad or trace visibility on or off. Show pads and traces in contrasting colors or the same color.
- The zoom range, 0.001 to 7000, lets you inspect the data as closely as you wish.
- Automatic inspection features allow you to go directly to each element of a specified class.
- The Design Rule Checking operation highlights design rules violations on screen.
- Reporting functions provide statistical information about the loaded files.

Controlling Layers of Data

ViewMaster can load up to 99 layers of plot data. Using the Layers Table, the Layers Toolbar, and the Current Element Toolbar you can control:

- Active Layer(s)
- Layer Number
- Board Layer
- Layer Name
- Layer Type
- Layer Element Counts
- Layer Color
- Layer Visibility
- Positive and Negative Layers
- Paint and Scratch Layers

You can also edit entire Layers:

- Delete Layers
- Swap Layers
- Transfer Layers
- Replicate Layers

Editing Data

You can correct design rule violations and prepare data for output with the editing features in ViewMaster.

- Insert pads, traces, elbows, rectangles, circles, and arcs.
- Select individual traces and pads, or groups of elements of specific types on single or multiple layers, or whole layers. The selection for editing can be as complex or as simple as you wish.
- Selected elements can be deleted, moved, copied, transferred, replicated, scaled, mirrored, rotated, transcoded, and step/repeated.
- Entire layers can easily be deleted, moved, aligned, transferred, replicated, swapped, rotated, mirrored, scaled, and step/repeated.
- Insert text at any size and angle.
- Change shape, size, and D Code of elements. ViewMaster can transcode, rotate, swell, and scale D Codes, individually or as a group. Design and use custom apertures.

Automatic Editing Features

In addition to its manual editing features, ViewMaster has several automatic editing features.

- Convert 360-degree Arcs to Quadrant Arcs
- Convert Arcs to Chords
- Sort Data into Optimized Order

Printing

ViewMaster can print a file on a color or black and white printer. You have a choice of print ranges, color schemes, and scale factors.

Running a Vector Design Rule Check

ViewMaster can run a Vector Design Rule Check to verify the accuracy and manufacturability of plot data using Lavenir's established Vector DRC routine.

The Vector DRC routine examines individual layers, layer sets, portions of layers selected with the reference frame, or the entire database, depending on how you set it up. The program reports design rule violations in a text file and flags the errors in the Viewing Area for easy identification. You can check for the following design rule violations:

- Air Gap Violations: Trace-to-Trace Air Gap, Trace-to-Pad Air Gap, Pad-to-Pad Air Gap.
- Soldermask Gap Violations: Pad-to-Mask Clearance, Trace-to-Mask Clearance.
- Annular Ring Violations: Drill-to-Outer Layers, Drill-to-Other Layers, Drill-to-Plane Layers, Drill-to-Thermal.
- Pad-to-Pad Contact Violations.
- Centerline Disconnection Violations.
- Unterminated Trace Violations.

- Trace Intersection Violations.
- Outline-to-Copper Area Violations.

Generating a Distance Histogram

ViewMaster can generate a Distance Histogram report to verify the manufacturability of plot data and aid in the quoting process. The Distance Histogram report is a text file that includes the number of times each particular clearance occurs in the plot.

ViewMaster PRO

With ViewMaster PRO, you have all of the importing, exporting, viewing, editing, printing and DRC features of ViewMaster. And in addition, you can perform many automated CAM operations and extract netlists with a Vector Netlist Extraction routine.

Using Specialized CAM Tools

ViewMaster PRO contains specialized CAM tools that automate the most frequently demanded CAM operations.

- Fill Polygons
- Add Venting Patterns
- Calculate Copper Area
- Delete Non-Functional Pads
- Snap Data to Padmaster
- Clip Silkscreen Traces
- Generate Soldermask Data
- Generate Filletting
- Generate Outlines
- Generate Polygon Contours
- Generate Centroid Data
- Compare Layers
- Correct Trace/Pad Overlap
- Convert Drawn Pads to Flashed

Extracting Vector Netlists

ViewMaster PRO can extract a variety of netlist data from multiple layers of Gerber and NC drill data using Lavenir's established Vector Netlist Extraction.

In addition to extracting netlist data, the program can import netlist data into the current job and has features for viewing and inspecting netlist data.

CAMMaster

With CAMMaster, you have all of the importing, exporting, viewing, editing, printing and Vector DRC features of ViewMaster. And you have all of the automated CAM operations and Vector Netlist Extraction features of ViewMaster PRO. In addition, you can extract netlists with a Raster Netlist Extraction Routine, convert foreign netlist formats to Lavenir netlist formats with a Netlist Conversion Routine, and compare two netlists with a Netlist Comparison feature. You can also run DRC checks with a Raster DCR Routine, and you can automate your operations with powerful Scripting capabilities.

Running a Raster Design Rule Check

CAMMaster can run a Design Rule Check to verify the accuracy and manufacturability of plot data using the new Raster DRC.

Both the Vector and Raster DRC routines examine individual layers, layer sets, portions of layers selected with the reference frame, or the entire database, depending on how you set it up. The program reports design rule violations in a text file and flags the errors in the Viewing Area for easy identification. You can check for the following design rule violations:

- Air Gap Violations: Trace-to-Trace Air Gap, Trace-to-Pad Air Gap, Pad-to-Pad Air Gap.
- Soldermask Gap Violations: Pad-to-Mask Clearance, Trace-to-Mask Clearance.
- Annular Ring Violations: Drill-to-Outer Layers, Drill-to-Other Layers, Drill-to-Plane Layers, Drill-to-Thermal.
- Outline-to-Copper Area Violations.
- Silkscreen on Pad Violations.

Extracting Raster Netlists

CAMMaster can extract a variety of netlist data from multiple layers of Gerber and NC drill data using the new Raster Netlist Extraction.

In addition to extracting netlist data, the program can import netlist data into the current job and has features for viewing and inspecting netlist data.

Converting Netlist Data Formats

CAMMaster can convert a variety of netlist data formats into Lavenir Format 2 or Format 4 (.F02 or .F04) files so that the files can be imported into CAMMaster and other Lavenir programs such as FixMaster and ProbeMaster.

Comparing Netlist Files

CAMMaster can compare two netlist files and display the differences graphically. You designate a Reference Net and a Net Under Test, and CAMMaster finds the differences. This allows you to make comparisons between CAD generated netlists and Gerber extracted netlists, or between pre- and post-editing Gerber extracted netlists.

Scripting Automatic Functions

CAMMaster incorporates the Sax Basic Editor and Sax Basic Language, a full-featured development environment and programming language. Using this system, the Lavenir Macro Recorder and the CAMMaster Automation object library of properties and methods, you can:

- Capture macros and record them as Sax Basic scripts which you can save, edit and execute.
- Program using variables, math, and flow control.
- Use CAMMaster functions in your scripts and have your scripts get and use values from the currently loaded job file.
- Use the functions of other programs whose methods and properties are available to you as automation object libraries.

Download Software Updates

Lavenir will be making updated versions of the software and Help files available to customers who have a current maintenance agreement or warranty. You can download the current software updates from the Lavenir Premier Support Web site.

To Download Software Updates:

1. Have your **User Name** and **Password** ready before logging on to the Lavenir Premier Web Site. Your User Name and Password are printed on your User Password Letter. If you do not know your User Name and Password, call Lavenir at (925) 680-7400.
2. Go to the **Lavenir Web Site** at <http://www.lavenir.com>.
3. On the Site Map, click on **Premier Support**.
4. On the User Name and Password dialog, enter your **User Name** and **Password**.
5. Click on **Software Library**.
6. Follow the instructions to download the <Program Name> **SETUP.EXE** update file to your system.
7. Double-click on the downloaded the <Program Name> **SETUP.EXE** file on your system and follow the setup instructions.

Send Us Your Comments

Lavenir is committed to continuous improvement. Your constructive comments on the software will help us to correct problems and improve features.

- Please e-mail your comments and suggestions regarding Lavenir Software to feedback@lavenir.com.
- Visit the Lavenir Web Site at <http://www.lavenir.com>.
- You can reach Lavenir between the hours of 8am and 5pm Pacific Time at **(925) 680-7400**
- Lavenir is located at
**2440 Estand Way
Pleasant Hill, CA 94523**

Lavenir Technical Support

Contact Lavenir Customer support with questions about Lavenir hardware and software or to arrange for training or maintenance.

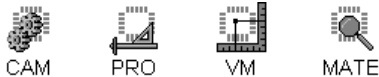
You can reach Lavenir Technical Support by:

- Telephone: **(925) 680-7400** between the hours of 8 AM and 5 PM Pacific Standard Time.
- E-Mail: **support@lavenir.com**.
- Web Site: **<http://www.lavenir.com>**
- Lavenir Technology is located at:
2440 Estand Way
Pleasant Hill, CA 94523

About this User's Guide

This Lavenir CAM Software User's Guide provides information about how to use ViewMate, ViewMaster, ViewMaster PRO and CAMMaster.

To indicate which documented features are available in which programs, the User's Guide uses the following system of icons:



A feature that has the icons above is available in all four products.



A feature that has the icons above is available in CAMMaster, ViewMaster PRO, and ViewMaster, but the feature is not available in ViewMate.



A feature that has the icons above is available in CAMMaster, and ViewMaster PRO, but the feature is not available in ViewMaster or ViewMate.



A feature that has the icons above is available in CAMMaster, but the feature is not available in ViewMaster PRO, ViewMaster or ViewMate.

Other icons are used to indicate supplemental information:



This icon indicates a hotkey that can be used instead of a menu command.



This icon indicates a toolbar button that can be used instead of a menu command.



This icon indicates a special note or warning about a feature.



This icon indicates a tip on how to handle an operation more efficiently.

Menu commands are in **bold**, and cascading menus are separated by a hyphen (-). For instance, an instruction that says to click on **File-Import-Gerber** means to click on the **File** menu, then go to the **Import** cascade menu, and then to click on the **Gerber** cascade menu.

Key commands can be unmodified by the **Shift** or **Ctrl** keys. For instance, to align the cursor to an element, you would be instructed to press **A**, which means to press the **A** key on the keyboard without pressing **Ctrl** or **Shift**.

And key commands can also be modified by the **Shift** or **Ctrl** keys. For instance, to align the cursor to an element and query the element's properties, you would be instructed to press **Shift+A**, which means to hold down the **Shift** key and press the **A** key.

Chapter 2

File Operations

The program Opens and Saves native format Job Files (.BIN) and can Import other file types into the open Job File and Export other file types from the Job File.

Job File (.BIN)

The Job File (.BIN) is the native file format for the Lavenir View Series of PCB editors and contains all information regarding the current state of the database and program settings. The Job File is a binary file that stores plot data for all loaded layers, layer configuration, aperture information, shape data, and menu parameters. Instead of reloading aperture and plot data files, and resetting menu configurations, you save work in progress in a Job File and then later open the Job File to restore the entire job and resume work. The Job File is the only file type that the program opens and saves with the Open and Save commands. However the program can Import other file types into the open Job File and Export other file types from the Job File.

Many of the commands for handling job files can be accessed using the Main Toolbar.



Main Toolbar

To Display the Main Toolbar:

- On the **View** menu, look at **Toolbars-Main**.
 - If Main has a checkmark next to it, then the Main Toolbar is displayed.
 - If Main does not have a checkmark next to it, then the Main Toolbar is not displayed.

To change the display of the Main Toolbar, click **Main**.

Start a New Job



The New command creates a new Job File that has nothing in it and is ready to have other files imported into it or to have data inserted into it. The program can only have one Job File open at a time; so, if a different Job File is already open when you start a new Job File, then the program prompts you to save and close the existing Job File before starting the new Job File.

To Start a New Job File:

- On to the **File** menu, click **New**.



Ctrl+N



When you first start the program, the program opens with a new, empty Job File.

Open a Job File



The Open command opens a previously saved Job File. The program can only have one Job File open at a time; so, if a different Job File is already open when you open another Job File, then the program prompts you to save and close the existing Job File before opening the new Job File.

To Open a Job File:

1. On the **File** menu, click **Open**.
2. In the **Look in** box, click the drive, folder, or network location that contains the Job File.
3. In the folder list, double-click folders until you open the folder that contains the Job File you want.
4. Double-click the **Job File**.



Ctrl+O



*To open a Job File you've used recently, click the file name on the **Recent Files** List at the bottom of the **File** menu.*



*You can also Drag and Drop Job Files into the program.
You can also Import a Job File, which is different than Opening a Job File.*

Save the Job File



Saving a Job File stores all information regarding the current state of the database and program settings in a Job File (.BIN) so that the information can be restored later when you open the file. As new capabilities have been added to the software, new versions of the Job File have been created to save information not previously used by the software (i.e., netlist information and step and repeat blocks).

To Save a New, Unnamed Job File:

1. If you want to include netlist information that was extracted with the Raster Netlist routine in the saved file, go to **File-Save Options-Include Net Info**. If the menu shows a **check mark** next to Include Net Info, then netlist information will be saved. If the menu does not show a check mark, then the netlist information will not be saved in the file. Clicking the menu switches the feature on and off.



The Job File only saves netlist information equivalent to a Lavenir Format 2 (.F02) file. It does not save the trace information or internal layer information that is present in a Lavenir Format 4 (.F04) file. So if you extract a netlist using Raster Netlist Extraction and want to export an .F04 file, do it before saving and closing the Job File.



Job Files that include netlist information cannot be opened by Lavenir DOS software or by Lavenir Windows software older than version 5.0.

2. If you want to include coded step and repeat blocks in the saved file, go to **File-Save Options-Step and Repeat Blocks**. If the menu shows a **check mark** next to Step and Repeat Blocks, then coded step and repeat blocks present in the database will be saved as coded step and repeat blocks. If the menu does not show a check mark, then coded step and repeat blocks present in the database will be converted to copied elements. Clicking the menu switches the feature on and off.



Job Files that include coded step and repeat blocks cannot be opened by Lavenir DOS software or by Lavenir Windows CAM software older than version 6.0 or by Pulsar firmware older than version 3.4.

3. If you want to save the file at high resolution (.001 mil English or .01 micron metric), go to **File-Save Options-High Resolution**. If the menu shows a **check mark** next to High resolution, then the file will be saved with a resolution of .001 mil English or .01 micron metric. If the menu does not show a check mark, then the file will be saved with a resolution of .1 mil English or 1micron metric. Clicking the menu switches the feature on and off.



Job Files saved at high resolution cannot be opened by Lavenir DOS software or by Lavenir Windows CAM software older than version 6.0.28 or by Pulsar firmware older than version 3.8.

4. On the **File** menu, click **Save**.

5. To save the Job File in a different folder, click a different drive in the **Save in** box, or double-click a different folder in the folder list.

To save the Job File in a new folder, click **Create New Folder**.

6. In the **File name** box, type a name for the Job File.



Ctrl+S



To Save Work in Progress:

When you have work in progress that you want to save in case of power failure or because you need to shut down the program, you can save it under the current file name and overwrite the original Job File.

- To save the open Job File under the current file name, go to the **File** menu, and click **Save**.

As long as the Job File already has a name and location, the program saves the file without further prompts.



Ctrl+S



*The Save command uses the same settings as those used the last time the file was saved. You can check the options for including netlist information and coded step and repeat blocks on the **File** menu under **Save Options**.*



If you want to save a temporary version of the file you are working on so that you have the option to undo large edits, use a Milestone file.

If you want to discard all changes to a Job File and restore to the last saved version of the file, use the Revert To Saved command.

To Save a Copy of a Job File:

1. If you want to include netlist information that was extracted with the Raster Netlist routine in the saved file, go to **File-Save Options-Include Net Info**. If there is a **check mark** next to Include Net Info, then netlist information will be saved. If there is no check mark, then the netlist information will not be saved. Clicking the menu switches the feature on and off.



The Job File only saves netlist information equivalent to a Lavenir Format 2 (.F02) file. It does not save the trace information or internal layer information that is present in a Lavenir Format 4 (.F04) file. So if you extract a netlist using Raster Netlist Extraction and want to export an .F04 file, do it before saving and closing the Job File.



Job Files that include netlist information cannot be opened by Lavenir DOS software or by Lavenir Windows CAM software older than version 5.0.

2. If you want to include coded step and repeat blocks in the saved file, go to **File-Save Options-Step and Repeat Blocks**. If the menu shows a **check mark** next to Step and Repeat Blocks, then coded step and repeat blocks present in the database will be saved as coded step and repeat blocks. If the menu does not show a check mark, then coded step and repeat blocks present in the database will be converted to copied elements. Clicking the menu switches the feature on and off.



Job Files that include coded step and repeat blocks cannot be opened by Lavenir DOS software or by Lavenir Windows CAM software older than version 6.0 or by Pulsar firmware older than version 3.4.

3. If you want to save the file at high resolution (.001 mil English or .01 micron metric), go to **File-Save Options-High Resolution**. If the menu shows a **check mark** next to High resolution, then the file will be saved with a resolution of .001 mil English or .01 micron metric. If the menu does not show a check mark, then the file will be saved with a resolution of .1 mil English or 1micron metric. Clicking the menu switches the feature on and off.



Job Files saved at high resolution cannot be opened by Lavenir DOS software or by Lavenir Windows CAM software older than version 6.0.28 or by Pulsar firmware older than version 3.8.

4. On the **File** menu, click **Save As**.
5. To save the copy in a different folder, click a different drive in the **Save in** box, or double-click a different folder in the folder list.

To save the copy in a new folder, click **Create New Folder**.

6. In the **File name** box, type a name for the copy.

Close a Job File



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The program can have one and only one Job File open at a time; so, closing the current Job File without opening another one is the same as exiting the program. The Open and New commands automatically close the current Job File; so, if a different Job File is already open when you open another Job File, then the program prompts you to save and close the existing Job File before opening the new Job File.

To Close a Job File:

1. On the **File** menu, click **Exit**.

Closing a Job File does not save the Job File. If you have changed the file since the last time it was saved, the program prompts if you want to save the changes before closing.

2. If prompted whether to save the file, click **Yes** or **No**.



If you have made a bad mistake in your editing since the last time you saved and you want to go back to your saved version, you can close the file without saving and then open the saved version. Or you can use the Revert to Saved command, which does the same thing automatically.

Revert to a Saved Job File



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The Revert To Saved command allows you to discard all changes to a Job File and restore to the last saved version of the file.

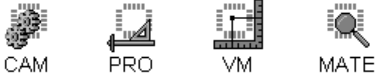
To Revert to a Saved Job File:

- To revert to a saved Job File, go to the **File** menu, and click **Revert to Saved**.



If you want to save a temporary version of the file you are working on so that you have the option to undo large edits, use a Milestone file.

Import a Job File



Importing a Job File is different than Opening a Job File in several ways:

- An Imported Job File is merged into the current Job File. It is not opened on its own, under its own file name, and with no other data present the way an Opened file is.
- An Imported job can be offset in the layer stack from the original way it was saved. If there is already data present in the layers of the Job File database when the new job is imported, the data in overlapping layers is merged into the existing layers, and the existing layer settings are maintained. Data imported into empty layers retains the layer settings of the imported job (i.e., layer name, color, etc.).
- An imported job can be offset in the X and Y dimensions from the original way it was saved.

To Import a Job File:

1. On the **File** menu, click **Import-Job**.
2. In the **Look in** box, click the drive, folder, or network location that contains the Job File.
3. In the folder list, double-click folders until you open the folder that contains the Job File you want.
4. Click the **Job File** so that it is selected.
5. Click **Options**.
6. If you want to offset the imported Job File in the layer stack from the original way it was saved, enter the **first layer** where you want the imported Job File to begin merging into the database in the **Layers Start At** field.
7. Select where you want the imported Job File's origin to be located.
 - **Absolute (0,0):** The imported Job File's absolute origin is located at the open file's absolute origin.
 - **At X, Y:** The imported Job File's absolute origin is offset by the X and Y amount from the open file's absolute origin.
8. On the Import Job Options dialog, click **OK**.
9. On the Import Job File dialog, click **Open**.



You can also Drag and Drop files into the program.

Import Files into the Job

Imported files are merged into the current Job File. To get Gerber, Drill, HPGL, aperture or netlist files into the job, use the Import commands, not the Open command. You can also import another Job File into the current Job File.

Drag-and-Drop File Import



The simplest method for importing files into a Job File or for opening a Job File is to drag and drop the file into the program. The program attempts to guess the format of the file and import it.

To Drag and Drop Files into the Program:

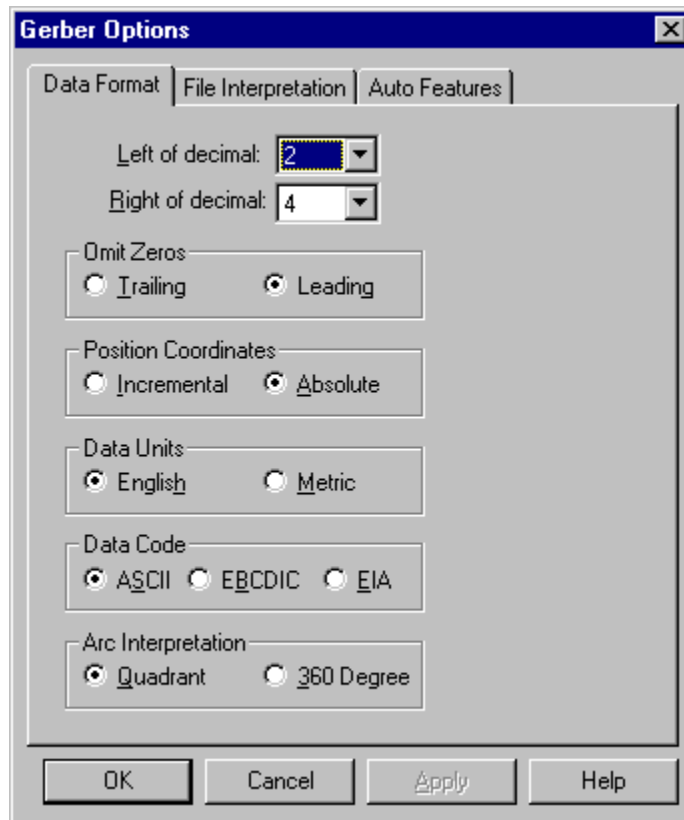
1. Open the Lavenir program and a file browser such as **Windows Explorer** or **My Computer** so that they are **side by side** on the desktop.
2. In the file browser, **select the files** that you want to drag into the Lavenir program:
 - **Click** on a file to select a single file.
 - **Shift+Click** to add files to the selection.
 - **Ctrl+Click** to remove files from the selection.
 - **Drag** across a range of files to select the whole range of files.
3. Click on the selected file(s), hold down the mouse, and **drag the selected file(s)** over to the Lavenir program.
4. **Release the mouse button** where you want to drop the files:
 - **Job (.BIN) Files:** To import a job, drop it on the Layers Toolbar on the layer where you want it imported. To open the job, drop it on the viewing area.
 - **Gerber Files:** Drop Gerber files on the Layers Toolbar on the layer where you want them imported.
 - **Drill Files:** Drop Drill files on the Layers Toolbar on the layer where you want them imported.
 - **Aperture Files:** Drop Aperture files on the Layers Toolbar. It does not matter which layer.
 - **Netlist Files:** Drop Netlist files on the Layers Toolbar. It does not matter which layer; the netlist file has its own layer definitions.
 - **HPGL Files:** Drop HPGL files on the Layers Toolbar on the layer where you want them imported.

The program attempts to guess the format of the files and import them. If there is not format information in the files themselves, the program uses the data format, file interpretation, auto features, and other options that were used the last time a file of the given format was imported.

Import Basic Gerber

The program imports several formats of Gerber data, including Basic Gerber, Gerber Extended and MDA Autoplot. Each format has format options and may have additional import options. In addition there are several options for simultaneously importing and merging associated aperture data along with the imported Gerber.

Gerber Data Format Options



Gerber Data Format Tab

The following are Gerber Data Format options on the Data Format tab of the Gerber Import and Export dialogs:

Left of Decimal: The number of digits in the data file to the left of the implied decimal point.

Right of Decimal: The number of digits in the data file to the right of the implied decimal point.

Omit Zeros

- **Trailing:** Trailing zeros are omitted.
- **Leading:** Leading zeros are omitted.

Position Coordinates

- **Incremental:** Position coordinates are incremental (coordinates are relative to the last position).
- **Absolute:** Position coordinates are absolute (coordinates are relative to the absolute origin).

Data Units

- **English:** Units are in inches.
- **Metric:** Units are in metric.

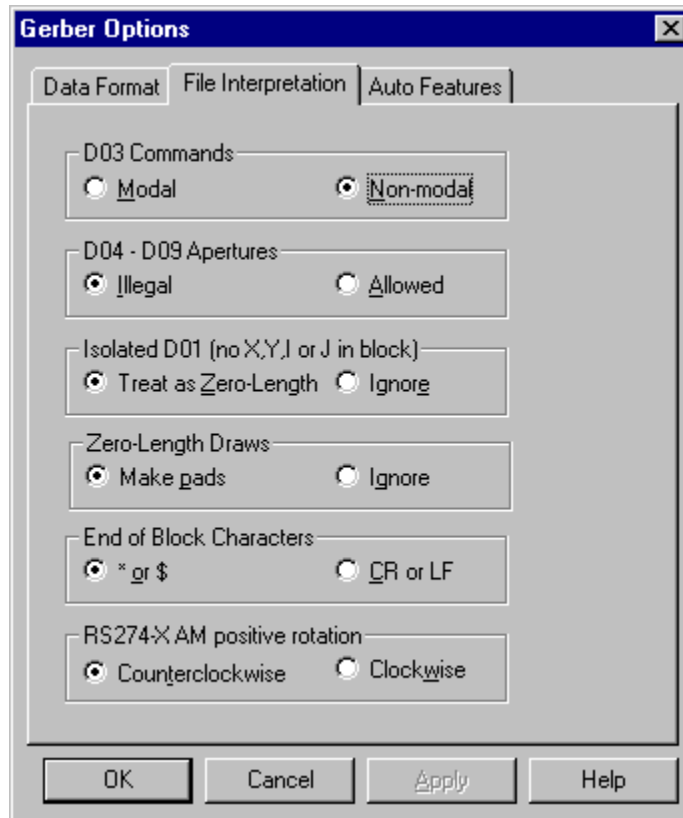
Data Code

- **ASCII:** The file is an ASCII text file.
- **EBCDIC:** The file is in EBCDIC
- **EIA:** The file is in EIA.

Arc Interpretation

- **Quadrant:** Arcs are Quadrant arcs.
- **360-degree:** Arcs are 360-degree arcs.

Gerber File Interpretation Options



Gerber File Interpretation Tab

The following are Gerber File Interpretation options on the File Interpretation tab of the Gerber Import dialog. Different systems that use Gerber data interpret the following commands and situations differently, so this is where you tell the program how you want these commands handled when importing your files:

D03 Commands

- **Modal:** D03 Commands are modal.
- **Non-Modal:** D03 Commands are non-modal.

D04 – D09 Apertures: The Gerber specification reserves D04 – D09 as unused and begins aperture definitions with D10. This option tells the program what to do if the file contains D04 – D09.

- **Illegal:** D04 – D09 apertures are illegal. This option complies with the specification. If the system encounters D04 – D09 apertures on import, the apertures are not imported into the Job File.

- **Allowed:** D04 – D09 apertures are allowed. Some systems output apertures for D04 – D09 even though this violates the Gerber specification, and this option allows the program to read those files as they were output.

Isolated D01 (no X, Y, I or J in block): D01 commands should have a coordinate position to indicate where the draw ends. This option tells the program what to do if the file contains D01 commands without coordinates.

- **Treat as Zero-Length:** Isolated D01 commands are considered to be zero-length draws.
- **Ignore:** Isolated D01 commands are ignored.

Zero-Length Draws: D01 commands should have a different ending coordinate position the beginning coordinate position. This option tells the program what to do if the file contains D01 commands with the same beginning and ending coordinates.

- **Make Pads:** Zero-Length Draws are made into pads.
- **Ignore:** Zero-Length Draws are ignored.

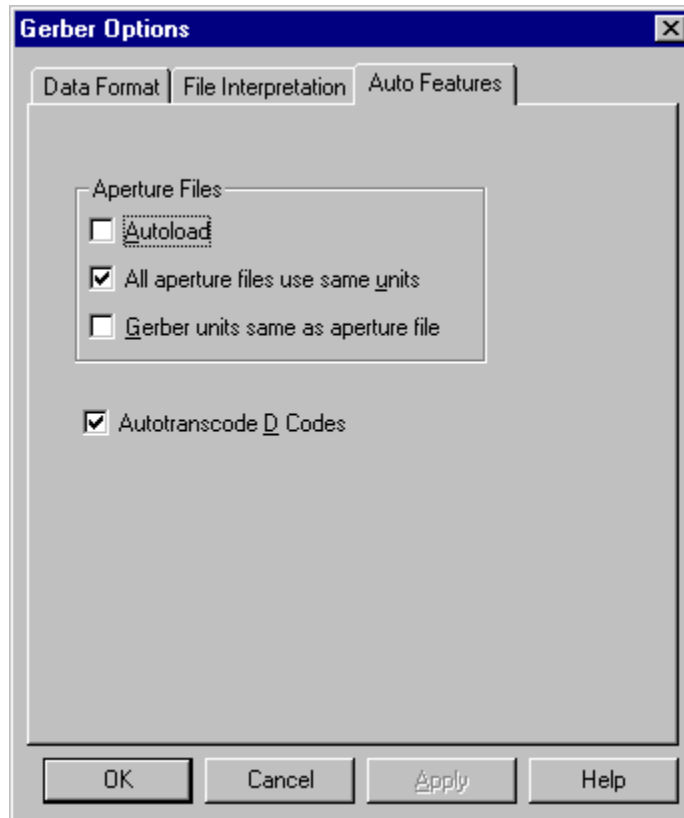
End of Block Characters

- *** or \$:** The end of a block is indicated by * or \$.
- **CR or LF:** The end of a block is indicated by CR or LF.

RS274X AM Positive Rotation: The Gerber Extended specifications for the positive rotation direction for the Aperture Macro (AM) command have changed from clockwise to counterclockwise, so there is some ambiguity in what to do with an AM rotation command. This option tells the program what direction is indicated by a positive AM rotation command.

- **Counterclockwise:** RS274X AM Positive Rotation is Counterclockwise. This matches the most recent specification.
- **Clockwise:** RS274X AM Positive Rotation is Clockwise. This matches previous specifications.

Gerber Auto Feature Options



Gerber Auto Feature Tab

The following are automatic file-loading options on the Auto Features tab of the Gerber Import dialogs.

- **Autoload Apertures:** When you use the Autoload Apertures option while importing Gerber files, the program searches the directory for aperture files that have the same prefix and attempts to load the aperture information simultaneously. If the option is not used, then the Gerber files are imported and the aperture files need to be imported separately.

The option is only relevant for Basic Gerber files that have a separate aperture file for each Gerber file, not for Gerber Extended and MDA Autoplot, which contain aperture information in the Gerber file itself.

In addition to being convenient, it is important that you use the Autoload Apertures feature if you are using the **Autotranscode D Code Conflicts** option below to merge aperture information for Basic Gerber files.

A similar command on the Import Apertures dialog is **Autoload Gerber**, which is set during the Import Apertures procedure.

- **All Aperture Files Use the Same Units:** This option tells the system that all aperture files have the same units as the first aperture file. This is useful if you are using the **Autoload Apertures** option above to load multiple aperture files and you want to avoid being prompted for units for each file.
- **Gerber Units Same as Aperture File:** This feature automatically sets the units of the Gerber file to the units specified in the associated aperture file imported with the Autoload Apertures option above and converts the aperture units to match, if needed. For instance, if an aperture file included information that the Gerber file was in English units, and the apertures were in metric units, then the aperture list would be translated into English units, and the Gerber would be imported in English units.
- **Autotranscode D Codes:** When you use the Autotranscode D Code Conflicts option while importing Gerber files, then as the files are imported, the program automatically transcodes elements with D Codes that have conflicting definitions in different files. If the Autotranscode D Code Conflicts option is not used, the last loaded conflicting D Code overwrites the previous conflicting definition.

In order for Autotranscode to work, the Gerber file must be imported with the aperture information. This means that the option is relevant when importing Gerber Extended and MDA Autoplot, which contain aperture information, or when importing Basic Gerber using the **Autoload Apertures** option above.

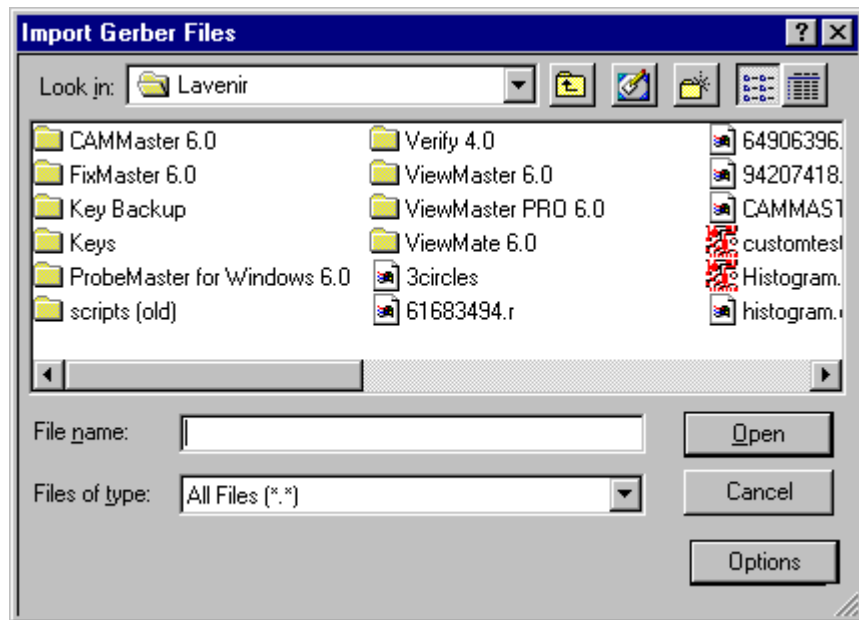
Import Basic Gerber Files into the Job Using the Import Command



The Import command allows you to pick multiple Gerber files simultaneously and import them into the current Job File.

To Import Basic Gerber Files into the Job Using the Import Command:

1. Set the first active, visible layer to which you want to read in Gerber Data. See *Select from the Active Layers* on page 152.
2. On the **Files** Menu, click **Import-Gerber**.



Import Gerber Dialog

3. In the **Look in** box, click the drive, folder, or network location that contains the Gerber Files.
4. In the folder list, double-click folders until you open the folder that contains the Gerber Files you want.
5. Click on the files that you want. You can select as many as you want using Shift+Click and Ctrl+Click to add or remove from the selection.
6. Click **Options**.
7. On the **Data Format** tab, set the Data Format options. See *Gerber Data Format Options* on page 29.

8. On the **File Interpretation** tab, set the File Interpretation options. See *Gerber File Interpretation Options* on page 31.
9. On the **Auto Features** Tab, set the Automatic File Loading options. See *Gerber Auto Feature Options* on page 33.
10. On the Options dialog, click **OK**.
11. Click **Open**.

The program imports the specified Basic Gerber Files and loads them into the Job File beginning with the first active, visible layer.



*F2 = Opens the Import Gerber dialog
F3 = Set the Gerber Import options only, without importing*



You can also Drag and Drop files into the program.

Import Basic Gerber into the Job Using a .ENV File



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Basic Gerber Files that were exported from the program (or saved from the DOS Lavenir VIEW Editor) along with a .ENV Environment file can be imported into the program using the .ENV file. This system requires less setup than the usual system for importing Basic Gerber because the Gerber format settings and options are saved in the .ENV file and do not have to be configured manually.

To Import Basic Gerber into the Job Using a .ENV File:

1. On the **Files** Menu, click **Import-Gerber**.
2. In the **Look in** box, click the drive, folder, or network location that contains the .ENV File and the Gerber Files.
3. In the folder list, double-click folders until you open the folder that contains the Files you want.
4. Double-click on the **.ENV File**.

The program imports the specified .ENV file and the associated Basic Gerber Files and loads them into the Job File.



F2 = Opens the Import Gerber dialog



You can also Drag and Drop files into the program.

Import Gerber Directly into the Layers Table



Rather than going through the **File-Import-Gerber** menu, it is sometimes more convenient to import Gerber directly into the Layers Table. This technique gives you control over exactly which file gets imported into which layer.

To Import Gerber Directly into the Layers Table:

1. To display the Layers Table, go to the **Setup** menu, and click **Layers**.
2. For each layer that you want to import data into, enter the file name into **Name** field. See *Layer Name on Layers Table* on page 352. You can use one of the following methods:
 - Enter a New Layer Name.
 - Rename Multiple Files Using Wildcards
 - Browse the Directories for File Names
3. If the files are not in the current directory, be sure to toggle the display of the path portion of the layer name so that the **path is shown**.
4. Make all layers that you want to import **visible**.
5. On the Layers Table, click **Gerber Options**.
6. On the **Data Format** tab, set the Data Format options. See *Gerber Data Format Options* on page 29.
7. On the **File Interpretation** tab, set the File Interpretation options. See *Gerber File Interpretation Options* on page 31.
8. On the **Auto Features** Tab, set the Automatic File Loading options. See *Gerber Auto Feature Options* on page 33.
9. On the Options dialog, click **OK**.
10. On the Layers Table, click **Import Layer Files**.



F10 = Display the Layers Table.

Set the Gerber Import Options without Importing



CAM



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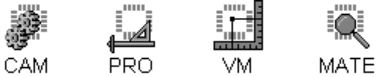
MATE

You may want to set the Gerber Import Options without actually importing the data at the same time. One reason for doing this would be if you intend to Drag and Drop files into the job or Import from Layers at a later time.

To Set the Gerber Import Options without Importing:

1. Press **F3**.
2. On the **Data Format** tab, set the Data Format options. See *Gerber Data Format Options* on page 29.
3. On the **File Interpretation** tab, set the File Interpretation options. See *Gerber File Interpretation Options* on page 31.
4. On the **Auto Features** Tab, set the Automatic File Loading options. See *Gerber Auto Feature Options* on page 33.
5. On the Options dialog, click **OK**.

Import Gerber Extended and MDA Autoplot



To Import Gerber Extended and MDA Autoplot into the Job

1. Set the first active, visible layer to which you want to read in Gerber Data. See *Select from the Active Layers* on page 152.
2. On the **Files** Menu, click **Import-Gerber**.
3. In the **Look in** box, click the drive, folder, or network location that contains the Gerber Files.
4. In the folder list, double-click folders until you open the folder that contains the Gerber Files you want.
5. Click on the files that you want. You can select as many as you want using Shift+Click and Ctrl+Click to add or remove from the selection.
6. Click **Options**.
7. If the file header does not contain this information, set the Data Format options on the **Data Format** tab. See *Gerber Data Format Options* on page 29. If the file header does contain this information, it will override the option settings on this dialog.
8. On the **File Interpretation** tab, set the File Interpretation options. See *Gerber File Interpretation Options* on page 31.
9. On the **Auto Features** Tab, set the Automatic File Loading options. See *Gerber Auto Feature Options* on page 33.



*Only the **Autotranscode D Codes** option on the Auto Features tab is relevant to Gerber Extended or MDA Autoplot files. The Apertures options are irrelevant for Gerber Extended or MDA Autoplot files because they contain the aperture information in the same file as the Gerber.*

10. Click **Open**.

The program imports the specified Gerber Extended or MDA Autoplot Files and loads them into the Job File beginning with the first active, visible layer.

The program also imports all aperture information included in the Gerber Extended or MDA Autoplot Files.



F2 = Opens the Import Gerber dialog



You can also Drag and Drop files into the program.

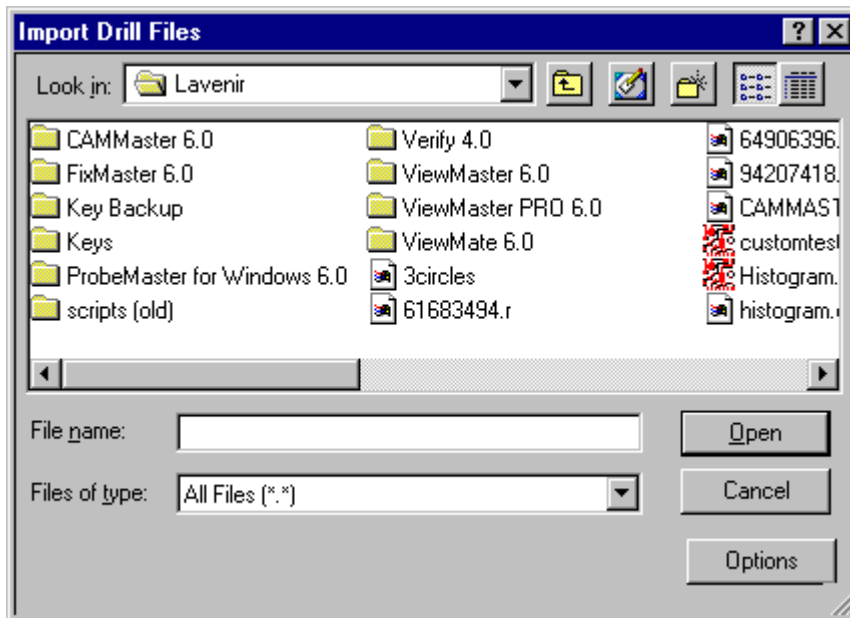
Import Drill Data



Drill data is translated into Gerber on import and is translated back to Drill on export. As Drill data is imported into the current Job File, drill data Tool Codes are mapped to N-type D Codes used to represent the drill data on screen.

To Import Drill Data into the Job:

1. Set the first active, visible layer to which you want to read in Drill Data. See *Select from the Active Layers* on page 152.
2. On the **Files** Menu, click **Import-Drill**.



Import Drill Dialog

3. In the **Look in** box, click the drive, folder, or network location that contains the Drill Files.
4. In the folder list, double-click folders until you open the folder that contains the Drill Files you want.
5. Click on the files that you want. You can select as many as you want using Shift+Click and Ctrl+Click to add or remove from the selection.
6. Click **Options**.
7. On the **Data Format** tab, set the Data Format options.



Drill Data Format Tab

Language

- **Excellon:** The file is in Excellon.
- **Wessel:** The file is in Wessel
- **Sieb and Meyer:** The file is in Sieb and Meyer.

Left of Decimal: The number of digits in the data file to the left of the implied decimal point.

Right of Decimal: The number of digits in the data file to the right of the implied decimal point.

Zeros

- **Omit Trailing Zeros:** Trailing zeros are omitted.
- **Omit Leading Zeros:** Leading zeros are omitted.
- **All Digits Present:** All digits are present and there are no zeros omitted.

- **Explicit Decimal Point:** The file has explicit decimal points, and the omitted zeros and number of digits to the right and left of the decimal are moot.

Position Coordinates

- **Incremental:** Position coordinates are incremental (coordinates are relative to the last position).
- **Absolute:** Position coordinates are absolute (coordinates are relative to the absolute origin).

Data Units

- **English:** Units are in inches.
- **Metric:** Units are in metric.

Data Code

- **ASCII:** The file is an ASCII text file.
 - **EBCDIC:** The file is in EBCDIC
 - **EIA:** The file is in EIA.
8. On the **Options** tab, set the **First D Code** to be used as the system automatically maps incoming D Codes to Tool Codes.
 9. On the options dialog, click **OK**.
 10. Click **Open**.

The program imports the specified Drill Files and loads them into the Job File beginning with the first active, visible layer.

The program also imports all Tool Code information included in the Drill Files and automatically maps the Tool Codes to new N-type D Codes.



You can also Drag and Drop files into the program.

Import Aperture Lists

There are several ways that aperture information can be brought into the open Job File.

- Import an aperture list using the Import command.
- Convert and import an aperture list using the Aperture File Wizard.
- Merge aperture information contained in Gerber Extended or MDA Autoplot file or by using the **Autoload Apertures** option on the Auto Features tab of the Gerber Import dialog.
- Insert D Code information manually using the D Code Table Editing commands.

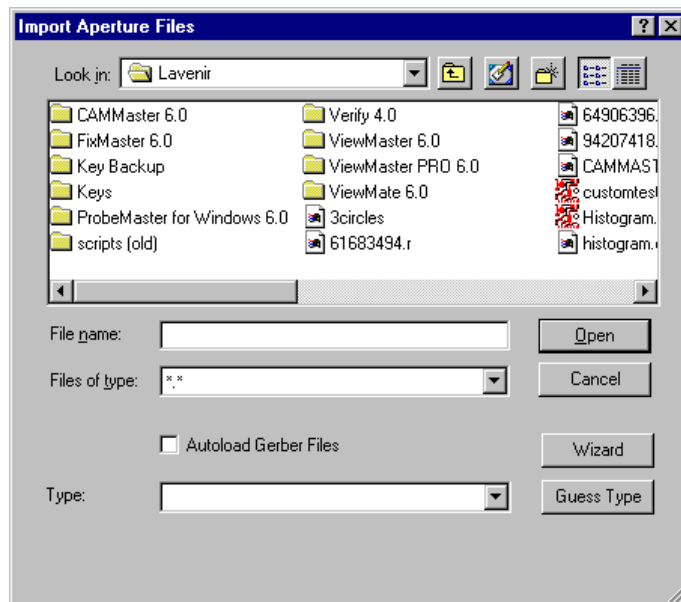
Import an Aperture List Using the Import Command



The program can import many formats of aperture list. The basic procedure, which follows, imports D Code definitions and overwrites conflicting D Code information already loaded into the open Job File.

To Import an Aperture List:

1. On the **Files** Menu, click **Import-Apertures**.



Import Apertures Dialog

2. In the **Look in** box, click the drive, folder, or network location that contains the Aperture File.

3. In the folder list, double-click folders until you open the folder that contains the Aperture File you want.
4. Click on the file that you want so that it is highlighted.
5. If you want to automatically load Gerber data with the aperture files, click the **Autoload Gerber** option so that it has a checkmark.

When you use the **Autoload Gerber** option while importing aperture files, the program searches the directory for Gerber files that are referenced by the aperture file and attempts to load the Gerber information simultaneously. If the option is not used, then the aperture files are imported and the Gerber files need to be imported separately.

A similar command on the Import Gerber Options dialog is **Autoload Apertures**, which is set in the Import Gerber procedure.

6. Pick the aperture list type on the **Type** drop down list, or click **Guess Type**.

If the file is not on the **Type** drop down list, or the program is unable to guess the type, or the program is unable to import the file correctly once the type has been identified, then you may be able to import the file with the Aperture File Wizard. See *Use the Aperture File Wizard* on page 45.

7. Click **Open**.

Depending on the aperture list type, the program may prompt for some additional information or files. If the program encounters aperture definitions that it cannot recognize it may prompt whether or not you want to import the shapes as Custom Apertures.

8. On the **Setup** menu, click **D Codes**.
9. On the D Code Table, compare your original aperture file to the D Code definitions that were imported to ensure that all definitions were imported correctly. Especially be sure to check any shapes that were converted to Custom Apertures on import.

For information on merging aperture lists see *Gerber Auto Feature Options* on page 33.



You can also Drag and Drop files into the program.

Use the Aperture File Wizard



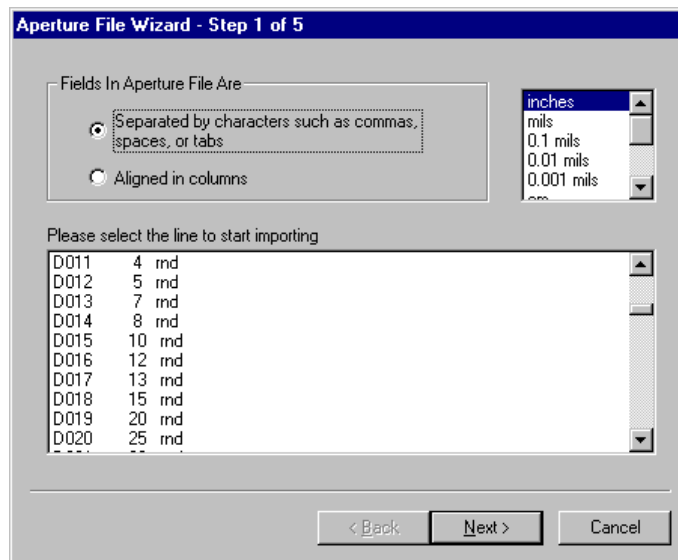
The Aperture File Wizard allows you to convert and import a foreign aperture list and save a method for converting the same type of aperture list in the future.

To Use the Aperture File Wizard:

1. On the **Files** Menu, click **Import-Apertures**.
2. In the **Look in** box, click the drive, folder, or network location that contains the Aperture File.
3. In the folder list, double-click folders until you open the folder that contains the Aperture File you want.
4. Click on the file that you want so that it is highlighted.
5. On the Import Apertures dialog, click **Wizard**.

The system displays the **Aperture File Wizard**, which takes you sequentially through the following five steps.

Aperture File Wizard Step 1:



Aperture File Wizard Step 1

1. In the box labeled **Fields in Aperture File Are**, indicate how the fields are separated:
 - **Separated by characters:** A file that is separated by characters has a specific character, such as a space or tab, separating the different fields. Also, files that have a character-to-

digit change or digit-to-character change indicating separate fields are considered to be separated by characters.

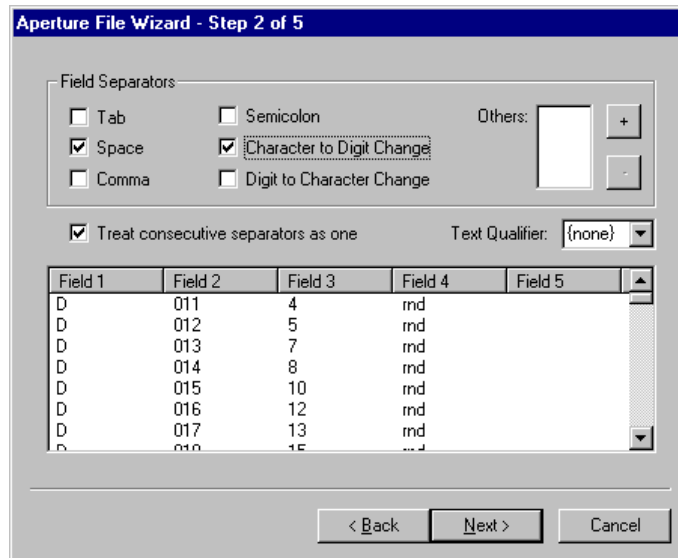
- **Aligned in Columns:** A file that is aligned in columns has each field type in the same column for every record. (A column is the character position in the line, so the second character in the line is the character in column 2 for that record, and the third character is in column 3). For example, a file in which the D Code always starts in column two (second character), the shape name always starts in column six (sixth character), and the X dimension always starts in column twenty (twentieth character) is a file whose fields are aligned in columns.

2. In the **Units** list box, click on the **units used in the file** so that the line is highlighted.
3. Click the **Next** button.

Depending on what you selected in Step 1, the system displays one of two Step 2 dialogs:

- See *Aperture File Wizard Step 2 for Files Separated by Characters*: below.
- Or*
- See *Aperture File Wizard Step 2 for Files Aligned in Columns* on page 48.

Aperture File Wizard Step 2 for Files Separated by Characters:



Aperture File Wizard Step 2 for Files Separated by Characters

The goal in Step 2 is to break your file up into fields, one for each data type.

As you add to your list of separators, the list box at the bottom of the dialog shows you how the file separates into fields.

1. In the **Field Separators** group box, click the check box(es) next to the characters that separate the fields in your file so that each one used in your file has a check mark. For example, if your

file always has a space between the D Code, shape, and X dimension, check the Space check box.

2. If your file is such that a change in field is indicated when the text in the file changes from a character to a digit, or vice versa, click the check boxes next to **Character to Digit Change** and/or **Digit to Character Change**. For example, if the fields for shape and dimension run together like C00100, where C is the shape and 00100 is the diameter, then the change from shape field to diameter field is indicated by a character to digit change.
3. If your file uses a separator character that is not listed, you can add it to the **Others** list:
 - Click on the + button.
 - Type the character you want to add.
 - Click **OK**.

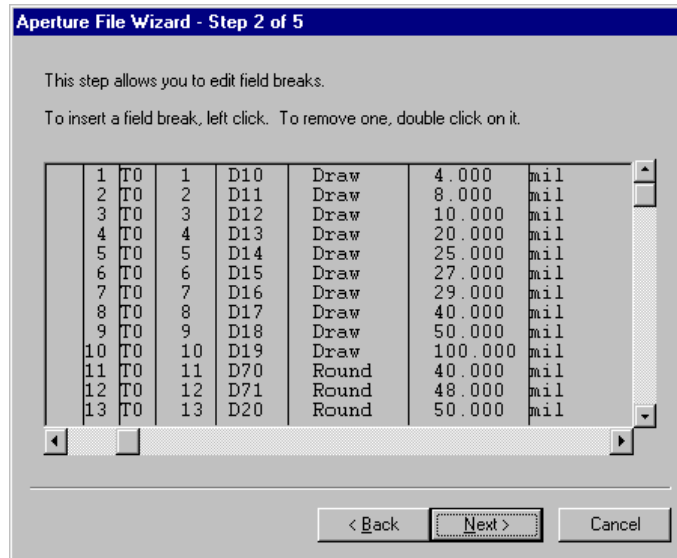
This adds the character to the Others list.

If you want to remove a character from the Others list:

- Click on the character so that it is highlighted.
 - Click the – button.
4. If your file sometimes contains multiple consecutive separator characters and you want them to be treated as one separator, click the **Treat Consecutive Separators as One** check box so that it has a check mark. When this option is checked, the program treats consecutive separators as one separator so that only one new field will be created for each group of consecutive separators. For instance, if you check the **Space** check box and your file contains 5 spaces between each field and the **Treat Consecutive Separators as One** check box is checked, then the 5 spaces are treated as one separator. In the same example, if the **Treat Consecutive Separators as One** check box is **not** checked, then 5 new fields will be created, one for each space.
 5. If your file contains text enclosed in quotes or single quotes and you do not want this text broken up into different fields, select a Text Qualifier from the **Text Qualifier** combo box.

As you add to your list of separators, the list box at the bottom of the dialog shows you how the file separates into fields. Add and remove separators until you have all the fields separated from each other.
 6. When all the fields are separated from each other, click the **Next** button to go to Step 3. See *Aperture File Wizard Step 3*: on page 49.

Aperture File Wizard Step 2 for Files Aligned in Columns:



Aperture File Wizard Step 2 for Files Aligned in Columns

The goal in Step 2 is to break your file up into fields, one for each data type.

1. In the box where the file is displayed, **click** between each field to draw a line separating the fields.
2. To remove a line **double-click** on it.
3. **Scroll** through the file to make sure you have placed all the lines correctly.
4. When all the lines are placed to properly separate all the fields, click the **Next** button to go to Step 3. See *Aperture File Wizard Step 3*: on page 49.

Aperture File Wizard Step 3:

Aperture File Wizard - Step 3 of 5

Please indicate the field number for each of the following field labels that apply.

D Code:
 Aperture Position:

Shape:
 X:
 Y:
 Hole/Radius:
 Rotation:

Custom File Name:

Field 1	Field 2	Field 3	Field 4	Field 5
D	011	4	md	
D	012	5	md	
D	013	7	md	
D	014	8	md	
D	015	10	md	
D	016	12	md	
D	017	13	md	

Aperture File Wizard Step 3

The goal of this step is to tell the Aperture File Wizard what each field in the file represents.



When setting up this dialog, it is possible that a single field in the file may be used for one thing in one record and another thing in another record. For example, Field 4 might represent the Y dimension if the shape is a Rectangle and represent a Hole if the shape is a Circle. This is OK. In this example you would enter 4 in the Y edit box and also enter 4 in the Hole/Radius edit box.

Also, if the file does not contain data for a particular field label, enter zero for that field label.

1. If your file contains D Codes, select the **D Code** radio button, and put the number of the field that contains the D Code numbers in the **D Code** edit box.
If your file contains aperture position numbers and not D Codes, select the **Aperture Position** radio button, and put the number of the field that contains the aperture position numbers in the **Aperture Position** edit box.
2. Put the number of the field that contains the shape names in the **Shape** edit box.
3. Put the number of the field that contains the X dimensions in the **X** edit box.
4. If any of the apertures in the file have a Y dimension, put the number of the field that contains the Y dimensions in the **Y** edit box.
5. If the file contains custom apertures and gives the path of the custom aperture file, put the number of the field that contains the custom aperture file paths in the **Custom Aperture File** edit box.

6. If the file has hole size or rounded rectangle radius data, put the number of that field in the **Hole/Radius** edit box.
7. If the file contains rotation data, put the field number in the **Rotation** edit box.
8. If the file contains thermal apertures:
 - Click the **Thermal Fields** button.
 - In the Thermals dialog, put the field number of each data type in the corresponding edit box.
 - If the file doesn't contain a data type, leave the field number 0, and the program will use a default value.

The Inner Diameter Default is outer diameter minus 2 times the cut width.

The Cut Width Default is 0.015 in.

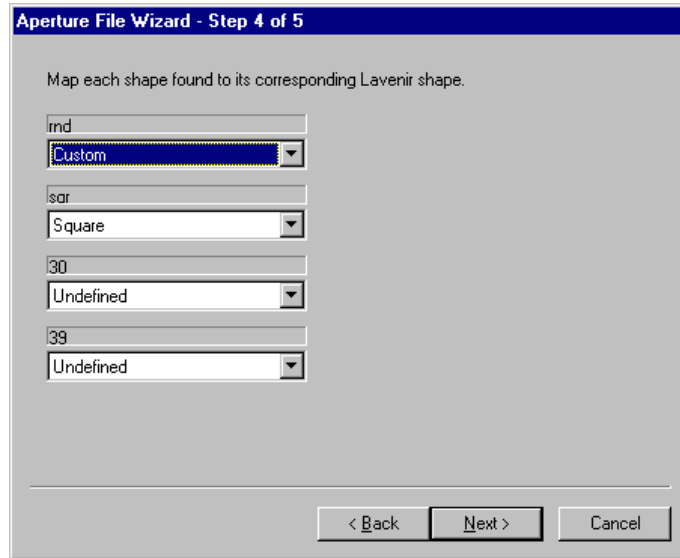
The Number of Cuts Default is 4.

The Angle Default is 45.

If the only thermal data in the file is the outer diameter and inner diameter, and the outer diameter field number is the same as the X dimension field number, and the inner diameter field number is the same as the Y dimension field number or undefined, then there is no need to fill in the thermal field numbers.

9. Click the **Next** button to go to Step 4.

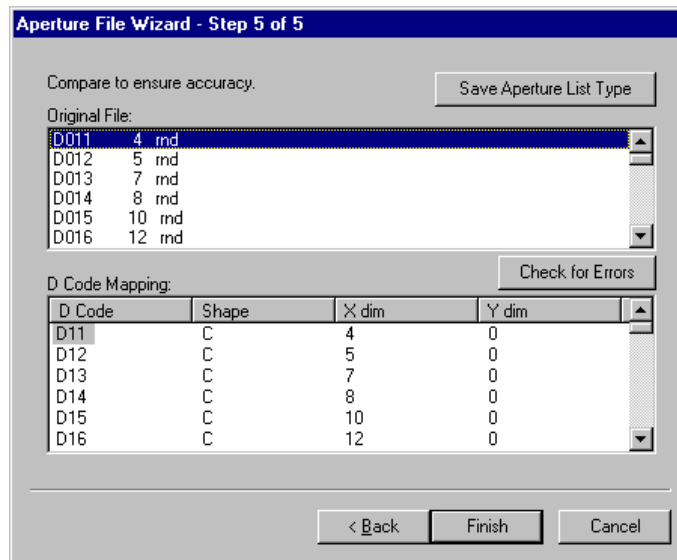
Aperture File Wizard Step 4:

*Aperture File Wizard Step 4*

The goal of this step is to tell the Aperture File Wizard what each shape in the file corresponds to in a Lavenir format aperture list.

1. For each shape listed, select the Lavenir shape that it corresponds to. If the shape is not in the list of Lavenir shapes or if it is not actually a shape (garbage data), select Undefined.
2. When all the listed shapes that are true shapes have been mapped to a corresponding Lavenir shape, click the **Next** button to go to Step 5.

Aperture File Wizard Step 5:

*Aperture File Wizard Step 5*

The goals of Step 5 are to verify the accuracy of the file conversion, to save a method for converting this type of file in the future, and to import the converted file into the program.

The **Original File** box contains the text of the original file, and the **D Code Mapping** contains the end result of the conversion process.

1. Click on a line in the **Original File** list box or on a D Code in the **D Code Mapping** list box to select that line and the corresponding line in the other box.
2. Compare each line in the **Original File** to the **D Code Mapping** and make sure the D Code Mapping matches what you think it should be.
3. If the data in the D Code Mapping box **does not match** what you think it should be, you can click the **Back** button to go back through the steps of the Aperture File Wizard and change settings and options. Or you can **edit the D Code mapping**:
 - To bring up a context menu where you can change the shape, dimensions and D Code number of the selected D Code, **Right-Click** on a D Code in the **D Code Mapping** box.
 - To change the dimensions of the selected D Code, **Double-Click** or press **I**.
 - To change the D Code number of the selected D Code, press **A**.
 - To change the shape of the selected D Code, press the letter of a **Lavenir shape code**. This also brings up the dimension dialog for the new shape.
 - If there is a line that you don't want translated, enter a **?** for the **D Code** or **Shape**. You can do this by selecting the D Code and pressing **U**, or do it by pressing **A** and entering **?**

for the **D Code number**. The program does not import any line in which the **D Code** or **Shape** is a ?.

4. To check the file for errors that will prevent the converted file from importing into the job, such as invalid D Code numbers and dimensions greater than 10 inches:
 - Click the **Check For Errors** button.
 - If any errors are found, an **Errors Found** dialog box is shown listing the errors.
 - To select the D Code that corresponds to the error, **click on the error**.
 - Edit the **D Code Mapping** to correct the errors.
 - When finished editing, click the **Check For Errors** button again to update the list of errors.
5. If you have other aperture lists of this type and you want to save the Aperture File Wizard settings so that you can import the same format in the future:
 - Click the **Save Aperture List Type** button.
 - Enter a **file name** prefix.
 - Select a **folder** to store all your Aperture Wizard files in.



You are only prompted for the folder the first time you save an Aperture Wizard file because all the Aperture Wizard files need to be saved in the same place. If you want to change where you save Aperture Wizard files, the folder name is stored in your registry under the key HKEY_LOCAL_MACHINE-Software-Lavenir Technology, Inc. in the string value Aperture Wizard Directory.

The next time you go into the Import Apertures dialog box, you will be able to select this file from the Type combo box and use the information you gave in Steps 1 through 4 to skip right to Step 5.

6. When the file is free of errors and ready to import, click the **Finish** button.

If an **Errors Found** dialog box pops up, you must correct these errors before you can import your aperture list. See the discussion above.

If there are no errors, the file is imported into the job and the aperture information is added to the D Code Table.
7. On the **Setup** menu, click **D Codes** and check the D Code Table to make sure your aperture list was imported properly.

Import HPGL



CAM



PRO



VM



MATE

The program translates HPGL data into Gerber on import. HPGL Pen widths are mapped to D Codes on Import.

To Import HPGL into the Job

1. Set the first active, visible layer to which you want to read in HPGL Data. See *Select from the Active Layers* on page 152.
2. On the **Files** Menu, click **Import-HPGL**.
3. In the **Look in** box, click the drive, folder, or network location that contains the HPGL Files.
4. In the folder list, double-click folders until you open the folder that contains the HPGL Files you want.
5. Click on the files that you want. You can select as many as you want using Shift+Click and Ctrl+Click to add or remove from the selection.
6. Click **Options**.
7. Set the **HPGL Import** options.

Zero-Length Draws

- **Make Pads:** Draw commands with no end coordinate are made into pads.
- **Ignore:** Draw commands with no end coordinate are ignored.

First New D Code: Enter the number of the first new D Code you want the program to generate when translating pen widths to D Codes.

Ignore IP Commands:

Isotropic Scaling:

Auto Select Text D Code:

Ignore Polygon Fills:

8. On the options dialog, click **OK**.
9. Click **Open**.

The program imports the specified HPGL Files and loads them into the Job File beginning with the first active, visible layer.



You can also Drag and Drop files into the program.

Import Netlist Data

The program can import Lavenir Format 2, Format 4, and IPC-D-356 netlists into the job. If you have a netlist of another format, it may be possible to convert it into a Lavenir format using the Netlist Conversion feature. See *Convert Netlist Files to Lavenir Format* on page 57.

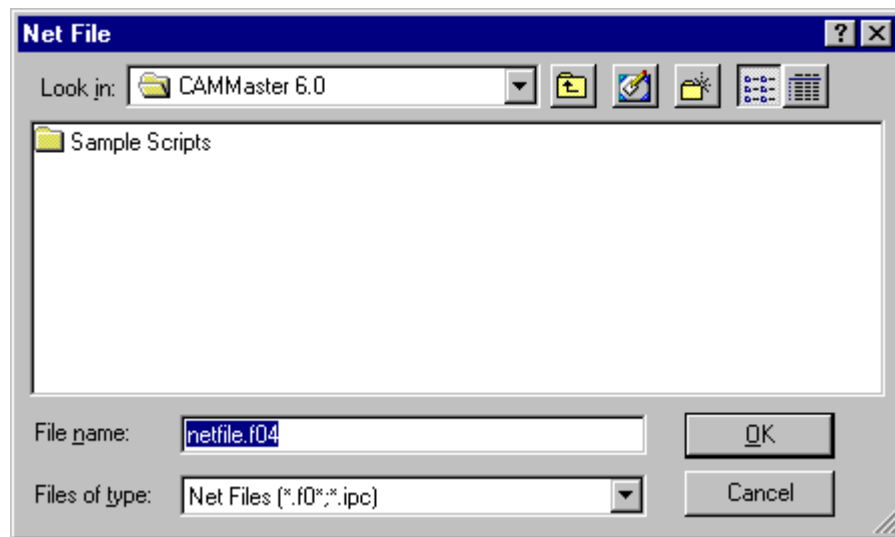
The program can import netlist information in two different ways. The program can import all netlist information in the netlist file and generate pads and traces to represent the netlist in the layers of the current job. Or the program can import the netlist information and match it to existing pads and traces already in the current job.

Import Netlist File into the Job and Generate Plot Data



To Import a Netlist File into the Job and Generate Plot Data:

1. On the **File** menu, click **Import-Netlist**.



Import Netlist Dialog

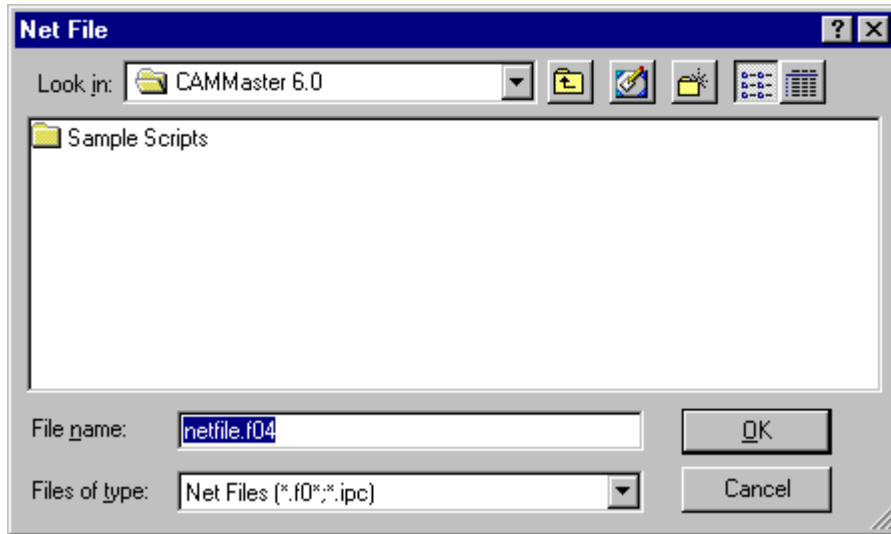
2. In the **Look in** box, click the drive, folder, or network location that contains the Netlist File.
3. In the folder list, double-click folders until you open the folder that contains the Netlist File you want.
4. Click the **Netlist File** so that it is highlighted and the name appears in the File Name field.
5. If you want the netlist file and representative plot data to begin in a specific layer, click **Options**, and select the **layer** in the layer dialog.
6. Click **OK**.

Import Netlist Data into the Job and Match to Existing Plot



To Import a Netlist File into the Job and Match to Existing Plot:

1. On the **File** menu, click **Import-Net Info**.



Import Netlist Dialog

2. In the **Look in** box, click the drive, folder, or network location that contains the Netlist File.
3. In the folder list, double-click folders until you open the folder that contains the Netlist File you want.
4. Double-click the **Netlist File**.

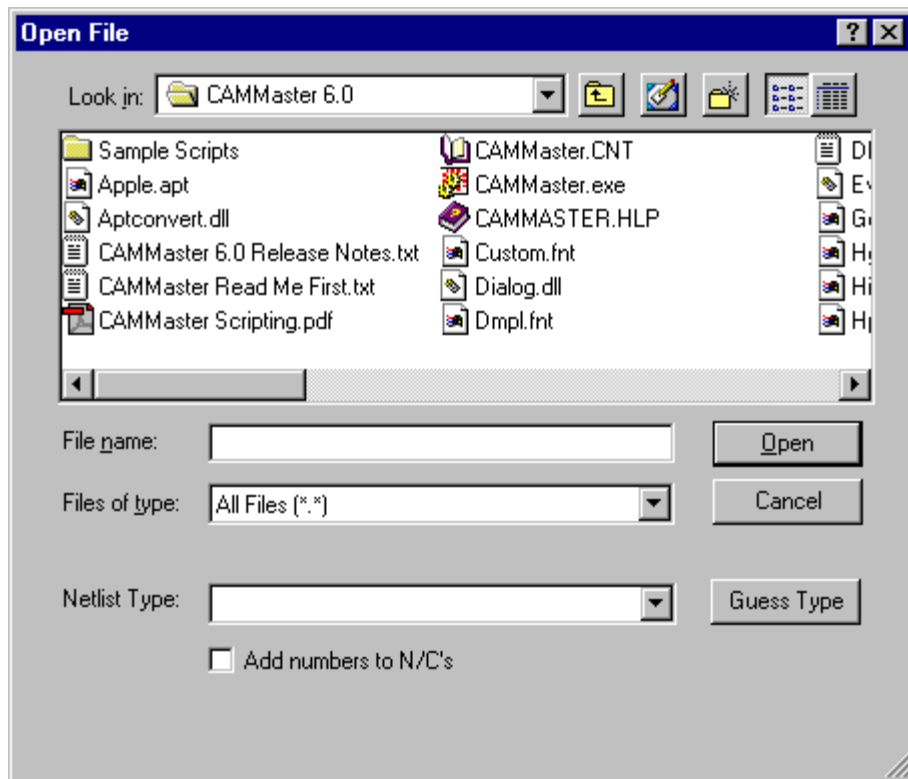
Convert Netlist Files to Lavenir Format



The program can convert many formats of netlist file into Lavenir Format 2 or Format 4 netlists. When the netlist is converted into a Lavenir format netlist, you can import the netlist into the job.

To Convert a Netlist File:

1. On the **Tools** Menu, click **Netlist-Convert Netlist**.



Convert Netlist Dialog

2. In the **Look in** box, click the drive, folder, or network location that contains the netlist file.
3. In the folder list, double-click folders until you open the folder that contains the netlist file you want.
4. Click on the file that you want so that it is highlighted.
5. Pick the netlist type on the **Type** drop down list, or click **Guess Type**.

6. If the file contains N/C records for non-connected points and you want those points to have unique identifiers, click on **Add Numbers to N/C's** so that the option has a check mark. If there is no check mark, then those points will have the N/C identifier with no unique net number.
7. If you want to automatically import the converted netlist after conversion, click on **Import Netlist** so that the option has a check mark. If there is no check mark, then the netlist will be converted and saved under a name you specify later, but it will not be imported.
8. Click **Open**.
Depending on the netlist type, the program may prompt for some additional information or files.
The program prompts for a name for the converted netlist file.
9. If you want to accept the default name, click **Accept Default**.
If you want to change the name or directory, click **Change Name**, and enter a new name or location for the converted netlist file. Then click **OK**.

Export Files from the Job

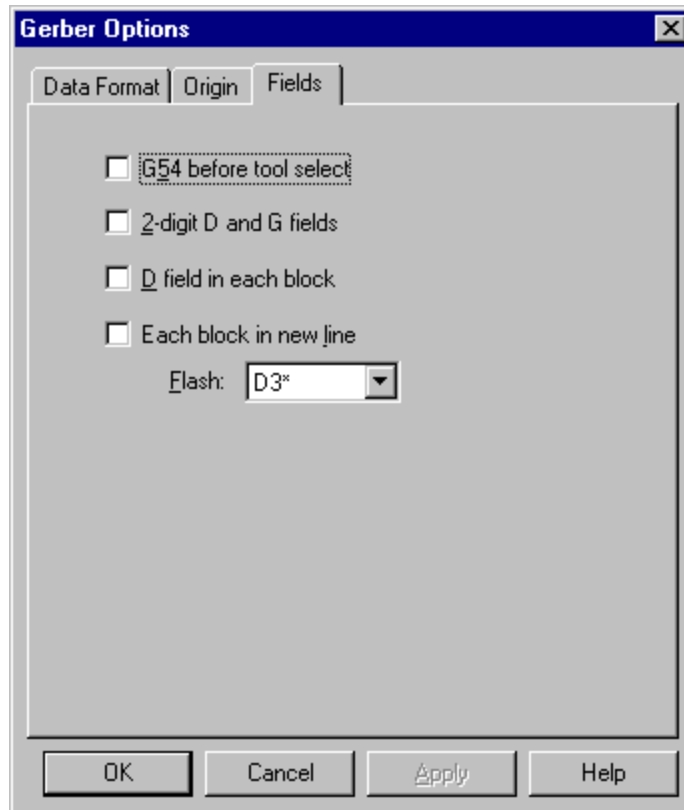
Exported files are files of a specific data format that are derived from the current Job File. To get Basic Gerber, Gerber Extended, MDA Autoplot, Drill, aperture or netlist files out of the Job File for use by other software or hardware, use the Export commands, not the Save command.

Export Basic Gerber



The program exports several formats of Gerber data, including Basic Gerber, Gerber Extended and MDA Autoplot. Each format has field and data format options and may have additional special export options.

Gerber Export Fields Options



Gerber Export Fields Tab

The following are Gerber Export options on the Fields tab of the Gerber Export dialog. Different systems that use Gerber data interpret commands and situations differently, so this is where you tell the program how to export the file so that your other systems can use the file:

G54 Before Tool Select: Inserts a G54 command before every tool select command.

2-Digit D and G Fields: Exports 2-digit D and G fields (D02 and D03 instead of D2 or D3).

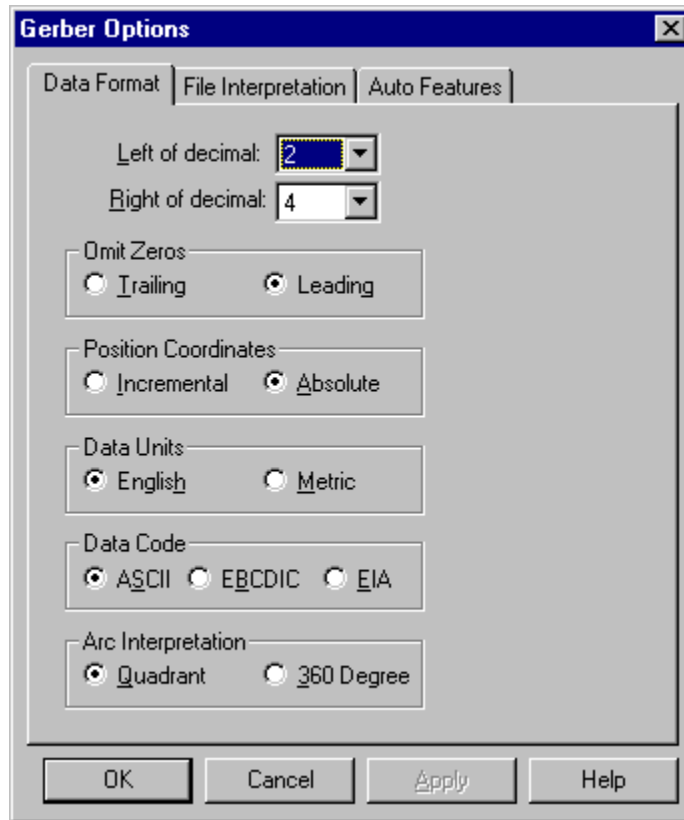
D Field in Each Block: Exports a D field in each block (required for non-modal systems); otherwise the system will not output a D field in each block if the D field command has not changed since the previous D field (appropriate for modal systems).

Each Block in New Line: Exports each block in a new line. Some systems require this, but it makes the file larger.

Flash: There are several options for how to export a flash:

- **D3*** : This is the standard.
- **D2*D3*** : Some systems require a move before the flash.
- **G55D3*** : Some systems require a G55 before the flash.
- **D3*D3*** : This is an odd format required by some Allegro systems.

Gerber Data Format Options



Gerber Data Format Tab

The following are Gerber Data Format options on the Data Format tab of the Gerber Import and Export dialogs:

Left of Decimal: The number of digits in the data file to the left of the implied decimal point.

Right of Decimal: The number of digits in the data file to the right of the implied decimal point.

Omit Zeros

- **Trailing:** Trailing zeros are omitted.
- **Leading:** Leading zeros are omitted.

Position Coordinates

- **Incremental:** Position coordinates are incremental (coordinates are relative to the last position).
- **Absolute:** Position coordinates are absolute (coordinates are relative to the absolute origin).

Data Units

- **English:** Units are in inches.
- **Metric:** Units are in metric.

Data Code

- **ASCII:** The file is an ASCII text file.
- **EBCDIC:** The file is in EBCDIC
- **EIA:** The file is in EIA.

Arc Interpretation

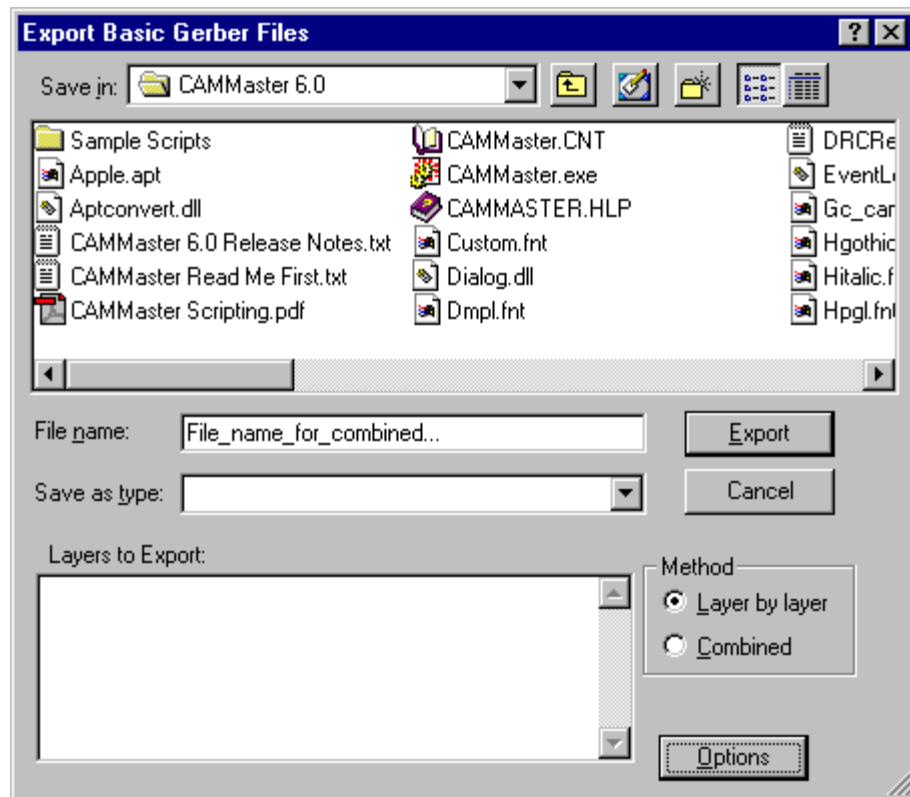
- **Quadrant:** Arcs are Quadrant arcs.
- **360-degree:** Arcs are 360-degree arcs.

Export Basic Gerber

The following steps outline the basic procedure for exporting Basic Gerber. You may have special considerations when photoplotting multiple layers on a single piece of film. See *Photoplot Multiple Layers on a Single Piece of Film* on page 72.

To Export Basic Gerber:

1. Check your visibility settings for:
 - Visible Layers
 - The program only exports visible elements, so make sure all pads, traces, selected, unselected elements and blanked D Codes to be exported are visible. See *Element Visibility* on page 84.
2. On the **Files** Menu, click **Export-Basic Gerber**.



Export Basic Gerber Dialog

3. In the **Look in** box, click the drive, folder, or network location where you want the Basic Gerber Files.

4. In the folder list, double-click folders until you open the folder where you want the Basic Gerber Files.
5. On the **Layers to Export** list, click to select the layers that you want to export. Only visible layers appear on the list.
6. Click **Options**.
7. On the **Data Format** tab, set the Data Format options. See *Gerber Data Format Options* on page 61.
8. On the **Origin** Tab, set the export file origin.
 - **Absolute origin (0,0):** Select this option if you want the origin of the export file to be the same as the origin of the loaded Job File database.
 - **Present Cursor Location:** Select this option if you want the origin of the export file to be the current cursor position instead of the origin of the loaded Job File database.
9. On the **Fields** tab, set the Gerber Field options. See *Gerber Export Fields Options* on page 59.
10. On the Options dialog, click **OK**.
11. Select whether to export the layers as Individual Layer-by-Layer files or as a Combined file.
 - **Layer-by-Layer:** When you use the **Layer-by-Layer** option to Export files, all files selected in the **Layers to Export** list are exported in **separate** files.
 - **Export Combined Files:** When you use the **Combined** option to Export files, all files selected in the **Layers to Export** list are exported in a **single** file. This means that the plot data for separate layers is merged into a single layer.
12. Depending on whether you selected Layer-by-Layer or Combined, you may need to enter a file name.
 - If exporting the layers Combined, enter a file name.
 - If exporting the layers Layer-by-Layer, the system uses the layer names in the Layers Table.
13. Click **Export**.

Because Basic Gerber does not contain aperture information you will probably want to export an aperture list. See *Export Aperture Data* on page 79.

Export Gerber Extended

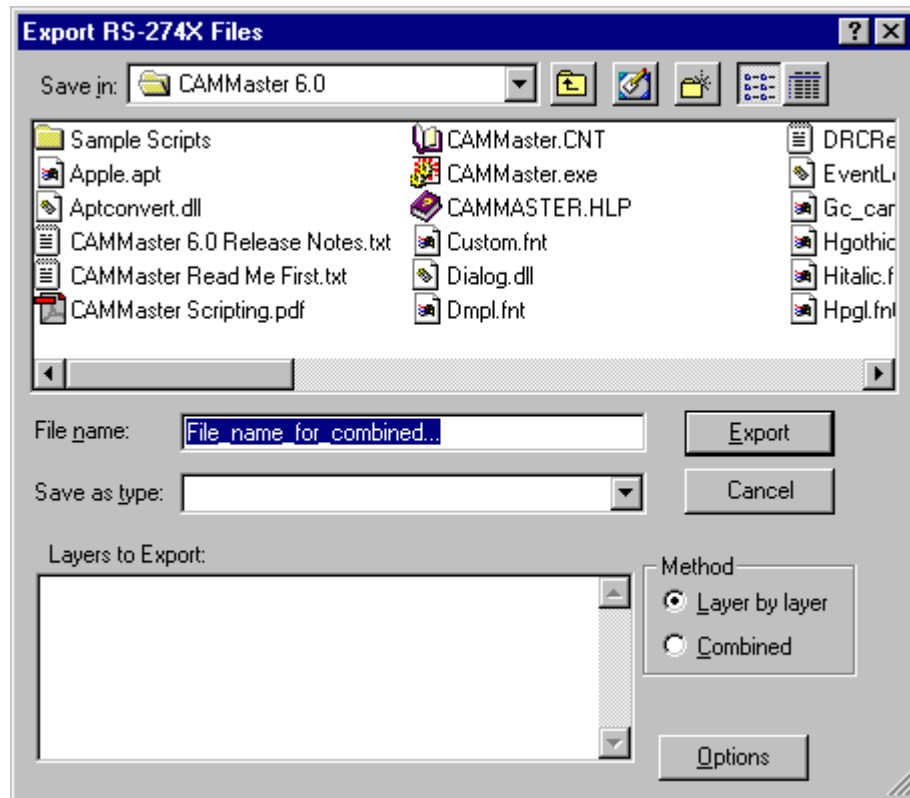


The following steps outline the basic procedure for exporting Gerber Extended. In addition to the basic procedure you may have some special considerations:

- See *Photoplot Multiple Layers on a Single Piece of Film* on page 72.
- See *Combine Paint, Scratch, Positive & Negative Layers in Extended Gerber* on page 67.
- See *Append Additional Files to Gerber Extended Headers* on page 68.

To Export Gerber Extended:

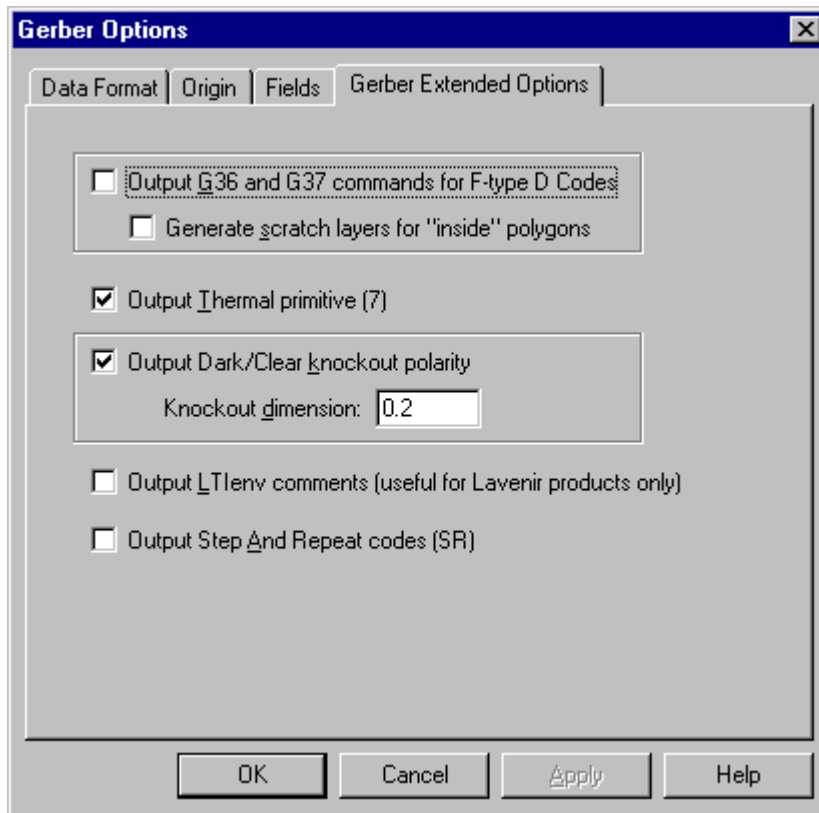
1. Check your **visibility** settings for:
 - Visible Layers
 - The operation only exports visible elements, so make sure all pads, traces, selected, unselected elements, and blank D Codes to be exported are visible. See *Element Visibility* on page 84.
2. On the **Files Menu**, click **Export-Gerber Extended**.



Export Gerber Extended Dialog

3. In the **Look in** box, click the drive, folder, or network location where you want the Gerber Extended Files.
4. In the folder list, double-click folders until you open the folder where you want the Gerber Extended Files.
5. On the **Layers to Export** list, click to select the layers that you want to export. Only visible layers appear on the list.
6. Click **Options**.

7. On the **Data Format** tab, set the Data Format options. See *Gerber Data Format Options* on page 61.
8. On the **Origin** Tab, set the export file origin.
 - **Absolute origin (0,0):** Select this option if you want the origin of the export file to be the same as the origin of the loaded Job File database.
 - **Present Cursor Location:** Select this option if you want the origin of the export file to be the current cursor position instead of the origin of the loaded Job File database.
9. On the **Fields** tab, set the Gerber Field options. See *Gerber Export Fields Options* on page 59.
10. On the **Gerber Extended Options** tab, set the Gerber Extended Export Options.



Gerber Extended Export Options Tab

The following are Gerber Extended Export options on the Gerber Extended Options tab of the Gerber Extended Export dialog.

- **Output G36 and G37 Commands for F-type D Codes:** Exports G36 and G37 commands for polygon boundary D Codes (type F).

