

PCB 编辑器

The KiCad Team

REVISION HISTORY			
NUMBER	DATE	DESCRIPTION	NAME

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53c2; 8003; 624b; 518c;

Note

This manual is in the process of being revised to cover the latest stable release version of KiCad. It contains some sections that have not yet been completed. We ask for your patience while our volunteer technical writers work on this task, and we welcome new contributors who would like to help make KiCad's documentation better than ever.

7248; 6743;

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672c; 6307; 5357; 4e2d; 7684; 6240; 6709; 5546; 6807; 5747; 5c5e; 4e8e; 5176; 8d21; 732e; 4eba; 5458;

8d21; 732e; 4eba; 5458;

Jean-Pierre Charras, Fabrizio Tappero, Wayne Stambaugh, Cirilo Bernardo, Jon Evans, Graham Keeth

7ffb; 8bd1; 4eba; 5458;

taotieren <admin@taotieren.com>, 2019, 2020, 2021.

Telegram 7b80; 4f53; 4e2d; 6587; 4ea4; 6d41; 7fa4;: https://t.me/KiCad_zh_CN

8bd1; 8005; 6ce8; ffla; 82f1; 6587; 53cc; 5f15; 53f7; 5305; 542b; 7684; 4e2d; 6587; 53cd; 9988;

53cd; 9988;

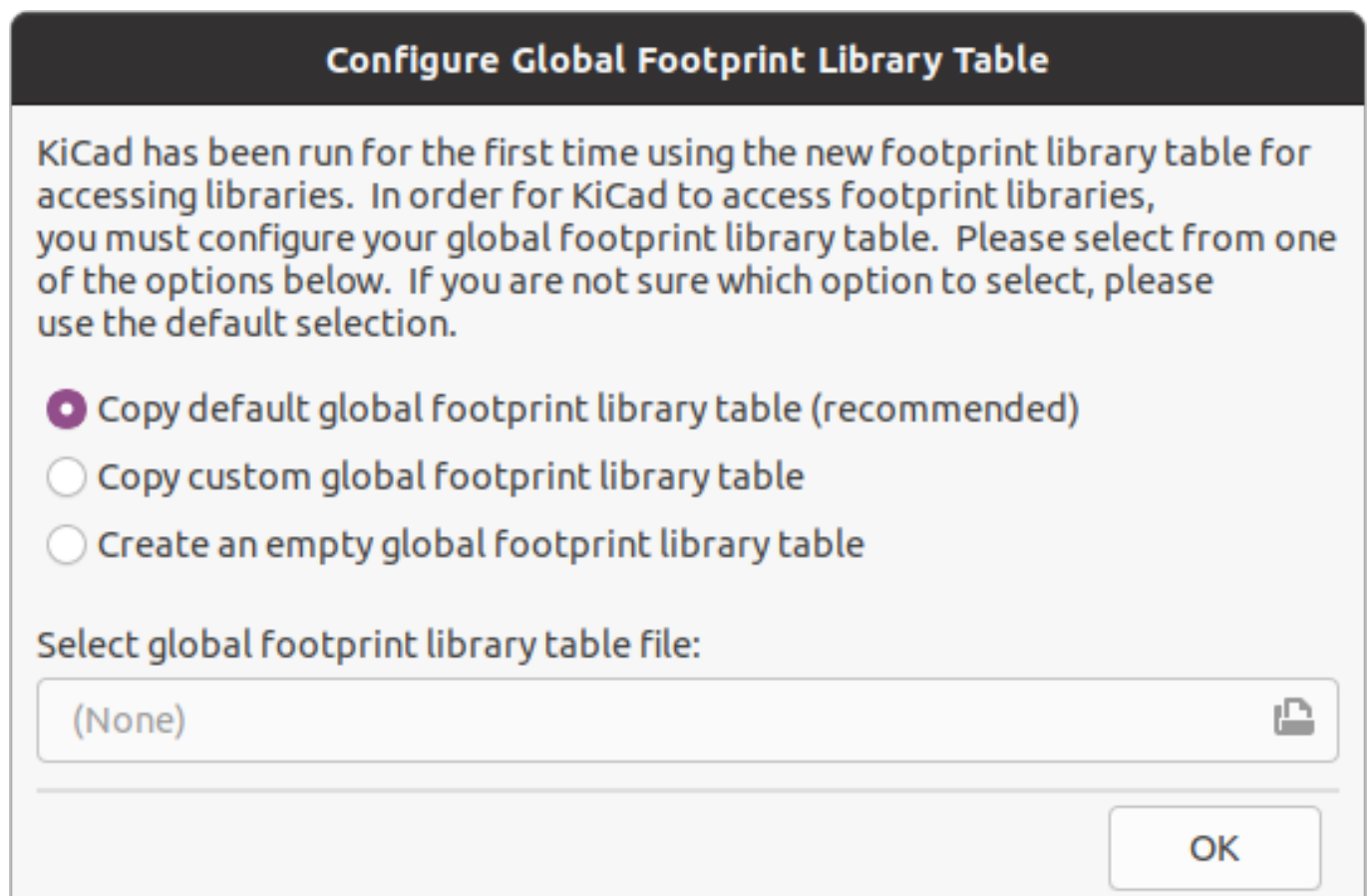
The KiCad project welcomes feedback, bug reports, and suggestions related to the software or its documentation. For more information on how to submit feedback or report an issue, please see the instructions at <https://www.kicad.org/help/report-an-issue/>

Chapter 1

Pcbnew

1.1

Pcbnew; KiCad footprint library table; Pcbnew



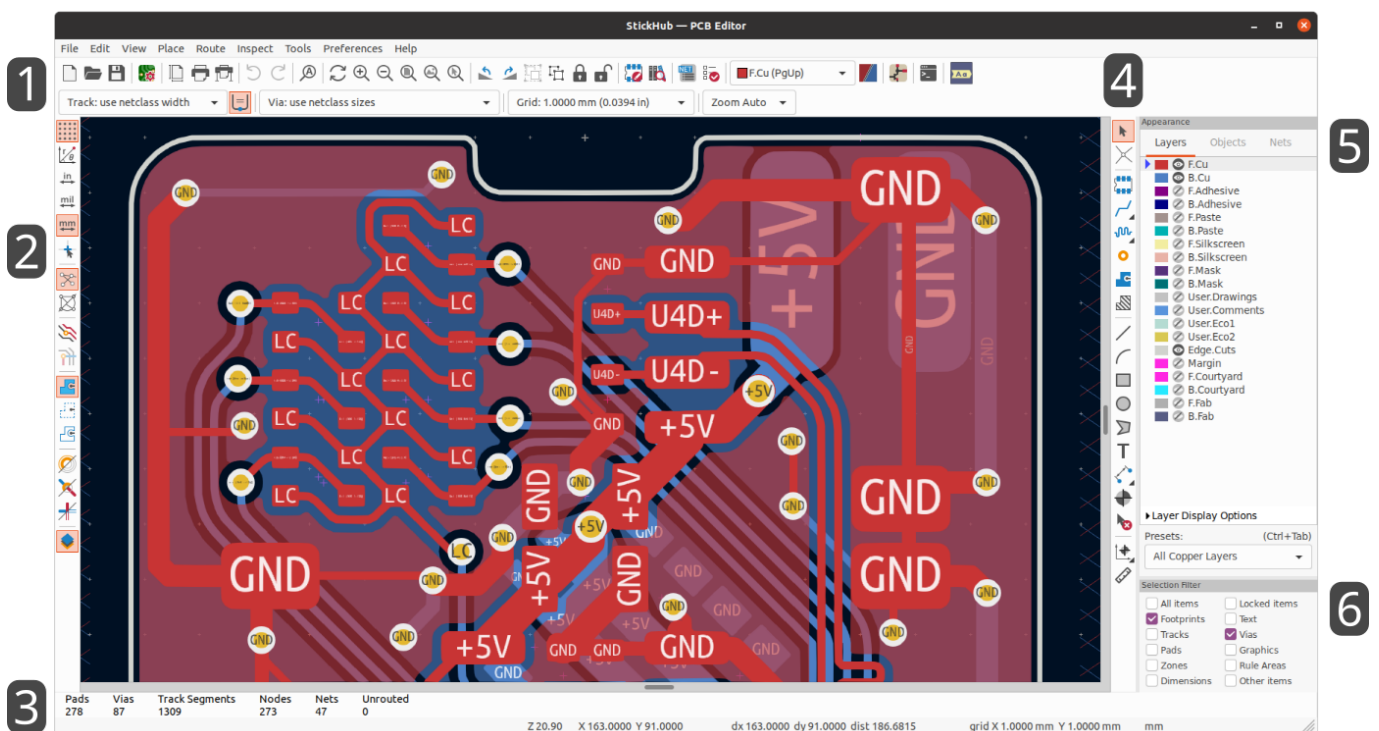
The first option is recommended (**Copy default global footprint library table (recommended)**). The default footprint library table includes all of the standard footprint libraries that are installed as part of KiCad.

If this option is disabled, KiCad was unable to find the default global footprint library table. This probably means you did not install the standard footprint libraries with KiCad, or they are not installed where KiCad expects to find them. On some systems the KiCad libraries are installed as a separate package.

- If you have installed the standard KiCad footprint libraries and want to use them, but the first option is disabled, select the second option and browse to the `fp-lib-table` file in the directory where the KiCad libraries were installed.
- If you already have a custom footprint library table that you would like to use, select the second option and browse to your `fp-lib-table` file.
- If you want to construct a new footprint library table from scratch, select the third option.

Footprint library management is described in more detail [later](#).

1.2 Pcbnew



1. `File > Open > Project > Open...`

2. `File > Open > Project > Open...`

3. `File > Open > Project > Open...`

4. `File > Open > Project > Open...`

5. `File > Open > Project > Open...`

6. `File > Open > Project > Open...`






7. `File > Open > Project > Open...`

1.3

1. `File > Open > Project > Open...`

By default, dragging with the middle or right mouse button will pan the canvas view and scrolling the mouse wheel will zoom the view in or out. You can change this behavior in the Mouse and Touchpad section of the preferences (see [Configuration and Customization](#) for details).

Several other zoom tools are available in the top toolbar:

-  zooms in on the center of the viewport.
-  zooms out from the center of the viewport.
-  zooms to fit the frame around the drawing sheet.
-  zooms to fit the items within the drawing sheet.
-  allows you to draw a box to determine the zoomed area.

The cursor's current position is displayed at the bottom of the window (X and Y), along with the current zoom factor (Z), the cursor's relative position (dx, dy, and dist), the grid setting, and the display units.

The relative coordinates can be reset to zero by pressing `kbd:[Space]`. This is useful for measuring distance between two points or aligning objects.

1.4 快捷键

The `kbd:[Ctrl+F1]` shortcut displays the current hotkey list. The default hotkey list is included in the [Actions Reference](#) section of the manual.

The hotkeys described in this manual use the key labels that appear on a standard PC keyboard. On an Apple keyboard layout, use the `kbd:[Cmd]` key in place of `kbd:[Ctrl]`, and the `kbd:[Option]` key in place of `kbd:[Alt]`.

Many actions do not have hotkeys assigned by default, but hotkeys can be assigned or redefined using the hotkey editor (**Preferences** → **Preferences...** → **Hotkeys**).

Note

通过热键可用的许多操作也可在&#x

Hotkeys are stored in the file `user.hotkeys` in KiCad's configuration directory. The location is platform-specific:

- Windows: `%APPDATA%\kicad\6.0\user.hotkeys`
- Linux: `~/ .config/kicad/6.0/user.hotkeys`
- macOS: `~/Library/Preferences/kicad/6.0/user.hotkeys`

KiCad can import hotkey settings from a `user.hotkeys` file using the **Import Hotkeys** button in the hotkey editor.

Chapter 2

显示和选择

2.1 板层

Pcbnew 中的层表示线路板上的物理”
在编辑器中始终有一个处于活
活动图层被画在其他层之上，
活动图层在顶部工具栏的层选
若要变更活动图层，可以左键S
可以隐藏图层以简化电路板视V

2.1.1 电路板层的显示顺序

Note

TODO：写下这一节。

2.2 外观面板

外观面板提供用于管理 Pcbnew 绘图u

2.2.1 图层控件

在外观面板的图层选项卡中，
活动图层在色块的左边有一个
左键点击一个图层来选择它作
左键单击相应的可见性图标，W
双击或中击色块来改变该图层

Note

必须先在首选参数中创建自定义&#x
然后才能在外观面板中更改图层&#x

在图层列表下方是一个包含图
"暗显" 或 "隐藏" 时，不能选择非活&#x
kbd:[Ctrl+H] 快速切换这些显示模式。

翻转电路板视图 ఆ显示电路板
Y 轴镜像)。此选项也可在视图菜&#x

Note

翻转电路板视图不会更改可视层˜

2.2.2 **2.2.2**

外观面板的"对象"选项卡与"图层"选项卡类似。主要区别在于，桶这里的不透明度设置将与图层顶默认情况下，所有对象都是完Q

2.2.3 \mathbb{R}^2 and \mathbb{R}^3

图 层 预 设 存 储 了 哪 些 图 层 和 对 讄 有 几 个 内 置 的 图 层 预 设 ， 您 可 了 自 定 义 预 设 存 储 在 一 个 电 路 板 的 要 加 载 一 个 预 设 ， 请 从 外 观 面 板 kbd:[Ctrl] 并 按 kbd:[Tab] 来 使 用 快 速 切 换 器 。 一 旦 快 速 切 换 器 窗 口 出 现 ， 你 可 kbd:[Tab] 和 kbd:[Shift+Tab] 来 循 环 浏 览 可 用 的 预 设 当 你 放 开 kbd:[Ctrl] 键 时 ， 高 亮 显 示 的 预 要 保 存 一 个 自 定 义 的 预 设 ， 首 存 给 您 的 预 设 一 个 名 字 ， 它 现 在 存 要 修 改 一 个 自 定 义 预 设 ， 请 遵 存 要 删 除 一 个 自 定 义 预 设 ， 从 下 板

2.2.4 \mathbb{R}^n and \mathbb{C}^n

外观面板的网络选项卡显示电

每个网络和网络类还可以指定N
(或网络类中的所有网络) 的飞线&#x

Note

默认网络类不能分配颜色，
因为该类中的网络将仅使用颜色&#

您还可以通过外观面板选择并	
网络类列表下面是一个包含网
(焊盘、布线、过孔和区域) 都将&#x
当选择“没有”时，网络和网络类	
第二个选项控制如何绘制飞线

2.3 2.3.2 2.3.2.1 2.3.2.1.1 2.3.2.1.1.1 2.3.2.1.1.1.1

Selecting items in the editing canvas is done with the left mouse button. Single-clicking on an object will select it and dragging will perform a box selection. A box selection from left to right will only select items that are fully inside the box. A box selection from right to left will select any items that touch the box. A left-to-right selection box is drawn in yellow, with a cursor that indicates exclusive selection, and a right-to-left selection box is drawn in blue with a cursor that indicates inclusive selection.

可以通过在单击或拖动的同时

Modifier Keys (Windows)	Modifier Keys (Linux)	Modifier Keys (macOS)	Selection Effect
kbd:[Shift]	kbd:[Shift]	kbd:[Shift]	Add the item to the existing selection.
kbd:[Ctrl + Shift]	kbd:[Ctrl + Shift]	kbd:[Cmd + Shift]	Remove the item from the existing selection.
long click	long click or kbd:[Alt]	long click or kbd:[Option]	Clarify selection from a pop-up menu.
kbd:[Ctrl]	kbd:[Ctrl]	kbd:[Cmd]	Highlight the net of the selected copper item.

拖动以执行选框时，将应用以

Modifier Keys (Windows)	Modifier Keys (Linux)	Modifier Keys (macOS)	Selection Effect
kbd:[Shift] or kbd:[Ctrl]	kbd:[Shift] or kbd:[Ctrl]	kbd:[Shift] or kbd:[Ctrl]	Add item(s) to the existing selection.
kbd:[Ctrl + Shift]	kbd:[Ctrl + Shift]	kbd:[Cmd + Shift]	Remove item(s) from the existing selection.

Pcbnew 窗口右下角的选择过滤器面g
当一个连接的铜线项目被选中c
"扩展选择" 命令或热键 kbd:[U] 将选择&#
第一次运行这个命令时，选择\
第二次，选择将被扩展到所有

Selecting an object displays information about the object in the message panel at the bottom of the window. Double-clicking an object opens a window to edit the object's properties.

按 kbd:[Esc] 将始终取消当前工具或操&#x
kbd:[Esc] 将清除当前选择。

2.4 \mathbb{R}^n and \mathbb{C}^n

```
&#x7535;&#x6c14;&#x7f51;&#x7edc;&#xff08;&#x6216;&#x4e00;&#x7ec4;&#x7f51;&#x7edc;&#xff09;&#x53ef;&#x4ee5;&#x572
PCB &#x7f16;&#x8f91;&#x5668;&#x4e2d;&#x88ab;&#x9ad8;&#x4eae;&#x663e;&#x793a;&#xff0c;&#x4ee5;&#x663e;&#x793a;&
PCB &#x4e0a;&#x5e03;&#x7ebf;&#x7684;&#x3002;&#x901a;&#x8fc7;&#x5728; PCB &#x7f16;&#x8f91;&#x5668;&#x4e2d;&#x
&#x5f53;&#x7f51;&#x7edc;&#x9ad8;&#x4eae;&#x6fc0;&#x6d3b;&#x65f6;&#xff0c;&#x9ad8;&#x4eae;&#x7684;&#x7f51;&#x621
&#x6709;&#x4e09;&#x79cd;&#x65b9;&#x6cd5;&#x53ef;&#x4ee5;&#x70b9;&#x51fb;&#x4e00;&#x4e2a;&#x6216;&#x591a;&#x4
PCB &#x7f16;&#x8f91;&#x5668;&#x4e2d;&#x9ad8;&#x4eae;&#xff1a;&#x70b9;&#x51fb;&#x94dc;&#x5bf9;&#x8c61;&#x540e;&
kbd[ ]&#xff0c;&#x4f7f;&#x7528;&#x4efb;&#x4f55;&#x94dc;&#x5bf9;&#x8c61;&#x7684;&#x4e0a;&#x4e0b;&#x6587;&#x83dc;
(&#x70ed;&#x952e; kbd[~])&#x6e05;&#x9664;&#x9ad8;&#x4eae;&#x3002;
```

选择一个或多个网络进行高亮
kbd:[Ctrl+`]访问)。此操作将打开或关闭&

2.5




KiCad 允许在原理图和 PCB 之间进行双有几种不同类型的交叉探测。

选择交叉探测 允许您在原理图如果存在) 中点击相应的封装戒默认情况下，交叉探查将导致晦可以在偏好设翾对话框的显示选

高亮交叉探测 允许您同时高亮中的网络。 如果在偏好设置对 " 高亮交叉网络" ， 则在原理图编编辑器中高亮。

2.6

左侧工具栏提供了更改Pcbnew 中项v

	打开/关闭栅格显示。 注意： 默认情况下，隐藏网格将禁&#x 可以在偏好设置的显示选项&#x
	在状态栏中的极坐标和笛卡&#x
 	以英寸、密耳或毫米为单位&#x
	在全屏和小编辑光标 (十字光标) 之间切换。
	打开/关闭飞线显示。
	在直线型和弧线型飞线之间&#x
	在正常和暗显之间切换非活&#x 注意： 当非活动层显示模式为暗显&#x 在这两种情况下，按下按钮&#x 隐藏模式只能通过外观面板&#x kbd:[Ctrl+H] 进入。
	选择要高亮的网络时，会打&#x 注意： 当没有高亮任何网络时，此 要高亮网络，可使用热键 kbd:[]， 右击网络中的任何铜对象并&#x 或右击外观面板的网络选项&#x
	显示分区填充区域。

	仅显示区域轮廓。
	将分区填充区域显示为轮廓。
	在填充模式和轮廓模式之间。
	在填充模式和轮廓模式之间。
	在填充模式和轮廓模式之间。
	显示敷铜填充区域。
	仅显示敷铜轮廓。
	将敷铜填充区域显示为轮廓。
	在填充模式和轮廓模式之间。
	在填充模式和轮廓模式之间。
	在填充模式和轮廓模式之间。
	显示或隐藏编辑器右侧的外。

Chapter 3

PCB

3.1 PCB

KiCad 中的印刷电路板通常由代表由封装、定义这些焊盘如何彼此走网络、形成每个网络中焊盘之通布线、过孔和填充区以及定义&

KiCad 通常会将 PCB 上的网络信息与相编辑器中创建和编辑网络。

3.2 $\times 6027; \times 80fd;$


KiCad ý够创建多达 32 个铜层、14 个技丝印、阻焊、元件粘合剂、焊和 13 个通用绘图层的印刷电路板&#x;

The internal measurement resolution of all objects in KiCad is 1 nanometer, and measurements are stored as 32-bit integers. This means it is possible to create boards up to approximately 4 meters by 4 meters.

KiCad 目前支持每个工程/原理图一个

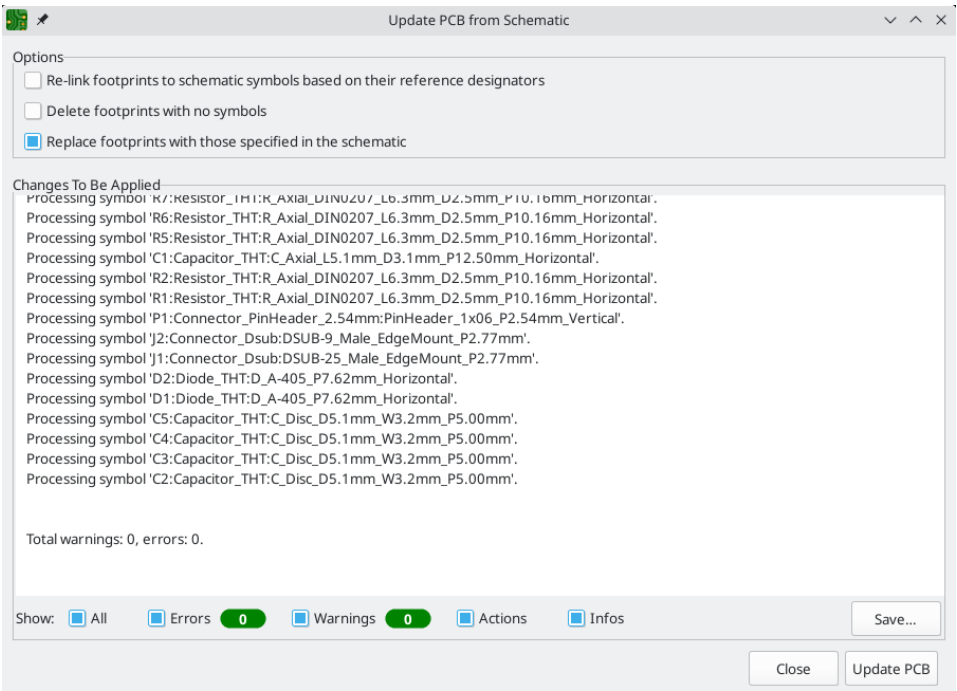
3.3 $\times 4\text{ece}; \times 539\text{f}; \times 7406; \times 56\text{fe}; \times 5\text{f00}; \times 59\text{cb};$

Creating a board from a schematic is the recommended workflow for KiCad. When you create a new project, KiCad will generate an empty board file with the same name as the project. To start designing the board after you have created a schematic, simply open the board file. You can do this either from the KiCad project manager, or by clicking the "Open PCB in board editor" button in the schematic editor. To import the schematic design information into the board editor, including footprints and net

connections, use the **Tools** → **Update Schematic from PCB...** action (kbd:[F8]). You can also use the  icon in the top toolbar.

Note

Update PCB from Schematic is the preferred way to transfer design information from the schematic to the PCB. In older versions of KiCad, the equivalent process was to export a netlist from the Schematic Editor and import it into the Board Editor. It is no longer necessary to use a netlist file.



The tool adds the footprint for each symbol to the board and transfers updated schematic information to the board. In particular, the board’s net connections are updated to match the schematic.

