# Magic VLSI Cheatsheet

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This cheat sheet compiles useful commands (to be entered in the Tcl console) and bind keys (in the layout window) as well as a summary of the mouse operations for the different tool modes. This compilation relates to Magic 8.3 (see https://github.com/RTimothyEdwards/magic).

A comprehensive Magic documentation and description of all macros can be found at http://opencircuitdesign.com/magic/userguide.html.

The command `macro layout` in the Magic Tcl console lists all defined macros.

| | |
|---|---|
| Useful commands: | |
| `addpath` [*path*] | add search *path* of cells |
| `antennacheck` | run antenna check on cell |
| `array` *xsize ysize* | array the selection *xsize*-times in X, *ysize*-times in Y, spacing by box |
| `box` [*options*] | print information about the box like `b`, or manipulate it in various ways |
| `cif` [*options*] | powerful command with various options (like generating mask layers, calculate density, etc.). Consult online help. |
| `contact` *type* | create contact inside box of intersecting layers |
| `copy` [*to x y*] | `copy` to current cursor position or to *x/y*-position |
| `corner` *dir1 dir2* | draws a corner inside box, first in *dir1*, then in *dir2* (cf. `fill`) |
| `drc find` | locate DRC error     drc style drc(full) |
| `drc why` | explain DRC errors in box |
| `dump` *cell* | copy given *cell* into current layout cell |
| `erase` *layers* | erase comma-separated list of *layers* in box |
| `erase *` | all layers but not labels |
| `erase $` | erase everything (like `CTRL-D`) |
| `erase labels` | erase selected label(s) in box |
| `fill` *dir* | extend layers from one side of box to the other in the given *dir*ection (cf. `corner`) |
| `findlabel` *label* | center the box on the *label* |
| `flatten` *cell* | flatten the current edit cell incl. hierarchy into a new *cell* |
| `flush` | revert edit cell to last state on disk |
| `get` *cell* | instantiate *cell* into current edit cell |
| `goto` *nodename* | move box to net *nodename*, throw error if not existing |
| `help` [*pattern*] | shows help for various commands |
| `identify` *cell-id* | name the selected cell as *cell-id* |
| `iroute` | interactive point-to-point router, from cursor to box |
| `label` *string* [*position* [*layer*]] | create a point, line or box label |
| `load` *cell* | open the *cell* in the layout window |

'grid on' and 'snap grid'

magic -d OGL or magic -d XR (better graphics)

cif see MCON (see the actual VIAs); feed clear (to unsee again)

Useful commands (cont'd):

| | |
|---|---|
| `macro` [*window_type*] [*key* [*value*]] | new macro definition |
| `measure` [hor\|ver\|auto] | create a ruler in the box |
| `move` *x y* | `move` the selection to the *x,y* coordinate, or relative by specifying direction and distance; parameters are in lambda or in *um* |
| `paint` *layers* | paint the comma-separated list of *layers* in box |
| `plot` *type filename* | plots a layout, either as *pnm* or *svg* type |
| `plow` *dir* | move layout structures incl. connectivity in *dir*ection, see manual |
| `port make` | create a port from selected label |
| `port index` *number* | assign a port index (must match the number from schematic) |
| `quit` [`-nocheck`] | exit magic (using `-nocheck` discards unsaved changes) |
| `see` [`no`] *layers* | show or hide comma-separated list of *layers* |
| `see` [`no`] `*` | show or hide all layers |
| `select save` *file* | Save selection as new *file*.mag |
| `select short` *label1 label2* | Find the path that electrically connects (shorts) the nodes labeled *label1* and *label2*. |
| `straighten` *dir* | try to repair jogs by pulling in *dir*ection |
| `tool` | changes the currently used `tool` to (box, wiring, netlist, pick) |
| `redraw` | redraws the window |
| `unmeasure` | remove all rulers in box |
| `what` | print information about the current selection |
| `xload` *cell* | open the *cell* in the layout window unexpanded |
| `xview` | full view, with unexpanded cells |