- **Generate Scratch Layers for “Inside” Polygons:** Generates scratch layers for G36 and G37 polygons that are inside other polygons.
 - **Output Thermal Primitive (7):** Outputs H-type Thermal D Codes using the Gerber Extended thermal macro #7.
 - **Output Dark/Clear Knockout Polarity:** Adds Knockout Polarity commands that allow some Crescent photoplotters to plot paint and scratch layers simultaneously on a single piece of film.
 - **Knockout Dimension:** Size of the knockout block to be added before the scratch layers.
 - **Output LTIenv Comments:** Adds a header to the Gerber Extended file that can be read by other Lavenir software and hardware. The header contains information that allows the Lavenir software to identify certain macros in the Gerber Extended file as Heat Reliefs, Rounded Rectangles, Octagons, etc. Without this information the software would import these macros as Custom Apertures (Type-M D Codes).
 - **Output Step and Repeat Codes (SR):** Exports coded step and repeat blocks in the Job File database using the Gerber Extended SR command. Otherwise the coded step and repeats are converted into copied data on export.
11. On the Options dialog, click **OK**.
 12. Select whether to export the layers as Individual Layer-by-Layer files or as a Combined file.
 - **Layer-by-Layer:** When you use the **Layer-by-Layer** option to Export files, all files selected in the **Layers to Export** list are exported in **separate** files.
 - **Export Combined Files:** When you use the **Combined** option to Export files, all files selected in the **Layers to Export** list are exported in a **single** file. This means that the plot data for separate layers is merged into a single layer.
 13. Depending on whether you selected Layer-by-Layer or Combined, you may need to enter a file name.
 - If exporting the layers Combined, enter a file name.
 - If exporting the layers Layer-by-Layer, the system uses the layer names in the Layers Table.
 14. Click **Export**.

Combine Paint, Scratch, Positive & Negative Layers in Extended Gerber

Most photoplotters that accept Gerber Extended can plot a particular sequence of paint, scratch, positive, and negative layers on a single piece of film. Gerber Extended headers can appear anywhere inside a plot file. Because of this, paint, scratch, positive, and negative data can appear inside the same file.

To output this data properly, integrate the following steps into the Export Gerber Extended procedure.

To Combine Paint, Scratch, Positive & Negative Layers in Extended Gerber:

1. Give all layers exactly the **same name, prefix and extension**.
2. Export the data **Layer-by-Layer**.

Append Additional Files to Gerber Extended Headers

You can set up custom entries for Gerber Extended headers in files that will be inserted by the program in the generated header. The name of the Gerber Extended file is GBX_HDR.ADD. If this file does not exist when the Gerber Extended files are output, no action is taken. If it does exist, it is inserted "as is" (i.e. no parsing of the contents is attempted).

Export MDA Autoplot



CAM



PRO



VM



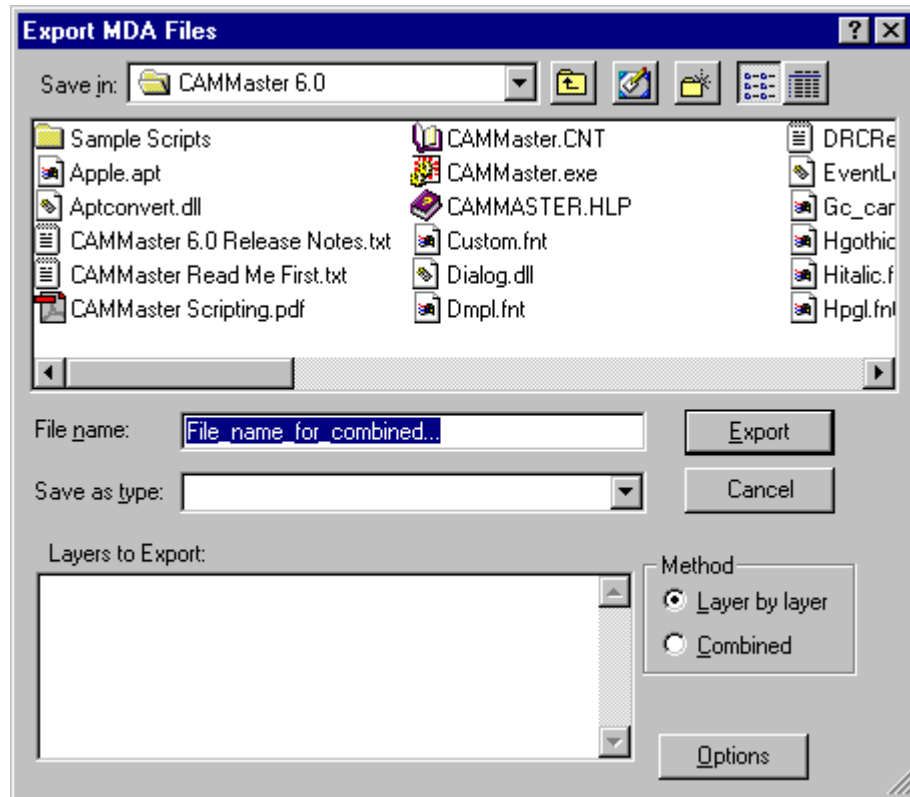
MATE

The following steps outline the basic procedure for exporting MDA Autoplot. In addition to the basic procedure you may have some special considerations:

- See *Photoplot Multiple Layers on a Single Piece of Film* on page 72.
- See *Combine Paint, Scratch, Positive & Negative Layers in MDA Autoplot* on page 71.
- See *Append Additional Files to MDA Autoplot Headers* on page 72.

To Export MDA Autoplot:

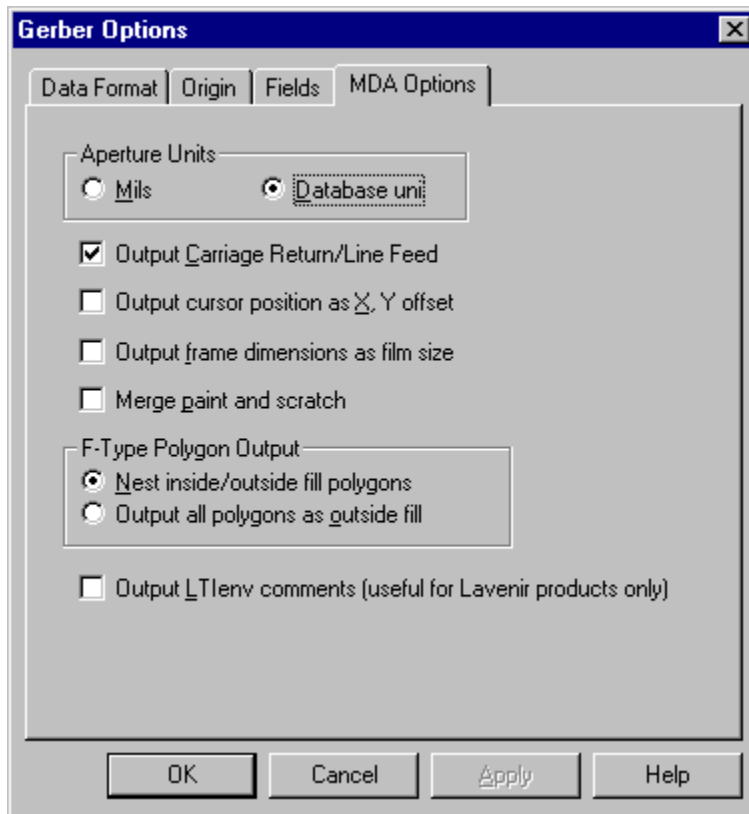
1. Check your **visibility** settings for:
 - Visible Layers
 - The operation only exports visible elements, so make sure all pads, traces, selected, unselected elements, and blank D Codes to be exported are visible. See *Element Visibility* on page 84.
2. On the **Files** Menu, click **Export-MDA Autoplot**.



Export MDA Autoplot Dialog

3. In the **Look in** box, click the drive, folder, or network location where you want the MDA Autoplot Files.
4. In the folder list, double-click folders until you open the folder where you want the MDA Autoplot Files.
5. On the **Layers to Export** list, click to select the layers that you want to export. Only visible layers appear on the list.
6. Click **Options**.
7. On the **Data Format** tab, set the Data Format options. See *Gerber Data Format Options* on page 61.
8. On the **Origin** Tab, set the export file origin.
 - **Absolute origin (0,0):** Select this option if you want the origin of the export file to be the same as the origin of the loaded Job File database.
 - **Present Cursor Location:** Select this option if you want the origin of the export file to be the current cursor position instead of the origin of the loaded Job File database.
9. On the **Fields** tab, set the Gerber Field options. See *Gerber Export Fields Options* on page 59.

10. On the **MDA Options** tab, set the MDA Export Options.



MDA Export Options Tab

The following are MDA Export options on the MDA Options tab of the MDA Export dialog.

Aperture Units

- **Mils:** Aperture units are converted to mils from the database units on export.
- **Database Units:** Aperture units exported in the database units.

Output Carriage Return/Line Feed: Adds a carriage return or line feed to separate each block.

Output Cursor Position as X, Y Offset: Exports the cursor position in the X, Y Offset field.

Output Frame Dimensions as Film Size: Exports the reference frame dimension in the Film Size field.

Merge Paint and Scratch: Adds a Merge command to combine two or more paint and scratch composite layers.

F-Type Polygon Output

- **Nest Inside/Outside Fill Polygons:** The program determines which polygons are inside other polygons and exports them as nested.
- **Output All Polygons as Outside Fill:** The program exports all polygons as outside fill polygons regardless of which polygons are inside other polygons.

Output LTIenv Comments: Adds a header to the MDA file that can be read by other Lavenir software and hardware. The header contains information that allows the Lavenir software to identify certain macros in the MDA file as Heat Reliefs, Rounded Rectangles, Octagons, etc. Without this information the software would import these macros as Custom Apertures (Type-M D Codes).

11. On the Options dialog, click **OK**.
12. Select whether to export the layers as Individual Layer-by-Layer files or as a Combined file.
 - **Layer-by-Layer:** When you use the **Layer-by-Layer** option to Export files, all files selected in the **Layers to Export** list are exported in **separate** files.
 - **Export Combined Files:** When you use the **Combined** option to Export files, all files selected in the **Layers to Export** list are exported in a **single** file. This means that the plot data for separate layers is merged into a single layer.
13. Depending on whether you selected Layer-by-Layer or Combined, you may need to enter a file name.
 - If exporting the layers Combined, enter a file name.
 - If exporting the layers Layer-by-Layer, the system uses the layer names in the Layers Table.
14. Click **Export**.

Combine Paint, Scratch, Positive & Negative Layers in MDA Autoplot

Most photoplotters that accept MDA Autoplot data can plot a particular sequence of paint, scratch, positive, and negative layers on a single piece of film. MDA Autoplot headers can appear only at the beginning of a plot file. Therefore a new file is required each time the data changes polarity.

To output a merged sequence of MDA Autoplot layers, integrate the following steps into the Export MDA Autoplot procedure.

To Combine Paint, Scratch, Positive & Negative Layers in MDA Autoplot:

1. Give each layer a **unique name**.
2. On the MDA Autoplot Export Options tab, put a check mark in the **Merge Paint and Scratch** option.
3. Export the data **Layer-by-Layer**.

The MDA headers in each file chain to the next via the NEXT command.

Append Additional Files to MDA Autoplot Headers

You can set up custom entries for MDA Autoplot headers in files that will be inserted by the program in the generated header. The name of MDA Autoplot file is MDA_HDR.ADD. If this file does not exist when MDA Autoplot files are output, no action is taken. If it does exist, it is inserted "as is" (i.e. no parsing of the contents is attempted).

Photoplot Multiple Layers on a Single Piece of Film

When photoplotting multiple layers on a single piece of film, some photoplotters plot the offset for you; most don't.

To be safe when photoplotting multiple layers on a single piece of film, integrate the following steps into the Export procedure.

To Photoplot Multiple Layers on a Single Piece of Film:

1. Arrange the data so that no layer overlaps another.
2. Export the file Combined.

Export Drill Data



CAM



PRO



VM



MATE

The program can export Gerber data as Drill Data in the Excellon, Wessel, or Sieb & Meyer formats.

There are two ways to export Drill data:

- Use the following basic Export Drill Data procedure.
- Designate the Layer Type as Drill (DRI), in the Type column on the Layers Table and export the data Layer-by-Layer using the Export Basic Gerber, Export Gerber Extended, or Export MDA Autoplot procedures.

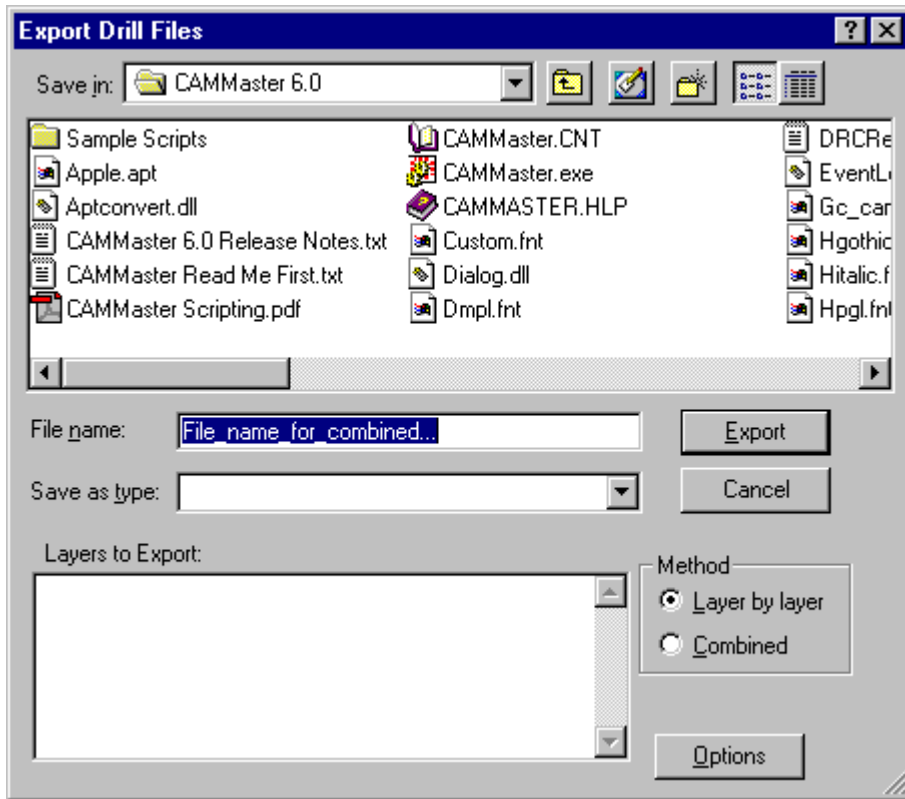
In addition to the basic procedure, you may have some special considerations if you are exporting an Excellon drilled slot pattern. See *Excellon Drilled Slot Pattern* on page 78.

Prepare the Plot Data for Drill Data Export:

- The program exports only N-Type D Codes as Drill Data. Before exporting drill data go to the D Code Table and verify that everything you want to export as drill data is mapped to Type N. Then go back and export the Drill Data.

To Export Drill Data from the Job:

1. Check your **visibility** settings for:
 - Visible Layers
 - The operation only exports visible elements, so make sure all pads, traces, selected, unselected elements, and blank D Codes to be exported are visible. See *Element Visibility* on page 84.
2. On the **Files** Menu, click **Export-Drill**.



Export Drill Dialog

3. In the **Look in** box, click the drive, folder, or network location where you want the Drill Files.
4. In the folder list, double-click folders until you open the folder where you want the Drill Files.
5. On the **Layers to Export** list, click to select the layers that you want to export. Only visible layers appear on the list.
6. Click **Options**.
7. On the **Data Format** tab, set the Data Format settings.



Drill Data Format Tab

Language

- **Excellon:** The file is in Excellon.
- **Wessel:** The file is in Wessel
- **Sieb and Meyer:** The file is in Sieb and Meyer.

Left of Decimal: The number of digits in the data file to the left of the implied decimal point.

Right of Decimal: The number of digits in the data file to the right of the implied decimal point.

Zeros

- **Omit Trailing Zeros:** Trailing zeros are omitted.
- **Omit Leading Zeros:** Leading zeros are omitted.
- **All Digits Present:** All digits are present and there are no zeros omitted.

- **Explicit Decimal Point:** The file has explicit decimal points, and the omitted zeros and number of digits to the right and left of the decimal are moot.

Position Coordinates

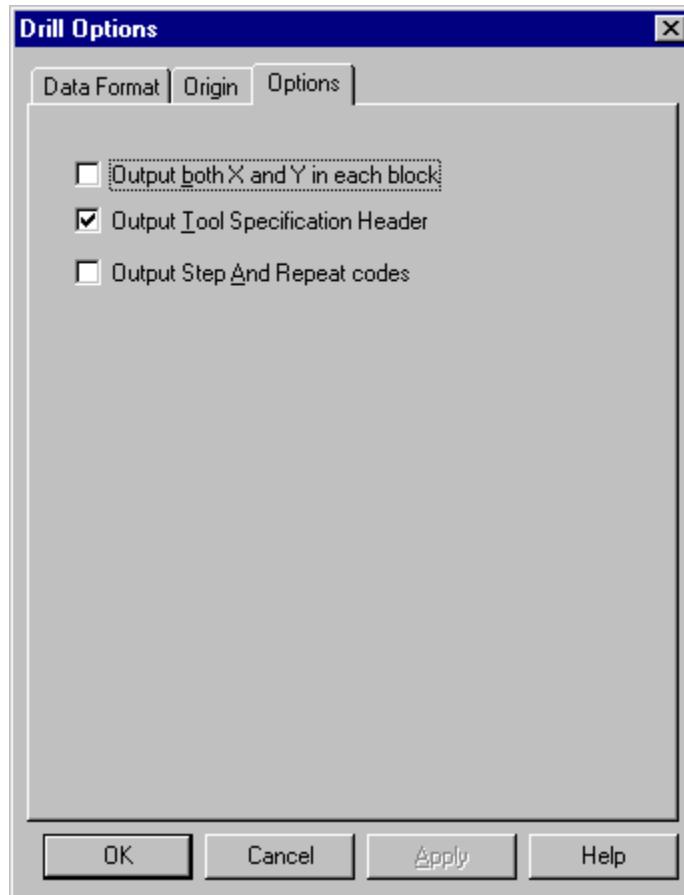
- **Incremental:** Position coordinates are incremental (coordinates are relative to the last position).
- **Absolute:** Position coordinates are absolute (coordinates are relative to the absolute origin).

Data Units

- **English:** Units are in inches.
- **Metric:** Units are in metric.

Data Code

- **ASCII:** The file is an ASCII text file.
 - **EBCDIC:** The file is in EBCDIC
 - **EIA:** The file is in EIA.
8. On the **Origin** Tab, set the export file origin.
 - **Absolute origin (0,0):** Select this option if you want the origin of the export file to be the same as the origin of the loaded Job File database.
 - **Present Cursor Location:** Select this option if you want the origin of the export file to be the current cursor position instead of the origin of the loaded Job File database.
 9. On the **Options** tab, set the special Drill Export Options.



Drill Export Options Tab

The following are Drill Export options on the Options tab of the Drill Export dialog.

Output Both X and Y in Each Block: Always exports both an X and Y field in each block. Otherwise the program only exports the coordinate that changed from the previous block.

Output Tool Specification Header/Trailer: Exports a tool specification header or trailer, depending on the drill language selected. Otherwise the header is not included in the exported file.

Output Step and Repeat Codes: Exports coded step and repeat blocks in the Job File database using the drill language step and repeat command. Otherwise the coded step and repeats are converted into copied data on export.

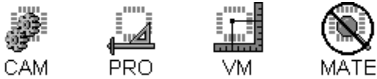
10. On the Options dialog, click **OK**.
11. Select whether to export the layers as Individual Layer-by-Layer files or as a Combined file.
 - **Layer-by-Layer:** When you use the **Layer-by-Layer** option to Export files, all files selected in the **Layers to Export** list are exported in **separate** files.

- **Export Combined Files:** When you use the **Combined** option to Export files, all files selected in the **Layers to Export** list are exported in a **single** file. This means that the plot data for separate layers is merged into a single layer.
12. Depending on whether you selected Layer-by-Layer or Combined, you may need to enter a file name.
 - If exporting the layers Combined, enter a file name.
 - If exporting the layers Layer-by-Layer, the system uses the layer names in the Layers Table.
 13. Click **Export**.

Excellon Drilled Slot Pattern

The Excellon G85 command, Drill Slot Pattern, defines a slot cut by drilling closely spaced holes between two endpoints. The syntax for this command is X#Y#G85X#Y#. If you select Excellon as your output language, then on export, any trace with a D Code of type N will be exported as a G85 block.

Export Aperture Data



The program exports aperture information in Lavenir VIEW Environment Files (.ENV).

To Export a VIEW Environment File:

1. On the Files Menu, click **Export-Apertures**.
2. In the Look in box, click the drive, folder, or network location where you want the Aperture Files.
3. In the folder list, double-click folders until you open the folder where you want the Aperture Files.
4. Click **Options**.
5. Select the Environment File Format.
6. On the Options dialog, click **OK**.
7. Click **Export**.

VIEW Environment Files (.ENV)

The VIEW environment file is more than an aperture list. It contains D Code and Tool Code tables plus layer file names, program configuration, menu settings, and the like.

The VIEW environment file has changed over time as the Lavenir VIEW Editor capabilities have increased. Currently, there are Versions 1, 2, 3 and 4. Since older versions of software and RPG firmware cannot read the newest version environment files, the program allows you to set the version to export.

Version 1 is appropriate for use with software earlier than the Lavenir VIEW Editor version 2.0.

Both **Versions 2 and 3** are currently used. Version 3 is more compact than Version 2 and it saves additional and enhanced D Code shapes: type H, Heat Relief; M, Custom Aperture; and N, NC Drill Hole.

The **Version 4** environment file allows you to save the Tool Code Table, layer types, as well as the Q shape D Code, Rounded Rectangle, and the E shape, Octagon.

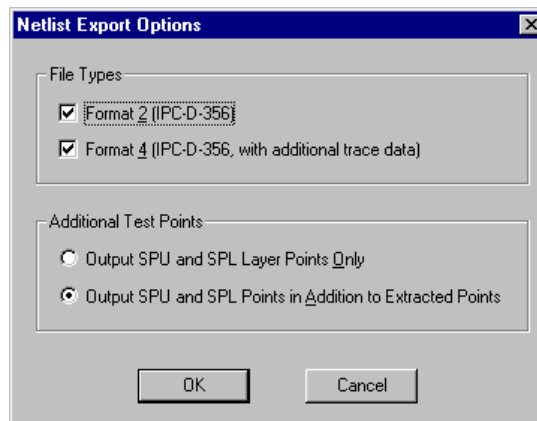
Export Netlist Data



The program can export netlist data extracted using the Raster Netlist Extraction routine. Netlist data extracted using the Vector Netlist Extraction routine is automatically exported at the time of extraction.

To Export Netlist Files:

1. On the **File** menu, click **Export-Netlist**.



Export Netlist Dialog

2. On the Netlist Export Options dialog, select the type(s) of netlist file(s) you wish to export:

Format 2: The Format 2 Netlist contains all IPC-D-356 data. The program exports the file using the Base Output File Name set during the Running the Raster Netlist Extraction procedure and the extension .F02.

Format 4: The Format 4 Netlist contains all IPC-D-356 data, plus addition trace data. The program exports the file using the Base Output File Name set during the Running the Raster Netlist Extraction procedure and the extension .F04.

3. Select whether you wish to export **only** the additional test point information or to export the standard IPC data **plus** the additional test point information.



No additional test point information will be exported unless your SPU and/or SPL layers were visible during the netlist extraction operation.

4. Click **OK**.

Milestone Files



A Milestone file is a temporary Job File that saves a copy of work in progress. The program automatically erases the temporary Milestone file when the current Job File is closed. You can use a Milestone file whenever you need to do a large edit that you might want to undo but that might exceed that amount of memory allocated for the undo feature. Save a Milestone file before the edit, do the edit, and then if you need to, restore the Milestone file. The Milestone file is convenient because the system manages it, and you do not need to keep track of multiple file names and directories the way you would if you wanted to do the same thing manually.

To Save a Milestone file:

- On the **File** menu, click **Milestone-Save Milestone**.

The system saves all the current job information in a temporary file without prompting for a file name or directory.

To Revert to a Saved Milestone file:

- On the **File** menu, click **Milestone-Revert to Milestone**.



Most of the automated editing tools available in CAMMaster and ViewMaster PRO, such as Venting and Fill Polygons, have a feature to save a milestone file on the operation dialog. This means that you don't have to save the Milestone yourself; just select the option for the operation to save a Milestone, then if the automated editing tool does not give you the results you want, you can revert to the Milestone file.

Set Current Directory



Most file import and export operations use dialogs that allow you to select the file names and directories. The program also has a way to set a target directory to use as a default directory without going to an import or export dialog.

To Set the Current Directory:

1. On the **Setup** menu, click **Set Current Directory**.
2. On the Browse for Folder dialog, click on folders until you **highlight the directory** that you want.
3. Click **OK**.

Chapter 3

View Plot Data

The program has many ways for you to control what you see on screen and how you see it. You can change the view of different kinds of elements and layers. You can control what part of the data is displayed and at what zoom level it is displayed. You can measure distance and go to specific locations in the data. You can also control how certain aspects of the interface, such as the screen grid and cursor, are displayed. And you can also display the properties of certain elements.

Many of the commands for controlling the visibility of elements on screen are available on the Visibility Toolbar.



Visibility Toolbar

To Display the Visibility Toolbar:

- On the **View** menu, look at **Toolbars-Visibility**.
 - If Visibility has a checkmark next to it, then the Visibility Toolbar is displayed.
 - If Visibility does not have a checkmark next to it, then the Visibility Toolbar is not displayed.

To change the display of the Visibility Toolbar, click **Visibility**.



Visibility Toolbar button on Main Toolbar. Down = Displayed, Up = Not Displayed

Many of the commands for controlling what the screen is looking at and where the cursor is are available on the Screen View Toolbar.



Screen View Toolbar

To Display the Screen View Toolbar:

- On the **View** menu, look at **Toolbars-Screen**.
 - If Screen has a checkmark next to it, then the Screen View Toolbar is displayed.
 - If Screen does not have a checkmark next to it, then the Screen View Toolbar is not displayed.

To change the display of the Screen View Toolbar, click **Screen**.

Element Visibility

The element visibility command control whether certain types of elements, such as pads or traces and selected or unselected elements, are displayed and how they are displayed.

Pads Visible



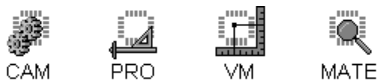
Pads can be made visible or not visible.

To Toggle Pad Visibility:

1. On the **View** menu, go to **Visibility-Element-Pads**.
 - If Pads is **checked**, pads are **visible**.
 - If Pads is **not checked**, pads are **not visible**.
2. To change the visibility, click **Pads**.



Traces Visible



Traces can be made visible or not visible.

To Toggle Trace Visibility:

1. On the **View** menu, go to **Visibility-Element-Traces**.
 - If Traces is **checked**, traces are **visible**.
 - If Traces is **not checked**, traces are **not visible**.
2. To change the visibility, click **Traces**.



Selected Elements Visible



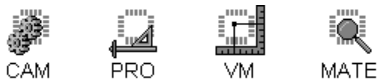
Selected elements can be made visible or not visible.

To Toggle Selected Element Visibility:

1. On the **View** menu, go to **Visibility-Element-Selected Elements**.
 - If Selected Elements is **checked**, selected elements are **visible**.
 - If Selected Elements is **not checked**, selected elements are **not visible**.
2. To change the visibility, click **Selected Elements**.



Unselected Elements Visible



Unselected elements can be made visible or not visible.

To Toggle Unselected Element Visibility:

1. On the **View** menu, go to **Visibility-Element-Unselected Elements**.
 - If Unselected Elements is **checked**, unselected elements are **visible**.
 - If Unselected Elements is **not checked**, unselected elements are **not visible**.
2. To change the visibility, click **Unselected Elements**.



Selected Elements Shown in White or Contrasting Color



Selected Elements can be displayed in white or in contrasting color.

To Display Selected Elements in White or Contrasting Color:

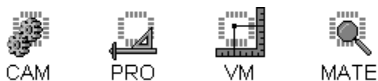
1. On the **View Menu**, go to **Visibility-Selected**.

The position of the bullet indicates how selected elements are displayed:

- If there is a bullet on **Display in White**, then selected elements are White.
- If there is a bullet on **Display in Contrasting Color**, then selected elements are shown in Contrasting Color.

2. To switch between the two, click **Display in White** or **Display in Contrasting Color**.

Blank D Codes



Control the visibility of elements of specific D Codes by “blinking” the D Codes. Elements with blank D Codes are not displayed on screen or exported, but the original shape is remembered by the system and can be restored by “unblinking” the D Code. One way to handle blank D Codes is to map the D Code to Shape B on the D Code Table. But you can also quickly blank and unblank D Codes without going to the D Code table.

To Toggle D Codes between Blank and Original Shape:

1. On the **View Menu**, click **Visibility-Element-Blank D Codes**.
2. Select elements in the **Visible D Codes** list or in the **Blank D Codes** list, and click the appropriate **arrow** to move them to the opposite list.



Shift+H

Pad and Trace Contrast



Pads and traces can be displayed in the same color or can be displayed at a contrasting color or intensity.

To Set Pad-Trace Contrast:

1. On the **View** Menu, click **Visibility-Element-Options**.
2. Click the **Pad-Trace Contrast** checkbox to turn **off** or **on** Pad-Trace Contrast.
3. Click the option to select **Contrasting Color** or **Contrasting Intensity**.
4. Click **OK**.



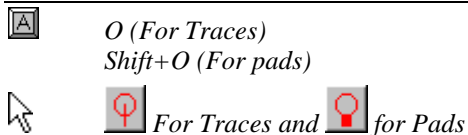
Zero-Width Elements



Traces can be displayed filled at actual width or at zero width. And when traces are zero width, pads can be displayed filled or outlined.

To Set the Element Display Mode:

1. On the **View** Menu, click **Visibility-Element-Options**.
2. Click the **Trace Width** option to **Zero Width** or **Filled**.
3. Click the **Pad Width** option so that when traces are zero width pads are shown **Outlined** or still **Filled**.
4. Click **OK**.



Layer Visibility

The visibility status of a layer indicates whether the layer is visible or not in the Viewing Area. There are several ways you can find out and control the Layer Visibility:

- See *Layer Visibility on Layers Table* on page 364.
- See *Layer Visibility on Layer Toolbar* on page 365.
- Use the layer visibility commands that follow.

Next Layer Visible



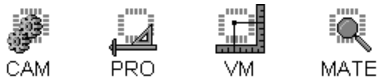
To Make the Next Layer Visible:

- On the **View Menu**, click **Visibility-Layer-Next Layer Visible**.



Shift+Equals

Previous Layer Visible



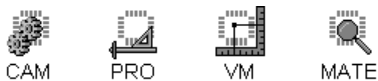
To Make the Previous Layer Visible:

- On the **View Menu**, click **Visibility-Layer-Previous Layer Visible**.



Shift+Backspace

Make Any Single Layer Visible



You can make a single layer visible and shut off visibility for all other layers.

To Make a Single Layer Visible:

1. On the **Setup Menu**, click **Layer-Only Visible and Active**.
2. Enter a single layer number.



Ctrl+L

Make a Range of Layers the Only Visible Layers

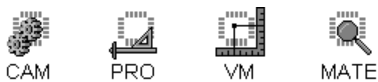


You can make a range of layers visible and shut off visibility for all other layers.

To Make a Range of Layers Visible and Shut off Visibility for All Other Layers:

1. On the **Setup** Menu, click **Layer-Only Visible**.
2. Enter a single **layer number** or a range of layers separated by a dash and/or a series of layers separated by commas (i.e., 1-4 or 5,7,9 or 1-4,5,7,9).

Layer Visibility Quick Keys



The Layer Visibility Quick Keys toggle the visibility of the layer with the corresponding Layer Number. This is the quickest way to toggle the visibility for layers 1 through 9.



1 through 9

All Layers Visible



To Make all Layers Visible:

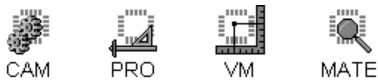
- On the **View** Menu, click **Visibility-Layer-All Layers Visible**.



Ctrl+0 (Zero)



Toggle Layer Visibility



You can toggle layer visibility so that visible layers are turned off and vice versa.

To Toggle Layer Visibility:

- On the **View** Menu, click **Visibility-Layer-Toggle Layer Visibility**.



Shift+0 (Zero)



Zoom Level

The program can display data at zoom levels that range from .0001 to 7000. The Zoom Tool is most versatile manual method for controlling zoom level, but there are also zoom commands, which are sometimes faster.

Zoom Tool



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The zoom tool combines the Zoom Up, Zoom Down, and Zoom on Area commands into one mouse-driven tool.

To Use the Zoom Tool:

1. On the **View Menu**, click **Zoom-Tool**.



Zoom Up Tool



Zoom Down Tool

2. Now you can zoom up, down and on an area:
 - To zoom up, **Click** where you want to zoom to.
 - To zoom down, **Shift+Click** where you want to zoom from.
 - To zoom on an area, **Drag** the mouse across that area you want to zoom on.
3. To release the zoom tool, click another tool or press **Esc**.



Z

Enter = Zoom Up

Shift+Enter = Zoom Down

Tab = Start drag area and Tab again to end



Zoom Up, Down



The Zoom Up and Zoom Down commands, zoom up or down on the crosshair position by a fixed factor of 1.39.

To Zoom Up or Down:

1. Position the crosshair where you want to zoom up.
2. Separate the crosshair and the cursor. See *Separate the Crosshair and Mouse Cursor* on page 112.
3. On the **View** Menu, click **Zoom-Up/Down**.

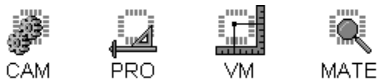


Page Up = Zoom up
Page Down = Zoom Down



It is usually preferable to run this operation using the key commands, because they do not require you to separate the cursor. Or you can use the Zoom Tool, which does not require you to separate the cursor.

Zoom To Show All Data



The Zoom to Show All Data command, zooms so that all visible data fits on the screen at the highest possible zoom.

To Show All Data:

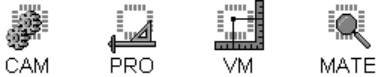
- On the **View** Menu, click **Zoom-To Show All**.



Home



Zoom On Reference Frame



The Zoom on Reference Frame command zooms so that the Reference Frame fits on the screen at the highest possible zoom.

To Zoom on the Reference Frame:

1. Position the **Reference Frame** where you want it. See *Reference Frame* on page 177.
2. On the **View Menu**, click **Zoom-On Frame**.

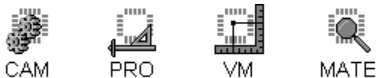


Shift+Home



There is an easier way to zoom on a specific area using the Zoom Tool.

Zoom To Exact Zoom Level



To Zoom to an Exact Zoom Level:

1. Position the crosshair where you want to zoom to.
2. Separate the crosshair and the cursor. See *Separate the Crosshair and Mouse Cursor* on page 112.
3. On the **View Menu**, click **Zoom-Set Level**.
4. Enter the **Zoom Level**.



Shift+Z



Zoom: 72.309 *Type the Zoom Level in the Screen View Toolbar*



It is usually preferable to run this operation using the key command, because it does not require you to separate the cursor.

Distance Measurement and Coordinate System

The cursor position is displayed in the Screen View Toolbar. The cursor position can be displayed in Rectangular Coordinates (X, Y) or Polar Coordinates (Distance, Angle). And the cursor position can be displayed relative to the Absolute Origin (0,0) or a Relative Origin that you can set that is offset from the absolute origin. The cursor position display is also where distance is displayed when in Distance Measurement mode. The program has commands to go to a coordinate location.

Distance Measurement



You can measure distance from a fixed point, or you can measure distance from the edge of an element. When the distance measurement feature is active, the distance and angle from the start point to the cursor is shown in the Screen View Toolbar, and it is as if the cursor position was displayed with Polar Coordinates from a Relative Origin.

To Measure Distance from a Point:

1. On the **View** menu, click **Distance-From Point**.
2. Position the cursor at the point where you want to measure from.
3. **Click** the mouse or press **Enter**.
4. Move the cursor to the position where you want to measure to.

The **distance** and **angle** from the start point to the cursor is shown in the Screen View Toolbar.

The Distance Measurement tool remains active so you can move the cursor to new locations where you want to measure to, or you can click the mouse again to set a new location to measure from.

5. To stop measuring distance, select another tool or press **Esc**.



D = Measure Distance from Point
Enter = Select start point or element



For precision, use the Align command when measuring from the exact centerpoint of an element.

To Measure Distance from the Edge of an Element:

1. On the **View** menu, click **Distance-From Edge**.
2. Position the cursor on the element where you want to measure from.
3. **Click** the mouse or press **Enter**.

The cursor snaps to the element and the “rubber band” extends from the closest point on the edge of the element to the cursor.

4. Move the cursor to the position where you want to measure to.
5. The **distance** and **angle** from the edge of the element to the cursor is shown in the Screen View Toolbar.

The Distance Measurement tool remains active so you can move the cursor to new locations where you want to measure to, or you can click the mouse again to select a new element to measure from.

To stop measuring distance, select another tool or press **Esc**.



For precision, use the Align command when measuring from the exact centerpoint of an element.

Polar Coordinates



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When the program displays Polar Coordinates the coordinates are given as the Distance (or Radius) and Angle to the cursor from the origin. The coordinate buttons on the Screen View Toolbar indicate **R**, for Radius, and **A**, for Angle, the Polar Coordinate button is down, and the program shows a line connecting the cursor to the origin. The alternative to viewing Polar Coordinates is to view (X, Y). Just like Rectangular Coordinates, Polar Coordinates can be displayed relative to the Absolute Origin or the Relative Origin .

To View Polar Coordinates:

- On the **View** menu, click **Coordinate Origin-Polar**.



Rectangular Coordinates



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When the program displays Rectangular Coordinates the coordinates are given as the X and Y distance to the cursor from the origin. The coordinate buttons on the Screen View Toolbar indicate **X** and **Y**, the Polar Coordinate button is up, and the program does not show a line connecting the cursor to the origin. Rectangular Coordinates can be displayed relative to the Absolute Origin or the Relative Origin. The alternative to viewing Rectangular Coordinates is to view Polar Coordinates.

To View Rectangular Coordinates:

- On the **View** menu and click **Coordinate Origin-(X, Y)**.



Absolute Origin



The Absolute Origin is the (0, 0) origin of the database. Coordinates are displayed relative to the Absolute Origin when the Coordinate buttons display capital letters, for instance (X, Y) or (R, A), and the relative origin button is up. The Absolute Origin cannot be moved, but data can be repositioned relative to it. The alternative to the Absolute Origin is to display relative to a Relative Origin, which can be moved.

To View Coordinates Relative to the Absolute Origin:

- On the **View** menu, click **Coordinate Origin-Absolute**.



R = Toggle between Relative and Absolute origin



When you switch to display relative to the Absolute Origin, the default method for positioning with the Go To Coordinates command also switches to Absolute.

Relative Origin



The Relative Origin is a coordinate position that you can set and measure relative to. Coordinates are displayed relative to the Relative Origin when the coordinate buttons display lower case letters preceded by the letter “d”, for instance (dx, dy) or (dr, da), and the Relative Origin button is down. The Relative Origin can be moved using the Set Relative Origin command so that you can measure coordinates relative to a new position. The alternative to the Relative Origin is to display relative to the Absolute Origin, which cannot be moved.

To View Coordinates Relative to the Relative Origin:

- On the **View** menu, click **Coordinate Origin-Relative**.



R = Toggle between Relative and Absolute origin



When you switch to display relative to the Relative Origin, the default method for positioning with the Go To Coordinates command also switches to Incremental.

Set Relative Origin



The Relative Origin is a coordinate position that you can set and measure relative to.

To Set the Relative Origin:

1. On the **View** menu, click **Coordinate Origin-Set Relative Origin**.



Set Relative Origin Tool

2. Position the cursor where you want the Relative Origin.
3. **Click** the mouse or press **Enter**.

The Set Relative Origin tool remains selected, so you can position the Relative Origin at one point after another.

4. To release the Set Relative Origin tool, click a different editing tool or press **Esc**.

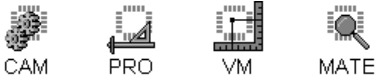


Shift+R = Set Relative Origin Tool
Enter = Activate Tool



Pan the Screen

Scroll the Screen



The program has scrollbars for navigating the viewing area.

To Turn On and Off the Display of Scrollbars:

- On the **View** menu, click **Scrollbars**. A check mark indicates that scrollbars are being displayed.

To Use the Scrollbars:

- To scroll by a small step, click the scroll arrows.
- To scroll by one screen, click the scroll bar above or below the scroll box.
- To scroll to a specific location, drag the scroll box.

The area that can be scrolled to using the scroll bars is called the Workspace.

To Set the Workspace Dimensions:

1. On the **Setup** menu, click **Workspace**.
2. On the Workspace dialog you can **set the dimensions** of the workspace several ways:
 - Enter the locations of the corners manually.
 - Click Around all Data to automatically set the corners to contain all data.
 - Click Around Frame to make the corners match the dimensions of the current Reference Frame. See *Reference Frame* on page 177.
 - Click Default to set the dimensions to the default film size for the Pulsar 8000 Photoplotter (26" x 20").
3. When the corner values are set, click **OK**.

Automatically Pan Screen at Viewing Area Edges



You have the option to have the screen pan automatically when you move the cursor to the edge of the Viewing Area with the arrow keys.

To Set the Screen to Automatically Pan:

1. On the **View** Menu, and look at **Pan at View Margins**.
 - If there is a **checkmark** on Pan at View Margins, then the screen will pan when you move the cursor to the edge of the Viewing Area with the arrow keys.
 - If there is **no checkmark** on Pan at View Margins, then the screen will not pan automatically.
2. To turn automatic panning on or off click **Pan at View Margins**.

Pan Screen Up, Down, Left, Right



Panning the screen using the following commands moves the view by one full screen. To scroll the view more smoothly, use the Scrollbars.

To Pan the Screen Up, Down, Left, Right:

- On the **View** Menu, click
Pan View-Up or
Pan View-Down or
Pan View-Left or
Pan View-Right



Ctrl+Up Arrow
Ctrl+Down Arrow
Ctrl+Left Arrow
Ctrl+Right Arrow



Pan Screen to Origin



To Pan the Screen to the Origin:

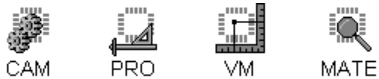
- On the **Go** menu, click **Origin**.



Ctrl+Home



Pan Screen to Center

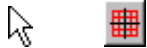


To Pan the Screen to the Center of the Visible Data:

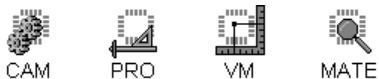
- On the **Go** menu, click **Center**.



C



Pan Screen to First Screenful



The first screenful of data is the lower left corner of the visible data that will fit on the screen at the current zoom level. Using this command and the Pan View to Next Screenful command you can be sure to view all data by sequential screens.

To Pan the Screen to the First Screenful of Data:

- On the **View Menu**, click **Pan View-First Screenful**.



Shift+F



Pan Screen to Next Screenful



You can step sequentially through each screen of data. The sequence of screens moves from the lower left corner of the visible data that will fit on the screen at the current zoom level, and moves to the right until there is nothing left to view. Then it moves back to the left and up one screen. Using this command and the Pan View to First Screenful command you can be sure to view all data by sequential screens.

To Pan the Screen to the Next Screenful of Data:

- On the **View** Menu, click **Pan View-Next Screenful**.



Shift+N



Center View on Cursor



The Center View on Cursor command pans the screen so that the cursor location moves to the center of the Viewing Area.

To Pan the Cursor Location to the Center of the View:

1. Position the crosshair at the point you want centered in the viewing area.
2. Separate the crosshair and the cursor. See *Separate the Crosshair and Mouse Cursor* on page 112.
3. On the **View** Menu, click **Center Display at Cursor**.



Shift+End



It may be preferable to run this command using its keyboard equivalent rather than the menu command. The key command does not require you to separate the cursor.

Go To Location

The program has many commands for making the cursor go to a specific location. You can go to specific coordinates. You can align to an element and also query an element for its layer, D Code and net. You can go to positions relative to other elements, such as the other end of a trace or the center of an arc. And you can go to positions relative to other interface features, such as a marker or the corners of the reference frame.

Go To Coordinates



To Position the Crosshair at a Precise Coordinate Location:

1. On the **Go** menu, click **Coordinates**.
2. Enter the coordinates that you want to go to.
3. Select whether you want to move to a position relative to the origin (**Absolute**), or relative to the current cursor position (**Incremental**).
4. Click **OK**.



X or Y



X:	0.9164	Y:	0.3929
----	--------	----	--------

Click on X or Y button on Screen View Toolbar



*For precision it is better to accept the values in the Coordinates dialog by pressing **Enter** rather than clicking **OK**. When you click on the mouse, you are likely to jiggle it and move the cursor out of alignment. The safest method is to separate the crosshair cursor from the pointer and run the operation from the keyboard. See Separate the Crosshair and Mouse Cursor on page 112.*

Align to Element



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The Align command aligns the crosshair to an element without selecting the element or querying the element's properties. The Align command will only align to elements that meet all the active Selection Criteria, if any:

- Current Layer
- Current D Code
- Current Net
- Special Element Class

Use this command when you want to precisely align the crosshair for an editing function.

To Align to an Element:

1. Position the crosshair near the element you want to align to.
2. Separate the crosshair and the cursor. See *Separate the Crosshair and Mouse Cursor* on page 112.
3. On the **Go** menu, click **Closest-Align**.



A



It may be preferable to run this command using its keyboard equivalent rather than the menu command. The key command does not require you to separate the cursor. However, the safest method is to separate the crosshair cursor from the pointer and run the operation from the keyboard.

Query Element



The Query command snaps the crosshair to an element and updates the Current Element Toolbar with the element's properties:

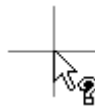
- Layer of the Element
- D Code of The Element
- Net of the Element
- Coordinates of the Element

The Query command will only query elements that meet all the active Selection Criteria, if any:

- Current Layer
- Current D Code
- Current Net
- Special Element Class

To Query an Element Using the Properties Tool:

1. On the **Go** menu, click **Closest-Properties Tool**.



Query Properties Tool

2. Click near the element you want to query.

To Query an Element Near the Cursor:

1. Position the crosshair near the element you want to query.
2. Separate the crosshair and the cursor. See *Separate the Crosshair and Mouse Cursor* on page 112.
3. On the **Go** menu, click **Closest-Properties**.



Shift+A



It may be preferable to run this command using the keyboard rather than the menu command. The key command does not require you to separate the cursor. However, the safest method is to separate the crosshair cursor from the pointer and run the operation from the keyboard.

Go To Other Endpoint of Trace



This command moves the cursor to the other end of a queried trace or to the center of a queried pad.

To Position the Cursor at the Other End of a Trace:

1. Query the trace. See *Query Element* on page 103.
2. Separate the crosshair from the cursor. See *Separate the Crosshair and Mouse Cursor* on page 112.
3. On the **Go** menu, click **Other Endpoint of Trace**.



E



It may be preferable to run this command using its keyboard equivalent rather than the menu command. The key command does not require you to separate the cursor. However, the safest method is to separate the crosshair cursor from the pointer and run the operation from the keyboard.

Go To Arc Center



This command moves the cursor to the center of a queried arc.

To Position the Cursor at the Center of an Arc:

1. Query the arc. See *Query Element* on page 103.
2. Separate the crosshair from the cursor. See *Separate the Crosshair and Mouse Cursor* on page 112.
3. On the **Go** menu, click **Arc Center**.

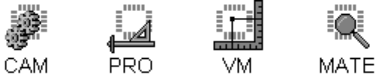


Shift+E



It may be preferable to run this command using its keyboard equivalent rather than the menu command. The key command does not require you to separate the cursor. However, the safest method is to separate the crosshair cursor from the pointer and run the operation from the keyboard.

Go To Reference Frame Corners



You can make the cursor go to the corners of the Reference Frame. This operation can be set to have the cursor go to only the upper right and lower left corners of the Reference Frame, or it can be set to go to all four corners. For more information about the reference frame, see *Reference Frame* on page 177.

To Go To Reference Frame Corners:

1. Separate the crosshair from the cursor. See *Separate the Crosshair and Mouse Cursor* on page 112.
2. On the **Go** menu, click **Frame Corner**.



Ctrl+E



It may be preferable to run this command using its keyboard equivalent rather than the menu command. The key command does not require you to separate the cursor. However, the safest method is to separate the crosshair cursor from the pointer and run the operation from the keyboard.

To Select 2-Corner or 4-Corner Mode:

1. On the **View** Menu, look at the **Go To-4 Corners Mode** menu item.
 - If there is a **check mark** next to 4 Corners Mode, then the cursor will go to **all four corners** of the Reference Frame.
 - If there is **no check mark** next to 4 Corners Mode, then the cursor will only go to the **upper right** and **lower left corners** of the Reference Frame.
2. To switch the mode, click on **4 Corners Mode**.

Go To Last Marked Position



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The program allows you to mark a position and return to the mark later.

To Return to a Marked Location:

1. Separate the crosshair from the cursor. See *Separate the Crosshair and Mouse Cursor* on page 112.
2. On the **Go** menu, click **Last Marked Position**.



H



It may be preferable to run this command using its keyboard equivalent rather than the menu command. The key command does not require you to separate the cursor. However, the safest method is to separate the crosshair cursor from the pointer and run the operation from the keyboard.

Mark a Location



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The program allows you to mark a location and return to the location later.

To Mark a Location:

1. Position the crosshair where you want the mark.
2. Separate the crosshair and the cursor. See *Separate the Crosshair and Mouse Cursor* on page 112.
3. On the **View** Menu, click **Mark**.



M



It may be preferable to run this command using its keyboard equivalent rather than the menu command. The key command does not require you to separate the cursor.

Screen Grid

The program has a screen grid that can be used for precisely positioning the cursor. The grid can be turned on and off as needed.

When the grid is off, the cursor can be moved freely to any position using the Arrow Keys or the mouse.

When the grid is on:

- The cursor moves only on the grid points when moved with the Arrow Keys.
- The cursor snaps to the closest grid point when you activate an editing command such as insert, copy or move.
- The cursor can be moved off the grid using the mouse or by Aligning to or Querying an element.

Some settings affect the behavior of the grid:

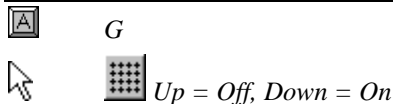
- The grid unit determines the spacing of grid points.
- The space between grid points can be Fixed at one interval or can be set to be Variable depending on the Zoom level.
- The grid can be Anchored so that it does not move, or it can be Dragged by the cursor.

Turn the Screen Grid On and Off



To Turn the Screen Grid On and Off:

1. On the **View** Menu, go to **Grid-Display Grid**.
 - If there is a **checkmark** on Display Grid, the grid is **On**.
 - If there is **no checkmark** on Display Grid, the grid is **Off**.
2. To turn the grid on or off click **Display Grid**



Anchored or Dragged Grid



You can toggle between a Grid that is Anchored and one that can be moved or Dragged with the cursor:

To Toggle between an Anchored and Dragged Grid:

1. On the **View** Menu, go to **Grid**.

The position of the bullet indicates the status of the grid:

- If there is a bullet on **Anchored**, the grid is stationary, and the cursor hops from one grid point to the next.
- If there is a bullet on **Dragged**, the grid is moveable, and the cursor drags the grid.

2. To switch between the two states, click **Anchored** or **Dragged**.



Shift+G



Up = Dragged, Down = Anchored

Fixed or Variable Grid



The grid can be set to Variable and Fixed Grid Mode. The difference between these two modes is the interval displayed between grid dots.

- **Variable Grid:** The program changes the displayed grid interval so that a comfortable number of grid dots appears on screen at any zoom level. The displayed grid interval will be equal to a multiple of the grid unit. The possible grid intervals are grid unit times a power of ten or any such value divided by two. As you increase the zoom level, the grid interval becomes smaller to the point of the finest resolution until it reaches the grid unit. It will never be smaller than the grid unit.
- **Fixed Grid:** The interval displayed between grid dots is always equal to the grid unit, at any zoom level. The grid interval does not change until the screen is almost filled with grid dots. When there are too many dots to display, the grid becomes invisible, but it is still on.

To Toggle between a Fixed Interval and Variable Interval Grid:

1. On the **View** Menu, go to **Grid**.

The position of the bullet indicates the status of the grid:

- If there is a bullet on **Variable**, the grid interval is variable **depending on zoom level**.
- If there is a bullet on **Fixed**, the grid interval is fixed **regardless of zoom level**.

2. To switch between the two states, click **Variable** or **Fixed**.



Ctrl+G



Up = Fixed, Down = Variable

Grid Units



The grid unit is the basis of the grid interval, the space between grid points.

To Set the Grid Units:

1. On the **View** menu, click, **Grid-Units**.
2. Set the grid unit.

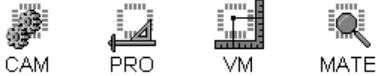


0.001

Properties

You can display the properties of selected elements, properties such as a general property breakdown of the selection, a D Code breakdown of the selection, or a Tool code breakdown of the selection.

Selected Element Properties



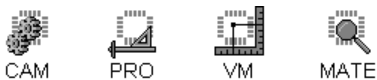
The system can show you the properties of the selected elements, including:

- Total Number of Elements Selected
- Number of Pads Selected
- Number of Traces Selected
- Number of Arcs Selected
- D Codes of Selected Elements
- Layers of Selected Elements
- Nets of Selected Elements
- Dimensions of Selection

To See Properties of the Selected Elements:

- On the **View** menu, click **Selection-Properties**.

Selected Element D Code Properties



The system can show you the D Code properties of the selected elements, including:

- All D Codes in the selection, sorted by size
- The shape and dimensions of each D Code

To See the D Code Properties of the Selected Elements:

- On the **View** menu, click **Selection-D Codes**.

Selected Element Drill Properties



The system can show you the properties of all elements in the selection that represent drill data (D Code Type N). The properties include:

- D Codes of NC drill data in the selection, sorted by size
- The diameter and Tool Code of each NC drill D Code

To See the NC Drill D Code Properties of the Selected Elements:

- On the **View** menu, click **Selection-NC Tools**.

Cursor Options

There are several options for how the crosshair cursor is displayed and how it is controlled by the mouse pointer.

Full-Screen Cursor



The crosshair cursor can be displayed at a small size (an inch or so), or it can be displayed at full-screen size.

To Toggle the Crosshair between Full-Screen Size and Small Size:

1. On the **View** menu, go to **Full Screen Cursor**.
 - If there is a **checkmark** next to Full Screen Cursor, then the cursor is displayed at **full-screen** size.
 - If there is a **no checkmark** next to Full Screen Cursor, then the cursor is displayed at **small** size.
2. To change the size, click **Full Screen Cursor**.



Separate the Crosshair and Mouse Cursor



The program allows you to separate the crosshair cursor and the arrow-shaped mouse pointer cursor. Do this when you need to leave the crosshair at a specific location on screen but you need to use the mouse to activate a command.

To Separate the Crosshair and the Mouse Cursor:

- Press Spacebar.

Refresh Screen



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The Refresh command redraws the screen. Use this command if you ever abort a lengthy operation and leave the screen partially drawn.

To Refresh the Screen:

- On the **View** menu, click **Refresh**.

*End*

Chapter 4

Edit Plot Data

The program has many features for inserting data, selecting data for editing, editing selected data, and editing entire layers of data. In addition, there are few special commands that edit existing data but do not use selection.

Insert New Plot Data

You can insert all types of data: pads and traces; special classes of traces and trace combinations such as orthogonals, 90-degree pairs, rectangular polygons, elbows; several types of arcs such as circles, 3-points arcs, chord and tangent arcs, chord and point arcs, center and chord arcs; and text.

Many of the commands for inserting new data are available on the Insert Toolbar.



Insert Toolbar

To Display the Insert Toolbar:

- On the **View** menu, look at **Toolbars-Insert**.
 - If Insert has a checkmark next to it, then the Insert Toolbar is displayed.
 - If Insert does not have a checkmark next to it, then the Insert Toolbar is not displayed.

To change the display of the Insert Toolbar, click **Insert**.



Insert Toolbar button on Main Toolbar. Down = Displayed, Up = Not Displayed

Insert Pad



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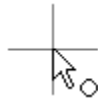


MATE

The Insert Pad feature inserts pads of the current D Code on the active, visible layers.

To Insert Pads:

1. Set the Current D Code. See *Current D Code* on page 314.
2. Set the Active Layers, and the Visible Layers. See *Select from the Active Layers* on page 152.
3. On the **Edit** Menu, click **Insert-Pad**.



Insert Pad Tool

4. Position the cursor where you want the pad.
5. **Click** the mouse or press **Enter**.

The Pad Insertion tool remains selected, so you can insert one pad after another.

6. To stop inserting pads, click a different editing tool or press **Esc**.



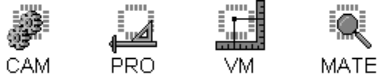
Insert Key = Pops up list of insert tool types.

Enter = Inserts selected type.

Esc = Releases insert tool.



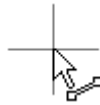
Insert Trace



The Insert Trace feature inserts traces of the current D Code on the active, visible layers.

To Insert Traces:

1. Set the Current D Code. See *Current D Code* on page 314.
2. Set the Active Layers, and the Visible Layers. See *Select from the Active Layers* on page 152.
3. On the **Edit** Menu, click **Insert-Trace**.



Insert Trace Tool

4. Position the cursor where you want the trace to start.
5. **Click** the mouse or press **Enter**.
6. Position the cursor where you want the trace to end.
7. **Click** the mouse or press **Enter**.

The end of the last trace becomes the beginning of the next, so you can chain one trace to another.

- To end a trace without chaining, **Double-Click** or **double-press Enter**.
- To stop inserting traces, click a different editing tool or press **Esc**.



*Insert Key = Pops up list of insert tool types.
Enter = Inserts selected type.
Esc = Releases insert tool.*



Insert Orthogonal Trace



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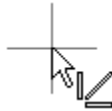


MATE

Orthogonal traces are traces that are exactly horizontal, vertical or at 45 degrees. The Insert Orthogonal Traces feature inserts orthogonal traces of the current D Code on the active, visible layers.

To Insert Orthogonal Traces:

1. Set the Current D Code. See *Current D Code* on page 314.
2. Set the Active Layers, and the Visible Layers. See *Select from the Active Layers* on page 152.
3. On the **Edit** Menu, click **Insert-Orthogonal Trace**.



Insert Orthogonal Trace Tool

4. Position the cursor where you want the orthogonal trace to start.
5. **Click** the mouse or press **Enter**.
6. Position the cursor where you want the orthogonal trace to end.
7. **Click** the mouse or press **Enter**.

The end of the last orthogonal trace becomes the beginning of the next, so you can chain one orthogonal trace to another.

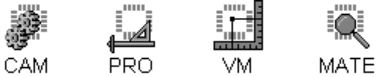
- To end an orthogonal trace without chaining, **Double-Click** or **double-press Enter**.
- To stop inserting orthogonal traces, click a different editing tool or press **Esc**.



*Insert Key = Pops up list of insert tool types.
Enter = Inserts selected type.
Esc = Releases insert tool.*



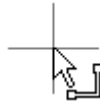
Insert 90-Degree Trace Pair



The 90-degree trace pair joins a starting point to an ending point using a horizontal trace chained to a vertical. The 90-degree trace pair is inserted using the current D Code on the active, visible layers.

To Insert a 90-Degree Trace Pair:

1. Set the Current D Code. See *Current D Code* on page 314.
2. Set the Active Layers, and the Visible Layers. See *Select from the Active Layers* on page 152.
3. On the **Edit** Menu, click **Insert-90-Degree Trace Pair**.



Insert 90-Degree Trace Pair Tool

4. Position the cursor where you want the first trace to start.
5. **Click** the mouse or press **Enter**.
6. Position the cursor where you want the second trace to end.
7. **Click** the mouse or press **Enter**.

The end of the last 90-degree trace pair becomes the beginning of the next, so you can chain one 90-degree trace pair to another.

- To end a 90-degree trace pair without chaining, **Double-Click** or **double-press Enter**.
- To stop inserting 90-degree trace pairs, click a different editing tool or press **Esc**.



Insert Key = Pops up list of insert tool types.

Enter = Inserts selected type.

Esc = Releases insert tool.



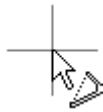
Insert Elbow in Existing Trace



Inserting an elbow in a trace creates two chained traces that connect the same endpoints as the original trace but meet in an offset vertex.

To Insert an Elbow in an Existing Trace:

1. Set the Active Layers, and the Visible Layers so that the existing trace is on an active visible layer. See *Select from the Active Layers* on page 152.
2. On the **Edit** Menu, click **Insert-Elbow**.



Insert Elbow Tool

3. Position the cursor near the trace in which you want to insert an elbow.
4. **Click** the mouse or press **Enter**.
5. Position the cursor where you want the elbow vertex.
6. **Click** the mouse or press **Enter**.

The Elbow Insertion tool remains selected, so you can insert elbows in one trace after another.

- To cancel inserting an elbow before setting the vertex point, press **Esc**.
- To stop inserting elbows, click a different editing tool or press **Esc**.



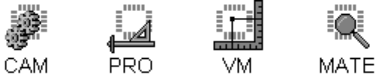
Insert Key = Pops up list of insert tool types.

Enter = Inserts selected type.

Esc = Releases insert tool.



Insert 90-Degree Elbow in Existing Trace



Inserting a 90-degree elbow in a trace creates a series of chained horizontal and vertical traces that connect the same endpoints as the original trace but pass through an offset cursor position.

To Insert a 90-Degree Elbow in an Existing Trace:

1. Set the Active Layers and the Visible Layers so that the existing trace is on an active visible layer. See *Select from the Active Layers* on page 152.
2. On the **Edit** Menu, click **Insert-90-Degree Elbow**.



Insert 90-Degree Elbow Tool

3. Position the cursor near the trace in which you want to insert a 90-degree elbow.
4. **Click** the mouse or press **Enter**.
5. Position the cursor where you want the new trace path to pass through.

To create a two-trace elbow with only one horizontal and one vertical trace, use the **Align** command to align the cursor to one end of the original trace.

6. **Click** the mouse or press **Enter**.

The 90-Degree Elbow Insertion tool remains selected, so you can insert 90-degree elbows in one trace after another.

- To cancel inserting a 90-degree elbow before setting the pass through point, press **Esc**.
- To stop inserting 90-degree elbows, click a different editing tool or press **Esc**.



Insert Key = Pops up list of insert tool types.

Enter = Inserts selected type.

Esc = Releases insert tool.



Insert Drawn Rectangle



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The drawn rectangle is a rectangular polygon of chained vertical and horizontal traces. The drawn rectangle is inserted using the current D Code on the active, visible layers.

To Insert a Drawn Rectangle:

1. Set the Current D Code. See *Current D Code* on page 314.
2. Set the Active Layers, and the Visible Layers. See *Select from the Active Layers* on page 152.
3. On the **Edit** Menu, click **Insert-Rectangle-Drawn**.



Insert Drawn Rectangle Tool

4. Position the cursor where you want one corner of the drawn rectangle.
5. **Click** the mouse or press **Enter**.
6. Position the cursor where you want the opposite corner of the drawn rectangle.
7. **Click** the mouse or press **Enter**.

The Drawn Rectangle Insertion tool remains selected, so you can insert one drawn rectangle after another.

- To cancel inserting a drawn rectangle before setting the second corner, press **Esc**.
- To stop inserting drawn rectangles, click a different editing tool or press **Esc**.



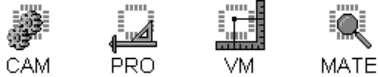
Insert Key = Pops up list of insert tool types.

Enter = Inserts selected type.

Esc = Releases insert tool.



Insert Frame-Sized Rectangular Polygon



The Insert Frame-Sized Rectangular Polygon command inserts a rectangular polygon at the same size as the Reference Frame using the current D Code on the active, visible layers.

To Insert a Reference Frame-Sized Rectangular Polygon:

1. Set the Active Layers, and the Visible Layers. See *Select from the Active Layers* on page 152.
2. Position the Reference Frame at the size and location that you want the new pad. See *Reference Frame* on page 177.
3. Set the Current D Code. See *Current D Code* on page 314.
4. On the **Edit** Menu, click **Insert-Rectangle-Frame Sized**



Shift+B

Insert Frame-Sized Pad



The Insert Frame-Sized Pad command inserts a pad inside the Reference Frame at the same size as the Reference Frame. If needed, a new D Code is created. The frame-sized pad is inserted on the active, visible layers.

To Insert a Reference Frame-Sized Pad:

1. Set the Active Layers, and the Visible Layers. See *Select from the Active Layers* on page 152.
2. Position the Reference Frame at the size and location that you want the new pad. See *Reference Frame* on page 177.
3. On the **Edit** Menu, click **Insert-Frame Sized Pad**
4. If prompted, enter the D Code for the new pad.
5. **Click** the mouse or press **Enter**.



Insert Key = Pops up list of insert commands



This key command does not select an insert tool like most of the other insert commands; the pad is inserted as soon as the command is selected from the pop up list.

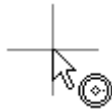
Insert Circle



A circle is an arc that forms a complete, joined, circular loop around a centerpoint. The circle is inserted using the current D Code on the active, visible layers.

To Insert a Circle:

1. Set the Current D Code. See *Current D Code* on page 314.
2. Set the Active Layers, and the Visible Layers. See *Select from the Active Layers* on page 152.
3. Set the Arc Insertion Direction.
4. On the **Edit** Menu, click **Insert-Circle**.



Insert Circle Tool

5. Position the cursor where you want the center of the circle.
6. **Click** the mouse or press **Enter**.
7. Position the cursor at any point on the circle.
8. **Click** the mouse or press **Enter**.

The Circle Insertion tool remains selected, so you can insert one circle after another.

- To cancel inserting a circle before setting the outside point, press **Esc**.
- To stop inserting circles, click a different editing tool or press **Esc**.



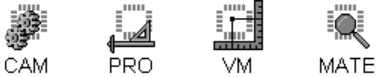
Insert Key = Pops up list of insert tool types.

Enter = Inserts selected type.

Esc = Releases insert tool.



Insert 3-Point Arc



A 3-point arc is an arc that is defined by three points located on the arc. The 3-point arc is inserted using the current D Code on the active, visible layers.

To Insert a 3-Point Arc:

1. Set the Current D Code. See *Current D Code* on page 314.
2. Set the Active Layers, and the Visible Layers. See *Select from the Active Layers* on page 152.
3. Set the Arc Insertion Direction.
4. On the **Edit** Menu, click **Insert-3-Point Arc**.



Insert 3-Point Arc Tool

5. Position the cursor where you want the 3-point arc to start.
6. **Click** the mouse or press **Enter**.
7. Position the cursor at a point on the 3-point arc that is between the endpoints.
8. **Click** the mouse or press **Enter**.
9. Position the cursor where you want the 3-point arc to end.
10. **Click** the mouse or press **Enter**.

The 3-Point Arc Insertion tool remains selected, so you can insert one 3-point arc after another.

- To cancel inserting a 3-point arc before setting the endpoint, press **Esc**.
- To stop inserting 3-point arcs, click a different editing tool or press **Esc**.



*Insert Key = Pops up list of insert tool types.
Enter = Inserts selected type.
Esc = Releases insert tool.*



Insert Chord and Tangent Arc



A chord and tangent arc is an arc that is defined by an endpoint chord and an endpoint tangent. The chord and tangent arc is inserted using the current D Code on the active, visible layers.

To Insert a Chord and Tangent Arc:

1. Set the Current D Code. See *Current D Code* on page 314.
2. Set the Active Layers, and the Visible Layers. See *Select from the Active Layers* on page 152.
3. Set the Arc Insertion Direction.
4. On the **Edit** Menu, click **Insert-Chord and Tangent Arc**.



Insert Chord and Tangent Arc Tool

5. Position the cursor where you want the chord and tangent arc to start.
6. **Click** the mouse or press **Enter**.
7. Position the cursor where you want the chord and tangent arc to end.
8. **Click** the mouse or press **Enter**.
9. Position the cursor on a tangent to the endpoint that you just entered. This sets the curvature of the arc.
10. **Click** the mouse or press **Enter**.

The Chord and Tangent Arc Insertion tool remains selected, so you can insert one chord and tangent arc after another.

- To cancel inserting a chord and tangent arc before setting the tangent point, press **Esc**.
- To stop inserting chord and tangent arcs, click a different editing tool or press **Esc**.



Insert Key = Pops up list of insert tool types.

Enter = Inserts selected type.

Esc = Releases insert tool.



Insert Chord and Point Arc



A chord and point arc is an arc that is defined by an endpoint chord and a point on the curve of the arc. The chord and point arc is inserted using the current D Code on the active, visible layers.

To Insert a Chord and Point Arc:

1. Set the Current D Code. See *Current D Code* on page 314.
2. Set the Active Layers, and the Visible Layers. See *Select from the Active Layers* on page 152.
3. Set the Arc Insertion Direction.
4. On the **Edit Menu**, click **Insert-Chord and Point Arc**.



Insert Chord and Point Arc Tool

5. Position the cursor where you want the chord and point arc to start.
6. **Click** the mouse or press **Enter**.
7. Position the cursor where you want the chord and point arc to end.
8. **Click** the mouse or press **Enter**.
9. Position the cursor at a point on the curve of the chord and point arc. This sets the curvature of the arc.
10. **Click** the mouse or press **Enter**.

The Chord and Point Arc Insertion tool remains selected, so you can insert one chord and point arc after another.

- To cancel inserting a chord and point arc before setting the point on the curve, press **Esc**.
- To stop inserting chord and point arcs, click a different editing tool or press **Esc**.



Insert Key = Pops up list of insert tool types.

Enter = Inserts selected type.

Esc = Releases insert tool.



Insert Center and Chord Arc



A center and chord arc is an arc that is defined by a centerpoint, a starting point and a point that establishes the chord angle. The center and chord arc is inserted using the current D Code on the active, visible layers.

To Insert a Center and Chord Arc:

1. Set the Current D Code. See *Current D Code* on page 314.
2. Set the Active Layers, and the Visible Layers. See *Select from the Active Layers* on page 152.
3. Set the Arc Insertion Direction.
4. On the **Edit** Menu, click **Insert-Center and Chord Arc**.



Insert Center and Chord Arc Tool

5. Position the cursor where you want the center of the center and chord arc.
6. **Click** the mouse or press **Enter**.
7. Position the cursor where you want the chord and point arc to start. This establishes the start point and the radius.
8. **Click** the mouse or press **Enter**.
9. Position the cursor at a point that is at the desired angle from the starting point.
10. **Click** the mouse or press **Enter**.

The Center and Chord Arc Insertion tool remains selected, so you can insert one center and chord arc after another.

- To cancel inserting a center and chord arc before setting the final angle, press **Esc**.
- To stop inserting center and chord arcs, click a different editing tool or press **Esc**.



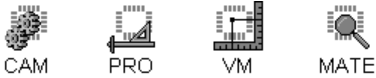
Insert Key = Pops up list of insert tool types.

Enter = Inserts selected type.

Esc = Releases insert tool.



Set Arc Direction - Clockwise/Counterclockwise



Arcs can be inserted in the clockwise or counterclockwise direction. When you insert an arc, this determines which direction the arc will be drawn between the points you designate as the start point and the end point. Arc direction may also be important if you export data to a router.



When you change the arc insertion direction, existing arcs are not changed.

To Set the Arc Direction Before You Insert an Arc:

- On the **Edit** menu, look at the **Insert-Clockwise Arc Mode** menu command.
 - This menu command indicates the current arc insertion direction and can switch between clockwise and counterclockwise.
 - A check mark indicates clockwise arc insertion.
 - No check mark indicates counterclockwise arc insertion.
 - To change insertion direction, **Click** on the command.

Insert Text



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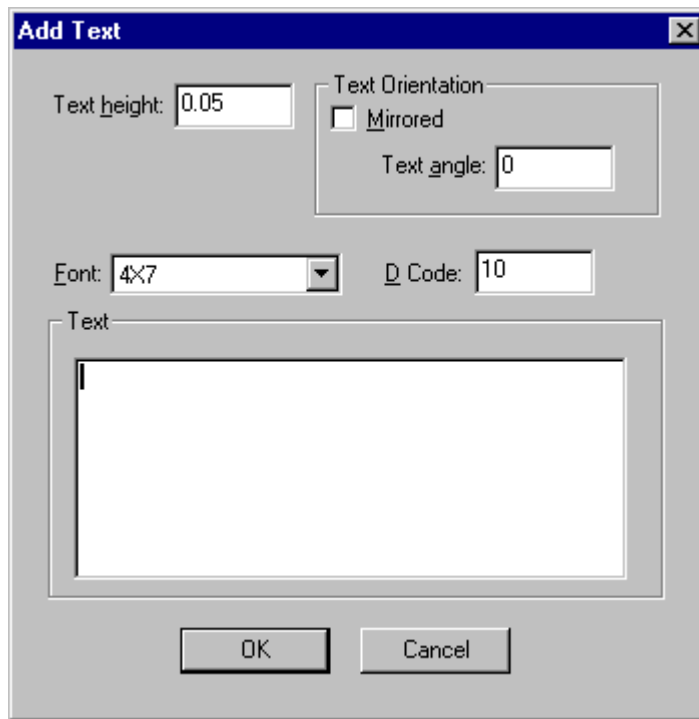


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The program can insert text at any size and orientation. The text is inserted with all traces selected so you can re-scale it or move it as you wish. The text is inserted using the current D Code on the active, visible layers.

To Insert Text:

1. Set the Current D Code. See *Current D Code* on page 314.
2. Set the Active Layers, and the Visible Layers. See *Select from the Active Layers* on page 152.
3. Clear the current selection, by going to the **Edit Menu** and clicking **Select-Clear Selection**.
4. Position the crosshair where you want the text to start.
5. Separate the crosshair and the cursor. See *Separate the Crosshair and Mouse Cursor* on page 112.
6. On the **Edit Menu**, click **Insert-Text**.



Insert Text Dialog

7. Set the **Size** of the text.

8. Set the **Orientation** of the text.
9. Set the **Font** of the text.
10. The dialog shows the **Current D Code** that will be used to form the text traces, and you can change the D Code here if you want to.
11. **Type** the text.
12. **Click** the mouse or press **Enter**.
13. The program inserts the text into the plot and selects it. If the size, position or orientation is not what you need, use Scale, Move, Mirror, or Rotate to edit the selected traces.



Insert Key = Pops up list of insert tool types.



Edit Selected Plot Data

The program has many commands for editing selected elements. Selected elements can be deleted, moved, copied, centered, transferred, replicated, mirrored, rotated, scaled, transcoded, snapped to grid and stepped and repeated. For information on how to select elements for these types of editing operations, see *Select Elements for Editing* on page 150.

Many of the commands for editing selected data are available on the Edit Toolbar.



Edit Toolbar

To Display the Edit Toolbar:

- On the **View** menu, look at **Toolbars-Edit**.
 - If Edit has a checkmark next to it, then the Edit Toolbar is displayed.
 - If Edit does not have a checkmark next to it, then the Edit Toolbar is not displayed.

To change the display of the Edit Toolbar, click **Edit**.



Edit Toolbar button on Main Toolbar. Down = Displayed, Up = Not Displayed

Delete Selected Elements



To Delete Selected Elements:

1. Select the elements. See *Select Elements for Editing* on page 150.
2. On the **Edit** Menu, click **Edit Selection-Delete**.

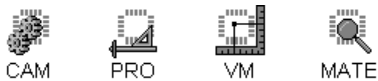


Delete Key



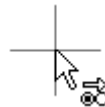
Instead of using the Delete command, you may want to use the Transfer command to transfer unwanted elements to an unused layer. The commands that delete groups of elements can't be undone. Elements transferred to an unused layer can be recovered later if necessary.

Move Selected Elements



To Move Selected Elements:

1. Select the elements. See *Select Elements for Editing* on page 150.
2. On the **Edit** Menu, click **Edit Selection-Move**.



Move Tool

3. Position the cursor at a reference point.
4. **Click** the mouse or press **Enter**.
5. Position the cursor where you want the reference point and selected elements to move to.
6. **Click** the mouse or press **Enter**.

The selected elements move to the new cursor position.



Shift+M

Enter = Activate move tool.



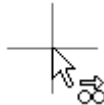
For precision, use the Align and Go To Coordinate commands when setting the reference and move-to points.

Copy Selected Elements



To Copy Selected Elements:

1. Select the elements. See *Select Elements for Editing* on page 150.
2. On the **Edit** Menu, click **Edit Selection-Copy**.



Copy Tool

3. Position the cursor at a reference point.
4. **Click** the mouse or press **Enter**.
5. Position the cursor where you want the new elements to be copied to.
6. **Click** the mouse or press **Enter**.



K



For precision, use the Align and Go To Coordinate commands when setting the reference and copy-to points.

Center Selected Elements to the Reference Frame



To Center Selected Elements to the Reference Frame:

1. Position the Reference Frame where you want the selected elements to be centered. See *Reference Frame* on page 177.
2. Select the elements. See *Select Elements for Editing* on page 150.
3. On the **Edit** Menu, click **Edit Selection-Center to Frame**.

The selected elements move to the center of the Reference Frame.

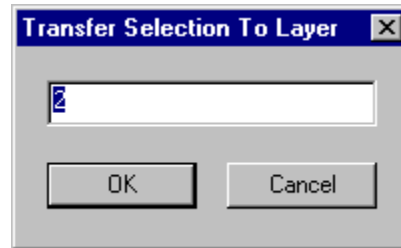
Transfer Selected Elements



The transfer command removes elements from one layer and transfers them to another layer.

To Transfer Selected Elements:

1. Select the elements. See *Select Elements for Editing* on page 150.
2. On the **Edit** Menu, click **Edit Selection-Transfer**.



Transfer Elements Dialog

3. Enter the destination layer.



*If elements are selected from more than one layer, the destination layer is the **first** layer that elements will be transferred to.*



J



Replicate Selected Elements



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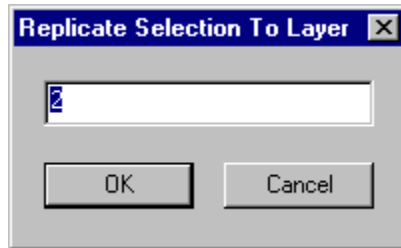


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The replicate command copies elements to another layer without removing them from their original layer.

To Replicate Selected Elements:

1. Select the elements. See *Select Elements for Editing* on page 150.
2. On the **Edit** Menu, click **Edit Selection-Replicate**.



Replicate Elements Dialog

3. Enter the destination layer.



*If elements are selected from more than one layer, the destination layer is the **first** layer that elements will be transferred to.*



Ctrl+J



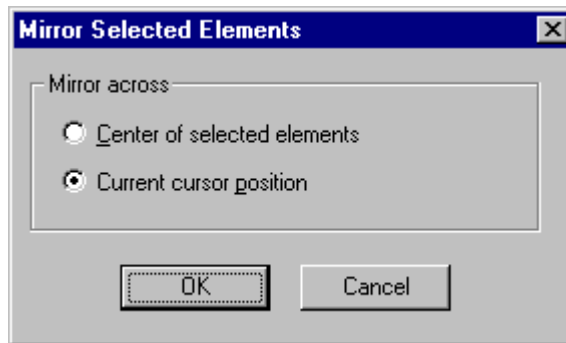
Mirror Selected Elements



The mirror commands flip the image composed of the selected elements. The elements are flipped in the X or Y direction, and are flipped to the opposite side of a reference point. The program reassigns shapes H, T and M to existing D Codes of the correct size or new D Codes defined to match the aperture. Other shapes are not affected by mirroring.

To Mirror Selected Elements:

1. Select the elements. See *Select Elements for Editing* on page 150.
2. On the **Edit** Menu, click **Edit Selection-Mirror X** or **Mirror Y**.



Mirror Elements Dialog

3. Select whether to mirror around a cursor position that you can set, or around the center of the group of selected elements.



Mirror Tool

4. If you are mirroring around the cursor position, then position the cursor and **click** the mouse or press **Enter**.
If you are mirroring around the center of the selection, **click** anywhere or press **Enter**.

The elements flip and stay selected.



Shift+X
Shift+Y

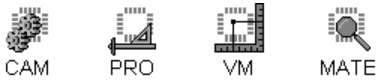


for Mirror X, and



for Mirror Y

Rotate Selected Elements



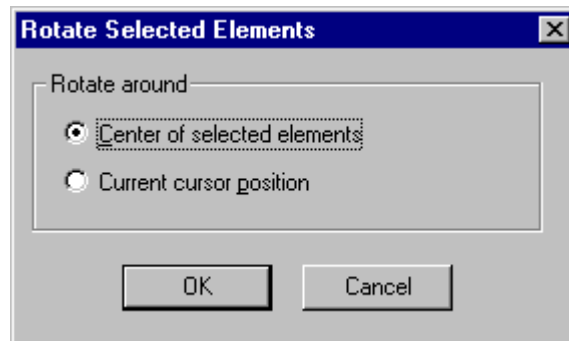
The rotate command rotates the image composed of the selected elements. The selected elements are rotated counterclockwise around a reference point.

If the angle of rotation is a multiple of 90 degrees, the program transcodes the X, Y asymmetrical shapes (shape codes R, O, X, H, T and M) to existing D Codes of the correct size or new D Codes defined to match the aperture. Generally these shapes will have the same shape code, but new, rotated dimensions.

If the angle is not a multiple of 90 degrees, the program transcodes shapes to new or existing D Codes to match the rotated aperture. For some shape codes, such as circles, no transcoding is necessary. For other shapes codes, such as heat reliefs (H) or customs (M), the shape code remains the same but the parameters or dimensions change to accommodate the new angle. For most shapes (types S, R, O, X, etc.), the shapes are transcoded to new Custom Aperture D Codes (type M) defined to match the rotated aperture. Targets (type T) are not rotated, by non-90-degree increments.

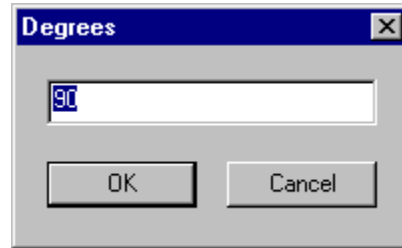
To Rotate Selected Elements:

1. Select the elements. See *Select Elements for Editing* on page 150.
2. On the **Edit** Menu, click **Edit Selection-Rotate**.



Rotate Elements Dialog

3. Select whether to rotate around a **Cursor Position** that you can set, or around the **Center** of the group of selected elements.



Rotation Angle Dialog

4. Set the **Rotation Angle**.



Rotate Tool

5. If you are rotating around the cursor position, then position the cursor and **click** the mouse or press **Enter**.



Ctrl+R



Scale Selected Elements



CAM



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VM



MATE

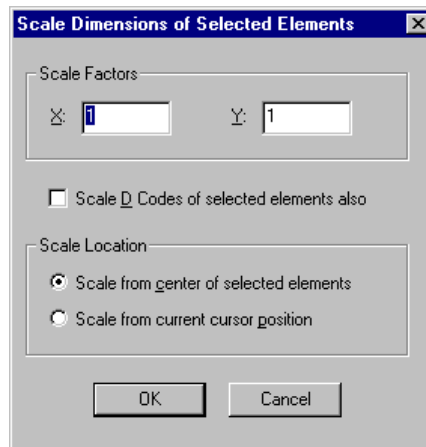
The scale command scales the image of the selected elements. If the X and Y scale factors are the same, the program can also scale the D Codes of the selected elements.



The Scale command does not transcode selected elements as their D Codes are scaled. So non-selected elements of the same D Code will also have their D Codes scaled.

To Scale Selected Elements:

1. Select the elements. See *Select Elements for Editing* on page 150.
2. On the **Edit** Menu, click **Edit Selection-Scale**.



Scale Elements Dialog

3. Set the X and Y **Scale Factors**.
4. If the X and Y factors are the same, set whether to also **scale the D Codes** of the selected elements.
5. Set whether to scale around a **cursor position** that you can set, or around the **center** of the group of selected elements.
6. If you are scaling around the cursor position, then position the cursor and **click** the mouse or press **Enter**.



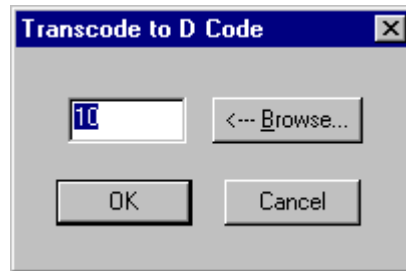
Transcode Selected Elements



The Transcode command changes the D Code assignment of selected elements.

To Transcode Selected Elements to a New D Code:

1. Select the elements. See *Select Elements for Editing* on page 150.
2. On the **Edit** Menu, click **Edit Selection-Transcode**.



Transcode Elements

3. Set the new **D Code**.



Ctrl+T



Snap Selected Elements to the Grid



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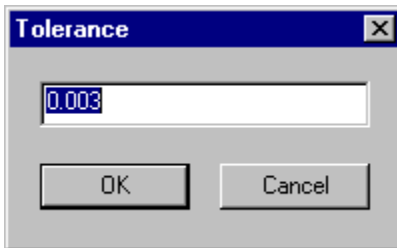


MATE

The Snap to Grid command moves selected elements to the nearest Grid points. This command should only be used to fine tune data that was designed for a grid. If you use too large a grid unit or a large tolerance, you may get elements stacked. For information about the Grid, see *Screen Grid* on page 107.

To Snap Selected Elements to the Grid:

1. Set the Grid Unit.
2. Turn the Grid On.
3. Make sure the Grid is Anchored where you want it.
4. Make sure the Grid is Fixed.
5. Select the elements you want to snap to the Grid. See *Select Elements for Editing* on page 150.
6. On the **Edit** menu, click **Edit Selection-Snap to Grid**.



Snap to Grid Tolerance Dialog

7. On the Tolerance dialog, set a **tolerance distance**:

If the tolerance is any value other than zero, selected elements within the tolerance distance of the nearest grid point will be snapped to the grid point, while elements that are not within tolerance distance will not be snapped. If the tolerance is zero, the elements are snapped to the nearest grid point regardless of distance.

8. Click **OK**.



Ctrl+M



The program can also snap data to a Padmaster Layer.

Step and Repeat Selected Data

The Step and Repeat command makes multiple copies of selected elements and positions the copies in an array as specified.

Differences between a Coded SR Block and Copied Step and Repeat



The program can handle stepped and repeated data in two ways.

Copy the Stepped and Repeated Data

The original image can be stepped and repeated by copying the original data to the new locations in the step and repeat array. After being stepped and repeated in this way, the elements in the array have no special relationship to each other in the database; they are ungrouped elements like any other and can be selected and edited in the normal way. When you step and repeat selected elements this way, it makes the database proportionately larger because the process makes multiple copies of the design data, and all the copies have to be stored in the file.

Use Coded SR Blocks for the Stepped and Repeated Data

The original image can be stepped and repeated by adding a step and repeat code block into the database. The step and repeat code block indicates that the data of the original image is part of a step and repeat array. This process does not make a physical copy of the original data for each image in the array. Instead it groups the original data into a block and adds a code that tells the system to display or output an array whenever the data is displayed, printed or plotted. In this system, the elements of the array are not individual elements like any other. They are grouped elements that must be selected and edited as a group. When you step and repeat selected elements this way, it makes the database only slightly larger than it was before the step and repeat operation because the process does not make multiple copies of the design data. Files that use coded step and repeat can be much smaller than files in which the step and repeat arrays are made with copied data.

The program can generate coded step and repeat blocks during a step and repeat operation. But it can also import coded step and repeat blocks Extended Gerber, MDA Autoplot,, and Drill Files.

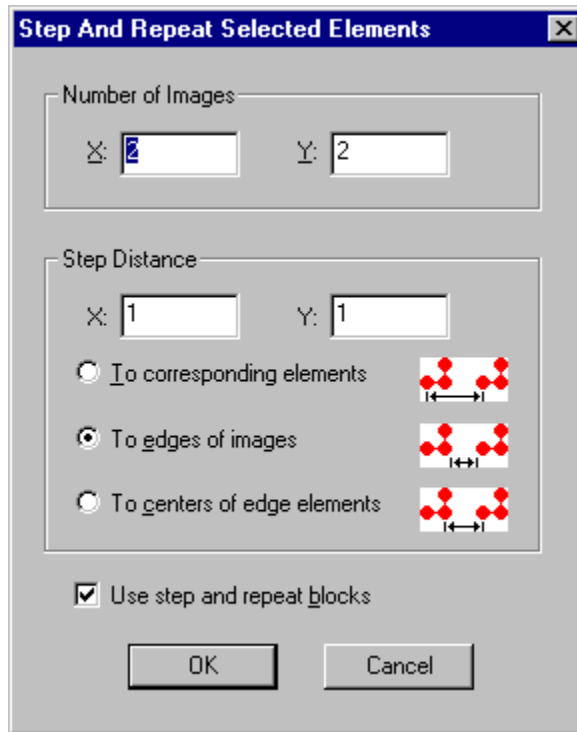
Step and Repeat Selected Elements



The Step and Repeat command makes multiple copies of selected elements and positions the copies in an array as specified.

To Step and Repeat Selected Elements:

1. Select the elements. See *Select Elements for Editing* on page 150.
2. On the **Edit** Menu, click **Edit Selection-Step and Repeat-New**.



Step and Repeat Dialog

3. On the Step and Repeat Selected Elements dialog:

- Enter the **number of images** you want in the X and Y dimensions. This includes the original image.
- Enter the distance you want between each image in the **Step Distance** boxes.
- Click on the method you want for calculating the distance between each image.

To Corresponding Elements: This option places the stepped images so that they have the step distance between corresponding elements in adjacent images.

To Edges of Images: This option places the stepped images so that they have the step distance between the edges of adjacent images.

To Centers of Edge Elements: This option places the stepped images so that they have the step distance between the centerpoints of elements at the edges of adjacent images.

