

Components and Examples of tikzircuit

December 7, 2014

Contents

1	Introductory Examples	5
1.1	Bridge Rectifier	5
1.2	Strain Gauges Bridge	6
1.3	Astable Multivibrator	7
2	Sources	8
2.1	Voltage Source in North-South Orientation	8
2.2	Voltage Source in South-North Orientation	8
2.3	Voltage Source in West-East Orientation	9
2.4	Voltage Source in East-West Orientation	9
2.5	Battery in North-South Orientation	9
2.6	Battery in South-North Orientation	9
2.7	Current Source in North-South Orientation	10
2.8	Current Source in South-North Orientation	10
2.9	Current Source in West-East Orientation	10
2.10	Current Source in East-West Orientation	11
3	Voltage and Current Arrows	11
3.1	Voltage Arrow Between Two Nodes	11
3.2	Curved Voltage Arrow Between Two Nodes	11
3.3	Current Arrow in North-South Orientation	12
3.4	Current Arrow in South-North Orientation	12
3.5	Current Arrow in West-East Orientation	12
3.6	Current Arrow in East-West Orientation	12
4	Resistors, Capacitors and Inductors	13
4.1	Resistor in West-East Orientation	13
4.2	Resistor in North-South Orientation	13
4.3	Capacitor in West-East Orientation	13
4.4	Capacitor in North-South Orientation	14

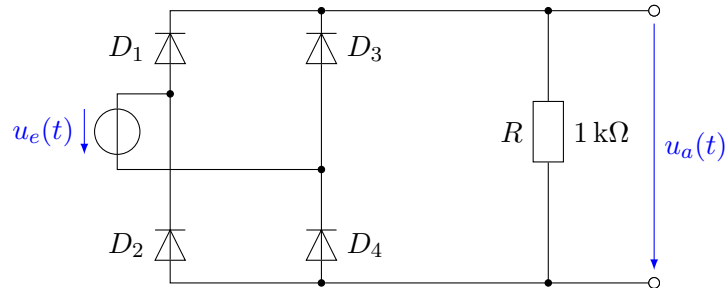
4.5	Inductor in West-East Orientation	14
4.6	Inductor in North-South Orientation	14
4.7	Inductor in North-South Orientation (Mirrored)	14
4.8	Varistor in West-East Orientation	15
4.9	Potentiometer in West-East Orientation, North Connection	15
4.10	Potentiometer in West-East Orientation, South Connection	15
4.11	Potentiometer in North-South Orientation, East Connection	16
4.12	Potentiometer in North-South Orientation, West Connection	16
5	Transformer	16
5.1	Transformer in North-South Orientation	16
6	Diodes	17
6.1	Diode In North-South Orientation	17
6.2	Diode in South-North Orientation	17
6.3	Diode in West-East Orientation	17
6.4	Diode in East-West Orientation	18
6.5	Zener Diode in North-South Orientation	18
6.6	Zener Diode in South-North Orientation	18
6.7	Zener Diode in West-East Orientation	19
6.8	Zener Diode in East-West Orientation	19
6.9	LED in North-South Orientation, Light in East Direction	19
6.10	LED in North-South Orientation, Light in West Direction	19
6.11	LED in South-North Orientation, Light in West Direction	20
6.12	LED in West-East orientation, Light in North Direction	20
6.13	LED in East-West orientation, Light in North Direction	20
6.14	Photo Diode in North-South Orientation, Light from East	21
6.15	photo diode in North-South Orientation, Light from West	21
7	Transistors	21
7.1	N-Channel JFET in North-South Orientation	21
7.2	N-Channel JFET in West-East Orientation	22
7.3	Enhancement-Mode N-Channel MOSFET in North-South Orientation	22
7.4	Enhancement-Mode P-Channel MOSFET in North-South Orientation	22
7.5	NPN Bipolar Junction Transistor in North-South Orientation	23
7.6	NPN Bipolar Junction Transistor in North-South Orientation (Mirrored)	23
7.7	NPN Bipolar Junction Transistor in South-North Orientation	23
7.8	NPN Bipolar Junction Transistor in East-West Orientation	24
7.9	PNP Bipolar Junction Transistor in North-South Orientation	24
8	Operational Amplifiers	24
8.1	OP-AMP, Standardized Symbol	24
8.2	OP-AMP, Standardized Symbol, N-Input above P-Input	25
8.3	OP-AMP	25

8.4	OP-AMP, N-Input above P-Input	26
8.5	General Amplifier	26
9	Amplifiers	27
9.1	Amplifier, Standardized Symbol	27
10	Logic Gates	27
10.1	Inversion Symbol for Logic Gates Outputs	27
10.2	Logic Gate Symbol, IEC Standard	28
10.3	Logic AND Gate Symbol	28
10.4	Logic NAND Gate Symbol	28
10.5	Logic OR Gate Symbol	29
10.6	Logic NOR Gate Symbol	29
10.7	Logic NOT Gate Symbol	29
10.8	Logic XOR Gate Symbol	30
10.9	Logic XNOR Gate Symbol	30
10.10	Logic AND Gate, ANSI Symbol	30
10.11	Logic NAND Gate, ANSI Symbol	31
10.12	Logic OR Gate, ANSI Symbol	31
10.13	Logic NOR Gate, ANSI Symbol	31
10.14	Logic NOT Gate, ANSI Symbol	32
10.15	Logic XOR Gate, ANSI Symbol	32
10.16	Logic XNOR Gate, ANSI Symbol	32
11	Flip-Flops	33
11.1	General Flip-Flop Symbol	33
11.2	General Flip-Flop Symbol for Negative Logic	33
11.3	Flip-Flop Changing on Rising Edge	33
11.4	Flip-Flop Changing on Falling Edge	34
11.5	RS Flip-Flop	34
11.6	RS NAND Flip-Flop (Negative Logic)	34
11.7	RS Flip-Flop Changing on Rising Edge	35
11.8	RS Flip-Flop Changing on Falling Edge	35
11.9	JK Flip-Flop Changing on Rising Edge	35
11.10	JK Master-Slave Flip-Flop	36
11.11	D Flip-Flop Changing on Rising Edge	36
11.12	T Flip-Flop Changing on Rising Edge	36
11.13	T Flip-Flop Changing on Falling Edge	37
11.14	Monoflop	37
11.15	Switch, West-East Direction	37
11.16	Closed Switch, West-East Direction	38
11.17	Switch, East-West Direction	38
11.18	Closed Switch, East-West Direction	38
11.19	Switch, South-North Direction	39

11.20	Closed Switch, South-North Direction	39
11.21	Pushbutton, West-East Direction	39
11.22	Pushbutton, South-North Direction	39
12	Miscellaneous	40
12.1	Ground as Symbol	40
12.2	Ground as Continued Drawing	40
12.3	Connecting Terminal	40
12.4	Junction (Black Filled Circle)	41
12.5	Junction in the Middle of a Path	41
12.6	Connection Node (for Referencing, not Visible)	41
12.7	Midway Connection Node	41
12.8	Invisible Node with Terminal Node Properties (Used with Voltage Arrows)	41
12.9	Speaker	42
12.10	Bulb	42
12.11	Multimeter (Circle for Voltmeter or Ammeter)	42
12.12	Voltsmeter	43
12.13	Ammeter	43
12.14	Brushless DC Electric Motor	43
12.15	Brushless DC Electric Generator	43
12.16	Brushes for Electric Motors and Generators	44
12.17	Brushless DC Electric Motor with Permanent Magnet	44
12.18	DC Electric Motor with Permanent Magnet	44
12.19	Shunt DC Electric Motor	45
12.20	Series DC Electric Motor	45

