



Seetrax

Computer Aided Engineering

XL Designer

Adding Slots & Extra Holes

(v2.25 or later)

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1.0 Introduction

This document describes the new Slots & Extra Holes features added in XL Designer v2.23.

It is aimed at users who are familiar with the operation and use of previous versions, so describes the new features/changes only.

Slots (for CNC routing) can now be added to the artwork, a component outline or custom pad definitions.

Arbitrary extra plated or non-plated drill holes can also be inserted in those editors.

Figure 1 shows slots and extra holes in use in the artwork editor.

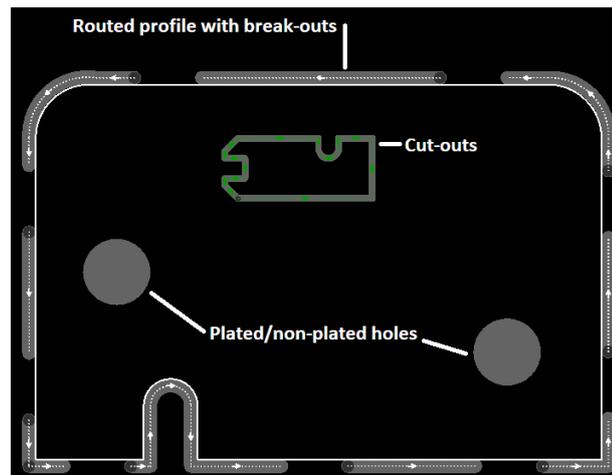


Figure 1

Break-out tabs may be inserted in the slots to assist “breaking out of a board” from a larger panel. The tabs may be solid or perforated (a series of close spaced small holes). Figure 2

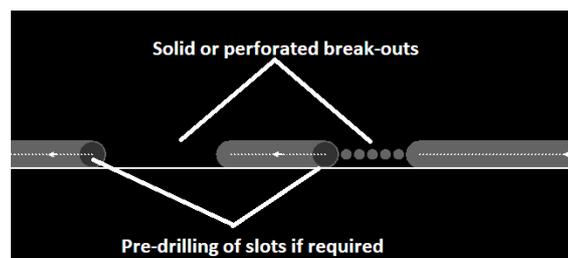


Figure 2

The slots can be pre-drilled (to avoid damaging the router cutter) if required.

The CNC drill and router data outputs have been updated to accommodate these changes and the resultant CNC output files now include tool definition information embedded in the file.

A new configuration panel **CNC Tools & Datasets** has been added. It allows pre-definition of all drills and routing tools needed for the board manufacture.

When the board is manufactured, it is likely that the drilling and/or routing will be done in stages:

- Drill holes/rout slots that need plating. Board is then plated.
- Drill holes/rout slots that are unplated.

- If slots need to be routed separately, an extra stage(s) would be required.
- Multilayer designs with blind/buried vias require extra stages, depending on the number of layers in use.

Each of these stages needs the drilling/routing data in a separate file. To achieve this, the drilling/routing data for each stage is added to its own “dataset” which can be output on its own.

Two datasets are pre-defined:

DS1 - plated holes (through the board)

DS2 - non-plated holes (through the board)

Additional user-defined datasets may be defined, from DS3 onwards.

Any drill dataset numbers that were previously defined to handle drilling of user defined via holes will be automatically imported into the new CNC Datasets table on design loadup.

2.0 Known limitations with this new feature

Designs saved in v2.23 cannot be opened in previous versions of XL Designer.

With the first release (v2.23) of the **Slots & Extra Holes** tool, there are some limitations which will be addressed in the next release. These are:

- The artwork checker is currently “blind” to the presence of slotted features and extra holes added to the design, so this must be borne in mind when slots or extra holes are added – a warning is given when checking is selected.
- Copper fill tool does not “see” slots or extra holes – temporarily add keepout areas around them .
- Powerplane tool does not “see” slots or extra holes – add clearance/anti-pads manually using Amend.
- Once a breakout is added to a slot, it is not yet possible to edit its parameters without deleting and recreating it.
- Once an extra hole is added, it is not yet possible to alter its size or drill dataset without deleting and recreating it.
- The 'Identify Feature' tool will not provide any information about slots and extra drill holes.
- Undo/Redo does not work within the Slots & Extra Holes tool.
- If a slot is defined in a component outline, then the tool cutting direction will be reversed if the part is flipped to the other side of the board.