- Select whether to use step and repeat blocks.

Copy the data: The image can be stepped and repeated by copying the original data to the new locations. To copy the data to new locations, be sure the Use Step and Repeat Blocks option does not have a checkmark.

Use Step and Repeat Blocks: Or the image can be stepped and repeated by adding a step and repeat code block into the database which indicates that the data of the original image is part of a step and repeat array. To use coded step and repeat blocks, click the Use Step and Repeat Blocks option so that it has a checkmark.



The choice to use step and repeat blocks does not make a difference in how the image is displayed. But it does make a difference in how the data can be selected, edited and saved later.

4. Click **OK**.



Shift+K



Convert Coded SR Blocks to Copied Step and Repeat Data



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MATE

Data that is in a coded step and repeat block is said to be “grouped.” This means that it can only be selected and edited as a group and not as individual elements. If you want to edit individual elements of a coded step and repeat block while not affecting other elements in the array, you must convert the coded step and repeat block into individual copied elements using the Ungroup command.

To Ungroup Elements of a Single Coded SR Block:

1. Select the coded step and repeat block that you want to convert. See *Select Elements for Editing* on page 150.
2. On the **Edit** menu, click **Edit Selection-Step and Repeat-Ungroup**.

You can also ungroup all step and repeat blocks in the entire database simultaneously.

To Ungroup All Coded Step and Repeat Blocks:

- On the **Edit** menu, click **All Step and Repeats-Ungroup**.

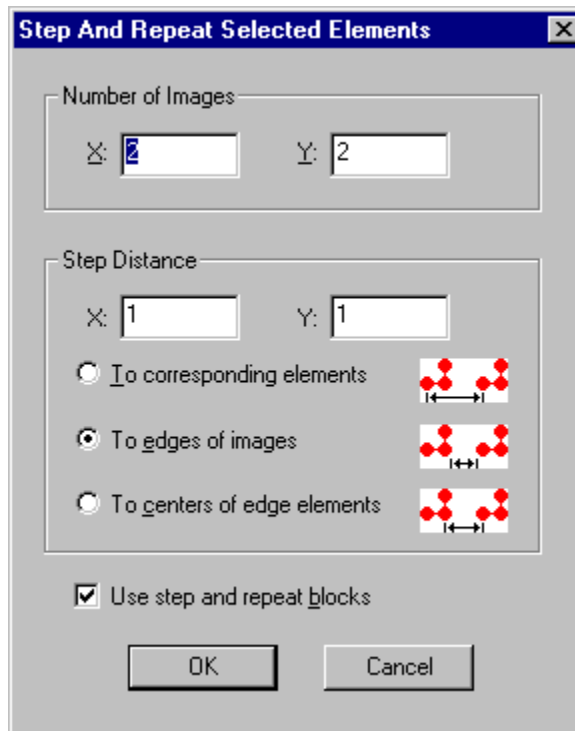
Change Step and Repeat Parameters of a Coded SR Block



Data that is in a coded step and repeat block is said to be “grouped.” This means that it can only be selected and edited as a group and not as individual elements. If you want to change the step and repeat parameters of a coded step and repeat block (i.e., change the number of copies in the array or change the step distance), use the Change command.

To Change Step and Repeat Parameters of a Coded SR Block:

1. Select the coded step and repeat block that you want to convert. See *Select Elements for Editing* on page 150.
2. On the **Edit** menu, click **Edit Selection-Step and Repeat-Change**.



Step and Repeat

3. On the Step and Repeat Selected Elements dialog:

- Enter the **number of images** you want in the X and Y dimensions. This includes the original image.
- Enter the distance you want between each image in the **Step Distance** boxes.
- Click on the method you want for calculating the distance between each image.

To Corresponding Elements: This options places the stepped images so that they have the step distance between corresponding elements in adjacent images.

To Edges of Images: This option places the stepped images so that they have the step distance between the edges of adjacent images.

To Centers of Edge Elements: This option places the stepped images so that they have the step distance between the centerpoints of elements at the edges of adjacent images.

- Select whether to use step and repeat blocks.

Copy the data: The image can be stepped and repeated by copying the original data to the new locations. To copy the data to new locations, be sure the Use Step and Repeat Blocks option does not have a checkmark.

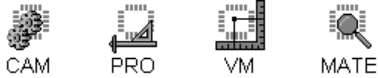
Use Step and Repeat Blocks: Or the image can be stepped and repeated by adding a step and repeat code block into the database which indicates that the data of the original image is part of a step and repeat array. To use coded step and repeat blocks, click the Use Step and Repeat Blocks option so that it has a checkmark.



The choice to use step and repeat blocks does not make a difference in how the image is displayed. But it does make a difference in how the data can be selected and edited later.

4. Click **OK**.

Select and Edit One-Up Image of a Coded SR Block



Data that is in a coded step and repeat block is said to be “grouped.” This means that it can only be selected and edited as a group and not as individual elements. If you want to edit individual elements in the one up image of a coded step and repeat block, you must convert the coded step and repeat block back into the individual elements of the one-up image using the One-Up command.

To Convert Elements of a Single Coded SR Block Back into a One-Up Image:

1. Select the coded step and repeat block that you want to convert. See *Select Elements for Editing* on page 150.
2. On the **Edit** menu, click **Edit Selection-Step and Repeat-One Up**.

The stepped and repeated images of the array are replaced by the single one-up image.

You can also convert all step and repeat blocks in the entire database back to their one-up images simultaneously.

To Convert All Coded SR Blocks to One-Up Images:

- On the **Edit** menu, click **All Step and Repeats-One Up**.

Select Elements for Editing

Many of the editing commands act on Selected Elements. Selected elements are shown highlighted in white or in contrasting color. So, when you activate an editing command such as Delete or Copy, the command will affect the selected elements highlighted in white or in contrasting color.

To make group editing of specific classes of elements easier, there are several selection criteria to limit what can be selected for editing. You can limit your selections to:

- Only a single layer or all visible layers
- Only the current D Code or any D Code
- Only the current net or any net
- Any class of element or only a specified class of element such as pads, traces, arcs, orthogonal traces, vertical traces, horizontal traces, 45-degree traces, non-orthogonal traces, chains of traces, polygons of traces, drawn pads, or a specified shape code

The selection criteria affect what can be selected when you select anything, regardless of whether it is a command to select a single element, a group of elements, a global selection from the entire database, or a chain of traces. The selection criteria do not affect what can be selected when you select all data.

When you have a selection in place, you can also add to the current selection, remove from the current selection, invert the selection, and clear the selection.

Selected elements can be made visible or not visible and they can be displayed in white or in contrasting color. For information on how to adjust the view of selected items, see *Element Visibility* on page 84.

Many of the commands for selecting data are available on the Selection Toolbar.



Selection Toolbar

To Display the Selection Toolbar:

- On the **View** menu, look at **Toolbars-Selection**.
 - If Selection has a checkmark next to it, then the Selection Toolbar is displayed.
 - If Selection does not have a checkmark next to it, then the Selection Toolbar is not displayed.

To change the display of the Selection Toolbar, click Selection.



Selection Toolbar button on Main Toolbar. Down = Displayed, Up = Not Displayed

Some of the features for controlling selection criteria are available on the Current Element Toolbar.



Current Element Toolbar

To Display the Current Element Toolbar:

- On the **View** menu, look at **Toolbars-Current Element**.
 - If Current Element has a checkmark next to it, then the Current Element Toolbar is displayed.
 - If Current Element does not have a checkmark next to it, then the Current Element Toolbar is not displayed.

To change the display of the Current Element Toolbar, click Current Element.

Selection Criteria

Selection criteria limit what can be selected for editing.

Select from the Active Layers

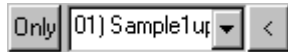


In order for elements in a layer to be selected or for elements to be inserted into a layer, the layer must be Active and Visible. Visible layers are indicated in the Layers Toolbar and in the Layers Table. If more than one layer is visible, you can designate one single layer to be active or all visible layers as active.

The single active layer is indicated in the drop down layers list on the Current Element Toolbar and when the “Only” button next to the list is down.

To Set a Single Active Layer:

1. Double-click on the layer in the **Layers Toolbar** to make the layer visible.
2. On the **Current Element Toolbar** pick the **Active Layer** from the drop down list.
3. On the **Current Element Toolbar** click the “**Only**” button next the drop down layers list so that the button is down.



Active layer controls in the Current Element Toolbar.

“Only” button up = All visible layers active, Down = Only the single layer is active.



0 (Zero) = Toggle between all layers active and single layer active (Changes the “Only” setting).

Related Key Commands:

The following key commands set the active layer but do not affect visibility or the “Only” button setting:

1 through 9 = Quick Set Active Layer

L = Set Active Layer

Plus Key = Set Next Sequential Layer as Active Layer

Backspace Key = Set Previous Sequential Layer as Active Layer

The following key commands make a single layer the active visible layer in an alternative way. They shut off visibility to all other layers, turn on visibility to the single layer, and make it active:

Ctrl+1 through 9 = Quick Set Single Active Visible Layer

Ctrl+L = Set Single Active Visible Layer

Ctrl+Plus Key = Set Next Sequential Layer as Single Active Visible Layer

Ctrl+Backspace Key = Set Previous Sequential Layer as Single Active Visible Layer

All visible layers are active when the “Only” button next to the drop down list is **up**.

To Make All Visible Layers Active:

1. Double-click on the layers you want to edit in the **Layers Toolbar** to make them visible.
2. On the **Current Element Toolbar** click the “**Only**” button next the drop down layers list so that the button is **up**.



0 (Zero) = Toggle between all layers active and single layer active (Changes the “Only” setting).



Active layer controls in the Current Element Toolbar.

“Only” button up = All visible layers active, Down = Only the single layer is active.

Select by Current D Code



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The Current D Code is the D Code indicated on the Current Element Toolbar. All newly inserted elements will be of the current D Code. You can also limit selection to only elements of the current D Code or allow elements of any D Code to be selected.

To Limit Selection to Only the Current D Code:

1. Set the current D Code in the **Current Element Toolbar**.
2. Click the “**Only**” button next to the **Current D Code** in the **Current Element Toolbar** so the button is down.



Current D Code controls on Current Element Toolbar.

“Only” button up = All D Codes active, Down = Only the single D Code is active.

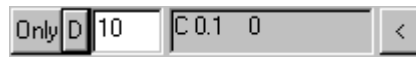
To Allow Elements of Any D Code to be Selected:

- Click the “**Only**” button next to the Current D Code in the Current Element Toolbar so the button is **up**.



Shift+D = Set Current D Code

Ctrl+D = Toggle Select Only Current D Code and Select Any D Code



Current D Code controls on Current Element Toolbar.

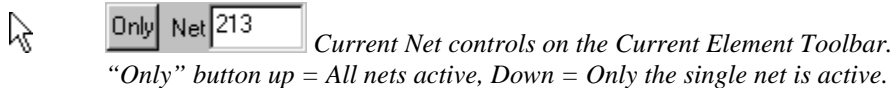
“Only” button up = All D Codes active, Down = Only the single D Code is active.

Select by Current Net

The Current Net is the Net indicated on the Current Element Toolbar. You can limit selection to only elements of the Current Net or allow elements of any Net to be selected.

To Limit Selection to Only the Current Net:

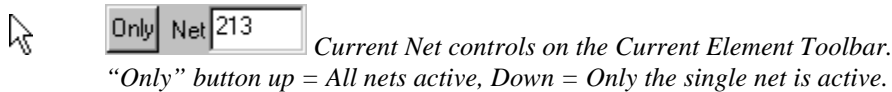
1. Set the Current Net in the Current Element Toolbar.
2. Click the **“Only”** button next to the **Current Net** in the **Current Element Toolbar** so the button is down.




To Allow Elements of Any Net to be Selected:

- Click the **“Only”** button next to the Current Net in the Current Element Toolbar so the button is **up**.

 *Ctrl+Shift+N = Set the Current Net in the Current Element Toolbar.*
Ctrl+F = Toggle Between Select Only Current Net and Select Any Net



 *Some netlist databases, such as those extracted using the CAMMaster Raster Netlist Extraction routine flag single-point nets as “N/C” and flag elements which cause short circuits between different types of plane layers as “S/C.” For these types of netlist databases, you may also select single point nets elements or short circuit elements by entering a net number of “N/C” or “S/C”, respectively, into the Current Net field.*

Select a Special Class of Element



You can limit selection to specialized classes of elements, or allow any class of element to be selected. The class of element is indicated on the drop down list on the Selection Toolbar. The types of element classes that you can select are:

- Any: No limitations, all types of elements can be selected.
- Pads
- Traces
- Arcs
- Orthogonal Traces
- Vertical Traces
- Horizontal Traces
- 45-Degree Traces
- Non-Orthogonal Traces
- Chains of Traces
- Polygons of Traces
- Drawn Pads
- Shape Code (C, S, R, O, D, H, T, E, N, M, F, ?)

To Limit Selection to Only a Special Element Class:

- On the drop down list on the Selection Toolbar, click the type of **special element class** you want to select so the special element class is displayed.



P = Select Pads Only
T = Select Traces Only



Special Element Class Control on Selection Toolbar.

To Allow Elements of Any Class to be Selected:

- On the drop down list on the Selection Toolbar, click “Any” so that “Any” is displayed.



U = Unrestricted, select Any Element



Special Element Class Control on Selection Toolbar.

Select a Single Element



To Select a Single Element:

1. Set the selection criteria that you want to use, if any:
 - Active Layer
 - Current D Code
 - Current Net
 - Special Element Class
2. On the **Edit** menu, click **Select-Selection Tool**.



Selection Tool

3. Click near the element you want to select.

The closest element that meets the selection criteria will be selected and highlighted.



S = Selection Tool
Enter = Select Element Near Tool



On Editing Toolbar

To Select a Single Element Using the Double-Click Shortcut:

1. Set the selection criteria that you want to use, if any:
 - Active Layer
 - Current D Code
 - Current Net
 - Special Element Class

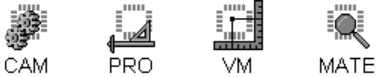


Selection Tool

2. Without any tool selected (i.e., insert pad tool, draw frame tool, zoom tool etc.), **double-click** near the element you want to select.

The closest element that meets the selection criteria will be selected and highlighted.

Select a Group of Elements



You can select a group of elements from inside or outside of an area.

To Select a Group of Elements:

1. Set the selection criteria that you want to use, if any:
 - Active Layer
 - Current D Code
 - Current Net
 - Special Element Class
2. On the **Edit** menu, click **Select-Options**.
3. Pick whether to select **inside** or **outside** the selection frame.
4. On the **Edit** menu, click **Select-Selection Tool**.



Selection Tool

5. **Drag** the mouse across the group of elements you want to select. Or for accuracy, press **Tab** at one corner of the area you want to select and press **Tab** again at the other corner.

All elements defined by the drag area that meet the selection criteria will be selected and highlighted.



I = Toggle between Inside and Outside Frame

S = Selection Tool

Tab = Start selection area. Press again to end selection area.



= Selection Tool



= Toggle between Inside and Outside Frame

Select All Data



The Select All Data command selects all data in the database. It is not limited by the selection criteria. The Select All Data command is different than the Global Select command because the Global Select command uses the selection criteria, while the Select All command does not.

To Select All Data in the Loaded Database:

- On the **Edit** menu, click **Select-Select All**.



Ctrl+A



Select Globally from the Entire Database



The Global Select command selects all data in the database that meet the selection criteria. The Global Select command is different than the Select All command because the Global Select command uses the selection criteria, while the Select All command does not.

To Select Globally from the Entire Database:

1. Set the selection criteria that you want to use, if any:

- Active Layer
- Current D Code
- Current Net
- Special Element Class

2. On the **Edit** menu, click **Select-Global-New**.

All elements in the loaded database that meet the selection criteria will be selected and highlighted.



Shift+V



To Add and Remove Global Selections:

- To add a Global selection to an existing selection, use **Edit-Select-Global-Add**.
- To remove a Global selection from an existing selection, use **Edit-Select-Global-Remove**.

Select a Chain of Traces



You can select a chain of traces. A chain of traces is a series of traces in which the endpoint of one trace is the exact start point of another trace. There are no limits on how many traces can be in a chain.

To Select a Chain of Traces:

1. Set the selection criteria that you want to use, if any:
 - Active Layer
 - Current D Code
 - Current Net
 - Special Element Class
2. On the **Edit** menu, go to **Select-Chain-**
 - If you want the chain to be able to branch when more than two traces intersect at the same endpoint, click **Branching**.
 - If you want the chain to end when more than two traces intersect at the same endpoint, click **No Branching**.



Chain Selection Tool

3. Click near the first trace in the chain you want to select.

To Add and Removing Chain Selections:

- To add a chain of traces to an existing selection, **Shift+Click** after selecting the chain selection tool with **Edit-Select-Chain-Branching/No Branching**.
- To remove a chain of traces from an existing selection, **Ctrl+Click** after selecting the chain selection tool with **Edit-Select-Chain-Branching/No Branching**.

Select and Edit Entire Array of a Coded SR Block



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Data that is in a coded step and repeat block is said to be “grouped.” This means that it can only be selected and edited as a group and not as individual elements.

To Select a Single Coded Step and Repeat Block:

1. Set the selection criteria that you want to use, if any:
 - Active Layer
 - Current D Code
 - Current Net
 - Special Element Class
2. On the **Edit** menu, click **Select-Selection Tool**.



Selection Tool

3. Click near the coded step and repeat block you want to select.
The entire step and repeat array is selected and highlighted.
4. Edit the entire block together as one entity using any of the editing commands.



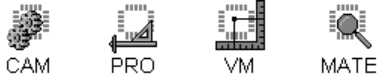
S = Selection tool

Enter = Select array near tool



= Selection Tool

Add to a Selection



You can add elements to a current selection by pressing the Shift key and selecting the elements you want to add.

To Add to a Selection:

1. Set the selection criteria that you want to use, if any:
 - Active Layer
 - Current D Code
 - Current Net
 - Special Element Class
2. On the **Edit** menu, click **Select-Selection Tool**.



Add to Selection Tool

- Press the **Shift** key and **Click** near the single element you want to add.
- Press the **Shift** key and **drag** across the elements you want to add.



S = Selection Tool

Shift+Enter = Add a single element.

Shift+Tab = Add elements in a selection area. Press again to end area.



= Selection Tool

To Add a Global Selection:

- To add a Global selection to an existing selection, use **Edit-Select-Global-Add**.

To Add a Chain Selection:

- To add a chain of traces to an existing selection, **Shift+Click** after selecting the chain selection tool with **Edit-Select-Chain-Branching/No Branching**.

Remove from a Selection



You can remove elements from a current selection by pressing the Ctrl key and selecting the elements you want to remove.

To Remove from a Selection:

1. Set the selection criteria, if any, for the elements you want to remove from selection:
 - Active Layer
 - Current D Code
 - Current Net
 - Special Element Class
2. On the **Edit** menu, click **Select-Selection Tool**.



Remove from Selection Tool

- Press the Ctrl key and Click near the element you want to remove.
- Press the Ctrl key and drag across the elements you want to remove.



S = Selection Tool

Ctrl+Enter = Remove a single element.

Ctrl+Tab = Remove elements in a selection area. Press again to end area.



= Selection Tool

To Remove a Global Selection:

- To remove a Global selection from an existing selection, use **Edit-Select-Global-Remove**.

To Remove a Chain Selection:

- To remove a chain of traces from an existing selection, **Ctrl+Click** after selecting the chain selection tool with **Edit-Select-Chain-Branching/No Branching**.

Invert the Selection



When you invert a selection, all selected data becomes unselected and all unselected data becomes selected.

To Invert the Selection:

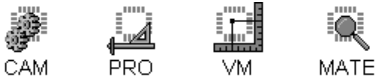
- On the **Edit** menu, click **Select-Invert Selection**.



Ctrl+I



Clear the Selection



The Clear Selection command completely clears a selection so that no elements are currently selected.

To Clear the Selection:

- On the **Edit** menu, click **Select-Clear Selection**.



Ctrl+U



Edit Entire Layers of Data

The program has features that allow you to edit entire layers of data without first selecting data. Layers can be moved, aligned, centered, transferred, replicated, swapped, and deleted.

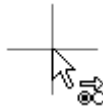
Move Layers



The Move Layers command moves the active layer(s) in the X, Y plane by moving a starting reference point to an ending reference point. To move a list of layers, instead of the active layers, see *Move Chosen Layers* on page 165. To move a layer by an exact displacement, see *Move Layers by Displacement* on page 166. Moving a layer is different than transferring a layer because moving a layer displaces the data in the X, Y plane while transferring a layer moves it to another layer.

To Move the Active, Visible Layers:

1. Set the Active Layers, and the Visible Layers that you want to move. See *Select from the Active Layers* on page 152.
2. On the **Edit** Menu, click **Layers Move-Move**.



Move Layers Tool

3. Position the cursor at a reference point.
4. **Click** the mouse or press **Enter**.
5. Position the cursor where you want the reference point and active, visible layers to move to.
6. **Click** the mouse or press **Enter**.

The active, visible layers move to the new cursor position.



Q



For precision, use the Align to Element and Go To Coordinate commands when setting the reference and move-to points.

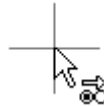
Move Chosen Layers



The Move Chosen Layers command moves a list of layer in the X, Y plane by moving a starting reference point to an ending reference point. To move active layers, instead of a list of layers, see *Move Layers* on page 164. To move a layer by an exact displacement, see *Move Layers by Displacement* on page 166. Moving a layer is different than transferring a layer because moving a layer displaces the data in the X, Y plane while transferring a layer moves it to another layer.

To Move the Chosen Layers:

1. On the **Edit** Menu, click **Layers Move-Move Chosen**.
2. On the layers dialog, enter a single **layer number** or a range of layers separated by a dash and/or a series of layers separated by commas (i.e., 1-4 or 5,7,9 or 1-4,5,7,9). Or click the button to the right, and pick the layers off a list.
3. Click **OK**.



Move Layers Tool

4. Position the cursor at a reference point.
5. **Click** the mouse or press **Enter**.
6. Position the cursor where you want the reference point and active, visible layers to move to.
7. **Click** the mouse or press **Enter**.

The active, visible layers move to the new cursor position.



For precision, use the Align to Element and Go To Coordinate commands when setting the reference and move-to points.

Move Layers by Displacement



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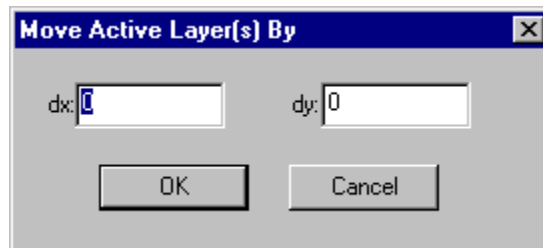


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The Move Layers by Displacement command moves a layer in the X, Y plane by an exact displacement. To move a layer by moving a starting reference point to an ending reference point, see *Move Layers* on page 164. Moving a layer is different than transferring a layer because moving a layer displaces the data in the X, Y plane while transferring a layer moves it to another layer.

To Move the Active, Visible Layers by Displacement:

1. Set the Active Layers, and the Visible Layers that you want to move. See *Select from the Active Layers* on page 152.
2. On the **Edit** Menu, click **Layers Move-Move by Displacement**.



Move Layers by Displacement Dialog

3. Enter the distance you want the layers to move in the X and Y directions.
4. Click **OK**.

The active, visible layers move by the displacement distance.

Align Layers



The program can align active, visible layers by using a reference pad in common to each of the layers. The reference pad must be of the same D Code in each of the layers you want to align. The program will move the layers so that all the reference pads are aligned.

To Align the Active, Visible Layers:

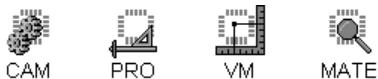
1. Set the Active Layers, and the Visible Layers that you want to move. See *Select from the Active Layers* on page 152.
2. Select the single pad that you want the other layers to align to.
3. On the **Edit** Menu, click **Layers Move-Align**.

If the active, visible layers have a pad of the same D Code as the selected reference pad, those layers move so that those pads align to the reference pad.



Ctrl+Q

Center Layer to Layers



The Center to Layers command centers the active layer to the combined centerpoint of the other visible layers.

To Center the Active Layer to the Other Visible Layers:

1. Set the Active Layer to be centered. See *Select from the Active Layers* on page 152.
2. Set the visible layers that the active layer will be centered to.
3. On the **Edit** Menu, click **Layers Move-Center to Layers**.



Shift+Q

Center Layers to Frame



The Center to Frame command moves all active, visible layers to the center of the Reference Frame. There are two options with this operation:

- Move all the active, visible layers as a unit, which preserves their alignment to each other.
- Or move them all independently so that if individual layers have different centerpoints, they move by different amounts and in different directions.

To Center the Active, Visible Layers to the Reference Frame:

1. Set the active, visible layers to be centered. See *Select from the Active Layers* on page 152.
2. Position the Reference Frame to which the layers will be centered. See *Reference Frame* on page 177.
3. On the **Edit** Menu, click **Layers Move-Center to Frame**.
4. Select whether to move the layers together as a single unit, or to independently center each layer to the Reference Frame.



Shift+C

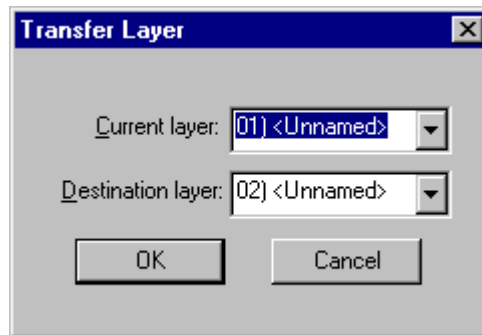
Transfer Layers



The Transfer Layers command takes all the data of the source layer and moves it to the destination layer. The original data is removed from the source layer.

To Transfer a Layer:

1. On the **Edit** menu, click **Layers Move-Transfer**.



Transfer Layers Dialog

2. On the Transfer dialog, select the source layer you want to transfer in the **Current Layer** field.
3. On the Transfer dialog, select the layer you want the data to be transfer to in the **Destination Layer** field.
4. If the Destination layer already has data, then the transferred data will be merged into that layer's existing data.
5. Click **OK**.

Replicate Layers



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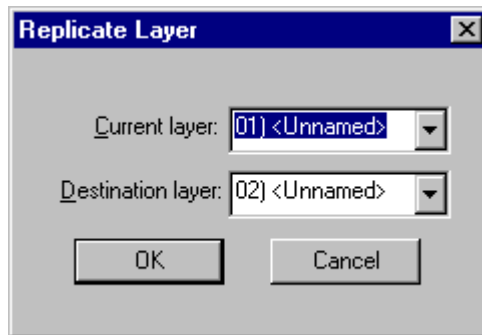


MATE

The Replicate Layers command takes all the data of the source layer and copies it to the destination layer. The original data remains in the source layer.

To Replicate a Layer:

1. On the **Edit** menu, click **Layers Move-Replicate**.



Replicate Layers Dialog

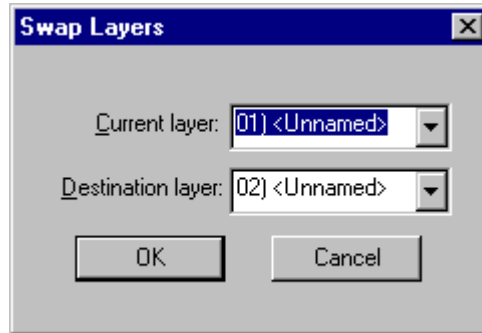
2. On the Replicate dialog, select the source layer you want to replicate in the **Current Layer** field.
3. On the Replicate dialog, select the layer you want the data to be replicated to in the **Destination Layer** field.
4. If the Destination layer already has data, then the replicated data will be merged into that layer's existing data.
5. Click **OK**.

Swap Layers



To Swap Two Layers:

1. On the **Edit** Menu, click **Layers Move-Swap**.



Swap Layers Dialog

2. On the Swap dialog, select the two layers you want to swap.
3. Click **OK**.



Shift+J

Delete Layers



You can delete data from a layer. You have options to delete all the data, or only the pads, or only the traces.

To Delete Data from a Layer:

1. Set the Active, Visible Layer from which you want to delete data. See *Select from the Active Layers* on page 152.
2. On the **Edit** menu, go to **Layers Delete-**
 - To delete all the data from the layer, click **All**.
 - To delete all pads from the layer, click **Pads**.
 - To delete all traces from the layer, click **Traces**.

You can also delete a layer in the Layers Table or delete a layer on the Layers Toolbar.

Special Editing Commands

Some types of editing commands alter existing elements but do not work on selection or on layers.

Break or Clip Traces



The Break Trace command has two modes of operation, one which breaks a single trace into two chained traces, and the other which breaks all traces that cross a region and is usually used for clipping data from a region. This command is different than most other editing commands in that it does not use selection.

To Break a Single Trace:

1. Set the Active Layers, and the Visible Layers. See *Select from the Active Layers* on page 152.
2. On the **Edit** Menu, click **Break Traces**.



Break Trace Tool

3. Position the crosshair at the point on the trace where you want the break.
4. **Click** the mouse or press **Enter**.

The cursor snaps to the trace at the point closest to the cursor. The trace is broken at the cursor location and half of the broken trace is selected.

5. To delete the selected portion of the trace use the Delete Selected Data command



Ctrl+B = Select the Break Traces tool
Enter = Break a Single trace
Esc = Release the Break Traces tool

To Clip Data from a Region:

1. Set the Active Layers, and the Visible Layers. See *Select from the Active Layers* on page 152.
2. On the **Edit** Menu, click **Break Traces**.



Clip Traces Tool

3. Position the crosshair at one corner of the area that you want to clip.

4. **Drag** the mouse across the group of elements you want to clip. Or for accuracy, press **Tab** at one corner of the area you want to clip and press **Tab** again at the other corner.

All traces that cross the drag frame are broken and the data inside the drag area, including the pads, is selected.

5. To delete the selected data use the Delete Selected Data command



Ctrl+B = Select the Break Traces tool

Tab = Start a clip area and tab again to finish the clip area

Esc = Release the Break Traces tool

Break Traces and Replace with Pad



The Break Trace and Replace with Pad command is like a combination of the Break Traces command and the Insert Frame-Sized Pad command. The command clips traces that cross a drag frame, deletes all data inside the drag frame, and inserts one large pad at the size of the drag frame. The main use of the command is to replace drawn fill areas with one pad to reduce file sizes and speed plotting.



Not all photoplotters will accept a pad of arbitrarily large size. The Lavenir Pulsar series of photoplotters can plot any size of rectangular pad.

To Break Traces and Replace with a Pad:

1. Set the Active Layers, and the Visible Layers. See *Select from the Active Layers* on page 152.
2. On the **Edit** Menu, click **Break Traces and Replace**.
3. On the D Code for Pad dialog, enter the **unused D Code** that you want to use to generate the replacement pad.



Break Traces and Replace Tool

4. Position the crosshair at one corner of the area that you want to clip and replace.
5. **Drag** the mouse across the group of elements you want to clip and replace. Or for accuracy, press **Tab** at one corner of the area you want to clip and press **Tab** again at the other corner.

All traces that cross the drag frame are broken and the data inside the drag area, including the pads, is selected.



When the Break Traces and Replace tool is selected:

Tab = Start a clip area and tab again to finish the clip area

Esc = Release the Break Traces and Replace tool

Stretch Traces



The Stretch Trace command has two modes of operation, one which selects the endpoint of a single trace and moves it to a new endpoint, and the other which selects all trace endpoints and pads that lie inside a region and move them as a group to a new location. The second is generally used to move a group of elements that make up a component while maintaining the same trace connectivity to the rest of the board. In both cases, the non-selected endpoints of the traces remain at their old locations and the traces are stretched to the new endpoint locations. This command is different than most other editing commands in that it does not use selection.

To Stretch a Single Trace:

1. Set the Active Layers, and the Visible Layers. See *Select from the Active Layers* on page 152.
2. On the **Edit** Menu, click **Stretch Trace**.



Stretch Traces Tool

3. Position the crosshair at the endpoint of the trace you want to stretch.
4. **Click** the mouse or press **Enter**.

The cursor snaps to the trace at the endpoint closest to the cursor. The system displays a “rubber band” stretching from the non-selected endpoint to the cursor.

5. Position the crosshair at the new location where you want the trace endpoint to be.
6. **Click** the mouse or press **Enter**.

The selected endpoint moves to the new location, while the non-selected endpoint remains at its old location.

The Stretch Traces tool remains selected, so you can stretch one trace after another.

7. To stop stretching traces, click a different editing tool or press **Esc**.



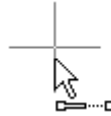
Ctrl+Shift+M = Select the Stretch Traces command

Enter = Stretch a Single trace

Esc = Release the Stretch Traces tool

To Stretch a Group of Traces:

1. Set the Active Layers, and the Visible Layers. See *Select from the Active Layers* on page 152.
2. On the **Edit** Menu, click **Stretch Trace**.



Stretch Traces Tool

3. Position the crosshair at one corner of the area of data that you want to move.
4. **Drag** the mouse across the group of elements you want to move. Or for accuracy, press **Tab** at one corner of the area you want to move and press **Tab** again at the other corner.
All traces that cross the drag frame are selected as well as all pads and traces inside the drag area. The system prompts for the start point of the move.
5. Position the cursor at a reference point.
6. **Click** the mouse or press **Enter**.
7. Position the cursor where you want the reference point and selected elements to move to.
8. **Click** the mouse or press **Enter**.
All selected trace endpoints and pad centerpoints move as a group so that the reference position moves to the cursor location. While the non-selected endpoints remains at their old locations. The Stretch Traces tool remains selected, so you can stretch more traces.
9. To stop stretching traces, click a different editing tool or press **Esc**.



Ctrl+Shift+M = Select the Stretch Traces command
Tab = Start a selection area and Tab again to finish the selection area
Enter = First reference point and Enter again for the second reference point
Esc = Release the Stretch Traces tool

Undo an Editing Action



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The Undo command can undo previous editing actions. The number of previous editing actions that can be undone and the size of the editing actions in terms of memory involved is limited by the amount of memory allocated for the undo feature. To save work in progress and undo edits regardless of memory allocation, see *Milestone Files* on page 81 and *Revert to a Saved Job File* on page 26.

To Undo a Previous Edit:

- On the **Edit** menu, click **Undo**. And to undo the next previous edit, click **Edit-Undo** again.



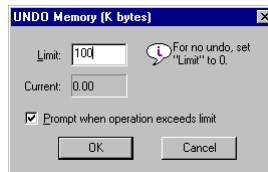
Ctrl+Z



If the edit can not be undone, it may mean there was not enough memory allocated for the undo feature. The system will be able to undo all previous edits that do not exceed the amount of memory allocated. For instance, the system may be able to undo hundreds of single-element edits, or it may be able to undo only a single multiple-element edit, or it may not be able to undo any edits at all if the edits are larger than the amount of memory allocated.

To Set the Amount of Memory Allocated for the Undo Feature :

1. On the **Setup** menu, click **Max Undo Memory**.



Undo Memory Dialog

2. On the **Undo Memory** dialog, enter the number of **Kbytes** of memory you want devoted to the Undo function in the Limits field.

The Current field is the amount of the memory that is already in use to store edits for Undo.

3. If you want the program to prompt you when an editing function will exceed the allocated undo memory, click **Prompt When Operation Exceeds Limit** so that the option has a checkmark. If there is no checkmark, the system will not prompt.



If you select this option, and the system later prompts you that an edit has exceeded the Undo Memory Limit, you can allocate more memory by entering a new Limit value in the warning dialog and then continue the operation, by clicking OK. Clicking Cancel does not cancel the edit, it cancels changes in the Limit value.

4. Click **OK**.

Reference Frame

Some features of the program make use of the Reference Frame. The Reference Frame appears in the Viewing Area as a rectangle outlined in white. In Lavenir DOS software, the Reference Frame was called the “Window” and was used to select elements for editing and as a reference location for operations like centering data. In Lavenir software for Windows there is a different method for selecting elements, and the Reference Frame is used mostly as a reference location.

Draw a New Reference Frame



To Draw a New Reference Frame:

1. On the **Setup** Menu, click **Frame-Draw New Frame**.



Draw New Reference Frame Tool

2. Position the cursor where you want the **first corner** of the Reference Frame.
3. **Click** the mouse or press **Enter**.
4. Position the cursor where you want the **opposite corner** of the Reference Frame.
5. **Click** the mouse or press **Enter**.

The frame-drawing tool remains selected so you can redraw the Reference Frame it you want to.

6. To deselect the frame-drawing tool, select a new tool or press **Esc**.



Shift+W = Frame-Drawing Tool

Enter = Set first corner and Enter again to set second corner



= Frame-Drawing Tool



For precision, you can run the operation from the keyboard and use the Go To Coordinate command, or you can use the Set Exact Reference Frame Corners command.

Set Exact Reference Frame Corners



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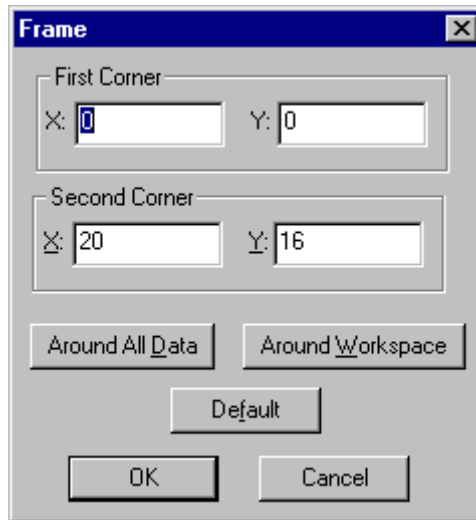
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To Set Exact Reference Frame Corners:

1. On the **Setup** menu, click **Frame-Corners**.



Set Reference Frame Corners Dialog

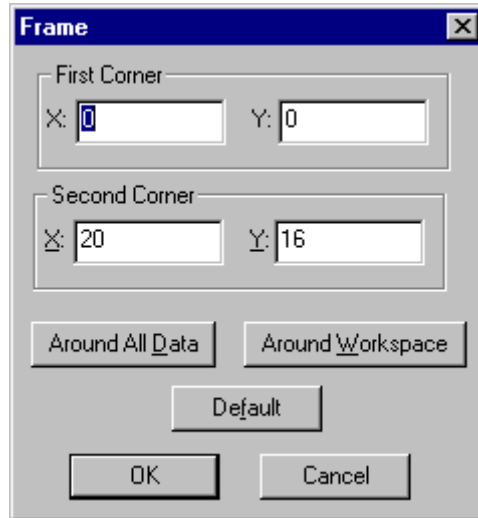
2. Enter the coordinates for the **lower left corner** and the **upper right corner** of the Reference Frame.
3. Click **OK**.

Automatically Insert a Reference Frame Around Workspace



To Insert a Reference Frame around Workspace:

1. On the **Setup** menu, click **Frame-Corners**.



Set Reference Frame Corners Dialog

2. Click **Around Workspace**.
3. Click **OK**.

For more information about the Workspace, see Set the Workspace Dimensions.

Automatically Insert a Reference Frame Around All Data



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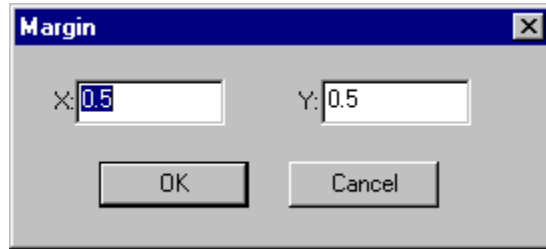
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To Insert a Reference Frame around All Data:

1. On the **Setup** menu, click **Frame-Surround All Data**.



Reference Frame Margin Dialog

2. If you want a margin around the data, enter the distance you want between the Reference Frame and the data on the Margin dialog. If you don't want a margin, enter zero for margins.
3. Click **OK**.



Ctrl+W



Move a Reference Frame



You can move a Reference Frame to a new location while still maintaining its size by grabbing and moving its lower left corner.

To Move a Reference Frame:

1. Separate the crosshair and the mouse cursor. See *Separate the Crosshair and Mouse Cursor* on page 112.
2. On the **Setup** Menu, click **Frame-Grab LL Corner**.
The lower left corner of the Reference Frame hops to the crosshair.
3. Position the crosshair where you want the **lower left corner** of the Reference Frame.
4. On the **Setup** Menu, click **Frame-Grab LL Corner** a second time.
The lower left corner of the Reference Frame is released from the crosshair.

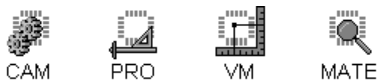


W = Grab lower left corner of Reference Frame, and press W again to release corner.



It may be preferable to run this command using its keyboard equivalent rather than the menu command. The key command does not require you to separate the cursor.

Resize a Reference Frame



You can resize a Reference Frame while still maintaining its lower left corner position by grabbing and moving its upper right corner.

To Resize a Reference Frame:

1. Separate the crosshair and the mouse cursor. See *Separate the Crosshair and Mouse Cursor* on page 112.
2. On the **Setup** Menu, click **Frame-Grab UR Corner**.
The upper right corner of the Reference Frame hops to the crosshair, while the lower left corner remains anchored.
3. Position the crosshair where you want the **upper right corner** of the Reference Frame.
4. On the **Setup** Menu, click **Frame-Grab UR Corner** a second time.
The upper right corner of the Reference Frame is released from the crosshair.



Ctrl+Shift+W = Grab upper right corner of Reference frame, and press Ctrl+Shift+W again to release corner.



It may be preferable to run this command using its keyboard equivalent rather than the menu command. The key command does not require you to separate the cursor.

Chapter 5

Use Automatic Editing Tools

The program has many automatic editing tools to perform complex operations. These features include some fairly basic operations such as converting arcs to quadrants or chords, and sorting the database by proximity. In addition the program includes some very complex labor-saving operations such as polygon filling, adding venting patterns, converting drawn pads to flashed, calculating copper area, deleting non-functional pads, snapping data to the padmaster layer, clipping silkscreen traces for padmaster clearance, generating soldermask data from a padmaster layer, generating outline data, generating pad filleting, generating centroid data, comparing layers, correcting trace/pad overlap problems, generating polygons from circuit element contours, and consolidating soldermask data into flashed pads.

Approximate Arcs with Chords



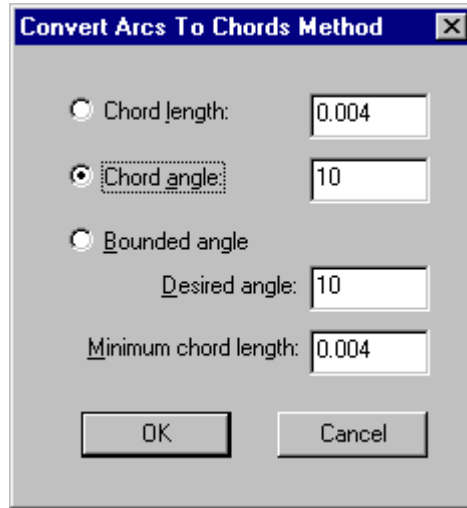
The program can approximate the curve of an arc by replacing it with chord segments. An arc converted to chords cannot be converted back.



This is one operation that does not use the normal selection system. The program converts arcs that are entirely surrounded by the reference frame regardless of their selection status.

To Approximate Arcs with Chords:

1. Position the reference frame around the arcs you want to convert to chords and set the Inside/Outside frame selection switch. See *Reference Frame* on page 177.
2. On the **Tools** menu, click **Convert Arcs-Approximate by Chords**.



Convert Arcs to Chords Dialog

3. On the Convert Arcs to Chords dialog, select the conversion method:

Chord Length: Converts the arc into a series of chords of the specified length.

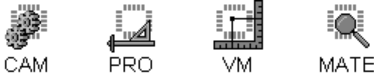
Angle: Converts the arc into a series of chords that intersect at the specified angle.

Bounded Angle: Converts the arc into a series of chords that intersect at the specified angle, unless that generates chords smaller than the specified length. In that case, it converts the arc into a series of chords of the specified length.

4. Click **OK**.

The program converts the arcs into chords, selects the chords, and reports the operation in the message line

Break 360-Degree Arcs into Quadrants



The program can convert 360-degree arcs to quadrant arcs. A 360-degree arc converted to a quadrant arc cannot be converted back.



This is one operation that does not use the normal selection system. The program converts arcs that are entirely surrounded by the reference frame regardless of their selection status.

To Convert 360-Degree Arcs to Quadrant Arcs:

1. Position the reference frame around the arcs you want to convert to quadrants and set the Inside/Outside frame selection switch. See *Reference Frame* on page 177.
2. On the **Tools** menu, click **Convert Arcs-Break Into Quadrants**.

The program converts the arcs into quadrants, selects the converted arcs, and reports the operation in the message line

Sort by Proximity



The program can sort pads and traces by calculating the distance to neighboring elements and placing the closest element next in the database. There are two algorithms for the sort:

- **Distance:** This algorithm uses the **straight-line distance** between two points.
- **Max (x, y):** The Max (x, y) algorithm calculates the distance as the **longest of the X and Y displacements** between the two points.

While the Distance option gives the real distance between two points, the Max (x, y) option can minimize travel time on devices, such as some NC drilling machines, that can move both axes at maximum speed independently.

To Sort the Database:

- On the Tools menu, click
Sort by Proximity-Using Distance or
Sort by Proximity-Using Max (x, y).



Sorting data reduces plot file size, reduces processing time, and organizes data for output. Any size file can benefit from sorting, but it is especially important for outline files, fab drawings, and drill files destined for routing or drilling later.

Polygon Filling



The program can fill polygon areas, around and between pads and traces, with hatched, crosshatched, and solid fills.

You have an option to just outline the polygons and the circuit elements without filling, and another option to fill inside the circuit elements.

Among many other uses, polygon filling operations can be used to:

- Shield traces from unwanted interference due to impedance or noise from surrounding circuits.
- Generate thief patterns around component and solder sides of the board for equalization of copper.
- Fill line drawings such as custom apertures, extra large apertures not available on some photoplotters, or outlines of liquid crystal displays.

These operations are similar to the venting operations, so if you do not see the type of fill pattern you want described in this section, see *Venting Patterns* on page 204.

Nested Polygons for Fill Operations

Polygons form the boundaries inside which the operation adds the fill patterns. A set of polygons drawn with F-type D Codes having the same ID that are completely nested, one inside the other, form a group. Nested groups tell the program where to fill and where to keep out.

To define polygon boundaries for filling, you can use polygons drawn with traces mapped to an F-type D Code, or you can use the reference frame, and often you will use a combination of both.

Use the Reference Frame as a Boundary

In addition to telling the system where to find the polygons to fill, the reference frame itself can be used as a polygon. With the Use Reference Frame as Additional Polygon option on the Polygon Selection tab, the system sees the reference frame as it does an F-type polygon. You can use the reference frame in combination with other drawn polygons to form a nested group with fill and keep out areas.

To Set Up the Reference Frame as a Fill Boundary:

1. Set the Inside/Outside Reference Frame selection mode.

The Inside/Outside Reference Frame selection mode tells the system whether to consider polygons on the inside or outside in a filling operation.

2. Position the Reference Frame. See *Reference Frame* on page 177.

The Reference Frame may be used solely to direct the filling to the right polygons (inside or outside as appropriate). Or it may also be used as the first or last polygon in a nested group, as indicated by the Use Reference Frame as Additional Polygon option on the Polygon Selection tab of the Fill Polygons dialog.

Draw Fill Boundary Polygons with Traces

In addition to using the reference frame you can also draw the polygonal areas yourself using traces of F-Type D Codes.

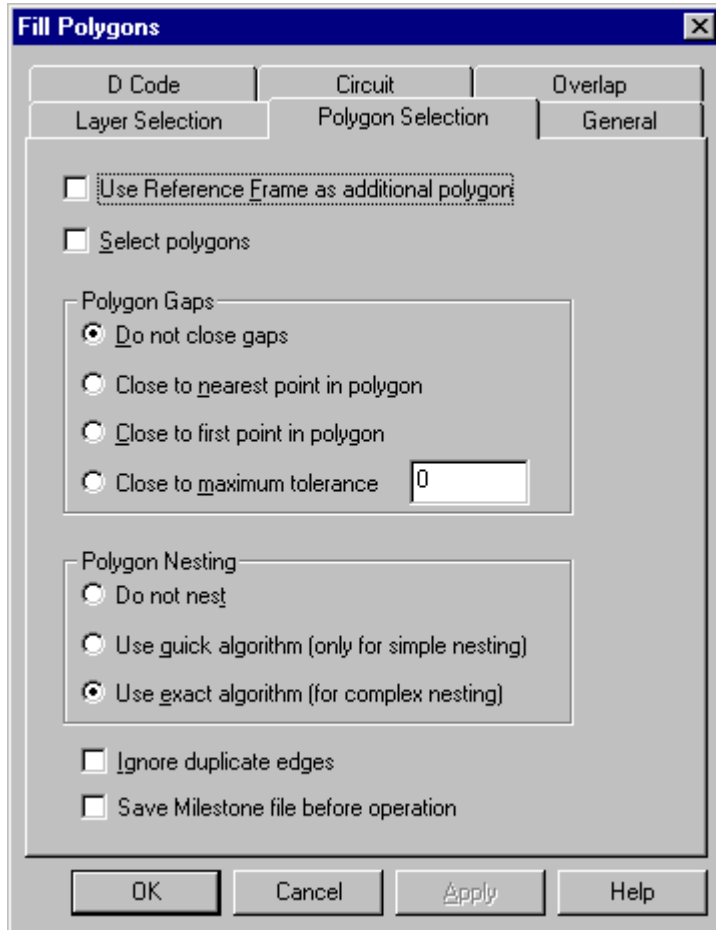
To Draw Fill Boundary Polygons with Traces:

1. Set the active, visible layers you want to put the polygon on. See *Select from the Active Layers* on page 152.
 - To fill around pads and traces, put the polygon on the same layer as the pads and traces.
 - To use the same boundary on more than one layer, make only those layers visible, and draw the outline with all layers active.
2. On the D Code Table define an F-type D Code for drawing polygons. If you plan to draw different groups of nested polygons, set up more than one F-type D Code, each with a unique ID.
3. Use one of the trace insertion commands to draw a polygon area with the F-type D Code you defined.
 - Rectangles and circles automatically form closed polygons. Other trace types must be chained together to avoid open sides.
 - Traces, Orthogonal Traces and 90-Degree Traces chain successive traces. To close the last side of the polygon, move the cursor close to the first point of the first trace and snap to it using the *Align* command. Then insert the final trace.
 - Arcs can be chained similarly. Align to points on previous traces for both the first and last points of the new arc.
 - Elbow trace insertion can be used to change the shape of a closed polygon without creating open sides.
4. Continue creating polygons as desired.
 - To add nested polygons, draw another polygon on the same layer entirely inside or entirely surrounding the previous polygon, using the same boundary D Code or another F-type D Code with the same ID.
 - To add a non-nested polygon entirely inside or surrounding an existing polygon, use an F-type D Code with a different ID.
 - To use an existing polygon from a Gerber file, make sure it is drawn correctly, and then change the boundary traces to an F-type D Code.

Standard Polygon Fill Options

There are a few options that have to be set for most fill patterns regardless of what specific type of polygon fill you are adding. The following sections describe these standard options. To do a specific type of fill, skip down and read the procedure for that type of fill. The specific procedure will refer you to these sections to set some of the options.

Set the Polygon Options for the Operation



Fill Polygons Polygon Selection Tab

On the Polygon Selection tab, set the options identifying the polygons for the operation.

Use Reference Frame as Additional Polygon: The Reference Frame may be used solely to direct the operation to the correct polygons (inside or outside as indicated by the Inside/Outside switch). Or it may also be used as the first or last polygon in a nested group. To use the Reference Frame

as a polygon, click this option so that it has a check mark. To use the Reference Frame only to identify where the drawn polygons are located, click this option so that there is no check mark.

Select Polygons: To have the system select the polygons during the operation so that they show up selected and highlighted after the operation, click this option so that it has a check mark. Otherwise do not check this option.

Polygon Gaps: Ideally polygons should be drawn so that there are no gaps between traces in the loop. In the case that the polygons are not drawn closed, there are several options for whether and how to close gaps in polygons.

- **Do not Close Gaps:** Select this option if you do not want to close polygons that have gaps. All other options provide a method to close the polygon gaps.
- **Close to First Point in Polygon:** This option connects the first trace in a polygon to the last trace.
- **Close to Nearest Point in Polygon:** This option connects the first trace in a polygon to the nearest point in the polygon.
- **Close to Maximum Tolerance:** This option connects the first trace in a polygon to the nearest point in the polygon that is within a tolerance distance. Set the maximum gap that the system may close.

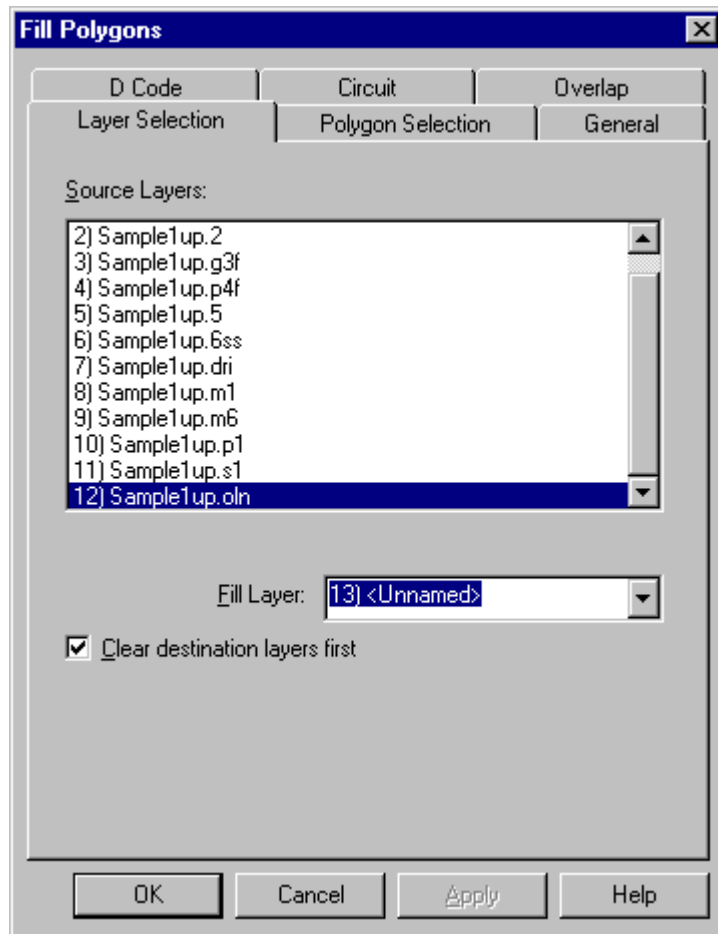
Polygon Nesting: There are several options for whether and how to determine if polygons form nested polygon groups.

- **Do Not Nest:** This option does not check to see if polygons are nested. It treats all polygons the same.
- **Use Quick Algorithm:** This option uses a quick algorithm to see if polygons are nested. It is faster than the exact algorithm, but it is not appropriate for complex nested polygons, especially polygons that have concave contours. This algorithm may incorrectly see a polygon inside another polygon's concave contour as being *inside* the other polygon.
- **Use Exact Algorithm:** This option uses an exact algorithm to see if polygons are nested and always correctly determines the nesting order of polygon groups. It is not as fast as the exact algorithm, but it is always correct.

Ignore Duplicate Edges: This option eliminates repetitive draws of polygon borders prior to the operation.

Save Milestone Before Operation: This option saves a Milestone file before running the operation, so in case the results are not what you want, you can easily revert to the Milestone file. To have the system save a Milestone file before running the operation, click this option so that it has a check mark. Otherwise do not check this option.

Select the Layers for the Fill Operation



Fill Polygons Layer Selection Tab

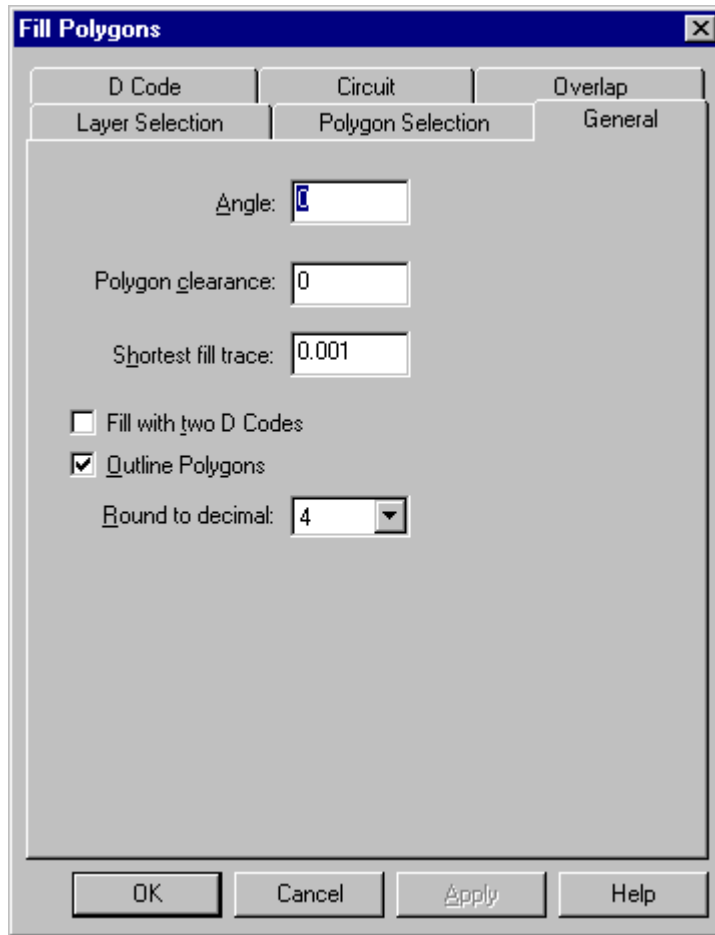
On the Layer Selection tab, select the layers for the fill operation.

Source Layers: Select the layers where the fill polygons are located.

Fill Layer: Select the first layer where you want the fill to be generated. By selecting **Same**, you can fill multiple layers with the fill traces being added to the same layer where the corresponding polygons are located.

Clear Destination Layers First: This option clears all data out of the fill layers before generating the fill. To have the system clear the fill layers before running the operation, click this option so that it has a check mark. Otherwise do not check this option. Do not use this option if there is any data on the fill layers that you want to keep, and especially if you are having the fill generated directly on the source layers.

Set the General Fill Options



Fill Polygons General Tab

On the General Tab, define the parameters for the fill.

Angle: Enter the angle for the fill traces. For a solid fill this is the angle of all the traces, and for a hatched or crosshatched fill this is the angle of the hatch traces. Set the angle to zero or 90 when filling around pads and traces in order to have an accurate element clearance.

Polygon Clearance: Enter the distance between fill and the polygons.

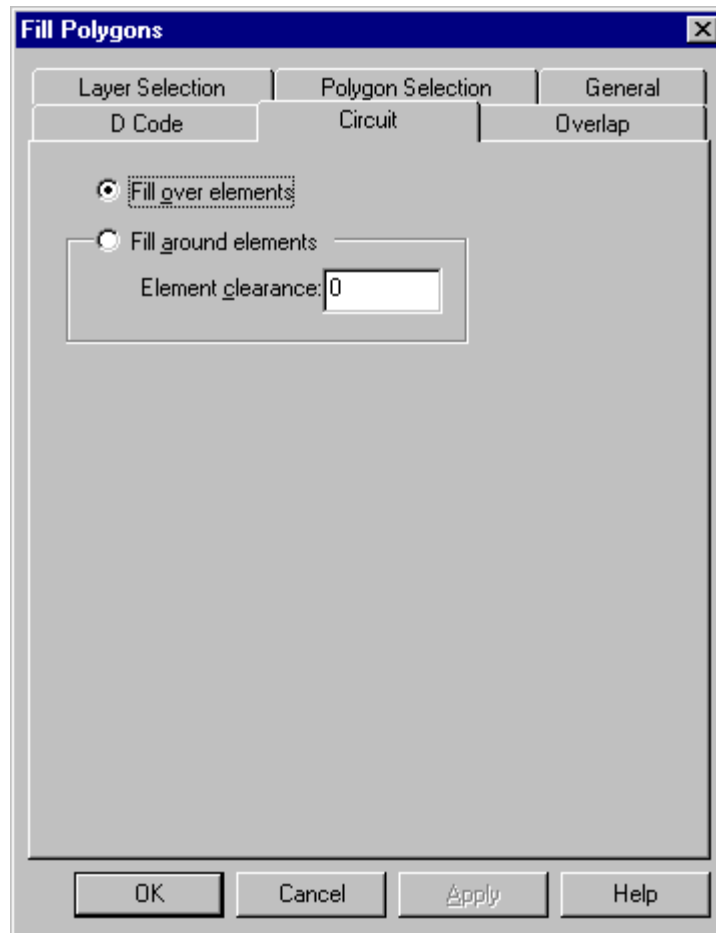
Fill with Two D Codes: This option allows you to fill with two D Codes, one larger than the other. The narrower one is used when the wider one would leave gaps or rounded corners. If you use this option, the two D Codes must be sequential in number. Enter the first of the two as the D Code on the D Code tab. Either of these can be the narrower one. You must still make sure that the wider one fits through any neckdowns that may exist in the polygons.

Shortest Fill Trace: Enter the length of the shortest trace that the system may generate as fill. Traces that would be shorter than this length are not generated.

Outline Polygons: This option outlines the fill to create a smooth fill shape.

Round to Decimal: Enter the accuracy of the fill. The system can calculate the exact positioning of the fill based on the position of the polygons, the width of the traces, and the overlap. Set the decimal you want this positioning to be rounded to.

Fill Around Pads and Traces



Fill Polygons Circuit Tab

On the Circuit Tab, set the options for filling around and between pads and traces.

Fill Over Elements: This option ignores the pads and traces present within the polygons. It fills the polygons so that the fill would cover the circuit elements.

Fill Around Elements: This option fills around and between the pads and traces within the polygons. If you select this option, enter an Element Clearance.

Element Clearance: Enter the distance between fill and the circuit elements.

Generate a Solid Fill



CAM



PRO



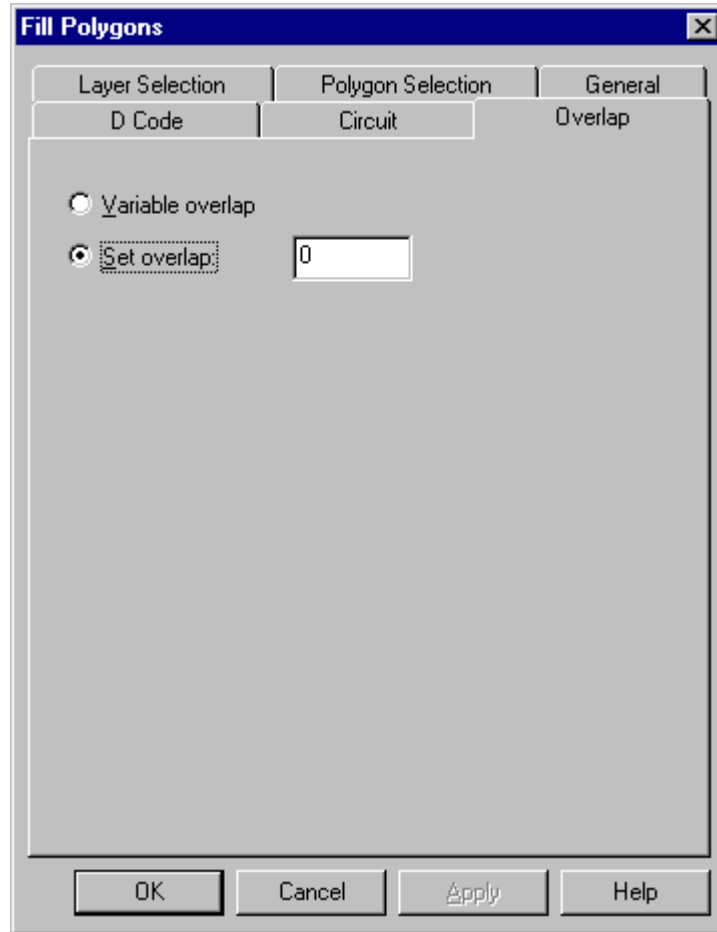
VM



MATE

To Generate a Solid Fill:

1. Define the Polygon Areas for Filling. See *Nested Polygons* on page 186.
2. On the **Tools** menu, click **Fill Polygons-Solid Fill**.
3. On the **Polygon Selection** tab, set the options identifying the polygons for the fill operation. See *Set the Polygon Options for the Operation* on page 188.
4. On the **Layer Selection** tab, select the layers for the fill operation. See *Select the Layers for the Fill Operation* on page 190.
5. On the **General** tab, define the general parameters for the fill. See *Set the General Fill Options* on page 191.
6. On the **Circuit** tab, set the options for filling around pads and traces. See *Fill Around Pads and Traces* on page 193.
7. On the **D Code** tab, select the fill D Code:
 - **D Code:** Select a C-type D Code for the fill trace, or if you are filling with two D Codes, select the first of two consecutive C-type D Codes. These D Codes do not have to be unused; however, when you use them as fill traces, the system forces them to type C, Circle.
 - **Size:** If you want to set the size of the fill D Code, enter it here; otherwise the system will use the existing size for the selected D Code.
8. On the **Overlap** Tab, set the solid fill overlap:



Fill Polygons Overlap Tab

- **Variable Overlap:** This option allows the system to use a variable overlap in order to squeeze traces into narrow neckdown areas.
 - **Set Overlap:** This option allows you to set the overlap to a specific value. Enter an overlap large enough to eliminate banding due to plotter resolution and database rounding. Typically .5 to 1 mil is enough.
9. On the main Fill Polygons dialog, click **OK**.

Generate a Hatched Fill



CAM



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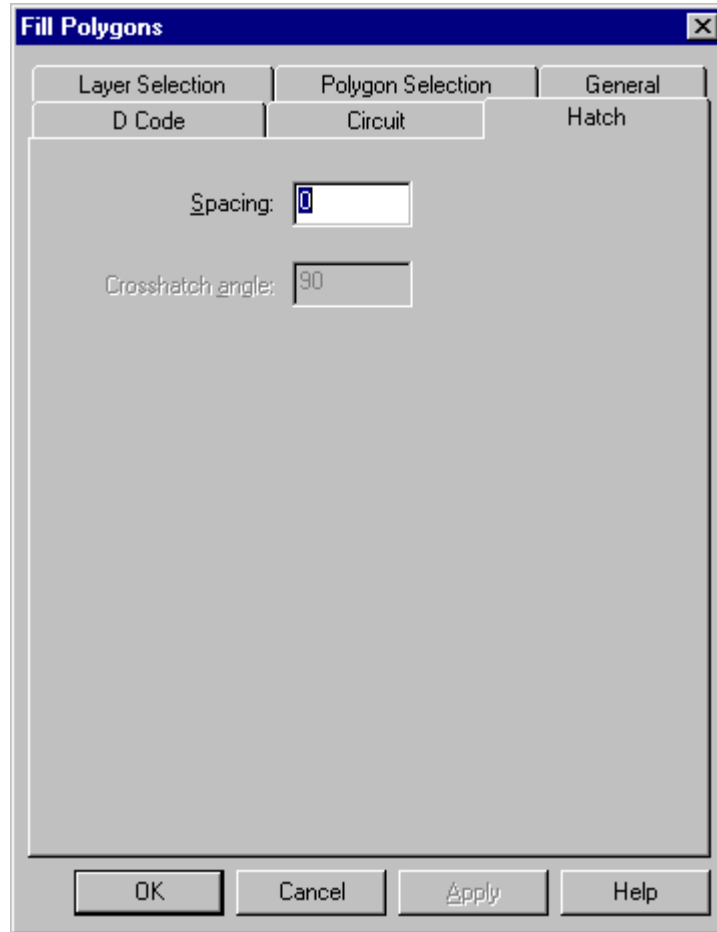
VM



MATE

To Generate a Hatched Fill:

1. Define the Polygon Areas for Filling. See *Nested Polygons* on page 186.
2. On the **Tools** menu, click **Fill Polygons-Hatched Fill**.
3. On the **Polygon Selection** tab, set the options identifying the polygons for the fill operation. See *Set the Polygon Options for the Operation* on page 188.
4. On the **Layer Selection** tab, select the layers for the fill operation. See *Select the Layers for the Fill Operation* on page 190.
5. On the **General** tab, define the general parameters for the fill. See *Set the General Fill Options* on page 191.
6. On the **Circuit** tab, set the options for filling around pads and traces. See *Fill Around Pads and Traces* on page 193.
7. On the D Code Tab, select the fill D Code:
 - **D Code:** Select a C-type D Code for the fill trace, or if you are filling with two D Codes, select the first of two consecutive C-type D Codes. These D Codes do not have to be unused; however, when you use them as fill traces, the system forces them to type C, Circle.
 - **Size:** If you want to set the size of the fill D Code, enter it here; otherwise the system will use the existing size for the selected D Code.
8. On the Hatch Tab, set the Hatch Spacing. The **Hatch Spacing** is the distance between hatch traces.



Fill Polygons Hatch Tab

9. On the main Fill Polygons dialog, click **OK**.

Generate a Crosshatched Fill



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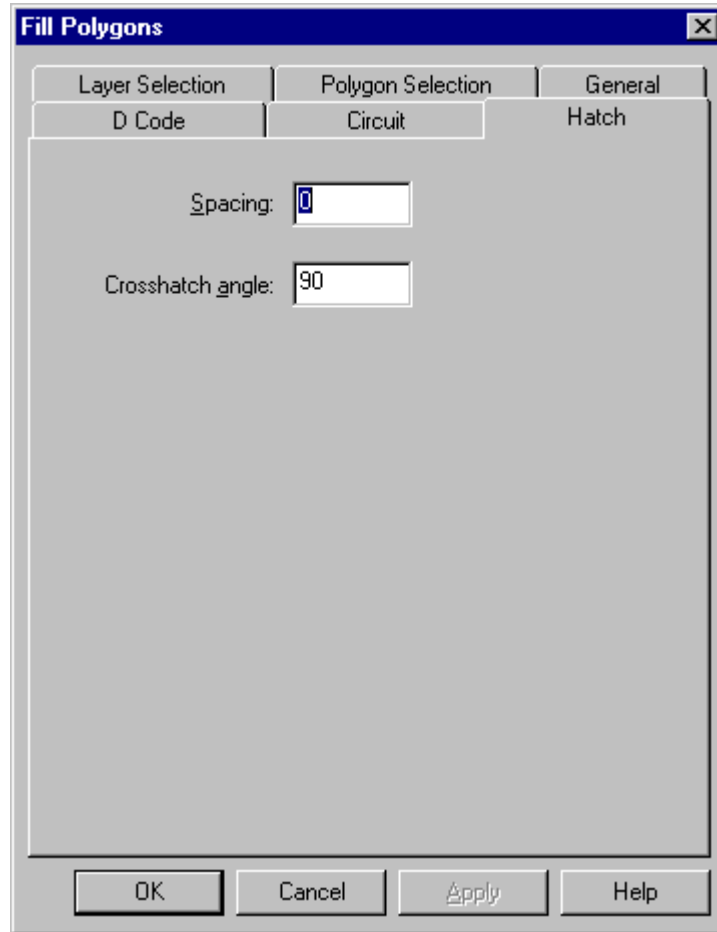
VM



MATE

To Generate a Crosshatched Fill:

1. Define the Polygon Areas for Filling. See *Nested Polygons* on page 186.
2. On the **Tools** menu, click **Fill Polygons-Crosshatched Fill**.
3. On the **Polygon Selection** tab, set the options identifying the polygons for the fill operation. See *Set the Polygon Options for the Operation* on page 188.
4. On the **Layer Selection** tab, select the layers for the fill operation. See *Select the Layers for the Fill Operation* on page 190.
5. On the **General** tab, define the general parameters for the fill. See *Set the General Fill Options* on page 191.
6. On the **Circuit** tab, set the options for filling around pads and traces. See *Fill Around Pads and Traces* on page 193.
7. On the D Code Tab, select the fill D Code:
 - **D Code:** Select a C-type D Code for the fill trace, or if you are filling with two D Codes, select the first of two consecutive C-type D Codes. These D Codes do not have to be unused; however, when you use them as fill traces, the system forces them to type C, Circle.
 - **Size:** If you want to set the size of the fill D Code, enter it here; otherwise the system will use the existing size for the selected D Code.
8. On the Hatch Tab, define the remaining crosshatch parameters:



Fill Polygons Crosshatch Tab

- **Hatch Spacing:** Enter the distance between fill traces.
 - **Crosshatch Angle:** Enter the angle of the crosshatch traces relative to the hatch traces. The angle of the hatch traces is set in the Angle field on the General Tab. In order to have an accurate element clearance when filling around pads and traces, set the Angle field on the General Tab to zero or 90, and set the Crosshatch Angle here to 90.
9. On the main Fill Polygons dialog, click **OK**.

Generate Outlines Only



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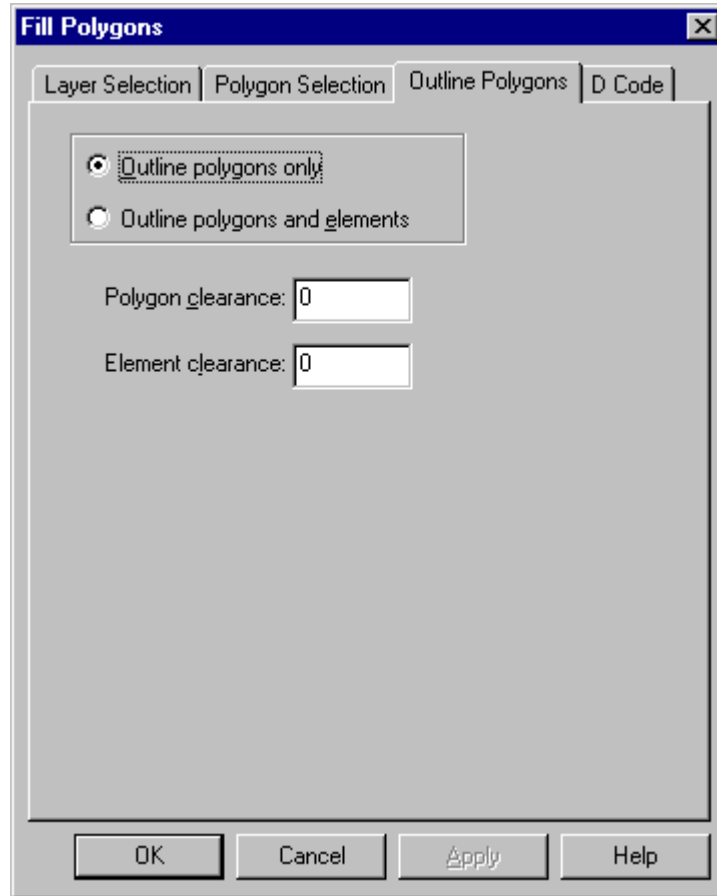
VM



MATE

To Generate Outlines Only:

1. Define the Polygon Areas for Filling. See *Nested Polygons* on page 186.
2. On the **Tools** menu, click **Fill Polygons-Outlines Only**.
3. On the **Polygon Selection** tab, set the options identifying the polygons for the fill operation. See *Set the Polygon Options for the Operation* on page 188.
4. On the **Layer Selection** tab, select the layers for the fill operation. See *Select the Layers for the Fill Operation* on page 190.
5. On the D Code Tab, select the fill D Code:
 - **D Code:** Select a C-type D Code for the fill trace. These D Codes do not have to be unused; however, when you use them as fill traces, the system forces them to type C, Circle.
 - **Size:** If you want to set the size of the fill D Code, enter it here; otherwise the system will use the existing size for the selected D Code.
6. On the Outline Polygons tab, set the outline parameters.



Fill Polygons Outline Polygons Tab

- **Outline Polygons Only:** This option outlines only the polygons and does not outline the pads and traces within the polygons. If you select this option, enter a Polygon Clearance.
 - **Outline Polygons and Elements:** This option outlines both the polygons and the pads and traces within the polygons. If you select this option, enter a Polygon Clearance and an Element Clearance.
 - **Polygon Clearance:** Enter the distance between outlines and the polygons.
 - **Element Clearance:** Enter the distance between outlines and the circuit elements.
7. On the main Fill Polygons dialog, click **OK**.

Fill Inside Elements



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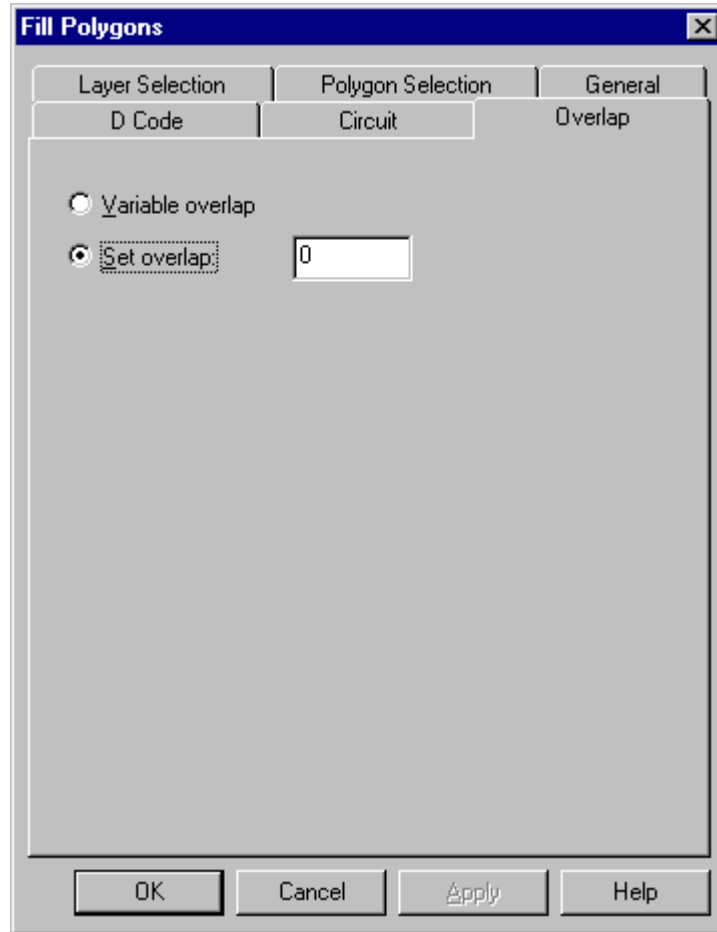
VM



MATE

To Fill Inside Elements:

1. Define the Polygon Areas for Filling. See *Nested Polygons* on page 186.
2. On the **Tools** menu, click **Fill Polygons-Fill Inside Elements**.
3. On the **Polygon Selection** tab, set the options identifying the polygons for the fill operation. See *Set the Polygon Options for the Operation* on page 188.
4. On the **Layer Selection** tab, select the layers for the fill operation. See *Select the Layers for the Fill Operation* on page 190.
5. On the **General** tab, define the general parameters for the fill. See *Set the General Fill Options* on page 191.
6. On the D Code Tab, select the fill D Code:
 - **D Code:** Select a C-type D Code for the fill trace, or if you are filling with two D Codes, select the first of two consecutive C-type D Codes. These D Codes do not have to be unused; however, when you use them as fill traces, the system forces them to type C, Circle.
 - **Size:** If you want to set the size of the fill D Code, enter it here; otherwise the system will use the existing size for the selected D Code.
7. On the Overlap Tab, set the solid fill overlap:



Fill Polygons Overlap Tab

- **Variable Overlap:** This option allows the system to use a variable overlap in order to squeeze traces into narrow neckdown areas.
 - **Set Overlap:** This option allows you to set the overlap to a specific value. Enter an overlap large enough to eliminate banding due to plotter resolution and database rounding. Typically .5 to 1 mil is enough.
8. On the main Fill Polygons dialog, click **OK**.

Venting Patterns



The program can fill polygon areas, around and between pads and traces, with venting and thieving patterns such as pads, positive VPI, negative VPI, starburst, solid, hatch, and crosshatch patterns.

These operations are similar to the Polygon Filling operations, so if you don't see the pattern you want described in this section, then see *Polygon Filling* on page 186.

Nested Polygons for Venting Operations

Polygons form the boundaries inside which the operation adds the venting patterns. A set of polygons drawn with F-type D Codes having the same ID that are completely nested, one inside the other, form a group. Nested groups tell the program where to add venting and where to keep out.

To define polygon boundaries for venting, you can use polygons drawn with traces mapped to an F-type D Code, or you can use the reference frame, and often you will use a combination of both.

Use the Reference Frame as a Boundary

In addition to telling the system where to find the polygons to fill, the reference frame itself can be used as a polygon. With the Use Reference Frame as Additional Polygon option on the Polygon Selection tab, the system sees the reference frame as it does an F-type polygon. You can use the reference frame in combination with other drawn polygons to form a nested group with vent and keep out areas.

To Set Up the Reference Frame as a Venting Boundary:

1. Set the Inside/Outside Reference Frame selection mode.

The Inside/Outside Reference Frame selection mode tells the system whether to consider polygons on the inside or outside in a venting operation.

2. Position the Reference Frame. See *Reference Frame* on page 177.

The Reference Frame may be used solely to direct the venting to the right polygons (inside or outside as appropriate). Or it may also be used as the first or last polygon in a nested group, as indicated by the Use Reference Frame as Additional Polygon option on the Polygon Selection tab of the Venting dialog.

Draw Venting Polygons with Traces

In addition to using the reference frame you can also draw the polygonal areas yourself using traces of F-Type D Codes.

To Draw Venting Polygons with Traces:

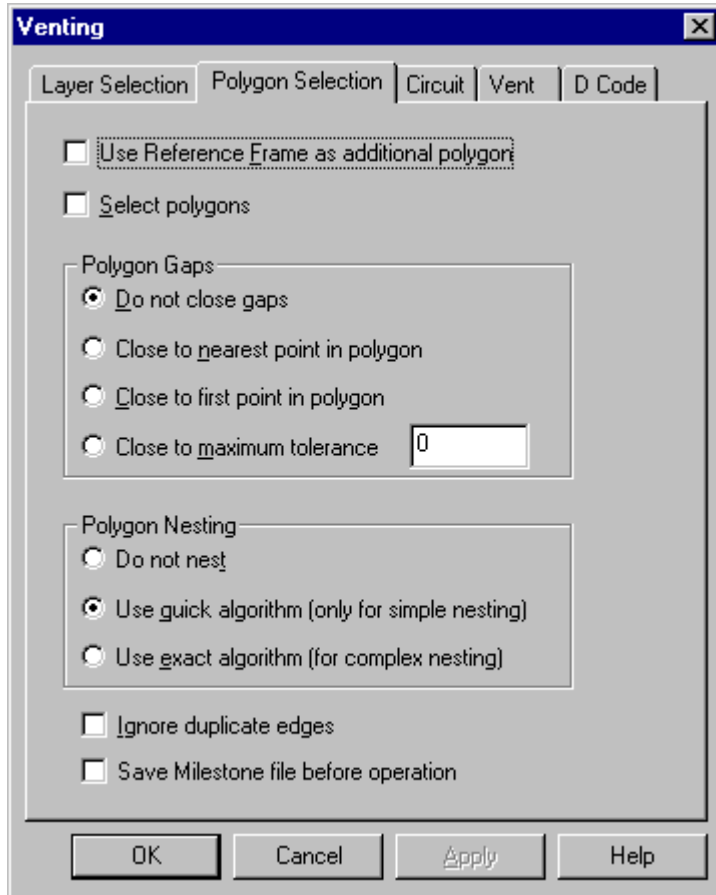
1. Set the active, visible layers you want to put the polygon on. See *Select from the Active Layers* on page 152.
 - To fill around pads and traces, put the polygon on the same layer as the pads and traces.
 - If you want to fill around pads and traces on multiple layers, make all those layers active and draw the polygon on all layers.

- If you are not going to be filling around elements, and you want the same venting pattern on several layers, you can draw the polygons on one layer and then generate the same venting pattern in all the desired vent layers.
2. On the D Code Table define an F-type D Code for drawing polygons. If you plan to draw different groups of nested polygons, set up more than one F-type D Code, each with a unique ID.
 3. Use one of the trace insertion commands to draw a polygon area with the F-type D Code you defined.
 - Rectangles and circles automatically form closed polygons. Other trace types must be chained together to avoid open sides.
 - Traces, Orthogonal Traces and 90-Degree Traces chain successive traces. To close the last side of the polygon, move the cursor close to the first point of the first trace and snap to it using the Align command. Then insert the final trace.
 - Arcs can be chained similarly. Align to points on previous traces for both the first and last points of the new arc.
 - Elbow trace insertion can be used to change the shape of a closed polygon without creating open sides.
 4. Continue creating polygons as desired.
 - To add nested polygons, draw another polygon on the same layer entirely inside or entirely surrounding the previous polygon, using the same boundary D Code or another F-type D Code with the same ID.
 - To add a non-nested polygon entirely inside or surrounding an existing polygon, use an F-type D Code with a different ID.
 - To use an existing polygon from a Gerber file, make sure it is drawn correctly, and then change the boundary traces to an F-type D Code.

Standard Venting Options

There are a few options that have to be set for most venting patterns regardless of what specific type of venting pattern you are adding. The following sections describe these standard options. To do a specific type of venting pattern, skip down and read the procedure for that type of pattern. The specific procedure will refer you to these sections to set some of the options.

Set the Polygon Options for the Operation



Venting Polygon Selection Tab

On the Polygon Selection tab, set the options identifying the polygons for the operation.

Use Reference Frame as Additional Polygon: The Reference Frame may be used solely to direct the operation to the correct polygons (inside or outside as indicated by the Inside/Outside switch). Or it may also be used as the first or last polygon in a nested group. To use the Reference Frame

as a polygon, click this option so that it has a check mark. To use the Reference Frame only to identify where the drawn polygons are located, click this option so that there is no check mark.

Select Polygons: To have the system select the polygons during the operation so that they show up selected and highlighted after the operation, click this option so that it has a check mark. Otherwise do not check this option.

Polygon Gaps: Ideally polygons should be drawn so that there are no gaps between traces in the loop. In the case that the polygons are not drawn closed, there are several options for whether and how to close gaps in polygons.

- **Do not Close Gaps:** Select this option if you do not want to close polygons that have gaps. All other options provide a method to close the polygon gaps.
- **Close to First Point in Polygon:** This option connects the first trace in a polygon to the last trace.
- **Close to Nearest Point in Polygon:** This option connects the first trace in a polygon to the nearest point in the polygon.
- **Close to Maximum Tolerance:** This option connects the first trace in a polygon to the nearest point in the polygon that is within a tolerance distance. Set the maximum gap that the system may close.

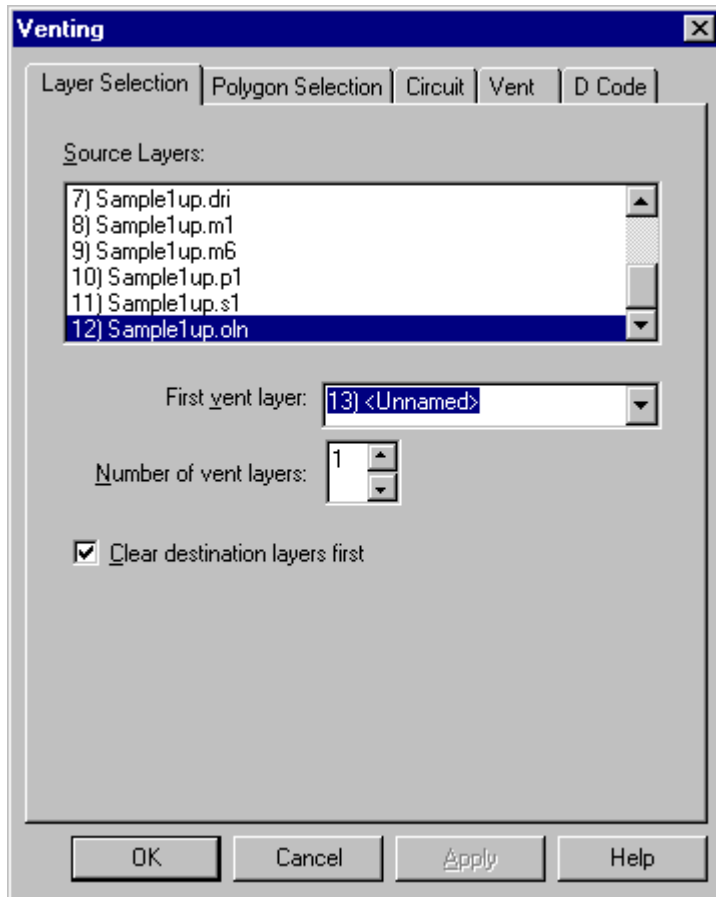
Polygon Nesting: There are several options for whether and how to determine if polygons form nested polygon groups.

- **Do Not Nest:** This option does not check to see if polygons are nested. It treats all polygons the same.
- **Use Quick Algorithm:** This option uses a quick algorithm to see if polygons are nested. It is faster than the exact algorithm, but it is not appropriate for complex nested polygons, especially polygons that have concave contours. This algorithm may incorrectly see a polygon inside another polygon's concave contour as being *inside* the other polygon.
- **Use Exact Algorithm:** This option uses an exact algorithm to see if polygons are nested and always correctly determines the nesting order of polygon groups. It is not as fast as the exact algorithm, but it is always correct.

Ignore Duplicate Edges: This option eliminates repetitive draws of polygon borders prior to the operation.

