

Editor degli schemi elettrici

The KiCad Team

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Manuale di riferimento

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.

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Traduzione

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Feedback

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/>

Introduzione all'editor schemi elettrici di KiCad

Descrizione

L'editor degli schemi di KiCad è un software distribuito come parte della suite KiCad, e disponibile per i seguenti sistemi operativi:

- Linux
- Apple macOS
- Windows

Indipendentemente dal sistema operativo, tutti i file KiCad sono 100% compatibili da un sistema all'altro.

L'editor degli schemi è un'applicazione integrata dove tutte le funzioni di disegno, controllo, disposizione, gestione librerie e accesso al software di progettazione di circuiti stampati sono svolte all'interno dell'editor stesso.

L'editor degli schemi elettrici di KiCad è stato concepito per cooperare il programma per la progettazione di circuiti stampati della suite di KiCad. Esso può anche esportare file di netlist, che descrivono le connessioni elettriche dello schema usabili da altri software.

L'editor degli schemi include un editor di librerie di simboli, che può creare e modificare simboli e gestire librerie. Esso integra le seguenti funzioni, aggiuntive ma essenziali, necessarie in ogni moderno software di elaborazione schemi elettrici:

- Controllo regole di progettazione (ERC) per il controllo automatico di connessioni errate o sconnesse
- Esportazione di file del disegno dello schema in molti formati (Postscript, PDF, HPGL e SVG).
- Generazione della distinta materiali (tramite script Python o XSLT, che consentono di modellarla in molti formati).

The Schematic Editor supports multi-sheet schematics in several ways:

- Flat hierarchies (schematic sheets are not explicitly connected in a master diagram).
- Simple hierarchies (each schematic sheet is used only once).
- Complex hierarchies (some schematic sheets are used multiple times).

Hierarchical schematics are described in detail [later in the manual](#).

Configurazione iniziale

When the Schematic Editor is run for the first time, if the the global symbol library table file `sym-lib-table` is not found in the KiCad configuration folder then KiCad will ask how to create this file:

Configure Global Symbol Library Table

KiCad has been run for the first time using the new symbol library table for accessing libraries. In order for KiCad to access symbol libraries, you must configure your global symbol library table. Please select from one of the options below. If you are not sure which option to select, please use the default selection.

- Copy default global symbol library table (recommended)
- Copy custom global symbol library table
- Create an empty global symbol library table

Select global symbol library table file:

(None)



OK

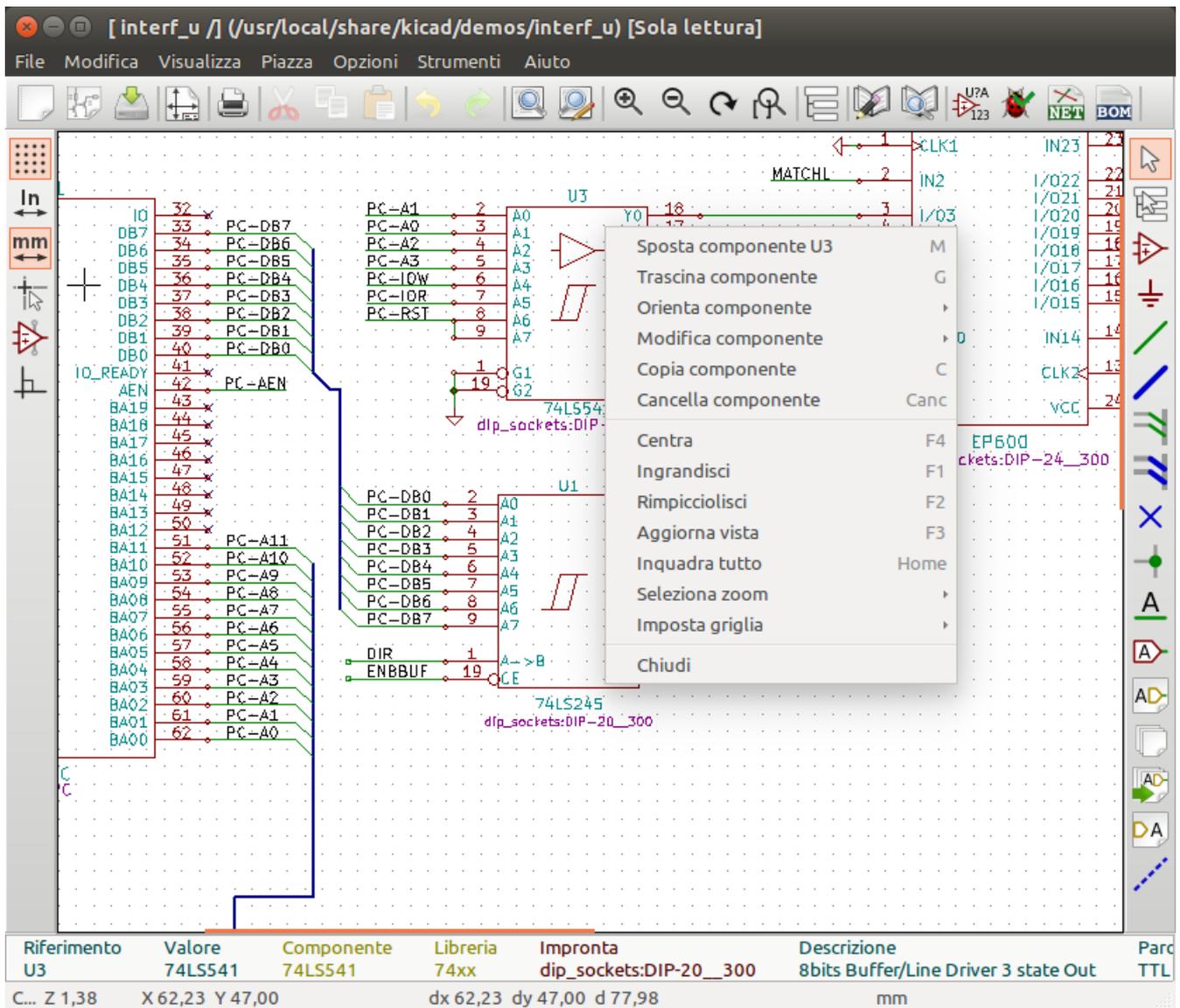
The first option is recommended (**Copy default global symbol library table (recommended)**). The default symbol library table includes all of the standard symbol libraries that are installed as part of KiCad.

If this option is disabled, KiCad was unable to find the default global symbol library table. This probably means you did not install the standard symbol 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 symbol libraries and want to use them, but the first option is disabled, select the second option and browse to the `sym-lib-table` file in the directory where the KiCad libraries were installed.
- If you already have a custom symbol library table that you would like to use, select the second option and browse to your `sym-lib-table` file.
- If you want to construct a new symbol library table from scratch, select the third option.

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

The Schematic Editor User Interface



The main Schematic Editor user interface is shown above. The center contains the main editing canvas, which is surrounded by:

- Top toolbars (file management, zoom tools, editing tools)
- Left toolbar (display options)
- Message panel and status bar at bottom
- Right panel (drawing and design tools)

Navigating the editing canvas

The editing canvas displays the schematic being designed. You can pan and zoom to different parts of the schematic and open any schematic sheet in the design.

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 . This is useful for measuring distance between two points or aligning objects.

Comandi da tastiera

The  +  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  key in place of , and the  key in place of .

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

NOTE

Many of the actions available through hotkeys are also available in context menus. To access the context menu, right-click in the editing canvas. Different actions will be available depending on what is selected or what tool is active.

I comandi da tastiera sono memorizzati nel file `user.hotkeys` nella cartella di configurazione di KiCad. La posizione cambia a seconda della piattaforma:

- 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.

Mouse operations and selection

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.

The selection action can be modified by holding modifier keys while clicking or dragging. The following modifier keys apply when clicking to select single items:

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

The following modifier keys apply when dragging to perform a box selection:

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

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.

Pressing Esc will always cancel the current tool or operation and return to the selection tool. Pressing Esc while the selection tool is active will clear the current selection.

Left toolbar display controls

The left toolbar provides options to change the display of items in the Schematic Editor.

	<p>Turns grid display on/off.</p> <p>Note: by default, hiding the grid will disable grid snapping. This behavior can be changed in the Display Options section of Preferences.</p>
  	<p>Display/entry of coordinates and dimensions in inches, mils, or millimeters.</p>
	<p>Switches between full-screen and small editing cursor (crosshairs).</p>
	<p>Turns invisible pin display on/off.</p>
	<p>Switches between free angle and horizontal/vertical placement of new wires, buses, and graphical lines.</p>

Creazione e modifica di schemi elettrici

Introduzione

Uno schema elettrico progettato con KiCad è più di una semplice rappresentazione grafica di un dispositivo elettronico. Esso normalmente è il punto di ingresso di una catena di sviluppo che permette:

- Il controllo di validità rispetto ad una serie di regole ([Controllo Regole Elettriche \(ERC\)](#)) per il rilevamento di errori e omissioni.
- Automaticamente generando a [bill of materials](#).
- La [generazione di una netlist](#) per software di simulazione tipo SPICE.
- [Defining a circuit](#) for transferring to PCB layout.

Uno schema elettrico consiste principalmente di simboli, fili, etichette, giunzioni, porte bus e pin di potenza. Per chiarezza, negli schemi elettrici, è possibile inserire elementi puramente grafici come elementi bus, commenti, e polilinee.

Symbols are added to the schematic from symbol libraries. After the schematic is made, the set of connections and footprints is imported into the PCB editor for designing a board.

Schematics can be contained in a single sheet or split among multiple sheets. In KiCad, multi-sheet schematics are organized hierarchically, with a root sheet and sub-sheet(s). Each sheet is its own `.kicad_sch` file and is itself a complete KiCad schematic. Working with hierarchical schematics is described in the [Hierarchical Schematics](#) chapter.

Schematic editing operations

Schematic editing tools are located in the right toolbar. When a tool is activated, it stays active until a different tool is selected or the tool is canceled with the  key. The selection tool is always activated when any other tool is canceled.

	Selection tool (the default tool)
	Highlight a net by marking its wires and net labels with a different color. If the PCB Editor is also open then copper corresponding to the selected net will be highlighted as well. Net highlighting can be cleared by clicking with the highlight tool in an empty space, or by using the Clear Net Highlighting hotkey ().
	Display the symbol selector dialog to place a new symbol.
	Display the power symbol selector dialog to place a new power symbol.
	Draw a wire.
	Draw a bus.
	Draw wire-to-bus entry points. These elements are only graphical and do not create a connection, thus they should not be used to connect wires together.
	Place a "No Connect" flag. These flags should be placed on symbol pins which are meant to be left unconnected. "No connect" flags indicate to the Electrical Rule Checker that the pin is intentionally unconnected and not an error.
	Place a junction. This connects two crossing wires or a wire and a pin, which can sometimes be ambiguous without a junction (i.e. if a wire end or a pin is not directly connected to another wire end).
	Place a local label. Local labels connect items located in the same sheet . For connections between two different sheets, use global or hierarchical labels.
	Place a global label. All global labels with the same name are connected, even when located on different sheets.
	Place a hierarchical label. Hierarchical labels are used to create a connection between a subsheet and the sheet's parent sheet. See the Hierarchical Schematics section for more information about hierarchical labels, sheets, and pins.
	Place a hierarchical subsheet. You must specify the file name for this subsheet.
	Import a hierarchical pin from a subsheet. This command can be executed only on hierarchical subsheets. It will create hierarchical pins corresponding to hierarchical labels placed in the target subsheet.
	Draw lines. Note: Lines are graphical objects and are not the same as wires placed with the Wire tool. They do not connect anything.
	Place a text comment.
	Place a bitmap image.
	Delete clicked items.

Grids

Nell'editor degli schemi il puntatore si sposta sempre sopra una griglia. La griglia può essere personalizzata:

- La dimensione è modificabile usando il tasto destro del mouse o usando **Visualizza** → **Proprietà griglia....**
- I colori possono essere modificati tramite la scheda **Colori** presente nella finestra di dialogo delle **Preferenze** (menu **Preferenze** → **Opzioni generali**).
- La visibilità può essere accesa/spenta usando il pulsante corrispondente nella barra strumenti di sinistra.

La dimensione predefinita della griglia è 50 mils (0.050") o 1,27 millimetri.

This is the recommended grid for placing symbols and wires in a schematic, and for placing pins when designing a symbol in the Symbol Editor.

NOTE

Wires connect with other wires or pins only if their ends coincide **exactly**. Therefore it is very important to keep symbol pins and wires aligned to the grid. It is recommended to always use a 50 mil grid when placing symbols and drawing wires because the KiCad standard symbol library and all libraries that follow its style also use a 50 mil grid. **Using a grid size other than 50 mil will result in schematics without proper connectivity!**

Smaller grids can also be used, but this is intended only for text and symbol graphics, and not recommended for placing pins and wires.

NOTE

Symbols, wires, and other elements that are not aligned to the grid can be snapped back to the grid by selecting them, right clicking, and clicking **Align Elements to Grid**.

Snapping

Schematic elements such as symbols, wires, text, and graphic lines are snapped to the grid when moving, dragging, and drawing them. Additionally, the wire tool snaps to pins even when grid snapping is disabled. Both grid and pin snapping can be disabled while moving the mouse by using the modifier keys in the table below.

NOTE

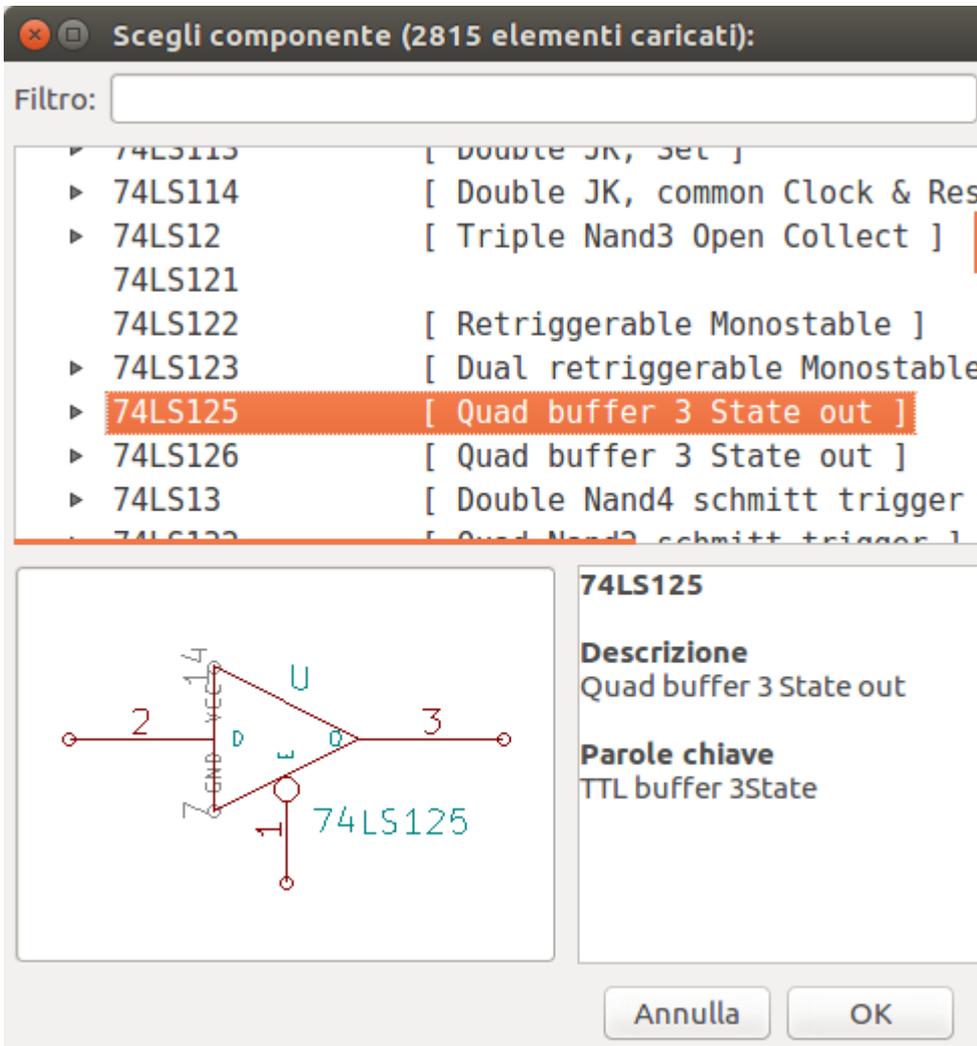
On Apple keyboards, use the **Cmd** key instead of **Ctrl**.

Modifier Key	Effect
Ctrl	Disable grid snapping.
Shift	Disable snapping wires to pins.

Working with symbols

Placing symbols

To load a symbol into your schematic you can use the icon . A dialog box allows you to type the name of the symbol to load.



The Choose Symbols dialog will filter symbols by name, keywords, and description according to what you type into the search field.

Some advanced filters are available:

- **Wildcards:** use the characters `?` and `*` respectively to mean "any single character or no characters" and "any number of any characters, including none".
- **Key-value pairs:** if a library part's description or keywords contain a tag of the format "Key:123", you can match relative to that by typing "Key>123" (greater than), "Key<123" (less than), etc. Numbers may include one of the following case-insensitive suffixes:

p	n	u	m	k	meg	g	t
10^{-12}	10^{-9}	10^{-6}	10^{-3}	10^3	10^6	10^9	10^{12}

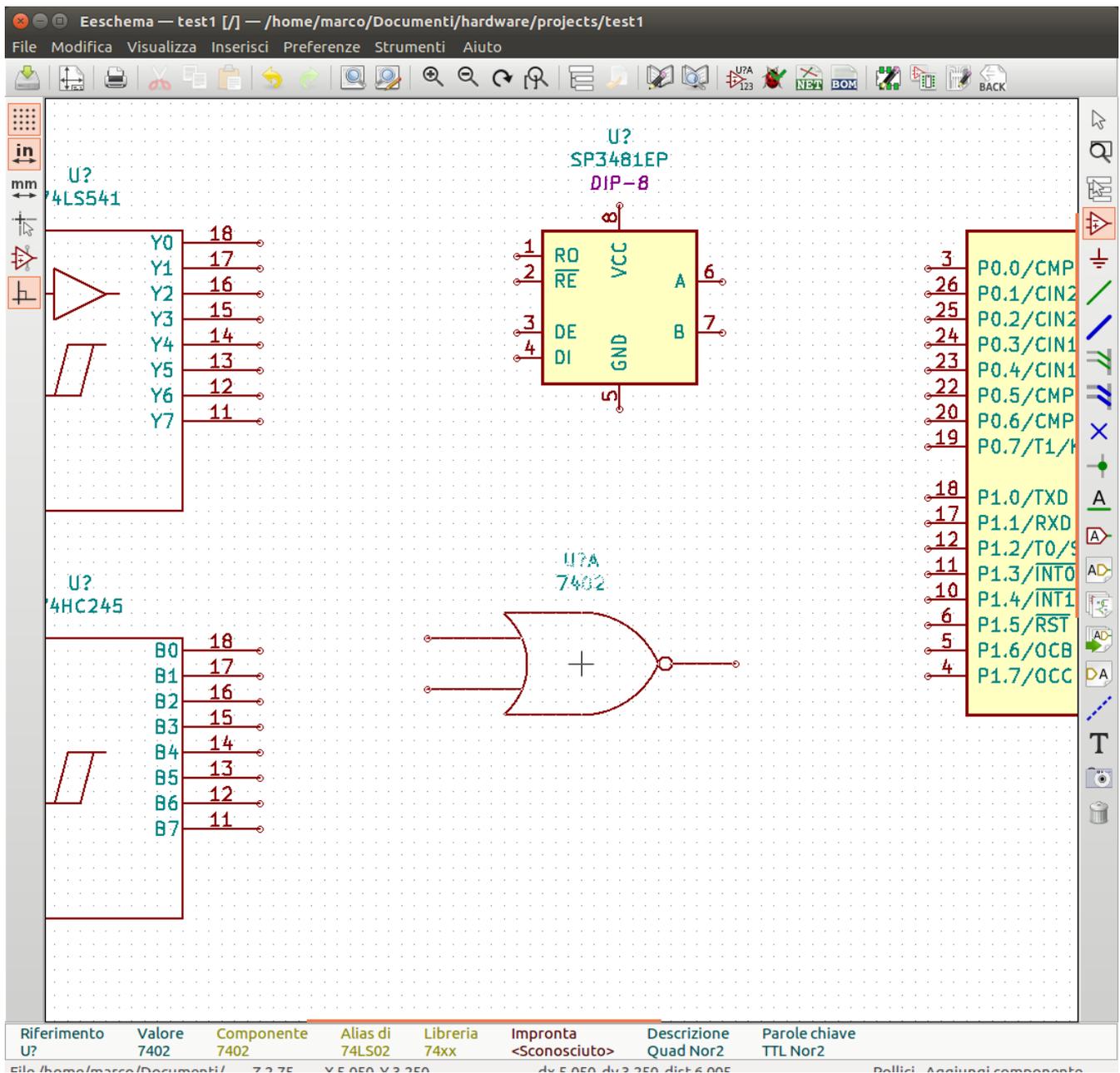
ki	mi	gi	ti
2^{10}	2^{20}	2^{30}	2^{40}

- **Regular expressions:** if you're familiar with regular expressions, these can be used too. The regular expression flavor used is the [wxWidgets Advanced Regular Expression style](#), which is similar to Perl regular expressions.

If the symbol specifies a default footprint, this footprint will be previewed in the lower right. If the symbol includes footprint filters, alternate footprints that satisfy the footprint filters can be selected in the footprint dropdown menu at right.

After selecting a symbol to place, the symbol will be attached to the cursor. Left clicking the desired location in the schematic places the symbol into the schematic. Before placing the symbol in the schematic, you can rotate it, mirror it, and edit its fields, by either using the hotkeys or the right-click context menu. These actions can also be performed after placement.

Ecco un simbolo durante il piazzamento:



If the **Place repeated copies** option is checked, after placing a symbol KiCad will start placing another copy of the symbol. This process continues until the user presses **Esc**.

For symbols with multiple units, if the **Place all units** option is checked, after placing the symbol KiCad will start placing the next unit in the symbol. This continues until the last unit has been placed or the user presses **Esc**.

Piazzamento porte di potenza

A **power port symbol** is a symbol representing a connection to a power net. The symbols are grouped in the **power** library, so they can be placed using the symbol chooser. However, as power placements are frequent, the  tool is available. This tool is similar, except that the search is done directly in the **power** library and any other library that contains power symbols.

Moving symbols

Symbols can be moved using the Move (**M**) or Drag (**G**) tools. These tools act on the selected symbol, or if no symbol is selected they act on the symbol under the cursor.

The **Move** tool moves the symbol itself without maintaining wired connections to the symbol pins.

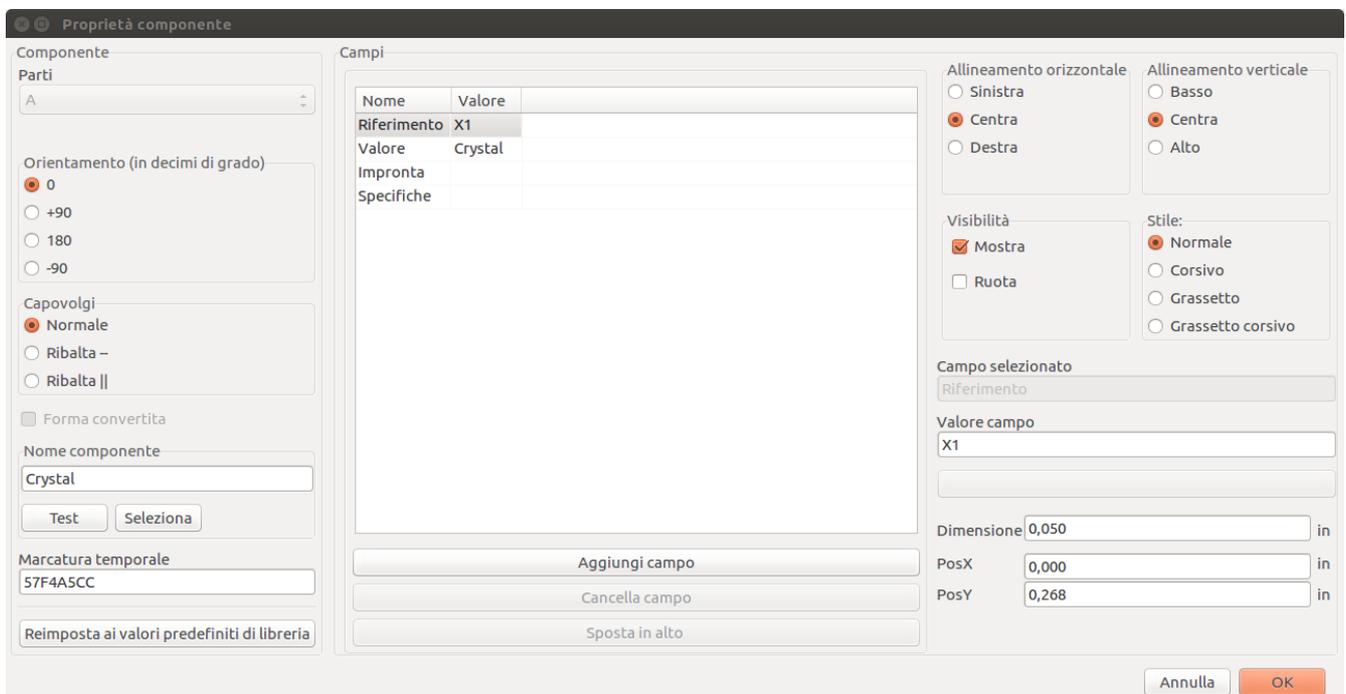
The **Drag** tool moves the symbol without breaking wired connections to its pins, and therefore moves the connected wires as well.

You can also Drag symbols by clicking and dragging them with the mouse, depending on the **Left button drag gesture** setting in the **Mouse and Touchpad** section of Preferences.

Symbols can also be rotated (**R**) or mirrored in the X (**X**) or Y (**Y**) directions.

Editing symbol properties

A symbol's fields can be edited in the symbol's Properties window. Open the Symbol Properties window for a symbol with the **E** hotkey or by double-clicking on the symbol.



The Symbol Properties window displays all the fields of a symbol in a table. New fields can be added, and existing fields can be deleted, edited, reordered, moved, or resized.

Ogni campo può essere visibile o nascosto, e mostrato orizzontalmente o verticalmente. La posizione mostrata è sempre indicata per un simbolo mostrato normalmente (nessuna rotazione o ribaltamento speculare) ed è relativa al punto di ancoraggio del simbolo.

The position and orientation properties of each field may be hidden in this dialog. They can be shown by right-clicking on the column header of the fields table and enabling the "Orientation", "X Position", and/or "Y Position" columns. Other columns can be shown or hidden as desired.

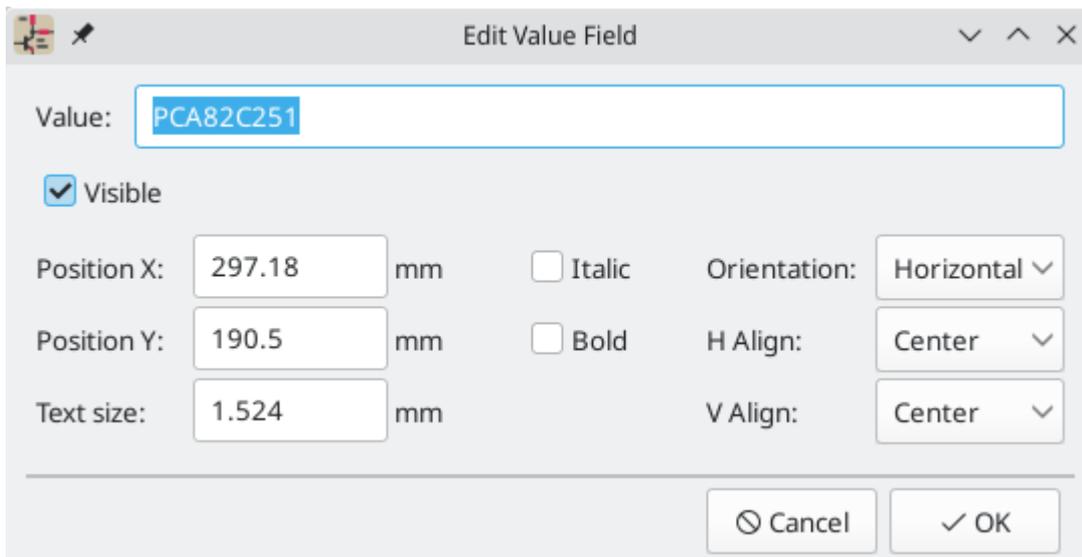
The "Update Symbol from Library..." button is used to update the schematic's copy of the symbol to match the copy in the library. The "Change Symbol..." button is used to swap the current symbol to a different symbol in the library.

"Edit Symbol..." opens the Symbol Editor to edit the copy of the symbol in the schematic. Note that the original symbol in the library will not be modified. The "Edit Library Symbol..." button opens the Symbol Editor to edit the original symbol in the library. In this case, the symbol in the schematic will not be modified until the user clicks the "Update Symbol from Library..." button.

Editing symbol fields individually

An individual symbol text field can be edited directly with the  hotkey (with a field selected instead of a symbol) or by double-clicking on the field.

Some symbol fields have their own hotkey to edit them directly. With the symbol selected, the Reference, Value, and Footprint fields can be edited with the , , or  hotkeys, respectively.



The options in this dialog are the same as those in the full Symbol Properties dialog, but are specific to a single field.

Symbol fields can be automatically moved to an appropriate location with the Autoplace Fields action (select a symbol and press ). Field autoplacement is configurable in the Schematic Editor's Editing Options, including a setting to always autoplace fields.

Symbol Fields Table

The Symbol Fields Table allows you to view and modify field values for all symbols in a spreadsheet interface. You can open the Symbol Fields Table with the  button.

Reference	Value	Footprint	Datasheet	Qty
ABRT_SW101	SW_PUSH	kit-dev-coldfire:SW_PUSH_5		1
ALLPST101	CONN_1	Connector_PinHeader_2.5.		1
BDM_PORT101	CONN_13X2	Connector_PinHeader_2.5.		1
> C102, C105	1nF	Capacitor_SMD:C_0805_20		2
> C106, C107	10pF	Capacitor_SMD:C_0805_20		2
C108	10uF	kit-dev-coldfire:SM1206PO		1
> C101, C103, C104, C109-C	100nF	Capacitor_SMD:C_0805_20		43
C119	100uF	kit-dev-coldfire:SM1206PO		1
C212	10uF	Capacitor_THT:CP_Radial_D		1
C215	220uF	Capacitor_THT:CP_Radial_D		1
CAN_EN201	CONN_2X2	Connector_PinHeader_2.5.		1
CAN_TERM201	JUMPER	Connector_PinHeader_2.5.		1
CLKOUT101	CONN_1	Connector_PinHeader_2.5.		1
> COM_SEL201-COM_SEL203	CONN_3	Connector_PinHeader_2.5.		3
CT101	JUMPER	Connector_PinHeader_2.5.		1
> D101, D102	BAT54	Diode_SMD:D_SOT-23_ANH		2
D201	1N4004	Diode_THT:D_DO-15_P12.7		1
> D301, D302	LED	LED_SMD:LED_1206_3216I		2
F201	FUSE	kit-dev-coldfire:FSUPCMS		1
FB101	BEAD	Resistor_SMD:R_1206_321		1
GND101	CONN_1	Connector_PinHeader_2.5.		1

Cells are navigated with the arrow keys, or with **Tab** / **Shift** + **Tab** to move right / left and **Enter** / **Shift** + **Enter** to move down / up, respectively.

A range of cells can be selected by clicking and dragging. The whole range of selected cells will be copied (**Ctrl** + **C**) or pasted into (**Ctrl** + **V**) on a copy or paste action. Copying a range of cells from the table can be useful for creating a BOM. More details of copying and pasting cells are described below.

Any symbol field can be shown or hidden using the **Show** checkboxes on the left, or by right-clicking on the header of the table. New symbol fields can be added using the **Add Field...** button.

Similar symbols can optionally be grouped by any symbol field using the **Group By** checkboxes. Grouped symbols are shown in a single row in the table. The grouped row can be expanded to show the individual symbols by clicking the arrow at the left of the row.

Tricks to simplify filling fields

There are several special copy/paste methods in the spreadsheet for pasting values into larger regions, including auto-incrementing pasted cells. These features may be useful when pasting values that are shared in several symbols.

Questi metodi sono illustrati sotto.

