

Components and Examples of tikzircuit

March 26, 2018

Contents

1	Introductory Examples	5
1.1	Bridge Rectifier	5
1.2	Strain Gauges Bridge	6
1.3	Astable Multivibrator	7
2	chktex-file 1	8
3	chktex-file 11	8
4	chktex-file 12	8
5	chktex-file 26	8
6	chktex-file 36	8
7	chktex-file 37	8
8	chktex-file 8	8
9	Sources	8
9.1	Voltage Source in North-South Orientation	8
9.2	Voltage Source in South-North Orientation	9
9.3	Voltage Source in West-East Orientation	9
9.4	Voltage Source in East-West Orientation	9
9.5	Battery in North-South Orientation	10
9.6	Battery in South-North Orientation	10
9.7	Current Source in North-South Orientation	10
9.8	Current Source in South-North Orientation	10
9.9	Current Source in West-East Orientation	11
9.10	Current Source in East-West Orientation	11

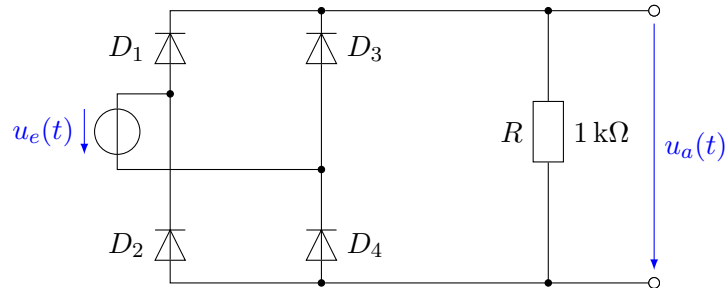
10 Voltage and Current Arrows	11
10.1 Voltage Arrow Between Two Nodes	11
10.2 Curved Voltage Arrow Between Two Nodes	12
10.3 Current Arrow in North-South Orientation	12
10.4 Current Arrow in South-North Orientation	12
10.5 Current Arrow in West-East Orientation	12
10.6 Current Arrow in East-West Orientation	13
11 Resistors, Capacitors and Inductors	13
11.1 Resistor in West-East Orientation	13
11.2 Resistor in North-South Orientation	13
11.3 Capacitor in West-East Orientation	13
11.4 Capacitor in North-South Orientation	14
11.5 Inductor in West-East Orientation	14
11.6 Inductor in North-South Orientation	14
11.7 Inductor in North-South Orientation (Mirrored)	15
11.8 Varistor in West-East Orientation	15
11.9 Potentiometer in West-East Orientation, North Connection	15
11.10 Potentiometer in West-East Orientation, South Connection	16
11.11 Potentiometer in North-South Orientation, East Connection	16
11.12 Potentiometer in North-South Orientation, West Connection	16
12 Transformer	17
12.1 Transformer in North-South Orientation	17
13 Diodes	17
13.1 Diode In North-South Orientation	17
13.2 Diode in South-North Orientation	17
13.3 Diode in West-East Orientation	18
13.4 Diode in East-West Orientation	18
13.5 Zener Diode in North-South Orientation	18
13.6 Zener Diode in South-North Orientation	19
13.7 Zener Diode in West-East Orientation	19
13.8 Zener Diode in East-West Orientation	19
13.9 Schottky Diode in North-South Orientation	19
13.10 Schottky Diode in South-North Orientation	20
13.11 Schottky Diode in West-East Orientation	20
13.12 Schottky Diode in East-West Orientation	20
13.13 LED in North-South Orientation, Light in East Direction	21
13.14 LED in North-South Orientation, Light in West Direction	21
13.15 LED in South-North Orientation, Light in West Direction	21
13.16 LED in West-East orientation, Light in North Direction	21
13.17 LED in East-West orientation, Light in North Direction	22
13.18 Photo Diode in North-South Orientation, Light from East	22