Save Milestone Before Operation: This option saves a Milestone file before running the operation, so in case the results are not what you want, you can easily revert to the Milestone file. To have the system save a Milestone file before running the operation, click this option so that it has a check mark. Otherwise do not check this option.

Select the Layers for the Venting Operation



Venting Layer Selection Tab

On the Layer Selection tab, select the layers for the venting operation.

Source Layers: Select the layers where the polygons are located.

First Vent Layer: Select the first layer where you want the venting to be generated. Venting can be added to a range of layers by entering the first layer here and then entering the number of layers to vent below.

Number of Vent Layers: Enter how many layers you want to add venting to. Venting can be added to a range of layers by entering the first layer above and then entering the number of layers to vent here.

Clear Destination Layers First: This option clears all data out of the venting layers before generating the fill. To have the system clear the venting layers before running the operation, click this option so that it has a check mark. Otherwise do not check this option. Do not use this option

if there is any data on the venting layers that you want to keep, and especially if you are having the venting generated directly on the source layers.

There are a few ways to set the layer options up.

To Add Venting to a Range of Layers Using Polygons on a Single Layer:

If you are not going to be filling around elements, and you want the same venting pattern on several layers, you can draw the polygons on one layer and then generate the same venting pattern in a consecutive range of desired vent layers.

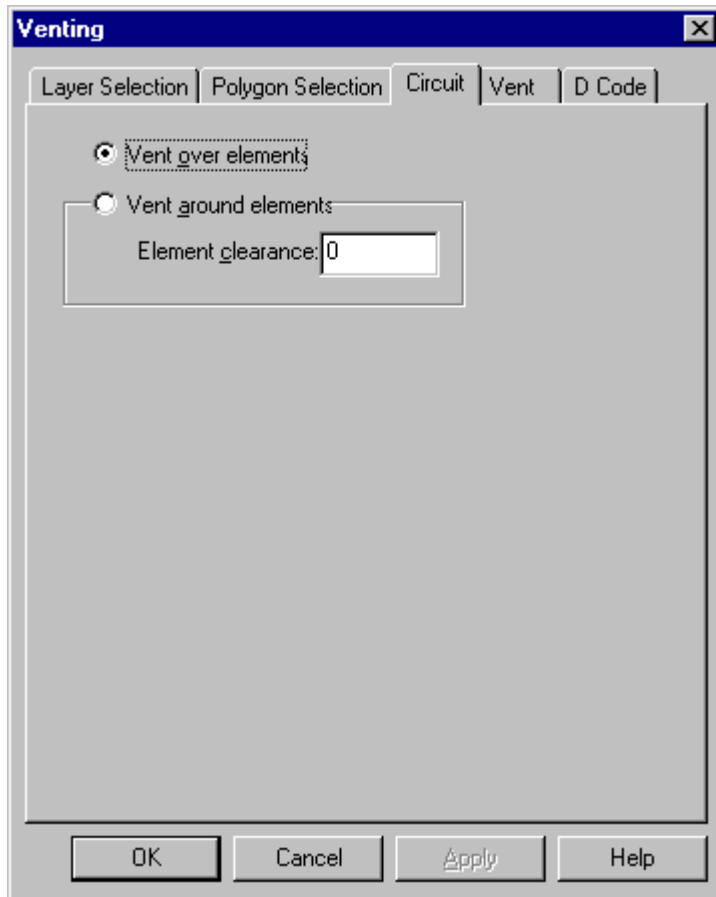
1. In the Source Layers field, select the single layer where the polygons are located.
2. In the First Vent Layer field, select the first layer of the range of layers where you want the venting to be generated.
3. In the Number of Vent Layers field, enter how many consecutive layers to which you want to add the same venting pattern.

To Add Venting to Multiple Layers Using Polygons on Multiple Layers:

If you are filling around elements, or you want to use a different polygon shape on several layers, you need to have polygons on every layer and select them all as Source Layers.

1. In the Source Layers field, select the all the layers where the polygons are located.
2. In the First Vent Layer field, select the first layer where you want the venting to be generated. This does not need to be a source layer or a layer with data, in fact you may want an unused layer to more easily check the results.
3. In the Number of Vent Layers field, enter enough layers to accommodate the venting patterns being generated.

Venting Around Pads and Traces



Venting Circuits Tab

On the Circuit Tab, set the options for adding venting around and between pads and traces.

Vent Over Elements: This option ignores the pads and traces present within the polygons. It adds venting so that the pattern would cover the circuit elements.

Vent Around Elements: This adds venting around and between the pads and traces within the polygons. If you select this option, enter an Element Clearance.

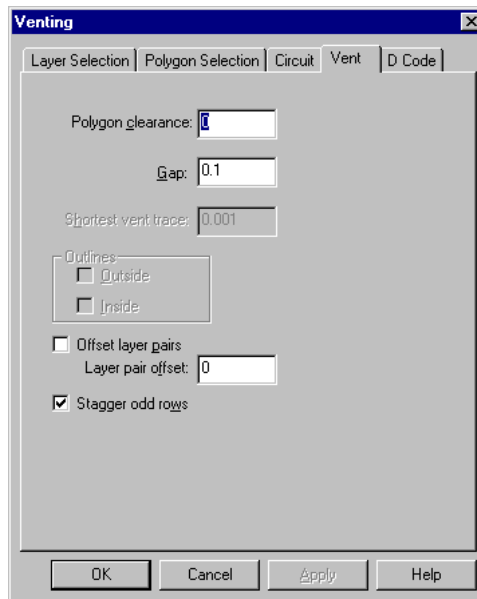
Element Clearance: Enter the distance between venting and the circuit elements.

Generate a Pad Venting Pattern



To Generate a Pad Venting Pattern:

1. Define the **Polygon Areas** for venting. See *Nested Polygons for Venting Operations* on page 204.
2. On the **Tools** menu, click **Venting-Pads**.
3. On the **Polygon Selection** tab, set the options identifying the polygons for the venting operation. See *Set the Polygon Options for the Operation* on page 206.
4. On the **Layer Selection** tab, select the layers for the venting operation. See *Select the Layers for the Venting Operation* on page 208.
5. On the **Circuit** tab, set the options for venting around pads and traces. See *Venting Around Pads and Traces* on page 210.
6. On the **D Code** tab, select the D Code:
 - **D Code:** Select a C-type D Code for the pads of the venting pattern. The D Codes does not have to be unused; however, when you use it for a venting pattern, the system forces it to type C, Circle.
 - **Size:** Enter the size of the D Code you selected for the pads of the venting pattern.
7. On the **Vent** tab, set options to define the pad venting pattern.



Venting Pad Pattern Vent Tab

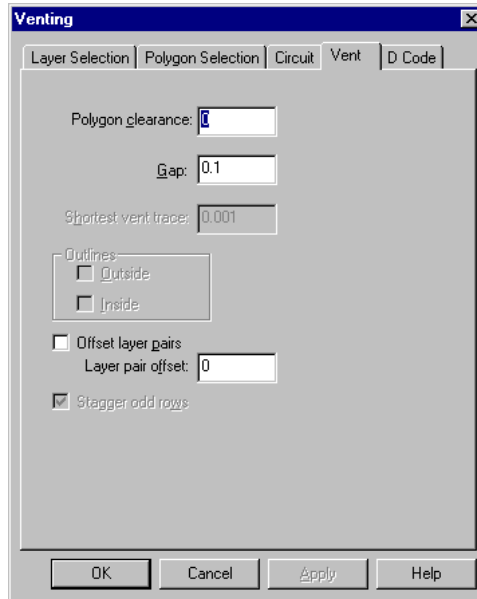
- **Polygon Clearance:** Enter the distance between venting and the polygons.
 - **Gap:** Enter the edge-to-edge distance between pads in layer pairs.
 - **Shortest Vent Trace:** This is not used for a pads fill.
 - **Outlines Outside:** This is not used for a pads fill.
 - **Outlines Inside:** This is not used for a pads fill.
 - **Offset Odd Rows:** Select this option to offset odd rows within a single venting layer. When this option is selected odd rows of pads within a single venting layer are offset so that they form a diagonal pattern. Otherwise the rows are not offset and the within a single venting layer pads form a grid pattern.
 - **Offset Layer Pairs:** When generating a Pads venting pattern, the system generates the pattern in layer pairs. The first and second venting layers are generated such that the pads in the second layer are placed half way between the pads in the first layer. Similarly, the pattern in the second pair of layers is generated such that the pads in the fourth layer fall half way between the pads in the third layer. Check this option to set an offset between layer pairs. When this option is checked, each subsequent layer pair is offset from the previous layer pair by the distance entered in the Offset Distance below. If the option is not checked, then the pads in all odd number layers overlay, and the pads in all even layers overlay.
 - **Offset Distance:** If the Offset Layer pairs option is checked above, enter the distance to offset layer pairs here.
8. On the main Venting dialog, click **OK**.

Generate a Positive VPI Venting Pattern



To Generate a Positive VPI Venting Pattern:

1. Define the **Polygon Areas** for venting. See *Nested Polygons for Venting Operations* on page 204.
2. On the **Tools** menu, click **Venting-Positive VPI**.
3. On the **Polygon Selection** tab, set the options identifying the polygons for the venting operation. See *Set the Polygon Options for the Operation* on page 206.
4. On the **Layer Selection** tab, select the layers for the venting operation. See *Select the Layers for the Venting Operation* on page 208.
5. On the **Circuit** tab, set the options for venting around pads and traces. See *Venting Around Pads and Traces* on page 210.
6. On the **D Code** tab, select the D Code:
 - **D Code:** Select a D Code for the triangular venting pads of the Positive VPI venting pattern. The D Code should be unused, because when you use it for Positive VPI venting, the system forces it to an unusual triangular custom aperture.
 - **Size:** Enter the size of the D Code you selected for the triangular venting pads of the Positive VPI venting pattern.
7. On the **Vent** tab, set options to define the Positive VPI venting pattern.



Venting Positive VPI Pattern Vent Tab

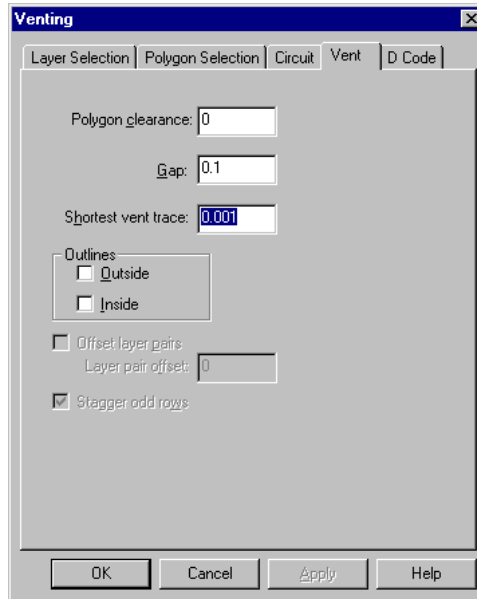
- **Polygon Clearance:** Enter the distance between venting and the polygons.
 - **Gap:** This is the size of the vent area between the triangular venting pads of the Positive VPI venting pattern.
 - **Shortest Vent Trace:** This is not used for a Positive VPI venting.
 - **Outlines Outside:** This is not used for a Positive VPI venting.
 - **Outlines Inside:** This is not used for a Positive VPI venting.
 - **Offset Odd Rows:** This is not used for a Positive VPI venting.
 - **Offset Layer Pairs:** When generating a Positive VPI venting pattern, the system generates the pattern in layer pairs. The first and second venting layers are generated such that the pads in the second layer are placed half way between the pads in the first layer. Similarly, the pattern in the second pair of layers is generated such that the pads in the fourth layer fall half way between the pads in the third layer. Check this option to set an offset between layer pairs. When this option is checked, each subsequent layer pair is offset from the previous layer pair by the distance entered in the Offset Distance below. If the option is not checked, then the pads in all odd number layers overlay, and the pads in all even layers overlay.
 - **Offset Distance:** If the Offset Layer pairs option is checked above, enter the distance to offset layer pairs here.
8. On the main Venting dialog, click **OK**.

Generate a Negative VPI Venting Pattern



To Generate a Negative VPI Venting Pattern:

1. Define the **Polygon Areas** for venting. See *Nested Polygons for Venting Operations* on page 204.
2. On the **Tools** menu, click **Venting-Negative VPI**.
3. On the **Polygon Selection** tab, set the options identifying the polygons for the venting operation. See *Set the Polygon Options for the Operation* on page 206.
4. On the **Layer Selection** tab, select the layers for the venting operation. See *Select the Layers for the Venting Operation* on page 208.
5. On the **Circuit** tab, set the options for venting around pads and traces. See *Venting Around Pads and Traces* on page 210.
6. On the **D Code** tab, select the D Code:
 - **D Code:** Select a C-type D Code for the traces of the Negative VPI venting pattern. The D Codes does not have to be unused; however, when you use it as a venting trace, the system forces it to type C, Circle.
 - **Size:** Enter the size of the D Code you selected for the venting traces of the Negative VPI venting pattern. This is the width of the venting path.
7. On the **Vent** tab, set options to define the Negative VPI venting pattern.



Venting Negative VPI Pattern Vent Tab

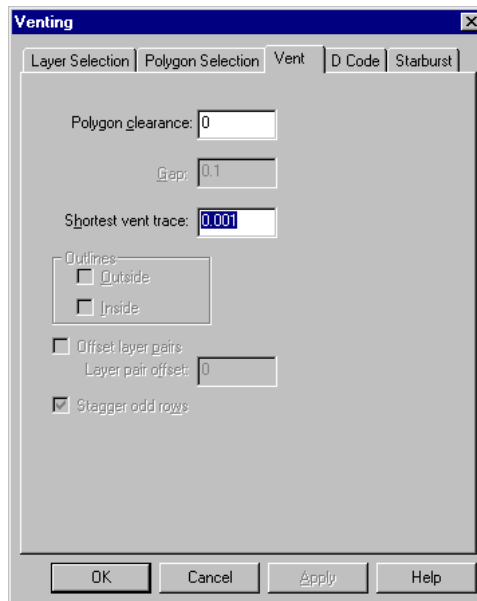
- **Polygon Clearance:** Enter the distance between venting and the polygons.
 - **Gap:** This is the height of the diamond-shaped area left between the traces of the Negative VPI venting pattern.
 - **Shortest Vent Trace:** Enter the length of the shortest trace that the system may generate as a venting trace. Traces that would be shorter than this length are not generated.
 - **Outlines Outside:** Select this option to have the program draw the inside boundary of a polygon the Negative VPI venting pattern.
 - **Outlines Inside:** Select this option to have the program draw the outside boundary of a polygon the Negative VPI venting pattern.
 - **Offset Odd Rows:** This is not used for a Negative VPI venting pattern.
 - **Offset Layer Pairs:** This is not used for a Negative VPI venting pattern.
 - **Offset Distance:** This is not used for a Negative VPI venting pattern.
8. On the main Venting dialog, click **OK**.

Generate a Starburst Venting Pattern



To Generate a Starburst Venting Pattern:

1. Define the **Polygon Areas** for venting. See *Nested Polygons for Venting Operations* on page 204.
2. On the **Tools** menu, click **Venting- Starburst**.
3. On the **Polygon Selection** tab, set the options identifying the polygons for the venting operation. See *Set the Polygon Options for the Operation* on page 206.
4. On the **Layer Selection** tab, select the layers for the venting operation. See *Select the Layers for the Venting Operation* on page 208.
5. On the **D Code** tab, select the D Code:
 - **D Code:** Select a C-type D Code for the fill traces of the Starburst venting pattern. The D Code does not have to be unused; however, when you use it as a venting trace, the system forces it to type C, Circle.
 - **Size:** Enter the size of the D Code you selected for the venting traces of the Starburst venting pattern.
6. On the **Vent** tab, set options to define the Starburst venting pattern.



Venting Starburst Pattern Vent Tab

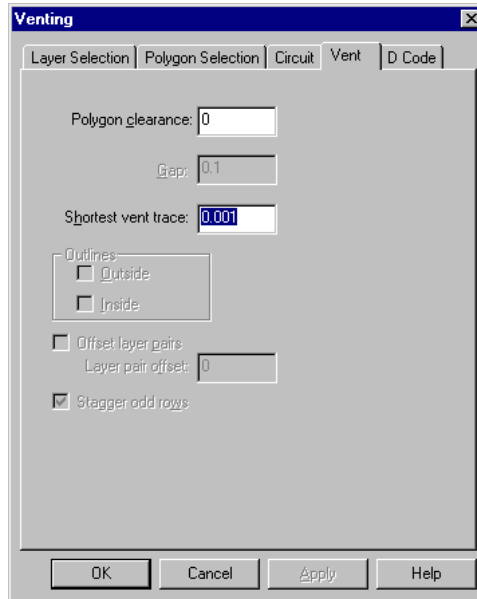
- **Polygon Clearance:** Enter the distance between venting and the polygons.
 - **Gap:** This is not used for a Starburst venting pattern.
 - **Shortest Vent Trace:** Enter the length of the shortest trace that the system may generate as a venting trace. Traces that would be shorter than this length are not generated.
 - **Outlines Outside:** This is not used for a Starburst venting pattern. The rays of the Starburst pattern are outlined automatically.
 - **Outlines Inside:** This is not used for a Starburst venting pattern. The rays of the Starburst pattern are outlined automatically.
 - **Offset Odd Rows:** This is not used for a Starburst venting pattern.
 - **Offset Layer Pairs:** This is not used for a Starburst venting pattern.
 - **Offset Distance:** This is not used for a Starburst venting pattern.
7. On the **Starburst** tab, enter the **Starburst Angle**. The Starburst Angle is the angle between the starburst rays.
 8. On the main Venting dialog, click **OK**.

Generate a Solid Venting Pattern



To Generate a Solid Venting Pattern:

1. Define the **Polygon Areas** for venting. See *Nested Polygons for Venting Operations* on page 204.
2. On the **Tools** menu, click **Venting-Solid**.
3. On the **Polygon Selection** tab, set the options identifying the polygons for the venting operation. See *Set the Polygon Options for the Operation* on page 206.
4. On the **Layer Selection** tab, select the layers for the venting operation. See *Select the Layers for the Venting Operation* on page 208.
5. On the **Circuit** tab, set the options for venting around pads and traces. See *Venting Around Pads and Traces* on page 210.
6. On the **D Code** tab, select the D Code:
 - **D Code:** Select a C-type D Code for the venting traces of the solid venting pattern. The D Codes does not have to be unused; however, when you use it as a venting trace, the system forces it to type C, Circle.
 - **Size:** Enter the size of the D Code you selected for the venting traces of the solid venting pattern.
7. On the **Vent** tab, set options to define the solid venting pattern.



Venting Solid Pattern Vent Tab

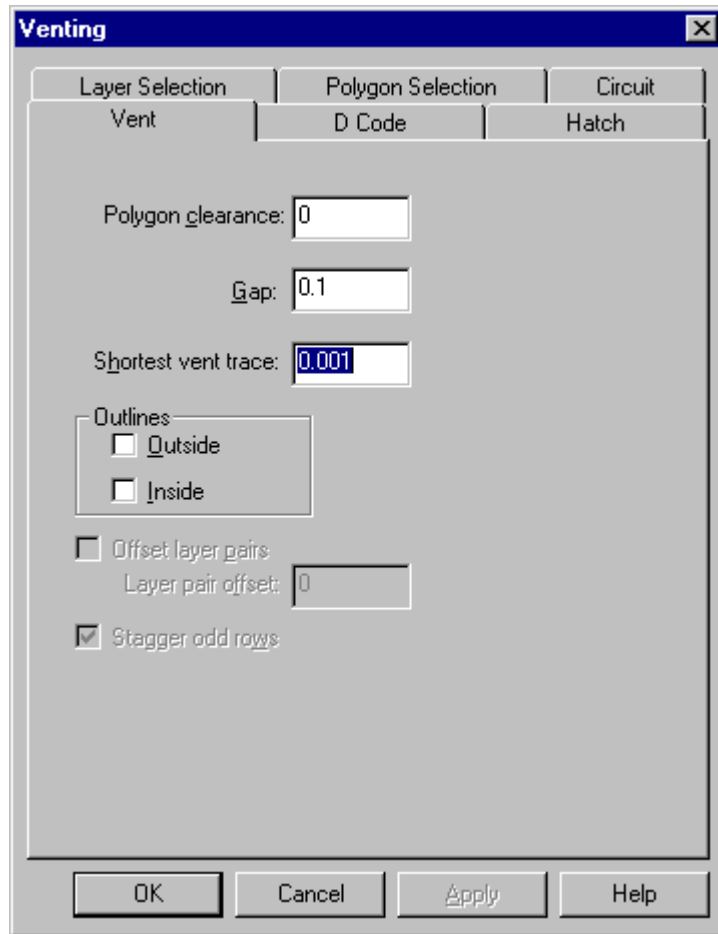
- **Polygon Clearance:** Enter the distance between venting and the polygons.
 - **Gap:** This is not used for a solid venting pattern.
 - **Shortest Vent Trace:** Enter the length of the shortest trace that the system may generate as a venting trace. Traces that would be shorter than this length are not generated.
 - **Outlines Outside:** This is not used for a solid venting pattern. The solid venting pattern is outlined automatically.
 - **Outlines Inside:** This is not used for a solid venting pattern. The solid venting pattern is outlined automatically.
 - **Offset Odd Rows:** This is not used for a solid venting pattern.
 - **Offset Layer Pairs:** This is not used for a solid venting pattern.
 - **Offset Distance:** This is not used for a solid venting pattern.
8. On the main Venting dialog, click **OK**.

Generate a Hatch Venting Pattern



To Generate a Hatch Venting Pattern:

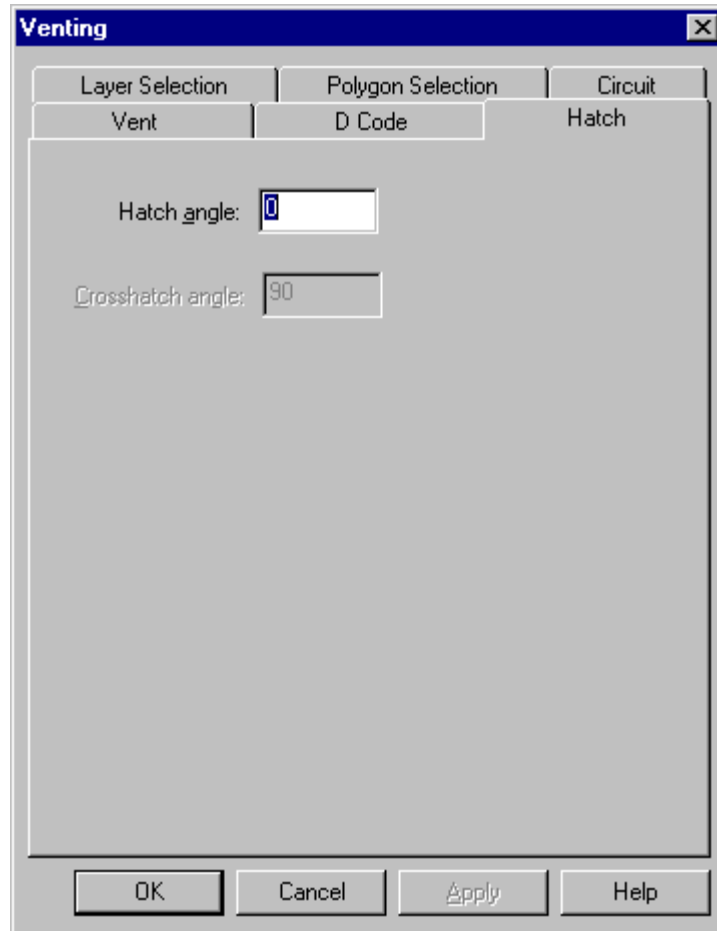
1. Define the **Polygon Areas** for venting. See *Nested Polygons for Venting Operations* on page 204.
2. On the **Tools** menu, click **Venting-Hatch**.
3. On the **Polygon Selection** tab, set the options identifying the polygons for the venting operation. See *Set the Polygon Options for the Operation* on page 206.
4. On the **Layer Selection** tab, select the layers for the venting operation. See *Select the Layers for the Venting Operation* on page 208.
5. On the **Circuit** tab, set the options for venting around pads and traces. See *Venting Around Pads and Traces* on page 210.
6. On the **D Code** tab, select the D Code:
 - **D Code:** Select a C-type D Code for the venting traces of the Hatch venting pattern. The D Codes does not have to be unused; however, when you use it as a venting trace, the system forces it to type C, Circle.
 - **Size:** Enter the size of the D Code you selected for the venting traces of the Hatch venting pattern.
7. On the **Vent** tab, set options to define the Hatch venting pattern.



Venting Hatch Pattern Vent Tab

- **Polygon Clearance:** Enter the distance between venting and the polygons.
- **Gap:** Enter the distance between the venting traces of the Hatch venting pattern
- **Shortest Vent Trace:** Enter the length of the shortest trace that the system may generate as a venting trace. Traces that would be shorter than this length are not generated.
- **Outlines Outside:** Select this option to have the program draw the inside boundary of a polygon for the Hatched venting pattern.
- **Outlines Inside:** Select this option to have the program draw the outside boundary of a polygon for the Hatched venting pattern.
- **Offset Odd Rows:** This is not used for Hatch venting pattern.
- **Offset Layer Pairs:** This is not used for Hatch venting pattern.

- **Offset Distance:** This is not used for Hatch venting pattern.
8. On the **Hatch** tab, set the special options for the Hatch venting pattern.



Venting Hatch Pattern Hatch Tab

- **Hatch Angle:** Enter the angle for the hatch traces. Set the angle to zero or 90 when venting around pads and traces in order to have an accurate element clearance.
 - **Crosshatch Angle:** This is not used for Hatch venting pattern.
9. On the main Venting dialog, click **OK**.

Generate a Crosshatch Venting Pattern



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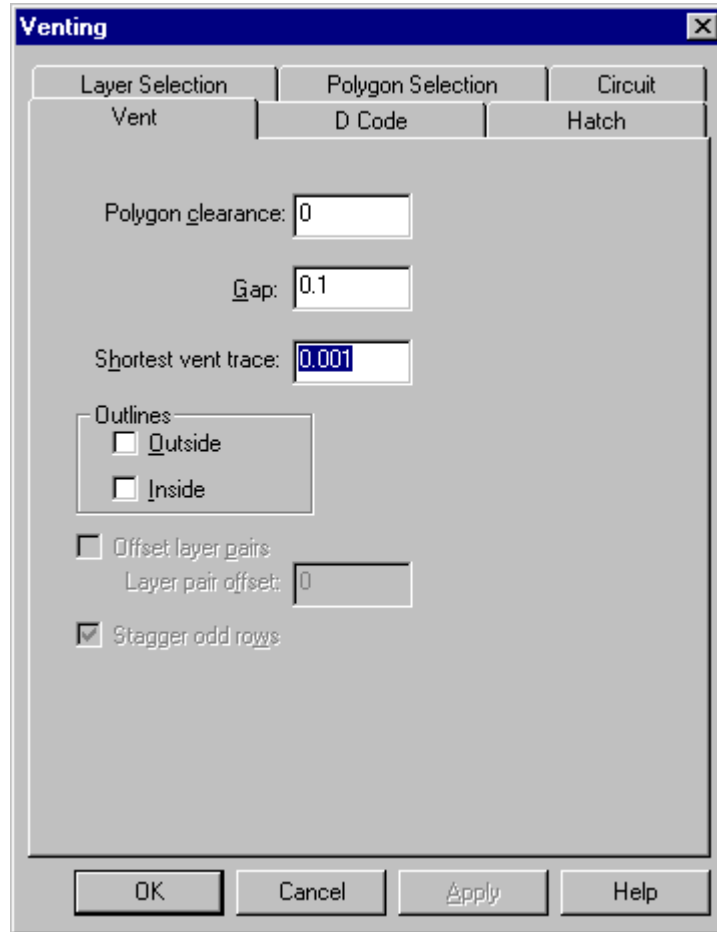
VM



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To Generate a Crosshatch Venting Pattern:

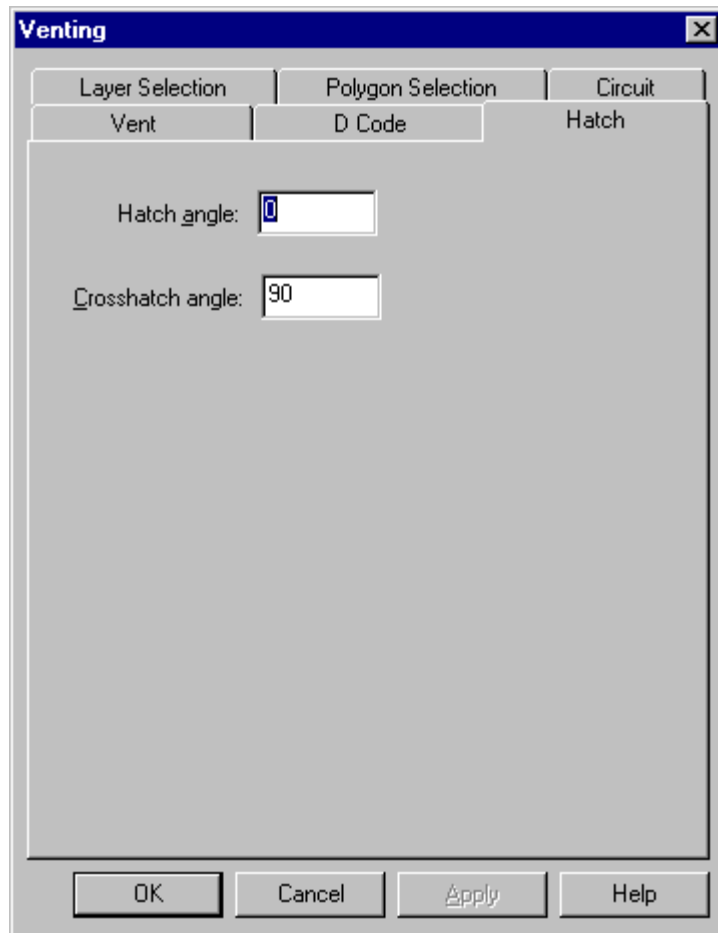
1. Define the **Polygon Areas** for venting. See *Nested Polygons for Venting Operations* on page 204.
2. On the **Tools** menu, click **Venting- Crosshatch**.
3. On the **Polygon Selection** tab, set the options identifying the polygons for the venting operation. See *Set the Polygon Options for the Operation* on page 206.
4. On the **Layer Selection** tab, select the layers for the venting operation. See *Select the Layers for the Venting Operation* on page 208.
5. On the **Circuit** tab, set the options for venting around pads and traces. See *Venting Around Pads and Traces* on page 210.
6. On the **D Code** tab, select the D Code:
 - **D Code:** Select a C-type D Code for the venting traces of the Crosshatch venting pattern. The D Codes does not have to be unused; however, when you use it as a venting trace, the system forces it to type C, Circle.
 - **Size:** Enter the size of the D Code you selected for the venting traces of the Crosshatch venting pattern.
7. On the **Vent** tab, set options to define the Crosshatch venting pattern.



Venting Crosshatch Pattern Vent Tab

- **Polygon Clearance:** Enter the distance between venting and the polygons.
- **Gap:** Enter the distance between the venting traces of the Crosshatch venting pattern
- **Shortest Vent Trace:** Enter the length of the shortest trace that the system may generate as a venting trace. Traces that would be shorter than this length are not generated.
- **Outlines Outside:** Select this option to have the program draw the inside boundary of a polygon for the Crosshatch venting pattern.
- **Outlines Inside:** Select this option to have the program draw the outside boundary of a polygon for the Crosshatch venting pattern.
- **Offset Odd Rows:** This is not used for Crosshatch venting pattern.
- **Offset Layer Pairs:** This is not used for Crosshatch venting pattern.

- **Offset Distance:** This is not used for Crosshatch venting pattern.
8. On the **Hatch** tab, set the special options for the Crosshatch venting pattern.



Venting Crosshatch Pattern Hatch Tab

- **Hatch Angle:** Enter the angle for the hatch traces. Set the angle to zero or 90 when venting around pads and traces in order to have an accurate element clearance.
 - **Crosshatch Angle:** Enter the angle of the crosshatch traces relative to the hatch traces. In order to have an accurate element clearance when filling around pads and traces, set the Hatch Angle to zero or 90, and set the Crosshatch Angle to 90.
9. On the main Venting dialog, click **OK**.

Convert Drawn Pads



The program can convert drawn shapes to flashed shapes and vice versa. The operation adds or substitutes a new flashed or drawn shape for an existing flashed or drawn shape in a plot file.

Converting drawn pads to flashed pads is useful for operations such as drill point extraction, netlist extraction, design rule checking, generating fab drawings of drill data from padmasters, and generating fillets where traces enter pads.

There are two main modes of operation:

- **Single Shape:** This is a manual draw-to-flash operation in which you can select single shapes in the viewing area and convert all instances of that shape in a file into flashed pads of a specific D Code. The operation can be run using key commands. The single shape method is useful for situations in which the same shapes are not found in many different files and you only want to do draw-to-flash conversions.
- **Shape Library:** This is an automatic shape-to-shape operation in which you can create and save shape files in a shape library and convert a list of shapes in multiple files to new flashed or drawn shapes. This is useful for situations in which the same drawn shapes are replaced in many different files and when you need to do shape-to-shape conversions, not just draw-to-flash.

Convert Single Shapes



This operation uses the contents of the reference frame as a shape model and finds matching shapes. The system can select matching shapes for editing or convert them to flashed pads.

To Convert Single Shapes:

1. Make the **layers** where you want to convert shapes active, visible layers. See *Select from the Active Layers* on page 152.

2. Set the **Visibility** settings.

The operation only checks visible elements, so make sure all pads, traces, selected, and unselected elements to be checked are visible. See *Element Visibility* on page 84.

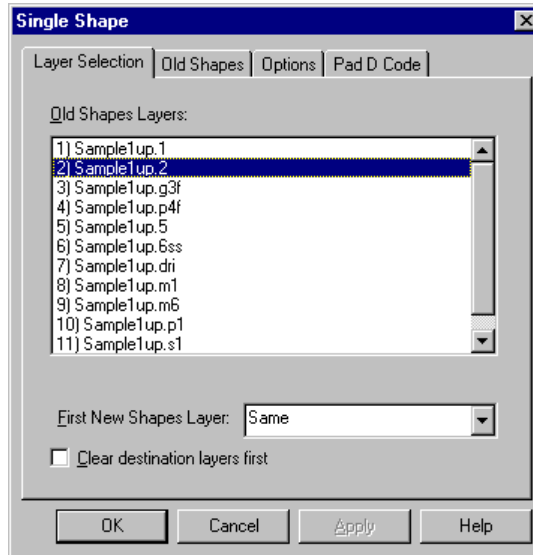
3. **Clear selection** from all elements.

Depending on your settings, the system can use selection to indicate shapes found by the operation. Clearing the selection first helps avoid confusion.

4. Position the **reference frame** around the elements that you want to use as the **shape model**. See *Reference Frame* on page 177.

5. On the **Tools** menu, click **Convert Drawn Pads-Single Shape**, or press **Ctrl+Shift+P**.

6. On the **Layers** tab, select the layers for the operation.



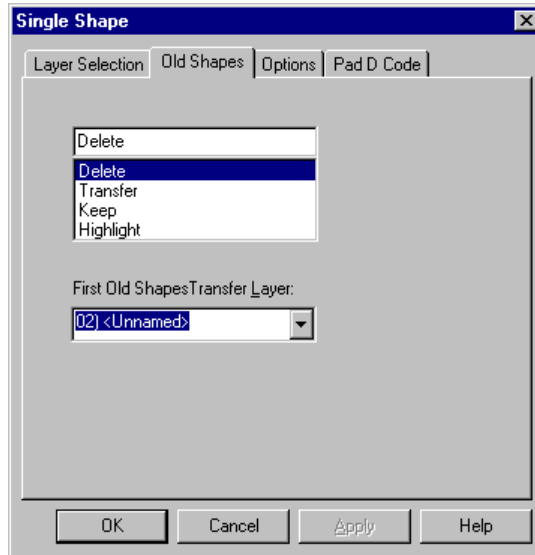
Single Shapes Layers Tab

Old Shapes Layers: Select the layer where the elements you want to convert are located.

First New Shapes Layer: Select the first consecutive layer where you want the converted shapes to be inserted.

Clear Destination Layers First: This option clears all data out of the new shapes layers before inserting the converted data. To have the system clear the destination layers before running the operation, click this option so that it has a check mark. Otherwise do not check this option. Do not use this option if there is any data on the destination layers that you want to keep.

7. On the Old Shapes tab, select options for how to handle the old shapes that are found by the operation.



Single Shapes Old Shapes Tab

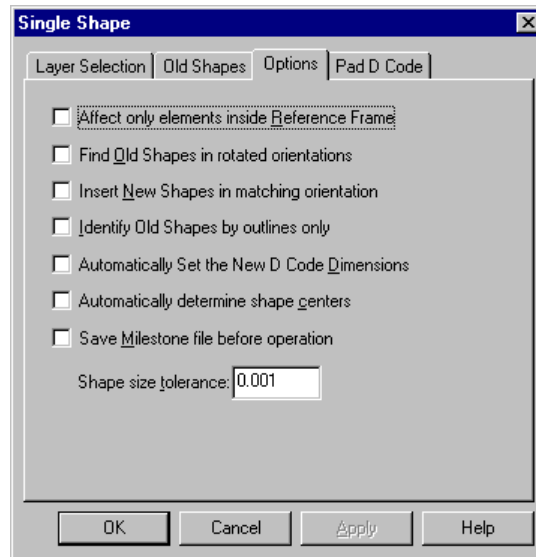
Delete: This option deletes the old shape and replaces it with a pad of the D Code specified on the D Code tab.

Transfer: This option transfers the old shape to the **Old Shapes Transfer Layer** which you specify and replaces it with a pad of the D Code specified on the D Code tab.

Keep: This option keeps the old shape on the original layer and adds a pad of the D Code specified on the D Code tab.

Highlight: This option selects the old shape and does not insert a new pad.

8. On the Options tab, set the shape conversion options.



Single Shapes Options Tab

Affect only Elements Inside the Reference Frame: This option is not used for Single Shape replacements because the reference frame is used to establish the shape model.

Find Old Shapes in Rotated Orientations: A check mark indicates the program identifies shapes that are rotated versions of the shape model. See the **Insert New Shape in Matching Orientation** option below.

Insert New Shape in Matching Orientation: A check mark indicates that, if the **Find Old Shapes in Rotated Orientations** option above is checked and the program does find rotated versions of the shape, then the program inserts new shapes oriented to match the rotated old shapes.

Identify Old Shapes by Outlines Only: A check mark indicates the program recognizes the outline of the shape to be replaced, rather than the elements it is composed of. This helps to avoid creating padstacks that may occur if the module were to recognize shapes composed of concentric traces as more than one shape, and it also identifies shapes that have the same outlines but have different interior fills.

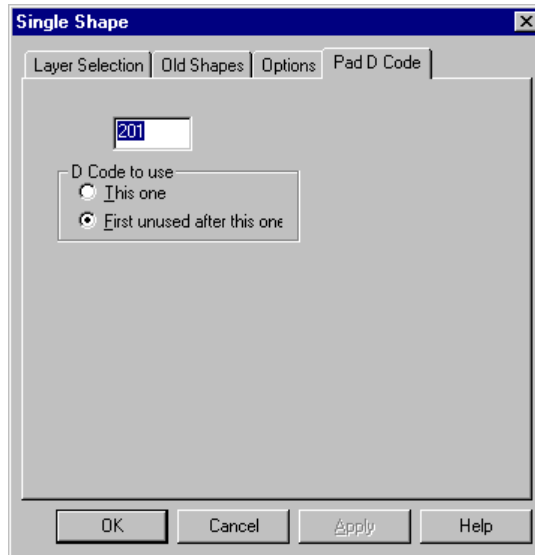
Automatically Set the New D Code Dimensions: A check mark indicates the program automatically calculates the replacement D Code size and shape.

Automatically Determine Shape Centers: A check mark indicates the program automatically calculates the center of the old shape and positions the new shape at the old center.

Save Milestone Before Operation: This option saves a Milestone file before running the operation, so in case the results are not what you want, you can easily revert to the Milestone file. To have the system save a Milestone file before running the operation, click this option so that it has a check mark. Otherwise do not check this option.

Shape Size Tolerance: If you want to allow the program to identify shapes that are approximately the same as the model old shape, enter a tolerance value in the **Tolerance** field. A zero tolerance means the program only finds exactly matching shapes. A tolerance in the range of 1 or 2 mils should catch most size variations due to data conversion or other factors.

9. On the Pad D Code tab, select the **Pad D Code** to use when inserting the flashed pad where the old shape is found and select a **D Code to Use** option:



Single Shapes Pad D Code Tab

This One: The operation uses the D Code you entered regardless of whether the D Code has already been used elsewhere in the job.

First Unused One after this One: The operation uses the first D Code after the D Code you entered. This option is useful if you repeat the process for another shape or run the operation repeatedly from the key command because the system automatically increments the Pad D Code.

10. On the main Single Shape dialog, click **OK**.



Ctrl+Shift+P = Opens the Convert Single Shapes dialog



= Opens the Convert Single Shapes dialog

Convert Libraries of Shapes



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This operation scans the job for a library of old shapes and finds all shapes in the file that match the old shapes in the library. The system can select the matching shapes for editing or convert them to new shapes. Both old shapes and new shapes can be either D Codes or stored shape files.

To Convert Libraries of Shapes:

1. Make the **layers** where you want to convert shapes active, visible layers. See *Select from the Active Layers* on page 152.

2. Set the **Visibility** settings.

The operation only checks visible elements, so make sure all pads, traces, selected, and unselected elements to be checked are visible. See *Element Visibility* on page 84.

3. **Clear selection** from all elements.

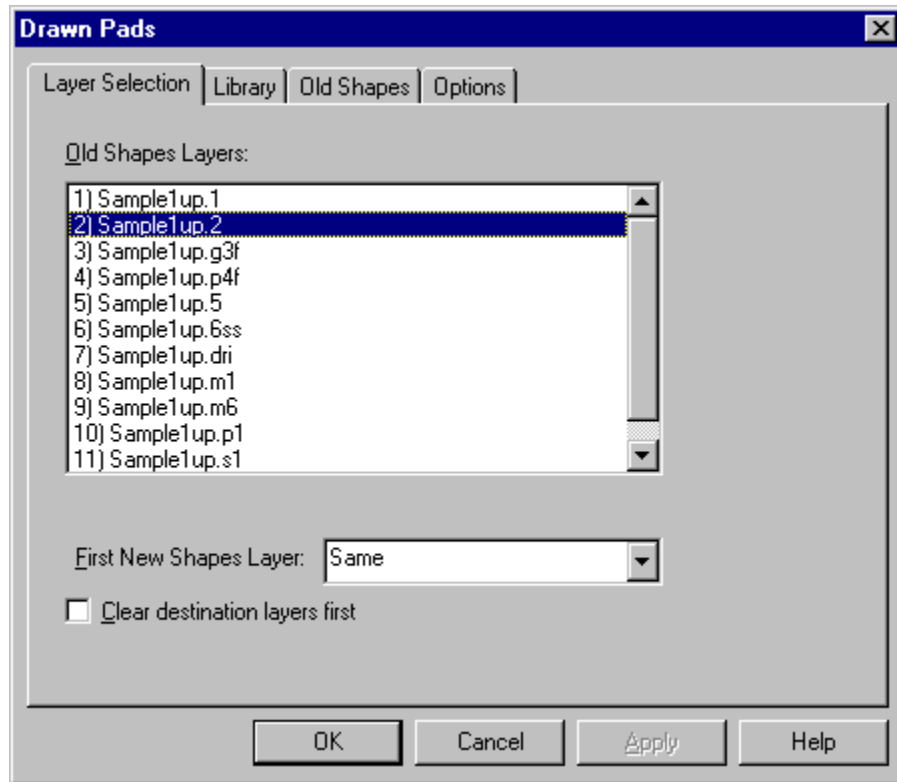
Depending on your settings, the system can use selection to indicate shapes found by the operation. Clearing the selection first helps avoid confusion.

4. If you want to perform the operation on only part of the file, position the **reference frame** around the part you want to check. See *Reference Frame* on page 177.



If you want to check all data, it does not matter where the reference frame is positioned.

5. On the **Tools** menu, click **Convert Drawn Pads-Conversion Library**.
6. On the **Layers** tab, select the layers for the operation.



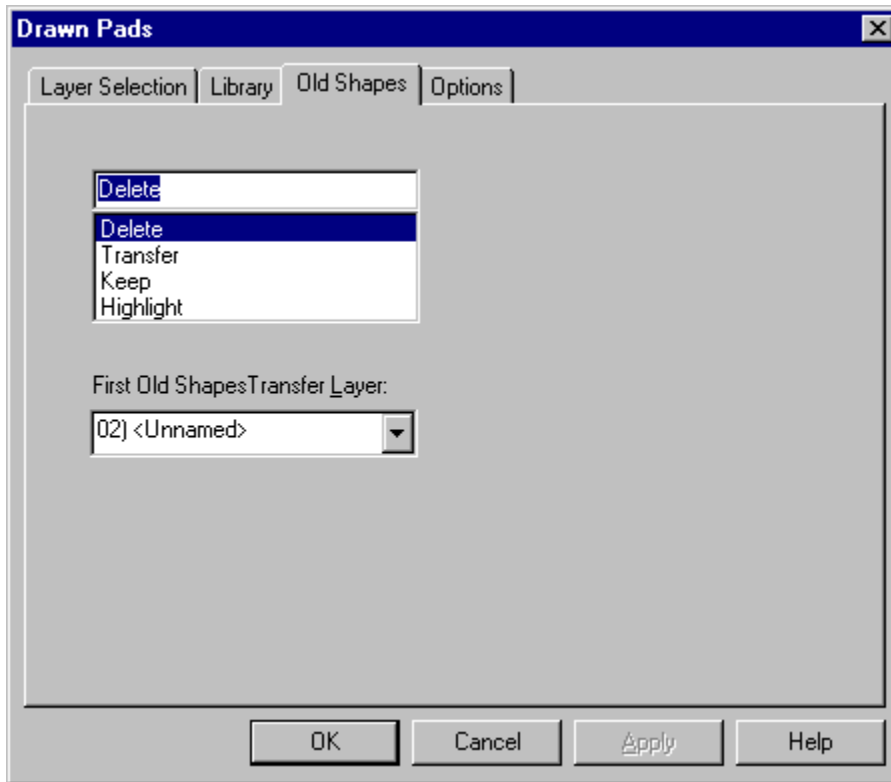
Drawn Pads Layers Selection Tab

Old Shapes Layers: Select the layer where the shapes you want to convert are located.

First New Shapes Layer: Select the first consecutive layer where you want the converted shapes to be inserted.

Clear Destination Layers First: This option clears all data out of the new shapes layers before inserting the converted data. To have the system clear the destination layers before running the operation, click this option so that it has a check mark. Otherwise do not check this option. Do not use this option if there is any data on the destination layers that you want to keep.

7. On the **Old Shapes** tab, select options for how to handle the old shapes that are found by the operation.



Drawn Pads Old Shapes Tab

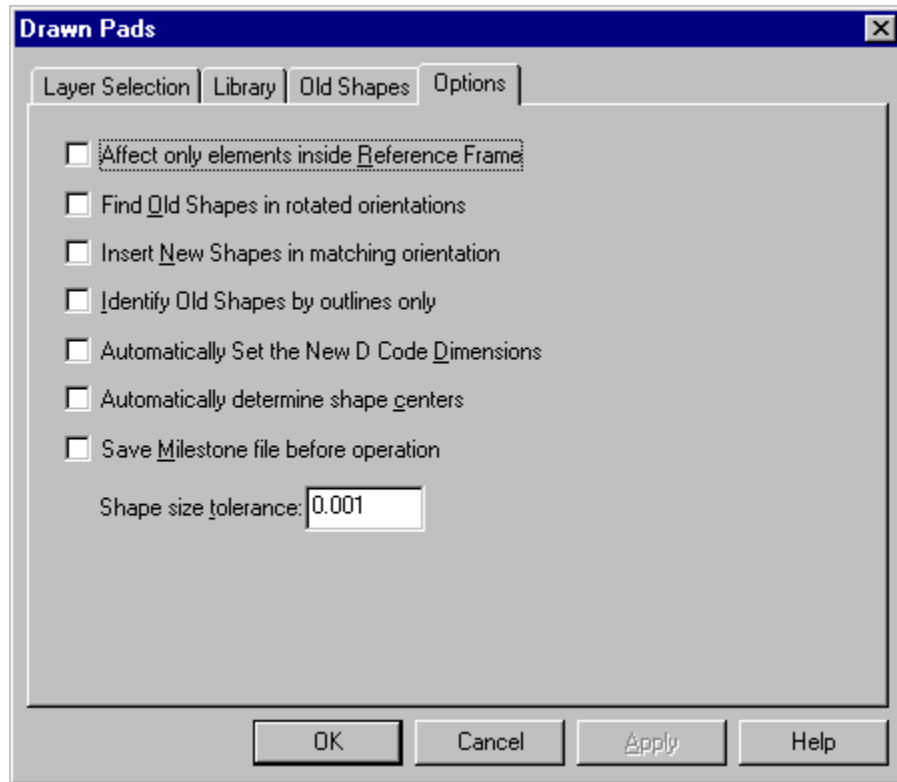
Delete: This option deletes the old shape and replaces it with the new shape.

Transfer: This option transfers the old shape to the **Old Shapes Transfer Layer** which you specify and replaces it with the new shape.

Keep: This option keeps the old shape on the original layer and adds the new shape.

Highlight: This option selects the old shape and does not insert the new shape.

8. On the **Options** tab, set the shape conversion options.



Drawn Pads Options Tab

Affect only Elements Inside the Reference Frame: A check mark indicates that the program only checks the part of the file inside the reference frame.

Find Old Shapes in Rotated Orientations: A check mark indicates the program identifies shapes that are rotated versions of the shape model. See the **Insert New Shape in Matching Orientation** option below.

Insert New Shape in Matching Orientation: A check mark indicates that, if the **Find Old Shapes in Rotated Orientations** option above is checked and the program does find rotated versions of the shape, then the program inserts new shapes oriented to match the rotated old shapes.

Identify Old Shapes by Outlines Only: A check mark indicates the program recognizes the outline of the shape to be replaced, rather than the elements it is composed of. This helps to avoid creating padstacks that may occur if the module were to recognize shapes composed of concentric traces as more than one shape, and it also identifies shapes that have the same outlines but have different interior fills.

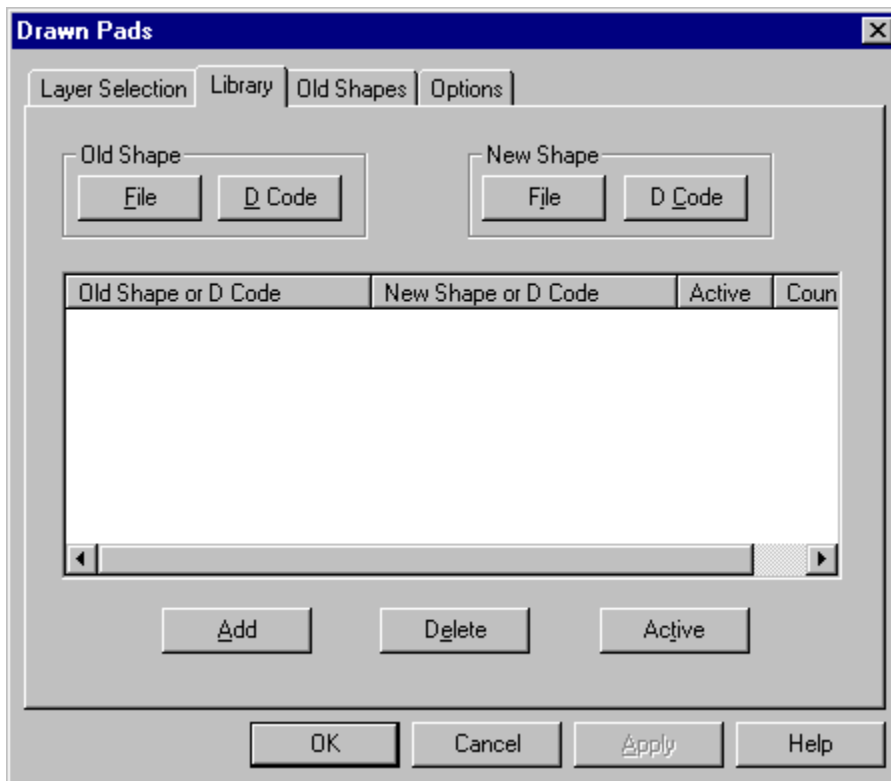
Automatically Set the New D Code Dimensions: A check mark indicates the program automatically calculates the replacement D Code size and shape.

Automatically Determine Shape Centers: A check mark indicates the program automatically calculates the center of the old shape and positions the new shape at the old center.

Save Milestone Before Operation: This option saves a Milestone file before running the operation, so in case the results are not what you want, you can easily revert to the Milestone file. To have the system save a Milestone file before running the operation, click this option so that it has a check mark. Otherwise do not check this option.

Shape Size Tolerance: If you want to allow the program to identify shapes that are approximately the same as the model old shape, enter a tolerance value in the **Tolerance** field. A zero tolerance means the program only finds exactly matching shapes. A tolerance in the range of 1 or 2 mils should catch most size variations due to data conversion or other factors.

9. On the **Library** tab, set up the Old Shapes to New Shapes conversion table. Set up the table so that in each row that is Active there is an Old Shape or D Code that is to be converted to a New Shape or D Code.



Drawn Pads Library Tab

To select a row in the table to change: Click on the item in the Old Shape or D Code column so that it is highlighted. Shift+Click to select a range of rows, and Ctrl+Click to add or remove a row from the selection. All selected rows will be changed simultaneously in the same way.

To change the Old Shape of a selected row: Click on **File** or **D Code** under Old Shape and select a stored Shape File or a D Code from the dialog that appears.

To change the New Shape of a selected row: Click on **File** or **D Code** under New Shape and select a stored Shape File or a D Code from the dialog that appears.

To make a selected row Active for the conversion: Click the **Active** button. Only rows that say **“On”** in the Active column will have their conversions carried out. Click once to turn on and again to turn off.

To delete a selected row: Click **Delete**.

To add a new row to the table: Click **Add**.

10. On the main Drawn Pads dialog, click **OK**.

Shape Files

Shape files are symbols, drawn pads, or element groupings that are identified by filenames and saved in small Gerber files. You can use any Gerber Extended or MDA Autoplot file as a shape file. Also, you can use any Basic Gerber file as a shape file as long as it is in Leading, Absolute, English 2.4 or Metric 4.3 format.

If you save a large number of shape files, you can assemble them into a library of shape files, which you can use to perform multiple conversions at once whenever you have a similar job. This is useful for situations in which the same drawn shapes are replaced in many different Job Files. To do this, add the shapes to the conversion table and save a Library Parameter File. When you have a similar Job File import the Library Parameter File and converting the library of shapes.

Save Shape Files



You can save shape files, which can then be substituted for other shapes or D Codes or imported into other jobs.

To Save Shape Files:

1. Make the **layers** where the model for the shape is active, visible layers. See *Select from the Active Layers* on page 152.

2. Set the **Visibility** settings.

The operation only checks visible elements, so make sure all pads, traces, selected, and unselected elements to be checked are visible. See *Element Visibility* on page 84.

3. **Clear selection** from all elements.

The system uses selection to indicate shapes found by the operation. Clearing the selection first helps avoid confusion.

4. Position the **reference frame** around the elements that you want to use as the **shape model**. See *Reference Frame* on page 177.

Your reference frame selection should contain only the elements that are part of the shape. If you can't position the window without also selecting extraneous elements, select and replicate the elements of the shape to another unused layer, then select the shape with the reference frame.

5. Position the cursor where you want the **centerpoint** of the shape file.
6. Separate the cursor. See *Separate the Crosshair and Mouse Cursor* on page 112.
7. On the **Tools** menu, go to **Convert Drawn Pads-Shape File-**.

- If you want to select the name and directory of the stored file, then on the menu cascade, click **Store**.
- If you want the file to be saved with a default name in the current directory, then on the menu cascade, click **Autorecord**.

The system saves the data in the frame as a shape file.

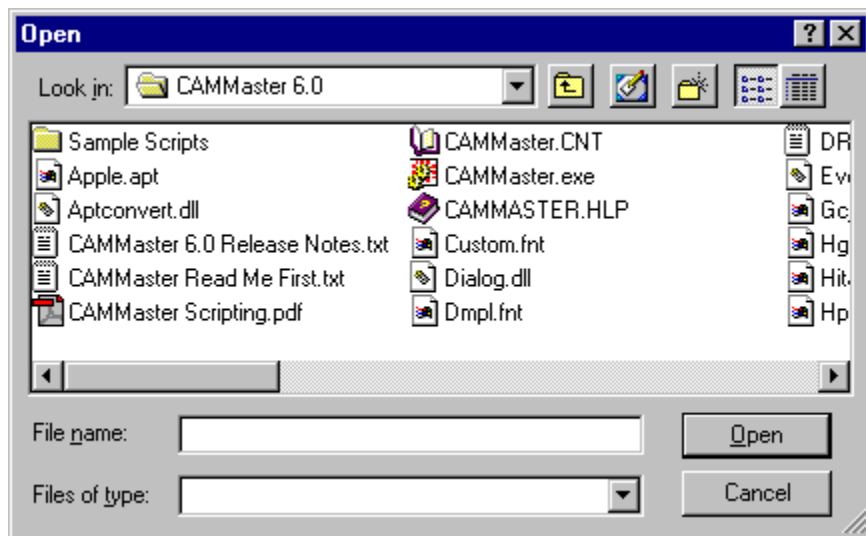
Import Shape Files



You can import a shape file into a current job and insert the design represented by the shape at the cursor location.

To Import a Shape File:

1. Make the **layers** where you want to insert the shape active, visible layers. See *Select from the Active Layers* on page 152.
2. Position the cursor where you want the **centerpoint** of the shape file.
3. Separate the cursor. See *Separate the Crosshair and Mouse Cursor* on page 112.
4. On the **Tools** menu, go to **Convert Drawn Pads-Shape File-Load**.



Drawn Pads Import Shape File Dialog

5. In the **Look in** box, click the drive, folder, or network location that contains the shape file.
6. In the folder list, double-click folders until you open the folder that contains the shape file you want.
7. **Double-click** the shape file.
The system inserts the shape file at the cursor.

Library Parameter Files

In situations where the same drawn shapes need to be replaced in many different Job Files, it can be useful to save a Library Parameter File that can be imported again when there is a similar job.

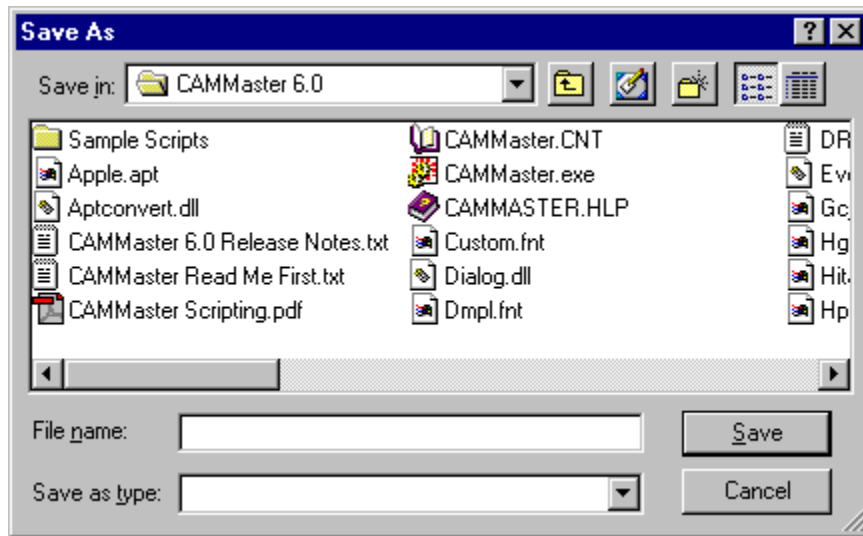
Save Library Parameter Files



You can save a Library Parameter File, which can be imported later when you need to replace similar shapes in another job.

To Save a Library Parameter File:

1. Set up and convert the Library of Shapes for the current job.
2. On the **Tools** menu, go to **Convert Drawn Pads-Parameter File-Save**.



Drawn Pads Save Library Parameter File Dialog

3. In the **Look in** box, click the drive, folder, or network location where you want to save the parameter file.
4. In the folder list, double-click folders until you open the folder where you want to save the parameter file.
5. In the **File name** box, type a name for the parameter file.
6. Click **Ok**.

The system saves the parameter file so that it can be imported again later.

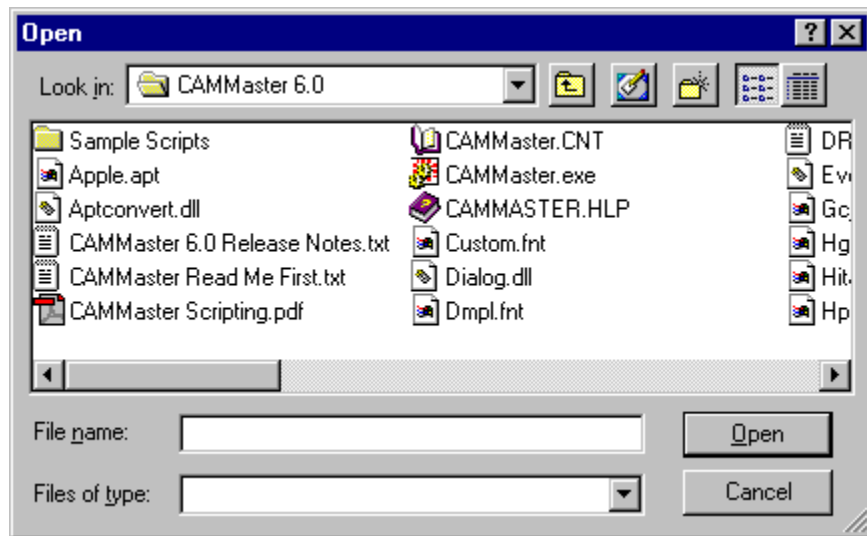
Import Library Parameter Files



You can import a Library Parameter File that was saved earlier when you replaced similar shapes in another job.

To Import a Library Parameter File:

1. On the **Tools** menu, go to **Convert Drawn Pads-Parameter File-Import**.



Drawn Pads Import Library Parameter File Dialog

2. In the **Look in** box, click the drive, folder, or network location that contains the parameter file.
3. In the folder list, double-click folders until you open the folder that contains the parameter file.
4. **Double-click** the parameter file.

The system imports the saved the parameter file and restores all the settings of the Convert Drawn Shapes dialog.

Calculate Copper Area



CAM



PRO



VM



MATE

The program can compute the copper area of layers of Gerber data and produce a report file showing the copper area in units of area and in percent of the area.

Copper area may be computed for each layer individually, for any combination of positive and negative layers, or for the CPU and CPL layers, including the copper of plated through-hole walls.

Calculate Copper Area



CAM



PRO



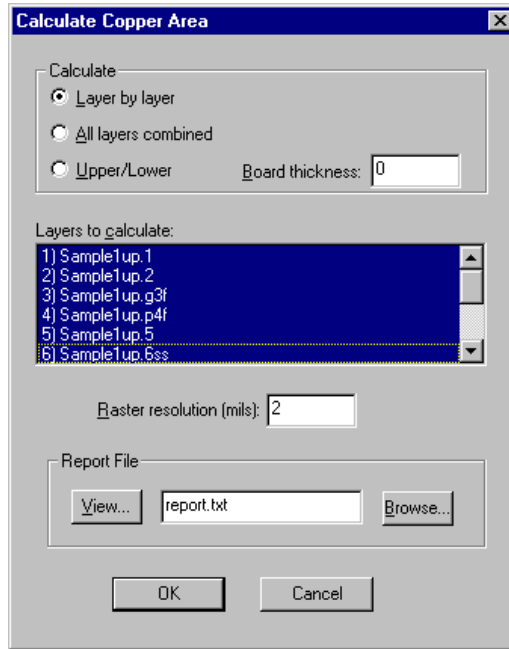
VM



MATE

To Calculate Copper Area:

1. On the **D Code Table** and the **Tool Code Table**, define all D Codes and Tool Codes. NC Drill Tool Codes must be defined as P-plated, N-non-plated, T-tooling, or V-via.
2. On the **Layers Table**, identify layers by **layer type** and stack them in the proper order.
3. If you want to calculate the copper of plated through-hole walls while calculating the CPU and CPL layers, set up a **padmaster** (PAD) or **drill** layer (DRI) as a **Scratch** layer.
4. Position the **reference frame** around the part of the plot you want to compute. See *Reference Frame* on page 177. When the percentage of copper area is calculated, it is calculated as a percentage of the reference frame area.
5. On the **Tools Menu**, click **Calculate Copper Area**.



Calculate Copper Area Dialog

6. Select a calculation option:
 - **Layer by Layer:** Provides individual layer analysis for each selected layer.
 - **All Layers Combined:** Provides analysis for all selected layers combined, including any combination of positive and negative layers.
 - **Upper/Lower:** Provides analysis for CPU and CPL layers. If a scratch layer of type PAD or DRI is present, you can enter a value for the Board Thickness to compute the copper area of the layer's plated hole walls.
7. On the **Layers to Calculate** list, select the layers you want to include in the calculation.
8. In the **Raster Resolution** box, enter the resolution for the rasterization.

The default Raster Resolution is set for 2 mils. A more fine-pitch resolution, such as 1 mil yields a more accurate calculation, but takes longer to calculate; while a less fine-pitch resolution, such as 4 mils is faster, but gives a less accurate calculation. As you go to finer resolutions, the difference in accuracy is not very significant, while the difference in time is dramatic.
9. Click **OK**.

After the system performs the calculations, it displays the copper area report file generated.

View a Copper Area Report



CAM



PRO



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MATE

This operation generates a report file of each calculation in a file called Report.txt in the current directory. If the file already exists, each successive calculation is added to this report. The report is automatically displayed after the calculation, but you can view it anytime.

To View a Copper Area Report:

1. On the **Tools** Menu, click **Calculate Copper Area**.
2. Click the **Browse** Button.
3. In the **Look in** box, click the drive, folder, or network location that contains the report.
4. In the folder list, double-click folders until you open the folder that contains the report you want.
5. **Double-click** the Report.



If you want to rename the file, then while you are viewing the file in the text editor, save it under a new name by using the Save As command.

Delete Non-Functional Pads



The program can delete, transfer or select non-functional pads from the plot.

Non-Functional pads can be defined as:

- Unconnected pads
- Padstacks of pads that have the same centerpoint
- Pads within a defined center offset distance from each other

To Delete Non-Functional Pads from a Plot:

1. Make the **layers** you want to edit active, visible layers. See *Select from the Active Layers* on page 152.
2. On the **D Code Table** and the **Tool Code Table**, define all D Codes and Tool Codes.
 - The program needs accurate dimensions in order to determine if pads are connected.
 - The program ignores pads defined as Blank (B) and Target (T).
3. Set the **Visibility** settings.

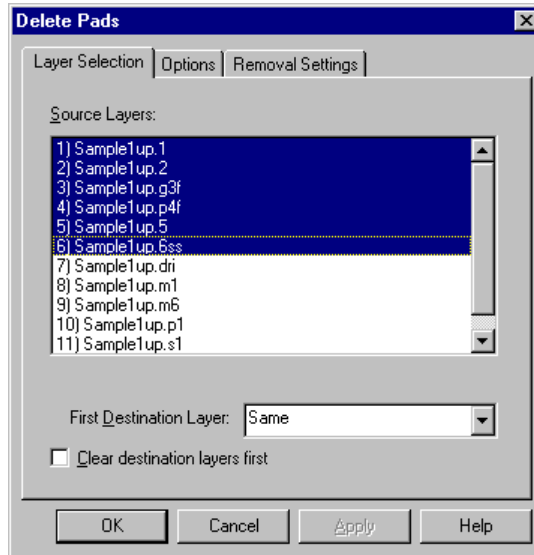
The operation only checks visible elements, so make sure all pads, traces, selected, and unselected elements to be checked are visible. See *Element Visibility* on page 84.

4. If you want to remove pads from only part of the plot, position the **reference frame** around that part. See *Reference Frame* on page 177.



If you want to check all data, it does not matter where the reference frame is positioned.

5. On the **Tools** menu, click **Delete Pads**.
6. On the **Layers** tab, select the layers for the operation.



Delete Pads Layers Selection Tab

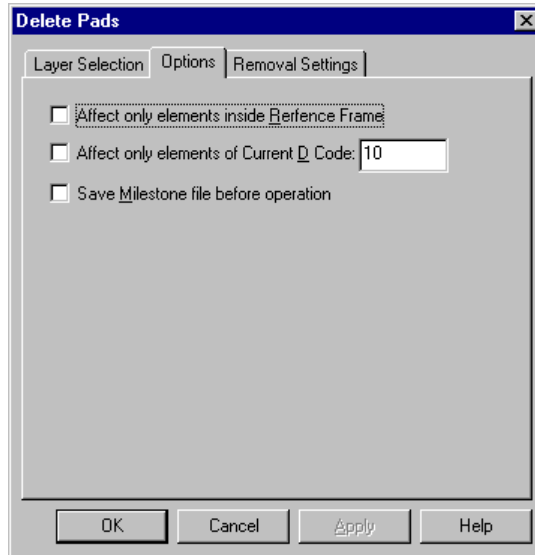
Source Layers: Select the layers where the non-functional pads are located.

First Destination Layer:

- If you are going to transfer pads, select the first layer where you want the non-functional pads to be transferred.
- If you want to select pads rather than delete or transfer them, select **Same**.
- If you want to delete pads, you don't need to select destination layers.

Clear Destination Layers First: This option clears all data out of the destination layers before transferring the pads. To have the system clear the destination layers before running the operation, click this option so that it has a check mark. Otherwise do not check this option. Do not use this option if there is any data on the destination layers that you want to keep.

7. On the **Options** tab, set the standard Options.



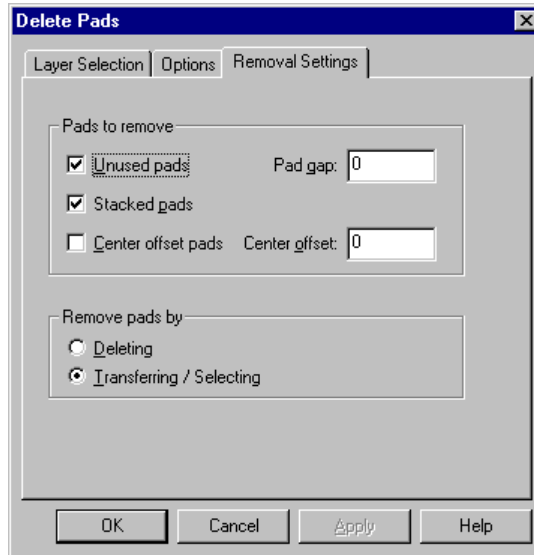
Delete Pads Options Tab

Affect only Elements Inside the Reference Frame: A check mark indicates the program will only affect pads that are inside the Reference Frame. No check mark means the system will check the entire plot.

Current D Code Only: A check mark indicates the program will only affect elements of the current D Code. If you select this option, set the current D Code in the D Code edit field. No check mark means the system will check all elements regardless of D Code.

Save Milestone Before Operation: This option saves a Milestone file before running the operation, so in case the results are not what you want, you can easily revert to the Milestone file. To have the system save a Milestone file before running the operation, click this option so that it has a check mark. Otherwise do not check this option.

8. On the **Removal Settings** tab, set the options for what pads to remove:



Delete Pads Removal Settings Tab

Unused Pads: This option removes every pad whose pad region does not touch a trace. The Unused Pads option should be used for inner layers only. The program does not remove pads that touch any part of a trace, not just pads that touch traces at the endpoints. That means that pads intended as feed-through holes are not removed. If you select the Unused Pads option, you can also enter a value for the Pad Gap. The size of the pad is extended by the Pad Gap in both the X and Y dimension to determine if it touches a trace.

Padstacks: This option removes all but the largest pad in a stack. Pads that have the same X and Y centerpoint coordinates are considered to be stacked. This option is especially useful for removing duplicate holes (bit-breakers) in drill files, but do not use the Padstacks option on drill files that contain pads intentionally stacked as leader holes.

Center Offset: This option removes all but the largest pad with a center-to-center distance smaller than the Center Offset Value. Do not use Center Offset on drill files that use holes to make slots.

9. On the **Removal Settings** tab, set the options for how to remove the pads:

Delete Pads: This option deletes pads from the plot.

Transfer Pads: This option transfers pads to the Destination Layers set on the Layers Tab. If you want to select pads rather than transfer or delete them, select this option, and select Same as the Destination Layer on the Layers Tab.

10. On the main Delete Pads dialog, click **OK**.

Snap Data to Padmaster



CAM



PRO



VM



MATE

The program can move all pads and traces in a set of source layers whose endpoints are within a user specified tolerance of a pad in the padmaster layer to the padmaster pad center.

This operation should be used to precisely align elements to a padmaster, not to align grossly misaligned layers. For instance, after Deleting Non-Functional Pads with the Center Offset option, you could use Snap to Padmaster to insure that the remaining pads are precisely aligned. Or you could use this operation to align scanned artwork to a drill file.

The program can also snap selected elements to the grid. See *Snap Selected Elements to the Grid* on page 142.

To Snap Data to the Padmaster:

1. Make the **layers** you want to edit are active, visible layers. See *Select from the Active Layers* on page 152.
2. Set the **Visibility** settings.

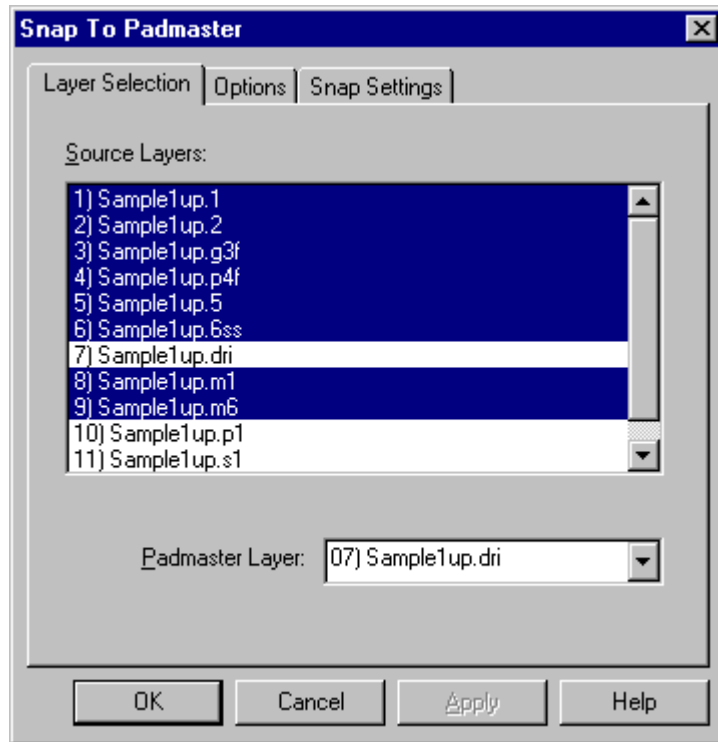
The operation only checks visible elements, so make sure all pads, traces, selected, and unselected elements to be checked are visible. See *Element Visibility* on page 84.

3. If you want to snap only part of the plot, position the **reference frame** around that part. See *Reference Frame* on page 177.



If you want to check all data, it does not matter where the reference frame is positioned.

4. On the **Tools** menu, click **Snap to Padmaster**.
5. On the **Layers** tab, select the layers for the operation.

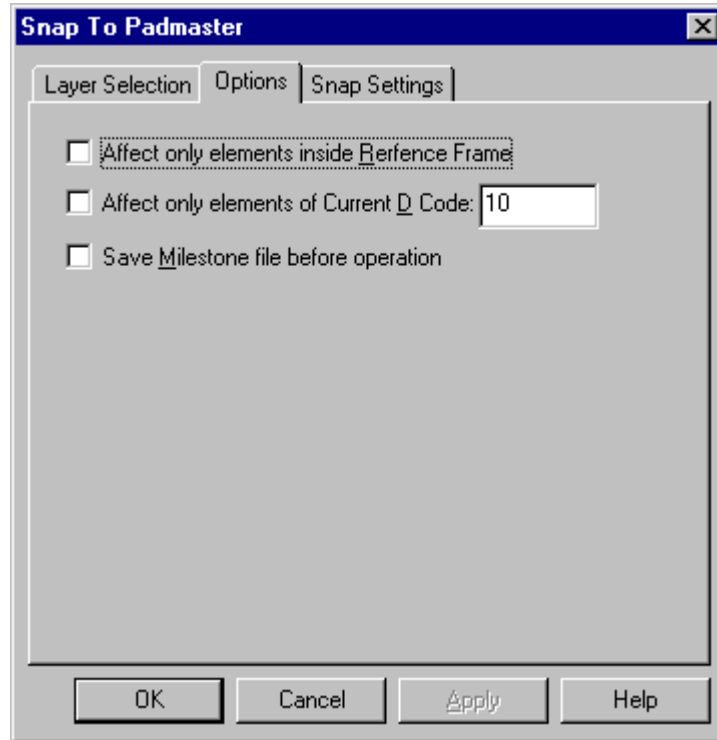


Snap to Padmaster Layers Selection Tab

Source Layers: Select the layers that contain the elements you want to snap.

Padmaster Layer: Select the padmaster layer that contains the pads you want the source layers to snap to.

6. On the **Options** tab, set the standard Options.



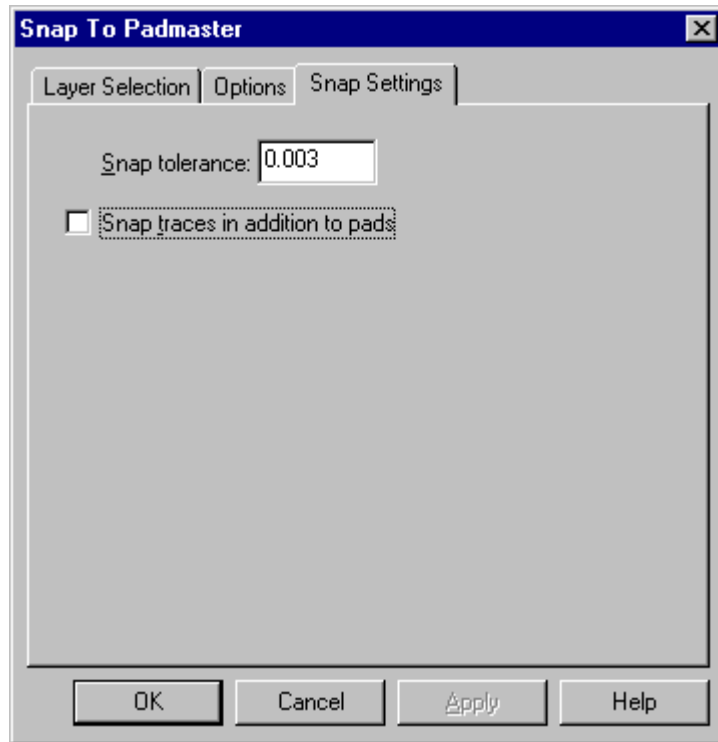
Snap to Padmaster Options Tab

Affect only Elements Inside the Reference Frame: A check mark indicates the program will only affect elements that are inside the Reference Frame. No check mark means the system will check the entire plot.

Current D Code Only: A check mark indicates the program will only affect elements of the current D Code. If you select this option, set the current D Code in the D Code edit field. No check mark means the system will check all elements regardless of D Code.

Save Milestone Before Operation: This option saves a Milestone file before running the operation, so in case the results are not what you want, you can easily revert to the Milestone file. To have the system save a Milestone file before running the operation, click this option so that it has a check mark. Otherwise do not check this option.

7. On the **Snap Settings** tab, set the snap settings.



Snap to Padmaster Snap Settings Tab

Tolerance: Enter the maximum distance from a Padmaster pad center within which the system may find a pad or trace endpoint to snap to that pad center. A tolerance of 0 is infinite tolerance, meaning there is no maximum distance that a trace endpoint or pad center may be snapped.

Warning: Using infinite tolerance or a large, finite tolerance may result in adjacent elements being snapped to the same padmaster centerpoint.

Snap Traces in Addition to Pads: A check mark indicates traces are snapped. No check mark indicates only pads are snapped.

8. On the main Snap to Padmaster dialog, click **OK**.

The program aligns the elements that are within tolerance to the pad centerpoints of the padmaster layer. The system reports how many elements were moved in the message line.

Clip Silkscreen Traces for Padmaster Clearance



The program can automatically clip traces in the silkscreen layer to allow for a specified clearance around pads in the padmaster layer.

To Clip Silkscreen Traces for Padmaster Clearance:

1. Make the padmaster and silkscreen layers active, visible layers. See *Select from the Active Layers* on page 152.
2. On the **D Code Table** and the **Tool Code Table**, define all D Codes and Tool Codes. The program needs accurate dimensions in order to determine the clearance.
3. Set the **Visibility** settings.

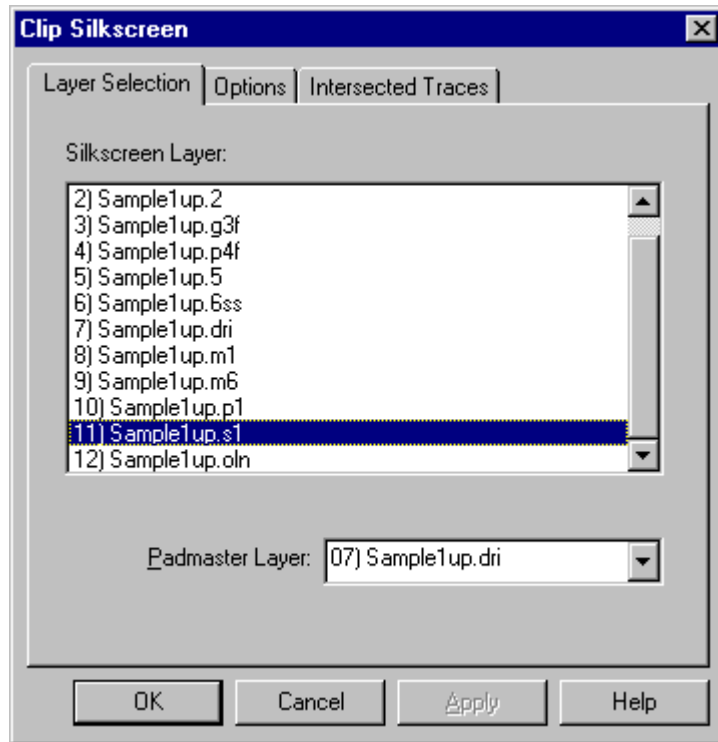
The operation only checks visible elements, so make sure all pads, traces, selected, and unselected elements to be checked are visible. See *Element Visibility* on page 84.

4. If you want to clip silkscreen from only part of the plot, position the **reference frame** around that part. See *Reference Frame* on page 177.



If you want to check all data, it does not matter where the reference frame is positioned.

5. On the **Tools** menu, click **Clip Silkscreen Traces**.
6. On the **Layers** tab, select the layers for the operation.

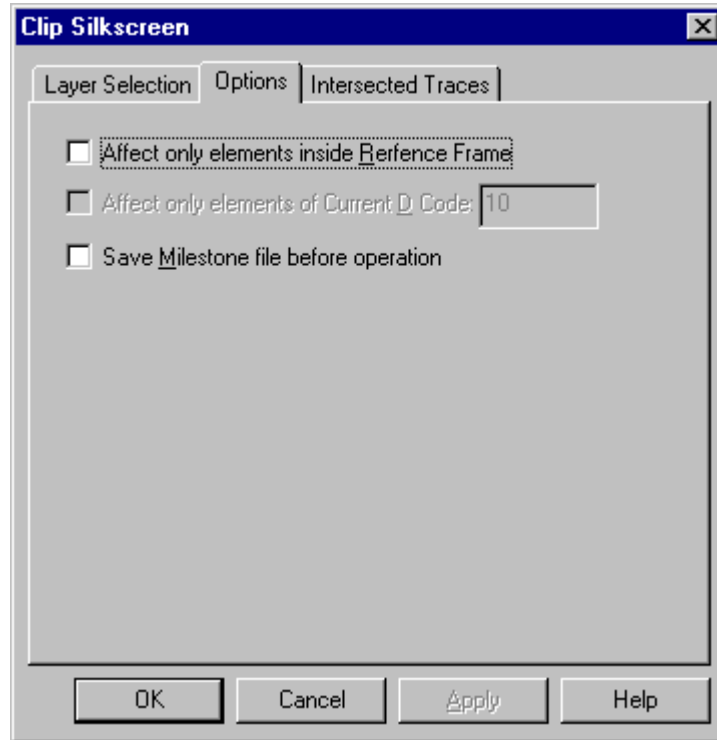


Clip Silkscreen Layers Selection Tab

Silkscreen Layer: Select the silkscreen layer to clip.

Padmaster Layer: Select the padmaster layer that the silkscreen layer will be clipped to.

7. On the **Options** tab, set the standard Options.

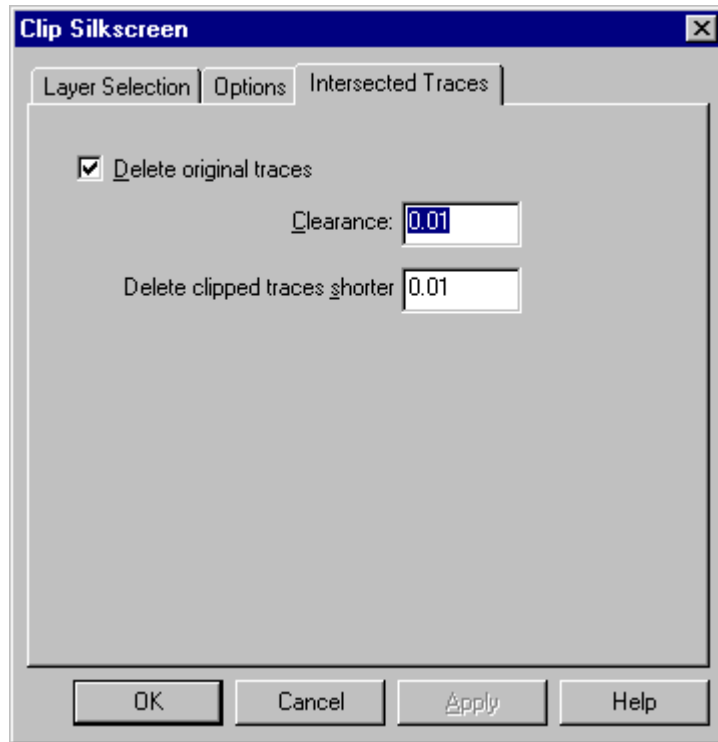


Clip Silkscreen Options Tab

Affect only Elements Inside the Reference Frame: A check mark indicates the program will only clip silkscreen traces that are inside the Reference Frame. No check mark means the system will check the entire plot.

Save Milestone Before Operation: This option saves a Milestone file before running the operation, so in case the results are not what you want, you can easily revert to the Milestone file. To have the system save a Milestone file before running the operation, click this option so that it has a check mark. Otherwise do not check this option.

8. On the Intersected Traces tab, set the options for determining whether and how traces are clipped.



Clip Silkscreen Intersected Traces Tab

Delete Original Traces: When this option has a check mark, the system deletes the original traces as it inserts the clipped traces. When this option does not have a check mark, the system selects the original traces as it inserts the clipped traces. You can view the selected traces, and if you want to delete them use the Delete command; otherwise revert to the Milestone file and run the operation again with different settings.

Clearance: Enter the minimum allowed clearance around pads in the padmaster layer. Silkscreen traces that come closer than the clearance are clipped.

Delete Traces Shorter Than: Enter the minimum clipped trace length allowed. Traces shorter than this after clipping are deleted.

9. On the main Clip Silkscreen dialog, click **OK**.

When the operation finishes, the system reports how many traces were affected on the message line.

Generate Soldermask Data from Padmaster



CAM



PRO



VM



MATE

The program can generate a soldermask layer from a padmaster layer. For each D Code in a padmaster layer the module generates a corresponding swelled D Code in the soldermask layer using existing D Codes of the correct size or creating new ones for the swelled D Codes.

To Generate a Soldermask Layer:

1. Make the padmaster layer and the new soldermask layer active, visible layers. See *Select from the Active Layers* on page 152.
2. On the **D Code Table** and the **Tool Code Table**, define all D Codes and Tool Codes. The program needs accurate dimensions in order to determine the new soldermask layer D Code dimensions.
3. Set the **Visibility** settings.

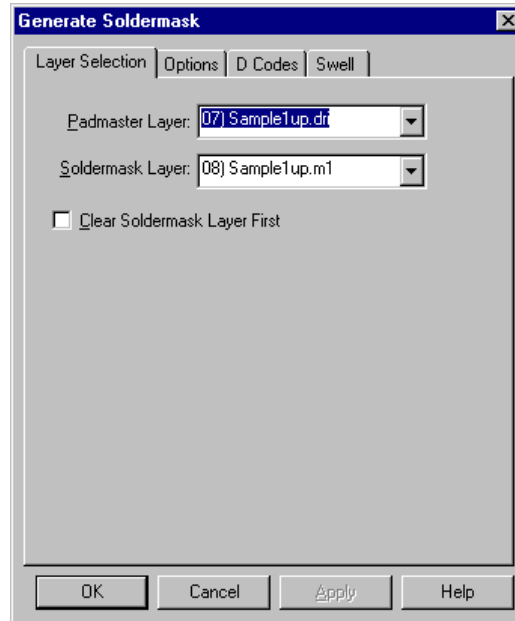
The operation only checks visible elements, so make sure all pads, traces, selected, and unselected elements to be checked are visible. See *Element Visibility* on page 84.