1. Copy (Ctrl + C)	2. Select target cells	3. Paste (Ctrl + V)																																													
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NOTE

Queste tecniche sono disponibili anche in altre finestre di dialogo con elementi di controllo a griglia.

Reference Designators and Symbol Annotation

Reference designators are unique identifiers for components in a design. They are often printed on a PCB and in assembly diagrams, and allow you to match symbols in a schematic to the corresponding components on a board.

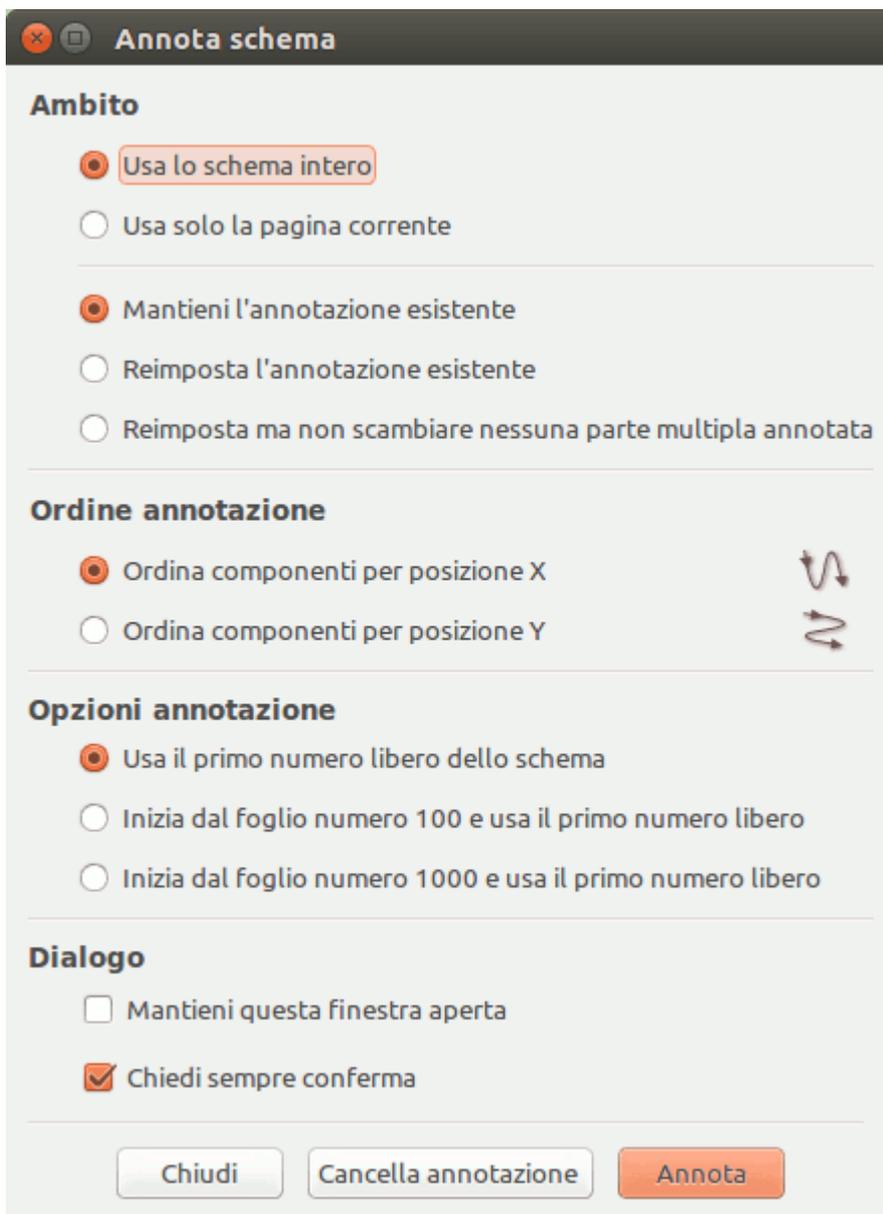
In KiCad, reference designators consist of a letter indicating the type of component (R for resistor, C for capacitor, U for IC, etc.) followed by a number. If the symbol has multiple units then the reference designator will also have a trailing letter indicating the unit. Symbols that don't have a reference designator set have a ? character instead of the number. Reference designators must be unique.

Reference designators can be set manually by editing a symbol's reference designator field, or automatically using the Annotation tool.

NOTE | The process of setting a symbol's reference designator is called **annotation**.

Strumento di annotazione

The Annotation tool automatically assigns reference designators to symbols in the schematic. To launch the Annotation tool, click the  button in the top toolbar.



The tool provides several options to control how symbols are annotated.

Scope: Selects whether annotation is applied to the entire schematic, to only the current sheet, or to only the selected symbols.

Options: Selects whether annotation should apply to all symbols and reset *existing reference designators, or apply only to unannotated symbols.

Order: Chooses the direction of numbering. If symbols are sorted by X position, all symbols on the left side of a schematic sheet will be lower numbered than symbols on the right side of the sheet. If symbols are sorted by Y position, all symbols on the top of a sheet will be lower numbered than symbols at the bottom of the sheet.

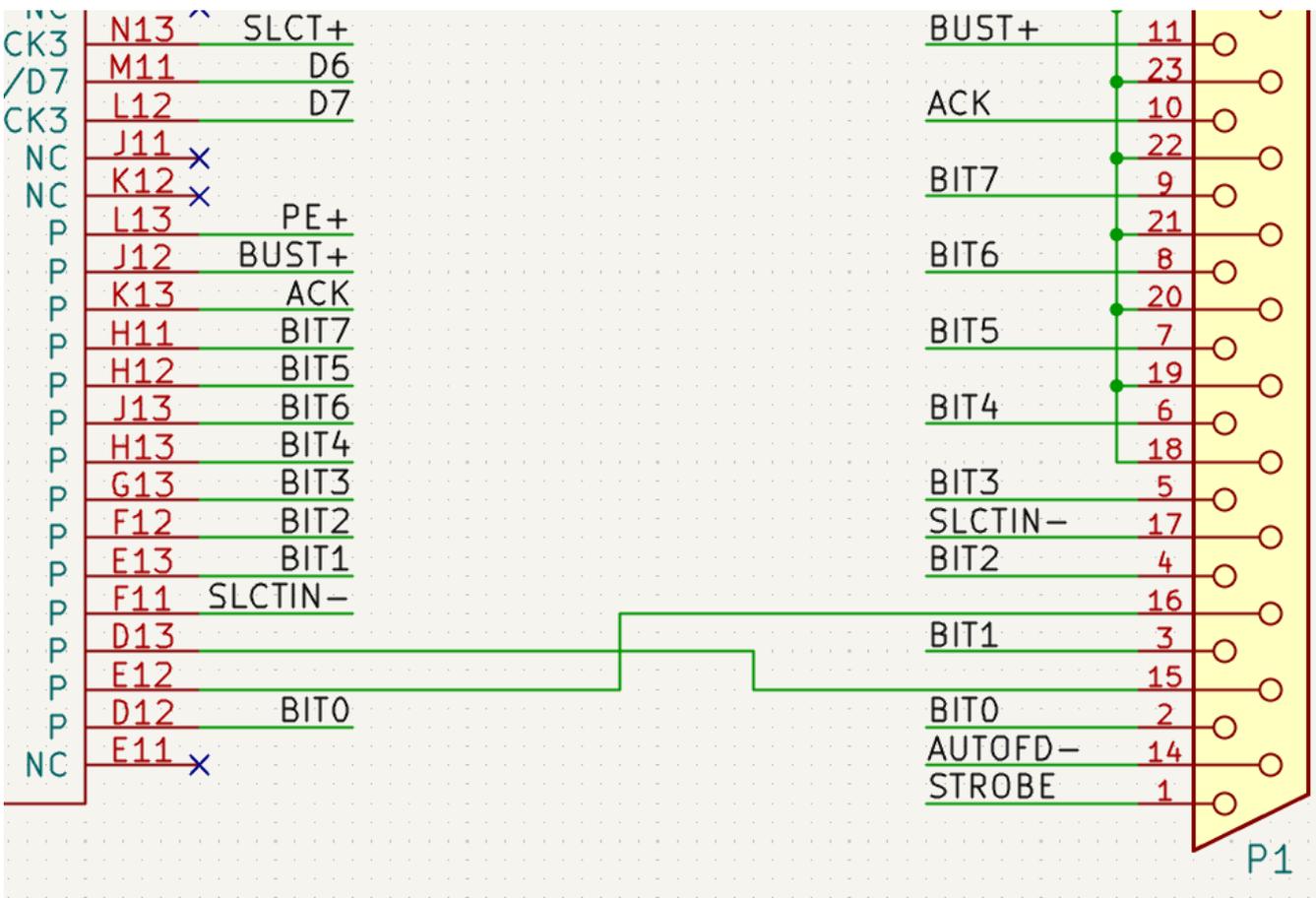
Numbering: Selects the starting point for numbering reference designators. The lowest unused number above the starting point is picked for each reference designator. The starting point can be an arbitrary number (typically zero), or it can be the sheet number multiplied by 100 or 1000 so that each part's reference designator corresponds to the schematic page it is on.

The **Clear Annotation** button clears all reference designators in the selected scope.

Annotation messages can be filtered with the checkboxes at the bottom or saved to a report using the **Save...** button.

Connessioni elettriche

There are two primary ways to establish connections: wires and labels. Both are shown in the schematic below.



Connections can also be made with buses and with implicit connections via hidden power pins.

This section will also discuss two special types of symbols that can be added with the "Power port" button on the right toolbar:

Porte di potenza: simboli per collegare fili a net di potenza o massa.

- **PWR_FLAG:** a specific symbol for indicating that a net is powered when it is not connected to a power output pin (for example, a power net that is supplied by an off-board connector).

Label Connections

Labels are used to assign net names to wires and pins. Wires with the same net name are considered to be connected. A net can only have one name. If two different labels are placed on the same net, an ERC violation will be generated. Only one of the net names will be used in the netlist.

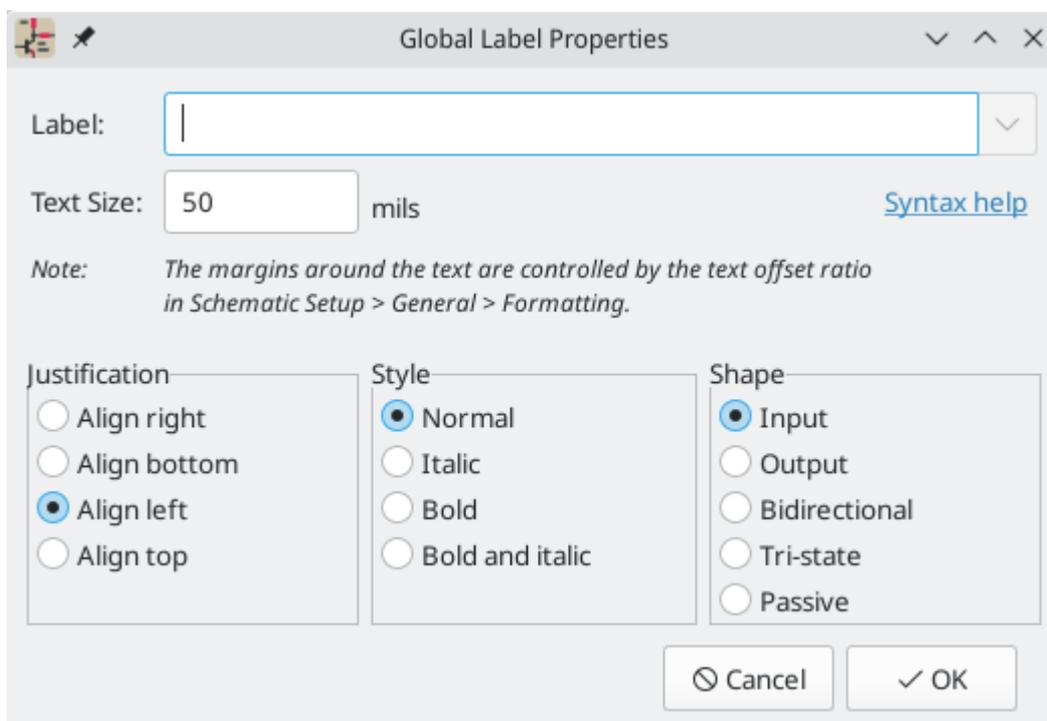
There are three types of labels, each with a different connection scope.

- **Local labels**, also referred to simply as labels, only make connections within a sheet. Add a local label with the **A** button in the right toolbar.
- **Global labels** make connections anywhere in a schematic, regardless of sheet. Add a global label with the  button in the right toolbar.
- **Hierarchical labels** connect to hierarchical sheet pins and are used in [hierarchical schematics](#) for connecting child sheets to their parent sheet. Add a hierarchical label with the  in the right toolbar.

NOTE

Labels that have the same name will connect, regardless of the label type, if they are in the same sheet.

After using the appropriate button or hotkey to create a label, the Label Properties dialog appears.



The image shows the 'Global Label Properties' dialog box. It has a title bar with a close button and a maximize button. The main area contains a 'Label:' text box, a 'Text Size:' field set to '50' with 'mils' as the unit, and a 'Syntax help' link. Below this is a note: 'The margins around the text are controlled by the text offset ratio in Schematic Setup > General > Formatting.' There are three sections: 'Justification' with radio buttons for 'Align right', 'Align bottom', 'Align left' (selected), and 'Align top'; 'Style' with radio buttons for 'Normal' (selected), 'Italic', 'Bold', and 'Bold and italic'; and 'Shape' with radio buttons for 'Input' (selected), 'Output', 'Bidirectional', 'Tri-state', and 'Passive'. At the bottom are 'Cancel' and 'OK' buttons.

The **Label** field sets the label's text, which determines the net that the label assigns to its attached wire. Label text supports [markup](#) for overbars, subscripts, etc., as well as [variable substitution](#). Use the **Syntax help** link in the dialog for a summary.

Justification sets the position of the label's connection point relative to the label's text. For example, when **Align right** is selected the connection point will be to the right of the text.

Text size and **Style** control the appearance of the label's text. **Shape** controls the shape of the outline around the label; this is purely visual and has no electrical consequence. Local labels do not have an outline, and therefore do not have **Shape** options.

NOTE

Global labels have additional settings to control margins around the label text in the [Schematic Setup dialog](#).

After accepting the label properties, the label is attached to the cursor for placement. The connection point for a label is the small square in the corner of the label. The square disappears when the label is connected to a wire or the end of a pin.



The connection point's position relative to the label text can be changed by choosing a different label orientation in the label's properties, or by mirroring/rotating the label.

The Label Properties dialog can be accessed at any time by selecting a label and using the **E** hotkey, double-clicking on the label, or with **Properties...** in the right-click context menu.

Wire Connections

To establish a connection, a segment of wire must be connected by its end to another segment or to a pin. Only wire ends create connections; if a wire crosses the middle of another wire, a connection will not be made.

Unconnected wire ends have a small square that indicates the connection point. The square disappears when a connection is made to the wire end. Unconnected pins have a circle, which also disappears when a connection is made.

NOTE

Wires connect with other wires or pins only if their ends coincide exactly. Therefore it is important to keep symbol pins and wires aligned to the grid. It is recommended to always use a 50 mil grid when placing symbols and drawing wires because the KiCad standard symbol library and all libraries that follow its style also use a 50 mil grid.

NOTE

Symbols, wires, and other elements that are not aligned to the grid can be snapped back to the grid by selecting them, right clicking, and selecting **Align Elements to Grid**.

Drawing and editing wires

To begin connecting elements with wire, use the Wire tool  in the right toolbar (**W**). Wires can also be automatically started by clicking on an unconnected symbol pin or wire end.

Wires can be moved using the Move (**M**) or Drag (**G**) tools. As with symbols, the **Move** tool moves only the selected segment, without maintaining existing connections to other segments. The **Drag** tool maintains

existing connections.

If a segment is selected or the cursor is over the middle of a wire, the move/drag action will move the entire segment. If the cursor is over a corner or wire end, the move/drag action will act on one end of the segment.

Giunzioni di fili

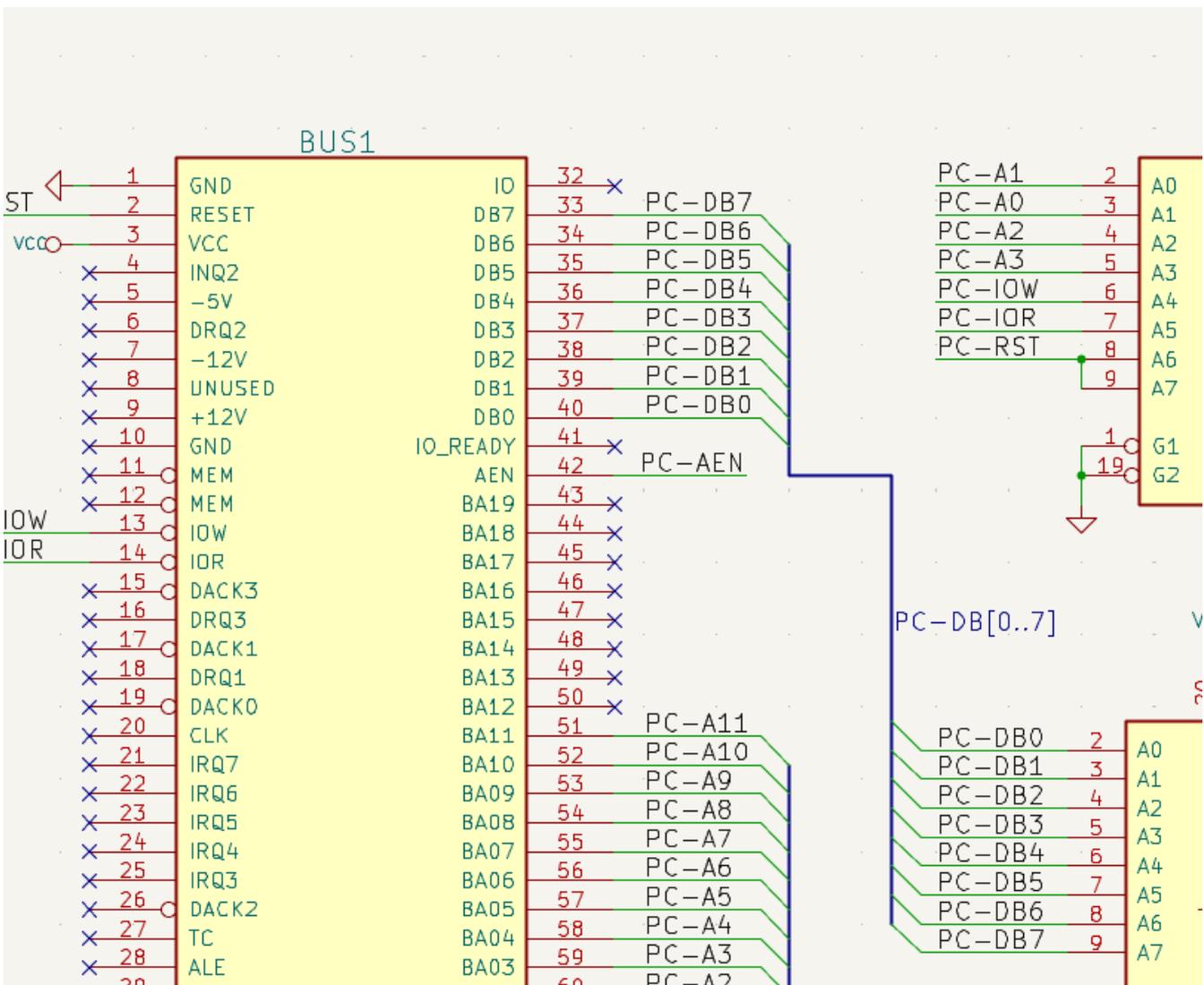
Wires that cross are not implicitly connected. It is necessary to join them by explicitly adding a junction dot if a connection is desired (⬤ button in the right toolbar). Junction dots will be automatically added to wires that start or end on top of an existing wire.

Junction dots are used in the schematic figure above on the wires connected to P1 pins 18, 19, 20, 21, 22, and 23.

Bus Connections

Buses are a way to group related signals in the schematic in order to simplify complicated designs. Buses can be drawn like wires using the bus tool , and are named using labels the same way signal wires are.

In the following schematic, many pins are connected to buses, which are the thick blue lines in the center.



Membri di bus

There are two types of bus in KiCad 6.0 and later: vector buses and group buses.

Un **bus vettoriale** è un insieme di segnali che cominciano con un prefisso comune e finiscono con un numero. I bus vettoriali hanno nome nella forma `<PREFISSO>[M..N]` dove `PREFISSO` è un qualsiasi nome di segnale valido, `M` è il primo numero del suffisso, e `N` è l'ultimo numero del suffisso. Per esempio, il bus `DATA[0..7]` contiene i segnali `DATA0`, `DATA1`, e così via fino a `DATA7`. Non importa in quale ordine `M` ed `N` vengono specificati, ma entrambi devono essere positivi.

Un **bus di gruppo** è un insieme di uno o più segnali e/o bus vettoriali. I bus di gruppo possono essere usati per tenere assieme segnali correlati anche quando questi hanno nomi diversi. I bus di gruppo usano una sintassi etichetta speciale:

```
<NOME_OPZIONALE>{SEGNALE1 SEGNALE2 SEGNALE3}
```

I membri del gruppo sono elencati dentro parentesi graffe (`{}`) separati da spazi. Il nome opzionale del gruppo va prima della prima parentesi. Se il bus di gruppo è anonimo, i collegamenti risultanti sul C.S. saranno semplicemente i nomi dei segnali dentro il gruppo. Se il bus di gruppo possiede un nome, i collegamenti risultanti avranno il nome come prefisso, con un punto (`.`) di separazione tra il prefisso e il nome del segnale.

Per esempio, il bus `{SCL SDA}` ha due segnali membri, e nella netlist questi segnali saranno `SCL` e `SDA`. Il bus `USB1{DP DM}` genererà collegamenti chiamati `USB1.DP` e `USB1.DM`. Per progetti con bus grandi, ripetuti tra diversi circuiti simili, l'uso di questa tecnica può far risparmiare tempo.

I bus di gruppo possono contenere anche bus vettoriali. Per esempio, il bus `MEMORY{A[7..0] D[7..0] OE WE}` contiene sia bus vettoriali che segnali normali, il che porterà a dei collegamenti del tipo `MEMORY.A7` e `MEMORY.OE` sul C.S..

Bus wires can be drawn and connected in the same manner as signal wires, including using junctions to create connections between crossing wires. Like signals, buses cannot have more than one name — if two conflicting labels are attached to the same bus, an ERC violation will be generated.

Connessioni tra membri di bus

Pins connected between the same members of a bus must be connected by labels. It is not possible to connect a pin directly to a bus; this type of connection will be ignored by KiCad.

Nell'esempio sopra, le connessioni vengono effettuate dalle etichette piazzate sui fili connessi ai piedini. Le voci di bus (segmenti di filo a 45 gradi) sono solo elementi grafici, e non sono necessarie per formare connessioni logiche.

In fact, using the repetition command (`Insert`), connections can be very quickly made in the following way, if component pins are aligned in increasing order (a common case in practice on components such as memories, microprocessors...):

- Place the first label (for example `PCA0`)
- Use the repetition command as much as needed to place members. KiCad will automatically create the next labels (`PCA1`, `PCA2` ...) vertically aligned, theoretically on the position of the other pins.
- Disegnare il filo sotto la prima etichetta. Usare poi il comando di ripetizione per piazzare gli altri fili sotto le etichette.
- Se necessario, piazzare le voci di bus allo stesso modo (piazzare la prima voce, poi usare il tasto di ripetizione).

In the **Schematic Editor** → **Editing Options** section of the Preferences menu, you can set the repetition parameters:

NOTE

- Horizontal pitch
- Vertical pitch
- Label increment (labels can be incremented or decremented by 1, 2, 3, etc.)

Dispiegamento bus

The unfold tool allows you to quickly break out signals from a bus. To unfold a signal, right-click on a bus object (a bus wire, etc) and choose **Unfold from Bus**. Alternatively, use the **Unfold Bus** hotkey (default:) when the cursor is over a bus object. The menu allows you to select which bus member to unfold.

Dopo aver selezionato il membro del bus, il successivo clic posizionerà l'etichetta del membro del bus alla posizione desiderata. Lo strumento genera automaticamente una voce bus ed un filo in direzione della posizione dell'etichetta. Dopo il posizionamento dell'etichetta, si può continuare a posizionare altri segmenti di filo (per esempio, per connetterli ai pin di un componente) e completare il collegamento in uno qualsiasi dei normali metodi.

Alias di bus

Gli alias di bus sono scorciatoie che permettono di lavorare con grandi insiemi di bus in modo più efficiente. Essi permettono di definire un gruppo di bus e dare ad esso un nome corto che può essere usato poi al posto del nome completo in tutto lo schema elettrico.

To create bus aliases, open the **Bus Definitions** dialog in the **Tools** menu.

Alias bus	Membri alias
USB (monitor_mixer.sch)	DP DM VBUS
Nome alias	Nome membro
<input type="text"/>	<input type="text"/>
<input type="button" value="Aggiungi"/> <input type="button" value="Rinomina"/> <input type="button" value="Rimuovi"/>	<input type="button" value="Aggiungi"/> <input type="button" value="Rinomina"/> <input type="button" value="Rimuovi"/>
<input type="button" value="✖ Annulla"/> <input type="button" value="✔ OK"/>	

Ad un alias si può dare come nome un qualsiasi nome di segnale valido. Usando la finestra di dialogo, si possono aggiungere segnali o bus vettoriali all'alias. Come scorciatoia, si può battere o incollare dentro un'elenco di segnali e/o buse separati da spazi, e questi verranno aggiunti alla definizione di alias. In questo esempio, definiamo un alias chiamato `USB` con membri `DP`, `DM`, e `VBUS`.

Dopo la definizione di un alias, esso può essere usato in una etichetta di bus di gruppo mettendo il nome dell'alias dentro le parentesi graffe del bus di gruppo: `{USB}`. Ciò ha lo stesso effetto dell'etichettare il bus `{DP DM VBUS}`. Si può anche aggiungere un nome prefisso al gruppo, come `USB1{USB}`, il che da come risultati collegamenti come `USB1.DP` come descritto sopra. Per bus complessi, l'uso di alias può rendere l'etichettatura dello schema elettrico molto più corta. Si faccia attenzione al fatto che gli alias sono solo scorciatoie, e che il nome dell'alias non viene incluso nella netlist.

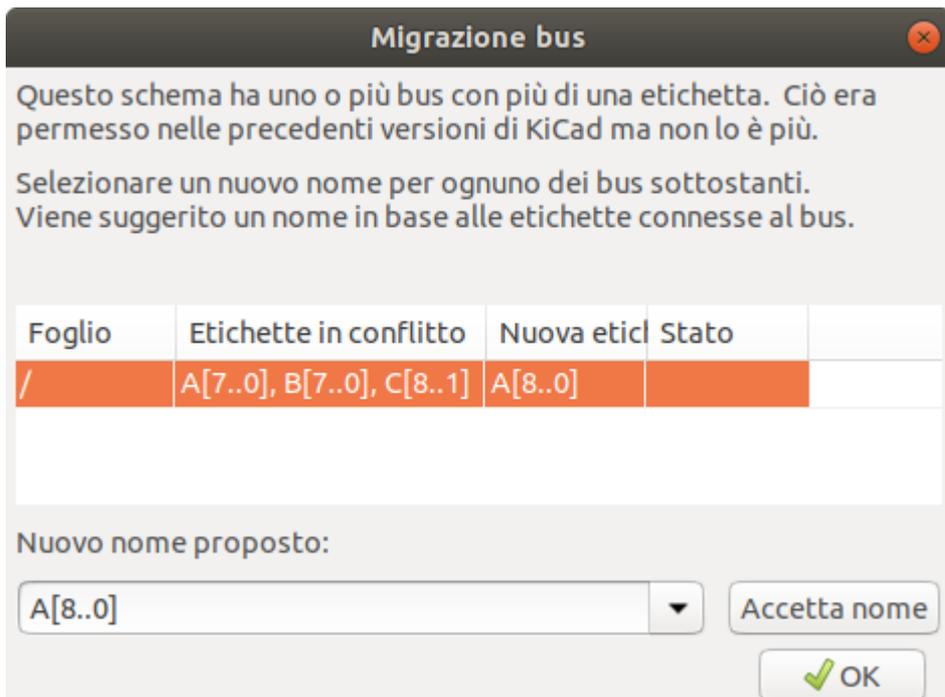
Gli alias dei bus vengono salvati nel file dello schema elettrico. Qualunque alias creato in un dato foglio dello schema elettrico è disponibile all'uso in qualunque altro foglio della gerarchia dello progetto.

Bus con più di una etichetta

KiCad 5.0 e versioni precedenti permettevano la connessione di bus con diverse etichette assieme, e collegavano assieme i membri di detti bus durante la creazione della netlist. Questo comportamento è stato eliminato in KiCad 6.0 perché è incompatibile con i bus di gruppo, e anche perché tendeva a creare confusione nelle netlist perché il nome che un dato segnale avrebbe ricevuto non era facilmente predicibile.

Se si apre un progetto che faceva uso di questa caratteristica in una versione moderna di KiCad, si potrà osservare la finestra di dialogo di "Migrazione bus" che vi guiderà attraverso la procedura di

aggiornamento dello schema in modo tale da garantire l'esistenza di una sola etichetta per un dato insieme di collegamenti bus.



Per ogni insieme di fili di bus che ha più di una etichetta, è necessario scegliere l'etichetta da tenere. Il menu a discesa permette di scegliere tra le etichette che esistono nel progetto, oppure è anche possibile scegliere un nome ancora diverso inserendolo manualmente nel campo del nuovo nome.

Hidden Power Pins

When the power pins of a symbol are visible, they must be connected, as with any other signal. However, symbols such as gates and flip-flops are sometimes drawn with hidden power input pins which are connected implicitly.

KiCad automatically connects invisible pins with type "power input" to a global net with the same name as the pin. For example, if a symbol has a hidden power input pin named `VCC`, this pin will be globally connected to the `VCC` net on all sheets.

NOTE

Hidden pins can be shown in the schematic by checking the **Show hidden pins** option in the **Schematic Editor** → **Display Options** section of the preferences, or by selecting **View** → **Show hidden pins**. There is also a toggle icon  on the left toolbar.

It may be necessary to join power nets of different names (for example, `GND` in TTL components and `VSS` in MOS components). To accomplish this, add a [power port symbol](#) for each net and connect them with a wire.

If hidden power pins are used, it is not recommended to use local labels for power connection, as they will not connect to hidden power pins on other sheets.

NOTE

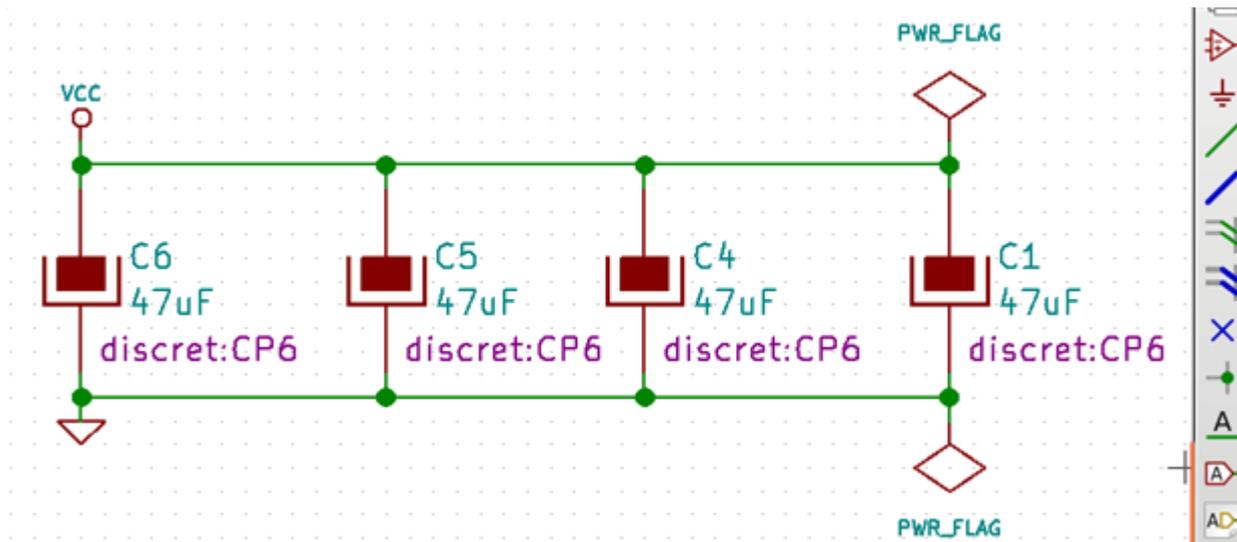
Care must be taken with hidden power input pins because they can create unintentional connections. By nature, hidden pins are invisible and do not display their pin name. This makes it easy to accidentally connect two power pins to the same net. For this reason, **using invisible power pins in symbols is not recommended** outside of power port symbols, and is only supported for compatibility with legacy designs and symbols.