3.0 Opening older jobs (prior to v2.23)

All router lines in v2.23 onwards must have a thickness assigned.

Any router lines defined in versions prior to v2.22 would not have had a thickness assigned to them.

For this reason, all router lines already in existence will be assigned a thickness of 0.1”/2.54mm when the job is opened. This will impact upon the edge of the profile or any cutouts defined, so remedial action will be required.

Either reduce the size of the cutter, move the lines appropriately, delete the lines and re-define them or a combination of all the above – the option chosen will depend on the circumstances of each job.

4.0 Slot & Extra Hole Visibility

In the artwork editor, Slots & Extra Holes have 3 visibility states:

- | | |
|-----------------------|---|
| Off (unticked) | Slots & Extra Holes are set as invisible |
| On (ticked) | Slots & Extra Holes are visible with the routing direction and pre-drilling details of slots visible. |
| Half On (greyed tick) | Slots & Extra Holes are shown, but without the routing direction and pre-drilling marks in slots. |

4.1 To set the visibility of slots:

In the View Control dialogue bar, repeated selection of the **Slots** check-box (indicated in Figure 3), toggles the slots between the 3 states.



Figure 3

5.0 How to Add a Slot

Whether the slot is added to a custom pad, component outline or the artwork, the procedure is the same.

The path of the slot is drawn, then break-out tabs are added along the path if required. Open the design and appropriate editor.

(In the artwork editor, ensure the slots are visible – see 3.0 above.)

Select **Tools > Slots & Extra Holes**, the **Slots** dialogue bar appears and indicates that no slots are defined, Figure 4 .

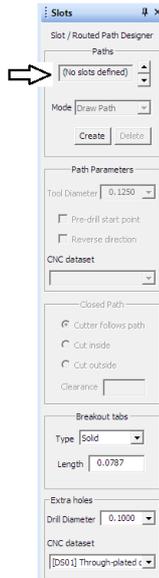


Figure 4

5.1 Create and Draw the Slot:

- a) Select the **Create** button from the Slots dialogue bar, Figure 5.

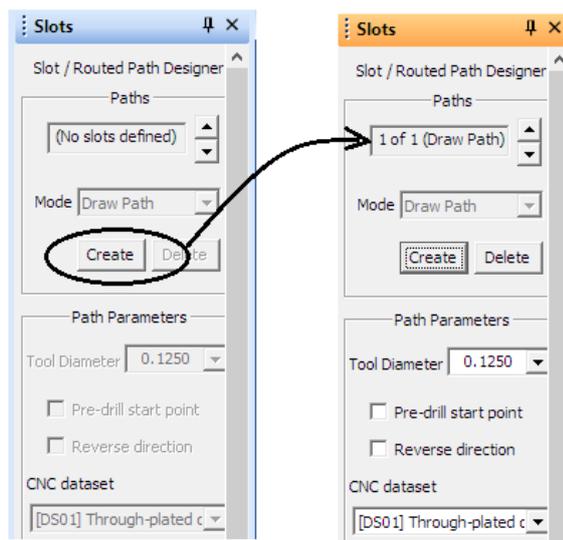


Figure 5

A path, number 1 of 1 has now been “created” and has to be defined.

- b) In the same dialogue bar, set the parameters for the slot to be added, Figure 6.

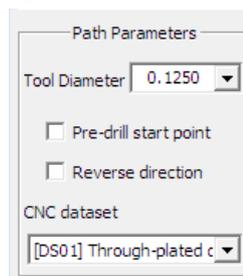


Figure 6

All of these settings can be changed whilst the slot is being drawn, or after the slot has been added if required - changes affect the currently selected or “active” slot - the dotted line/arrows in the active slot will be white.

