

pst-circ

A PSTricks package for drawing electric circuits

ver. 1.44

Christophe Jorssen* Herbert Voß† François Boone‡

February 27, 2008

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.

Contents

1	Introduction	2			
2	The basic system	2			
2.1	Parameters	2			
2.2	Macros	3			
2.2.1	Dipole macros	3			
2.2.2	Tripole macros	5			
2.2.3	Quadrupole macros	6			
2.2.4	Multidipole	7			
2.2.5	Wire	7			
2.2.6	Potential	7			
2.2.7	ground	8			
2.3	Parameters	8			
2.3.1	Label parameters	8			
2.3.2	Current intensity and electrical potential parameters	9			
2.3.3	Parallel parameters	11			
2.3.4	Wire intersections	12			
2.3.5	Dipole style parameters	13			
2.3.6	Tripole style parameters	15			
2.3.7	Potentiometer tripole	16			
2.3.8	Other Parameters	16			
2.4	Special objects	18			
			2.4.1	\dashpot	18
			2.5	Examples	19
3	Microwave symbols	27			
3.1	New monopole components	27			
3.1.1	New ground	27			
3.1.2	Antenna	28			
3.2	New monopole macro-components	28			
3.2.1	Oscillator	28			
3.3	New dipole macro-components	29			
3.3.1	Filters	29			
3.3.2	Isolator	29			
3.3.3	Frequency multiplier/divider	30			
3.3.4	Phase shifter	30			
3.3.5	VCO	31			
3.3.6	Amplifier	31			
3.3.7	Detector	31			
3.4	New tripole macro-components	32			
3.4.1	Mixer	32			
3.4.2	Circulator	32			
3.4.3	Agc	33			
3.5	New quadrupole macro-components	33			

*<CJ@PSTricks.de>

†<voss@PSTricks.de>

‡(microwave symbols) francois.boone@usherbrooke.ca

3.5.1	Coupler	33	4.2.5	Not	39
3.6	Examples	34	4.2.6	Exclusive OR	40
3.6.1	Radiometer block diagram example	34	4.2.7	Exclusive NOR	41
3.6.2	Ku-band Transceiver	35	4.3	RS Flip Flop	41
4	Flip Flops – logical elements	36	4.4	D Flip Flop	42
4.1	The Options	36	4.5	JK Flip Flop	42
4.2	Basic Logical Circuits	36	4.6	Other Options	43
4.2.1	And	37	4.7	The Node Names	43
4.2.2	NotAnd	37	4.8	Examples	44
4.2.3	Or	38	5	Adding new components	45
4.2.4	Not Or	39	6	Acknowledgements	47

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

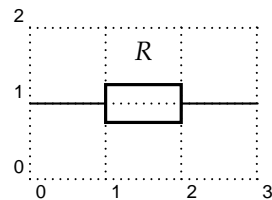
There are specific parameters defined to change easily the behaviour of the pst-circ objects you are drawing.

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

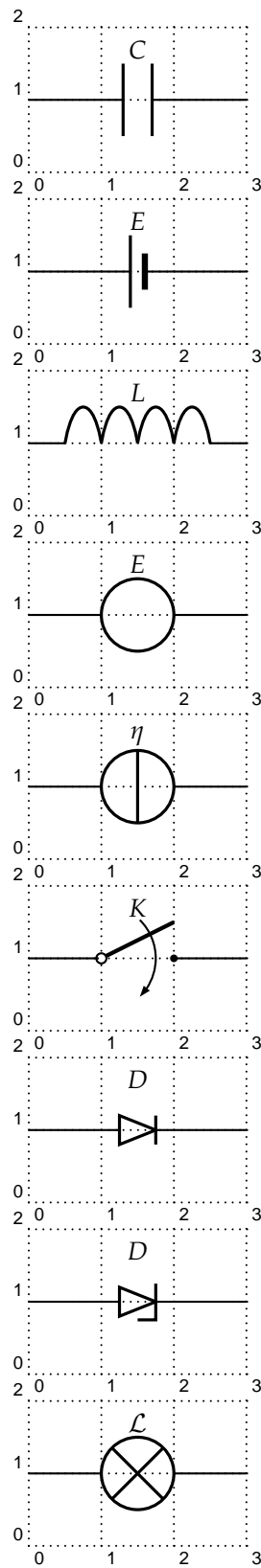
2.2.1 Dipole macros



```

\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}
```

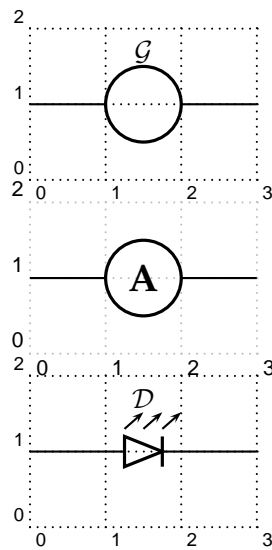
```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1){A}
\pnode(3,1){B}
\Icc(A)(B){\eta$}
\end{pspicture}
```

```
\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}
```



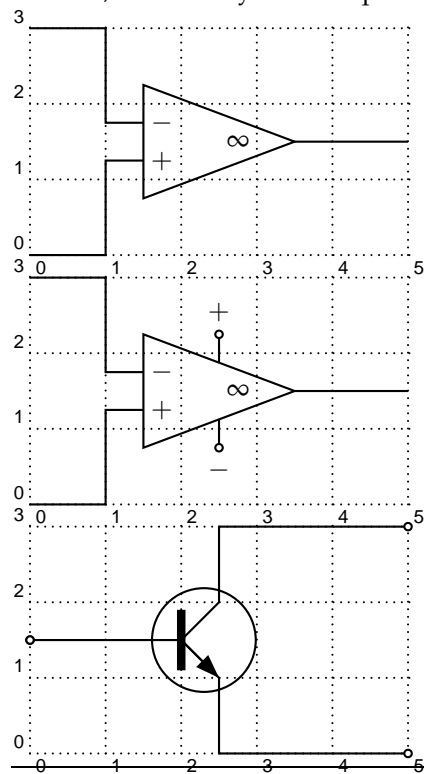
```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1){A}
\pnode(3,1){B}
\circledipole(A)(B){$\mathcal{G}$}
\end{pspicture}
```

```
\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 chosen¹, so don't try to use tripole macros in strange situations!

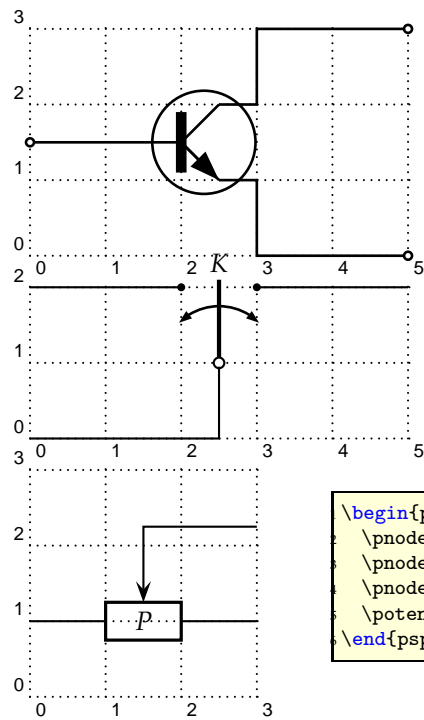


```
\begin{pspicture}(5,3)\psgrid
\pnode(0,0){A}
\pnode(0,3){B}
\pnode(5,1.5){C}
\OA(B)(A)(C)
\end{pspicture}
```

```
\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}
```

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.

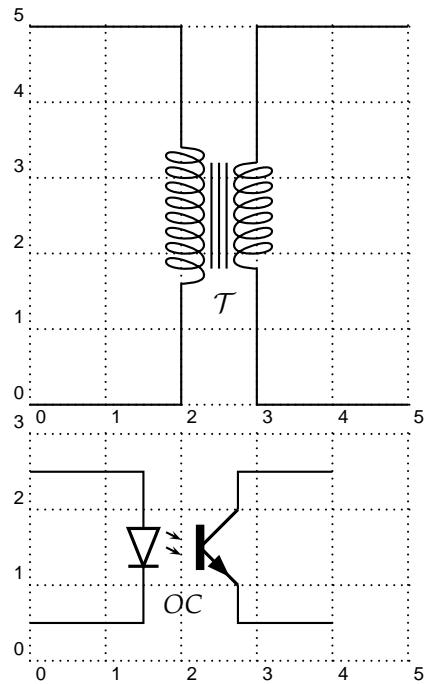


```
\begin{pspicture}(5,3)\psgrid
  \pnode(0,1.5){A}\psset{linewidth=1pt}
  \transistor[basesep=2cm,arrows=o-o](A){Emitter}{
    Collector}
  \psline{o-}(5,3)(3,3)(3,3|Collector)(Collector)
  \psline{o-}(5,0)(3,0)(3,3|Emitter)(Emitter)
  \psline{o-}(A)([nodesep=2]A)
\end{pspicture}
```

```
\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

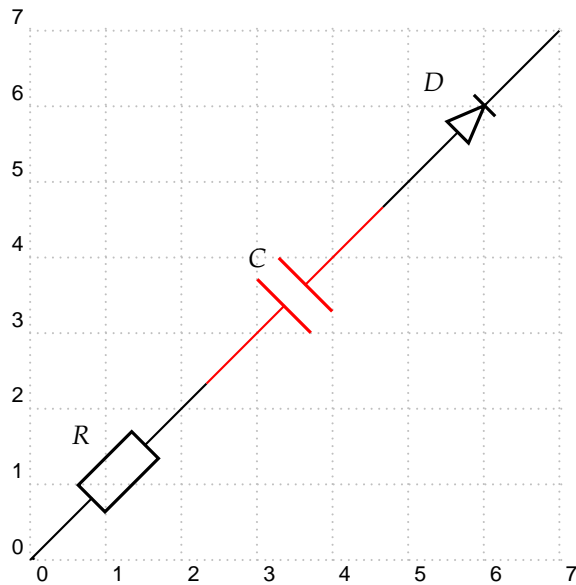


```
\begin{pspicture}(5,5)\psgrid
  \pnode(0,5){A}
  \pnode(0,0){B}
  \pnode(5,5){C}
  \pnode(5,0){D}
  \transformer(A)(B)(C)(D){\mathcal T$}
\end{pspicture}
```

```
\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

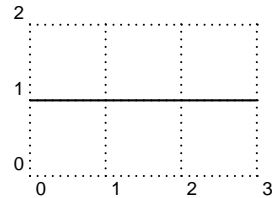
`\multidipole` is a macro that allows multiple dipoles to be drawn between two specified nodes. `\multidipole` takes as many arguments as you want. **Note the dot that is after the last dipole.**



