

# pst-circ

## A PSTricks package for drawing electric circuits

ver. 1.45

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### 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 interconnected to produce circuit diagrams of a reasonable level of complexity.

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## 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 The basic system

### 2.1 Parameters

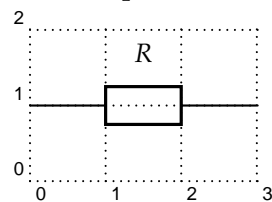
There are specific parameters defined to change easily the behaviour of the pst-circ objects you are drawing.

**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)  
**parallelsep** (real): (default: 0)  
**parallelnode** (boolean): (default: false)  
**intersect** (boolean): (default: false)  
**intersectA** (node):  
**intersectB** (node):  
**OAinvert** (boolean): (default: true)  
**OApertect** (boolean): (default: true)  
**OAplus** (boolean): (default: false)  
**OAmminus** (boolean): (default: false)  
**OAiout** (boolean): (default: false)  
**OApluslabel** (string): (default: )  
**OAmminuslabel** (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)

## 2.2 Macros

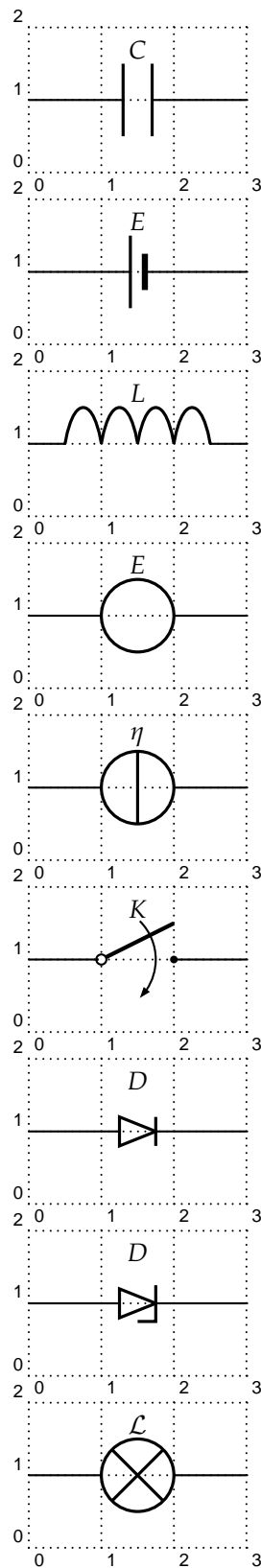
### 2.2.1 Dipole macros



```

\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}
```

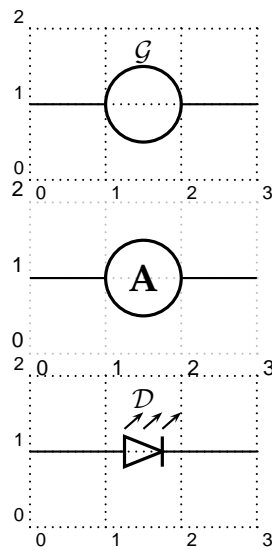
```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1){A}
\pnode(3,1){B}
\Icc(A)(B){\eta$}
\end{pspicture}
```

```
\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}
```



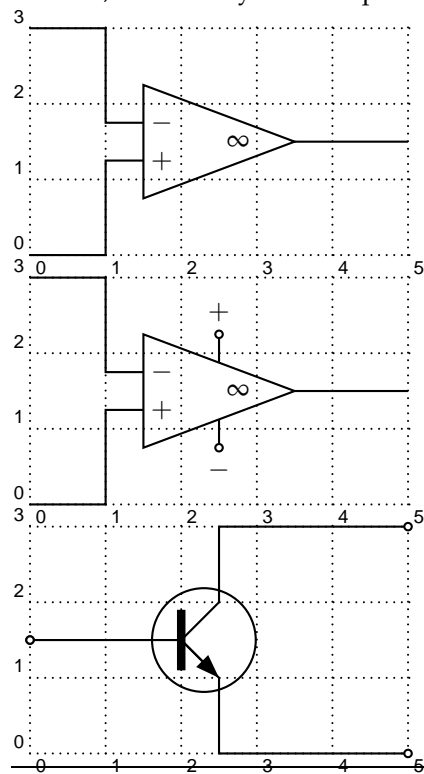
```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1){A}
\pnode(3,1){B}
\circledipole(A)(B){$\mathcal{G}$}
\end{pspicture}
```

```
\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}
```

## 2.2.2 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 chosen<sup>1</sup>, so don't try to use tripole macros in strange situations!

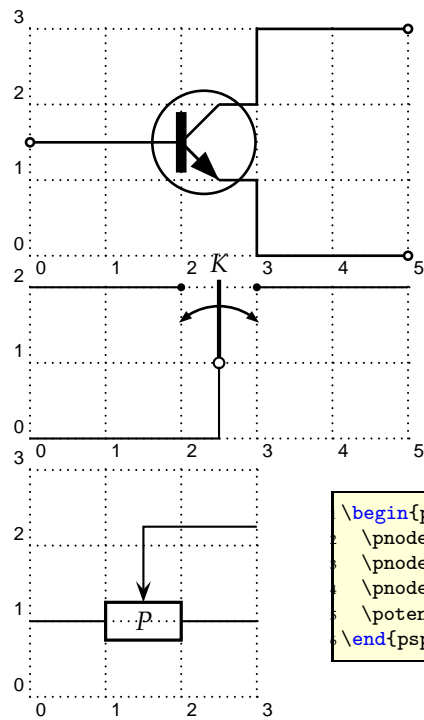


```
\begin{pspicture}(5,3)\psgrid
\pnode(0,0){A}
\pnode(0,3){B}
\pnode(5,1.5){C}
\OA(B)(A)(C)
\end{pspicture}
```

```
\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}
```

<sup>1</sup>This 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.

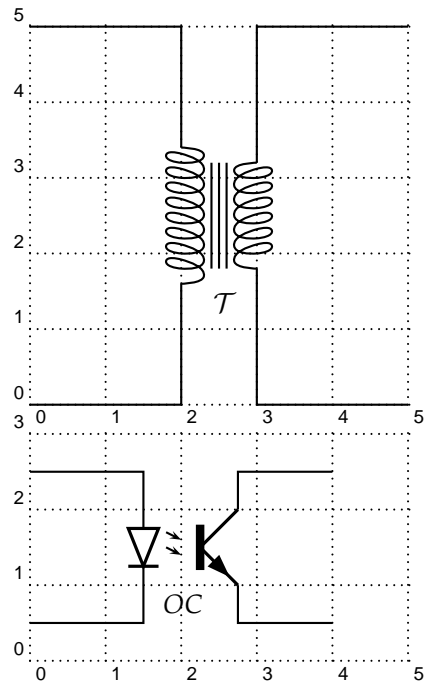


```
\begin{pspicture}(5,3)\psgrid
\pnode(0,1.5){A}\psset{linewidth=1pt}
\transistor[basesep=2cm,arrows=o-o](A){Emitter}{
Collector}
\psline{o-}(5,3)(3,3)(3,3|Collector)(Collector)
\psline{o-}(5,0)(3,0)(3,3|Emitter)(Emitter)
\psline{o-}(A)([nodesep=2]A)
\end{pspicture}
```

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

```
\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}
```

### 2.2.3 Quadrupole macros

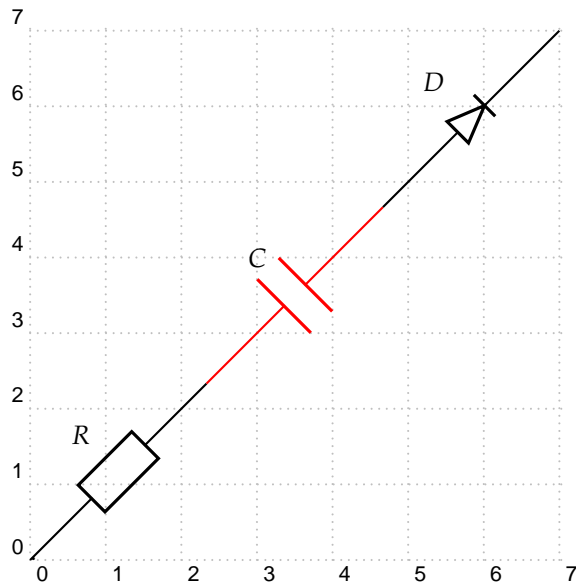


```
\begin{pspicture}(5,5)\psgrid
\pnode(0,5){A}
\pnode(0,0){B}
\pnode(5,5){C}
\pnode(5,0){D}
\transformer(A)(B)(C)(D){\mathcal T$}
\end{pspicture}
```

```
\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}
```

### 2.2.4 Multidipole

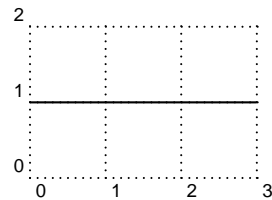
`\multidipole` is a macro that allows multiple dipoles to be drawn between two specified nodes. `\multidipole` takes as many arguments as you want. **Note the dot that is after the last dipole.**



```
\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}
```

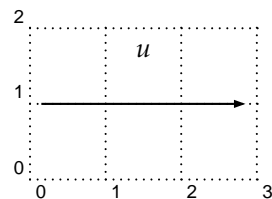
Important: for the time being, `\multidipole` takes optional arguments but does not restore original values. We recommend not using it.

### 2.2.5 Wire



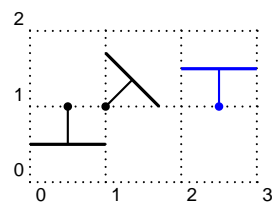
```
\begin{pspicture}(3,2)\psgrid
  \pnode(0,1){A}
  \pnode(3,1){B}
  \wire(A)(B)
\end{pspicture}
```

### 2.2.6 Potential



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

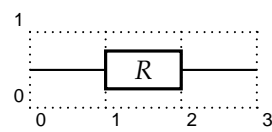
### 2.2.7 ground



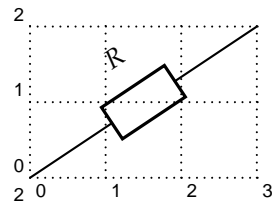
```
\begin{pspicture}(3,2)\psgrid
\pnode(0.5,1){A}
\pnode(1,1){B}
\pnode(2.5,1){C}
\ground(A)
\ground{135}(B)
\ground[linecolor=blue]{180}(C)
\end{pspicture}
```

## 2.3 Parameters

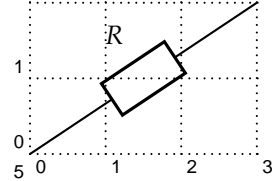
### 2.3.1 Label parameters



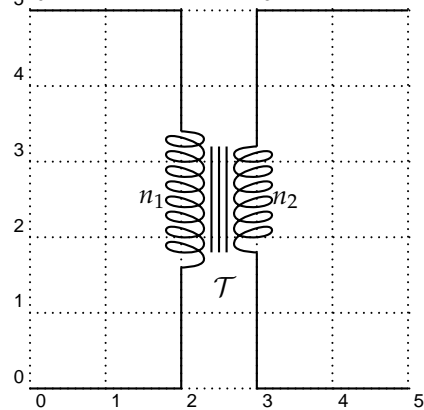
```
\begin{pspicture}(3,1)\psgrid
\pnode(0,.5){A}
\pnode(3,.5){B}
\resistor[labeloffset=0](A)(B){R$}
\end{pspicture}
```