Tool diameter: the width of the active slot (Edit > Units to change between inches/mm,)
Type in a value (keep the cursor within the area) or choose from the drop-down list, which is populated from the CNC Tools table (more about this later).

Pre-drill Start Point: Pre-drilling can help reduce tool breakage - a hole is drilled before the router tool plunges into the board to cut the slotted path.
The pre-drill size is specified in the CNC Tools table (more about this later).
To see the pre-drills in a slot, the size of the pre-drill in the CNC Tools table must be defined.
If a pre-drill size is not specified in the CNC Tools table, then it will not be pre-drilled even if this box is ticked.
The pre-drill will appear at the start of each slot, and after each break-out within the slot if added.

Reverse direction: The slot is routed in the direction in which the line is drawn unless the box is checked. The direction is indicated by the dotted line/arrows in the slot.
The direction can be changed as it is important to obtain the best edge finish on the correct side of the slot.

CNC Dataset: Each slot can be added to one dataset and this controls which drill/router output file it is included in.
When the slots are output, they are output with other drilled holes and/or slots in the same dataset. Which dataset is chosen depends on the stage in the manufacturing process that they will be used.
There are two pre-defined datasets, one for plated (DS1) and one for non-plated holes/slots (DS2).
Other user-defined datasets are available and they are defined in the CNC Tools & Dataset table (more about this later).
Speak to the manufacturer if you do not know which slots to include in which dataset.

- c) Now add the slot - this will be the path followed by the cutter, from start to finish - ignore the position of break-outs as they will be added later.

Select **Slot Definition > Add Line** (or **Arc** or **Circle**) and draw the line/arc/circle in the usual way.

Once the first segment has been drawn, the thickness of the slot, the pre-drill hole (if selected) and a dotted line with an arrow in the centre of the slot, which shows the cutting tool direction, will appear.

These settings can be changed in the dialogue bar whilst the line is attached to the cursor if required.

Draw the shape required; if necessary make the two ends coincident to form a closed shape.

Each defined slot can only have one line/arc or circle - use the **Create** button to add an extra slot.

Use the **Slot Definition > Corner, Move Point**, etc. commands to adjust the shape of the slot.

5.2 Add break-out tabs if required:

Break-out tabs stop the board falling out of a panel once routed (shown in Figure 1 & Figure 2).

Either a solid or perforated tab can be inserted. A perforated tab is made up from a small row of holes that form the weak point where the board will be broken out.

a) Set the parameters (Figure 7) for the break-out tab.

Note: currently (v2.23) these cannot be altered once the tab has been added, so delete the tab and add a new one if required.

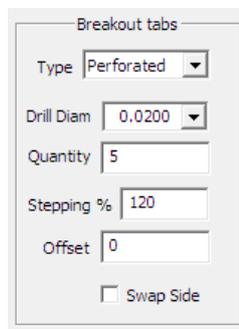


Figure 7

Type:	The breakout can be solid or perforated (shown in Figure 2).
Length:	If a solid break-out tab is chosen, then a length for the tab has to be specified.
Drill Diam:	If a perforated break-out tab is chosen, then a size for the drill that will make the perforations has to be specified.
Quantity:	The number of drilled holes within the perforated break-out tab.
Stepping %:	Is the distance between the perforation holes as a percentage of drill diameter, see Figure 8.

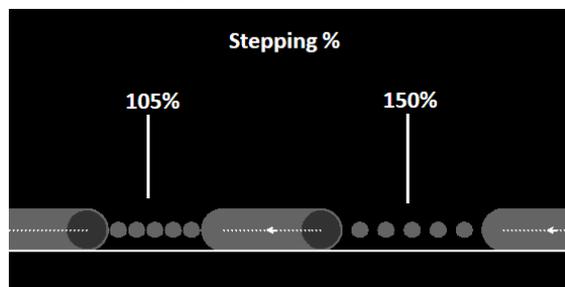


Figure 8

150% would mean that the holes are spaced apart by one and a half times the drill's diameter. Note: 105% is the minimum value permitted to avoid tool breakage.

