

pst-circ

A PSTricks package for drawing electric circuits

ver. 1.41

Christophe Jorssen*and Herbert Voß†

October 15, 2007

Abstract

‘pst-circ’ is a PSTricks package to draw easily electric circuits. Most dipoles, tripoles and quadrupoles used in classical electrotechnical circuits are provided as graphical units which can readily be interconnectedd to produce circuit diagrams of a reasonable level of complexity.

Contents	
1 Introduction	2
2 Usage	2
2.1 Parameters	2
3 Macros	3
3.1 Dipole macros	3
3.2 Tripole macros	5
3.3 Quadrupole macros	6
3.4 Multidipole	7
3.5 Wire	7
3.6 Potential	7
3.7 ground	8
4 Parameters	8
4.1 Label parameters	8
4.2 Current intensity and electrical potential parameters	9
4.3 Parallel parameters	11
4.4 Wire intersections	12
4.5 Dipole style parameters	13
4.6 Tripole style parameters	15
4.7 Potentiometer tripole	16
4.8 Other Parameters	16
5 Special objects	18
5.1 \dashpot	18
6 Examples	19
7 Flip Flops – logical elements	27
7.1 The Options	27
7.2 Basic Logical Circuits	27
7.2.1 And	28
7.2.2 NotAnd	28
7.2.3 Or	29
7.2.4 Not Or	30
7.2.5 Not	30
7.2.6 Exclusive OR	31
7.2.7 Exclusive NOR	32
7.3 RS Flip Flop	32
7.4 D Flip Flop	33
7.5 JK Flip Flop	33
7.6 Other Options	34
7.7 The Node Names	34
7.8 Examples	35
8 Adding new components	36
9 Acknowledgements	38

*[<christophe.jorssen@noos.fr>](mailto:christophe.jorssen@noos.fr)

†[<voss@PSTricks.de>](mailto:voss@PSTricks.de)

1 Introduction

The package 'pst-circ' is a collection of graphical elements based on PSTricks that can be used to facilitate display of electronic circuit elements. For example, an equivalent circuit of a voltage source, its source impedance, and a connected load can easily be constructed along with arrows indicating current flow and potential differences. The emphasis is upon the circuit elements and the details of the exact placement are hidden as much as possible so the author can focus on the circuitry without the distraction of sorting out the underlying vector graphics.

2 Usage

2.1 Parameters

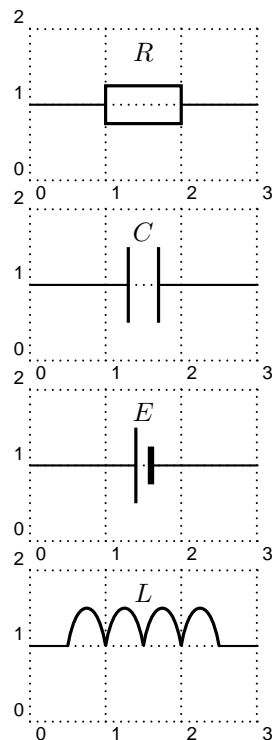
There are specific parameters defined to change easily the behaviour of the pst-circ objects you are drawing.

intensity (boolean): (default: false)
intensitylabel (string): (default:)
intensitylabeloffset (dimension): (default: 0.5)
intensitycolor (PSTricks color): (default: black)
intensitylabelcolor (PSTricks color): (default: black)
intensitywidth (dimension): (default: \pslinewidth)
tension (boolean): (default: false)
tensionlabel (string): (default:)
tensionoffset (dimension): (default: 1)
tensionlabeloffset (dimension): (default: 1.2)
tensioncolor (PSTricks color): (default: black)
tensionlabelcolor (PSTricks color): (default: black)
tensionwidth (dimension): (default: \pslinewidth)
labeloffset (dimension): (default: 0.7)
labelangle (PSTricks label angle): (default: 0)
labelInside (integer): (default: 0)
dipoleconvention (default: receptor)
directconvention (boolean): (default: true)
dipolestyle (string): (default: normal)
variable (boolean): (default: false)
parallel (boolean): (default: false)
parallelarm (dimension): (default: 1.5)
parallelep (real): (default: 0)
parallelnode (boolean): (default: false)
intersect (boolean): (default: false)
intersectA (node):
intersectB (node):
OAinvert (boolean): (default: true)
OApertect (boolean): (default: true)
OAIplus (boolean): (default: false)
OAIMinus (boolean): (default: false)
OAIout (boolean): (default: false)
OAIpluslabel (string): (default:)

OAminuslabel (string): (default:)
OAioutlabel (string): (default:)
transistorcircle (boolean): (default: true)
transistorinvert (boolean): (default: false)
transistoribase (boolean): (default: false)
transistoricollector (boolean): (default: false)
transistoriemitter (boolean): (default: false)
transistoribaselabel (string): (default:)
transistoricollectorlabel (string): (default:)
transistoriemitterlabel (string): (default:)
TRot (angle): (default: 0)
edge (macro): (default: \ncangles)
transistortype (string): (default: PNP)
FETchanneltype (string): (default: N)
primarylabel (string): (default:)
secondarylabel (string): (default:)
transformerprimary (boolean): (default: false)
transformersecondary (boolean): (default: false)
transformerprimarylabel (string): (default:)
transformersecondarylabel (string): (default:)
tripolestyle (string): (default: normal)

3 Macros

3.1 Dipole macros



```

\begin{pspicture}(3,2)\psgrid
\pnode(0,1){A}
\pnode(3,1){B}
\resistor(A)(B){$R$}
\end{pspicture}

```

```

\begin{pspicture}(3,2)\psgrid
\pnode(0,1){A}
\pnode(3,1){B}
\capacitor(A)(B){$C$}
\end{pspicture}

```

```

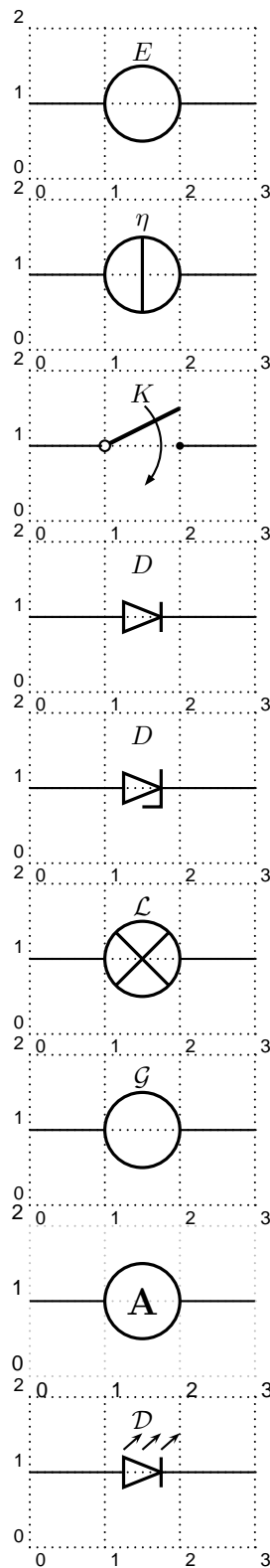
\begin{pspicture}(3,2)\psgrid
\pnode(0,1){A}
\pnode(3,1){B}
\battery(A)(B){$E$}
\end{pspicture}

```

```

\begin{pspicture}(3,2)\psgrid
\pnode(0,1){A}
\pnode(3,1){B}
\coil(A)(B){$L$}
\end{pspicture}

```



```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1){A}
\pnode(3,1){B}
\Ucc(A)(B){$E$}
\end{pspicture}
```

```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1){A}
\pnode(3,1){B}
\Icc(A)(B){$\eta$}
\end{pspicture}
```

```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1){A}
\pnode(3,1){B}
\switch(A)(B){$K$}
\end{pspicture}
```

```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1){A}
\pnode(3,1){B}
\diode(A)(B){$D$}
\end{pspicture}
```

```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1){A}
\pnode(3,1){B}
\Zener(A)(B){$D$}
\end{pspicture}
```

```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1){A}
\pnode(3,1){B}
\lamp(A)(B){$\mathcal{L}$}
\end{pspicture}
```

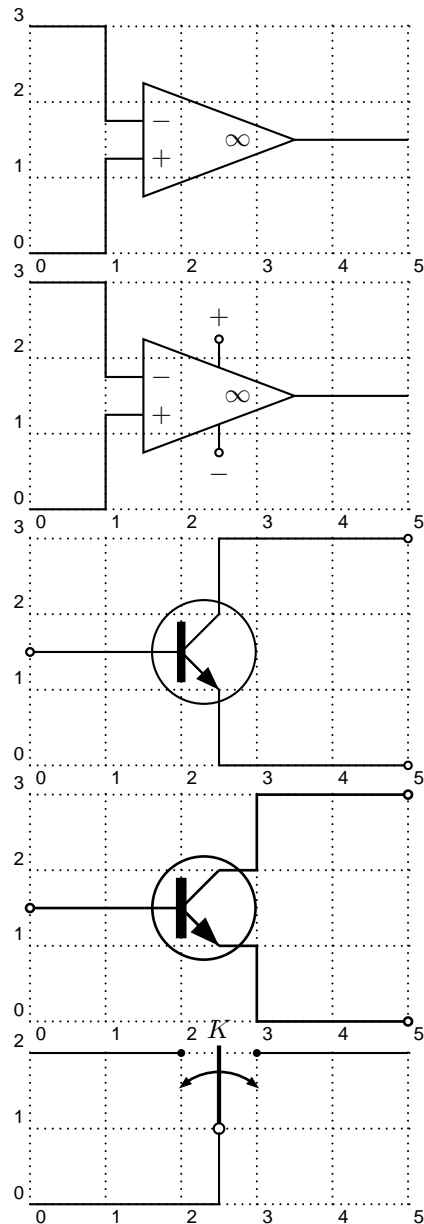
```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1){A}
\pnode(3,1){B}
\circledipole(A)(B){$\mathcal{G}$}
\end{pspicture}
```

```
\begin{pspicture}[showgrid=true](3,2)
\pnode(0,1){A}
\pnode(3,1){B}
\circledipole[labeloffset=0](A)(B){\Large\textbf{A}}
\end{pspicture}
```

```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1){A}
\pnode(3,1){B}
\LED(A)(B){$\mathcal{D}$}
\end{pspicture}
```

3.2 Tripole macros

Obviously, tripoles are not node connections. So 'pst-circ' tries its best to adjust the position of the tripole regarding the three nodes. Internally, the connections are done by the `\ncangle` pst-node macro. However, the auto-positionning and the auto-connections are not always well chosen¹, so don't try to use tripole macros in strange situations!



```
\begin{pspicture}(5,3)\psgrid
\pnode(0,0){A}
\pnode(0,3){B}
\pnode(5,1.5){C}
\OA(B)(A)(C)
\end{pspicture}
```

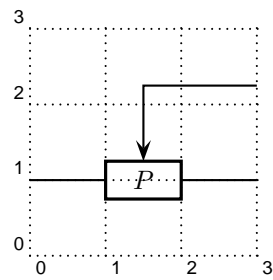
```
\begin{pspicture}(5,3)\psgrid
\pnode(0,0){A}
\pnode(0,3){B}
\pnode(5,1.5){C}
\OA[OApower=true](B)(A)(C)
\end{pspicture}
```

```
\begin{pspicture}(5,3)\psgrid
\pnode(0,1.5){A}
\pnode(5,0){B}
\pnode(5,3){C}
\transistor[basesep=2cm,arrows=o-o](A)(B)(C)
\end{pspicture}
```

```
\begin{pspicture}(5,3)\psgrid
\pnode(0,1.5){A}\psset{linewidth=1pt}
\transistor[basesep=2cm,arrows=o-o](A){Emitter}{
Collector}
\psline{o-}(5,3)(3,3)(3,3|Collector)(Collector)
\psline{o-}(5,0)(3,0)(3,3|Emitter)(Emitter)
\psline{o-}(A)([nodesep=2]A)
\end{pspicture}
```

```
\begin{pspicture}(5,2)\psgrid
\pnode(0,2){A}
\pnode(5,2){B}
\pnode(0,0){C}
\Tswitch(A)(B)(C){$K$}
\end{pspicture}
```

¹This is something we are working on. I think that auto-positionning and auto-connections should be done at PostScript level and not at PSTricks level. If someone has any ideas, please mail us.