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

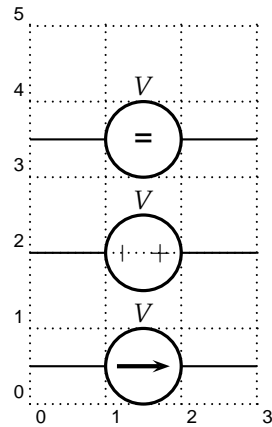


```
\begin{pspicture}(3,2)\psgrid
\pnode(0,0){A}
\pnode(3,2){B}
\resistor[labelangle=0](A)(B){R$}
\end{pspicture}
```



```
\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}
```





```

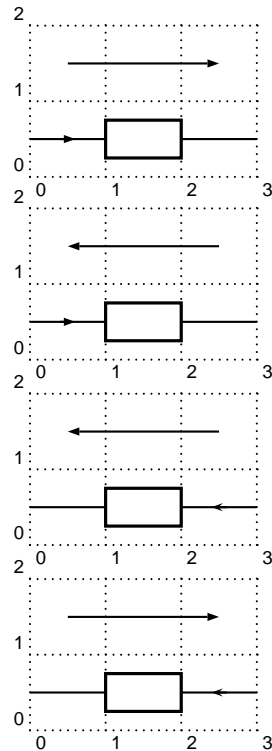
\begin{pspicture}(3,4.5)\psgrid
\pnode(0,.5){A}
\pnode(3,.5){B}
\Ucc[labelInside=1](A)(B){$V$}
\pnode(0,2){A}
\pnode(3,2){B}
\Ucc[labelInside=2](A)(B){$V$}
\pnode(0,3.5){A}
\pnode(3,3.5){B}
\Ucc[labelInside=3](A)(B){$V$}
\end{pspicture}

```

### 2.3.2 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}

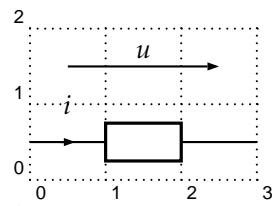
```

```

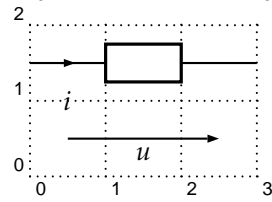
\begin{pspicture}(3,2)\psgrid
\pnode(0,.5){A}
\pnode(3,.5){B}
\resistor[intensity,tension,
dipoleconvention=generator,directconvention=false](A)(B){}
\end{pspicture}

```

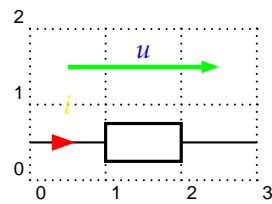
If intensitylabel is set to a non empty argument, then intensity is automatically set to true. If tensionlabel is set to a non empty argument, then tension is automatically set to true.



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

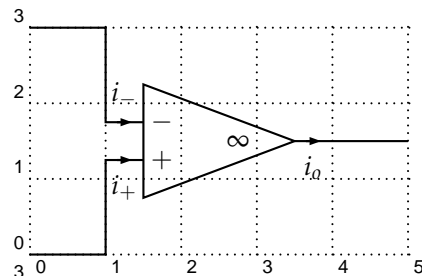


```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1.5){A}
\pnode(3,1.5){B}
\resistor[intensitylabel=$i$,intensitylabeloffset=-0.5,
tensionlabel=$u$,tensionlabeloffset=-1.2,
tensionoffset=-1](A)(B){}
\end{pspicture}
```

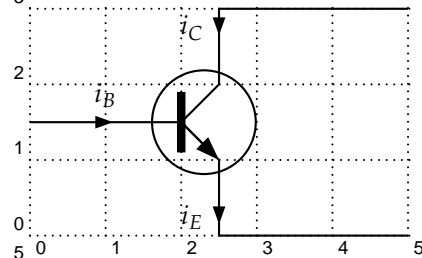


```
\begin{pspicture}(3,2)\psgrid
\pnode(0,.5){A}
\pnode(3,.5){B}
\resistor[intensitylabel=$i$,intensitywidth=3\pslinewidth,
intensitycolor=red,intensitylabelcolor=yellow,
tensionlabel=$u$,tensionwidth=2\pslinewidth,
tensioncolor=green,tensionlabelcolor=blue](A)(B){}
\end{pspicture}
```

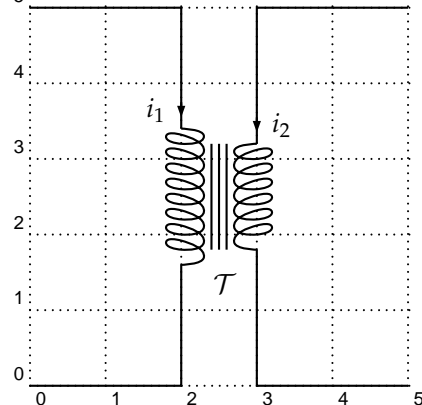
Some specific intensity parameters are available for tripoles and quadrupoles.



```
\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}
```



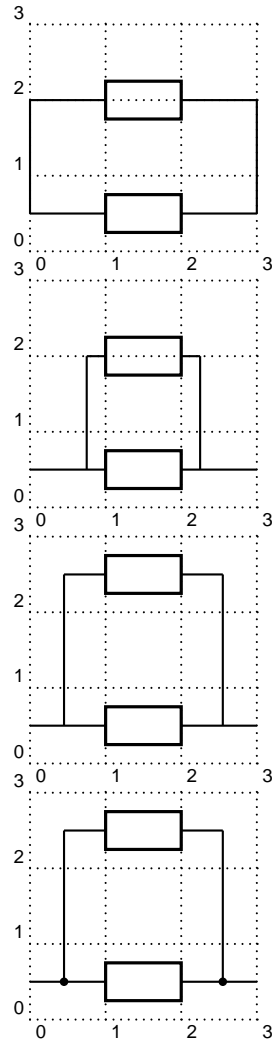
```
\begin{pspicture}(5,3)\psgrid
\pnode(0,1.5){A}
\pnode(5,0){B}
\pnode(5,3){C}
\transistor[basesep=2cm,transistoribaselabel=$i_B$,
transistoricollectorlabel=$i_C$,
transistoriemitterlabel=$i_E$](A)(B)(C)
\end{pspicture}
```



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

### 2.3.3 Parallel parameters

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

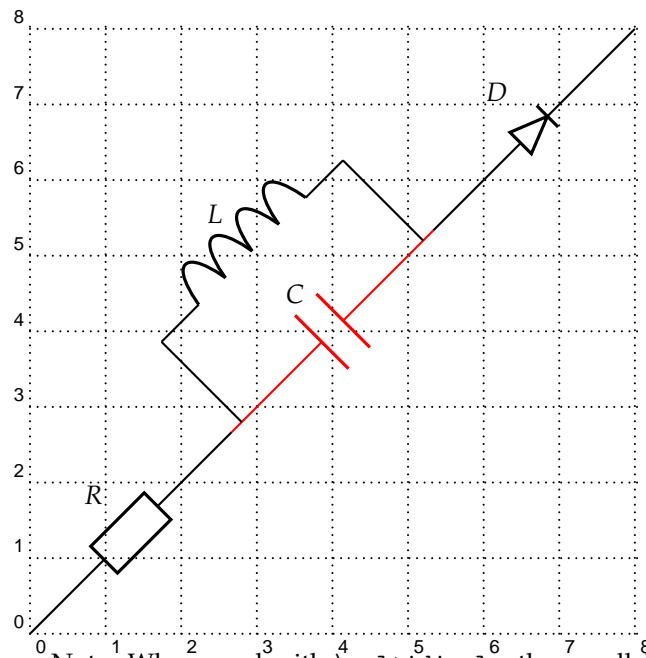


```
\begin{pspicture}(3,3)\psgrid
\pnode(0,.5){A}
\pnode(3,.5){B}
\resistor(A)(B){}
\resistor[parallel](A)(B){}
\end{pspicture}
```

```
\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}
```

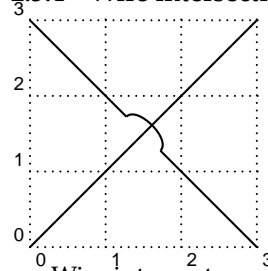
```
\begin{pspicture}(3,3)\psgrid
\pnode(0,.5){A}
\pnode(3,.5){B}
\resistor(A)(B){}
\resistor[parallel,parallelsep=.3,
parallelarm=2,parallelnode](A)(B){}
\end{pspicture}
```



```
\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}
```

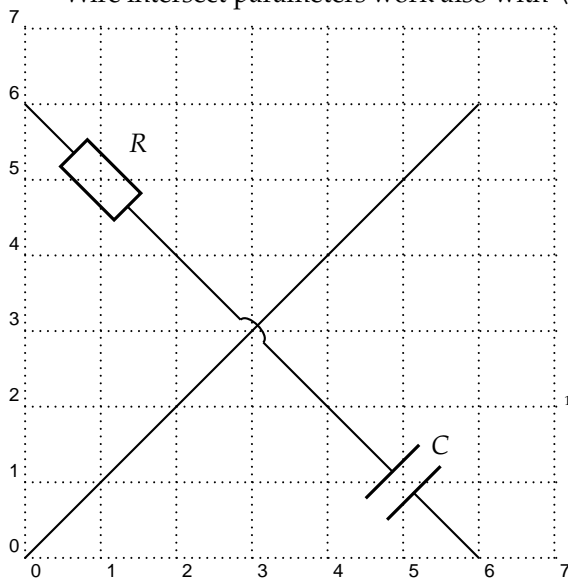
Note: When used with `\multidipole`, the `parallel` parameter must not be set for the first dipole.

### 2.3.4 Wire intersections



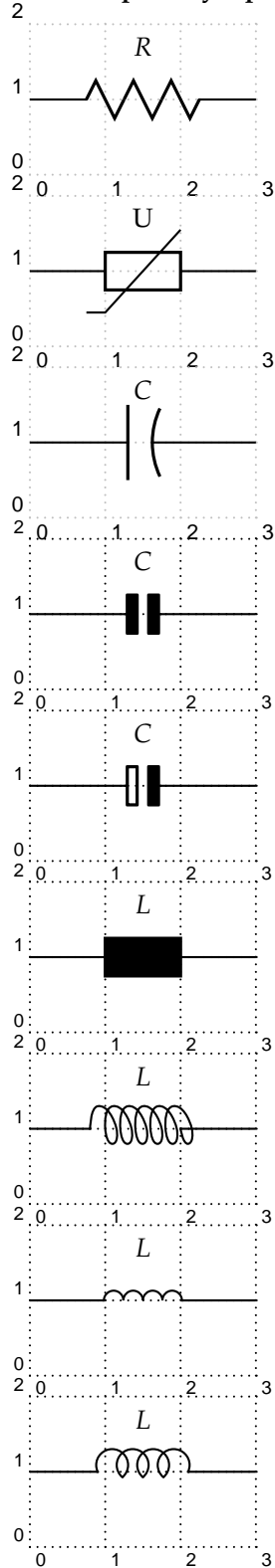
```
\begin{pspicture}(3,3)\psgrid
\pnode(0,0){A}
\pnode(3,3){B}
\pnode(0,3){C}
\pnode(3,0){D}
\wire(A)(B)
\wire[intersect,intersectA=A,intersectB=B](C)(D)
\end{pspicture}
```

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}
```

