CircuiTi*k*Z

version 0.2.2

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Contents

1 Introduction

After two years of little exposure only on my personal website[1], I did a major rehauling of the code of CircuiTi*k*Z, fixing several problems and converting everything to Ti*k*Z version 2.0.

I'm not too sure about the result, because my (La)TEX skills are much to be improved, but it seems it's time for more user feedback. So, here it is...

I know the documentation is somewhat scant. Hope to have time to improve it a bit.

1.1 About

This package provides a set of macros for naturally typesetting electrical and (somewhat less naturally, perhaps) electronical networks.

It was born mainly for writing my own exercise book and exams sheets for the Elettrotecnica courses at Politecnico di Milano, Italy. I wanted a tool that was easy to use, with a lean syntax, native to LATEX, and supporting directly PDF output format.

So I based everything with the very impressive (if somewhat verbose at times) Ti*k*Z package.

1.2 Loading the package

```
\usepackage{circuitikz}
```

Ti*k*Z will be automatically loaded.

1.3 License

1.4 Feedback

Much appreciated: `mredaelli@elet.polimi.it`. Although I don't guarantee quick answers.

[1] `http://home.dei.polimi.it/mredaelli`.

1.5 Requirements

- `tikz`, version ≥ 2;
- `xstring`;
- `siunitx`, if using `siunitx` option.

1.6 Incompatible packages

None, as far as I know.

2 Options

- `europeanvoltage`: uses arrows to define voltages, and uses european-style voltage sources;
- `americanvoltage`: uses $-$ and $+$ to define voltages, and uses american-style voltage sources;
- `europeancurrent`: uses european-style current sources;
- `americancurrent`: uses american-style current sources;
- `europeanresistor`: uses rectangular empty shape for resistors, as per european standards;
- `americanresistor`: uses zig-zag shape for resistors, as per american standards;
- `europeaninductor`: uses rectangular filled shape for inductors, as per european standards;
- `americaninductor`: uses coil shape for inductors, as per american standards;
- `european`: equivalent to `europeancurrent`, `europeanvoltage`, `europeanresistor`, `europeaninductor`;
- `american`: equivalent to `americancurrent`, `americanvoltage`, `americanresistor`, `americaninductor`;
- `siunitx`: integrates with `SIunitx` package. If labels, currents or voltages are of the form `#1<#2>` then what is shown is actually `\SI{#1}{#2}`;
- `nosiunitx`: labels are not interpreted as above;
- `fulldiode`: the various diodes are drawn *and* filled by default, i.e. when using styles such as `diode`, `D`, `sD`, ... Un-filled diode can always be forced with `Do`, `sDo`, ...
- `emptydiode`: the various diodes are drawn *but not* filled by default, i.e. when using styles such as `diode`, `D`, `sD`, ... Filled diode can always be forced with `D*`, `sD*`, ...

- `arrowmos`: pmos and nmos have arrows analogous to those of pnp and npn transistors;
- `noarrowmos`: pmos and nmos do not have arrows analogous to those of pnp and npn transistors.

Loading the package with no options is equivalent to my own personal liking, that is to the following options:
`[european current, european voltage, american resistor, american inductor, nosiunitx, noarrowmos]`.

3 The components

Here follows the list of all the shapes defined by CircuiTi*k*Z. These are all `pgf` nodes, so they are usable in both `pgf` and Ti*k*Z.

Each bipole is shown using the following command, where `#1` is the name of the component[2]:

```
\begin{center}\begin{circuitikz} \draw
   (0,0) to[ #1 ] (2,0)
; \end{circuitikz} \end{center}
```

The other shapes are shown with:

```
\begin{center}\begin{circuitikz} \draw
   (0,0) node[ #1 ] {}
; \end{circuitikz} \end{center}
```

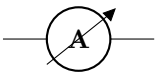
3.1 Monopoles

- Ground (`ground`)

3.2 Bipoles

Instruments

- Ammeter (`ammeter`)



- Voltmeter (`voltmeter`)

[2] If `#1` is the name of the bipole/the style, then the actual name of the shape is `#1shape`.

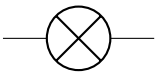
Basic resistive bipoles

- Short circuit (`short`)

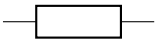
- Open circuit (`open`)

- Potentiometer (`pR`, or `potentiometer`)

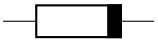
- Lamp (`lamp`)



- Generic (symmetric) bipole (`generic`)



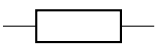
- Generic asymmetric bipole (`ageneric`)



- Generic asymmetric bipole (`fullgeneric`)

The resistor If `europeanresistor` option is active (or the style `[european resistor]` is used), the resistor is displayed as follows:

- Resistor (`R`, or `resistor`)

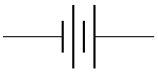


If instead (default behaviour) `americanresistor` option is active (or the style `[american resistor]` is used), the resistor is displayed as follows:

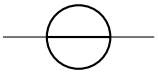
- Resistor (`R`, or `resistor`)

Stationary sources

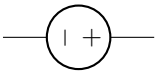
- Battery (`battery`)



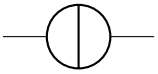
- Voltage source (european style) (`european voltage source`)



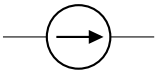
- Voltage source (american style) (`american voltage source`)



- Current source (european style) (`european current source`)



- Current source (american style) (`american current source`)

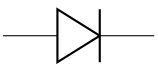


The options `europeancurrent` [resp. `europeanvoltage`] (the default) and `americancurrent` [resp. `americanvoltage`] define which current [resp. voltage] source is selected by default when the abbreviated styles `current source`, `csource`, `I` [resp. `voltage source`, `vsource`, `V`] are used.

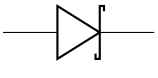
One can also use the related styles `[european current]` [resp. `[european voltage]`] and `[american current]` [resp. `[american voltage]`].