The changes that will be made to the PCB are listed in the *Changes To Be Applied* pane. The PCB is not modified until you click the **Update PCB** button.

You can show or hide different types of messages using the checkboxes at the bottom of the window. A report of the changes can be saved to a file using the **Save...** button.

3.3.1

The tool has several options to control its behavior.

Option	Description
Re-link footprints to schematic symbols based on their reference designators	Footprints are normally linked to schematic symbols via a unique identifier created when the symbol is added to the schematic. A symbol’s unique identifier cannot be changed. If checked, each footprint in the PCB will be re-linked to the symbol that has the same reference designator as the footprint. If unchecked, footprints and symbols will be linked by unique identifier as usual, rather than by reference designator. Each footprint’s reference designator will be updated to match the reference designator of its linked symbol. This option should generally be left unchecked. It is useful for specific workflows that rely on changing the links between schematic symbols and footprints, such as refactoring a schematic for easier layout or replicating layout between identical channels of a design.
Delete footprints with no symbols	If checked, any footprint in the PCB without a corresponding symbol in the schematic will be deleted from the PCB. Footprints with the "Not in schematic" attribute will be unaffected. If unchecked, footprints without a corresponding symbol will not be deleted.
Replace footprints with those specified in the schematic	If checked, footprints in the PCB will be replaced with the footprint that is specified in the corresponding schematic symbol. If unchecked, footprints that are already in the PCB will not be changed, even if the schematic symbol is updated to specify a different footprint.

3.4 $\times 5934; \times 5f00; \times 59cb;$

也可以创建没有匹配原理图的u
PCB编辑器(而不是从 KiCad 工程管理器&#x
"另存为..."从文件菜单选择保存电

3.5 \mathbb{R}^n and \mathbb{C}^n

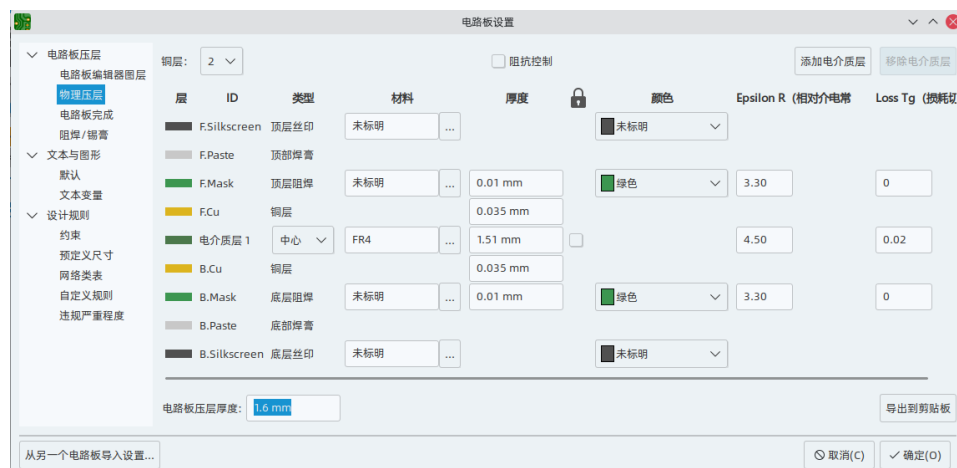
在开始您的线路板设计之前，O



图标或选择 "电路板设置..." 从文&#x

3.5.1

在电路板设置中有两个部分用
(非铜) 层，并在需要时为层指定&#x
要配置电路板的压层，从物理



在左上角设置铜层的数量，然T
这些参数可以保留其默认值，O
3D模型时，将使用电路板的厚度&#x

Note

KiCad 目前仅支持铜层数为偶数的压&#x
要创建具有奇数层的设计
(例如，柔性印刷电路板或金属芯&#x
只需选择下一个最高的偶数，而&

接下来，如果需要，可以使用用
 B. Silkreen 层旁边的复选框。:



Note

在电路板编辑器层部分，可以将部本指南仅供用户参考。无论在此

在电路板编辑器对话框的电路板如镶边或边缘电镀) 的设置。请板属性阻焊/锡膏部分允许全局调整电这些值将被添加到在个别封装正的间隙值将导致阻焊层或锡装更大。 负的间隙值将导致开口板小。

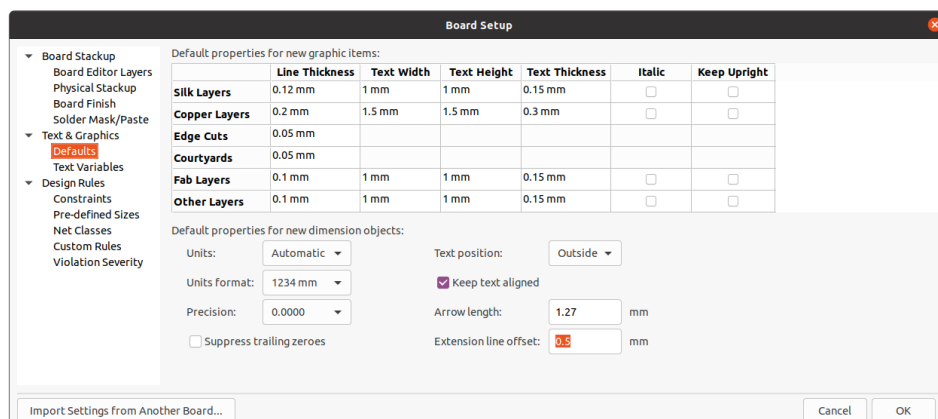
Warning



大多数商业 PCB 制造商希望这些׊M 过程中自行调整阻焊和粘贴彫通常最好将这些值保留为默认除非您自己制作 PCB， 或者您的ԣ

3.5.2

电路板设置对话框的文本和图_



可以为对话框中显示的六种不可本替换变量可以在文本变量这些变量允许你将变量名称替c这种替换发生在变量名称在 \$ {VARIABLEN的变量替换语法内的任何地方0例如，您可以创建一个名为 VERSION的变量，并将文本替换设置为 1 . 0 现在，在 PCB 上的任何文本对象中d \$ {VERSION} ，KiCad 将替代 1 . 0 ' 。 如 果 你 把 f` 2 . 0 ' ， 每 个 包 括 ` \$ {VERSION} 的文本对象你也可以混合使用普通文本和S例如，你可以创建一个文本对ࣆ版 本 ： \$ {VERSION} ，它将被替换为 版 &#

3.5.3

设计规则控制交互式布线器的

3.5.3.1

基本设计规则是在电路板设置[这一部分的约束条件适用于整这里设置的任何最小值都是一Ӣ绝对(absolute) 的最小值，不能被更具O例如，如果你需要电路板的一ऀ.2mm，其余部分为 0.3mm，你必须在约&#x其 0.2mm 的最小铜间隙，并使用网络类其 0.3mm 间隙。



除了设置最小间隙外，还可以在

设置	描述
允许盲哅妇兔启用此设置，然盲孔是机械钻孔，从外埋孔是机械钻孔，在内	
允许微字在使用布线器放置微孔微孔是典型的激光钻孔	
	KiCad 支持单独的微孔尺寸限

设置	描述
由线段近伶磙的圆弧ᠿ圆，KiCad	必须使用一系列直线段此设置控制此近似所允将其设置为比默认值0.005mm
敷铜填计充策略	的敷铜填充算法进行了新算法产生的结果与旧以防止在最新版本的KiCad
允许圆角计兓呾铜车娃属性对	中打开旧设计时产生不我们建议对所有新设计郒计兓呾铜车娃属性对
在布线角计兓呾铜车娃属性对	此计算依赖于正确配置在某些情况下，最好忽禁用此设置将从布线长

3.5.3.2 预定义大小

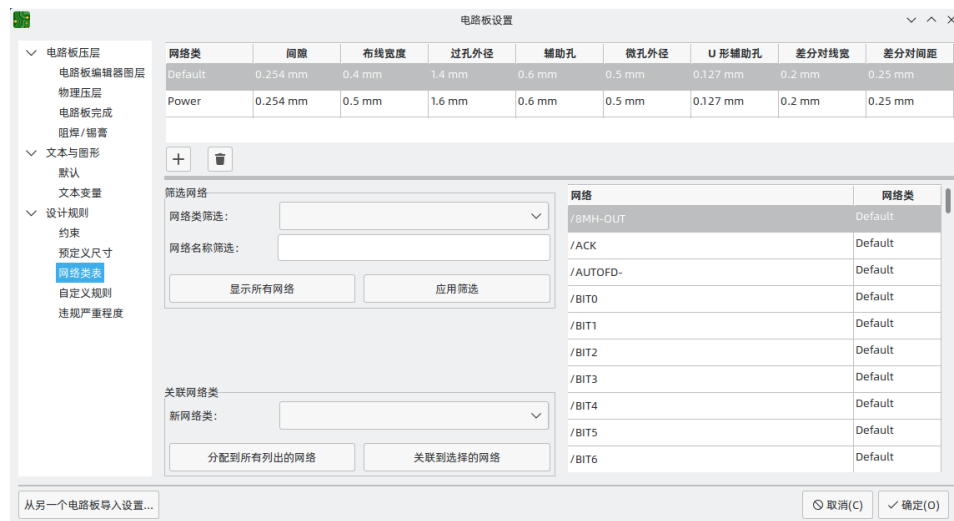
预定义的尺寸部分允许你定义佑络类可以用来定义不同网络例如，你可能希望电路板上的默0.2 mm，但对于一些承载更多电流的0.3 mm，而对于一些空间有限的部分0.15 mm。 您可以在电路板设置对话h



3.5.3.3 网络类

网络类部分允许你为不同网类郒 KiCad 中，每个网络都是一个网络

如果你不把一个网络添加到一一飞线可以通过原理图设置和电贀编辑器中添加到网络类。



网络类部分的上部包含一个表每个网络类都有铜间隙、布线񛣙些值将在创建布线和过孔时O

Note

0.1 mm，Ӷ约束条件部分中的最小间€.2 mm，则该类网络的间距将为 0.2 mm。

当 PCB 编 辑 器 中 的 布 线 宽 度 和 过 孔 使 用 网 络 类 值" 时 ， 就 会 使 用 为 时 这 些 宽 度 和 尺 寸 被 认 为 是 该 网 繛 它 们 不 是 最 小 或 最 大 值 。 手 动 大 值 要 将 布 线 宽 度 或 过 孔 大 小 限

3.5.3.4 $\frac{1}{2} \frac{1}{2} \frac{1}{2} \frac{1}{2} \frac{1}{2}$

自定义规则部分包含一个文本&#x
自定义规则用于创建基本约束b
只有在自定义规则定义中没有	
在关闭电路板设置之前，使用h
请参阅高级主题一章中的自定

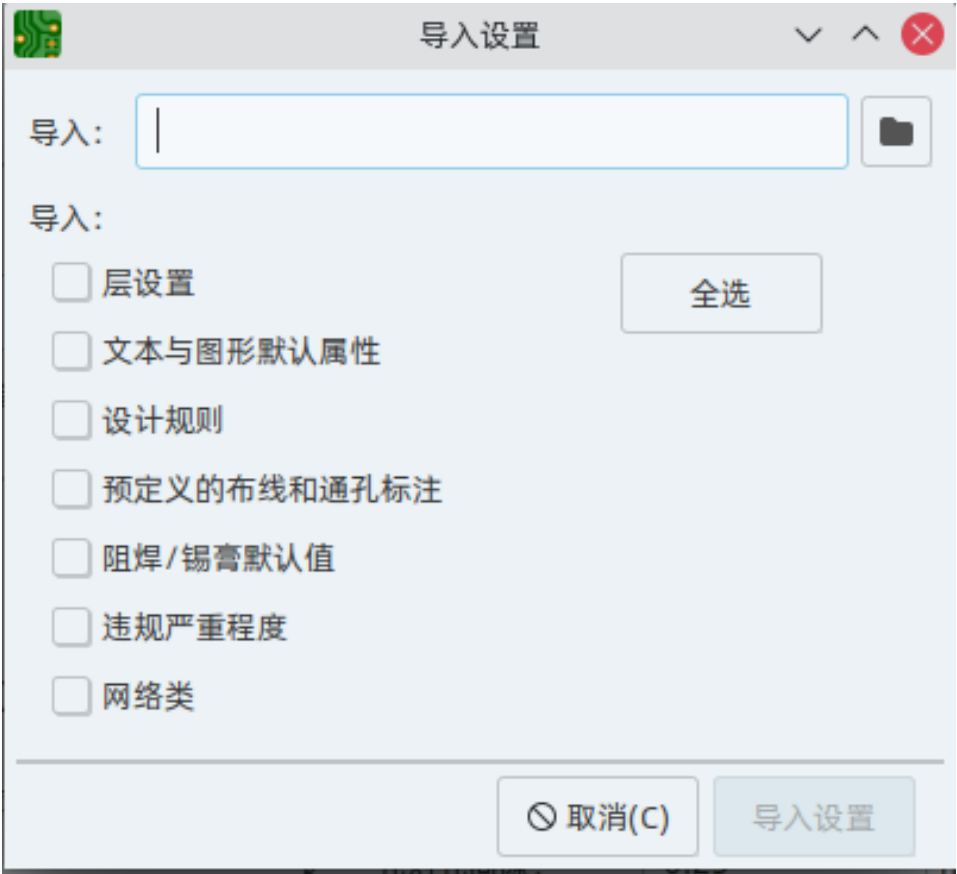


3.5.3.5

Note



3.5.3.6






















PCB 文件
kicad_pcb 文件

Chapter 4



4.1

This chapter describes the tools used in the PCB Editor to create and edit the physical layout of a PCB. The tools are organized into several categories, and each category is described in detail. The tools are:

	Selection tool (the default tool).
	Local ratsnest tool: when the board ratsnest is hidden, selecting footprints with this tool will show the ratsnest for the selected footprint only. Selecting the same footprint again will hide its ratsnest. The local ratsnest setting for each footprint will remain in effect even after the local ratsnest tool is no longer active.
	Footprint placement tool: click on the board to open the footprint chooser, then click again after choosing a footprint to confirm its location.
	Route tracks / route differential pairs: These tools activate the interactive router and allow placing tracks and vias. The interactive router is described in more detail in the Routing Tracks section below.
	Tune length: These tools allow you to tune the length of single tracks or the length or skew of differential pairs, after they have been routed. See the Routing Tracks section for details.
	Add vias: allows placing vias without routing tracks. Vias placed on top of tracks using this tool will take on the net of the closest track segment and will become part of that track (the via net will be updated if the pads connected to the tracks are updated). Vias placed anywhere else will take on the net of a copper zone at that location, if one exists. These vias will not automatically take on a new net if the net of the copper zone is changed.
	Add filled zone: Click to set the start point of a zone, then configure its properties before drawing the rest of the zone outline. Zone properties are described in more detail below.

	Add rule area: Rule areas, formerly known as keepouts, can restrict the placement of items and the filling of zones and can also define named areas to apply specific custom design rules to.
	Draw lines. Note: Lines are graphical objects and are not the same as tracks placed with the Route Tracks tool. Graphical objects cannot be assigned to a net.
	Draw arcs: pick the center point of the arc, then the start and end points.
	Draw rectangles. Rectangles can be filled or outlines.
	Draw circles. Circles can be filled or outlines.
	Draw graphical polygons. Polygons can be filled or outlined. Note: Filled graphical polygons are not the same as filled zones: graphical polygons cannot be assigned to a net and will not keep clearance from other items.
	Add text.
	Add dimensions. Dimension types are described in more detail below.
	Add layer alignment mark.
	Deletion tool: click objects to delete them.
	Set drill/place origin. Used for fabrication outputs.
	Set grid origin.

4.2

	
kbd:[Ctrl]	
kbd:[Shift]	

4.3

8981;6f3;4e00;6b21;7f16;8f91;4e0d;540c;7c7b;578b;7684;9879;76ee;x7
 5728;5c5e;6027;5bf9;8bdd;6846;4e2d;ffc;4efb;4f55;5305;542b;6570;5f
 4f8b;5982;xf0c;4e00;4e2a;5c3a;5bf8;53ef;4ee5;88ab;8f93;5165;4e3a; 2
 * 2mmffc;7ed3;679c;662f; 4mm7684;503c;3002; 652f;6301;57fa;672c;7b97;#

4.4

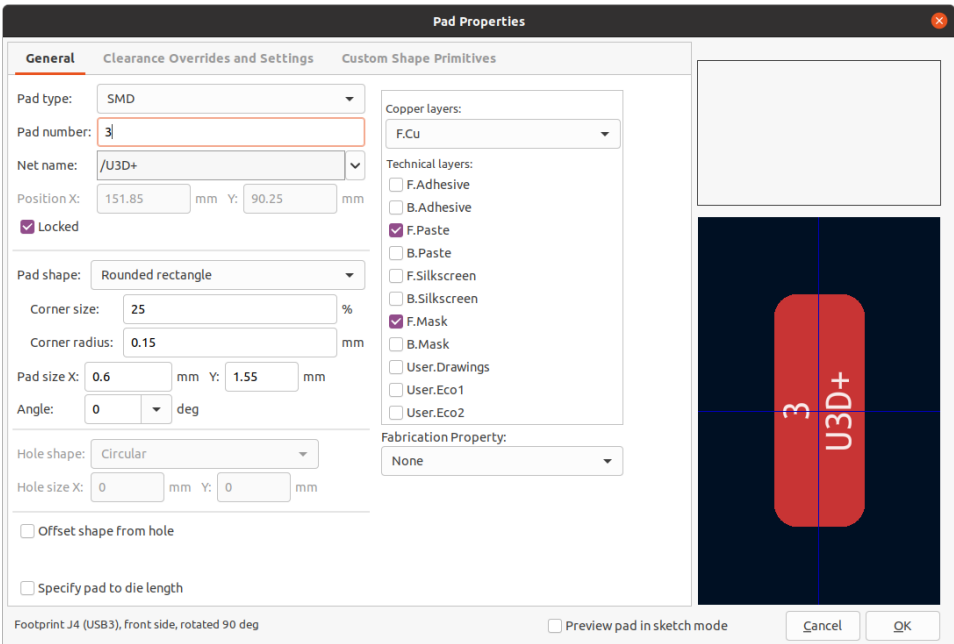
Note
 TODO: 7f16;5199;8fd9;4e00;8282;—5305;62ec;5c01;88c5;5c5e;6027;xf0c;4ece;#

4.5

The properties of each individual pad of a footprint can be inspected and edited after placing the footprint on the board. In other words, it is possible to override the design of an individual footprint pad in a specific instance of the footprint on the board, if the footprint design in the library is not appropriate. For example, you may wish to remove the solder paste aperture for a pad that needs to remain unsoldered in a specific design, or you may wish to move the location of a through-hole pad for an axial-lead resistor in order to fit a specific design.

Note
 By default, the position of all footprint pads are locked, so it is possible to edit the pad properties but not move the pad's location relative to the rest of the footprint. Pads may be unlocked to allow free movement, which can be useful for certain applications (such as through-hole footprints with varying lead positions) but is generally never recommended for surface-mount footprints.

The pad properties dialog is opened through the context menu or default hotkey kbd:[E] when a pad is selected. Note that KiCad assumes that if you click near a pad, you are probably trying to select the entire footprint rather than a single pad. To select a single pad, make sure to click inside the pad area, or turn off the Footprints setting in the selection filter (and make sure the Pads setting is turned on) to prevent accidental selection of the entire footprint rather than a specific pad.



The General tab of the pad properties dialog shows the physical properties of the pad, including its geometry, shape, and layer settings.

Pad type: this setting controls which features are enabled for the pad:

SMD pads are electrically-connected and have no hole. In other words, they exist on a single copper layer.

Through-hole pads are electrically-connected and have a plated hole. The hole exists on every layer, and the copper pad exists on multiple layers (see **Copper layers** setting below).

Edge Connector pads are SMD pads that are allowed to overlap the board outline on the Edge.Cuts layer.

NPTH, Mechanical pads are non-plated through holes that do not have an electrical connection.

SMD Aperture pads are pads that have no hole and no electrical connection. These can be used to add specific designs to a technical layer, for example a paste or solder mask aperture.

The **Copper layers** setting controls which copper layers will have a shape associated with the pad.

For SMD pads, the options are F.Cu or B.Cu, controlling whether the pad sits on the front or the back of the board *relative to the footprint's location*. In other words, if a pad is set to exist on B.Cu in its properties, and the footprint is flipped to the back of the board, *that pad will now exist on F.Cu, because it also has been flipped*.

For through-hole pads, it is possible to remove the pad shape from copper layers where the pad is not electrically connected to other copper (tracks or filled zones). Setting the copper layers to **connected layers only** will remove the pad shape from any unconnected layers, and setting to **F.Cu, B.Cu, and connected layers** will remove the pad shape from any internal unconnected layers. This can be useful in dense board designs to increase the routable area on internal layers.

The **Technical layers** checkboxes control which technical layers will have an aperture added with the pad's shape. By default, pads have apertures on the paste and mask layers matching their copper layer.

Note

It is not possible to define a different pad shape or size on different copper layers in the current version of KiCad.

Specify pad to die length: This setting allows a length to be associated with this pad that will be added to the routed track length by the track length tuning tools and the Net Inspector. This can be used to specify internal bondwire lengths for more accurate length matching, or in other situations where the electrical length of a net is longer than the length of the routed tracks on the board.

Pad Properties

General **Clearance Overrides and Settings** Custom Shape Primitives

Clearances
Set values to 0 to use parent footprint or netclass values.
Positive clearance means area bigger than the pad (usual for mask clearance).
Negative clearance means area smaller than the pad (usual for paste clearance).

Pad clearance: 0 mm

Solder mask clearance: 0 mm

Solder paste absolute clearance: -0 mm

Solder paste relative clearance: -0 %

Note: solder mask and paste values are used only for pads on copper layers.
Note: solder paste clearances (absolute and relative) are added to determine the final clearance.

Connection to Copper Zones

Pad connection: From parent footprint

Thermal relief spoke width: 0 mm

Thermal relief gap: 0 mm

Custom pad shape in zone: Use pad shape

Footprint: J4 (USB3), front side, rotated 90 deg

☐ Preview pad in sketch mode

Cancel OK

The aperture appearing on any technical layer will have the same shape and size as the pad shape on the copper layer(s). In the PCB manufacturing process, the manufacturer will often change the relative size of mask and paste apertures relative to the copper pad size, but since this size change is specific to a manufacturing process, most manufacturers expect the design data to be provided with the apertures set to the same size as the copper pads. For specific situations where you need to oversize or undersize a technical layer aperture in the design data, you can use the settings in the Overrides tab.

Pad clearance controls the minimum clearance between the pad and any copper shape (tracks, vias, pads, zones) on a different net. This value is normally set to 0 which will cause the pad clearance to be inherited from any clearance override set on the footprint, or the board's design rules and netclass rules if the footprint clearance is also set to 0.

Solder mask clearance controls the size difference between the pad shape and the aperture shape on the F.Mask and B.Mask layers. A positive number means the solder mask aperture will be larger than the copper shape. This number is an inflation applied to all directions. For example, a value of 0.1mm here will cause the solder mask aperture to be inflated by 0.1mm, meaning that there will be an 0.1mm border on all sides of the pad and the solder mask opening will be 0.2mm wider than the pad when measured along a given axis.

Solder paste absolute clearance controls the size difference between the pad shape and the aperture shape on the F.Paste and B.Paste layers. Its behavior is otherwise identical to the behavior of the **solder mask clearance** setting.

Solder paste relative clearance allows setting a solder paste clearance value as a percentage of the pad size rather than an absolute distance value. If both relative and absolute clearances are specified, they are added together to determine the solder paste aperture size.

The Overrides tab also has controls for how the pad connects to any copper zone that overlaps it and shares its net.

Pad connection controls whether the pad will have a solid, thermal relief, or no connection to the zone. Like the other overrides, this one may be set for an individual pad or for an entire footprint. The default setting for this control is *From parent footprint*, and the default footprint setting is to use the connection mode specified in the zone properties.

Thermal relief spoke width controls the width of the spokes generated when the zone connection mode is Thermal Relief.

Thermal relief gap controls the length of the thermal spokes, or the gap between the pad's shape and the filled copper area of the zone.