## 2.3.5 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}
```

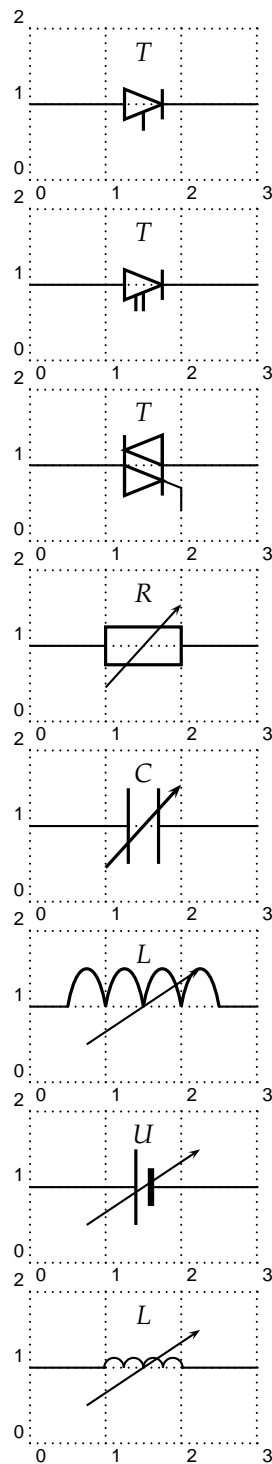
```
\begin{pspicture}(3,2)\psgrid
  \pnode(0,1){A}
  \pnode(3,1){B}
  \capacitor[dipolestyle=elektorchemical](A)(B){$C$}
\end{pspicture}
```

```
\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}
```

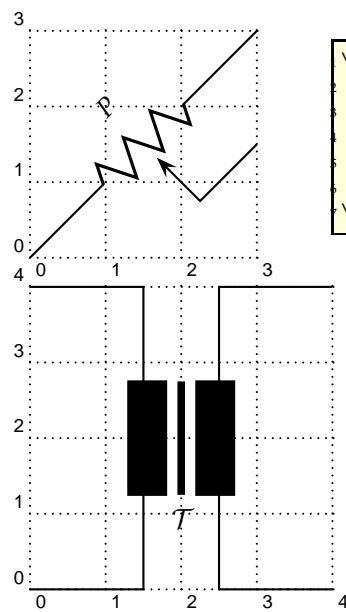
```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1){A}
\pnode(3,1){B}
\capacitor[variable](A)(B){$C$}
\end{pspicture}
```

```
\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}
```

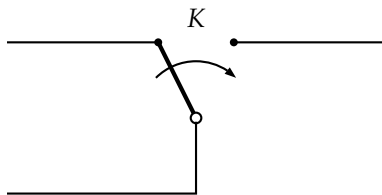
In the following example the parameter `dipolestyle` is used for a tripole and quadrupole, because the coils are drawn as rectangles and the resistor as a zigzag.



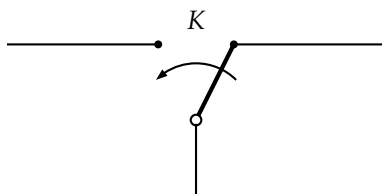
```
\begin{pspicture}(3,3)\psgrid
\pnode(0,0){A}
\pnode(3,3){B}
\pnode(3,1.5){C}
\potentiometer[dipolestyle=zigzag,%
labelangle=:U](A)(B)(C){P$}
\end{pspicture}
```

```
\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}
```

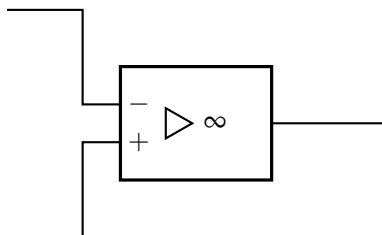
### 2.3.6 Tripole style parameters



```
\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}
```

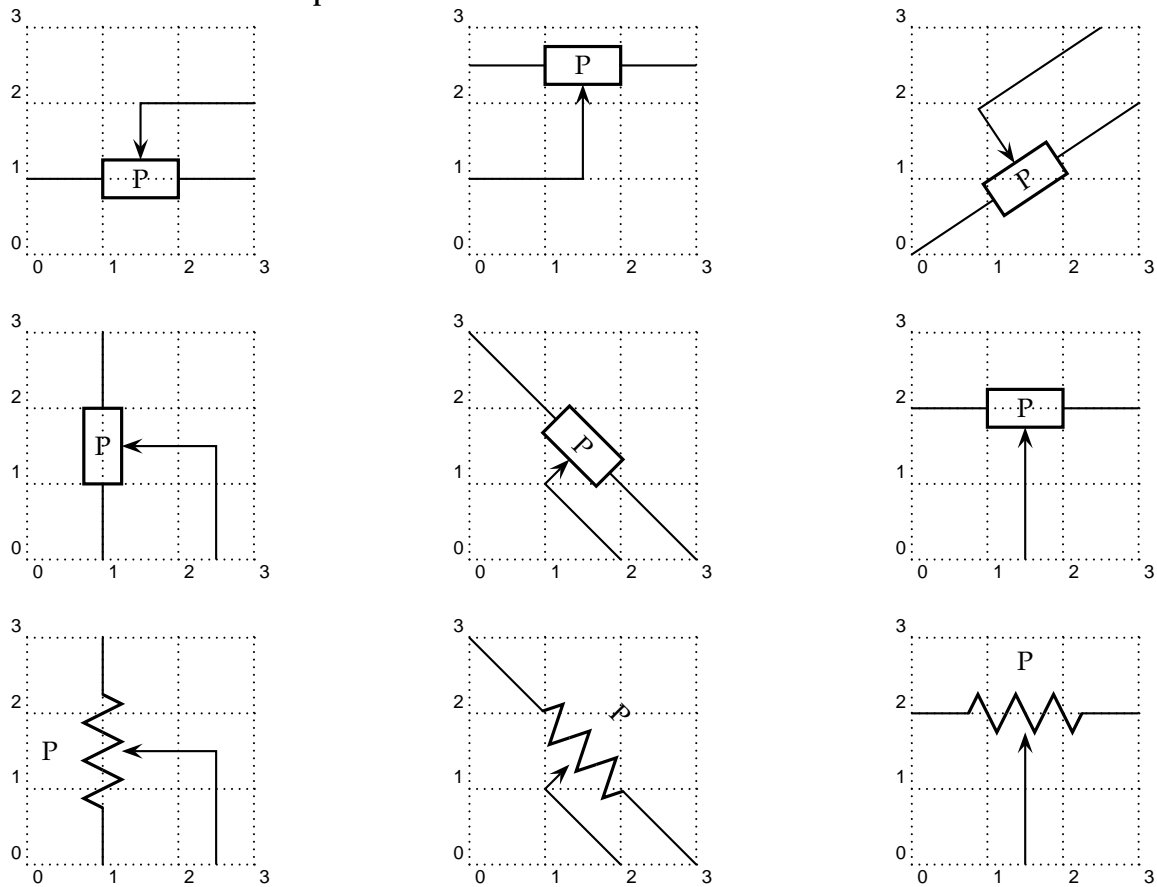


```
\begin{pspicture}(5,3)
\pnode(0,2){A}
\pnode(5,2){B}
\pnode(0,0){C}
\Tswitch[tripolestyle=right](A)(B)(C){K$}
\end{pspicture}
```

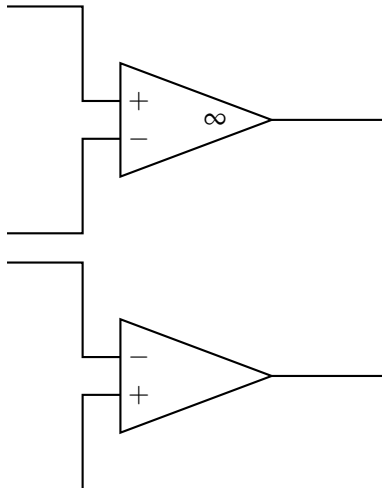


```
\begin{pspicture}(5,3)
\pnode(0,3){A}
\pnode(0,0){B}
\pnode(5,1.5){C}
\OA[tripolestyle=french](A)(B)(C)
\end{pspicture}
```

## 2.3.7 Potentiometer tripole



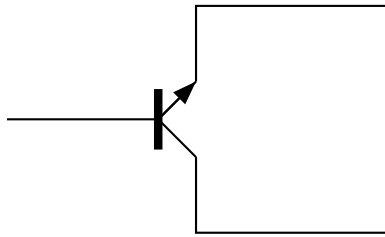
## 2.3.8 Other Parameters



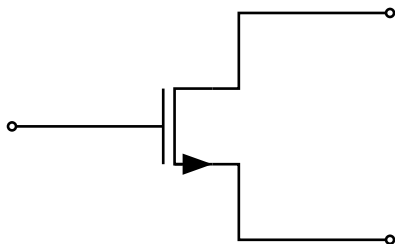
```
\begin{pspicture}(5,3)
  \pnode(0,0){A}
  \pnode(0,3){B}
  \pnode(5,1.5){C}
  \OA[OAinvert=false](B)(A)(C)
\end{pspicture}
```

```
\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}
```

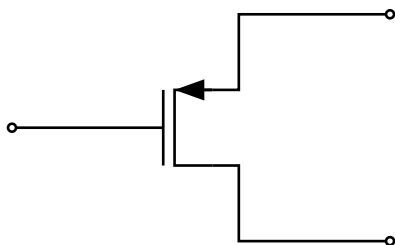




```
\begin{pspicture}(5,3)
\pnode(0,1.5){A}
\pnode(5,0){B}
\pnode(5,3){C}
\transistor[basesep=2cm,%
transistorinvert,transistorcircle=false](A)(B)(C)
\end{pspicture}
```



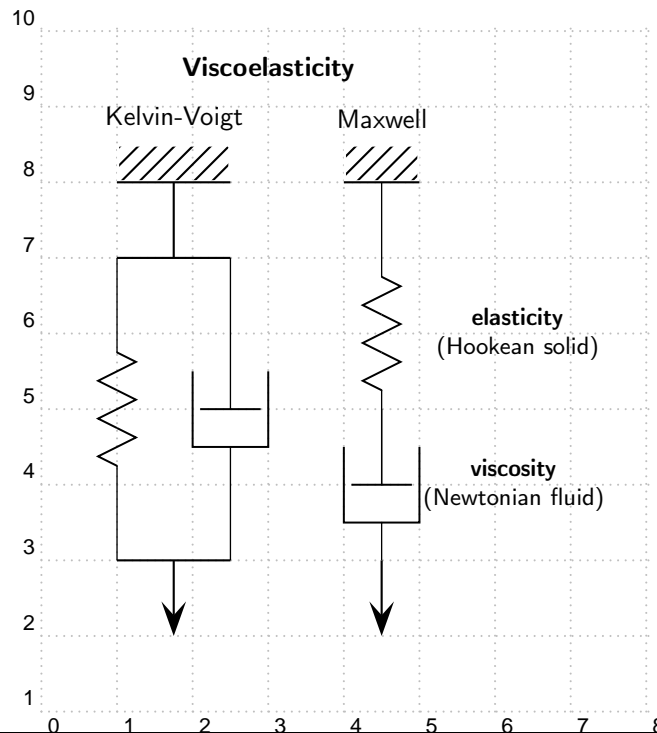
```
\begin{pspicture}(5,3)
\pnode(0,1.5){A}\psset{linewidth=1pt}
\transistor[basesep=2cm,arrows=o-o,
transistortype=FET](A){Emitter}{Collector}
\psline{o-}(5,3)(3,3)(3,3|Collector)(Collector)
\psline{o-}(5,0)(3,0)(3,3|Emitter)(Emitter)
\psline{o-}(A)([nodesep=2]A)
\end{pspicture}
```