13.19photo diode in North-South Orientation, Light from West	22
13.20photo diode in South-North Orientation, Light from West	23
14 Transistors	23
14.1 N-Channel JFET in North-South Orientation	23
14.2 N-Channel JFET in West-East Orientation	23
14.3 Enhancement-Mode N-Channel MOSFET in North-South Orientation . .	24
14.4 Enhancement-Mode P-Channel MOSFET in North-South Orientation . .	24
14.5 NPN Bipolar Junction Transistor in North-South Orientation	24
14.6 NPN Bipolar Junction Transistor in North-South Orientation (Mirrored) .	25
14.7 NPN Bipolar Junction Transistor in South-North Orientation	25
14.8 NPN Bipolar Junction Transistor in East-West Orientation	25
14.9 PNP Bipolar Junction Transistor in North-South Orientation	26
15 Operational Amplifiers	26
15.1 OP-AMP, Standardized Symbol	26
15.2 OP-AMP, Standardized Symbol, N-Input above P-Input	26
15.3 OP-AMP	27
15.4 OP-AMP, N-Input above P-Input	27
15.5 General Amplifier	28
16 Amplifiers	28
16.1 Amplifier, Standardized Symbol	28
17 Logic Gates	29
17.1 Inversion Symbol for Logic Gates Outputs	29
17.2 Logic Gate Symbol, IEC Standard	29
17.3 Logic AND Gate Symbol	30
17.4 Logic NAND Gate Symbol	30
17.5 Logic OR Gate Symbol	30
17.6 Logic NOR Gate Symbol	31
17.7 Logic NOT Gate Symbol	31
17.8 Logic XOR Gate Symbol	31
17.9 Logic XNOR Gate Symbol	32
17.10Logic AND Gate, ANSI Symbol	32
17.11Logic NAND Gate, ANSI Symbol	32
17.12Logic OR Gate, ANSI Symbol	33
17.13Logic NOR Gate, ANSI Symbol	33
17.14Logic NOT Gate, ANSI Symbol	33
17.15Logic XOR Gate, ANSI Symbol	33
17.16Logic XNOR Gate, ANSI Symbol	34
18 Flip-Flops	34
18.1 General Flip-Flop Symbol	34

18.2	General Flip-Flop Symbol for Negative Logic	34
18.3	Flip-Flop Changing on Rising Edge	35
18.4	Flip-Flop Changing on Falling Edge	35
18.5	RS Flip-Flop	35
18.6	RS NAND Flip-Flop (Negative Logic)	36
18.7	RS Flip-Flop Changing on Rising Edge	36
18.8	RS Flip-Flop Changing on Falling Edge	36
18.9	JK Flip-Flop Changing on Rising Edge	37
18.10	JK Master-Slave Flip-Flop	37
18.11	D Flip-Flop Changing on Rising Edge	37
18.12	T Flip-Flop Changing on Rising Edge	38
18.13	T Flip-Flop Changing on Falling Edge	38
18.14	Monoflop	38
18.15	Switch, West-East Direction	39
18.16	Closed Switch, West-East Direction	39
18.17	Switch, East-West Direction	39
18.18	Closed Switch, East-West Direction	40
18.19	Switch, South-North Direction	40
18.20	Closed Switch, South-North Direction	40
18.21	Pushbutton, West-East Direction	40
18.22	Pushbutton, South-North Direction	41
19	Miscellaneous	41
19.1	Ground as Symbol	41
19.2	Ground as Continued Drawing	41
19.3	Connecting Terminal	42
19.4	Junction (Black Filled Circle)	42
19.5	Junction in the Middle of a Path	42
19.6	Connection Node (for Referencing, not Visible)	42
19.7	Midway Connection Node	43
19.8	Invisible Node with Terminal Node Properties (Used with Voltage Arrows)	43
19.9	Speaker	43
19.10	Buzzer	43
19.11	Bulb	44
19.12	Multimeter (Circle for Voltmeter or Ammeter)	44
19.13	Voltsmeter	44
19.14	Ammeter	44
19.15	Brushless DC Electric Motor	45
19.16	Brushless DC Electric Generator	45
19.17	Brushes for Electric Motors and Generators	45
19.18	Brushless DC Electric Motor with Permanent Magnet	46
19.19	DC Electric Motor with Permanent Magnet	46
19.20	Shunt DC Electric Motor	46
19.21	Series DC Electric Motor	47