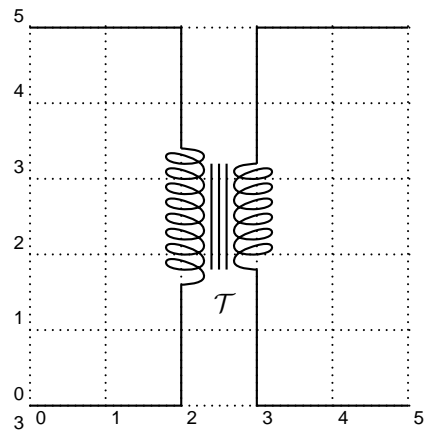


```

\begin{pspicture}(3,3)\psgrid
\pnode(0,1){A}
\pnode(3,1){B}
\pnode(3,2.25){C}
\potentiometer[labeloffset=0pt](A)(B)(C){P}
\end{pspicture}

```

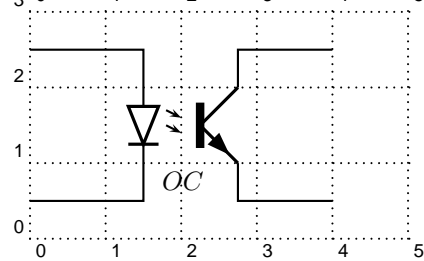
3.3 Quadrupole macros



```

\begin{pspicture}(5,5)\psgrid
\pnode(0,5){A}
\pnode(0,0){B}
\pnode(5,5){C}
\pnode(5,0){D}
\transformer(A)(B)(C)(D){\mathcal T}
\end{pspicture}

```



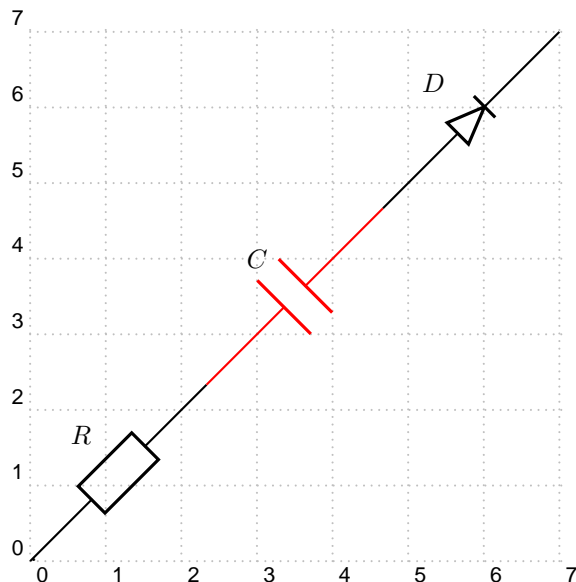
```

\begin{pspicture}(5,3)\psgrid
\pnode(0,2.5){A}
\pnode(0,0.5){B}
\pnode(4,2.5){C}
\pnode(4,0.5){D}
\optocoupler(A)(B)(C)(D){OC}
\end{pspicture}

```

3.4 Multidipole

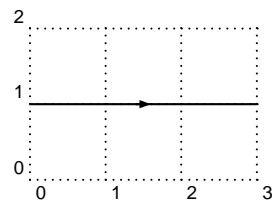
`\multidipole` is a macro that allows multiple dipoles to be drawn between two specified nodes. `\multidipole` takes as many arguments as you want. **Note the dot that is after the last dipole.**



```
\begin{pspicture}[showgrid=true](7,7)
  \pnode(0,0){A}
  \pnode(7,7){B}
  \multidipole(A)(B)\resistor{$R$}%
    \capacitor[linecolor=red]{$C$}%
    \diode{$D$}{.}
\end{pspicture}
```

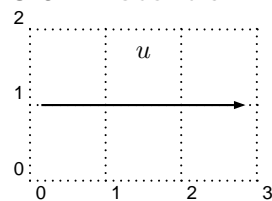
Important: for the time being, `\multidipole` takes optional arguments but does not restore original values. We recommend not using it.

3.5 Wire



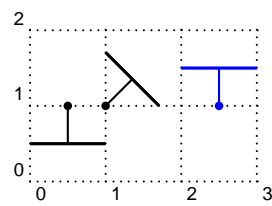
```
\begin{pspicture}(3,2)\psgrid
  \pnode(0,1){A}
  \pnode(3,1){B}
  \wire(A)(B)
\end{pspicture}
```

3.6 Potential



```
\begin{pspicture}(3,2)\psgrid
  \pnode(0,1){A}
  \pnode(3,1){B}
  \tension(A)(B){$u$}
\end{pspicture}
```

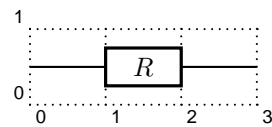
3.7 ground



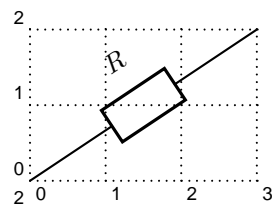
```
\begin{pspicture}(3,2)\psgrid
\pnode(0.5,1){A}
\pnode(1,1){B}
\pnode(2.5,1){C}
\ground(A)
\ground{135}(B)
\ground[linecolor=blue]{180}(C)
\end{pspicture}
```

4 Parameters

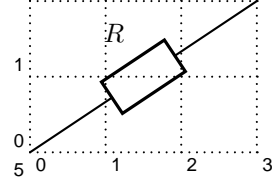
4.1 Label parameters



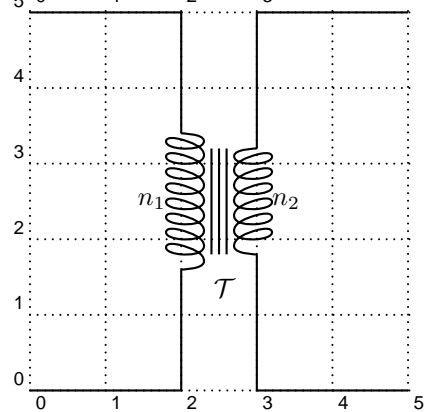
```
\begin{pspicture}(3,1)\psgrid
\pnode(0,.5){A}
\pnode(3,.5){B}
\resistor[labeloffset=0](A)(B){$R$}
\end{pspicture}
```



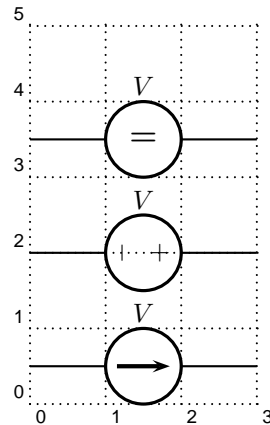
```
\begin{pspicture}(3,2)\psgrid
\pnode(0,0){A}
\pnode(3,2){B}
\resistor[labelangle=:U](A)(B){$R$}
\end{pspicture}
```



```
\begin{pspicture}(3,2)\psgrid
\pnode(0,0){A}
\pnode(3,2){B}
\resistor[labelangle=0](A)(B){$R$}
\end{pspicture}
```



```
\begin{pspicture}(5,5)\psgrid
\pnode(0,5){A}
\pnode(0,0){B}
\pnode(5,5){C}
\pnode(5,0){D}
\transformer[primarylabel=$n_1$,
secondarylabel=$n_2$](A)(B)(C)(D){$\mathcal{T}$}
\end{pspicture}
```

```

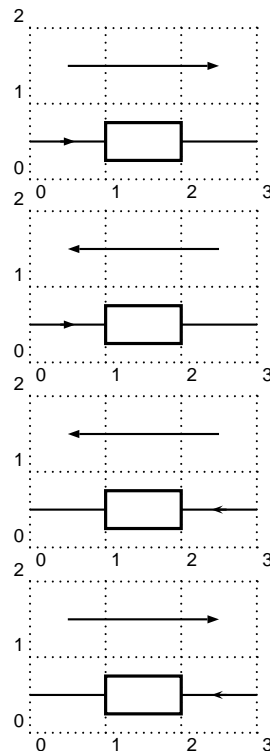
\begin{pspicture}(3,4.5)\psgrid
\pnode(0,.5){A}
\pnode(3,.5){B}
\Ucc[labelInside=1](A)(B){$V$}
\pnode(0,2){A}
\pnode(3,2){B}
\Ucc[labelInside=2](A)(B){$V$}
\pnode(0,3.5){A}
\pnode(3,3.5){B}
\Ucc[labelInside=3](A)(B){$V$}
\end{pspicture}

```

4.2 Current intensity and electrical potential parameters

If the **intensity** parameter is set to **true**, an arrow is drawn on the wire connecting one of the nodes to the dipole. If the **tension** parameter is set to **true**, an arrow is drawn parallel to the dipole.

The way those arrows are drawn is set by **dipoleconvention** and **directconvention** parameters. **dipoleconvention** can take two values : **generator** or **receptor**. **directconvention** is a boolean.



```

\begin{pspicture}(3,2)\psgrid
\pnode(0,.5){A}
\pnode(3,.5){B}
\resistor[intensity,tension](A)(B){}
\end{pspicture}

```

```

\begin{pspicture}(3,2)\psgrid
\pnode(0,.5){A}
\pnode(3,.5){B}
\resistor[intensity,tension,
dipoleconvention=generator](A)(B){}
\end{pspicture}

```

```

\begin{pspicture}(3,2)\psgrid
\pnode(0,.5){A}
\pnode(3,.5){B}
\resistor[intensity,tension,
directconvention=false](A)(B){}
\end{pspicture}

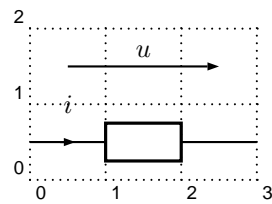
```

```

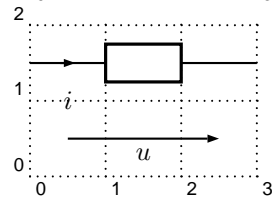
\begin{pspicture}(3,2)\psgrid
\pnode(0,.5){A}
\pnode(3,.5){B}
\resistor[intensity,tension,
dipoleconvention=generator,directconvention=false](A)(B){}
\end{pspicture}

```

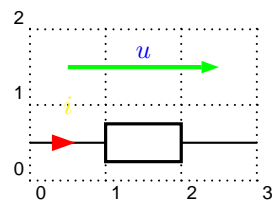
If **intensitylabel** is set to a non empty argument, then **intensity** is automatically set to **true**. If **tensionlabel** is set to a non empty argument, then **tension** is automatically set to **true**.



```
\begin{pspicture}(3,2)\psgrid
\pnode(0,.5){A}
\pnode(3,.5){B}
\resistor[intensitylabel=$i$,tensionlabel=$u$](A)(B){}
\end{pspicture}
```

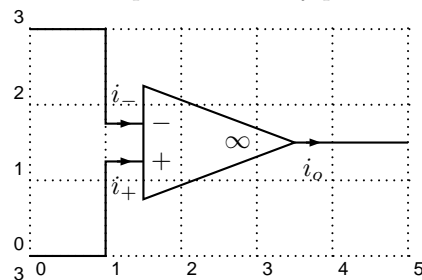


```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1.5){A}
\pnode(3,1.5){B}
\resistor[intensitylabel=$i$,intensitylabeloffset=-0.5,
tensionlabel=$u$,tensionlabeloffset=-1.2,
tensionoffset=-1](A)(B){}
\end{pspicture}
```

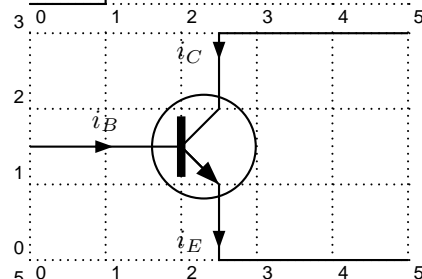


```
\begin{pspicture}(3,2)\psgrid
\pnode(0,.5){A}
\pnode(3,.5){B}
\resistor[intensitylabel=$i$,intensitywidth=3\pslinewidth,
intensitycolor=red,intensitylabelcolor=yellow,
tensionlabel=$u$,tensionwidth=2\pslinewidth,
tensioncolor=green,tensionlabelcolor=blue](A)(B){}
\end{pspicture}
```

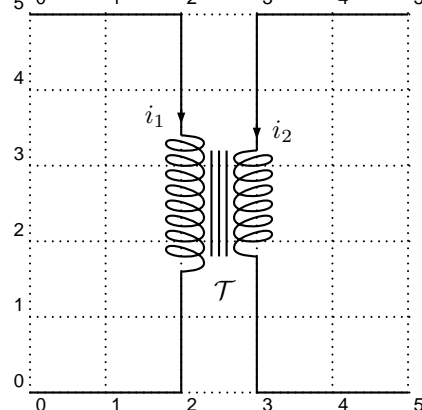
Some specific intensity parameters are available for tripoles and quadrupoles.



```
\begin{pspicture}(5,3)\psgrid
\pnode(0,0){A}
\pnode(0,3){B}
\pnode(5,1.5){C}
\OA[OAipluslabel=$i_+$,
OAiminuslabel=$i_-$,
OAioutlabel=$i_o$](B)(A)(C)
\end{pspicture}
```



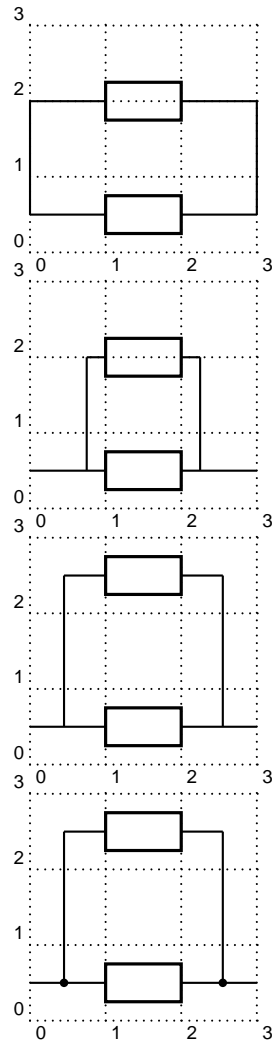
```
\begin{pspicture}(5,3)\psgrid
\pnode(0,1.5){A}
\pnode(5,0){B}
\pnode(5,3){C}
\transistor[basesep=2cm,transistoribaselabel=$i_B$,
transistoricollectorlabel=$i_C$,
transistoriemitterlabel=$i_E$](A)(B)(C)
\end{pspicture}
```



```
\begin{pspicture}(5,5)\psgrid
\pnode(0,5){A}
\pnode(0,0){B}
\pnode(5,5){C}
\pnode(5,0){D}
\transformer[transformerprimarylabel=$i_1$,
transformerisecsecondarylabel=$i_2$](A)(B)(C)(D){\mathcal T}
\end{pspicture}
```

4.3 Parallel parameters

If the `parallel` parameter is set to `true`, the dipole is drawn parallel to the line connecting the nodes.