```
\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}
```

## 2.4 Special objects

### 2.4.1 \dashpot

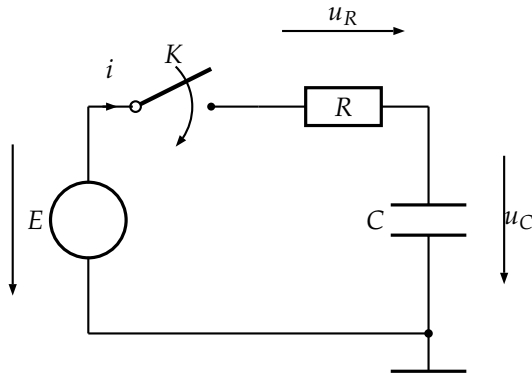


```

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

```

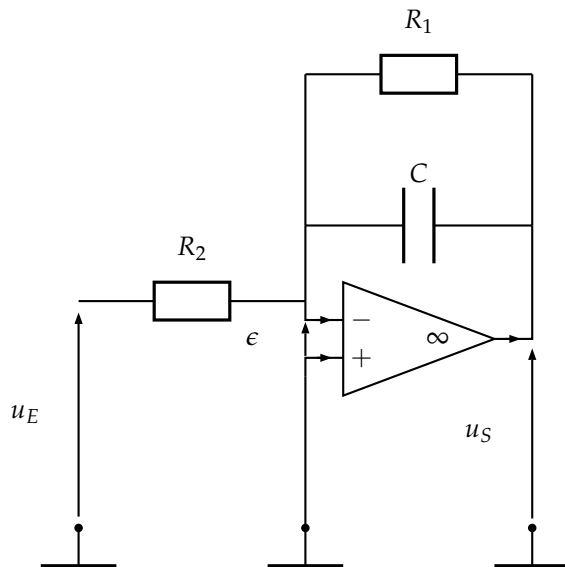
## 2.5 Examples



```

\begin{pspicture}(-1.5,-1)(6,5)
% \psgrid[subgriddiv=1,griddots=10]
% Node definitions
\node(0,0){A}
\node(0,3){B}
\node(4.5,3){C}
\node(4.5,0){D}
% Dipole node connection
\Ucc[tension,dipoleconvention=
generator](A)(B){E$}
\multidipole(B)(C)%
\switch[intensitylabel=i$]{K$}%
\resistor[labeloffset=0,
tensionlabel=$u_R$]{R$}.
\capacitor[tensionlabel={u_C$},
tensionlabeloffset=-1.2,
tensionoffset=-1,
directconvention=false](D)(C){C$}
% Wire to complete circuit
\wire(A)(D)
% Ground
\ground(D)
\end{pspicture}

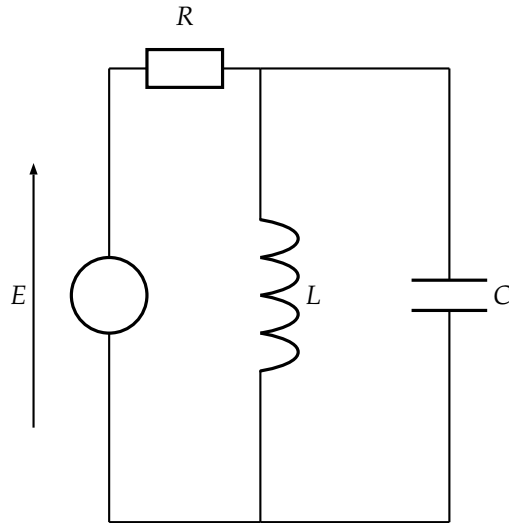
```



```

\begin{pspicture}(-0.5,0)(7,8)
% \psgrid[subgriddiv=1,griddots=10]
% Node definitions
\node(0.5,1){A}
\node(3.5,1){B}
\node(6.5,1){C}
\node(0.5,4){D}
\node(3.5,4){Minus}
\node(3.5,3){Plus}
\node(6.5,5){S}
\node(3.5,5){E}
% Dipole node connections
\resistor(D)(Minus){R_2$}
\capacitor(E)(S){C$}
\resistor[parallel,parallelarm=2](E)(
S){R_1$}
\OA[intensity](Minus)(Plus)(S)
% Wires
\wire(Minus)(E)
\wire(Plus)(B)
% Tensions
\tension(A)(D){u_E$}
\makeatletter% (special tricks see
below)
\tension(C)(S@@){u_S$}
\tension[linecolor=blue](Plus@@)(
Minus@@){\epsilon$}
\makeatother
% Grounds
\ground(A)
\ground(B)
\ground(C)
\end{pspicture}

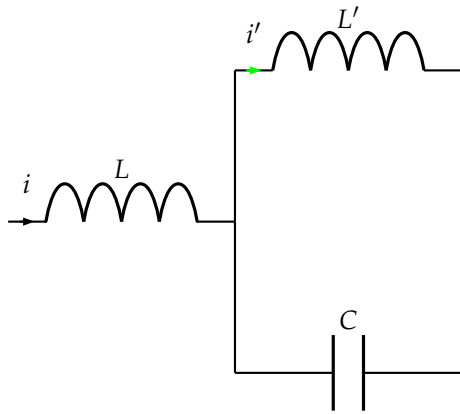
```



```

\begin{pspicture}(-1,0)(7,8)
% \psgrid[subgriddiv=1,griddots=10]
% Node definitions
\node(1,1){A}
\node(1,7){B}
\node(3,1){C}
\node(3,7){D}
% Dipole node connections
\Ucc[tensionlabel=$E$](A)(B){}
\resistor(B)(D){$R$}
\coil(D)(C){$L$}
\capacitor[parallel,parallelarm
=2.5](D)(C){$C$}
% Wire
\wire(A)(C)
\end{pspicture}

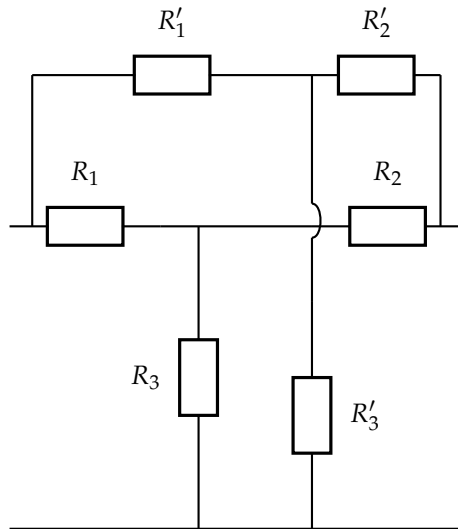
```



```

\begin{pspicture}(-0.25,-0.25)
(6,6)
% \psgrid[subgriddiv=1,griddots=10]
% Node definitions
\node(0,3){A}
\node(3,3){B}
\node(6,3){C}
% Dipole node connections
\coil[intensitylabel=$i$](A)(B){$L$}
\coil[intensitylabel=$i'$,
intensitycolor=green,%
parallel,parallelarm=2](B)(C){$L'$}
\capacitor[parallel,parallelarm
=-2](B)(C){$C$}
\end{pspicture}

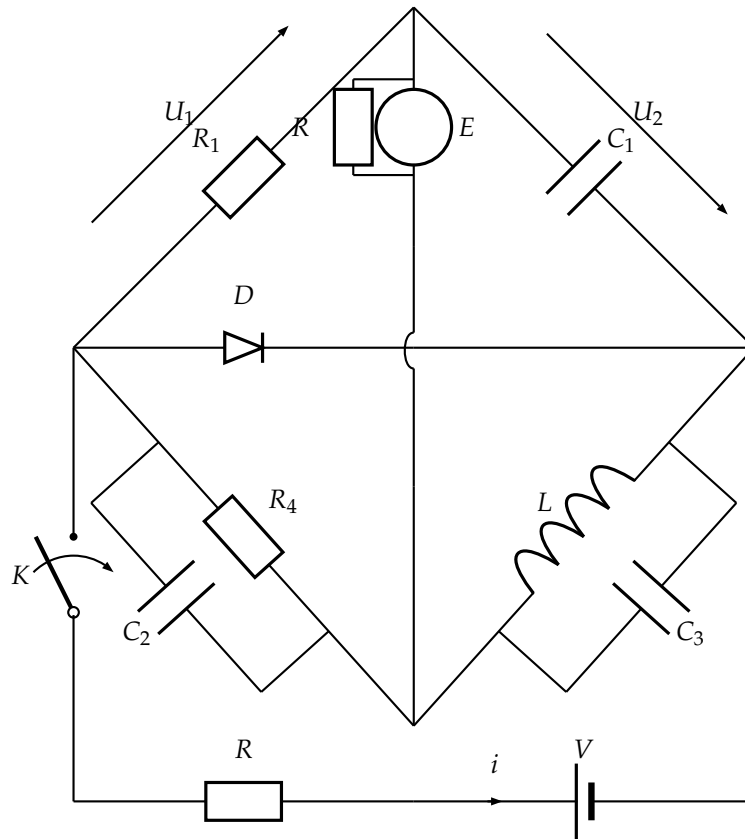
```



```

\begin{pspicture}(6,6)
% \psgrid[subgriddiv=1,griddots=10]
% Node definitions
\node(0,0){A}\node(6,0){B}
\node(0.3,4){Cprime}\node
(5.7,4){Dprime}
\node(2.5,4){Gprime}\node
(2.5,0){Hprime}
\node(0,4){C}\node(6,4){D}
\node(0.3,6){E}\node(5.7,6){F}
\node(4,6){G}\node(4,0){H}
\multidipole(G)(H)%
\wire[intersect,
intersectA=C,intersectB=D]
\resistor{$R'_3$}.
\resistor(E)(G){$R'_1$}
\resistor(G)(F){$R'_2$}
\multidipole(C)(D)\resistor{$R
_1$}%
\wire\resistor{$R_2$}.
\wire(A)(B)\wire(Cprime)(E)
\wire(Dprime)(F)
\resistor(Hprime)(Gprime){$R_3$}
\end{pspicture}