Offset: The holes can be offset away from the centre line of the slot, see Figure 9.

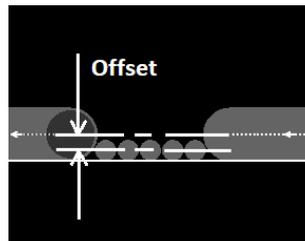


Figure 9

- 0 the perforations are along the centre line of the slot
- 100 the perforations have their centre line aligned with the edge of the slot (i.e they are displaced by half the slot width from its centre line).

Think about positioning the perforations so they do not violate the edge of the board, whilst leaving the board with minimum cleanup required after it has been broken out.

Swap Side: Makes the holes appear on the opposite side of the path, Figure 10.

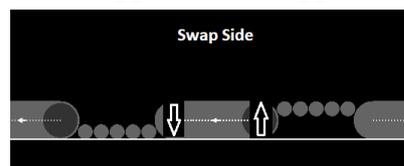


Figure 10

- b) Select **Slot Definition > Add Breakout**, position the cursor over the centre of the intended breakout position and click the left button. Repeat as required.
- c) Use the **Slot Definition > Move/Delete Breakout** commands to adjust the breakout.

The settings of the tab cannot be altered in v2.23, delete and re-add the breakout tab.

Break-out tabs, are selected about their centre, along the axis of the slot - see Figure 11.

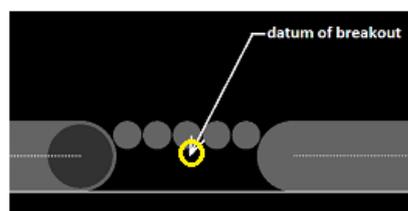


Figure 11

6.0 How to edit a slot and or break-out tab

- a) The currently active slot will have its centre-line highlighted in white. Only the active slot can be edited.

Click through the 'Paths' list (Figure 12) to select a slot for editing.

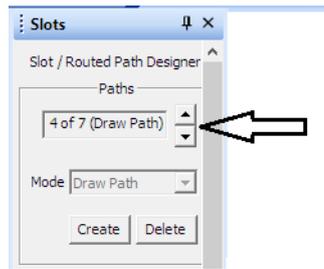


Figure 12

- b) Change the settings in the dialogue bar as required, any changes made will be reflected in the active slot.

7.0 CNC Tools & Data Sets

In the descriptions above, mention was made of the **CNC Tools & Data Sets** tables and these will be found in the **Configuration** folder. Select **Configuration > CNC Tools & Data Sets** to view and edit the tables, Figure 13.