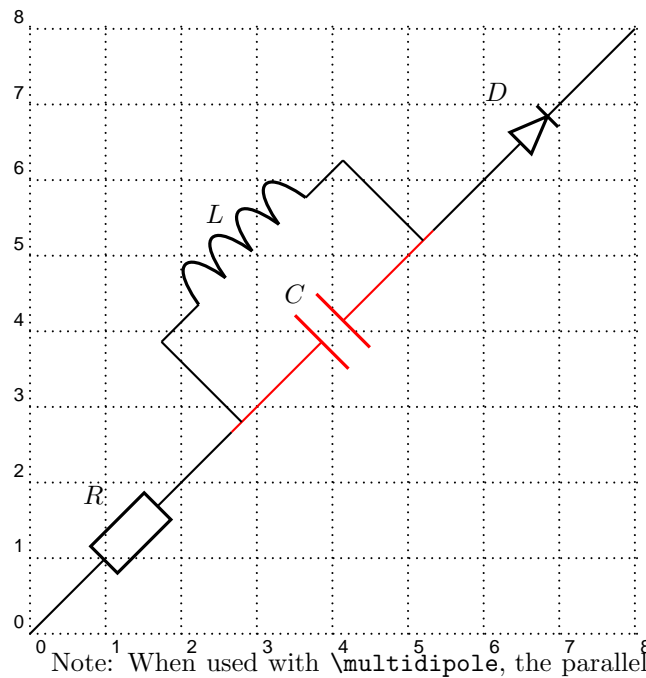


```
\begin{pspicture}(3,3)\psgrid
\pnode(0,.5){A}
\pnode(3,.5){B}
\resistor(A)(B){}
\resistor[parallel](A)(B){}
\end{pspicture}
```

```
\begin{pspicture}(3,3)\psgrid
\pnode(0,.5){A}
\pnode(3,.5){B}
\resistor(A)(B){}
\resistor[parallel,parallelsep=.5](A)(B){}
\end{pspicture}
```

```
\begin{pspicture}(3,3)\psgrid
\pnode(0,.5){A}
\pnode(3,.5){B}
\resistor(A)(B){}
\resistor[parallel,parallelsep=.3,
parallelarm=2](A)(B){}
\end{pspicture}
```

```
\begin{pspicture}(3,3)\psgrid
\pnode(0,.5){A}
\pnode(3,.5){B}
\resistor(A)(B){}
\resistor[parallel,parallelsep=.3,
parallelarm=2,parallelnode](A)(B){}
\end{pspicture}
```



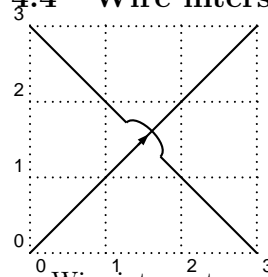
```

\begin{pspicture}(8,8)\psgrid
\pnode(0,0){A}
\pnode(8,8){B}
\multidipole(A)(B)\resistor{R}%
\capacitor[linecolor=red]{C}%
\coil[parallel,parallelsep=.1]{L}%
\diode{D}.
\end{pspicture}

```

Note: When used with `\multidipole`, the `parallel` parameter must not be set for the first dipole.

4.4 Wire intersections

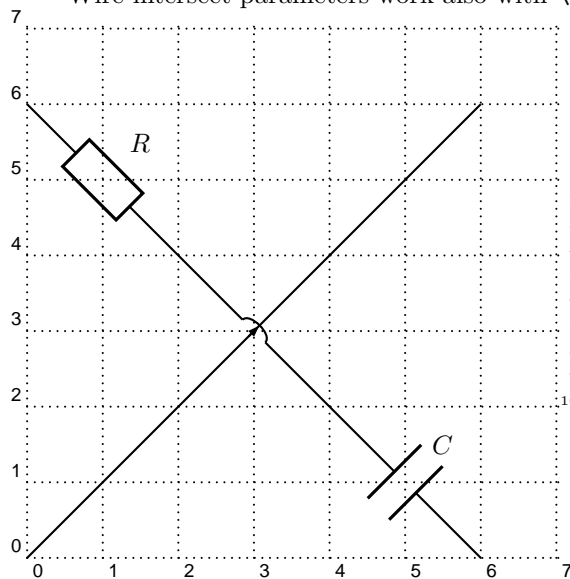


```

\begin{pspicture}(3,3)\psgrid
\pnode(0,0){A}
\pnode(3,3){B}
\pnode(0,3){C}
\pnode(3,0){D}
\wire(A)(B)
\wire[intersect,intersectA=A,intersectB=B](C)(D)
\end{pspicture}

```

Wire intersect parameters work also with `\multidipole`.

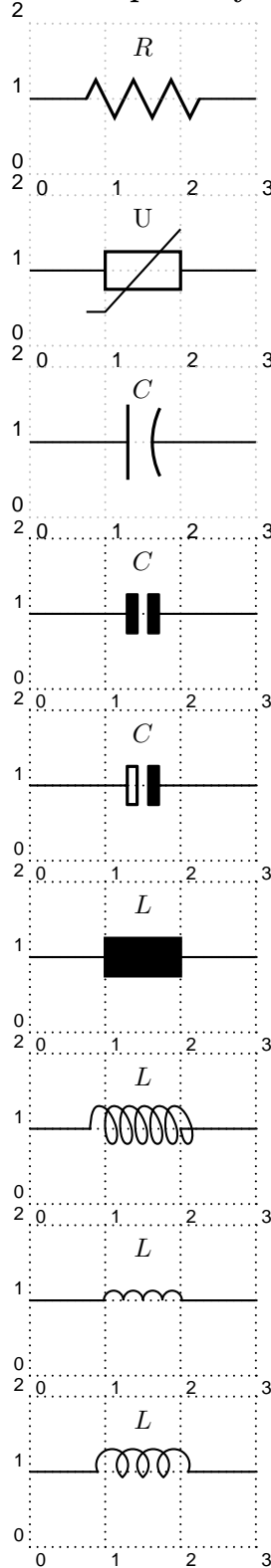


```

\begin{pspicture}(7,7)\psgrid
\pnode(0,0){A}
\pnode(6,6){B}
\pnode(0,6){C}
\pnode(6,0){D}
\wire(A)(B)
\multidipole(C)(D)\resistor{R}%
\wire[intersect,intersectA=A,intersectB=B]
\capacitor{C}.
\end{pspicture}

```

4.5 Dipole style parameters



```
\begin{pspicture}[showgrid=true](3,2)
  \pnode(0,1){A}
  \pnode(3,1){B}
  \resistor[dipolestyle=zigzag](A)(B){$R$}
\end{pspicture}
```

```
\begin{pspicture}[showgrid=true](3,2)
  \pnode(0,1){A}
  \pnode(3,1){B}
  \resistor[dipolestyle=varistor](A)(B){U}
\end{pspicture}
```

```
\begin{pspicture}[showgrid=true](3,2)
  \pnode(0,1){A}
  \pnode(3,1){B}
  \capacitor[dipolestyle=chemical](A)(B){$C$}
\end{pspicture}
```

```
\begin{pspicture}(3,2)\psgrid
  \pnode(0,1){A}
  \pnode(3,1){B}
  \capacitor[dipolestyle=elektor](A)(B){$C$}
\end{pspicture}
```

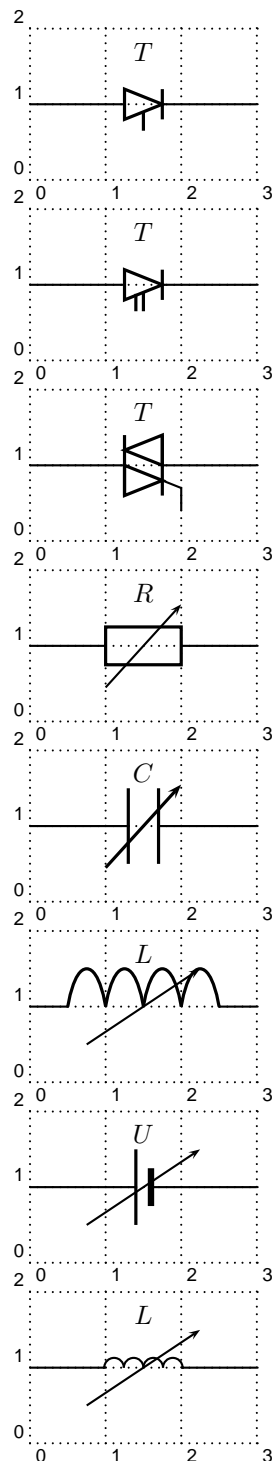
```
\begin{pspicture}(3,2)\psgrid
  \pnode(0,1){A}
  \pnode(3,1){B}
  \capacitor[dipolestyle=elektorchemical](A)(B){$C$}
\end{pspicture}
```

```
\begin{pspicture}(3,2)\psgrid
  \pnode(0,1){A}
  \pnode(3,1){B}
  \coil[dipolestyle=rectangle](A)(B){$L$}
\end{pspicture}
```

```
\begin{pspicture}(3,2)\psgrid
  \pnode(0,1){A}
  \pnode(3,1){B}
  \coil[dipolestyle=curved](A)(B){$L$}
\end{pspicture}
```

```
\begin{pspicture}(3,2)\psgrid
  \pnode(0,1){A}
  \pnode(3,1){B}
  \coil[dipolestyle=elektor](A)(B){$L$}
\end{pspicture}
```

```
\begin{pspicture}(3,2)\psgrid
  \pnode(0,1){A}
  \pnode(3,1){B}
  \coil[dipolestyle=elektorcurved](A)(B){$L$}
\end{pspicture}
```



```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1){A}
\pnode(3,1){B}
\diode[dipolestyle=thyristor](A)(B){$T$}
\end{pspicture}
```

```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1){A}
\pnode(3,1){B}
\diode[dipolestyle=GTO](A)(B){$T$}
\end{pspicture}
```

```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1){A}
\pnode(3,1){B}
\diode[dipolestyle=triac](A)(B){$T$}
\end{pspicture}
```

```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1){A}
\pnode(3,1){B}
\resistor[variable](A)(B){$R$}
\end{pspicture}
```

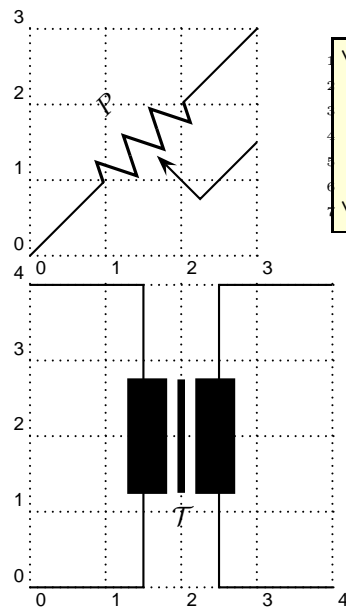
```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1){A}
\pnode(3,1){B}
\capacitor[variable](A)(B){$C$}
\end{pspicture}
```

```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1){A}
\pnode(3,1){B}
\coil[variable](A)(B){$L$}
\end{pspicture}
```

```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1){A}
\pnode(3,1){B}
\battery[variable](A)(B){$U$}
\end{pspicture}
```

```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1){A}
\pnode(3,1){B}
\coil[dipolestyle=elektor,variable](A)(B){$L$}
\end{pspicture}
```

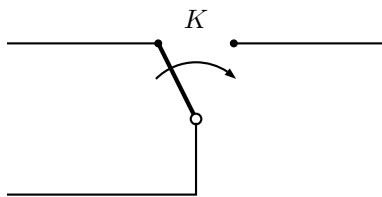
In the following example the parameter `dipolestyle` is used for a tripole and quadrupole, because the coils are drawn as rectangles and the resistor as a zigzag.