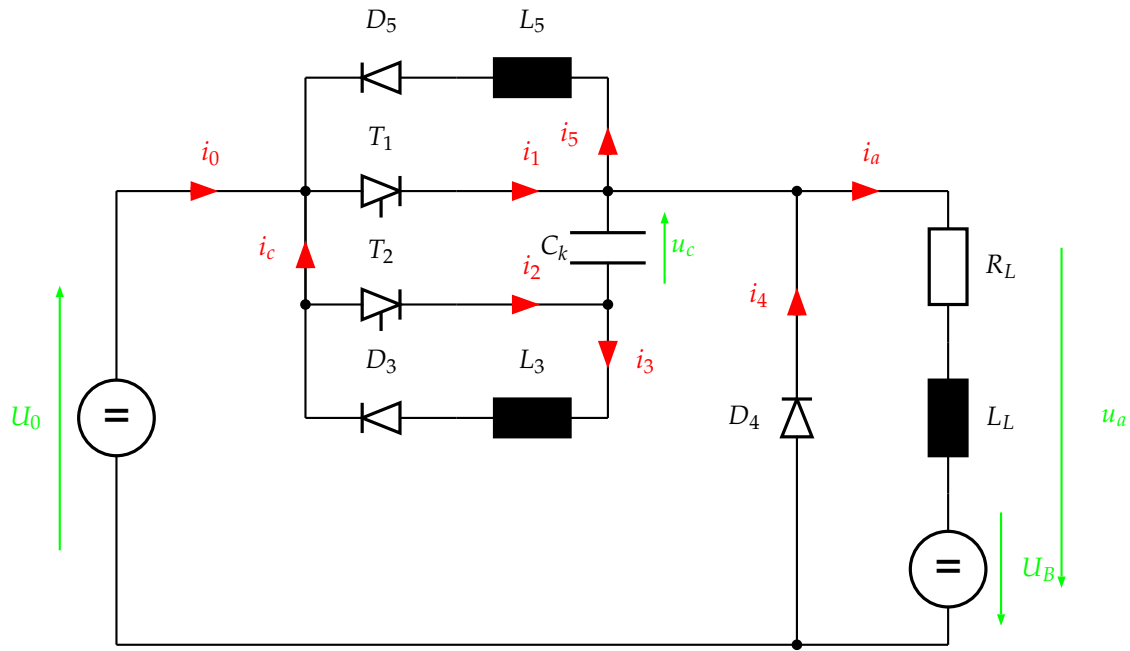
```



```

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}

```

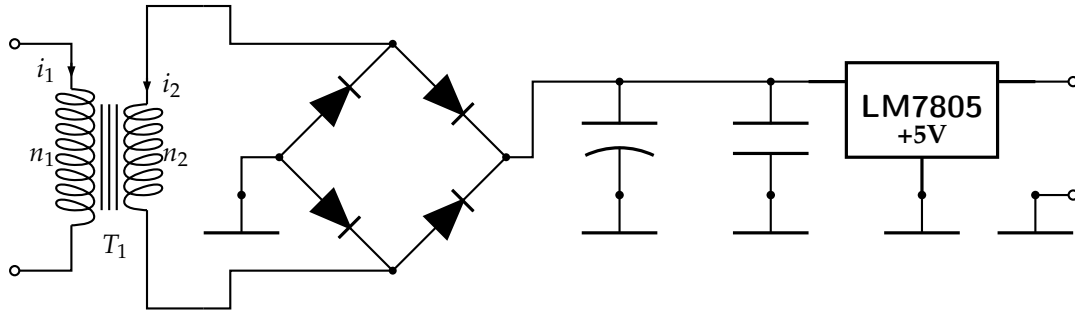


```

\begin{pspicture}(0,-0.2)(13,8)
\psset{intensitycolor=red,intensitylabelcolor=red,tensioncolor=green,
tensionlabelcolor=green,intensitywidth=3pt}
\circledipole[tension,tensionlabel=$U_0$,
tensionoffset=0.75,labeloffset=0](0,0)(0,6){\LARGE\textbf{=}}
\wire[intensity,intensitylabel=$i_0$](0,6)(2.5,6)
\diode[dipolestyle=thyristor](2.5,6)(4.5,6){$T_1$}
\wire[intensity,intensitylabel=$i_1$](4.5,6)(6.5,6)
\multidipole(6.5,7.5)(2.5,7.5)%
\coil[dipolestyle=rectangle,labeloffset=-0.75]{$L_5$}%
\diode[labeloffset=-0.75]{$D_5$}.
\wire[intensity,intensitylabel=$i_5$](6.5,6)(6.5,7.5)
\wire(2.5,7.5)(2.5,3)
\wire[intensity,intensitylabel=$i_c$](2.5,4.5)(2.5,6)
\qdisk(2.5,6){2pt}\qdisk(6.5,6){2pt}
\diode[dipolestyle=thyristor](2.5,4.5)(4.5,4.5){$T_2$}
\wire[intensity,intensitylabel=$i_2$](4.5,4.5)(6.5,4.5)
\capacitor[tension,tensionlabel=$u_c$,tensionoffset=-0.75,
tensionlabeloffset=-1](6.5,4.5)(6.5,6){$C_k$}
\qdisk(2.5,4.5){2pt}\qdisk(6.5,4.5){2pt}
\wire[intensity,intensitylabel=$i_3$](6.5,4.5)(6.5,3)
\multidipole(6.5,3)(2.5,3)%
\coil[dipolestyle=rectangle,labeloffset=-0.75]{$L_3$}%
\diode[labeloffset=-0.75]{$D_3$}.
\wire(6.5,6)(9,6)\qdisk(9,6){2pt}
\diode(9,0)(9,6){$D_4$}
\wire[intensity,intensitylabel=$i_4$](9,3.25)(9,6)
\wire[intensity,intensitylabel=$i_a$](9,6)(11,6)
\multidipole(11,6)(11,0)%
\resistor{$R_L$}
\coil[dipolestyle=rectangle]{$L_L$}
\circledipole[labeloffset=0,tension,tensionoffset=0.7,tensionlabel=$U_B$]{\LARGE\textbf{=}}.
\wire(0,0)(11,0)\qdisk(9,0){2pt}
\pnode(12.5,5.5){A}\pnode(12.5,0.5){B}
\tension(A)(B){$u_a$}
\end{pspicture}

```

The following example was written by Manuel Luque.



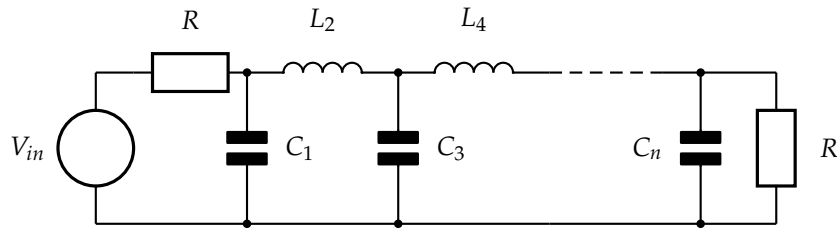
```

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

```



The following example was written by Lionel Cordesses.

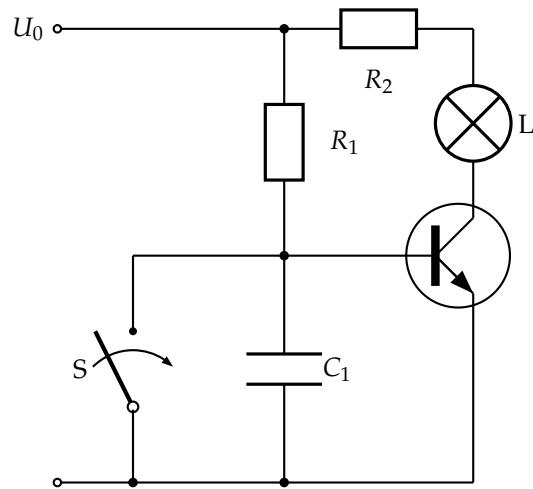


```

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 \pscircle*(D){2\pslinewidth}\pscircle*(Dm){2\pslinewidth}
16 \pscircle*(A){2\pslinewidth}\pscircle*(Am){2\pslinewidth}
17 \pscircle*(B){2\pslinewidth}\pscircle*(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 \pnode(0,6){plus}
4 \pnode(3,3){basis}
5 \pnode([nodesep=-2] basis){schalter}
6 \pnode(0,0){masse}
7 \wire[arrows=o-](plus)(basis|plus)
8 \uput[l](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}

```

### 3 Microwave symbols

Since for microwave signal, the direction in which the signal spreads is very important, There are dipoleinput or tripoleinput or quadripoleinput and arrowinput parameters. The value of these parameters are left or right for the first one and true or false for second one.

```

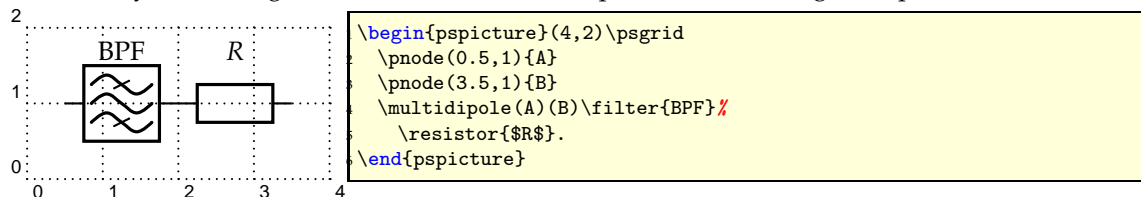
%%%%
\ifPst@inputarrow
  \ifx\psk@Dinput\pst@Dinput@right
    \pcline[arrows=-C] (#2) (dipole@1)
    \pcline[arrows=->,arrowinset=0] (#3) (dipole@2)
  \else
    \pcline[arrows=->,arrowinset=0] (#2) (dipole@1)
    \pcline[arrows=C-] (dipole@2) (#3)
  \fi
\else
  \pcline[arrows=-C] (#2) (dipole@1)
  \pcline[arrows=C-] (dipole@2) (#3)
\fi
\pcline[fillstyle=none,linestyle=none] (#2) (#3)
%%%%

```

The last line is to correct some problems when I use colors (see example2)

To add color in components (Monopole, tripole and Quadripole) I add a new argument since I don't know how to do this by another way. However, I think it is not the optimal solution. For dipole, to put commands for color in the first optionnal argument is ok.

Finally, something doesn't work with multidipole: this following example works:



However, this following one doesn't work:

```

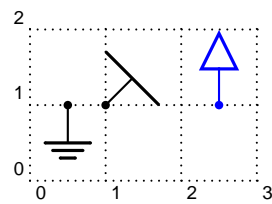
\begin{LTXexample}[width=3.5cm,rframe={}]
\begin{pspicture}(4,2)\psgrid
  \pnode(0.5,1){A}
  \pnode(3.5,1){B}
  \multidipole(A)(B)\amplifier{LNA}%
  \resistor{R$$.
\end{pspicture}
\end{LTXexample}

```

#### 3.1 New monopole components

##### 3.1.1 New ground

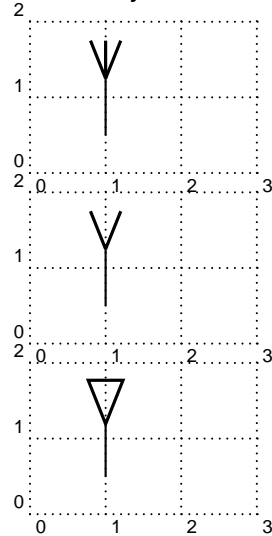
**groundstyle:** ads | old | triangle



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

### 3.1.2 Antenna

**antennastyle:** two | three | triangle



```
\begin{pspicture}(3,2)\psgrid
\pnode(1,0.5){A}
\antenna[antennastyle=three](A)
\end{pspicture}
```

```
\begin{pspicture}(3,2)\psgrid
\pnode(1,0.5){A}
\antenna(A)
\end{pspicture}
```

```
\begin{pspicture}(3,2)\psgrid
\pnode(1,0.5){A}
\antenna[antennastyle=triangle](A)
\end{pspicture}
```

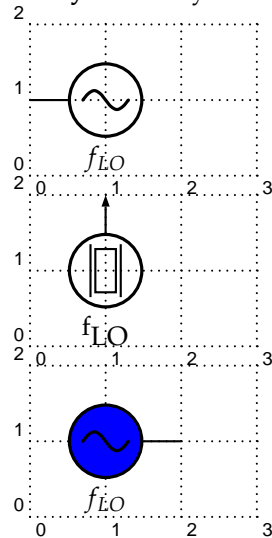
## 3.2 New monopole macro-components

### 3.2.1 Oscillator

**output:** top | right | bottom | left

**inputarrow:** false | true

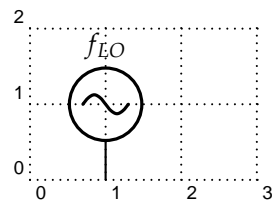
**L0style:** - | crystal