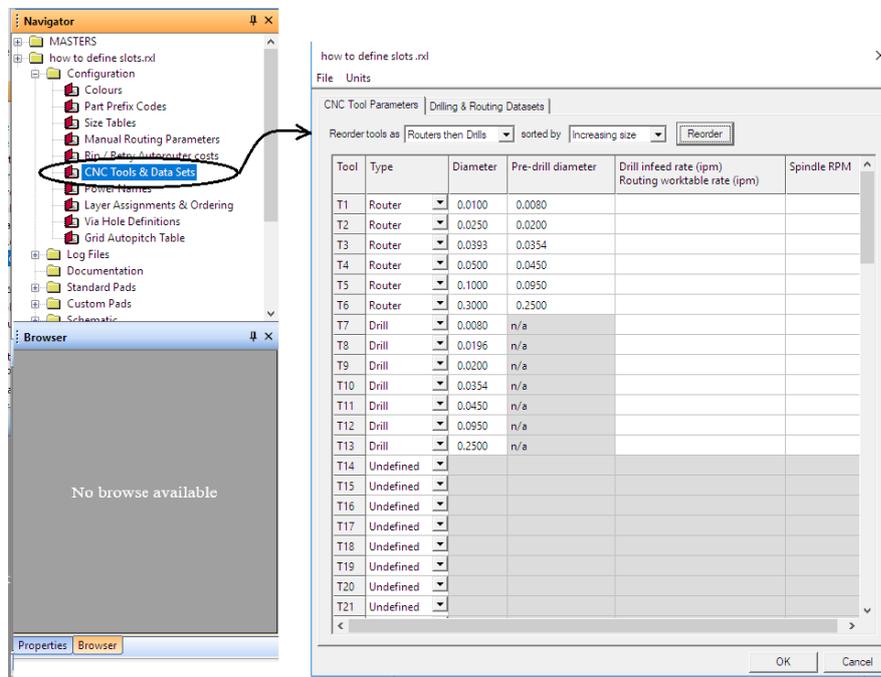


Figure 13

The tabs at the top of the window provide access to both tables, Figure 14.

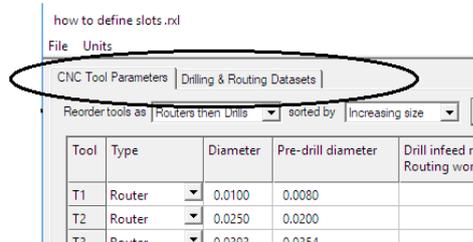


Figure 14

CNC Tool Parameters

The **CNC Tool Parameters** table is used to define the routing and drilling tools that are needed to manufacture the board.

If this table is not filled in, then the NC Drill/Router output task will fill it in, by fetching all the required tool sizes from the pad sizes table and the slot definitions in the design.

However, it is necessary to manually complete this table in order to use the pre-drilling facility to avoid breakage of small routing tools used for slots.

Once this table has been filled in, the slot diameter and drill diameters in the **Slots** dialogue bar can be selected from a drop down list, Figure 15.

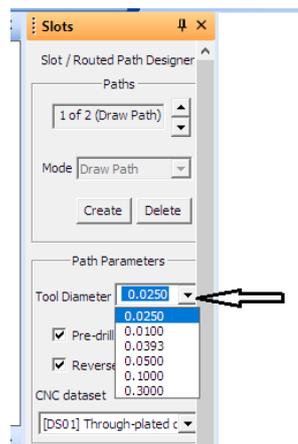


Figure 15

Each different drilled hole and slot has to be assigned a unique tool to produce the hole or slot. The tools are numbered from 1, ie T1, T2, T3, etc.

Note: If a slot is pre-drilled, then two tools have to be defined, one for the slot and one for the pre-drilled hole.

Tool	The tool number assigned to a particular tool, they are always shown in ascending order (the actual number is irrelevant at this stage).
Type	Whether the tool will be used by the router to produce a slot, or for drilling holes - choose from the drop-down list.
Diameter	The diameter of the tool – in inches or mm (change units using the Units command from the top of the window).
Pre-drill Diameter	If the tool “Type” is set to Router and pre-drilling is required, specify the diameter of the pre-drilled hole. Note: it is also necessary to add a drill for the pre-drilled hole, which should match the pre-drill size.
Drill Infeed Rate	and Routing worktable rate (ipm). These will generally be left unassigned and controlled by the manufacturer.
Spindle RPM	This will generally be left unassigned and controlled by the manufacturer.

The table can be sorted in various orders, using the **Reorder** button, which helps identify sizes already defined in the list to avoid repetition, Figure 16.