Porte di potenza

Power port symbols are conventionally used to connect pins to power nets. Power port symbols have a single pin which is invisible and marked as a power input. As described in the [hidden power pins section](#), any wire connected to the pin of a power port is therefore automatically connected to the power net with the same name as the port's pin.

In the KiCad standard library, power ports are found in the `power` library, but power port symbols can be created in any library. To create a custom power port, make a new symbol with a hidden pin marked as a power input. Name the pin according to the desired power net.

La figura sottostante mostra un esempio di connessioni di porte di potenza.



In this example, power ports symbols are used to connect the positive and negative terminals of the capacitors to the `VCC` and `GND` nets, respectively.

Power port symbols are found in the `power` symbol library. They can also be created by drawing a symbol with a hidden "power input" pin that has the name of the desired power net.

PWR_FLAG

Two `PWR_FLAG` symbols are visible in the screenshot above. They indicate to ERC that the two power nets `VCC` and `GND` are actually connected to a power source, as there is no explicit power source such as a voltage regulator output attached to either net.

Without these two flags, the ERC tool would diagnose: *Error: Input Power pin not driven by any Output Power pins.*

The `PWR_FLAG` symbol is found in the `power` symbol library. The same effect can be achieved by connecting any "Power Output" pin to the net.

No-connection flag

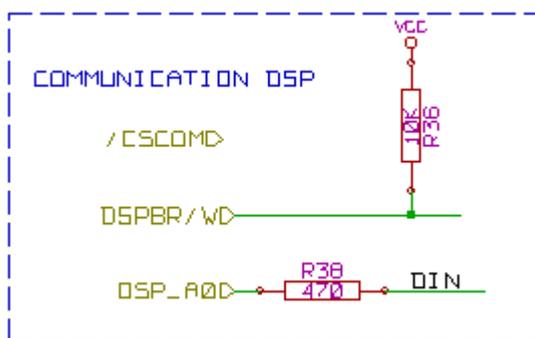
No-connection flags (→~~X~~) are used to indicate that a pin is intentionally unconnected. These flags do not have any effect on the schematic's connectivity, but they prevent "unconnected pin" ERC warnings for pins that are intentionally unconnected.

Graphical items

Text and graphic lines

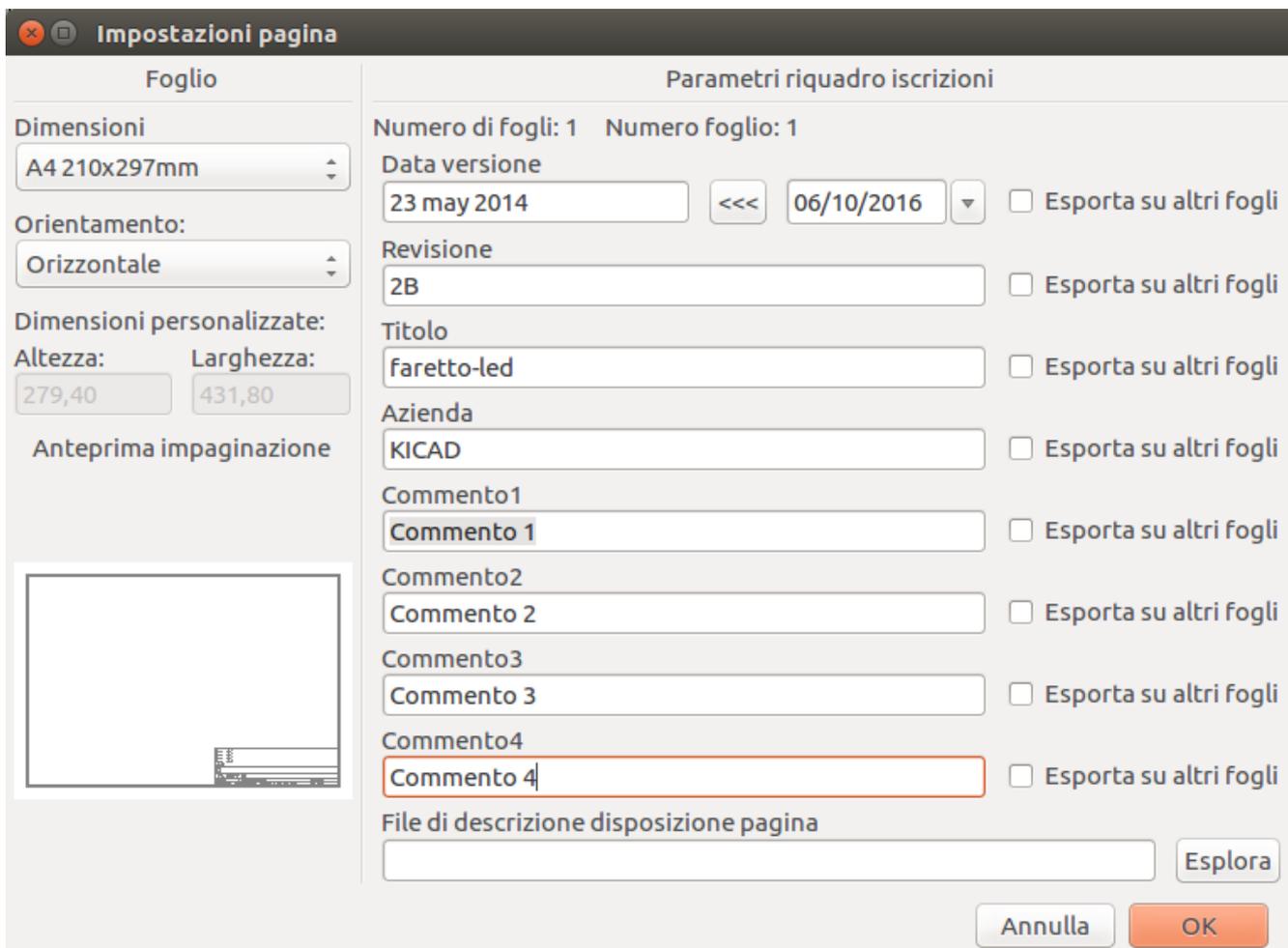
It can be useful to place annotations such as text fields and frames to aid in understanding the schematic. Text fields (**T**) and graphic lines (**L**) are intended for this use, as opposed to labels and wires, which are connection elements.

The image below shows graphic lines and text in addition to wires, local labels, and hierarchical labels.



Blocco del titolo del foglio

The title block is edited with the Page Settings tool ().



Each field in the title block can be edited, as well as the paper size and orientation. If the "Export to other sheets" option is checked for a field, that field will be updated in the title block of all sheets, rather than only the current sheet.

You can set the date to today's or any other date by pressing the left arrow button by "Issue Date", but the date in the schematic will not be automatically updated.

A drawing sheet template file can also be selected.

Commento4		
Commento3		
Commento2		
Commento1		
Sheet: /		
File: interf_u.sch		
Title: INTERFACCIA UNIVERSALE		
Size: A3	Date: 03/10/2015	Rev: 2B
KiCad E.D.A. kicad (2016-10-10 revision aa7d784)-master		Id: 1/1
7		8

The sheet number (Sheet X/Y) is automatically updated, but sheet page numbers can also be manually set using **Edit** → **Edit Sheet Page Number...**

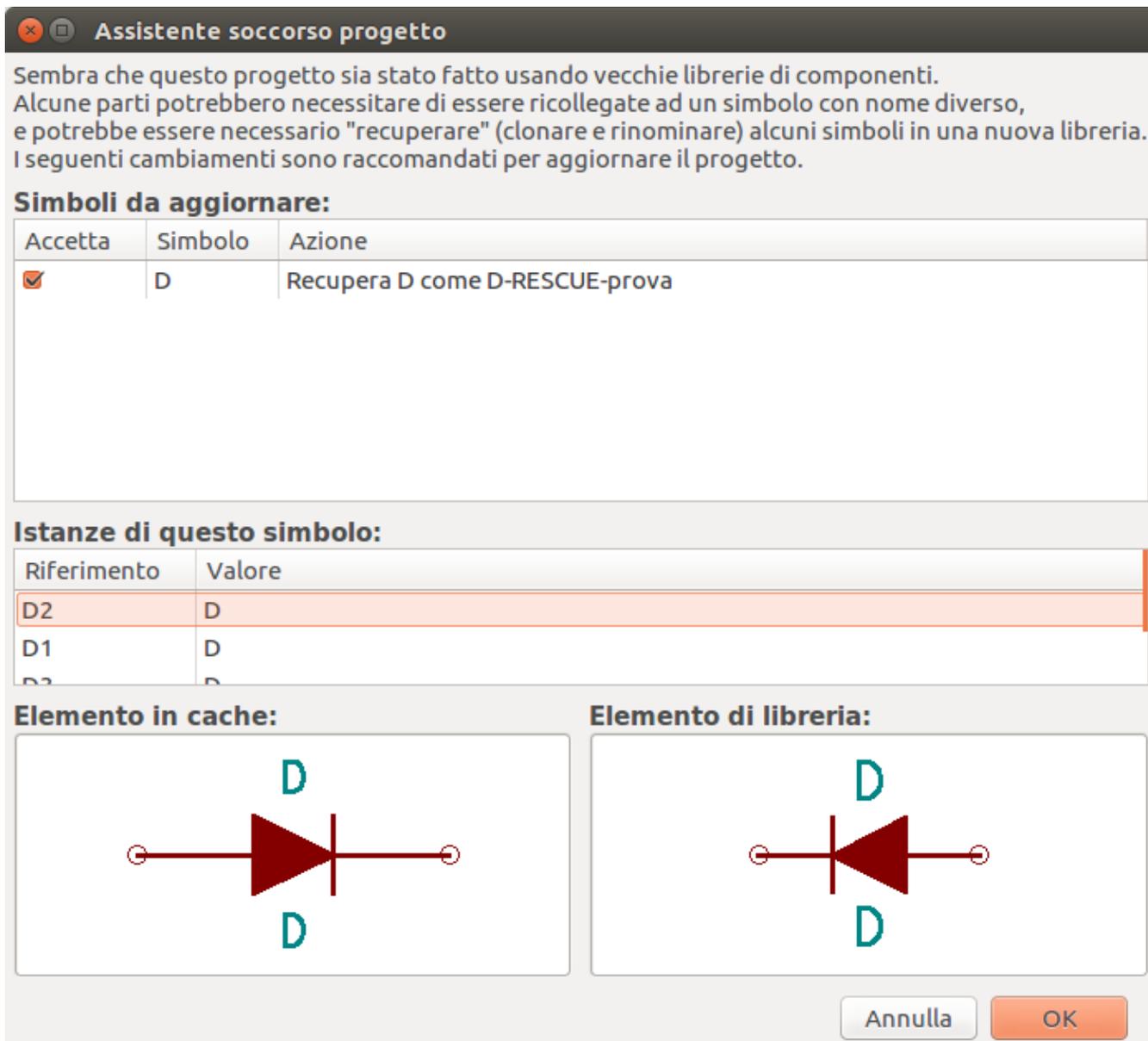
Schematic Setup

The Schematic Setup window is used to set schematic options that are specific to the currently active schematic. For example, the Schematic Setup window contains formatting options, electrical rule configuration, netclass setup, and schematic text variable setup.

Recupero di simboli dalla cache

By default, KiCad loads symbols from the project libraries according to the set paths and library order. This can cause a problem when loading a very old project: if the symbols in the library have changed or have been removed or the library no longer exists since they were used in the project, the ones in the project would be automatically replaced with the new versions. The new versions might not line up correctly or might be oriented differently leading to a broken schematic.

When a project is saved, a cache library with the contents of the current library symbols is saved along with the schematic. This allows the project to be distributed without the full libraries. If you load a project where symbols are present both in its cache and in the system libraries, KiCad will scan the libraries for conflicts. Any conflicts found will be listed in the following dialog:



You can see in this example that the project originally used a diode with the cathode facing up, but the library now contains one with the cathode facing down. This change would break the schematic! Pressing OK here will cause the symbol cache library to be saved into a special `rescue` library and all the symbols are renamed to avoid naming conflicts.

If you press Cancel, no rescues will be made, so KiCad will load all the new components by default. If you save the schematic at this point, your cache will be overwritten and the old symbols will not be recoverable. If you have saved the schematic, you can still go back and run the rescue function again by selecting "Rescue Cached Components" in the "Tools" menu to call up the rescue dialog again.

Se si preferisce non visualizzare questa finestra di dialogo, è possibile premere ``Non mostrare più''. L'impostazione predefinita non farà nulla e permetterà di caricare i nuovi componenti. Questa opzione può essere ripristinata nelle preferenze delle librerie.

Schemi elettrici gerarchici

Introduzione

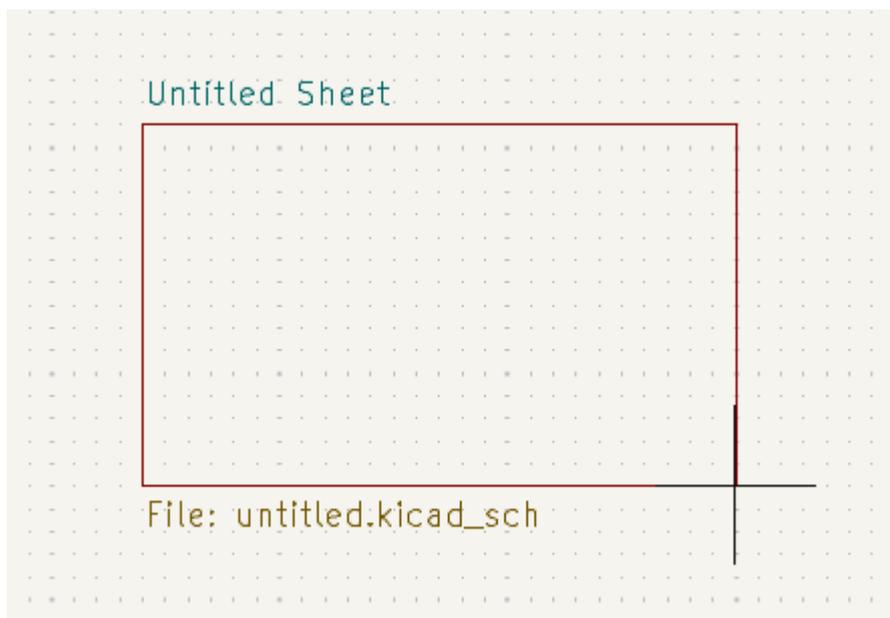
In KiCad, multi-sheet schematics are hierarchical: there is a single root sheet, and additional sheets are created as subsheets of either the root sheet or another subsheet. Sheets can be included in a hierarchy multiple times, if desired.

Carefully drawing a schematic as a hierarchical design improves schematic legibility and reduces repetitive drawing.

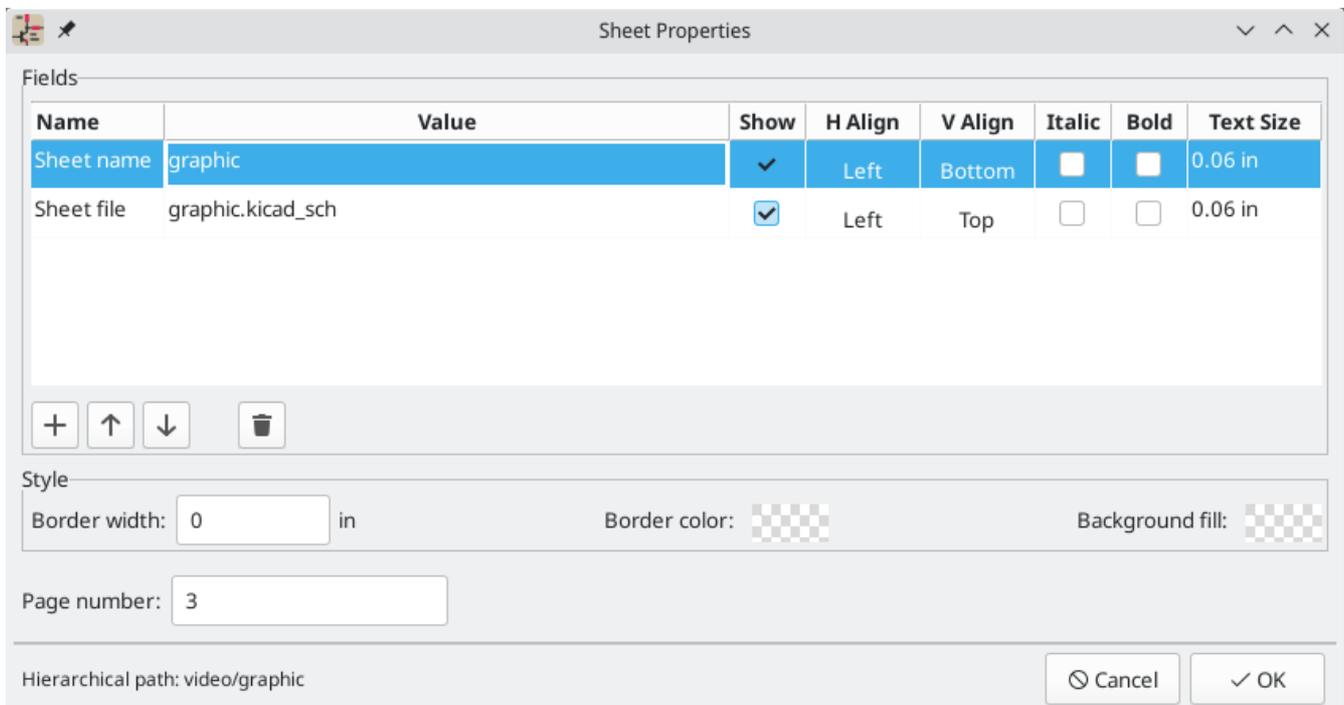
Creating a hierarchical schematic starts from the root sheet. The process is to create a subsheet, then draw the circuit in the subsheet and make the necessary electrical connections between sheets. Connections can be made between nets in a subsheet and nets in the parent sheet using hierarchical pins and labels, or between any two nets in the hierarchy using global labels.

Adding sheets to a design

You can add a subsheet to a design with the Add Hierarchical Sheet tool (`S` hotkey, or the  button in the right toolbar). Launch the tool, then click twice in the canvas to draw the upper left and lower right corners of the subsheet symbol. Make the sheet outline large enough to fit the [hierarchical pins you will add later](#).



The Sheet Properties dialog will appear and prompt you for a sheet name and filename.



The **sheet name** must be unique, as it is used in the full net name for any nets in the subsheet. For example, a net with the local label `net1` in the sheet `sheet1` would have a full net name of `/sheet1/net1`. The sheet name is also used to refer to the sheet in various places in the GUI, including the [title block](#) and the [hierarchy navigator](#).

The **sheet filename** specifies the file that the new sheet will be saved to or loaded from. A single sheet file can be used more than once in a project; the circuit drawn in the sheet will be instantiated once per usage. The same filename will be reused for each instantiation. The path to the sheet file can be relative or absolute. It is usually preferable to save subsheet files in the project directory and use a relative path so that the project is portable.

NOTE

Sheet files can be shared between multiple projects to allow design reuse between projects. However, this is not recommended due to path portability concerns and the risk of unintentionally changing other projects while editing a shared sheet.

The sheet's **page number** is configurable here. The page number is displayed in the sheet [title block](#) and the [hierarchy navigator](#), and sheets are sorted by page number in the hierarchy navigator and when [printing or plotting](#).

Several graphical options are also available. **Border width** sets the width of the border around the sheet shape. **Border color** and **Background fill** set the color for the border and fill of the sheet shape, respectively. If no color is set, a checkerboard swatch is shown and the default values from the color theme are used.

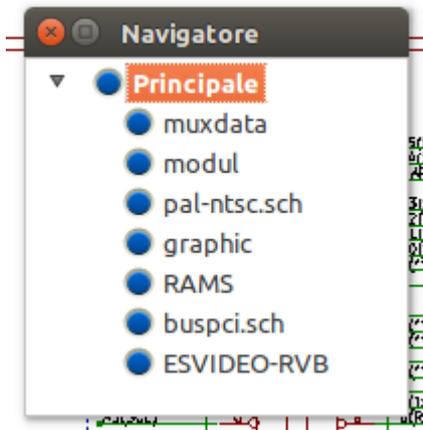
The Sheet Properties dialog can be accessed at any time by selecting a sheet and using the **E** hotkey, or with **Properties...** in the right-click context menu.

Navigating between sheets

You can enter a hierarchical sheet from the parent sheet by double-clicking the child sheet's shape, or right-clicking the child sheet and selecting **Enter Sheet**.

Return to the parent sheet by using the  button in the top toolbar, or by right-clicking in an empty part of the schematic and clicking **Leave Sheet**.

Alternatively, you can jump to any sheet with the hierarchy navigator. To open the hierarchy navigator, click the  button in the top toolbar. Each sheet in the design is displayed as an item in the tree. Clicking a sheet name opens that sheet in the editing canvas.



By default, the hierarchy navigator closes after a new sheet is opened. It can be configured to always remain open by selecting the **Keep hierarchy navigator open** option in the Editing Options section of the Schematic Editor preferences.

Electrical connections between sheets

Label overview

Electrical connections between sheets are made with **labels**. There are several kinds of labels in KiCad, each with a different connection scope.

- **Local labels** only make connections within a sheet. Therefore local labels cannot be used to connect between sheets. Local labels are added with the  button.
- **Global labels** make connections anywhere in a schematic, regardless of sheet. Global labels are added with the  button.
- **Hierarchical labels** connect to **hierarchical sheet pins** accessible in the parent sheet. Hierarchical designs rely on hierarchical labels and pins to make connections between parent sheets and child sheets; you can think of hierarchical pins as defining the interface for a sheet. Hierarchical labels are added with the  button.

NOTE

Labels that have the same name will connect, regardless of the label type, if they are in the same sheet.

NOTE

Hidden power pins can also be considered global labels, because they connect anywhere in the schematic hierarchy.

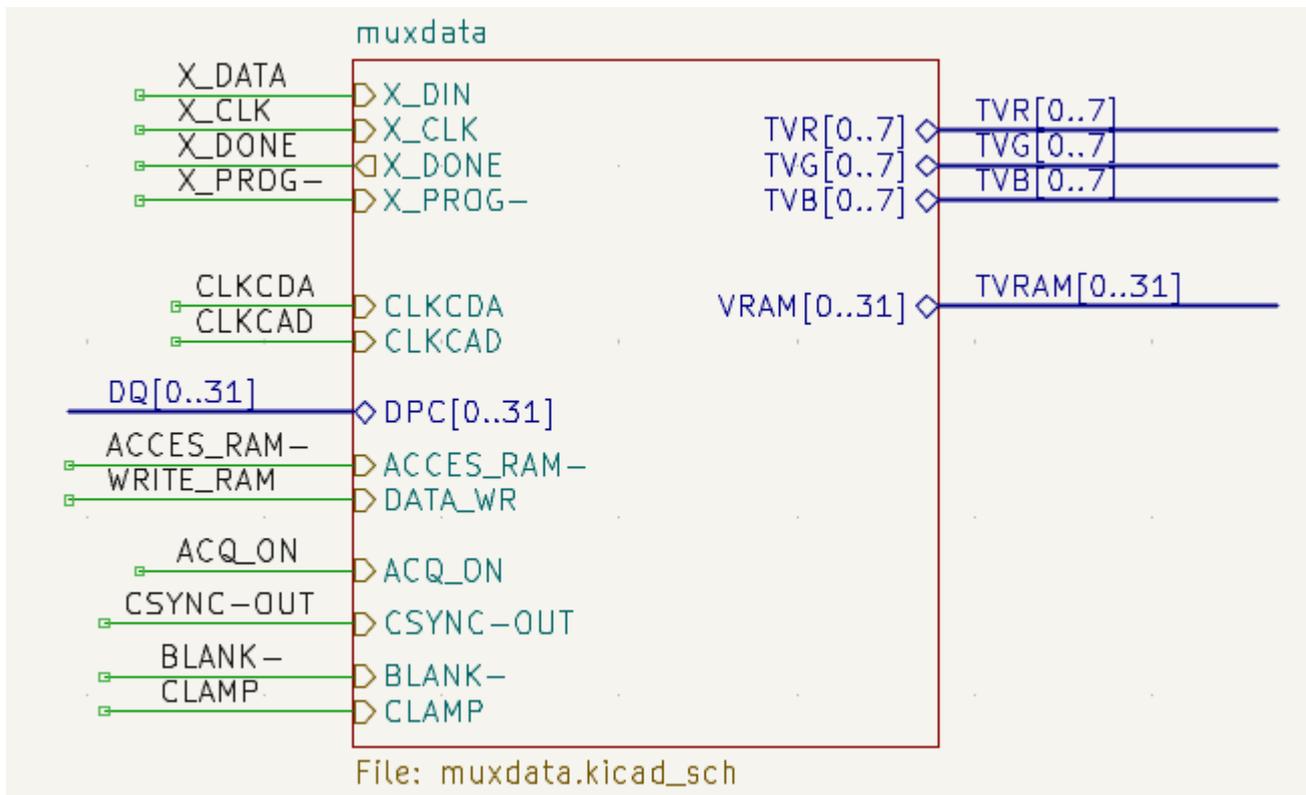
Hierarchical sheet pins

After placing hierarchical labels within the subsheet, matching **hierarchical pins** can be added to the subsheet symbol in the parent sheet. You can then make connections to the hierarchical pins with wires,

labels, and buses. Hierarchical pins in a subsheet symbol are connected to the matching hierarchical labels in the subsheet itself.

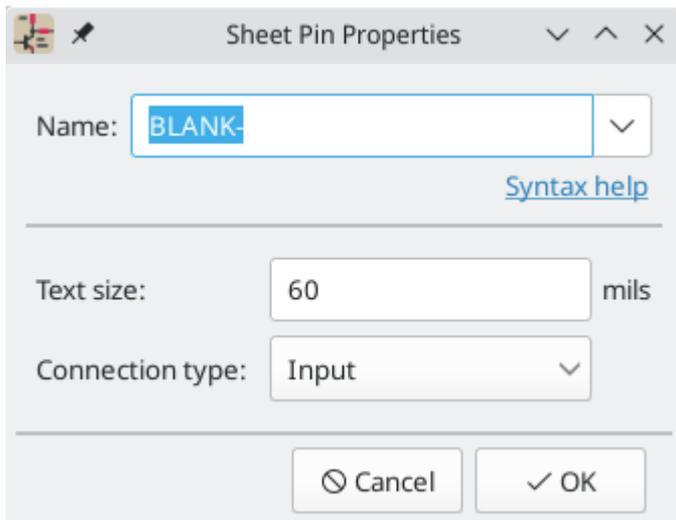
NOTE

Hierarchical labels must be defined in the subsheet before the corresponding hierarchical sheet pin can be imported in the sheet symbol.



For every hierarchical label in the subsheet, import the corresponding hierarchical pin into the sheet symbol by clicking the  button in the right toolbar, then clicking on the sheet symbol. A sheet pin for the first unmatched hierarchical label will be attached to the cursor, where it can be placed anywhere along the border of the sheet symbol. Clicking again with the tool will continue to import additional sheet pins until there are no more hierarchical pins to import from the subsheet. Sheet pins can also be imported by selecting **Import Sheet Pin** in a sheet symbol's right-click context menu.

You can edit the properties of a sheet pin in the Sheet Pin Properties dialog. Open this dialog by double-clicking a sheet pin, selecting a sheet pin and using the  hotkey, or right-clicking a sheet pin and selecting **Properties....**



The sheet pin's **name** can be edited in the textbox or by selecting from the dropdown list of hierarchical labels in the subsheet. A sheet pin's name has to match the corresponding hierarchical label in the subsheet, so if a pin name is changed the label must change as well.

The **connection type** changes the shape of the sheet pin, and has no electrical effect. It can be set to Input, Output, Bidirectional, Tri-state, or Passive. The pin's **text size** can also be changed.

Hierarchical design examples

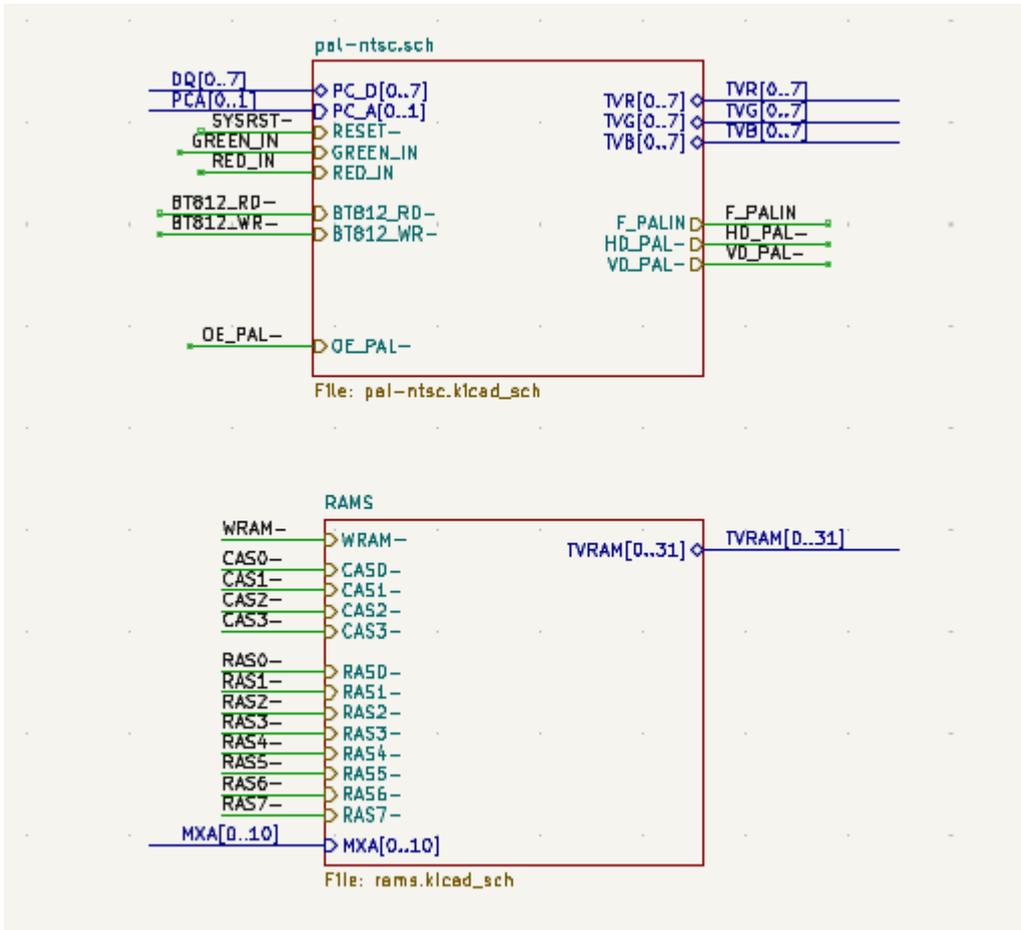
Hierarchical designs can be put into one of several categories:

- **Simple:** each sheet is used only once.
- **Complex:** some sheets are instantiated multiple times.
- **Flat:** a sub-case of a **simple** hierarchy, without connections between subsheets and their parent. Flat hierarchies can be used to represent a non-hierarchical design.

Each hierarchy model can be useful; the most appropriate one depends on the design.