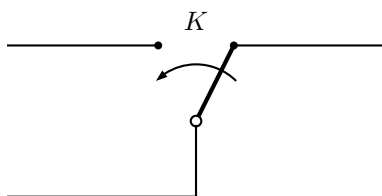
```
\begin{pspicture}(3,3)\psgrid
\pnode(0,0){A}
\pnode(3,3){B}
\pnode(3,1.5){C}
\potentiometer[dipolestyle=zigzag,%
labelangle=:U](A)(B)(C){$P$}
\end{pspicture}
```

```
\begin{pspicture}(4,4)\psgrid
\pnode(0,4){A}
\pnode(0,0){B}
\pnode(4,4){C}
\pnode(4,0){D}
\transformer[dipolestyle=rectangle](A)(B)(C)(D){$\mathcal{T}$}
\end{pspicture}
```

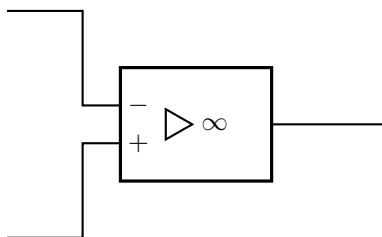
4.6 Tripole style parameters



```
\begin{pspicture}(5,3)
\pnode(0,2){A}
\pnode(5,2){B}
\pnode(0,0){C}
\Tswitch[tripolestyle=left](A)(B)(C){$K$}
\end{pspicture}
```

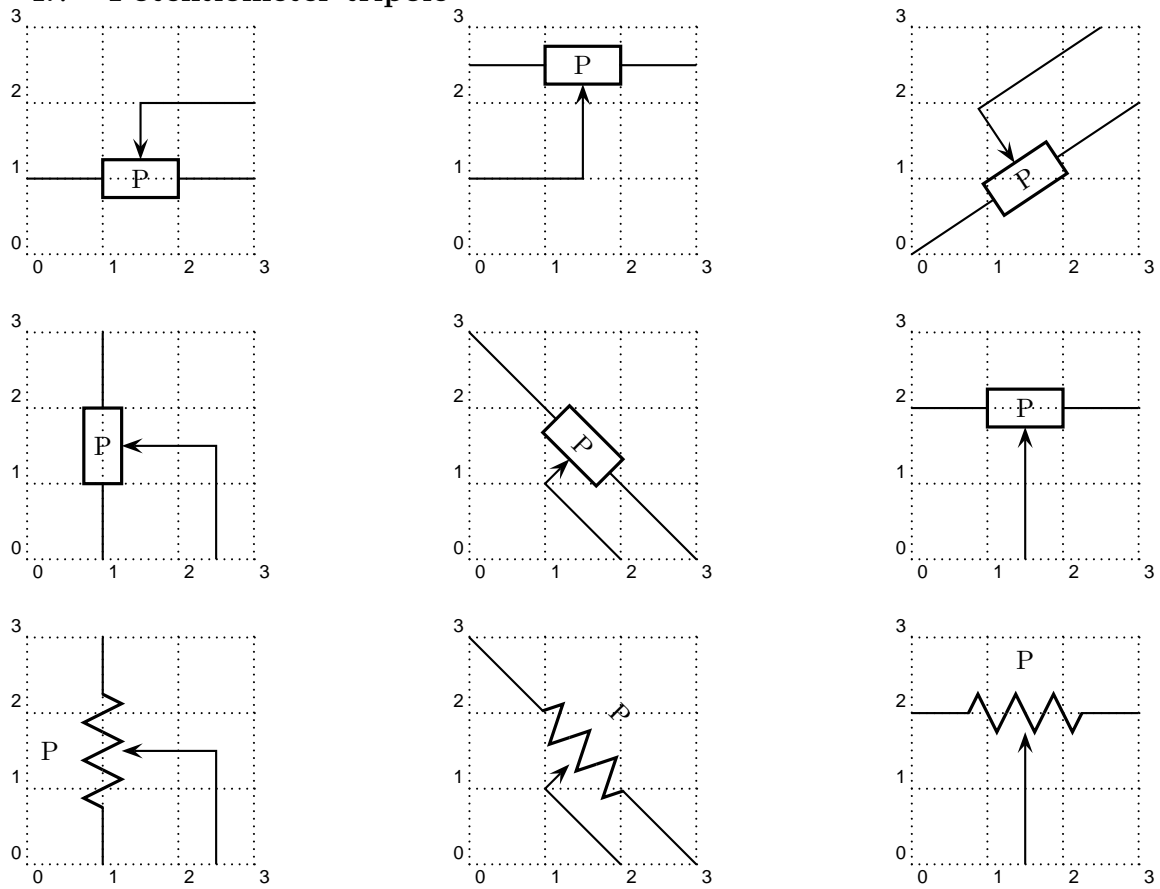


```
\begin{pspicture}(5,3)
\pnode(0,2){A}
\pnode(5,2){B}
\pnode(0,0){C}
\Tswitch[tripolestyle=right](A)(B)(C){$K$}
\end{pspicture}
```

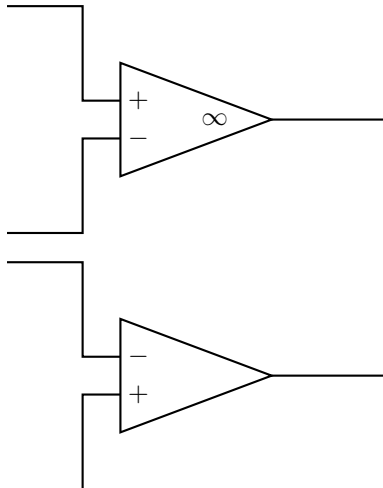


```
\begin{pspicture}(5,3)
\pnode(0,3){A}
\pnode(0,0){B}
\pnode(5,1.5){C}
\OA[tripolestyle=french](A)(B)(C)
\end{pspicture}
```

4.7 Potentiometer tripole

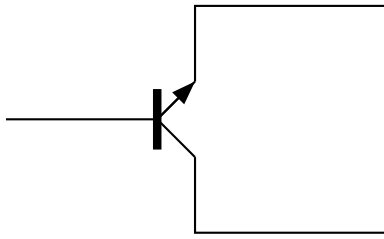


4.8 Other Parameters



```
\begin{pspicture}(5,3)
  \pnode(0,0){A}
  \pnode(0,3){B}
  \pnode(5,1.5){C}
  \OA[OAinvert=false](B)(A)(C)
\end{pspicture}
```

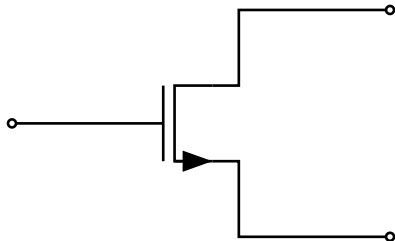
```
\begin{pspicture}(5,3)
  \pnode(0,0){A}
  \pnode(0,3){B}
  \pnode(5,1.5){C}
  \OA[OAperfect=false](B)(A)(C)
\end{pspicture}
```

```

\begin{pspicture}(5,3)
\pnode(0,1.5){A}
\pnode(5,0){B}
\pnode(5,3){C}
\transistor[basesep=2cm,%
transistorinvert,transistorcircle=false](A)(B)(C)
\end{pspicture}

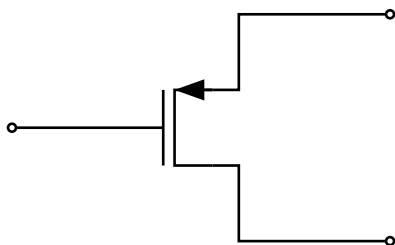
```



```

\begin{pspicture}(5,3)
\pnode(0,1.5){A}\psset{linewidth=1pt}
\transistor[basesep=2cm,arrows=o-o,
transistortype=FET](A){Emitter}{Collector}
\psline{o-}(5,3)(3,3)(3,3|Collector)(Collector)
\psline{o-}(5,0)(3,0)(3,3|Emitter)(Emitter)
\psline{o-}(A)([nodesep=2]A)
\end{pspicture}

```



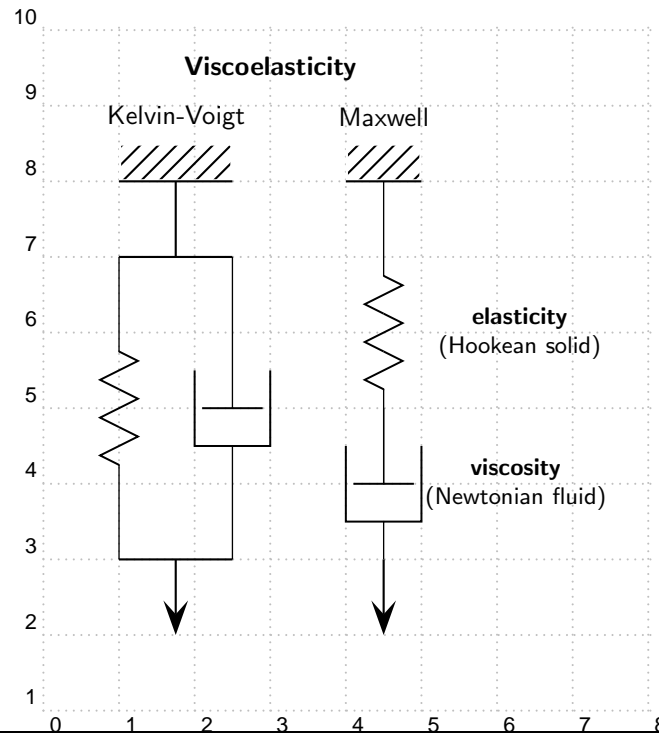
```

\begin{pspicture}(5,3)
\pnode(0,1.5){A}\psset{linewidth=1pt}
\transistor[basesep=2cm,arrows=o-o,
transistortype=FET,
FETchanneltype=P](A){Emitter}{Collector}
\psline{o-}(5,3)(3,3)(3,3|Collector)(Collector)
\psline{o-}(5,0)(3,0)(3,3|Emitter)(Emitter)
\psline{o-}(A)([nodesep=2]A)
\end{pspicture}

```

5 Special objects

5.1 \dashpot

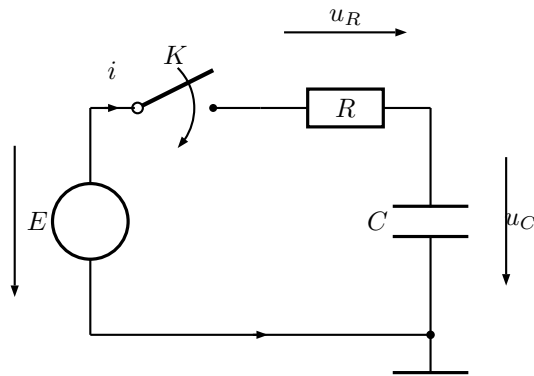


```

1 \newcommand*\pswall[3]{% ll ur lr
2   \psframe[linecolor=white,fillstyle=hlines,hatchcolor=black](#1)(#2)% (ll)(ur)
3   \psline[linecolor=black](#1)(#3)}
4 \begin{pspicture}[showgrid=true](0.5,1)(8,10)
5   \rput(3,9.5){\sffamily\textbf{Viscoelasticity}}
6   % Kelvin-Voigt model (spring and dashpot parallel): =====
7   \rput[c](1.75,8.85){\sffamily Kelvin-Voigt}
8   \pswall{1,8}{2.5,8.5}{2.5,8}% top
9   \psline(1.75,8)(1.75,7)% top vertical line
10  % node definitions:
11  \pnode(1,7){ul1}\pnode(2.5,7){ur1} \pnode(1,3){ll1}\pnode(2.5,3){lr1}%
12  \psline(ul1)(ur1)% top line
13  \psline(ll1)(lr1)% bottom line
14  \resistor[dipolestyle=zigzag,linewidth=0.5pt](ul1)(ll1){}% spring
15  \dashpot[linewidth=0.5pt](ur1)(lr1){}% dashpot
16  \psline[arrowscale=3]{->}(1.75,3)(1.75,2)% force
17  % Maxwell model (spring and dashpot serial): =====
18  \rput[c](4.5,8.85){\sffamily Maxwell}
19  \pswall{4,8}{5,8.5}{5,8}% top
20  \pnode(4.5,8){t}\pnode(4.5,4){b}% node definitions
21  \resistor[dipolestyle=zigzag,linewidth=0.5pt,labeloffset=1.8](t)(b)% spring
22  {\sffamily\small\begin{tabular}{c}\textbf{elasticity}\\(Hookean solid)\end{tabular}}% end
23  spring
24  \dashpot[linewidth=0.5pt,labeloffset=1.8](4.5,5)(4.5,3)% dashpot
25  {\sffamily\small\begin{tabular}{c}\textbf{viscosity}\\(Newtonian fluid)\end{tabular}}% end dashpot
26  \psline[arrowscale=3]{->}(4.5,3)(4.5,2)% force
27 \end{pspicture}