Custom pad shape in zone controls the behavior of the zone filler when the pad uses a custom shape rather than one of the default shapes. This can be used to achieve different results when using thermal reliefs and custom pad shapes.

4.6 使用区域

Copper zones, also sometimes called copper pours or fills by other EDA tools, are solid or hatched areas of copper assigned to a particular net that automatically keep clearance from other copper objects. Zones are commonly used to fill in all free space on a board layer (or a portion of a layer) in order to create ground and power planes, carry high currents, or to provide shielding.

Note


Some EDA tools have separate tools for creating "plane layers" and for creating copper zones on signal layers. In KiCad, the Copper Zone tool is used for both these applications.

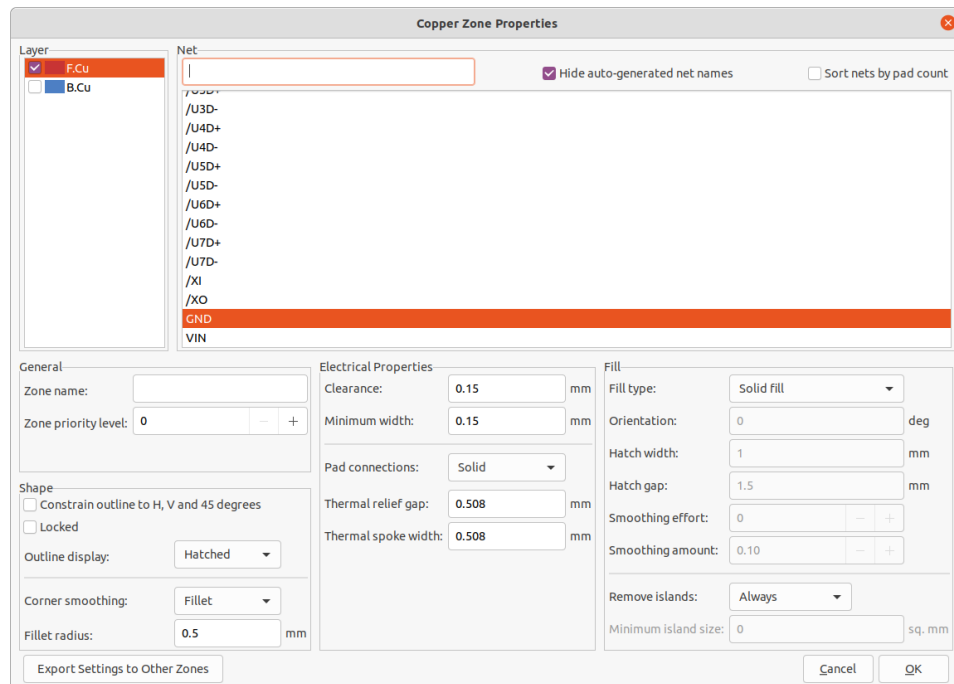
Zones are defined by a polygonal **outline** that defines the maximum extent of the filled copper area. This outline does not represent physical copper and will not appear in exported manufacturing data. The actual copper areas of the zone must be **filled** each time the outline, or any objects inside the outline, are modified. The filling process may be run on a single zone, or on all zones in a board (default hotkey kbd:[B]). Zones may be **unfilled** (default hotkey kbd:[Ctrl+B]) to improve performance and reduce visual clutter while editing large boards.

Note

Zone filling is a manual process rather than occurring every time an object changes that would result in a change to the zone copper. This is because zone filling can be a slow process on older computers or very large designs. It is important to make sure zone fills are up-to-date before generating outputs. KiCad will check that zones have been updated and warn you before generating outputs or running DRC when zones have not yet been refilled.



To draw a zone, click the Add Filled Zone tool () on the right toolbar, or use default hotkey kbd:[Ctrl+Shift+Z]. Click to choose the first point of the zone outline. The Zone Properties dialog will appear, allowing you to choose the zone net and other properties. These properties may be edited at any time, so it is not critical to choose them all correctly at first. Accept the dialog and continue placing points to define the zone outline. To finish the zone, double-click to set the last point. Zone outline points may be modified like graphic polygons, by dragging the square handles to move a corner or dragging the circular handles to move an edge. To edit the zone's properties, use hotkey kbd:[E] or select Properties from the context menu.



The image shows the 'Copper Zone Properties' dialog box. It has several sections: 'Layer' with checkboxes for F.Cu and B.Cu; 'Net' with a list of nets including /U3D-, /U4D+, /U4D-, /U5D+, /U5D-, /U6D+, /U6D-, /U7D+, /U7D-, /X1, /X0, GND (highlighted), and VIN; 'General' with fields for Zone name and Zone priority level; 'Shape' with checkboxes for 'Constrain outline to H, V and 45 degrees' and 'Locked', and dropdowns for 'Outline display' (set to Hatched) and 'Corner smoothing' (set to Fillet); 'Electrical Properties' with fields for Clearance, Minimum width, Pad connections (set to Solid), Thermal relief gap, and Thermal spoke width; and 'Fill' with a dropdown for Fill type (set to Solid fill), Orientation, Hatch width, Hatch gap, Smoothing effort, Smoothing amount, Remove islands (set to Always), and Minimum island size. There are 'Export Settings to Other Zones', 'Cancel', and 'OK' buttons at the bottom.

Layer: A single zone object can create filled copper on one or more copper layers. Check the box next to each copper layer that this zone outline should fill on. The copper on each layer will be filled independently, but all layers will share the same net.

Net: Select the electrical net that the zone copper should be connected to. It is possible to create zones with no net assignment. Zones with no net will keep clearance from any copper objects on any net.

Zone name can be used to assign a specific name to a zone. This name can be used to refer to the zone in custom DRC rules.

Zone priority level determines the order in which multiple zones on a single layer are filled. The highest priority level zone on a given layer will be filled first. Lower-priority zones will keep clearance to the filled areas of higher-priority zones. Two zones on the same layer with the same priority level will overlap (short-circuit) with each other.



Warning

Zones with the same priority level will never keep clearance from each other, even if they are assigned to different nets! The design rule checker will report these short-circuits, but they will not be prevented by the zone filler.

Constrain outline to H, V and 45 degrees controls the *initial* behavior of the zone outline drawing tool. When this option is enabled, the zone outline will be restricted to 45-degree angles. Note that after the zone outline has been created, this option has no effect. Outline points may be modified freely after creation.

Locked controls whether or not the zone outline object is locked. Locked objects may not be manipulated or moved, and cannot be selected unless the **Locked Items** option is enabled in the Selection Filter panel.

Outline display controls how the zone outline is drawn on screen. In **Line** mode, only the border lines of the outline are drawn. In **Hatched** mode, hatch lines are drawn on the inside of the outline border for a short distance, to make the zone outline more apparent. In **Fully Hatched** mode, hatch lines are drawn across the entire inside of the zone outline.

Corner smoothing controls the behavior of the filled copper areas at corners of the outline. Corners can be smoothed by a chamfer or fillet, or can extend all the way to the outline corner if smoothing is disabled.

Note

By default, chamfers and fillets are not added to **inside corners** of the zone outline, because this would result in filled copper extending *outside* the outline. If smooth inside corners are desired, enable the **Allow fillets outside zone outline** option in the Constraints section of the Board Setup dialog.

Clearance controls the minimum clearance the filled areas of this zone will keep from other copper objects. Note that if two clearance values are in conflict, the larger clearance value will be used. For example, if a zone is set to use 0.2mm clearance but its netclass is set to use 0.3mm clearance, the result will be an 0.3mm clearance.

Minimum width controls the minimum size of narrow necks of copper created inside the zone. Any copper areas that would be below this minimum width are removed during the filling process.

Pad connection controls the way that the filled zone areas will connect to footprint pads on the same net. **Solid** connections will result in the copper completely overlapping the pads. **Thermal reliefs** will result in small copper spokes connecting the pad to the rest of the copper zone, increasing the thermal resistance between the pad and the rest of the zone. This can be useful for hand soldering. **Reliefs for PTH** will apply thermal reliefs to plated through-hole pads and use solid connections for surface mount pads. **None** will result in the zone not connecting to any pads on the same net.

Thermal relief gap controls the distance maintained between any pad and the copper zone when the pad connection mode is set to generate thermal reliefs.

Thermal spoke width controls the width of the "spokes", or short copper segments connecting the pad to the rest of the copper zone.

Fill type controls how the copper zone is filled: the default is **solid fill**, which will result in copper filling in all available space within the zone outline. The zone can also be set to fill a **hatch pattern**, which will fill the area with a pattern that contains less copper. This can be useful for flexible printed circuits and other specialty applications.

Orientation controls the angle of the hatch pattern lines. An orientation of 0 degrees will result in the hatch pattern using horizontal and vertical lines.

Hatch width controls the width of each line in the hatch pattern.

Hatch gap controls the distance between each line in the hatch pattern.

Smoothing effort controls the style of smoothing applied to the hatch pattern. A value of 0 will result in no smoothing, and a value of 3 will result in the finest smoothing. Higher values will result in longer processing time and larger Gerber files.






Smoothing amount is a ratio that controls the size of the smoothing chamfers or fillets that are generated when **smoothing effort** is set to a value other than 0. An amount of 0.0 results in no smoothing, and a value of 1.0 results in maximum smoothing (in other words, a chamfer or fillet equal to half of the hatch gap).

Remove islands controls the behavior of isolated copper areas, also called islands, after the initial zone fill. When this is set to **always**, isolated areas inside the zone are removed. When set to **never**, isolated areas are left alone, and will result in copper areas that are not connected to the rest of the net. When set to **below area limit**, a **minimum island size** can be specified, and islands below this threshold will be removed.

4.7 图形对象

图形对象 (直线、圆弧、矩形、倀" 以禁用轮廓。

4.7.1 正在创建图形形状

The right toolbar can be used to create lines (, default hotkey kbd:[Ctrl+Shift+L]), arcs (, default hotkey kbd:[Ctrl+Shift+A]), rectangles (, circles (, default hotkey kbd:[Ctrl+Shift+C]), and polygons (, default hotkey kbd:[Ctrl+Shift+P]).

Rectangles, circles, and polygons can be filled shapes or outlines. The **line width** option controls the width of the outline. The outline width extends on both sides of the "ideal" shape of the graphic object. For example, a graphic circle that is defined to have 2mm radius and 0.2mm line width will consist of a torus with an outer radius of 2.2mm and inner radius of 1.8mm. If the **filled shape** option is enabled and the line width is set to 0, the shape will be a filled circle with 2mm radius.

Line Segment Properties

Start Point

End Point

X: 148.33 mm

X: 151.68 mm

Y: 77.28 mm

Y: 77.28 mm

☐ Locked


Line width: 0.2 mm

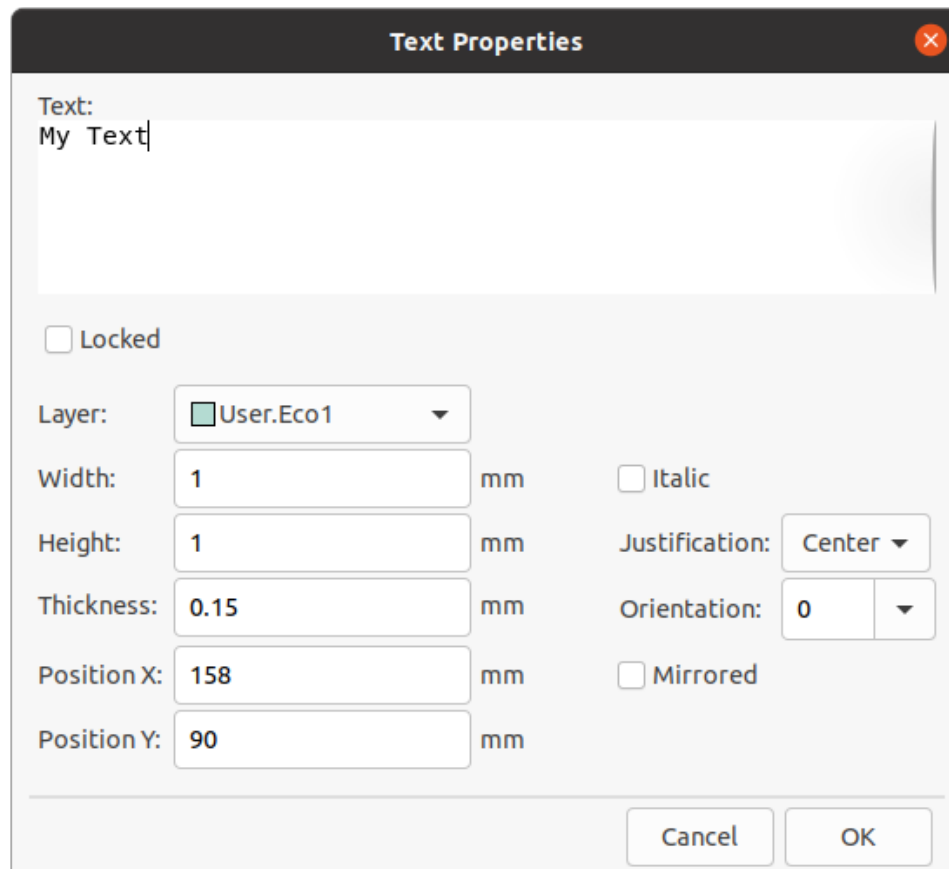
Layer: F.Cu

Cancel

OK

4.7.2

Graphical text may be placed by using the () icon in the right toolbar or by keyboard shortcut kbd:[Ctrl+Shift+T]. Click to place the text origin, and then edit the text and its properties in the dialog that will appear:



Text may be placed on any layer, but note that text on copper layers cannot be associated with a net and cannot form connections to tracks or pads. Copper zones will fill around the rectangular bounding box of text objects.

4.7.3 Text Properties (Text Properties)

KiCad Edge . Cuts 层上的图形对象来定上该轮廓必须是一个连续（封闭）如果没有定义电路板的轮廓，戽查看器和一些设计规则的检查标注

4.8 Text Properties

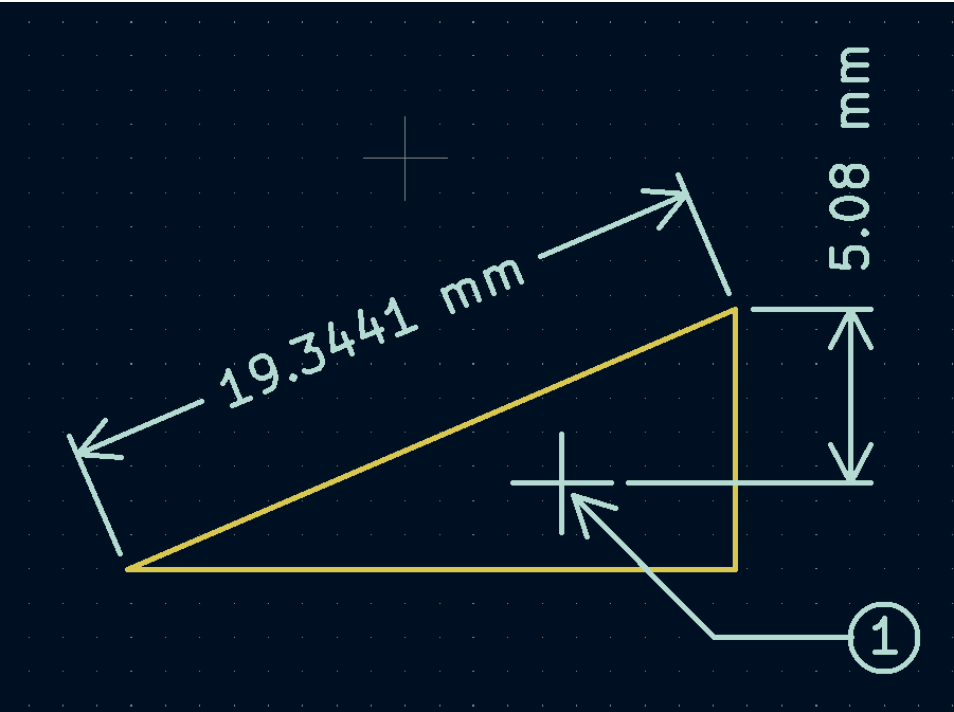
标注是用于显示测量值或电路殃们可以被添加到任何绘图层上目前支持四种不同类型的标注

对齐 标注 () 表示两点之间距离的测量轴是连接这两个点的线，标注

正交 标注 () 也测量两点之间的轴或 Y 轴。 换句话说，这些标注创建正交标注时，在选择要测量创建一个十字标记标注

Ⓝ

Ⓝ



Ⓝ

Ⓝ

Note

Ⓝ

标注属性

标注格式

值:115.5700

☐ 覆盖值

单位:mm

前缀:

单位格式:1234 mm

后缀:

精度:0.0000

层:User.Eco1

☐ 隐藏尾随零

预览:115.5700 mm

标注文本

宽度:1.524 mm

位置 X:137.16 mm

高度:2.032 mm

位置 Y:26.20772 mm

粗细:0.21082 mm

位置模式:外部

☐ 斜体

方向:0.0

☐ 镜像

☒ 与标注保持对齐

对齐:居中

标注线

线粗细:0.21082 mm

箭头长度:1.27 mm

尺寸界线偏移:0 mm

确定

取消

4.8.1

Figure 4-8-1: Dimension Properties dialog box. The dialog box is divided into three main sections: Dimension Format, Dimension Text, and Dimension Line. The Dimension Format section includes fields for Value (115.5700), Prefix, Suffix, Layer (User.Eco1), Units (mm), Unit Format (1234 mm), Precision (0.0000), and a checkbox for Hide Trailing Zeros. The Dimension Text section includes fields for Width (1.524 mm), Height (2.032 mm), Thickness (0.21082 mm), Position X (137.16 mm), Position Y (26.20772 mm), Position Mode (External), Direction (0.0), and checkboxes for Italic, Mirror, and Align with Dimension (checked). The Dimension Line section includes fields for Line Thickness (0.21082 mm), Arrow Length (1.27 mm), and Dimension Line Offset (0 mm). The dialog box has 'OK' and 'Cancel' buttons at the bottom right.

4.8.2

Figure 4-8-2: Dimension Properties dialog box. The dialog box is divided into three main sections: Dimension Format, Dimension Text, and Dimension Line. The Dimension Format section includes fields for Value (115.5700), Prefix, Suffix, Layer (User.Eco1), Units (mm), Unit Format (1234 mm), Precision (0.0000), and a checkbox for Hide Trailing Zeros. The Dimension Text section includes fields for Width (1.524 mm), Height (2.032 mm), Thickness (0.21082 mm), Position X (137.16 mm), Position Y (26.20772 mm), Position Mode (External), Direction (0.0), and checkboxes for Italic, Mirror, and Align with Dimension (checked). The Dimension Line section includes fields for Line Thickness (0.21082 mm), Arrow Length (1.27 mm), and Dimension Line Offset (0 mm). The dialog box has 'OK' and 'Cancel' buttons at the bottom right.

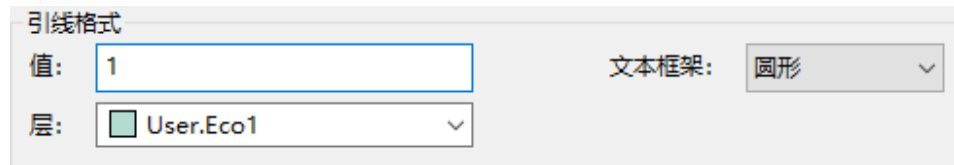
Position mode: Choose whether to position the dimension text manually, or to automatically keep it aligned with the dimension measurement lines.

Figure 4-8-3: Dimension Properties dialog box. The dialog box is divided into three main sections: Dimension Format, Dimension Text, and Dimension Line. The Dimension Format section includes fields for Value (115.5700), Prefix, Suffix, Layer (User.Eco1), Units (mm), Unit Format (1234 mm), Precision (0.0000), and a checkbox for Hide Trailing Zeros. The Dimension Text section includes fields for Width (1.524 mm), Height (2.032 mm), Thickness (0.21082 mm), Position X (137.16 mm), Position Y (26.20772 mm), Position Mode (External), Direction (0.0), and checkboxes for Italic, Mirror, and Align with Dimension (checked). The Dimension Line section includes fields for Line Thickness (0.21082 mm), Arrow Length (1.27 mm), and Dimension Line Offset (0 mm). The dialog box has 'OK' and 'Cancel' buttons at the bottom right.

4.8.3

线条粗细： 设置构成标注形状标注界线偏移： 设置测量点到箭头长度： 设置标注的形状的&#x

4.8.4



值： 输入要在引线行末尾显示的功能： 文本框架： 选择所需的文本周&#x

4.9

KiCad 具有交互式布线器的功能：

- 允许对单轨和差分对进行手动半自动) 布线。
- 可通过以下方式修改现有设计拖动现有布线时重新布线现有拖动封装时重新布线连接到封允许通过插入蛇形线 + 来调整布为具有严格时序要求的设计调默认情况下，布线器在放置布~如果需要的话，可以通过使用š违规选项来禁用这种行为（见布线器有三种模式，可以随时ऀ布线器模式用于布线新布线，Ӵ命令拖动现有布线时。 这ө
- 高䲮冲突：在此模式下，大部布线时，冲突 (间隙违规) 将以绿动冲突选项。 在此模式下，一ڲ例如，一个水平线步和一个对推挤：在此模式下，被布线的例如，焊盘和锁定的布线/孔孔) 推挤 障碍，这些障碍物可以移的如果无法布线到不违反 DRC 的绕走：在此模式下，布线器的&#x

使用哪种模式是一个偏好问题。񛾹于大多数用户，我们建议使用E度()布线段。如果需要使用//以外的角度布线段，则必须使用有五个主要的布线功能。单轨啊()相位。所有这些都存在于顶部()上面介绍了重载图标的使用。一个用于两个布线功能，一个用此外，布线菜单允许选择设置啊要布线，请点击布线图标（从()布线下）或使用热键()点击于被布线的网络会自动高亮显示，可以通过改变()偏好设置()񛾹话框()间隙轮廓()设置来禁用间隙轮廓()()

Note

间隙轮廓显示从布线网络到 PCB
上任何其他铜线的最大间隙。
可以使用自定义设计规则为不同&
布线器将考虑这些间隙，但仅直

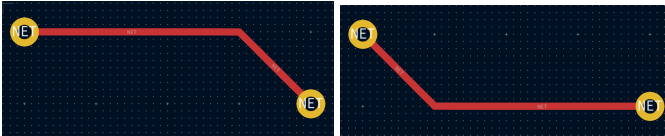
当布线器处于活动状态时，将一 (unfixed temporary) 对象，它们显示当您使用嵌 kbd:[Enter] 键来固定布线 (fix the route) 时将创建哪嵌 kbd:[Esc] 键或通过选择另一个工具退嵌 kbd:[End]) 将固定所有布线并退出布线并在布线时，可以使用撤消最后一 (热键 kbd:[Backspace]) 取消固定最近固定的布在以前的 KiCad 版本中，使用鼠标巯 kbd:[Enter] 来固定已布线的线段会固定木 在 KiCad 6 中，这种行为现在是可选的 包括 在鼠标光标位置结束的线木 通过在交互式布线器设置对话标 " 点击后固定所有线段" 选项，可布线时，可以按住 kbd:[Ctrl] 键禁用网标 kbd:[Shift] 键禁用对焊盘和过孔等对象一

Note

也可以通过更改首选项对话框的&#
我们建议您在一般情况下 added; 持启&

4.9.1 4.9.1 4.9.1 4.9.1

在垂直(H) / 水平 (V) / 45 度模式下布线时是指一组两个线段如何连接单一 H/V/45 度线段无法到达的两个点。在这种情况下，这些点将由一是 (45度) 线段连接。形态指的是这些&



KiCad 的布线器试图根据一系列因紭
" 坏" 拐角 (如锐角)。当从焊盘布线将选择将路线与焊盘最长边缘[
在某些情况下，KiCad 无法正确猜۔
(热键 kbd:[/])。