Simple hierarchy

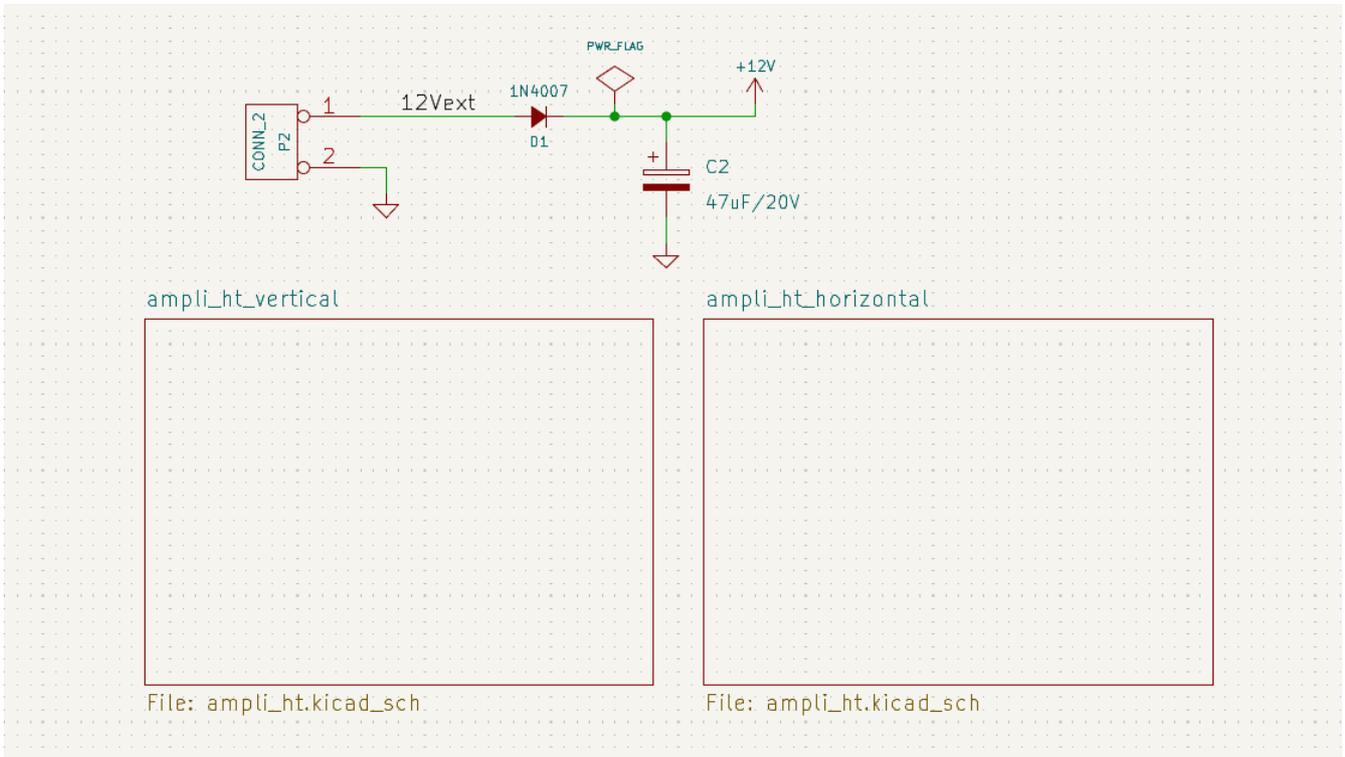
An example of a simple hierarchy is the [video](#) demo project included with KiCad. The root sheet contains seven unique subsheets, each with hierarchical labels and sheet pins linking the sheets to each other in the root sheet. Two of the subsheet symbols are shown below.



Gerarchia complessa

The `complex_hierarchy` demo project is an example of a complex hierarchy. The root sheet contains two subsheet symbols, which both refer to the same sheet file (`ampli_ht.kicad_sch`). This allows the design to include two copies of the same amplifier circuit. Although the two sheet symbols refer to the same filename, the sheet names are unique (`ampli_ht_vertical` and `ampli_ht_horizontal`). Inside each subsheet the circuits are identical except for the reference designators, which as always are unique.

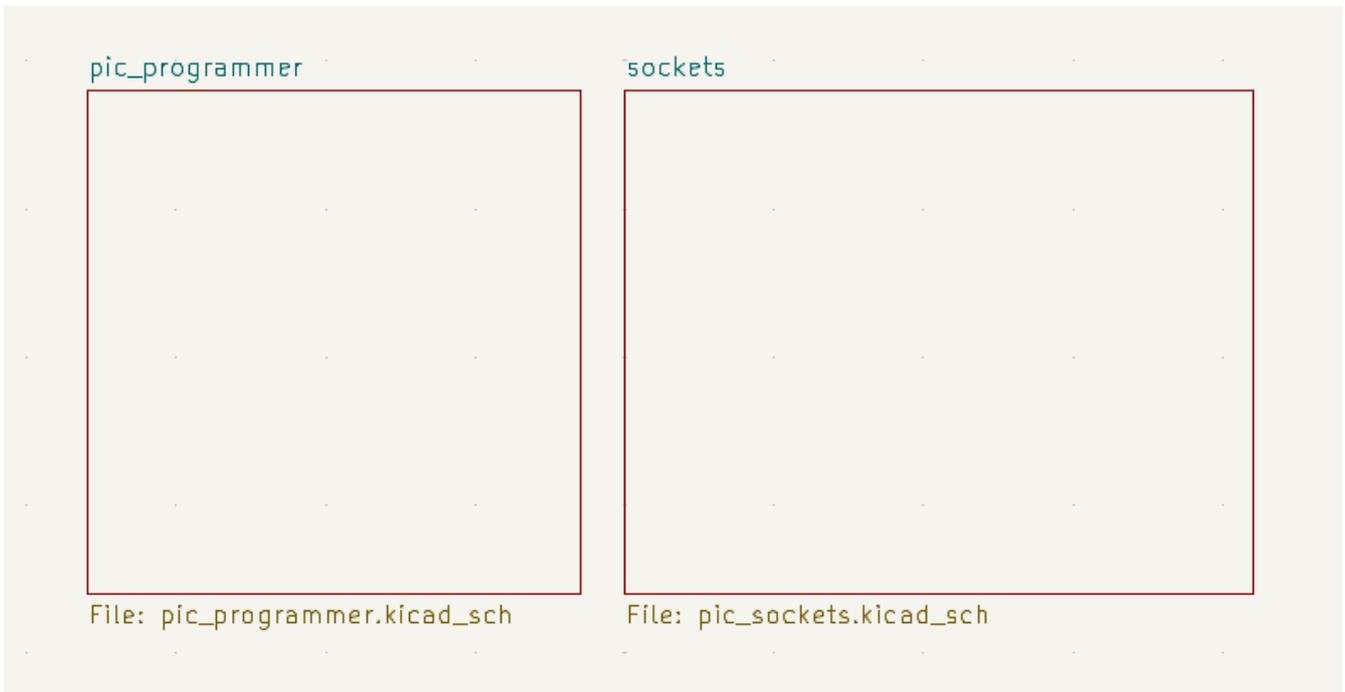
This project contains no sheet pin connections. The only connections between the root sheet and the subsheets are global power connections made with [power port symbols](#). However, sheets in a complex hierarchy could include sheet pin connections if appropriate for the design.



Gerarchia piatta

The `flat_hierarchy` demo project is an example of a flat hierarchy. The root sheet contains two unique subsheet symbols with no hierarchical sheet pins. The root sheet in this project does nothing except hold the subsheets, and the subsheets are used only as additional pages in the schematic.

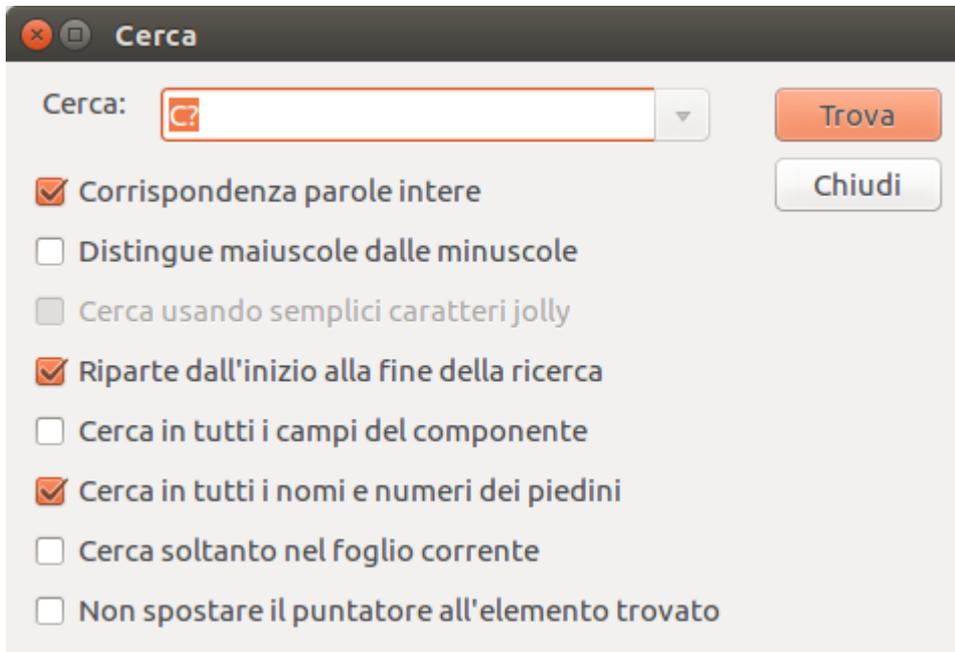
NOTE | This is the simplest way to create multi-page schematics in KiCad.



Inspecting a schematic

Find tool

The Find tool searches for text in the schematic, including reference designators, pin names, symbol 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 schematic. When unselected, the search will match if the search term is part of a larger word in the schematic.

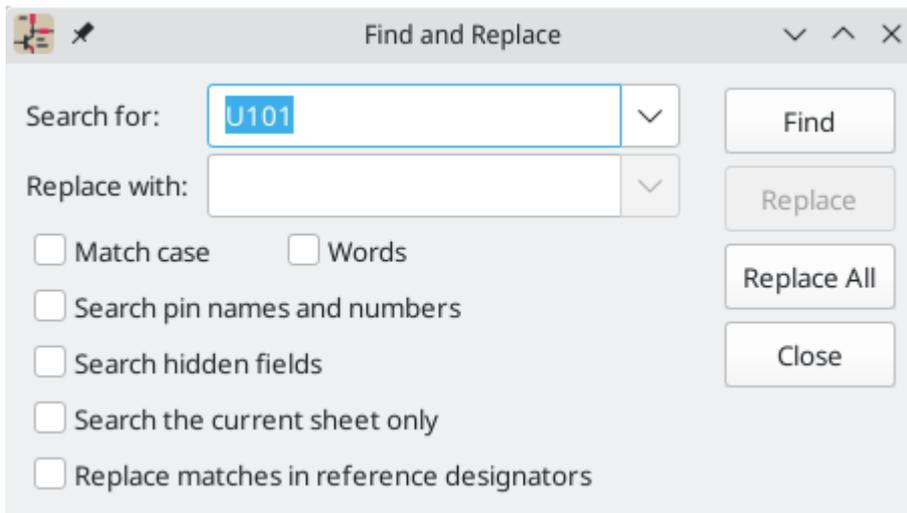
Wildcards: When selected, wildcards can be used in the search terms. `?` matches any single character, and `*` matches any number of characters. Note that when this option is selected, partial matches are not returned: searching for `abc*` will match the string `abcd`, but searching for `abc` will not.

Search pin names and numbers: Selects whether the search should apply to pin names and numbers.

Search hidden fields: Selects whether the search should apply only to visible fields or if it should include hidden symbol fields.

Search the current sheet only: Selects whether the search should be limited to the current schematic sheet or to the entire schematic.

There is also a Find and Replace tool which is activated with the  button in the top toolbar. This tool behaves the same as the Find tool, but additionally can replace some or all matches with different text.



If the **Replace matches in reference designators** option is checked, reference designators will be modified if they contain matching text. Otherwise reference designators will not be affected.

Net highlighting

An electrical net can be highlighted in the schematic editor to visualize all of the places it appears in the schematic. Net highlighting can be activated in the Schematic Editor or by highlighting the corresponding net in the PCB editor when cross-probe highlighting is enabled (see below). When net highlighting is active, the highlighted net will be shown in a different color. By default this color is pink, but it is configurable in the Color section of the Preferences dialog.

Nets can be highlighted by clicking on a wire or pin using the Highlight Net tool in the right toolbar () . Alternatively, the Highlight Net hotkey () highlights the net under the cursor. If there are no nets or pins under the cursor, any existing highlighting will be cleared. The highlighting can also be cleared by using the Clear Net Highlight action (hotkey ) .

Cross-probing from the PCB

KiCad allows bi-directional cross-probing between the schematic and the PCB. There are several different types of cross-probing.

Selection cross-probing allows you to select a symbol or pin in the schematic to select the corresponding footprint or pad in the PCB (if one exists) and vice-versa. By default, cross-probing will result in the display centering on the cross-probed item and zooming to fit. This behavior can be disabled in the Display Options section of the Preferences dialog.

Highlight cross-probing allows you to highlight a net in the schematic and PCB at the same time. If the option "Highlight cross-probed nets" is enabled in the Display Options section of the Preferences dialog, highlighting a net or bus in the schematic editor will cause the corresponding net or nets to be highlighted in the PCB editor, and vice versa.

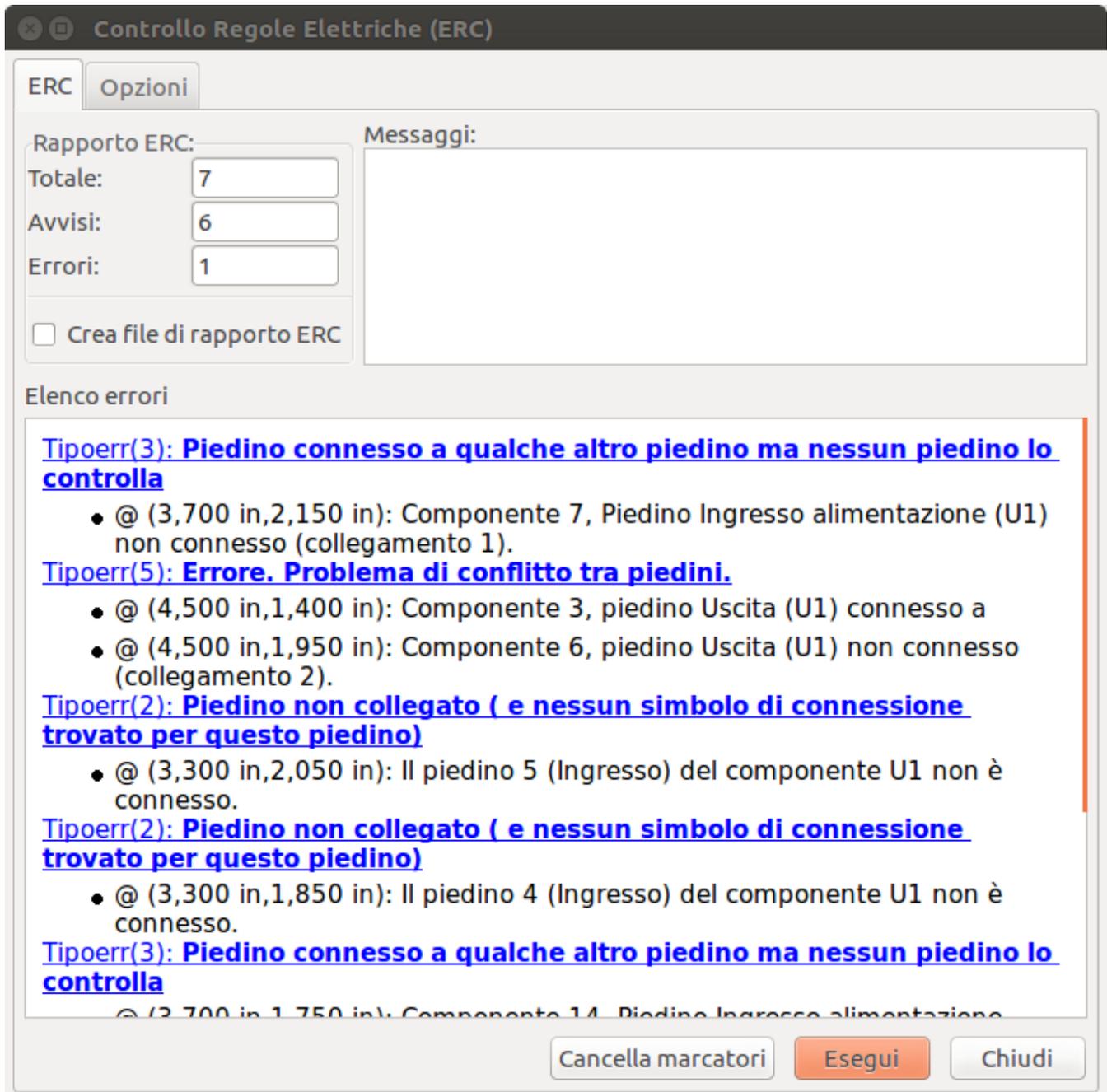
Verifica della progettazione con il Controllo Regole Elettriche (ERC)

The Electrical Rules Check (ERC) tool performs an automatic check of your schematic. The ERC checks for any errors in your sheet, such as unconnected pins, unconnected hierarchical symbols, shorted outputs, etc. ERC output is reported as errors or warnings depending on the severity of the issue detected.

Naturally, an automatic check is not infallible, and it is not possible to detect all design errors. Such a check is still very useful, because it allows you to detect many oversights and small errors. All detected issues should be checked and addressed before proceeding.

The quality of the ERC is directly related to the care taken in declaring [electrical pin properties](#) during symbol library creation.

ERC can be started by clicking on the  button in the top toolbar and clicking the **Run ERC** button.



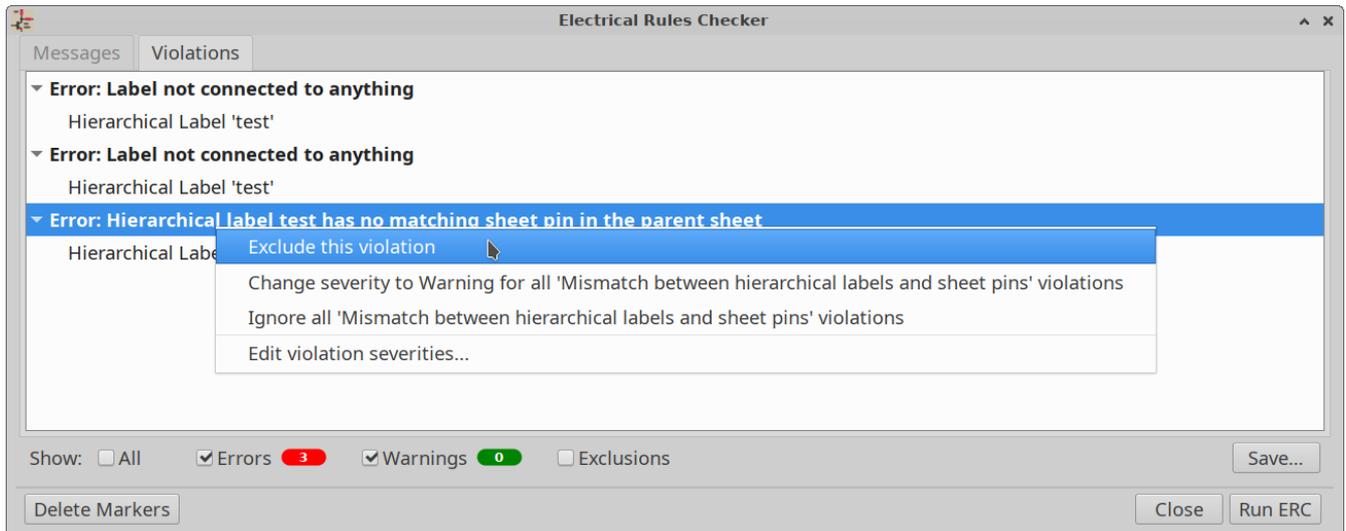
Any warnings or errors are reported in the **Violations** tab, and markers for each violation are placed in the schematic so that they point to the relevant part of the schematic. Warnings are indicated by yellow arrows, and errors have red arrows. Excluded violations are shown as green arrows.

NOTE

Selecting a violation in the ERC window jumps to the selected violation marker in the schematic.

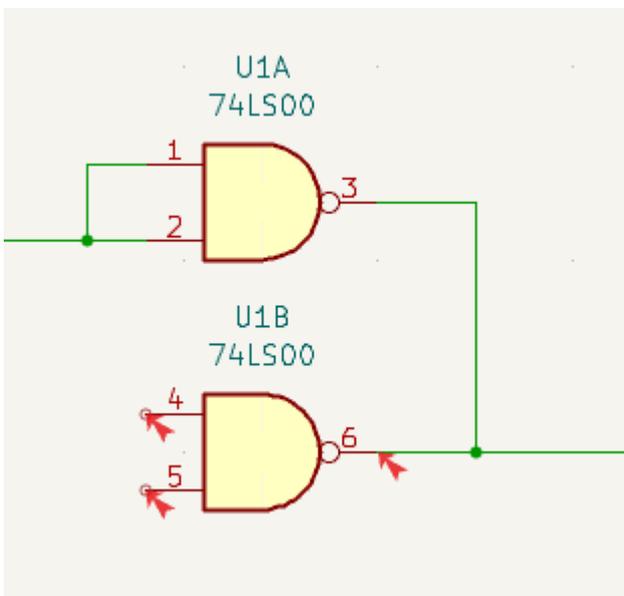
The numbers at the bottom of the window show the number of errors, warnings, and exclusions. Each type of violation can be filtered from the list using the respective checkboxes. Clicking **Delete Markers** will clear all violations until ERC is run again.

Violations can be right-clicked in the dialog to ignore them or change their severity:



- **Exclude this violation:** ignores this particular violation, but does not affect any other violations.
- **Change severity:** changes a type of violation from warning to error, or error to warning. This affects all violations of a given type.
- **Ignore all:** ignores all violations of a given type.

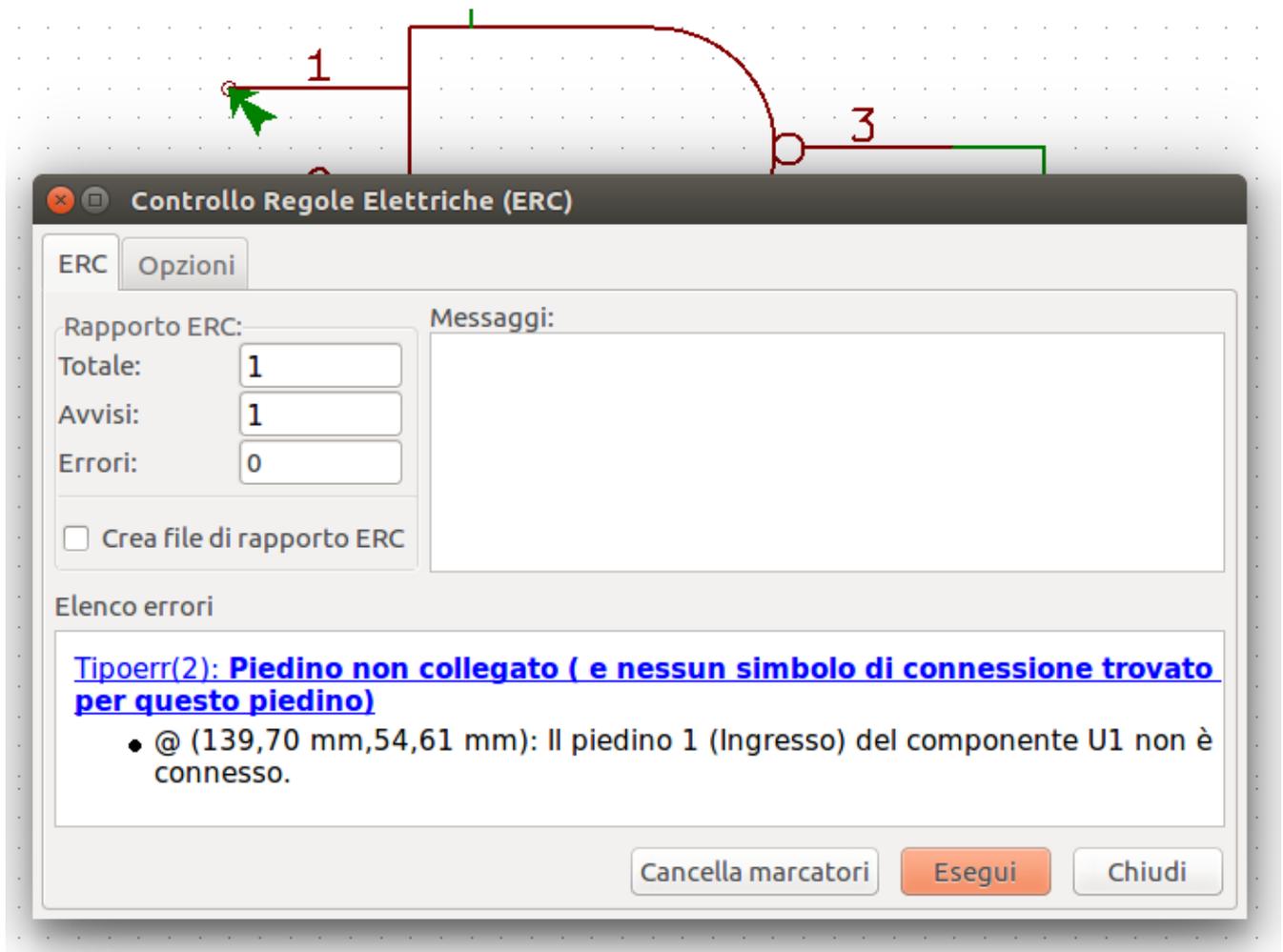
ERC example



Here you can see three errors:

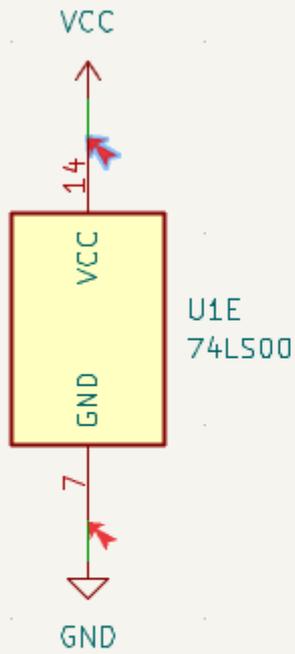
- Two outputs have been connected together (red arrow at right).
- Two inputs have been left unconnected (red arrows at left).

Selecting an ERC marker displays a description of the violation in the message pane at the bottom of the window.



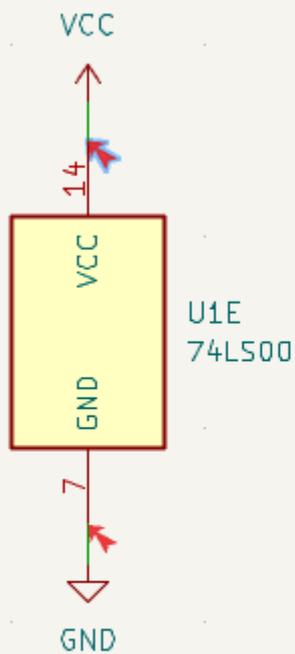
Power pins and power flags

It is common to have an "Input Power pin not driven by any Output Power pins" error on power pins, as shown in the example below, even though the power pins seem to be properly connected to a power rail. This happens in designs where the power is provided through connectors or other components that are not marked as In these cases ERC won't detect any Output Power pins connected to the net and will determine the Input Power pin is not driven by a power source.



Electrical Rule Check Error
Input Power pin not driven by any Output Power pins

To avoid this warning, connect the net to `PWR_FLAG` symbol on such a power net as shown in the following example. The `PWR_FLAG` symbol is found in the `power` symbol library. Alternatively, connect any power output pin to the net; `PWR_FLAG` is simply a symbol with a single power output pin.



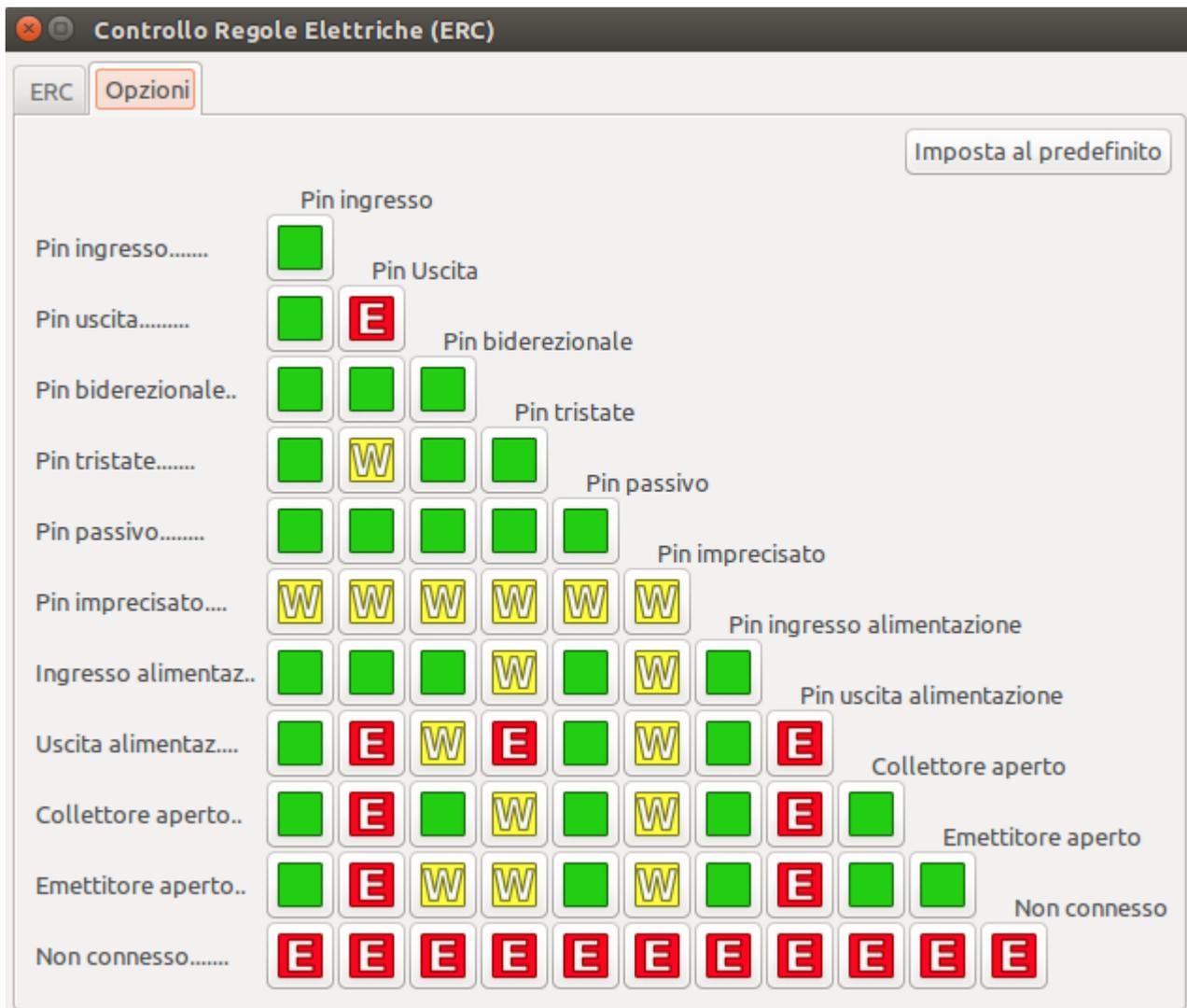
Electrical Rule Check Error
Input Power pin not driven by any Output Power pins

Ground nets often need a `PWR_FLAG` as well, because voltage regulators have outputs declared as power outputs, but their ground pins are typically marked as power inputs. Therefore grounds can appear unconnected to a source unless a `PWR_FLAG` symbol is used.