```

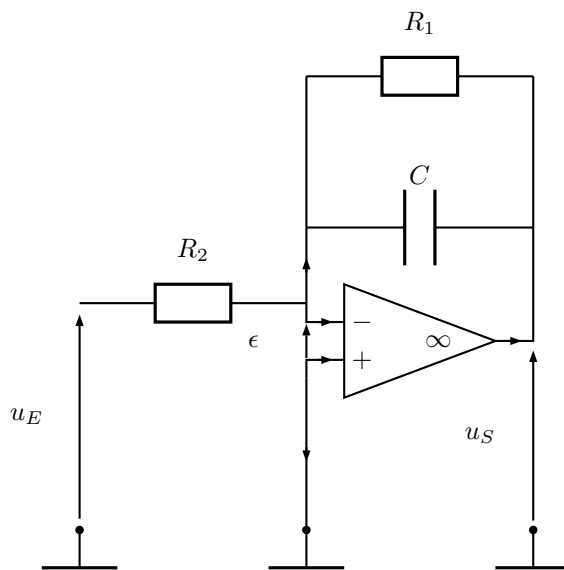
6 Examples



```

1 \begin{pspicture}(-1.5,-1)(6,5)
2 % \psgrid[subgriddiv=1,griddots=10]
3 % Node definitions
4 \nnode(0,0){A}
5 \nnode(0,3){B}
6 \nnode(4.5,3){C}
7 \nnode(4.5,0){D}
8 % Dipole node connection
9 \Ucc[tension,dipoleconvention=
10 generator](A)(B){E$}
11 \multidipole(B)(C)%
12 \switch[intensitylabel=i$]{K$}%
13 \resistor[labeloffset=0,
14 tensionlabel=$u_R$]{R$}.
15 \capacitor[tensionlabel={$u_C$},
16 tensionlabeloffset=-1.2,
17 tensionoffset=-1,
18 directconvention=false](D)(C){C$}
19 % Wire to complete circuit
20 \wire(A)(D)
21 % Ground
22 \ground(D)
23 \end{pspicture}

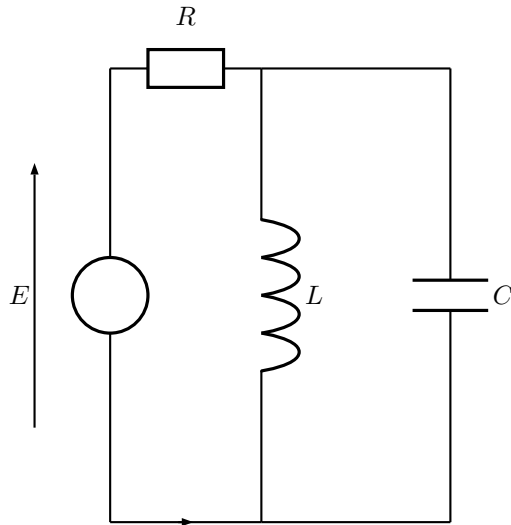
```



```

1 \begin{pspicture}(-0.5,0)(7,8)
2 % \psgrid[subgriddiv=1,griddots=10]
3 % Node definitions
4 \nnode(0.5,1){A}
5 \nnode(3.5,1){B}
6 \nnode(6.5,1){C}
7 \nnode(0.5,4){D}
8 \nnode(3.5,4){Minus}
9 \nnode(3.5,3){Plus}
10 \nnode(6.5,5){S}
11 \nnode(3.5,5){E}
12 % Dipole node connections
13 \resistor(D)(Minus){R_2$}
14 \capacitor(E)(S){C$}
15 \resistor[parallel,parallelarm=2](E)(C){R_1$}
16 \OA[intensity](Minus)(Plus)(S)
17 % Wires
18 \wire(Minus)(E)
19 \wire(Plus)(B)
20 % Tensions
21 \tension(A)(D){u_E$}
22 \makeatletter % (special tricks see
23 below)
24 \tension(C)(S@){u_S$}
25 \tension[linecolor=blue](Plus@)(
26 Minus@){$\epsilon$}
27 \makeatother
28 % Grounds
29 \ground(A)
30 \ground(B)
31 \ground(C)
32 \end{pspicture}

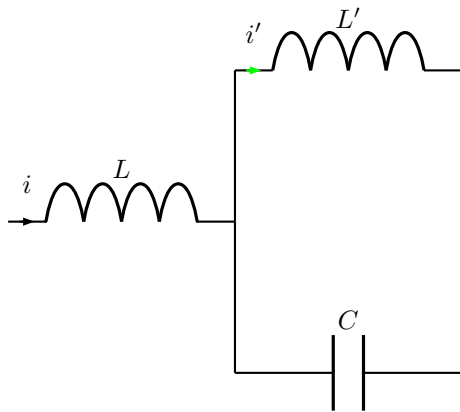
```



```

1 \begin{pspicture}(-1,0)(7,8)
2 % \psgrid[subgriddiv=1,griddots=10]
3 % Node definitions
4 \pnode(1,1){A}
5 \pnode(1,7){B}
6 \pnode(3,1){C}
7 \pnode(3,7){D}
8 % Dipole node connections
9 \Ucc[tensionlabel=$E$](A)(B){}
10 \resistor(B)(D){$R$}
11 \coil(D)(C){$L$}
12 \capacitor[parallel,parallelarm
13 =2.5](D)(C){$C$}
14 % Wire
15 \wire(A)(C)
16 \end{pspicture}

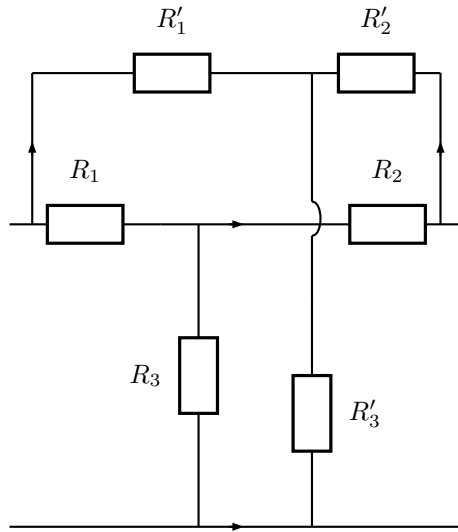
```



```

1 \begin{pspicture}(-0.25,-0.25)
2 (6,6)
3 % \psgrid[subgriddiv=1,griddots=10]
4 % Node definitions
5 \pnode(0,3){A}
6 \pnode(3,3){B}
7 \pnode(6,3){C}
8 % Dipole node connections
9 \coil[intensitylabel=$i$](A)(B){$
10 L$}
11 \coil[intensitylabel=$i'$,
12 intensitycolor=green,%
13 parallel,parallelarm=2](B)(C){$L'$}
14 \capacitor[parallel,parallelarm
15 =-2](B)(C){$C$}
16 \end{pspicture}

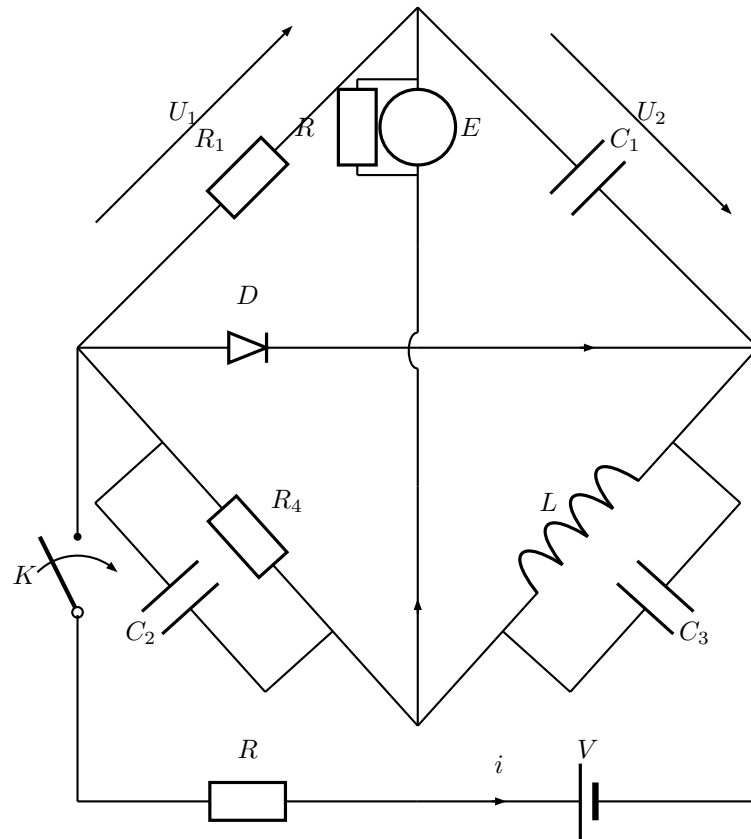
```



```

1 \begin{pspicture}(6,6)
2 % \psgrid[subgriddiv=1,griddots=10]
3 % Node definitions
4 \nnode(0,0){A}\nnode(6,0){B}
5 \nnode(0.3,4){Cprime}\nnode
6   (5.7,4){Dprime}
7 \nnode(2.5,4){Gprime}\nnode
8   (2.5,0){Hprime}
9 \nnode(0,4){C}\nnode(6,4){D}
10 \nnode(0.3,6){E}\nnode(5.7,6){F}
11 \nnode(4,6){G}\nnode(4,0){H}
12 \multidipole(G)(H)%
13   \wire[intersect,
14     intersectA=C,intersectB=D]
15   \resistor{$R'_3$}.
16 \resistor(E)(G){$R'_1$}
17 \resistor(G)(F){$R'_2$}
18 \multidipole(C)(D)\resistor{$R_1$}
19 \wire\resistor{$R_2$}.
20 \wire(A)(B)\wire(Cprime)(E)
21 \wire(Dprime)(F)
22 \resistor(Hprime)(Gprime){$R_3$}
23 \end{pspicture}

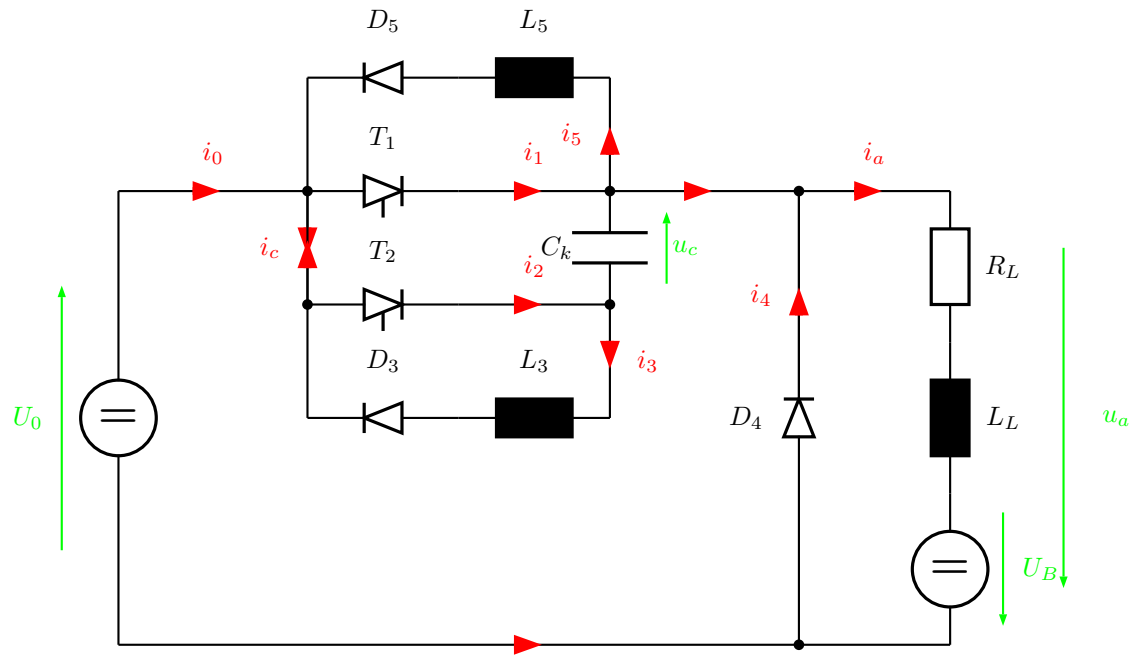
```



```

1 \begin{pspicture}(0,-0.25)(9,11)
2 % Node definitions
3 \pnode(0,0){A}\pnode(9,0){B}\pnode(0,6){C}\pnode(9,6){D}\pnode(4.5,1){E}\pnode(4.5,10.5){F}
4 %
5 \switch(A)(C){$K$}
6 \multidipole(A)(B)\resistor{$R$}\battery[intensitylabel=$i$]{$V$}.
7 \wire(B)(D)
8 \multidipole(C)(D)\diode{$D$}\wire.
9 \resistor[tensionlabel=$U_1$](C)(F){$R_1$} \resistor(C)(E){$R_4$}
10 \capacitor[parallel,parallelarm=1.2,parallelspace=1.5](C)(E){$C_2$}
11 \coil(E)(D){$L$}
12 \capacitor[parallel,parallelarm=1.2,parallelspace=1.5](E)(D){$C_3$}
13 \capacitor[tensionlabel=$U_2$](F)(D){$C_1$}
14 \multidipole(E)(F)\wire\wire[intersect,intersectA=C,intersectB=D]
15 \circledipole[labeloffset=-0.7]{$E$}
16 \resistor[parallel,parallelspace=.6,parallelarm=.8]{$R$}.
17 \end{pspicture}