在民有明显的“最佳”形态的情况将使用鼠标光标的移动来选择商水平或垂直)线段开始，请在水&#x

Note

如果使用切换布线形态命令覆盖
KiCad 选择的形态，则在当前布线操O

4.9.2 $\frac{d}{dt} \left(\frac{\partial L}{\partial \dot{x}} \right) = \frac{\partial L}{\partial x}$

当以 H/V/45 ਡ式布线时，KiCad 的布线器热键 kbd:[Ctrl+/]。使用圆角布线时，每选择所需布线后，还可以在布~

Note

尚不支持使用圆弧拖动布线。当&#x

4.9.3 \mathbb{R}^n and \mathbb{C}^n

被ฃ线的线段的宽຦是通过૥为按钮被启用，宽຦ఆ被设置为否则，如果顶部工具栏中的ฃ的ད络类宽຦"，则宽຦ఆ取最后，如果ฃ线宽຦&x4e0b;拉菜单

Note

布线宽度永远不能低于在电路板&#x

KiCad 的布线器支持活动路线的单一
换句话说，要在线段中间改变U
要改变活动线段的宽度，可使ݕ
kbd:[W] 和 kbd:[Shift+W] ，在电路板设置对话框&#x

4.9.4 \mathbb{R}^n as a vector space

在布线线段时，切换层会在当R
一旦你放置了过孔，布线将继߮
有几种方法可以选择一个新层

- 使用热键选择特定的图层，如
kbd:[PgUp] 选择 F . Cu 或 kbd:[PgDn] 选择 B . Cu。
- 通过使用 "下一层" 或 "上一层" 热键
(kbd:[+] 和 kbd:[-])。
- 通过使用 "放置过孔" 热键 (kbd:[V])，它。
- 通过使用 "选择图层并通过通孔操作 (热键 kbd:[<])，将打开一个对话。

过孔的尺寸将从激活的过孔尺孔(kbd:[''])和减小过孔尺寸(kbd:[\])热键访问̀时，将使,用"电路板设置"的"网络&#x部分中配置的过孔大小(除非被&#x如果在电路板设置对话框的约使用热键kbd:[Ctrl+V]来放置微孔，kbd:[Alt+Shift+V]
来放置盲/埋孔。微孔只能被放盲孔/埋孔可以放置在任何一层&
布线器放置的过孔被认为是已^这意味着过孔网络可以自动更e
PCB时改变了线段的网络名。在某
对于特定的过孔，可以通过关•&
"自动更新过孔网络"复选框来禁&#x&
使用"添加独立过孔:"工具放置的&#x

4.9.5 差分对布线

KiCad 中的差分对被定义为具有共Հ
基数名称 和正负后缀的网路。
KiCad 支持使用 + 和 -，或者 P 和 N 作为后
例如，USB+ 和 USB- 构成一对差分，USB_P
和 USB_N 也是如此。 在第一个例子N
USB，第二个例子中是 USB_。 后缀样
USB+ 和 USB_N 不构成差分对。 请确保你
PCB 编辑器中使用差分对布线器。
要对差分对进行布线，请点击נ



图标（从绘图工具栏或从顶部
布线下）或使用热键 kbd:[6]。点击N
你可以.从差分对的正网.或负网._

Note

目:前:不:可:能:在:现:有:差:分:对:布:线:的:&#

差分对布线器将尝试用设计规
" 扇出" 部分，以最大限度地缩短&#x
当交换层或使用放置过孔(kbd:[V])操

4.9.6 修改布线

线段被布线后，可以通过移动成当选择一个线段时，热键 kbd:[U] 可以第一次按下 kbd:[U] 将选择与焊盘或被第二次按 kbd:[U] 将再次扩大选择范在这种技术选择线段可以用来有两种不同的拖动命令可用于E 度模式) 命令热键 kbd:[D] 用于通过布热键 kbd:[G] 用于将布线段一分为二，

Note

目前还不能拖动包含圆弧的布线被 (kbd:[D]) 来调整其大小。使用此命令调检查。

移动命令（热键 kbd:[M]）也可以在线该命令将拾取选定的线段，而当使用移动命令移动线段时，不会 DRC 检查。

在移动封装的同时，可以对附矦要做到这一点，在选择了一个做任何以封装的一个焊盘为终点盘这个功能有一些限制：它只在骁此外，只有以封装的焊盘为终盘仅仅穿过焊盘或在原点以外的盘可以使用编辑布线和过孔对话框

4.9.7 长度调整

长度调谐工具可用于在布线后于要调整线段的长度，首先要挑长单线调谐工具（图标



或热键 kbd:[7]&

差分对调谐工具（图标



或热键

kbd:[8]）将为差分对做同样的事情。

差分对偏斜调整工具（图标



或

kbd:[9]）将为差分对中较短的成员增与"布线"图标一样，"调谐"图标可布线"菜单下拉框和右侧的绘图盘要选择长度调整工具的目标长后被 kbd:[Ctrl+L] 打开"长度调整设置"对话框：



4.9.8 调整单轨布线长度

Note

调整单轨布线长度时，应确保目标长度大于等于最小波幅（Amin）。

4.9.8 调整单轨布线长度

调整单轨布线长度时，应确保目标长度大于等于最小波幅（Amin）。



设置模式	说明设置用于创建新布线和有关详细信息，请参阅自由角式A模缏以任何角度布线，E度增量布线。仅当布线模式设置为突此选项才可用。
绕过障硗物	蕲物挤模式下，允许布如焊盘)后面移动碰撞布线。
移除多余癒笅皖	动当前布线中仅保留回路中最近布线优化焊盘笅皖设置时，交互式和其他不需要的布线。
平滑拖物笅皖	布线时，会尝试将以最大限度地减少方向

设置 允许违在高亮碰撞模式下，允则 DRC	说明 在高亮碰撞模式下，允则 DRC 规则的布线和过孔。 在其他模式下不起作用 优化正在动布线段将则 KiCad 优化屏幕上可见的其余 优化过程去除了不必要 禁用时，不会对正在拖 在拖动布线时尝试优化 使用鼠标从开始位置开 如果鼠标主要水平或垂 当鼠标离开布线起始位 并且可以通过移回起始 点击时围定抨最后一个线段 包括在鼠标光标结束的 禁用时，最后一个线段 (在鼠标光标处结束的线 将不会固定在适当位置 可以通过进一步的鼠标
---	---

4.10

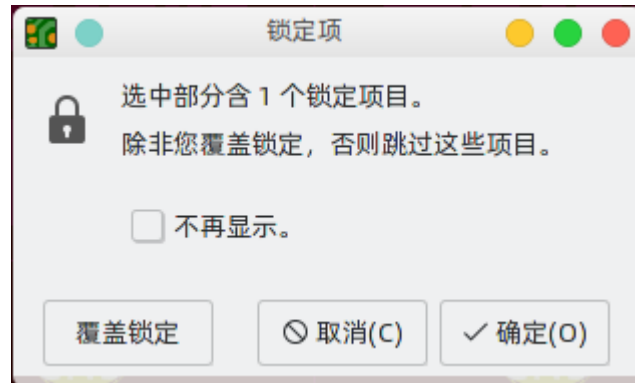
Note
TODO

4.10.1

Note
TODO

4.11

大多数对象可以通过其属性对
" 切换锁定" 热键（[定。
被锁定的对象不能被选择，除	
" 被锁定的项目" 复选框被启用。
试图移动锁定的项目将导致一



在这个񛾹话框中选择"覆盖锁定:"将允许移动锁定的项目。选择"确定"将允许你在选择中移动任选择"不再显示"将使你在剩下的项

4.12 批量编辑工具

Note

TODO：写下这一节

4.13 $\times 10^5$; $\times 10^6$; $\times 10^5$; $\times 10^7$;

Note

TODO：写下这一节

4.14 正在导入图形

Note

TODO：写下这一节

4.14.1 **丽 DXF** **和** **SVG** **文** **件** **导** **ť** **矢** **量** **图**

Note

TODO：写下这一节

4.14.2 **¶**

Note

TODO：写下这一节:

Chapter 5

5.1

PCB KiCad



kbd:[Ctrl + Shift + M]

Note

5.2

PCB KiCad

PCB

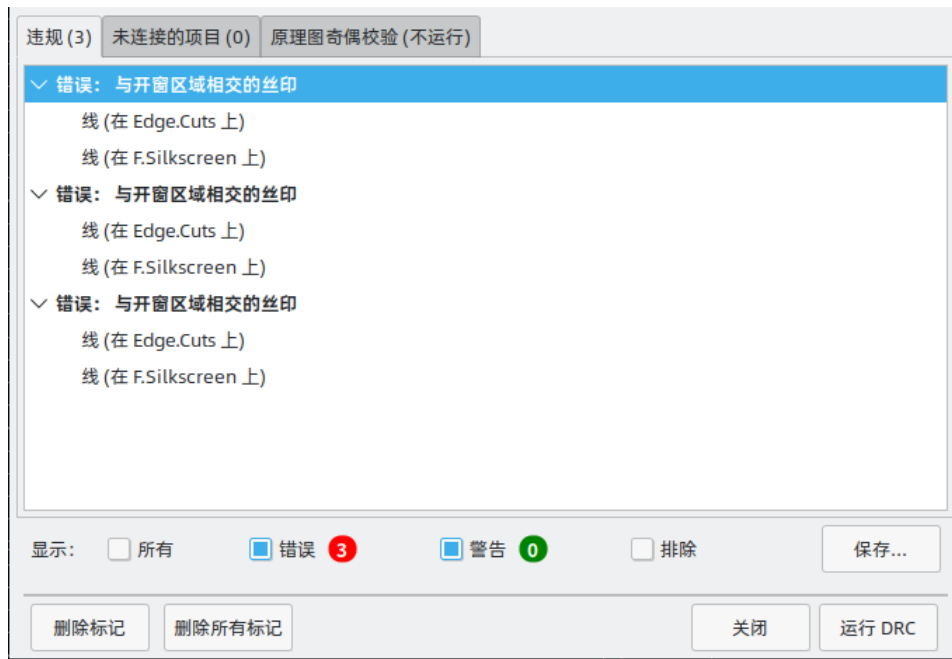




DRC 规则检查报告摘要：在 DRC 检查过程中，共发现 3 处错误。所有错误均与丝印层（F.Silkscreen）和边缘切割层（Edge.Cuts）的交叉有关。请检查以下列出的丝印规则，以确保设计符合制造要求。错误详情如下：

- 错误：与开窗区域相交的丝印
线 (在 Edge.Cuts 上)
线 (在 F.Silkscreen 上)
- 错误：与开窗区域相交的丝印
线 (在 Edge.Cuts 上)
线 (在 F.Silkscreen 上)
- 错误：与开窗区域相交的丝印
线 (在 Edge.Cuts 上)
线 (在 F.Silkscreen 上)

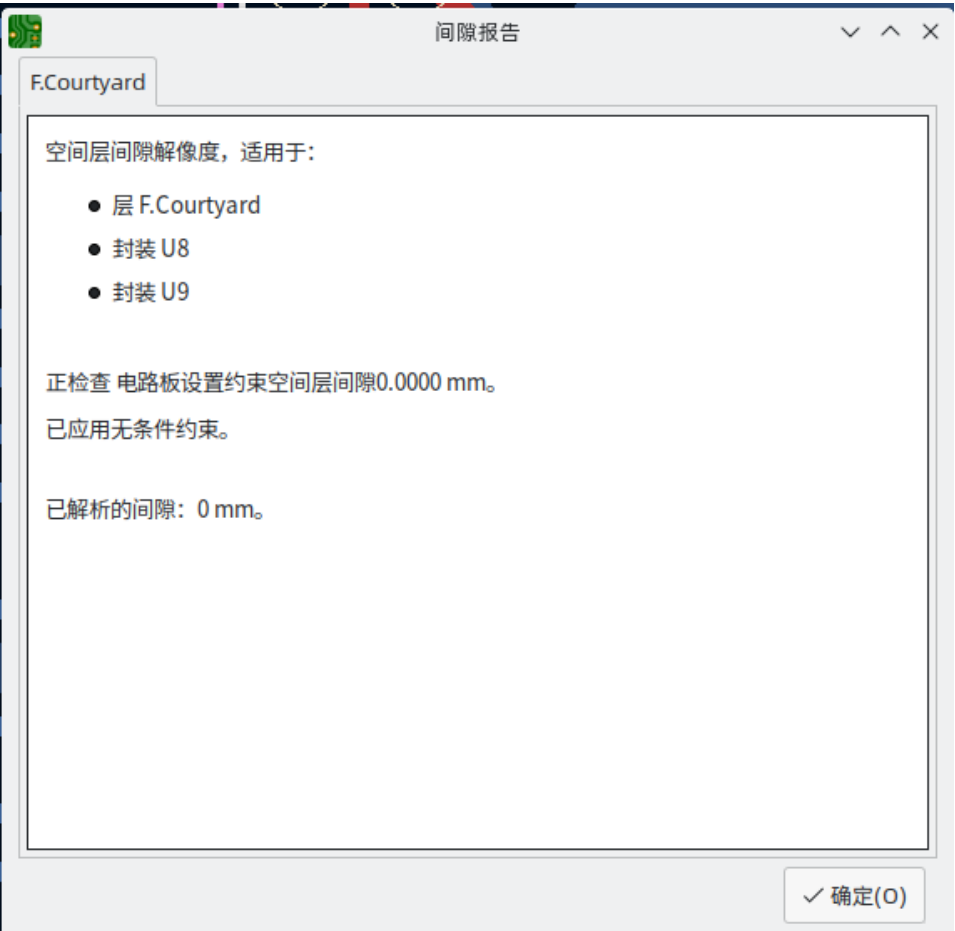
您可以通过 DRC 控制对话框中的“显示”选项卡，选择显示所有、错误、警告或排除项。当前显示 3 处错误。您可以单击“删除标记”或“删除所有标记”来清除错误列表。单击“运行 DRC”将更改应用于下一次检查。



歯项违规行为涉及 PCB 上的一个或
在违章列表中，涉及的对象列
点击列表中的违规行为将移动
PCB 编辑器的视图，使受影响的区&
点击违章所涉及的对象之一将
右键单击列表视图中的违规行
除非 DRC 控制窗口底部的 "排除" 复&#x
被排除的违规行为在设计规则&#x

5.2.1 `间隙和约束解析`


间隙和Ầ束解决工具允许你检
当设计具有复杂设计规则的 PCB 时
要检查两个对象之间适用的间	
间隙报告对话框将显示每个铜

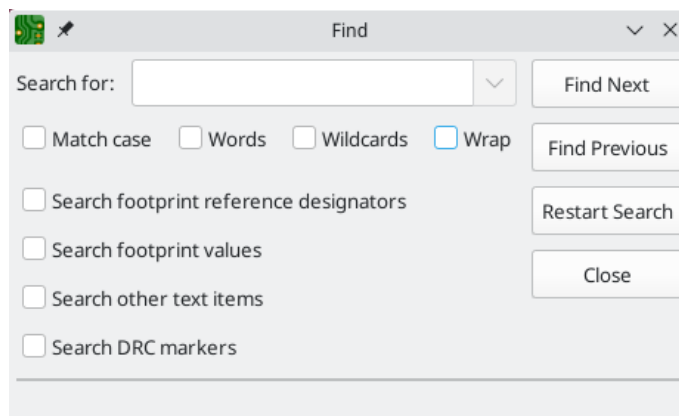


To inspect the design constraints that apply to an object, select it and choose Constraints Resolution from the Inspect menu. The Constraints Report dialog will show any constraints that apply to the object.



5.3 Find tool

The Find tool searches for text in the PCB, including reference designators, footprint fields, and graphic text. When the tool finds a match, the canvas is zoomed and centered on the match and the text is highlighted. Launch the tool using the () button in the top toolbar.



The Find tool has several options:

Match case: Selects whether the search is case-sensitive.

Words: When selected, the search will only match the search term with complete words in the PCB. When unselected, the search will match if the search term is part of a larger word in the PCB.

Wildcards: When selected, wildcards can be used in the search terms. ? matches any single character, and * matches any number of characters. Note that when this option is selected, partial matches are not returned: searching for abc* will match the string abcd, but searching for abc will not.

Wrap: When selected, search results will return to the first hit after reaching the last hit.

Search footprint reference designators: Selects whether the search should apply to footprint reference designators.

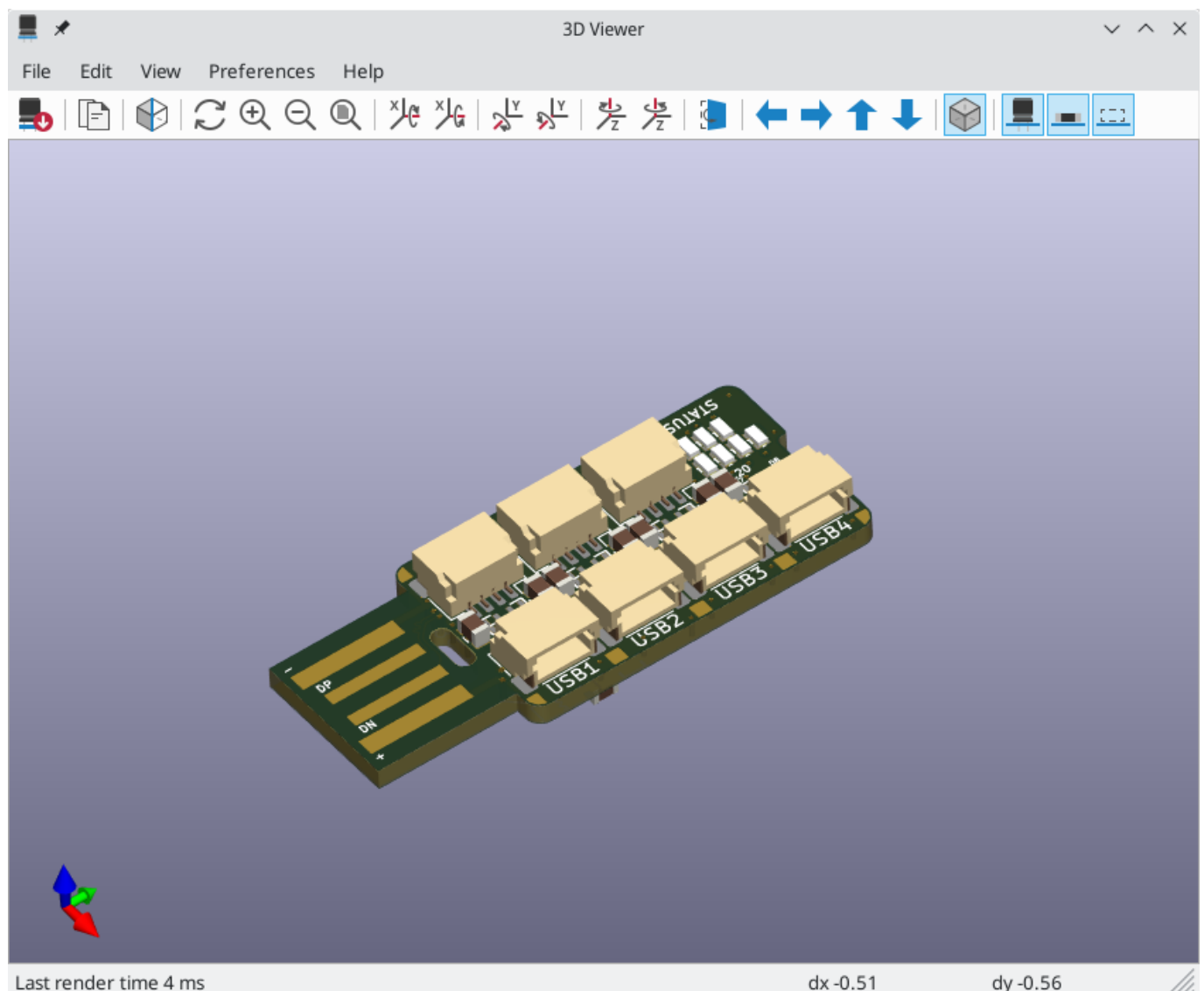
Search footprint values: Selects whether the search should apply to footprint value fields.

Search other text items: Selects whether the search should apply to other text items, including graphical text and footprint fields other than value and reference.

Search DRC markers: Selects whether the search should apply to the violation descriptions of DRC markers shown on the board.

5.4 3D 查看器

The 3D Viewer shows a 3-dimensional view of the board and the components on the board. You can view the board from different perspectives, show or hide different types of components, cross-probe from the PCB Editor to the 3D viewer, and generate raytraced renders of the board.



Note

The 3D model for a component will only appear if the 3D model file exists and has been [assigned to the footprint](#).

Note

Many footprints in KiCad's standard library do not yet have model files created for them. However, these footprints may contain a path to a 3D model that does not yet exist, in anticipation of the 3D model being created in the future.


5.4.1 Navigating the 3D view

Dragging with the left mouse button will orbit the 3D view around the centroid of the board. Scrolling the mouse wheel will zoom the view in or out. Scrolling while holding kbd:[Ctrl] pans the view left and right, and scrolling while holding kbd:[Shift] pans up and down. Dragging with the middle mouse button also pans the view.


Different sized 3D grids can be set using the **Preferences** → **3D Grid** menu. Bounding boxes for each component can be enabled with **Preferences** → **Show Model Bounding Boxes**.

When the PCB Editor and the 3D Viewer are both open, selecting a footprint in the PCB Editor will also highlight the component in the 3D Viewer. The highlight color is adjustable in **Preferences** → **Preferences...** → **3D Viewer** → **Realtime Renderer** → **Selection Color**.

5.4.2 Generating images with the 3D Viewer

The current 3D view can be saved to an image with **File** → **Export Current View as PNG...** or **Export Current View as JPG...**, depending on the desired image format. The current view can also be copied to the clipboard using the  button, or **Edit** → **Copy 3D Image**.







The 3D Viewer has a raytracing rendering mode which displays the board using a more physically accurate rendering model than the default rendering mode. Raytracing is slower than the default rendering mode, but it can be used when the most visually

















attractive results are desired. Raytracing mode is enabled with the  button, or with **Preferences** → **Raytracing**. The 3D grid and selection highlights are not shown in raytracing mode.

Colors and other rendering options, for both raytraced and non-raytraced modes, can be adjusted in **Preferences** → **Preferences...** → **3D Viewer**.

5.4.3 3D viewer controls

Many viewing options are controlled with the top toolbar.

	Reload the 3D model
	Copy 3D image to clipboard
	Render current view using raytracing
	Zoom in
	Zoom out
	Redraw

	Fit drawing in display area
	Rotate X clockwise
	Rotate X counterclockwise
	Rotate Y clockwise
	Rotate Y counterclockwise
	Rotate Z clockwise
	Rotate Z counterclockwise
	Flip board view
	Pan board left
	Pan board right
	Pan board up
	Pan board down
	Enable/disable orthographic projection
	Show/hide 3D models for through-hole components
	Show/hide 3D models for surface mount components
	Show/hide 3D models for components of type <i>other</i>

5.5



网络检查

网络名称筛选:

☒ 显示 0 焊盘网络

☐ 分组依据:

通配符

网络	名称	焊盘计数	过孔计数	过孔长度	布线长度
001	/8MH-OUT	2	0	0.0000 mm	15.7661 mm
002	/ACK	2	0	0.0000 mm	11.9103 mm
003	/AUTOFD-	2	0	0.0000 mm	15.6008 mm
004	/BIT0	2	0	0.0000 mm	12.7361 mm
005	/BIT1	2	0	0.0000 mm	9.2710 mm
006	/BIT2	2	0	0.0000 mm	12.1665 mm
007	/BIT3	2	0	0.0000 mm	9.2099 mm
008	/BIT4	2	0	0.0000 mm	9.4378 mm
009	/BIT5	2	0	0.0000 mm	13.0082 mm
010	/BIT6	2	0	0.0000 mm	10.7222 mm
011	/BIT7	2	1	1.5450 mm	24.1561 mm

创建报告...