```
\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}
```

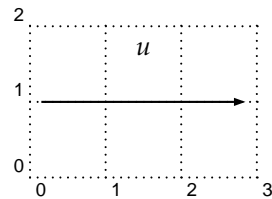
Important: for the time being, `\multidipole` takes optional arguments but does not restore original values. We recommend not using it.

2.2.5 Wire



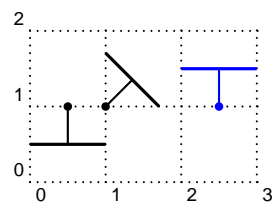
```
\begin{pspicture}(3,2)\psgrid
  \pnode(0,1){A}
  \pnode(3,1){B}
  \wire(A)(B)
\end{pspicture}
```

2.2.6 Potential



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

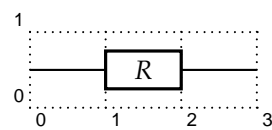
2.2.7 ground



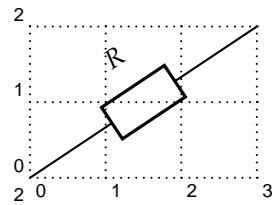
```
\begin{pspicture}(3,2)\psgrid
\pnode(0.5,1){A}
\pnode(1,1){B}
\pnode(2.5,1){C}
\ground(A)
\ground{135}(B)
\ground[linecolor=blue]{180}(C)
\end{pspicture}
```

2.3 Parameters

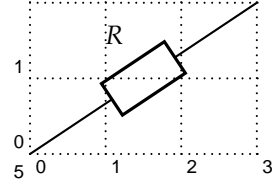
2.3.1 Label parameters



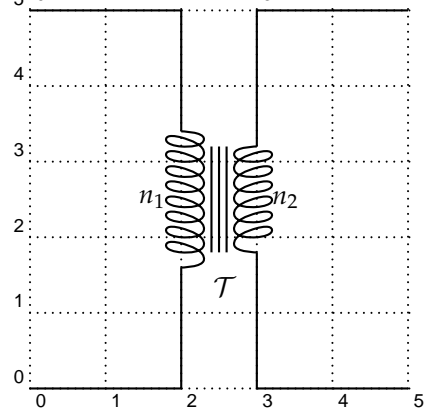
```
\begin{pspicture}(3,1)\psgrid
\pnode(0,.5){A}
\pnode(3,.5){B}
\resistor[labeloffset=0](A)(B){R$}
\end{pspicture}
```



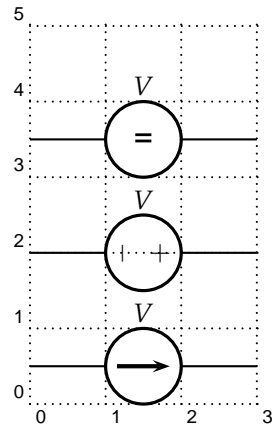
```
\begin{pspicture}(3,2)\psgrid
\pnode(0,0){A}
\pnode(3,2){B}
\resistor[labelangle=:U](A)(B){R$}
\end{pspicture}
```



```
\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}
```



```

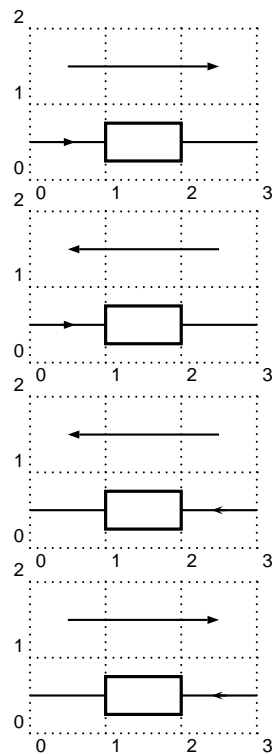
\begin{pspicture}(3,4.5)\psgrid
\pnode(0,.5){A}
\pnode(3,.5){B}
\Ucc[labelInside=1](A)(B){$V$}
\pnode(0,2){A}
\pnode(3,2){B}
\Ucc[labelInside=2](A)(B){$V$}
\pnode(0,3.5){A}
\pnode(3,3.5){B}
\Ucc[labelInside=3](A)(B){$V$}
\end{pspicture}

```

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}

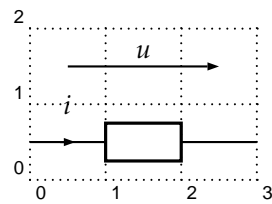
```

```

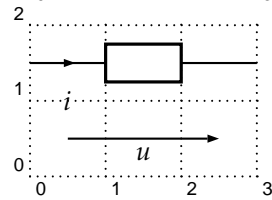
\begin{pspicture}(3,2)\psgrid
\pnode(0,.5){A}
\pnode(3,.5){B}
\resistor[intensity,tension,
dipoleconvention=generator,directconvention=false](A)(B){}
\end{pspicture}

```

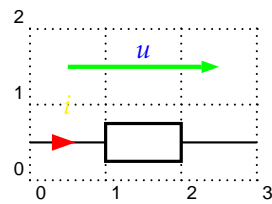
If intensitylabel is set to a non empty argument, then intensity is automatically set to true. If tensionlabel is set to a non empty argument, then tension is automatically set to true.



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

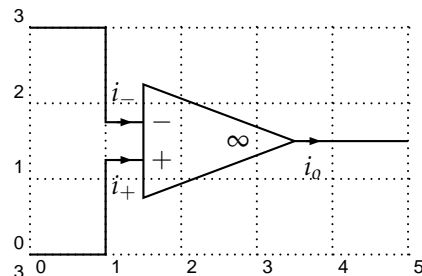


```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1.5){A}
\pnode(3,1.5){B}
\resistor[intensitylabel=$i$,intensitylabeloffset=-0.5,
tensionlabel=$u$,tensionlabeloffset=-1.2,
tensionoffset=-1](A)(B){}
\end{pspicture}
```

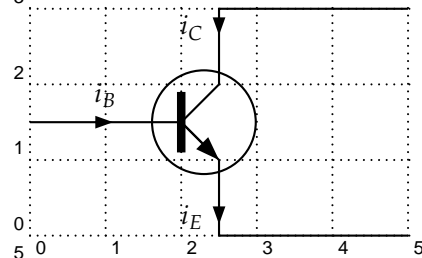


```
\begin{pspicture}(3,2)\psgrid
\pnode(0,.5){A}
\pnode(3,.5){B}
\resistor[intensitylabel=$i$,intensitywidth=3\pslinewidth,
intensitycolor=red,intensitylabelcolor=yellow,
tensionlabel=$u$,tensionwidth=2\pslinewidth,
tensioncolor=green,tensionlabelcolor=blue](A)(B){}
\end{pspicture}
```

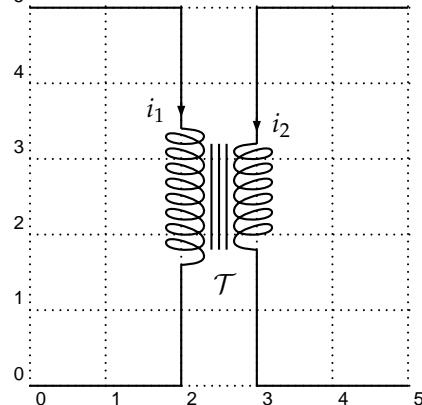
Some specific intensity parameters are available for tripoles and quadrupoles.



```
\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}
```



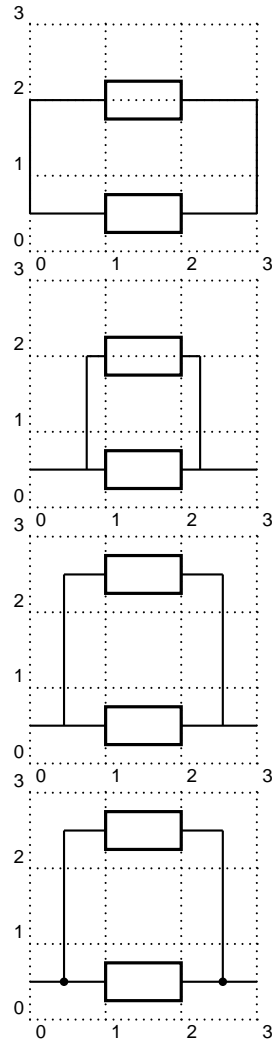
```
\begin{pspicture}(5,3)\psgrid
\pnode(0,1.5){A}
\pnode(5,0){B}
\pnode(5,3){C}
\transistor[basesep=2cm,transistoribaselabel=$i_B$,
transistoricollectorlabel=$i_C$,
transistoriemitterlabel=$i_E$](A)(B)(C)
\end{pspicture}
```



```
\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.

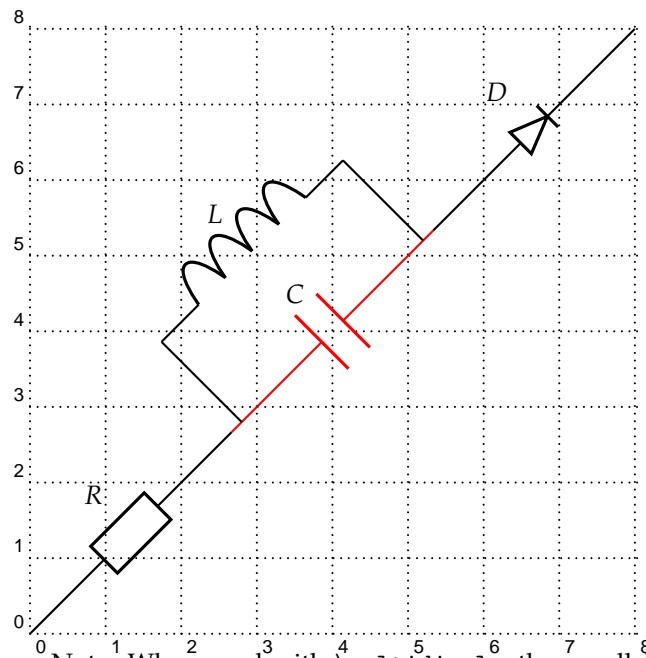