```
\begin{pspicture}(3,2)\psgrid
\pnode(1,1){A}
\oscillator[output=left,inputarrow=false](A)%
{$f_{LO}$}{}
\end{pspicture}
```

```
\begin{pspicture}(3,2)\psgrid
\pnode(1,1){A}
\oscillator[output=top,inputarrow=true,L0style=crystal](A)%
{f$_{\text{L0}}$}{}
\end{pspicture}
```

```
\begin{pspicture}(3,2)\psgrid
\pnode(1,1){A}
\oscillator[output=right,inputarrow=false](A)%
{$f_{LO}$}{\fillstyle=solid,fillcolor=blue}
\end{pspicture}
```



```
\begin{pspicture}(3,2)\psgrid
\pnode(1,1){A}
\oscillator[output=bottom,inputarrow=false](A){%
{$f_{LO}$}{}}
\end{pspicture}
```

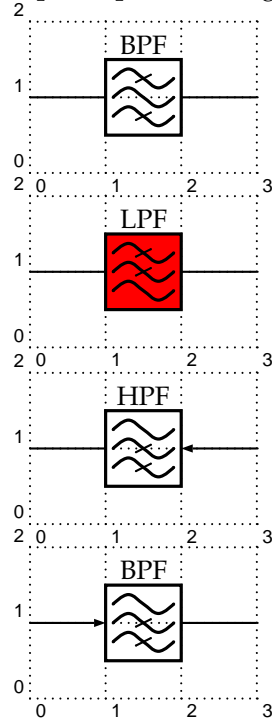
### 3.3 New dipole macro-components

#### 3.3.1 Filters

**dipolestyle:** bandpass | lowpass | highpass

**inputarrow:** false | true

**dipoleinput:** left | right



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

```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1){A}
\pnode(3,1){B}
\filter[dipolestyle=lowpass,fillstyle=solid,%
fillcolor=red](A)(B){LPF}
\end{pspicture}
```

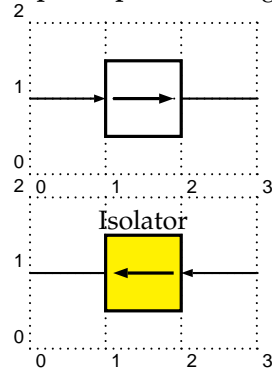
```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1){A}
\pnode(3,1){B}
\filter[dipolestyle=highpass,dipoleinput=right,%
inputarrow=true](A)(B){HPF}
\end{pspicture}
```

```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1){A}
\pnode(3,1){B}
\filter[dipolestyle=highpass,inputarrow=true](A)(B){BPF}
\end{pspicture}
```

#### 3.3.2 Isolator

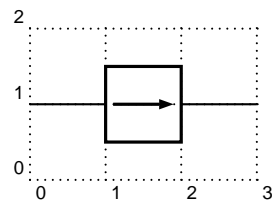
**inputarrow:** false | true

**dipoleinput:** left | right



```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1){A}
\pnode(3,1){B}
\isolator[inputarrow=true](A)(B){}
\end{pspicture}
```

```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1){A}
\pnode(3,1){B}
\isolator[dipoleinput=right,inputarrow=true,fillstyle=solid,%
fillcolor=yellow](A)(B){Isolator}
\end{pspicture}
```



```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1){A}
\pnode(3,1){B}
\isolator[dipoleinput=left](A)(B){}
\end{pspicture}
```

### 3.3.3 Frequency multiplier/divider

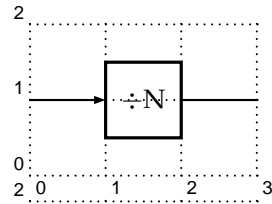
**dipolestyle:** multiplier | divider

**value:**  $N$  |  $n \in N$

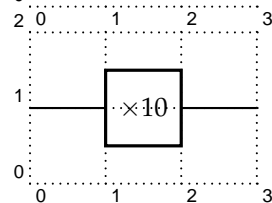
**programmable:** false | true

**inputarrow:** false | true

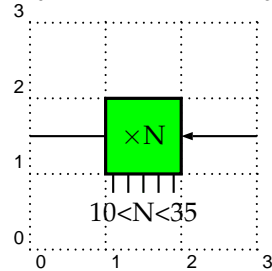
**dipoleinput:** left | right



```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1){A}
\pnode(3,1){B}
\freqmult[dipolestyle=divider,inputarrow=true](A)(B){}
\end{pspicture}
```



```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1){A}
\pnode(3,1){B}
\freqmult[dipolestyle=multiplier,value=10](A)(B){}
\end{pspicture}
```

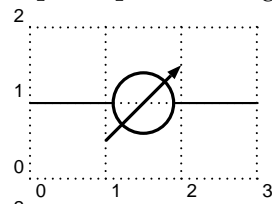


```
\begin{pspicture}(3,3)\psgrid
\pnode(0,1.5){A}
\pnode(3,1.5){B}
\freqmult[dipolestyle=multiplier,programmable=true,%
labeloffset=-1,%
dipoleinput=right,%
inputarrow=true,%
fillstyle=solid,%
fillcolor=green](A)(B){10<N<35}
\end{pspicture}
```

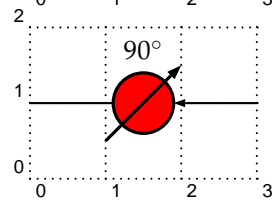
### 3.3.4 Phase shifter

**inputarrow:** false | true

**dipoleinput:** left | right

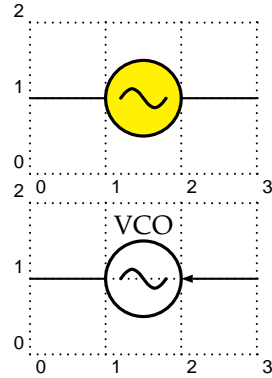


```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1){A1}
\pnode(3,1){A2}
\phaseshifter(A1)(A2){}
\end{pspicture}
```



```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1){B1}
\pnode(3,1){B2}
\phaseshifter[inputarrow=true,%
dipoleinput=right,fillstyle=solid,fillcolor=red]%
(B1)(B2){90\ensuremath{\sim\circ}}
\end{pspicture}
```

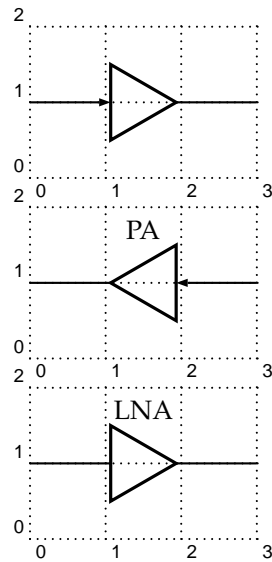
## 3.3.5 VCO

**inputarrow:** false | true**dipoleinput:** left | right

```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1){A1}
\pnode(3,1){A2}
\vco[fillstyle=solid,fillcolor=yellow](A1)(A2){}
\end{pspicture}
```

```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1){B1}
\pnode(3,1){B2}
\vco[dipoleinput=right,inputarrow=true](B1)(B2){VCO}
\end{pspicture}
```

## 3.3.6 Amplifier

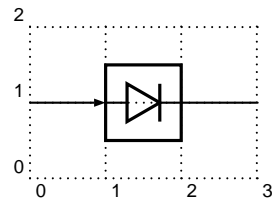
**inputarrow:** false | true**dipoleinput:** left | right

```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1){A}
\pnode(3,1){B}
\amplifier[inputarrow=true](A)(B){}
\end{pspicture}
```

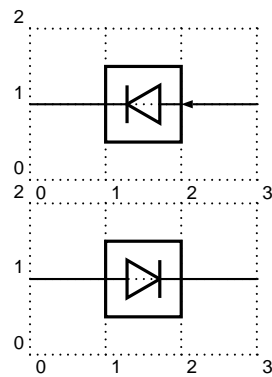
```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1){A}
\pnode(3,1){B}
\amplifier[dipoleinput=right,inputarrow=true](A)(B){PA}
\end{pspicture}
```

```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1){A}
\pnode(3,1){B}
\amplifier[dipoleinput=left](A)(B){LNA}
\end{pspicture}
```

## 3.3.7 Detector

**inputarrow:** false | true**dipoleinput:** left | right

```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1){A}
\pnode(3,1){B}
\detector[inputarrow=true](A)(B){}
\end{pspicture}
```



```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1){A}
\pnode(3,1){B}
\detector[dipoleinput=right,inputarrow=true](A)(B){}
\end{pspicture}
```

```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1){A}
\pnode(3,1){B}
\detector[dipoleinput=left](A)(B){}
\end{pspicture}
```

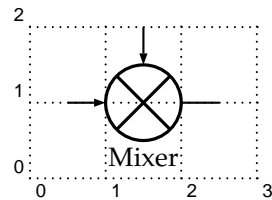
## 3.4 New tripole macro-components

### 3.4.1 Mixer

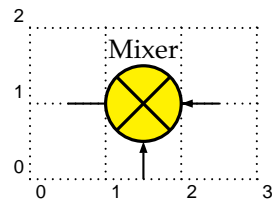
**tripolestyle:** bottom | top

**tripoleconfig:** left | right

**inputarrow:** false | true



```
\begin{pspicture}(3,2)\psgrid
\pnode(0.5,1){A}
\pnode(2.5,1){B}
\pnode(1.5,2){C}
\mixer[tripolestyle=top,inputarrow=true](A)(B)(C){}
\end{pspicture}
```



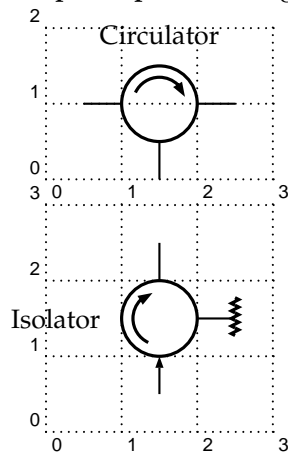
```
\begin{pspicture}(3,2)\psgrid
\pnode(0.5,1){A}
\pnode(2.5,1){B}
\pnode(1.5,0){C}
\mixer[inputarrow=true,tripoleinput=right](A)(B)(C){}
\mixer{fillstyle=solid,fillcolor=yellow}
\end{pspicture}
```

### 3.4.2 Circulator

**tripolestyle:** circulator | isolator

**inputarrow:** false | true

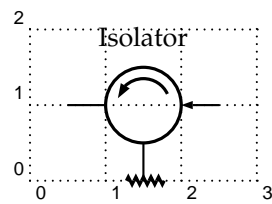
**tripoleinput:** left | right



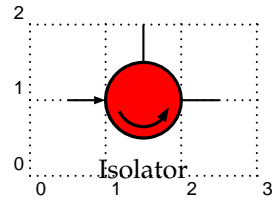
```
\begin{pspicture}(3,2)\psgrid
\pnode(0.5,1){A}
\pnode(2.5,1){B}
\pnode(1.5,0){C}
\circulator{0}(A)(B)(C){Circulator}{}
\end{pspicture}
```