Diodes and such

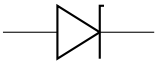
- Empty diode (`empty diode`, or `Do`)



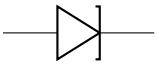
- Empty Schottky diode (`empty Schottky diode`, or `sDo`)



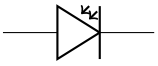
- Empty Zener diode (`empty Zener diode`, or `zDo`)



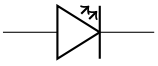
- Empty tunnel diode (`empty tunnel diode`, or `tDo`)



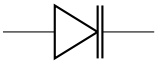
- Empty photodiode (`empty photodiode`, or `pDo`)



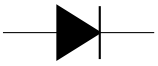
- Empty led (`empty led`, or `leDo`)



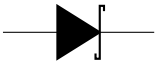
- Empty varcap (`empty varcap`, or `VCo`)



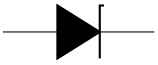
- Full diode (`full diode`, or `D*`)



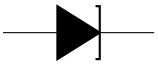
- Full Schottky diode (`full Schottky diode`, or `sD*`)



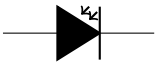
- Full Zener diode (`full Zener diode`, or `zD*`)



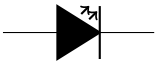
- Full tunnel diode (`full tunnel diode`, or `tD*`)



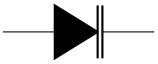
- Full photodiode (`full photodiode`, or `pD*`)



- Full led (`full led`, or `leD*`)



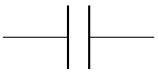
- Full varcap (`full varcap`, or `VC*`)



> The options `fulldiode` and `emptydiode` (and the styles `[full diode]` and `[full diode]`) define which shape will be used by abbreviated commands such that `D`, `sD`, `zD`, `tD`, `pD`, `leD`, and `VC`.

Basic dynamical bipoles

- Capacitor (`capacitor`, or `C`)

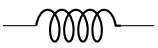


If `europeaninductor` option is active (or the style `[european inductor]` is used), the inductor is displayed as follows:

- Inductor (`L`, or `inductor`)

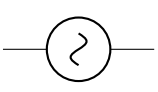
If instead (default behaviour) `americaninductor` option is active (or the style `[american inductor]` is used), the inductor is displayed as follows:

- Inductor (`L`, or `inductor`)

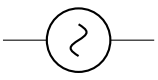


Sinusoidal sources Here because I was asked for them. But how do you distinguish one from the other?!

- Sinusoidal voltage source (`sinusoidal voltage source`, or `vsourcesin`, `sV`)



- Sinusoidal current source (`sinusoidal current source`, or `isourcesin`, `sI`)



Switch

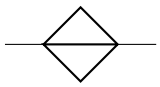
- Closing switch (`closing switch`, or `cspst`)

- Opening switch (`opening switch`, or `ospst`)

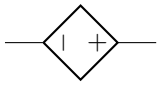
3.3 Tripoles

Controlled sources Admittedly, graphically they are bipoles. But I couldn't...

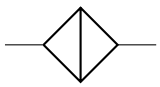
- Controlled voltage source (european style) (`european controlled voltage source`)



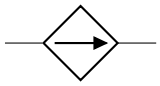
- Controlled voltage source (american style) (`american controlled voltage source`)



- Controlled current source (european style) (`european controlled current source`)



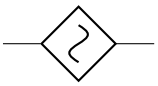
- Controlled current source (american style) (`american controlled current source`)



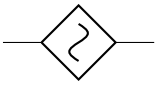
The options `europeancurrent` [resp. `europeanvoltage`] (the default) and `americancurrent` [resp. `americanvoltage`] define which controlled current [resp. voltage] source is selected by default when the abbreviated styles are used.

One can also use the related styles `[european current]` [resp. `[european voltage]`] and `[american current]` [resp. `[american voltage]`].

- Controlled sinusoidal voltage source (`controlled sinusoidal voltage source`, or `controlled vsourcesin, cvsourcesin, csV`)

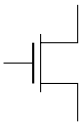


- Controlled sinusoidal current source (`controlled sinusoidal current source`, or `controlled isourcesin, cisourcesin, csI`)

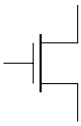


Transistors

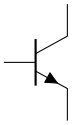
- nmos (`nmos`)



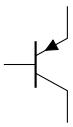
- pmos (`pmos`)



- npn (`npn`)

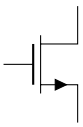


- pnp (`pnp`)

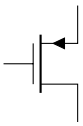


If the option `arrowmos` is used (or after the commant `\ctikzset{tripoles/mos style/arrows}` is given), this is the output:

- nmos (`nmos`)

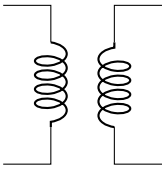


- pmos (`pmos`)

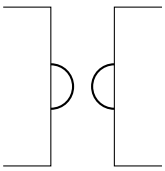


3.4 Double bipoles

- Transformer (`transformer`)

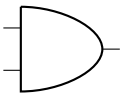


- Gyrator (`gyrator`)

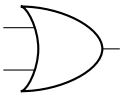


3.5 Logic gates

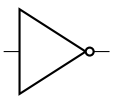
- AND port (`and port`)



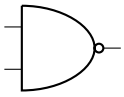
- OR port (`or port`)



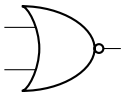
- NOT port (`not port`)



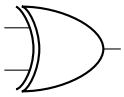
- NAND port (`nand port`)



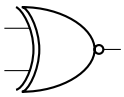
- NOR port (`nor port`)



- XOR port (`xor port`)

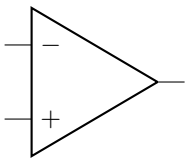


- XNOR port (`xnor port`)



3.6 Operational Amplifier

- Operational amplifier (`op amp`)



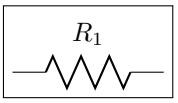
3.7 Support shapes

- Arrows (current and voltage) (`currarrow`)

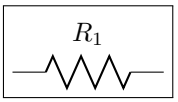
- Connected terminal (`circ`)

- Unconnected terminal (`ocirc`)

4 Usage

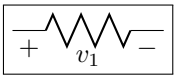



```
\begin{circuitikz}
    \draw (0,0) to[R, l=$R_1$] (2,0);
\end{circuitikz}
```

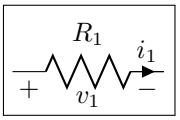



```
\begin{circuitikz}
    \draw (0,0) to[R=$R_1$] (2,0);
\end{circuitikz}
```

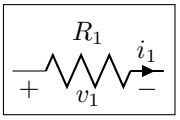

```
\begin{circuitikz}
    \draw (0,0) to[R, i=$i_1$]  (2,0);
\end{circuitikz}
```




```
\begin{circuitikz}
    \draw (0,0) to[R, v=$v_1$] (2,0);
\end{circuitikz}
```