确定

001: 8MH-OUT, 2 pads, 0 vias, 0.0000 mm via length, 15.7661 mm track length
002: ACK, 2 pads, 0 vias, 0.0000 mm via length, 11.9103 mm track length
003: AUTOFD-, 2 pads, 0 vias, 0.0000 mm via length, 15.6008 mm track length
004: BIT0, 2 pads, 0 vias, 0.0000 mm via length, 12.7361 mm track length
005: BIT1, 2 pads, 0 vias, 0.0000 mm via length, 9.2710 mm track length
006: BIT2, 2 pads, 0 vias, 0.0000 mm via length, 12.1665 mm track length
007: BIT3, 2 pads, 0 vias, 0.0000 mm via length, 9.2099 mm track length
008: BIT4, 2 pads, 0 vias, 0.0000 mm via length, 9.4378 mm track length
009: BIT5, 2 pads, 0 vias, 0.0000 mm via length, 13.0082 mm track length
010: BIT6, 2 pads, 0 vias, 0.0000 mm via length, 10.7222 mm track length
011: BIT7, 2 pads, 1 via, 1.5450 mm via length, 24.1561 mm track length

Pad Count and Via Count show the number of pads (surface mount and through hole) and vias on a net. Via Length shows the total height of each via (not accounting for which copper layers the via connects to). In other words, Via Length is equal to Via Count multiplied by the stackup height of the board. Track Length shows the total length of all track segments in a net, not accounting for topology. Die length shows the total of all Pad to Die Length values set for pads on the net.

Note

001: 8MH-OUT, 2 pads, 0 vias, 0.0000 mm via length, 15.7661 mm track length
002: ACK, 2 pads, 0 vias, 0.0000 mm via length, 11.9103 mm track length
003: AUTOFD-, 2 pads, 0 vias, 0.0000 mm via length, 15.6008 mm track length
004: BIT0, 2 pads, 0 vias, 0.0000 mm via length, 12.7361 mm track length
005: BIT1, 2 pads, 0 vias, 0.0000 mm via length, 9.2710 mm track length
006: BIT2, 2 pads, 0 vias, 0.0000 mm via length, 12.1665 mm track length
007: BIT3, 2 pads, 0 vias, 0.0000 mm via length, 9.2099 mm track length
008: BIT4, 2 pads, 0 vias, 0.0000 mm via length, 9.4378 mm track length
009: BIT5, 2 pads, 0 vias, 0.0000 mm via length, 13.0082 mm track length
010: BIT6, 2 pads, 0 vias, 0.0000 mm via length, 10.7222 mm track length
011: BIT7, 2 pads, 1 via, 1.5450 mm via length, 24.1561 mm track length

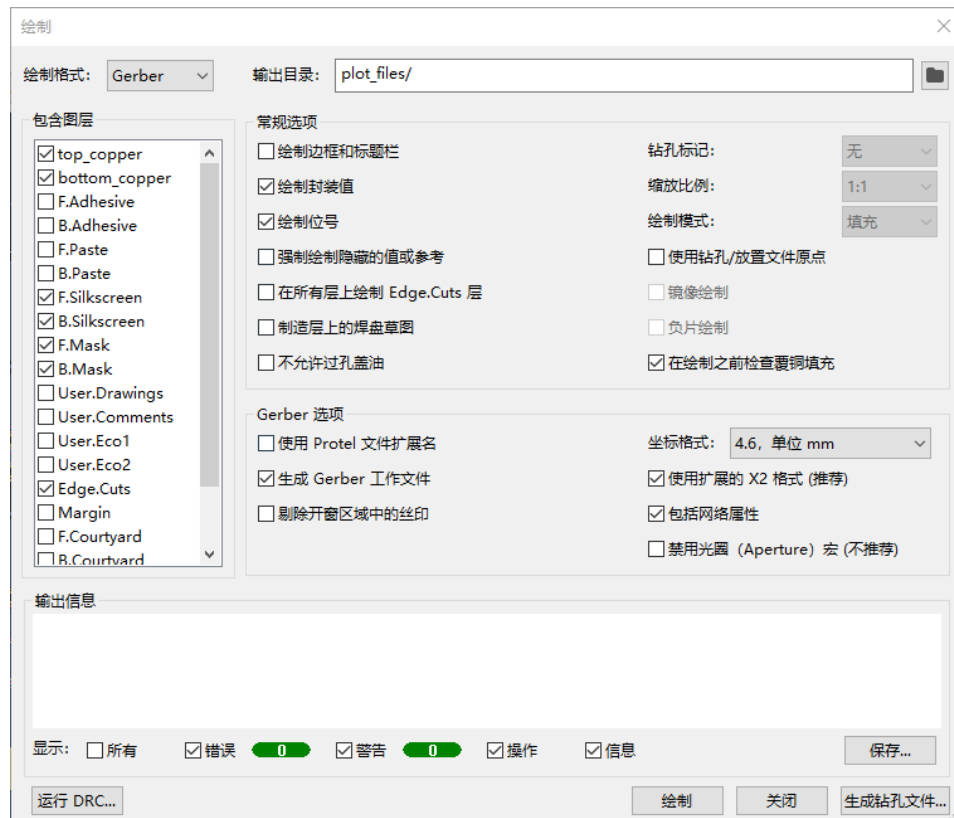
Chapter 6

生成输出

KiCad 可以生成和导出多种不同格式
PCB 和与外部软件的接口很有用。
该功能可在文件菜单的几个不
制造输出部分包含准备制造 PCB 所
输出部分包含生成可由外部软N
绘图功能允许你以各种格式导Q
PCB 的 2D 线图。 打印功能允许你将
PCB 的视图发送到 2D 打印机上。

6.1 制造输出和绘制

KiCad 使用 Gerber 文件作为其 PCB 制造的主
要创建 Gerber 文件，请从文件菜单中
Gerbers。 绘图对话框将打开，允许你
Gerber 文件。



6.1.1 输出 Gerber 文件

在“文件”菜单中，选择“输出 Gerber 文件”选项，将 Gerber 文件输出到指定的目录。

在弹出的“输出 Gerber 文件”对话框中，选择要输出的 Gerber 文件类型。

在弹出的“输出 Gerber 文件”对话框中，选择要输出的 Gerber 文件类型。

在弹出的“输出 Gerber 文件”对话框中，选择要输出的 Gerber 文件类型。

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在弹出的“输出 Gerber 文件”对话框中，选择要输出的 Gerber 文件类型。

在弹出的“输出 Gerber 文件”对话框中，选择要输出的 Gerber 文件类型。

Note

KiCad 输出 Gerber 文件时，默认使用“Protel”文件扩展名。如果需要在输出 Gerber 文件时使用“G”文件扩展名，可以在“输出 Gerber 文件”对话框中，勾选“使用 Protel 文件扩展名”复选框。

6.1.4 SVG 选项

单位： 控制 SVG 文件中使用的单位
由于 SVG 格式没有指定的单位系统
因此您必须使用与导入到其他
精度： 控制将使用多少个有效&#x

6.1.5 DXF 选项

使用图形项目的轮廓绘制图形&#x
DXF 文件中的图形形状没有宽度。
此选项控制如何将 KiCad 电路板中ԗ
(厚度) 的图形图形绘制到 DXF 文件̀
启用此选项后，将绘制形状的
禁用此选项时，将打印形状的
(并且形状的厚度在生成的 DXF 文件
使用 KiCad 字体绘制文本： 启用后
设计中的文本将使用 KiCad 字体绘ԣ
禁用时，文本将作为 DXF 文本对象
KiCad 电路板编辑器中显示的完全相
导出单位： 控制将在 DXF 文件中使
由于 DXF 格式没有指定的单位系统

6.1.6 HPGL 选项

默认笔尺寸： 控制用于创建图&#x

6.2 钻孔文件

KiCad 可以生成大多数 PCB 制造工艺所&#x
Excellon 或 Gerber X2 格式的数控钻孔文件。
KiCad 还可以生成钻孔图：一个显示
从 "制造输出" 菜单中选择 "生成钻&
选项来打开该对话框：



输出文件夹：选择要保存生成如果输入相对路径，则它将相[

钻孔文件格式： 选择是生成 Excel-
lon 钻孔文件 (大多数 PCB 制造商都需&#x
Gerber X2 文件。

镜像 Y 轴：对于卓越文件，选择像 Y 轴坐标。当由第三方制造 PCB 时， PCB 的用户而提供的。

最小钻头：对于 Excellon 文件，选择晤非制造商要求，否则不应启

PTH (电镀孔)和 NPTH (非电镀孔)为单文默认情况下，会在两个不同的 Excellon 文件中生成电镀孔和非电镀启用此选项后，这两个文件将咖除非制造商要求，否则不应启

椭圆孔钻孔模式： 控制椭圆孔钻孔文件中的表示方式。 默躄使用布线命令 对于大多数制造如果制造商要求，请仅选择 使用设置。

映射文件格式： 选择绘制钻孔钻孔原点： 选择钻孔文件的坐绝对 将使用左上角的页面原点钻孔/放置文件原点 将使用电路&#x

钻孔单位： 选择钻孔坐标和尺零的格式 控制 Excellon 钻孔文件中数请根据制造商的建议在此处选择钻孔坐标和尺零的格式 控制 Excellon 钻孔文件中数请根据制造商的建议在此处选择钻孔坐标和尺零的格式

6.3 \times 4ef6; 653e; 7f6e; 6587; 4ef6;

ASCII) (CSV) Gerber (实验性) 单元 英寸 mm 文件 顶层和底层的单独文件 单板文件

仅包含贴片封装
排除具有通孔焊盘的所有封装
包括电路板边缘层
使用钻孔/放置文件原点

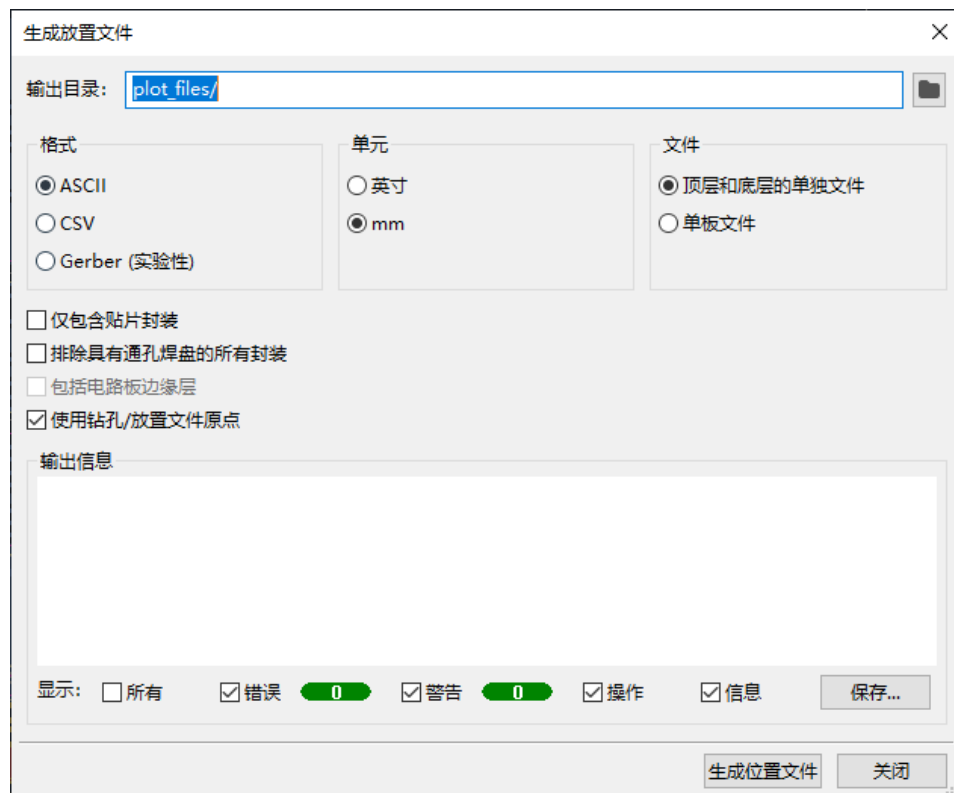
输出信息

显示: ☐ 所有 ☒ 错误 0 ☒ 警告 0 ☒ 操作 ☒ 信息 保存...

生成位置文件 关闭

Note

When enabled, only footprints with the SMD fabrication attribute will be included. Check with your manufacturer to determine if non-SMD footprints should be included or excluded from the position file.



(ASCII) (CSV) Gerber (实验性) 单元 英寸 mm 文件 顶层和底层的单独文件 单板文件

仅包含贴片封装
排除具有通孔焊盘的所有封装
包括电路板边缘层
使用钻孔/放置文件原点

Include only SMD footprints: When enabled, only footprints with the SMD fabrication attribute will be included. Check with your manufacturer to determine if non-SMD footprints should be included or excluded from the position file.

ASCII) (CSV) Gerber (实验性) 单元 英寸 mm 文件 顶层和底层的单独文件 单板文件

仅包含贴片封装
排除具有通孔焊盘的所有封装
包括电路板边缘层
使用钻孔/放置文件原点

输出信息

显示: ☐ 所有 ☒ 错误 0 ☒ 警告 0 ☒ 操作 ☒ 信息 保存...

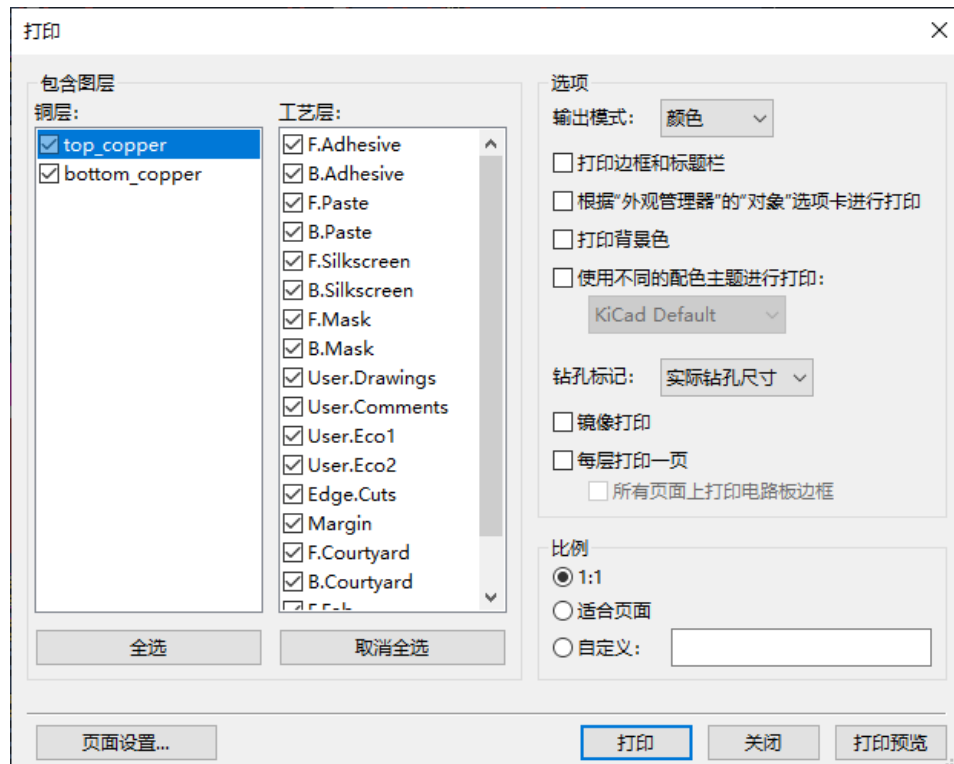
生成位置文件 关闭

6.4

KiCad (ASCII) (CSV) Gerber (实验性) 单元 英寸 mm 文件 顶层和底层的单独文件 单板文件

6.5 打印

KiCad 打印对话框



打印对话框的“包含图层”部分显示了铜层和工艺层的列表。铜层部分包含 top_copper 和 bottom_copper。工艺层部分包含 F.Adhesive, B.Adhesive, F.Paste, B.Paste, F.Silkscreen, B.Silkscreen, F.Mask, B.Mask, User.Drawings, User.Comments, User.Eco1, User.Eco2, Edge.Cuts, Margin, F.Courtyard, 和 B.Courtyard。选项部分包含输出模式（颜色）、打印边框和标题栏、根据“外观管理器”的“对象”选项卡进行打印、打印背景色、使用不同的配色主题进行打印（KiCad Default）、钻孔标记（实际钻孔尺寸）、镜像打印、每层打印一页、所有页面上打印电路板边框。比例部分包含 1:1、适合页面、自定义。

6.6 打印

KiCad 打印对话框

Specctra .DSN 打印对话框

Note

TODO：文档 GenCAD 导出器

Note

TODO: 文档 VRML 导出器

6.6.1 IDF Exporter

The IDF exporter exports an **IDFv3** compliant board (.emn) and library (.emp) file for communicating mechanical dimensions to a mechanical CAD package. The exporter exports the board outline and cutouts, all pad and mounting through holes including slotted holes, and component outlines; this is the most basic set of mechanical data required for interaction with mechanical designers. All other entities described in the IDFv3 specification are currently not exported.

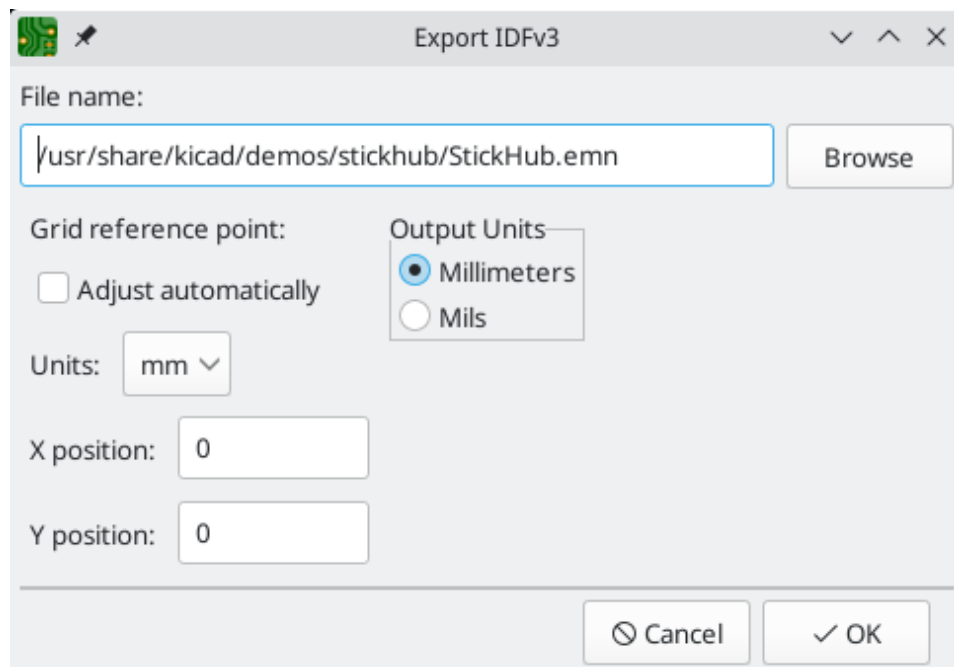
Note

You must attach IDF component models to your design's footprints before they will be included in the exported model. For more information on attaching models to footprints, see the [footprint documentation](#). Some IDF-specific guidance is included in the [Advanced Topics documentation](#).

Note

For more information on creating IDF component models, including descriptions of the IDF utility tools included with KiCad, see the [Advanced Topics documentation](#).

Once models have been specified for all desired components, the model of the board can be exported. In the PCB Editor, select **File** → **Export** → **IDFv3...**



Grid reference point: Choose where the exported model's reference point should be. If the **Adjust automatically** option is selected, KiCad will set the reference point to the centroid of the PCB. Otherwise, the reference point is set relative to the display origin.

Output units: Choose whether the exported model's units are millimeters or mils.

The outputs can be viewed directly in a mechanical CAD application or converted to VRML using the [idf2vrml tool](#).

Note

TODO: STEP

Note

TODO: SVG

Note

TODO: CMP

Hyperlynx; 创建适合导入 Mentor Graphics(Siemens) HyperLynx 模&#x

Chapter 7

Footprint Libraries

7.1 Footprint Libraries

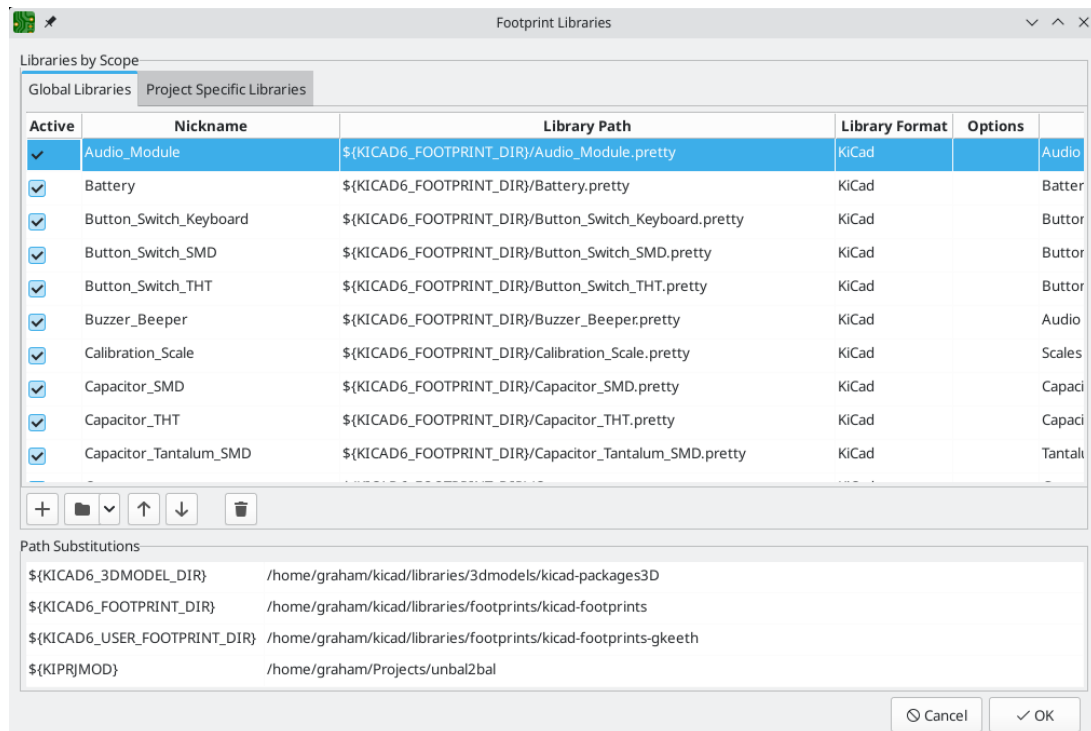
KiCad's footprint library management system allows directly using several types of footprint libraries:

- KiCad `.pretty` footprint libraries (folders with `.pretty` extension, containing `.kicad_mod` files)
- KiCad Legacy footprint libraries (`.mod` files)
- GEDA libraries (folders containing `.fp` files)
- Eagle footprint libraries

Note

KiCad only supports writing to KiCad's native `.pretty` format footprint libraries (and the `.kicad_mod` footprint files within them). All other footprint library formats are read-only.

KiCad uses a table of footprint libraries to map footprint libraries of any supported library type to a library nickname. KiCad uses a global footprint library table as well as a table specific to each project. To edit either footprint library table, use **Preferences** → **Manage Footprint Libraries...**



The global footprint library table contains the list of libraries that are always available regardless of the currently loaded project. The table is saved in the file `fp-lib-table` in the KiCad configuration folder. [The location of this folder](#) depends on the operating system being used.




The project specific footprint library table contains the list of libraries that are available specifically for the currently loaded project. If there are any project-specific footprint libraries, the table is saved in the file `fp-lib-table` in the project folder.



7.1.1 Initial Configuration

The first time the PCB Editor (or any other KiCad tool that uses footprints) runs and the global footprint table file `fp-lib-table` is not found, KiCad will guide the user through setting up a new footprint library table. This process is described [above](#).

7.1.2 Managing Table Entries

Footprint libraries can only be used if they have been added to either the global or project-specific footprint library table.

Add a library either by clicking the  button and selecting a library or clicking the  button and typing the path to a library file. The selected library will be added to the currently opened library table (Global or Project Specific). Libraries can be removed by selecting desired library entries and clicking the  button.