```
\begin{pspicture}(3,3)\psgrid
\pnode(1.5,0.5){A}
\pnode(1.5,2.5){B}
\pnode(0.5,1.5){C}
\circulator[tripolestyle=isolator,inputarrow=true]{90}{}
(A)(B)(C){Isolator}{}
\end{pspicture}
```





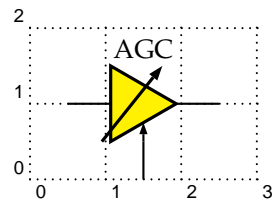
```
\begin{pspicture}(3,2)\psgrid
\pnode(0.5,1){A}
\pnode(2.5,1){B}
\pnode(1.5,0){C}
\circulator[tripoleconfig=right,tripolestyle=isolator,%
inputarrow=true,tripoleinput=right]{0}%
(B)(A)(C){Isolator}{}
\end{pspicture}
```



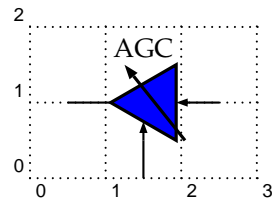
```
\begin{pspicture}(3,2)\psgrid
\pnode(0.5,1){A}
\pnode(2.5,1){B}
\pnode(1.5,2){C}
\circulator[tripoleconfig=right,inputarrow=true]{180}%
(A)(B)(C){Isolator}{fillstyle=solid,fillcolor=red}
\end{pspicture}
```

### 3.4.3 Agc

**inputarrow:** false | true  
**tripoleinput:** left | right



```
\begin{pspicture}(3,2)\psgrid
\pnode(0.5,1){A}
\pnode(2.5,1){B}
\pnode(1.5,0){C}
\agc(A)(B)(C){AGC}{fillstyle=solid,fillcolor=yellow}
\end{pspicture}
```

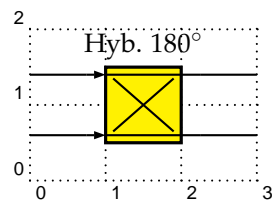


```
\begin{pspicture}(3,2)\psgrid
\pnode(0.5,1){A}
\pnode(2.5,1){B}
\pnode(1.5,0){C}
\agc[tripoleinput=right,inputarrow=true](A)(B)(C)%
{AGC}{fillstyle=solid,fillcolor=blue}
\end{pspicture}
```

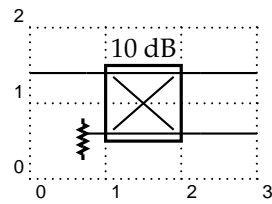
## 3.5 New quadripole macro-components

### 3.5.1 Coupler

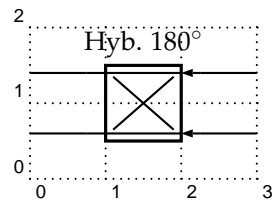
**couplerstyle:** hybrid | directional  
**inputarrow:** false | true  
**quadripoleinput:** left | right



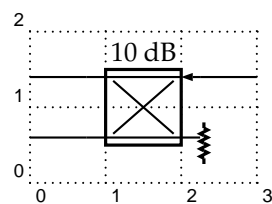
```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1.4){A}
\pnode(0,0.6){B}
\pnode(3,1.4){C}
\pnode(3,0.6){D}
\coupler[couplerstyle=hybrid,inputarrow=true](A)(B)(C)(D)%
{Hyb. $180^\circ\ensuremath{\sim\circlearrowleft}$}%
{fillstyle=solid,fillcolor=yellow}
\end{pspicture}
```



```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1.4){A}
\pnode(0,0.6){B}
\pnode(3,1.4){C}
\pnode(3,0.6){D}
\coupler[couplerstyle=directional](A)(B)(C)(D){10~dB}{-}
\end{pspicture}
```



```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1.4){A}
\pnode(0,0.6){B}
\pnode(3,1.4){C}
\pnode(3,0.6){D}
\coupler[couplerstyle=hybrid,inputarrow=true,%
quadripoleinput=right](A)(B)(C)(D){%
{Hyb. $180^\circ$}\ensuremath{\sim\circ}}{}
\end{pspicture}
```

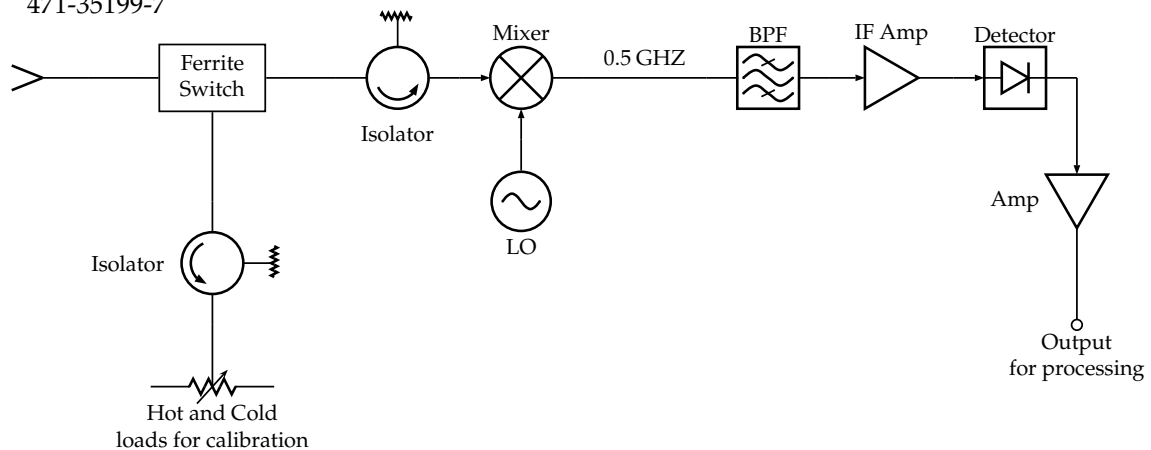


```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1.4){A}
\pnode(0,0.6){B}
\pnode(3,1.4){C}
\pnode(3,0.6){D}
\coupler[couplerstyle=directional,quadripoleinput=right,%
inputarrow=true](A)(B)(C)(D){10~dB}{-}
\end{pspicture}
```

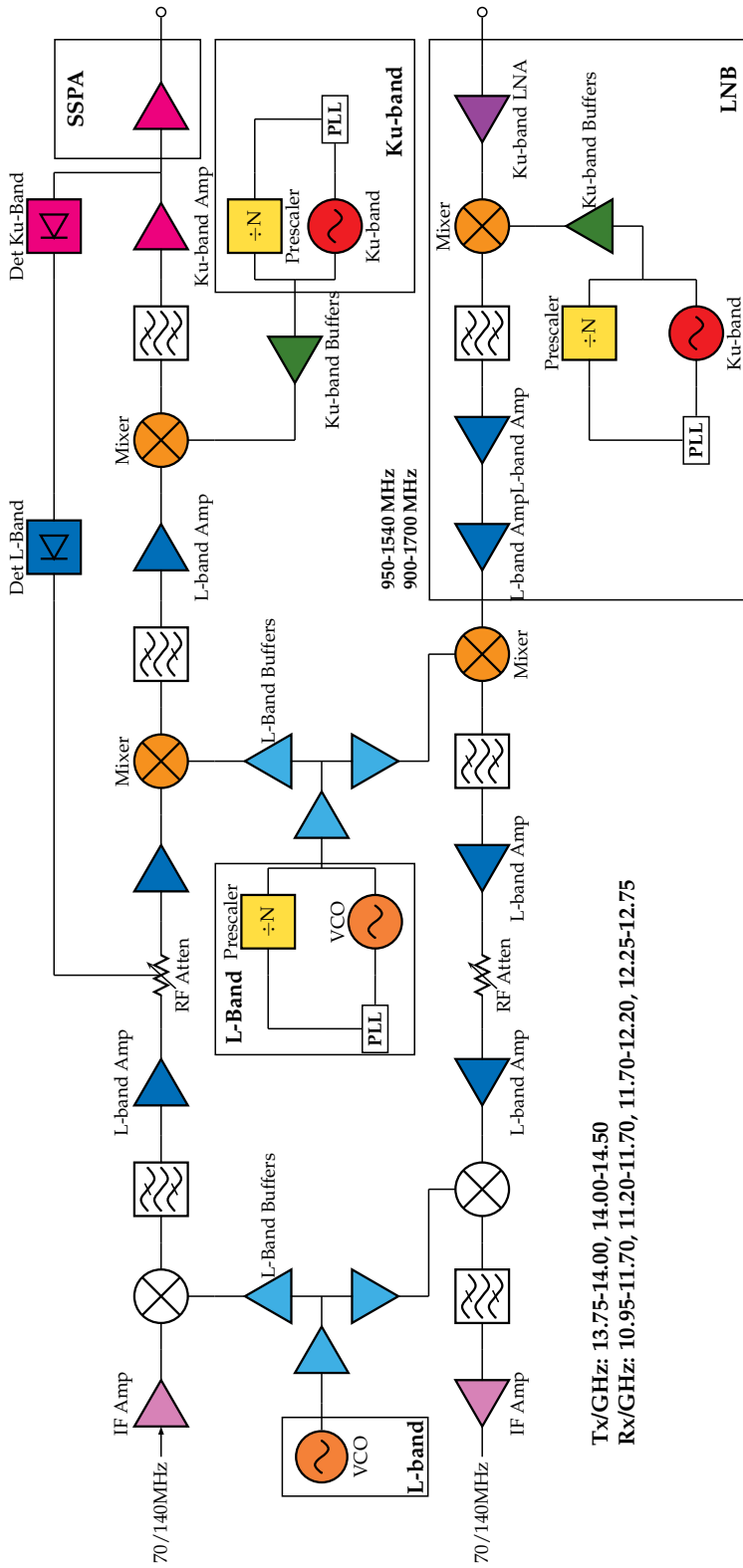
## 3.6 Examples

### 3.6.1 Radiometer block diagram example

From Chang, K., RF and Microwave Wireless Systems, Wiley InterScience, page 319, ISBN 0-471-35199-7



### 3.6.2 Ku-band Transceiver



Tx/GHz: 13.75-14.00, 14.00-14.50

Rx/GHz: 10.95-11.70, 11.20-11.70, 11.70-12.20, 12.25-12.75

## 4 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.

### 4.1 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)*

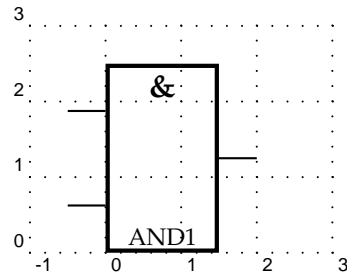
### 4.2 Basic Logical Circuits

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:

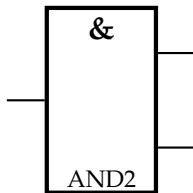
```
And0
a0
a123
12
NOT123a
```

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

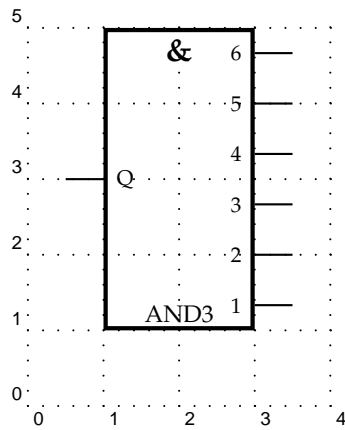
## 4.2.1 And



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

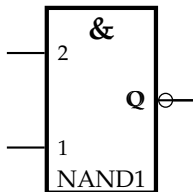


```
\begin{pspicture}(-0.5,0)(3,3)
\logic[logicChangeLR=true]{AND2}
\end{pspicture}
```

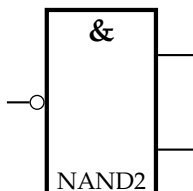