1 Introductory Examples

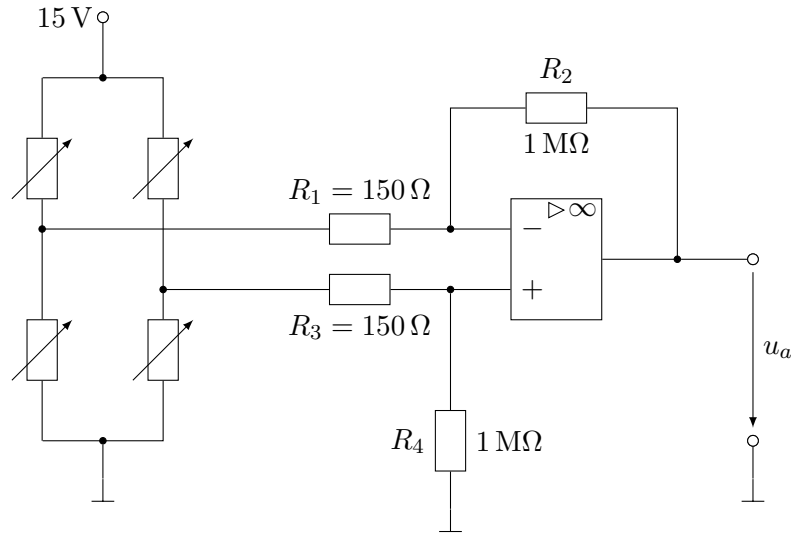
1.1 Bridge Rectifier



```
\begin{tikzpicture}
  \renewcommand{\voltagecolor}{blue}
  \voltageSourceNS{Uin}{(0.3,0)}{left}{\$u_e(t)\$}
  \diodeSN{diodeOne}{(1,1.3)}{left}{\$D_{1}\$}
  \diodeSN{diodeThree}{(3,1.3)}{right}{\$D_{3}\$}
  \diodeSN{diodeTwo}{(1,-1.3)}{left}{\$D_{2}\$}
  \diodeSN{diodeFour}{(3,-1.3)}{right}{\$D_{4}\$}
  \draw (UinN) -- ++(0,0.2) node (UinHelpOne) {} -- (UinHelpOne -|
    diodeOneA) \junction{UinOne};
  \draw (UinS) -- ++(0,-0.2) node (UinHelpTwo) {} -- (UinHelpTwo -|
    diodeThreeA) \junction{UinTwo};
  \draw (diodeOneA) -- (diodeTwoC) (diodeThreeA) -- (diodeFourC);

  \draw (diodeThreeC) -- ++(0,0.3) \junction{jThree} -| (diodeOneC);
  \draw (diodeFourA) -- ++(0,-0.3) \junction{jFour} -| (diodeTwoA);
  \resistorNS{resistor}{(6,0)}{\$R\$}{\SI{1}{\kilo\ohm}}
  \draw (jThree) -| (resistorN);
  \draw (jFour) -| (resistorS);
  \draw (jThree -| resistor) \junction{jrN} -- ++(1.4,0)
    \terminal{tuOutPlus};
  \draw (jFour -| resistor) \junction{jrS} -- (jFour -| tuOutPlus)
    \terminal{tuOutMinus};
  \voltagearrow{(tuOutPlus)}{(tuOutMinus)}{right,midway}{\$u_{a}(t)\$}
\end{tikzpicture}
```

1.2 Strain Gauges Bridge



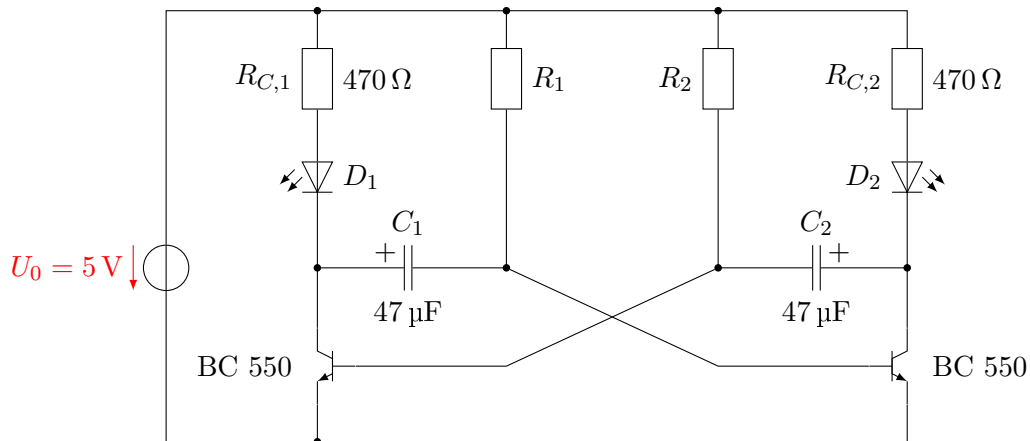
```
\begin{tikzpicture}
  \renewcommand{\voltagecolor}{black}
  \opampNormInv{op}{(0,0)}
  \resistorWE{rOne}{(opInMinus)++(-2,0)}{\$R_1=\SI{150}{\ohm}\$}{\}
  \resistorWE{rThree}{(opInPlus|-rOne)}{\$R_3=\SI{150}{\ohm}\$}{\}
  \resistorWE{rTwo}{(op)++(0,2)}{\$R_2\$}{\$\SI{1}{\mega\ohm}\$}
  \draw (rOneE) -- (opInMinus) \mjunction{jopInMinus};
  \draw (rThreeE) -- (opInPlus) \mjunction{jopInPlus};
  \resistorNS{rFour}{(jopInPlus)++(0,-2)}{\$R_4\$}{\$\SI{1}{\mega\ohm}\$}
  \path (op) ++(-6,0) \cnode{dms};
  \foreach \x/\y/\name in {-0.8/1.2/One, -0.8/-1.2/Two, 0.8/1.2/Three,
    0.8/-1.2/Four}{%
    \resistorNS{dms\name}{(dms)++(\x,\y)}{\$ \$}{\$ \$}
    \draw[-latex] (dms)++(\x,\y) ++(-0.4,-0.4) -- ++(0.8,0.8);
  }
  \draw (dmsOneN) -- ++(0,0.8) \cnode{foo};
  \draw (dmsThreeN) -- (dmsThree|-foo) -- (foo) \mjunction{jdmsN};
  \draw (jdmsN) -- ++(0,0.8) \terminal{tudmsPlus} node [left] {\SI{15}{\volt}};
  \draw (dmsTwoS) -- ++(0,-0.8) \cnode{foo};
  \draw (dmsFourS) -- (dmsFour|-foo) -- (foo) \mjunction{jdmsS};
  \draw (jdmsS) -- ++(0,-0.5) \cnode{gnddms};
  \gnd{(gnddms)}
  \draw (dmsOneS) -- (dmsTwoN) (rOneW) -- (rOne|-dmsOne) \junction{jLeft};
  \draw (dmsThreeS) -- (dmsFourN);
  \draw (rThreeW) -- (rThree|-dmsThree) \junction{jRight};
  \draw (jopInPlus) -- (rFourN) (rFourS) -- ++(0,-0.5) \cnode{gndRFour};
  \gnd{(gndRFour)}
  \draw (jopInMinus) |- (rTwoW);
```

```

\draw (opOut) -- ++(1,0) \junction{jopOut} |- (rTwoE);
\draw (jopOut) -- ++(1,0) \terminal{tuaPlus};
\draw (tuaPlus|-gnddms) \cnode{gndOut} -- ++(0,0.5) \terminal{tuaMinus};
\gnd{(gndOut)}
\voltagearrow{(tuaPlus)}{(tuaMinus)}{right}{\mathfrak{u}_{\mathfrak{a}}}}
\end{tikzpicture}

```

1.3 Astable Multivibrator



```

\begin{tikzpicture}
\renewcommand{\voltagecolor}{red}
\BJTnpnNSMirror{bjtOne}{(0,0)}
\path (bjtOne) ++(-0.2,0) node[left] {BC 550};
\BJTnpnNS{bjtTwo}{(bjtOne)+(7.8,0)}
\path (bjtTwo) ++(0.2,0) node [right] {BC 550};
\ledNSW{ledOne}{(bjtOneC)+(0,1.8)}{\mathfrak{D}_{\mathfrak{1}}}}
\ledNSE{ledTwo}{(bjtTwoC |- ledOne)}{\mathfrak{D}_{\mathfrak{2}}}}
\resistorNS{rcOne}{(ledOne)+(0,1.5)}{\mathfrak{R}_{\mathfrak{C},1}}{\mathfrak{SI}{470}}{\ohm}}
\resistorNS{rcTwo}{(ledTwo |- rcOne)}{\mathfrak{R}_{\mathfrak{C},2}}{\mathfrak{SI}{470}}{\ohm}}
\capacitorWE{cOne}{(ledOne)+(1.2,-1)}{\mathfrak{C}_{\mathfrak{1}}}}{\mathfrak{SI}{47}}{\micro}{farad}}
\path (cOne) ++(-0.3,0.2) node {\mathfrak{C}_{\mathfrak{1}}}};
\resistorNS{rOne}{(rcOne)+(2.5,0)}{\mathfrak{R}_{\mathfrak{1}}}}
\resistorNS{rTwo}{(rcTwo)+(-2.5,0)}{\mathfrak{R}_{\mathfrak{2}}}}{}
\capacitorWE{cTwo}{(ledTwo)+(-1.2,-1)}{\mathfrak{C}_{\mathfrak{2}}}}{\mathfrak{SI}{47}}{\micro}{farad}}
\path (cTwo) ++(0.3,0.2) node {\mathfrak{C}_{\mathfrak{2}}}};
\voltagesourceNS{u}{(ledOne |- cOne)+(-2,0)}{left}{\mathfrak{U}_{\mathfrak{0}}}=\mathfrak{SI}{5}}{\volt}}
\draw (rcOneN) -- ++(0,0.5) \junction{jrcN} |- (uN);
\draw (bjtOneE) -- ++(0,-0.5) \junction{jbjtE} |- (uS);
\draw (jrcN) |- (rcTwoN);
\draw (jbjtE) |- (bjtTwoE);
\draw (rOneN) -- (rOne |- jrcN) \junction{jrcOneN};