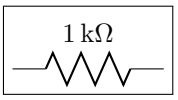



```
\begin{circuitikz}
    \draw (0,0) to[R=$R_1$, i=$i_1$, v=$v_1$] (2,0);
\end{circuitikz}
```



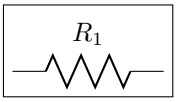

```
\begin{circuitikz}
    \draw (0,0) to[R=$R_1$, i=$i_1$, v=$v_1$] (2,0);
\end{circuitikz}
```

Long names/styles for the bipoles can be used:

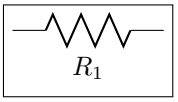



```
\begin{circuitikz}\draw
  (0,0)  to[ resistor =1<\kilo\ohm>] (2,0)
;\end{circuitikz}
```

4.1 Labels



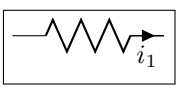

```
\begin{circuitikz}
    \draw (0,0) to[R, l^=$R_1$] (2,0);
\end{circuitikz}
```




```
\begin{circuitikz}
    \draw (0,0) to[R, l_=$R_1$] (2,0);
\end{circuitikz}
```

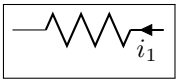
4.2 Currents


```
\begin{circuitikz}
    \draw (0,0) to[R, i^>=$i_1$] (2,0);
\end{circuitikz}
```



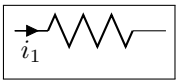

```
\begin{circuitikz}
    \draw (0,0) to[R, i_>=$i_1$] (2,0);
\end{circuitikz}
```


```
\begin{circuitikz}
    \draw (0,0) to[R, i^<=$i_1$] (2,0);
\end{circuitikz}
```



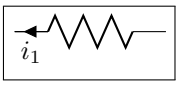

```
\begin{circuitikz}
    \draw (0,0) to[R, i_<=$i_1$] (2,0);
\end{circuitikz}
```


```
\begin{circuitikz}
    \draw (0,0) to[R, i>^=$i_1$] (2,0);
\end{circuitikz}
```




```
\begin{circuitikz}
    \draw (0,0) to[R, i>_=$i_1$] (2,0);
\end{circuitikz}
```


```
\begin{circuitikz}
    \draw (0,0) to[R, i<^=$i_1$] (2,0);
\end{circuitikz}
```



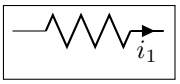

```
\begin{circuitikz}
    \draw (0,0) to[R, i<_=$i_1$] (2,0);
\end{circuitikz}
```

Also


```
\begin{circuitikz}
    \draw (0,0) to[R, i<=$i_1$] (2,0);
\end{circuitikz}
```


```
\begin{circuitikz}
    \draw (0,0) to[R, i>=$i_1$] (2,0);
\end{circuitikz}
```

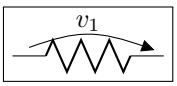

```
\begin{circuitikz}
    \draw (0,0) to[R, i^=$i_1$] (2,0);
\end{circuitikz}
```



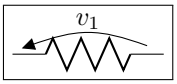

```
\begin{circuitikz}
    \draw (0,0) to[R, i_=$i_1$] (2,0);
\end{circuitikz}
```

4.3 Voltages

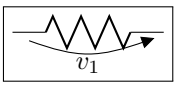
European style The default, with arrows. Use option `europeanvoltage` or style `[european voltage]`.



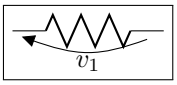

```
\begin{circuitikz}[european voltage]
    \draw (0,0) to[R, v^>=$v_1$] (2,0);
\end{circuitikz}
```




```
\begin{circuitikz}[european voltage]
    \draw (0,0) to[R, v^<=$v_1$] (2,0);
\end{circuitikz}
```

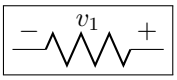



```
\begin{circuitikz}[european voltage]
    \draw (0,0) to[R, v_>=$v_1$] (2,0);
\end{circuitikz}
```

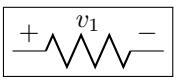



```
\begin{circuitikz}[european voltage]
    \draw (0,0) to[R, v_<=$v_1$] (2,0);
\end{circuitikz}
```

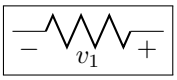
American style For those who like it (not me). Use option `americanvoltage` or set `[american voltage]`.



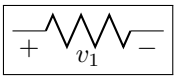

```
\begin{circuitikz}[american voltage]
    \draw (0,0) to[R, v^>=$v_1$] (2,0);
\end{circuitikz}
```




```
\begin{circuitikz}[american voltage]
    \draw (0,0) to[R, v^<=$v_1$] (2,0);
\end{circuitikz}
```




```
\begin{circuitikz}[american voltage]
    \draw (0,0) to[R, v_>=$v_1$] (2,0);
\end{circuitikz}
```




```
\begin{circuitikz}[american voltage]
    \draw (0,0) to[R, v_<=$v_1$] (2,0);
\end{circuitikz}
```

4.4 Nodes

```
\begin{circuitikz}
    \draw (0,0) to[R, o-o] (2,0);
\end{circuitikz}
```

```
\begin{circuitikz}
    \draw (0,0) to[R, -o] (2,0);
\end{circuitikz}
```

```
\begin{circuitikz}
    \draw (0,0) to[R, o-] (2,0);
\end{circuitikz}
```

```
\begin{circuitikz}
    \draw (0,0) to[R, *-*] (2,0);
\end{circuitikz}
```

```
\begin{circuitikz}
    \draw (0,0) to[R, -*] (2,0);
\end{circuitikz}
```

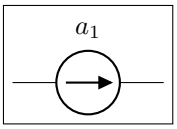
```
\begin{circuitikz}
    \draw (0,0) to[R, *-] (2,0);
\end{circuitikz}
```

```
\begin{circuitikz}
    \draw (0,0) to[R, o-*] (2,0);
\end{circuitikz}
```

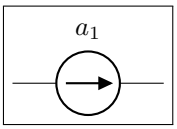
```
\begin{circuitikz}
    \draw (0,0) to[R, *-o] (2,0);
\end{circuitikz}
```

4.5 Special components

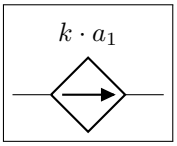
For some components label, current and voltage behave as one would expect:



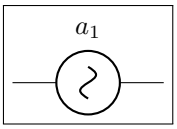

```
\begin{circuitikz}
    \draw (0,0) to[I=$a_1$] (2,0);
\end{circuitikz}
```