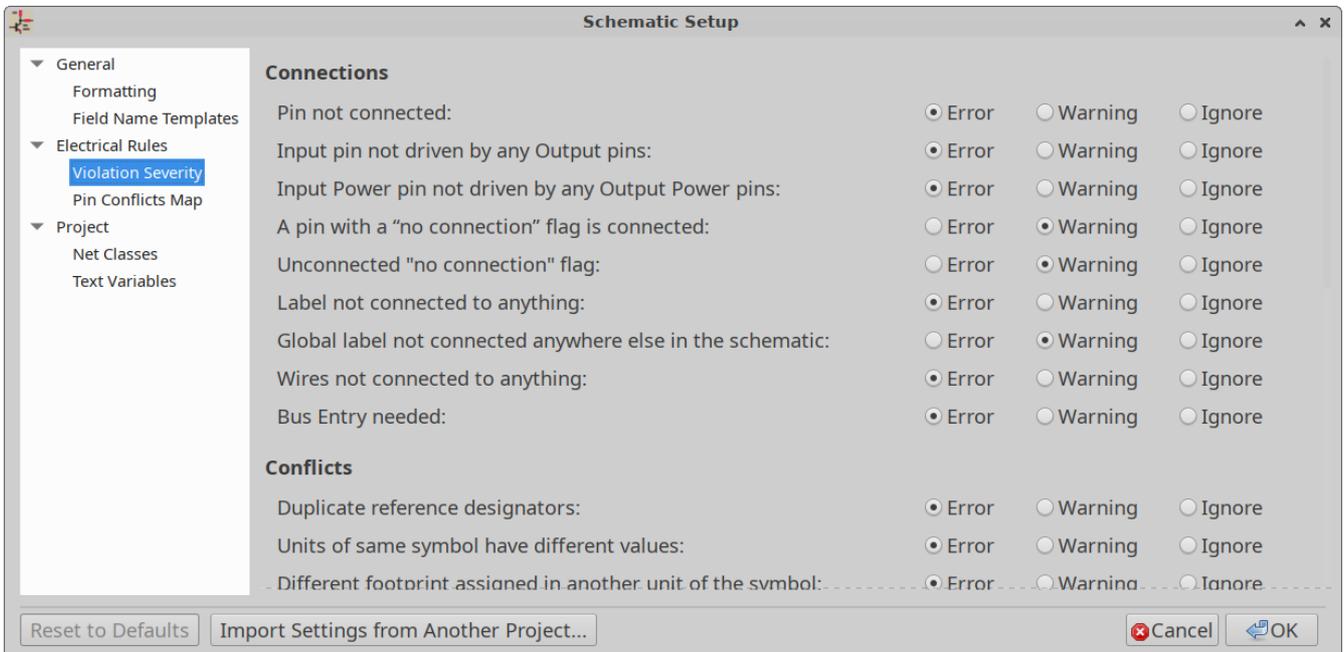
For more information about power pins and power flags, see the [PWR_FLAG documentation](#).

ERC Configuration

The *Pin Conflicts Map* panel in [Schematic Setup](#) allows you to configure connectivity rules to define electrical conditions for errors and warnings based on what types of pins are connected to each other.



Le regole possono essere cambiate facendo clic sul riquadro desiderato della matrice, in modo da selezionare la scelta desiderata: normale, avvertimento, errore.



The *Violation Severity* panel in [Schematic Setup](#) lets you configure what types of ERC messages should be reported as Errors, Warnings or ignored.

File rapporto ERC

An ERC report file can be generated and saved by clicking the **Save...** button in the ERC dialog. The file extension for ERC report files is `.rpt`. Here is an example ERC report file.

```
ERC report (Fri 21 Oct 2022 02:07:05 PM EDT, Encoding UTF8)

***** Sheet /
[pin_not_driven]: Input pin not driven by any Output pins
; Severity: error
  @(149.86 mm, 60.96 mm): Symbol U1B [74LS00] Pin 4 [, Input, Line]
[pin_not_connected]: Pin not connected
; Severity: error
  @(149.86 mm, 60.96 mm): Symbol U1B [74LS00] Pin 4 [, Input, Line]
[pin_not_connected]: Pin not connected
; Severity: error
  @(149.86 mm, 66.04 mm): Symbol U1B [74LS00] Pin 5 [, Input, Line]
[pin_to_pin]: Pins of type Output and Output are connected
; Severity: error
  @(165.10 mm, 63.50 mm): Symbol U1B [74LS00] Pin 6 [, Output, Inverted]
  @(165.10 mm, 46.99 mm): Symbol U1A [74LS00] Pin 3 [, Output, Inverted]
[pin_not_driven]: Input pin not driven by any Output pins
; Severity: error
  @(149.86 mm, 66.04 mm): Symbol U1B [74LS00] Pin 5 [, Input, Line]

** ERC messages: 5 Errors 5 Warnings 0
```

Assigning Footprints

Before routing a PCB, footprints need to be selected for every component that will be assembled on the board. Footprints define the copper connections between physical components and the routed traces on a circuit board.

Some symbols come with footprints pre-assigned, but for many symbols there are multiple possible footprints, so the user needs to select the appropriate one.

KiCad offers several ways to assign footprints:

- Proprietà del simbolo
 - Symbol Properties Dialog
 - Symbol Fields Table
- While placing symbols
- Strumento di assegnamento impronte

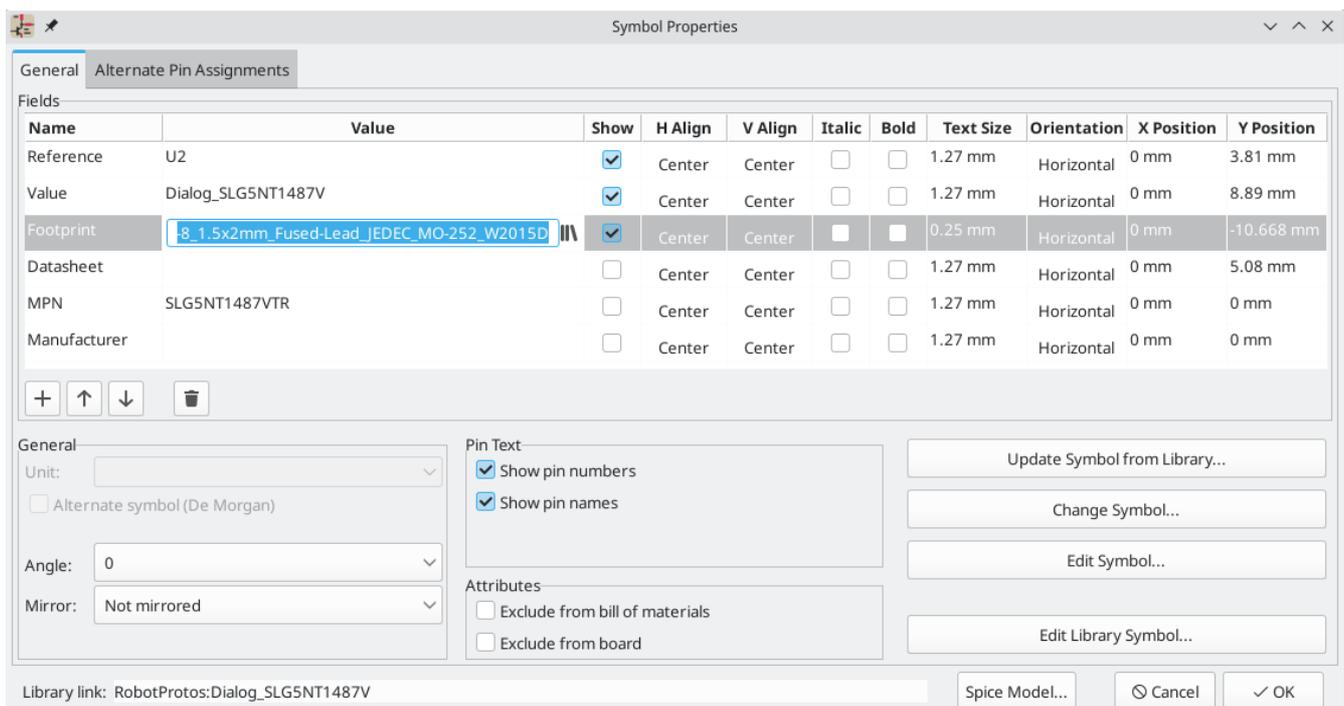
Each method will be explained below. Which to use is a matter of preference; one method may be more convenient depending on the situation. All of these methods are equivalent in that they store the name of the selected footprint in the symbol's `Footprint` field.

NOTE

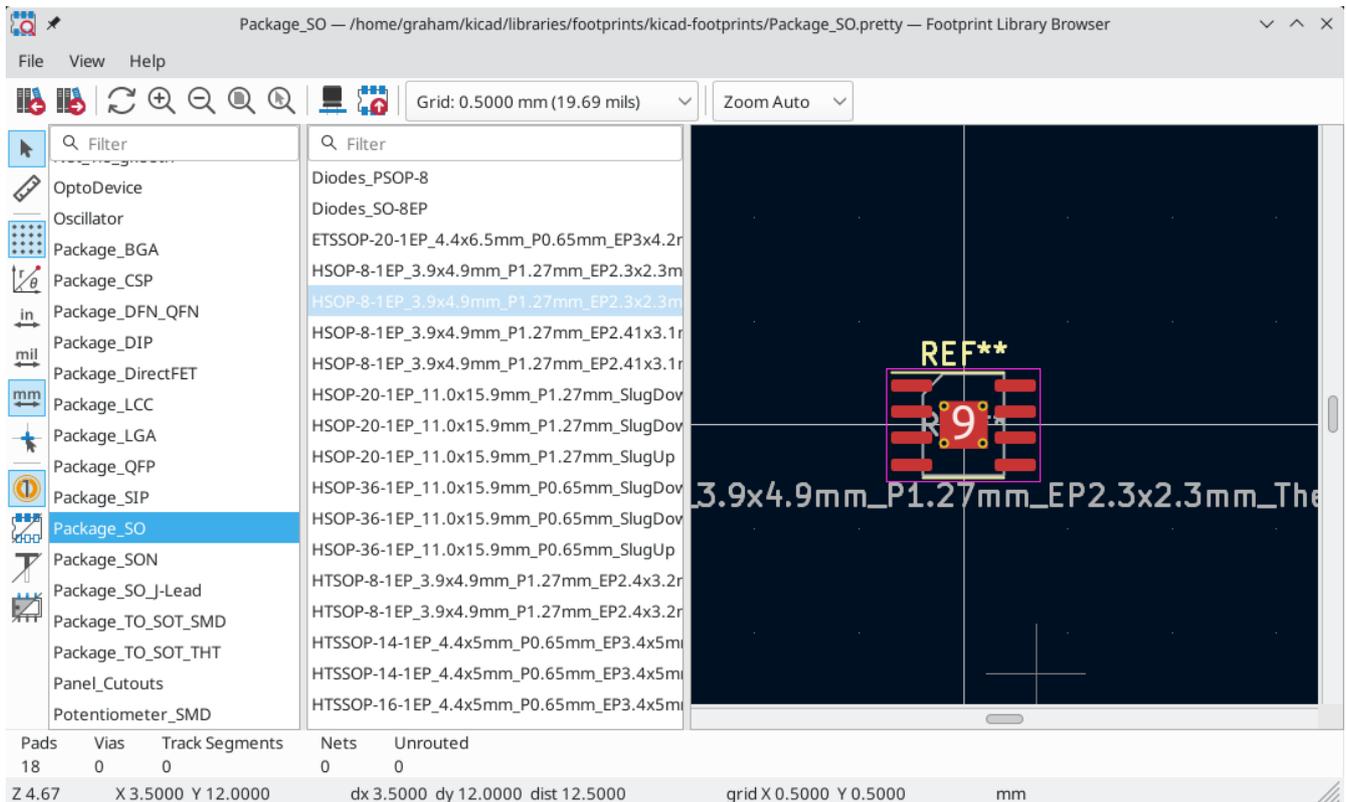
The Footprint Library Table needs to be configured before footprints can be assigned. For information on configuring the Footprint Library Table, please see the [PCB Editor manual](#).

Assigning Footprints in Symbol Properties

A symbol's `Footprint` field can be edited directly in the symbol's Properties window.



Clicking the  button in the Footprint field opens the Footprint Library Browser, which shows the available footprints and footprint libraries. Single clicking a footprint name selects the footprint and displays it in the preview pane on the right, while double clicking on a footprint closes the browser and sets the symbol's Footprint field to the selected footprint.

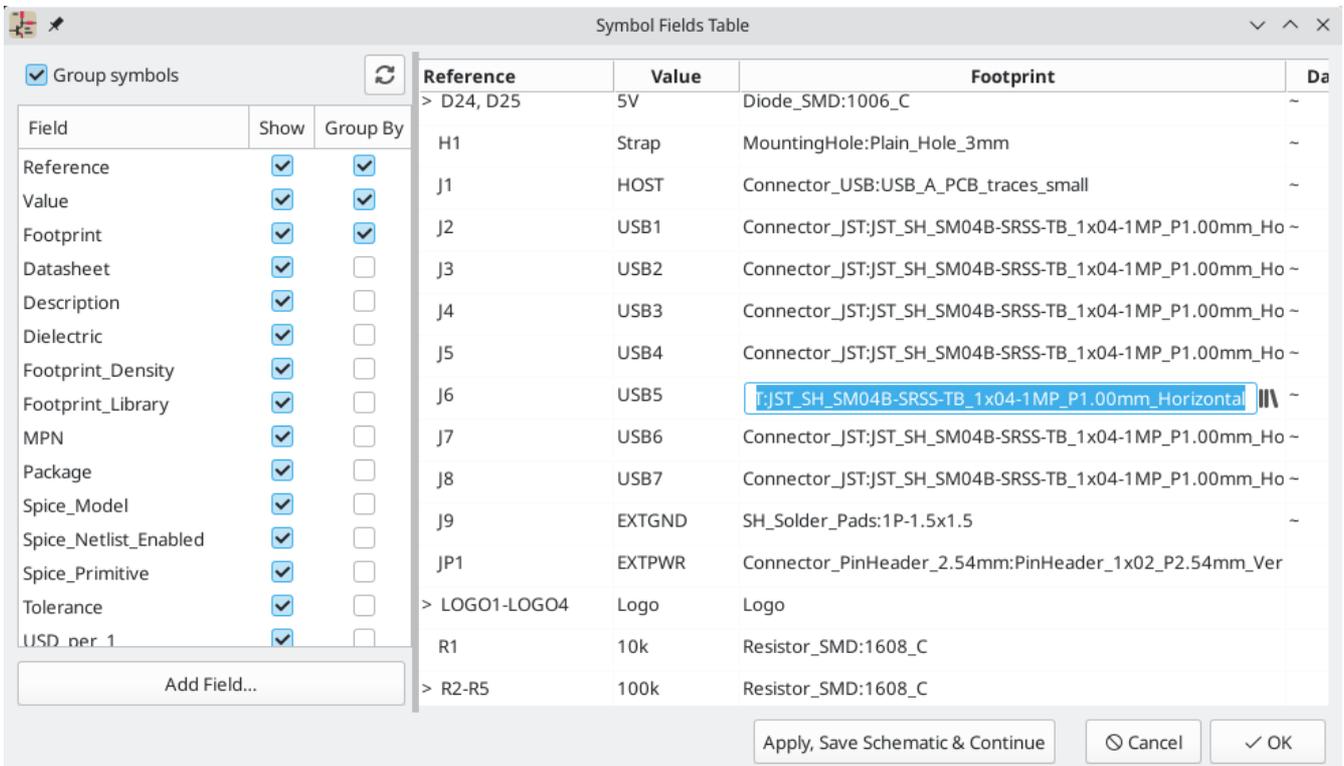


Assigning Footprints with the Symbol Fields Table

Rather than editing the properties of each symbol individually, the Symbol Fields Table can be used to view and edit the properties of all symbols in the design in one place. This includes assigning footprints by editing the Footprint field of each symbol.

The Symbol Fields Table is accessed with **Tools** → **Edit Symbol Fields...**, or with the  button on the top toolbar.

The Footprint field behaves the same here as in the Symbol Properties window: it can be edited directly, or footprints can be selected visually with the Footprint Library Browser.

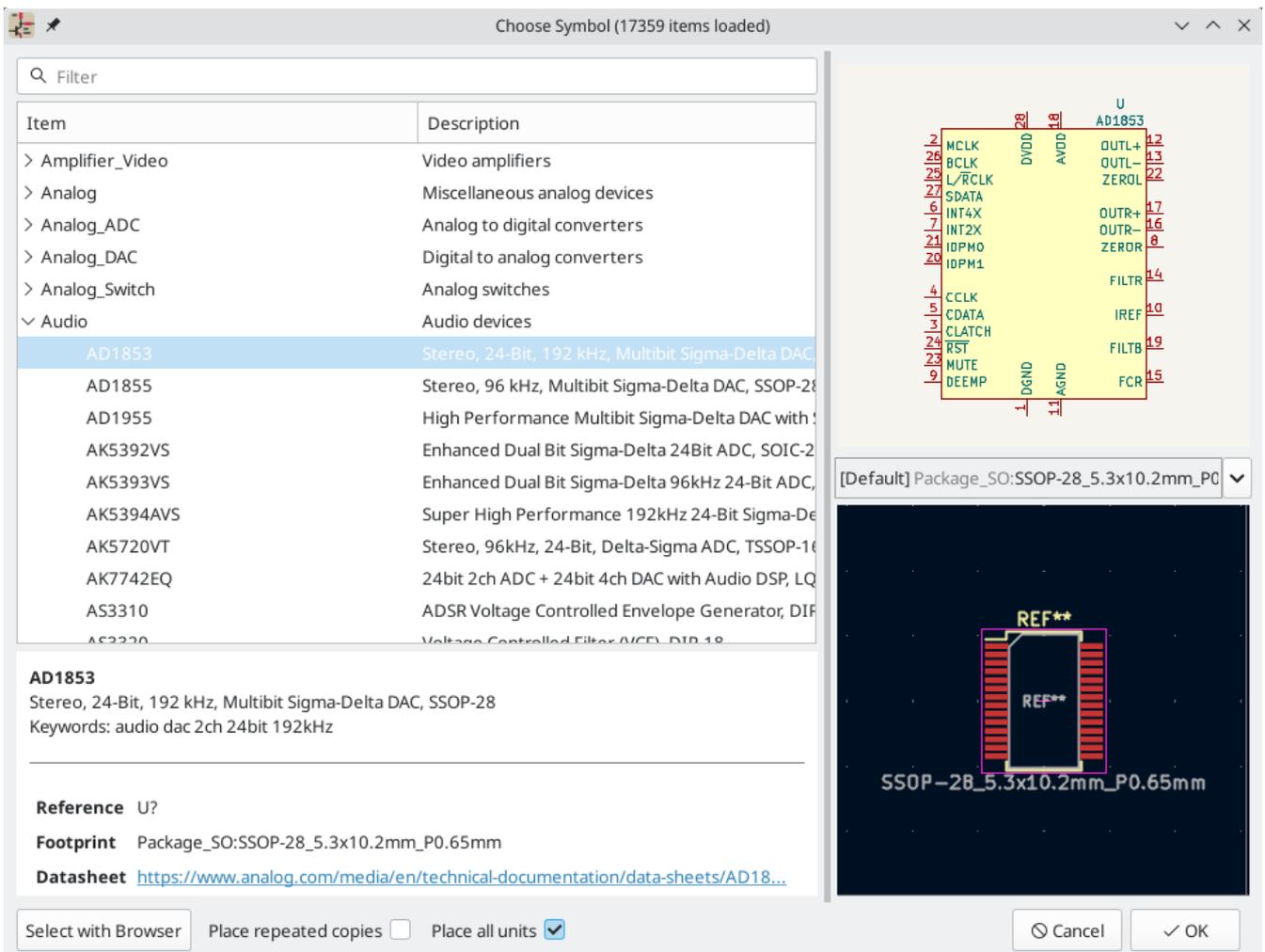


For more information on the Symbol Fields Table, see the [section on editing symbol properties](#).

Assigning Footprints While Placing Symbols

Footprints can be assigned to symbols when the symbol is first added to the schematic.

Some symbols are defined with a default footprint. These symbols will have this footprint preassigned when they are added to the schematic. The default footprint is shown in the Add Symbol dialog. For symbols without a default symbol defined, the footprint dropdown will say "No default footprint", and the footprint preview canvas will say "No footprint specified".



Symbols can have footprint filters that specify which footprints are appropriate to use with that symbol. If footprint filters are defined for the selected symbol, all footprints that match the footprint filters will appear as options in the footprint dropdown. The selected footprint will be displayed in the preview canvas and will be assigned to the symbol when the symbol is added to the schematic.

NOTE

Footprint options will not appear in the footprint dropdown unless the footprint libraries are loaded. Footprint libraries are loaded the first time the Footprint Editor or Footprint Library Browser are opened in a session.

For more information on footprint filters, see the [Symbol Editor Documentation](#).

Assigning Footprints with the Footprint Assignment Tool

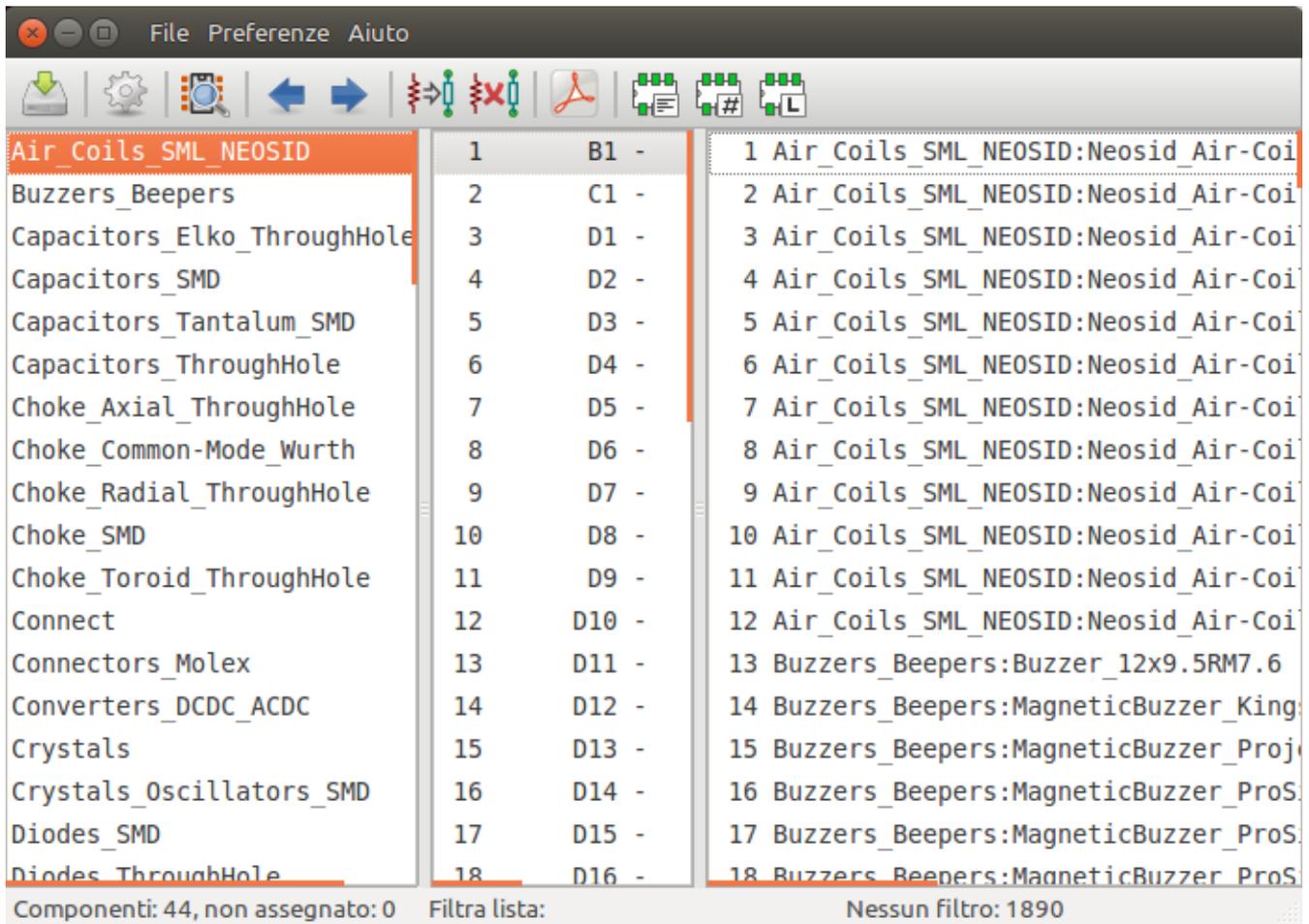
The Footprint Assignment Tool allows you to associate symbols in your schematic to footprints used when laying out the printed circuit board. It provides footprint list filtering, footprint viewing, and 3D component model viewing to help ensure the correct footprint is associated with each component.

Components can be assigned to their corresponding footprints manually or automatically by creating equivalence files (.equ files). Equivalence files are lookup tables associating each component with its footprint.

Run the tool with **Tools** → **Assign Footprints...**, or by clicking the  icon in the top toolbar.

Footprint Assignment Tool Overview

The image below shows the main window of the Footprint Assignment Tool.



- The left pane contains the list of available footprint libraries associated with the project.
- The center pane contains the list of symbols in the schematic.
- The right pane contains the list of available footprints loaded from the project footprint libraries.
- The bottom pane describes the filters that have been applied to the footprint list and prints information about the footprint selected in the rightmost pane.

The top toolbar contains the following commands:

	Transfer the current footprint associations to the schematic.
	Edit the global and project footprint library tables.
	View the selected footprint in the footprint viewer.
	Select the previous symbol without a footprint association.
	Select the next symbol without a footprint association.
	Undo last edit.
	Redo last edit.
	Perform automatic footprint association using an equivalence file.
	Delete all footprint assignments.
	Filter footprint list by footprint filters defined in the selected symbol.
	Filter footprint list by pin count of the selected symbol.
	Filter footprint list by selected library.

The following table lists the keyboard commands for the Footprint Assignment Tool:

Right Arrow / Tab	Activate the pane to the right of the currently activated pane. Wrap around to the first pane if the last pane is currently activated.
Left Arrow	Activate the pane to the left of the currently activated pane. Wrap around to the last pane if the first pane is currently activated.
Up Arrow	Select the previous item of the currently selected list.
Down Arrow	Select the next item of the currently selected list.
Page Up	Select the item one full page upwards of the currently selected item.
Page Down	Select the item one full page downwards of the currently selected item.
Home	Select the first item of the currently selected list.
End	Select the last item of the currently selected list.

Manually Assigning Footprints with the Footprint Assignment Tool

To manually associate a footprint with a component, first select a component in the component (middle) pane. Then select a footprint in the footprint (right) pane by double-clicking on the name of the desired

footprint. The footprint will be assigned to the selected component, and the next component without an assigned footprint is automatically selected.

NOTE

If no footprints appear in the footprint pane, check that the [footprint filter options](#) are correctly applied.

When all components have footprints assigned to them, click the **OK** button to save the assignments and exit the tool. Alternatively, click **Cancel** to discard the updated assignments, or **Apply, Save Schematic & Continue** to save the new assignments without exiting the tool.

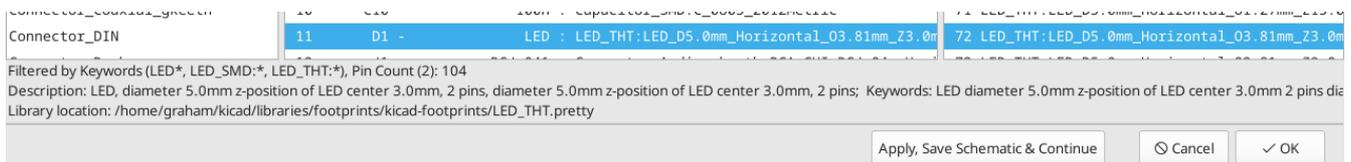
Filtro dell'elenco impronte

There are four filtering options which restrict which footprints are displayed in the footprint pane. The filtering options are enabled and disabled with three buttons and a textbox in the top toolbar.

- : Activate [filters that can be defined in each symbol](#). For example, an opamp symbol might define filters that show only SOIC and DIP footprints.
- : Only show footprints that match the selected symbol's pin count.
- : Only show footprints from the library selected in the left pane.
- Entering text in the textbox hides footprints that do not match the text. This filter is disabled when the box is empty.

When all filters are disabled, the full footprint list is shown.

The applied filters are described in the bottom pane of the window, along with the number of footprints that meet the selected filters. For example, when the symbol's footprint filters and pin count filters are enabled, the bottom pane prints the footprint filters and pin count:



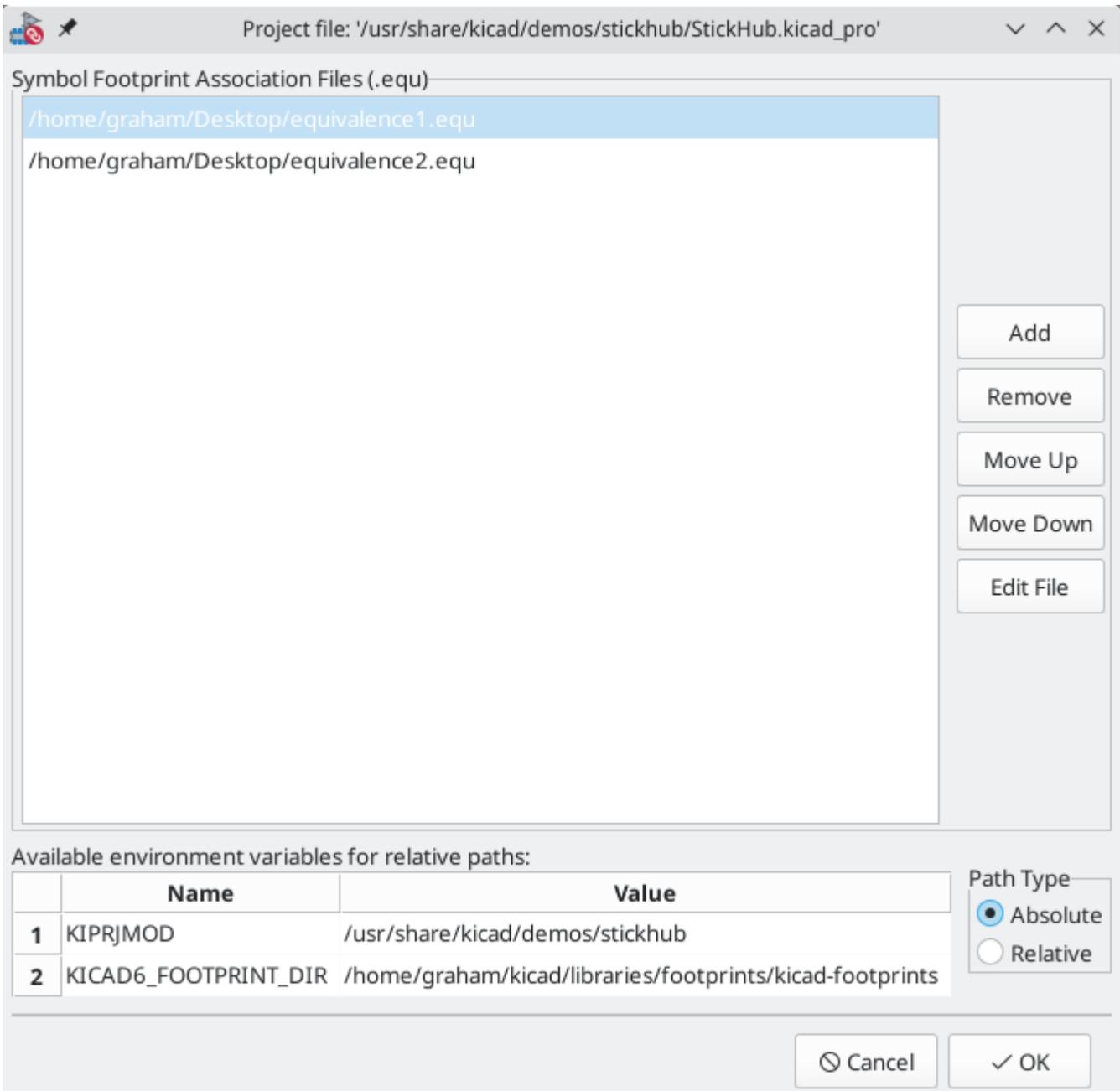
Multiple filters can be used at once to help narrow down the list of possibly appropriate footprints in the footprint pane. The symbols in KiCad's standard library define footprint filters that are designed to be used in combination with the pin count filter.

Automatically Assigning Footprints with the Footprint Assignment Tool

The Footprint Assignment Tool allows you to store footprint assignments in an external file and load the assignments later, even in a different project. This allows you to automatically associate symbols with the appropriate footprints.

The external file is referred to as an equivalence file, and it stores a mapping of a symbol value to a corresponding footprint. Equivalence files typically use the `.equ` file extension. Equivalence files are plain text files with a simple syntax, and must be created by the user using a text editor. The syntax is described below.

You can select which equivalence files to use by clicking **Preferences** → **Manage Footprint Association Files** in the Footprint Assignment Tool.



- Add new equivalence files by clicking the **Add** button.
- Remove the selected equivalence file by clicking the **Remove** button.
- Change the priority of equivalence files by clicking the **Move Up** and **Move Down** buttons. If a symbol's value is found in multiple equivalence files, the footprint from the last matching equivalence file will override earlier equivalence files.
- Open the selected equivalence file by clicking the **Edit File** button.

Relevant environment variables are shown at the bottom of the window. When the **Relative** path option is checked, these environment variables will automatically be used to make paths to selected equivalence files relative to the project or footprint libraries.

Once the desired equivalence files have been loaded in the correct order, automatic footprint association can be performed by clicking the  button in the top toolbar of the Footprint Assignment Tool.