4. If you want to generate soldermask for only part of the plot, position the **reference frame** around that part. See *Reference Frame* on page 177.



If you want to check all data, it does not matter where the reference frame is positioned.

5. On the **Tools** menu, click **Generate Soldermask**.
6. On the **Layers** tab, select the layers for the operation.



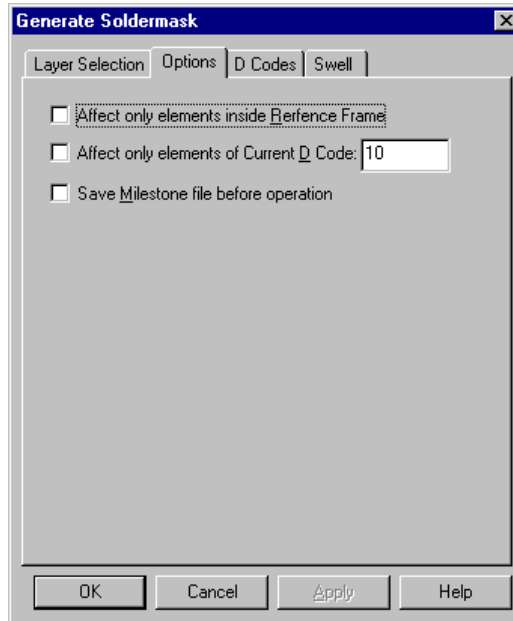
Generate Soldermask Layers Selection Tab

Padmaster Layer: Select the padmaster layer to be used as the model for the soldermask.

Soldermask Layer: Select the new soldermask layer to be generated.

Clear Soldermask Layers First: This option clears all data out of the new soldermask layers before generating the soldermask. To have the system clear the soldermask layer before running the operation, click this option so that it has a check mark. Otherwise do not check this option. Do not use this option if there is any data on the soldermask layer that you want to keep.

7. On the **Options** tab, set the standard Options.



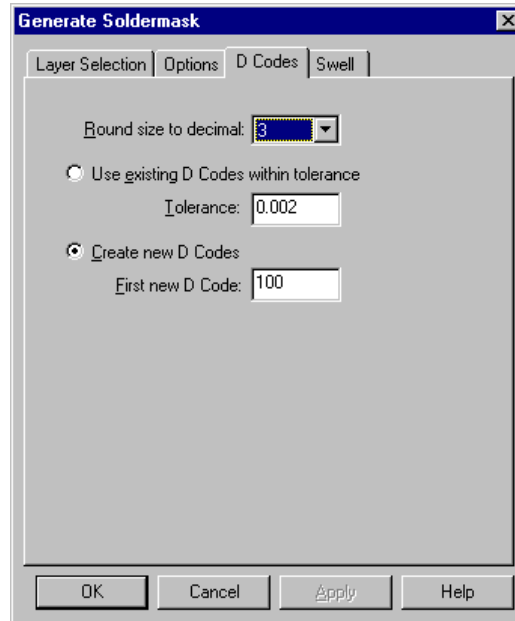
Generate Soldermask Options Tab

Affect only Elements Inside the Reference Frame: A check mark indicates the program will only generate soldermask for the padmaster data that are inside the Reference Frame. No check mark means the system will check the entire plot.

Current D Code Only: A check mark indicates the program will only generate soldermask for the padmaster data of the current D Code. If you select this option, set the current D Code in the D Code edit field. No check mark means the system will check all elements regardless of D Code.

Save Milestone Before Operation: This option saves a Milestone file before running the operation, so in case the results are not what you want, you can easily revert to the Milestone file. To have the system save a Milestone file before running the operation, click this option so that it has a check mark. Otherwise do not check this option.

8. On the D Codes tab, set the options for how you want to handle D Codes for the new soldermask data.



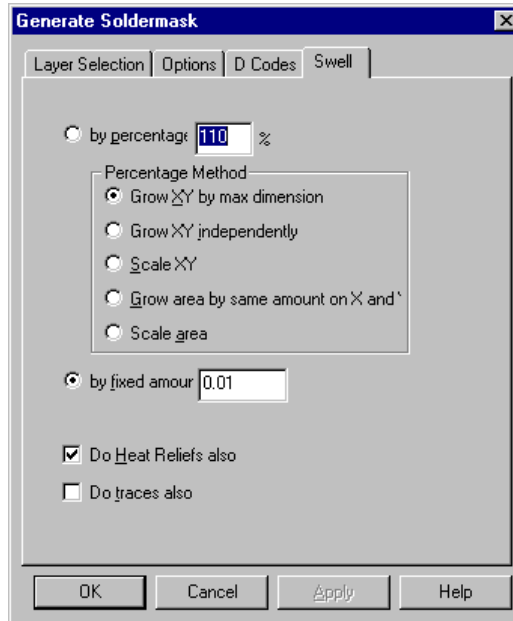
Generate Soldermask D Codes Tab

Round Decimal to: Enter the number of places after the decimal point for new D Code sizes. The program can calculate exact sizes for new D Codes based on parameters of the Swell tab, but you can set the decimal place to round the sizes to.

Use Existing D Codes within Tolerance: This option uses the closest available existing D Code size within tolerance for the soldermask data. If you use this option, enter a **Tolerance**. A tolerance of zero forces the system to select exact-size D Codes. If no appropriate D Code is found, the system aborts the operation with a message indicating the aperture shape and size were not found.

Create New D Code: This option creates new D Codes not currently defined in the D Code table for the soldermask data. If you select this option, enter the **First New D Code** to be created.

9. On the Swell tab, set the options for how to swell the soldermask data.



Generate Soldermask Swell Tab

By Percentage: This option swells the soldermask elements to a percentage of the padmaster elements (i.e., 100 percent equals no increase, 110 means soldermask pads are 110 percent of the size of padmaster pads, etc.). If you select this option you must also set the percentage and pick one of the following methods:

- **Area:** The area of the soldermask elements equals the designated percentage of the padmaster elements.
- **X and Y Independently:** The X and Y dimensions of the soldermask elements equal the designated percentage of the padmaster element dimensions.
- **Scale:**

Fixed Amount: This option makes the soldermask element dimensions a fixed amount larger than the padmaster elements. If you select this option you must also set the amount to increase the soldermask element dimension over the padmaster elements.

Swell Heat Reliefs also: This option swells Heat Reliefs in addition to other pads in the soldermask.

Swell Traces also: This option swells Traces in addition to pads in the soldermask.

10. On the main Generate Soldermask dialog, click **OK**.

The program generates the soldermask data. In the message line the system reports how many elements were generated and how many new D Codes were defined.

Generate Outline Data



The Raster Outline Routine is only available in CAMMaster, while the Vector Outline Routine is available in ViewMaster PRO as well.

The program can generate outline files for all elements in selected layers using either a Raster outline Routine or a Vector Outline Routine.

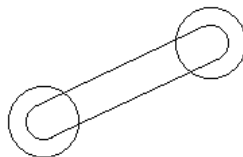
Differences between Raster and Vector Outline Routines

The Vector Outline Routine generates linear and arc data outlines for all elements. Elements that overlap generate overlapping outlines with the Vector Outline Routine. The outlines can be swollen or contracted by a designated amount, and you have the option to generate outlines for traces and pads or for pads only.

The Raster Outline Routine first creates a raster bitmap of the image and then generates outlines that trace the vertices of the outline of the bitmap. Elements that overlap do not generate overlapping outlines with the Raster Outline Routine; the operation produces one outline for the overlapped image. The accuracy of the outlines generated by the Raster Outline Routine is limited by the raster resolution, and round elements and arcs are generally jagged due to the raster resolution. The Raster Outline Routine does not generate any arc data.



Original Data Elements to Outline



Vector Outlines



Raster Outlines

Vector Outline Routine



The program can generate outline files for all elements in selected layers. Outlines are drawn on destination layers with an F-type D Code and can be swollen or contracted by a designated amount.

The outlines represent linear and arc data that can be used to generate cut patterns for making stencils.

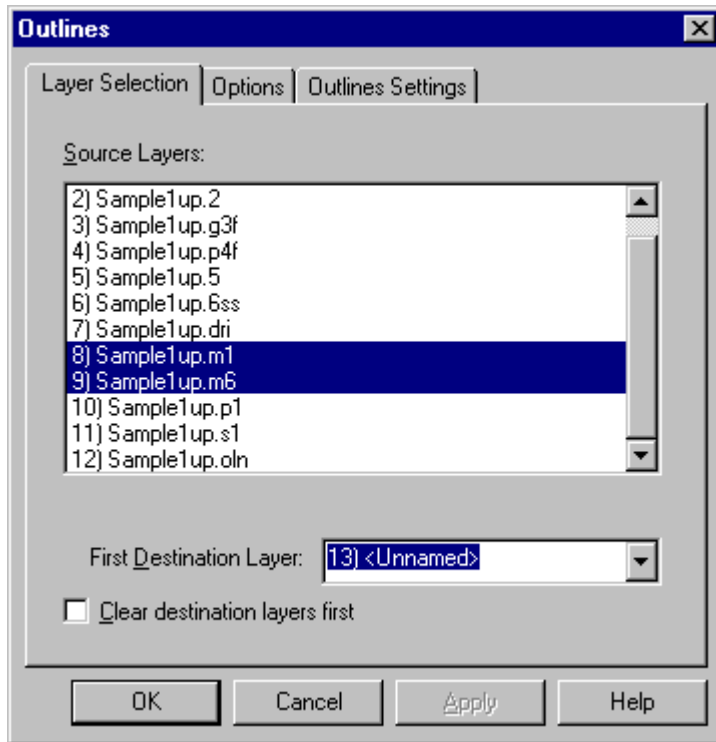
To Generate Element Outlines with the Vector Outline Routine:

1. Make the **source layers** and **destination layers** active, visible layers. See *Select from the Active Layers* on page 152.
2. On the **D Code Table** and the **Tool Code Table**, define all D Codes and Tool Codes. The program needs accurate dimensions in order to outline the elements properly.
3. Set the **Visibility** settings.
The operation only checks visible elements, so make sure all pads, traces, selected, and unselected elements to be checked are visible. See *Element Visibility* on page 84.
4. If you want to outline elements on only part of the plot, position the **reference frame** around that part. See *Reference Frame* on page 177.



If you want to check all data, it does not matter where the reference frame is positioned.

5. On the **Tools** menu, click **Generate Outlines-Vector**.
6. On the **Layers** tab, select the layers for the operation.



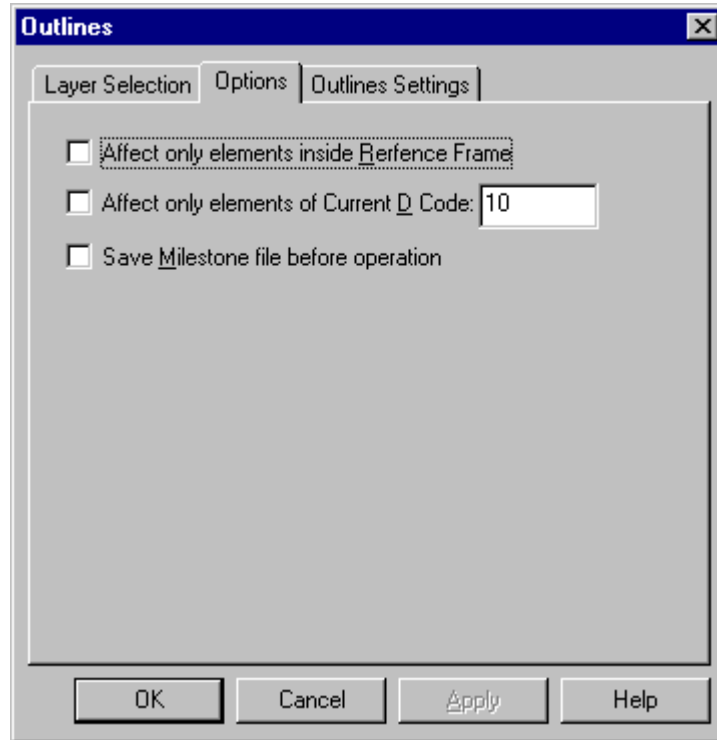
Generate Outlines Layers Selection Tab

Source Layers: Select the layers where the elements you want to outline are located.

First Destination Layer: Select the first layer where the outlines are to be generated.

Clear Destination Layers First: This option clears all data out of the destination layers before generating the outline data. To have the system clear the destination layers before running the operation, click this option so that it has a check mark. Otherwise do not check this option. Do not use this option if there is any data on the destination layers that you want to keep.

7. On the **Options** tab, set the standard Options.



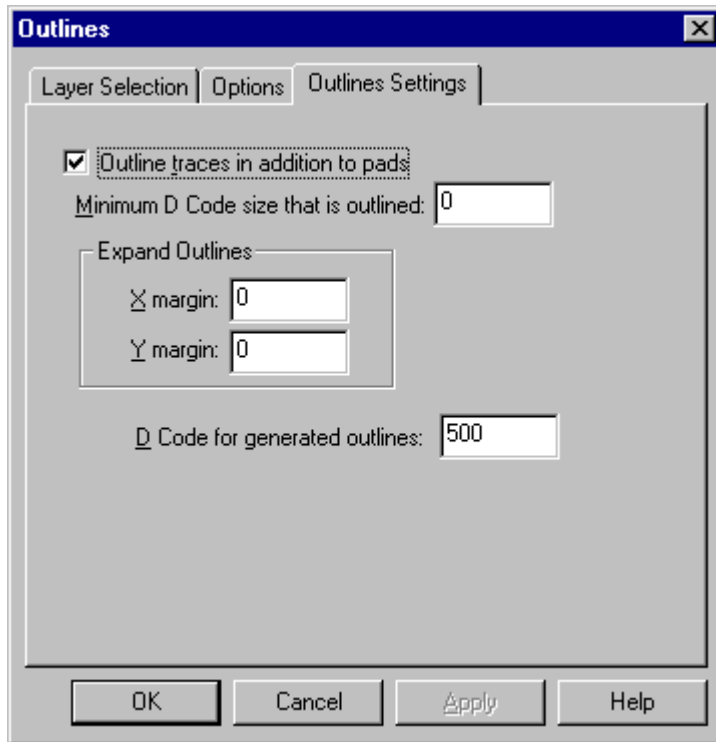
Generate Outlines Options Tab

Affect only Elements Inside the Reference Frame: A check mark indicates the program will only outline elements that are inside the Reference Frame. No check mark means the system will check the entire plot.

Current D Code Only: A check mark indicates the program will only outline elements of the current D Code. If you select this option, set the current D Code in the D Code edit field. No check mark means the system will check all elements regardless of D Code.

Save Milestone Before Operation: This option saves a Milestone file before running the operation, so in case the results are not what you want, you can easily revert to the Milestone file. To have the system save a Milestone file before running the operation, click this option so that it has a check mark. Otherwise do not check this option.

8. On the **Outlines Settings** tab, set the outlines settings.



Generate Outlines Settings Tab

Outline Traces in Addition to Pads: A check mark indicates the program will outline traces in addition to pads. No check mark indicates only traces will be outlined.

Minimum D Code Size that is Outlined: Enter a minimum D Code size to outline. Only D Codes larger than this will be outlined. If you do not want to limit the D Code size, enter a Zero.

Expand Outlines: Enter the X and Y amounts for the outlines to be expanded or contracted. If you do not want to expand or contract the outlines, enter a Zero.

D Code for Generated Outlines: Enter the D Code to use for the outlines. The system will make this D Code into an F-type.

9. On the main Generate Outlines dialog, click **OK**.

The program generates the outline data. In the message line, the system reports how many elements were outlined.

Raster Outline Routine



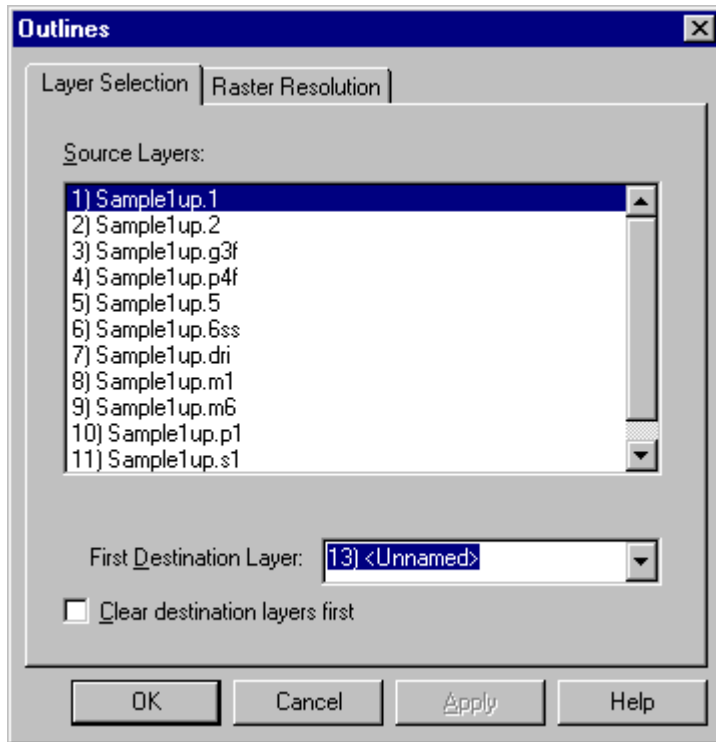
The program can generate outline files for the images in selected layers. Outlines are drawn on destination layers with an F-type D Code. The accuracy of the outlines is limited by the raster resolution.

To Generate Element Outlines with the Raster Outline Routine:

1. Make the **source layers** and **destination layers** active, visible layers. See *Select from the Active Layers* on page 152.
2. On the **D Code Table** and the **Tool Code Table**, define all D Codes and Tool Codes. The program needs accurate dimensions in order to outline the elements properly.
3. Set the **Visibility** settings.

The operation only checks visible elements, so make sure all pads, traces, selected, and unselected elements to be checked are visible. See *Element Visibility* on page 84.

4. On the **Tools** menu, click **Generate Outlines-Raster**.
5. On the **Layers** tab, select the layers for the operation.



Generate Raster Outlines Layers Selection Tab

Source Layers: Select the layers where the elements you want to outline are located.

First Destination Layer: Select the first layer where the outlines are to be generated.

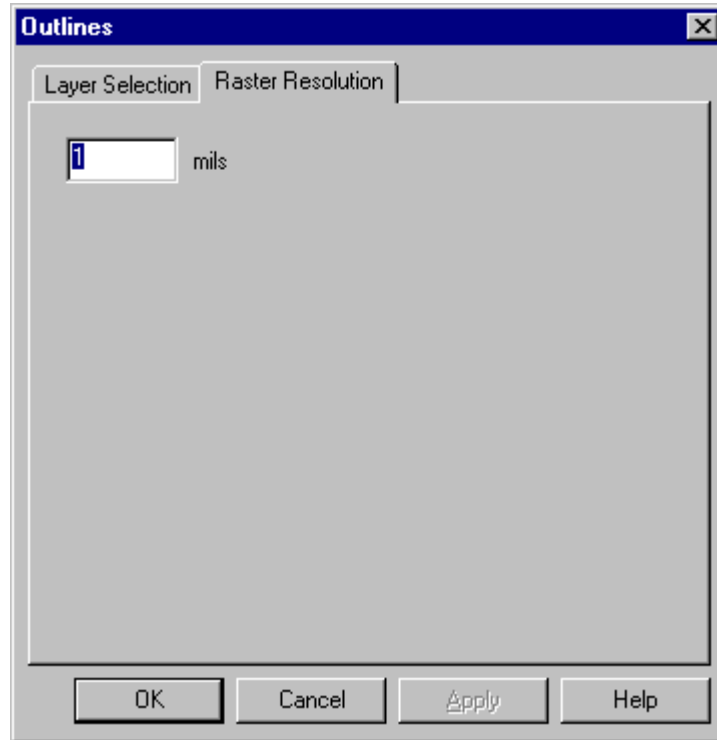
Clear Destination Layers First: This option clears all data out of the destination layers before generating the outline data. To have the system clear the destination layers before running the operation, click this option so that it has a check mark. Otherwise do not check this option. Do not use this option if there is any data on the destination layers that you want to keep.

6. On the **Raster Resolution** tab, enter the **Raster Tools Resolution**.



The Raster Tools Resolution is a very important value because it determines the accuracy of the outlines.

The raster tools resolution is the size of each pixel in the raster bitmaps. You may enter a value from 0.1 through 50 mils, or from 1 through 1000 microns, inclusive. For more information regarding important considerations for setting the Raster Tools Resolution, see *Raster Tools Resolution* on page 425.



Generate Outlines Raster Resolution Tab

7. On the main Generate Outlines dialog, click **OK**.

The program generates the outline data. In the message line, the system reports how many elements were outlined.

Generate Pad Filleting



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The program can generate snowman or teardrop filleting for Gerber plots.

Generate Snowman Fillets



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The program generates Snowman filleting by adding a new, smaller circular pad at the intersection points of existing pads and traces. The resulting shape, smaller pad on top of larger pad, looks like a snowman. You set the fillet placement and size. Fillet pads can be mapped either to existing D Codes or new D Codes.

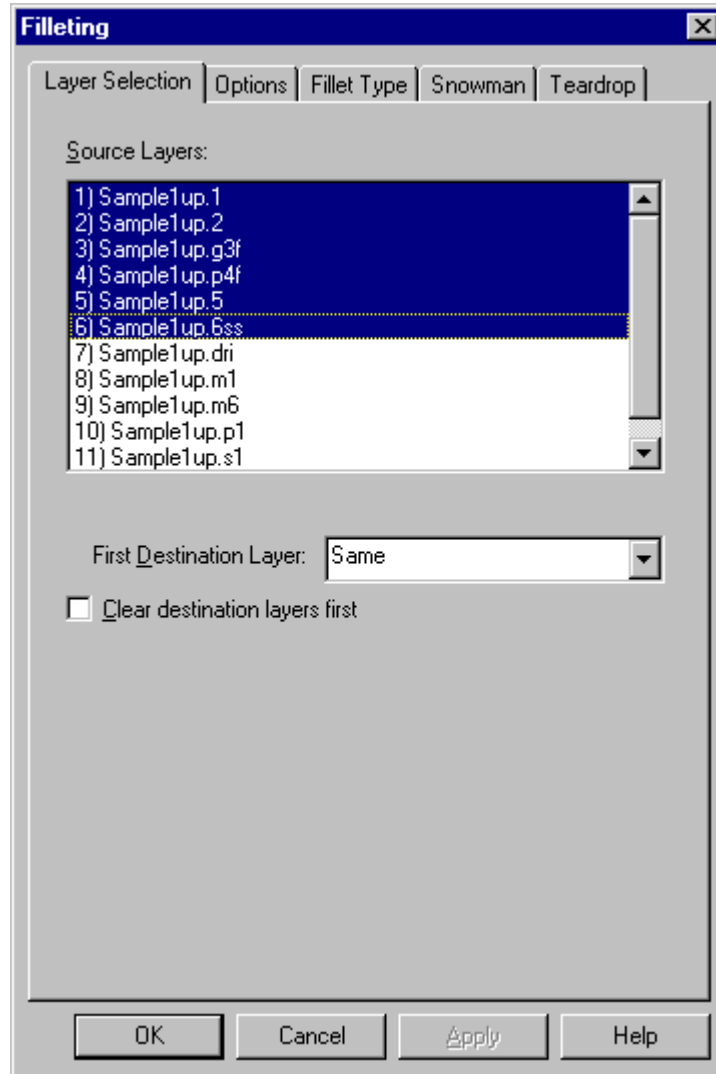
To Generate Snowman Fillets:

1. Make the **layers** you want to add filleting to active, visible layers. See *Select from the Active Layers* on page 152.
2. On the **D Code Table** and the **Tool Code Table**, define all D Codes and Tool Codes. The program needs accurate dimensions in order to determine fillet size and placement.
3. Set the **Visibility** settings.
The operation only checks visible elements, so make sure all pads, traces, selected, and unselected elements to be checked are visible. See *Element Visibility* on page 84.
4. If you want to add filleting to only part of the plot, position the **reference frame** around that part. See *Reference Frame* on page 177.



If you want to check all data, it does not matter where the reference frame is positioned.

5. On the **Tools** menu, click **Add Filleting**.
6. On the **Layers** tab, select the layers for the operation.



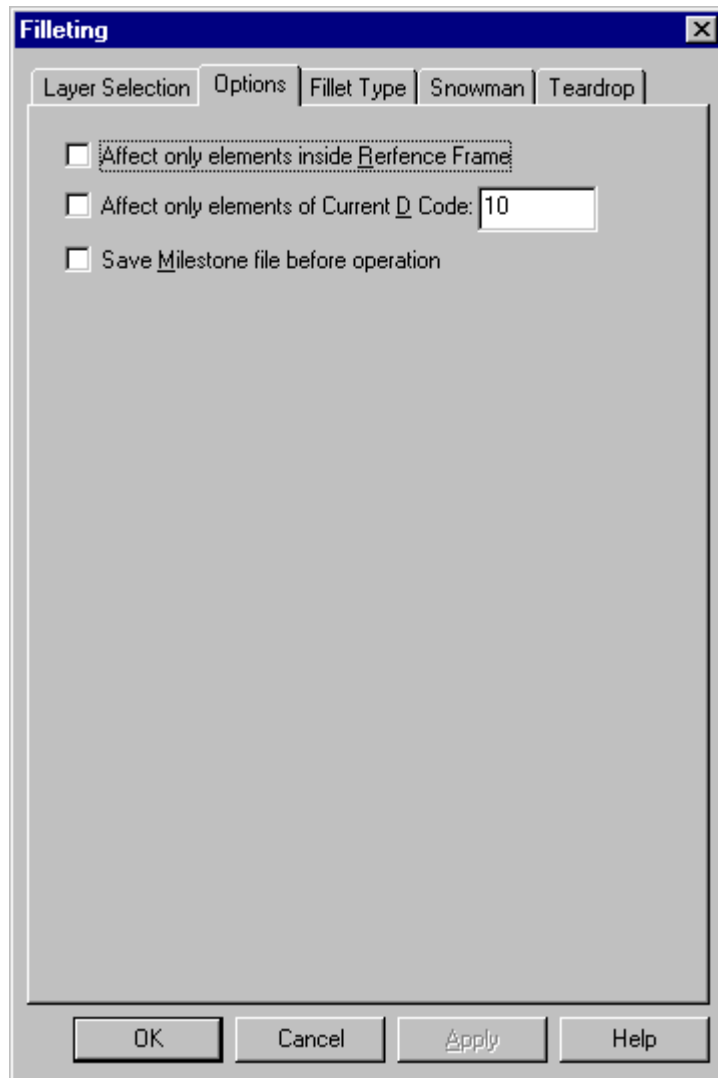
Filleting Layers Selection Tab

Source Layers: Select the layers where the elements you want to generate filleting for are located.

First Destination Layer: Select the layers where you want the filleting elements to be added. If you want the filleting to be added directly to the source layers, select **Same**.

Clear Destination Layers First: This option clears all data out of the destination layers before generating the filleting elements. To have the system clear the destination layers before running the operation, click this option so that it has a check mark. Otherwise do not check this option. Do not use this option if there is any data on the destination layers that you want to keep.

7. On the **Options** tab, set the standard Options.



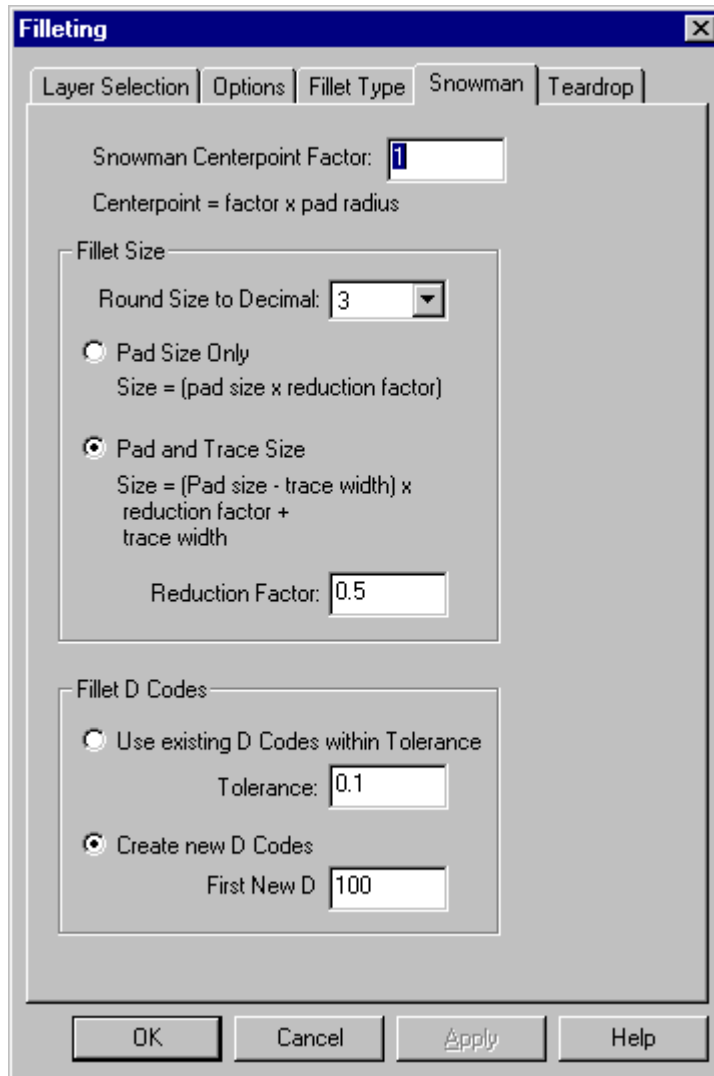
Filleting Options Tab

Affect only Elements Inside the Reference Frame: A check mark indicates the program will only generate fillets for pads that are inside the Reference Frame. No check mark means the system will generate fillets for the entire plot.

Current D Code Only: A check mark indicates the program will only generate fillets for elements of the current D Code. If you select this option, set the current D Code in the D Code edit field. No check mark means the system will generate fillets for all elements regardless of D Code.

Save Milestone Before Operation: This option saves a Milestone file before running the operation, so in case the results are not what you want, you can easily revert to the Milestone file. To have the system save a Milestone file before running the operation, click this option so that it has a check mark. Otherwise do not check this option.

8. On the **Fillet Type** tab, select **Snowman Filletting**.
9. On the **Snowman** tab, set the snowman filleting options.



Filleting Snowman Tab

Snowman Centerpoint Factor: Enter a Snowman Centerpoint Factor to determine the placement of the snowman pad. The snowman pad is placed at a point on the incoming trace that is at a distance from the original pad's centerpoint. The Distance is equal to the Factor x Radius of the original pad. So a factor of 1 puts the snowman at the intersection of the trace and the edge of the pad. And a factor of .5 puts the snowman pad half way between the edge of the original pad and it's center.

Fillet Size options:

- **Round Size to Decimal:** Enter the decimal position to round the size to. The system can calculate an exact size for the snowman pads based on the equations below, but you pick the decimal position to round to.
- **Pad Size Only:** This option calculates the snowman pad size based on only the original pad's size. The Snowman Pad Size is equal to the Original Pad Size x the Reduction Factor.
- **Pad and Trace Size:** This option calculates the snowman pad size based on both the original pad's size and the width of the incoming trace. The Snowman Pad Size is equal to (Original Pad Size – Trace Width) x the Reduction Factor + Trace Width.
- **Reduction Factor:** Enter a reduction factor for the size formula you selected.

D Code options:

- **Use Existing D Codes within Tolerance:** This option uses the closest available existing D Code size within tolerance for the fillet pads. If you use this option, enter a **Tolerance**. A tolerance of zero forces the system to select exact-size D Codes. If no appropriate D Code is found, the system aborts the operation with a message indicating the aperture shape and size were not found.
- **Create New D Code:** This option creates new D Codes not currently defined in the D Code table for the fillet pads. If you select this option, enter the **First New D Code** to be created.

10. On the main Filleting dialog, click **OK**.

Generate Teardrop Fillets



The program generates Teardrop filleting by drawing a triangular shape at the intersection points of existing pads and traces. The fillet is drawn from traces of the same D Code as the incoming trace. You set the start point on the incoming trace. Teardrop filleting can only be added to round pads.

To Set Teardrop Fillet Options:

1. Make the **layers** you want to add filleting to active, visible layers. See *Select from the Active Layers* on page 152.
2. On the **D Code Table** and the **Tool Code Table**, define all D Codes and Tool Codes.
 - The program needs accurate dimensions in order to determine fillet size and placement.
 - Teardrop filleting can only be added to Round © shapes. To add teardrop filleting to another shape pad, temporarily transcode it to a Round pad, add the filleting, and then convert the pad back to its original shape.
3. Set the **Visibility** settings.

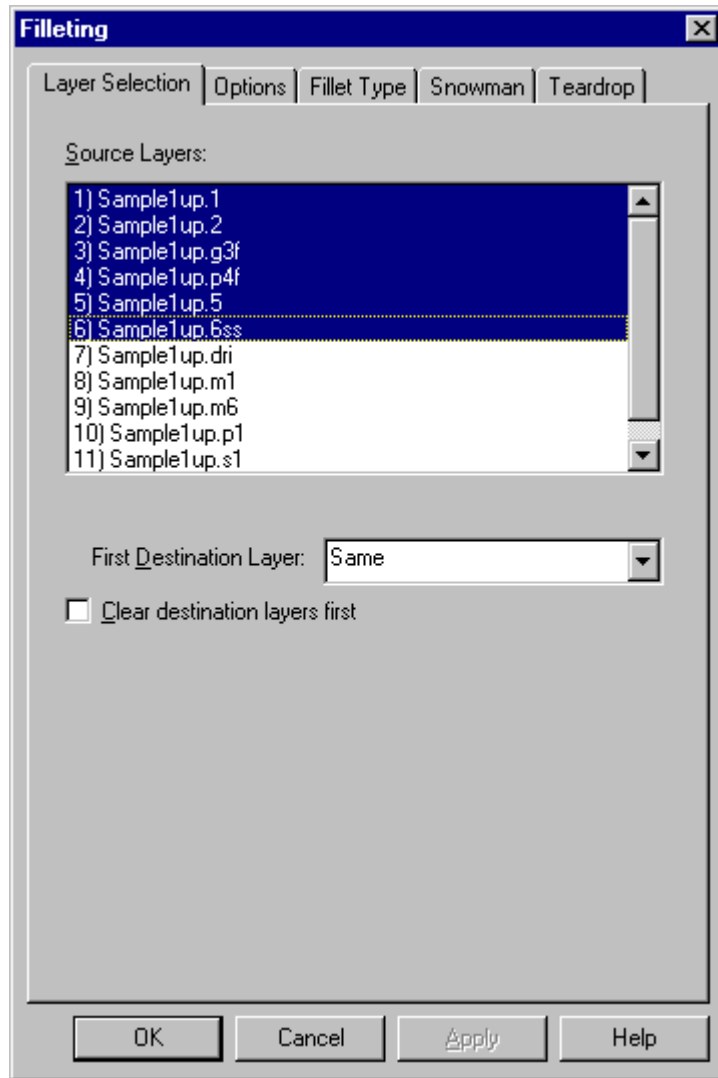
The operation only checks visible elements, so make sure all pads, traces, selected, and unselected elements to be checked are visible. See *Element Visibility* on page 84.

4. If you want to add filleting to only part of the plot, position the **reference frame** around that part. See *Reference Frame* on page 177.



If you want to check all data, it does not matter where the reference frame is positioned.

5. On the **Tools** menu, click **Add Filleting**.
6. On the Layers tab, select the layers for the operation.



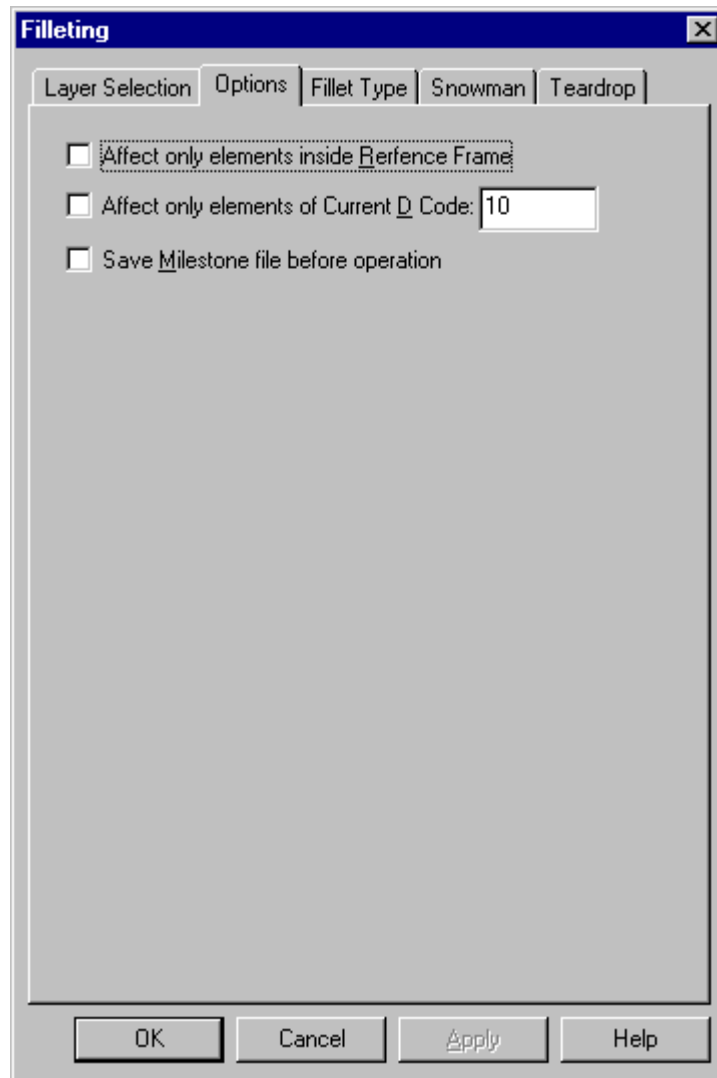
Filleting Layers Selection Tab

Source Layers: Select the layers where the elements you want to generate filleting for are located.

First Destination Layer: Select the layers where you want the filleting elements to be added. If you want the filleting to be added directly to the source layers, select **Same**.

Clear Destination Layers First: This option clears all data out of the destination layers before generating the filleting elements. To have the system clear the destination layers before running the operation, click this option so that it has a check mark. Otherwise do not check this option. Do not use this option if there is any data on the destination layers that you want to keep.

7. On the **Options** tab, set the standard Options.



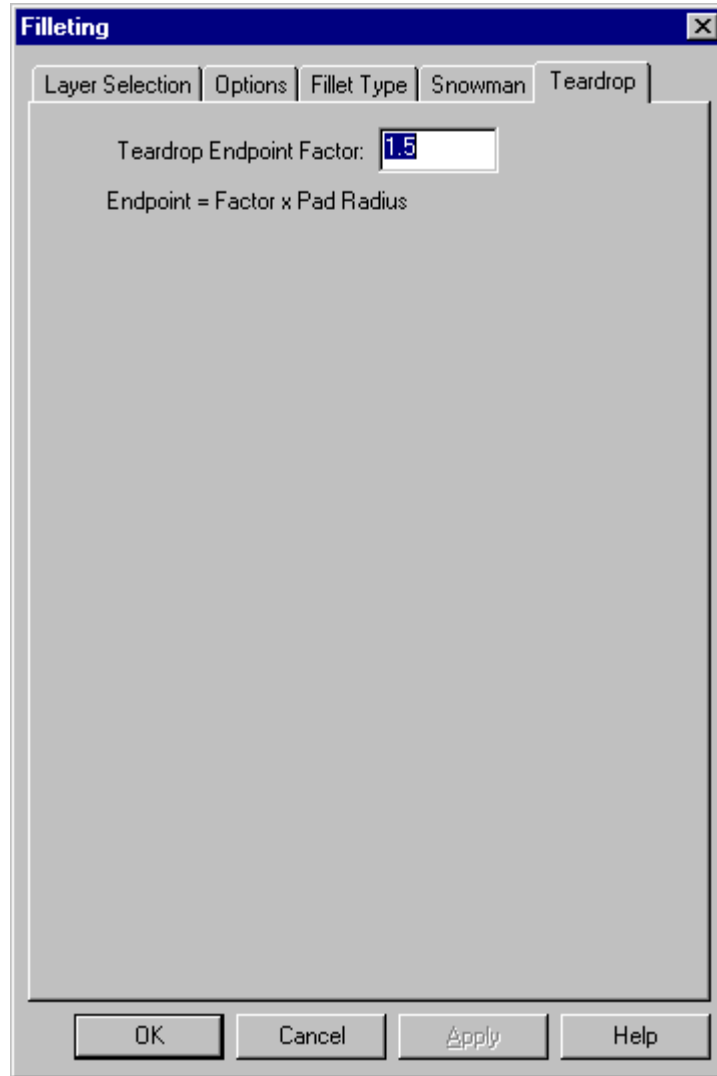
Filleting Options Tab

Affect only Elements Inside the Reference Frame: A check mark indicates the program will only generate fillets for pads that are inside the Reference Frame. No check mark means the system will generate fillets for the entire plot.

Current D Code Only: A check mark indicates the program will only generate fillets for elements of the current D Code. If you select this option, set the current D Code in the D Code edit field. No check mark means the system will generate fillets for all elements regardless of D Code.

Save Milestone Before Operation: This option saves a Milestone file before running the operation, so in case the results are not what you want, you can easily revert to the Milestone file. To have the system save a Milestone file before running the operation, click this option so that it has a check mark. Otherwise do not check this option.

8. On the **Fillet Type** tab, select **Teardrop Filleting**.
9. On the **Teardrop** tab, enter a value for the **Teardrop Endpoint Factor** to determine the fillet size. The Teardrop Endpoint Factor determines the distance from the pad center to the start of the fillet. The distance is equal to the Factor x the Pad Radius. So a factor of 1 would place the start point right at the pad/trace intersection and would yield no filleting. The factor must be greater than 1, and the larger the teardrop factor, the larger the fillet.



Filleting Teardrop Tab

10. On the main Filleting dialog, click **OK**.

Generate Centroid Data



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The program can generate two types of Centroid data files: an ASCII text file containing component numbers and the X, Y coordinates of the pad centers of the source layer, and a Gerber reference file showing pad outlines and component numbers. With some editing the ASCII text file may be used by pick-and-place machines and glue dispensers. The Gerber reference file can be displayed in the viewing area, printed and plotted.

Prepare a Component Footprint File



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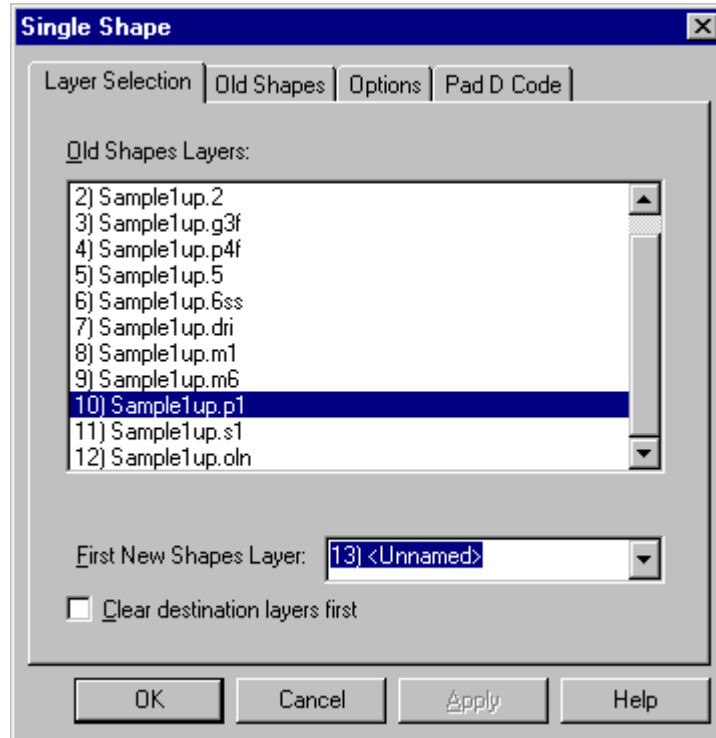
The Centroid Data operation finds individual pad centers and does not automatically recognize component footprints composed of several pads. Therefore, you must represent component footprints as single pads. The following steps convert the multi-pad component footprints of a source layer into single pads on a component footprint layer that you can use for the Centroid Data operation.

To Prepare a Component Footprint File:

1. Import a solderpaste layer.
2. Delete any elements that are not parts of component footprints to be included in the pick-and-place file.
3. Position the **Reference Frame** around the first component footprint to be converted. See *Reference Frame* on page 177.

Because large, complex footprints may look to the program like several smaller and less complex footprints, convert the largest and most complex footprints first.

4. On the **Tools** menu, click **Convert Drawn Pads-Single Shape**.
5. On the **Layers** tab, set the parameters as follows:



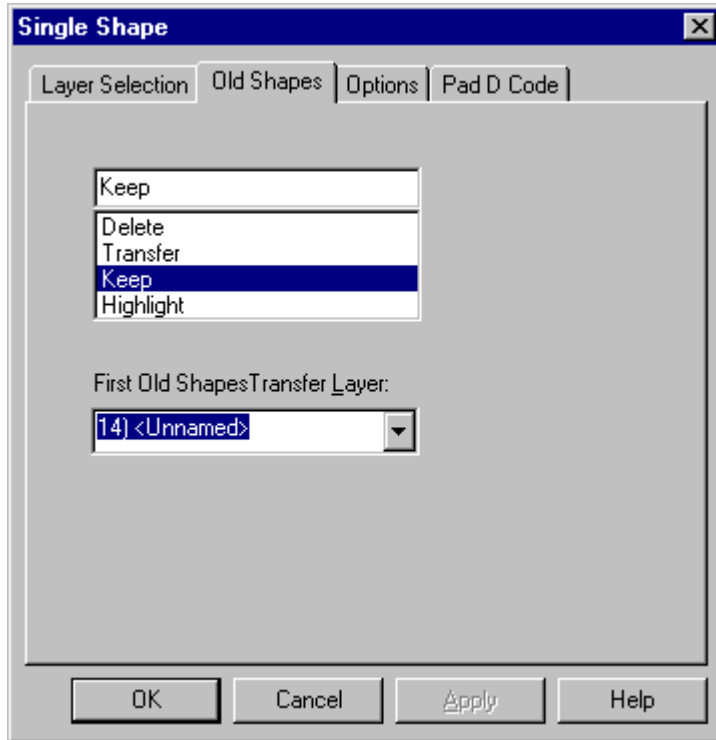
Single Shape Layers Tab for Footprint File

Old Shapes Layers: Select the solderpaste source layer.

First New Shapes Layer: Select the new component footprint layer.

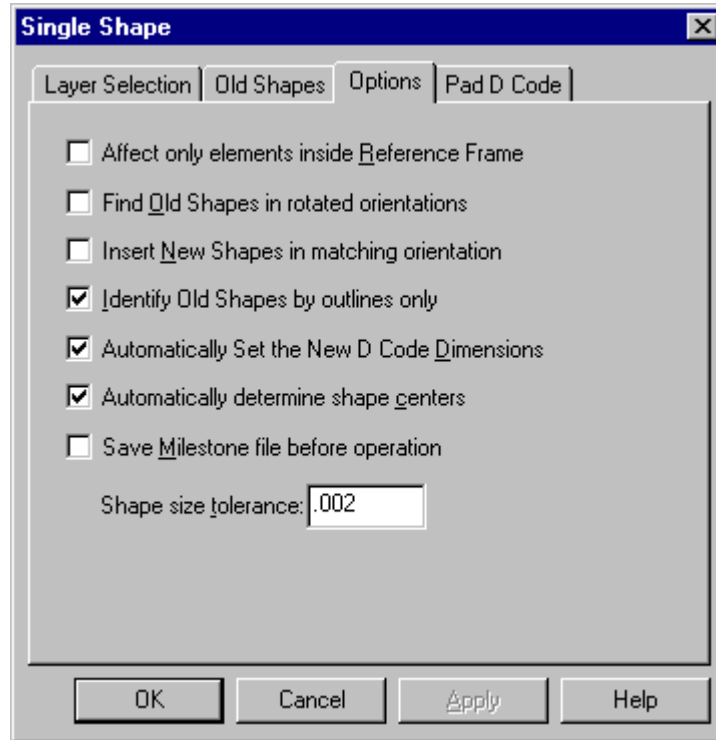
Clear Transfer Layer: Do not check this option.

6. On the **Old Shapes** tab, select **Keep**.



Single Shape Old Shape Tab for Footprint File

7. On the **Options** tab, set the parameters as follows:



Single Shape Options Tab for Footprint File

Identify Old Shapes by Outlines Only: Check this option.

Automatically Set the New D Code Dimensions: Check this option.

Automatically Determine Shape Centers: Check this option.

Tolerance: Enter 1 or 2 mils

Do not check any other Options.

8. On the **Pad D Code** tab, select an **unused D Code**.
9. Click **OK**.

The system converts all instances of the selected component footprint into flashed pads. Continue at step 3 to convert all the remaining component footprints.

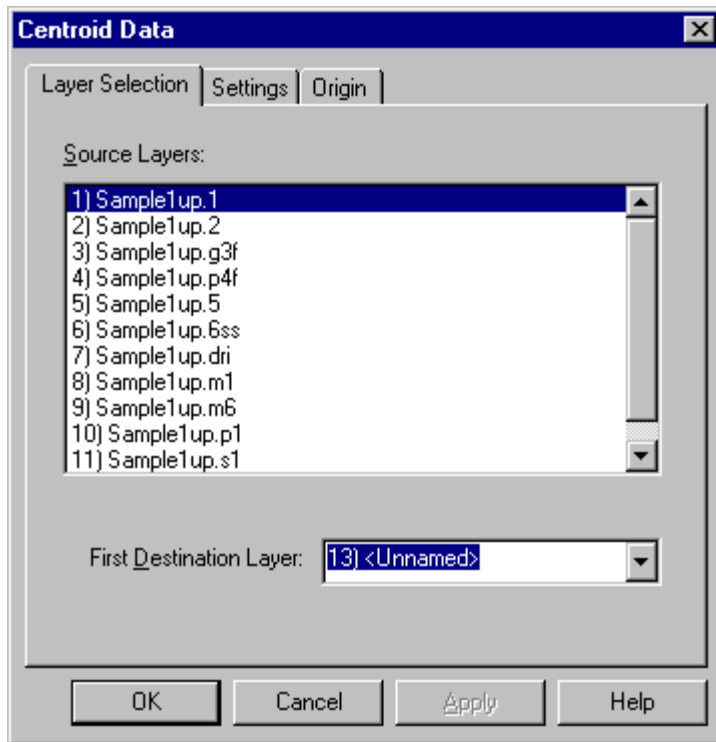
Once all the footprints have been converted to flashed pads, you are ready to run the Centroid operation on the component footprint layer.

Run the Centroid Operation



To Run the Centroid Operation:

1. Make the footprint layer and the destination layer for the Gerber reference data active, visible layers. See *Select from the Active Layers* on page 152.
2. Set the **Visibility** settings.
The operation only works on visible elements, so make sure elements in the footprint file are visible. See *Element Visibility* on page 84.
3. On the **Tools** menu, click **Generate Centroid Data**.
4. On the **Layers** tab, select the layers for the operation.

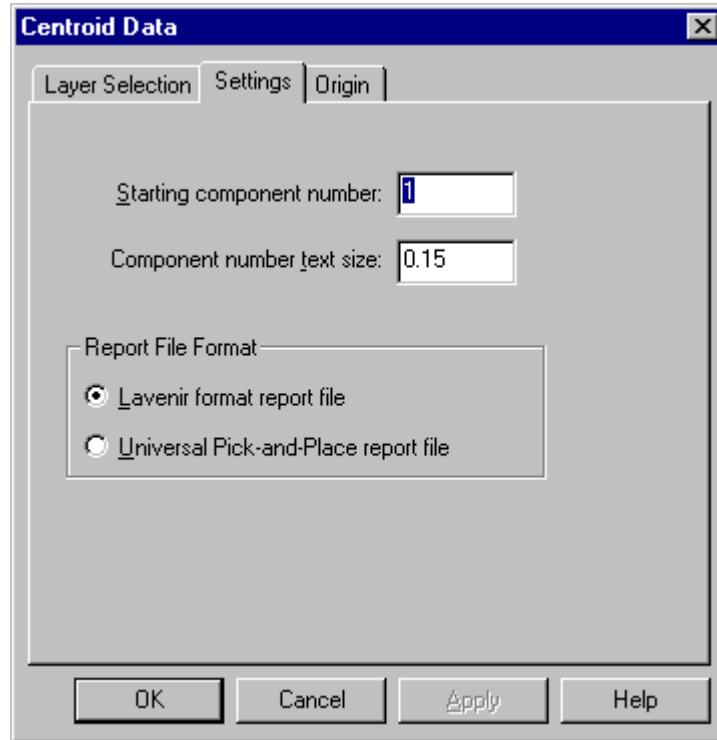


Centroid Data Layers Selection Tab

Source Layer: Select the component footprint layer.

Destination Layer: Select the layer where you want the Gerber reference data to be generated.

5. On the **Settings** tab, set the Centroid options.



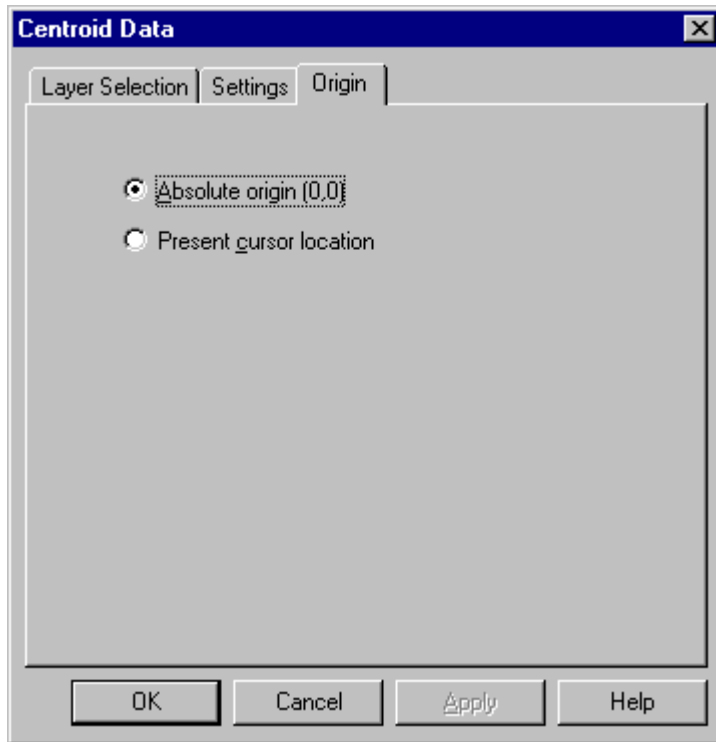
Centroid Data Settings Tab

Starting Component Number: Enter the first number for the program to use when numbering the components.

Component Number Text Size: Enter the size of lettering for the program to use when numbering the components in the Gerber reference file.

Report File Format: Select the format for the ASCII data file: either a **Lavenir Format** report file, or a **Universal Pick-and-Place** report file.

6. On the **Origin** tab, set the origin to be used in the report file.



Centroid Data Origin Tab

Absolute: The report file references the Absolute origin (0,0) as the origin.

Current Cursor Position: The report file references the current cursor position as the origin.

7. On the main Centroid Data dialog, click **OK**.

The program calculates the center for each component footprint pad and assigns each a component number.

The program generates the ASCII file containing component numbers and X, Y coordinate locations for the component centers in the current directory. You will probably need to edit the Centroid report file to the specific requirements of your machine.

View and Edit a Centroid Report File



The Centroid operation generates an ASCII text file containing component numbers and the X, Y coordinates of the pad centers of the component footprint source layer. The file is automatically given the prefix of the Job File with the extension .CEN. With some editing the ASCII text file may be used by pick-and-place machines and glue dispensers.

To View and Edit the Centroid Report File:

1. On the **File** Menu, click a **Report-View**.
2. In the Files of Type list, select All Files (*.*) .
3. In the **Look in** box, click the drive, folder, or network location that contains the report.
4. In the folder list, double-click folders until you open the folder that contains the report you want.
5. **Double-click** the Report.
6. Edit the file as necessary
7. If you want to rename the file, save it under a new name by using the **Save As** command.

Compare Layers



The program can show you differences between any two layers. The program selects or transfers to a destination layer all elements that appear on one of the two original layers but not on the other. You may set the system to ignore D Code differences, which is useful when comparing a padmaster or drill layer to a soldermask.

Run the Layer Comparison



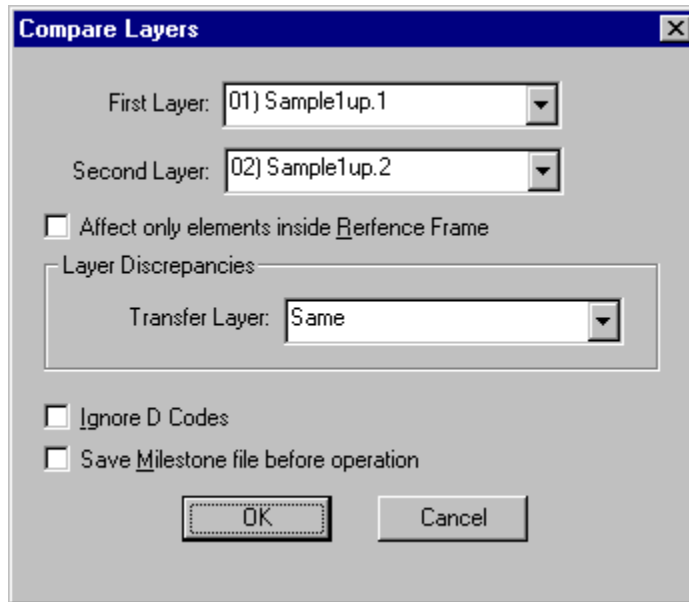
To Run the Layer Comparison:

1. Make the two **layers** you want to compare active, visible layers. See *Select from the Active Layers* on page 152.
2. Set the **Visibility** settings.
The operation only compares visible elements, so make sure all Pads, Traces, Selected, and Unselected Elements to compare are visible. See *Element Visibility* on page 84.
3. If you want to compare only part of the plot, position the **reference frame** around that part. See *Reference Frame* on page 177.



If you want to check all data, it does not matter where the reference frame is positioned.

4. **Clear selection** from all elements.
Depending on your preference, the operation can use selection to indicate layer differences. Clearing the selection first helps avoid confusion.
5. On the **Tools** menu, click **Compare Layers**.



Compare Layers Dialog

6. Select the layers for the operation.

First Layer: Select one of the layers to compare.

Second Layer: Select the other layer to compare.

Layer Discrepancy Transfer Layer: Select the layers you want the differing elements to be transferred to. If you want the differences to be **selected** instead of transferred, select **Same**.

7. Set the remaining options.

Affect only Elements Inside the Reference Frame: A check mark indicates the program only compares elements that are inside the Reference Frame. No check mark means the system compares the entire plot.

Ignore D Codes: A check mark indicates the program only compares element locations; any element that doesn't have a corresponding element at the same location is flagged. No check mark means the system compares both the locations and the D Codes; any element that doesn't have another element of the same D Code at the same location is flagged.

Save Milestone Before Operation: This option saves a Milestone file before running the operation, so in case the results are not what you want, you can easily revert to the Milestone file. To have the system save a Milestone file before running the operation, click this option so that it has a check mark. Otherwise do not check this option.

8. On the main Compare Layers dialog, click **OK**.

The system compares the layers and transfers or selects the elements that are different in the two layers. You can inspect the differences.

Inspect the Layer Differences



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After you have run the layer comparison, differences between the two layers are flagged by transferring or selecting differing elements, depending on the option you set. Here are some suggestions for inspecting the differences:

To Inspect the Layer Differences:

- To clearly see all instances of selected differences, shut off the visibility of unselected elements, leaving only the selected elements visible. See *Element Visibility* on page 84.
- To clearly see all instances of transferred differences, shut off the layer visibility of the non-transfer layers, leaving only the transferred elements visible.
- To see all instances of a particular type of element, query the properties of a selected or transferred element, set the selection criteria to look for only that type of element, and use the First Element and Next Element commands.

Compare Netlists



The netlist comparison feature compares two netlists: one netlist is the netlist under test (NUT) and the other one is the reference netlist (REF). The REF netlist is assumed to be accurate, and the NUT is compared to the REF to find differences. For every pad in the NUT, the system looks for a corresponding pad in the REF. When the system finds corresponding pads, it compares the corresponding nets to find the following types of errors:

- **Shorts:** One net in the NUT corresponds to two or more nets in the REF.
- **Opens:** Two or more nets in the NUT correspond to one net in the REF.
- **Unmapped Nets:** Nets that exist only in the NUT, with no corresponding elements in the REF.



Netlists that exist only in the REF are ignored.

Prepare Data for Netlist Comparison



The netlist data need to be properly prepared in order for the netlist comparison to be accurate.

To Prepare Data for Netlist Comparison:

1. **Load the NUT** netlist information into the system using one of the following techniques.
 - Extract the netlist. See *Netlist Extraction* on page 413. If you do a vector netlist extraction, you will still need to import the netlist.
 - Open or import a job file containing netlist information. See *Open a Job File* on page 22 or *Import a Job File* on page 27.
 - Import a netlist. See *Import Netlist Data* on page 55.
2. **Load the REF** netlist into layers that start at a layer number higher than any of the layers of the NUT. You can use any of the same techniques used to load the NUT.
3. **Align REF and NUT netlists.** See *Move Layers* on page 164 and *Align Layers* on page 167.
4. If necessary, **change the board layer numbers** so that layers in the NUT match corresponding layers in the REF.



The netlist comparison feature compares the netlist information board layer by board layer. Any layer with a board layer number 0 will be compared against all other board layers; this follows the IPC-356 convention of layer 0 being the through hole layer.

- When the data is prepared, you can run the netlist comparison.

Run the Netlist Comparison



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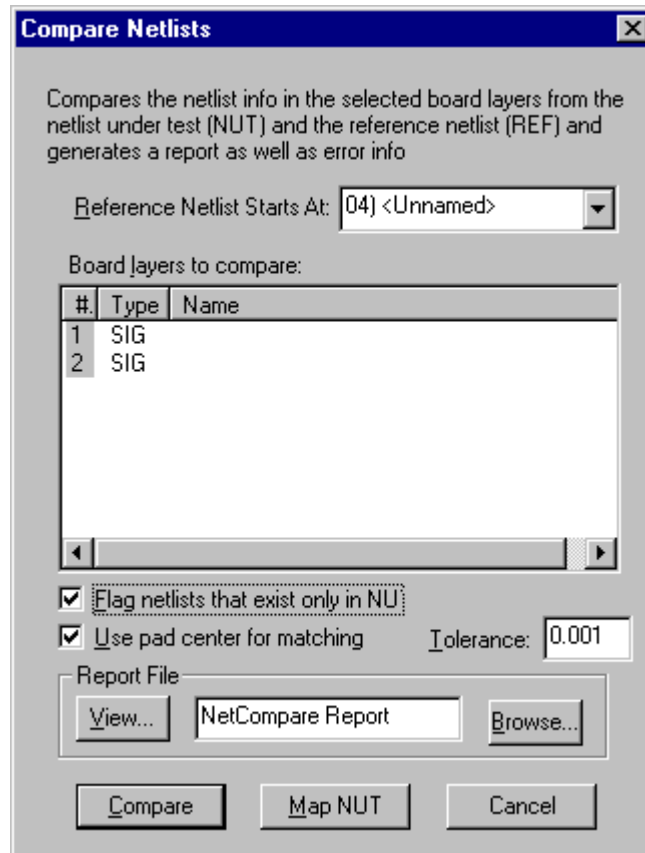
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To Run the Netlist Comparison:

1. When the data is prepared, go to the **Tools** menu, and click **Netlist-NetCompare-Compare Two Netlists**.



Netlist Comparison Dialog

2. On the **Netlist Comparison Dialog**, set the following options:

Reference Net Starts At: Enter the Layer Number where the REF netlist begins. The REF netlist must begin at a higher layer number than any layer of the NUT netlist.

Board Layers to Compare: Select the board layers to compare:

- **Click** a layer to select that layer.

- **Shift+Click** to add multiple layers to the selection.
- **Ctrl+Click** to remove layers from the selection.

Flag Netlists that Exist Only in NUT:

- If the option has a checkmark, then the system will flag netlists that exist only in the NUT and do not have any corresponding elements in the REF.
- If the option does not have a checkmark, then the system will not flag netlists that exist only in the NUT and do not have any corresponding elements in the REF.

Use Pad Center for Matching:

- If the option has a checkmark, then the system will find elements in the REF that correspond to elements in the NUT by comparing the centerpoints of elements. If this option is selected, you can enter a Tolerance value within which the system can identify corresponding centerpoints. A Tolerance of 0 (zero) means that centerpoints must match exactly.
- If the option does not have a checkmark, then the system will find elements in the REF that correspond to elements in the NUT by determining if the elements overlap.

Report File: Enter a file name and path for the report file, or click the Browse button to select from the available directories.

3. Click **Compare**.

The system compares the netlists and reports any differences found by generating a report file and displaying a Netlist Comparison Error dialog.

Inspect Netlist Comparison Discrepancies



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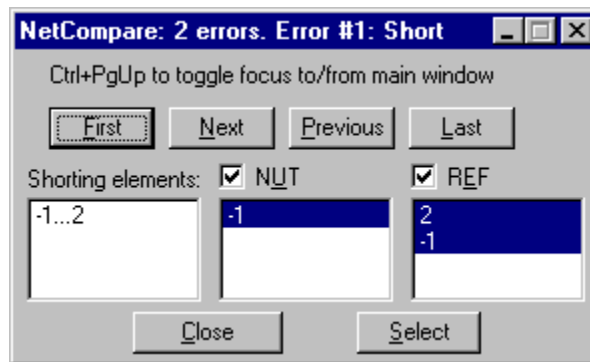
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To Inspect Netlist Comparison Discrepancies:

1. Display the Netlist Comparison Error dialog. The dialog is automatically displayed when the netlist comparison ends or can be displayed by going to the **Tools** menu, and clicking **Netlist-NetCompare-Display Errors**.



Netlist Comparison Error Dialog

In the dialog title bar, the Netlist Comparison Error dialog indicates **how many errors** were found, which **error number** is currently shown and whether the error is a **Short**, an **Open** or an **Unmapped Net**.

Shorting Elements List: If the system can identify elements that cause shorts between nets, then those elements are listed in the Shorting Elements list box. The element is identified in the list box by which two nets it shorts.

NUT/REF Checkboxes: Indicates whether the NUT and REF netlists are visible or not.

- If there is a checkmark in the given checkbox, then that netlist is visible.
- If there is not a checkmark in the given checkbox, then that netlist is not visible.

NUT/REF List Boxes: Indicates which nets in the NUT and REF netlists are involved in the current error.

- In the case of a short, one net in the NUT list box corresponds to two or more nets in the REF list box.
- In the case of an open, two or more nets in the NUT list box correspond to two one net in the REF list box.
- In the case of an unmapped net, a net in the NUT list box corresponds to no net in the REF list box.

2. Navigate to the error you want to inspect by clicking the **First**, **Next**, **Previous** or **Last** buttons.
3. To see a Shorting element on screen, click on the element you want to see in the **Shorting Elements** list box.
On screen, the crosshair hops to the element you clicked on in the list.
4. To turn on or off the display of the two netlists, click on the checkboxes next to **NUT** and **REF**.
 - If there is a checkmark in the given checkbox, then that net is visible.
 - If there is not a checkmark in the given checkbox, then that net is not visible.
5. To highlight nets related to the current error on screen, click on the net(s) you want to highlight in the NUT or REF columns so that they are highlighted in the lists. Use Shift+Click to add multiple nets to the selection, and use Ctrl+Click to remove nets from the selection. Then click **Select**.

The system selects the nets on screen so that they are highlighted.

Make Net Numbers in the NUT Match Net Numbers in the REF



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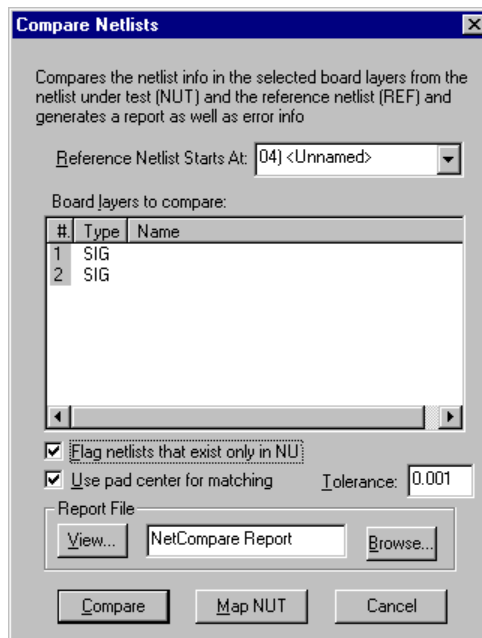


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In addition to doing netlist comparison, the program also has a feature for mapping the net numbers in the NUT to the corresponding net numbers in the REF. This feature can be useful for mapping the REF net numbers to alphanumeric net names, or for facilitating the inspection of errors by having the same net numbers or names in the REF and the NUT.

To Make Net Numbers in the NUT Match Net Numbers in the REF:

1. Prepare the netlist data the same way you would prepare it for a netlist comparison. See *Prepare Data for Netlist Comparison* on page 291.
2. When the data is prepared, go to the **Tools** menu, and click **Netlist-NetCompare-Compare Two Netlists**.



Netlist Comparison Dialog

3. On the **Netlist Comparison Dialog**, set the following options:
 - Reference Net Starts At:** Enter the Layer Number where the REF netlist begins. The REF netlist must begin at a higher layer number than any layer of the NUT netlist.
 - Board Layers to Compare:** Select the board layers to compare:

- **Click** a layer to select that layer.
- **Shift+Click** to add multiple layers to the selection.
- **Ctrl+Click** to remove layers from the selection.

Flag Netlists that Exist Only in NUT: This setting is not important for mapping net numbers; it is used for doing netlist comparisons.

Use Pad Center for Matching:

- If the option has a checkmark, then the system will find elements in the REF that correspond to elements in the NUT by comparing the centerpoints of elements. If this option is selected, you can enter a Tolerance value within which the system can identify corresponding centerpoints. A Tolerance of 0 (zero) means that centerpoints must match exactly.
- If the option does not have a checkmark, then the system will find elements in the REF that correspond to elements in the NUT by determining if the elements overlap.

Report File: Enter a file name and path for the report file, or click the Browse button to select from the available directories.

4. Click **Map NUT**.

The system changes the net numbers of the NUT to match the corresponding net numbers of the REF.

Correct Trace/Pad Overlap Problems



CAM



PRO



VM



MATE

The program can fix trace overlap problems. The program can retract traces to edges of center holes or to pad borders, extend traces to pad centers or to intersecting trace endpoints, and transfer duplicate traces and pads, traces covered by pads, and dangling traces to other layers. These operations are useful for cleaning up scanned artwork.

To Correct Trace Overlap Problems:

1. Make the sources **layers** and destination layers active, visible layers. See *Select from the Active Layers* on page 152.
2. On the **D Code Table** and the **Tool Code Table**, define all D Codes and Tool Codes. The program needs accurate dimensions in order to correct the overlap properly.

3. Set the **Visibility** settings.

The operation only checks visible elements, so make sure all pads, traces, selected, and unselected elements to be checked are visible. See *Element Visibility* on page 84.

4. **Clear selection** from all elements.

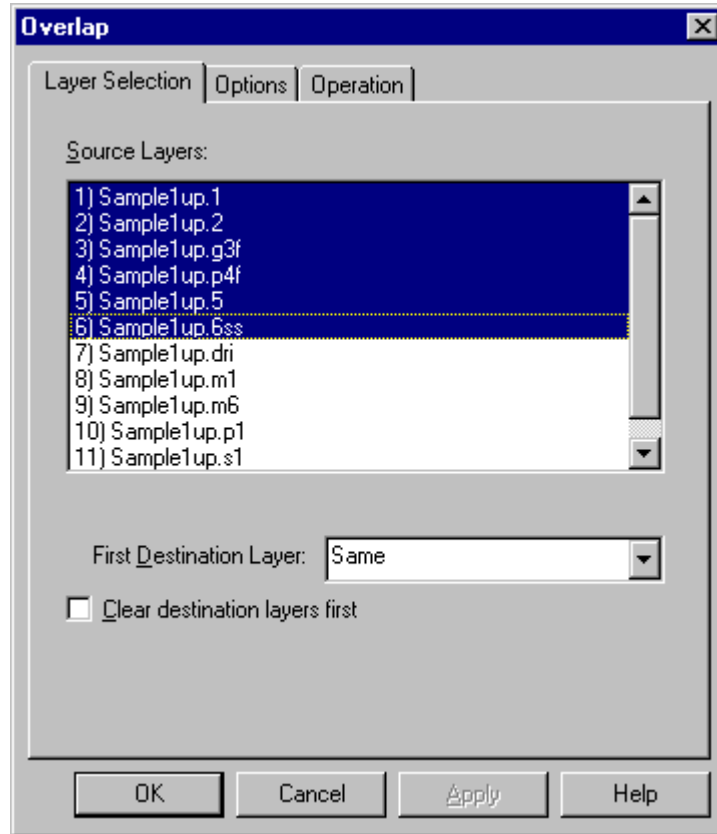
Depending on the options you select, some of the operations select elements for identification. Clearing the selection first helps avoid confusion.

5. If you want to correct overlap problems for only part of the plot, position the **reference frame** around that part. See *Reference Frame* on page 177.



If you want to check all data, it does not matter where the reference frame is positioned.

6. On the **Tools** menu, click **Trace/Pad Overlap**.
7. On the **Layers** tab, select the layers for the operation.



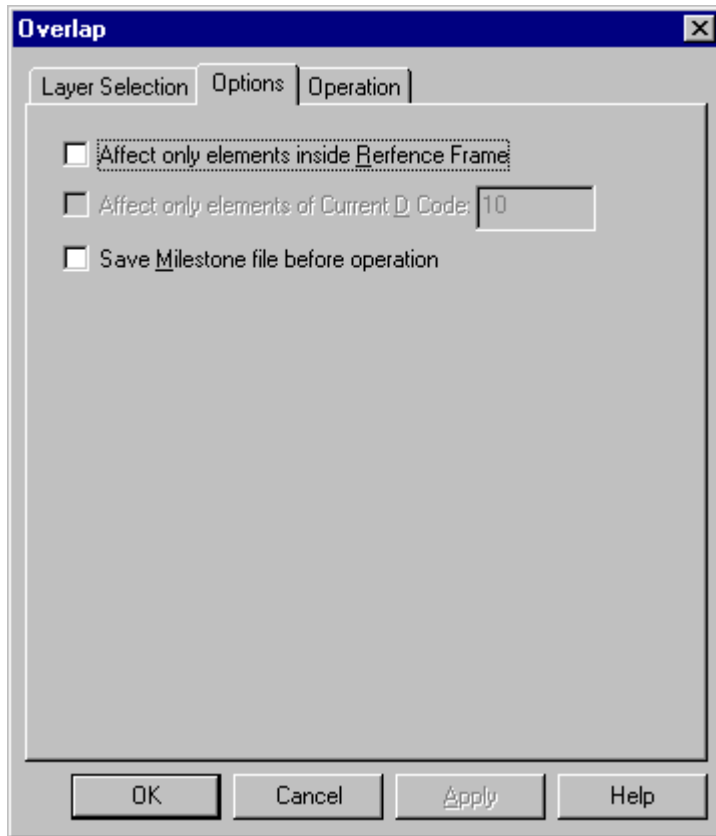
Overlap Layers Selection Tab

Source Layers: Select the layers where the elements you want to correct are located.

First Destination Layer: Select the first layer where elements are to be transferred for transfer operations. If you want elements to be selected rather than transferred, select **Same**. Some of the operations do not transfer elements, and for those operations, this setting is irrelevant.

Clear Destination Layers First: This option clears all data out of the destination layers before transferring elements. To have the system clear the destination layers before running the operation, click this option so that it has a check mark. Otherwise do not check this option. Do not use this option if there is any data on the destination layers that you want to keep.

8. On the **Options** tab, set the standard Options.

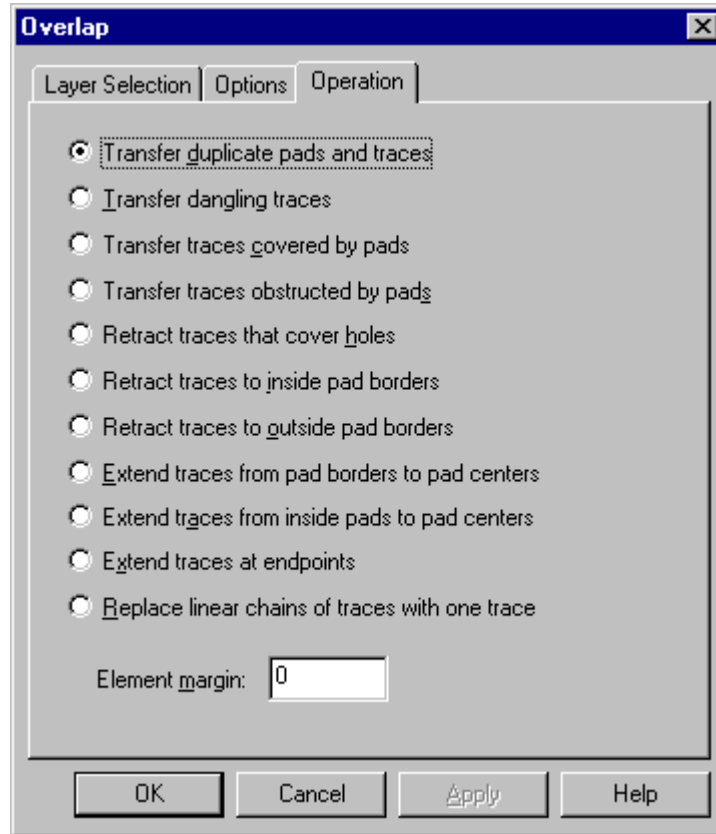


Overlap Options Tab

Affect only Elements Inside the Reference Frame: A check mark indicates the program will only check elements that are inside the Reference Frame. No check mark means the system will check the entire plot.

Save Milestone Before Operation: This option saves a Milestone file before running the operation, so in case the results are not what you want, you can easily revert to the Milestone file. To have the system save a Milestone file before running the operation, click this option so that it has a check mark. Otherwise do not check this option.

9. On the **Operations** tab, select the overlap operation:



Overlap Operations Tab

Transfer Duplicate Pads and Traces: This operation transfers duplicate elements to the destination layer. Duplicate traces are defined as having the same size, shape and endpoints. And duplicate pads are defined as having the same size, shape and centerpoint.

Transfer Dangling Traces: This operation transfers to the destination layer traces that don't have both endpoints connected to either a pad centerpoint or another trace endpoint.

Transfer Traces Covered by Pads: This operation transfers any trace covered by a single pad to the destination layer. If you enter a value for the **Margin**, the pad and trace sizes are increased by the margin to determine if the trace is completely covered by the pad. The difference between this option and the Transfer Traces Obstructed by Pads option is that this option requires that the trace be covered by a *single* pad in order to be transferred.

Transfer Traces Obstructed by Pads: This operation transfers any trace covered by a pad or by a combination of pads to the destination layer. If you enter a value for the **Margin**, the pad and trace sizes are increased by the margin to determine if the trace is completely covered by the pad. The difference between this option and the Transfer Traces Obstructed by Pads options is that this option allows the trace to be covered by a *combination* of pads in order to be transferred.

Retract Traces that Cover Holes: This operation retracts traces covering the center holes of Heat Reliefs (H), Squares (S), Diamonds (D), or Rounds © to the edge of the center hole. If you enter a value for the **Margin**, the hole and trace size are increased by the margin to determine if the trace penetrates the hole and to what point it will be retracted.

Retract Traces to Inside Pad Borders: This operation retracts traces that end in pads so that the trace endpoint area will be inside the pad border. If you enter a value for the **Margin**, the pad and trace sizes are increased by the margin to determine if the trace penetrates the pad and to what point it will be retracted.

Retract Traces to Outside Pad Borders: This operation retracts traces that end in pads so that the trace endpoint area will be outside the pad border. If you enter a value for the **Margin**, the pad and trace sizes are increased by the margin to determine if the trace penetrates the pad and to what point it will be retracted.

Extend Traces from Pad Borders to Pad Centers: This operation finds all traces that end at pad borders, and either extends the trace to the pad center or adds a new trace connecting the original endpoint to the pad center.

Extend Traces from Inside Pads to Pad Centers: This operation finds all traces that end in a pad, but not in a pad centerpoint, and either extends the trace to the pad center or adds a new trace connecting the original endpoint to the pad center. If you enter a value for the **Margin**, then the trace endpoint must be that far inside the pad outline to be extended by this operation.

Extend Traces at Endpoints: This operation extends traces of the same D Code that touch in their endpoint area but are not chained exactly. The traces are extended to make them intersect. If you enter a value for the **Margin** setting, the trace sizes are extended by this amount to determine if they touch.

Replace Linear Chains of Traces with One Trace: This operation finds traces that are chained endpoint to endpoint and that continue in a straight line. The feature replaces the chain with a single trace that extends from one end of the chain to the other.

10. On the main Overlap dialog, click **OK**.

The program corrects the overlap problems as you specified.

Generate Contours



CAM



PRO



VM



MATE

The program can generate closed polygon contours from existing trace contours. The system identifies existing loops of intersecting traces and replicates the contours using an F-type D Code. The original traces do not need to be chained and do not need to form perfectly closed polygons. The operation generates a perfectly closed polygon contour by connecting all intersection points and adding traces to bridge gaps. This feature can be used to generate split plane layers for netlist extraction.

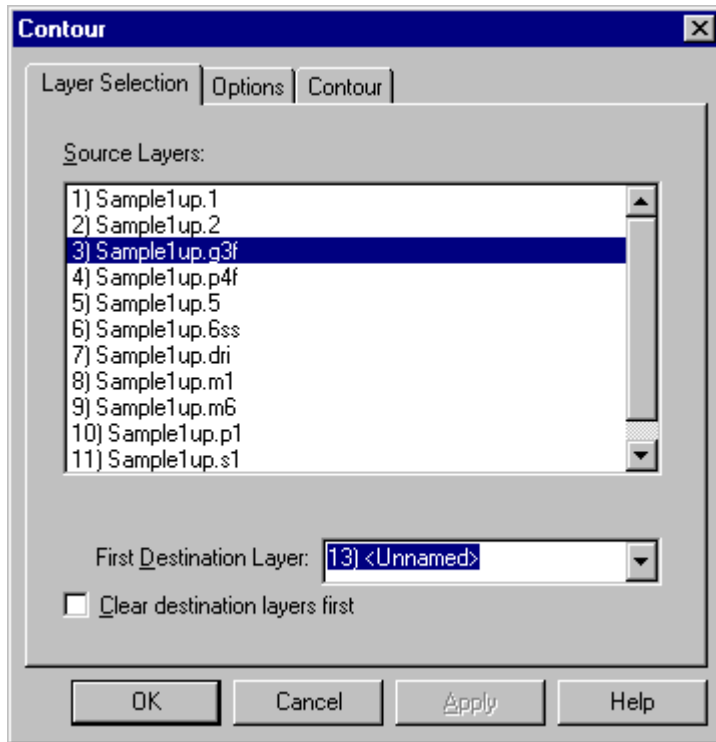
To Generate Contours:

1. Make the **layers** where the original traces are and where you want to generate contours active, visible layers. See *Select from the Active Layers* on page 152.
2. Set the **Visibility** settings.
The operation only checks visible elements, so make sure all pads, traces, selected, and unselected elements to be checked are visible. See *Element Visibility* on page 84.
3. If you want to generate contours from traces on only part of the plot, position the **reference frame** around that part. See *Reference Frame* on page 177.



If you want to check all data, it does not matter where the reference frame is positioned.

4. On the **Tools** menu, click **Build Contour**.
5. On the **Layers** tab, select the layers for the operation.



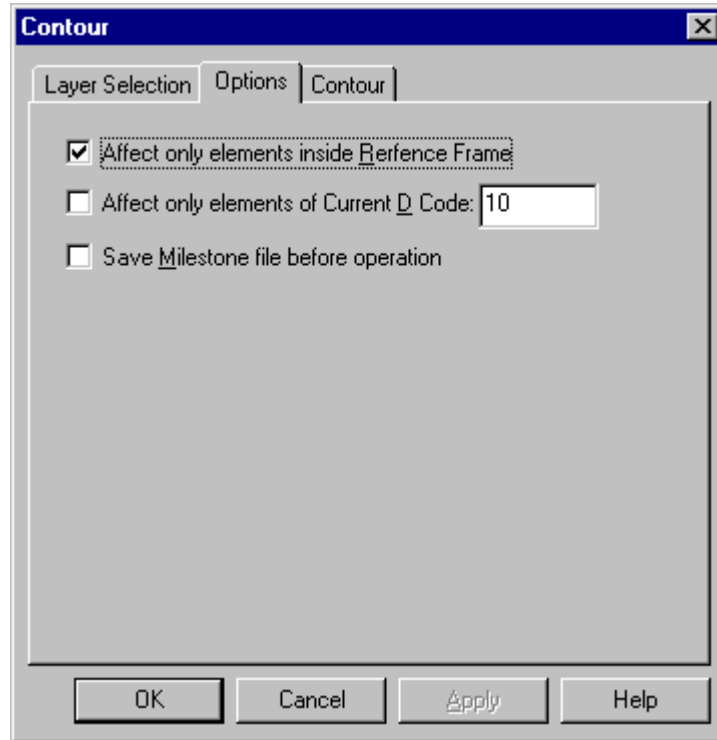
Build Contour Layers Selection Tab

Source Layers: Select the layers where the traces you want to generate the contour from are located.

First Destination Layer: Select the layers where you want the contour traces to be added. If you want the contour traces to be added directly to the source layers, select **Same**.

Clear Destination Layers First: This option clears all data out of the destination layers before generating the contour traces. To have the system clear the destination layers before running the operation, click this option so that it has a check mark. Otherwise do not check this option. Do not use this option if there is any data on the destination layers that you want to keep.

6. On the **Options** tab, set the standard Options.



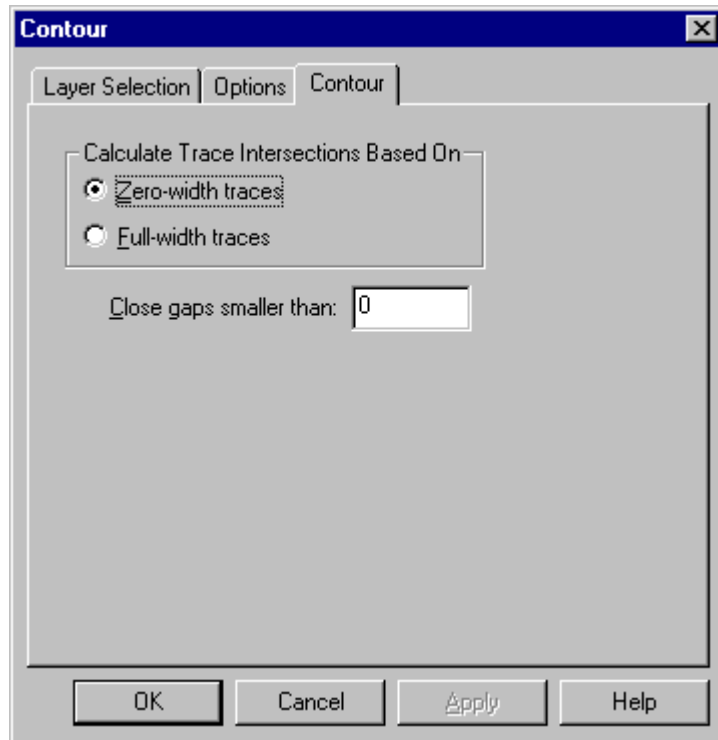
Build Contour Options Tab

Affect only Elements Inside the Reference Frame: A check mark indicates the program will only generate contour traces for source traces that are inside the Reference Frame. No check mark means the system will generate contour traces for the entire plot.

Current D Code Only: A check mark indicates the program will only generate contour traces for source traces of the current D Code. If you select this option, set the current D Code in the D Code edit field. No check mark means the system will generate contour traces for all elements regardless of D Code.

Save Milestone Before Operation: This option saves a Milestone file before running the operation, so in case the results are not what you want, you can easily revert to the Milestone file. To have the system save a Milestone file before running the operation, click this option so that it has a check mark. Otherwise do not check this option.

7. On the **Contour** tab, set the options for generating the Contours.



Build Contour Contours Tab

Calculate Trace Intersections Based on Zero-Width Traces: This option looks at source trace centerlines, endpoint to endpoint, to determine if they intersect and are part of the polygon contour.

Calculate Trace Intersections Based on Full-Width Traces: This option looks at full-width source traces to determine if they intersect and are part of the polygon contour.