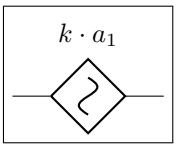

```
\begin{circuitikz}
    \draw (0,0) to[I, i=$a_1$] (2,0);
\end{circuitikz}
```




```
\begin{circuitikz}
    \draw (0,0) to[cI=$k\cdot a_1$] (2,0);
\end{circuitikz}
```

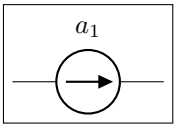



```
\begin{circuitikz}
    \draw (0,0) to[sI=$a_1$] (2,0);
\end{circuitikz}
```

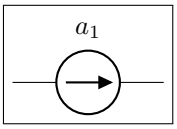



```
\begin{circuitikz}
    \draw (0,0) to[csI=$k\cdot a_1$] (2,0);
\end{circuitikz}
```

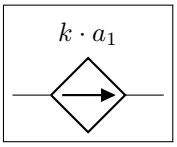
The following results from using the option `americancurrent` or using the style `[american current]`.



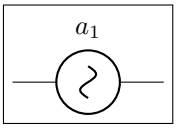

```
\begin{circuitikz}[american current]
    \draw (0,0) to[I=$a_1$] (2,0);
\end{circuitikz}
```



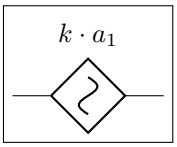

```
\begin{circuitikz}[american current]
    \draw (0,0) to[I, i=$a_1$] (2,0);
\end{circuitikz}
```




```
\begin{circuitikz}[american current]
    \draw (0,0) to[cI=$k\cdot a_1$] (2,0);
\end{circuitikz}
```

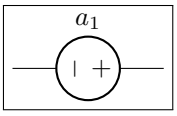



```
\begin{circuitikz}[american current]
    \draw (0,0) to[sI=$a_1$] (2,0);
\end{circuitikz}
```

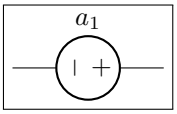



```
\begin{circuitikz}[american current]
    \draw (0,0) to[csI=$k\cdot a_1$] (2,0);
\end{circuitikz}
```

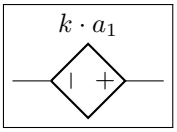
The same holds for voltage sources:



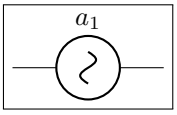

```
\begin{circuitikz}
    \draw (0,0) to[V=$a_1$] (2,0);
\end{circuitikz}
```



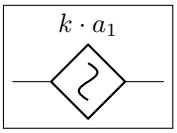

```
\begin{circuitikz}
    \draw (0,0) to[V, v=$a_1$] (2,0);
\end{circuitikz}
```




```
\begin{circuitikz}
    \draw (0,0) to[cV=$k\cdot a_1$] (2,0);
\end{circuitikz}
```

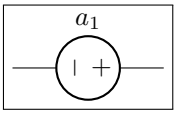



```
\begin{circuitikz}
    \draw (0,0) to[sV=$a_1$] (2,0);
\end{circuitikz}
```

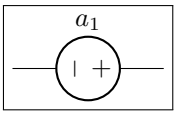



```
\begin{circuitikz}
    \draw (0,0) to[csV=$k\cdot a_1$] (2,0);
\end{circuitikz}
```

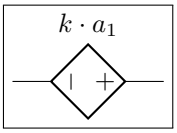
The following results from using the option `americanvoltage` or the style `[american voltage]`.



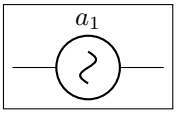

```
\begin{circuitikz}[american voltage]
    \draw (0,0) to[V=$a_1$] (2,0);
\end{circuitikz}
```



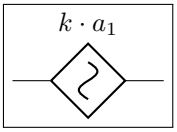

```
\begin{circuitikz}[american voltage]
    \draw (0,0) to[V, v=$a_1$] (2,0);
\end{circuitikz}
```




```
\begin{circuitikz}[american voltage]
    \draw (0,0) to[cV=$k\cdot a_1$] (2,0);
\end{circuitikz}
```



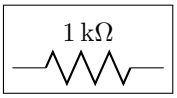

```
\begin{circuitikz}[american voltage]
    \draw (0,0) to[sV=$a_1$] (2,0);
\end{circuitikz}
```



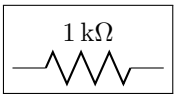

```
\begin{circuitikz}[american voltage]
    \draw (0,0) to[csV=$k\cdot a_1$] (2,0);
\end{circuitikz}
```

4.6 Integration with `siunitx`

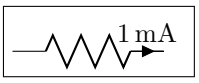
If the option `siunitx` is active, then the following are equivalent:



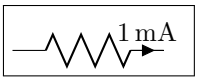

```
\begin{circuitikz}
    \draw (0,0) to[R, l=1<\kilo\ohm>] (2,0);
\end{circuitikz}
```



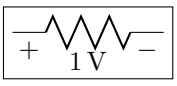

```
\begin{circuitikz}
    \draw (0,0) to[R, l=$\SI{1}{\kilo\ohm}$] (2,0);
\end{circuitikz}
```



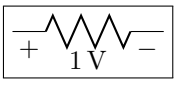

```
\begin{circuitikz}
    \draw (0,0) to[R, i=1<\milli\ampere>] (2,0);
\end{circuitikz}
```




```
\begin{circuitikz}
    \draw (0,0) to[R, i=$\SI{1}{\milli\ampere}$] (2,0);
\end{circuitikz}
```

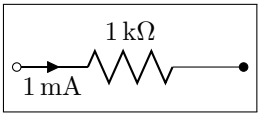



```
\begin{circuitikz}
    \draw (0,0) to[R, v=1<\volt>] (2,0);
\end{circuitikz}
```

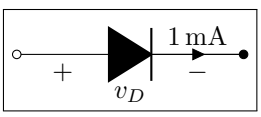



```
\begin{circuitikz}
    \draw (0,0) to[R, v=$\SI{1}{\volt}$] (2,0);
\end{circuitikz}
```

4.7 Putting them together



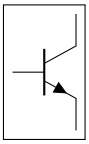

```
\begin{circuitikz}
    \draw (0,0) to[R=1<\kilo\ohm>,
        i>_=1<\milli\ampere>, o-*] (3,0);
\end{circuitikz}
```




```
\begin{circuitikz}
    \draw (0,0) to[D*, v=$v_D$,
        i=1<\milli\ampere>, o-*] (3,0);
\end{circuitikz}
```

5 Not only bipoles

Since only bipoles can be placed "along a line", components with more than two terminals are placed as nodes:

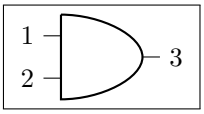


```
\tikz \node[npn] at (0,0) {};
```

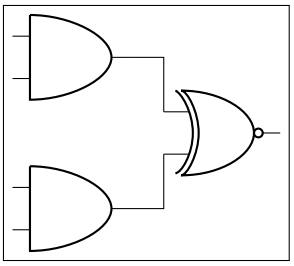
5.1 Anchors

In order to allow connections with other components, all components define anchors.