```

```

\draw (rTwoN) -- (rTwo |- jrcN) \junction{jrTwoN};
\draw (rcOneS) -- (ledOneA) (ledOneC) -- (bjtOneC);
\draw (rcTwoS) -- (ledTwoA) (ledTwoC) -- (bjtTwoC);
\draw (bjtOneC |- cOne) \junction{jbjtOneC} -- (cOneW);
\draw (bjtTwoC |- cTwo) \junction{jbjtTwoC} -- (cTwoE);
\draw (cOneE) -- (cOne -| rOne) \junction{jcOneW} -- (rOneS);
\draw (cTwoW) -- (cTwo -| rTwo) \junction{jcTwoE} -- (rTwoS);
\draw (jcOneW) -- (rTwo |- bjtTwo) -- (bjtTwoB);
\draw (jcTwoE) -- (rOne |- bjtOne) -- (bjtOneB);
\end{tikzpicture}

```

2 Sources

2.1 Voltage Source in North-South Orientation

```
\voltageSourceNS{name}{position}{align:left|right}{text}
```

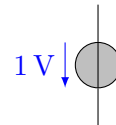
node endings: N: north, S: south

Example:

```

\renewcommand{\voltagecolor}{blue}
\renewcommand{\fillcolor}{lightgray}
\voltageSourceNS{u}{(0,0)}{left}{\SI{1}{\volt}}
\draw (uN) -- ++(0,0.5) (uS) -- ++(0,-0.5);

```



2.2 Voltage Source in South-North Orientation

```
\voltageSourceSN{name}{position}{align:left|right}{text}
```

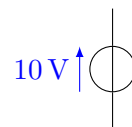
node endings: N: north, S: south

Example:

```

\renewcommand{\voltagecolor}{blue}
\voltageSourceSN{Ua}{(0,0)}{left}{\SI{10}{\volt}}
\draw (uN) -- ++(0,0.5) (uS) -- ++(0,-0.5);

```



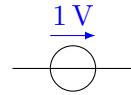
2.3 Voltage Source in West-East Orientation

`\voltageSourceWE{name}{position}{align:above|below}{text}`

node endings: W: west, E: east

Example:

```
\voltageSourceWE{u}{(0,0)}{above}{\SI{1}{\volt}}
\draw (uW) -- ++(-0.5,0) (uE) -- ++(0.5,0);
```



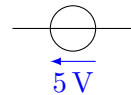
2.4 Voltage Source in East-West Orientation

`\voltageSourceEW{name}{position}{align:above|below}{text}`

node endings: W: west, E: east

Example:

```
\voltageSourceEW{u}{(0,0)}{below}{\SI{5}{\volt}}
\draw (uW) -- ++(-0.5,0) (uE) -- ++(0.5,0);
```



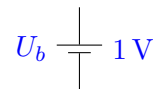
2.5 Battery in North-South Orientation

`\batteryNS{name}{position}{left text}{right text}`

node endings: N: north, S: south

Example:

```
\batteryNS{u}{(0,0)}{\$U_{b}\$}{\SI{1}{\volt}}
\draw (uN) -- ++(0,0.5) (uS) -- ++(0,-0.5);
```



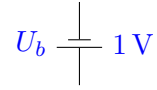
2.6 Battery in South-North Orientation

`\batterySN{name}{position}{left text}{right text}`

node endings: N: north, S: south

Example:

```
\batterySN{u}{(0,0)}{$U_{b}$}{\SI{1}{\volt}}
\draw (uN) -- ++(0,0.5) (uS) -- ++(0,-0.5);
```



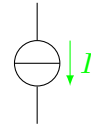
2.7 Current Source in North-South Orientation

```
\currentsourceNS{name}{position}{align:left|right}{text}
```

node endings: N: north, S: south

Example:

```
\renewcommand{\currentcolor}{green}
\currentsourceNS{i}{(0,0)}{right}{$I$}
\draw (iN) -- ++(0,0.5) (iS) -- ++(0,-0.5);
```



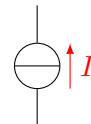
2.8 Current Source in South-North Orientation

```
\currentsourceSN{name}{position}{align:left|right}{text}
```

node endings: N: north, S: south

Example:

```
\renewcommand{\currentcolor}{red}
\currentsourceSN{i}{(0,0)}{right}{$I$}
\draw (iN) -- ++(0,0.5) (iS) -- ++(0,-0.5);
```



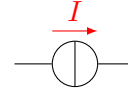
2.9 Current Source in West-East Orientation

```
\currentsourceWE{name}{position}{align:above|below}{text}
```

node endings: W: west, E: east

Example:

```
\currentsourceWE{i}{(0,0)}{above}{ $I$ }
\draw (iW) -- ++(-0.5,0) (iE) -- ++(0.5,0);
```



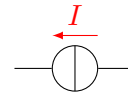
2.10 Current Source in East-West Orientation

```
\currentsourceEW{name}{position}{align:above|below}{text}
```

node endings: W: west, E: east

Example:

```
\currentsourceEW{i}{(0,0)}{above}{ $I$ }
\draw (iW) -- ++(-0.5,0) (iE) -- ++(0.5,0);
```



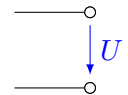
3 Voltage and Current Arrows

3.1 Voltage Arrow Between Two Nodes

```
\voltagearrow{begin}{end}{text parameters}{text}
```

Example:

```
\draw (0,1) -- (1,1) \terminal{tOne};
\draw (0,0) -- (1,0) \terminal{tTwo};
\voltagearrow{(tOne)}{(tTwo)}{right}{ $U$ }
```

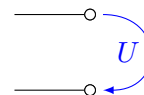


3.2 Curved Voltage Arrow Between Two Nodes

```
\voltagearrowC{begin}{end}{control option}{text parameters}{text}
```

Example:

```
\draw (0,1) -- (1,1) \terminal{tA};
\draw (0,0) -- (1,0) \terminal{tB};
\voltagearrowC{(tA)}{(tB)}{+(1,0) and +(1,0)}{left}{ $U$ }
```



3.3 Current Arrow in North-South Orientation

`\currentarrowNS{position}{align:left|right}{text}`

Example:

```
\draw (0,0) -- (0,1) \mnode{ia};  
\currentarrowNS{(ia)}{left}{$I$}
```



3.4 Current Arrow in South-North Orientation

`\currentarrowSN{position}{align:left|right}{text}`

Example:

```
\draw (0,0) -- (0,1) \mnode{ia};  
\currentarrowSN{(ia)}{left}{$I$}
```



3.5 Current Arrow in West-East Orientation

`\currentarrowWE{position}{align:above|below}{text}`

Example:

```
\draw (0,0) -- (1,0) \mnode{ia};  
\currentarrowWE{(ia)}{above}{$I$}
```



3.6 Current Arrow in East-West Orientation

`\currentarrowEW{position}{align:above|below}{text}`

Example:

```
\draw (0,0) -- (1,0) \mnode{ia};  
\currentarrowEW{(ia)}{above}{$I$}
```



4 Resistors, Capacitors and Inductors

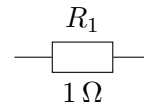
4.1 Resistor in West-East Orientation

`\resistorWE{name}{position}{text above}{text below}`

node endings: W: west, E: east

Example:

```
\resistorWE{r}{(0,0)}{$R_{1}$}{\SI{1}{\ohm}}
\draw (rW) -- ++(-0.5,0) (rE) -- ++(0.5,0);
```



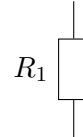
4.2 Resistor in North-South Orientation

`\resistorWE{name}{position}{text left}{text right}`

node endings: N: north, S: south

Example:

```
\resistorNS{r}{(0,0)}{$R_{1}$}{ }
\draw (rN) -- ++(0,0.5) (rS) -- ++(0,-0.5);
```