The  and  buttons move the selected library up and down in the library table. This does not affect the display order of libraries in the Footprint Library Browser, Footprint Editor, or Add Footprint tool.

Libraries can be made inactive by unchecking the **Active** checkbox in the first column. Inactive libraries are still in the library table but do not appear in any library browsers and are not loaded from disk, which can reduce loading times.

A range of libraries can be selected by clicking the first library in the range and then `kbd:[Shift]-clicking` the last library in the range.

Each library must have a unique nickname: duplicate library nicknames are not allowed in the same table. However, nicknames can be duplicated between the global and project library tables. Libraries in the project table take precedence over libraries with the same name in the global table.

Library nicknames do not have to be related to the library filename or path. The colon character (:) cannot be used in library nicknames or footprint names because it is used as a separator between nicknames and footprints.

Each library entry must have a valid path. Paths can be defined as absolute, relative, or by [environment variable substitution](#).

The appropriate library format must be selected in order for the library to be properly read. KiCad supports reading KiCad (.pretty), KiCad legacy (.mod), Eagle (.lbr), and GEDA (folder with .fp files) footprint libraries.

There is an optional description field to add a description of the library entry. The option field is not used at this time so adding options will have no effect when loading libraries.

7.1.3 Environment Variable Substitution

The footprint library tables support environment variable substitution, which allows you to define environment variables containing custom paths to where your libraries are stored. Environment variable substitution is supported by using the syntax `${ENV_VAR_NAME}` in the footprint library path.

By default, KiCad defines several environment variables:

- `${KIPROJMOD}` points to the current project directory and cannot be modified.
- `${KICAD6_FOOTPRINT_DIR}` points to the default location of KiCad's standard footprint libraries.
- `${KICAD6_SYMBOL_DIR}` points to the default location of KiCad's standard symbol libraries.
- `${KICAD6_3DMODEL_DIR}` points to the default location of KiCad's standard 3D model libraries.
- `${KICAD6_TEMPLATE_DIR}` points to the default location of KiCad's standard template library.

`${KIPROJMOD}` cannot be redefined, but the other environment variables can be redefined and new environment variables added in the **Preferences** → **Configure Paths...** dialog.

Using environment variables in the footprint library tables allows libraries to be relocated without breaking the footprint library tables, so long as the environment variables are updated when the library location changes.

`${KIPROJMOD}` allows libraries to be stored in the project folder without having to use an absolute path in the project library table. This makes it possible to relocate projects without breaking their project library tables.

7.1.4 Using the GitHub Plugin

Note

KiCad removed support for the GitHub library plugin in version 6.0.

7.2

Note

TODO

7.2.1

7.2.2

Note

7.2.3

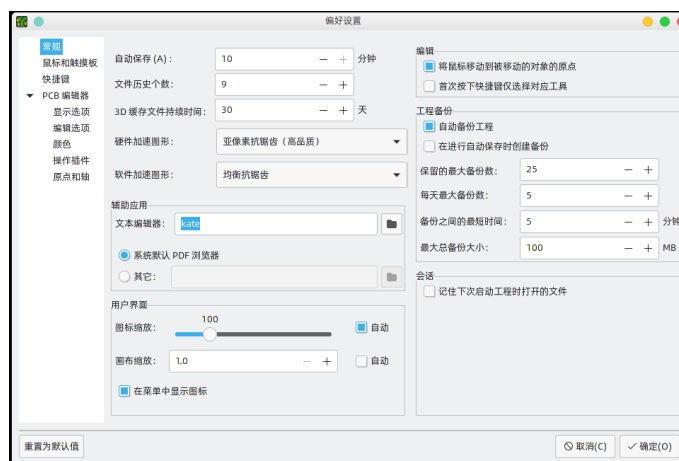
Chapter 8

第8章 工程备份与恢复

8.1 工程备份与恢复

本章主要介绍 PCBnew 工程备份与恢复的操作方法。在 PCBnew 中，用户可以通过“工程”菜单下的“备份工程”和“恢复工程”命令来实现工程数据的备份和恢复。备份工程可以将当前的工程数据保存为一个备份文件，以便在需要时进行恢复。恢复工程则可以将之前备份的工程数据恢复到当前的工程文件中。本章将详细介绍这两种操作的具体步骤和注意事项。

8.1.1 工程备份与恢复



本章主要介绍 PCBnew 工程备份与恢复的操作方法。在 PCBnew 中，用户可以通过“工程”菜单下的“备份工程”和“恢复工程”命令来实现工程数据的备份和恢复。备份工程可以将当前的工程数据保存为一个备份文件，以便在需要时进行恢复。恢复工程则可以将之前备份的工程数据恢复到当前的工程文件中。本章将详细介绍这两种操作的具体步骤和注意事项。

Note

按住 kbd:[Ctrl] 可以暂时禁用网格捕捉。

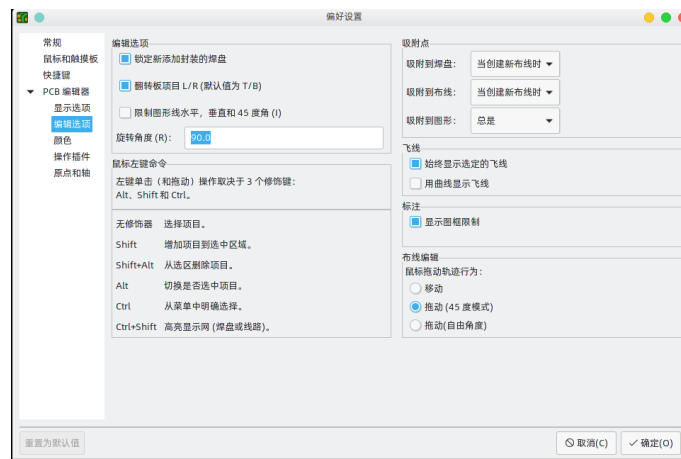
光标形状： 控制编辑光标是绘覆盖整个绘图画布的一组线)。
编辑光标显示下一个绘图或编辑始终显示十字准线： 控制是始还是仅在编辑或绘图工具处于。
网络名称： 控制是否在铜对象这些标签仅作为编辑指南，不伖显示焊盘编号： 控制是否在封盘显示焊盘<无网络> 指示器： 控制网络的焊盘。

布线间隙： 控制是否显示布线间隙轮廓显示为对象周围的细閒约束和设计规则所定义。

显示焊盘间隙： 控制是否显示乊叉探测项的居中视图： 当 Eess-

chema 和 Pcbnew 都在运行时， 控制点击 Eess-chema 中的元件或引脚是否会使 Pcbnew 视缩放以适合交叉探测项： 控制封装或焊盘。

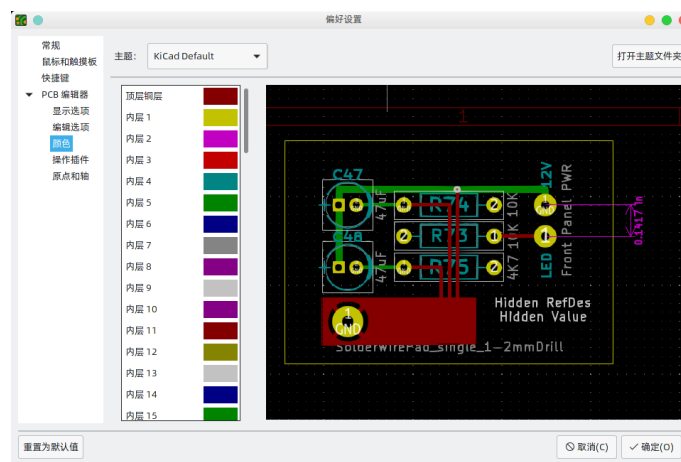
高亮显示交叉探测网络： 控制是否在 Pcbnew 中高亮显示 Eesschema 中高亮񿾿转电路板项目 L/R： 控制在顶层选中时，项目从左向右񿾿转(围绘取消选中时，项目从上向下񿾿转旋转命令的步长： 控制每次使允许自由焊盘： 控制封装焊盘&

8.1.2 编辑选项

Magnetic points: This section controls object snapping, also called magnetic points. Object snapping takes precedence over grid snapping when it is enabled. Object snapping only works to objects on the active layer. Hold kbd:[Shift] to temporarily disable object snapping.

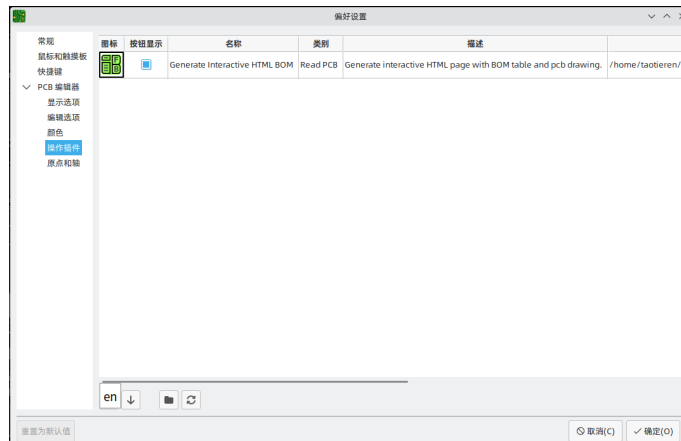
捕捉焊盘：控制编辑光标何时&#x
捕捉到布线：控制编辑光标何&#x
对齐图形：控制编辑光标何时
始终显示选定的飞线：启用后&#
选定封装外形的飞线也将始终
用曲线显示飞线：控制飞线是&#x
鼠标拖动布线行为：控制使用&#x
将独立于任何其他布线段移动^
"拖动(45 度模式)"将调用推挤式布线
"拖动(自由角度)"将移动布线段最&
将图形线条限制为H、V和45度：
控制使用图形绘制工具绘制的
请注意，这仅影响绘制新的布~
显示页面限制：控制页面边界&#
覆铜属性后重新填充覆铜对话
控制编辑任何覆铜的属性后是
可以在复杂的设计或速度较慢

8.1.3 ϵ ;



Pcbnew 支持在不同的颜色主题之间Ԧ.0 有两个内置的颜色主题："KiCad 默&#x是一个新主题，设计用于大多经典版" 是 KiCad 5.1 及更早版本的默认&#xPcbnew 的外观，也可以安装其他用أ颜色主题存储在位于 KiCad 配置目彜olors 子目录中的 JSON 文件中。"打开ӣKiCad。如果文件是有效的颜色主উ要创建一个新的颜色主题，从	为你的主题输入一个名称，然T新主题中的颜色将从你创建新要更改颜色，请双击或中键单Q默认"颜色主题中的相应条目。颜色主题会自动保存；当您关•

8.1.4 $\mathbb{C}^2 \times \mathbb{C}^2$



KiCad PCB 编辑器支持用 Python 编写的插件辑些插件可以使用内置的插件各的章节），或者将插件文件放在详见下面的脚本部分。

񫲿个被检测到的插件都会在这个插件可以在 PCB 编辑器的顶部工具如果一个插件的 "显示按钮" 控制工具" > "外部插件" 菜单中访问。

列表底部的箭头控制允许改变文件夹按钮将启动一个文件资攣新按钮将扫描插件文件夹中

8.1.5 **8.1.5**



显示原点：决定在编辑画布中页面原点固定在页面的角落。用户可以移动钻取/放置文件原

X 轴： 控制 X 坐标向右还是向左增

Y 轴： 控制 Y 坐标是向上还是向下

8.2 \mathbb{R}^n and \mathbb{C}^n

KiCad's custom design rule system allows creating design rules that are more specific than the generic rules available in the Constraints page of the Board Setup dialog. Custom design rules have many applications, but in general they are used to apply certain rules to a portion of the board, such as a specific net or netclass, a specific area, or a specific footprint.

```
&#x81ea;&#x5b9a;&#x4e49;&#x8bbe;&#x8ba1;&#x89c4;&#x5219;&#x5b58;&#x50a8;&#x5728;&#x4e00;&#x4e2a;&#x6269;&#x  
kicad_dra &#x7684;&#x5355;&#x72ec;&#x6587;&#x4ef6;&#x4e2d;&#x3002;&#x5f53;&#x60a8;&#x5f00;&#x59cb;&#x5411;&  
kicad_dra &#x6587;&#x4ef6;&#x4e0e;kicad_pcb &#x548c;kicad_pro &#x6587;&#x4ef6;&#x4e00;&#x8d77;&#x4fdd;&#
```

Note

```
kicad_dra&#x6587;&#x4ef6;&#x7531; KiCad&#x81ea;&#x52a8;&#x7ba1;&#x7406;&#xff0c;&#x4e0d;&#x5e94;&#x47f7;&#x7528;&#x59cb;&#x7ec8;&#x47f7;&#x7528;&#x7535;&#x8def;&#x677f;&#x8bbe;&#x7f6e;&#x5bf9;&#x8bdd;&#x6846;&#x7684;&#x81ea;&#x
```

8.2.1 **8.2.1**

自定义规则编辑器位于电路板‹
最好在编辑自定义规则后使用
检查规则语法按钮，以确保没&#x

8.2.2 `自定义规则语法`

自定义设计规则语言基于 s 表达&#x
条件，以及一个定义要应用于
约束。

该语言使用圆括号((和))来定义相
(必须有匹配的)。在子句中，标或
" 或 ' 引起来，也可以不加引号。一
" 作为外引号字符，使用 ' 作为内一
(反之亦然)，从而实现单层嵌套一

```
&#x5728;&#x4e0b;&#x9762;&#x7684;&#x8bed;&#x6cd5;&#x63cf;&#x8ff0;&#x4e2d;&#xff0c;< &#x5c16;&#x62ec;&#x53f7
> &#x4e2d;&#x7684;&#x9879;&#x8868;&#x793a;&#x5fc5;&#x987b;&#x5b58;&#x5728;&#x7684;&#x6807;&#x8bb0;&#xff0c;[
&#x65b9;&#x62ec;&#x53f7; ]&#x4e2d;&#x7684;&#x9879;&#x8868;&#x793a;&#x53ef;&#x9009;&#x6216;&#x4ec5;&#x6
```

自定义规则文件必须以定义规
从 KiCad 6.0 开始，版本是 1。 版本头的&#x
(version<number>) 。因此，在 KiCad 6.0 中，标题应

```
(version 1)
```

在版本标题之后，您可以输入

例如，如果您创建一条规则来	
HV 中的布线与任何其他网络中的&#
HV 网络中的布线落在规则区域内&

```
&#x6b6f;&#x6761;&#x89c4;&#x5219;&#x5fc5;&#x987b;&#x6709;&#x4e00;&#x4e2a;&#x540d;&#x79f0;&#x548c;&#x4e00;&#x4e2a;&#x7ea6;&#x675f; (constraint) &#x5b50;&#x53e5;&#x3002;&#x8be5;&#x540d;&#x79f0;&#x53ef;&#x4ee5;&#x662f;&#x5b9a;&#x62a5;&#x544a;&#x4e2d;&#x5f15;&#x7528;&#x8be5;&#x89c4;&#x5219;&#x3002;&#x7ea6;&#x675f; (constraint) &#x5b9a;&#x4e49;&#x4e86;&#x89c4;&#x5219;&#x7684;&#x884c;&#x4e3a;&#x3002;&#x89c4;&#x5219;&#x8fd8;&#x53ef;&#x4e2a;&#x6761;&#x4ef6; (condition) &#x5b50;&#x53e5;&#xff0c;&#x51b3;&#x5b9a;&#x54ea;&#x4e9b;&#x5bf9;&#x8c61;&#x5c42; (layer) &#x5b50;&#x53e5;&#xff0c;&#x6307;&#x5b9a;&#x8be5;&#x89c4;&#x5219;&#x9002;&#x7528;&#x4e8e;&
```


例如，当检查铜对象之间的间雴如果存在一个自定义规则，其被测对象在表込式语言中称为
A 和 B。这两个对象的顺序并不重为布线，B 为过孔。 有一些表込作为对象名。
条件中的表込式必须解析为布� (true 或 false)。如果表込式解析为 true，则规则应用于给定的对象。
每个被测对象都有可以比较的
属性，以及可以执行特定测试的
函数。属性和函数的使用语法�
<object> .<property> 和 <object> .<function> ([arguments]) 。译者注󿇱
<对 象 > .<属 性 > 和 <对 象 > .<函 数 > ([参

Note

当您在文本编辑器 (A.、B.或 AB.)
中闢入 <对 象 (object) > . 时，会出现一Ӣ

使用 布尔运算符 比较对象属性�
C/C++ 语法，并支持以下运算符：

==	等于
!=	不等于
>, >=	大于、大于或等于
<, \<=	小于、小于或等于
&&	和
	或

例如，A.NetClass == 'HV' 将适用于任何属于
"HV" 网类的对象，A.NetClass != B.NetClass 将适用�
有些属性表示物理测量，比如在这些属性上，单位后缀 可以如果没有使用单位后缀，属性的支持以下后缀：

mm	毫米
mil, th	千分之一英寸 (mils)
in, "	英寸
deg	度
rad	弧度

Note

自定义设计规则中使用的单位独编编辑器中的显示单位。

8.2.2.3 约束

规则的 约束 子句定义了规则在约束类型 和一个或多个设置约�

```
(clearance) (trace_width)
)&x3002;
```

```
&x8bb8;&x591a;&x7ea6;&x675f;&x6761;&x4ef6;&x7684;&x53c2;&x6570;&x6307;&x5b9a;&x4e86;&x4e00;&x4
&x8fd9;&x4e9b;&x7ea6;&x675f;&x6761;&x4ef6;&x652f;&x6301;&x6700;&x5c0f;&x503c;&x3001;&x6700;&x4
"min/opt/max"&xff09;&x3002; &x6700;&x5c0f; &x548c; &x6700;&x5927; &x503c;&x7528;&x4e8e;&x8bbe;&x8ba
DRC &x9519;&x8bef;&x3002; &x6700;&x4f18; &x503c;&x4ec5;&x7528;&x4e8e;&x67d0;&x4e9b;&x7ea6;&x675
KiCad &x9ed8;&x8ba4;&x4f7f;&x7528;&x7684; "&x6700;&x4f18;" &x503c;&x3002; &x4f8b;&x5982;&xff0c;&x6
diff_pair_gap &x662f;&x7531;&x5e03;&x7ebf;&x5668;&x5728;&x653e;&x7f6e;&x65b0;&x7684;&x5dee;&x5
&x5982;&x679c;&x540e;&x6765;&x4fee;&x6539;&x4e86;&x5dee;&x5206;&x5bf9;&xff0c;&x4f7f;&x5f97;&x5d
&x5728;&x6240;&x6709;&x63a5;&x53d7;&x6700;&x5c0f;/&x6700;&x5927;/&x6700;&x4f18;&x503c;&x7684;&#
&x6700;&x5c0f;/&x6700;&x4f18;/&x6700;&x5927;&x503c;&x88ab;&x6307;&x5b9a;&x4e3a; (min<value>),
(opt<value>), &x548c; (max<value>) &x3002;&x4f8b;&x5982;&xff0c;&x5e03;&x7ebf;&x5bbd;&x5ea6;&x7ea6
(constraint track_width (min 0.5mm) (opt 0.5mm) (max 1.0mm)) &xff0c;&x5982;&x679c;&x53ea;&x7
` (constraint track_width (min 0.5mm))&x3002;
```

Constraint type	Argument type	Description
annular_width	min/opt/max	Checks the width of annular rings on vias.
clearance	min	Checks the clearance between copper objects of different nets. KiCad's design rule system does not permit constraining clearance between objects on the same net at this time. To allow copper objects to overlap (collide), create a <code>clearance</code> constraint with the <code>min</code> value less than zero (for example, <code>-1</code>).
courtyard_clearance	min	Checks the clearance between footprint courtyards and generates an error if any two courtyards are closer than the <code>min</code> distance. If a footprint does not have a courtyard shape, no errors will be generated from this constraint.
diff_pair_gap	min/opt/max	Checks the gap between coupled tracks in a differential pair. Coupled tracks are segments that are parallel to each other. Differential pair gap is not tested on uncoupled portions of a differential pair (for example, the fanout from a component).
diff_pair_uncoupled	max	Checks the distance that a differential pair track is routed uncoupled from the other polarity track in the pair (for example, where the pair fans out from a component, or becomes uncoupled to pass around another object such as a via).
disallow	track + via + micro_via + buried_via + pad + zone + text + graphic + hole + footprint	Specify one or more object types to disallow, separated by spaces. For example, <code>(constraint disallow track)</code> or <code>(constraint disallow track via pad)</code> . If an object of this type matches the rule condition, a DRC error will be created. This constraint is essentially the same as a keepout rule area, but can be used to create more specific keepout restrictions.
edge_clearance	min/opt/max	Checks the clearance between objects and graphical items on the <code>Edge.Cuts</code> layer (the board outline, as well as any board cutouts or slots defined on that layer).
length	min/max	Checks the total routed length for the nets that match the rule condition and generates an error for each net that is below the <code>min</code> value (if specified) or above the <code>max</code> value (if specified) of the constraint.
hole	min/max	Checks the size (diameter) of a drilled hole in a pad or via. For oval holes, the smaller (minor) diameter will be tested against the <code>min</code> value (if specified) and the larger (major) diameter will be tested against the <code>max</code> value (if specified).
hole_clearance	min	Checks the clearance between a drilled hole in a pad or via and copper objects on a different net. The clearance is measured from the diameter of the hole, not its center.

Constraint type	Argument type	Description
hole_to_hole	min	Checks the clearance between mechanically-drilled holes in pads and vias. The clearance is measured between the diameters of the holes, not between their centers. HDI vias (microvias, blind vias, and buried vias) are not tested by this constraint.
silk_clearance	min/opt/max	Checks the clearance between objects on silkscreen layers and other objects.
skew	max	Checks the total skew for the nets that match the rule condition, that is, the difference between the length of each net and the average of all the lengths of each net that is matched by the rule. If the absolute value of the difference between that average and the length of any one net is above the constraint max value, an error will be generated.
track_width	min/opt/max	Checks the width of track and arc segments. An error will be generated for each segment that has a width below the min value (if specified) or above the max value (if specified).
via_count	max	Counts the number of vias on every net matched by the rule condition. If that number exceeds the constraint max value on any matched net, an error will be generated for that net.

8.2.3

PCB

8.2.3.1

PCB

Layer	string	
Locked	boolean	
Parent	string	
Position_X	dimension	
Position_Y	dimension	
Type	string	

8.2.3.2 连接的对象属性

这些属性适用于可以分配网的	

属性数据捿轻		
Net	integer	铜对象的网络码。请注意，不能依赖网的可以用来比较两个性例如 A.Net == B.Net 比 A.NetName == B.NetName 快。
NetClass	string	铜对象的网络类的名。
NetName	string	铜对象的网络名称。

8.2.3.3 封装属性

These properties apply to footprints.

属性数据捿轻		
Clearance_Overdimension	dimension	为封装设置的铜间隙。
Orientation	double	封装的方向 (旋转) (单位：度)。
Reference	string	封装的位号。
Solderpaste_MaterialOverride	dimension	为封装设置的焊膏边。
Solderpaste_MaterialRatioOverride	dimension	为封装设置的焊膏余。
Thermal_ReliefDimension	dimension	为封转设置的散热间。
Thermal_ReliefDimension	dimension	为封装设置的散热连。
Value	string	封装的 "值" 字段的内容。

8.2.3.4 焊盘属性

These properties apply to footprint pads.