```

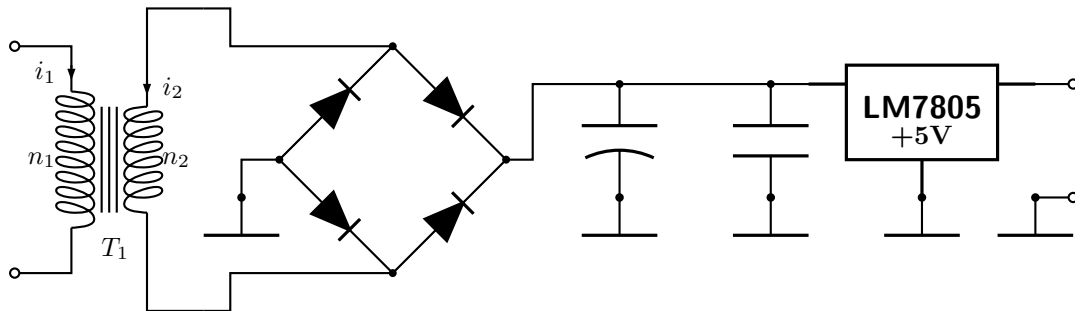


```

1 \begin{pspicture}(0,-0.2)(13,8)
2   \psset{intensitycolor=red,intensitylabelcolor=red,tensioncolor=green,
3     tensionlabelcolor=green, intensitywidth=3pt}
4   \circledipole[tension,tensionlabel=$U_0$,
5     tensionoffset=0.75,labeloffset=0](0,0)(0,6){\LARGE\textbf{=}}
6   \wire[intensity,intensitylabel=$i_0$](0,6)(2.5,6)
7   \diode[dipolestyle=thyristor](2.5,6)(4.5,6){$T_1$}
8   \wire[intensity,intensitylabel=$i_1$](4.5,6)(6.5,6)
9   \multidipole(6.5,7.5)(2.5,7.5)%
10    \coil[dipolestyle=rectangle,labeloffset=-0.75]{$L_5$}%
11    \diode[labeloffset=-0.75]{$D_5$}.
12   \wire[intensity,intensitylabel=$i_5$](6.5,6)(6.5,7.5)
13   \wire(2.5,7.5)(2.5,3)
14   \wire[intensity,intensitylabel=$i_c$](2.5,4.5)(2.5,6)
15   \qdisk(2.5,6){2pt}\qdisk(6.5,6){2pt}
16   \diode[dipolestyle=thyristor](2.5,4.5)(4.5,4.5){$T_2$}
17   \wire[intensity,intensitylabel=$i_2$](4.5,4.5)(6.5,4.5)
18   \capacitor[tension,tensionlabel=$u_c$,tensionoffset=-0.75,
19     tensionlabeloffset=-1](6.5,4.5)(6.5,6){$C_k$}
20   \qdisk(2.5,4.5){2pt}\qdisk(6.5,4.5){2pt}
21   \wire[intensity,intensitylabel=$i_3$](6.5,4.5)(6.5,3)
22   \multidipole(6.5,3)(2.5,3)%
23    \coil[dipolestyle=rectangle,labeloffset=-0.75]{$L_3$}%
24    \diode[labeloffset=-0.75]{$D_3$}.
25   \wire(6.5,6)(9,6)\qdisk(9,6){2pt}
26   \diode(9,0)(9,6){$D_4$}
27   \wire[intensity,intensitylabel=$i_4$](9,3.25)(9,6)
28   \wire[intensity,intensitylabel=$i_a$](9,6)(11,6)
29   \multidipole(11,6)(11,0)%
30    \resistor{$R_L$}
31    \coil[dipolestyle=rectangle]{$L_L$}
32    \circledipole[labeloffset=0,tension,tensionoffset=0.7,tensionlabel=$U_B$]{\LARGE\textbf{=}}
33    \wire(0,0)(11,0)\qdisk(9,0){2pt}
34    \pnode(12.5,5.5){A}\pnode(12.5,0.5){B}
35    \tension(A)(B){$u_a$}
36 \end{pspicture}

```

The following example was written by Manuel Luque.

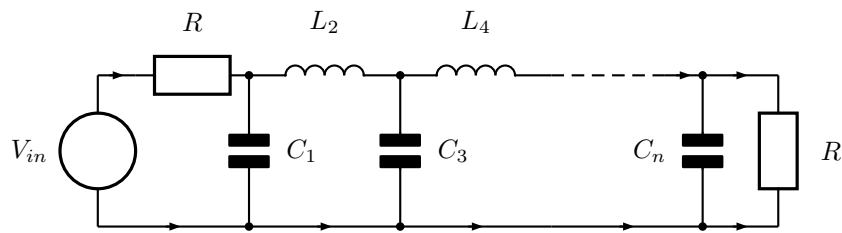


```

1 \begin{pspicture}(0,-0.5)(14,4)
2 % \psgrid[subgriddiv=1,griddots=10]
3 \pnode(0,0){B}\pnode(0,3){A}
4 \pnode(2.5,3.5){C}\pnode(2.5,-0.5){D}\pnode(5,3){E}\pnode(6.5,1.5){F}
5 \pnode(5,0){G}\pnode(3.5,1.5){H} \pnode(8,2.5){I}\pnode(8,1){J}
6 \pnode(10,2.5){K}\pnode(10,1){L} \pnode(14,2.5){M}\pnode(12,1){N}
7 \pnode(3,1){H'}\pnode(14,2.5){O} \pnode(14,1){P}\pnode(13.5,1){Q}
8 \transformer[transformerprimarylabel=$i_1$,transformersecondarylabel=$i_2$,
9   primarylabel=$n_1$,secondarylabel=$n_2$](A)(B)(C)(D){$T_1$}
10 {\psset{fillstyle=solid,fillcolor=black}
11 \diode(H)(E){}\diode(H)(G){} \diode(E)(F){}\diode(G)(F){}
12 \capacitor[dipolestyle=chemical](I)(J){} \capacitor(K)(L){}
13 \REG(K)(M)(N)%
14 {\shortstack{\textsf{%
15   \textbf{\large LM7805}}\textbf{+5V}}}}
16 \ncangle{I}{F}\psline(I)(K) \ncangle{E}{C}\ncangle{G}{D}
17 \ncangle[arm=0]{P}{Q} \ncangle[arm=0]{H}{H'}
18 \ground(H')\ground(J)\ground(L)\ground(N)
19 \ground(Q)\qdisk(I){1.5pt}\qdisk(K){1.5pt}\qdisk(E){1.5pt}
20 \qdisk(G){1.5pt}\qdisk(H){1.5pt}\qdisk(F){1.5pt}
21 \pscircle[fillstyle=solid](A){0.075} \pscircle[fillstyle=solid](B){0.075}
22 \pscircle[fillstyle=solid](P){0.075} \pscircle[fillstyle=solid](O){0.075}
23 \end{pspicture}

```


The following example was written by Lionel Cordesses.

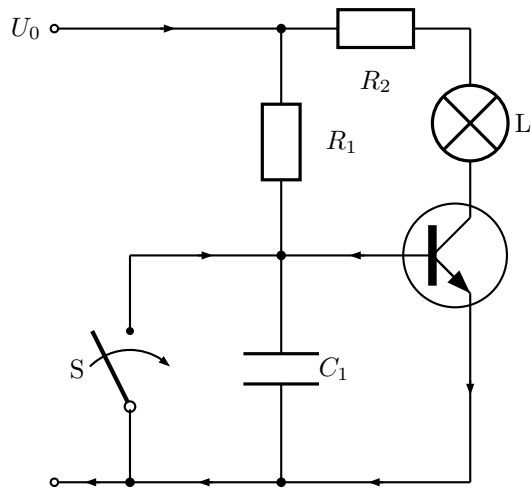


```

1 \begin{pspicture}(11,3)
2 \psset{dipolestyle=elektor}
3 \pnode(1,2){Vin}\pnode(0.5,2){S}\pnode(0.5,0){Sm}
4 \pnode(2.5,2){A}\pnode(4.5,2){B}\pnode(6.5,2){C}
5 \pnode(8,2){Cd}\pnode(8.5,2){D}\pnode(9.5,2){E}
6 \pnode(2.5,0){Am}\pnode(4.5,0){Bm}\pnode(6.5,0){Cm}
7 \pnode(8.5,0){Dm}\pnode(9.5,0){Em}
8 \Ucc[labeloffset=0.9](Sm)(S){$V_{in}$}\resistor(Vin)(A){$R$}
9 \capacitor(A)(Am){$C_1$}\capacitor(B)(Bm){$C_3$}
10 \capacitor[labeloffset=-0.7](D)(Dm){$C_n$}\resistor(E)(Em){$R$}
11 \coil(A)(B){$L_2$}\coil(B)(C){$L_4$}
12 \wire(Am)(Bm)\wire(Bm)(Cm)\wire(Cm)(Dm)\wire(Dm)(Em)\wire(D)(E)
13 \wire(Cd)(D)\psline[linestyle=dashed](C)(Cd)
14 \wire(S)(Vin)\wire(Sm)(Am)
15 \pscicle*(D){2\pslinewidth}\pscicle*(Dm){2\pslinewidth}
16 \pscicle*(A){2\pslinewidth}\pscicle*(Am){2\pslinewidth}
17 \pscicle*(B){2\pslinewidth}\pscicle*(Bm){2\pslinewidth}
18 \end{pspicture}

```

The following example was written by Christian Hoffmann.



```

1 \SpecialCoor
2 \begin{pspicture}(0,-1)(7,6.5)%\psgrid
3 \node(0,6){plus}
4 \node(3,3){basis}
5 \node([nodesep=-2] basis){schalter}
6 \node(0,0){masse}
7 \wire[arrows=o-](plus)(basis|plus)
8 \uput[1](plus){$U_0$}
9 \resistor[labeloffset=.8](basis|plus)(basis){$R_1$}
10 \transistor[basesep=2cm](basis){emitter}{kollektor}
11 \wire[arrows=-*](schalter)(basis)
12 % \wire(basis)([nodesep=2] basis)
13 \wire(TBaseNode)(basis)
14 \switch(schalter|masse)(schalter){S}
15 \lamp(kollektor|plus)(kollektor){L}
16 \resistor(kollektor|plus)(basis|plus){$R_2$}
17 \wire(emitter)(emitter|masse)
18 \wire(emitter|masse)(basis|masse)
19 \capacitor(basis)(basis|masse){$C_1$}
20 \wire[arrows=-*](basis|masse)(schalter|masse)
21 \wire[arrows=-o](schalter|masse)(masse)
22 \end{pspicture}

```

7 Flip Flops – logical elements

The syntax for all logical base circuits is

```
logic[<options>](<originX,originY>){Label}
```

where the options and the origin are optional. If they are missing, then the default options, described in the next section and the default origin (0,0) is used. The origin specifies the lower left corner of the logical circuit.

```
logic{Demo}
logic[logicType=and]{Demo}
logic(0,0){Demo}
logic[logicType=and](0,0){Demo}
```

The above four „different“ calls of the `logic` macro give the same output, because they are equivalent.

7.1 The Options

```
logicShowNode (boolean): (default: false)
logicShowDot (boolean): (default: false)
logicNodestyle (command): (default: \footnotesize)
logicSymbolstyle (command): (default: \large)
logicSymbolpos (value): (default: 0.5)
logicLabelstyle (command): (default: \small)
logicType (string): (default: and)
logicChangeLR (boolean): (default: false)
logicWidth (length): (default: 1.5)
logicHeight (length): (default: 2.5)
logicWireLength (length): (default: 0.5)
logicNInput (number): (default: 2)
logicJInput (number): (default: 2)
logicKInput (number): (default: 2)
```

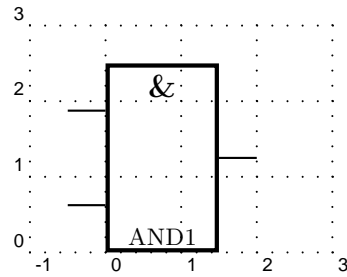
7.2 Basic Logical Circuits

At least the basic objects require a unique label name, otherwise it is not sure, that all nodes will work well. The label may contain any alphanumerical character and most of all symbols. But it is save using only combinations of letters and digits. For example:

```
And0
a0
a123
12
NOT123a
```

`A_1` is not a good choice, the underscore may causes some problems.