All symbols with a value found in a loaded equivalence file will have their footprints automatically assigned. However, symbols that already have footprints assigned will not be updated.

Formato file delle equivalenze

Equivalence files consist of one line for each symbol value. Each line has the following structure:

```
'<symbol value>' '<footprint library>:<footprint name>'
```

Each name/value must be surrounded by single quotes (') and separated by one or more spaces. Lines starting with # are comments.

For example, if you want all symbols with the value LM4562 to be assigned the footprint Package_S0:SOIC-8_3.9x4.9_P1.27mm, the line in the equivalence file should be:

```
'LM4562' 'Package_S0:SOIC-8_3.9x4.9_P1.27mm'
```

Ecco un esempio di file di equivalenze:

```
#regulators 'LP2985LV' 'Package_TO_SOT_SMD:SOT-23-5_HandSoldering' ``
```

```
==== Visualizzazione dell'impronta corrente
```

The Footprint Assignment Tool contains a footprint viewer. Clicking the image:images/icons/icon_footprint_browser_24.png[footprint viewer icon] button in the top toolbar launches the footprint viewer and shows the selected footprint.

```
image::images/it/footprint_view.png[scaledwidth="90%", alt="Visualizzazione di un'impronta"]
```

The top toolbar contains the following commands:

```
[width="90%", cols="10%,90%"]
|=====
|image:images/icons/refresh_24.png[]
|Refresh view
|image:images/icons/zoom_in_24.png[]
|Zoom in
|
|image:images/icons/zoom_out_24.png[]
|Zoom out
|
|image:images/icons/zoom_fit_in_page_24.png[]
|Zoom to fit drawing in display area
|
|image:images/icons/shape_3d_24.png[]
|Show 3D viewer
|=====
```

The left toolbar contains the following commands:

```
[width="90%", cols="10%,90%"]
|=====
|image:images/icons/cursor_24.png[]
|Use the select tool
|
|image:images/icons/measurement_24.png[]
|Interactively measure between two points
|
|image:images/icons/grid_24.png[]
|Display grid dots or lines
|
|image:images/icons/polar_coord_24.png[]
|Switch between polar and cartesian coordinate systems
|
|image:images/icons/unit_inch_24.png[]
|Use inches
|
|image:images/icons/unit_mil_24.png[]
|Display coordinates in mils (1/1000 of an inch)
|
|image:images/icons/unit_mm_24.png[]
|Display coordinates in millimeters
|
|image:images/icons/cursor_shape_24.png[]
|Toggle display of full-window crosshairs
|
|image:images/icons/pad_number_24.png[]
|Toggle between drawing pads in sketch or normal mode
```

(export (version "E") (design (source "/usr/share/kicad/demos/simulation/sallen_key/sallen_key.kicad_sch") (date "Sun 01 May 2022 03:14:05 PM EDT") (tool "Eeschema (6.0.4)") (sheet (number "1") (name "/") (tstamps "/") (title_block (title) (company) (rev) (date) (source "sallen_key.kicad_sch") (comment (number "1") (value "")) (comment (number "2") (value "")) (comment (number "3") (value "")) (comment (number "4") (value "")) (comment (number "5") (value "")) (comment (number "6") (value "")) (comment (number "7") (value "")) (comment (number "8") (value "")) (comment (number "9") (value "")))) (components (comp (ref "C1") (value "100n") (libsource (lib "sallen_key_schlib") (part "C") (description "")) (property (name "Sheetname") (value "")) (property (name "Sheetfile") (value "sallen_key.kicad_sch")) (sheetpath (names "/") (tstamps "/") (tstamps "00000000-0000-0000-0000-00005789077d")) (comp (ref "C2") (value "100n") (fields (field (name "Fieldname") "Value") (field (name "SpiceMapping") "1 2") (field (name "Spice_Primitive") "C")) (libsource (lib "sallen_key_schlib") (part "C") (description "")) (property (name "Fieldname") (value "Value")) (property (name "Spice_Primitive") (value "C")) (property (name "SpiceMapping") (value "1 2")) (property (name "Sheetname") (value "")) (property (name "Sheetfile") (value "sallen_key.kicad_sch")) (sheetpath (names "/") (tstamps "/") (tstamps "00000000-0000-0000-0000-00005789085b")) (comp (ref "R1") (value "1k") (fields (field (name "Fieldname") "Value") (field (name "SpiceMapping") "1 2") (field (name "Spice_Primitive") "R")) (libsource (lib "sallen_key_schlib") (part "R") (description "")) (property (name "Fieldname") (value "Value")) (property (name "SpiceMapping") (value "1 2")) (property (name "Spice_Primitive") (value "R")) (property (name "Sheetname") (value "")) (property (name "Sheetfile") (value "sallen_key.kicad_sch")) (sheetpath (names "/") (tstamps "/") (tstamps "00000000-0000-0000-0000-0000578906ff")) (comp (ref "R2") (value "1k") (fields (field (name "Fieldname") "Value") (field (name "SpiceMapping") "1 2") (field (name "Spice_Primitive") "R")) (libsource (lib "sallen_key_schlib") (part "R") (description "")) (property (name "Fieldname") (value "Value")) (property (name "SpiceMapping") (value "1 2")) (property (name "Spice_Primitive") (value "R")) (property (name "Sheetname") (value "")) (property (name "Sheetfile") (value "sallen_key.kicad_sch")) (sheetpath (names "/") (tstamps "/") (tstamps "00000000-0000-0000-0000-000057890691")) (comp (ref "U1") (value "AD8051") (fields (field (name "Spice_Lib_File") "ad8051.lib") (field (name "Spice_Model") "AD8051") (field (name "Spice_Netlist_Enabled") "Y") (field (name "Spice_Primitive") "X")) (libsource (lib "sallen_key_schlib") (part "Generic_Opamp") (description "")) (property (name "Spice_Primitive") (value "X")) (property (name "Spice_Model") (value "AD8051")) (property (name "Spice_Lib_File") (value "ad8051.lib")) (property (name "Spice_Netlist_Enabled") (value "Y")) (property (name "Sheetname") (value "")) (property (name "Sheetfile") (value "sallen_key.kicad_sch")) (sheetpath (names "/") (tstamps "/") (tstamps "00000000-0000-0000-0000-00005788ff9f")) (comp (ref "V1") (value "AC 1") (libsource (lib "sallen_key_schlib") (part "VSOURCE") (description "")) (property (name "Sheetname") (value "")) (property (name "Sheetfile") (value "sallen_key.kicad_sch")) (sheetpath (names "/") (tstamps "/") (tstamps "00000000-0000-0000-0000-000057336052")) (comp (ref "V2") (value "DC 10") (fields (field (name "Fieldname") "Value") (field (name "Spice_Node_Sequence") "1 2") (field (name "Spice_Primitive") "V")) (libsource (lib "sallen_key_schlib") (part "VSOURCE") (description "")) (property (name "Fieldname") (value "Value")) (property (name "Spice_Primitive") (value "V")) (property (name "Spice_Node_Sequence") (value "1 2")) (property (name "Sheetname") (value "")) (property (name "Sheetfile") (value "sallen_key.kicad_sch")) (sheetpath (names "/") (tstamps "/") (tstamps "00000000-0000-0000-0000-0000578900ba")) (comp (ref "V3") (value "DC 10") (fields (field (name "Fieldname") "Value") (field (name "Spice_Node_Sequence") "1 2") (field (name "Spice_Primitive") "V")) (libsource (lib "sallen_key_schlib") (part "VSOURCE") (description "")) (property (name "Fieldname") (value "Value")) (property (name "Spice_Primitive") (value "V")) (property (name "Spice_Node_Sequence") (value "1 2")) (property (name "Sheetname") (value "")) (property (name "Sheetfile") (value "sallen_key.kicad_sch")) (sheetpath (names "/") (tstamps "/") (tstamps "00000000-0000-0000-0000-000057890232")) (libparts (libpart (lib "sallen_key_schlib") (part "C") (footprints (fp "C?") (fp "C_????*") (fp "C????") (fp "SMD*c") (fp "Capacitor*")) (fields (field (name "Reference") "C") (field (name "Value") "C")) (pins (pin (num "1") (name "") (type "passive")) (pin (num "2") (name "") (type "passive")))) (libpart (lib

```
"sallen_key_schlib") (part "Generic_Opamp") (fields (field (name "Reference") "U") (field (name "Value")
"Generic_Opamp")) (pins (pin (num "1") (name "") (type "input")) (pin (num "2") (name "-") (type "input")) (pin
(num "3") (name "V") (type "power_in")) (pin (num "4") (name "V-") (type "power_in")) (pin (num "5") (name "")
(type "output")))) (libpart (lib "sallen_key_schlib") (part "R") (footprints (fp "R*") (fp "Resistor_*")) (fields
(field (name "Reference") "R") (field (name "Value") "R")) (pins (pin (num "1") (name "") (type "passive")) (pin
(num "2") (name "") (type "passive")))) (libpart (lib "sallen_key_schlib") (part "VSOURCE") (fields (field (name
"Reference") "V") (field (name "Value") "VSOURCE") (field (name "Fieldname") "Value") (field (name
"Spice_Primitive") "V") (field (name "Spice_Node_Sequence") "1 2")) (pins (pin (num "1") (name "") (type
"input")) (pin (num "2") (name "") (type "input")))) (libraries (library (logical "sallen_key_schlib") (uri
"/usr/share/kicad/demos/simulation/sallen_key/sallen_key_schlib.kicad_sym"))) (nets (net (code "1") (name
"/lowpass") (node (ref "C1") (pin "1") (pintype "passive")) (node (ref "U1") (pin "2") (pinfunction "-") (pintype
"input")) (node (ref "U1") (pin "5") (pintype "output"))) (net (code "2") (name "GND") (node (ref "C2") (pin "2")
(pintype "passive")) (node (ref "V1") (pin "2") (pintype "input")) (node (ref "V2") (pin "2") (pintype "input"))
(node (ref "V3") (pin "1") (pintype "input"))) (net (code "3") (name "Net-(C1-Pad2)") (node (ref "C1") (pin "2")
(pintype "passive")) (node (ref "R1") (pin "1") (pintype "passive")) (node (ref "R2") (pin "2") (pintype
"passive"))) (net (code "4") (name "Net-(C2-Pad1)") (node (ref "C2") (pin "1") (pintype "passive")) (node (ref
"R2") (pin "1") (pintype "passive")) (node (ref "U1") (pin "1") (pinfunction "") (pintype "input"))) (net (code "5")
(name "Net-(R1-Pad2)") (node (ref "R1") (pin "2") (pintype "passive")) (node (ref "V1") (pin "1") (pintype
"input"))) (net (code "6") (name "VDD") (node (ref "U1") (pin "3") (pinfunction "V") (pintype "power_in"))
(node (ref "V2") (pin "1") (pintype "input"))) (net (code "7") (name "VSS") (node (ref "U1") (pin "4")
(pinfunction "V-") (pintype "power_in")) (node (ref "V3") (pin "2") (pintype "input"))))
```

In Spice format, the netlist is as follows:

```
include "ad8051.lib"
```

```
XU1 Net-C2-Pad1 /lowpass VDD VSS /lowpass AD8051 C2 Net-C2-Pad1 GND 100n C1 /lowpass Net-C1-Pad2
100n R2 Net-C2-Pad1 Net-C1-Pad2 1k R1 Net-C1-Pad2 Net-R1-Pad2 1k V1 Net-R1-Pad2 GND AC 1 V2 VDD GND
DC 10 V3 GND VSS DC 10 .ac dec 10 1 1Meg .end
```

```
[[notes-on-netlists]]
==== Note sulla netlist
```

```
[[netlist-name-precautions]]
===== Precauzioni sul nomi netlist
```

Many software tools that use netlists do not accept spaces in component names, pins, nets, or other fields. Avoid using spaces in pins, labels, names, and value fields of components to ensure maximum compatibility.

In the same way, special characters other than letters and numbers can cause problems. Note that this limitation is not related to KiCad, but to the netlist formats that can then become untranslatable by other software that reads those netlist files.

```
[[spice-netlists]]
===== Spice netlists
```

Spice simulators expect simulation commands (`.PROBE`, `.AC`, `.TRAN`, etc.) to be included in the netlist.

Any text line included in the schematic diagram starting with a period (`. `) will be included in the netlist. If a text object contains multiple lines, only the lines beginning with a period will be included.

``.include`` directives for including model library files are automatically added to the netlist based on the Spice model settings for the symbols in the schematic.

[[other-formats]]

==== Other netlist formats

KiCad supports custom netlist generators for exporting netlists in other formats. This process is explained in the <<custom-netlist-and-bom-formats,custom netlist generators section>>.

:experimental:

[[managing-symbol-libraries]]

== Managing Symbol Libraries

Le librerie di simboli contengono raccolte di simboli utilizzati durante la creazione degli schemi elettrici. Ogni simbolo in uno schema è identificato in modo univoco da un nome completo composto da un nickname di libreria e da un nome di simbolo. Un esempio è `Audio:AD1853`.

=== Tabella librerie di simboli

KiCad uses a table of symbol libraries to map symbol libraries to a library nickname. Kicad uses a global symbol library table as well as a table specific to each project. To edit either symbol library table, use **Preferences** -> **Manage Symbol Libraries...**

image::images/it/options_symbol_lib.png[scaledwidth="80%", alt="finestra tabella librerie di simboli"]

The global symbol library table contains the list of libraries that are always available regardless of the currently loaded project. The table is saved in the file ``sym-lib-table`` in the KiCad configuration folder. `xref:../kicad/kicad.adoc#config-file-location`[The location of this folder] depends on the operating system being used.

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

==== Configurazione iniziale

The first time the KiCad Schematic Editor is run and the global symbol table file ``sym-lib-table`` is not found in the KiCad configuration folder, KiCad will guide the user through setting up a new symbol library table. This process is described <<initial-configuration,above>>.

==== Managing Table Entries

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

Add a library either by clicking the `image:images/icons/small_folder_16.png`[Folder icon] button and selecting a library or clicking the `image:images/icons/small_plus_16.png`[Plus icon] 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 `image:images/icons/small_trash_16.png`[Delete icon] button.

The `image:images/icons/small_up_16.png`[Up icon] and `image:images/icons/small_down_16.png`[Down icon] buttons move the selected library up and down in the library table. This does not affect the display order of libraries in the Symbol Library Browser, Symbol Editor, or Add Symbol 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 symbol names because it is used as a separator between nicknames and symbols.

Each library entry must have a valid path. Paths can be defined as absolute, relative, or by `<<environment-variable-substitution,environment variable substitution>>`.

The appropriate library format must be selected in order for the library to be properly read. "KiCad" format is used for KiCad version 6 libraries (``.kicad_sym`` files), while "Legacy" format is used for libraries from older versions of KiCad (``.lib`` files). Legacy libraries are read-only, but can be migrated to KiCad format libraries using the ***Migrate Libraries*** button (see section `<<migrating-libraries,Migrating Legacy 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.

```
[[environment-variable-substitution]]  
==== Sostituzione delle variabili ambiente
```

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

``${KIPROJMOD}`` allows libraries to be stored in the project folder without having to use an absolute path in the project library table. This makes it possible to relocate projects without breaking their project library tables. One of the most powerful features of the symbol library table is environment variable substitution. This allows for definition of custom paths to where symbol libraries are stored in environment variables. Environment variable substitution is supported by using the syntax ``${ENV_VAR_NAME}`` in the library path.

==== Modelli di utilizzo

Symbol libraries can be defined either globally or specifically to the currently loaded project. Symbol libraries defined in the user's global table are always available and are stored in the ``sym-lib-table`` file in the user's KiCad configuration folder. The project-specific symbol library table is active only for the currently open project file.

Ci sono vantaggi e svantaggi per ogni metodo. Definire tutte le librerie nella tabella globale significa che queste saranno sempre disponibili alla bisogna. Lo svantaggio di ciò è aumenterà che il tempo di caricamento.

Definire tutte le librerie di simboli su base specifica del progetto significa che si avranno solamente le librerie necessarie per quel progetto e ciò diminuirà il tempo di caricamento dei simboli. Lo svantaggio è che sarà sempre necessario ricordarsi di aggiungere ogni libreria di simboli necessaria per ogni progetto.

Uno schema di utilizzo potrebbe essere quello di definire le librerie di uso comune a livello globale e le librerie richieste solo per il progetto nella tabella della libreria specifica del progetto.

```
[[migrating-libraries]]
==== Migrating Legacy Libraries
```

Legacy libraries (`.lib` files) are read-only, but they can be migrated to KiCad version 6 libraries (`.kicad_sym`). KiCad version 6 libraries cannot be viewed or edited by KiCad versions older than 6.0.0.

Legacy libraries can be converted to KiCad 6 libraries by selecting them in the symbol library table and clicking the **Migrate Libraries** button. Multiple libraries can be selected and migrated at once by `kbd:[Ctrl]-clicking` or `kbd:[shift]-clicking`.

Libraries can also be converted one at a time by opening them in the Symbol Editor and saving them as a new library.

```
==== Rimappatura dei vecchi progetti
```

When loading a schematic created prior to the symbol library table implementation, KiCad will attempt to remap the symbol library links in the schematic to the appropriate library table symbols. The success of this process is dependent on several factors:

- le librerie originali usate nello schema sono ancora disponibili e invariate da quando il simbolo è stato aggiunto allo schema.
- tutte le operazioni di salvataggio sono state eseguite quando sono state rilevate per creare una libreria di salvataggio o mantenere aggiornata la libreria di salvataggio esistente.
- l'integrità della libreria cache dei simboli del progetto non è stata danneggiata.

```
[WARNING]
```

```
====
```

La rimappatura eseguirà un salvataggio di tutti i file che vengono modificati durante l'operazione, nella cartella di salvataggio all'interno della cartella del progetto. Effettuare sempre un salvataggio del progetto prima di rimappare, (N.d.T. per evitare brutte sorprese) nel caso in cui qualcosa vada storto.

```
====
```

```
[WARNING]
```

```
====
```

L'operazione di recupero viene eseguita anche se è stata disabilitata per garantire che i simboli corretti siano disponibili per la rimappatura. Non annullare questa operazione o la rimappatura non riuscirà a rimappare correttamente i simboli degli schemi. Eventuali collegamenti a simboli spezzati dovranno essere corretti manualmente.

```
====
```

```
[NOTE]
```

```
====
```

If the original libraries have been removed and the rescue was not performed, the cache library can be used as a recovery library as a last resort. Copy the cache library to a new file name and add the new library file to the top of the

library list using a version of KiCad prior to the symbol library table implementation.
====

:experimental:

[[symbol-editor]]

== Editor dei simboli

[[general-information-about-symbol-libraries]]

=== Informazioni generali sulle librerie di simboli

Un simbolo è un elemento dello schema elettrico che contiene una rappresentazione grafica, connessioni elettriche e campi di testo che definiscono il simbolo stesso. I simboli usati in uno schema elettrico vengono memorizzati in librerie di simboli. KiCad fornisce uno strumento per la modifica dei simboli che permette di creare librerie, aggiungere, eliminare o trasferire simboli tra librerie, esportare simboli su file e importare simboli da file. In breve, lo strumento di modifica dei simboli fornisce un modo semplice per gestire simboli e librerie di simboli.

[[symbol-library-overview]]

=== Panoramica delle librerie di simboli

Una libreria di simboli è composta da uno o più simboli. Generalmente i simboli sono raggruppati per funzione, tipo e/o produttore.

Un simbolo è composto di:

- * Elementi grafici (linee, cerchi, archi, testo, ecc.) che determinano l'aspetto del simbolo nello schema elettrico.
- * I piedini hanno sia proprietà grafiche (linea, clock, inversione, attivo basso, ecc.) che proprietà elettriche (ingresso, uscita, bidirezionale, ecc.) usate dallo strumento di controllo regole elettriche (ERC).
- * Campi come riferimenti, valori, nomi impronte corrispondenti per la progettazione del circuito stampato, ecc.

Symbols can be derived from another symbol in the same library. Derived symbols share the base symbol's graphical shape and pin definitions, but can override the base symbol's property fields (value, footprint, footprint filters, datasheet, description, etc.). Derived symbols can be used to define symbols that are similar to a base part. For example, 74LS00, 74HC00, and 7437 symbols could all be derived from a 7400 symbol. In previous versions of KiCad, derived symbols were referred to as aliases.

La corretta progettazione di simboli richiede:

- * Specificare se il simbolo è formato da più di un'unità.
- * Specificare se il simbolo possiede uno stile corpo alternativo (altrimenti detto rappresentazione De Morgan).
- * La progettazione della sua rappresentazione simbolica usando linee, rettangoli, cerchi, poligoni e testo.
- * L'aggiunta di pin definendo con cura l'elemento grafico di ogni pin, il nome, il numero, e le sue proprietà elettriche (ingresso, uscita, tri-state, potenza,

ecc.).

* Determining if the symbol should be derived from another symbol with the same graphical design and pin definition.

* L'aggiunta di campi opzionali come il nome dell'impronta usata dal software di progettazione di circuiti stampati e/o la definizione della loro visibilità.

* La documentazione del simbolo aggiungendo una stringa di descrizione, collegamenti ai datasheet, ecc.

* Il salvataggio nella libreria scelta.

[[symbol-library-editor-overview]]

=== Panoramica dell'editor dei simboli di libreria

Di seguito si può osservare la finestra principale dell'editor di librerie di simboli. Esso consiste in tre barre degli strumenti che servono a velocizzare l'accesso alle funzioni più comuni, e un'area di visualizzazione/modifica del simbolo. Sulle barre degli strumenti non sono disponibili tutti comandi, ma quelli che mancano sono comunque accessibili tramite i menu.

image::images/it/libedit_main_window.png[alt="Symbol Editor main window", scaledwidth="95%"]

[[main-toolbar]]

==== Barra strumenti principale

La barra degli strumenti principale è collocata in cima alla finestra principale, come mostrato sotto, e consiste nei comandi di annullamento e ripetizione delle ultime operazioni, zoom, finestre di dialogo delle proprietà dei simboli, controlli di gestione unità/rappresentazione.

image::images/it/toolbar_libedit.png[alt="Barra editor dei simboli", scaledwidth="95%"]

[width="100%", cols="20%,80%"]

|=====

|image:images/icons/new_component_24.png[New symbol icon]

|Create a new symbol in the selected library.

|image:images/icons/save_24.png[Save icon]

|Save the currently selected library. All modified symbols in the library will be saved.

|image:images/icons/undo_24.png[Undo icon]

|Undo last edit.

|image:images/icons/redo_24.png[Redo icon]

|Redo last undo.

|image:images/icons/refresh_24.png[Refresh icon]|Refresh display.

|image:images/icons/zoom_in_24.png[Zoom in icon]|Zoom in.

|image:images/icons/zoom_out_24.png[Zoom out icon]|Zoom out.

|image:images/icons/zoom_fit_in_page_24.png[Zoom to fit page icon]|Zoom to fit

```

symbol in display.

|image:images/icons/zoom_area_24.png[Zoom to selection icon]|Zoom to fit selection.

|image:images/icons/rotate_ccw_24.png[Rotate counterclockwise icon]|Rotate counter-
clockwise.

|image:images/icons/rotate_cw_24.png[Rotate clockwise icon]|Rotate clockwise.

|image:images/icons/mirror_h_24.png[Mirror horizontally icon]|Mirror horizontally.

|image:images/icons/mirror_v_24.png[Mirror vertically icon]|Mirror vertically.

|image:images/icons/part_properties_24.png[Symbol properties icon]
|Edit the current symbol properties.

|image:images/icons/pin_table_24.png[Pin table icon]
|Edit the symbol's pins in a tabular interface.

|image:images/icons/datasheet_24.png[Datasheet icon]
|Open the symbol's datasheet. The button will be disabled if no datasheet is
defined for the current symbol.

|image:images/icons/erc_24.png[ERC icon]
|Test the current symbol for design errors.

|image:images/icons/morgan1_24.png[Normal body style icon]
|Select the normal body style. The button is disabled if the current
symbol does not have an alternate body style.

|image:images/icons/morgan2_24.png[Alternate body style icon]
|Select the alternate body style. The button is disabled if the current
symbol does not have an alternate body style.

|image:images/toolbar_libedit_part.png[alt="Unit dropdown",width="80%"]
|Select the unit to display. The drop down control will be disabled if
the current symbol is not derived from a symbol with multiple units.

|image:images/icons/pin2pin_24.png[Synchronized pin edit mode icon]
|Enable synchronized pins edit mode. When this mode is enabled, any pin
modifications are propagated to all other symbol units. Pin number changes are
not propagated. This mode is automatically enabled for symbols with multiple
interchangeable units and cannot be enabled for symbols with only one unit.

|image:images/icons/add_symbol_to_schematic_24.png[Add symbol to schematic icon]
Insert current symbol into schematic.

|=====

[[element-toolbar]]
==== Barra strumenti elementi

```

La barra strumenti verticale sul lato destro della finestra principale permette di piazzare tutti gli elementi richiesti per progettare un simbolo.

```
[width="100%", cols="10%,90%"]
|=====
|image:images/icons/cursor_24.png[Icona puntatore]
|Strumento di selezione. Clic destro con lo strumento di selezione apre il
|menu contestuale per l'oggetto sottostante il puntatore. Clic sinistro con
|lo strumento di selezione visualizza gli attributi dell'oggetto nel pannello
|messaggi in fondo alla finestra principale. Doppio clic sinistro con lo
|strumento di selezione apre la finestra di dialogo delle proprietà dello
|stesso oggetto.

|image:images/icons/pin_24.png[Icona pin]
|Strumento pin. Clic sinistro per aggiungere un nuovo piedino.

|image:images/icons/text_24.png[Icona testo]
|Strumento testo grafico. Clic sinistro per aggiungere un nuovo elemento di testo grafico.

|image:images/icons/add_rectangle_24.png[Icona aggiungi rettangolo]
|Strumento rettangolo. Clic sinistro per cominciare a disegnare il primo
|vertice di un rettangolo grafico. Un secondo clic sinistro per piazzare
|il vertice opposto del rettangolo.

|image:images/icons/add_circle_24.png[Icona aggiungi cerchio]
|Strumento cerchio. Clic sinistro per cominciare a disegnare un nuovo cerchio
|grafico dal centro. Un secondo clic sinistro imposta il raggio del cerchio.

|image:images/icons/add_arc_24.png[Icona aggiungi arco]
|Strumento arco. Clic sinistro per cominciare a disegnare un nuovo elemento
|arco grafico dal primo capo. Altro clic sinistro per impostare il secondo capo.
|Per regolare il raggio trascinare il punto di centro dell'arco.

|image:images/icons/add_line_24.png[Icona aggiungi linea]
|Strumento linea connessa. Clic sinistro per cominciare a disegnare un nuovo elemento
|grafico linea nel simbolo corrente. Clic sinistro per ogni linea connessa aggiuntiva.
|Doppio clic sinistro per completare la linea.

|image:images/icons/anchor_24.png[Icona àncora]
|Strumento àncora. Clic sinistro per impostare la posizione dell'àncora del simbolo.

|image:images/icons/delete_24.png[Icona elimina]
|Strumento elimina. Clic sinistro per eliminare un oggetto dal simbolo corrente.
|=====

[[options-toolbar]]
==== Barra opzioni
```

La barra strumenti verticale, posizionata sul lato sinistro della finestra

principale, permette di impostare alcune opzioni di disegno dell'editor.

```
[width="100%", cols="10%,90%"]
|=====
|image:images/icons/grid_24.png[Icona griglia]
|Commuta la visibilità griglia.

|image:images/icons/unit_inch_24.png[Icona unità griglia]
|Imposta le unità a pollici.

|image:images/icons/unit_mil_24.png[Icona unità mils]
|Imposta le unità a mils (0.001 pollici).

|image:images/icons/unit_mm_24.png[Icona unità millimetri]
|Imposta le unità a millimetri.

|image:images/icons/cursor_shape_24.png[Icona forma puntatore]
|Commuta la forma del puntatore (pieno schermo/piccolo).

|image:images/icons/pin_show_etype_24.png[Icona mostra tipo di pin]
|Commuta la visibilità della tipologia elettrica dei pin.

|image:images/icons/search_tree_24.png[Icona albero dei simboli]
|Commuta la visibilità delle librerie e dei simboli.
|=====
```

```
[[library-selection-and-maintenance]]
=== Selezione e manutenzione librerie
```

La selezione della libreria corrente è possibile tramite l'icona `image:images/icons/search_tree_24.png` [Icona albero dei simboli] che mostra tutte le librerie disponibili e permette di selezionarne una. Quando un simbolo viene caricato o salvato, esso viene messo in questa libreria. Il nome di libreria di un simbolo è il contenuto del suo campo valore.

```
[[select-and-save-a-symbol]]
==== Selezione e salvataggio di un simbolo
```

```
[[symbol-selection]]
===== Selezione simboli
```

Facendo clic sull'icona `image:images/icons/search_tree_24.png` [Icona albero dei simboli] sulla barra degli strumenti di sinistra commuta la visualizzazione ad albero di librerie e simboli. Facendo clic su un simbolo si apre quel simbolo.

[NOTE]

Alcuni simboli sono derivati da altri simboli. I nomi dei simboli derivati vengono visualizzati in `__corsivo__` nella vista ad albero. Se un simbolo derivato viene aperto, la sua grafica non sarà modificabile. I suoi campi simbolo invece saranno modificabili normalmente. Per modificare la grafica di un simbolo base e di tutti i suoi simboli derivati, bisogna aprire il simbolo base.

```
[[save-a-symbol]]
```

==== Salvare un simbolo

Dopo la modifica, un simbolo può essere salvato nella libreria corrente o in una nuova libreria.

Per salvare il simbolo modificato nella libreria corrente, fare clic sull'icona `image:images/icons/save_24.png`[Icona salva]. Le modifiche verranno scritte sul simbolo esistente.

NOTE: Saving a modified symbol also saves all other modified symbols in the same library.

Per salvare i cambiamenti del simbolo in un nuovo simbolo, fare clic su **File** -> **Salva con nome...**. Il simbolo può essere salvato nella libreria corrente o in una diversa libreria. Si può impostare anche un nuovo nome per il simbolo.

Per creare un nuovo file contenente solo il simbolo corrente, fare clic su **File** -> **Esporta** -> **Simbolo...**. Questo file sarà un file di libreria standard che conterrà solo un simbolo.

[[creating-library-symbols]]
=== Creare simboli di libreria

[[create-a-new-symbol]]
==== Creare un nuovo simbolo

Un nuovo simbolo può essere creato facendo clic sull'icona `image:images/icons/new_component_24.png`[Icona nuovo simbolo]. Verranno richieste un certo numero di proprietà del simbolo.

- * Un nome simbolo (questo nome viene usato come valore predefinito del campo `Valore` nell'editor dello schema elettrico).
- * An optional base symbol to derive the new symbol from. The new symbol will use the base symbol's graphical shape and pin configuration, but other symbol information can be modified in the derived symbol. The base symbol must be in the same library as the new derived symbol.
- * Il prefisso del riferimento (`U`, `C`, `R`...).
- * The number of units per package, and whether those units are interchangeable (for example a 7400 is made of 4 units per package).
- * If an alternate body style (sometimes referred to as a "De Morgan equivalent") is desired.
- * Whether the symbol is a power symbol. Power symbols appear in the "Add Power Port" dialog in the Schematic editor, their `Value` fields are not editable in the schematic, they cannot be assigned a footprint and they are not added to the PCB, and they are not included in the bill of materials.
- * Whether the symbol should be excluded from the bill of materials.
- * Whether the symbol should be excluded from the PCB.

There are also several graphical options.

- * The offset between the end of each pin and its pin name.
- * Whether the pin number and pin name should be displayed.
- * Whether the pin names should be displayed alongside the pins or at the ends

of the pins inside the symbol body.

These properties can also be changed later in the <<symbol-properties, Symbol Properties window>>.

```
image::images/eeschema_new_symbol_properties.png[alt="Proprietà del nuovo simbolo", scaledwidth="50%"]
```

Un nuovo simbolo verrà creato usando le proprietà sopraesposte e apparirà nell'editor come mostrato sotto.

```
image::images/it/eeschema_libedit_new.png[alt="Simbolo appena creato", scaledwidth="95%"]
```

The blue cross in the center is the symbol anchor, which specifies the symbol origin i.e. the coordinates (0, 0). The anchor can be repositioned by selecting the `image:images/icons/anchor_24.png[Anchor icon]` icon and clicking on the new desired anchor position.

```
[[create-a-symbol-from-another-symbol]]  
==== Creare un simbolo da un altro simbolo
```

Spesso, il simbolo che si vuole creare è simile ad un altro già presente in una libreria componenti. In questo caso risulta più facile caricare e modificare un simbolo esistente (N.d.T. piuttosto che ricrearne uno nuovo da zero).