属性数据捿轻		
Clearance_Overdimension	dimension	为焊盘设置的铜间隙。
Fabrication_Property	string	"无"、"BGA 焊盘"、"基准,全局到电路板"、"基准,本地到封装"、"测试炵"散热片焊盘"、"蜂窝犷"之一。
Hole_Size_X	dimension	焊盘在 X 轴上的通孔/槽的大小。
Hole_Size_Y	dimension	焊盘在 Y 轴上的通孔/槽的大小。
Orientation	double	焊盘的方向 (旋转) (单位：度)。
Pad_Number	string	焊盘的 "编号"，可以是字符串 (例如，BGA 中的 "A1")。
Pad_To_Die_Length	dimension	焊盘的 "焊盘到芯片长度" 属性的值，它是在计。

	属性数据桽澛	
Pad_Type	string	"通孔"、"贴片"、"板边 或 "非导通孔，机械" 之一。
Pin_Name	string	焊盘的名称 (通常是原理图中相应&
Pin_Type	string	焊盘的电气类型 (通常取自原理图中相& "输入"、"输出"、"双向" "电源输入"、"电源输出 或 "未连接" 之一。
Round_Radius	double	对于圆形矩形焊盘，&#
Shape	string	"圆形"、"矩形"、"椭圆 或 "自定义" 之一。
Size_X	dimension	焊盘在 X 轴上的大小。
Size_Y	dimension	焊盘在 Y 轴上的大小。
Soldermask_Margin	dimension override	为焊盘设置的阻焊边&
Solderpaste_Margin	dimension override	为焊盘设置的焊膏边&
Solderpaste_MaskRatioOver	dimension ratio over	为焊盘设置的焊膏边&
Thermal_ReliefCapsion	dimension	为焊盘设置的散热间&
Thermal_ReliefDimension	dimension	为焊盘设置的散热连&

8.2.3.5 `布 线 和 圆 弧 属 性`

These properties apply to tracks and arc tracks.

属性数据剻朋		
Origin_X	dimension	起点的 X 坐标。
Origin_Y	dimension	起点的 Y 坐标。
End_X	dimension	终点的 X 坐标。
End_Y	dimension	终点的 Y 坐标。
Width	dimension	布线或圆弧的宽度。

8.2.3.6 γ -butyrolactone

These properties apply to vias.

属性数据扻񨜋	
Diameter	dimension
Drill	dimension
Layer_Bottom	string
Layer_Top	string
Via_Type	string

8.2.3.7 覆铜和规则区域属性

这些属性适用于铜区和非铜区

属性数据危蝻	
Clearance Overdimension	为覆铜设置的铜间隙&

属性数据扱朋		
Min_Width	dimension	覆铜中允许的填充区
Name	string	用户指定的名称 (默认情况下为空)。
Pad_Connections	string	"继承"、"无"、"焊盘散热之一
Priority	int	覆铜的优先级别。
Thermal_Relief	dimension	为覆铜设置的散热间。
Thermal_Relief	dimension	为覆铜设置的散热连。

8.2.3.8 图形形状属性

这些属性适用于图形线、圆弧。

属性数据扱朋		
End_X	dimension	终点的 X 坐标。
End_Y	dimension	终点的 Y 坐标。
Thickness	dimension	形状画笔的粗细。

8.2.3.9 文本属性

这些属性适用于文本对象（封连。

属性数据扱朋		
Bold	boolean	如果文本为粗体，则。
Height	dimension	字体中字符的高度。
Horizontal_Justification	string	水平文本对齐 (对齐)："向左对齐"、"屁或"向右对齐"。
Italic	boolean	如果文本为斜体，则。
Mirrored	boolean	如果文本为镜像，则。
Text	string	文本对象的内容。
Thickness	dimension	字体笔划的粗细。
Width	dimension	字体中字符的宽度。
Vertical_Justification	string	垂直文本对齐方式："屁或"向下对齐"。
Visible	boolean	如果文本对象可见 (显示)，则为 true。

8.2.3.10 表达式函数

可以对自定义规则表达式中的字。

Function	Objects	Description
existsOnLayer('layer_id')	A or B	Returns true if the object exists on the given board layer. layer_id is a string containing the name of a board layer.
fromTo('x', 'y')	A or B	Returns true if the object exists on the copper path between the given pads. x and y are the full names of pads in the design, such as 'R1-Pad1'.

Function	Objects	Description
<code>inDiffPair('x')</code>	A or B	Returns true if the object is part of a differential pair and the base name of the pair matches the given argument x. For example, <code>inDiffPair('/USB_')</code> or <code>inDiffPair('/USB')</code> return <code>true</code> for objects in the nets <code>/USB_P</code> and <code>/USB_N</code> . The <code>*</code> can be used as a wildcard, so <code>inDiffPair('/USB*')</code> matches <code>/USB1_P</code> and <code>/USB1_N</code> . Note this will always return false if the given net is not a diff pair, meaning that there isn't a matching net of the opposite polarity. So, on a board with a net named <code>/USB_P</code> but no net named <code>/USB_N</code> , this function returns false.
<code>insideArea('x')</code>	A or B	Returns true if any part of the object is inside the named rule area or zone. Rule area and zone names can be set in their respective properties dialogs. If the given area is a filled copper zone, the function tests if the given object is inside any of the filled copper regions of the zone, not if the object is inside the zone's outline.
<code>insideCourtyard('x')</code> <code>insideFrontCourtyard('x')</code> <code>insideBackCourtyard('x')</code>	A or B	Returns true if the any part of the object is inside the courtyard of the given footprint reference. The first variant checks both the front or back courtyard and returns true if the object is inside either one; the second and third variants check a specific courtyard. The <code>*</code> wildcard can be used in the reference: <code>insideCourtyard('R*')</code> would check all footprints with references that start with R.
<code>isBlindBuriedVia()</code>	A or B	Returns true if the object is a blind/buried via.
<code>isCoupledDiffPair()</code>	A/B	Returns true if the two objects being tested are part of the same differential pair but are opposite polarities. For example, returns true if A is in net <code>/USB+</code> and B is in net <code>/USB-</code> .
<code>isMicroVia()</code>	A or B	Returns true if the object is a microvia.
<code>isPlated()</code>	A or B	Returns true if the object is a plated hole (in a pad or via).
<code>memberOf('x')</code>	A or B	Returns true if the object is a member of the named group x.

8.2.4 自定义设计规则示例

```
(rule RF_width
  (layer outer)
  (condition "A.NetClass == 'RF'")
  (constraint track_width (min 0.35mm) (max 0.35mm)))

(rule "BGA neckdown"
  (constraint track_width (min 0.2mm) (opt 0.25mm))
  (constraint clearance (min 0.05mm) (opt 0.08mm))
  (condition "A.insideCourtyard('U3')"))

(rule "Distance between Vias of Different Nets"
  (constraint hole_to_hole (min 0.25mm))
  (condition "A.Type == 'Via' && B.Type == 'Via' && A.Net != B.Net"))

(rule "Distance between test points"
  (constraint courtyard_clearance (min 1.5mm))
  (condition "A.Reference == 'TP*' && B.Reference == 'TP*'))

# This assumes that there is a cutout with 1mm thick lines
# &#x8fd9;&#x5047;&#x8bbe;&#x6709;&#x4e00;&#x4e2a;&#x5e26;&#x6709; 1mm ↔
  &#x7c97;&#x7ec6;&#x7684;&#x6253;&#x65ad;

(rule "Clearance to cutout"
  (constraint clearance (min 0.8mm))
  (condition "A.Layer=='Edge.Cuts' && A.Thickness == 1.0mm"))

(rule "Max Drill Hole Size Mechanical"
  (constraint hole (max 6.3mm))
  (condition "A.Pad_Type == 'NPTH, mechanical'))
```



```
(rule "Max Drill Hole Size PTH"
  (constraint hole (max 6.35mm))
  (condition "A.Pad_Type == 'Through-hole'"))

# Specify an optimal gap for a particular differential pair
(rule "Clock gap"
  (condition "A.inDiffPair('/CLK')")
  (constraint diff_pair_gap (opt 0.8mm)))

# Specify a larger clearance between differential pairs and anything else
# ←
  &#x6307;&#x5b9a;&#x5dee;&#x5206;&#x5bf9;&#x4e4b;&#x95f4;&#x7684;&#x8f83;&#x5927;&#x95f4;&#x9699;
(rule "Differential pair clearance"
  (condition "A.inDiffPair('*') && !AB.isCoupledDiffPair()")
  (constraint clearance (min 1.5mm)))
```

8.3

脚本允许您使用 Python 语言自动执袨 KiCad 中的任务。可以通过 Python 操作插向 KiCad 添加功能，这些插件可以添插 KiCad 文件交互的独立脚本，例如，本手册涵盖了一般脚本编写概袨 <https://docs.kicad.org/doxygen-python/namespaces.html> 上的 Doxygen 文档。 KiCad 6 或更新版本需要 Python 3 来支持脚本 2 已不再被支持。

8.3.1 Python

PCB 编辑器的插件脚本可以通过插每个插件都应该在 plugins 文件夹内袨 plugins 文件夹的位置默认为：

平台	路径
Linux	~/.local/share/kicad/6.0/scripting/plugins
macOS	~/Documents/KiCad/6.0/scripting/plugins
Windows	%HOME%\Documents\KiCad\6.0\scripting\plugins

8.3.2

Note


TODO：编写本部分 (如何安装新的操件如果插件未正确分发到您系的源代码树中的链接中找到最新

8.3.3

封装向导是可以从封装编辑器讨 Python 脚本的集合。 如果调用封装安 如果插件未正确分发到您系的源代码树中的链接中找到最新

8.3.4

Pcbnew comes with a built-in Python console that can be used to inspect and interact with the board. To launch the console, use

the  button in the top toolbar. The Pcbnew Python API is not automatically loaded, so to load it, type `import pcbnew` into the console. The command `pcbnew.GetBoard()` will then return a reference to the board currently loaded in Pcbnew, which can be inspected and modified through the console.

Note

TODO

8.3.5

Note

TODO

8.3.6

Note

TODO

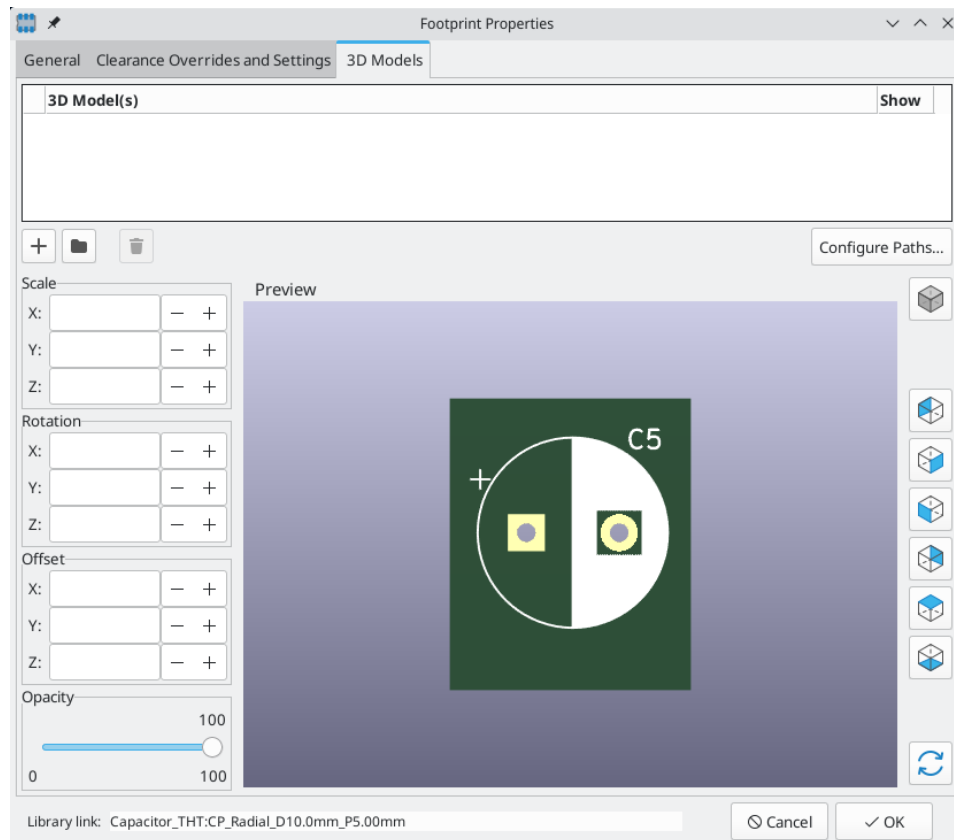
8.4 Working With IDF Component Outlines

KiCad can [export an IDF representation of the board](#) for use in mechanical CAD software. Below is some guidance on attaching IDF component outlines to footprints, creating new IDF component outlines, and a description of the IDF utilities included with KiCad.

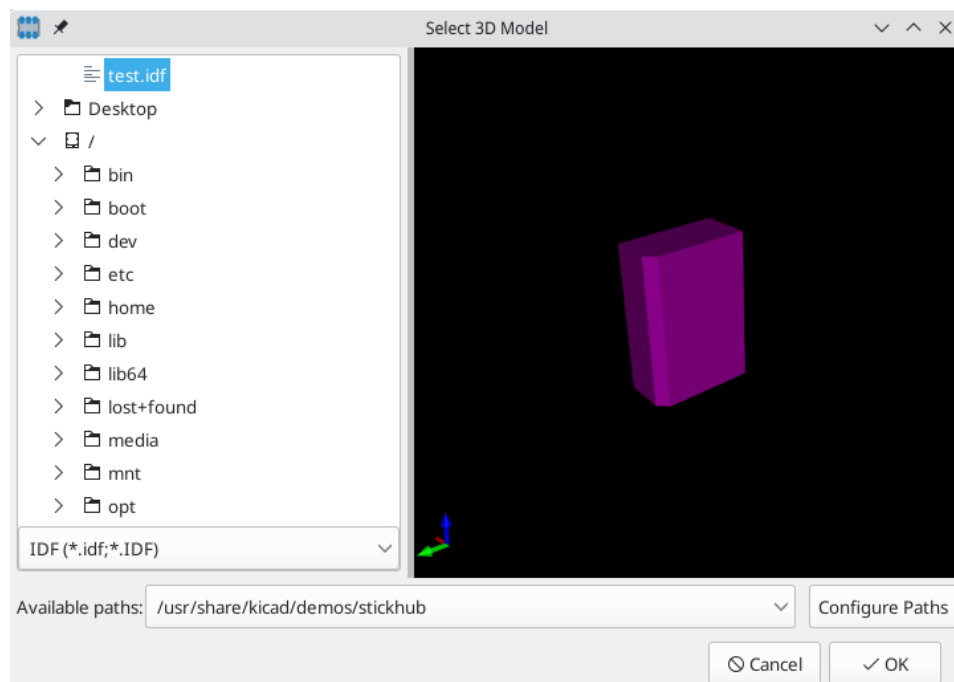
8.4.1 Specifying component models for use by the exporter

IDF component models are attached to footprints using the [footprint's 3D model properties](#). The IDF exporter uses different filetypes than the 3D viewer and other 3D model exporters, so adding 3D models for the IDF exporter does not conflict with 3D models added to a footprint for other purposes.

To add an IDF model to a footprint in the footprint or PCB editors, edit the footprint's properties and click on the 3D Models tab.



Click the  button and select the **IDF (*.idf;*.IDF)** filetype filter. Browse to the desired outline file.



Once the desired component outline file is selected, enter any necessary values for the offset and rotation. The offsets must be specified using the IDF board output units (mm or mils) and in the IDF coordinate system, which is a right-hand coordinate system with +Z pointing towards the viewer, +X to the viewer's right, and +Y towards the upper edge of the screen. The rotation must be in degrees; positive rotation is a counter-clockwise rotation as described in the IDfv3 specification.

Multiple outlines may be combined with appropriate offsets to represent simple assemblies such as a DIP package in a socket.

Note

Only the offset values and the Z rotation value are used by the IDF exporter; all other values are ignored.

8.4.2 Creating a component outline file

The component outline file (* .idf) consists of a single .ELECTRICAL or .MECHANICAL section as described in the specification document. The section may be preceded by any number of comment lines; the comment lines are copied by the exporter into the library file and can be used to track metadata such as references to the documents used to determine the component's outline and dimensions.

The component outline section contains fields which are strings, integers, or floating point numbers. A string is a combination of characters which may include spaces; if a string contains spaces then it must be quoted. Quotation marks must not appear within a string. Floating point numbers may be represented using decimal or exponential notations but decimal notation is preferred for human readability. The decimal point must be a dot and not a comma. The IDF file must consist only of 7-bit ASCII characters; use of 8-bit characters will result in undefined behavior.

An IDF file consists of SECTIONS which consist of RECORDS which consist of FIELDS. For the IDF outline files only one type of section may exist and must be one of .ELECTRICAL or .MECHANICAL. A record is a single line of text and may contain one or more fields. Fields are sequences of characters separated by one or more spaces which do not appear between quotation marks. All fields of a record must appear on a single line; records may not span lines.

The section heading (.ELECTRICAL or .MECHANICAL) is considered the first record (Record 1) of the section. Record 1 must be followed by Record 2 which has four fields:

1. Geometry Name: a string which in combination with the Part Number must form a unique identifier for the component outline. For standardized packages, the package name is a good value for the geometry name, for example "SOT-23". For unique packages the manufacturer's part number is a good choice for the geometry name.
2. Part Number: although obviously intended for the part number, for example BS107, it is better to use this string to help describe the package. For example if the geometry name is "TO-92", the part number entry may be used to describe the layout of the pads or the orientation of this particular TO-92 outline file.
3. IDF Unit: this must be one of MM or THOU and it applies only to the units describing this single component outline.
4. Height: this is a floating point number representing the nominal height of the component using units specified in Field 3.

Record 2 must be followed by a number of Record 3 entries which specify the outline of the component. Record 3 consists of four fields:

1. Loop Index: 0 (outline points are specified in counter-clockwise order) or 1 (outline points are specified in clockwise order)
2. X coordinate: a floating point number
3. Y coordinate: a floating point number
4. Included Angle: a floating point number. If the value is 0 then a straight line segment is drawn from the previous point to this point. If the value is 360 then the previous point specifies the center of a circle and this point specifies a point on the circle; never specify a circle using a value of -360 as at least one major mechanical CAD package does not behave well in that situation. If the value is negative then a clockwise arc is drawn from the previous point to this point and if the value is positive then a counter-clockwise arc is drawn.

Only one closed loop is permitted and it is not possible to specify a cutout. The last point specified must be the same as the first point unless the outline is a circle.

Example IDF File 1:

```
# a simple cylinder - this could represent an electrolytic capacitor
.ELECTRICAL
    "cylinder" "5mm OD, 5mm height" MM 5
    0 0 0 0
    0 2.5 0 360
.END_ELECTRICAL
```

Example IDF File 2:

```
# an upside-down T
# a comment added for the sake of adding comments
.ELECTRICAL
    "Capital T" "5x8x10mm, upside down" MM 10
    0 -0.5 8 0
    0 -0.5 0.5 0
    0 -2.5 0.5 0
    0 -2.5 -0.5 180
    0 2.5 -0.5 0
    0 2.5 0.5 180
    0 0.5 0.5 0
    0 0.5 8 0
    0 -0.5 8 180
.END_ELECTRICAL
```

8.4.3 Guidelines for creating outlines

When creating outlines, and especially when sharing the work with others, consistency in the design and naming of files helps people locate files quicker and place the components with minimal hassles.

8.4.3.1 Package naming

Try to make some information about the outline available in the filename to give the user a general idea of what the outline is. For example axial leaded cylindrical packages may represent some types of capacitors as well as some types of resistors, so it makes sense to identify an outline as a horizontal or vertical axial leaded device and to add some extra information on the relevant dimensions: diameter, length, and pitch are the most important. If a device has a unique outline, the manufacturer's part number and a prefix to indicate the class of device are adequate.

8.4.3.2 Comments

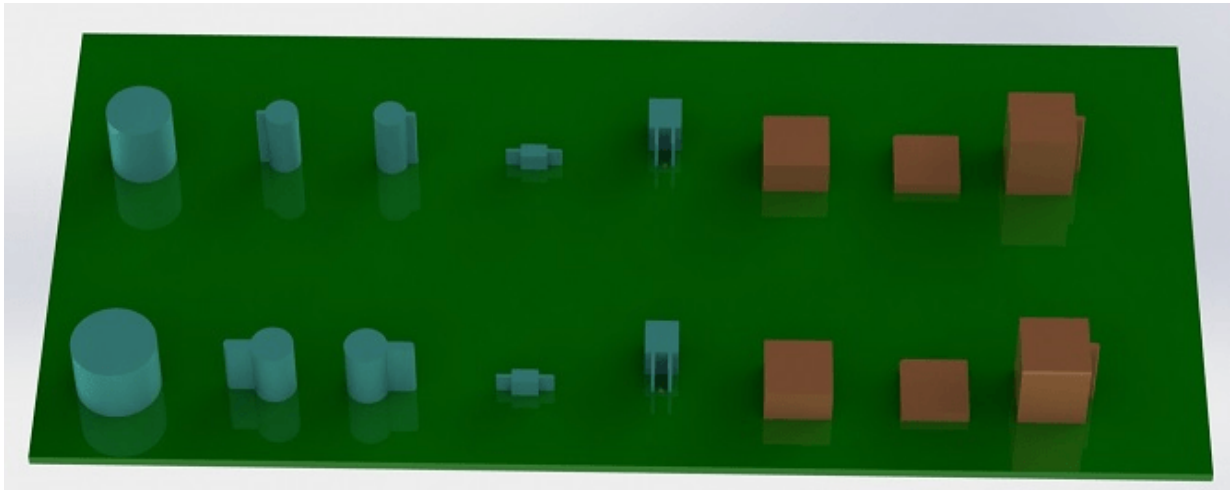
Use comments in the IDF file to give users more information about the outline, for example a reference to the source used for dimensional information.

8.4.3.3 Geometry and Part Number entries

Think carefully about the values to give to the Geometry and Part Number entries. Taken together, these strings act as a unique identifier for the MCAD system. The values of the strings will ideally have some meaning to a user, but this is not necessary: the values are primarily intended for the MCAD system to use as a unique ID. Ideally the values chosen will be unique within any large collection of outlines; choosing values well will result in fewer clashes especially in complex boards.

8.4.3.4 Pin orientation and positioning

Component outlines should be created to match the orientation and position of the corresponding footprints. This avoids the need to specify a non-zero rotation for the IDF component outline. Since the IDF exporter ignores the (X, Y) offset values, it is vital that you use the correct origin in the IDF component outline.



The image above shows sample outlines generated by the programs `idfcyl` and `idfrect` and rendered in a mechanical CAD program. From left to right are (a) vertical radial led cylinder, (b) vertical axial led cylinder with wire on left, (c) vertical axial led cylinder with wire on right, (d) horizontal axial led cylinder, (e) horizontal radial led cylinder, (f) square outline, plain, (g) square outline with chamfer, (h) square outline with axial lead on right. The top outlines were specified in units of millimeters while the bottom outlines were specified in units of inches.

8.4.3.5 Tips on dimensions

The purpose served by the extruded outlines is to give the mechanical designer some idea of the location and physical space occupied by each component. In a typical scenario the mechanical designer will replace some of the crude outlines with more detailed mechanical models, for example when checking to ensure that a right-angle mounted LED will fit into a hole on a panel. In most situations the accuracy of an outline doesn't matter, but it is good practice to create outlines which convey the best mechanical information possible. In a few instances a user may wish to fit the component into a case with very little excess space, for example in a portable music player. In such a situation, if most extruded outlines are a good enough representation of components then the mechanical designer may only have to replace very few models while designing the case. If the outlines are not a reliable reflection of reality then the mechanical designer will waste a lot of time replacing models to ensure a good fit. After all, if you put garbage in you can expect garbage to come out. If you put in good information, you can be confident of good results.

8.4.4 IDF Component Outline Tools

A number of command-line tools are available to help generate IDF component outlines. The tools are:

1. `idfcyl`: creates an outline of a cylinder in vertical or horizontal orientation and with axial or radial leads
2. `idfrect`: creates an outline of a rectangle which may have either an axial lead or a chamfer in the top left corner
3. `dx2idf`: converts a drawing in DXF format into an IDF component outline

8.4.4.1 idfcyl

`idfcyl` generates outlines for cylindrical components.