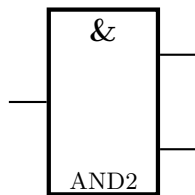
7.2.1 And



```

\begin{pspicture}(-1,0)(3,3)
\psgrid
\logic{AND1}
\end{pspicture}

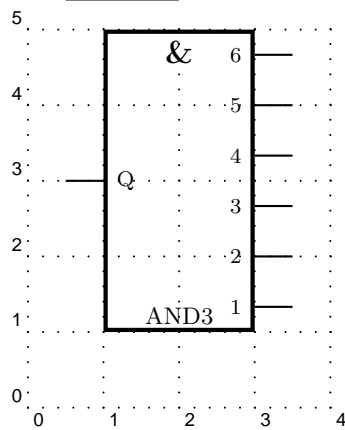
```



```

\begin{pspicture}(-0.5,0)(3,3)
\logic[logicChangeLR=true]{AND2}
\end{pspicture}

```

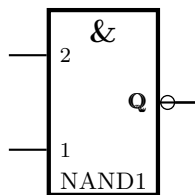


```

\begin{pspicture}(-0.5,0)(4,5)
\psgrid
\logic[logicShowNode=true,%
      logicWidth=2,%
      logicHeight=4,%
      logicNInput=6,%
      logicChangeLR=true](1,1){AND3}
\end{pspicture}

```

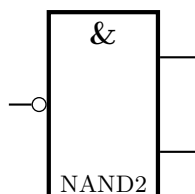
7.2.2 NotAnd



```

\begin{pspicture}(-0.5,0)(3,3)
\logic[logicType=nand,%
      logicShowNode=true]{NAND1}
\end{pspicture}

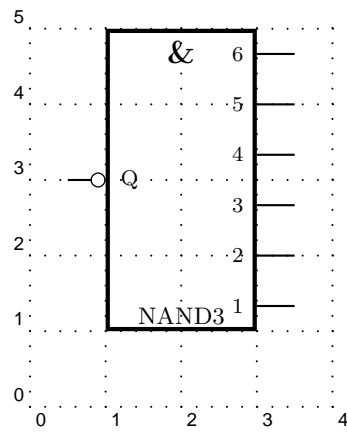
```



```

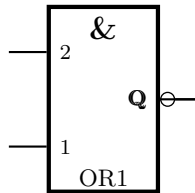
\begin{pspicture}(-0.5,0)(3,3)
\logic[logicType=nand,%
      logicChangeLR=true]{NAND2}
\end{pspicture}

```

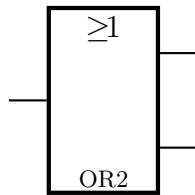


```
\begin{pspicture}(4,5)
\psgrid
\logic[logicType=nand,%
  logicShowNode=true,%
  logicWidth=2,%
  logicHeight=4,%
  logicNInput=6,%
  logicChangeLR=true](1,1){NAND3}
\end{pspicture}
```

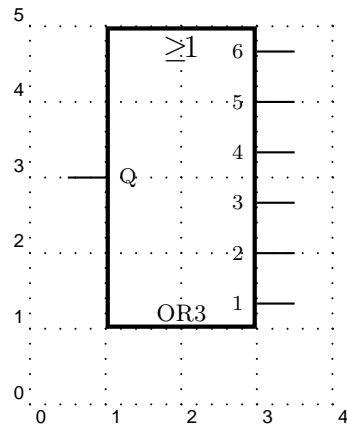
7.2.3 Or



```
\begin{pspicture}(-0.5,0)(3,3)
\logic[logicType=or,%
  logicShowNode=true]{OR1}
\end{pspicture}
```

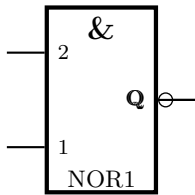


```
\begin{pspicture}(-0.5,0)(3,3)
\logic[logicType=or,%
  logicChangeLR=true]{OR2}
\end{pspicture}
```



```
\begin{pspicture}(4,5)
\psgrid
\logic[logicType=or,%
  logicShowNode=true,%
  logicWidth=2,%
  logicHeight=4,%
  logicNInput=6,%
  logicChangeLR=true](1,1){OR3}
\end{pspicture}
```

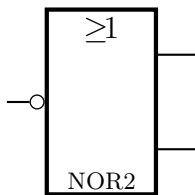
7.2.4 Not Or



```

\begin{pspicture}(-0.5,0)(3,3)
\logic[logicType=nor,%
      logicShowNode=true]{NOR1}
\end{pspicture}

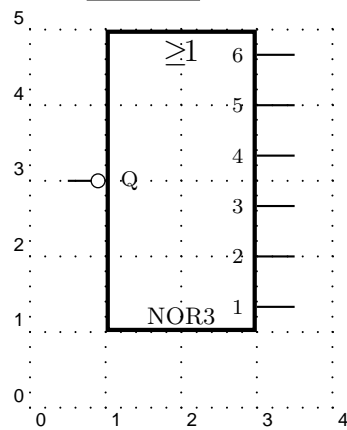
```



```

\begin{pspicture}(-0.5,0)(3,3)
\logic[logicType=nor,%
      logicChangeLR=true]{NOR2}
\end{pspicture}

```

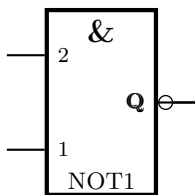


```

\begin{pspicture}(4,5)
\psgrid
\logic[logicType=nor,%
      logicShowNode=true,%
      logicWidth=2,%
      logicHeight=4,%
      logicNInput=6,%
      logicChangeLR=true](1,1){NOR3}
\end{pspicture}

```

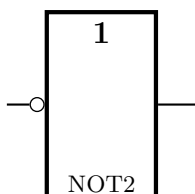
7.2.5 Not



```

\begin{pspicture}(-0.5,0)(3,3)
\logic[logicType=not,%
      logicShowNode=true]{NOT1}
\end{pspicture}

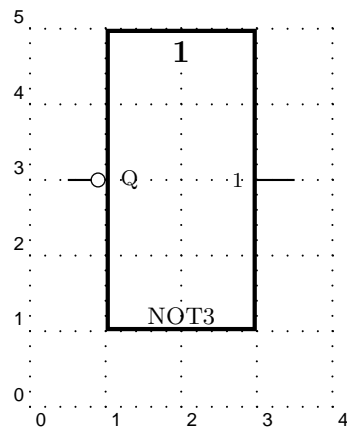
```



```

\begin{pspicture}(-0.5,0)(3,3)
\logic[logicType=not,%
      logicChangeLR=true]{NOT2}
\end{pspicture}

```

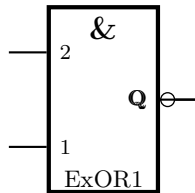


```

\begin{pspicture}(4,5)
\psgrid
\logic[logicType=not,%
  logicShowNode=true,%
  logicWidth=2,%
  logicHeight=4,%
  logicChangeLR=true](1,1){NOT3}
\end{pspicture}

```

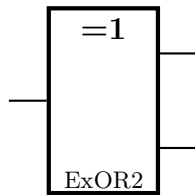
7.2.6 Exclusive OR



```

\begin{pspicture}(-0.5,0)(3,3)
\logic[logicType=exor,%
  logicShowNode=true]{ExOR1}
\end{pspicture}

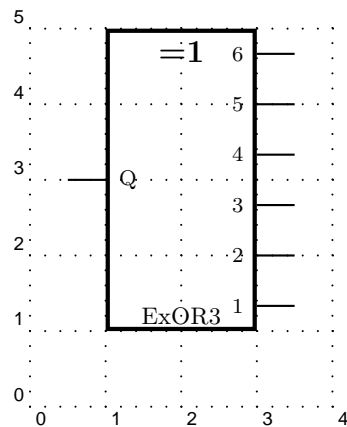
```



```

\begin{pspicture}(-0.5,0)(3,3)
\logic[logicType=exor,%
  logicChangeLR=true]{ExOR2}
\end{pspicture}

```

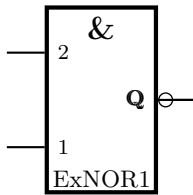


```

\begin{pspicture}(4,5)
\psgrid
\logic[logicType=exor,%
  logicShowNode=true,%
  logicNInput=6,%
  logicWidth=2,%
  logicHeight=4,%
  logicChangeLR=true](1,1){ExOR3}
\end{pspicture}

```

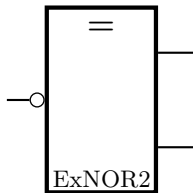
7.2.7 Exclusive NOR



```

1 \begin{pspicture}(-0.5,0)(3,3)
2 \logic[logicType=exnor,%
3   logicShowNode=true]{ExNOR1}
4 \end{pspicture}

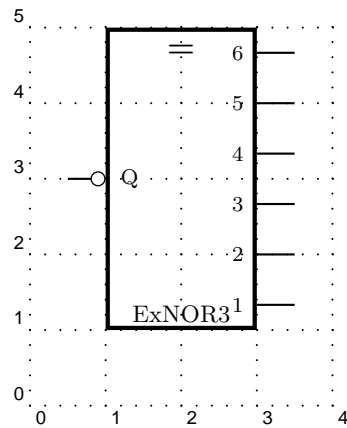
```



```

1 \begin{pspicture}(-0.5,0)(3,3)
2 \logic[logicType=exnor,%
3   logicChangeLR=true]{ExNOR2}
4 \end{pspicture}

```

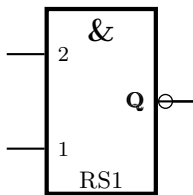


```

1 \begin{pspicture}(4,5)
2 \psgrid
3 \logic[logicType=exnor,%
4   logicShowNode=true,%
5   logicNInput=6,%
6   logicWidth=2,%
7   logicHeight=4,%
8   logicChangeLR=true](1,1){ExNOR3}
9 \end{pspicture}

```

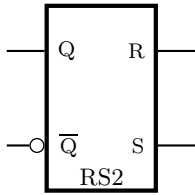
7.3 RS Flip Flop



```

1 \begin{pspicture}(-1,-1)(3,3)
2 \logic[logicShowNode=true,%
3   logicType=RS]{RS1}
4 \end{pspicture}

```

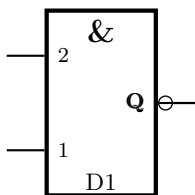



```

1 \begin{pspicture}(-1,-1)(3,3)
2 \logic[logicShowNode=true,%
3   logicType=RS,%
4   logicChangeLR=true]{RS2}
5 \end{pspicture}

```

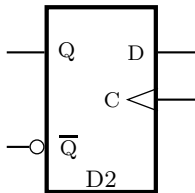
7.4 D Flip Flop



```

1 \begin{pspicture}(-1,-1)(3,3)
2 \logic[logicShowNode=true,%
3   logicType=D"]{D1}
4 \end{pspicture}

```

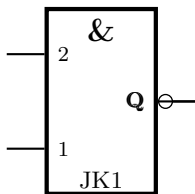


```

1 \begin{pspicture}(-1,-1)(3,3)
2 \logic[logicShowNode=true,%
3   logicType=D,%
4   logicChangeLR=true]{D2}
5 \end{pspicture}

```

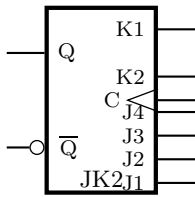
7.5 JK Flip Flop



```

1 \begin{pspicture}(-1,-1)(3,3)
2 \logic[logicShowNode=true,%
3   logicType=JK",%
4   logicKInput=2,%
5   logicJInput=2]{JK1}
6 \end{pspicture}

```

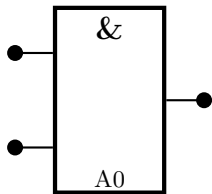


```

\begin{pspicture}(-1,-1)(3,3)
\logic[logicShowNode=true,%
  logicType=JK,%
  logicKInput=2, logicJInput=4,%
  logicChangeLR=true]{JK2}
\end{pspicture}

```

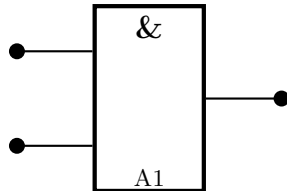
7.6 Other Options



```

\begin{pspicture}(-0.5,0)(3,2.5)
\logic[logicShowDot=true]{A0}
\end{pspicture}

```



```

\begin{pspicture}(-1,0)(3,2.5)
\logic[logicWireLength=1,%
  logicShowDot=true]{A1}
\end{pspicture}

```

The unit of `logicWireLength` is the same than the actual one for `pstricks`, set by the `unit` option.