| Bind keys: | |
| --- | --- |
| `a` | select everything in box |
| `A` | select additional objects in box |
| `CTRL-A` | deselect objects in box |
| `b` | print information about the `box` |
| `B` | center window on the box |
| `c` | `copy` |
| `d` | `delete` selection |
| `CTRL-D` | delete all layers and labels in box selected by cursor |
| `e` | makes the selected cell the new `edit` cell |
| `F` | flip the selection upside-down |
| `g` | toggle `grid` |
| `G` | toggle `grid 2` |
| `i` | select instance under cursor |
| `I` | select additional instance under cursor |
| `CTRL-I` | deselect instance under cursor |
| `m` | `move` selection to cursor position |
| `o` | `openwindow` (with current selection) |
| `r` | `rotate` 90 degree |
| `R` | `rotate` -90 degree |
| `s` | `select` objects under cursor |
| `S` | `select` additional objects under cursor |
| `CTRL-S` | deselect objects under cursor |
| `u` | `undo` the last operation |
| `U` | `redo` the last undo |
| `v` | `view`, full view of layout |
| `w` | `writeall` changed cells to disk |
| `x` | `expand` cells (make visible) in box |
| `X` | `unexpand` cells (hide) inside the box |
| `CTRL-X` | toggle the visibility of cells in box |
| `y` | `drc why` |
| `z` | zoom out |
| `Z` | zoom in |
| `CTRL-Z` | zoom in on box |
| `>` | edit the selected cell in layout window (cf. <) |
| `<` | return from editing a cell (cf. >) |
| `,` | clear selection |
| `:` | directly jump to command window (like VI) |
| `SPACE` | change the tool |
| `SHIFT + SPACE` | change to the box tool |
| `KEYPAD-2` | move selection south, equivalent to '`move` s 1' |
| `SHIFT + KEYPAD-2` | stretch selection south, equivalent to '`stretch` s 1' |
| `KEYPAD-4` | move selection west, equivalent to '`move` w 1' |
| `SHIFT + KEYPAD-4` | stretch selection west, equivalent to '`stretch` w 1' |
| `KEYPAD-6` | move selection east, equivalent to '`move` e 1' |
| `SHIFT + KEYPAD-6` | stretch selection east, equivalent to '`stretch` e 1' |
| `KEYPAD-8` | move selection north, equivalent to '`move` n 1' |
| `SHIFT + KEYPAD-8` | stretch selection north, equivalent to '`stretch` n 1' |

| Bind keys (IIC add-on): | |
| --- | --- |
| `f` | full layout view |
| `CTRL-F` | flip the selection sideways |
| `k` | measure (ruler) |
| `K` | remove rulers |
| `p` | draw a wiring path |
| `q` | open poperty dialog of p-cell |
| `?` | show what is contained in box |
| `=` | find DRC error(s) and zoom to it (thanks M. Guthaus) |
| `0` | show locali |
| `!` | show metal-1 |
| `@` | show metal-2 |
| `#` | show metal-3 |
| `$` | show metal-4 |
| `%` | show metal-5 |
| `9` | show all layers |

| Mouse operations: | |
|---|---|
| **Box tool:** | |
| LEFT | set lower-left corner of box |
| RIGHT | set upper-right corner of box |
| MIDDLE | `paint` layer pointed with cursor in box |
| SHIFT + MIDDLE | `erase` layer pointed with cursor in box |
| **Layer selection tool:** | |
| LEFT | show selected layer, cf. `see` |
| RIGHT | hide selected layer, cf. `see` no |
| **Wiring tool:** | |
| LEFT | pick wire material and size from cursor |
| MIDDLE | place wire at cursor |
| RIGHT | cancel wire |
| SHIFT + LEFT | change to higher layer (e.g. m1 to m2) |
| SHIFT + RIGHT | change to lower layer (e.g. m2 to m1) |
| SHIFT + MIDDLE | place a contact at cursor and continue on higher layer |
| **Pick tool:** | |
| LEFT | remove current selection and follow cursor |
| MIDDLE | place a copy and continue |
| RIGHT | cancel |
| SHIFT + MIDDLE | make a copy of selection and follow cursor |