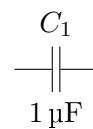
4.3 Capacitor in West-East Orientation

`\capacitorWE{name}{position}{text above}{text below}`

node endings: W: west, E: east

Example:

```
\capacitorWE{c}{(0,0)}{$C_{1}$}{\SI{1}{\micro\farad}}
\draw (cW) -- ++(-0.5,0) (cE) -- ++(0.5,0);
```



4.4 Capacitor in North-South Orientation

`\capacitorNS{name}{position}{text left}{text right}`

node endings: N: north, S: south

Example:

`\capacitorNS{c}{(0,0)}{C_{1}}{\SI{1}{\micro\farad}}`
`\draw (cN) -- ++(0,0.5) (cS) -- ++(0,-0.5);`

$$C_1 \begin{array}{c} | \\ \hline \hline | \end{array} 1\,\mu\text{F}$$

4.5 Inductor in West-East Orientation

`\inductorWE{name}{position}{text above}{text below}`

node endings: W: west, E: east

Example:

`\inductorWE{l}{(0,0)}{L_{1}}{\SI{1}{\micro\henry}}`
`\draw (lW) -- ++(-0.5,0) (lE) -- ++(0.5,0);`

$$\begin{array}{c} L_1 \\ \text{---} \text{---} \text{---} \\ 1\,\mu\text{H} \end{array}$$

4.6 Inductor in North-South Orientation

`\inductorNS{name}{position}{text left}{text right}`

node endings: N: north, S: south

Example:

`\inductorNS{l}{(0,0)}{L_{1}}{\SI{1}{\micro\henry}}`
`\draw (lN) -- ++(0,0.5) (lS) -- ++(0,-0.5);`

$$L_1 \begin{array}{c} | \\ | \\ | \\ | \\ | \end{array} 1\,\mu\text{H}$$

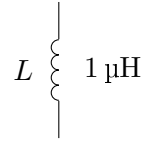
4.7 Inductor in North-South Orientation (Mirrored)

`\inductorNS{name}{position}{text left}{text right}`

node endings: N: north, S: south

Example:

```
\inductorNSmirror{1}{(0,0)}{$L$}{\SI{1}{\micro\henry}}
\draw (1N) -- ++(0,0.5) (1S) -- ++(0,-0.5);
```



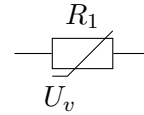
4.8 Varistor in West-East Orientation

```
\varistorWE{name}{position}{text left}{text right}{controlling voltage}
```

node endings: W: west, E: east

Example:

```
\varistorWE{r}{(0,0)}{$R_{1}$}{}{$U_{v}$}
\draw (rW) -- ++(-0.5,0) (rE) -- ++(0.5,0);
```



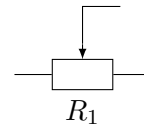
4.9 Potentiometer in West-East Orientation, North Connection

```
\potentiometerWEN{name}{position}{text}
```

node endings: W: west, E: east, N: north

Example:

```
\potentiometerWEN{p}{(0,0)}{$R_{1}$}
\draw (pW) -- ++(-0.5,0) (pE) -- ++(0.5,0);
\draw (pN) |- ++(0.5,0.5);
```



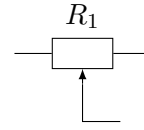
4.10 Potentiometer in West-East Orientation, South Connection

```
\potentiometerWES{name}{position}{text}
```

node endings: W: west, E: east, S: south

Example:

```
\potentiometerWES{p}{(0,0)}{R_1$}
\draw (pW) -- ++(-0.5,0) (pE) -- ++(0.5,0);
\draw (pS) |- ++(0.5,-0.5);
```



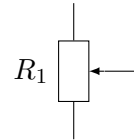
4.11 Potentiometer in North-South Orientation, East Connection

```
\potentiometerNSE{name}{position}{text}
```

node endings: N: north, S: south, E: east

Example:

```
\potentiometerNSE{p}{(0,0)}{R_1$}
\draw (pS) -- ++(0,-0.5) (pN) -- ++(0,0.5);
\draw (pE) -- ++(0.5,0);
```



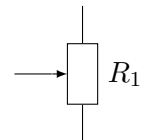
4.12 Potentiometer in North-South Orientation, West Connection

```
\potentiometerNSW{name}{position}{text}
```

node endings: N: north, S: south, W: west

Example:

```
\potentiometerNSW{p}{(0,0)}{R_1$}
\draw (pS) -- ++(0,-0.5) (pN) -- ++(0,0.5);
\draw (pW) -- ++(-0.5,0);
```



5 Transformer

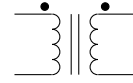
5.1 Transformer in North-South Orientation

```
\transformerNS{name}{position}
```


node endings: N: north, S: south

Example:

```
\transformerNS{tf}{(0,0)}
\draw (tfAN) -- ++(-0.5,0) (tfAS) -- ++(-0.5,0);
\draw (tfBN) -- ++( 0.5,0) (tfBS) -- ++( 0.5,0);
```



6 Diodes

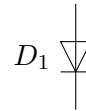
6.1 Diode In North-South Orientation

```
\diodeNS{name}{position}{align:left|right}{text}
```

node endings: A: anode, C: cathode

Example:

```
\diodeNS{d}{(0,0)}{left}{$D_{1}$}
\draw (dA) -- ++(0,0.5) (dC) -- ++(0,-0.5);
```



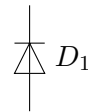
6.2 Diode in South-North Orientation

```
\diodeSN{name}{position}{align:left|right}{text}
```

node endings: A: anode, C: cathode

Example:

```
\diodeSN{d}{(0,0)}{right}{$D_{1}$}
\draw (dA) -- ++(0,-0.5) (dC) -- ++(0,0.5);
```



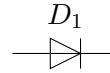
6.3 Diode in West-East Orientation

```
\diodeWE{name}{position}{align:above|below}{text}
```

node endings: A: anode, C: cathode

Example:

```
\diodeWE{d}{(0,0)}{above}{D_1}
\draw (dA) -- ++(-0.5,0) (dC) -- ++(0.5,0);
```



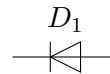
6.4 Diode in East-West Orientation

```
\diodeEW{name}{position}{align:above|below}{text}
```

node endings: A: anode, C: cathode

Example:

```
\diodeEW{d}{(0,0)}{above}{D_1}
\draw (dA) -- ++(0.5,0) (dC) -- ++(-0.5,0);
```



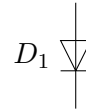
6.5 Zener Diode in North-South Orientation

```
\zDiodeNS{name}{position}{align:left|right}{text}
```

node endings: A: anode, C: cathode

Example:

```
\zDiodeNS{zd}{(0,0)}{left}{D_1}
\draw (zdA) -- ++(0,0.5) (zdC) -- ++(0,-0.5);
```



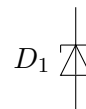
6.6 Zener Diode in South-North Orientation

```
\zDiodeSN{name}{position}{align:left|right}{text}
```

node endings: A: anode, C: cathode

Example:

```
\zDiodeSN{zd}{(0,0)}{left}{D_1}
\draw (zdA) -- ++(0,-0.5) (zdC) -- ++(0,0.5);
```



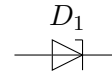
6.7 Zener Diode in West-East Orientation

`\zDiodeWE{name}{position}{align:above|below}{text}`

node endings: A: anode, C: cathode

Example:

```
\zDiodeWE{zd}{(0,0)}{above}{$D_1$}
\draw (zdA) -- ++(-0.5,0) (zdC) -- ++(0.5,0);
```



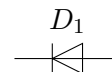
6.8 Zener Diode in East-West Orientation

`\zDiodeEW{name}{position}{align:above|below}{text}`

node endings: A: anode, C: cathode

Example:

```
\zDiodeEW{zd}{(0,0)}{above}{$D_1$}
\draw (zdA) -- ++(0.5,0) (zdC) -- ++(-0.5,0);
```



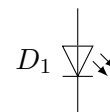
6.9 LED in North-South Orientation, Light in East Direction

`\ledNSE{name}{position}{text}`

node endings: A: anode, C: cathode

Example:

```
\ledNSE{led}{(0,0)}{$D_1$}
\draw (ledA) -- ++(0,0.5) (ledC) -- ++(0,-0.5);
```



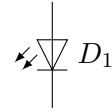
6.10 LED in North-South Orientation, Light in West Direction

`\ledNSW{name}{position}{text}`

node endings: A: anode, C: cathode

Example:

```
\ledNSW{led}{(0,0)}{D_1}
\draw (ledA) -- ++(0,0.5) (ledC) -- ++(0,-0.5);
```



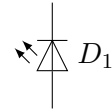
6.11 LED in South-North Orientation, Light in West Direction

```
\ledSNW{name}{position}{text}
```

node endings: A: anode, C: cathode

Example:

```
\ledSNW{led}{(0,0)}{D_1}
\draw (ledA) -- ++(0,-0.5) (ledC) -- ++(0,0.5);
```