```
\begin{pspicture}(3,3)\psgrid
\pnode(0,.5){A}
\pnode(3,.5){B}
\resistor(A)(B){}
\resistor[parallel](A)(B){}
\end{pspicture}
```

```
\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}
```



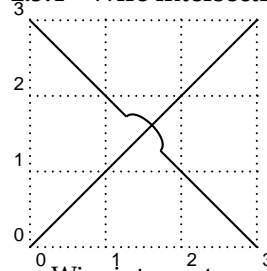
```

\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

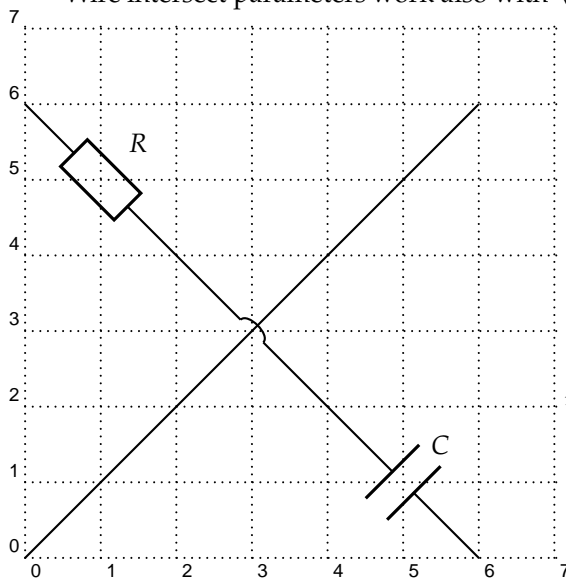


```

\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`.

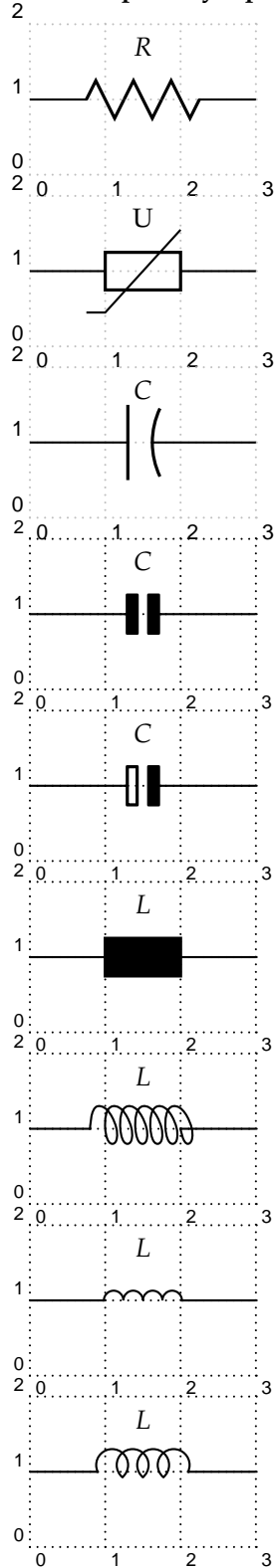


```

\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}
```

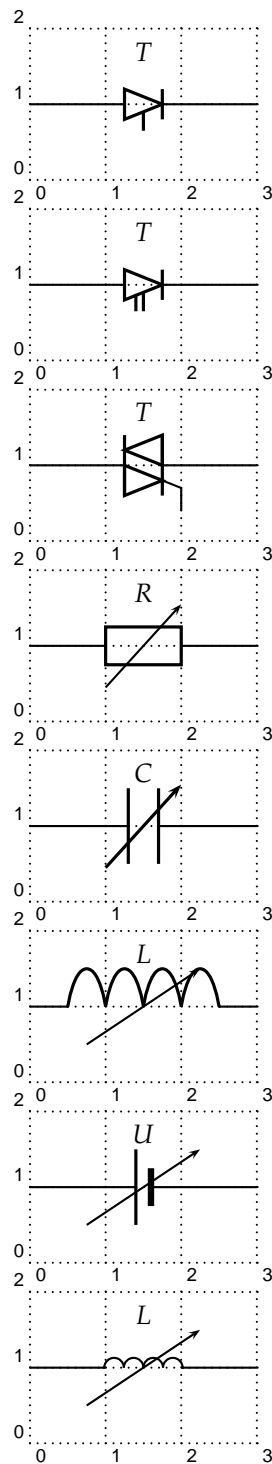
```
\begin{pspicture}(3,2)\psgrid
  \pnode(0,1){A}
  \pnode(3,1){B}
  \capacitor[dipolestyle=elektorchemical](A)(B){C$}
\end{pspicture}
```

```
\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=GT0](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}
```

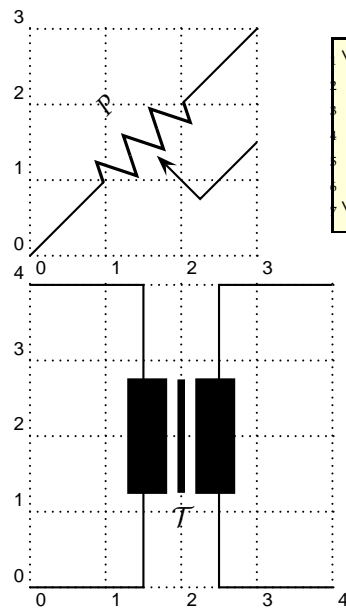
```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1){A}
\pnode(3,1){B}
\capacitor[variable](A)(B){$C$}
\end{pspicture}
```

```
\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}
```

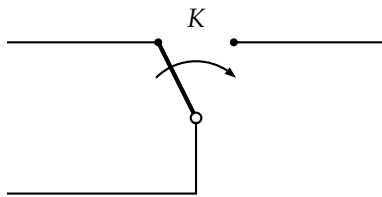
In the following example the parameter `dipolestyle` is used for a tripole and quadrupole, because the coils are drawn as rectangles and the resistor as a zigzag.



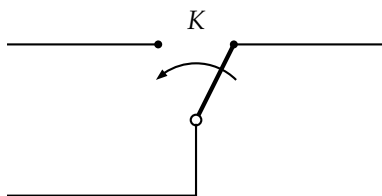
```
\begin{pspicture}(3,3)\psgrid
\pnode(0,0){A}
\pnode(3,3){B}
\pnode(3,1.5){C}
\potentiometer[dipolestyle=zigzag,%
labelangle=:U](A)(B)(C){$P$}
\end{pspicture}
```

```
\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}
```

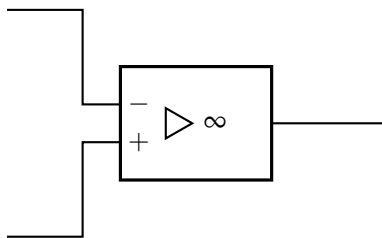
2.3.6 Tripole style parameters



```
\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}
```

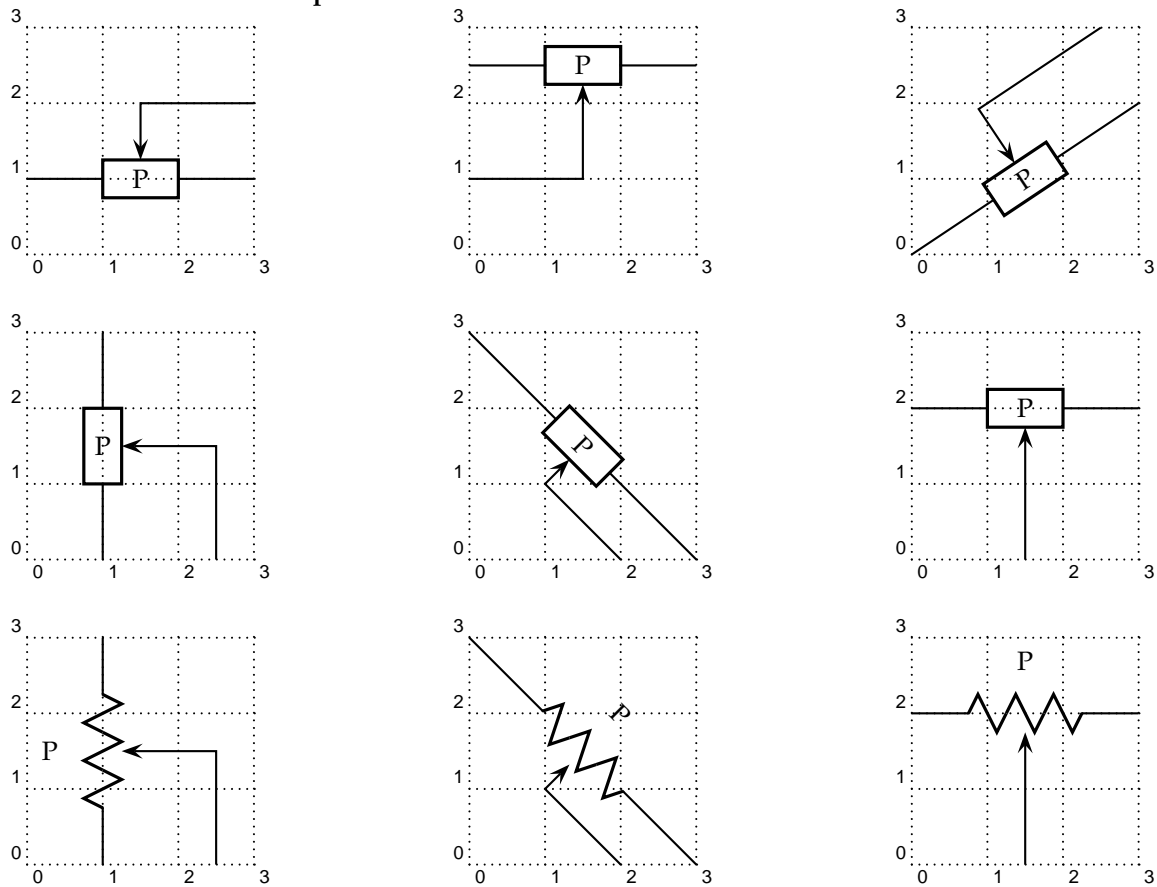