Close Gaps Smaller Than: Enter the maximum size gap that the operation can close to form a polygon contour. When the operation encounters a gap smaller than this value it adds a trace to close the gap on the replicated polygon contour. The replicated polygon has no gaps.

8. On the main Build Contours dialog, click **OK**.

The system displays a Build Contours cursor to indicate that the Build Contours operation is selected.



Build Contour Tool

9. Click the cursor inside a loop of traces that you want to replicate as a polygon contour.

The system looks at the traces surrounding the cursor, finds the smallest loop of intersecting traces that forms a closed loop around the cursor, and replicates the polygon contour on the destination layer. The message line reports how many traces were generated to form the contour.

The Build Contours operation remains selected, so you can replicate as many polygon contours as you want until you release the tool or select another one.

Consolidate Soldermask Data



The program can consolidate drawn features in a soldermask layer into flashed pads. This is basically an automatic Draw-to-Flash operation for the soldermask layer. The feature was called “Autoblob” in the DOS View2001 software.

To Consolidate Soldermask Data:

1. Make the **sources layers** and **destination layers** active, visible layers. See *Select from the Active Layers* on page 152.
2. On the **D Code Table** and the **Tool Code Table**, define all D Codes and Tool Codes. The program needs accurate dimensions in order to consolidate the elements properly.
3. Set the **Visibility** settings.

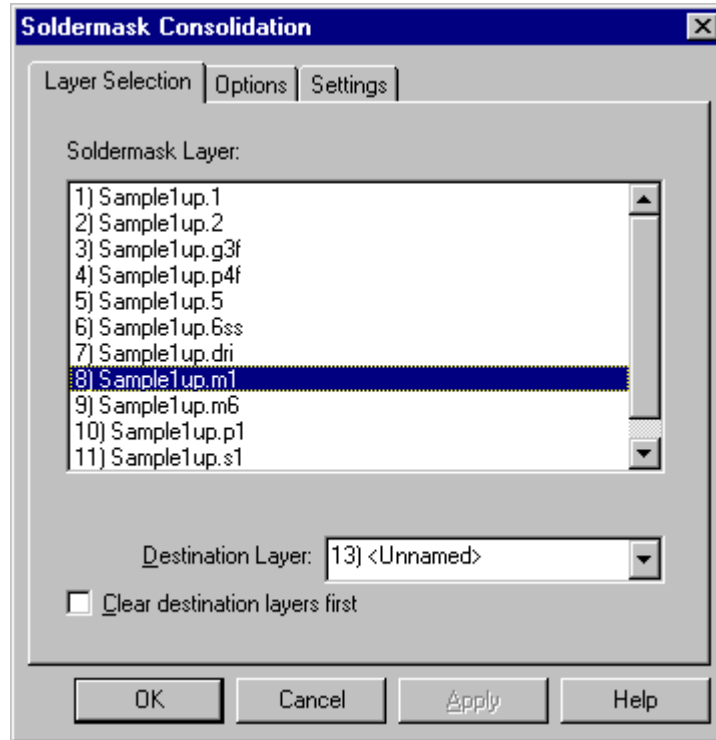
The operation only checks visible elements, so make sure all pads, traces, selected, and unselected elements to be checked are visible. See *Element Visibility* on page 84.

4. If there is a board outline on the soldermask layer, remove the board outline.
5. If you want to consolidate elements on only part of the plot, position the **reference frame** around that part. See *Reference Frame* on page 177.



If you want to check all data, it does not matter where the reference frame is positioned.

6. On the **Tools** menu, click **Soldermask Consolidation**.
7. On the **Layers** tab, select the layers for the operation.



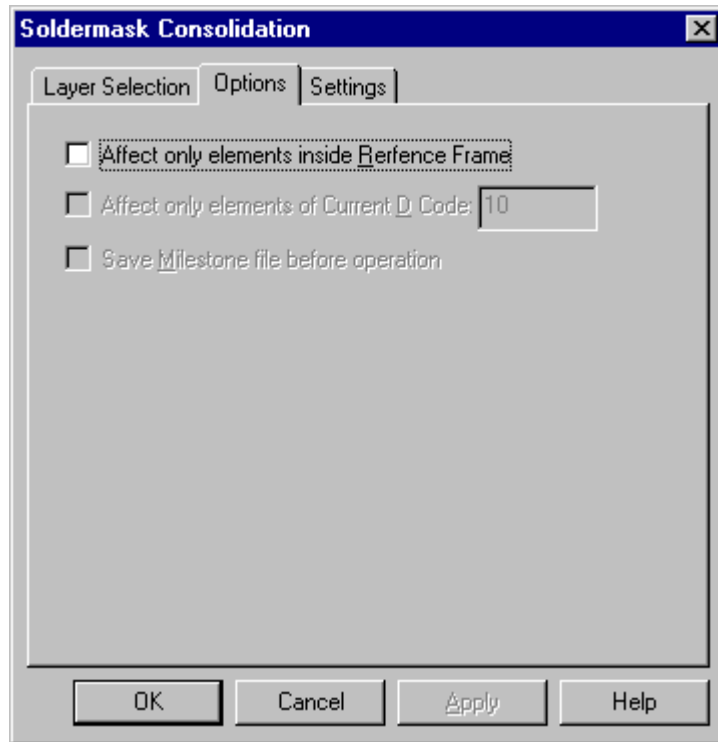
Soldermask Consolidation Layers Selection Tab

Soldermask Layer: Select the soldermask layer where the elements you want to consolidate are located.

Destination Layer: Select the layer where the consolidated data is to be generated.

Clear Destination Layers First: This option clears all data out of the destination layer before generating the consolidated data. To have the system clear the destination layers before running the operation, click this option so that it has a check mark. Otherwise do not check this option. Do not use this option if there is any data on the destination layers that you want to keep.

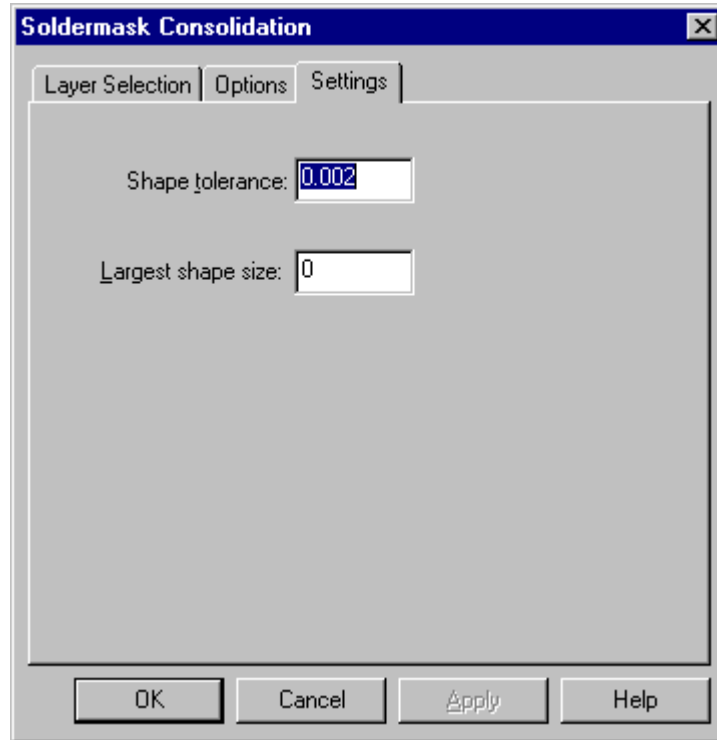
8. On the **Options** tab, set the standard Options.



Soldermask Consolidation Options Tab

Affect only Elements Inside the Reference Frame: A check mark indicates the program will only consolidate elements that are inside the Reference Frame. No check mark means the system will check the entire plot.

9. On the **Settings** tab, set the consolidation settings.



Soldermask Consolidation Settings Tab

Shape Tolerance: Drawn features that are not exactly the same size but whose size difference is within the Shape Tolerance size are flashed to the same shape using the same D Code.

Largest Shape Size: Drawn features that are larger than the Largest Shape Size are not flashed as pads. This is to avoid converting large drawn features, such as text blocks, that should not be converted into soldermask pads.

10. On the main Soldermask Consolidation dialog, click **OK**.

The program generates the consolidated soldermask data.

Chapter 6

D Code Table Overview



On the D Code Table, the program handles shape, size and other aperture information for up to 2000 total D Codes definitions per file, ranging from D10 to D9999. Additional information for up to 255 Tool Codes is handled on the Tool Code Table. Together these two tables describe the plot data elements.

To Display the D Code Table:

- On the **Setup** menu, click **D Codes**.



F5

DCode	Shape	X dim	Y dim	Traces (Arcs)	Pads
*D36	C	0.09	0		484
*D37	C	0.091	0		124
*D38	M	0.06	0.06		104
*D39	M	0.071	0.071		10
*D40	M	0.076	0.076		46
*D41	M	0.079	0.079		16
*D42	H	0.085	0.015		2
*D43	M	0.086	0.086		23
*D44	M	0.11	0.11		1
*D45	C	0.01	0	662	
*D46	C	0.012	0	2623	
*D47	C	0.015	0	10	
*D48	C	0.02	0	46	
*D49	C	0.025	0	284	
*D50	C	0.004	0	359	
*D51	C	0.005	0	144	
D52	C	0.05	0		
*D53	C	0.0079	0	72	
*D54	C	0.008	0	9623	
*D55	R	0.1	0.033		14
*D56	R	0.122	0.0709		8
*D57	R	0.128	0.0768		4
*D58	R	0.014	0.063		624
*D59	R	0.016	0.041		32
*D60	R	0.16	0.04		8

D Code Table

Aperture information for imported Gerber, NC Drill, HPGL, DMPL, and Pattern Generator data can be imported from any of several CAD/CAM systems or you can manually set up new aperture information.

D Code numbers can have up to five digits. Leading zeros are allowed, as in D00125. D Codes have a resolution to 0.001 mil when the Database Units are English and .01 micron when in metric.

On the D Code Table you can see the number of occurrences of each D Code in the loaded data, including the number of pads, traces, and arcs for each D Code.

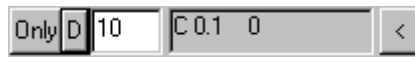
The D Code Table has its own menu bar with many D Code editing commands that allow you to insert and delete D Codes from the table; change D Code values by directly editing them, or by rotating, swelling, growing, scaling, or rounding off D Code dimensions; transcode elements to a new D Code or transcode D Codes to unique shapes.

To help you navigate the table and select D Codes for operations, you can select D Codes manually, select all D Codes, select used D Codes, select D Codes of the same shape, invert the selected D Codes, and select D Codes by size.

Current D Code



The Current D Code is indicated in the Current Element Toolbar.



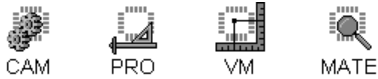
Current D Code in Current Element Toolbar

The Current D Code is the D Code of elements inserted using the Insert Commands and it is also one of the optional selection criteria for selecting elements for editing. Selection can be limited to only elements of the Current D Code.

To Set the Current D Code:

- Set the Current D Code in the Current Element Toolbar.
- Select a single D Code in the D Code Table.
- Query an Element in the Graphics Screen. See *Query Element* on page 103.

D Code Shapes and Dimensions



All aperture shapes built into the Lavenir Photoplotters are legal shape entries. A D Code is described by its Shape Code and its Dimension Values.

Round “C”



Round Shape Dimensions:

- Symmetrical X, Y Diameter
- Center Hole Diameter (set to 0 when there is no hole.)

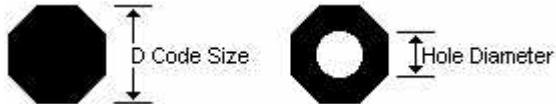
Diamond “D”



Diamond Shape Dimensions:

- Symmetrical X, Y Size
- Center Hole Diameter (set to 0 when there is no hole.)

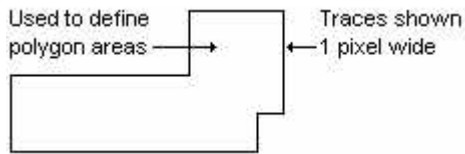
Octagon “E”



Octagon Shape Dimensions:

- Symmetrical X, Y Size
- Center Hole Diameter (set to 0 when there is no hole.)

Polygon Trace “F”



On screen, the Polygon Trace is drawn 1 pixel wide; however, the trace is considered to have zero-width. The Polygon Trace is used to define polygon boundaries for polygon-filling operations such as Copper Pouring and Venting and Thieving. The polygon ID is used to identify the polygon for determining the polygon nesting order. The fill polarity determines whether a polygon is to be filled inside or whether it defines a keep-out area.

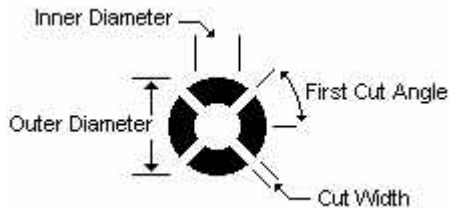


The Fill Polarity setting is not saved in Lavenir .ENV files.

Polygon Shape Dimensions:

- ID number
- Fill Polarity:
 - Auto: Polarity is determined automatically by determining whether one polygon is inside another.
 - POEX: The polygon is an external polygon that is to be filled inside.
 - POIN: The polygon is an internal polygon that defines a keep-out area for fill.

Heat Relief “H”



Heat Relief Shape Dimensions:

- Outer Diameter
- Inner Diameter
- Number of Cuts
- Cut Width
- Cut Angle of the first cut

Custom Aperture “M”

Custom apertures are shapes that are constructed from other more basic pads and traces called primitives. Custom apertures can be composed of any combination of paint and scratch or positive and negative primitives. The custom apertures are exported as miniature plot files of various formats. When you want to include the shape in a job, use a custom aperture that references the shape file.

The program has many commands that allow you to process custom apertures. You can capture, export, and import custom aperture files. You can also recreate primitives used in a custom aperture and convert elements of custom aperture D Codes to primitives. For information on handling custom apertures and what to do if your custom apertures only display as an M in a square in the viewing area, see *Custom Apertures* on page 334.

Custom Aperture Shape Dimensions:

- File Name: Name of the miniature plot file where the custom aperture definition is exported.
- File Format: Format of the miniature plot file where the custom aperture definition is exported.

MEMPACK: Lavenir RPG series photoplotter MEMPACK format.

MDA Autoplot

Gerber Extended

Subfigure

NC Drill Hole “N”



NC Drill data is represented in the system by the N shape D Code.

Map Drill data to shape N as you import it or as you add it. When you output Drill data, only N shape pads are output.

In the D Code table you can assign a Tool Code to each N shape D Code and then you can set the Tool Code parameters for that Tool Code. You can also set the Tool Code parameters on the Tool Code table, but you cannot map N Shape D Codes there.

Drill Shape Dimensions:

- Tool Code Number: This defines the corresponding Tool Code. Click Setup Tool to see the current parameters for this Tool Code in the Tool Code Table and to change the Tool Type and Diameter if you wish.

Tool Parameters:

- Diameter. This is the diameter of the hole. It is the same as the Diameter value in the Tool Code Table, and it can be entered and edited in either table.
- Four tool types are supported. This value is the same as the Type value in the Tool Code Table, and it can be entered and edited in either table.

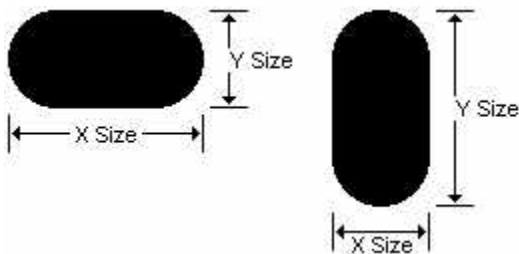
Plated

Non-Plated

Tooling

Via (X)

Obround “O”

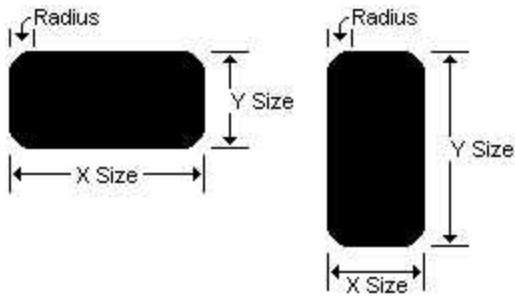


Obrounds are like rectangles that have been rounded to a semi-circle on the short sides.

Obround Shape Dimensions:

- X size
- Y size

Rounded Rectangle “Q”

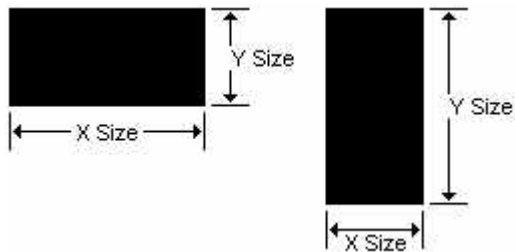


Rounded Rectangles are rectangular shapes that have corners rounded to a specific radius.

Rounded Rectangle Shape Dimensions:

- X size
- Y Size
- Radius

Rectangle “R”



Rectangle Shape Dimensions:

- X size
- Y size

Square “S”



Square Shape Dimensions:

- Symmetrical X, Y size
- Center Hole Diameter (set to 0 when there is no hole.)

Undefined “?”

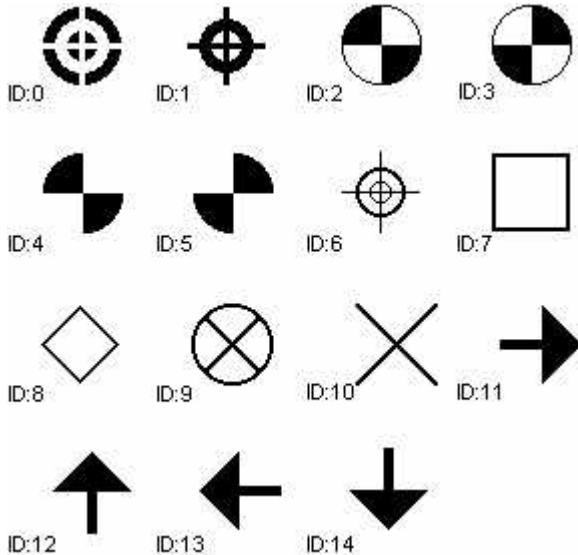


Shown as round on screen

This is the shape of all newly created D Codes before they are mapped to some other shape. On the Graphics Screen these shapes will be displayed as circular.

The system generates a warning message if you try to export an environment file, Extended Gerber file or report that contains undefined shapes.

Target “T”

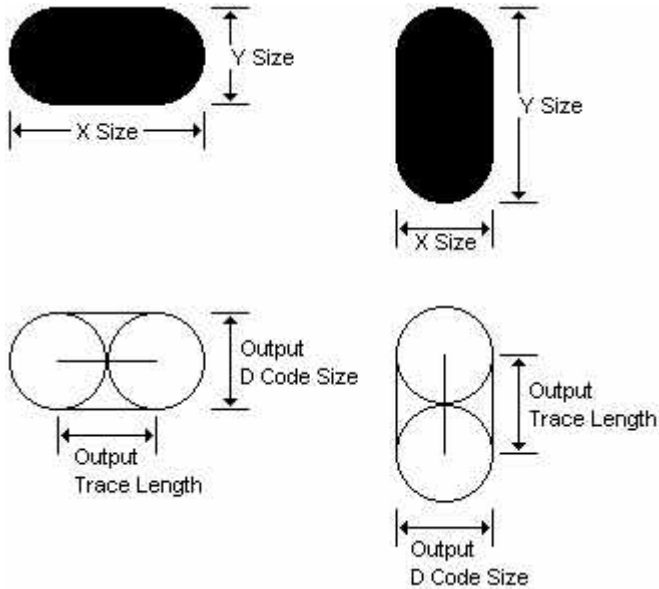


The Target ID determines the shape of the target.

Target Shape Dimensions:

- Symmetrical X, Y size
- Target ID. The RPG photoplotter plots targets T0 to T3. Targets T0 to T14 appear on the graphics screen as shown here.

Drawn Obround "X"



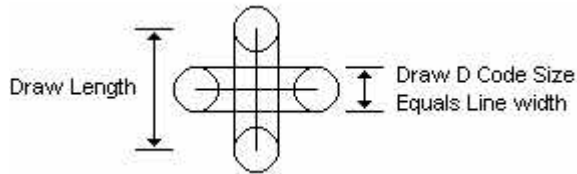
The Drawn Obround is displayed as an obround on screen. The D Code is used to convert flashed rectangles or obrounds to drawn pads on output. This shape can be used to generate surface mount pads with a vector plotter that does not have the appropriate aperture shape.

When exporting the file, the program generates a drawn trace for Drawn Obround D Codes. If you then manually convert the D Code to a circular or square aperture with a size equal to the smaller of the X or Y size fields, the vector plotter can draw the pads to the correct size.

Drawn Obround Shape Dimensions:

- X size of drawn pad
- Y size of drawn pad

Drawn Crosshair “Y”



The drawn crosshair is drawn from specified lengths of traces of the draw D Code.

Drawn Crosshair Shape Dimensions:

- Symmetrical X, Y Draw Length
- Draw D Code: This D Code must be set to shape C. Line width is the diameter of the draw D Code.

Blank “B”

Blank D Codes are not displayed on screen or exported.

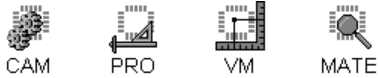
Imported Environment File data mapped to shape B is ignored. If a D Code is changed to Blank, all elements with the corresponding D Code have visibility turned off on the Graphics Screen.

The Blank shape can be toggled. When a D Code is blanked, the system remembers the old shape. Selecting shape B for a D Code that is already shape B will unblank it, restoring the previously remembered shape.

Select D Codes

The program includes many commands to allow you to select D Codes in the D Code Table.

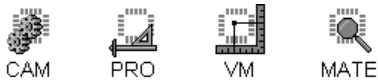
Manually Select D Codes



To Manually Select D Codes on the D Code Table:

- To select a single D Code, **Click** on it.
- To select a range of D Codes, use **Shift+Click**.
- To add a single D Code to a group of selected D Codes, or to remove one, use **Ctrl+Click**.

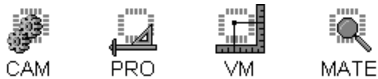
Select All D Codes



To Select All D Codes:

- On the **Edit** Menu of the D Code Table, click **Select-All**.

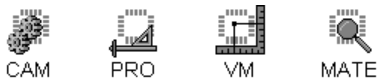
Select Used D Codes



To Select All Used D Codes:

- On the **Edit** Menu of the D Code Table, click **Select-Used**.

Select D Codes of the Same Shape



You can select all of the D Codes on the D Code table that have the same Shape Code. This operation selects all D Codes with the same Shape Code, but the selected D Codes do not necessarily have the same dimensions.

To Select All D Codes of the Same Shape Code:

1. On the D Code Table, click on a single D Code with the Shape Code you want to select.
2. On the **Edit** Menu of the D Code Table, click **Select-Of Same Shape**.

Invert the Selected D Codes



The Invert Selection command inverts the group of selected D Codes so that the selected ones are unselected and the unselected ones are selected.

To Invert the Selected D Codes:

- On the **Edit** Menu of the D Code Table, click **Select-Invert Selection**.

Select the Smallest Shape D Code

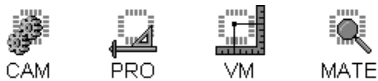


This operation selects the first D Code in the D Code table with the smallest large dimension.

To Select the Smallest Shape D Code:

- On the **Edit** Menu of the D Code Table, click **Select-By Size-Smallest**.

Select the Next Smaller Shape D Code



The operation selects the D Code with the next smaller large dimension compared to the current selected D Code.

To Select the Next Smaller Shape D Code:

- On the **Edit** Menu of the D Code Table, click **Select-By Size-Previous (Smaller)**.

Select the Next Larger Shape D Code

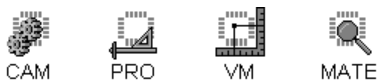


The operation selects the D Code with the next larger large dimension compared to the current selected D Code.

To Select the Next Larger Shape D Code:

- On the **Edit** Menu of the D Code Table, click **Select-By Size-Next (Larger)**.

Select the Largest Shape D Code



This operation selects the first D Code in the D Code Table with the largest large dimension.

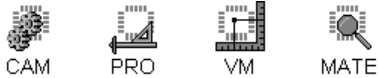
To Select the Largest Shape D Code:

- On the **Edit** Menu of the D Code Table, click **Select-By Size-Largest**.

Edit D Codes

The program has many commands to edit D Codes on the D Code Table. Most of these commands are activated from menus on the D Code Table.

Change D Code Shapes on the D Code Table



To Change the Shape of a Selected D Code:

1. On the D Code Table, select the D Code.
2. Type the Shape Code for the new shape.

After you select the new shape, the system displays a dialog in which you set the shape dimensions.

If you don't know the Shape Code for the Shape you want, the system provides a list of supported D Code shapes and Shape Codes from which you can select the shape of a D Code. There are several ways to display the list.

To Display the Shape Code List:

- Click the **Shapes** menu on the D Code Table Menu Bar.
- **Right-Click** on a selected D Code to display the list on the **Context Menu**.
- The system displays the list automatically when you **insert a new D Code**.

Change D Code Dimensions on the D Code Table



To Change D Code Dimensions on the D Code Table:

1. On the D Code Table, **select** the D Code.
2. On the D Code Table Menu Bar, click the **Dimensions** menu.



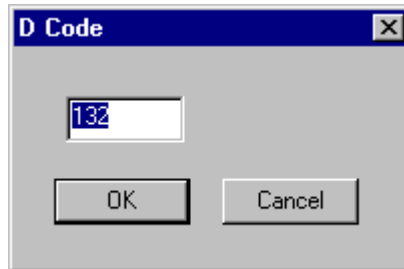
You can also access the dimensions dialog on the Right-Click Context Menu, and the system automatically displays the dimensions dialog after you select a new shape for a D Code.

Insert a D Code on the D Code Table



To Insert a D Code on the D Code Table:

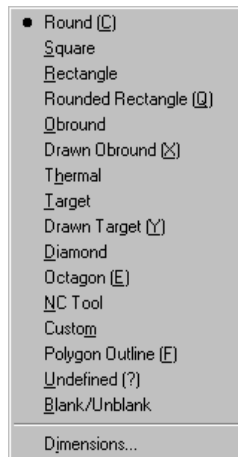
1. On the **Edit** menu of the D Code Table Menu Bar., click **Insert**
The system prompts with the first available unused D Code.



Insert D Code Dialog

2. Enter the **D Code number** you want to insert.
3. Click **OK**.

The system prompts you to set the Shape Code.



Shape Code List

Delete a D Code on the D Code Table

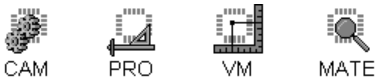


The Delete command deletes selected unused D Codes from the D Code Table. To protect your data, the system will not delete D Codes that are used in the loaded plot. If you want to delete a used D Code, first transcode the elements to a new D Code, then delete the D Code.

To Delete a D Code on the D Code Table:

1. On the D Code Table, **select the D Codes** you want to delete.
2. On the **Edit** menu of the **D Code Table Menu Bar**, click **Delete**.

Transcode D Codes



Transcoding is the process of reassigning plot elements to new D Codes.

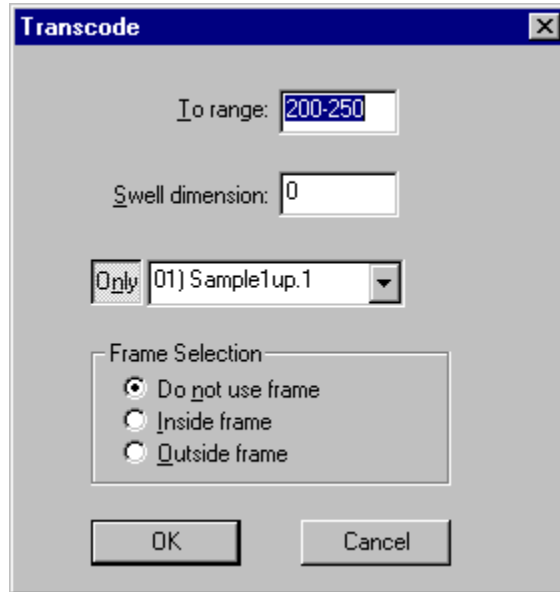
To Transcode Elements of the Selected D Code on the D Code Table:

1. If you only want to transcode elements for a portion of the data, then surround the elements to be transcoded with the **reference frame** in the viewing area. See *Reference Frame* on page 177.



If you want to check all data, it does not matter where the reference frame is positioned.

2. On the **Setup** menu, click **D Codes**.
3. On the **D Code Table**, **select the D Codes** to be transcoded.
4. On the **Operations** menu of the **D Code Table**, click **Transcode**.



Transcode D Codes Dialog

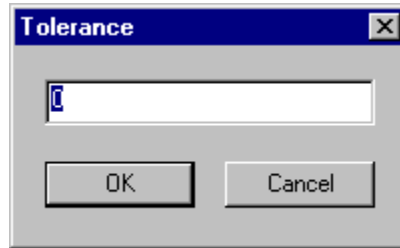
5. In the **To** box, enter the range of unused D Codes that you want to transcode the selected D Codes to.
6. To also swell the selected D Codes as they are transcoded, enter the amount to swell the D Codes in the **Swell Dimension** box.
7. Select an option for Frame Selection:
 - **Do Not Use Frame:** Transcodes all elements of the selected D Codes.
 - **Inside Frame:** Transcodes only elements of the selected D Codes inside the Frame in the Viewing Area.
 - **Outside Frame:** Transcodes only elements of the selected D Codes outside the Frame in the Viewing Area.
8. Click **OK**.

The system transcodes the selected elements to the unused D Codes in the new range.

To Transcode to Unique shapes on the D Code Table:

The **Unique Shapes** command on the **D Code Table** transcodes all D Codes that have the same shape and size to the first D Code of that shape and size. This decreases the size of the aperture list.

1. On the **Setup** menu, click **D Codes**.
2. On the **Operations** menu of the **D Code Table**, click **Unique Shapes**.



Unique Shapes Tolerance Dialog

3. To transcode only D Codes of exactly the same size, enter 0 in the **Tolerance** box. If you set the **Tolerance** to a value other than 0, the system transcodes D Codes within the tolerance to the smallest D Code in the group.
4. Click **OK**.

The program reports how many shapes were transcoded in the Toolbar and appends the information to the report file.

Rotate D Codes



If you rotate a plot by 90 degrees, you must also rotate the rectangular and obround shapes in the file or the resulting plot won't be correct. This procedure covers rotating D Codes on the D Code Table by 90 degrees. See also *Rotate Selected Elements* on page 138.

To Rotate D Codes on the D Code Table 90 Degrees:

1. On the **Setup** menu, click **D Codes**.
2. On the **D Code Table**, select the D Codes to be rotated.
3. On the **Operations** menu of the **D Code Table**, click **Rotate 90 Degrees**.

The system swaps the X and Y dimensions of X, Y asymmetrical-shaped selected elements so that they are rotated in the plot. The affected shapes are R, O, X, H, T, Q and M.

Swell D Code

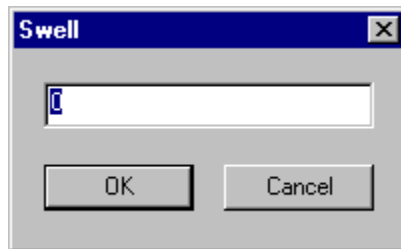


The Swell D Code command changes the size of selected D Codes by the positive or negative amount entered in the Swell box.

Holes in C, S and D shapes will be swelled the opposite way from the dimension of the shape. So, if the shape gets bigger the hole gets smaller. Custom shapes (M) cannot be swelled.

To Swell a D Code:

1. On the **Setup** menu, click **D Codes**.
2. On the **D Code Table**, select the D Codes to be swelled.
3. On the **Operations** menu of the **D Code Table**, click **Swell**.

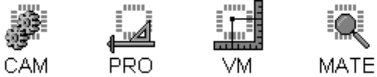


Swell D Codes

4. Enter the amount to increase the dimensions in the **Swell** box.
5. Click **OK**.

Elements can also be swelled as they are transcoded.

Grow D Code

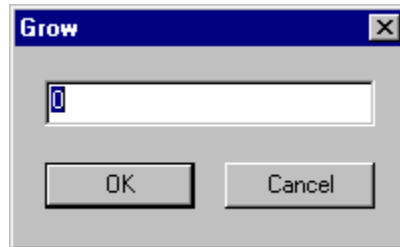


The Grow D Code command changes the size of selected D Codes by the positive or negative amount entered in the Grow box.

Holes in C, S and D shapes will be grown the same way as the dimension of the shape. So, if the shape gets bigger the hole also gets bigger. Custom shapes (M) cannot be grown.

To Grow a D Code:

1. On the **Setup** menu, click **D Codes**.
2. On the **D Code Table**, select the D Codes to be grown.
3. On the **Operations** menu of the **D Code Table**, click **Grow**.



Grow D Codes

4. Enter the amount to increase the dimensions in the **Grow** box.
5. Click **OK**.

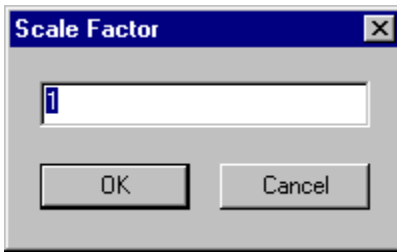
Scale D Code Dimensions



The Scale D Code Dimensions command multiplies dimensions of selected D Codes by the factor entered in the Scale Factor box. To make shapes bigger, the factor must be greater than 1.0.

To Scale D Code Dimensions:

1. On the **Setup** menu, click **D Codes**.
2. On the **D Code Table**, select the D Codes to be scaled.
3. On the **Operations** menu of the **D Code Table**, click **Scale Dim**.



Scale D Code Dimensions Dialog

4. Enter the amount to multiply the dimensions in the **Scale Factor** box.
5. Click **OK**.

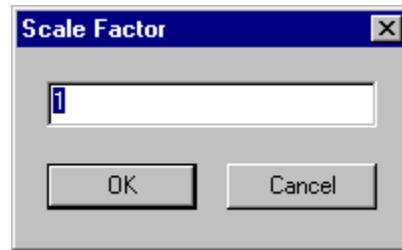
Scale D Code Area



The Scale D Code Area command scales the areas of selected D Codes by the factor entered in the Scale Factor box. This is similar to Scale Dimension, except that the factor multiplies the area of the shape instead of the dimensions. The linear dimensions increase by the square root of the given factor.

To Scale D Code Area:

1. On the **Setup** menu, click **D Codes**.
2. On the **D Code Table**, select the D Codes to be scaled.
3. On the **Operations** menu of the **D Code Table**, click **Scale Area**.



Scale D Code Area

4. Enter the amount to multiply the area in the **Scale Factor** box.
5. Click **OK**.

Round D Code Dimensions to the Nearest mil or .01mm



The program can round D Code dimensions to the nearest mil when in English units, and the nearest .01mm when in metric. This can be useful after converting from English to metric or vice versa.

To Round D Code Dimensions to the Nearest mil or .01mm:

1. On the **Setup** menu, click **D Codes**.
2. On the **D Code Table**, select the D Codes to be rounded.
3. On the **Operations** menu of the **D Code Table**, click **Round to Closest mill or .01mm**.
4. Click **OK**.

Custom Apertures

Custom apertures are shapes that are constructed from other more basic pads and traces called primitives. Custom apertures can be composed of any combination of paint and scratch or positive and negative primitives. The custom apertures are exported as miniature plot files of various formats. When you want to include the shape in a job, use a custom aperture that references the shape file.

The program has many commands that allow you to process custom apertures. You can capture, export, and import custom aperture files. You can also recreate primitives used in a custom aperture and convert elements of custom aperture D Codes to primitives.

Capture a Custom Aperture



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The program can capture a model of a custom aperture composed of primitive elements in the current Job File and then use the custom aperture like any other D Code.

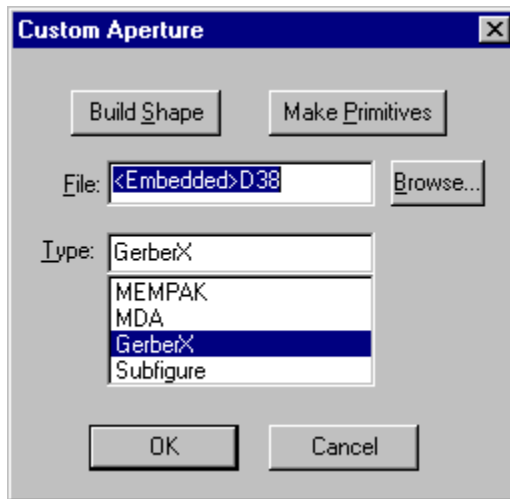
To Capture a Custom Aperture:

1. In the Viewing Area, **build an aperture** following these rules:
 - Insert the primitives on paint and scratch layers to build the shape you want to capture.
 - Traces of F-type D Code are assumed to form polygons that will be filled when the custom aperture is made. Polygons must be convex, no indents.
 - Use primitives supported by the format you will be saving to.
 - Don't use another M-type D Code as a primitive unless it has already been defined.
2. Make the **layers** where the model for the custom aperture is active, visible layers. See *Select from the Active Layers* on page 152.
3. Set the **Visibility** settings.

The operation only checks visible elements, so make sure all pads, traces, selected, and unselected elements to be checked are visible. See *Element Visibility* on page 84.
4. Position the **reference frame** around the elements that you want to use as the custom aperture model. See *Reference Frame* on page 177.

Your reference frame selection should contain only the elements that are part of the custom aperture model. If you can't position the reference frame without also selecting extraneous elements, select and replicate the elements of the custom aperture model to another unused layer, then select the custom aperture model with the reference frame.
5. If you do not want the system to automatically determine the **centerpoint** of the custom aperture, position the cursor where you want the centerpoint of the custom aperture to be and separate the cursor. See *Separate the Crosshair and Mouse Cursor* on page 112.
6. On the **Setup** menu, click **D Codes**.

7. Click on the **unused D Code** that you want to make the custom aperture.
8. Type **M** for custom aperture.



Custom Aperture Dialog

9. On the custom aperture dialog, click **Build Shape**.

The system prompts whether you want to Autocenter the custom aperture.

10. If you want the system to automatically determine the centerpoint of the custom aperture, click **Yes**.

If you want the system to use the current crosshair position as the centerpoint of the custom aperture, click **No**.

The custom aperture is now captured and part of the current Job File database. It can be used in the current Job File like any other D Code and can be saved with the job. However, capturing the custom aperture does not save the custom aperture outside of the current job. If you close the job without exporting the aperture, you can't import the aperture for use in another job.

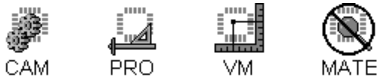
If a plot file containing this aperture is subsequently exported in either Extended Gerber or MDA Autoplot format, the aperture definition is exported as part of the plot file header.

If a plot file containing this aperture is subsequently exported in basic Gerber format and the aperture has not been exported, then the aperture definition will not be part of the Gerber file.

11. If you want to export the custom aperture file at this point, see the procedure to export a custom aperture file and begin the procedure at step 4.

If you do not want to export the custom aperture file at this point, click **OK**. You can always export the custom aperture file from the saved Job File later.

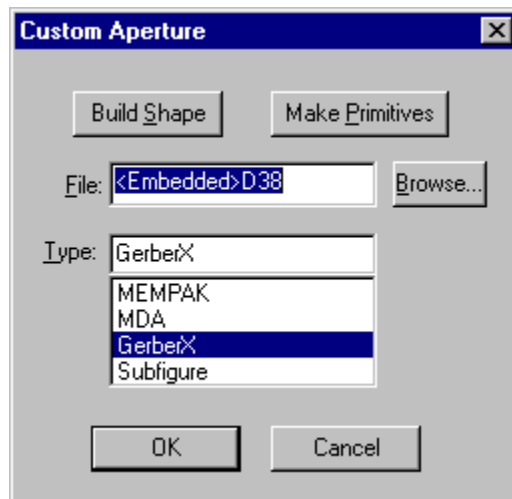
Export a Custom Aperture File



In order for a custom aperture captured in one job to be used in another job, the custom aperture must be exported. Later it can be imported into another job.

To Export a Custom Aperture File:

1. On the **Setup** menu, click **D Codes**.
2. Click on the **M-type D Code** you want to export.
3. Click the **Dimensions** menu.



Custom Aperture Dialog

4. In the **File** field of the Custom Aperture dialog, enter a **File Name** including the path or click **Browse** to select from available directories and file names.
5. In the **Type** list of the Custom Aperture dialog, click on the **File Format** that you want to use for the custom aperture file:
 - **MEMPAK:** This is the Lavenir QuickPAD format. An aperture exported in Lavenir QuickPAD format, with extension .AP, can be saved in a MEMPAK cartridge and read by RPG photoplotters.
 - **MDA:** An aperture exported in MDA Autoplot format can be automatically merged into the file header of an exported MDA Autoplot file.
 - **GerberX:** An aperture exported in Extended Gerber format can be automatically merged into the file header of an exported Extended Gerber file.

- **Subfigure:** The aperture is exported as an Extended Gerber file, and represented on screen as the standard unmapped custom shape, the letter M over a square.
6. On the Custom Aperture dialog, click **OK**.
 7. On the **D Code Table**, go to the **Custom Apertures** menu, and click **Export to File**.
The aperture definition is exported and can be imported into the D Code Table in subsequent jobs.

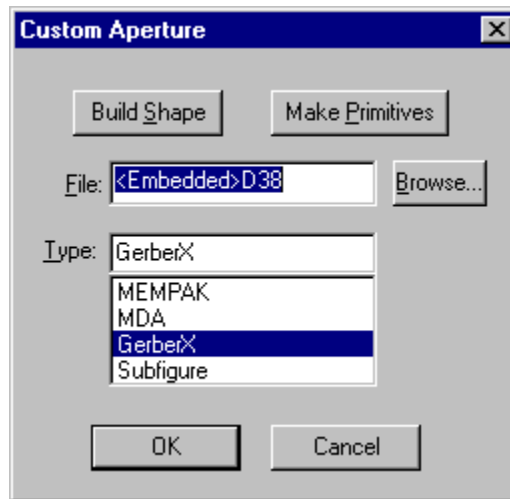
Import a Custom Aperture File into the D Code Table



In order for a custom aperture that was captured and exported from one job to be used in another job it needs to be imported into the second job.

To Import a Custom Aperture File into the D Code Table:

1. On the **Setup** menu, click **D Codes**.
2. Click on the unused D Code for which you want to import a custom aperture file, and type **M** for custom aperture.



Custom Aperture Dialog

3. In the **File** field of the Custom Aperture dialog, enter the **File Name** including the path of the custom aperture file, or click **Browse** to select the file from available directories.
4. In the **Type** list of the Custom Aperture dialog, click on the **file format** of the custom aperture file:
5. On the Custom Aperture dialog, click **OK**.
6. On the **D Code Table**, go to the **Custom Apertures** menu, and click **Import from File**.

The system imports the aperture definition into the D Code Table.



*In some cases the D Code Table may already contain several M-type D Codes with file names and formats already set, but no custom aperture files imported. You can import all of the custom aperture files simultaneously, by selecting all the M-Type D Codes on the D Code Table, going to the **Custom Apertures** menu, and clicking **Import from File**.*

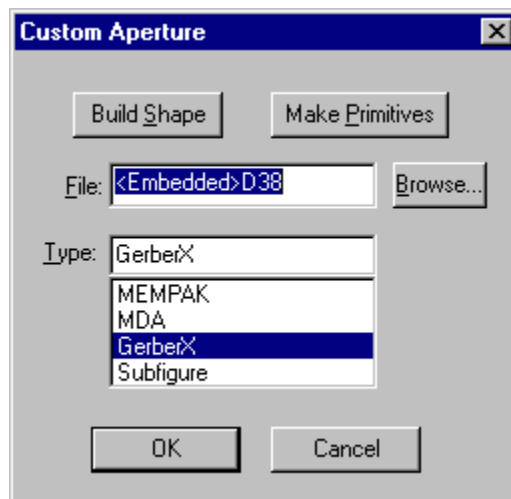
Recreate Primitives Used in a Custom Aperture



The program can recreate the primitives of the selected custom aperture D Code and insert those primitives into the job at the cursor location. The operation inserts any paint and scratch primitives on separate layers, starting with the layer you designate. This operation does not convert elements of custom aperture D Codes to primitives.

To Recreate Primitives Used in a Custom Aperture:

1. Position the cursor where you want the custom aperture primitives to be inserted and separate the cursor. See *Separate the Crosshair and Mouse Cursor* on page 112.
2. On the **Setup** menu, click **D Codes**.
3. Click on the **M-type D Code** for which you want to recreate primitives.
4. Click the **Dimensions** menu.



Custom Aperture Dialog

5. On the Custom Aperture dialog, click **Make Primitives**.
6. On the Start Layer dialog enter the **first layer** where you want the program to insert primitives.

The program inserts any paint and scratch primitives on separate layers, starting with the layer you designate.

7. Click **OK**.

Convert Elements of Custom Aperture D Codes to Primitives



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The program can convert elements of M-type D Codes into their primitive elements. The original custom elements are removed and replaced by their primitive components.



The elements of the selected M-Type D Codes are replaced by their primitives in the same active, visible layers as the original M-type elements, so only shapes that don't have both paint and scratch components can be converted this way.

To Convert Elements of Custom Aperture D Codes to Primitives:

1. Make the **layers** where you want to convert custom apertures active, visible layers. See *Select from the Active Layers* on page 152.
2. On the **Setup** menu, click **D Codes**.
3. **Select** the M-type D Codes for which you want to recreate primitives. This operation is not limited to one D Code at a time, so select all the M-Type D Codes you want to convert.
4. On the **D Code Table**, go to the **Custom Apertures** menu, and look at **Rounded Ends OK**.
 - If Rounded Ends OK has a check mark, then the system will replace square-ended trace primitives with round-ended ones in cases where the system would otherwise generate polygons. This applies only to non-vertical and non-horizontal traces. This option is useful for languages such as Extended Gerber in which there are no round-ended primitives. In such languages round-ended primitives are usually made with a trace and two circles, and it is OK to replace them with round-ended primitives on conversion.
 - If Rounded Ends OK does not have a check mark, then the system will not replace square-ended primitive traces with round-ended traces.
5. On the **D Code Table**, go to the **Custom Apertures** menu, and click **Replace with Primitives**.

If You See an M in a Square in the Viewing Area



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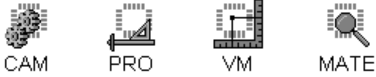


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If you see an element that looks like an M in a square in the viewing area, then the file contains an undefined custom aperture. The square with an M is a default placeholder for your custom aperture. To see the custom aperture the way it is supposed to look, import the custom aperture file into the D Code Table.

Chapter 7

Tool Code Table Overview



The program handles diameter and type information for up to 255 unique Tool Codes, ranging from T1 to T255. Even though it is possible to completely set up Tool Codes in the D Code Table, the Tool Code table provides a more condensed summary of Tool Code information than the D Code table.

To Display the Tool Code Table:

- On the **Setup** menu, click **Tool Codes**.



Shift+F5

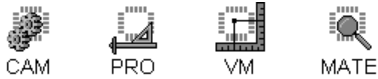
T Code	Type	Diameter	Count
T3	Plated	0.1	
T4	Plated	0.02	929
T5	Plated	0.031	80
T6	Plated	0.036	230
T7	Plated	0.039	295
T8	Plated	0.045	4
T9	Plated	0.046	117
T10	Plated	0.07	4
T11	Plated	0.094	2
T12	Plated	0.096	4
T13	Plated	0.125	2
T14	Plated	0.156	1

Tool Code Table

On the Tool Code table you can select Tool Codes for editing, change tool type and tool diameter, see the number of occurrences of each Tool Code in the loaded data and sort the Tool Code Table by various criteria such as Tool Code, tool type, tool diameter, or number of occurrences

Each Tool Code record includes two editable fields: tool type and tool diameter.

Tool Type



Four tool types are supported:

- **Plated:** Plated through holes are plated with copper that electrically connects pads in different layers. Plated through holes are often used for mounting components.
- **Non-Plated:** Non-Plated through holes are not plated with copper and do not electrically connect different layers.
- **Tooling:** Tooling holes may or may not be plated with copper. They are typically used for attaching the board to other things.
- **Via (X):** Vias are plated with copper that electrically connects pads in different layers. Vias are generally only for electrical connection and are typically not used for mounting components or for testing. Vias that pass through the entire board can be placed in PAD or DRI layer types; blind or buried vias can be placed in VIA or VID layer types. See *Layer Type* on page 355.

Tool types are used for netlist extraction, in Copper Area Calculation, and in other Lavenir programs such as FixMaster and ProbeMaster.

Tool Diameter



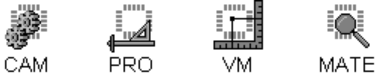
Tool Diameter is the diameter of the hole. Tool Codes have a resolution to 0.001 mil when the Database Units are English and .01 micron when in metric.

Number of Occurrences of each Tool Code



The number of occurrences of each Tool Code is shown in the Counts column of the Tool Code Table.

Select Tool Codes



In order to edit a Tool Code, you must select it. You can select and edit more than one Tool Code at a time.

To Select Tool Codes on the Tool Code Table:

- To select a **single** Tool Code, **Click** on the Tool Code in the T Code column of the Tool Code table.
- To select a **range** of Tool Codes, **Shift+Click** on the first and last Tool Codes of the range in the T Code column of the Tool Code table.
- To **add** or **remove** a single Tool Code from the selection, **Ctrl+Click** on the Tool Code in the T Code column of the Tool Code table.

Change Tool Type and Tool Diameter



To Change Tool Type and Tool Diameter on the Tool Table:

1. On the **Setup** menu, click **Tool Codes**.
2. On the Tool Codes table, **select** the Tool Code(s) you want to edit.
All selected Tool Codes will be set to the same values when you edit the Tool Codes.
3. **Double+Click** or press **Spacebar** on the selected Tool Code(s).
4. Enter the new **Diameter**.
5. Enter the new **Tool Type**.
6. Click **OK**.



*Spacebar = Display the Tool Code Values dialog, same as a double-click.
Arrow Keys = Go up and down to other Tool Codes in the table.*

Sort the Tool Code Table



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To make it easier to inspect Tool Code information you can sort the Tool Code Table by Tool Code, Tool Type, Tool Diameter, or Number of Occurrences.

To Sort the Tool Code Table:

1. On the **Setup** menu, click **Tool Codes**.
2. On the Tool Codes table, click on the labeled button at the **top of the column** you want to sort:
 - T Code
 - Type
 - Diameter
 - Count

One click sorts the table in ascending order, and the second click on the same column sorts the table in descending order.



*Sorting the table does not change the values of the Tool Codes, it just displays the table in a different order. To transcode the table in ascending order, see **Transcode the Tool Code Table in Ascending Order** below.*

Transcode the Tool Code Table in Ascending Order



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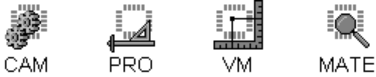
MATE

The program can change the Tool Codes of all tools in use so that their diameters are in ascending order. For instance, T1 would have the smallest diameter, T2 would have the next larger diameter, and so on.

To Transcode the Tool Code Table in Ascending Order:

- On the Tool Code Table, click **Transcode Ascending**.

Set Up Tool Codes In the D Code Table

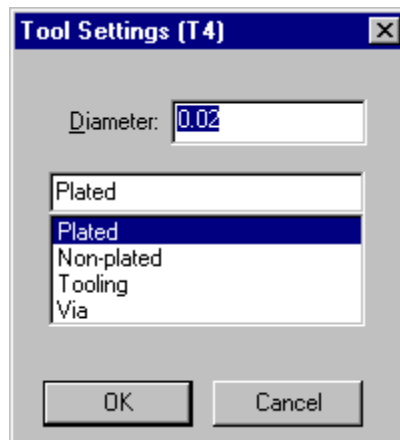


Plot elements must be defined by D Codes. To represent Drill data, set up an N-Shape D Code in the D Code Table. The N-Shape D Code represents an NC Drill Hole. Then map that D Code to a corresponding Tool Code. When you export Drill data, only N-shape pads are output with the corresponding Tool Code information.

To Set Up Tool Codes in the D Code Table:

1. On the **Setup** menu, click **D Codes**.
2. In the D Code Table, select the **N-shape** for a new D Code.
3. In the Drill dimensions dialog for the N-shape, enter a **Tool Code**.
4. Click **Tool Setup**.

The program displays the **Tool Setup** dialog that you would see if setting up the Tool Code on the Tool Code Table.



Tool Setup Dialog

5. Enter the new **Diameter**.
6. Enter the new **Tool Type**.
7. On the Tool Setup dialog, click **OK**.
8. On the Drill dimensions dialog, click **OK**.
9. On the D Code Table, click **OK**.

Chapter 8

Layers of Data



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The program can load up to 99 layers of plot data.

Your tools for managing layers of plot data are the Layers Table, the Layers Toolbar and the Current Element Toolbar.

Using these tools you can see and control the active layer(s), the layer number, board layer, layer name, layer type, layer element counts, layer color, layer visibility, positive and negative layers, paint and scratch layers.

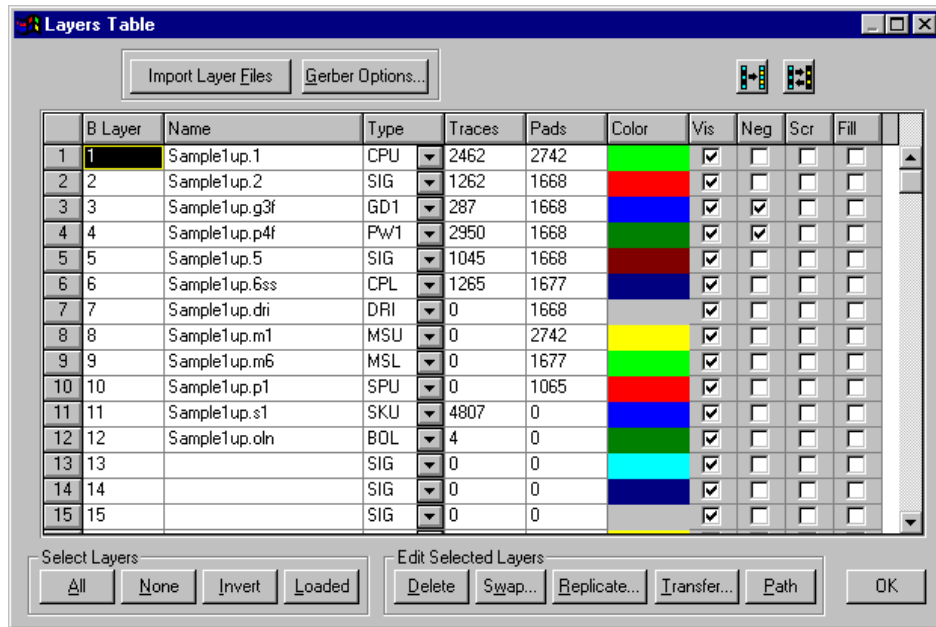
The Layers Table and Layers Toolbar also have commands for editing entire layers. You can delete, swap, replicate, and transfer layers. For information on editing layers using menu and keyboard commands outside of the Layers Table and Layers Toolbar, see *Edit Entire Layers of Data* on page 164.

You can also import Gerber data directly into the Layers Table. See *Import Gerber Directly into the Layers Table* on page 37.

Layers Table



The Layers Table is the most comprehensive tool for controlling layers of plot data.



Layers Table

To Display the Layers Table:

- On the **Setup** menu, click **Layers**.



F10

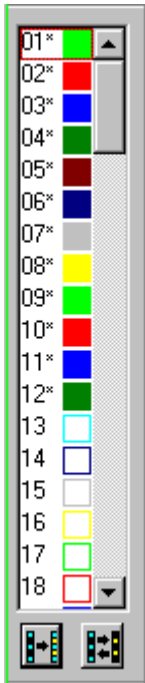


You can resize the Layers Table to show more layers by dragging the corner of the dialog or by clicking on the maximize button.

Layer Toolbar



The Layers Toolbar is a compact tool for controlling layers of plot data. It is not as comprehensive as the Layers Table, but it is small enough that it can remain docked to the side of the viewing area while you do other work.



Layers Toolbar

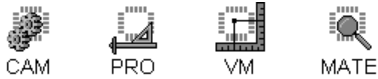
To Display the Layers Toolbar:

- On the **View** menu, look at **Toolbars-Layers**.
 - If Layers has a checkmark next to it, then the Layers Toolbar is displayed.
 - If Layers does not have a checkmark next to it, then the Layers Toolbar is not displayed.

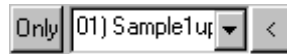
To change the display of the Layers Toolbar, click Layers.



Active Layers



A rectangular box around a layer on the Layers Toolbar indicates the Active Layer. And the Layer Number of the active layer is shown in the Current Element Toolbar.



Active Layer in Current Element Toolbar

To Set the Active Layer on the Layers Toolbar:

- Click on the layer you want to be active.

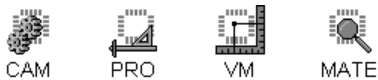
For more information on how to use the active layer for selection and editing, see *Select from the Active Layers* on page 152.

Layer Number

The Layer Number indicates the order of the layers in the loaded database.

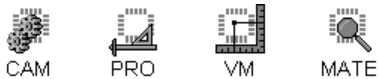
You can see the Layer Numbers in the Layers Table and the Layers Toolbar. And the Layer Number of the active layer is shown in the Current Element Toolbar.

Layer Number on Layers Table



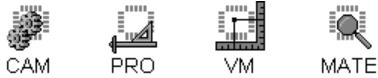
The buttons on the left edge of the Layers Table show the Layer Numbers. The Layer Number indicates the order of the layers in the Layers Table. You cannot edit the Layer Number directly, so to change the layer number of a layer of data you must Transfer or Replicate the layer data to a new layer.

Layer Number on Layer Toolbar



The left column of the Layers Toolbar contains the Layer Number. The Layer Number indicates the order of the layers in the Layers Toolbar. You cannot edit the Layer Number directly, so to change the layer number of a layer of data you must Transfer or Replicate the layer data to a new layer.

Board Layer



The Board Layer indicates where a layer of data will be in the finished board. By setting the Board Layer to the same value for more than one layer of data, you can combine those layers into a single Board Layer. By doing so you indicate that all of the features of the combined layers will be manufactured on the same layer of the finished board.

The concept of several data layers combined into a single board layer has use in several operations:

- Exporting Combined Files
- Combining Paint and Scratch Layers
- Raster Design Rule Checking
- Raster Netlist Extraction

Board Layer on the Layers Table

The B Layer column of the Layers Table shows the Board Layer.

To Set the Board Layer on the Layers Table:

1. Click in the **B Layer** field for the layer you want to edit.
2. Type the new **Board Layer**.



To make the Board Layer the same for several layers, select all the layers first. Then when you set the Board Layer for one layer, all the selected layers are given the same Board Layer.

To Renumber the Board Layers Sequentially from the Top of the Layers Table:

1. Right-Click on **B Layer** at the top of the B Layer column.
2. On the context menu that pops up, click **Renumber Board Layers**.

The program rennumbers the board layers sequentially from the top of the table.

Board Layer on the Layers Toolbar

To Set the Board Layer on the Layers Toolbar:

1. **Right-click** the Layers Toolbar on the layer you want to change.
The context menu shows the current Board Layer number.
2. On the **context menu**, click **Board Layer**.
3. Select the new **Board Layer** from the drop down list.
4. Click **OK**.

Layer Name

The Layer Names are for organizing the layer data and are used for the layer file names if you export Gerber data layer-by-layer.

You can see and set the Layer Name in the Layers Table and the Layers Toolbar. And the Layer Name of the Active Layer is shown on the Current Element Toolbar.

Layer Name on Layers Table



The Name column of the Layers Table contains the Layer Names. If Gerber Files are imported into the Job File, the individual layer file names become the Layer Names and may contain the entire path name for the layer file.

To Enter a New Layer Name on the Layers Table:

1. Click on the **Name** field for the layer you want to rename.
2. Type the new **Layer Name**.



To make the Layer Name the same for several layers, select all the layers first. Then when you set the Layer Name for one layer, all the selected layers are given the same Layer Name.

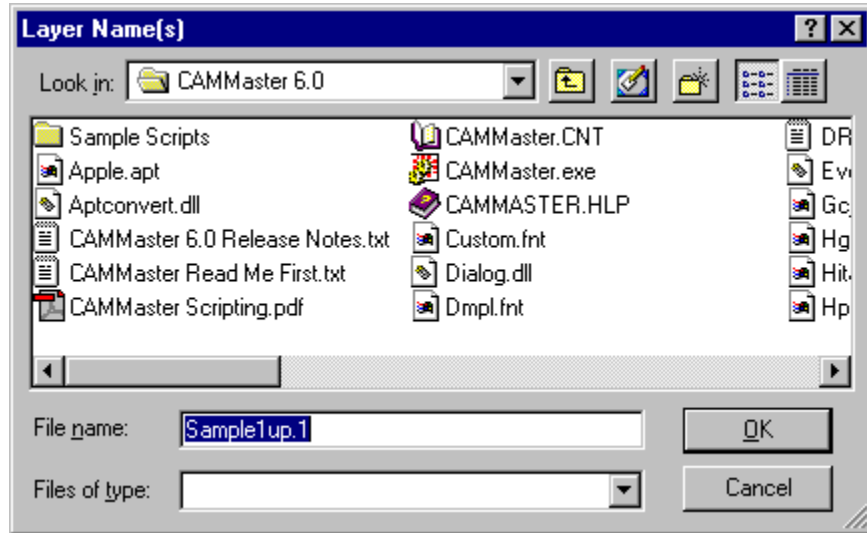
To Rename Multiple files using Wildcards in the Layers Table:

1. Click on the **Name** field for the first of the layers you want to rename.
2. Type the new Layer Name with the **extension** “.*” For instance, type: *name.**
 - If the existing Layer Name prefixes are different, the system renames this layer and all following loaded layers with the new prefix and a sequentially numbered suffix, .01, .02, .03, etc.
 - If the existing Layer Name prefixes are all the same, the system renames this layer and all following loaded layers with the new prefix and keeps the original suffixes.

To Browse the Directories for File Names:

- **Double-click** the **Name** field for the layer you want to rename.

The system displays the File Open dialog where you can pick among available drives, directories and files.



Browse for Layer Name Dialog

To Toggle Display of the Path Portion of the Layer Name:

1. Select the layers.
2. Click **Path**

Layer Name on the Layers Toolbar

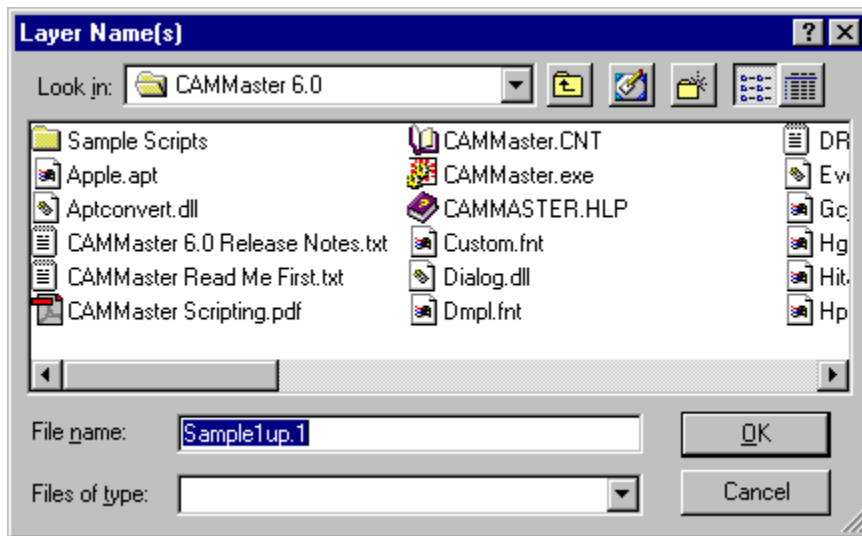


To See the Name of a Layer on the Layers Toolbar:

- Hold the cursor over the layer for a second, and a **ToolTip** with the layer name will pop up.
- Or **right-click** the Layers Table on the layer you want to check, and read the layer name off the **context menu**.

To Change the Name of a Layer on the Layers Toolbar:

1. **Right-click** the Layers Toolbar on the layer you want to change.
2. On the **context menu**, click the **layer name**.



Set Layer Name Dialog

3. On the Set Layer Name dialog, enter the new **layer name**, or click **Browse** to browse a list of directories and files for the layer name you want.

Layer Type

The Layer Type identifies the layer by its function in the completed board.

You can see and set the Layer Type in the Layers Table and the Layers Toolbar.

The Layer Types include:

- **CPU, CPL:** Component Layer Upper and Lower
- **PAD:** Gerber Padmaster
- **DRI:** NC Drill Padmaster



When you enter a Layer Name with a .DRI extension, the Layer Type is automatically set to DRI also.

- **VIA:** Gerber Blind or Buried Via Layer
- **VID:** NC Drill Blind or Buried Via Layer
- **GD1-5:** Ground Plane Layers 1-5
- **GS1-5:** Ground Split Layers 1-5
- **PW1-5:** Power Plane Layers 1-5
- **PS1-5:** Power Split Layers 1-5
- **SIG:** Internal Signal Layer
- **MSU, MSL:** Soldermask Layers Upper and Lower
- **SKU, SKL:** Silkscreen Layers Upper and Lower
- **SPU, SPL:** Solderpaste Layers Upper and Lower, also “Filter” Layers Upper and Lower
- **OTH:** Layers of a type other than those in the Layer Types list
- **NFL:** Non-Functional Layer
- **BOL:** Board Outline Layer

The concept of identifying layers by Layer Type has use in several operations including netlist extraction and design rule checking.

Layer Type on Layers Table



The Type column of the Layers Table indicates the Layer Type. The Layer Type identifies the layer by its function in the completed board.

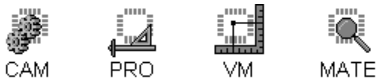
To Set the Layer Type on the Layers Table:

1. Click on the **Type** field drop down list for the layer you want to edit.
2. Select the **Layer Type** off the list.



To make the Layer Type the same for several layers, select all the layers first. Then when you set the Layer Type for one layer, all the selected layers are given the same Layer Type.

Layer Type on the Layers Toolbar



To Set the Layer Type on the Layers Toolbar:

1. **Right-click** on the layer and look at the Layer Type on the **context menu**.
2. **Click** the Layer Type on the context menu.
3. **Select** the new Layer Type off the Layer Type dialog.

Layer Color

The Layer Color is the color used to display the layer in the Viewing Area. The program supports a palette of 15 layer colors that you can use for layer colors at any one time, and you can select the 15 color palette from as many colors as your graphics card supports.

You can see and set the Layer Color in the Layers Table and the Layers Toolbar.

Layer Color on Layers Table



The Color column of the Layers Table indicates the color used to display the layer in the Viewing Area.

Quick Set the Layer Color on the Layers Table Using the Color Index:

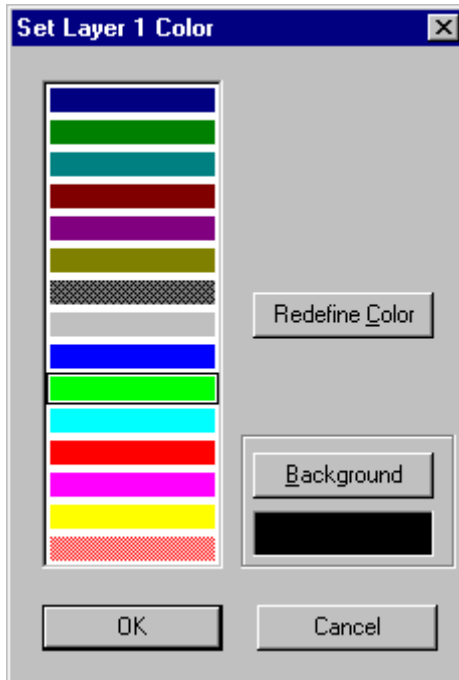
1. Click on the **Layer Color** field of the layer you want to change in the Layers Table.
The program displays the current color index number for that layer.
2. Type a new **color index number**.

To Set the Layer Color on the Layers Table:



To make the Layer Color the same for several layers, select all the layers first. Then when you set the Layer Color for one layer, all the selected layers are given the same Layer Color.

1. **Double-click** on the **Layer Color** field of the layer you want to change in the Layers Table.
The program displays the palette of 15 layer colors currently available to choose from.



Color Palette

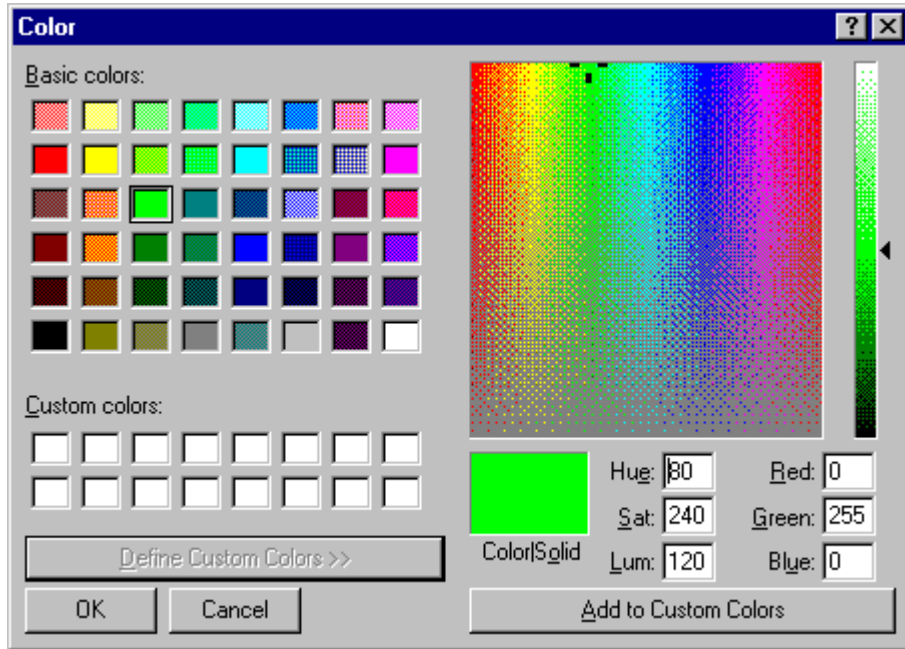
2. If you see the color you want in the **current palette**, then **click on the color** you want, and click **OK**.
If you do not see the color you want in the current palette, then click **Redefine Color**.
The program displays the basic and custom colors currently available to add to the pallet.



Basic and Custom Color Dialog

3. If you see the color you want in the **basic and custom colors**, then **click on the color** you want, and click **OK**.
If you do not see the color you want in the basic and custom colors, then click on **Define Custom Colors**.

The program displays the custom color picker.



Custom Color Picker

4. Adjust the **color values** to what you want.
5. Click **Add to Custom Colors**.
6. Click **OK**.

Layer Color on Layer Toolbar



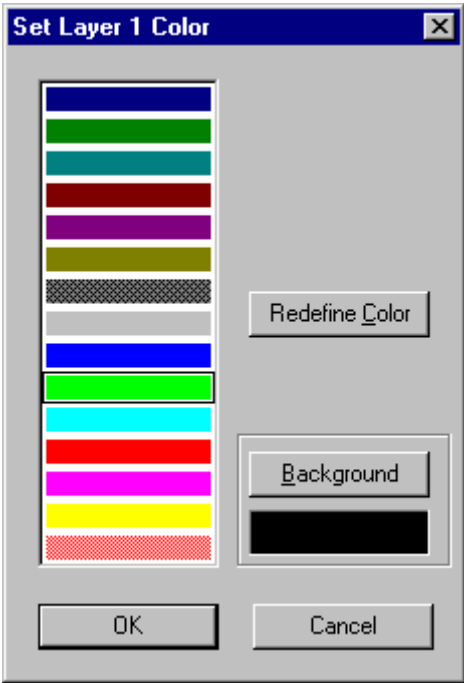
A block of color on the right side of the Layers Toolbar indicates the color used to display the layer in the Viewing Area. The block can be solid or crosshatched, depending on whether the layer is visible or not.

The program supports a palette of 15 layer colors that you can use for layer colors at any one time, and you can select the 15 color palette from as many colors as your graphics card supports. Using the layer color system you can:

To Set the Layer Color on the Layers Toolbar:

1. **Right-click** on the layer you want to change in the Layers Toolbar.
2. From the context menu, click on **Color**.

The program displays the palette of 15 layer colors currently available to choose from.



Color Palette

3. If you see the color you want in the **current palette**, then **click on the color** you want, and click **OK**.
If you do not see the color you want in the current palette, then click **Redefine Color**.

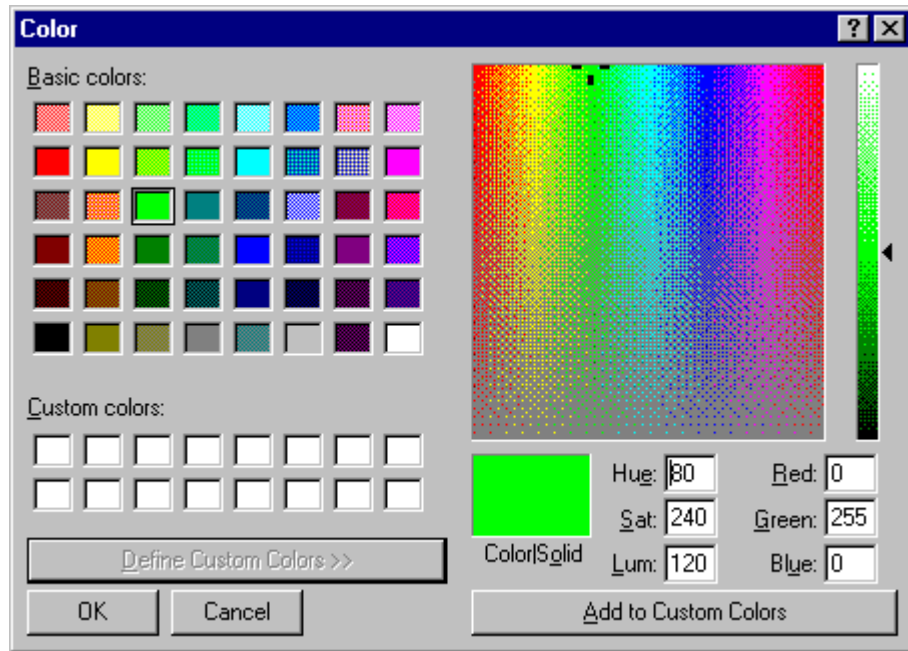
The program displays the basic and custom colors currently available to add to the pallet.



Basic and Custom Color Dialog

4. If you see the color you want in the **basic and custom colors**, then **click on the color** you want, and click **OK**.
If you do not see the color you want in the basic and custom colors, then click on **Define Custom Colors**.

The program displays the custom color picker.



Custom Color Picker

5. Adjust the **color values** to what you want.
6. Click **Add to Custom Colors**.
7. Click **OK**.

Layer Visibility

Layers can be either visible or not visible. Visible layers are shown in the Viewing Area and non-visible layers are not.

Layer Visibility on Layers Table



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The Vis column of the Layers Table indicates the Visibility status of the layer. A check mark indicates the layer is visible in the Viewing Area and no check mark indicates the layer is not visible.

To Toggle the Visibility of a Single Layer on the Layers Table:

- Click on the **Vis** field for the layer you want to switch.



*Spacebar (in the Vis field of the layer you want to switch)
V (in the row of the layer you want to switch)*



To make the Layer Visibility the same for several layers, select all the layers first. Then when you set the Layer Visibility for one layer, all the selected layers are given the same Layer Visibility.

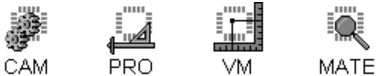
To Make All Layers Visible on the Layers Table:

- Click the **All Layers Visible** button above the Vis column.

To Toggle the Visibility of All Layers on the Layers Table:

- Click the **Toggle All Layers** button above the Vis column.

Layer Visibility on Layer Toolbar




The block of color on the right side of the Layers Toolbar that indicates the layer color also indicates whether the layer is visible in the Viewing Area.

- If the block is solid the layer is visible.
- If the block is crosshatched, the layer is not visible.

To Toggle the Visibility of a Single Layer on the Layers Toolbar:

- **Double-click** on the layer you want to switch.
- Or **right-click** on the layer you want to switch, and click **Visibility** on the Context Menu.

 *After you have switched the focus to the Layers Toolbar by clicking on it, you can use the following key commands to toggle visibility of individual layers:
Enter Key = Toggle Visibility for the current layer
Arrow Keys = Go up or down to the next layer in the Layers Toolbar.*

To Make All Layers Visible on the Layers Toolbar:

- Click the **All Layers Visible** button at the bottom of the toolbar.



To Toggle the Visibility of All Layers on the Layers Toolbar:

- Click the **Toggle All Layers** button at the bottom of the toolbar.



Positive and Negative Layers

The Positive/Negative setting indicates whether a layer is positive or negative. Positive layers are displayed in the Viewing Area as colored elements on a black background. And negative elements are displayed in the Viewing Area as black elements on a colored background.

You can see and set the Positive/Negative setting in the Layers Table and the Layers Toolbar.

Positive and Negative on Layers Table



The Neg column on the Layers Table indicates whether a layer is Positive or Negative. If there is a check mark in the Neg column, then that layer is Negative, and if there is no check mark, the layer is Positive.

To Switch the Positive/Negative Setting of a Layer on the Layers Table:

- Click on the **Neg** field for the layer you want to switch.



*Spacebar (in the Neg field of the layer you want to switch)
N (in the row of the layer you want to switch)*



To make the Positive/Negative setting the same for several layers, select all the layers first. Then when you set the Positive/Negative setting for one layer, all the selected layers are given the same Positive/Negative setting.

Positive and Negative on the Layers Toolbar



To Set Positive and Negative Polarity on the Layers Toolbar:

1. On the Layers Toolbar, **right-click** on the layer. And look at Negative on the Context Menu.
 - If there is a check mark next to the word Negative on the context menu, then that layer is **Negative**
 - If there is no check mark next to the word Negative on the context menu, the layer is **Positive**.
2. To switch the Positive/Negative setting of the layer, **click** on Negative on the context menu.

Paint and Scratch Layers

The Paint/Scratch setting indicates whether a layer is a Paint or Scratch layer.

When displayed in the Viewing Area, a Scratch layer scratches away its color from previous layers of the same color. By combining alternating paint and scratch layer pairs, sophisticated artwork can be generated.

In order to be plotted, paint and scratch layer combinations need to be exported in formats that support the paint and scratch layer types, such as MDA Autoplot (“MRGE=PAINT” or “MRGE=SCRATCH” commands) or Extended Gerber files (“LPD” or “LPC” commands). Other techniques may involve exporting the layers separately and combining them later.

You can see and set the Paint/Scratch setting in the Layers Table and the Layers Toolbar.

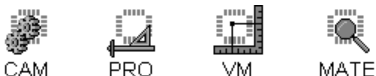
Paint and Scratch on the Layers Toolbar



To Set the Paint and Scratch Setting on the Layers Toolbar:

1. On the Layers Toolbar, **right-click** on the layer, and look at **Scratch** on the Context Menu.
 - If there is a check mark next to the word Scratch on the context menu, then that layer is a **Scratch** layer.
 - If there is no check mark next to the word Scratch on the context menu, the layer is a **Paint** layer.
2. To switch the Paint /Scratch setting of the layer, click on **Scratch** on the context menu.

Paint and Scratch on Layers Table



The Scr column on the Layers Table indicates whether a layer is a Paint or Scratch layer. If there is a check mark in the Scr column, then that layer is a Scratch layer, and if there is no check mark, the layer is a Paint layer.

To Switch the Paint/Scratch Setting of a Layer on the Layers Table:

- On the Layers Table, click on the **Scr** field for the layer you want to switch.



*Spacebar (in the Scr field of the layer you want to switch)
S (in the row of the layer you want to switch)*



To make the Paint/Scratch setting the same for several layers, select all the layers first. Then when you set the Paint/Scratch setting for one layer, all the selected layers are given the same Paint/Scratch setting.

Fill Layer



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The Fill column on the Layers Table indicates whether a layer is a Fill layer. If there is a check mark in the Fill column, then that layer is a Fill layer, and if there is no check mark, the layer is not a Fill layer.

A Fill layer is generally a layer with large plane areas that are drawn using lots of traces. By designating such a layer as a fill layer you can speed up the processing of certain operations such as Vector Design Rule Checking and Vector Netlist Extraction.

To Switch the Fill Setting of a Layer on the Layers Table:

- On the Layers Table, click on the **Fill** field for the layer you want to switch.



*Spacebar (in the Fill field of the layer you want to switch)
F (in the row of the layer you want to switch)*



To make the Fill setting the same for several layers, select all the layers first. Then when you set the Fill setting for one layer, all the selected layers are given the same Fill setting.

Loaded Data in a Layer

The Layers Table and Layers Toolbar indicate whether there is data in a given layer.

Layer Element Counts on Layers Table



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The Traces and Pads columns of the Layers Table report the number of elements on each layer. This is statistical information and cannot be edited. Layers that do not contain data are shown in the table with a gray background.

Loaded Data on Layer Toolbar



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When a layer in the Layers Toolbar contains data, an asterisk is shown next to the layer number in the Layers Toolbar. Element counts for each layer are not shown in the Layers Toolbar, but are shown on the Layers Table.

Select Layers on Layers Table

In order to edit layers on the Layers Table, you must first select them. Selected layers are indicated when the button at the left of the row is down and the row is highlighted in color.

When more than one layer is selected and you change a setting (such as board layer, layer name, type, visibility, paint/scratch, positive/negative, or fill) on one of the selected layers, then all of the selected layers are given the same setting.

Manually Select Single or Multiple Layers on the Layers Table



When a layer is selected, its Layer Number button is down, and the row is highlighted.

To Manually Select Single or Multiple Layers on the Layers Table:

- To select a **single** layer on the Layers Table, **click** on the **Layer Number button** to the left of the layer row.
- To select a **range** of layers, use **Shift+Click**.
- To **add** a single layer to a group of selected layers, or to **remove** one, use **Ctrl+Click**.

Select All Layers on the Layers Table



To Select All Layers on the Layers Table:

- On the Layers Table, click the **All** button at the bottom of the table.

Select None on the Layers Table



The Select None button clears selection from all layers in the Layers Table so that you can make certain that no layers are selected.

To Clear Selection from All Layers in the Layers Table:

- On the Layers Table, click the **None** button at the bottom of the table.

Invert Selected Layers on the Layers Table



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The Invert Selection command inverts the selection of layers in the Layers Table, so that selected layers become unselected and the unselected become selected.

To Invert Selected Layers on the Layers Table:

- On the Layers Table, click the **Invert** button at the bottom of the table.

Select Loaded Layers on the Layers Table



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To Select Only the Loaded Layers on the Layers Table:

- On the Layers Table, click the **Loaded** button at the bottom of the table.

Delete Layers

You can delete layers in the Layers Table or in the Layers Toolbar. For information on deleting layers using menu commands outside of the Layers Table and Layers Toolbar, see *Delete Layers* on page 171.

Delete Layers on the Layers Table



To Delete Layers on the Layers Table:

1. **Select** the layers to delete.
2. Click the **Delete** button.

Delete Layers on the Layers Toolbar



You can delete data from a layer on the Layers Toolbar. You have options to delete all the data, or only the pads, or only the traces.

To Delete Data from a Layer on the Layers Toolbar:

1. **Right-click** the Layers Toolbar on the layer you want to delete.
2. On the context menu, go to **Edit-Delete-**
 - To delete all the data from the layer, click **All**.
 - To delete all pads from the layer, click **Pads**.
 - To delete all traces from the layer, click **Traces**.

Replicate Layers

Replicating layers means to copy the data of one layer or a range of layers into new layers. The data remains at the old location and is copied to the new location.

You can Replicate Layers in the Layers Table or in the Layers Toolbar. For information on replicating layers using menu commands outside of the Layers Table and Layers Toolbar, see *Replicate Layers* on page 170.

Replicate Layers on the Layers Table



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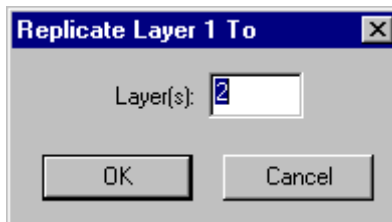
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To Replicate Layers on the Layers Table:

1. **Select** the layers you want to Replicate.
2. Click the **Replicate** button.



Replicate Selected Layers Dialog

3. In the **Replicate Layers** dialog, enter the **first of the layers** where the selected layers are to be copied in.
4. Click **OK**.

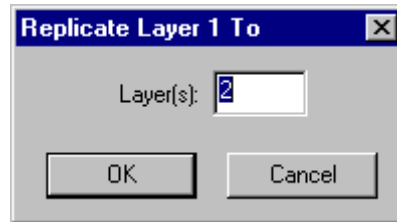
The program copies the data of the selected layers into a series of layers beginning with the one in the Replicate Layers dialog. If the layers copied to are empty, this results in exact layer copies of the selected layers. If the layers copied to have data, the data from the selected layers are merged into the target layers as the data are copied.

Replicate Layers on the Layers Toolbar



To Replicate a Layer on the Layers Toolbar:

1. **Right-click** the Layers Toolbar on the **layer** you want to replicate to another layer.
2. On the **context menu**, click **Replicate**.



Replicate Selected Layers Dialog

3. On the Replicate Layers dialog, enter the **layer** to which you want to replicate the selected layer.

Transfer Layers

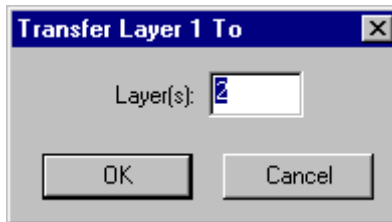
You can transfer layers in the Layers Table or in the Layers Toolbar. For information on transferring layers using menu commands outside of the Layers Table and Layers Toolbar, see *Transfer Layers* on page 169.

Transfer Layers on the Layers Table



To Transfer Layers on the Layers Table:

1. **Select** the layers you want to transfer.
2. Click the **Transfer** button.



Transfer Selected Layers Dialog

3. In the **Transfer Layers** dialog, enter the **first of the layers** where the selected layers are to be transferred to.
4. Click **OK**.

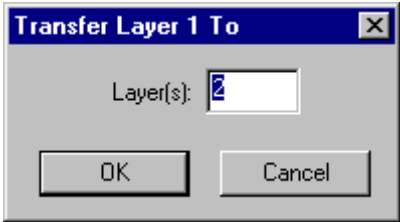
The program transfers the selected layers to a series of layers beginning with the one in the Transfer Layers dialog. If the layers where the data is transferred to are empty, the selected layers are transferred exactly as they were. If the layers where the data is transferred to have data, the data from the selected layers are merged into the target layers as the data are transferred.

Transfer Layers on the Layers Toolbar



To Transfer a Layer on the Layers Toolbar:

1. **Right-click** the Layers Toolbar on the layer you want to transfer to another layer.
2. On the **context menu**, click **Transfer**.



Transfer Selected Layers Dialog

3. On the Transfer Layers dialog, enter the layer to which you want to transfer the selected layer.

Swap Layers

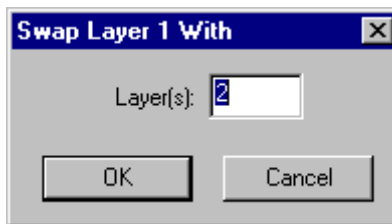
You can swap layers in the Layers Table or in the Layers Toolbar. For information on swapping layers using menu commands outside of the Layers Table and Layers Toolbar, see *Swap Layers* on page 171.

Swap Layers on the Layers Table



To Swap Layers on the Layers Table:

1. **Select** the layers you want to swap with other layers.
2. Click the **Swap** button.



Swap Selected Layers Dialog

3. In the **Swap Layers** dialog, enter the **first of the layers** to be swapped with the selected layers.
4. Click **OK**.

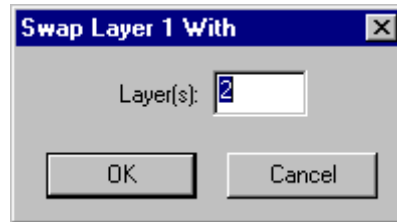
The program swaps the selected layers with a series of layers beginning with the one in the Swap layers dialog.

Swap Layers on the Layers Toolbar



To Swap Layers on the Layers Toolbar:

1. **Right-click** the Layers Toolbar on the layer you want to swap with another layer.
2. On the **context menu**, click **Swap**.



Swap Selected Layers Dialog

3. On the **Swap Layers** dialog, enter the **layer** you want to swap with the first layer.

Chapter 9

Printing

The program can print a file on a color or black and white printer.

Print a Plot



To Print a Plot:

1. If you only want to print part of the data, adjust the view of the data and set the visibility settings so that exactly what you want to print is on screen.
2. On the **Files** menu, click **Print**.
3. On the **Print** dialog, select a **Print Range**:
 - **Screen**: Prints the visible data on screen.
 - **All Board Layers**: Prints all visible layers, one Board Layer at a time. The print is not limited to the data within the rectangle of the viewing area; it includes the entire extents of each Board Layer.
 - **Current Board Layer**: Prints all data that shares the same Board Layer as the active layer. The print is not limited to the data within the rectangle of the viewing area; it includes the entire extents of the Board Layer.
4. On the **Print** dialog, select a **Color Scheme**:
 - **Black on White**: Data on screen is printed as black, and background color is left white. This is the most useful choice for a black and white laser printer.
 - **White on Black**: Background color is printed as black, and data on screen is left white. This is the other choice for a black and white laser printer.
 - **Screen Colors**: Data and background color is printed as it is shown on screen. This option requires a color printer. Do not choose this option for a black and white laser printer because all colors will be forced to black.
 - **Colors on White Background**: Data on screen is printed as it is shown on screen, and background color is left white. This option requires a color printer. Do not choose this option for a black and white laser printer because all colors will be forced to black.