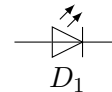
6.12 LED in West-East orientation, Light in North Direction

```
\ledWEN{name}{position}{text}
```

node endings: A: anode, C: cathode

Example:

```
\ledWEN{led}{(0,0)}{D_1}
\draw (ledA) -- ++(-0.5,0) (ledC) -- ++(0.5,0);
```



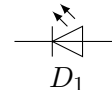
6.13 LED in East-West orientation, Light in North Direction

```
\ledEWN{name}{position}{text}
```

node endings: A: anode, C: cathode

Example:

```
\ledEWN{led}{(0,0)}{D_1}
\draw (ledA) -- ++(0.5,0) (ledC) -- ++(-0.5,0);
```



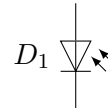
6.14 Photo Diode in North-South Orientation, Light from East

`\photodiodeNSE{name}{position}{text}`

node endings: A: anode, C: cathode

Example:

```
\photodiodeNSE{pd}{(0,0)}{$D_{1}$}
\draw (pdA) -- ++(0,0.5) (pdC) -- ++(0,-0.5);
```



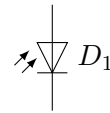
6.15 photo diode in North-South Orientation, Light from West

`\photodiodeNSW{name}{position}{text}`

node endings: A: anode, C: cathode

Example:

```
\photodiodeNSW{pd}{(0,0)}{$D_{1}$}
\draw (pdA) -- ++(0,0.5) (pdC) -- ++(0,-0.5);
```



7 Transistors

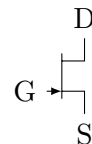
7.1 N-Channel JFET in North-South Orientation

`\nChnJFETNS{name}{position}`

node endings: D: drain, G: gate, S: source

Example:

```
\nChnJFETNS{jfet}{(0,0)}
\path (jfetG) node [left]{G};
\path (jfetD) node [above]{D};
\path (jfetS) node [below]{S};
```



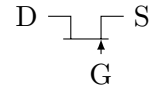
7.2 N-Channel JFET in West-East Orientation

`\nChnJFETWE{name}{position}`

node endings: D: drain, G: gate, S: source

Example:

```
\nChnJFETWE{jfet}{(0,0)}
\path (jfetG) node [below]{G};
\path (jfetD) node [left]{D};
\path (jfetS) node [right]{S};
```



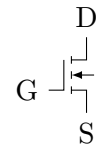
7.3 Enhancement-Mode N-Channel MOSFET in North-South Orientation

`\NMOSFETenhNS{name}{position}`

node endings: D: drain, G: gate, S: source, B: bulk

Example:

```
\NMOSFETenhNS{jfet}{(0,0)}
\path (jfetG) node [left]{G};
\path (jfetD) node [above]{D};
\path (jfetS) node [below]{S};
```



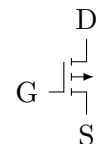
7.4 Enhancement-Mode P-Channel MOSFET in North-South Orientation

`\PMOSFETenhNS{name}{position}`

node endings: D: drain, G: gate, S: source, B: bulk

Example:

```
\PMOSFETenhNS{jfet}{(0,0)}
\path (jfetG) node [left]{G};
\path (jfetD) node [above]{D};
\path (jfetS) node [below]{S};
```



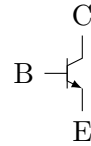
7.5 NPN Bipolar Junction Transistor in North-South Orientation

`\BJTnpnNS{name}{position}`

node endings: B: basis, E: emitter, C: collector

Example:

```
\BJTnpnNS{b}{(0,0)}
\path (bB) node [left]{B};
\path (bC) node [above]{C};
\path (bE) node [below]{E};
```



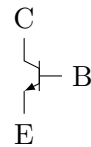
7.6 NPN Bipolar Junction Transistor in North-South Orientation (Mirrored)

`\BJTnpnNSMirror{name}{position}`

node endings: B: basis, E: emitter, C: collector

Example:

```
\BJTnpnNSMirror{b}{(0,0)}
\path (bB) node [right]{B};
\path (bC) node [above]{C};
\path (bE) node [below]{E};
```



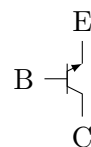
7.7 NPN Bipolar Junction Transistor in South-North Orientation

`\BJTnpnSN{name}{position}`

node endings: B: basis, E: emitter, C: collector

Example:

```
\BJTnpnSN{b}{(0,0)}
\path (bB) node [left]{B};
\path (bC) node [below]{C};
\path (bE) node [above]{E};
```



7.8 NPN Bipolar Junction Transistor in East-West Orientation

`\BJTnpnEW{name}{position}`

node endings: B: basis, E: emitter, C: collector

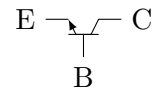
Example:

`\BJTnpnEW{b}{(0,0)}`

`\path (bB) node [below]{B};`

`\path (bC) node [right]{C};`

`\path (bE) node [left]{E};`



7.9 PNP Bipolar Junction Transistor in North-South Orientation

`\BJTnpnNS{name}{position}`

node endings: B: basis, E: emitter, C: collector

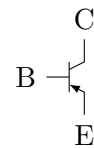
Example:

`\BJTnpnNS{b}{(0,0)}`

`\path (bB) node [left]{B};`

`\path (bC) node [above]{C};`

`\path (bE) node [below]{E};`



8 Operational Amplifiers

8.1 OP-AMP, Standardized Symbol

`\opampNorm{name}{position}`

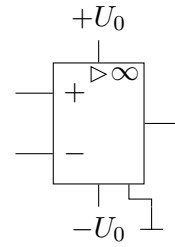
node endings: Out: output, InMinus: n-input, InPlus: p-input, UbattPlus: positive power supply, UbattMinus: negative power supply Gnd: ground

Example:


```

\opampNorm{op}{(0,0)}
\draw (opOut) -- ++(0.5,0);
\draw (opInMinus) -- ++(-0.5,0);
\draw (opInPlus) -- ++(-0.5,0);
\draw (opUbattPlus) -- ++(0,0.3) node [above]{$+U_{0}$};
\draw (opUbattMinus) -- ++(0,-0.3) node [below]{$-U_{0}$};
\draw (opGnd) -- ++(0,-0.2) -| ++(0.3,-0.1) \cnode{gnd};
\gnd{(gnd)}

```



8.2 OP-AMP, Standardized Symbol, N-Input above P-Input

```

\opampNormInv{name}{position}

```

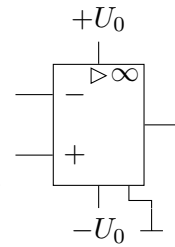
node endings: Out: output, InMinus: n-input, InPlus: p-input, UbattPlus: positive power supply, UbattMinus: negative power supply Gnd: ground

Example:

```

\opampNormInv{op}{(0,0)}
\draw (opOut) -- ++(0.5,0);
\draw (opInMinus) -- ++(-0.5,0);
\draw (opInPlus) -- ++(-0.5,0);
\draw (opUbattPlus) -- ++(0,0.3) node [above]{$+U_{0}$};
\draw (opUbattMinus) -- ++(0,-0.3) node [below]{$-U_{0}$};
\draw (opGnd) -- ++(0,-0.2) -| ++(0.3,-0.1) \cnode{gnd};
\gnd{(gnd)}

```



8.3 OP-AMP

```

\opamp{name}{position}

```

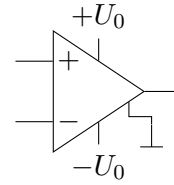
node endings: Out: output, InMinus: n-input, InPlus: p-input, UbattPlus: positive power supply, UbattMinus: negative power supply Gnd: ground

Example:

```

\opamp{op}{(0,0)}
\draw (opOut) -- ++(0.5,0);
\draw (opInMinus) -- ++(-0.5,0);
\draw (opInPlus) -- ++(-0.5,0);
\draw (opUbattPlus) -- ++(0,0.3) node [above]{$+U_0$};
\draw (opUbattMinus) -- ++(0,-0.3) node [below]{$-U_0$};
\draw (opGnd) -- ++(0,-0.2) -| ++(0.3,-0.1) \cnode{gnd};
\gnd{(gnd)}

```



8.4 OP-AMP, N-Input above P-Input

```

\opampInv{name}{position}

```

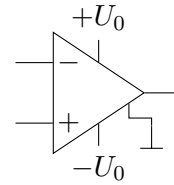
node endings: Out: output, InMinus: n-input, InPlus: p-input, UbattPlus: positive power supply, UbattMinus: negative power supply Gnd: ground