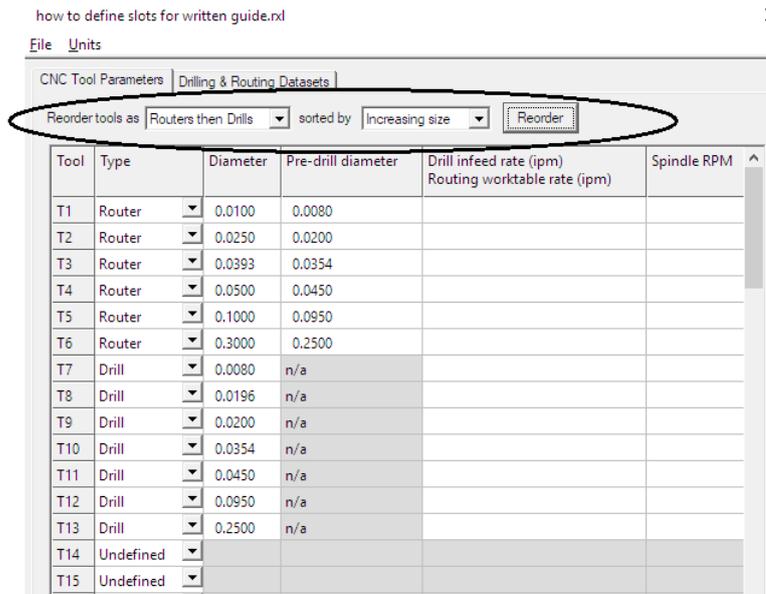


Figure 16

Drilling & Routing Datasets

The **Drilling & Routing Datasets** table is where names & descriptions can be assigned to the different sets of drilling data that will be required for a complex board, such as one with blind/buried via holes.

As already mentioned, if a board has plated and non-plated holes, then at least two drilling output files will be required.

Additional files are required for each blind/buried via stack.

Two pre-defined datasets exist, these are:

DS1 for through plated drill holes/slots

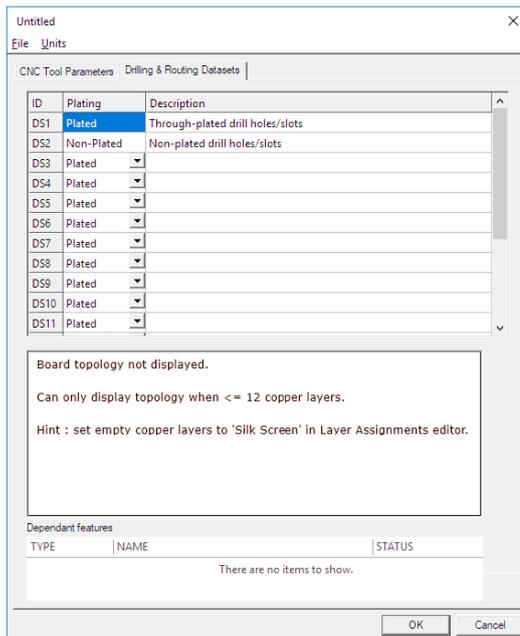
DS2 for Non-plated drill holes/slots

Any slots or holes that should be output alone should have their own datasets.

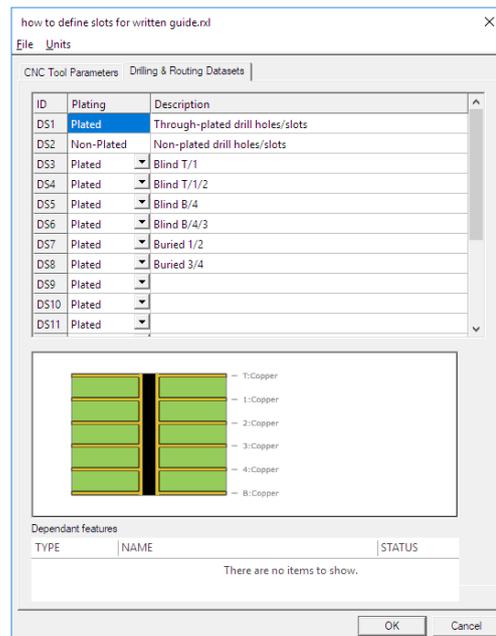
All the slots/drills in the same dataset will be output together.

Figure 17 shows the table for a new design on the left and for a 6 layer design with blind and buried vias on the right.

Most single/double-sided designs contain through the board holes, either plated or non-plated, so typically just two drill datasets are required, one for each type.