Logical ports All logical ports, except NOT, have to inputs and one output. They are called respectively `in 1`, `in 2`, `out`:

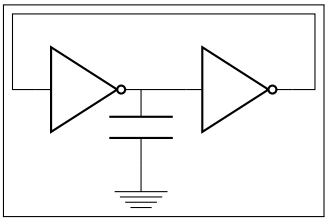



```
\begin{circuitikz} \draw
  (0,0) node[and port] (myand) {}
  (myand.in 1) node[anchor=east] {1}
  (myand.in 2) node[anchor=east] {2}
  (myand.out) node[anchor=west] {3}
;\end{circuitikz}
```



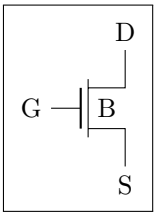
```
\begin{circuitikz} \draw
  (0,2) node[and port] (myand1) {}
  (0,0) node[and port] (myand2) {}
  (2,1) node[xnor port] (myxnor) {}
  (myand1.out) -| (myxnor.in 1)
  (myand2.out) -| (myxnor.in 2)
;\end{circuitikz}
```

In the case of NOT, there are only `in` and `out`:

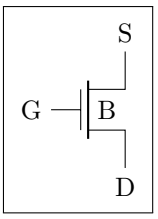


```
\begin{circuitikz} \draw
  (1,0) node[not port] (not1) {}
  (3,0) node[not port] (not2) {}
  (0,0) -- (not1.in)
  (not2.in) -- (not1.out)
  ++(0,-1) node[ground] {} to[C] (not1.out)
  (not2.out) -| (4,1) -| (0,0)
;\end{circuitikz}
```

Transistors For MOS transistors one has `base`, `gate`, `source` and `drain` anchors (which can be abbreviated with `B`, `G`, `S` and `D`):

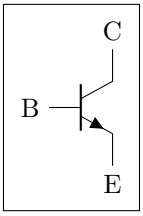



```
\begin{circuitikz} \draw
  (0,0) node[nmos] (mos) {}
  (mos.base) node[anchor=west] {B}
  (mos.gate) node[anchor=east] {G}
  (mos.drain) node[anchor=south] {D}
  (mos.source) node[anchor=north] {S}
;\end{circuitikz}
```

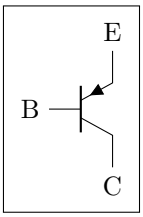



```
\begin{circuitikz} \draw
  (0,0) node[pmos] (mos) {}
  (mos.B) node[anchor=west] {B}
  (mos.G) node[anchor=east] {G}
  (mos.D) node[anchor=north] {D}
  (mos.S) node[anchor=south] {S}
;\end{circuitikz}
```

For BJT transistors the anchors are `base`, `emitter` and `collector` anchors (which can be abbreviated with `B`, `E` and `C`):

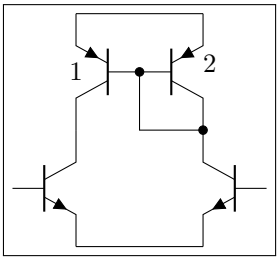



```
\begin{circuitikz} \draw
  (0,0) node[npn] (npn) {}
  (npn.base) node[anchor=east] {B}
  (npn.collector) node[anchor=south] {C}
  (npn.emitter) node[anchor=north] {E}
;\end{circuitikz}
```



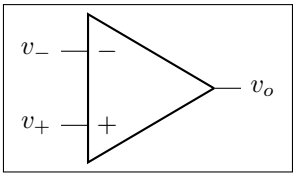

```
\begin{circuitikz} \draw
  (0,0) node[pnp] (pnp) {}
  (pnp.B) node[anchor=east] {B}
  (pnp.C) node[anchor=north] {C}
  (pnp.E) node[anchor=south] {E}
;\end{circuitikz}
```

Here is one composite example (please notice that the `xscale=-1` style would also reflect the label of the transistors, so here a new node is added and its text is used, instead of that of `pnp1`):



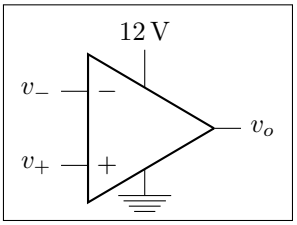

```
\begin{circuitikz} \draw
  (0,0) node[pnp] (pnp2) {2}
  (pnp2.B) node[pnp, xscale=-1, anchor=B] (pnp1) {}
    (pnp1) node {1}
  (pnp1.C) node[npn, anchor=C] (npn1) {}
  (pnp2.C) node[npn, xscale=-1, anchor=C] (npn2) {}
  (pnp1.E) -- (pnp2.E) (npn1.E) -- (npn2.E)
  (pnp1.B) node[circ] {} |- (pnp2.C) node[circ] {}
;\end{circuitikz}
```

Operational amplifier The op amp defines the inverting input (`-`), the non-inverting input (`+`) and the output (`out`) anchors:



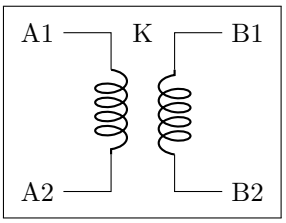

```
\begin{circuitikz} \draw
  (0,0) node[op amp] (opamp) {}
  (opamp.+) node[left] {$v_+$}
  (opamp.−) node[left] {$v_−$}
  (opamp.out) node[right] {$v_o$}
;\end{circuitikz}
```

There are also two more anchors defined, `up` and `down`, for the power supplies:

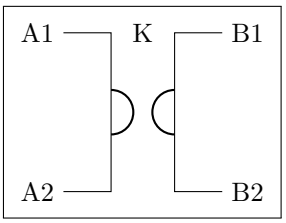



```
\begin{circuitikz} \draw
  (0,0) node[op amp] (opamp) {}
  (opamp.+) node[left] {$v_+$}
  (opamp.−) node[left] {$v_−$}
  (opamp.out) node[right] {$v_o$}
  (opamp.down) node[ground] {}
  (opamp.up) ++ (0,.5) node[above] {\SI{12}{\volt}}
     −− (opamp.up)
;\end{circuitikz}
```

Double bipoles All the (few, actually) double bipoles/quadrupoles have the four anchors, two for each port. The first port, to the left, is port `A`, having the anchors `A1` (up) and `A2` (down); same for port `B`. They also expose the `base` anchor, for labelling:




```
\begin{circuitikz} \draw
  (0,0) node[transformer] (T) {}
  (T.A1) node[anchor=east] {A1}
  (T.A2) node[anchor=east] {A2}
  (T.B1) node[anchor=west] {B1}
  (T.B2) node[anchor=west] {B2}
  (T.base) node{K}
;\end{circuitikz}
```



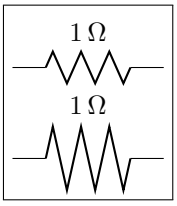

```
\begin{circuitikz} \draw
  (0,0) node[gyrator] (G) {}
  (G.A1) node[anchor=east] {A1}
  (G.A2) node[anchor=east] {A2}
  (G.B1) node[anchor=west] {B1}
  (G.B2) node[anchor=west] {B2}
  (G.base) node{K}
;\end{circuitikz}
```

6 Customization

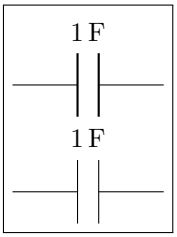
6.1 Parameters

Pretty much all CircuiTi*k*Z relies heavily on `pgfkeys` for value handling and configuration. Indeed, at the beginning of `circuitikz.sty` a series of key definitions can be found that modify all the graphical characteristics of the package.

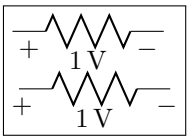
All can be varied using the `\ctikzset` command, anywhere in the code:



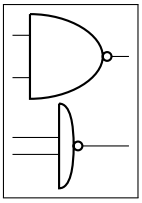

```
\tikz \draw (0,0) to[R=1<\ohm>] (2,0); \par
\ctikzset{bipoles/ resistor /height=.6}
\tikz \draw (0,0) to[R=1<\ohm>] (2,0);
```



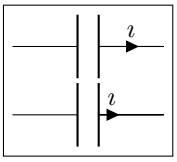

```
\tikz \draw (0,0) to[C=1<\farad>] (2,0); \par
\ctikzset{bipoles/thickness=1}
\tikz \draw (0,0) to[C=1<\farad>] (2,0);
```




```
\tikz \draw (0,0) to[R, v=1<\volt>] (2,0); \par
\ctikzset{voltage/distance from node=.1}
\tikz \draw (0,0) to[R, v=1<\volt>] (2,0);
```

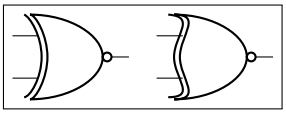


```
\tikz \draw (0,0) node[nand port] {}; \par
\ctikzset{ tripoles /nand port/input height=.2}
\ctikzset{ tripoles /nand port/port width=.2}
\tikz \draw (0,0) node[nand port] {};
```




```
\tikz \draw (0,0) to[C, i=$\imath$] (2,0); \par
\ctikzset{current/distance = .2}
\tikz \draw (0,0) to[C, i=$\imath$] (2,0);
```

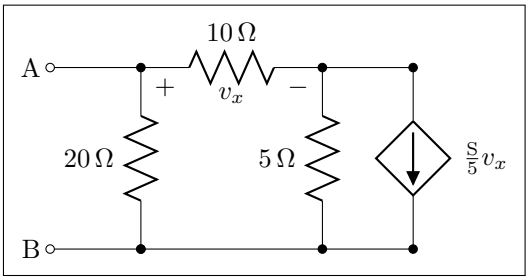
Admittedly, not all graphical properties have understandable names, but for the time it will have to do:



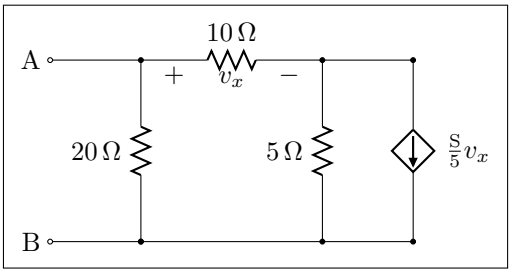
```
\tikz \draw (0,0) node[xnor port] {};
\ctikzset{ tripoles /xnor port/aaa=.2}
\ctikzset{ tripoles /xnor port/bbb=.6}
\tikz \draw (0,0) node[xnor port] {};
```

6.2 Components size

Perhaps the most important parameter is `\circuitikzbasekey/bipoles/length`, which can be interpreted as the length of a resistor (including reasonable connections): all other lenghts are relative to this value. For instance:




```
\ctikzset{bipoles/length=1.4cm}
\begin{circuitikz}[scale=1.2]\draw
  (0,0) node[anchor=east] {B}
        to[short, o-*] (1,0)
        to[R=20<\ohm>, *-*] (1,2)
        to[R=10<\ohm>, v=$v_x$] (3,2) -- (4,2)
        to[cI=$\frac{\siemens}{5} v_x$, *-*] (4,0) -- (3,0)
        to[R=5<\ohm>, *-*] (3,2)
  (3,0) -- (1,0)
  (1,2) to[short, -o] (0,2) node[anchor=east]{A}
;\end{circuitikz}
```

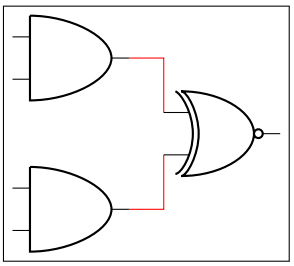



```
\ctikzset{bipoles/length=.8cm}
\begin{circuitikz}[scale=1.2]\draw
  (0,0) node[anchor=east] {B}
        to[short, o-*] (1,0)
        to[R=20<\ohm>, *-*] (1,2)
        to[R=10<\ohm>, v=$v_x$] (3,2) -- (4,2)
        to[cI=$\frac{\siemens}{5} v_x$, *-*] (4,0) -- (3,0)
        to[R=5<\ohm>, *-*] (3,2)
  (3,0) -- (1,0)
  (1,2) to[short, -o] (0,2) node[anchor=east]{A}
;\end{circuitikz}
```

6.3 Colors

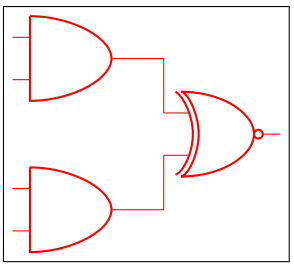
The color of the components is stores in the key `\circuitikzbasekey/color`. CircuiTi*k*Z tries to follow the color set in Ti*k*Z, although sometimes it fails. If you change color in the picture, please do not use just the color name as a style, like `[red]`, but rather assign the style `[color=red]`.