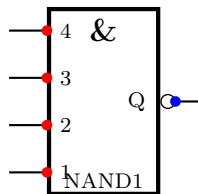
7.7 The Node Names

Every logic circuit is defined with its name, which should be a unique one. If we have the following NAND circuit, then `pst-circ` defines the nodes

NAND11, NAND12, NAND13, NAND14, NAND1Q

If there exists an inverted output, like for alle Flip Flops, then the negated one gets the appendix `neg` to the node name. For example:

NAND1Q, NAND1Qneg



```

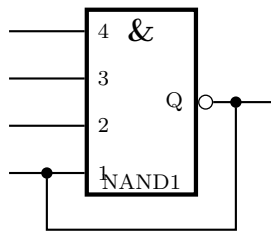
\begin{pspicture}(-0.5,0)(2.5,3)
\logic[logicShowNode=true,%
  logicLabelstyle=\footnotesize,%
  logicType=nand,%
  logicNInput=4]{NAND1}
\multido{\n=1+1}{4}{%
  \pscircle*[linecolor=red](NAND1\n){2pt}%
}
\pscircle*[linecolor=blue](NAND1Q){2pt}
\end{pspicture}

```

Now it is possible to draw a line from the output to the input

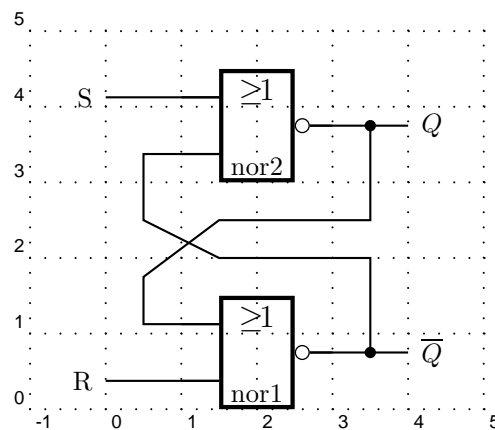
```
\ncbar[angleA=0,angleB=180]{<Node A>}{<Node B>}
```

It may be easier to print a grid since the drawing phase and then comment it out if all is finished.

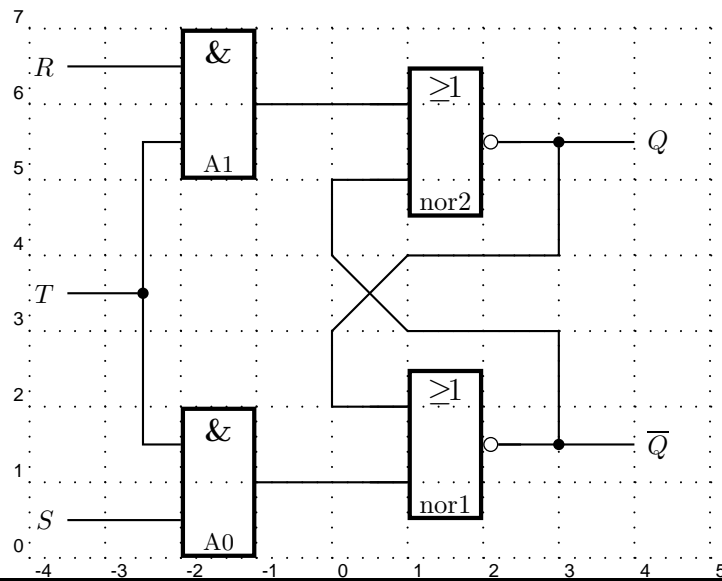


```
\begin{pspicture}(-1,-1)(2.5,3)
\logic[logicShowNode=true,%
  logicLabelstyle=\footnotesize,%
  logicType=nand,%
  logicWireLength=1,%
  logicNInput=4]{NAND1}
\pnode(-0.5,0|NAND1){tempA}
\pnode(2,0|NAND1){tempB}
\end{pspicture}
\ncbar[angleA=-90,angleB=0,arm=0.75,%
  arrows=**, dotsize=0.15]{tempA}{tempB}
```

7.8 Examples



```
\begin{pspicture}(-1,0)(5,5)
\psgrid
\psset{logicType=nor, logicLabelstyle=\normalsize,%
  logicWidth=1, logicHeight=1.5, dotsize=0.15}
\logic(1.5,0){nor1}
\logic(1.5,3){nor2}
\psline(nor2Q)(4,0|nor2Q)
\uput[0](4,0|nor2Q){Q}
\psline(nor1Q)(4,0|nor1Q)
\uput[0](4,0|nor1Q){\overline{Q}}
\psline{*-}(3.5,0|nor2Q)(3.5,2.5)(1.5,2.5)
(0.5,1.75)(0.5,0|nor12)(nor12)
\psline{*-}(3.5,0|nor1Q)(3.5,2)(1.5,2)
(0.5,2.5)(0.5,0|nor21)(nor21)
\psline(0,0|nor11)(nor11)\uput[180](0,0|nor11){R}
\psline(0,0|nor22)(nor22)\uput[180](0,0|nor22){S}
\end{pspicture}
```



```

1 \begin{pspicture}(-4,0)(5,7)
2   \psgrid
3   \psset{logicWidth=1, logicHeight=2, dotsize=0.15}
4   \logic[logicWireLength=0](-2,0){A0}
5   \logic[logicWireLength=0](-2,5){A1}
6   \ncbar[angleA=-180,angleB=-180,arm=0.5]{A11}{A02}
7   \psline[dotsize=0.15]{-}* (-3.5,3.5) (-2.5,3.5)
8   \uput[180](-3.5,3.5){$T$}
9   \psline(-3.5,0.5)(A01)\uput[180](-3.5,0.5){$S$}
10  \psline(-3.5,6.5)(A12)\uput[180](-3.5,6.5){$R$}
11  \psset{logicType=nor, logicLabelstyle=\normalsize}
12  \logic(1,0.5){nor1}
13  \logic(1,4.5){nor2}
14  \psline(nor2Q)(4,0|nor2Q)
15  \uput[0](4,0|nor2Q){$Q$}
16  \psline(nor1Q)(4,0|nor1Q)
17  \uput[0](4,0|nor1Q){$\overline{Q}$}
18  \psline{*} (3,0|nor2Q) (3,4) (1,4) (0,3) (0,0|nor12) (nor12)
19  \psline{*} (3,0|nor1Q) (3,3) (1,3) (0,4) (0,0|nor21) (nor21)
20  \psline(A0Q)(nor11)
21  \psline(A1Q)(nor22)
22 \end{pspicture}

```

8 Adding new components

Adding new components is not simple. As a matter of fact, because of the complex mechanism of `\multidipole`, there are multiple steps. Nevertheless, it can take some time...

If you want to modify the code, you need to know the following things. For a dipole, you first need to define the following items:

```

1 \def\component_name{\@ifnextchar [{\pst@component_name}{\pst@component_name
2   []}}
3 %
4 \def\pst@component/_name[#1](#2)(#3)#4{
5   \pst@draw@dipole{#1}{#2}{#3}{#4}\pst@draw@component_name
6   }\ignorespaces}
7 %

```

```

7 \def\pst@multidipole@component_name{\@ifnextchar [{\pst@multidipole@component_
  name@}%
8 {\pst@multidipole@component_name@[]}}
9 %
10 \def\pst@multidipole@component_name@[#1]#2{%
11 \expandafter\def\csname pst@circ@tmp@\number\pst@circ@count@iii\endcsname
  {#2}%
12 {\psset{#1}%
13 \ifPst@circ@parallel\aftergroup\advance\aftergroup\pst@circ@count@i\
  aftergroup\m@ne\fi}%
14 \pst@circ@count@ii=\pst@circ@count@i%
15 \advance\pst@circ@count@ii\@ne%
16 \toks0\expandafter{\pst@multidipole@output}%
17 \edef\pst@multidipole@output{%
18 \the\toks0%
19 \pst@multidipole@def@coor%
20 \noexpand\component_name[#1]%
21 (! X@{\the\pst@circ@count@i\space Y@{\the\pst@circ@count@i})%
22 (! X@{\the\pst@circ@count@ii\space Y@{\the\pst@circ@count@ii})%
23 {\noexpand\csname pst@circ@tmp@\number\pst@circ@count@iii\endcsname}%
24 }%
25 \pst@multidipole@
26 }
27 %
28 \def\pst@draw@component_name{%
29 % The PSTricks code for your component
30 % The center of the component is at (0,0)
31 \pnode(component_left_end,0){dipole@1}
32 \pnode(component_right_end,0){dipole@2}}

```

Then, you have to make some changes in the \multidipole core code... In the definition of \pst@multidipole, look for the last \ifx test

```

1 % ...
2 % Extract from \pst@multidipole
3 \else
4 \ifx\circledipole #4%
5 \let\next\pst@multidipole@circledipole
6 \else
7 \ifx\LED #4%
8 \let\next\pst@multidipole@LED
9 \else
10 % Put your modification here
11 \let\next\ignorespaces
12 \fi
13 \fi
14 \fi
15 % Extract form \pst@multidipole
16 % ...

```

and add (marked with %%)

```

1 % ...
2 % Extract from \pst@multidipole
3 \else
4 \ifx\circledipole #4%
5 \let\next\pst@multidipole@circledipole
6 \else
7 \ifx\LED #4%
8 \let\next\pst@multidipole@LED
9 \else
10 \ifx\component_name #4%%

```

```

11         \let\next\pst@multidipole@component_name%%
12         \else%%
13         \let\next\ignorespaces
14         \fi%%
15     \fi
16 \fi
17 \fi
18 % Extract form \pst@multidipole
19 % ...

```

Do the same in \pst@multidipole@

```

1 % ...
2 % Extract from \pst@multidipole@
3
4     \else
5     \ifx\circledipole #1%
6     \let\next\pst@multidipole@circledipole
7     \else
8     \ifx\LED #1%
9     \let\next\pst@multidipole@LED
10    \else
11    \ifx\component_name #1%%
12    \let\next\pst@multidipole@component_name%%
13    \else%%
14    \let\next\ignorespaces
15    \pst@multidipole@output
16    \fi%%
17    \fi
18 \fi
19 % Extract form \pst@multidipole@
20 % ...

```

and that's it! All you have to do then is send your modified `pst-circ.tex` to me and it will become part of the official release of 'pst-circ'.

Important: Pay attention to the comment character `%` at the end of lines. They are *very* important in order to avoid spurious blanks.

9 Acknowledgements

We thank of course Manuel Luque for his original work on `pst-circ` and for his circuit drawings: this wouldn't have been possible without him. As usual, Denis Girou gave us a precious hand with some dark tricks of \TeX and PSTricks. Jean-Côme Charpentier wrote the outline of `\multidipole` (a story about riri, fifi and loulou...).

Thanks also to Douglas Waud, Patrick Drechsler (dashpot), Alan Ristow, and Ted Pavlic.

References

- [1] Denis Girou and Manuel Luque. *PST-lens - PostScript macros for Generic TeX*. <ftp://ftp.dante.de/tex-archive/graphics/pstricks/contrib/pst-lens/>, 2001.
- [2] Michel Goossens, Frank Mittelbach, and Alexander Samarin. *The \LaTeX Graphics Companion*. Addison-Wesley Publishing Company, Reading, Mass., 2. edition, 2004.
- [3] Laura E. Jackson and Herbert Voß. Die Plot-Funktionen von `pst-plot`. *Die \TeX nische Komödie*, 2/02:27–34, June 2002.

- [4] Nikolai G. Kollock. *PostScript richtig eingesetzt: vom Konzept zum praktischen Einsatz*. IWT, Vaterstetten, 1989.
- [5] Manuel Luque. *Vue en 3D*. <http://members.aol.com/Mluque5130/vue3d16112002.zip>, 2002.
- [6] Herbert Voß. Die mathematischen Funktionen von Postscript. *Die T_EXnische Komödie*, 1/02:40–47, March 2002.
- [7] Herbert Voss. *PSTricks Support for pdf*. <http://PSTricks.de/pdf/pdfoutput.phtml>, 2002.
- [8] Herbert Voß. *L^AT_EX in Mathematik und Naturwissenschaften*. Franzis-Verlag, Poing, 2006.
- [9] Herbert Voß. *PSTricks – Grafik für T_EX und L^AT_EX*. DANTE – Lehmanns, Heidelberg/Hamburg, 4. edition, 2007.
- [10] Michael Wiedmann and Peter Karp. *References for T_EX and Friends*. <http://www.miwiie.org/tex-refs/>, 2003.
- [11] Timothy Van Zandt. *PSTricks - PostScript macros for Generic TeX*. <http://www.tug.org/application/PSTricks>, 1993.