Drilling & Routing Dataset for a new design



Drilling & Routing Dataset for an existing 6 layer design with blind and buried vias

Figure 17

- ID A unique number assigned to each dataset.
- DS1 and DS2 are pre-defined and cannot be changed.
- Plating Whether the holes/slots included in this dataset will be plated or unplated.
- Description A description to aid recognition of the dataset by the user.
- Board topology The board topology can only be displayed when there are less than 12 copper layers.
Most designs generally have all unused layers defined as copper layers, so there are too many to display. To change this:
From the **Configuration** folder, select **Layer Assignments and Ordering**, then select the **Set empty copper layers to silkscreen** button.
Return to the **Drilling & Routing Datasets** table, you will see that the board topology is displayed graphically; the topology of a double-sided design is shown in Figure 18.
(Figure 17 shows the topology of a through plated hole in a 6 layer design.)



Figure 18

If there are additional copper layers, and a dataset other than DS1 or DS2 is selected, the top and bottom of the drilled zone can be moved up and down in the board topology using the **Layer Span** buttons, identified in Figure 19.

Figure 19 shows DS4 selected, which is being used for a blind via from the top of the board through to layer 2.

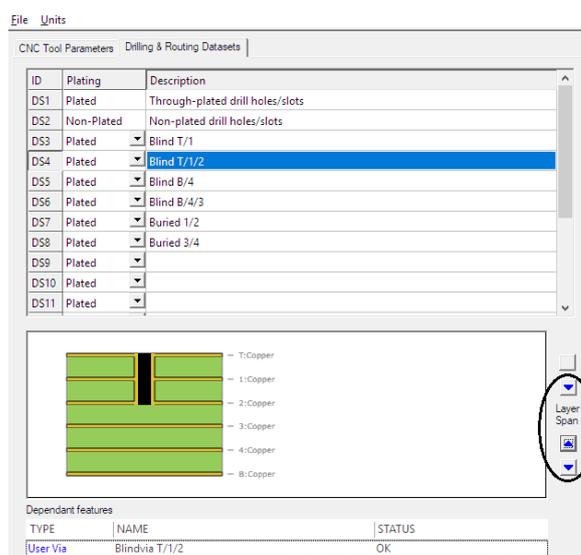


Figure 19

At the moment, this graphic is just an advisory to help the designer understand what the various drilling and routing sets of data are being used for, but eventually it will also guide the validation of the board.

8.0 How to Add a Plated/Non-Plated Hole –“Extra Holes”

Standard pads of any shape or custom pads with a hole, have a copper area with a hole inside the area. When drilled, they are always output with Dataset 1 (plated).

Extra Holes added using the **Slots** command menu are simply a hole – they do not have a copper area of any shape around them, though the hole itself can be plated through.

8.1 To add an Extra Hole

Whether the *Extra Hole* is added to a custom pad, component outline or the artwork, the procedure is the same.

Open the design and appropriate editor.

Select **Tools > Slots & Extra Holes**, the **Slots** dialogue bar appears. Depending on the screen size, it may be necessary to scroll down to the bottom of the dialogue bar to see the *Extra Hole* settings, as shown in Figure 20.

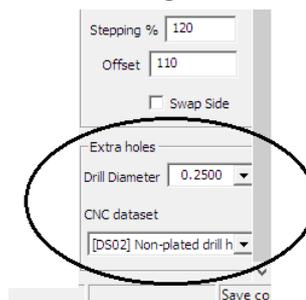


Figure 20

Set the parameters as required:

Drill Diameter:	Size of hole required
CNC Dataset	Which CNC Dataset the hole will be included in.

Select **Extra Holes > Add Hole**, the hole appears attached to the cursor, position as required with a left click.

In v2.23 it is not possible to edit extra holes, so to change their diameter or dataset, they must be deleted and reinserted – this will be rectified in a future release.

9.0 Checking Slots & Extra Holes

As previously mentioned, in v2.23 the artwork checking routines have **NO** knowledge of the slots or extra holes.

It is imperative that every slot & extra hole is visually checked – they may cause open circuits or short circuits on any of the layers – don't forget that on power plane layers the slots and extra holes will need clearance zones added around them (using Amend) to avoid possible shorts between layers.