- * Caricare il simbolo che verrà usato come punto di partenza.
- * Save a new copy of the symbol using ****File**** -> ****Save As...****. The Save As dialog will prompt for a name for the new symbol and the library to save it in.
- * Modifica il nuovo simbolo come richiesto.
- * Salva il simbolo modificato.

```
[[symbol-properties]]  
==== Proprietà del simbolo
```

Le proprietà del simbolo vengono impostate durante la creazione del simbolo ma queste possono essere modificate in qualsiasi momento. Per cambiare le proprietà del simbolo, fare clic su `image:images/icons/part_properties_24.png[Icona proprietà del simbolo]` per mostrare la finestra seguente.

```
image::images/it/eeschema_properties_for_symbol.png[alt="Proprietà del simbolo", scaledwidth="60%"]
```

È molto importante impostare correttamente il numero di unità per contenitore e la rappresentazione simbolica alternativa, se abilitata, perché quando i pin vengono modificati o creati, sono coinvolti i pin corrispondenti per ogni unità. Se si cambia il numero di unità per contenitore dopo la creazione e modifica dei pin, ci sarà ulteriore lavoro per specificare i pin e le grafiche per le nuove unità. Comunque, è possibile modificare queste proprietà in ogni momento.

The graphic options "Show pin number" and "Show pin name" define the visibility of the pin number and pin name text. The option "Place pin names inside"

defines the pin name position relative to the pin body. The pin names will be displayed inside the symbol outline if the option is checked. In this case the "Pin Name Position Offset" property defines the shift of the text away from the body end of the pin. A value from 0.02 to 0.05 inches is usually reasonable.

L'esempio sottostante mostra un simbolo con l'opzione ``Nome piedino interno'' non selezionata. Si noti la posizione dei nomi e dei numeri di pin.

image::images/eeschema_uncheck_pin_name_inside.png[alt="Place pin name inside unchecked", scaledwidth="95%"]

[[symbol-name-description-and-keywords]]
===== Symbol Name, Description, and Keywords

The symbol's name is the same as the `Value` field. When the symbol name is changed the value also changes, and vice versa. The symbol's name in the library also changes accordingly.

The symbol description should contain a brief description of the component, such as the component function, distinguishing features, and package options. The keywords should contain additional terms related to the component. Keywords are used primarily to assist in searching for the symbol.

image::images/eeschema_add_symbol_search_description.png[alt="Searching for a symbol in the add a symbol dialog", scaledwidth="65%"]

A symbol's name, description, and keywords are all used when searching for symbols in the Symbol Editor and Add a Symbol dialog. The description and keywords are displayed in the Symbol Library Browser and Add a Symbol dialog.

[[footprint-filters]]
===== Footprint Filters

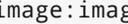
The footprint filters tab is used to define which footprints are appropriate to use with the symbol. The filters can be applied in the Footprint Assignment tool so that only appropriate footprints are displayed for each symbol.

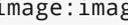
Multiple footprint filters can be defined. Footprints that match any of the filters will be displayed; if no filters are defined, then all footprints will be displayed.

Filters can use wildcards: ``*` matches any number of characters, including zero, and ``?` matches zero or one characters. For example, ``SOIC-*` would match the ``SOIC-8_3.9x4.9mm_P1.27mm` footprint as well as any other footprint beginning with ``SOIC-`. The filter ``SOT?23` matches ``SOT23` as well as ``SOT-23`.

image::images/it/eeschema_libedit_footprint.png[alt="Filtri impronte", scaledwidth="70%"]

[[symbols-with-alternate-symbolic-representation]]
===== Definizione piedini per simboli multipli e rappresentazioni simboliche alternative

If the symbol has an alternate body style defined, one body style must be selected for editing at a time. To edit the normal representation, click the  icon.

To edit the alternate representation, click on the  icon. Use the  dropdown shown below to select the unit you wish to edit.

[alt="Selecting a symbol unit", scaledwidth="80%"]

[[graphical-elements]]
=== Elementi grafici

Gli elementi grafici formano la rappresentazione di un simbolo e non contengono informazioni di connessioni elettriche. Vengono creati usando i seguenti strumenti:

- * Linee e poligoni definiti da punti di inizio e fine.
- * Rettangoli definiti da due angoli diagonali.
- * Cerchi definiti da centro e raggio.
- * Archi definiti da punti di inizio e fine dell'arco ed il suo centro. Un arco va da 0° a 180°.

La barra strumenti verticale sul lato destro della finestra principale permette di piazzare tutti gli elementi grafici richiesti per progettare la rappresentazione di un simbolo.

[[graphical-element-membership]]
==== Appartenenza di elementi grafici

Ogni elemento grafico (linea, arco, cerchio, ecc.) può essere definito come comune a tutte le unità e/o stili di corpi o specifico di una data unità e/o stile corpo. Le opzioni dell'elemento sono accessibili facilmente facendo clic destro sull'elemento per mostrare il menu contestuale per l'elemento selezionato. Di seguito è mostrato il menu contestuale per un elemento linea.

[alt="Menu contestuale linea grafica", scaledwidth="80%"]

Si può anche fare doppio clic sinistro su un elemento per modificare le sue proprietà. Di seguito viene mostrata la finestra di dialogo delle proprietà di un elemento poligono.

[alt="Proprietà linea grafica", scaledwidth="50%"]

Le proprietà di un elemento grafico sono:

- * "Line width" defines the width of the element's line in the current drawing units.
- * "Fill Style" determines if the shape defined by the graphical element is to be drawn unfilled, background filled, or foreground filled.

* "Common to all units in symbol" determines if the graphical element is drawn for each unit in symbol with more than one unit per package or if the graphical element is only drawn for the current unit.

* "Common to all body styles (De Morgan)" determines if the graphical element is drawn for each symbolic representation in symbols with an alternate body style or if the graphical element is only drawn for the current body style.

```
[[graphical-text-elements]]
==== Elementi di testo grafico
```

The image:images/icons/text_24.png[Text icon] icon allows for the creation of graphical text. Graphical text is automatically oriented to be readable, even when the symbol is mirrored. Please note that graphical text items are not the same as symbol fields.

```
[[multiple-units-per-symbol-and-alternate-body-styles]]
=== Unità multiple per simbolo e stili di corpo alternativi
```

Symbols can have up to two body styles (a standard symbol and an alternate symbol often referred to as a "De Morgan equivalent") and/or have more than one unit per package (logic gates for example). Some symbols can have more than one unit per package each with different symbols and pin configurations.

Consider for instance a relay with two switches, which can be designed as a symbol with three different units: a coil, switch 1, and switch 2. Designing a symbol with multiple units per package and/or alternate body styles is very flexible. A pin or a body symbol item can be common to all units or specific to a given unit or they can be common to both symbolic representation so are specific to a given symbol representation.

By default, pins are specific to a unit and body style. When a pin is common to all units or all body styles, it only needs to be created once. This is also the case for the body style graphic shapes and text, which may be common to each unit, but typically are specific to each body style).

```
[[example-of-a-symbol-with-multiple-noninterchangeable-units]]
==== Esempio di simbolo multiunità non interscambiabili
```

For an example of a symbol with multiple units that are not interchangeable, consider a relay with 3 units per package: a coil, switch 1, and switch 2.

The three units are not all the same, so "All units are interchangeable" should be deselected in the Symbol Properties dialog. Alternatively, this option could have been specified when the symbol was initially created.

```
image::images/it/eeschema_libedit_not_interchangeable.png[alt="Uncheck all units are interchangeable", scaledwidth="60%"]
```

```
==== Unità A
```

```
image::images/eeschema_libedit_unit1.png[alt="Relè unità A", scaledwidth="45%"]
```

```
==== Unità B
```

image::images/eeschema_libedit_unit2.png[alt="Relè unità B", scaledwidth="45%"]

==== Unità C

image::images/eeschema_libedit_unit3.png[alt="Relè unità C", scaledwidth="45%"]

L'unità A non ha lo stesso simbolo e disposizione di pin delle unità B e C, perciò le unità non sono intercambiabili.

NOTE: "Synchronized Pins Edit Mode" can be enabled by clicking the `image:images/icons/pin2pin_24.png`[Synchronized pins edit mode icon] icon. In this mode, pin modifications are propagated between symbol units; changes made in one unit will be reflected in the other units as well. When this mode is disabled, pin changes made in one unit do not affect other units. This mode is enabled automatically when "All units are interchangeable" is checked, but it can be disabled. The mode cannot be enabled when "All units are interchangeable" is unchecked or when the symbol only has one unit.

[[graphical-symbolic-elements]]
==== Elementi simbolici grafici

Shown below are properties for a graphic body element. In the relay example above, the three units have different symbolic representations. Therefore, each unit was created separately and the graphical body elements have the "Common to all units in symbol" setting disabled.

image::images/it/eeschema_libedit_disable_common.png[alt="Disable common to all units in symbol", scaledwidth="70%"]

[[pin-creation-and-editing]]
=== Creazione e modifica di piedini

Si può fare clic sull'immagine `image:images/icons/pin_24.png`[Icona pin] per creare e inserire un pin. La modifica di tutte le proprietà del pin viene fatta facendo doppio clic sul pin o facendo clic destro sul pin per aprire il menu contestuale del pin. I pin si devono creare con attenzione, dato che ogni errore avrà conseguenze sul circuito stampato in progettazione. Ogni pin già posizionato può essere modificato, cancellato e/o spostato.

[[pin-overview]]
==== Panoramica piedino

A pin is defined by its graphical representation, its name and its number. The pin's name and number can contain letters, numbers, and symbols, but not spaces. For the Electrical Rules Check (ERC) tool to be useful, the pin's electrical type (input, output, tri-state...) must also be defined correctly. If this type is not defined properly, the schematic ERC check results may be invalid.

Note importanti:

- * Symbol pins are matched to footprint pads by number. The pin number in the symbol must match the corresponding pad number in the footprint.
- * Do not use spaces in pin names and numbers. Spaces will be automatically

replaced with underscores (`_`).

* Per definire un nome pin con un segnale invertito (overline) usare il carattere `~` (tilde) seguito dal testo da invertire in parentesi graffe. Per esempio `~{F0}0` mostrerà `[overline]#F0# 0`.

* Se il nome pin è vuoto, il pin viene considerato senza nome.

* I nomi di pin possono essere ripetuti in un simbolo.

* I numeri di pin devono essere univoci in un simbolo.

[[pin-properties]]

==== Proprietà piedino

image::images/it/eeschema_libedit_pin_properties.png[alt="Proprietà pin", scaledwidth="95%"]

La finestra di dialogo delle proprietà del pin permette di modificare tutte le caratteristiche di un pin. Questa finestra di dialogo salta fuori automaticamente quando si crea un pin o facendo doppio clic su un pin già esistente. Questa finestra di dialogo permette di modificare:

* Nome e dimensione testo del pin.

* Numero e dimensione testo del pin.

* Lunghezza pin.

* Tipo elettrico e stile grafico del piedino.

* Unità e appartenenza a rappresentazioni alternative.

* Visibilità pin.

* <<alternate-pin-definitions,Definizioni alternative del pin>>.

[[pin-graphic-styles]]

==== Stili grafici pin

Shown in the figure below are the different pin graphic styles. The choice of graphic style does not have any influence on the pin's electrical type.

image::images/it/eeschema_libedit_pin_properties_style.png[alt="Stili grafici pin", scaledwidth="95%"]

[[pin-electrical-types]]

==== Tipi elettrici del pin

Choosing the correct electrical type is important for the schematic ERC tool. ERC will check that pins are connected appropriately, for example ensuring that input pins are driven and power inputs receive power from an appropriate source.

[width="100%", cols="25%,75%"]

|=====

| Pin Type | Description

| Input | A pin which is exclusively an input.

| Output | A pin which is exclusively an output.

| Bidirectional | A pin that can be either an input or an output, such as a microcontroller data bus pin.

| Tri-state | A three state output pin (high, low, or high impedance)

| Passive | A passive symbol pin: resistors, connectors, etc.

| Free | A pin that can be freely connected to any other pin without electrical

concerns.

| Unspecified | A pin for which the ERC check does not matter.

| Power input | A symbol's power pin. As a special case, power input pins that are marked invisible are automatically connected to the net with the same name. See the <<creating-power-ports, Power Ports section>> for more information.

| Power output | A pin that provides power to other pins, such as a regulator output.

| Open collector | An open collector logic output.

| Open emitter | An open emitter logic output.

| Unconnected | A pin that should not be connected to anything.

|=====

[[pushing-pin-properties-to-other-pins]]

==== Pushing Pin Properties to Other Pins

You can apply the length, name size, or number size of a pin to the other pins in the symbol by right clicking the pin and selecting **Push Pin Length**, **Push Pin Name Size**, or **Push Pin Number Size**, respectively.

image::images/it/eeschema_libedit_pin_context_menu.png[alt="Menu contestuale pin", scaledwidth="60%"]

[[defining-pins-for-multiple-units-and-alternate-symbolic-representations]]

==== Definizione piedini per componenti multipli e rappresentazioni simboliche alternative

Symbols with multiple units and/or graphical representations are particularly problematic when creating and editing pins. The majority of pins are specific to each symbol unit (because each unit has a different set of pins) and to each body style (because the form and position is different between the normal body style and the alternate form).

The symbol library editor allows the simultaneous creation of pins. By default, changes made to a pin are made for all units of a multiple unit symbol and to both representations for symbols with an alternate symbolic representation. The only exception to this is the pin's graphical type and name, which remain unlinked between symbol units and body styles. This dependency was established to allow for easier pin creation and editing in most cases. This dependency can be disabled by toggling the image:images/icons/pin2pin_24.png[Synchronized pin edit mode icon] icon on the main tool bar. This will allow you to create pins for each unit and representation completely independently.

Pins can be common or specific to different units. Pins can also be common to both symbolic representations or specific to each symbolic representation. When a pin is common to all units, it only has to be drawn once. Pins are set as common or specific in the pin properties dialog.

An example is the output pin in the 7400 quad dual input NAND gate. Since there are four units and two symbolic representations, there are eight separate output pins defined in the symbol definition. When creating a new 7400 symbol, unit A of the normal symbolic representation will be shown in the library editor. To edit the pin style in the alternate symbolic representation, it must first be enabled by clicking the image:images/icons/morgan2_24.png[Alternate representation icon] button on the tool bar. To edit the pin number for each

unit, select the appropriate unit using the `image:images/toolbar_libedit_alias.png[images/toolbar_libedit_alias.png]` drop down control.

```
[[pin-table]]  
==== Pin Table
```

Another way to edit pins is to use the Pin Table, which is accessible via the `image:images/icons/pin_table_24.png[Pin table icon]` icon. The Pin Table displays all of the pins in the symbol and their properties in a table view, so it is useful for making bulk pin changes.

Any pin property can be edited by clicking on the appropriate cell. Pins can be added and removed with the `image:images/icons/small_plus_16.png[Plus icon]` and `image:images/icons/small_trash_16.png[Trash icon]` icons, respectively.

NOTE: Columns of the pin table can be shown or hidden by right-clicking on the header row and checking or unchecking additional columns. Some columns are hidden by default.

The screenshot below shows the pin table for a quad opamp.

```
image::images/eeschema_libedit_pin_table.png[alt="Pin table", scaledwidth="95%"]
```

```
[[alternate-pin-definitions]]  
==== Definizioni alternative dei pin
```

Pins can have alternate pin definitions added to them. Alternate pin definitions allow a user to select a different name, electrical type, and graphical style for a pin when the symbol has been placed in the schematic. This can be used for pins that have multiple functions, such as microcontroller pins.

Alternate pin definitions are added in the Pin Properties dialog as shown below. Each alternate definition contains a pin name, electrical type, and graphic style. This microcontroller pin has all of its peripheral functions defined in the symbol as alternate pin names.

```
image::images/eeschema_libedit_alternate_pin_definitions.png[alt="Alternate pin definitions", scaledwidth="60%"]
```

Alternate pin definitions are selected in the Schematic Editor once the symbol has been placed in the schematic. The alternate pin is assigned in the Alternate Pin Assignments tab of the Symbol Properties dialog. Alternate definitions are selectable in the dropdown in the Alternate Assignment column.

```
image::images/eeschema_alternate_pin_assignment_selection.png[alt="Selecting an alternate pin definition", scaledwidth="60%"]
```

```
[[symbol-fields]]  
=== Campi del simbolo
```

All library symbols are defined with four default fields. The reference

designator, value, footprint assignment, and datasheet link fields are created whenever a symbol is created or copied. Only the reference designator and value fields are required.

Symbols defined in libraries are typically defined with only these four default fields. Additional fields such as vendor, part number, unit cost, etc. can be added to library symbols but generally this is done in the schematic editor so the additional fields can be applied to all of the symbols in the schematic.

NOTE: A convenient way to create additional empty symbol fields is to use define field name templates. Field name templates define empty fields that are added to each symbol when it is inserted into the schematic. Field name templates can be defined globally (for all schematics) in the Schematic Editor Preferences, or they can be defined locally (specific to each project) in the Schematic Setup dialog.

[[editing-symbol-fields]]
==== Modifica campi del simbolo

Per modificare un campo simbolo esistente, fare clic destro sul testo del campo per mostrare il menu contestuale mostrato sotto.

image::images/it/eeschema_libedit_field_context_menu.png[alt="Menu contestuale campo simbolo", scaledwidth="35%"]

To add new fields, delete optional fields, or edit existing fields, use the image:images/icons/part_properties_24.png[Component properties icon] icon on the main tool bar to open the <<symbol-properties,Symbol Properties dialog>>.

Fields are text information associated a the symbol. Do not confuse them with text in the graphic representation of a symbol.

Note importanti:

- * Modifying the `Value` field changes the name of the symbol. The symbol's name in the library will change when the symbol is saved.
- * The Symbol Properties dialog must be used to edit a field that is empty or has the invisible attribute enabled because such fields cannot be clicked on.
- * The footprint is defined as an absolute footprint using the `LIBNAME:FOOTPRINTNAME` format where `LIBNAME` is the name of the footprint library defined in the footprint library table (see the "Footprint Library Table" section in the PCB Editor manual) and `FOOTPRINTNAME` is the name of the footprint in the library `LIBNAME`.

[[creating-power-ports]]
=== Porte di potenza

Power ports, or power symbols, are conventionally used to label a wire as part of a power net, like `VCC`, `+5V`, or `GND`. In the schematic below, the `+3.3V` and `GND` symbols are power ports. In addition to acting as a visual indicator that a net is a power rail, a power port will determine the name of the net it is attached to. This is true even if there is another net label attached to the net; the net name determined by the power symbol overrides any other net names.

`image::images/eeschema_power_port_example.png[alt="Esempio di porta di potenza", scaledwidth="60%"]`

It may be useful to place power symbols in a dedicated library. KiCad's symbol library places power symbols in the `power` library, and users may create libraries to store their own power symbols. If the "Define as power symbol" box is checked in a symbol's properties, that symbol will appear in the Schematic Editor's "Add Power Port" dialog for convenient access.

Power symbols are handled and created the same way as normal symbols, but there are several additional considerations described below. They consist of a graphical symbol and a pin of the type "Power input" that is marked hidden.

Below is an example of a `GND` power symbol.

`image::images/it/eeschema_libedit_power_symbol.png[alt="Modifica di un simbolo di potenza", scaledwidth="95%"]`

==== Creazione di simbolo porta di potenza

Power Port symbols consist of a pin of type "Power input" that is marked invisible. Invisible power input pins have a special property of automatically connecting to a net with the same name as the pin name. A net that is wired to an invisible power input pin will therefore be named after the pin, even if there are other net labels on the net. This connection is global.

NOTE: If the power symbol has the "Define as power symbol" property checked, the power input pin does not need to be marked invisible. However, the convention is to make these pins invisible anyway.

`image::images/eeschema_libedit_power_symbol_pin.png[alt="Pin simbolo di potenza", scaledwidth="60%"]`

Per creare un simbolo di potenza, seguire questi passi:

- * Add a pin of type "Power input", with "Visible" unchecked, and the pin named according to the desired net. Make the pin number `1`, the length `0`, and set the graphic style to "Line". The pin name establishes the connection to the net; in this case the pin will automatically connect to the net `GND`. The pin number, length, and line style do not matter electrically.
- * Place the pin on the symbol anchor.
- * Use the shape tools to draw the symbol graphics.
- * Set the symbol value. The symbol value does not matter electrically, but it is displayed in the schematic. To eliminate confusion, it should match the pin name (which determines the connected net name).
- * Check the "Define as power symbol" box in Symbol Properties window. This makes the symbol appear in the "Add Power Port" dialog, makes the `Value` field read-only in the schematic, prevents the symbol from being assigned a footprint, and excludes the symbol from the board, BOM, and netlists.
- * Set the symbol reference and uncheck the "Show" box. The reference text is not important except for the first character, which should be `#`. For the power port shown above, the reference could be `#GND`. Symbols with references that begin with `#` are not added to the PCB, are not included in Bill of Materials exports or netlists, and they cannot be assigned a footprint in the

footprint assignment tool. If a power port's reference does not begin with `#`, the character will be inserted automatically when the annotation or footprint assignment tools are run.

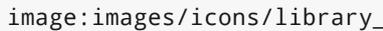
An easier method to create a new power port symbol is to use another symbol as a starting point, <<creating-a-symbol-from-another-symbol,as described earlier>>.

NOTE: When modifying an existing power port symbol, make sure to rename the pin name so that the new symbol connects to the appropriate power net.

:experimental:

```
[[viewlib]]  
== Esploratore libreria di simboli
```

```
=== Introduzione
```

The Symbol Library Browser allows you to quickly examine the content of symbol libraries. The Symbol Library Viewer can be accessed by clicking  icon on the main toolbar, **View** -> **Symbol Library Browser...**, or clicking **Select With Browser** in the "Choose Symbol" window.

```
image::images/it/eeschema_viewlib_choose.png[alt="eeschema_viewlib_choose_png",  
scaledwidth="60%"]
```

```
[[viewlib---main-screen]]  
=== Viewlib - schermo principale
```

```
image::images/it/eeschema_viewlib_select_library.png[alt="eeschema_viewlib_select_library_p  
ng", scaledwidth="95%"]
```

Per esaminare i contenuti della libreria, selezionare la libreria desiderata dall'elenco sul lato sinistro. I simboli disponibili appariranno nel secondo pannello. Selezionare il nome di un simbolo per visualizzarlo.

```
image::images/it/eeschema_viewlib_select_component.png[alt="eeschema_viewlib_select_compone  
nt_png", scaledwidth="95%"]
```

```
[[viewlib-top-toolbar]]  
=== Barra alta dell'esploratore delle librerie di simboli
```

La barra in alto dell'esploratore di librerie di simboli viene mostrata di seguito.

```
image::images/it/toolbar_viewlib.png[alt="images/it/toolbar_viewlib.png",  
scaledwidth="95%"]
```

I comandi disponibili sono:

```
[width="100%", cols="20%,80%"]  
|=====|  
|image:images/icons/library_browser_24.png[Symbol selection icon]
```

|Selection of the symbol which can be also selected in the displayed list.

|image:images/icons/lib_previous_24.png[Previous symbol icon]
|Display previous symbol.

|image:images/icons/lib_next_24.png[Next symbol icon]
|Display next symbol.

|image:images/icons/refresh_24.png[] image:images/icons/zoom_in_24.png[]
image:images/icons/zoom_out_24.png[] image:images/icons/zoom_fit_in_page_24.png[]
|Zoom tools.

|image:images/icons/morgan1_24.png[] image:images/icons/morgan2_24.png[]
|Selection of the representation (normal or alternate) if an alternate representation exists.

|image:images/toolbar_viewlib_part.png[alt="images/toolbar_viewlib_part.png",width="70%"]
|Selection of the unit for symbols that contain multiple units.

|image:images/icons/datasheet_24.png[icons/datasheet_png]
|If they exist, display the associated documents.

|image:images/icons/add_symbol_to_schematic_24.png[Add symbol to schematic icon]
|Close the browser and place the selected symbol in the schematic.
|=====

:experimental:

[[simulator]]
== Simulatore ==

KiCad provides an embedded electrical circuit simulator using <http://ngspice.sourceforge.net>[ngspice] as the simulation engine.

Quando si lavora con il simulatore, si può trovare utile la libreria ufficiale `_pspice_`. Essa contiene simboli comuni usati per la simulazione come sorgenti di tensione o corrente, o transistor con pin numerati in modo da corrispondere alle specifiche di ordine del nodo di ngspice.

Ci sono anche dei progetti dimostrativi per illustrare le capacità di simulazione. Si trovano nella cartella `_demos/simulation_`.

=== Assegnazione modelli

Prima di avviare una simulazione, i componenti devono avere assegnato un modello Spice.

Ogni componente può avere solo un modello assegnato, anche se il componente consiste di più unità. In tal caso, la prima unità deve specificare il modello.

[[sim-passive-models]] I componenti passivi con riferimento all'accoppiamento di un tipo di dispositivo in notazione Spice (`_R*` per le resistenze, `_C*` per i condensatori, `_L*` per le induttanze) avranno modelli assegnati implicitamente e useranno il campo valore per determinare le loro proprietà.

[NOTE]

Si faccia presente che nella notazione spice, 'M' sta per milli e 'Meg' per mega. Se si preferisce usare 'M' per indicare il prefisso mega, è possibile indicarlo nella <<sim-settings, finestra di dialogo delle impostazioni di simulazione>>.

Le informazioni sui modelli Spice sono memorizzate come testo nei campi dei simboli, perciò li si può definire sia nell'editor dei simboli che in quello dello schema elettrico. Aprire la finestra di dialogo delle proprietà del simbolo e fare clic sul pulsante `_Modifica modello Spice_` per aprire la finestra di dialogo dell'editor del modello Spice.

La finestra di dialogo della modifica del modello Spice ha tre linguette corrispondenti a diversi tipi di modello. Ci sono due opzioni comuni a tutti i tipi di modello:

```
[width="90%", cols="30%,70%a"]
```

```
|====
```

```
|Disabilita simbolo per la simulazione
```

```
|Quando è abilitato il componente viene escluso dalla simulazione.
```

```
|Sequenza nodi alternativa
```

```
|Permette di imporre la mappatura nodi del modello ai pin del simbolo.
```

```
Per definire una mappatura diversa, specificare i numeri dei pin nell'ordine che si aspetta il modello.
```

```
'Esempio:' +
```

```
-----  
`* connessioni:` +
```

```
`* 1: ingresso non-invertente` +
```

```
`* 2: ingresso invertente` +
```

```
`* 3: terminale positivo di potenza` +
```

```
`* 4: terminale negativo di potenza` +
```

```
`* 5: uscita` +
```

```
`.subckt tl071 1 2 3 4 5`  
-----
```

```
image::images/opamp_symbol.png[alt="Simbolo generico di amplificatore operazionale"]
```

Per accoppiare i pin del simbolo ai nodi del modello Spice mostrati sopra, è necessario usare l'opzione sequenza di nodi alternativa con valore: "1{nbsp}3{nbsp}5{nbsp}2{nbsp}4". È un elenco di numeri di pin corrispondenti all'ordine dei nodi del modello Spice.

```
|====
```

```
==== Passivo
```

La scheda `_Passivo_` permette all'utente di assegnare un modello di dispositivo passivo (resistore, condensatore o induttore) ad un componente. È un'opzione

usata raramente, dato che i componenti passivi hanno modelli assegnati <<sim-passive-models,implicitamente>>, a meno che il riferimento del componente non corrisponda all'effettivo tipo di dispositivo.

[NOTE]

I modelli di dispositivi passivi esplicitamente definiti hanno la priorità su quelli assegnati implicitamente. Questo significa che una volta che un modello di dispositivo passivo viene assegnato, i campi di riferimento e valore non sono presi in considerazione durante la simulazione. Ciò può portare ad una situazione di confusione dove il valore del modello assegnato non corrisponde con quello mostrato sullo schema elettrico.

image::images/it/sim_model_passive.png[alt="Scheda modifica modello dispositivo passivo"]

```
[width="90%", cols="30%,70%a"]
```

```
|====
```

```
|Tipo
```

```
|Seleziona il tipo di dispositivo (resistore, condensatore o induttore).
```

```
|Valore
```

```
|Definisce la proprietà del dispositivo (resistenza, capacità o induttanza). Il valore può usare i soliti prefissi di unità di Spice (come elencato sotto il campo di inserimento testo) e dovrebbe usare il punto come separatore decimale. Si noti che Spice non interpreta correttamente i prefissi inseriti nei valori (per es. 1k5).
```

```
|====
```

```
==== Modello
```

La scheda `_Modello_` viene usata per assegnare un semiconduttore o un modello complesso definito in un file di libreria esterno. Le librerie del modello Spice vengono spesso fornite dal costruttore del dispositivo.

La finestra di testo principale mostra i contenuti del file di libreria selezionato. È pratica comune mettere la descrizione del modello dentro i file delle librerie, includendo l'ordine dei nodi.

image::images/it/sim_model_subckt.png[alt="Scheda modifica modello dispositivo a semiconduttore"]

```
[width="90%", cols="30%,70%a"]
```

```
|=====
```

```
|File
```

```
|Percorso ad un file di libreria Spice. Questo file verrà usato dal simulatore, come viene aggiunto usando la direttiva _.include_.
```

```
|Modello
```

```
|Il modello di dispositivo selezionato. Quando un file viene selezionato, l'elenco viene riempito con i modelli disponibili tra cui scegliere.
```

```
|Tipo
```

```
|Seleziona il tipo di modello (subcircuito, BJT, MOSFET o diodo). Normalmente viene impostato
```

```
automaticamente quando viene selezionato un modello.
```

```
|=====
```

==== Sorgente

La scheda `_Sorgente_` viene usata per assegnare un modello di sorgente di potenza o di segnale. Ci sono due sezioni: `_Analisi DC/AC_` e `_Analisi del transiente_`. Ognuna definisce i parametri sorgente per il tipo di simulazione corrispondente.

L'opzione `_Tipo sorgente_` si applica a tutti i tipi di simulazione.

`image::images/it/sim_model_source.png[alt="Scheda modifica modello sorgente"]`

Fare riferimento alla <http://ngspice.sourceforge.net/docs/ngspice-27-manual.pdf> [documentazione ngspice], capitolo 4 (Sorgenti di tensione e corrente) per ulteriori dettagli sulle sorgenti.

[[sim-directives]]

=== Direttive Spice

It is possible to add Spice directives by placing them in text fields on a schematic sheet. This approach is convenient for defining the default simulation type. This functionality is limited to Spice directives starting with a dot (e.g. `.tran 10n 1m``), it is not possible to place additional components using text fields.

=== Simulazione

To launch a simulation, open `_Spice Simulator_` dialog by selecting menu `_Tools->Simulator_` in the schematics editor window.

`image::images/sim_main_dialog.png[alt="La finestra principale di simulazione"]`

La finestra è divisa in diverse sezioni:

- * <<sim-toolbar,Barra strumenti>>
- * <<sim-plot-panel,Pannello grafici>>
- * <<sim-output-console,Console di uscita>>
- * <<sim-signals-list,Elenco segnali>>
- * <<sim-cursors-list,Elenco cursori>>
- * <<sim-tune-panel,Pannello di regolazione>>

==== Menu

[[sim-menu-file]]

===== File

[width="90%", cols="30%,70%"]

|=====

|Nuovo grafico

| Crea una nuova scheda nel pannello del grafico.

|Apri libretto di lavoro

|Apri un elenco di segnali graficati.

|Salva libretto di lavoro

| Salva un elenco di segnali graficati.

|Salva come immagine

| Esporta il grafico attivo in un file .png .

```

|Salva come file .csv
| Esporta i punti dei dati grezzi del grafico attivo in un file .csv .
|Esci dalla simulazione
| Chiude la finestra di dialogo.
|====

[[sim-menu-simulation]]
===== Simulazione
[width="90%", cols="30%,70%"]
|====
|Avvia simulazione
|Esegue una simulazione usando le impostazioni correnti.
|Aggiungi segnali...
|Apri una finestra di dialogo per selezionare i segnali da graficare.
|Campiona dallo schema
|Avvia lo strumento <<sim-probe-tool,Sonda>> sullo schema elettrico.
|Regola il valore dei componenti
|Avvia lo strumento <<sim-tuner-tool,Regola>>.
|Mostra la netlist SPICE...
|Apri una finestra di dialogo che mostra la netlist generata per il circuito simulato.
|Impostazioni...
|Apri la <<sim-settings,finestra di dialogo delle impostazioni di simulazione>>.
|====

[[sim-menu-view]]
===== Vista
[width="90%", cols="30%,70%"]
|====
|Ingrandisci
|Ingrandisce il grafico attivo.
|Rimpicciolisce
|Rimpicciolisce il grafico attivo.
|Adatta allo schermo
|Regola l'ingrandimento per visualizzare tutto il grafico.
|Mostra griglia
|Commuta la visibilità della griglia.
|Mostra legenda
|Commuta la visibilità della legenda.
|====

[[sim-toolbar]]
===== Barra strumenti
image::images/it/sim_main_toolbar.png[alt="Barra principale della finestra di simulazione"]
Questa barra strumenti dà accesso alle funzioni utilizzate più frequentemente.

[width="90%", cols="30%,70%"]
|====
|Avvia/Blocca Simulazione
|Avvia o blocca la simulazione.
|Aggiungi segnali
|Apri una finestra di dialogo per selezionare i segnali da graficare.