On some printers the Black on White and White on Black options print in reverse of how they are labeled. If this happens with your printer, reverse your selection for the color scheme, and the print should come out how you want it.

5. On the **Print** dialog, select a **Scale Factor**:

- **Fit on Page:** All data within the rectangle of the viewing area is scaled to fit the selected paper size.
 - **By Factor:** All data within the rectangle of the viewing area is scaled to the factor that you enter.
6. If you want to print a page header containing file name, scale factor and date, click **Add Page Header** so that the option has a check mark.
 7. Click **OK**.
The system displays the printer setup dialog where you can set printer driver settings.
We recommend you select a **Non-PostScript printer driver** that is compatible with your printer.
 8. Click **OK**.



Ctrl+P



Preview a Print



CAM



PRO



VM



MATE

You can preview what is going to be printed before actually printing the image. This gives you the option of changing settings before printing the file.

To Preview a Print:

- Follow the procedure for how to print, but instead of going to **File-Print**, go to **File-Print Preview**.

Before printing the image, the system displays a print preview screen in which you can:

- Zoom in on the image
- View each page in the print job
- Select to print or cancel the print job

If You Get a Black Rectangle



CAM



PRO



VM



MATE

If you get a black rectangle when you print, check the following.

Select Only Black and White Options for a Black and White Printer

The printing feature is capable of generating a print file for a color printer. So if you are using a black and white printer and select a color scheme other than **black on white** or **white on black**, all colors will be forced to black, and you will get a black rectangle.

Try a Non-PostScript Printer Driver

The printing feature does not generate a print file that is compatible with all PostScript printer drivers. If you get a black rectangle, click **Setup** on the **Print** dialog and try selecting a **Non-PostScript** printer driver that is compatible with your printer. If this does not help, you may also try installing an updated printer driver; updated drivers are generally available for download from the printer manufacturer's web site.

Chapter 10

Report File



The program can generate a Report File that provides information about the loaded data, and the program can also open a text editor in which you can view the Report File.

The report file provides the following information:

- Date
- Report file name and path
- Units of the database
- Gerber data format
- Drill data format
- Table of information on the visible layers, including:
 - Layer number
 - Counts of traces, arcs, and pads
 - Layer dimensions
 - Layer name
 - Layer type
 - Positive or Negative
 - Paint or Scratch
 - Board layer
- Table of D Code information, including:
 - D Code number
 - Shape Code
 - D Code dimensions
 - Counts of traces, arcs, and pads
- List of D Codes in order of size, including:
 - D Code number
 - Shape Code
 - D Code dimensions
- Table of Tool Code information, including:
 - Tool Code
 - Hole Type
 - Tool size
 - Counts of Holes

The program also automatically creates other types of reports during certain types of operations such as netlist extraction, design rule checking, copper area calculation, and transcoding.

Generate a Report File



CAM



PRO



VM



MATE

To Generate a Report File:

1. Make all the **layers** you want included in the Report File Layers Table **visible**.
2. On the **File** menu, click **Report-Generate**.
3. To save the Report File in a different folder, click a different drive in the **Look in** box, or double-click a different folder in the folder list.

To save the Report File in a new folder, click **Create New Folder**.

4. In the **File name** box, type a name for the Report File.

View A Report File



CAM



PRO



VM



MATE

To View A Report File:

1. On the **File** menu, click **Report-View**.
2. In the **Look in** box, click the drive, folder, or network location that contains the Report File.
3. In the folder list, double-click folders until you open the folder that contains the Report File you want.
4. Double-click the **Report File**.

Chapter 11

Design Rule Checking



The Raster DRC is only available in CAMMaster, while the Vector DRC and Distance Histogram are available in ViewMaster PRO and ViewMaster as well.

The program can run a Design Rule Check to verify the accuracy and manufacturability of plot data using either a Raster Design Rule Check routine or a Vector Design Rule Check routine.

In addition to Design Rule Checking, the program can generate a Distance Histogram report.

Two Types of Design Rule Checking Routines



There are some significant differences between the technique and the error inspection methods of the Raster and Vector DRC routines, and there are advantages to both systems.

Raster vs. Vector DRC Technique



Raster DRC converts the Gerber image into a raster bitmap and uses that bitmap to create polygonal outlines of the image. Then the Raster DRC checks for clearances and contact between polygons.

Vector DRC uses the Gerber description of the position, size and shape of elements to determine clearance and contact between elements.

Raster vs. Vector DRC Error Inspection Method



The Raster DRC routine tags DRC errors with a user-definable color-coded graphic. You can go to the first, next, previous, or last error of each error type using a specialized DRC error inspection tool.

Vector DRC tags errors by inserting selected elements of special error tag D Codes into the file at the location of the error. You can inspect the Vector DRC errors by using the program's selection and inspection tools to find each element that has an error tag D Code.

Raster DRC Advantages



The Raster DRC technique can process paint and scratch images, while the Vector DRC technique cannot.

Images that are comprised of many elements, such as planes drawn with traces, do not necessarily slow down Raster DRC, while these types of images do slow down Vector DRC. So Raster DRC can be much faster than Vector DRC on files that contain many elements.

The Raster DRC error inspection tool is much easier to use than the Vector DRC method, and it does not involve inserting data into the file the way Vector DRC does.

Raster DRC can do a Silkscreen-to-Pad check, while the Vector DRC cannot.

Vector DRC Advantages



The time required to do a Vector DRC is related more to the number of elements than to the physical size of the image or elements. So a large board does not necessarily take longer than a small board, as long as they both have the same number of elements. The time required to do a Raster DRC is related more to the number of pixels that have to be examined than to the number of elements. So a large image or an image with very small parts that has to be examined at high resolution can take longer than a smaller or low-resolution image, regardless of the number of elements involved. This means that Vector DRC can be faster than Raster DRC on boards that have a large physical size.

Vector DRC does not have a concept of image resolution, and the accuracy of Vector DRC is not affected by user-specified variables. In contrast, Raster DRC operations that are not performed at adequately fine raster resolution may have errors.

Vector DRC can do the following checks that Raster DRC cannot:

- Pad-to-Pad Contact
- Unterminated Traces
- Centerline Disconnect
- Trace Intersection

Raster DRC



The program can run a Raster Design Rule Check to verify the accuracy and manufacturability of plot data. The process examines individual layers, layer sets, portions of layers selected with the reference frame, or the entire database, depending on how you set it up. The program reports design rule violations in a text file and flags the errors in the Viewing Area for easy identification.

Prepare Plot Data for the Raster Design Rule Check



The best Raster Design Rule Check results are obtained from plot data that has been prepared. You need complete and accurate D Code and Tool Code information and Layer Type identification. Flashed (not drawn) pads are essential for any check involving pads. The Board Layer is important if you have composite layers or paint and scratch layer combinations.

To Prepare Plot Data for the Raster Design Rule Check:

1. Extract a netlist by running the **Raster Netlist Extraction** procedure using the same raster resolution as will be used in Raster DRC. See *Raster Netlist Extraction* on page 415.

The Raster DRC routine needs net information to correctly run the design rules checks. Specifically, the air-gap checks do not flag violations between elements of the same net. And the soldermask checks use this information to avoid flagging masks as being too close to the traces connecting to the pad the mask is covering. If the net information is missing, the system tries to guess the correct connections, but this is not always possible.

If you run the raster netlist extraction as instructed above, then you will have already performed most of the following data preparation for the netlist extraction. Verify the data has been set up as follows:

2. On the **D Code Table** and the **Tool Code Table**, define all **D Codes** and **Tool Codes**.

- NC Drill Tool Codes must be defined as P-plated, N-non-plated, T-tooling, or V-via.
- If you use a Gerber padmaster to define drill data rather than a drill file, the D Code hole sizes must reflect the actual tool sizes.

3. On the **Layers Table**, set up the **Layer Types**.

In layer-to-layer checks for soldermask and annular ring violations, the system has to know the type of each layer used.

4. On the **Layers Table**, set the **Board Layer Number** for each layer.

Layers are processed consecutively by board layer number, and all layers that have the same Board Layer Number are processed as single composite layers. This allows DRC on paint and scratch combinations.

5. Convert **drawn pads** to **flashed pads**. See *Convert Drawn Pads* on page 227.

If you don't have flashed pads on the CPU and CPL layers, extract them from the top and bottom soldermasks. The surface layer pad files do not have to match the padmaster since many of the component pads will not be drilled.

6. Set the **Visibility** settings.

The Raster Design Rule Check only checks visible elements.

- Make sure all the layers to be checked are visible layers.
- Make sure all pads, traces, selected, and unselected elements to be checked are visible. See *Element Visibility* on page 84.

7. If you want to check only part of the data, put a **reference frame** around that data. See *Reference Frame* on page 177.



If you want to check all data, it does not matter where the reference frame is positioned.

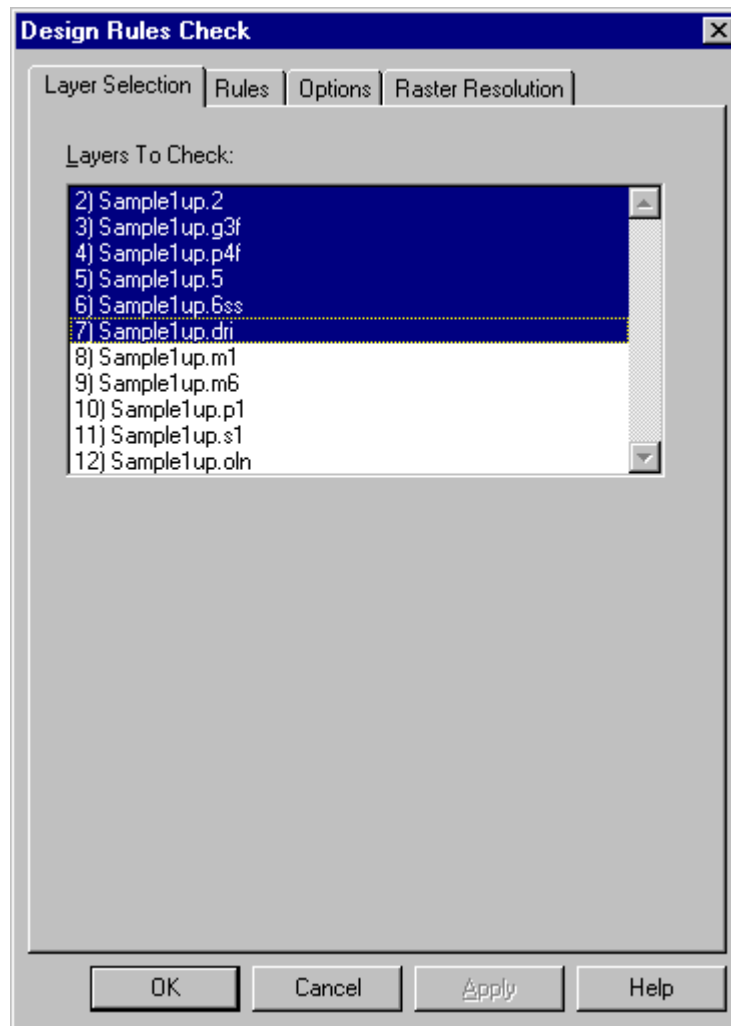
Once you are done preparing the plot data, go ahead and run the Raster Design Rule Check.

Run the Raster Design Rule Check



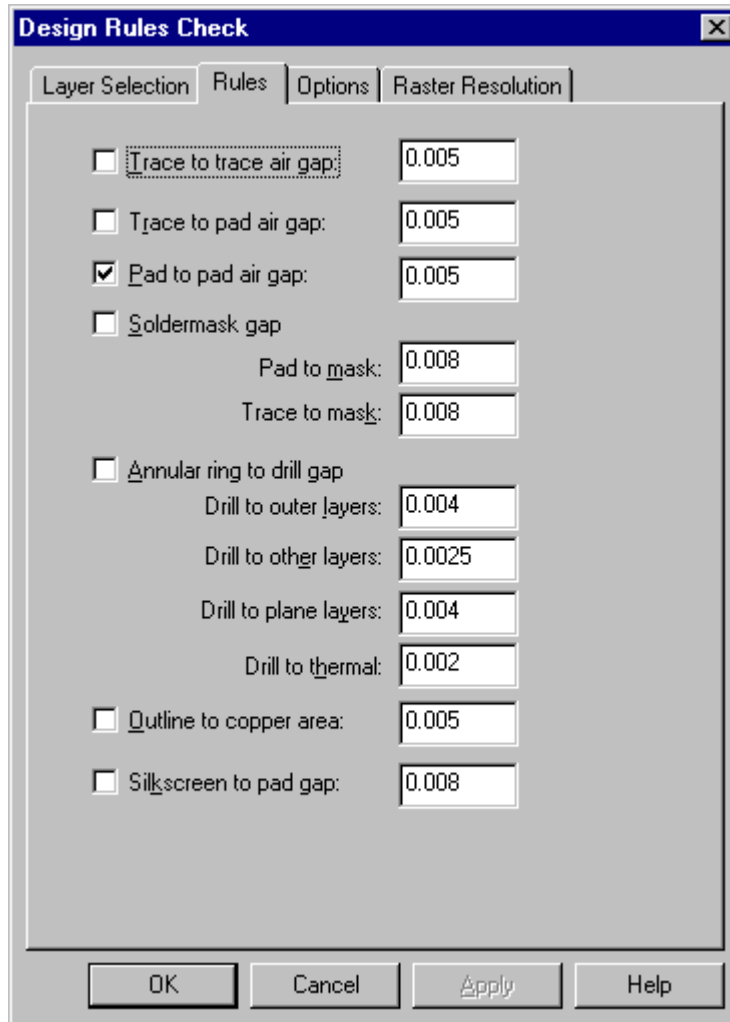
To Run the Raster Design Rule Check:

1. After you have prepared the plot data for the Raster Design Rule Check, go to the **Tools** menu and click **Design Rules Check-Raster-Run DRC**.
2. On the **Layer** tab, select which **layers to check**. Only currently visible layers are displayed.



Raster DRC Layers Selection Tab

3. On the **Rules** tab, select the type of **Design Rule Violations** to include in the Raster Design Rule Check. Click the types of violations you want to check so that there is a check mark next to the violation, and set the required gap settings to your specifications. For the types of violations you do not want to check, click so that there is no check mark.



Raster DRC Rules Tab

Air Gap Violations: The system flags elements that are closer together than the minimum acceptable air gap. Set values for:

- **Trace-to-Trace Air Gap:** Gap between traces on the same layer. (CPU, CPL, SIG, OTH, no negative plane layers)

- **Trace-to-Pad Air Gap:** Gap between traces and pads on the same layer. (CPU, CPL, SIG, OTH, no negative plane layers)
- **Pad-to-Pad Air Gap:** Gap between pads on the same layer. (CPU, CPL, SIG, OTH, no negative plane layers)

Soldermask Gap Violations: The system checks the upper soldermask against the upper component layer and the lower soldermask against the lower component layer looking for clearance between a component pad and an enclosing soldermask pad and a component trace and a soldermask pad. Set values for:

- **Pad-to-Mask Clearance:** Clearance between pads on component layers and their enclosing soldermask pads (CPU to MSU, CPL to MSL).
- **Trace-to-Mask Clearance:** Clearance between traces on component layers and soldermask pads (CPU to MSU, CPL to MSL).



In addition to the soldermask checks you specify above, the system flags soldermask pads (MSU, MSL) that are smaller than their component layer pads (CPU, CPL). Also the system checks for soldermask to soldermask gaps using the value of trace-to-mask clearance.

Annular Ring Violations: The system flags violations between drill holes and the corresponding clearing pads, landing pads, or thermals on the other layers. The system also flags drills that make connection in more than one power or ground layer and elements too close to drills or clearing pads. A DRI or PAD layer must be present. VIA layers are not checked. Set clearance values for:

- **Drill-to-Outer Layers:** Clearance between drills (DRI or PAD) and corresponding outer layer clearing or landing pads (CPU, CPL).
- **Drill-to-Other Layers:** Clearance between drills (DRI or PAD) and corresponding other layer clearing or landing pads (OTH, SIG).
- **Drill-to-Plane Layers:** Clearance between drills (DRI or PAD) and corresponding clearing pads on power and ground layers (GD1-5, PW1-5).
- **Drill-to-Thermal:** Inner ring clearance between drills (DRI or PAD) and thermals on power and ground layers (GD1-5, PW1-5).

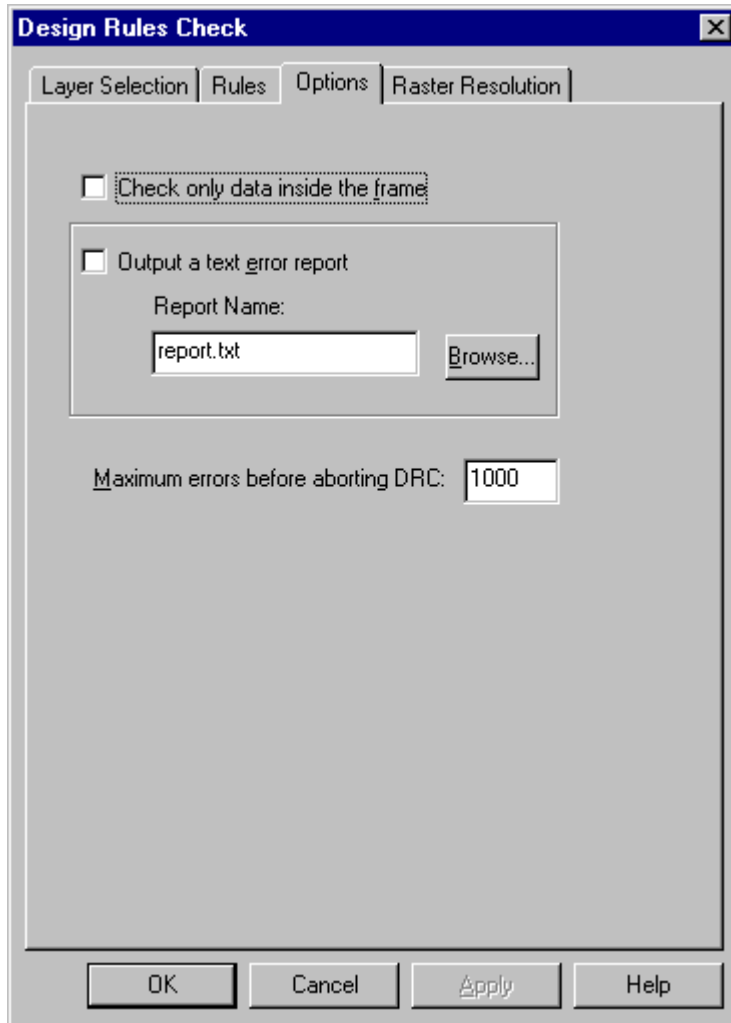


In addition to the annular ring checks you specify above, the system flags drills (DRI or PAD) that do not have landing pad on CPx, SIG, and OTH layers or that do not have clearing pads or thermals on GDx and PWx layers. The system flags unplated drills close to elements on CPx, SIG, and OTH layers using the clearance value of drill-to-plane.

Outline-to-Copper Area Violations: The system flags any copper area elements that are closer than the minimum distance to the board outline layer (BOL). For Outline-to-copper area checks to be run, a BOL layer must be present. The system checks CPx, SIG, OTH, GDx, and PWx for copper elements within the specified distance of the board outline. Set a value for the Outline-to-Copper Area clearance.

Silkscreen-to-Pad Gap Violations: The system flags any silkscreen elements (SKU, SKL) that are closer than the minimum distance to the pads of the corresponding component layer (CPU, CPL).

4. On the **Options** tab, set the Raster Design Rule Check **Options**:



Raster DRC Options Tab

Reference Frame: If you want to check only a portion of the plot, click the **Check Only Data Inside Frame** option so that there is a check mark next to the option. Otherwise, click the option so that there is no check mark. If you are using this option, you need to have positioned the frame when you prepared the plot data for the Raster Design Rule Check.

Text Error Report: The Raster DRC can output a text error report containing the conditions specified for the Raster DRC and the results of the check. Violations are listed by board layer and by type within the layer. If you want to output a text error report, click the **Output a Text Error Report** option so that there is a check mark next to the option and enter a name for the file. Otherwise, click the option so that there is no check mark. If you run the Raster Design Rule Check without outputting a text error report, you will still get the error tags that you can inspect added to the CAMMaster database.

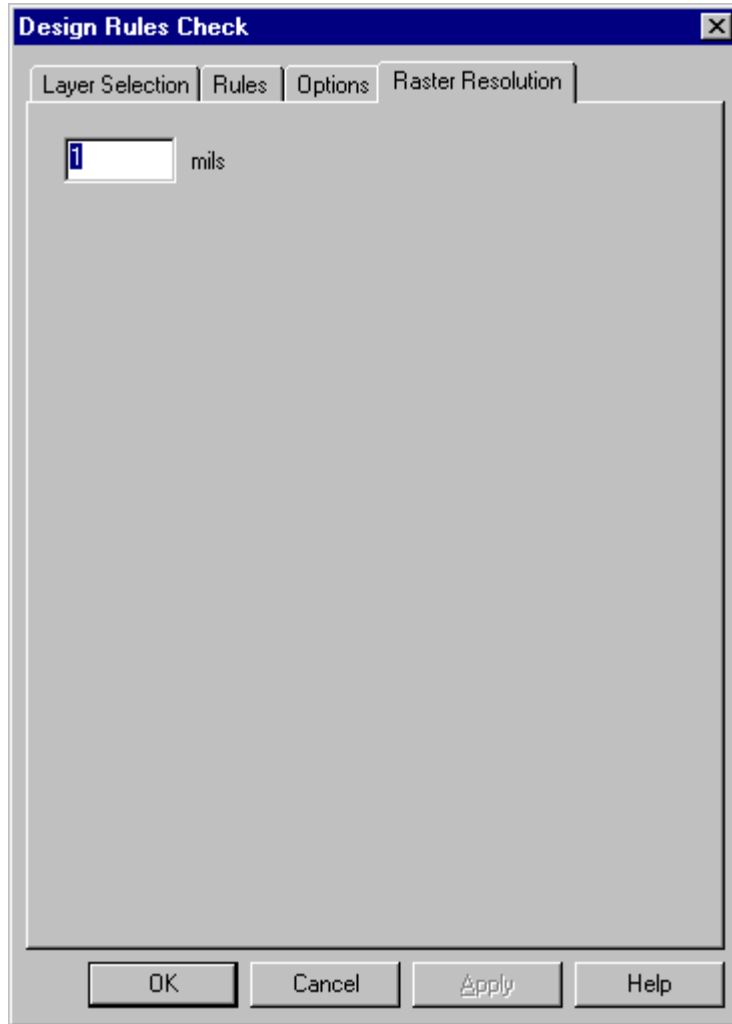
Maximum Errors: Set the maximum number of errors before aborting the Raster Design Rule Check. The system gives you the option to abort a DRC when it hits this number on the theory that the setup may be faulty to have generated so many errors. You can stop to correct the problem on the plot or change the Raster Design Rule Check parameters. Entering zero turns off this feature.

5. On the **Raster Resolution** tab, enter the **Raster Tools Resolution**.



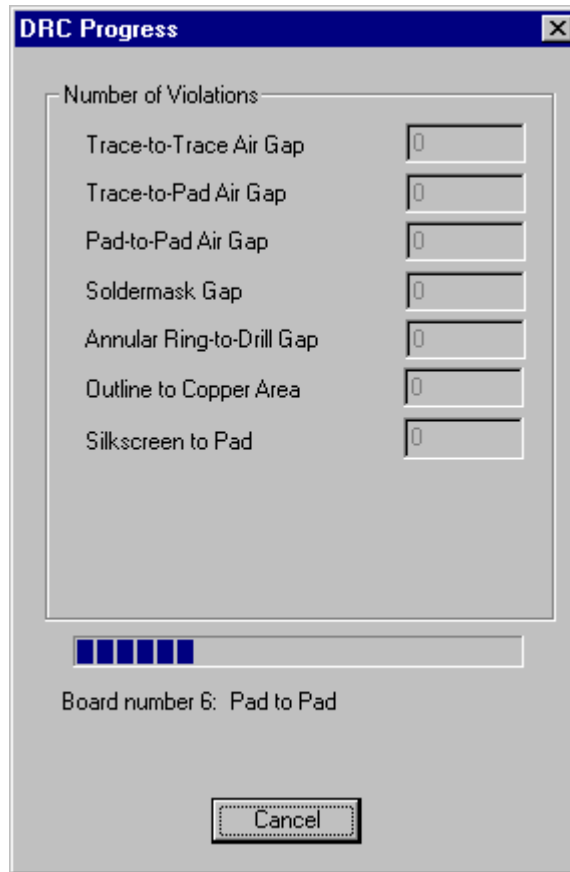
The Raster Tools Resolution is a very important value because it determines the accuracy of the DRC.

The Raster Tools Resolution is the size of each pixel in the raster bitmaps. You may enter a value from 0.1 through 50 mils, or from 1 through 1000 microns, inclusive. For more information regarding important considerations for setting the Raster Tools Resolution, see *Raster Tools Resolution* on page 425.



Raster DRC Raster Resolution Tab

6. At the bottom of the **DRC Setup** dialog, click **OK**.



Raster DRC Progress Dialog

The system displays the error count for each violation on the fly so you can keep track of the process.

After the Raster Design Rule Check is complete, the Toolbar displays the elapsed time and the total number of violations detected.

If any violations were detected, the Inspect DRC Errors dialog is displayed, so you can inspect the Raster DRC violations.

You can also view the Raster DRC error report. See *View the DRC Report* on page 412.

View Raster DRC Errors on Screen



The Raster DRC errors are displayed as colored lines indicating the closest approach of the offending elements. The endpoints of the colored lines correspond to the pixels in the bitmaps generated by the selected raster resolution. The lower the raster resolution number, the closer the bitmap corresponds to the elements in the display.

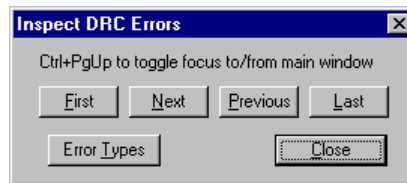
Only the violations for the visible layers are shown. When there are more than one layer with the same board number, it is sufficient to have one of these layers visible; although some of the violations won't make sense unless all the layers selected for the DRC are visible.

The violations are ordered by type and within a type they are ordered by severest violation first.

The Inspect DRC Errors dialog allows you to automatically move the cursor to the violations.

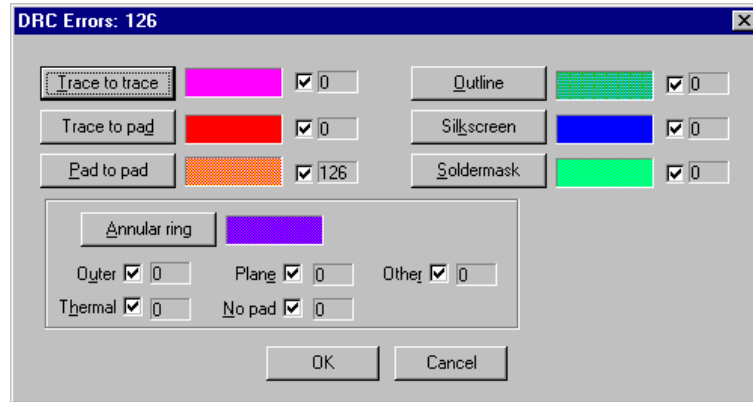
To Inspect Raster DRC Violations:

1. Make the **layers** you want to inspect **visible**.
2. Display the Inspect DRC Errors dialog. The dialog box is displayed automatically after completion of Raster DRC or can be displayed by going to the **Tools** menu and clicking **Design Rule Checking-Raster-Display Errors**.



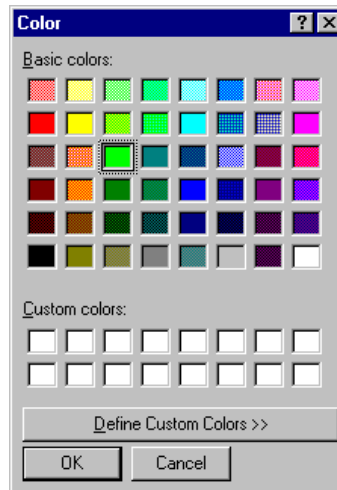
Raster DRC Inspect DRC Errors Dialog

3. On the **Inspect DRC Errors** dialog, click **Error Types**.



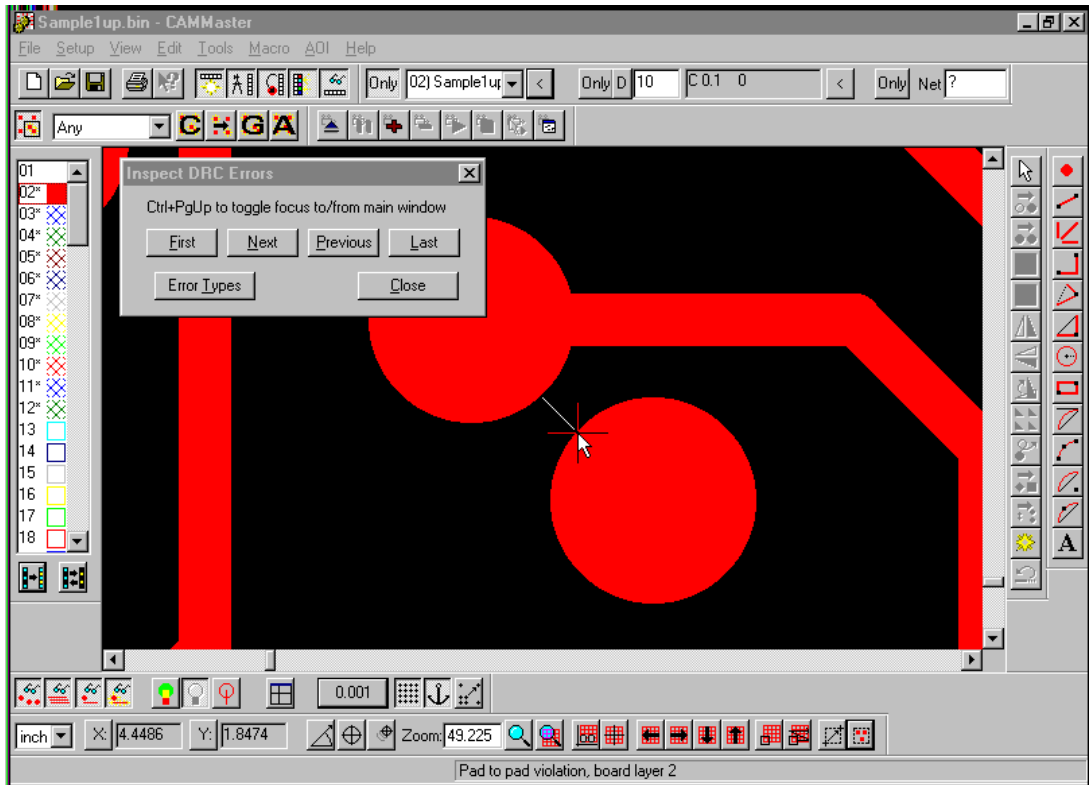
Raster DRC Error Types Dialog

4. On the **DRC Errors** dialog, click each error type that you want to display so that it has a checkmark.
5. To change the color for a DRC error type, click the button for that error type, and select a new color.



Raster DRC Error Colors Dialog

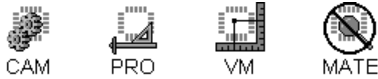
6. When you have selected the types and colors to display, click **OK**.



Raster DRC Error Tag

7. To sequentially go to each error of the selected type, click the **First**, **Next**, **Previous**, and **Last** buttons on the **Inspect DRC Errors** dialog.
8. To toggle focus between the Inspect DRC Errors dialog and the main application window, press **Ctrl+PgUp**. This is useful for returning to the main application window for adjusting the zoom factor or editing.

Vector DRC



The program can run a Vector Design Rule Check to verify the accuracy and manufacturability of plot data. The process examines individual layers, layer sets, portions of layers selected with the reference frame, or the entire database, depending on how you set it up. The program reports design rule violations in a text file and flags the errors in the Viewing Area for easy identification.

Prepare Plot Data for the Vector Design Rule Check



The best Vector Design Rule Check results are obtained from plot data that has been prepared. You need complete and accurate D Code and Tool Code information and layer type identification. Flashed (not drawn) pads are essential for any check involving pads. Layer stacking is important if you have more than one via, drill, or padmaster layer.

To Prepare Plot Data for the Vector Design Rule Check:

1. On the **D Code Table** and the **Tool Code Table**, define all **D Codes** and **Tool Codes**.

- NC Drill Tool Codes must be defined as P-plated, N-non-plated, T-tooling, or V-via.
- If you use a Gerber padmaster to define drill data rather than a drill file, the D Code hole sizes must reflect the actual tool sizes.

2. On the **Layers Table**, set up the **Layer Types**.

In layer-to-layer checks for soldermask and annular ring violations, the system has to know the type of each layer used.

3. Arrange the layers in **order** on the Layers Table.

Layers are processed consecutively as listed. When there are multiple drill files, each new one takes precedence over the previous one. List the layers the way the board will be built or the way the layer sets will be drilled.

4. Convert **drawn pads** to **flashed pads**. See *Convert Drawn Pads* on page 227.

If you don't have flashed pads on the top and bottom sides, extract them from the top and bottom soldermasks. The surface layer pad files do not have to match the padmaster since many of the component pads will not be drilled.

5. Set the **Visibility** settings.

The Vector Design Rule Check only checks visible elements.

- Make sure all the layers to be checked are visible layers.
- Make sure all pads, traces, selected, and unselected elements to be checked are visible. See *Element Visibility* on page 84.

6. **Clear selection** from all elements.

The Vector Design Rule Check inserts selected data to indicate errors. Clearing the selection first helps avoid confusion.

7. If you want to check only part of the data, put a **reference frame** around that data. See *Reference Frame* on page 177.



If you want to check all data, it does not matter where the reference frame is positioned.

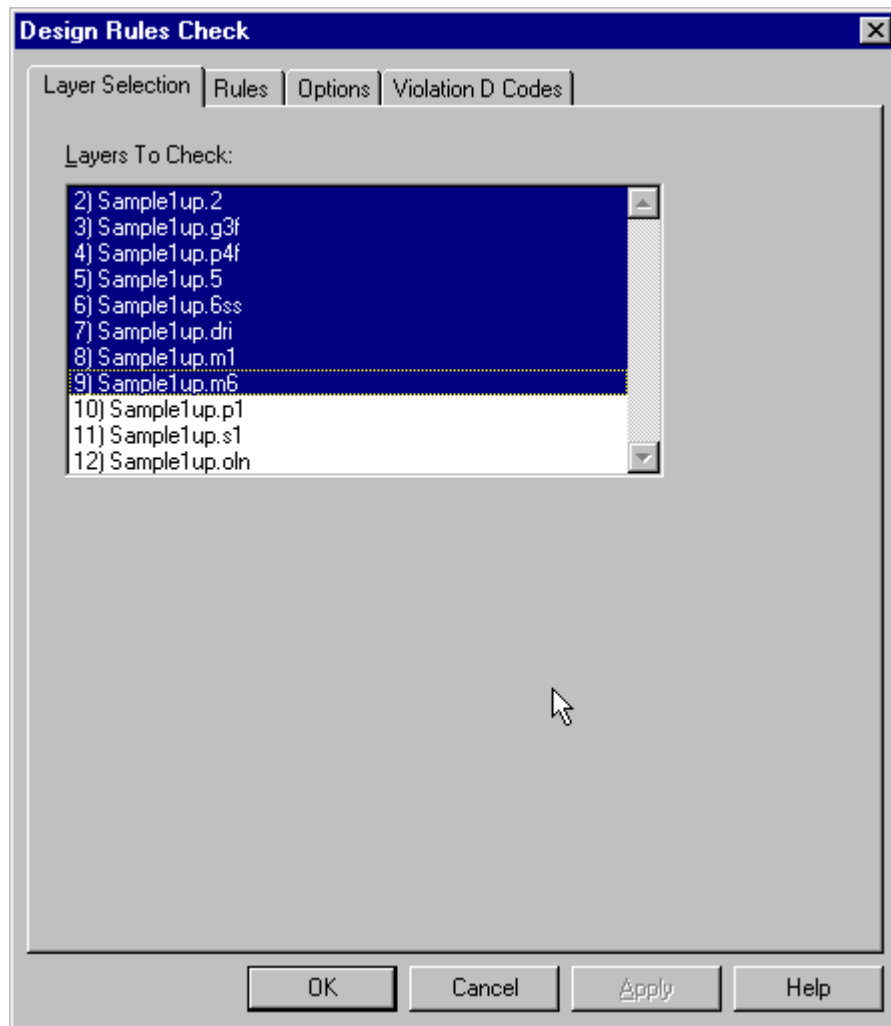
Once you are done preparing the plot data, go ahead and run the Vector Design Rule Check.

Run the Vector Design Rule Check



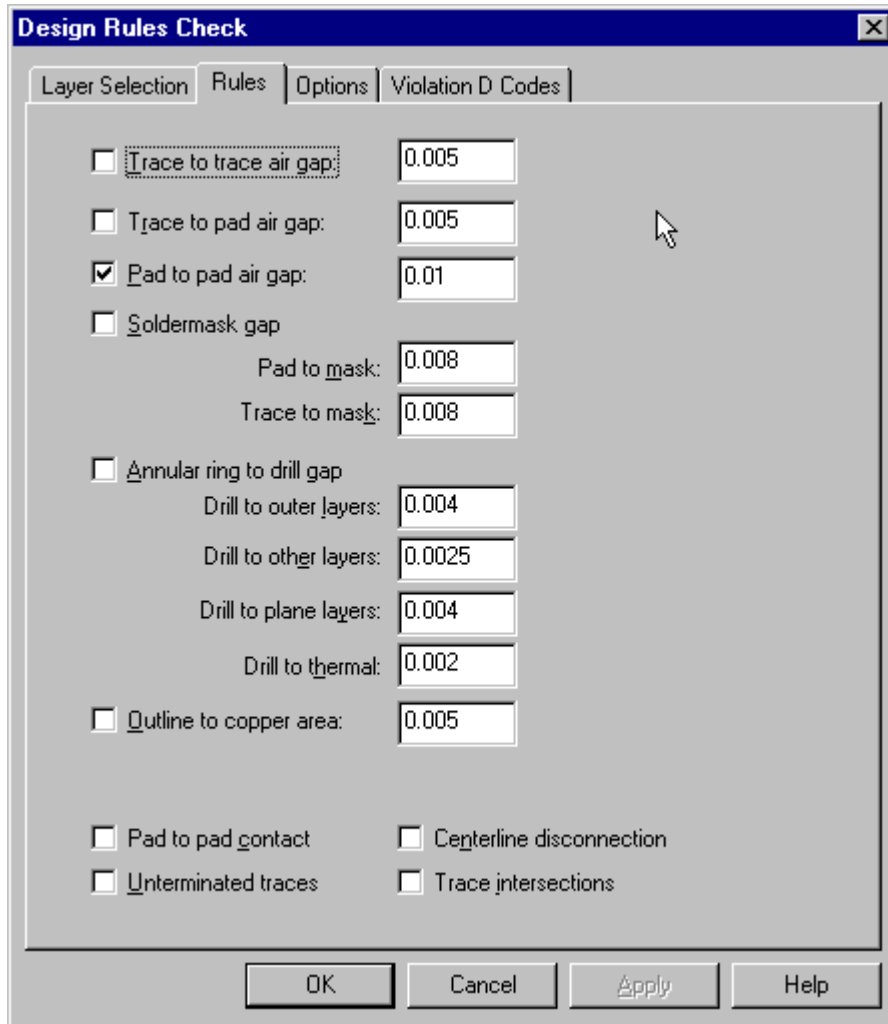
To Run the Vector Design Rule Check:

1. After you have prepared the plot data for the Vector Design Rule Check, go to the **Tools** menu and click **Design Rules Check-Vector-Run DRC**.
2. On the **Layer** tab, select which **layers to check**. Only currently visible layers are displayed.



Vector DRC Layers Selection Tab

- On the **Rules** tab, select the type of Design Rule Violations to include in the Vector Design Rule Check. Click the types of violations you want to check so that there is a check mark next to the violation, and set the required gap settings to your specifications. For the types of violations you do not want to check, click so that there is no check mark.



Vector DRC Rules Tab

Air Gap Violations: The system flags elements that are closer together than the minimum acceptable air gap. Set values for:

- Trace-to-Trace Air Gap:** Gap between traces on the same layer. (CPU, CPL, SIG, OTH, no negative plane layers)

- **Trace-to-Pad Air Gap:** Gap between traces and pads on the same layer. (CPU, CPL, SIG, OTH, no negative plane layers)
- **Pad-to-Pad Air Gap:** Gap between pads on the same layer. (CPU, CPL, SIG, OTH, no negative plane layers)

Soldermask Gap Violations: The system checks the upper soldermask against the upper component layer and the lower soldermask against the lower component layer looking for clearance between a component pad and an enclosing soldermask pad and a component trace and a soldermask pad. Set values for:

- **Pad-to-Mask Clearance:** Clearance between pads on component layers and their enclosing soldermask pads (CPU to MSU, CPL to MSL).
- **Trace-to-Mask Clearance:** Clearance between traces on component layers and soldermask pads (CPU to MSU, CPL to MSL).

Annular Ring Violations: The system flags violations between drill holes and the corresponding clearing pads, landing pads, or thermals on the other layers. The system also flags drills that make connection in more than one power or ground layer and elements too close to drills or clearing pads. Set clearance values for:

- **Drill-to-Outer Layers:** Clearance between drills (DRI or PAD) and corresponding outer layer clearing or landing pads (CPU, CPL).
- **Drill-to-Other Layers:** Clearance between drills (DRI or PAD) and corresponding other layer clearing or landing pads (OTH, SIG).
- **Drill-to-Plane Layers:** Clearance between drills (DRI or PAD) and corresponding clearing pads on power and ground layers (GD1-5, PW1-5).
- **Drill-to-Thermal:** Inner ring clearance between drills (DRI or PAD) and thermals on power and ground layers (GD1-5, PW1-5).

Pad-to-Pad Contact Violations: The system flags touching pads, including padstacks. (CPU, CPL, SIG, OTH)

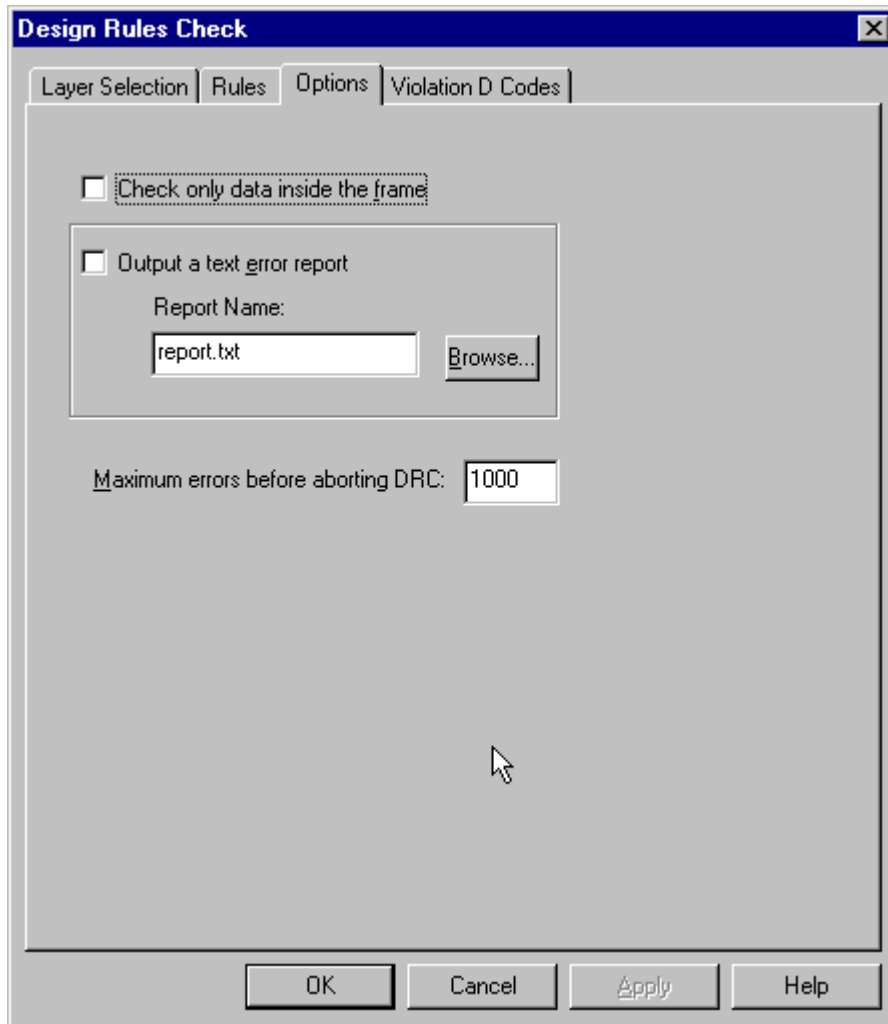
Centerline Disconnection Violations: The flags any trace to trace connections that are not endpoint to endpoint and trace to pad connections that are not endpoint to centerpoint.

Unterminated Trace Violations: The system flags any traces whose endpoints do not terminate in the endpoint of a trace or the centerpoint of a pad.

Trace Intersection Violations: The system flags traces that intersect anywhere other than at endpoints.

Outline-to-Copper Area Violations: The system flags any copper area elements that are closer than the minimum distance to the board outline. Set a value for the Outline-to-Copper Area clearance.

4. On the **Options** tab, set the Vector Design Rule Check **Options**:



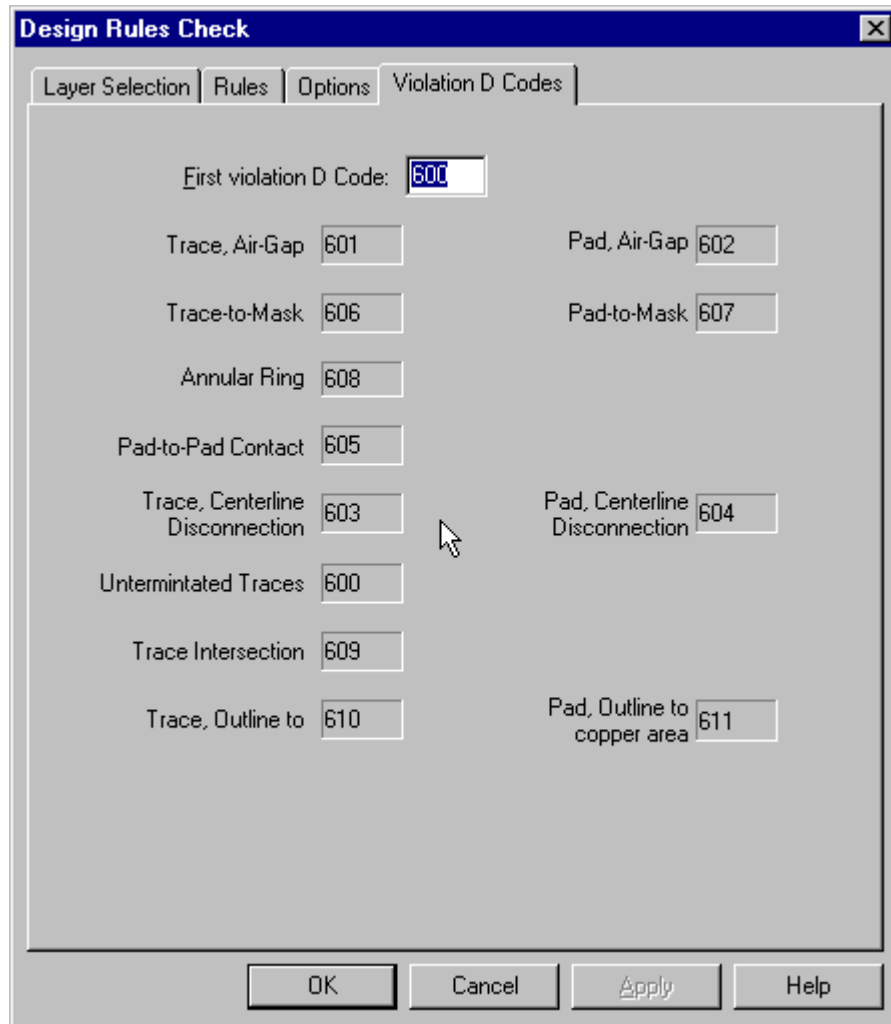
Vector DRC Options Tab

Reference Frame: If you want to check only a portion of the plot, click the **Check Only Data Inside Frame** option so that there is a check mark next to the option. Otherwise, click the option so that there is no check mark. If you are using this option, you need to have positioned the frame when you prepared the plot data for the Vector Design Rule Check.

Text Error Report: If you want to output a text error report, click the **Output a Text Error Report** option so that there is a check mark next to the option and enter a name for the file. Otherwise, click the option so that there is no check mark. If you run the Vector Design Rule Check without outputting a text error report, you will still get the Gerber error tags.

Maximum Errors: Set the maximum number of errors before aborting the Raster Design Rule Check. The system gives you the option to abort a DRC when it hits this number on the theory that the setup may be faulty to have generated so many errors. You can stop to correct the problem on the plot or change the Vector Design Rule Check parameters.

5. On the **Violations D Code** tab, set the first **violation D Code**.



Vector DRC Violations D Code Tab

The Violations D Code should be the first of 12 consecutive, available D Codes for on-screen error reporting. The system assigns the remaining D Codes automatically. Each type of error is automatically mapped to a different D Code for easy identification.

6. At the bottom of the DRC Setup dialog, click **OK**.

The system displays the error count for each violation on the fly so you can keep track of the process.

Violations are flagged by inserting selected elements of the Violation D Codes on the original layers. Each type of error is automatically mapped to a different D Code for easy identification.



*The error flags are real data elements and should be removed before exporting data or saving the file. See **Remove Vector Design Rule Check Errors Flags from the Plot** on page 408.*

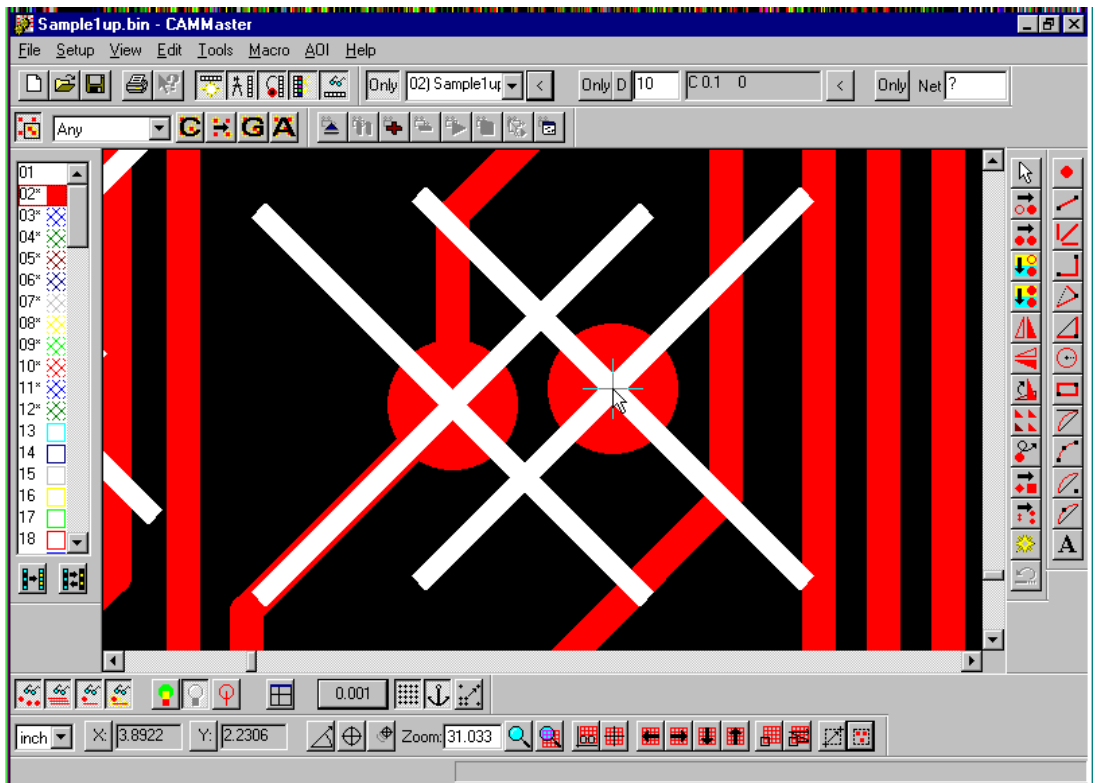
Errors are recorded in the error file V2001DRC.DRC in the current directory. See *View the DRC Report* on page 412.

After the Vector Design Rule Check is complete, the system reports in the message line if any violations were found.

View Vector Design Rule Check Errors on Screen



Violations are flagged by inserting selected elements of the Violation D Codes on the original layers. Each type of error is automatically mapped to a different D Code for easy identification. Selected error flags make it easy to view violations. Here are other suggestions for working with error data.



Vector DRC Error Tags

To View Vector Design Rule Check Errors on Screen:

- To clearly see all instances of design rule violations, shut off the visibility of unselected elements, leaving only the selected error flags visible. See *Element Visibility* on page 84.
- To see intersections and connections, try viewing data at zero width.
- To see all instances of a particular type of violation, query the properties of a selected error flag, set the selection criteria to look for only that D Code, and use the First Element and Next Element commands.

- To export the selected error flags separate from the original data, shut off the visibility of unselected elements, leaving only the selected error flags visible, and then export the files as usual.
- The D Codes of highlighted violations can be changed as any other D Code can be. Change D Code Shapes and Dimensions if it will make visual inspection easier.

Remove Vector Design Rule Check Errors Flags from the Plot

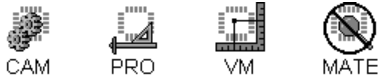


The error flags are real data elements and should be removed before exporting data or saving the file.

To Remove Vector Design Rule Check Errors Flags from the Plot:

1. Make all elements visible (Pads, Traces, Selected, Unselected).
2. Make all layers visible.
3. Make all layers active. See *Select from the Active Layers* on page 152.
4. If the error flags are no longer selected, go to the **Edit** menu and click **Select-Select All**.
The error tags must be selected in order to be removed. The Select All command selects all the data, including the tags. But don't worry, the following command will only delete the error tags, nothing else.
5. On the **Tools Menu**, click **Design Rules Checking-Clear Errors**.
The program removes all of the selected error flags.

Distance Histogram



The program can generate a Distance Histogram report to verify the manufacturability of plot data and aid in the quoting process. The Distance Histogram report is a text file that includes the number of times each particular clearance occurs in the plot.

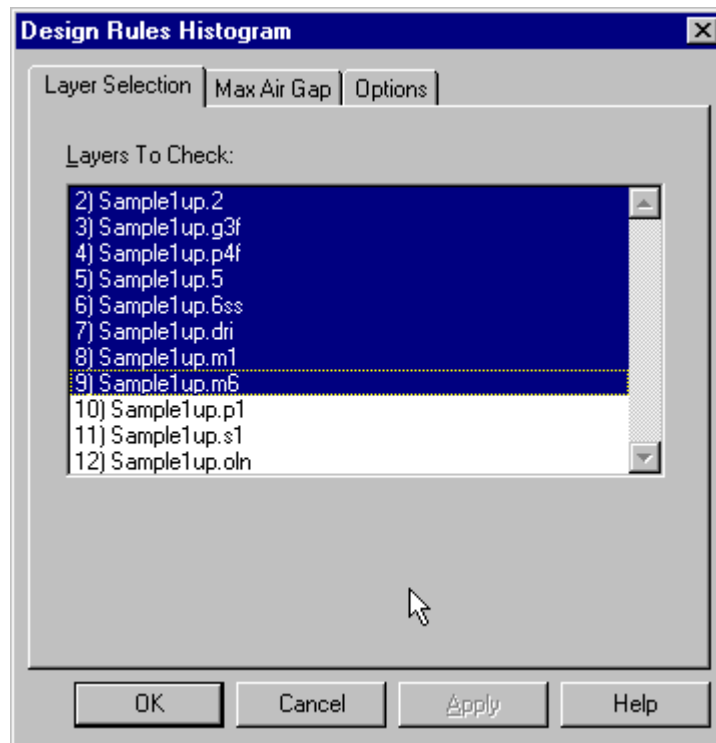
To Generate the Distance Histogram Report:

1. If you want to check only a portion of the plot, position the **reference frame** around the data you want to check. See *Reference Frame* on page 177.



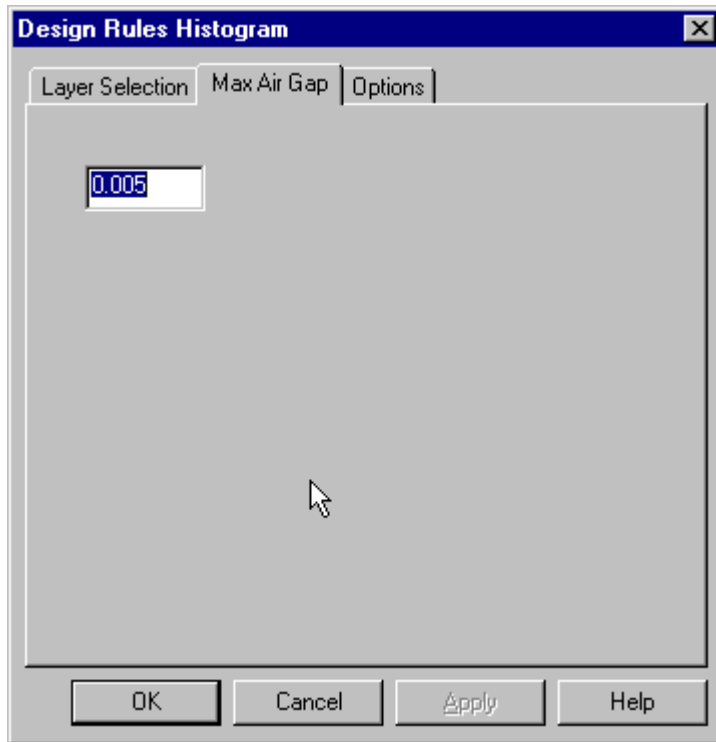
If you want to check all data, it does not matter where the reference frame is positioned.

2. On to the **Tools** menu, click **Design Rules Check-Vector-Generate**.
3. On the **Layer** tab, select which **layers to check**. Only currently visible layers are displayed.



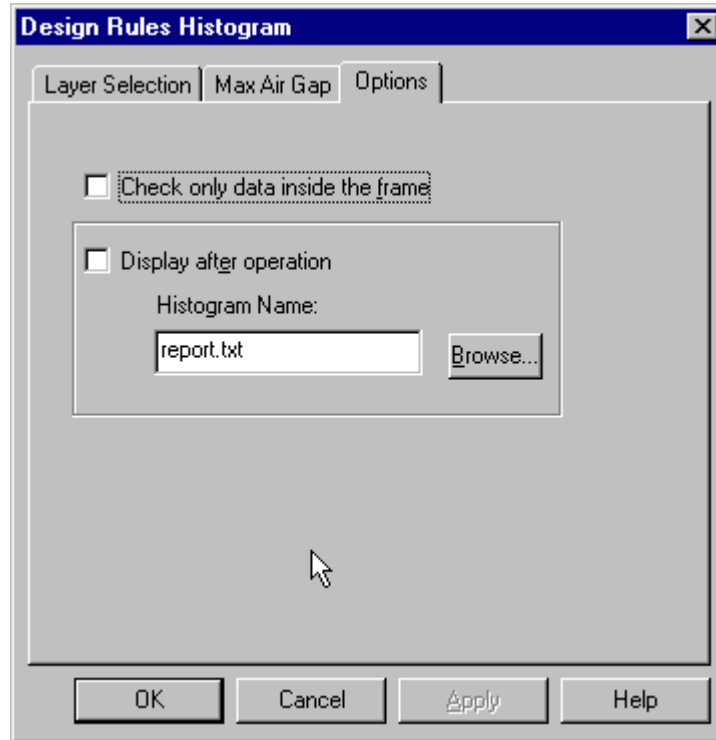
Distance Histogram Layers Selection Tab

4. On the **Max Air Gap** tab, set the **largest clearance** to include in the report. The report will count all instances of clearances in the plot that are smaller than the Max Air Gap.



Distance Histogram Max Air Gap Tab

5. On the **Options** tab, set the Distance Histogram **Options**:



Distance Histogram Options Tab

Reference Frame: If you want to check only a portion of the plot, click the **Check Only Data Inside Frame** option so that there is a check mark next to the option. Otherwise, click the option so that there is no check mark. If you are using this option, you need to have positioned the Reference Frame before setting up this dialog.

Histogram Report Name: Enter a name for the Distance Histogram report file. If you want to select an existing file name or set a different directory, click Browse. The default file extension is .DST.

Display Histogram Report after Operation: If you want the system to display the report automatically when the operation is done, click this option so that there is a check mark. Otherwise, click the option so that there is no check mark. If you do not select this option, you can always view the report later.

6. At the bottom of the Design Rules Histogram dialog, click **OK**.

The system displays the clearance count on the fly so you can keep track of the process. When complete, the program saves the Distance Histogram report. If the option was selected, the system displays the report; otherwise you can view the report later. See *View the DRC Report* on page 412.

View the DRC Report



CAM



PRO



VM



MATE

The Vector and Raster DRC routines can generate an optional Vector Design Rule Check report, which you name when you set up the design rule check. And the Distance Histogram is also a report that you can view.

To View the DRC Report:

1. On the **File** Menu, click **Report-View**.
2. In the **Files of Type** list, select **All Files (*.*)**.
3. In the **Look in** box, click the drive, folder, or network location that contains the Report.
4. In the folder list, double-click folders until you open the folder that contains the report you want.
5. **Double-click** the **report**.

Chapter 12

Netlist Extraction



The Raster Netlist Extraction Routine is only available in CAMMaster, while the Vector Netlist Extraction Routine is available in ViewMaster PRO as well.

The program can extract a variety of netlist data from multiple layers of Gerber and NC drill data using either a Raster Netlist Extraction routine or a Vector Netlist Extraction routine.

In addition to extracting netlist data, the program can import netlist data into the current Job. See *Import Netlist Data* on page 55.

Two Types of Netlist Extraction Routines



There are some significant differences between the technique and the output of the Raster and Vector Netlist Extraction routines, and there are advantages to both systems.

Raster vs. Vector Netlist Extraction Technique



Raster Netlist Extraction converts the Gerber image into a raster bitmap and uses that bitmap to create polygonal outlines of the image. The Raster Netlist Extraction routine defines elements that are inside a single polygon to be in the same net.

Vector Netlist Extraction uses the Gerber description of the position, size and shape of elements to determine if the elements intersect. The Vector Netlist Extraction routine defines elements that intersect to be in the same net.

Raster vs. Vector Netlist Extraction Output



The Raster Netlist Extraction saves the netlist information in the current Job File database. When you want to create a netlist file from the current Job File database, you export the netlist.

When doing a Vector Netlist Extraction, you select the type of output you want at the time of the extraction. The Vector Netlist Extraction does not save any netlist information in the current Job File database; instead, the Vector Netlist Extraction exports the extracted netlist information in the form of the selected netlist file formats, report files or Gerber files. To get this information into the database, you import the netlist file and/or Gerber files.

Raster Netlist Extraction Advantages



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The Raster Netlist Extraction technique can process paint and scratch images, while the Vector Netlist Extraction technique cannot.

Images that are comprised of many elements, such as planes drawn with traces, do not necessarily slow down Raster Netlist Extraction, while these types of images do slow down Vector Netlist Extraction. So Raster Netlist extraction can be much faster than Vector on files that contain many elements.

Negative plane layers that have more than one power or ground region do not need to have split plane layers generated before Raster Netlist Extraction, while these types of files do need to have split plane layers generated before a Vector Netlist Extraction. So Raster Netlist Extraction does not require as much file preparation as Vector does.

Vector Netlist Extraction Advantages



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The time required to do a Vector Netlist extraction is related more to the number of elements than to the physical size of the image or elements. So a large board does not necessarily take longer than a small board, as long as they both have the same number of elements. The time required to do a Raster Netlist extraction is related more to the number of pixels that have to be examined than to the number of elements. So a large image or an image with very small parts that has to be examined at high resolution can take longer than a smaller or low-resolution image, regardless of the number of elements involved. This means that Vector Netlist Extraction can be faster than Raster Netlist Extraction on boards that have a large physical size.

Vector Netlist Extraction does not have a concept of image resolution and the accuracy of Vector Netlist Extraction is not affected by user-specified variables. In contrast, Raster Netlist Extractions that are not performed at adequately fine raster resolution may have errors.

Raster Netlist Extraction



The program can extract a variety of netlist data from multiple layers of Gerber and NC drill data.

Prepare Plot Data for Raster Netlist Extraction



Accurate and useful netlist results depend on correctly prepared plot data. Raw data must be edited for problems such as drawn pads, misalignment, and design rule violations. In some cases, you may have to generate additional layers of data or eliminate data to define conductivity clearly. Finally, composite layers and paint and scratch layer combinations must be given the same Board Layer, and layers must be organized in the proper Board Layer order on the Layers Table.

To Prepare Plot Data for Raster Netlist Extraction:

1. Clean up the raw data. Examine your original files for the following problems, and resolve each before attempting to extract a netlist:
 - **Drawn Pads:** The Raster Netlist Extraction routine generates net nodes for flashed, not drawn pads. With the Convert Drawn Pads tool, convert drawn pads to flashed pads of the same size and orientation. See *Convert Drawn Pads* on page 227.
 - **Non-Circular Pads on Padmaster or Drill Layers:** All pads on a padmaster or drill master layer should be circular. Transcode non-circular pads on the padmaster to circular pads of the same size and orientation. The Raster Netlist Extraction routine flags as shorts pads in the padmaster that do not have adequate annular clearance on the plane layers, and these types of shorts are sometimes caused by non-circular pads for which a circular aperture of the same diameter would not cause a short.
 - **Padstacks:** Using the Delete Pads tool, delete all but the largest pad in a padstack. This is to avoid having multiple netlist nodes generated for a single location. See *Delete Non-Functional Pads* on page 245.
 - **Layers Misaligned:** Using the Snap to Padmaster tool, align all layers to a padmaster layer. See *Snap Data to Padmaster* on page 249.
2. On the **D Code Table** and the **Tool Code Table**, define all **D Codes** and **Tool Codes**.
NC Drill Tool Codes must be defined as P-plated, N-non-plated, T-tooling, or V-via. Every pad in a VIA or VID layer is considered to be conductive unless its D Code indicates that it is a non-plated through hole.
3. Generate **supplemental layers**. The original layers may require further detail for an accurate netlist to be generated. Look for these situations in the original layers:

- **Additional Test Points:** You can set up special test points on filter layers SPU, for the upper component layer, and SPL, for the lower component or solder side layer. The system uses these test points exclusively or in addition to the normal test points in extracting the netlist data, depending on how you set up the operation.
 - **Buried Vias:** The system recognizes buried vias in internal layers as opposed to through-hole drills by processing padmaster and via files differently. The Gerber padmaster (PAD) or NC Drill master drill file (DRI) contains the primary drill holes defined for through-hole conductivity. The Gerber via files (VIA) or NC Drill via files (VID) contain drill information for internal layer conductivity between layers. Sometimes the buried via data is already separated on its own layer. If it isn't, transfer the buried vias to separate layers.
4. **Exclude** part of the data.

If the PCB data has elements too small or fragile to test, or borders, text, or nonfunctional traces unrelated to the electrical characteristics of the board, use the Blank D Codes command to remove certain D Codes from the process.
 5. Set the **Visibility** settings.

The Raster Netlist Extraction only checks visible elements, so make sure all pads, traces, selected, and unselected elements to be checked are visible. See *Element Visibility* on page 84.
 6. On the **Layers Table**, set up the **Layer Types**.

The system has to know the layer type of each layer used.

 - **CPU, CPL:** Component layers, upper and lower. You must have one of each. Surface-mount pads, if present, are included as nodes of the netlist.
 - **PAD or DRI:** Gerber or Drill padmaster layer. Use only one padmaster file per plot (or at least one via layer) to define the electrical connectivity between layers. In Gerber padmasters, pads are assumed to have the same sizes as their corresponding drill points; traces are ignored.
 - **VIA or VID:** Gerber or Drill buried via layers. In the case of inner layers with buried vias, there may be more than one via layer in addition to a padmaster. In the absence of a padmaster, there should be a via layer between each two consecutive layers to define the electrical connectivity between layers.
 - **GD1-5:** Ground planes.
 - **GS1-5:** Split ground planes. **Do not generate or use split planes for Raster Netlist Extraction.** Split planes are required to define different non-connected negative plane areas for Vector Netlist Extraction, but are not used for Raster Netlist Extraction.
 - **PW1-5:** Power planes.
 - **PS1-5:** Split power planes. **Do not generate or use split planes for Raster Netlist Extraction.** Split planes are required to define different non-connected negative plane areas for Vector Netlist Extraction, but are not used for Raster Netlist Extraction.
 - **SIG:** Internal signal layers. Only drill points may appear as nodes in the netlist. Other pads are not included in netlist output.

- **MSU, MSL:** Soldermask layers, upper and lower. These layers are used to determine if pads in the netlist are cleared of soldermask.
 - **SKU, SKL:** silkscreen layers, upper and lower. These layers are used to determine if pads in the netlist are cleared of silkscreen.
 - **SPU, SPL:** Filter Layers for CPU and CPL. These layers define additional test points that may be used in addition to or in place of normal test points. Corresponding pads on the CPU, CPL are not necessary.
7. On the **Layers Table**, make sure all the **layers** to be checked are **visible** layers. Make sure all layers you do not want to process are turned off. For instance, if you want the Raster Netlist Extraction to ignore the soldermask and/or silkscreen information, make the MSU, MSL and/or SKU, SKL layers non-visible. Or if you want the Raster Netlist Extraction to ignore any additional test points, make the SPU, SPL layers non-visible.
 8. On the **Layers Table**, identify **Negative** layers.
 9. On the **Layers Table**, set the **Board Layer Number** for each layer.

Layers are processed consecutively by Board Layer Number, and all layers that have the same Board Layer Number are processed as single composite layers. This allows netlist extraction on paint and scratch combinations. Assign board layer numbers to define the way the board will be built or the way the layer sets will be drilled. See *Board Layer Stacking Examples* on page 418.

- Once you are done preparing the plot data, go ahead and run the Raster Netlist Extraction.

Board Layer Stacking Examples



In general, board layers should be sequenced the way the board is to be built or the way the layer sets are to be drilled. The standard procedure is to put all layers for the upper board layer into board layer number 1, and to put layers for “descending” board layers into ascending-numbered board layers. The drill file or padmaster and the remaining supplemental layers can be stacked anywhere. The following examples illustrate typical cases:

Composite Board Layers



When the image for a single layer of the board is to be made by combining the images on several layers in the Layers Table, all the layers that make up the composite image need to be given the same Board Layer Number. That way, the single Board Layer can be processed as a single image. This makes it possible to process paint and scratch composites.

In this example, layers 3 and 4, which form board layer 3, will be processed as a single composite layer, and layers 6 and 7, which form board layer 5, will be processed together.

Layer Number:	Board Layer:	Layer Type:	Explanation:
1	1	CPU	Upper Component Layer
2	2	SIG	Signal Layer 1
3	3	PW1	1 st layer in Composite Power Layer
4	3	PW1	2 nd layer in Composite Power Layer
5	4	SIG	Signal Layer 2
6	5	GD1	1 st layer in Composite Ground Layer
7	5	GD1	2 nd layer in Composite Ground Layer
8	6	SIG	Signal Layer 3
9	7	CPL	Lower Component Layer
10	8	PAD or DRI	Padmaster or Drill file (Connects all Layers)

Buried Vias

Board layers which contain VIA or VID layers may not contain any other types of layers. If a Job File does not contain either a PAD or DRI layer, every alternating internal board layer must be a VIA or VID layer.

This example has buried vias (VIA layers) stacked with signal layers (SIG). Each via layer defines the conductivity for the preceding and following layers in the stack. All layers are drilled by the padmaster (PAD), including layers that are not stacked before or after a VIA layer.

Layer Number:	Board Layer:	Layer Type:	Explanation:
1	1	PAD	Padmaster (Connects all layers)
2	2	CPU	Upper Component Layer (Connected by padmaster to all)
3	3	SIG	Signal Layer 1 (Connected by padmaster to all)
4	4	GD1	Ground Layer 1 (Connected by padmaster to all)
5	5	PW1	Power Layer 1 (Connected by padmaster to all)
6	6	SIG	Signal Layer 2 (Connected by Padmaster to all and connected to Signal 3 by Via 1)
7	7	VIA	Buried Via Layer 1 (Connects Signal 2 to Signal 3)
8	8	SIG	Signal Layer 3 (Connected by Padmaster to all and connected to Signal 2 by Via 1 and connected to Signal 4 by via 2)
9	9	VIA	Buried Via Layer 2 (Connects Signal 3 to Signal 4)
10	10	SIG	Signal Layer 4 (Connected by Padmaster to all and connected to Signal 3 by Via 2)
11	11	SIG	Signal Layer 5 (Connected by padmaster to all)
12	12	CPL	Lower Component layer (Connected by padmaster to all)

No Through-Hole Padmaster



This example is a surface mount board with no padmaster. Instead the example has a via layer containing main pads and via holes shared by each working layer and the next.

Layer Number:	Board Layer:	Layer Type:	Explanation:
1	1	CPU	Upper component layer
2	2	VIA	Blind common via layer 1 (Connects Upper Comp. To Signal 1)
3	3	SIG	Signal layer 1
4	4	VIA	Buried common via layer 2 (Connects Signal 1 to Signal 2)
5	5	SIG	Signal layer 2
6	6	VIA	Buried common via layer 3 (Connects Signal 2 to Signal 3)
7	7	SIG	Signal layer 3
8	8	VIA	Buried common via layer 4 (Connects Signal 3 to Signal 4)
9	9	SIG	Signal layer 4
10	10	VIA	Blind common via layer 5 (Connects Signal 4 to Lower Comp.)
11	11	CPL	Lower component layer

Supplemental Layers



Supplemental layers such as soldermask layers (MSU, MSL), silkscreen layers (SKU, SKL), or layers defining additional test points (SPU, SPL) do not need to be stacked in any particular order because they do not define conductivity. In this example the soldermask, silkscreen, and additional test point layers are placed after the layers that define conductivity.

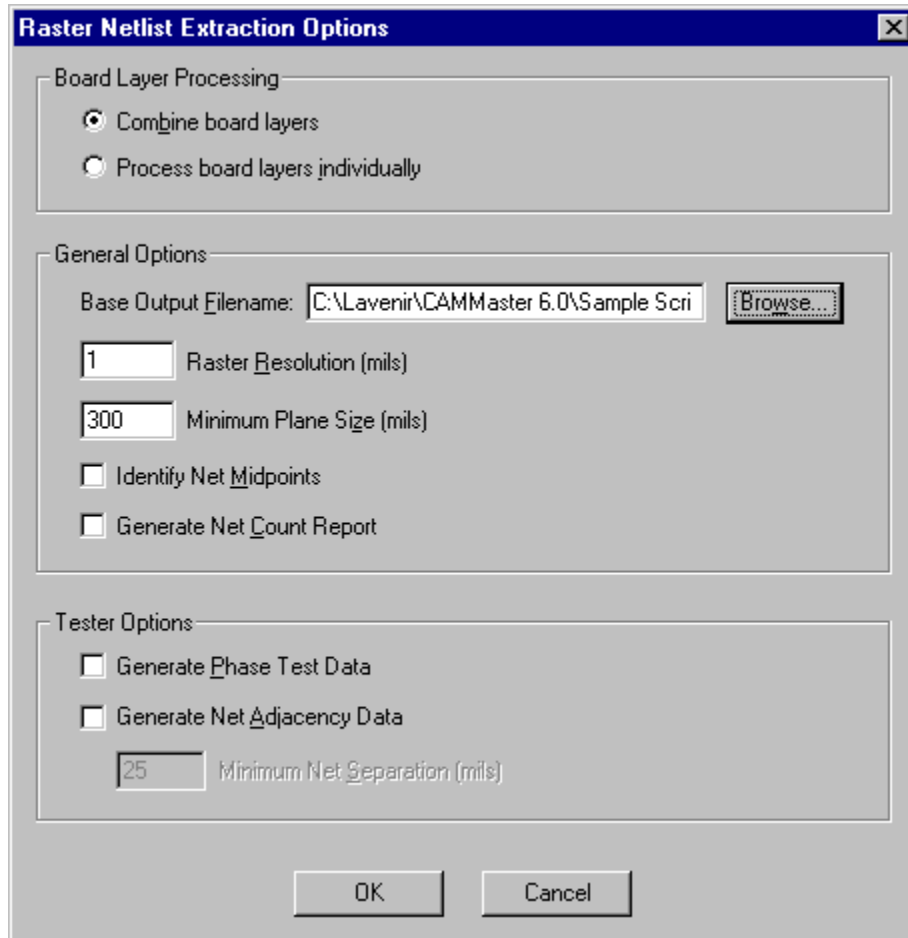
Layer Number:	Board Layer:	Layer Type:	Explanation:
1	1	CPU	Upper Component Layer
2	2	SIG	Signal Layer 1
3	3	PW1	Power Layer 1
4	4	SIG	Signal Layer 2
5	5	GD1	Ground Layer 1
6	6	SIG	Signal Layer 3
7	7	CPL	Lower Component Layer
8	8	PAD or DRI	Padmaster or Drill file (Connects all Layers)
9	9	MSU	Upper Soldermask
10	10	MSL	Lower Soldermask
11	11	SKU	Upper Silkscreen
12	12	SKL	Lower Silkscreen
13	13	SPU	Upper Additional Test Points
14	14	SPL	Lower Additional Test Points

Run the Raster Netlist Extraction



To Run the Raster Netlist Extraction:

1. After you have prepared the data for raster netlist extraction, go to the **Tools** menu, and click **Netlist-Extract Raster**.



Raster Netlist Extraction Options Dialog

2. On the **Raster Netlist Extraction Options** dialog, set the **Board Layer Processing Options**:

- **Combine Board Layers:** Extracts a single netlist for the board, processing all board layers together as connected by the drill layers and defined by the layer stack up. This is the most commonly used option.
 - **Process Board Layers Individually:** Extracts a separate netlist for each Board Layer and does not consider the inter-layer connectivity of the drill files. This option is sometimes used to generate netlist data for AOI machines, such as Lloyd Doyle. When this option is taken and the netlist data is subsequently exported, it is exported as individual netlist files for each Board Layer.
3. Set the **General Options:**
- **Base Output File Name:** This provides the path and base name for any files generated by the raster netlist extraction. CAMMaster extends the base name with a unique extension for each type of file generated by the raster netlist extension.
 - **Raster Tools Resolution:** This is the size of each pixel in the raster bitmaps. You may enter a value from 0.1 through 50 mils, or from 1 through 1000 microns, inclusive. For more information regarding important considerations for setting the Raster Tools Resolution, see *Raster Tools Resolution* on page 425.



The Raster Tools Resolution is a very important value because it determines the accuracy of the Netlist Extraction.

- **Minimum Plane Size:** Features in the plane layers that are smaller than this size are not considered to be planes. So, nets that only make contact in the plane layers to features smaller than this value are not considered to be plane layer nets. The reason for this is so that board designs in which there are covering pads for drill holes in plane layers will not generate net numbers over 200 or false short circuit reports.
 - **Identify Net Midpoints:** Format 2 and Format 4 netlists may contain midpoint records. If you want net midpoints to be identified when you export your Format 2 and Format 4 netlist files, click on the Identify Net Midpoints checkbox so that it has a check mark.
 - **Generate Net Count Report:** The Net Count Report is an ASCII text file that lists the number of points and traces in each net and the number of nets with the same point count. If you want to generate a Net Count Report for this netlist extraction operation, click the Generate Net Count Report checkbox so that it has a check mark. The program generates the file using the Base Output File Name and the extension .REP.
4. If you are generating netlist data for use with a MP Series moving probe tester, you may set the following **Tester Options:**
- **Generate Phase Test Data:** The program can generate phase test data for a MP Series moving probe tester when you export your Format 4 netlist file. If you want to generate phase test data for an MP Series tester, click the Generate Phase Test Data checkbox so that it has a check mark. Since generating the phase test data takes additional time, you should probably only check this box if you will be using ProbeMaster to drive an MP Series tester from your Format 4 netlist files.

- **Generate Net Adjacency Data:** The program can generate net adjacency data for ProbeMaster when you export your Format 4 netlist file. If you want to generate net adjacency data, click the Generate Net Adjacency Data checkbox so that it has a check mark and enter a value for the minimum allowable separation between elements from different nets. The legal range is from 1 through 3000 mils, or from 10 through 70,000 microns, inclusive. If you produce net adjacency data, your exported Format 4 netlist file will contain unique net numbers for all test points, even those points for single point nets. In other words, no test point will have a net identifier of "N/C".

5. Click **OK**.

Once the Extracting Netlist Data dialog disappears, the net information has been deposited into the CAMMaster database.

If any short circuits were detected between different types of plane layers, CAMMaster displays the message "possible short circuits were detected" in the dialog box which appears at the conclusion of the netlist extraction operation. See *Short Circuits* on page 426.

Once the Raster Netlist Extraction is complete you can export the netlist files. See *Export Netlist Data* on page 80.

Raster Tools Resolution



The Raster Tools Resolution determines the accuracy of raster operations such as Raster DRC, Raster Netlist Extraction and Raster Outline Generation.

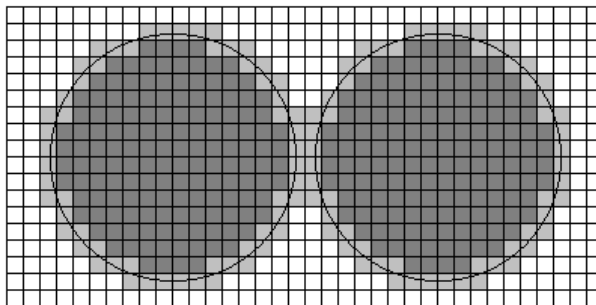
The Raster Tools Resolution is the size of each pixel in the raster bitmaps. You may enter a value from 0.1 through 50 mils, or from 1 through 1000 microns, inclusive.

In general, you should select a resolution value which is as large as possible, but not so large that the smallest features in your data lose their definition. The reason is that larger resolution values result in larger pixels, and therefore in fewer pixels per inch and shorter processing times.

For example, doubling the Raster Tools Resolution means:

- Double the pixel size.
- Half the number of pixels per inch.
- Quarter the number of pixels in an image.
- Quarter the time required to process.

So using larger resolution values makes the process run much faster. However, larger resolution values also result in less detailed bitmaps. In addition there is some uncertainty as to whether a pixel on the edge of an element will be considered to be inside the element or outside. For example, if a pair of pads is separated by 2 mils, the pads will appear to touch at resolution values larger than 2 mils, and they may appear to touch at resolutions as low as 1 mil. This is because the raster resolution is about the same size as the separation between the pads.



Raster Pixels

In addition, with larger resolution values, smaller features will become a single pixel in size, which is undesirable because the Raster Netlist Extraction and Raster DRC do not recognize single-pixel-sized shapes reliably.

Short Circuits



The netlist extraction operation identifies drill holes and/or vias that connect plane layers of different types (e.g., GD1 and GD2) as short circuit elements. The program generates a Short Circuit Report file containing the list of offending pads and gives the file the base output file name with the extension .SCT. The program also flags the short circuit elements with the “S/C” identifier in the job file database, so you can use the selection tools to select the elements. See *View Netlist Data On Screen* on page 440.

Vector Netlist Extraction



The program can extract a variety of netlist data from multiple layers of Gerber and NC drill data.

Types of Netlist Data, Files and Reports Extracted



The Vector Netlist Extraction can extract a variety of netlist data and can generate the following files and reports.

Lavenir Format 0 Netlist (.F00)

The Lavenir Format 0 Netlist file (.F00) lists the location and aperture information for each net point in the padmaster layer, component layers, and/or filter layers. This is a Lavenir proprietary netlist format that can be used by other Lavenir software, such as FixMaster, ProbeMaster, and Verify.

Lavenir Format 1 Netlist (.F01)

The Lavenir Format 1 Netlist file (.F01) lists the net number, layer number, D Code or Tool Code, and coordinates for each net point in the padmaster and each pad and trace in the component layers and/or the filter layers. This is a Lavenir proprietary netlist format that can be used by other Lavenir software, such as FixMaster, ProbeMaster, and Verify.

Lavenir Format 2 Netlist (.F02)

The Lavenir Format 2 Netlist file (.F02) is the IPC-D-356 netlist format. It lists the Operation Code, Identifiers and aperture information for each net point in the padmaster layer, component layers, and/or filter layers. Format 2 netlists may distinguish between endpoints and midpoints and may include alternate test points and soldermask information. This is an open format that is used by many types of software including the Lavenir software FixMaster, ProbeMaster, and Verify.

Lavenir Format 3 Netlist (.F03)

The Lavenir Format 3 Netlist file (.F03) lists X and Y coordinates and net number of each net point in the padmaster layer, component layers, and/or filter layers. This is a Lavenir proprietary netlist format that can be used by other Lavenir software, such as FixMaster, ProbeMaster, and Verify.

Lavenir Format 4 Netlist (.F04)

The Lavenir Format 4 Netlist file (.F04) is a version of the IPC-D-356 netlist format that contains additional trace information. It lists the Operation Code, Identifiers and aperture information for each net point and trace in the padmaster layer, component layers, and/or filter layers. Format 4 netlists may distinguish between endpoints and midpoints and may include alternate test points and soldermask information. This standard IPC-D-356 portion of this file is an open format that is used by many types of software including the Lavenir software FixMaster, ProbeMaster, and Verify. The trace information is what distinguishes it from the standard IPC-D-356 format and the Lavenir Format 2.

Net Count Report (.REP)

The Vector Netlist Extraction can produce a Net Count Report file. The Net Count Report file (.REP) is an ASCII text file that lists the number of points and traces in each net and the number of nets with the same point count.

Gerber Reference Plot (.GNT)

The Vector Netlist Extraction can produce a Gerber Reference Plot file. The Gerber Reference Plot file (.GNT) is a Gerber file that contains pads at the net point coordinates, each identified by a net number plotted in Gerber text. The file can be imported into the Job File like any Gerber file for reference on screen, or it can be plotted or printed.

Short Circuit Report (.SCT)

The Vector Netlist Extraction automatically generates a Short Circuit Report file (.SCT) when it finds a ground plane layer shorted to a power plane layer. The file is an ASCII text file, with a list of (X, Y) coordinate locations of elements that appear to be in contact with both a power and ground plane layer. If this happens, make sure that pads in the padmaster and drill layers, especially and non-circular elements, have annular clearance with the clearing pads in the plane layers.

Short Circuit Gerber Plot (.VGD)

The Vector Netlist Extraction automatically generates a Short Circuit Gerber Plot file (.VGD) when it finds a ground plane layer shorted to a power plane layer. The file is Gerber plot that shows the locations of elements that appear to be in contact with both a power and ground plane layer. If this happens, make sure that pads in the padmaster and drill layers, especially and non-circular elements, have annular clearance with the clearing pads in the plane layers.

Split Plane Error Report (.SPT)

The Vector Netlist Extraction automatically generates a Split Plane Error Report file (.SPT) when it finds open or overlapping polygons on the split plane layers PS1-5 and GS1-5. If this happens, make sure that the polygons that define the split planes are closed polygons with traces that chain end-to-end, and make sure that none of the polygons overlap.



The CAMMaster Raster Netlist Extraction does not generate a Split Plane Error Report.

Prepare Plot Data for Vector Netlist Extraction



Accurate and useful netlist results depend on correctly prepared plot data. Raw data must be edited for problems such as drawn pads, misalignment, and design rule violations. In some cases, you may have to generate additional layers of data or eliminate data to define conductivity clearly. Finally, the layers have to be stacked in the proper order on the Layers Table

To Prepare Plot Data for Vector Netlist Extraction:

1. Clean up the raw data. Examine your original files the following problems, and resolve each before attempting to extract a netlist:
 - **Drawn Pads:** The Vector Netlist Extraction routine recognizes flashed, not drawn pads. With the Convert Drawn Pads tool, convert drawn pads to flashed pads of the same size and orientation. See *Convert Drawn Pads* on page 227.
 - **Non-Circular Pads:** The Vector Netlist Extraction routine flags non-circular pads in the padmaster that do not have adequate annular clearance on the plane layers as shorts. Transcode non-circular pads on the padmaster to circular pads of the same size and orientation.
 - **Padstacks:** Using the Delete Pads tool, delete all but the largest pad in a padstack. See *Delete Non-Functional Pads* on page 245.
 - **Trace and Pad Connections and Traces Covered by Pads or Other Traces:** Using the Trace/Pad Overlap tool, find and correct problems with traces not ending exactly at pad center point or at the endpoint of another trace as well as traces completely covered by other pads or traces. See *Correct Trace/Pad Overlap Problems* on page 298.
 - **Layers Misaligned:** Using the Snap to Padmaster tool, align all layers to a padmaster layer. See *Snap Data to Padmaster* on page 249.
2. On the **D Code Table** and the **Tool Code Table**, define all **D Codes** and **Tool Codes**. NC Drill Tool Codes must be defined as P-plated, N-non-plated, T-tooling, or V-via.
3. Generate **supplemental layers**. The original layers may require further detail for an accurate netlist to be generated. Look for these situations in the original layers:
 - **Buried Traces or Pads in Power and Ground Planes:** Transfer buried elements in power and ground plane layers to new layers, and designate these new layers as layer type SIG.
 - **Splits in Power and Ground Planes:** Power and ground plane layers that have split power areas in them must have corresponding layers that outline the splits. These layers are type PS1-5 and GS1-5, where the split layer number is the same as its original plane layer number.