```
\begin{pspicture}(5,3)
\pnode(0,2){A}
\pnode(5,2){B}
\pnode(0,0){C}
\Tswitch[tripolestyle=right](A)(B)(C){$K$}
\end{pspicture}
```

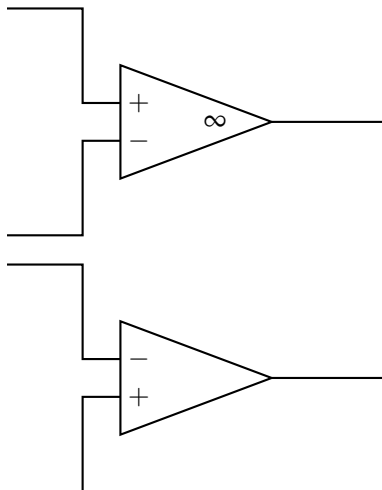


```
\begin{pspicture}(5,3)
\pnode(0,3){A}
\pnode(0,0){B}
\pnode(5,1.5){C}
\OA[tripolestyle=french](A)(B)(C)
\end{pspicture}
```

2.3.7 Potentiometer tripole

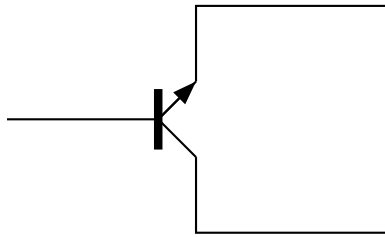


2.3.8 Other Parameters

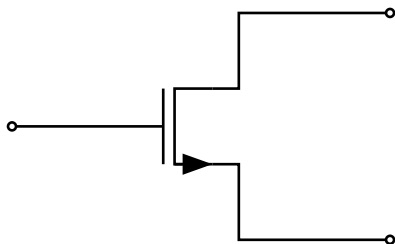


```
\begin{pspicture}(5,3)
  \pnode(0,0){A}
  \pnode(0,3){B}
  \pnode(5,1.5){C}
  \OA[OAinvert=false](B)(A)(C)
\end{pspicture}
```

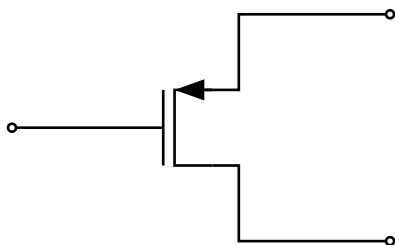
```
\begin{pspicture}(5,3)
  \pnode(0,0){A}
  \pnode(0,3){B}
  \pnode(5,1.5){C}
  \OA[OAperfect=false](B)(A)(C)
\end{pspicture}
```



```
\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}
```



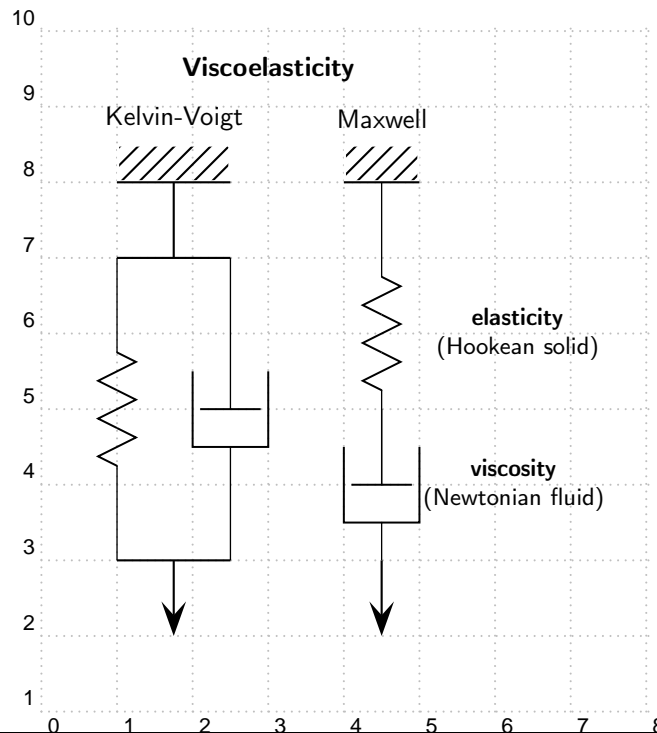
```
\begin{pspicture}(5,3)
\pnode(0,1.5){A}\psset{linewidth=1pt}
\transistor[basesep=2cm,arrows=o-o,
transistortype=FET](A){Emitter}{Collector}
\psline{o-}(5,3)(3,3)(3,3|Collector)(Collector)
\psline{o-}(5,0)(3,0)(3,3|Emitter)(Emitter)
\psline{o-}(A)([nodesep=2]A)
\end{pspicture}
```



```
\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

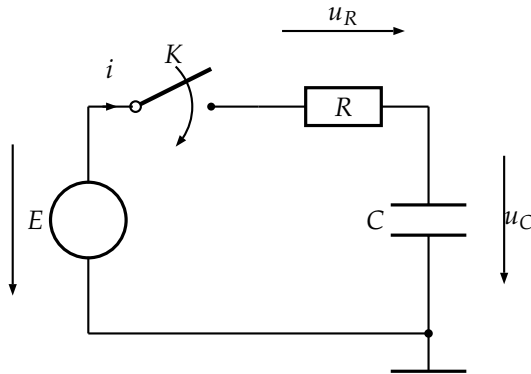


```

\newcommand*\pswall[3]{% ll ur lr
\psframe[linewidth=white,fillstyle=hlines,hatchcolor=black](#1)(#2){% (ll)(ur)
\psline[linewidth=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(ur1){ll1}% 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}\end{tabular}}\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}\end{tabular}}\end{tabular}% end dashpot
\psline[arrowscale=3]{->}(4.5,3)(4.5,2)% force
\end{pspicture}

```

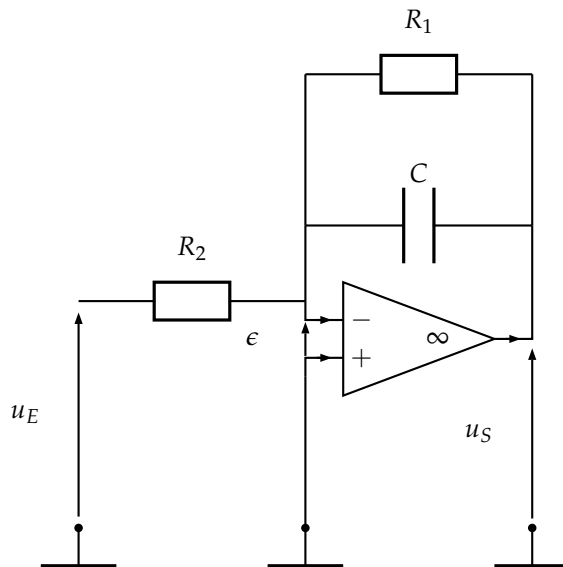
2.5 Examples



```

\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}

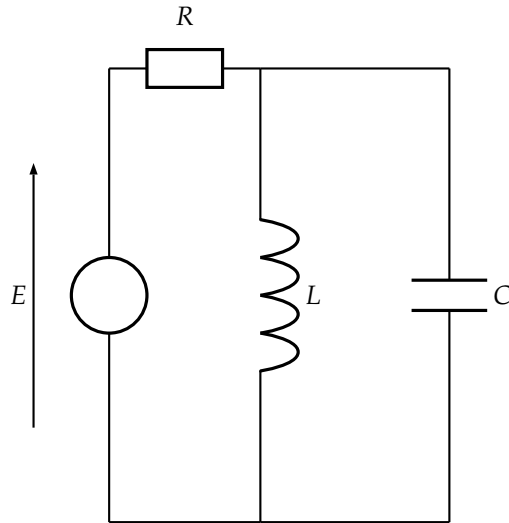
```



```

\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}

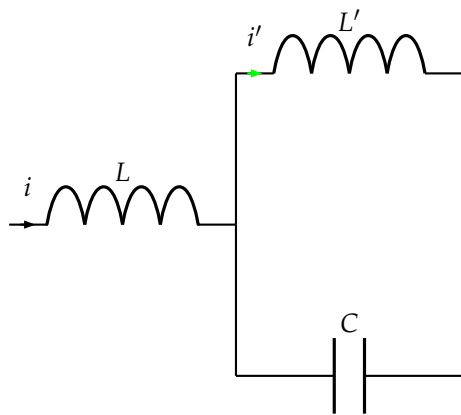
```



```

\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}

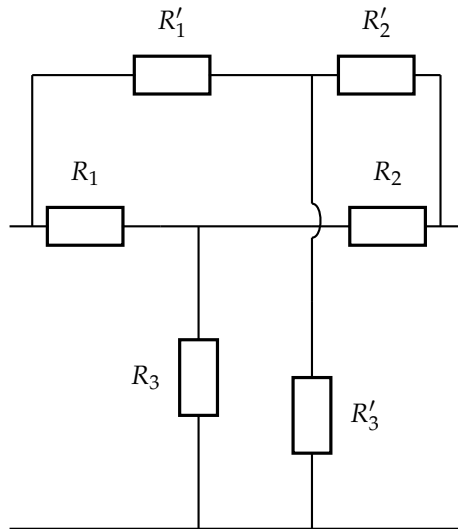
```



```

\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}

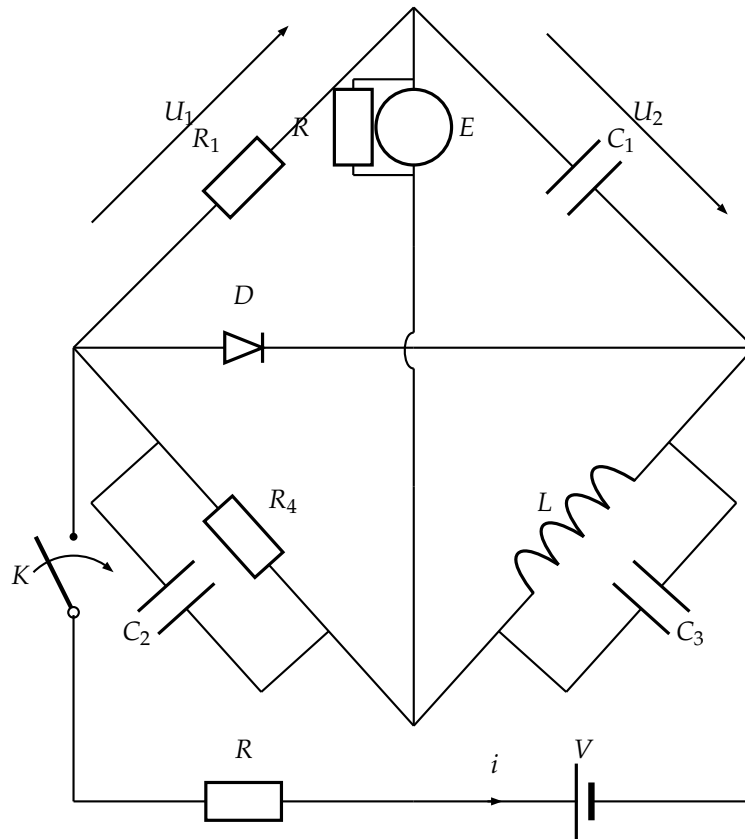
```



```

\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}

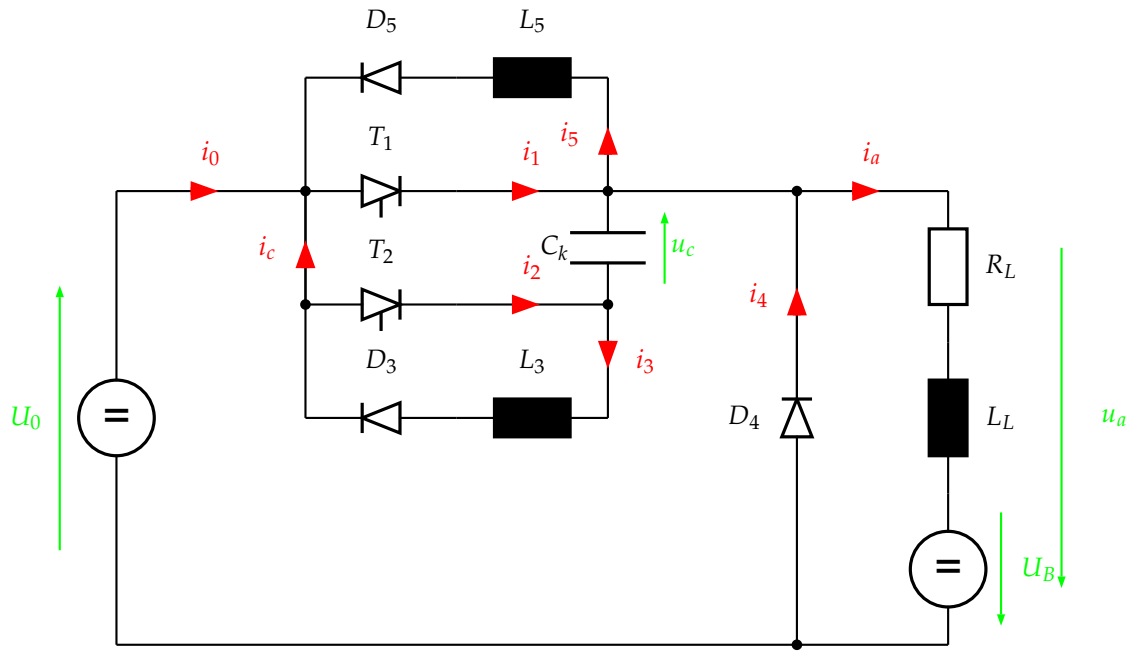
```



```

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}