```

```
|Sonda
|Avvia lo strumento <<sim-probe-tool,Sonda>> sullo schema elettrico.
|Regola
|Avvia lo strumento <<sim-tuner-tool,Regola>> sullo schema elettrico.
|Impostazioni
| Apre la <<sim-settings,finestra delle impostazioni di simulazione>>.
|====
```

```
[[sim-plot-panel]]
```

```
==== Il pannello grafico
```

Visualizza i risultati della simulazione in forma di grafici. Si possono avere più grafici aperti in schede separate ma solo quella attiva viene aggiornata quando viene eseguita una simulazione. In questo modo è possibile confrontare i risultati di simulazione di esecuzioni diverse.

I grafici possono essere personalizzati abilitando o disabilitando la visibilità della griglia e della legenda usando il menu <<sim-menu-view,Visualizza>>. Quando la legenda è visibile, questa può essere trascinata per cambiarne la posizione.

Interazione del pannello del grafico:

- * la rotellina del mouse per ingrandire / rimpicciolire
- * clic destro per aprire il menu a scomparsa e regolare la visualizzazione
- * disegnare un rettangolo di selezione per fare lo zoom sull'area selezionata
- * trascinare un cursore per cambiarne le coordinate

```
[[sim-output-console]]
```

```
==== Console d'uscita
```

La console d'uscita mostra i messaggi generati dal simulatore. Si consiglia di controllare sempre la console di uscita per verificare che non ci siano errori o avvertenze.

```
[[sim-signals-list]]
```

```
==== Elenco segnali
```

Mostra l'elenco dei segnali mostrati nel grafico attivo.

Interazione elenco segnali:

- * click destro apre un menu contestuale che consente di nascondere il segnale o commutare il cursore
- * doppio clic per nascondere il segnale

```
[[sim-cursors-list]]
```

```
==== Elenco cursori
```

Mostra l'elenco dei cursori e delle loro coordinate. Ogni segnale può avere un cursore visualizzato. La visibilità dei cursori viene impostata usando l'elenco <<sim-signals-list,Segnali>>.

```
[[sim-tune-panel]]
```

```
==== Pannello di regolazione
```

Mostra i componenti prelevati con lo strumento <<sim-tuner-tool,Regola>>. Il pannello Regola permette all'utente di modificare velocemente i valori del componente e di osservare la loro influenza sui risultati della simulazione -

ogni volta che il valore di un componente viene cambiato, la simulazione viene riavviata e i grafici aggiornati.

Per ogni componente ci sono alcuni controlli associati:

- * Il campo di testo in cima imposta il valore massimo del componente.
- * Il campo di testo di mezzo imposta il valore corrente del componente.
- * Il campo di testo in fondo imposta il valore minimo del componente.
- * Il cursore permette all'utente di modificare il valore del componente in modo agevole.
- * Il pulsante `_Salva_` modifica il valore del componente sullo schema al valore impostato con il cursore.
- * Il pulsante `_X_` rimuove il componente dal pannello di regolazione e ne ripristina il valore originale.

I tre campi di testo riconoscono i prefissi di unità Spice.

[[sim-tuner-tool]]

==== Strumento di regolazione

Lo strumento di regolazione permette all'utente di prelevare i componenti per regolarli.

Per selezionare un componente per la regolazione, fare clic su uno sullo schema con lo strumento attivo. I componenti selezionati appariranno nel pannello `<<sim-tune-panel,Regola>>`. Si possono regolare solo i componenti passivi.

[[sim-probe-tool]]

==== Strumento sonda

Lo strumento sonda fornisce un modo semplice per selezionare i segnali da usare per i grafici.

Per aggiungere un segnale al grafico, fare clic su un filo corrispondente nell'editor dello schema elettrico mentre lo strumento è attivo.

[[sim-settings]]

==== Impostazioni di simulazione

`image::images/it/sim_settings.png[alt="Finestra di dialogo delle impostazioni di simulazione"]`

La finestra di impostazione della simulazione permette all'utente di impostare il tipo e i parametri di simulazione. Ci sono quattro schede:

- * AC
- * Trasferimento DC
- * Transiente
- * Personalizzato

Le prime tre schede forniscono dei moduli nei quali si possono specificare i parametri di simulazione. L'ultima scheda permette all'utente di inserire direttive Spice personalizzate per impostare la simulazione. È possibile trovare ulteriori informazioni sui tipi e sui parametri di simulazione nella <http://ngspice.sourceforge.net/docs/ngspice-27-manual.pdf> [documentazione ngspice], capitolo 1.2.

Un modo alternativo per configurare una simulazione consiste nel battere le <<sim-directives,direttive Spice>> nei campi testo nello schema. Ogni campo testo contenente una direttiva relativa ad un tipo di simulazione viene superata dall'impostazione selezionata nella finestra di dialogo. Significa che una volta che si usa la finestra di dialogo di simulazione, la finestra di dialogo passa sopra alle direttive dello schema elettrico fino alla riapertura della simulazione.

Ci sono due opzioni comuni a tutti i tipi di simulazione:

```
[width="90%", cols="30%,70%"]
```

```
|====
```

```
|Regola i valori dei simboli passivi
```

```
|Rimpiazza i valori dei simboli passivi per convertire la notazione dei valori dei componenti comuni alla notazione Spice.
```

```
|Aggiungi il percorso completo per la direttiva di libreria .include
```

```
|Antepone i nomi file delle librerie di modelli Spice con il percorso completo. Normalmente ngspice richiede il percorso completo per accedere ad un file di libreria.
```

```
|====
```

```
:experimental:
```

```
[[advanced]]
```

```
== Advanced Topics
```

```
[[color-settings]]
```

```
[[configuration-and-customization]]
```

```
=== Configuration and Customization
```

```
NOTE: TODO: write this section
```

```
[[text-variables]]
```

```
=== Text variables
```

```
NOTE: TODO: write this section
```

```
////
```

```
[[preferences-common]]
```

```
===== Common Preferences
```

```
NOTE: TODO: write this section
```

```
image::images/en/options_common.png[alt="Common settings",scaledwidth="70%"]
```

```
[[preferences-mouse]]
```

```
===== Mouse and Touchpad
```

```
[width="100%",cols="40%,60%",]
```

```
|=====
```

```
|Center and warp cursor on zoom | If checked, the pointed location is warped to the screen center when zooming in/out.
```

```
|Use touchpad to pan |When enabled, view is panned using scroll wheels (or touchpad gestures) and to zoom one needs to hold kbd:[Ctrl]. Otherwise scroll wheels zoom in/out and kbd:[Ctrl]/kbd:[Shift] are the panning modifiers.
```

|Pan while moving object |If checked, automatically pans the window if the cursor leaves the window during drawing or moving.

|=====

[[preferences-controls]]

==== Hotkeys

Redefine hotkeys.

image::images/en/options_hotkeys.png[alt="Hotkeys settings",scaledwidth="70%"]

Select a new hotkey by double clicking an action or right click on an action to show a popup menu:

[width="100%",cols="40%,60%",]

|=====

|Edit | Define a new hotkey for the action (same as double click).

|Undo Changes | Reverts the recent hotkey changes for the action.

|Clear Assigned Hotkey |

|Restore Default | Sets the action hotkey to its default value.

|=====

[[preferences-display]]

==== Display Options

image::images/en/options_display.png[alt="Display options",scaledwidth="70%"]

[width="100%",cols="40%,60%",]

|=====

|Grid Size| Grid size selection.

It is *recommended* to work with normal grid (0.050 inches or 1,27 mm). Smaller grids are used for component building.

|Bus thickness |Pen size used to draw buses.

|Line thickness |Pen size used to draw objects that do not have a specified pen size.

|Part ID notation |Style of suffix that is used to denote symbol units (U1A, U1.A, U1-1, etc.)

|Icon scale| Adjust toolbar icons size.

|Show Grid | Grid visibility setting.

|Restrict buses and wires to H and V orientation| If checked, buses and wires are drawn only with vertical or horizontal lines. Otherwise buses and wires can be placed at any orientation.

|Show hidden pins: |Display invisible (or __hidden__) pins, typically power pins.

|Show page limits |If checked, shows the page boundaries on screen.

|Footprint previews in symbol chooser| Displays a footprint preview frame and footprint selector when placing a new symbol.

Note: it may cause problems or delays, use at your own risk.

|=====

[[preferences-editing]]

==== Editing Options

image::images/en/options_editing.png[alt="Editing settings",scaledwidth="70%"]

[width="100%",cols="40%,60%",]

|=====

|Measurement units |Select the display and the cursor coordinate units (inches or millimeters).

|Horizontal pitch of repeated items |

Increment on X axis during element duplication (default: 0)

(after placing an item like a symbol, label or wire, a duplication is made by the kbd:[Insert] key)

|Vertical pitch of repeated items| Increment on Y axis during

element duplication (default: 0.100 inches or 2,54 mm).

|Increment of repeated labels |Increment of label value during duplication of texts ending in a number, such as bus members (usual value 1 or -1).

|Default text size |Text size used when creating new text items or labels.

|Auto-save time interval |Time in minutes between saving backups.

|Automatically place symbol fields | If checked, symbol fields (e.g. value and reference) in newly placed symbols might be moved to avoid collisions with other items.

|Allow field autoplace to change justification | Extension of 'Automatically place symbol fields' option. Enable text justification adjustment for symbol fields when placing a new part.

|Always align autoplaced fields to the 50 mil grid |Extension of 'Automatically place symbol fields' option. If checked, fields are autoplaced using 50 mils grid, otherwise they are placed freely.

|=====

[[preferences-colors]]

==== Colors

Color scheme for various graphic elements. Click on any of the color swatches to select a new color for a particular element.

image::images/en/options_color.png[alt="Color settings",scaledwidth="95%"]

```
[[preferences-default-fields]]
```

```
==== Default Fields
```

Define additional custom fields and corresponding values that will appear in newly placed symbols.

```
image::images/en/options_default_fields.png[alt="Default Fields settings",scaledwidth="70%"]  
////
```

```
[[custom-netlist-and-bom-formats]]
```

```
=== Custom Netlist and BOM Formats
```

KiCad can output netlists and BOMs in various formats, and users can define new formats if desired.

The process of exporting a netlist is described in the <<netlist-export,netlist export section>>. BOM output is described in the <<bom-export,BOM export section>>.

The following section describes how to create an exporter for a new output format.

```
[[adding-new-netlist-generators]]
```

```
==== Adding new netlist generators
```

New netlist generators are added by clicking the **Add Generator...** button.

```
image::images/it/eeschema_netlist_dialog_add_plugin.png[alt="Custom Netlist Generator",scaledwidth="40%"]
```

New generators require a name and a command. The name is shown in the tab label, and the command is run whenever the **Export Netlist** button is clicked.

When the netlist is generated, KiCad creates an intermediate XML file which contains all of the netlist information from the schematic. The generator command is then run in order to transform the intermediate netlist into the desired netlist format.

The netlist command must be set up properly so that the netlist generator script takes the intermediate netlist file as input and outputs the desired netlist file. The `%I` argument represents the input intermediate netlist filename and the `%O` argument represents the output netlist filename. The exact netlist command will depend on the generator script used.

Python and XSLT are commonly used tools to create custom netlist generators.

```
==== Adding a new BOM generator
```

BOMs can also be created from the intermediate netlist file. BOM generators can be automatically launched from the Schematic Editor with the BOM export tool. Adding a new netlist generator to the BOM export tool is described in the <<bom-export,BOM export tool documentation>>.

==== Formato a linea di comando

Consider the following example which uses `xsltproc` to generate a netlist in PADS ASC format. `xsltproc` converts the intermediate netlist using the `netlist_form_pads-pcb.asc.xsl` stylesheet to define the output format:

```
`xsltproc -o %0.net /usr/share/kicad/plugins/netlist_form_pads-pcb.asc.xsl %I`
```

The purpose of each part of the command is as follows:

```
[width="100%", cols="58%,42%"]
```

```
|=====
|`xsltproc` |A tool to convert an XML file (the intermediate netlist) according
|to an XSLT stylesheet.
```

```
|`-o %0.net` |Output filename. `%0` is replaced with the name of the
|intermediate netlist file, which is `.xml`. Therefore in this
|example the complete output filename is `.xml.net`. An arbitrary
|output filename can be specified if desired with `-o <filename>`.
```

```
|`/usr/share/kicad/plugins/netlist_form_pads-pcb.asc.xsl` |XSLT stylesheet which
|determines how the output is formatted. This particular stylesheet is included
|with KiCad, but custom stylesheets can also be created.
```

```
|`%I` |Input (intermediate netlist) filename. `%I` is replaced with the name of
|the intermediate netlist file, which is `.xml`.
```

```
|=====
```

For netlist generators that do not use `xsltproc`, the generator command will differ.

==== File di netlist intermedio

When exporting BOM files and netlists, KiCad creates an intermediate netlist file and then runs a separate tool which post-processes the intermediate netlist into the desired netlist or BOM format.

The intermediate netlist uses XML syntax. It contains a large amount of data about the design. Depending on the output (BOM or netlist), different subsets of the complete intermediate netlist file will be included in the final output file.

The structure of the intermediate netlist file is described in detail <<intermediate-netlist-structure, later>>.

Because the conversion from intermediate netlist file to output netlist or BOM is a text-to-text transformation, the post-processing filter can be written using Python, XSLT, or any other tool capable of taking XML as input.

NOTE: XSLT is not recommended for new netlist or BOM exporters; Python or another tool should be used instead. Beginning with KiCad 7, `xsltproc` is no longer installed with KiCad, although it can be installed separately.

Nevertheless, several examples of netlist exporters using XSLT are included below.

[[intermediate-netlist-structure]]

==== Struttura etlist intermedia

Questo campione dà un'idea del formato del file netlist.

```
``xml
<?xml version="1.0" encoding="utf-8"?>
<export version="D">
  <design>
    <source>F:\kicad_aux\netlist_test\netlist_test.sch</source>
    <date>29/08/2010 21:07:51</date>
    <tool>eeschema (2010-08-28 BZR 2458)-unstable</tool>
  </design>
  <components>
    <comp ref="P1">
      <value>CONN_4</value>
      <libsource lib="conn" part="CONN_4"/>
      <sheetpath names="/" tstamps="/" />
      <tstamps>4C6E2141</tstamps>
    </comp>
    <comp ref="U2">
      <value>74LS74</value>
      <libsource lib="74xx" part="74LS74"/>
      <sheetpath names="/" tstamps="/" />
      <tstamps>4C6E20BA</tstamps>
    </comp>
    <comp ref="U1">
      <value>74LS04</value>
      <libsource lib="74xx" part="74LS04"/>
      <sheetpath names="/" tstamps="/" />
      <tstamps>4C6E20A6</tstamps>
    </comp>
    <comp ref="C1">
      <value>CP</value>
      <libsource lib="device" part="CP"/>
      <sheetpath names="/" tstamps="/" />
      <tstamps>4C6E2094</tstamps>
    <comp ref="R1">
      <value>R</value>
      <libsource lib="device" part="R"/>
      <sheetpath names="/" tstamps="/" />
      <tstamps>4C6E208A</tstamps>
    </comp>
  </components>
  <libparts/>
  <libraries/>
  <nets>
    <net code="1" name="GND">
      <node ref="U1" pin="7"/>
      <node ref="C1" pin="2"/>
      <node ref="U2" pin="7"/>
    </net>
  </nets>
</export>
</D>
</export>
</D>
```

```

<node ref="P1" pin="4"/>
</net>
<net code="2" name="VCC">
  <node ref="R1" pin="1"/>
  <node ref="U1" pin="14"/>
  <node ref="U2" pin="4"/>
  <node ref="U2" pin="1"/>
  <node ref="U2" pin="14"/>
  <node ref="P1" pin="1"/>
</net>
<net code="3" name="">
  <node ref="U2" pin="6"/>
</net>
<net code="4" name="">
  <node ref="U1" pin="2"/>
  <node ref="U2" pin="3"/>
</net>
<net code="5" name="/SIG_OUT">
  <node ref="P1" pin="2"/>
  <node ref="U2" pin="5"/>
  <node ref="U2" pin="2"/>
</net>
<net code="6" name="/CLOCK_IN">
  <node ref="R1" pin="2"/>
  <node ref="C1" pin="1"/>
  <node ref="U1" pin="1"/>
  <node ref="P1" pin="3"/>
</net>
</nets>
</export>

```

Struttura generale del file netlist

La netlist intermedia consta di cinque sezioni.

- La sezione intestazione.
- La sezione componenti.
- La sezione librerie di parti.
- La sezione librerie.
- La sezione collegamenti.

The file content has the delimiter `<export>`

```
... ``" data-lang="xml ... ``">[[the-header-section]]
```

==== Sezione intestazione

The header has the delimiter `<design>`

```
``xml <design> <source>F:\kicad_aux\netlist_test\netlist_test.sch</source>
<date>21/08/2010 08:12:08</date> <tool>eeschema (2010-08-09 BZR 2439)-unstable</tool>
</design> ``
```

Questa sezione può essere considerata una sezione di commento.

```
[[the-components-section]]
```

==== La sezione componenti

The component section has the delimiter `<components>`

```
``xml <components> <comp ref="P1"> <value>CONN_4</value> <libsource lib="conn"
part="CONN_4"/> <sheetpath names="/" tstamps="/" /> <tstamps>4C6E2141</tstamps> </comp>
</components> `` This section contains the list of components in your schematic. Each
component is described like this:
```

```
``xml <comp ref="P1"> <value>CONN_4</value> <libsource lib="conn" part="CONN_4"/>
<sheetpath names="/" tstamps="/" /> <tstamps>4C6E2141</tstamps> </comp> ``
```

```
[width="100%", cols="37%,63%"]
```

```
|=====
|Element name |Element description
```

```
|`libsource` |name of the lib where this component was found.
```

```
|`part` |component name inside this library.
```

```
|`sheetpath` |path of the sheet inside the hierarchy: identify the sheet
within the full schematic hierarchy.
```

```
|`tstamps` |timestamp of the component.
```

```
|=====
```

```
[[note-about-time-stamps-for-components]]
```

==== Note about time stamps for components

To identify a component in a netlist and therefore on a board, the timestamp reference is used as unique for each component. However KiCad provides an auxiliary way to identify a component which is the corresponding footprint on the board. This allows the re-annotation of components in a schematic project and does not lose the link between the component and its footprint.

Un marcatore temporale è un identificatore univoco per ogni componente o foglio in un progetto di schema elettrico. Ma in caso di gerarchie complesse, lo stesso foglio viene usato più di una volta, perciò il foglio contiene componenti aventi la stessa marcatura temporale.

A given sheet inside a complex hierarchy has an unique identifier: its sheetpath. A given component (inside a complex hierarchy) has a unique identifier: the sheetpath and its timestamp.

```
[[the-libparts-section]]
```

==== La sezione libparts

The libparts section has the delimiter `<libparts>`, and the content of this section is defined in the schematic libraries.

```
``xml
```

Element name	Element description
<footprints>	The symbol's footprint filters. Each footprint filter is in a separate <fp> tag.
<fields>	The symbol's fields. Each field's name and value is given in a separate `<field name="fieldname">...</field>` tag.
<pins>	The symbol's pins. Each pin is given in a separate <pin num="pinnum" type="pintype"/> tag. Possible pintypes are described below.

Possible electrical pin types are:

Pintype	Description
Input	Usual input pin
Output	Usual output
Bidirectional	Input or Output
Tri-state	Bus input/output
Passive	Usual ends of passive components
Unspecified	Unknown electrical type
Power input	Power input of a component
Power output	Power output like a regulator output
Open collector	Open collector often found in analog comparators
Open emitter	Open emitter sometimes found in logic
Not connected	Must be left open in schematic

La sezione librerie

The libraries section has the delimiter `<libraries>`. This section contains the list of schematic libraries used in the project.

```
<libraries>
  <library logical="device">
    <uri>F:\kicad\share\library\device.lib</uri>
  </library>
  <library logical="conn">
    <uri>F:\kicad\share\library\conn.lib</uri>
  </library>
</libraries>
```

La sezione collegamenti

The nets section has the delimiter `<nets>`. This section describes the connectivity of the schematic by listing all nets and the pins connected to each net.

```
<nets>
  <net code="1" name="GND">
    <node ref="U1" pin="7"/>
    <node ref="C1" pin="2"/>
    <node ref="U2" pin="7"/>
    <node ref="P1" pin="4"/>
  </net>
  <net code="2" name="VCC">
    <node ref="R1" pin="1"/>
    <node ref="U1" pin="14"/>
    <node ref="U2" pin="4"/>
    <node ref="U2" pin="1"/>
    <node ref="U2" pin="14"/>
    <node ref="P1" pin="1"/>
  </net>
</nets>
```

Un tipico collegamento contiene i seguenti elementi.

```
<net code="1" name="GND">
  <node ref="U1" pin="7"/>
  <node ref="C1" pin="2"/>
  <node ref="U2" pin="7"/>
  <node ref="P1" pin="4"/>
</net>
```

Element name	Element Description
net code	an internal identifier for this net
name	the net name
node	the pin (identified by <code>pin</code>) of a symbol (identified by <code>ref</code>) which is connected to the net

Example netlist exporters

Some example netlist exporters using XSLT are included below.

XSLT itself is an XML language very suitable for XML transformations. The `xsltproc` program can be used to read the Intermediate XML netlist input file, apply a style-sheet to transform the input, and save the results in an output file. Use of `xsltproc` requires a style-sheet file using XSLT conventions. The full conversion process is handled by KiCad, after it is configured once to run `xsltproc` in a specific way.

The document that describes XSL Transformations (XSLT) is available here: <http://www.w3.org/TR/xslt>

NOTE

When writing a new netlist exporter, consider using Python or another tool rather than XSLT.

PADS netlist example using XSLT

The following example shows how to create an exporter for the PADS netlist format using `xlstproc`.

The PADS netlist format is comprised of two sections:

- A list of footprints
- A list of nets, together with the pads connected to each net.

Below is an XSL style-sheet which converts the intermediate netlist file to the PADS netlist format.

```

<?xml version="1.0" encoding="ISO-8859-1"?>
<!--XSL style sheet to Eeschema Generic Netlist Format to PADS netlist format
Copyright (C) 2010, SoftPLC Corporation.
GPL v2.

How to use:
https://lists.launchpad.net/kicad-developers/msg05157.html
-->

<!DOCTYPE xsl:stylesheet [
  <!ENTITY nl "&#xd;&#xa;"> <!--new line CR, LF -->
]>

<xsl:stylesheet version="1.0" xmlns:xsl="http://www.w3.org/1999/XSL/Transform"> <xsl:output
method="text" omit-xml-declaration="yes" indent="no"/>

<xsl:template match="/export">
  <xsl:text>*PADS-PCB*&nl;*PART*&nl;</xsl:text>
  <xsl:apply-templates select="components/comp"/>
  <xsl:text>&nl;*NET*&nl;</xsl:text>
  <xsl:apply-templates select="nets/net"/>
  <xsl:text>*END*&nl;</xsl:text>
</xsl:template>

<!-- for each component -->
<xsl:template match="comp">
  <xsl:text> </xsl:text>
  <xsl:value-of select="@ref"/>
  <xsl:text> </xsl:text>
  <xsl:choose>
    <xsl:when test = "footprint != ' ' ">
      <xsl:apply-templates select="footprint"/>
    </xsl:when>
    <xsl:otherwise>
      <xsl:text>unknown</xsl:text>
    </xsl:otherwise>
  </xsl:choose>
  <xsl:text>&nl;</xsl:text>
</xsl:template>

<!-- for each net -->
<xsl:template match="net">
  <!-- nets are output only if there is more than one pin in net -->
  <xsl:if test="count(node)>1">
    <xsl:text>*SIGNAL* </xsl:text>
    <xsl:choose>
      <xsl:when test = "@name != ' ' ">
        <xsl:value-of select="@name"/>
      </xsl:when>
      <xsl:otherwise>
        <xsl:text>N-</xsl:text>
        <xsl:value-of select="@code"/>
      </xsl:otherwise>
    </xsl:choose>
    <xsl:text>&nl;</xsl:text>
    <xsl:apply-templates select="node"/>
  </xsl:if>
</xsl:template>

<!-- for each node -->

```

La riga di comando per effettuare questa conversione è:

```
kicad\bin\xsltproc.exe -o test.net kicad\bin\plugins\netlist_form_pads-pcb.xsl test.tmp
```

Cadstar netlist example using XSLT

The following example shows how to create an exporter for the Cadstar netlist format using `xsltproc`.

The Cadstar format is comprised of two sections:

- The footprint list
- The Nets list: grouping pads references by nets

Below is an XSL style-sheet which converts the intermediate netlist file to the Cadstar netlist format.

```

<?xml version="1.0" encoding="ISO-8859-1"?>
<!--XSL style sheet to Eeschema Generic Netlist Format to CADSTAR netlist format
  Copyright (C) 2010, Jean-Pierre Charras.
  Copyright (C) 2010, SoftPLC Corporation.
  GPL v2. -->

<!DOCTYPE xsl:stylesheet [
  <!ENTITY nl "&#xd;&#xa;"> <!--new line CR, LF -->
]>

<xsl:stylesheet version="1.0" xmlns:xsl="http://www.w3.org/1999/XSL/Transform"> <xsl:output
method="text" omit-xml-declaration="yes" indent="no"/>

<!-- Netlist header -->
<xsl:template match="/export">
  <xsl:text>.HEA&nl;</xsl:text>
  <xsl:apply-templates select="design/date"/> <!-- Generate line .TIM <time> -->
  <xsl:apply-templates select="design/tool"/> <!-- Generate line .APP <eeschema version>
-->
  <xsl:apply-templates select="components/comp"/> <!-- Generate list of components -->
  <xsl:text>&nl;&nl;</xsl:text>
  <xsl:apply-templates select="nets/net"/> <!-- Generate list of nets and
connections -->
  <xsl:text>&nl;.END&nl;</xsl:text>
</xsl:template>

  <!-- Generate line .TIM 20/08/2010 10:45:33 -->
<xsl:template match="tool">
  <xsl:text>.APP "</xsl:text>
  <xsl:apply-templates/>
  <xsl:text>"&nl;</xsl:text>
</xsl:template>

  <!-- Generate line .APP "eeschema (2010-08-17 BZR 2450)-unstable" -->
<xsl:template match="date">
  <xsl:text>.TIM </xsl:text>
  <xsl:apply-templates/>
  <xsl:text>&nl;</xsl:text>
</xsl:template>

<!-- for each component -->
<xsl:template match="comp">
  <xsl:text>.ADD_COM </xsl:text>
  <xsl:value-of select="@ref"/>
  <xsl:text> </xsl:text>
  <xsl:choose>
    <xsl:when test = "value != '' ">
      <xsl:text>"</xsl:text> <xsl:apply-templates select="value"/> <xsl:text>"
</xsl:text>
    </xsl:when>
    <xsl:otherwise>
      <xsl:text>""</xsl:text>
    </xsl:otherwise>
  </xsl:choose>
  <xsl:text>&nl;</xsl:text>
</xsl:template>

<!-- for each net -->
<xsl:template match="net">
  <!-- nets are output only if there is more than one pin in net -->

```

TER C1.2

```
        U2.7
        P1.4
.ADD_TER R1.1 "VCC"
.TER     U1.14
        U2.4
        U2.1
        U2.14
        P1.1
.ADD_TER U1.2 "N-4"
.TER     U2.3
.ADD_TER P1.2 "/SIG_OUT"
.TER     U2.5
        U2.2
.ADD_TER R1.2 "/CLOCK_IN"
.TER     C1.1
        U1.1
        P1.3
```

END

```
==== OrcadPCB2 netlist example using XSLT
```

This format has only one section which is the footprint list. Each footprint includes a list of its pads with reference to a net.

Below is an XSL style-sheet which converts the intermediate netlist file to the Orcad netlist format.

```
``xml
<?xml version="1.0" encoding="ISO-8859-1"?>
<!--XSL style sheet to Eeschema Generic Netlist Format to CADSTAR netlist format
  Copyright (C) 2010, SoftPLC Corporation.
  GPL v2.

  How to use:
  https://lists.launchpad.net/kicad-developers/msg05157.html
-->

<!DOCTYPE xsl:stylesheet [
  <!ENTITY nl "&#xd;&#xa;"> <!--new line CR, LF -->
]>

<xsl:stylesheet version="1.0" xmlns:xsl="http://www.w3.org/1999/XSL/Transform"> <xsl:output
method="text" omit-xml-declaration="yes" indent="no"/>

<!--
  Netlist header
  Creates the entire netlist
  (can be seen as equivalent to main function in C
-->
<xsl:template match="/export">
  <xsl:text>( { Eeschema Netlist Version 1.1  </xsl:text>
  <!-- Generate line .TIM <time> -->
<xsl:apply-templates select="design/date"/>
<!-- Generate line eeschema version ... -->
<xsl:apply-templates select="design/tool"/>
<xsl:text>}&nl;</xsl:text>

<!-- Generate the list of components --> <xsl:apply-templates select="components/comp"/>
<!-- Generate list of components -->

<!-- end of file --> <xsl:text>)&nl;*&nl;</xsl:text> </xsl:template>

<!--
  Generate id in header like "eeschema (2010-08-17 BZR 2450)-unstable"
-->
<xsl:template match="tool">
  <xsl:apply-templates/>
</xsl:template>

<!--
  Generate date in header like "20/08/2010 10:45:33"
-->
<xsl:template match="date">
  <xsl:apply-templates/>
  <xsl:text>&nl;</xsl:text>
</xsl:template>

<!--
```

```
( { Eeschema Netlist Version 1.1 29/08/2010 21:07:51 eeschema (2010-08-28 BZR 2458)-unstable} ( 4C6E2141 $noname P1 CONN_4 ( 1 VCC ) ( 2 /SIG_OUT ) ( 3 /CLOCK_IN ) ( 4 GND ) ) ( 4C6E20BA $noname U2 74LS74 ( 1 VCC ) ( 2 /SIG_OUT ) ( 3 N-04 ) ( 4 VCC ) ( 5 /SIG_OUT ) ( 6 ? ) ( 7 GND ) ( 14 VCC ) ) ( 4C6E20A6 $noname U1 74LS04 ( 1 /CLOCK_IN ) ( 2 N-04 ) ( 7 GND ) ( 14 VCC ) ) ( 4C6E2094 $noname C1 CP ( 1 /CLOCK_IN ) ( 2 GND ) ) ( 4C6E208A $noname R1 R ( 1 VCC ) ( 2 /CLOCK_IN ) ) ) *
```

:experimental:

[[eeschema-actions-reference]]

== Actions reference

Below is a list of every available *action* in the KiCad Schematic Editor: a command that can be assigned to a hotkey.

////

Note to translators: you do not need to translate this table by hand.

It is generated from KiCad using the Dump Hotkeys button that is shown in the hotkeys editor if you add the line `HotkeysDumper=1` to your advanced config file (`kicad_advanced` file in the config directory)

////

=== Editor degli schemi elettrici

[width="100%", options="header", cols="20%,15%,65%"]

|===

Action	Default Hotkey	Description
Align Elements to Grid		
Annotate Schematic...		
Fill in schematic symbol reference designators		
Assign Footprints...		
Run footprint assignment tool		
Clear Net Highlighting	kbd:[~]	Clear any existing net highlighting
Export Drawing to Clipboard		
Export drawing of current sheet to clipboard		
Edit Library Symbol...	kbd:[Ctrl+Shift+E]	Open the library symbol in the Symbol Editor
Edit Sheet Page Number...		
Edit the page number of the current or selected sheet		
Edit Symbol Fields...		
Bulk-edit fields of all symbols in schematic		
Edit Symbol Library Links...		
Edit links between schematic and library symbols		
Edit with Symbol Editor	kbd:[Ctrl+E]	Open the selected symbol in the Symbol Editor
Highlight on PCB		
Highlight corresponding items in PCB editor		
Export Netlist...		
Export file containing netlist in one of several formats		
Force H/V Wires and Buses		