Compare for instance



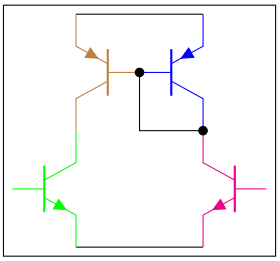
```
\begin{circuitikz} \draw[red]
  (0,2) node[and port] (myand1) {}
  (0,0) node[and port] (myand2) {}
  (2,1) node[xnor port] (myxnor) {}
  (myand1.out) -| (myxnor.in 1)
  (myand2.out) -| (myxnor.in 2)
;\end{circuitikz}
```

and



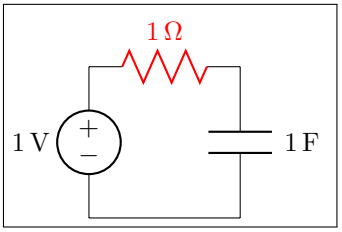
```
\begin{circuitikz} \draw[color=red]
  (0,2) node[and port] (myand1) {}
  (0,0) node[and port] (myand2) {}
  (2,1) node[xnor port] (myxnor) {}
  (myand1.out) -| (myxnor.in 1)
  (myand2.out) -| (myxnor.in 2)
;\end{circuitikz}
```

One can of course change the color *in medias res*:



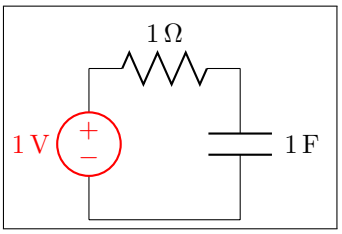
```
\begin{circuitikz} \draw
  (0,0) node[pnp, color=blue] (pnp2) {}
  (pnp2.B) node[pnp, xscale=-1, anchor=B, color=brown] (pnp1) {}
  (pnp1.C) node[npn, anchor=C, color=green] (npn1) {}
  (pnp2.C) node[npn, xscale=-1, anchor=C, color=magenta] (npn2) {}
  (pnp1.E) -- (pnp2.E) (npn1.E) -- (npn2.E)
  (pnp1.B) node[circ] {} |- (pnp2.C) node[circ] {}
;\end{circuitikz}
```

The all-in-one stream of bipoles poses some challanges, as only the actual body of the bipole, and not the connecting lines, will be rendered in the specified color. Also, please notice the curly braces around the `to`:



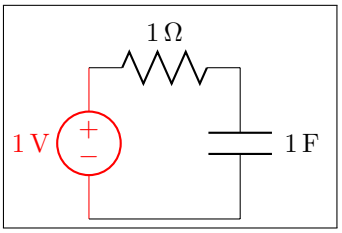

```
\begin{circuitikz} \draw
  (0,0) to[V=1<\volt>] (0,2)
        { to[R=1<\ohm>, color=red] (2,2) }
          to[C=1<\farad>] (2,0) -- (0,0)
;\end{circuitikz}
```

Which, for some bipoles, can be frustrating:




```
\begin{circuitikz} \draw
  (0,0){to[V=1<\volt>, color=red] (0,2) }
        to[R=1<\ohm>] (2,2)
        to[C=1<\farad>] (2,0) -- (0,0)
;\end{circuitikz}
```

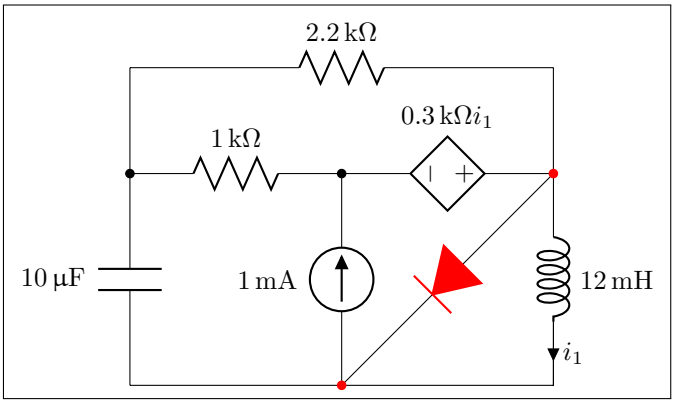
The only way out is to specify different paths:



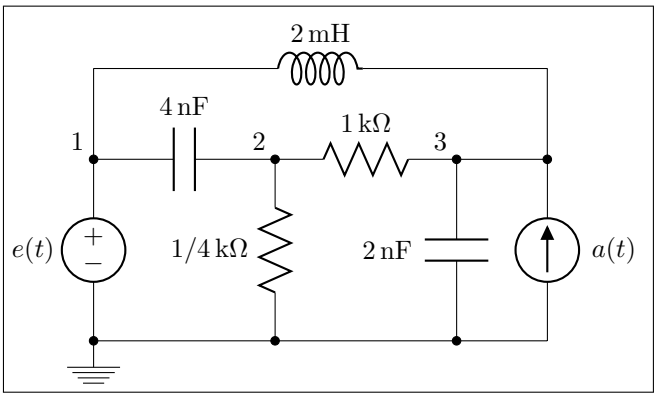

```
\begin{circuitikz} \draw[color=red]
  (0,0)  to[V=1<\volt>, color=red] (0,2);
  \draw (0,2) to[R=1<\ohm>] (2,2)
        to[C=1<\farad>] (2,0) -- (0,0)
;\end{circuitikz}
```

And yes: this is a bug and *not* a feature...