```

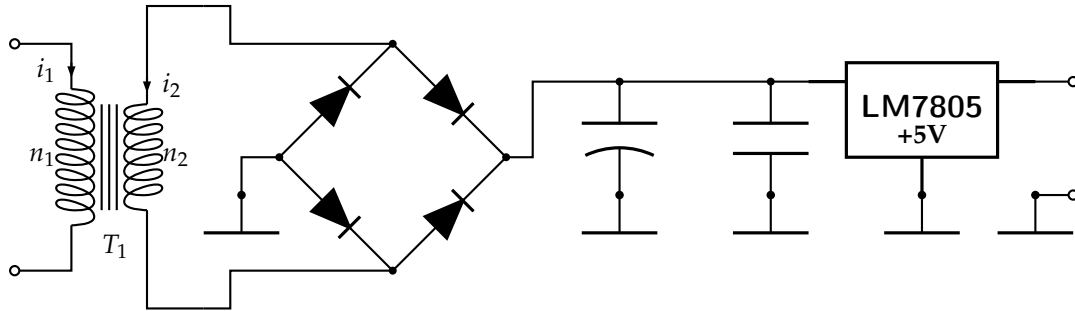


```

\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.

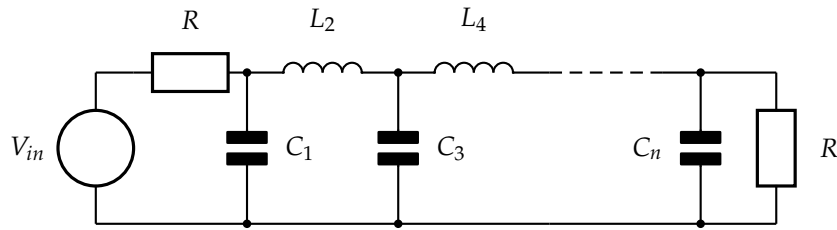


```

\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.

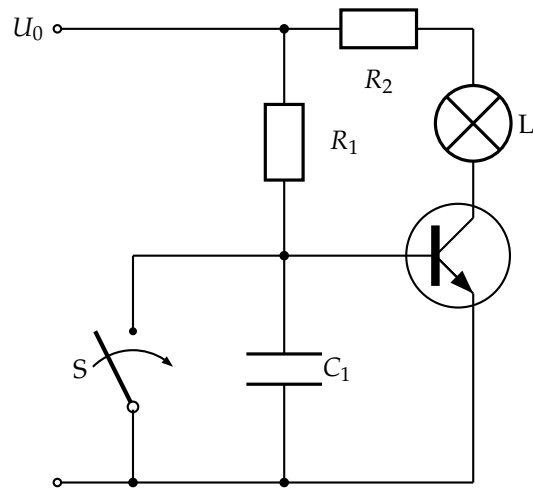


```

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[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}

```

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.

```

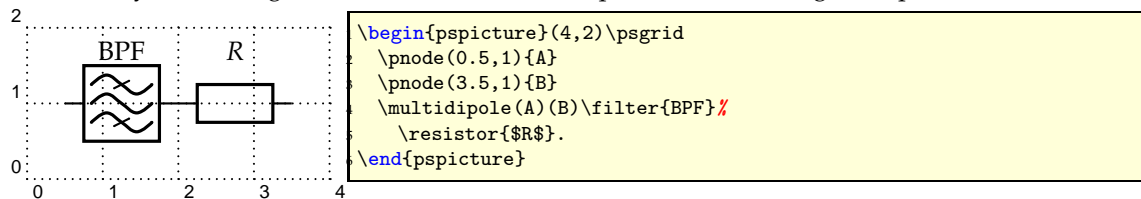
%%%%
\ifPst@inputarrow
  \ifx\psk@Dinput\pst@Dinput@right
    \pcline[arrows=-C] (#2) (dipole@1)
    \pcline[arrows=->,arrowinset=0] (#3) (dipole@2)
  \else
    \pcline[arrows=->,arrowinset=0] (#2) (dipole@1)
    \pcline[arrows=C-] (dipole@2) (#3)
  \fi
\else
  \pcline[arrows=-C] (#2) (dipole@1)
  \pcline[arrows=C-] (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:

```

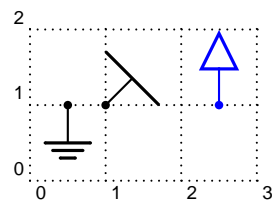
\begin{LTXexample}[width=3.5cm,rframe={}]
\begin{pspicture}(4,2)\psgrid
  \pnode(0.5,1){A}
  \pnode(3.5,1){B}
  \multidipole(A)(B)\amplifier{LNA}%
  \resistor{R$$.
\end{pspicture}
\end{LTXexample}

```

3.1 New monopole components

3.1.1 New ground

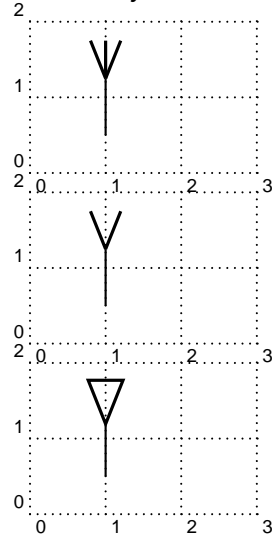
groundstyle: ads | old | triangle



```
\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}
```

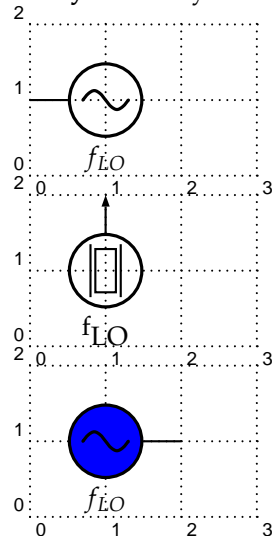
3.2 New monopole macro-components

3.2.1 Oscillator

output: top | right | bottom | left

inputarrow: false | true

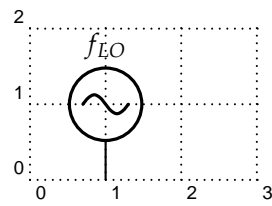
L0style: - | crystal