To define splits in a plane layer, replicate the traces that outline the split power area on a new layer using the Build Contour tool. This command automatically recreates the outline of a

split on a new layer using an F-type D Code specifically for this purpose. See *Generate Contours* on page 303.

Outlines drawn with the same F-type D Code are interpreted as having the same voltage. Outlines drawn with unique F-type D Codes indicate different voltage areas. Splits may be nested, but not overlapping. Outlines of the splits don't have to be drawn perfectly, but they must include all the data in that power area. Make sure the outline is closed, with no gaps in the corners.

- **Additional Test Points:** You can set up special test points on filter layers SPU, for the upper component layer, and SPL, for the lower component or solder side layer. The system uses these test points exclusively or in addition to the normal test points in extracting the netlist data, depending on how you set up the operation.
 - **Buried Vias:** The system recognizes buried vias in internal layers as opposed to through-hole drills by processing padmaster and via files differently. The Gerber padmaster (PAD) or NC Drill master drill file (DRI) contains the primary drill holes defined for through-hole conductivity. The Gerber via files (VIA) or NC Drill via files (VID) contain drill information for internal layer conductivity between layers. Sometimes the buried via data is already separated on its own layer. If it isn't, transfer the buried vias to separate layers.
4. **Exclude** part of the data. If the PCB data has elements too small or fragile to test, or borders, text, or nonfunctional traces unrelated to the electrical characteristics of the board, omit them from Vector Netlist Extraction in one of these ways:
 - **Blanking Elements:** Use the **Blank D Codes** command to remove certain D Codes from the process.
 - **Isolating Part of a Board:** Enclose the data you want used for the Vector Netlist Extraction in the **Reference Frame**. Later, when you set up the extraction options, turn on the Check Inside Frame only option. The system will check only the data inside the window, including nets that begin inside and end outside the window frame.
 5. Set the **Visibility** settings.

The Vector Netlist Extraction only checks visible elements, so make sure all pads, traces, selected, and unselected elements to be checked are visible. See *Element Visibility* on page 84.
 6. **Clear selection** from all elements.

The Vector Netlist Extraction uses selection to indicate extracted nets. Clearing the selection first helps avoid confusion.
 7. On the **Layers Table**, set up the **Layer Types**.

The system has to know the layer type off each layer used.

 - **CPU, CPL:** Component layers, upper and lower. You must have one of each. Surface-mount pads, if present, are included as part of the netlist.
 - **PAD or DRI:** Gerber or Drill padmaster layer. Use only one padmaster file per plot (or at least one via layer) to define the electrical connectivity between layers. In Gerber

padmasters, pads are assumed to have the same sizes as their corresponding drill points; traces are ignored.

- **VIA or VID:** Gerber or Drill buried via layers. In the case of inner layers with buried vias, there may be more than one via layer in addition to a padmaster. In the absence of a padmaster, there should be a via layer between each two consecutive layers to define the electrical connectivity between layers.
 - **GD1-5, GS1-5:** Ground planes and split ground planes.
 - **PW1-5, PS1-5:** Power planes and split power planes.
 - **SIG:** Internal signal layers. Only drill points may appear in the netlist as net points; other pads are not included in netlist output.
 - **MSU, MSL:** Soldermask layers, upper and lower. These layers are used to determine if pads in the netlist are cleared of soldermask (Format 2 or 4 netlists only).
 - **SPU, SPL:** Filter Layers for CPU and CPL. These layers define additional test points that may be used in addition to or in place of normal test points. Corresponding pads on the CPU, CPL are not necessary.
8. On the **Layers Table**, make sure all the layers to be checked are **visible** layers.
 9. On the **Layers Table**, add all other information as needed to identify **Negative** or **Filled** layers.
 10. Arrange the layers in **order** on the **Layers Table**.

Layers are processed consecutively as listed in the Layers Table. List the layers the way the board will be built or the way the layer sets will be drilled. See *Layer Stacking Examples* on page 432.

Once you are done preparing the plot data, go ahead and run the Vector Netlist Extraction.

Layer Stacking Examples



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In general, original layers, vias and supplemental splits should be sequenced the way the board is to be built or the way the layers sets are to be drilled. The drill file or padmaster and the remaining supplemental layers can be stacked anywhere.

Split Plane Layers



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Both plane layers in this example had splits. The splits are stacked in order with their respective planes. The padmaster or drill layer defines through-hole conductivity for every layer.

Layer Number:	Layer Type:	Explanation:
1	CPU	Upper Component Layer
2	SIG	Signal Layer 1
3	PW1	Power Layer 1
4	PS1	Splits from Power Layer 1
5	SIG	Signal Layer 2
6	GD1	Ground Layer 2
7	GS1	Splits from Ground Layer 2
8	SIG	Signal Layer 3
9	CPL	Lower Component Layer
10	PAD or DRI	Padmaster or Drill file (Connects all Layers)

Buried Vias



This example has buried vias (VIA layers) stacked with signal layers (SIG). Each via layer defines the conductivity for the preceding and following layers in the stack. All layers are drilled by the padmaster (PAD), including layers that are not stacked before or after a via layer.

Layer Number:	Layer Type:	Explanation:
1	PAD	Padmaster (Connects all layers)
2	CPU	Upper Component Layer (Connected by padmaster to all)
3	SIG	Signal Layer 1 (Connected by padmaster to all)
4	GD1	Ground Layer 1 (Connected by padmaster to all)
5	PW1	Power Layer 1 (Connected by padmaster to all)
6	SIG	Signal Layer 2 (Connected by Padmaster to all and connected to Signal 3 by Via 1)
7	VIA	Buried Via Layer 1 (Connects Signal 2 to Signal 3)
8	SIG	Signal Layer 3 (Connected by Padmaster to all and connected to Signal 2 by Via 1 and connected to Signal 4 by via 2)
9	VIA	Buried Via Layer 2 (Connects Signal 3 to Signal 4)
10	SIG	Signal Layer 4 (Connected by Padmaster to all and connected to Signal 3 by Via 2)
11	SIG	Signal Layer 5 (Connected by padmaster to all)
12	CPL	Lower Component layer (Connected by padmaster to all)

No Through-Hole Padmaster



This example is a surface mount board with no padmaster. Instead the example has a via layer containing main pads and via holes shared by each working layer and the next.

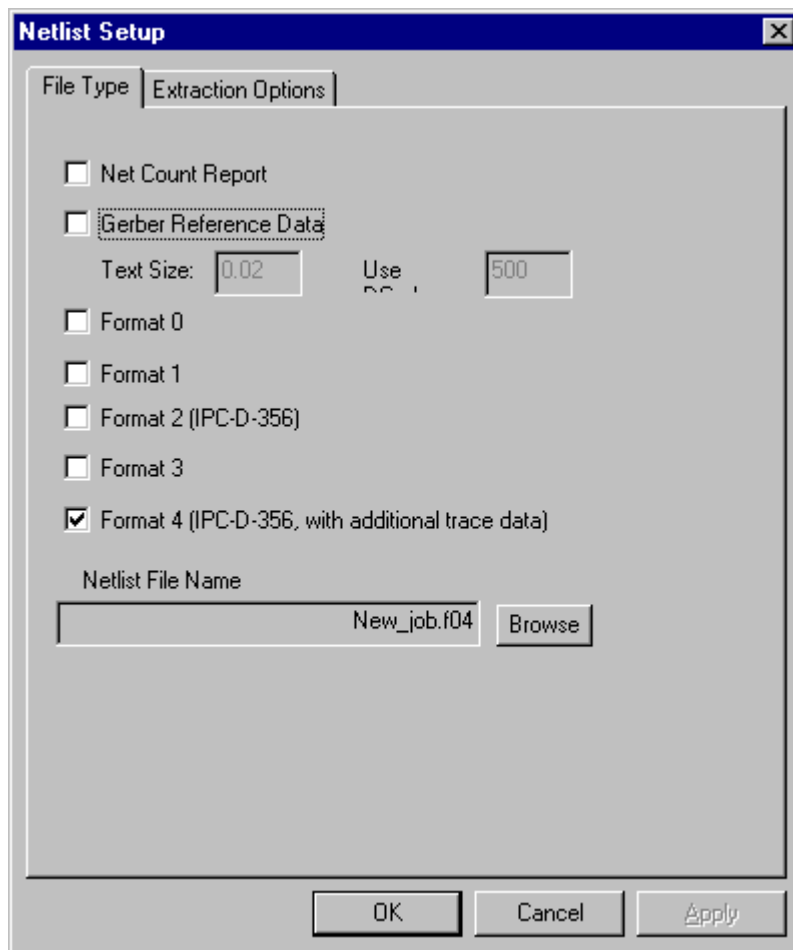
Layer Number:	Layer Type:	Explanation:
1	CPU	Upper component layer
2	VIA	Blind common via layer 1 (Connects Upper Comp. To Signal 1)
3	SIG	Signal layer 1
4	VIA	Buried common via layer 2 (Connects Signal 1 to Signal 2)
5	SIG	Signal layer 2
6	VIA	Buried common via layer 3 (Connects Signal 2 to Signal 3)
7	SIG	Signal layer 3
8	VIA	Buried common via layer 4 (Connects Signal 3 to Signal 4)
9	SIG	Signal layer 4
10	VIA	Blind common via layer 5 (Connects Signal 4 to Lower Comp.)
11	CPL	Lower component layer

Run the Vector Netlist Extraction



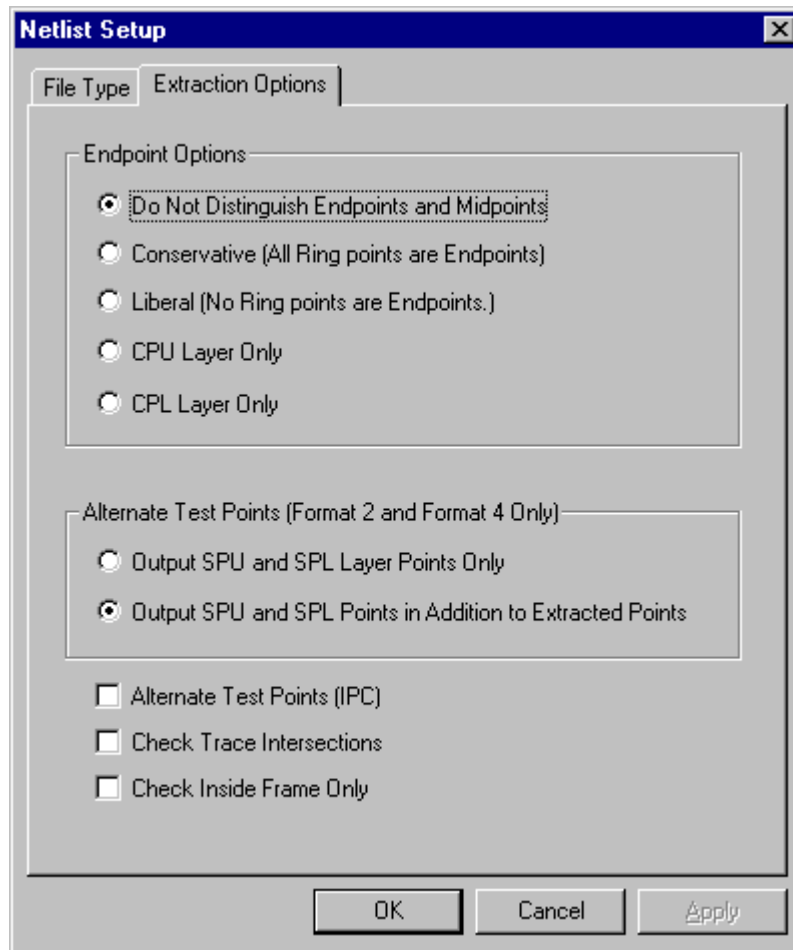
To Run the Vector Netlist Extraction:

1. After you have prepared the data for Vector Netlist Extraction, go to the **Tools** menu and click **Netlist-Extract Vector**.
2. On the **File Type** tab, select the types of netlist files and reports to generate. Click the types of files you want to generate so that there is a check mark next to the ones you want. For the types of files you do not want, click so that there is no check mark.



Vector Netlist File Type Tab

3. In the **Netlist File Name** box, enter the prefix of the files to be generated. The system supplies the appropriate suffix. If you want to browse for directories or file names click the **Browse** button.
4. On the **Extraction Options** tab, select the options you want.



Vector Netlist Extraction Options Tab

Endpoint Options: This option determines whether and how endpoints are distinguished from midpoints. If midpoints are distinguished from endpoints, then Format 2 and Format 4 netlists include both types of points and a special record to indicate which are which; for all other netlist formats, the output is limited to endpoints only. If endpoints are not distinguished from endpoints, then the Format 2 and Format 4 netlists do not include a special record to indicate which are which, and the other formats are not limited to endpoints only.

- **Do Not Distinguish Endpoints and Midpoints:** If this option is selected, midpoints are not distinguished from endpoints. All other options indicate that endpoints are distinguished from midpoints and designate the method used to distinguish between the two.
- **Conservative:** The system requires at least two endpoints per net per layer before designating any points as midpoints. This conservative approach to identifying midpoints results in more endpoints. For example, every point on a ring net or loop would be tested as an endpoint.
- **Liberal:** Pads with more than one trace coming in are marked as midpoints, as are vias that are part of plane layers. This liberal approach to midpoint identification results in fewer endpoints. For example, every point on a ring net or loop would be a midpoint, and there would be no endpoints.
- **CPU Layer Only:** Looking at only the CPU layer results in vias which would normally be midpoints being selected and tested as endpoints.
- **CPL Layer Only :** Looking at only the CPL layer results in vias which would normally be midpoints being selected and tested as endpoints.

Alternate Test Points Options: This options tells the system how to deal with filter layer (SPU, SPL) points, if any. To include only SPU and SPL points in the netlist output, ignoring all other extracted test points, check Output SPU and SPL Layer Points Only. To include SPU and SPL points in addition to the other extracted test points, check the Output SPU and SPL Points in Addition to Extracted Points.

Alternate Test Points Options: This option is for Format 2 and 4 reports, a check here turns on the Alternate Test Point field and causes the system to match the closest through hole with a surface mount pad if possible; no check disables Alternate Test Points.

Check Traces Intersections: To consider crossed traces as making electrical connection, select this option with a check mark. When this option is selected, the system also uses information from the Filled column on the Layers Table to process the netlist. Without a check mark, the system does not recognize crossed traces as making electrical connection, and entries in the Filled column are ignored.

Check Inside Frame Only: To use the Reference Frame to define the Vector Netlist Extraction area, select the Check Inside Frame Only option with a check mark. Otherwise, turn the option off, by clicking so that there is no check mark.

5. At the bottom of the **Netlist Setup** dialog, click **OK**.

The system displays a progress dialog so you can keep track of the process. The extracted netlist database is added to the current Job and the netlist file is exported.

To load the extracted netlist file into the job file, import the netlist file. See *Import Netlist Data* on page 55.

Net Numbering Conventions in Lavenir Software

Nets are extracted arbitrarily and numbered according to the following table:

Net Number:	Type of Net:
-1	Power to Ground shorts
0	Isolated points in the padmaster
1 to 5	Points connected to unsplit power planes
6 to 10	Points connected to unsplit ground planes
11 to 199	Points connected to split power and ground planes
200 and above	Connected points not part of power or ground plane nets.

Layer Numbering Conventions in Lavenir Software

Layers are numbered by the operation according to the order in which they are listed on the Layers Table. Any point with a layer numbered 0 (zero) is a via. Any point with a non-zero layer number is a surface mount pad on that layer.

View Netlist Data



View the Netlist Extraction Gerber Reference Plot



The system generates several Gerber files for referencing net data:

- Gerber Reference Plot (.GNT)
- Short Circuit Gerber Plot (.VGD)

To view these files, import them just as you would any other plot data. See *Import Basic Gerber* on page 29.

View the Netlist Reports



The system generates several ASCII text reports:

- Net Count Report (.REP)
- Short Circuit Report (.SCT)
- Split Plane Error Report (.SPT)

To View the Netlist Reports:

1. On the **File** Menu, click a **Report-View**.
2. In the Files of Type list, select All Files (*.*)
3. In the **Look in** box, click the drive, folder, or network location that contains the report.
4. In the folder list, double-click folders until you open the folder that contains the report you want.
5. **Double-click** the Report.



If you want to rename the file, then while you are viewing the file in the text editor, save it out under a new name by using the Save As command.

View Netlist Data On Screen



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When netlist information is present in the currently loaded Job File database, either by Raster Netlist extraction or by importing a netlist file, each element is identified with a particular net code that indicates what net it is in, if any. Here are some suggestions for visually inspecting the netlist data on screen.

To Find Out What Net a Particular Element Is In:

- Query the properties of that element. See *Query Element* on page 103.

To Step Through All Elements in the Same Net:

- Set the selection criteria to search for only that particular net, and use the First Element and Next Element commands.

To Select the Entire Net:

- Set the selection criteria to search for only that particular net, and use the Global Select command.

To Clearly See Only the Selected Net:

- After selecting the net, shut off the visibility of unselected elements, leaving only the selected net visible. See *Element Visibility* on page 84.



Some netlist databases, such as those extracted using the CAMMaster Raster Netlist Extraction routine, flag single-point nets as “N/C” and flag elements which cause short circuits between different types of plane layers as “S/C.” For these types of netlist databases, you may also select single point nets elements or short circuit elements by entering a net number of “N/C” or “S/C”, respectively, into the Current Net field.

Chapter 13

Scripting



CAMMaster incorporates the Sax Basic Editor, an interactive design environment for developing, testing and executing Sax Basic scripts. The Sax Basic Language provides the core language definition and is Visual Basic for Applications compatible. The program also has a macro recorder for capturing macros and recording them as Sax Basic scripts which can be saved, edited and executed.

The Sax Basic Engine and Sax Basic Language are a full-featured development environment and programming language. Instead of just playing back a recorded list of commands, you can program using variables, math and flow control. This script development system can also make use of the functions of other programs whose methods and properties are available to you as automation object libraries.

Most major CAMMaster functions are provided in the CAMMaster Automation Object Library of properties and methods. This means you can easily insert and use CAMMaster functions in your scripts and you can also have your scripts get values from the currently loaded Job File.

Use Macros



The CAMMaster Macro Interface



The Macro Menu and the Macro Toolbar contain the CAMMaster commands for controlling macros.



Macro Toolbar

To Display the Macro Toolbar:

- On the **View** menu, look at **Toolbars-Macro**.
 - If Macro has a checkmark next to it, then the Macro Toolbar is displayed.
 - If Macro does not have a checkmark next to it, then the Macro Toolbar is not displayed.

To change the display of the Macro Toolbar, click **Macro**.

Record a Macro



CAMMaster has a macro recorder that allows you to record CAMMaster Automation methods and properties as Sax Basic scripts.

To Record a Macro:

1. Click **Macro-Record**.
2. Do the **CAMMaster operations** that you want to record as part of the macro.

The Macro Recorder records the CAMMaster Automation methods and properties that correspond to the operations you activate.



Not all CAMMaster operations have a corresponding CAMMaster Automation object, and likewise, not all CAMMaster Automation objects correspond exactly to a CAMMaster operation that you can activate manually. But macro recording is still a good way to capture scripts of commonly used CAMMaster operations.

3. When you are done recording the macro, stop the macro recording by clicking **Macro-Record** a second time.



Pause Macro Recording



Pausing a macro allows you to perform a CAMMaster operation that you do not want recorded when the Macro Recorder is running.

To Pause a Macro:

- Click **Macro-Pause**. When you want to resume recording, click **Macro-Pause** again to release the pause.



Load and Run a Macro



The Load and Run command loads a macro into the system and runs it in one step.

To Load and Run a Macro:

1. Click **Macro-Load and Run**.
2. In the **Look in** box, click the drive, folder, or network location that contains the macro file.
3. In the **folder list**, double-click folders until you open the folder that contains the macro file.
4. Double-click the **macro file**.



The four most recently used macro files are listed on the Recent Macro list at the bottom of the Macro menu, and can be loaded and run by clicking on them.



Macros can also be dragged and dropped into the system.

*You can also load a macro and run it in two separate steps. See **Load a Macro** on page 444 and **Run a Macro** on page 445.*

*You can also run a macro by opening it and running it from within the Sax Basic Editor. See **Sax Basic Editor** on page 447.*

Drag and Drop a Macro into the System



You can load a macro by dragging and dropping it into the system.

To Drag and Drop a Macro into the System:

1. Open the Lavenir program and a file browser such as **Windows Explorer** or **My Computer** so that they are **side by side** on the desktop.
2. In the file browser, **select the macro file** that you want to drag into the Lavenir program:
3. Click on the selected macro file, hold down the mouse, and **drag the selected macro file** over to the Lavenir program.
4. **Release the mouse button** over the viewing area or the program icon.

The macro is loaded into the program.



*You can also load and run a macro using the command menus rather than drag and drop. See **Load and Run a Macro** above.*

*You can also run a macro by opening it and running it from within the Sax Basic Editor. See **Sax Basic Editor** on page 447.*

Load a Macro



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Before a macro can be run from the CAMMaster Macro menu, it needs to be loaded into the system.



Macros are automatically loaded after they are recorded.

To Load a Macro:

1. Click **Macro-Load**.
 2. In the **Look in** box, click the drive, folder, or network location that contains the macro file.
 3. In the **folder list**, double-click folders until you open the folder that contains the macro file you want.
 4. Double-click the **macro file**.
-



*You can also run a macro by opening it and running it from within the Sax Basic Editor. See **Sax Basic Editor** on page 447.*

Unload a Macro



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Unloading a macro removes the macro from the system, meaning that it cannot be run again until it is loaded again.

To Unload a Macro:

- Click **Macro-Unload**.
-



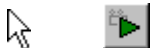
Run a Macro



After you load a macro, you can run the macro from the Macro Menu.

To Run a Macro from the Macro Menu:

- After you load a macro, you can run the macro by clicking **Macro-Run**.



You can also run the macro at the cursor location using the Macro Tool. This is useful if you want to run a macro on a particular element or location.

To Run the Macro at the Cursor Location Using the Macro Tool:

1. After you load a macro, click **Macro-Tool**.
2. **Position the cursor** where you want the macro to run.
3. **Click** the mouse or press **Enter**.



*You can also run a macro by opening it and running it from within the Sax Basic Editor. See **Sax Basic Editor** on page 447.*

Stop a Macro



You can stop a macro that is currently running. The primary use for this command is when a macro has failed but is still running.

To Stop a Macro that is Running:

- Click **Macro-Stop**.



*You can also stop a macro from within the Sax Basic Editor. See **Sax Basic Editor** on page 447.*

Edit a Macro



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You can edit a macro in the Sax Basic Editor.

To Edit a Macro:

- Click **Macro-Editor**.

This opens the Sax Basic Editor, where you can edit macros of the Sax Basic Language. See **Sax Basic Editor** on page 447.



Save a Macro



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You can save a macro from within the Sax Basic Editor.

To Save a Macro Captured with the Macro Recorder:

When you stop the Macro Recorder, the macro will be automatically loaded into the system.

1. Click **Macro-Editor**.

The Sax Editor opens, and the macro that was loaded into CAMMaster is open within the Editor.

2. On the **Sax Editor menu bar**, click **File-Save**.
3. To save the macro file in a different folder, click a different drive in the **Save in** box, or double-click a different folder in the folder list.
4. To save the macro file in a new folder, click **Create New Folder**.
5. In the **File Name** box, type a **name** for the macro file.

Sax Basic Editor



The Sax Basic Editor is an editing and development environment for macros and scripts written in the Sax Basic Language. It has specialized tools for editing, running, and debugging Sax Basic scripts.

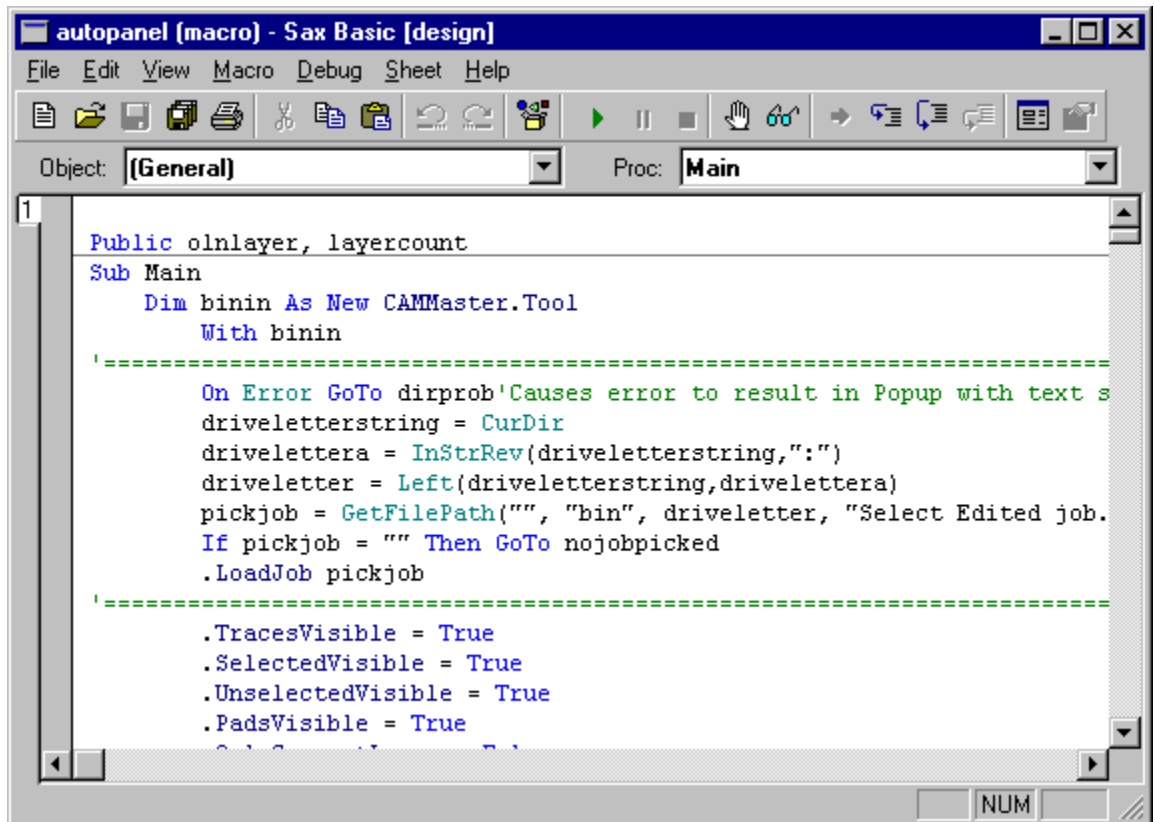
To Display the Sax Basic Editor:

- Click on **Macro-Editor**.



To Display On-Line Help for the Sax Basic Editor:

- Go to the Sax Basic Editor menu bar, and click on **Help-Editor Help**.



Sax Basic Editor

Sax Basic Language



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The Sax Basic Language provides the core language definition for scripting in Lavenir products. The Sax Basic Language is Visual Basic for Applications™ compatible. The two languages are almost identical languages, but there are a few things in VBA that are not in Sax Basic and vice versa.

To Display On-Line Help for the Sax Basic Language:

- Go to the Sax Basic Editor menu bar, and click on **Help-Language Help**.

What is in VBA but not in Sax Basic



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Collection

- Add
- Count
- ItemRemove

Conditional Compilation

- #Const
- #If...Then...#Else...#EndIf

Control Flow

- GoSub...Return
- On...GoSub
- On...GoTo

Line Numbers

- All line numbers

DDE

- LinkExecute
- LinkPoke
- LinkRequest
- LinkSend

Error Handling

- Erl
- Resume ‘ current line

Financial

- All financial functions

Objects

- Clipboard
- Collection
- LoadPicture

Options

- Option Compare

What is in Sax Basic but not in VBA



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Clipboard

- Clipboard

DDE

- DDEExecute
- DDEInitiate
- DDEPoke
- DDERequest
- DDETerminate
- DDETerminateAll

Dialogs

- Dialog
- DlgControlId
- DlgCount
- DlgEnable
- DlgEnd
- DlgFocus
- DlgListBoxArray
- DlgName
- DlgNumber
- DlgSetPicture
- DlgText
- DlgType
- DlgValue
- DlgVisible
- CancelButton
- CheckBox
- ComboBox
- DropListBox
- GroupBox

- ListBox
- OKButton
- OptionGroup
- Picture
- PushButton
- Text
- TextBox
- UserDialog

Execution

- MacroDir
- MacroRun
- MacroRunThis

Miscellaneous

- CallersLine
- PortInt
- Wait

String

- InStrRev
- Replace

CAMMaster Automation Object Library



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The CAMMaster Automation Object Library is a library of CAMMaster methods and properties that you can include in your scripts. Using these methods and properties (objects), you can easily insert and use CAMMaster functions in your scripts, and you can also have your scripts get values from the currently loaded Job File.

The macro recorder operates by capturing CAMMaster objects as you activate the corresponding operations in CAMMaster and recording the objects in a Sax Basic script.

Use a CAMMaster Automation Object in a Script



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The CAMMaster objects are identified as the object type **CAMMaster.Tool**

To use the CAMMaster Automation Object Library, include a line such as the one below in your scripts:

```
Dim LTI As New CAMMaster.Tool
```

This line declares that **LTI** is a variable that identifies a CAMMaster object. In this example, **LTI** is just an arbitrary variable name, and you can use any other variable name in the declaration as long as you use it thereafter in that macro to refer to CAMMaster objects. For example, if you wanted to use **LAV** as the variable, the declaration would be as follows:

```
Dim LAV As New CAMMaster.Tool
```

In the above example, which uses **LAV** as the variable to identify CAMMaster objects, subsequent lines that use CAMMaster objects would appear as follows:

```
LAV.ClearSelection  
LAV.OnlyCurrentLayer = True  
LAV.CursorY = 0
```

In these examples, the variable **LAV** identifies the objects **ClearSelection**, **OnlyCurrentLayer**, and **CursorY** as CAMMaster objects.

Property Strings



Some CAMMaster properties and arguments of methods take a string as input to set various subproperties. This method minimizes the number of properties needed in the CAMMaster Automation Object Library. For example:

```
LTI.GerberDataFormat="Left=2, Right=3, Leading, Absolute,
English, 360-Degree, ASCII"
```

In this example, the property **GerberDataFormat** takes the string **“Left=2, Right=3, Leading, Absolute, English, 360-Degree, ASCII”** to set seven subproperties.

When you want to change any of the subproperties, you don't need to include all of them in the subproperties string, only the ones you want to change. All the non-specified subproperties will remain unmodified. For example:

```
LTI.GerberDataFormat="Right=4"
```

In this example the subproperty **“Right=4”** is set, while the other six subproperties of **GerberDataFormat** remain the same.

Also, for any text in the subproperties string, any non-ambiguous prefix is enough to set the subproperty. For example:

```
LTI.GerberDataFormat="Le=2, Eng"
```

is the same as:

```
LTI.GerberDataFormat="Left=2, English"
```

because the only **GerberDataFormat** subproperty to begin with **Le** is **Left**, and the only subproperty to begin with **Eng** is **English**.

Browse the CAMMaster Automation Object Library



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You can browse the CAMMaster Automation Object Library in the Sax Basic Editor.

To Browse the CAMMaster Automation Object Library:

1. In the **CAMMaster menu bar**, click **Macro-Editor**.
2. In the **Sax Editor menu bar**, click **Edit-References**.
3. In the **References dialog**, click **Lavenir CAMMaster Type Library (1.0)** so that it has a check mark.
4. In the **References dialog**, click **OK**.
5. In the **Sax Editor toolbar**, click the **Browse Object** button.
6. In the **ActiveX Automation Members dialog**, go to the **Library** drop down list and select **CAMMaster**.
7. In the **ActiveX Automation Members dialog**, go to the **Data Type** drop down list and select **Tool**.

The ActiveX Automation Members dialog shows the methods and properties of the CAMMaster Automation Object Library in the Methods/Properties list.

8. In the **ActiveX Automation Members** dialog, click on a **method or property** in the **Methods/Properties** list to see additional information about that method or property.



*For Help on the Sax Editor, go to the Sax Basic Editor menu bar, and click on **Help-Editor Help**.*

Chapter 14

AutoPanel Script



CAMMaster comes with the AutoPanel.BAS script as way to demonstrate the power of Sax Basic scripting in CAMMaster.

What the AutoPanel Script Does



The CAMMaster AutoPanel script automatically processes a prepared one-up .BIN file into panelized layer files ready for output.

Steps and Repeats the Prepared One-up File



The AutoPanel script steps and repeats the prepared one-up file within an area that you define. AutoPanel determines the size of the one-up file from the board outline layer (.OLN). AutoPanel prompts you for the size of the area within which you want to step and repeat the file and for the distance you want between stepped images. Then AutoPanel determines the orientations that will yield the most stepped images within the area you defined. When AutoPanel determines the best orientation and position for the stepped pattern, the script shows a preview of what the step pattern will look like. You can select whether to accept the pattern or decline the pattern and try again with different steppable area dimensions and different clearance values. When you accept the previewed step pattern, AutoPanel steps and repeats the file to match the preview.

Imports Predefined Panel Data



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AutoPanel includes panel data files for three sizes of panels:

- 12" x 18"
- 16" x 18"
- 18" x 24"

The predefined panel files have:

- Robber bars
- Boundaries for venting and thieving fill
- Targets for optical inspection and registration
- Areas defined for title blocks, drill final hits, layer number blocks.

The predefined panel files are located in the

C:\Lavenir\CAMMaster 6.0\Sample Scripts\Panel directory.

After AutoPanel steps and repeats the file, the script determines which panel sizes will fit the dimensions of the steppable area that you defined. AutoPanel prompts you to pick a panel size, and then it imports the predefined panel data and merges it into the proper layers.

Generates Venting and Thieving Patterns



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The AutoPanel script generates venting and thieving patterns for inner and outer layers. The script prompts you for which types of patterns to use for inner and outer layers. When you have selected the parameters, AutoPanel automatically generates the venting and thieving patterns for each layer type. The system automatically handles positive and negative data, drawn and flashed planes, paint and scratch layers.

Adds Job Information to the Panel as Text



AutoPanel gathers information about the job and adds it to the panel as text:

- Adds the one-up file name as text to a title block.
- Drills the one-up file name into the drill layer.
- Runs a copper area calculation and adds the results as text to a title block.
- Prompts for mask type and silkscreen color and adds the information as text to the appropriate layers.
- Numbers each layer in a layer number block.
- Adds scale factors as text to each inner layer.

Optimizes Drill Data and Adds Final Hits



AutoPanel optimizes the stepped drill data and adds final hits for each tool.

Scales and Flips Layers for Output



AutoPanel prompts for scale factors for each layer and prompts for the construction type, cap or foil. Then AutoPanel scales each layer as you specified and flips layers to match the construction type.

File Preparation



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The CAMMaster AutoPanel script requires that the one-up .BIN file be prepared in a particular way. In addition to the CAM work that you would normally do prior to panelization, the script requires an outline layer, a labeled solder side layer, an NC drill layer, and a particular layer naming convention in order to run properly. All prepared one-up data must be saved in a single .BIN file prior to starting the AutoPanel script.

Outline Layer



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AutoPanel requires an outline layer. The script uses the outline layer to determine the dimensions of the one-up part for stepping and repeating and also to determine the board profile for the venting and thieving operations. The outline layer must contain a polygon that encloses all data of the one-up part. The outline layer must be named with the extension “.OLN” as described in the Naming Convention. See *Naming Convention* on page 460.

Solder Side Layer



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AutoPanel requires that you label the solder side layer. The script uses the solder side layer to determine the number of layers in the part. The solder side layer must be named with the extension that contains “SS” as described in the Naming Convention. See *Naming Convention* on page 460.

Drill Layer



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AutoPanel requires a drill layer defined in a particular way:

- The drill layer must have the layer type DRI in the Layers Menu.
- The drill layer must contain only D Codes of type N mapped to Tool Codes. The system will not work with a Gerber layer for the drill layer.
- The drill layer must only use Tool Codes 3 and higher. The AutoPanel script reserves Tool Codes 1 and 2 for its own standard tooling.
- The drill layer must be named with the extension that contains “DRI” as described in the Naming Convention. See *Naming Convention* on page 460.

Maximum Layer Count



The AutoPanel script can only process files that have 20 layers or fewer.

Directory Structure



The AutoPanel script requires the Panel directory containing the predefined panel files to be inside the same directory that contains the AutoPanel.BAS script. Also, the PlotOut.BAS script must be in the same directory that contains the AutoPanel.BAS script. By default this is how the AutoPanel directory structure is installed on your system by the Setup program.

Naming Convention



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The AutoPanel script requires that layer names in the one-up file follow a standard Naming Convention for layer name extensions. The layer name prefix must be the same as the one-up .BIN file prefix, and the extension must come from the following table.



*The **NameExtension.BAS** script can help you apply this naming convention to the layers in your job. See **Naming Convention Script** on page 477.*

Layer Name Extension:	Layer Type:
"1"	Component layer 1
"1d"	Component layer 1 Drawn Plane
"1f"	Component layer 1 Flashed Plane
"1s"	Component layer 1 First Scratch
"1p"	Component layer 1 First Paint
"1s1"	Component layer 1 Second Scratch
"1p1"	Component layer 1 Second Paint
"s1"	Component Silkscreen
"s1s"	Component Silkscreen Scratch
"m1"	Component Soldermask
"m1s"	Component Soldermask Scratch
"p1"	Component Paste Mask
"#ss"	Solder Side
"#ssd"	Solder Side Drawn Plane
"#ssf"	Solder Side Flashed Plane
"#sss"	Solder Side First Scratch
"#ssp"	Solder Side First Paint
"#sss1"	Solder Side Second Scratch
"#ssp1"	Solder Side Second Paint
"#"	Internal Signal

Layer Name Extension:	Layer Type:
“g#f”	Internal Ground Flash
“p#f”	Internal Power Flash
“g#d”	Internal Ground Drawn
“p#d”	Internal Power Drawn
“#s”	First Scratch
“#p”	First Paint
“#s1”	Second Scratch
“#p1”	Second Paint
“#s2”	Third Scratch
“#p2”	Third Paint
“s#”	Silkscreen
“s#s”	Silkscreen Scratch
“m#”	Soldermask
“m#s”	Soldermask Scratch
“p#”	Paste Mask
“oln”	Board Outline
“pol”	Array Outline
“dri”	Primary Drill
“dri#”	Drill 2 nd , 3 rd , 4 th , etc.
“bv#”	Blind/Buried Via (bv1-5, bv5-6, etc)
“rt”	Primary Rout Profile
“#rt”	Rout Profile 2 nd , 3 rd , 4 th , etc.
“fab”	Fab Drawing
“fab#”	Fab Drawing 2 nd , 3 rd , 4 th , etc.
“oth”	Other
“oth#”	Other 2 nd , 3 rd , etc.

Use the AutoPanel Script



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The following are step-by-step instructions for using the AutoPanel script. AutoPanel comes with a prepared sample one-up file, so you can try out the script without preparing your own Job File. To use the AutoPanel script on your own files, first prepare your files as described in the *File Preparation* section on page 458.

Load and Run the AutoPanel Script



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1. Start in CAMMaster, with no data loaded.
2. On the **Macro** menu, click **Load**.
3. On the **Open** dialog, navigate to
C:\Lavenir\CAMMaster 6.0\Sample Scripts\AutoPanel.BAS
4. Click on **AutoPanel.BAS** so that it appears in the **File Name** field.
5. Click **OK**.

The AutoPanel script is loaded into the system.

6. On the **Macro** menu, click **Run**.

The system prompts you to “Select the Edited job.bin.”

Example:

AutoPanel comes with a sample prepared Job File called

C:\Lavenir\CAMMaster 6.0\Sample Scripts\Sample1up\Sample1up.BIN.

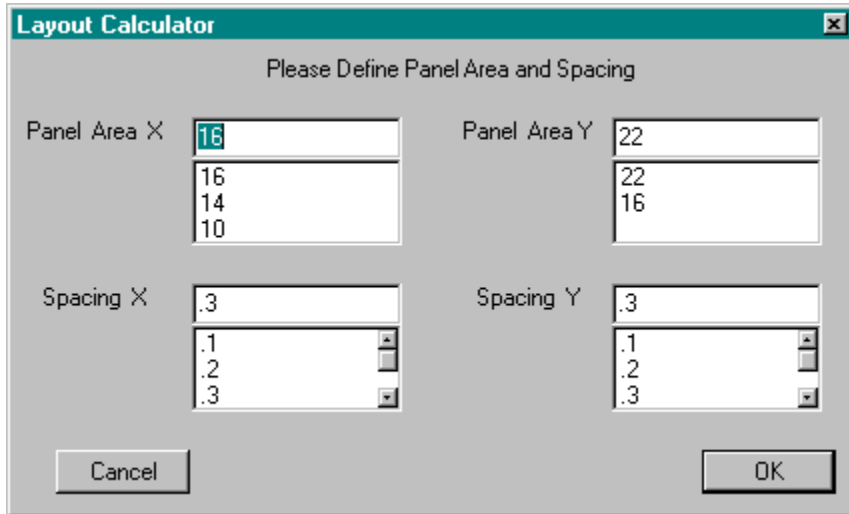
If you are just trying out AutoPanel, click on this file. Otherwise use your own prepared Job File.

7. On the **Select the Edited job.bin** dialog, navigate to the **directory** that contain the prepared Job File that you want to panelize and click on the **prepared Job File** that you want to panelize so that its name appears in the **File Name** field.
8. Click **Save**.

Step and Repeat inside the Panel Area



The system prompts you for the panel area and spacing.



Layout Calculator

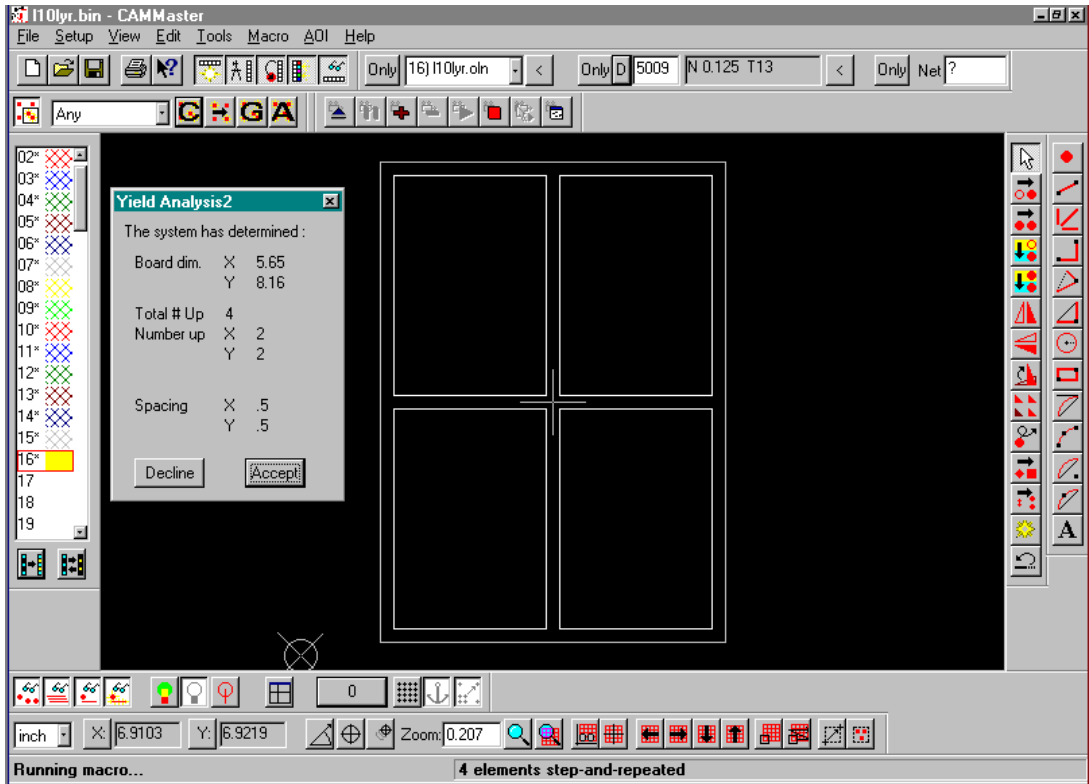
9. In the **Panel Area X and Y** fields of the **Layout Calculator** dialog, enter the **X and Y dimensions** of the area in which you want the script to step and repeat the Job File.



Because of the panel features outside of the steppable area (i.e. coupons, targets, title blocks, etc.), the finished panel size is going to be larger than the area you specify here as the steppable area.

10. In the **Spacing X and Y** fields of the **Layout Calculator** dialog, enter the **X and Y distance** you want between the repeated images of the Job File.

The system calculates the most efficient step pattern and previews it on screen along with a yield analysis dialog. The system uses the dimensions of the board outline layer and the Panel X and Y and the Spacing X and Y dimensions to determine how many stepped images can fit in both horizontal and vertical orientations, and then the system displays the orientation that yields the most images.



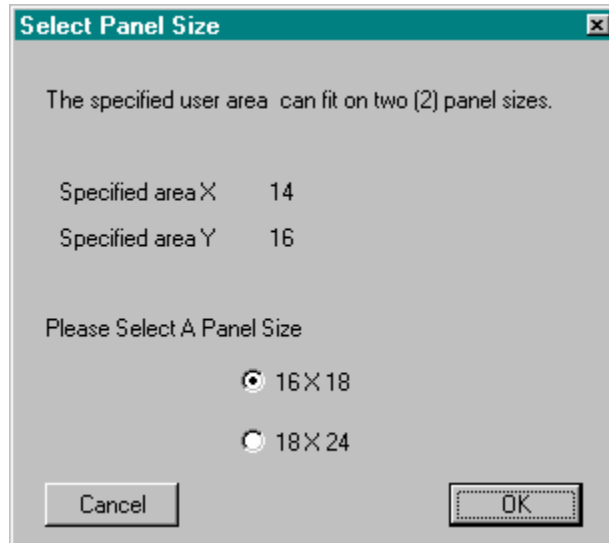
Step Pattern Preview

11. If you **like the pattern preview**, then click **Accept** on the Yield Analysis dialog.
 If you **do not like the pattern preview**, then click **Decline** on the Yield Analysis dialog and change the Panel X and Y and the Spacing X and Y dimensions until you get a pattern you like.
 After you click Accept, the system steps and repeats the job to match the previewed image.

If the Panel X and Y dimensions that you specified earlier will fit on more than one predetermined panel size, the system prompts you to select a panel size.



If the specified Panel X and Y dimensions will only fit on the largest panel size, then the system will skip this step.



Select Panel Size

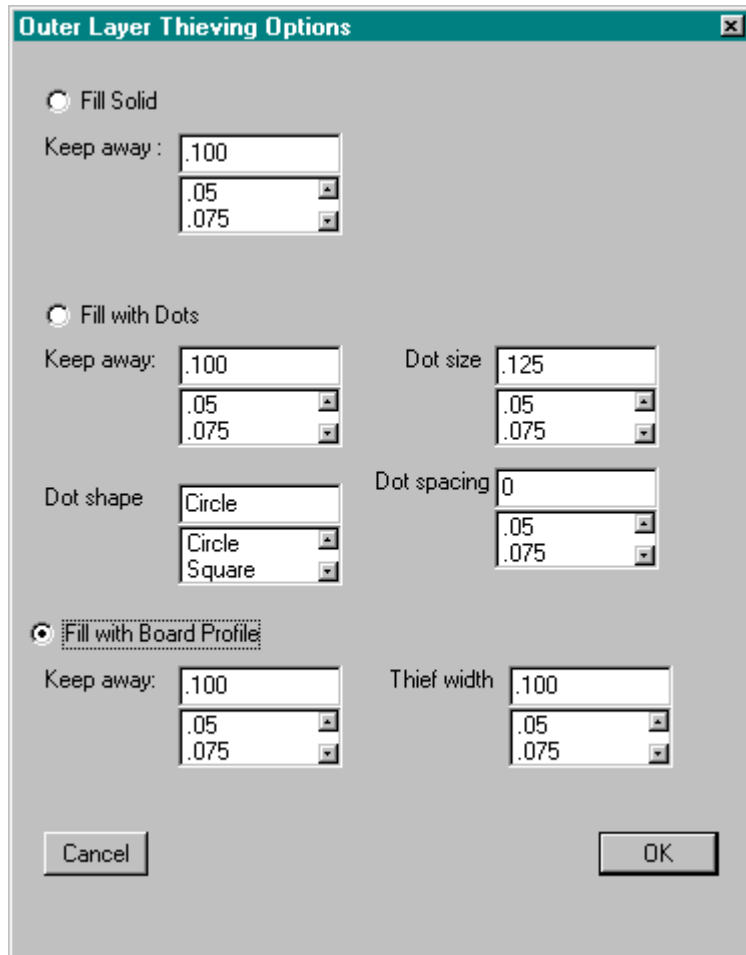
12. On the **Select Panel Size** dialog, click on the **panel size** that you want to use.
13. Click **OK**.

After you select the panel size, the system imports the files for the predetermined panel size.

Add Venting and Thieving Patterns



The system prompts you to select options for the thieving pattern to be used on the outer layers.



Outer Layer Thieving Options

14. On the **Outer Layer Thieving Options** dialog set the options for the thieving pattern that you want to use on the outer layers.

Solid Fill: The Solid Fill option adds a solid fill of traces between the profile of the stepped boards and the inner profile of the panel. If you want a solid fill for the outer layer thieving pattern:

- Click **Solid Fill**.
- In the **Keep Away** field, enter the distance you want between the fill pattern and the stepped images.
- Click **OK**.

Fill with Dots: The Fill with Dots option adds an alternating dot pattern between the profile of the stepped boards and the inner profile of the panel. If you want a dot fill for the outer layer thieving pattern:

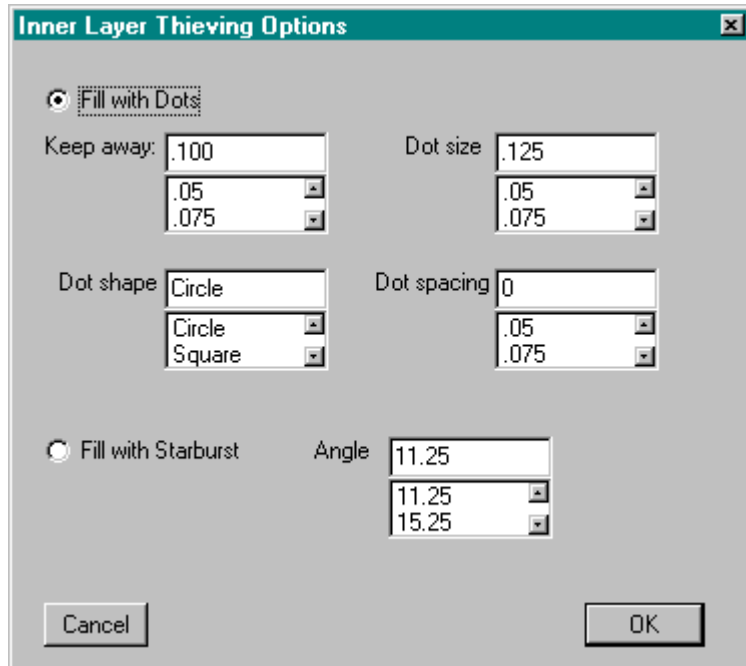
- Click **Fill with Dots**.
- In the **Keep Away** field, enter the distance you want between the fill pattern and the stepped images.
- In the **Dot Size** field, enter the **size of the D Code** to use for the dot pattern.
- In the **Dot Shape** field, enter **shape of the D Code** to use for the dot pattern.
- In the **Dot Spacing** field, enter the **distance you want between dots** on a layer.
- Click **OK**.

Fill with Board Profile: The Fill with Board Profile option adds a trace of specified width around the profile of the stepped boards. If you want a board profile fill for the outer layer thieving pattern:

- Click **Fill with Board Profile**.
- In the **Keep Away** field, enter the distance you want between the board profile trace and the stepped images.
- In the **Thief Width** field, enter the **size of the D Code** to use for the board profile trace.
- Click **OK**.

After you specify the options to use for the outer layer thieving, the system generates the fill pattern you specified.

The system prompts you to select options for the thieving pattern to be used on the inner layers.



Inner Layer Thieving Options

15. On the **Inner Layer Thieving Options** dialog set the options for the thieving pattern that you want to use on the inner layers.

Fill with Dots: The Fill with Dots option adds an alternating dot pattern between the profile of the stepped boards and the inner profile of the panel. If you want a dot fill for the inner layer thieving pattern:

- Click **Fill with Dots**.
- In the **Keep Away** field, enter the distance you want between the fill pattern and the stepped images.
- In the **Dot Size** field, enter the **size of the D Code** to use for the dot pattern.
- In the **Dot Shape** field, enter **shape of the D Code** to use for the dot pattern.
- In the **Dot Spacing** field, enter the **distance you want between dots** on a layer.
- Click **OK**.

Fill with Starburst: The Fill with Starburst draws a starburst pattern with traces between the profile of the stepped boards and the inner profile of the panel. If you want a starburst fill for the inner layer thieving pattern:


- Click **Fill with Starburst**.
- In the **Angle** field, enter the angle you want between rays of the starburst pattern.
- Click **OK**.

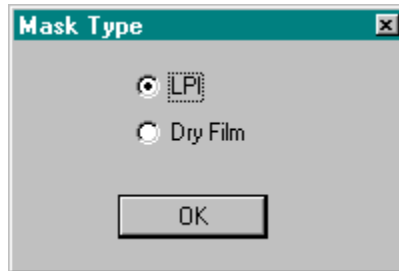
After you specify the options to use for the inner layer thieving, the system generates the fill pattern you specified.

Add Job Info to the Panel as Text



The system prompts for the type of solder mask that is going to be used for the job.


 *AutoPanel adds the mask type to the soldermask layers as text.*



Soldermask Type

16. On the **Mask Type** dialog, click on the type of solder mask that is going to be used for the job, either **LPI** or **Dry Film**.
17. Click **OK**.

The system prompts for the color of silkscreen that is to be used for the job.

 *AutoPanel adds the silk color to the silkscreen layers as text.*



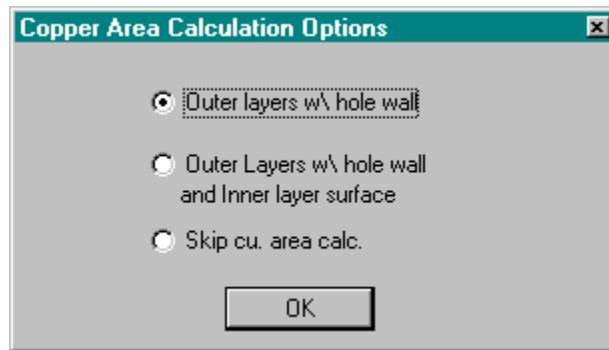
Silkscreen Color

18. In the **Silk Color** dialog, click on the **color of the silkscreen** to be used for the job.
19. Click **OK**.

The system prompts for options to be used in the copper area calculation.



The system puts the calculated copper area on the layer as text in a title block and also exports a report file with the calculated copper area.



Copper Area Calculation Options

20. In the Copper Area Calculation Options dialog, select the options you want for copper area calculation.

Outer Layers with Hole Wall: Click this option if you want to calculate the copper area for the outer layers only and include the copper area of plated through holes.

Outer Layer with Hole Wall and Inner Layer Surface: Click this option if you want to calculate the copper area for the outer layers, including the copper area of plated through holes, and also calculate the copper area of the inner layer surfaces.

Skip Cu Area Calc.: Click this option if you do not want to do a copper area calculation on the panel.

21. Click **OK**.

The system calculates the copper area and inserts the results as text on the layers.

Next, the system optimizes the drill data and reports the shortened path length.



Path length of optimized drill path

22. Click **OK**.

The system reports that the panelization is complete.



The macro still has more scaling and mirroring for output to do, but the macro pauses at this point for you to inspect the data. The data at this point represents the board as it will be built. You should thoroughly inspect the data before resuming the macro.



Panelization Complete

23. Click **OK**.

The AutoPanel macro is paused, and you can operate CAMMaster normally at this point.

24. Thoroughly inspect the panelized plot.



*The system places any **scratch layers** that it needs to generate into the **layers 31 and higher**. To view these layers as composites you need to turn on visibility for both the original layer and the generated scratch layer.*

*For example the sample file, **Sample1up.BIN**, contains flashed ground and power planes. The venting patterns generated for these flashed plane layers require the system to generate scratch layers. To view the composite for the ground plane layer, turn on visibility for **layer 3** (Sample1up.g3f) and **layer 33** (Sample1up.3scratch). To view the power plane composite, turn on **4 and 34**.*

Save a Copy of the Panelized Files

While the macro is paused, you can **save a copy** of the file at this point before mirroring and scaling for output.

25. Click **Save As**.
26. Enter the new **file name**.

Example:

*If you are trying out the AutoPanel script with the sample file **Sample1up.BIN**, you could rename the file **Sample Panel.BIN** to avoid inadvertently overwriting the original sample file.*

27. Click **OK**.

Scale and Flip the Data for Output

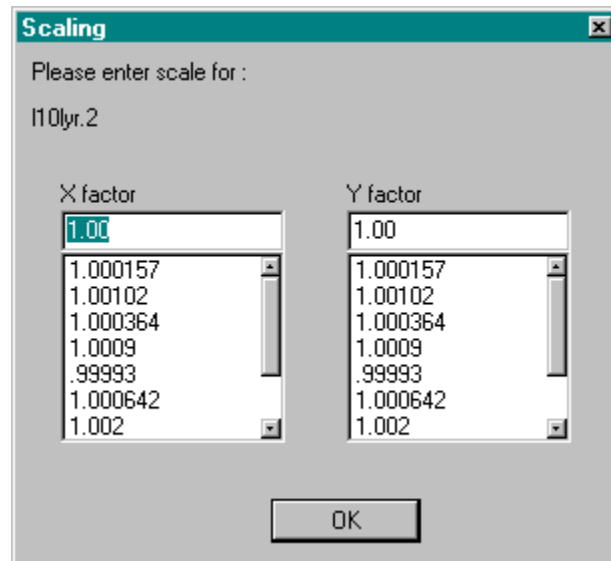


28. On the **Macro** menu, click **Resume**.

The system prompts for an X and Y scale factor for each layer.



In addition to using this information to actually scale the data, AutoPanel also adds the scale factors to the layers as text.



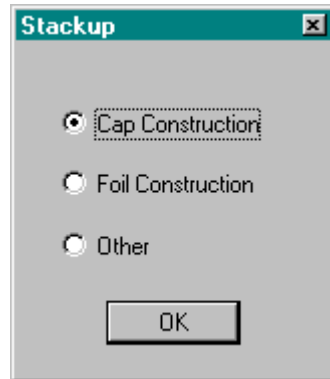
Scale Factor

29. For each layer enter **X and Y scale factors** into the **Scaling** dialog.
30. Click **OK**.

The system prompts for the type of construction for this job.



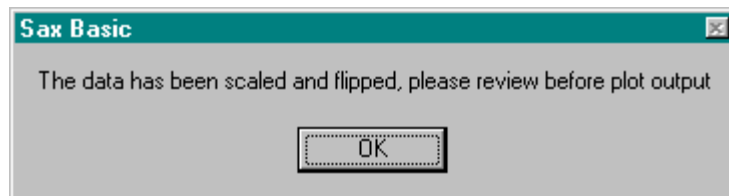
AutoPanel uses this information to determine how to flip the data for output. Depending on cap or foil construction, text on alternating layers is flipped to read right from the top or bottom, and data is flipped to have the correct emulsion side up or down.



Construction

31. In the **Stackup** dialog, click on the type of construction to be used for the job, **cap** or **foil**.
32. Click **OK**.

AutoPanel scales and flips that data as you specified and adds the scale factor to the layers as text. The system indicates that the data have been scaled and flipped.



Scaled and Flipped

33. Click **OK**.

This is the end of the AutoPanel script, but there are a few more manual steps to the procedure.

Save a Copy of the Output Files



34. Thoroughly inspect the data before output.
35. Click **Save As**.
36. Enter the new **file name**.

Example:

*If you are trying out the AutoPanel script with the sample file **Sample1up.BIN**, you could rename the file **Sample Output.BIN** to avoid inadvertently overwriting the original sample file.*

37. Click **OK**.
38. Export the data for photoplotting as usual using the **File-Export** menu command and the format and options you usually use.

Troubleshoot AutoPanel Error Messages



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Most problems that have been encountered with the AutoPanel script have been related to improper setup of the one-up file. Here are some of the more common error messages and what to check for.

Can't Find #SS



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This error message happens when the script is having trouble locating and classifying the layers that it needs. This could be due to several reasons:

- Be sure the one-up .BIN file contains a solder side layer with the extension containing “SS”. See *Solder Side Layer* on page 458.
- Be sure the one-up .BIN file contains an outline layer with the extension .OLN. See *Outline Layer* on page 458.
- Be sure the one-up .BIN file contains a drill layer with the extension .DRI and the layer type DRI, and be sure the drill layer does not use tool codes 1-3. See *Drill Layer* on page 458.
- Be sure all layer name extensions in the one-up .BIN file are correct as specified in the naming convention. See *Naming Convention* on page 460.
- Be sure all layer names in the one-up .BIN file have the same prefix as the .BIN file. See *Naming Convention* on page 460.

Floating Point Error



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This error message happens when the script encounters a math error. This could be due to several reasons:

- Be sure the outline layer with the extension .OLN contains a complete, closed polygon. See *Outline Layer* on page 458.
- Be sure the outline layer with the extension .OLN does not contain a double-drawn polygon. See *Outline Layer* on page 458.
- Be sure all layer name extensions in the one-up .BIN file are correct as specified in the naming convention. See *Naming Convention* on page 460.

Chapter 15

Sample Scripts



In addition to the AutoPanel script CAMMaster contains several other sample scripts.

Naming Convention Script



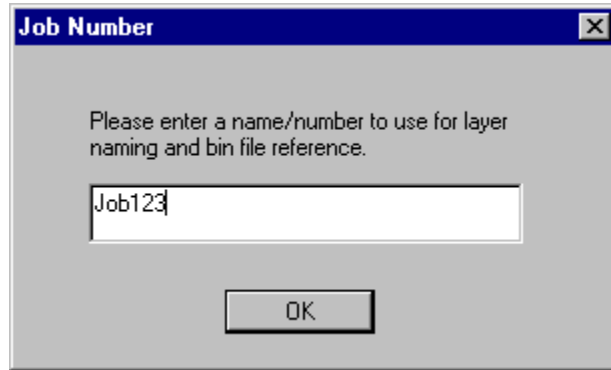
The **NameExtension.BAS** script assists you in applying the Lavenir layer naming convention used by the AutoPanel.BAS script and other Lavenir scripts. You can use the script to prepare your own files for automatic panelization.

To Apply the Lavenir Naming Convention with the NameExtension.BAS Script:

1. Begin with the files you want to rename open in CAMMaster.
2. If you want to save the files with their original names before applying the naming convention, go to the **Files** menu and click **Save**.
3. On the **Macro** menu, click **Load**.
4. On the **Open** dialog, navigate to **C:\Lavenir\CAMMaster 6.0\Sample Scripts\NameExtension.BAS**.
5. Double-click **NameExtension.BAS**.
6. On the **Macro** menu, click **Run**.
7. On the **Job Number** dialog, enter the **name or number** you want to use for this job.



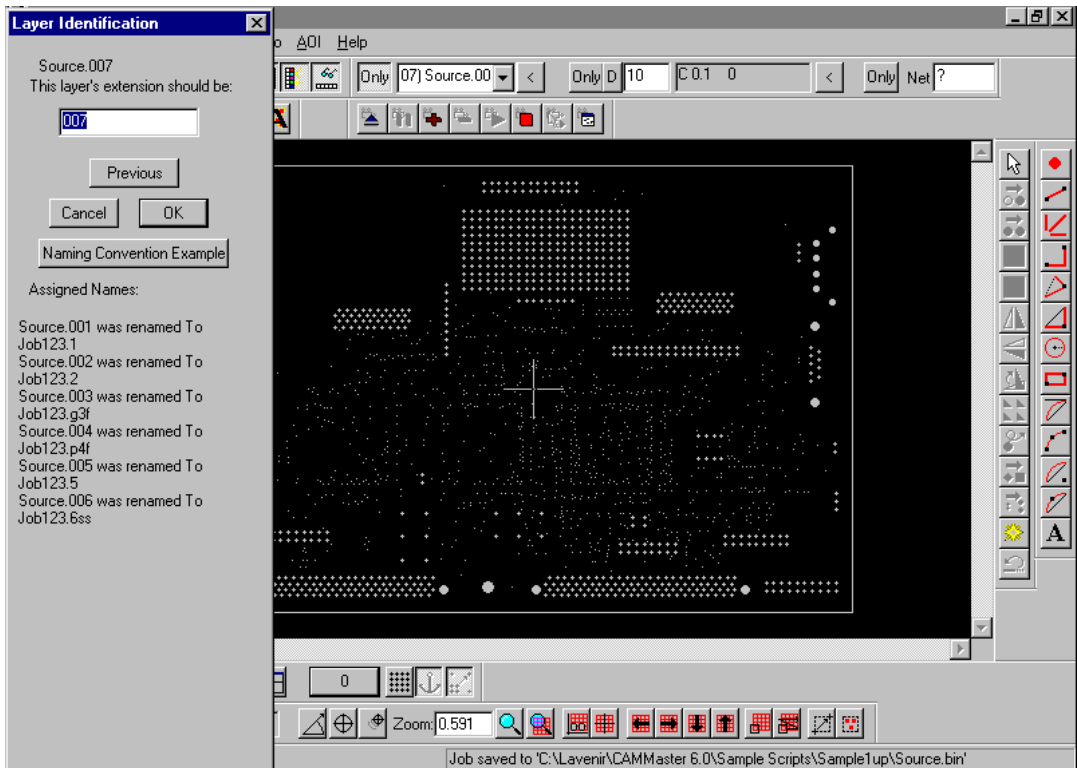
The script uses the name or number you enter here as the name for a new directory containing the new .BIN file, the prefix for the new .BIN file, the prefix for the individual layer names, and the prefix for a report file containing the name changes.



Job Number or Name

8. Click **OK**.

The script displays the **Layer Identification** dialog. The dialog shows the name of the first layer in the currently loaded files, and the layer is also displayed in the CAMMaster viewing area. The dialog prompts you to enter the new layer extension from the naming convention for the layer shown.



Layer Identification

9. If you don't know what the correct extension should be, click **Naming Convention Example**. The script displays a text file in Notepad. The file explains the naming convention extensions. You may want to print the file from Notepad if you think you will need to refer to it frequently.



*The naming convention extensions are also listed in this document.
See **Naming Convention** on page 460.*

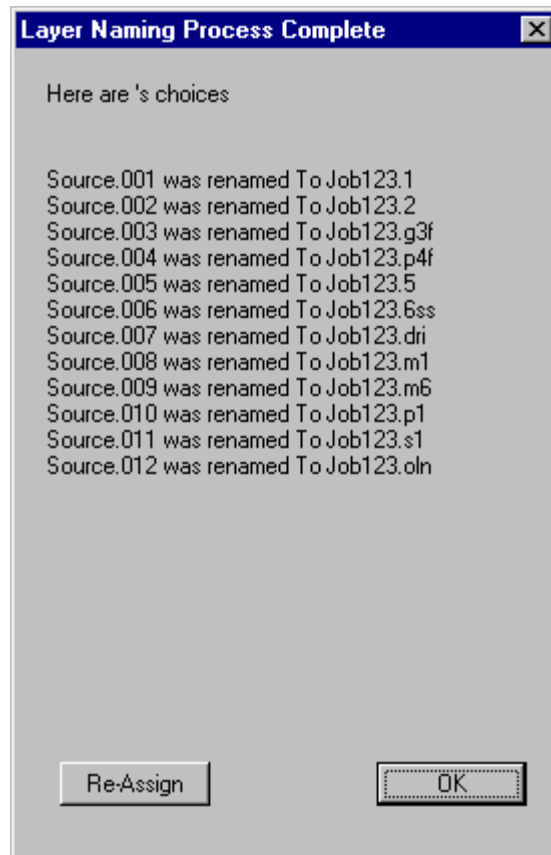
10. In the **Layer Identification** dialog, enter the new layer extension from the naming convention for the layer shown.
11. Click **OK**.

The script renames the current layer using the new job name prefix and naming convention extension. In the **Assigned Names** section, the Layer Identification dialog displays a history of the

layers that have been renamed during the current session. Then the script displays the next layer in the **Layer Identification** dialog and the CAMMaster viewing area.

12. If you need to **go back** to rename a layer that you have already passed, click **Previous**.
13. **Continue renaming layers** until you have processed all the loaded layers.

When you have processed all the loaded layers, the script displays the **Layer Naming Process Complete** dialog that shows the **history of all name changes** during the current session.



History of Changes

14. **Review** the name changes to be sure all are correct.
15. If you need to change anything in the list, click **Reassign**.
16. When all the layer names are correct on the **Layer Naming Process Complete** dialog, click **OK**.

The system displays a dialog that indicates all layer name extensions have been changed and reviewed and prompts whether you want to view a layer name text document. The document contains the **history of all name changes** during the current session

17. To view the text document, click **Yes**.
To skip the text document, click **No**.

The script creates a directory with the job name. Inside that directory, the script saves the new .BIN with the layer name changes and gives that .BIN file the job name prefix. The script also saves a text report with a history of the layer name changes in that directory.

The system displays a dialog indicating that the directory and .BIN file have been saved.

18. Click **OK**.

The script is done.

Location Marker Script



The **Location.BAS** script marks the cursor location and inserts the cursor coordinates as text. This is useful for verifying data against fab drawings. You can use the script to mark locations and elements on the data that you want to compare to the drawings and then print out or plot the file with the marked locations. The script is run from the Macro Tool, so it can demonstrate the usefulness of the Macro Tool Feature.

To Mark a Location with the Location.BAS Script:

1. On the **Macro** menu, click **Load**.
2. On the **Open** dialog, navigate to **C:\Lavenir\CAMMaster 6.0\Sample Scripts\Location.BAS**.
3. Double-click **Location.BAS**.
4. On the **Macro** menu, click **Tool**.
5. **Position the cursor** at the point you want to mark.

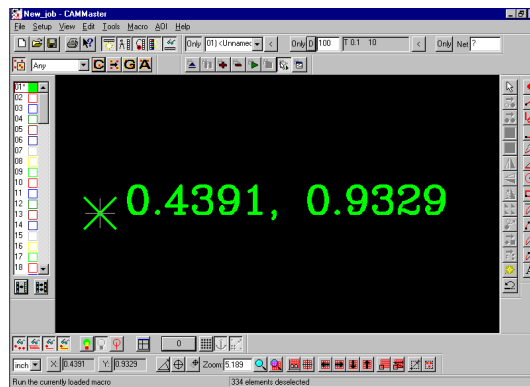


For precision, use the Align and Go To Coordinate commands when setting the cursor position.

6. **Click** the mouse or press **Enter**.

The Location script inserts a mark at the cursor location and inserts the coordinates of the mark as text.

The Macro Tool remains selected with the Location.BAS macro loaded, so you can mark one location after another.



Location Marked in File

Padstack Selection Script



The **StackSelect.BAS** script allows you to select entire padstacks in all visible layers with a mouse click, just like you would use the selection tool to select single pads in a single layer. The script displays the properties of the selected pads in the stack. Once the stack is selected, it can be copied, moved or edited in any other way. The script is run from the Macro Tool, so it can demonstrate the usefulness of the Macro Tool Feature.

To Select a Padstack with the StackSelect.BAS Script:

1. Begin with all layers that you want to select from **active and visible**. See *Select from the Active Layers* on page 152.
2. On the **Macro** menu, click **Load**.
3. On the **Open** dialog, navigate to **C:\Lavenir\CAMMaster 6.0\Sample Scripts\StackSelect.BAS**.
4. Double-click **StackSelect.BAS**.
5. On the **Macro** menu, click **Tool**.
6. **Position the cursor** near the padstack that you want to select.
7. **Click** the mouse or press **Enter**.

The cursor snaps to the nearest pad and selects all flashed pads in the active visible layers within .001 inch of the first pad. The script pops up the properties dialog for selected elements to indicate what was selected.

8. To dismiss the properties dialog, click **OK**.

The selected padstack can be copied, moved or edited in any other way.

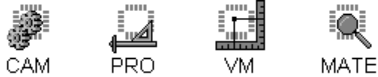
The Macro Tool remains selected with the StackSelect.BAS macro loaded, so you can select one stack after another.

Chapter 16

Key Commands

To support power users and speed operation, the program has accelerator keys for almost every function. The accelerator keys for the new Lavenir line of View Editors for Windows are in many cases different than those in the DOS View2001 and View+386 editors.

New Key Commands Listed by Function



This is a list of all of the new key commands, broken out by function. The table includes the equivalent key commands in the old DOS View2001 and View+386 software.

Selection Commands

Function	New Key	Old DOS Key
Selection Tool	S Enter for single Tab to start area Tab again to end	--
Global Selection	Shift+V	--
Select All Data	Ctrl+A	--
Invert Selection	Ctrl+I	--
Clear Selection	Ctrl+U	--
Select Inside/Outside Selection Frame	I	Alt+I
Select Any Element Class	U	--
Select Only from Current Layer	0 (Zero)	Alt+L
Select Only Elements of Current D Code	Ctrl+D	--
Set the Current D Code	Shift+D	Shift+D
Select Only Elements of Current Net	Ctrl+F	--
Set the Current Net	Ctrl+Shift+N	--
Select Only Pads	P	P
Select Only Traces	T	T
View Properties of Selected Elements	Alt+Shift+Enter	--

Editing Commands

Function	New Key	Old DOS Key
Activate Selected Editing Tool	Enter	--
Turn Off Selected Editing Tool	Escape	Slash
Undo Editing Command	Ctrl+Z	U
Delete Selected Elements	Delete	Delete, Alt+D, Ctrl+D, Shift+Delete
Copy Selected Elements	K	K, Ctrl+K
Move Selected Elements	Shift+M	Tab, Shift+Tab
Rotate Selected Elements	Ctrl+R	Alt+Q
Mirror Selected Elements Horizontal, Vertical	Shift+X, Shift+Y	Alt+X, Alt+Y
Transfer Selected Elements to New layer	J	J, Alt+J, Ctrl+J
Replicate Selected Elements to New layer	Ctrl+J	Alt+R, Ctrl+R
Step and Repeat Selected Elements	Shift+K	Alt+K
Snap Selected Elements to Grid	Ctrl+M	Alt+M, Ctrl+M
Transcode Selected Elements	Ctrl+T	Alt+T, Ctrl+T
Insert Element	Insert Key for element Enter to Activate	Insert
Insert Rectangular Polygon at Frame	Shift+B	Shift+B
Break Traces	Ctrl+B Enter for Single Tab to start area Tab again to end	Ctrl+B

Function	New Key	Old DOS Key
Stretch Traces	Ctrl+Shift+M Enter for Single Tab to start area Tab again to end	--
Convert Drawn Pads to Flashed	Ctrl+Shift+P	Alt-P

Layer Editing Commands

Function	New Key	Old DOS Key
Align Layers	Ctrl+Q	Ctrl+Q
Move Layers	Q	Q
Center Layer in other Layers	Shift+Q	Shift+Q
Center Layer to Frame	Shift+C	Shift+C
Swap Layers	Shift+J	--

Layer Commands

Function	New Key	Old DOS Key
Layers Table	F10	F10
Layers Toolbar	Ctrl+Shft+L Arrow to Layers Enter for Visibility Space for Menu Escape to Exit	--
Make Only Single Layer Active	L	Alt+L
Make All Layers Active	0 (Zero)	Alt+A
Make Next Layer Active	Equals	Equals
Make Previous Layer Active	Backspace	--
Toggle Single Layer Visibility	Shift+L	--
Toggle Visibility of All Layers	Shift+0 (Zero)	--
Toggle Visibility of Current Layer	Ctrl+Shift+0(Zero)	--
Make All Layers Visible	Ctrl+0 (Zero)	--
Make Only Next Layer Active and Visible	Shift+Equals	Shift+O
Make Only Previous Layer Active and Visible	Shift+Backspace	Shift+Backspace
Make Only Single Layer Active and Visible	Ctrl+L	--
Quick Access Active	1-9	1-8
Quick Access Visible	Shift+1-9	--
Quick Access Single Layer Active and Visible	Ctrl+1-9	--
Quick Access Set Color	Ctrl+Shift+1-9	--

Reference Frame Commands

Function	New Key	Old DOS Key
Frame Around All Data	Ctrl+W	Ctrl+W, Shift+W
Draw New Frame	Shift+W Enter to activate	--
Move Frame at Same Size	W Press once to grab corner and again to release	0 (Zero)
Resize Frame	Ctrl+Shift+W Press once to grab corner and again to release	9

Zoom Commands

Function	New Key	Old DOS Key
Zoom Tool	Z Enter for Up Shift+Enter Down Tab to start area Tab again to end	--
Zoom Up	Page Up	Page Up
Zoom Down	Page Down	Page Down
Set Zoom Level	Shift+Z	Alt+Z
Zoom on Frame	Shift+Home	W
Zoom to Show All Data	Home	Home
Zoom to Reference Zoom Level	Minus	Minus
Set Reference Zoom Level	Shift+Minus	Plus

Distance Measurement Commands

Function	New Key	Old DOS Key
Distance Measurement	D	D
Switch Coordinates between Relative/Absolute	R	R
Set Relative Origin	Shift+R Enter to activate	R
Mark Location	M	M

Visibility Commands

Function	New Key	Old DOS Key
Pads Switch between Visible/Not Visible	Shift+P	Shift+P
Traces Switch between Visible/Not Visible	Shift+T	Shift+T
Selected Elements Switch btw. Visible/Not Visible	Shift+S	Ctrl+I
Unselected Elements Switch btw. Visible/Not Vis.	Shift+U	Shift+I
Trace Width Switch btw Full Width/Centerline	O	Ctrl+Z
Pad Outline Switch betw. Full Width/Outline	Shift+O	--
Pad Contrast Switch betw. Same Color/Contrast	V	Alt+C
D Code Switch between Blank and Shape	Shift+H	Shift+H
Redraw Viewing Area	End	Enter
Redraw Viewing Area at Cursor	Shift+End	End

Go To Commands

Function	New Key	Old DOS Key
Align Cursor to Element	A	A
Align Cursor to Element and Query Properties	Shift+A	S
Move Cursor	Arrow Keys	Arrow Keys
Move Cursor Slowly	Shift+Arrows	Shift+Arrows
Pan Screen	Ctrl+Arrows	Ctrl+Arrows
Pan to First Screenful	Shift+F	Shift+F
Pan to Next Screenful	Shift+N	Shift+N
Go To X, Y Coordinate	X, Y	X, Y
Go to Origin	Ctrl+Home	Z
Go To Center of Data in Frame	C	C
Go To Center of Arc	Shift+E	Shift+E
Go to Trace Ends	E	E
Go To Frame Corner	Ctrl+E	Alt+W
Go To Marker	H	H
Mark Location	M	M
Go To First Element	F	F
Go To Next Element	N	N
Go To Previous Element	B	Ctrl+N
Separate Pointer and Crosshair	Spacebar	Spacebar

Grid Commands

Function	New Key	Old DOS Key
Turn Grid On/Off	G	G
Switch Grid between Variable and Fixed	Ctrl+G	Ctrl+G
Switch Grid between Anchored and Dragged	Shift+G	Alt+G

Setup Commands

Function	New Key	Old DOS Key
Layers Table	F10	F10
D Code Table	F5	F5
Set Current D Code	Shift+D	Shift+D
Tool Code Table	Shift+F5	Alt+F5
Set Current Net	Ctrl+Shift+N	--

File Commands

Function	New Key	Old DOS Key
Import Layer Files	Ctrl+F2	Ctrl+F2
Import Gerber	F2	F2
Import Gerber (options only)	F3	--
New Job File	Ctrl+N	--
Open Job File	Ctrl+O	--
Print Job File	Ctrl+P	--
Save Job File	Ctrl+S	--
Job File Properties	Alt+Enter	--

Help Commands

Function	New Key	Old DOS Key
Help Topics	F1	F9
Context Sensitive Help	Shift+F1	--

System Commands

Function	New Key	Old DOS Key
Abort Operation	Ctrl+Break	Ctrl+Break
Exit Program	Alt+F4	Escape

DOS Key Commands and Equivalent New Keys

This is a list of all the old DOS key commands and their equivalent new keys. The equivalent new keys are for new functions that are similar to the old DOS functions, but the exact operation of the new function may be different than the old function. For Instance, the new command may require you to select data before activating the command, or the new command may select an editing tool that you need to activate by pressing Enter. The table is sorted alphabetically by the old DOS key command.

Old DOS Key	New Key	Function
0 (Zero)	W	Move Frame at Same Size
0 and then 9	Shift+W Enter to Activate	Draw New Frame
1-8	1-9	Quick Access Make Layer Active
9	Ctrl+Shift+W	Resize Frame
A	A	Align Cursor to Element
Alt+A	0 (Zero)	Make all Layers Active
Ctrl+A	--	Arc Insertion Direction
Arrow Key	Arrow Key	Move Cursor
Ctrl+Arrow Key	Ctrl+Arrow Key	Pan Screen
Shift+Arrow Key	Shift+Arrow Key	Move Cursor Slowly
Asterisk (Shift+8)	--	Toggle Cursor Resolution for Arrow Keys
B	--	Toggle Blinking Cursor
Alt+B	--	Program Mouse Buttons
Ctrl+B	Ctrl+B	Break Trace
Shift+B	Shift+B	Insert Rectangular Polygon
Shift+Backspace	Shift+Backspace	Make Only Previous Layer Active and Visible
Ctrl+Break	Ctrl+Break	Abort Operation
C	C	Go To Center
Alt+C	V	Toggle Pad Contrast
Ctrl+C	--	Toggle Full-Screen Cursor
Shift+C	Shift+C	Center Layer to Frame
D	D	Distance Measurement

Old DOS Key	New Key	Function
Alt+D	Delete	Delete Group
Ctrl+D	Delete	Delete Group
Shift+D	Shift+D	Set Current D Code
Delete	Delete	Delete Element
Shift+Delete	Delete	Delete Group
E	E	Go to Trace Ends
Alt+E	--	Draw Polygon from Chain of Traces
Ctrl+E	--	Draw Polygon from Chain of Traces
Shift+E	Shift+E	Go To Center of Arc
End	Shift+End	Redraw Graphics at Cursor
Enter	End	Redraw Graphics
Ctrl+Enter	--	Start DOS Shell
Equals	Equals	Make Next Layer Active
Escape	Alt+F4	Exit Program
F	F	Go To First Element
Shift+F	Shift+F	Pan to First Screenful
F10	F10	Layers Menu
F12	Enter	Simulate Left Mouse Click
Shift+F12	--	Simulate Right Mouse Click
F2	F2	Import File
Alt+F2	--	Import Environment
Ctrl+F2	Ctrl+F2	Import Layers
F4	--	Clear and Load File
Alt+F4	--	Clear
Ctrl+F4	--	Clear and Load Layers
F5	F5	D Code Table
Alt+F5	Shift+F5	Tool Code Table
F7	--	Design Rule Check

Old DOS Key	New Key	Function
F9	F1	Help
G	G	Toggle Grid On/Off
Alt+G	Shift+G	Toggle Grid Anchored/Dragged
Ctrl+G	Ctrl+G	Toggle Grid Variable/Fixed
H	H	Go To Marker
Alt+H	S	Highlight Group
Ctrl+H	S	Highlight Group
Shift+H	Shift+H	Blank/Unblank D Code
Home	Home	Zoom to show all data
Alt+I	I	Toggle Inside/Outside Frame Selection
Ctrl+I	Shift+S	Toggle Visibility of Highlighted Elements
Shift+I	Shift+U	Toggle Visibility Highlighted Elements
Ctrl+Ins	--	Insert Rectangular Pad
Insert	Insert	Insert Element
J	J	Transfer
Alt+J	J	Transfer Group
Ctrl+J	J	Transfer Group
Shift+J	--	Set Destination Layer
K	K	Copy Element
Alt+K	Shift+K	Step and Repeat
Ctrl+K	K	Copy Group
L	--	Text Entry
Alt+L	L	Make Layer Active
Ctrl+L	--	Text Entry with New Parameters
Shift+L	--	Text Entry at Window Size
M	M	Mark Location
Alt+M	Ctrl+M	Snap Group to Grid
Ctrl+M	Ctrl+M	Snap Group to Grid

Old DOS Key	New Key	Function
Minus	Minus	Zoom to Reference Zoom
Alt+Minus	--	Transfer Chain
Ctrl+Minus	--	Transfer Chain
N	N	Go To Next Element
Alt+N	--	Highlight Net
Ctrl+N	B	Go To Previous Element
Shift+N	Shift+N	Pan to Next Screenful
Alt+O	--	Toggle Constrain/Redraw Cursor
Ctrl+O	--	Toggle Visibility of Active Layer
Shift+O	Shift+Equals	Make Only Next Layer Active/Visible
P	P	Pad Editing Mode
Shift+P	Shift+P	Toggle Visibility of Pads
Page Down	Page Down	Zoom Down
Page Up	Page Up	Zoom Up
Plus	Shift+Minus	Set Reference Zoom Level
Q	Q	Move Layers
Alt+Q	Ctrl+R	Rotate Elements
Ctrl+Q	Ctrl+Q	Align Layers
Shift+Q	Shift+Q	Center Layer in other Layers
R	R, Shift+R	Toggle Relative/Absolute Coordinate and Set Relative Origin
Alt+R	Ctrl+J	Replicate Group
Ctrl+R	Ctrl+J	Replicate Group
Shift+R	--	Swap Group
S	Shift+A	Select Nearest Element and Query Nearest Element Properties
Alt+S	--	Scale Elements
Ctrl+S	S	Highlight Nearest Element
Shift+S	--	Unhighlight Nearest Element

Old DOS Key	New Key	Function
Slash	Escape	Turn Trace insert off
Spacebar	Spacebar	Separate Pointer and Crosshair Cursor
T	T	Trace Editing Mode
Alt+T	Ctrl+T	Transcode Current D Code
Ctrl+T	Ctrl+T	Transcode Element
Shift+T	Shift+T	Toggle Trace Visibility
Tab	Shift+M	Move Element
Shift+Tab	Shift+M	Move Group
U	Ctrl+Z	Undo
Alt+U	--	Unhighlight Group
Ctrl+U	--	Unhighlight Group
V	--	Transfer Traces of Special Types
Alt+V	--	Show D Code Values
Ctrl+V	--	Select D Code by Size
W	Shift+Home	Zoom on Frame
Alt+W	Ctrl+E	Go To Frame Corner
Ctrl+W	Ctrl+W	Insert Frame Around Data
Shift+W	Ctrl+W	Insert Frame Around Data with Margin
X	X	Go To X
Alt+X	Shift+X	Mirror Horizontal
Y	Y	Go To Y
Alt+Y	Shift+Y	Mirror Vertical
Z	Ctrl+Home	Go to Origin
Alt+Z	Shift+Z	Set Zoom Level
Ctrl+Z	O	Toggle Display of Traces at Zero Width

Why Did Lavenir Change the Key Commands?

The key commands in the new Lavenir line of View Editors for Windows are different than those in the old DOS View+386 and View2001 editors. The key commands needed to change for several reasons:

- In Windows, some key combinations are reserved for special Windows functions. For instance the Alt key is reserved for accessing the menus from the keyboard. This eliminated many of the key commands that were used in the DOS software.
- In Windows, some key commands are standardized for certain operations. For instance, Ctrl+S for Save file, Ctrl+N for New file, Ctrl+P for Print, and Ctrl+Z for Undo. The desire to support the standards of the platform eliminated a number of other key commands that were used in the DOS software.
- The new selection method does away with some of the redundancy of key commands required for similar operations. For instance the old J, Ctrl+J, Alt+J commands are now all handled by one command, J, which transfers selected elements. Fortunately, the new selection system freed up a wealth of key combinations that we were able to use for the old commands displaced by the needs of Windows.
- Because of the need to change so many commands we took the opportunity to rethink some combinations to make more sense. For instance the old visibility commands Shift+P, Shift+T, Ctrl+I, Shift+I are now Shift+P, Shift+T, Shift+S, Shift+U for Pad, Trace, Selected, Unselected.

These changes are not going to be popular with established users of the Lavenir DOS editors that are trying to adapt to the new Windows products. Nobody likes change, especially when they have work to do. But considering the changes required to bring the old features to the new platform, there really was very little choice. Established users will find that the new accelerator key list is as usable as the old. We tried to keep as much the same as was possible, and gave the rest a lot of thought.

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