7 Examples

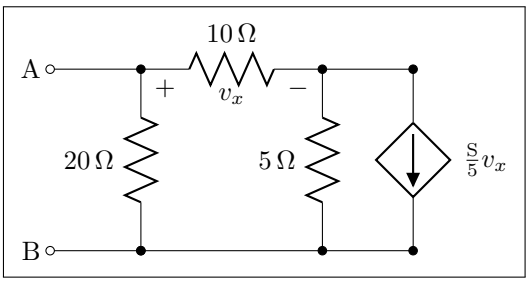



```
\begin{circuitikz}[scale=1.4]\draw
  (0,0)  to[C, l=10<\micro\farad>] (0,2) -- (0,3)
         to[R, l=2.2<\kilo\ohm>] (4,3) -- (4,2)
         to[L, l=12<\milli\henry>, i=$i_1$] (4,0) -- (0,0)
  (4,2)  { to[D*, *-*, color=red] (2,0) }
  (0,2)  to[R, l=1<\kilo\ohm>, *-] (2,2)
         to[cV, v=$\SI{.3}{\kilo\ohm} i_1$] (4,2)
  (2,0)  to[I,  i=1<\milli\ampere>, -*] (2,2)
;\end{circuitikz}
```

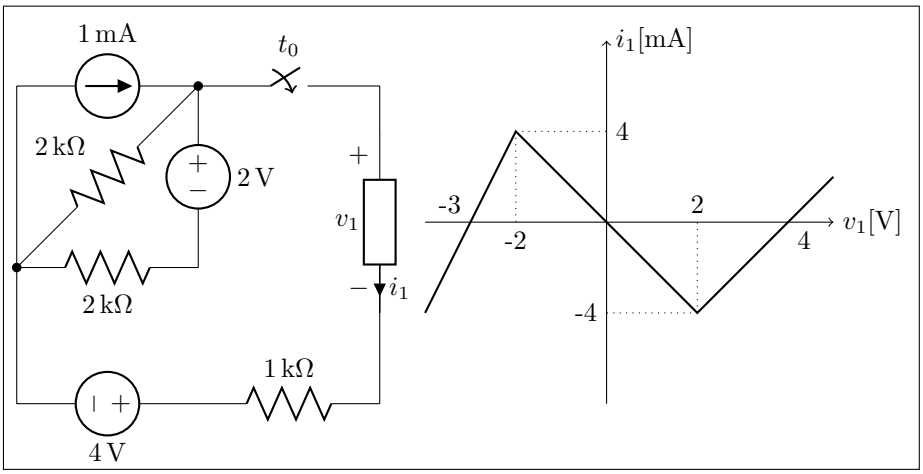



```
\begin{circuitikz}[scale=1.2]\draw
  (0,0) node[ground] {}
        to[V=$e(t)$, *-*] (0,2) to[C=4<\nano\farad>] (2,2)
        to[R, l_=1/4<\kilo\ohm>, *-*] (2,0)
  (2,2) to[R=1<\kilo\ohm>] (4,2)
        to[C, l_=2<\nano\farad>, *-*] (4,0)
  (5,0) to[I, i_=$a(t)$, -*] (5,2) -- (4,2)
  (0,0) -- (5,0)
  (0,2) -- (0,3) to[L, l=2<\milli\henry>] (5,3) -- (5,2)

 {[anchor=south east] (0,2) node {1} (2,2) node {2} (4,2) node {3}}
;\end{circuitikz}
```




```
\begin{circuitikz}[scale=1.2]\draw
  (0,0) node[anchor=east] {B}
        to[short, o-*] (1,0)
        to[R=20<\ohm>, *-*] (1,2)
        to[R=10<\ohm>, v=$v_x$] (3,2) -- (4,2)
        to[cI=$\frac{\siemens}{5} v_x$, *-*] (4,0) -- (3,0)
        to[R=5<\ohm>, *-*] (3,2)
  (3,0) -- (1,0)
  (1,2) to[short, -o] (0,2) node[anchor=east]{A}
;\end{circuitikz}
```




```
\begin{circuitikz}[scale=1.2, american]\draw
  (0,2) to[I=1<\milli\ampere>] (2,2)
        to[R, l_=2<\kilo\ohm>, *-*] (0,0)
        to[R, l_=2<\kilo\ohm>] (2,0)
        to[V, v_=2<\volt>] (2,2)
        to[cspst, l=$t_0$] (4,2) -- (4,1.5)
        to [generic, i=$i_1$, v=$v_1$] (4,-.5) -- (4,-1.5)
  (0,2) -- (0,-1.5) to[V, v_=4<\volt>] (2,-1.5)
        to [R, l=1<\kilo\ohm>] (4,-1.5);

  \begin{scope}[xshift=6.5cm, yshift=.5cm]
   \draw [->] (-2,0) -- (2.5,0) node[anchor=west] {$v_1 [\volt]$};
   \draw [->] (0,-2) -- (0,2) node[anchor=west] {$i_1 [\SI{}{\milli\ampere}]$} ;
   \draw (-1,0) node[anchor=north] {-2} (1,0) node[anchor=south] {2}
         (0,1) node[anchor=west] {4} (0,-1) node[anchor=east] {-4}
         (2,0) node[anchor=north west] {4}
         (-1.5,0) node[anchor=south east] {-3};
   \draw [thick] (-2,-1) -- (-1,1) -- (1,-1) -- (2,0) -- (2.5,.5);
   \draw [dotted] (-1,1) -- (-1,0) (1,-1) -- (1,0)
         (-1,1) -- (0,1) (1,-1) -- (0,-1);
  \end{scope}
\end{circuitikz}
```

8 Revision history

version 0.2.2 (20090520).

1. Added the shape for lamps.
2. Added options `europeanresistor`, `europeaninductor`, `americanresistor` and `americaninductor`, with corresponding styles.
3. **Fixed**: error in transistor arrow positioning and direction under negative `xscale` and `yscale`.

version 0.2.1 (20090503).

1. Op-amps added.
2. Added options `arrowmos` and `noarrowmos`.

version 0.2 First public release on CTAN (20090417).

1. **Backward incompatibility**: labels ending with `:`*angle* are not parsed for positioning anymore.
2. Full use of Ti*k*Z keyval features.
3. White background is not filled anymore: now the network can be drawn on a background picture as well.
4. Several new components added (logical ports, transistors, double bipoles, ...).
5. Color support.
6. Integration with `siunitx`.
7. Voltage, american style.
8. Better code, perhaps. General cleanup at the very least.

version 0.1 First public release (2007).