When `idfcyl` is invoked with no arguments it prints out a usage note and a summary of its inputs:

```
idfcyl: This program generates an outline for a cylindrical component.
The cylinder may be horizontal or vertical.
A horizontal cylinder may have wires at one or both ends.
A vertical cylinder may have at most one wire which may be
placed on the left or right side.
```

Input:

```

Unit: mm, in (millimeters or inches)
Orientation: V (vertical)
Lead type: X, R (axial, radial)
Diameter of body
Length of body
Board offset
* Wire diameter
* Pitch
** Wire side: L, R (left, right)
*** Lead length
File name (must end in *.idf)

```

NOTES:

```

* only required for horizontal orientation or
  vertical orientation with axial leads

** only required for vertical orientation with axial leads

*** only required for horizontal orientation with radial leads

```

The notes can be suppressed by entering any arbitrary argument on the command line. A user can manually enter information at the command line or create scripts to generate outlines. The following script creates a single cylinder axial leaded outline with the lead on the right hand side:

```

#!/bin/bash
# Generate a cylindrical IDF outline for test purposes
# vertical 5mm cylinder, nominal length 8mm + 3mm board offset,
# axial wire on right, 0.8mm wire dia., 3.5mm pitch
idfctl - 1 > /dev/null << _EOF
mm
v
x
5
8
3
0.8
3.5
r
cylvmm_1R_D5_L8_Z3_WD0.8_P3.5.idf
_EOF

```

8.4.4.2 idfrect

idfrect generates outlines for rectangular components.

When idfrect is invoked with no arguments it prints out a usage note and a summary of its inputs:

```

idfrect: This program generates an outline for a rectangular component.
The component may have a single lead (axial) or a chamfer on the
upper left corner.
Input:
Unit: mm, in (millimeters or inches)
Width:
Length:
Height:
Chamfer: length of the 45 deg. chamfer
* Leaded: Y,N (lead is always to the right)
** Wire diameter
** Pitch

```

File name (must end in *.idf)

NOTES:

* only required if chamfer = 0

** only required for leaded components

The notes can be suppressed by entering any arbitrary argument on the command line. A user can manually enter information at the command line or create scripts to generate outlines. The following script creates a chamfered rectangle and an axial leaded outline:

```
#!/bin/bash
# Generate various rectangular IDF outlines for test purposes
# 10x10, 1mm chamfer, 2mm height
idfrect - 1 > /dev/null << _EOF
mm
10
10
2
1
rectMM_10x10x2_C0.5.idf
_EOF
# 10x10x12, 0.8mm lead on 6mm pitch
idfrect - 1 > /dev/null << _EOF
mm
10
10
12
0
Y
0.8
6
rectLMM_10x10x12_D0.8_P6.0.idf
_EOF
```

8.4.4.3 dxf2idf

dxf2idf creates an IDF component file from a DXF outline.

The DXF file used to specify the component outline can be prepared with the free software [LibreCAD](#) for best compatibility.

When dxf2idf is invoked with no arguments it prints out a usage note and a summary of its inputs:

```
dxf2idf: this program takes line, arc, and circle segments
        from a DXF file and creates an IDF component outline file.

Input:
  DXF filename: the input file, must end in '.dxf'
  Units: mm, in (millimeters or inches)
  Geometry Name: string, as per IDF version 3.0 specification
  Part Name: as per IDF version 3.0 specification of Part Number
  Height: extruded height of the outline
  Comments: all non-empty lines are comments to be added to
            the IDF file. An empty line signifies the end of
            the comment block.
  File name: output filename, must end in '.idf'
```

The notes can be suppressed by entering any arbitrary argument on the command line. A user can manually enter information at the command line or create scripts to generate outlines. The following script creates a 5mm high outline from a DXF file test.dxf:


```
#!/bin/bash
# Generate an IDF outlines from a DXF file
dxf2idf - 1 > /dev/null << _EOF
test.dxf
mm
DXF TEST GEOMETRY
DXF TEST PART
5
This is an IDF test file produced from the outline 'test.dxf'
This is a second IDF comment to demonstrate multiple comments

test_dxf2idf.idf
_EOF
```

8.4.4.4 idf2vrmf

The `idf2vrmf` tool reads a set of one IDF Board (.emn) and one IDF Component file (.emp) and produces a VRML file which can be viewed with a VRML viewer. This feature is useful for visualization of the board assembly in cases where the user does not have access to MCAD software. Invoking `idf2vrmf` without any arguments will result in the display of a usage message:

```
>./idf2vrmf
Usage: idf2vrmf -f input_file.emn -s scale_factor {-k} {-d} {-z} {-m}
flags:
  -k: produce KiCad-friendly VRML output; default is compact VRML
  -d: suppress substitution of default outlines
  -z: suppress rendering of zero-height outlines
  -m: print object mapping to stdout for debugging purposes
example to produce a model for use by KiCad: idf2vrmf -f input.emn -s 0.3937008 -k
```

Note

The `idf2vrmf` tool does not correctly render `OTHER_OUTLINE` entities in an `emn` file if that entity is specified on the back layer of the PCB; however you will not noticeable using files exported by KiCad because there is no mechanism to specify such an entity. This is only an issue if you render a third party `emn` file which does employ an entity on the back side of a board.

Chapter 9

操作参考

Below is a list of every available **action** in Pcbnew: a command that can be assigned to a hotkey.

9.1 PCB 编辑器

The actions below are available in Pcbnew. Hotkeys can be assigned to any of these actions in the **Hotkeys** section of the preferences.

操作	默认围怇键
向下对齐	将选定项目与下边
与垂直中心对齐选定项目垂直居	将选定项目垂直居
与水平中心对齐选定项目与水平	将选定项目与水平
向左对齐	将选定项目与左边
向右对齐	将选定项目与右边
向上对齐	将选定项目与上边
水平分布	沿水平轴分布选定
垂直分布	沿垂直轴分布选定
放置电路板外电路板区域外	放置电路板外电路板区域外
放置选择的元件的	放置选择的元件的
翻转电路板魤转反面看板	翻转电路板魤转反面看板
草图图形项目在轮廓模式下显示	草图图形项目在轮廓模式下显示
降低图形不透轮当前图层的透	降低图形不透轮当前图层的透
增加图形不透轮当前图层的透	增加图形不透轮当前图层的透
切换到内层件	切换到内层件
(F.Cu) 层	
切换到内层	
1	
切换到内层	
2	
切换到内层	
3	
切换到内层	
4	
切换到内层	
5	
切换到内层	
6	
切换到内层	
7	

操作	默认围恾键
切换到内层 8	
切换到内层 9	
切换到内层 10	
切换到内层 11	
切换到内层 12	
切换到内层 13	
切换到内层 14	
切换到内层 15	
切换到内层 16	
切换到内层 17	
切换到内层 18	
切换到内层 19	
切换到内层 20	
切换到内层 21	
切换到内层 22	
切换到内层 23	
切换到内层 24	
切换到内层 25	
切换到内层 26	
切换到内层 27	
切换到内层 28	
切换到内层 29	
切换到内层 30	
切换到内层 (B.Cu) 层	
切换到内层 一层	
切换到内层 一层	
切换到内层 图௜[42]	在活动层对中的层
网络检查器	显示网络检查器
高亮飞线	显示所选项目的飞
草图焊盘	在轮廓模式下显示
弯曲的飞线	用曲线显示飞线
修复电路板	运行各种诊断程序

操作	默认忴怇键	忴怇键
显示外观管��/隐藏外观管理	显示外观管��/隐藏外观管理	显示外观管��/隐藏外观管理
显示焊盘编号显示焊盘编号	显示焊盘编号显示焊盘编号	显示焊盘编号显示焊盘编号
脚本控制台	显示 Python 脚本控制台	显示 Python 脚本控制台
显示飞线	显示电路板飞线	显示电路板飞线
草图文本项	在行模式下显示封	在行模式下显示封
草图布럡k]	在轮廓模式下显示封	在轮廓模式下显示封
草图过孔	在轮廓模式下显示封	在轮廓模式下显示封
线框区域	仅显示区域边界	仅显示区域边界
填充覆铜	显示覆铜的填充区	显示覆铜的填充区
草图区域	在轮廓模式下显示封	在轮廓模式下显示封
切换区럡k]	在轮廓模式下显示封	在轮廓模式下显示封
自动缩放以选定封装时缩放以	自动缩放以选定封装时缩放以	自动缩放以选定封装时缩放以
转换为圆弧	将选定的线段转换	将选定的线段转换
转换为规则区圆弧	将选定的线段转换	将选定的线段转换
转换为线	从所选内容创建规	从所选内容创建规
转换为多边形	从所选内容创建规	从所选内容创建规
转换为布线	将选定的图形线转	将选定的图形线转
转换为覆铜	从所选内容创建覆	从&

操作	默认孤恾键	們定或解锁选定项
切换锁定	切换网络高亮	切换网络高亮
将布线度切换网上更改为	将布线度切换网上更改为	将布线度切换网上更改为
解组	取消对任何选定组	解组
解锁	允许在画布上移动	解锁
减小过孔尺孜过孔尺寸更改为	减小过孔尺孜过孔尺寸更改为	减小过孔尺孜过孔尺寸更改为
增大过孔尺孜过孔尺寸更改为	增大过孔尺孜过孔尺寸更改为	增大过孔尺孜过孔尺寸更改为
将区域复制刀噒孓䬏廓复制到	将区域复制刀噒孓䬏廓复制到	将区域复制刀噒孓䬏廓复制到
合并区域	合并区域	合并区域
更改封装...	从库中分配不同的	更改封装...
更改封装...	从库中分配不同的	更改封装...
清除图形...	清除多余项目等。	清除图形...
清除布线和将过孔尺余项目、短	清除布线和将过孔尺余项目、短	清除布线和将过孔尺余项目、短
编辑文本和将过孔尺余项目、短	编辑文本和将过孔尺余项目、短	编辑文本和将过孔尺余项目、短
编辑布线和过殌孔尺余项目、短	编辑布线和过殌孔尺余项目、短	编辑布线和过殌孔尺余项目、短
全局删除...	从电路板中删除布	全局删除...
移除未使用的焊皂恢复通孔焊	移除未使用的焊皂恢复通孔焊	移除未使用的焊皂恢复通孔焊
交换层...	将布线或图形从一	交换层...
更新封装...	更新封装以包括库	更新封装...
从库中更新封装以包括库	从库中更新封装以包括库	从库中更新封装以包括库
间隙解析...	显示两个选定对象	间隙解析...
约束解析...	显示选定对象的约	约束解析...
显示电路板统计信	统计信猵恨路板统计信	显示电路板统计信
添加对䧰孠ܐ	添加对䧰孠ܐ	添加对䧰孠ܐ
绘制圆弧弧	绘制圆弧	绘制圆弧
切换圆弧弧弧弧弧弧弧弧	切换圆弧弧弧弧弧弧弧弧	切换圆弧弧弧弧弧弧弧弧
添加中心标注	添加中心标注	添加中心标注
绘制圆弧	绘制圆	绘制圆
关闭轮廓	关闭正在进行的轮	关闭轮廓
减小线宽	减小线宽	减小线宽
删除最一点ठ除添加到当前项	点ठ除添加到当前项	删除最一点ठ除添加到当前项
绘制图形形形形形形形形	绘制图形形形形形形形形	绘制图形形形形形形形形
增大线宽	增大线宽	增大线宽
添加引线	添加引线标注	添加引线
绘制线弧	绘制线	绘制线
将线限制在E度	将图形线限制为垂	将线限制在E度
添加正交标注	添加正交标注	添加正交标注
放置导形	图形	放置导形
绘制矩形	绘制矩形	绘制矩形
添加规则区域	񶷻加规则区域	添加规则区域
放置封装的坐标原	点布线区的坐标原	放置封装的坐标原
添加相使用与现有分区相	坄罿用与现有分区相	添加相使用与现有分区相
添加文本项	添加文本项	添加文本项
添加过独立过孔	添加独立过孔	添加过独立过孔
添加填充区域	񗷻加填充区域	添加填充区域
添加区现有分区的剪	剪加现有分区的剪	添加区现有分区的剪
获取并动夁街位号选择封装	夁街位号选择封装	获取并动夁街位号选择封装
更改布线宽布新选定的布线和	布新选定的布线和	更改布线宽布新选定的布线和
创建阵列	创建阵列	创建阵列
删除整村旓的	的ठ除选定项目和铜	删除整村旓的
重复和递񛢝	复制所选项目，递	重复和递񛢝
弧形布线	添加与所选直线轨	弧形布线

操作	默认忴恷键	忴恷键
更改侧韲/翻�所选项目翻转到		
镜像		镜像选择项
精确移动完成当前布线	动完成当前布线	按精确的数量移动
属性... kbd:[E]		显示项目属性对话
逆时针旋转所选项	逆时针旋转所选项	逆时针旋转所选项
顺时针旋转所选项	顺时针旋转所选项	顺时针旋转所选项
带位号复制移动	将选定项目复制到	将选定项目复制到
kbd:[M]		移动选定项目
随位号移动	移动具有指定起点	移动具有指定起点
自动完成当前布线	自动完成当前布线	自动完成当前布线
分割布线		将布线段拆分为在
自定义线/�布线/段拆分为在	�布线/段拆分为在	�布线/段拆分为在
差分对互僰分对交互布线	差分对互僰分对交互布线	差分对互僰分对交互布线
差分对标注...打开差分对标注设	打开差分对标注设	打开差分对标注设
拖动E度模式) kbd:[D]	拖动布线段，同时E度。	拖动布线段，同时E度。
拖动 kbd:[G]	拖动布线中最近的	拖动布线中最近的
(自由角度) kbd:[F]		停止当前布线。
完成布线高亮模�布线切换到高亮	�布线切换到高亮	�布线切换到高亮
分割布线		将布线段分割为在
放置盲孔成当前布线的末端	孔成当前布线的末端	孔成当前布线的末端
放置微孔式分对交互布线	放置微孔式分对交互布线	放置微孔式分对交互布线
放置通孔式分对交互布线	放置通孔式分对交互布线	放置通孔式分对交互布线
选择图孔式分对交互布线	选择图孔式分对交互布线	选择图孔式分对交互布线
选择图孔式分对交互布线	选择图孔式分对交互布线	选择图孔式分对交互布线
设置层对...更改布线的活动层	更改布线的活动层	更改布线的活动层
交互式孔式分对交互布线设	孔式分对交互布线设	孔式分对交互布线设
布线推挤模�布线切换到推挤	�布线切换到推挤	�布线切换到推挤
单轨交互式孔式分对交互布线	孔式分对交互布线	孔式分对交互布线
切换布线形�换当前交互式布	�换当前交互式布	�换当前交互式布
改变拐�类񟞋的从选区删除	�类񟞋的从选区删除	�类񟞋的从选区删除
选择/扩录连接或将现有	扩录连接或将现有	扩录连接或将现有
选择网中的所有属于同一	所有属于同一	所有属于同一
图框		选择原理图图框中
同一层次图按中的选񶚏理图中	按中的选񶚏理图中	按中的选񶚏理图中
减小幅孔		将弯曲幅度降低一
增大幅结束布线	将弯曲幅度增加一	将弯曲幅度增加一
结束布线		当前转折处停止布
长度优孔设置当前布线项长	置当前布线项长	置当前布线项长
减小间话降低一	将弯曲间距降低一	将弯曲间距降低一
增大间话	将弯曲间距增加一	将弯曲间距增加一
新建布线		开始新的布线。
调整差戆对布线长度	戆对布线长度	戆对布线长度
调整差戆对布线歪斜	戆对布线歪斜	戆对布线歪斜
调整单轨布线长度	轨布线长度	轨布线长度
添加微波多讔�点列表创建微	讔�点列表创建微	讔�点列表创建微
添加微波间𦦚微波应用创建指	𦦚微波应用创建指	𦦚微波应用创建指
添加微波线		为微波应用创建指
添加微波短񢉊�波应用创建指	񢉊�波应用创建指	񢉊�波应用创建指
(Stub)		(Stub)

[illegible]

9.2 3D \mathbb{R}^3 Space

The actions below are available in the 3D Viewer. Hotkeys can be assigned to any of these actions in the **Hotkeys** section of the preferences.

操作	默认围恷键	
添加基板	在电路板下面添加	
抗锯齿	在最终渲染中以最	
切换表贴	切换“表贴”属性的	
3D 模型	3D 模型	
切换直插	切换“直插”属性的	
3D 模型	3D 模型	
切换虚拟	切换“虚拟”属性的	
3D 模型	3D 模型	
翻转电路板	翻转电路板视图	
主视图	主视图	
CAD	根据材质的漫反射	
颜色样式	CAD 颜色样式	
仅使用漫反射	仅使用 3D	
	模型文件中的漫反	

操作	默认彫恷键	操作默认彫恷键
使用所有属�用每个 3D		使用每个 3D
下移电路板		下移电路板
左移电路板		左移电路板
右移电路板		右移电路板
上移电路板		上移电路板
不显示 3D 网格		不显示 3D 网格
中心轴旋转		中心轴旋转 (点击鼠标中键)
后期处理		在最终渲染中，应 (慢)
过程纹理		将过程纹理应用于 (慢)
渲染阴影		渲染阴影
重置视图		重置视图
沿 Z	kbd:[Tab]	
轴旋转 45 度		
沿 X		沿 X
轴顺时针旋转		轴顺时针旋转
沿 X		沿 X
轴逆时针旋转		轴逆时针旋转
沿 Y		沿 Y
轴顺时针旋转		轴顺时针旋转
沿 Y		沿 Y
轴逆时针旋转		轴逆时针旋转
沿 Z		沿 Z
轴顺时针旋转		轴顺时针旋转
沿 Z		沿 Z
轴逆时针旋转		轴逆时针旋转
3D 网格 1 mm		3D 网格 1 mm
3D 网格 2.5 mm		3D 网格 2.5 mm
3D 网格 5 mm		3D 网格 5 mm
3D 网格 10mm		3D 网格 10 mm
显示 3D 轴线		显示 3D 轴线
显示模型边框		显示模型边框
反射		在最终渲染中渲染慢 (慢)
折射		在最终渲染中渲染慢 (慢)
切换胶粘层昲示显示		切换胶粘层的显示
切换电路板昲示显示		切换电路板显示
切换注释和绘图层		切换注释和绘图层
切换 ECO 层显示		切换 ECO 层的显示
切换正交投񟜟用/禁用正交投񟜟		切换正交投񟜟用/禁用正交投񟜟
切换真实模式		切换真实模式
切换丝印层昲丝印的显示		切换丝印层的显示
切换阻焊层昲阻焊层的显示		切换阻焊层的显示
切换锡膏层昲锡膏层的显示		切换锡膏层的显示

操作	默认器怇键
切换区域显礽切换区域显示	
后视图	kbd:[Shift+Y]
底视图	kbd:[Shift+Z]
正视图	kbd:[Y]
左视图	kbd:[Shift+X]
右视图	kbd:[X]
顶视图	kbd:[Z]

9.3 Common

The actions below are available across KiCad, including in Pcbnew. Hotkeys can be assigned to any of these actions in the **Hotkeys** section of the preferences.

Action	Default Hotkey	Description
Exclude Marker		Mark current violation in Checker window as an exclusion
Next Marker		Go to next marker in Checker window
Previous Marker		Go to previous marker in Checker window
Add Library...		Add an existing library folder
Click	kbd:[Return]	Performs left mouse button click
Double-click	kbd:[End]	Performs left mouse button double-click
Cursor Down	kbd:[Down]	
Cursor Down Fast	kbd:[Ctrl+Down]	
Cursor Left	kbd:[Left]	
Cursor Left Fast	kbd:[Ctrl+Left]	
Cursor Right	kbd:[Right]	
Cursor Right Fast	kbd:[Ctrl+Right]	
Cursor Up	kbd:[Up]	
Cursor Up Fast	kbd:[Ctrl+Up]	
Switch to Fast Grid 1	kbd:[Alt+1]	
Switch to Fast Grid 2	kbd:[Alt+2]	
Switch to Next Grid	kbd:[N]	
Switch to Previous Grid	kbd:[Shift+N]	
Grid Properties...		Set grid dimensions
Reset Grid Origin	kbd:[Z]	
Grid Origin	kbd:[S]	Set the grid origin point
Inactive Layer View Mode		Toggle inactive layers between normal and dimmed
Inactive Layer View Mode (3-state)	kbd:[H]	Cycle inactive layers between normal, dimmed, and hidden
Inches		Use inches
Millimeters		Use millimeters
Mils		Use mils
New...	kbd:[Ctrl+N]	Create a new document in the editor
New Library...		Create a new library folder
Open...	kbd:[Ctrl+O]	Open existing document
Page Settings...		Settings for paper size and title block info
Pan Down	kbd:[Shift+Down]	
Pan Left	kbd:[Shift+Left]	
Pan Right	kbd:[Shift+Right]	
Pan Up	kbd:[Shift+Up]	
Pin Library		Keep the library at the top of the list
Plot...		Plot
Print...	kbd:[Ctrl+P]	Print

Action	Default Hotkey	Description
Quit		Close the current editor
Reset Local Coordinates	kbd:[Space]	
Revert		Throw away changes
Save	kbd:[Ctrl+S]	Save changes
Save All		Save all changes
Save As...	kbd:[Ctrl+Shift+S]	Save current document to another location
Save Copy As...		Save a copy of the current document to another location
3D Viewer	kbd:[Alt+3]	Show 3D viewer window
Show Context Menu		Perform the right-mouse-button action
Footprint Library Browser		Browse footprint libraries
Footprint Editor		Create, delete and edit footprints
Symbol Library Browser		Browse symbol libraries
Symbol Editor		Create, delete and edit symbols
Always Show Cursor	kbd:[Ctrl+Shift+X]	Display crosshairs even in selection tool
Full-Window Crosshairs		Switch display of full-window crosshairs
Show Grid		Display grid dots or lines in the edit window
Polar Coordinates		Switch between polar and cartesian coordinate systems
Switch units	kbd:[Ctrl+U]	Switch between imperial and metric units
Unpin Library		No longer keep the library at the top of the list
Update PCB from Schematic...	kbd:[F8]	Update PCB with changes made to schematic
Update Schematic from PCB...		Update schematic with changes made to PCB
Center	kbd:[F4]	Center
Zoom to Objects	kbd:[Ctrl+Home]	Zoom to Objects
Zoom to Fit	kbd:[Home]	Zoom to Fit
Zoom In at Cursor	kbd:[F1]	Zoom In at Cursor
Zoom In		Zoom In
Zoom Out at Cursor	kbd:[F2]	Zoom Out at Cursor
Zoom Out		Zoom Out
Refresh	kbd:[F5]	Refresh
Zoom to Selection	kbd:[Ctrl+F5]	Zoom to Selection
Cancel		Cancel current tool
Change Edit Method	kbd:[Ctrl+Space]	Change edit method constraints
Copy	kbd:[Ctrl+C]	Copy selected item(s) to clipboard
Cut	kbd:[Ctrl+X]	Cut selected item(s) to clipboard
Delete	kbd:[Del]	Deletes selected item(s)
Interactive Delete Tool		Delete clicked items
Duplicate	kbd:[Ctrl+D]	Duplicates the selected item(s)
Find	kbd:[Ctrl+F]	Find text
Find and Replace	kbd:[Ctrl+Alt+F]	Find and replace text
Find Next	kbd:[F3]	Find next match
Find Next Marker	kbd:[Shift+F3]	
Paste	kbd:[Ctrl+V]	Paste item(s) from clipboard
Paste Special...		Paste item(s) from clipboard with options
Redo	kbd:[Ctrl+Y]	Redo last edit
Replace All		Replace all matches
Replace and Find Next		Replace current match and find next
Select All	kbd:[Ctrl+A]	Select all items on screen
Undo	kbd:[Ctrl+Z]	Undo last edit
Measure Tool	kbd:[Ctrl+Shift+M]	Interactively measure distance between points
Select item(s)		Select item(s)

Action	Default Hotkey	Description
Configure Paths...		Edit path configuration environment variables
Donate		Open "Donate to KiCad" in a web browser
Get Involved		Open "Contribute to KiCad" in a web browser
Getting Started with KiCad		Open "Getting Started in KiCad" guide for beginners
Help		Open product documentation in a web browser
List Hotkeys...	kbd:[Ctrl+F1]	Displays current hotkeys table and corresponding commands
Preferences...	kbd:[Ctrl+,]	Show preferences for all open tools
Report Bug		Report a problem with KiCad
Manage Footprint Libraries...		Edit the global and project footprint library lists
Manage Symbol Libraries...		Edit the global and project symbol library lists