```
\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{trm}{LO}}\$}{\{}}
\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}
```

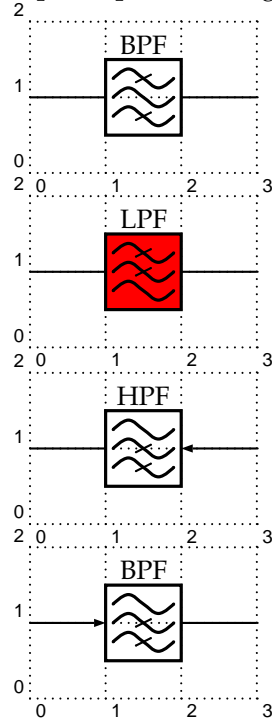
3.3 New dipole macro-components

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}
```

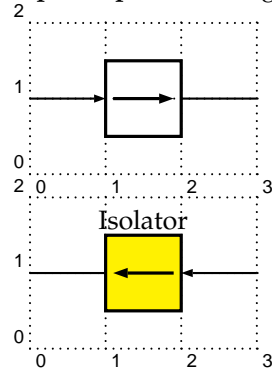
```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1){A}
\pnode(3,1){B}
\filter[dipolestyle=highpass,dipoleinput=right,%
inputarrow=true](A)(B){HPF}
\end{pspicture}
```

```
\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

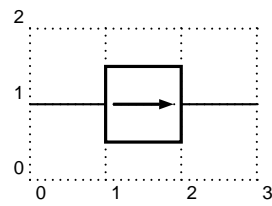
inputarrow: false | true

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

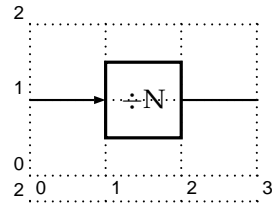
dipolestyle: multiplier | divider

value: N | $n \in N$

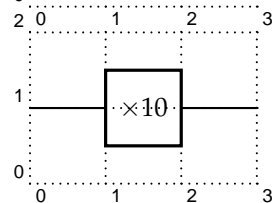
programmable: false | true

inputarrow: false | true

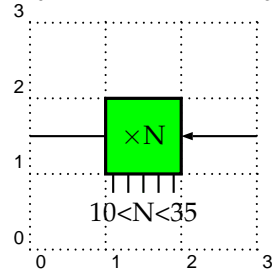
dipoleinput: left | right



```
\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}
```

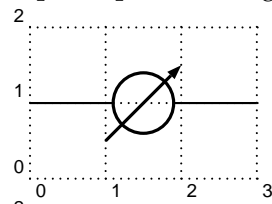


```
\begin{pspicture}(3,3)\psgrid
\pnode(0,1.5){A}
\pnode(3,1.5){B}
\freqmult[dipolestyle=multiplier,programmable=true,%
labeloffset=-1,%
dipoleinput=right,%
inputarrow=true,%
fillstyle=solid,%
fillcolor=green](A)(B){10<N<35}
\end{pspicture}
```

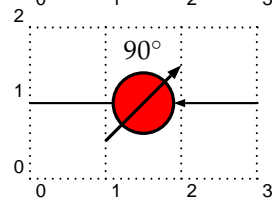
3.3.4 Phase shifter

inputarrow: false | true

dipoleinput: left | right

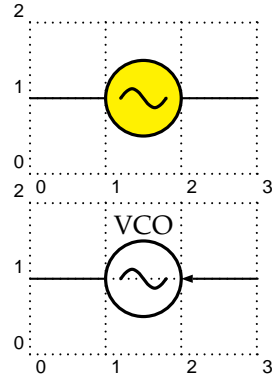


```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1){A1}
\pnode(3,1){A2}
\phaseshifter(A1)(A2){}
\end{pspicture}
```



```
\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}
```

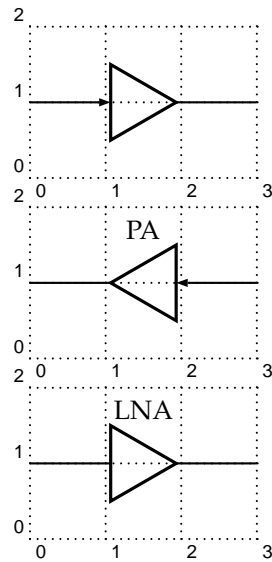
3.3.5 VCO

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

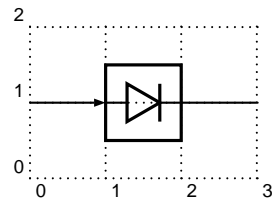
inputarrow: false | true**dipoleinput:** left | right

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

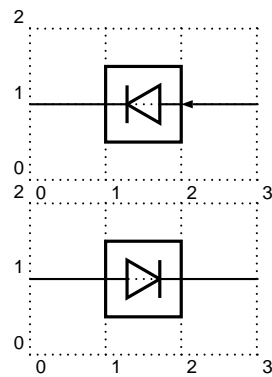
```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1){A}
\pnode(3,1){B}
\amplifier[dipoleinput=right,inputarrow=true](A)(B){PA}
\end{pspicture}
```

```
\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}
```

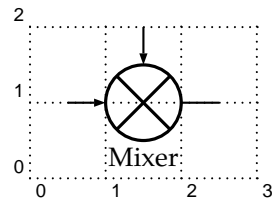
3.4 New tripole macro-components

3.4.1 Mixer

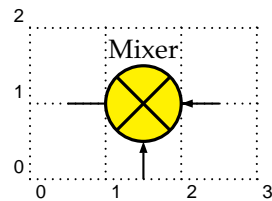
tripolestyle: bottom | top

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}
```



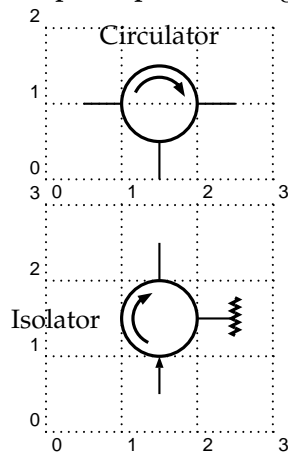
```
\begin{pspicture}(3,2)\psgrid
\pnode(0.5,1){A}
\pnode(2.5,1){B}
\pnode(1.5,0){C}
\mixer[inputarrow=true,tripoleinput=right](A)(B)(C){}
\mixer{fillstyle=solid,fillcolor=yellow}
\end{pspicture}
```

3.4.2 Circulator

tripolestyle: circulator | isolator

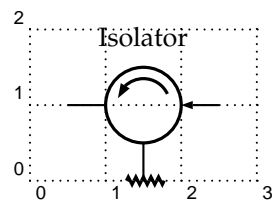
inputarrow: false | true

tripoleinput: left | right

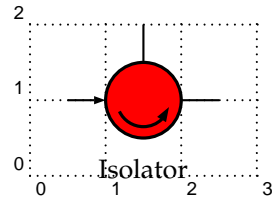


```
\begin{pspicture}(3,2)\psgrid
\pnode(0.5,1){A}
\pnode(2.5,1){B}
\pnode(1.5,0){C}
\circulator{0}(A)(B)(C){Circulator}{}
\end{pspicture}
```

```
\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}
```



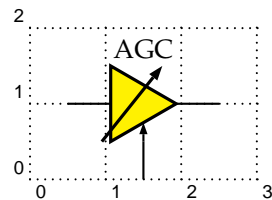
```
\begin{pspicture}(3,2)\psgrid
\pnode(0.5,1){A}
\pnode(2.5,1){B}
\pnode(1.5,0){C}
\circulator[tripoleconfig=right,tripolestyle=isolator,%
inputarrow=true,tripoleinput=right]{0}%
(B)(A)(C){Isolator}{}
\end{pspicture}
```



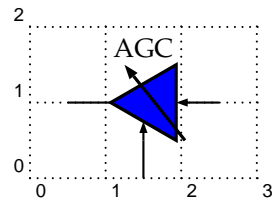
```
\begin{pspicture}(3,2)\psgrid
\pnode(0.5,1){A}
\pnode(2.5,1){B}
\pnode(1.5,2){C}
\circulator[tripoleconfig=right,inputarrow=true]{180}%
(A)(B)(C){Isolator}{fillstyle=solid,fillcolor=red}
\end{pspicture}
```

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}
```

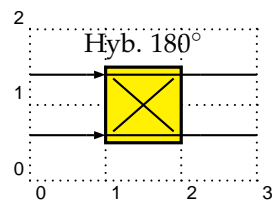


```
\begin{pspicture}(3,2)\psgrid
\pnode(0.5,1){A}
\pnode(2.5,1){B}
\pnode(1.5,0){C}
\agc[tripoleinput=right,inputarrow=true](A)(B)(C)%
{AGC}{fillstyle=solid,fillcolor=blue}
\end{pspicture}
```

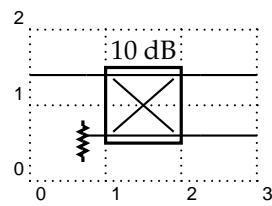
3.5 New quadripole macro-components

3.5.1 Coupler

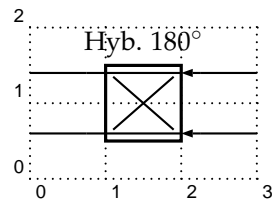
couplerstyle: hybrid | directional
inputarrow: false | true
quadripoleinput: left | right



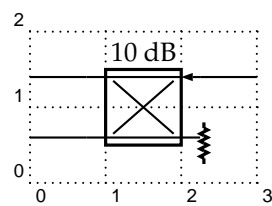
```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1.4){A}
\pnode(0,0.6){B}
\pnode(3,1.4){C}
\pnode(3,0.6){D}
\coupler[couplerstyle=hybrid,inputarrow=true](A)(B)(C)(D)%
{Hyb. $180^\circ\ensuremath{\sim\circlearrowleft}$}%
{fillstyle=solid,fillcolor=yellow}
\end{pspicture}
```