Example:

```

\opampInv{opamp}{(0,0)}
\draw (opampOut) -- ++(0.5,0);
\draw (opInMinus) -- ++(-0.5,0);
\draw (opInPlus) -- ++(-0.5,0);
\draw (opUbattPlus) -- ++(0,0.3) node [above]{$+U_0$};
\draw (opUbattMinus) -- ++(0,-0.3) node [below]{$-U_0$};
\draw (opGnd) -- ++(0,-0.2) -| ++(0.3,-0.1) \cnode{gnd};
\gnd{(gnd)}

```



8.5 General Amplifier

```

\amplifier{name}{position}

```

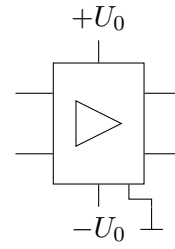
node endings: OutPlus: p-output OutMinus: n-output, InMinus: n-input, InPlus: p-input, UbattPlus: positive power supply, UbattMinus: negative power supply Gnd: ground

Example:

```

\amplifier{a}{(0,0)}
\draw (aOutPlus) -- ++(0.5,0);
\draw (aOutMinus) -- ++(0.5,0);
\draw (aInMinus) -- ++(-0.5,0);
\draw (aInPlus) -- ++(-0.5,0);
\draw (aUBattPlus) -- ++(0,0.3) node [above]{$+U_{0}$};
\draw (aUBattMinus) -- ++(0,-0.3) node [below]{$-U_{0}$};
\draw (aGnd) -- ++(0,-0.2) -| ++(0.3,-0.1) \cnode{gnd};
\gnd{(gnd)}

```



9 Amplifiers

9.1 Amplifier, Standardized Symbol

```

\ampNorm{name}{position}{amplification factor}

```

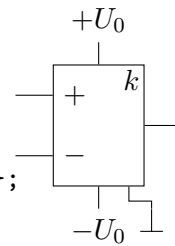
node endings: Out: output, InMinus: n-input, InPlus: p-input, UbattPlus: positive power supply, UbattMinus: negative power supply Gnd: ground

Example:

```

\ampNorm{amp}{(0,0)}{$k$}
\draw (ampOut) -- ++(0.5,0);
\draw (ampInMinus) -- ++(-0.5,0);
\draw (ampInPlus) -- ++(-0.5,0);
\draw (ampUbattPlus) -- ++(0,0.3) node [above]{$+U_{0}$};
\draw (ampUbattMinus) -- ++(0,-0.3) node [below]{$-U_{0}$};
\draw (ampGnd) -- ++(0,-0.2) -| ++(0.3,-0.1) \cnode{gnd};
\gnd{(gnd)}

```



10 Logic Gates

10.1 Inversion Symbol for Logic Gates Outputs

```

\NOTcircle{name}{position}

```

Example:

```

\draw (0,0) -- (0,1);
\NOTcircle{n}{(0,0.5)}

```



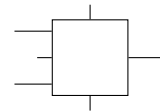
10.2 Logic Gate Symbol, IEC Standard

`\LogicGateIEC{name}{position}`

node endings: In: input, Out: output, InN: north input, InS: south input, N: north, S: south

Example:

```
\LogicGateIEC{g}{(0,0)}
\draw (gIn) -- ++(-0.2,0);
\draw (gOut) -- ++(0.5,0);
\draw (gInN) -- ++(-0.5,0);
\draw (gInS) -- ++(-0.5,0);
\draw (gN) -- ++(0,0.2);
\draw (gS) -- ++(0,-0.2);
```



10.3 Logic AND Gate Symbol

`\GateAND{name}{position}`

node endings: In: input, Out: output, InN: north input, InS: south input, N: north, S: south

Example:

```
\GateAND{g}{(0,0)}
\draw (gOut) -- ++(0.5,0);
\draw (gInN) -- ++(-0.5,0);
\draw (gInS) -- ++(-0.5,0);
```



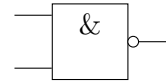
10.4 Logic NAND Gate Symbol

`\GateNAND{name}{position}`

node endings: In: input, Out: output, InN: north input, InS: south input, N: north, S: south

Example:

```
\GateNAND{g}{(0,0)}  
\draw (gOut) -- ++(0.5,0);  
\draw (gInN) -- ++(-0.5,0);  
\draw (gInS) -- ++(-0.5,0);
```



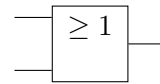
10.5 Logic OR Gate Symbol

```
\GateOR{name}{position}
```

node endings: In: input, Out: output, InN: north input, InS: south input, N: north, S: south

Example:

```
\GateOR{g}{(0,0)}  
\draw (gOut) -- ++(0.5,0);  
\draw (gInN) -- ++(-0.5,0);  
\draw (gInS) -- ++(-0.5,0);
```



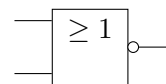
10.6 Logic NOR Gate Symbol

```
\GateNOR{name}{position}
```

node endings: In: input, Out: output, InN: north input, InS: south input, N: north, S: south

Example:

```
\GateNOR{g}{(0,0)}  
\draw (gOut) -- ++(0.5,0);  
\draw (gInN) -- ++(-0.5,0);  
\draw (gInS) -- ++(-0.5,0);
```



10.7 Logic NOT Gate Symbol

```
\GateNOT{name}{position}
```

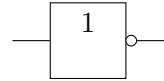
node endings: In: input, Out: output, InN: north input, InS: south input, N: north, S: south

Example:

```
\GateNOT{g}{(0,0)}
```

```
\draw (gOut) -- ++(0.5,0);
```

```
\draw (gIn) -- ++(-0.5,0);
```



10.8 Logic XOR Gate Symbol

```
\GateXOR{name}{position}
```

node endings: In: input, Out: output, InN: north input, InS: south input, N: north, S: south

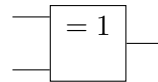
Example:

```
\GateXOR{g}{(0,0)}
```

```
\draw (gOut) -- ++(0.5,0);
```

```
\draw (gInN) -- ++(-0.5,0);
```

```
\draw (gInS) -- ++(-0.5,0);
```



10.9 Logic XNOR Gate Symbol

```
\GateXNOR{name}{position}
```

node endings: In: input, Out: output, InN: north input, InS: south input, N: north, S: south

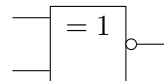
Example:

```
\GateXNOR{g}{(0,0)}
```

```
\draw (gOut) -- ++(0.5,0);
```

```
\draw (gInN) -- ++(-0.5,0);
```

```
\draw (gInS) -- ++(-0.5,0);
```



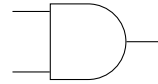
10.10 Logic AND Gate, ANSI Symbol

```
\ANSIGateAND{name}{position}
```

node endings: Out: output, InN: north input, InS: south input, N: north, S: south

Example:

```
\ANSIGateAND{g}{(0,0)}  
\draw (gOut) -- ++(0.5,0);  
\draw (gInN) -- ++(-0.5,0);  
\draw (gInS) -- ++(-0.5,0);
```



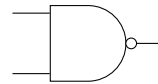
10.11 Logic NAND Gate, ANSI Symbol

```
\ANSIGateNAND{name}{position}
```

node endings: Out: output, InN: north input, InS: south input, N: north, S: south

Example:

```
\ANSIGateNAND{g}{(0,0)}  
\draw (gOut) -- ++(0.5,0);  
\draw (gInN) -- ++(-0.5,0);  
\draw (gInS) -- ++(-0.5,0);
```



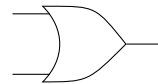
10.12 Logic OR Gate, ANSI Symbol

```
\ANSIGateOR{name}{position}
```

node endings: Out: output, InN: north input, InS: south input, N: north, S: south

Example:

```
\ANSIGateOR{g}{(0,0)}  
\draw (gOut) -- ++(0.5,0);  
\draw (gInN) -- ++(-0.5,0);  
\draw (gInS) -- ++(-0.5,0);
```



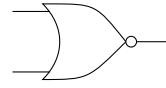
10.13 Logic NOR Gate, ANSI Symbol

```
\ANSIGateNOR{name}{position}
```

node endings: Out: output, InN: north input, InS: south input, N: north, S: south

Example:

```
\ANSIGateNOR{g}{(0,0)}  
\draw (gOut) -- ++(0.5,0);  
\draw (gInN) -- ++(-0.5,0);  
\draw (gInS) -- ++(-0.5,0);
```



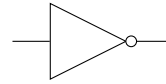
10.14 Logic NOT Gate, ANSI Symbol

```
\ANSIGateNOT{name}{position}
```

node endings: Out: output, In: input, N: north, S: south

Example:

```
\ANSIGateNOT{g}{(0,0)}  
\draw (gOut) -- ++(0.5,0);  
\draw (gIn) -- ++(-0.5,0);
```