10.0 CNC Output Tool

A separate NC drill output file is required for each of the datasets:

- conventional through hole vias/component holes
- non-plated holes
- each set of blind vias
- each set of buried vias

Some drilling machines can also rout short slots, so the slots might be included with the appropriate drilling datasets.

Longer slots, particularly those that define the outer edge of the board may need their own separate output file. This is something that should be checked with the individual manufacturer.

10.1 To create the drilling/routing files

Create a new *New NC Drill & Rout Data Output* task in the Outputs/Task folder and rename it to reflect the type of output file that will be produced.

One task will be required for each CNC Dataset.

Open the Task, a window similar to the one shown in Figure 21 appears

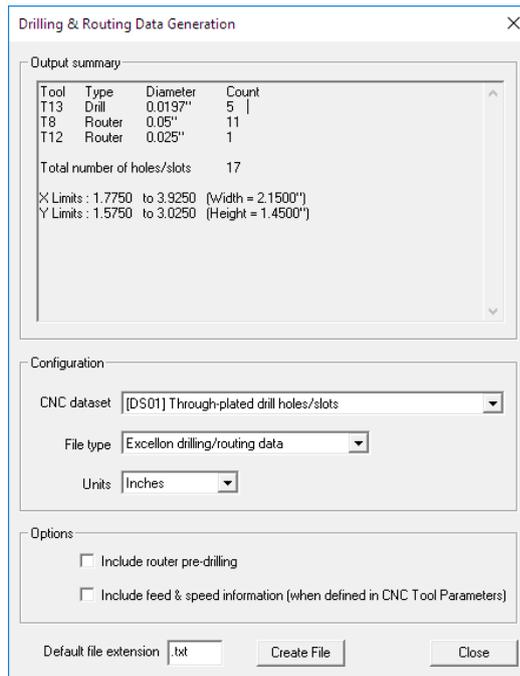


Figure 21

The window provides a summary of the output data, set the parameters as required:

CNC Dataset all the drills and slots included in the selected dataset will be output in the file.

File Type Either Excellon or Sieb & Meyer format files can be output. Both file types have the tooling information embedded in the file.

A separate file with just the tooling information can also be output for reference.

Units An imperial (inches) or metric format file can be chosen.

Options:

Include router pre-drilling: all of the pre-drilling information within slots can be included or excluded as required.

Include feed & speed info: if defined in the CNC Tool Parameters, the feed & speed information can be included or excluded as required.

Note: most modern drilling/routing machines have pre-set speeds and feeds for different sized drills/cutters, therefore consult your manufacturer before overriding these values.

Default file extension: the output file will be given the specified file extension.

10.2 Drill sheet (drawing) output

If drill sheet drawings are required, a separate drill sheet drawing output will be required for each of the datasets, so create/name new output tasks accordingly.

The dataset is chosen from the Drill drawing setup window, as indicated in Figure 22.

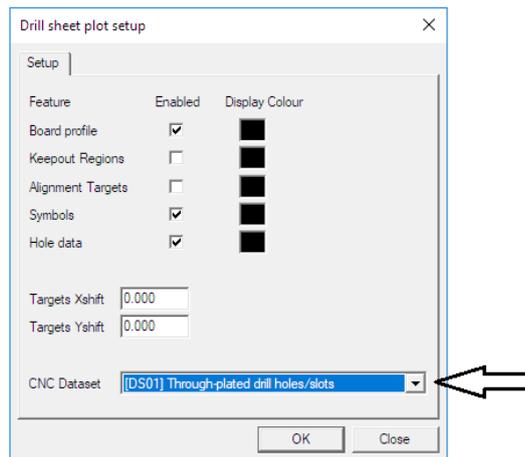


Figure 22

11.0 Conclusion

We hope this document provides you with all the information needed to use the new slots & extra holes features added in version 2.23. If you have any queries at all, please contact your local support office. Thank you!

Produced 27 June 2019, updated 14 August 2019

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