```
\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}
```

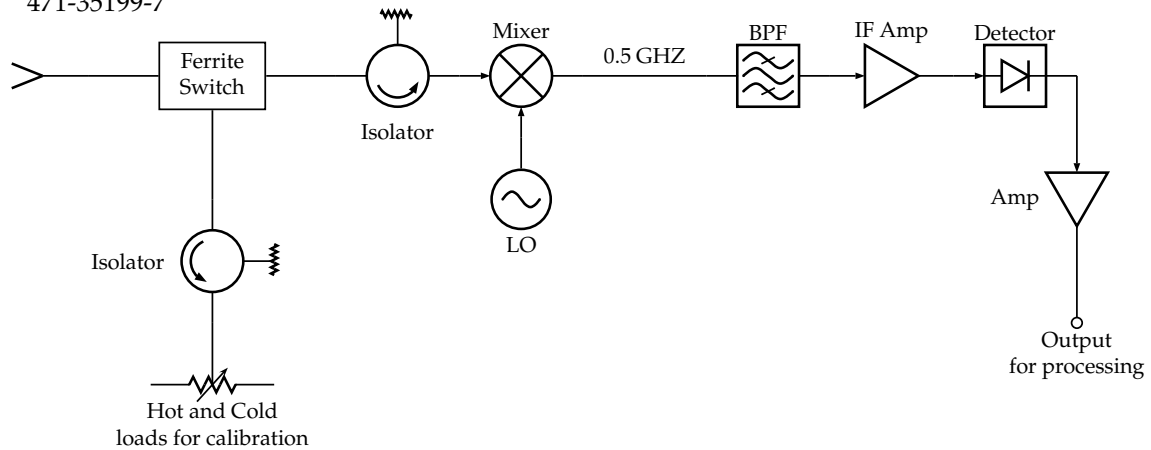


```
\begin{pspicture}(3,2)\psgrid
\pnode(0,1.4){A}
\pnode(0,0.6){B}
\pnode(3,1.4){C}
\pnode(3,0.6){D}
\coupler[couplerstyle=directional,quadripoleinput=right,%
inputarrow=true](A)(B)(C)(D){10~dB}{-}
\end{pspicture}
```

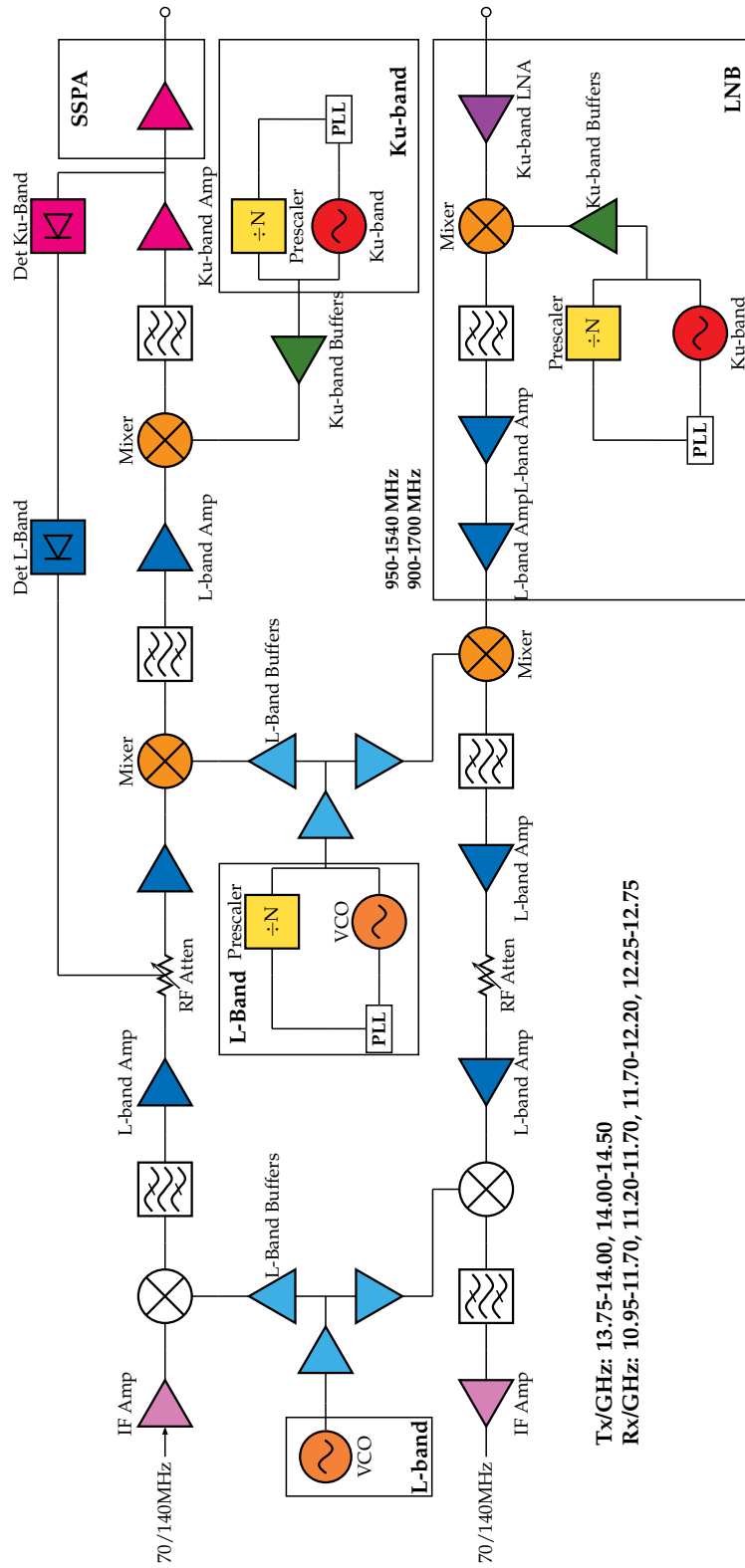
3.6 Examples

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)*

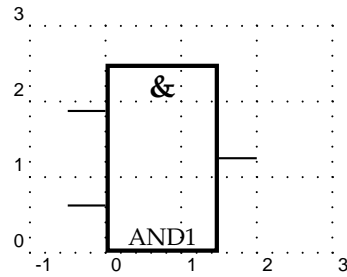
4.2 Basic Logical Circuits

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:

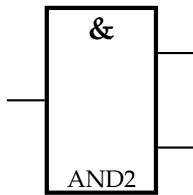
```
And0
a0
a123
12
NOT123a
```

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

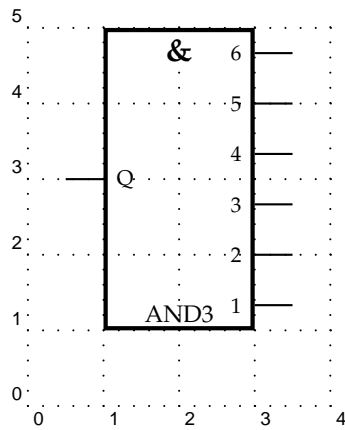
4.2.1 And



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

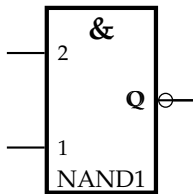


```
\begin{pspicture}(-0.5,0)(3,3)
\logic[logicChangeLR=true]{AND2}
\end{pspicture}
```

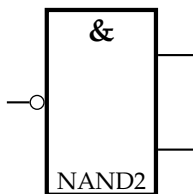


```
\begin{pspicture}(-0.5,0)(4,5)
\psgrid
\logic[logicShowNode=true,%
logicWidth=2,%
logicHeight=4,%
logicNInput=6,%
logicChangeLR=true](1,1){AND3}
\end{pspicture}
```

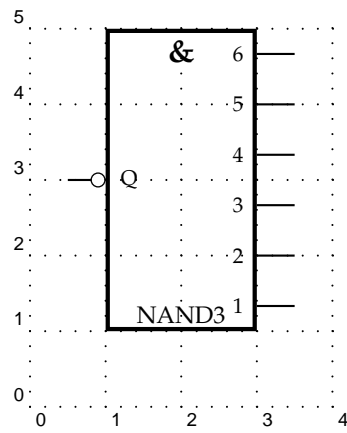
4.2.2 NotAnd



```
\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}
```

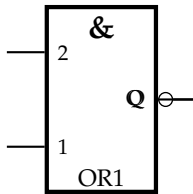


```

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

```

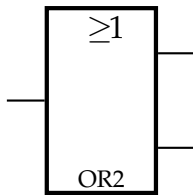
4.2.3 Or



```

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

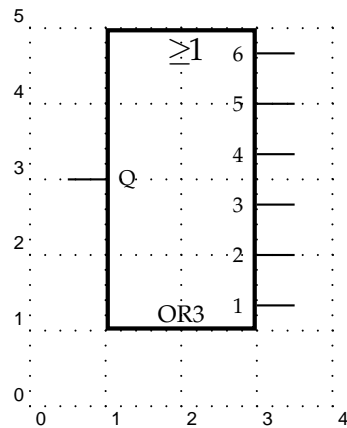
```



```

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

```

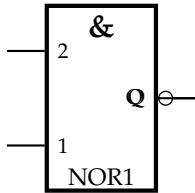


```

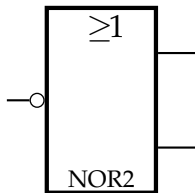
\begin{pspicture}(4,5)
\psgrid
\logic[logicType=or,%
  logicShowNode=true,%
  logicWidth=2,%
  logicHeight=4,%
  logicNInput=6,%
  logicChangeLR=true](1,1){OR3}
\end{pspicture}

```

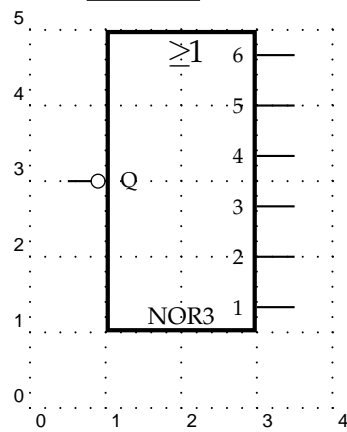
4.2.4 Not Or



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

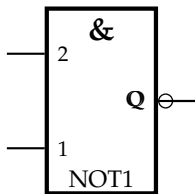


```
\begin{pspicture}(-0.5,0)(3,3)
\logic[logicType=nor,%,
logicChangeLR=true]{NOR2}
\end{pspicture}
```

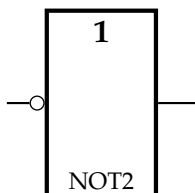