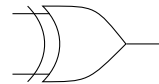
10.15 Logic XOR Gate, ANSI Symbol

```
\ANSIGateXOR{name}{position}
```

node endings: Out: output, InN: north input, InS: south input, N: north, S: south

Example:

```
\ANSIGateXOR{g}{(0,0)}  
\draw (gOut) -- ++(0.5,0);  
\draw (gInN) -- ++(-0.5,0);  
\draw (gInS) -- ++(-0.5,0);
```



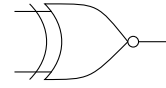
10.16 Logic XNOR Gate, ANSI Symbol

```
\ANSIGateXNOR{name}{position}
```

node endings: Out: output, InN: north input, InS: south input, N: north, S: south

Example:

```
\ANSIGateXNOR{g}{(0,0)}
\draw (gOut) -- ++(0.5,0);
\draw (gInN) -- ++(-0.5,0);
\draw (gInS) -- ++(-0.5,0);
```



11 Flip-Flops

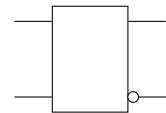
11.1 General Flip-Flop Symbol

```
\FlipFlop{name}{position}
```

node endings: OutN: north output, OutS: south output InN: north input, InS: south input, N: north, S: south W: middle input

Example:

```
\FlipFlop{ff}{(0,0)}
\draw (ffInN) -- ++(-0.5,0) (ffInS) -- ++(-0.5,0);
\draw (ffOutN) -- ++(0.5,0) (ffOutS) -- ++(0.5,0);
```



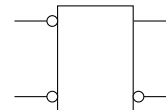
11.2 General Flip-Flop Symbol for Negative Logic

```
\FlipFlopNegLogic{name}{position}
```

node endings: OutN: north output, OutS: south output InN: north input, InS: south input, N: north, S: south W: middle input

Example:

```
\FlipFlopNegLogic{ff}{(0,0)}
\draw (ffInN) -- ++(-0.5,0) (ffInS) -- ++(-0.5,0);
\draw (ffOutN) -- ++(0.5,0) (ffOutS) -- ++(0.5,0);
```



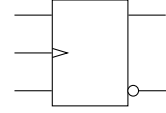
11.3 Flip-Flop Changing on Rising Edge

```
\FlipFlopRisingEdge{name}{position}
```

node endings: OutN: north output, OutS: south output InN: north input, InS: south input, N: north, S: south W: middle input

Example:

```
\FlipFlopRisingEdge{ff}{(0,0)}
\draw (ffInN) -- ++(-0.5,0) (ffInS) -- ++(-0.5,0);
\draw (ffW) -- ++(-0.5,0);
\draw (ffOutN) -- ++(0.5,0) (ffOutS) -- ++(0.5,0);
```



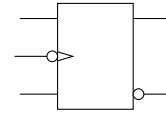
11.4 Flip-Flop Changing on Falling Edge

`\FlipFlopFallingEdge{name}{position}`

node endings: OutN: north output, OutS: south output InN: north input, InS: south input, N: north, S: south W: middle input

Example:

```
\FlipFlopFallingEdge{ff}{(0,0)}
\draw (ffInN) -- ++(-0.5,0) (ffInS) -- ++(-0.5,0);
\draw (ffInC) -- ++(-0.5,0);
\draw (ffOutN) -- ++(0.5,0) (ffOutS) -- ++(0.5,0);
```



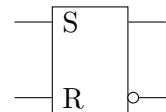
11.5 RS Flip-Flop

`\RSFlipFlop{name}{position}`

node endings: OutN: north output, OutS: south output InN: north input, InS: south input, N: north, S: south W: middle input

Example:

```
\RSFlipFlop{ff}{(0,0)}
\draw (ffInN) -- ++(-0.5,0) (ffInS) -- ++(-0.5,0);
\draw (ffOutN) -- ++(0.5,0) (ffOutS) -- ++(0.5,0);
```



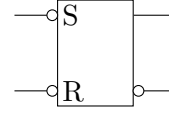
11.6 RS NAND Flip-Flop (Negative Logic)

`\RSNANDFlipFlop{name}{position}`

node endings: OutN: north output, OutS: south output InN: north input, InS: south input, N: north, S: south W: middle input

Example:

```
\RSNANDFlipFlop{ff}{(0,0)}
\draw (ffInN) -- ++(-0.5,0) (ffInS) -- ++(-0.5,0);
\draw (ffOutN) -- ++(0.5,0) (ffOutS) -- ++(0.5,0);
```



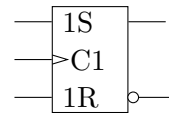
11.7 RS Flip-Flop Changing on Rising Edge

```
\RSFlipFlopRisingEdge{name}{position}
```

node endings: OutN: north output, OutS: south output InN: north input, InS: south input, N: north, S: south W: middle input

Example:

```
\RSFlipFlopRisingEdge{ff}{(0,0)}
\draw (ffInN) -- ++(-0.5,0) (ffInS) -- ++(-0.5,0);
\draw (ffW) -- ++(-0.5,0);
\draw (ffOutN) -- ++(0.5,0) (ffOutS) -- ++(0.5,0);
```



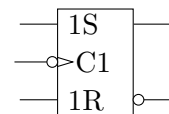
11.8 RS Flip-Flop Changing on Falling Edge

```
\RSFlipFlopFallingEdge{name}{position}
```

node endings: OutN: north output, OutS: south output InN: north input, InS: south input, N: north, S: south W: middle input

Example:

```
\RSFlipFlopFallingEdge{ff}{(0,0)}
\draw (ffInN) -- ++(-0.5,0) (ffInS) -- ++(-0.5,0);
\draw (ffInC) -- ++(-0.5,0);
\draw (ffOutN) -- ++(0.5,0) (ffOutS) -- ++(0.5,0);
```



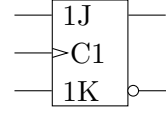
11.9 JK Flip-Flop Changing on Rising Edge

```
\JKFlipFlopRisingEdge{name}{position}
```

node endings: OutN: north output, OutS: south output InN: north input, InS: south input, N: north, S: south W: middle input

Example:

```
\JKFlipFlopRisingEdge{ff}{(0,0)}
\draw (ffInN) -- ++(-0.5,0) (ffInS) -- ++(-0.5,0);
\draw (ffW) -- ++(-0.5,0);
\draw (ffOutN) -- ++(0.5,0) (ffOutS) -- ++(0.5,0);
```



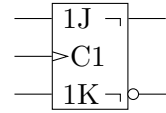
11.10 JK Master-Slave Flip-Flop

`\JKMSFlipFlop{name}{position}`

node endings: OutN: north output, OutS: south output InN: north input, InS: south input, N: north, S: south W: middle input

Example:

```
\JKMSFlipFlop{ff}{(0,0)}
\draw (ffInN) -- ++(-0.5,0) (ffInS) -- ++(-0.5,0);
\draw (ffW) -- ++(-0.5,0);
\draw (ffOutN) -- ++(0.5,0) (ffOutS) -- ++(0.5,0);
```



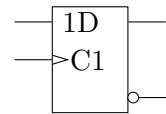
11.11 D Flip-Flop Changing on Rising Edge

`\DFlipFlopRisingEdge{name}{position}`

node endings: OutN: north output, OutS: south output InN: north input, InS: south input, N: north, S: south W: middle input

Example:

```
\DFlipFlopRisingEdge{ff}{(0,0)}
\draw (ffInN) -- ++(-0.5,0);
\draw (ffW) -- ++(-0.5,0);
\draw (ffOutN) -- ++(0.5,0) (ffOutS) -- ++(0.5,0);
```



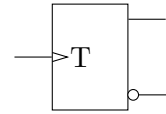
11.12 T Flip-Flop Changing on Rising Edge

`\TFlipFlopRisingEdge{name}{position}`

node endings: OutN: north output, OutS: south output InN: north input, InS: south input, N: north, S: south W: middle input

Example:

```
\TFlipFlopRisingEdge{ff}{(0,0)}
\draw (ffW) -- ++(-0.5,0);
\draw (ffOutN) -- ++(0.5,0) (ffOutS) -- ++(0.5,0);
```



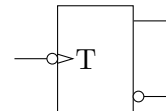
11.13 T Flip-Flop Changing on Falling Edge

```
\TFlipFlopFallingEdge{name}{position}
```

node endings: OutN: north output, OutS: south output InN: north input, InS: south input, N: north, S: south W: middle input