```
\begin{pspicture}(-0.5,0)(4,5)
\psgrid
\logic[logicShowNode=true,%
logicWidth=2,%
logicHeight=4,%
logicNInput=6,%
logicChangeLR=true](1,1){AND3}
\end{pspicture}
```

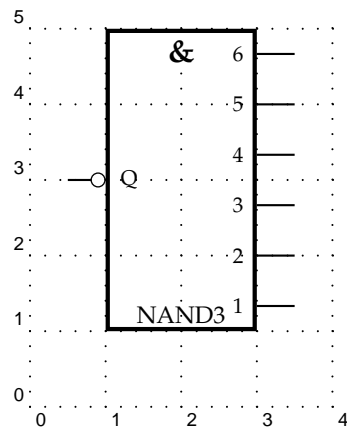
## 4.2.2 NotAnd



```
\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}
```

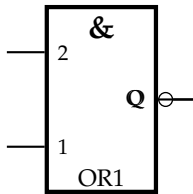


```

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

```

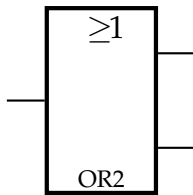
### 4.2.3 Or



```

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

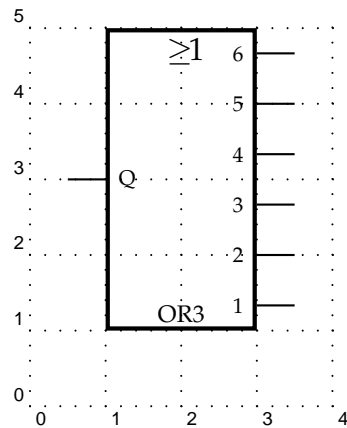
```



```

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

```

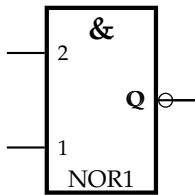


```

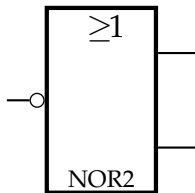
\begin{pspicture}(4,5)
\psgrid
\logic[logicType=or,%
  logicShowNode=true,%
  logicWidth=2,%
  logicHeight=4,%
  logicNInput=6,%
  logicChangeLR=true](1,1){OR3}
\end{pspicture}

```

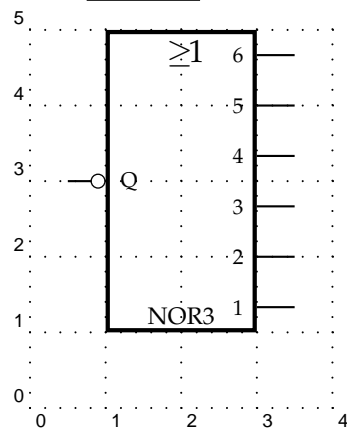
## 4.2.4 Not Or



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

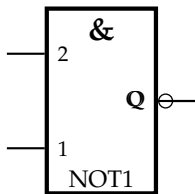


```
\begin{pspicture}(-0.5,0)(3,3)
\logic[logicType=nor,%,
logicChangeLR=true]{NOR2}
\end{pspicture}
```

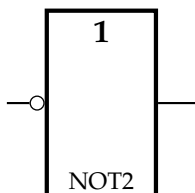


```
\begin{pspicture}(4,5)
\psgrid
\logic[logicType=nor,%,
logicShowNode=true,%,
logicWidth=2,%,
logicHeight=4,%,
logicNInput=6,%,
logicChangeLR=true](1,1){NOR3}
\end{pspicture}
```

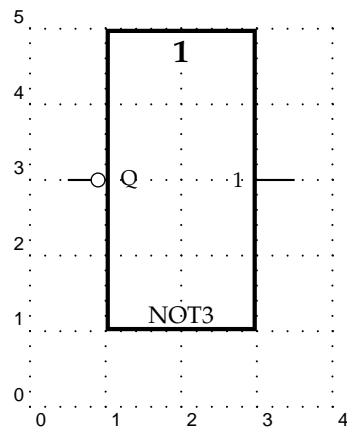
## 4.2.5 Not



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

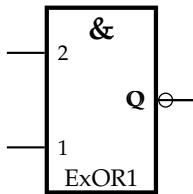


```
\begin{pspicture}(-0.5,0)(3,3)
\logic[logicType=not,%,
logicChangeLR=true]{NOT2}
\end{pspicture}
```

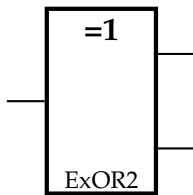


```
\begin{pspicture}(4,5)
\psgrid
\logic[logicType=not,%
      logicShowNode=true,%
      logicWidth=2,%
      logicHeight=4,%
      logicChangeLR=true](1,1){NOT3}
\end{pspicture}
```

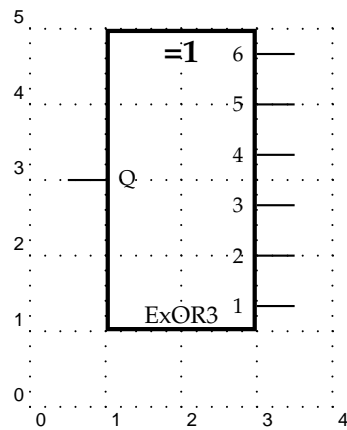
#### 4.2.6 Exclusive OR



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



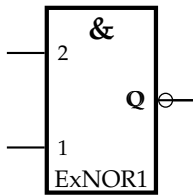
```
\begin{pspicture}(-0.5,0)(3,3)
\logic[logicType=exor,%
      logicChangeLR=true]{ExOR2}
\end{pspicture}
```



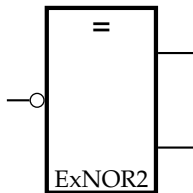
```
\begin{pspicture}(4,5)
\psgrid
\logic[logicType=exor,%
      logicShowNode=true,%
      logicNInput=6,%
      logicWidth=2,%
      logicHeight=4,%
      logicChangeLR=true](1,1){ExOR3}
\end{pspicture}
```



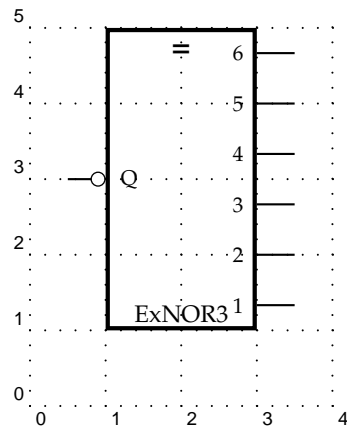
## 4.2.7 Exclusive NOR



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

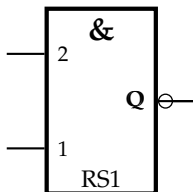


```
\begin{pspicture}(-0.5,0)(3,3)
\logic[logicType=exnor, %
logicChangeLR=true]{ExNOR2}
\end{pspicture}
```

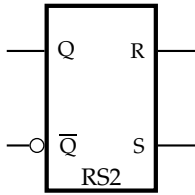


```
\begin{pspicture}(4,5)
\psgrid
\logic[logicType=exnor, %
logicShowNode=true, %
logicNInput=6, %
logicWidth=2, %
logicHeight=4, %
logicChangeLR=true](1,1){ExNOR3}
\end{pspicture}
```

## 4.3 RS Flip Flop



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

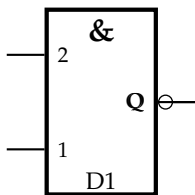


```

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

```

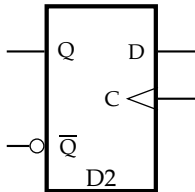
#### 4.4 D Flip Flop



```

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

```

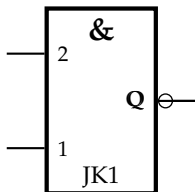


```

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

```

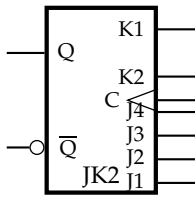
#### 4.5 JK Flip Flop



```

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

```

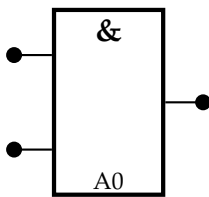


```

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

```

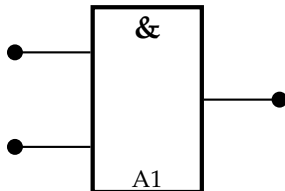
## 4.6 Other Options



```

\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.

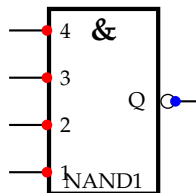
## 4.7 The Node Names

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



```

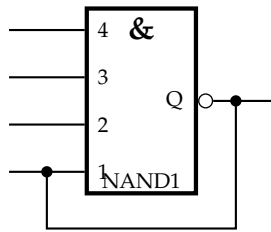
\begin{pspicture}(-0.5,0)(2.5,3)
\logic[logicShowNode=true,%
logicLabelstyle=\footnotesize,%
logicType=nand,%
logicNInput=4]{NAND1}
\multido{\n=1+1}{4}{%
\pscircle*[linecolor=red](NAND1\n){2pt}%
}
\pscircle*[linecolor=blue](NAND1Q){2pt}
\end{pspicture}

```

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

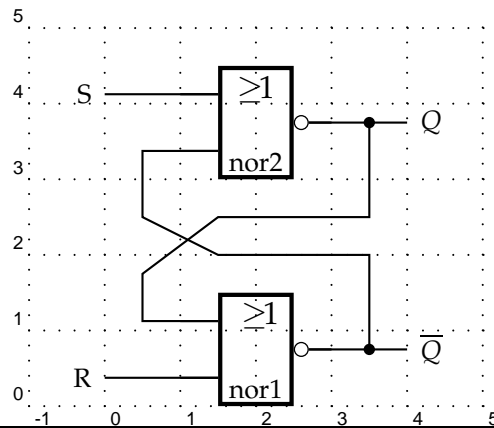
```
\ncbar[angleA=0,angleB=180]{<Node A>}{<Node B>}
```

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

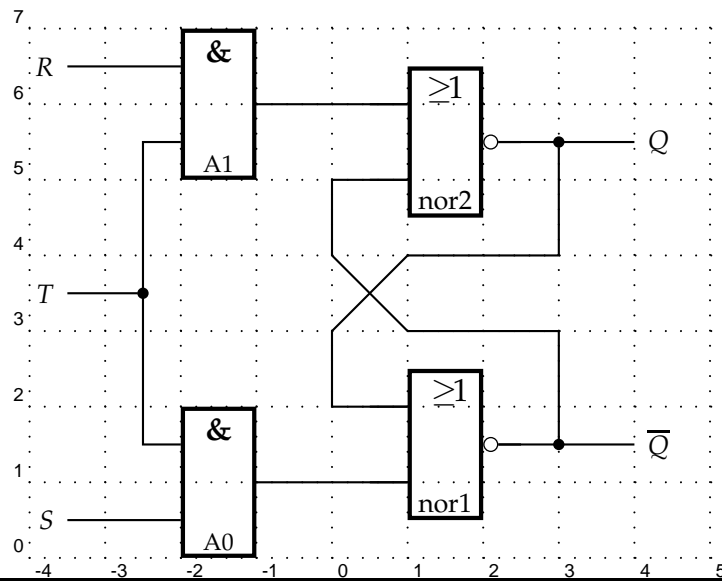


```
\begin{pspicture}(-1,-1)(2.5,3)
\logic[logicShowNode=true,%
logicLabelstyle=\footnotesize,%
logicType=nand,%
logicWireLength=1,%
logicNInput=4]{NAND1}
\node(-0.5,0|NAND1){tempA}
\node(2,0|NAND1Q){tempB}
\end{pspicture}
10 \ncbar[angleA=-90,angleB=0,arm=0.75,%
1 \arrows=*, dotsize=0.15]{tempA}{tempB}
```

## 4.8 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}

```

## 5 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.

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