```
\begin{pspicture}(4,5)
\psgrid
\logic[logicType=nor,%,
logicShowNode=true,%,
logicWidth=2,%,
logicHeight=4,%,
logicNInput=6,%,
logicChangeLR=true](1,1){NOR3}
\end{pspicture}
```

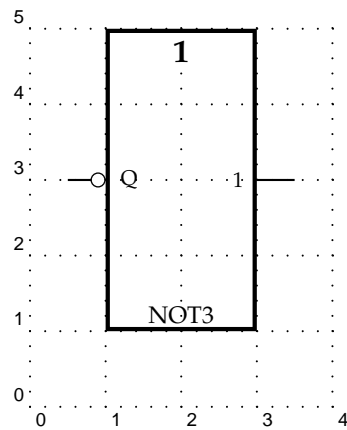
4.2.5 Not



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

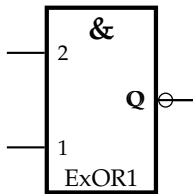


```
\begin{pspicture}(-0.5,0)(3,3)
\logic[logicType=not,%,
logicChangeLR=true]{NOT2}
\end{pspicture}
```

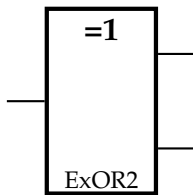


```
\begin{pspicture}(4,5)
\psgrid
\logic[logicType=not,%
  logicShowNode=true,%
  logicWidth=2,%
  logicHeight=4,%
  logicChangeLR=true](1,1){NOT3}
\end{pspicture}
```

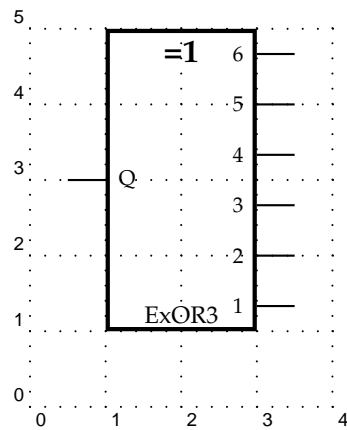
4.2.6 Exclusive OR



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

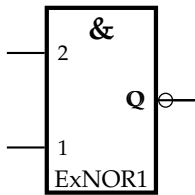


```
\begin{pspicture}(-0.5,0)(3,3)
\logic[logicType=exor,%
  logicChangeLR=true]{ExOR2}
\end{pspicture}
```

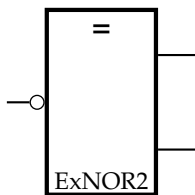


```
\begin{pspicture}(4,5)
\psgrid
\logic[logicType=exor,%
  logicShowNode=true,%
  logicNInput=6,%
  logicWidth=2,%
  logicHeight=4,%
  logicChangeLR=true](1,1){ExOR3}
\end{pspicture}
```

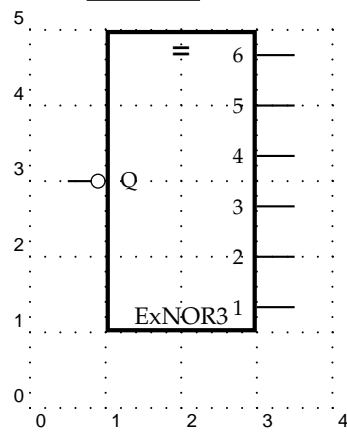
4.2.7 Exclusive NOR



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

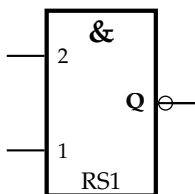


```
\begin{pspicture}(-0.5,0)(3,3)
\logic[logicType=exnor, %
logicChangeLR=true]{ExNOR2}
\end{pspicture}
```

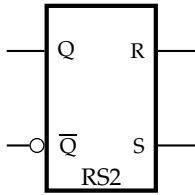


```
\begin{pspicture}(4,5)
\psgrid
\logic[logicType=exnor, %
logicShowNode=true, %
logicNInput=6, %
logicWidth=2, %
logicHeight=4, %
logicChangeLR=true](1,1){ExNOR3}
\end{pspicture}
```

4.3 RS Flip Flop



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

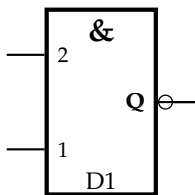


```

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

```

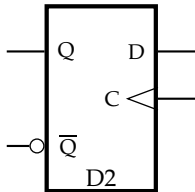
4.4 D Flip Flop



```

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

```

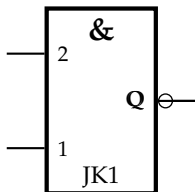


```

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

```

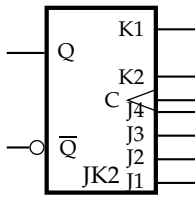
4.5 JK Flip Flop



```

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

```

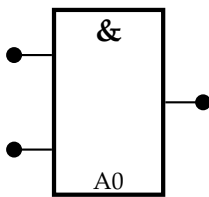


```

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

```

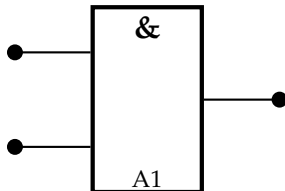
4.6 Other Options



```

\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.

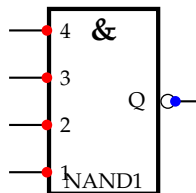
4.7 The Node Names

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



```

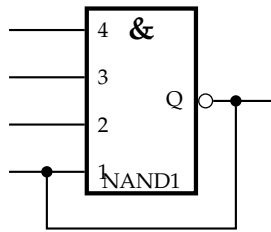
\begin{pspicture}(-0.5,0)(2.5,3)
\logic[logicShowNode=true,%
logicLabelstyle=\footnotesize,%
logicType=nand,%
logicNInput=4]{NAND1}
\multido{\n=1+1}{4}{%
\pscircle*[linecolor=red](NAND1\n){2pt}%
}
\pscircle*[linecolor=blue](NAND1Q){2pt}
\end{pspicture}

```

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

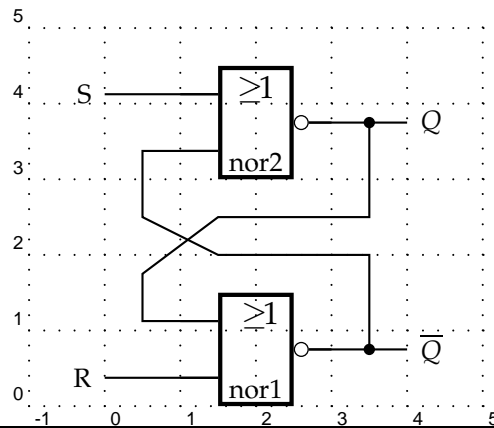
```
\ncbar[angleA=0,angleB=180]{<Node A>}{<Node B>}
```

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

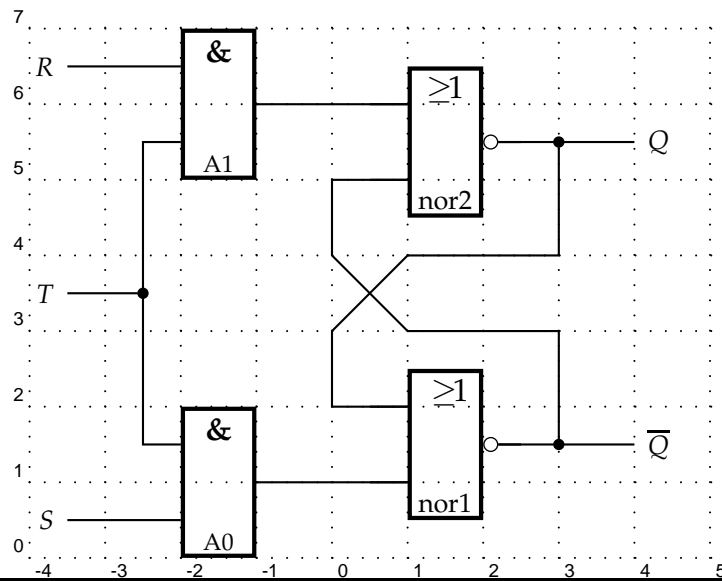


```
\begin{pspicture}(-1,-1)(2.5,3)
\logic[logicShowNode=true,%
logicLabelstyle=\footnotesize,%
logicType=nand,%
logicWireLength=1,%
logicNInput=4]{NAND1}
\node(-0.5,0|NAND1){tempA}
\node(2,0|NAND1Q){tempB}
\end{pspicture}
\ncbar[angleA=-90,angleB=0,arm=0.75,%
arrows=*, dotsize=0.15]{tempA}{tempB}
```

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_
8   name@}%
9   {\pst@multidipole@component_name@[]}}
10 %
11 \def\pst@multidipole@component_name@[#1]#2{%
12   \expandafter\def\csname pst@circ@tmp@\number\pst@circ@count@iii\endcsname
13     {#2}%
14   {\psset{#1}%
15     \ifPst@circ@parallel\aftergroup\advance\aftergroup\pst@circ@count@i\
16       aftergroup\m@ne\fi}%
17   \pst@circ@count@ii=\pst@circ@count@i%
18   \advance\pst@circ@count@ii\@ne%
19   \toks0\expandafter{\pst@multidipole@output}%
20   \edef\pst@multidipole@output{%
21     \the\toks0%
22     \pst@multidipole@def@coor%
23     \noexpand\component_name[#1]%
24     (! X@{\the\pst@circ@count@i\space Y@{\the\pst@circ@count@i})%
25     (! X@{\the\pst@circ@count@ii\space Y@{\the\pst@circ@count@ii})%
26     {\noexpand\csname pst@circ@tmp@\number\pst@circ@count@iii\endcsname}%
27   }%
28   \pst@multidipole@
29 }
30 %
31 \def\pst@draw@component_name{%
32   % The PSTricks code for your component
33   % The center of the component is at (0,0)
34   \pnode(component_left_end,0){dipole@1}
35   \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.

6 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, Sebastian Rahtz, Denis Roegel, and Herbert Voß. *The L^AT_EX Graphics Companion*. Addison-Wesley Publishing Company, Reading, Mass., 2nd edition, 2007.

- [3] Laura E. Jackson and Herbert Voß. Die Plot-Funktionen von `pst-plot`. *Die T_EXnische 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.miwi.e.org/tex-refs/>, 2003.
- [11] Timothy Van Zandt. *PSTricks - PostScript macros for Generic T_EX*. <http://www.tug.org/application/PSTricks>, 1993.