Example:

```
\TFlipFlopFallingEdge{ff}{(0,0)}
\draw (ffInC) -- ++(-0.5,0);
\draw (ffOutN) -- ++(0.5,0) (ffOutS) -- ++(0.5,0);
```



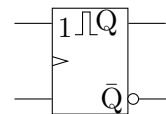
11.14 Monoflop

```
\Monoflop{name}{position}
```

node endings: OutN: north output, OutS: south output InN: north input, InS: south input, N: north, S: south W: middle input

Example:

```
\Monoflop{ff}{(0,0)}
\draw (ffInN) -- ++(-0.5,0) (ffInS) -- ++(-0.5,0);
\draw (ffOutN) -- ++(0.5,0) (ffOutS) -- ++(0.5,0);
```



11.15 Switch, West-East Direction

```
\switchWE{name}{position}
```

node endings: W: west, E: east, N: north connection

Example:

```
\switchWE{s}{(0,0)}  
\draw (sW) -- ++(-0.5,0) (sE) -- ++(0.5,0);
```



11.16 Closed Switch, West-East Direction

```
\switchClosedWE{name}{position}
```

node endings: W: west, E: east, N: north connection

Example:

```
\switchClosedWE{s}{(0,0)}  
\draw (sW) -- ++(-0.5,0) (sE) -- ++(0.5,0);
```



11.17 Switch, East-West Direction

```
\switchEW{name}{position}
```

node endings: W: west, E: east, N: north connection

Example:

```
\switchEW{s}{(0,0)}  
\draw (sW) -- ++(-0.5,0) (sE) -- ++(0.5,0);
```



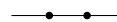
11.18 Closed Switch, East-West Direction

```
\switchClosedEW{name}{position}
```

node endings: W: west, E: east, N: north connection

Example:

```
\switchClosedEW{s}{(0,0)}  
\draw (sW) -- ++(-0.5,0) (sE) -- ++(0.5,0);
```



11.19 Switch, South-North Direction

`\switchSN{name}{position}`

node endings: S: south, N: north, W: west connection

Example:

```
\switchSN{s}{(0,0)}
\draw (sS) -- ++(0,-0.5) (sN) -- ++(0,0.5);
```



11.20 Closed Switch, South-North Direction

`\switchClosedSN{name}{position}`

node endings: S: south, N: north, W: west connection

Example:

```
\switchClosedSN{s}{(0,0)}
\draw (sS) -- ++(0,-0.5) (sN) -- ++(0,0.5);
```



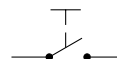
11.21 Pushbutton, West-East Direction

`\pushbuttonWE{name}{position}`

node endings: W: west, E: east, N: north connection

Example:

```
\pushbuttonWE{b}{(0,0)}
\draw (bW) -- ++(-0.5,0) (bE) -- ++(0.5,0);
```



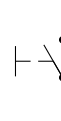
11.22 Pushbutton, South-North Direction

`\pushbuttonSN{name}{position}`

node endings: S: south, N: north, W: west connection

Example:

```
\pushbuttonSN{b}{(0,0)}  
\draw (bS) -- ++(0,-0.5) (bN) -- ++(0,0.5);
```



12 Miscellaneous

12.1 Ground as Symbol

`\gnd{position}`

Example:
`\draw (0,0) -- (1,0) \junction{gnd};`
`\gnd{(gnd)}`



12.2 Ground as Continued Drawing

`\gndNow`

Example:
`\draw (0,0) -- (1,0) \junction{foo} \gndNow;`



12.3 Connecting Terminal

`\terminal{name}`

node endings: Con: use terminal as connector (no space when wired)

Example:
`\renewcommand{\fillcolor}{white}`
`\draw (0,0) -- ++(1,0) \terminal{t};`



12.4 Junction (Black Filled Circle)

`\junction{name}`

Example:

```
\draw (0,0) -- (1,0);  
\draw (0.5,0) \junction{j} -- ++(0,-0.5);
```



12.5 Junction in the Middle of a Path

`\junction{name}`

Example:

```
\draw (0,0) -- (1,0) \mjunction{j} (j) -- ++(1,0);
```



12.6 Connection Node (for Referencing, not Visible)

`\cnode{name}`

Example:

```
\draw (0,0) -- (0.5,0) \cnode{c} -- (0.5,0.5);  
\draw (c) -- ++(0,-0.5);
```



12.7 Midway Connection Node

`\mnode{name}`

Example:

```
\draw (0,0) -- (1,0) \mnode{m};  
\draw (m) -- ++(0,-0.5);
```



12.8 Invisible Node with Terminal Node Properties (Used with Voltage Arrows)

`\node{name}`

Example:

```
\draw (0,0) -- ++(1,0) \tnode{t};
```



12.9 Speaker

```
\speakerWE{name}{position}
```

node endings: N: north, S: south,

Example:

```
\speakerWE{sp}{(0,0)}  
\draw (spN) -- ++(0,0.5) (spS) -- ++(0,-0.5);
```



12.10 Bulb

```
\bulb{name}{position}
```

node endings: N: north, S: south, W: west, E: east

Example:

```
\bulb{b}{(0,0)}  
\draw (bN) -- ++(0,0.5) (bS) -- ++(0,-0.5);
```



12.11 Multimeter (Circle for Voltmeter or Ammeter)

```
\multimeter{name}{position}{letter}
```

node endings: N: north, S: south, W: west, E: east

Example:

```
\multimeter{m}{(0,0)}{M}  
\draw (mN) -- ++(0,0.5) (mS) -- ++(0,-0.5);
```



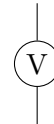
12.12 Voltmeter

`\voltmeter{name}{position}`

node endings: N: north, S: south, W: west, E: east

Example:

```
\voltmeter{v}{(0,0)}
\draw (vN) -- ++(0,0.5) (vS) -- ++(0,-0.5);
```



12.13 Ammeter

`\ammeter{name}{position}`

node endings: N: north, S: south, W: west, E: east

Example:

```
\ammeter{a}{(0,0)}
\draw (vW) -- ++(-0.5,0) (vE) -- ++(0.5,0);
```



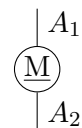
12.14 Brushless DC Electric Motor

`\BLDCMotor{name}{position}{pin1}{pin2}`

node endings: N: north, S: south, W: west, E: east

Example:

```
\BLDCMotor{motor}{(0,0)}{A_1}{A_2}
\draw (motorN) -- ++(0,0.5);
\draw (motorS) -- ++(0,-0.5);
```



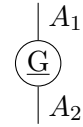
12.15 Brushless DC Electric Generator

`\BLDCGenerator{name}{position}{pin1}{pin2}`

node endings: N: north, S: south, W: west, E: east

Example:

```
\BLDCGenerator{gen}{(0,0)}{A_1}{A_2}
\draw (genN) -- ++(0,0.5);
\draw (genS) -- ++(0,-0.5);
```



12.16 Brushes for Electric Motors and Generators

`\brushes{position}`

Only useful in combination with motors or generators.

Example:

```
\brushes{(0,0)}
```



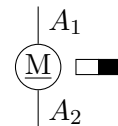
12.17 Brushless DC Electric Motor with Permanent Magnet

`\permanentMagnetBLDCMotor{name}{position}{pin1}{pin2}`

node endings: N: north, S: south, W: west, E: east

Example:

```
\permanentMagnetBLDCMotor{motor}{(0,0)}{A_1}{A_2}
\draw (motorN) -- ++(0,0.5);
\draw (motorS) -- ++(0,-0.5);
```



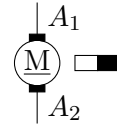
12.18 DC Electric Motor with Permanent Magnet

`\permanentMagnetDCMotor{name}{position}{pin1}{pin2}`

node endings: N: north, S: south, W: west, E: east

Example:

```
\permanentMagnetDCMotor{motor}{(0,0)}{A_1}{A_2}
\draw (motorN) -- ++(0,0.5);
\draw (motorS) -- ++(0,-0.5);
```



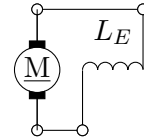
12.19 Shunt DC Electric Motor

```
\shuntDCMotor{name}{position}
```

node endings: N: north, S: south, W: west, E: east

Example:

```
\shuntDCMotor{motor}{(0,0)}
\draw (motorN) -- ++(0,0.5);
\draw (motorS) -- ++(0,-0.5);
```



12.20 Series DC Electric Motor

```
\seriesDCMotor{name}{position}
```

node endings: N: north, S: south, W: west, E: east

Example:

```
\seriesDCMotor{motor}{(0,0)}
\draw (motorN) -- ++(0,0.5);
\draw (motorS) -- ++(0,-0.5);
```