1 Introductory Examples

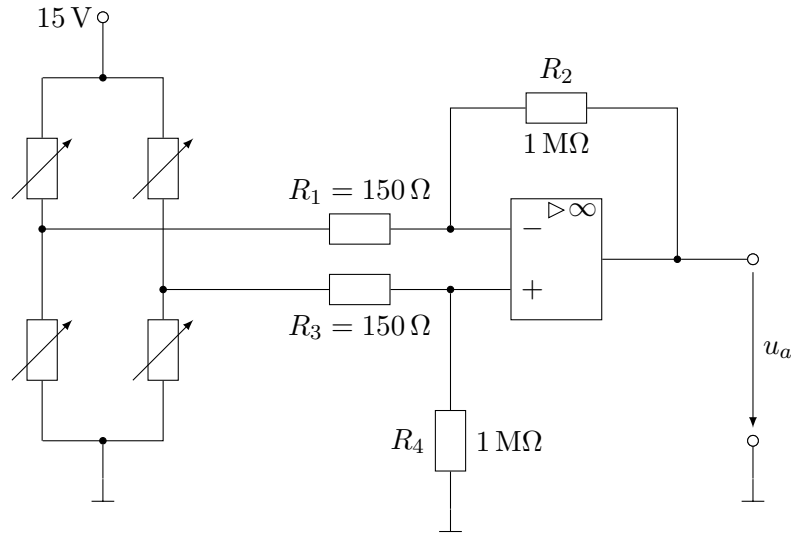
1.1 Bridge Rectifier



```
\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);

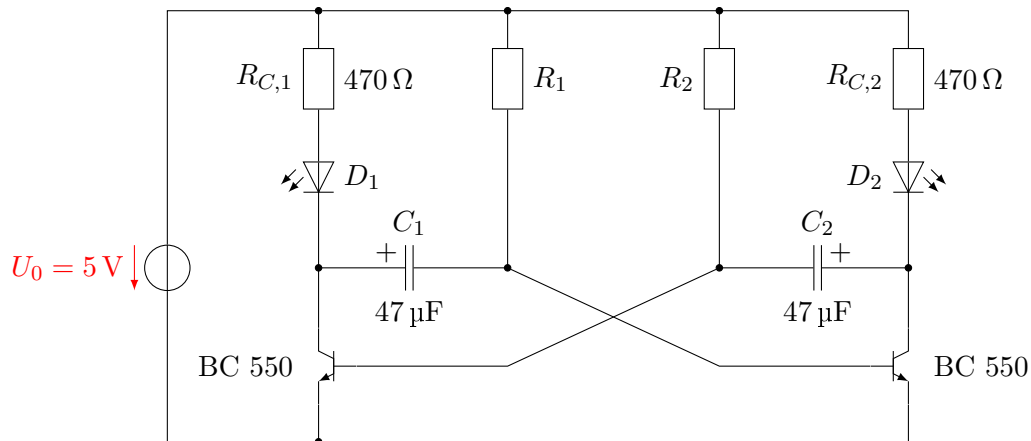
```

```

\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}}}}{\mathfrak{C}_{\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 chktex-file 1

3 chktex-file 11

4 chktex-file 12

5 chktex-file 26

6 chktex-file 36

7 chktex-file 37

8 chktex-file 8

9 Sources

9.1 Voltage Source in North-South Orientation

```

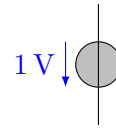
\voltagesourceNS{name}{position}{align:left|right}{text}

```

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);
```



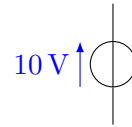
9.2 Voltage Source in South-North Orientation

```
\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);
```



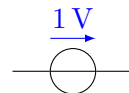
9.3 Voltage Source in West-East Orientation

```
\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);
```



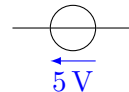
9.4 Voltage Source in East-West Orientation

```
\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);
```



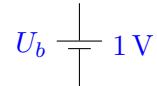
9.5 Battery in North-South Orientation

`\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);
```



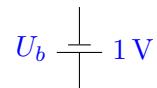
9.6 Battery in South-North Orientation

`\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);
```



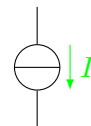
9.7 Current Source in North-South Orientation

`\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);
```



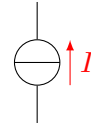
9.8 Current Source in South-North Orientation

`\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);
```



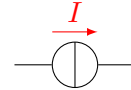
9.9 Current Source in West-East Orientation

```
\currentsourceWE{i}{(0,0)}{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);
```



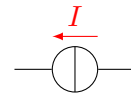
9.10 Current Source in East-West Orientation

```
\currentsourceEW{i}{(0,0)}{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);
```



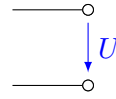
10 Voltage and Current Arrows

10.1 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}{$U$}
```

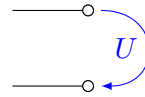


10.2 Curved Voltage Arrow Between Two Nodes

```
\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}{$U$}
```



10.3 Current Arrow in North-South Orientation

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

Example:

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



10.4 Current Arrow in South-North Orientation

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

Example:

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



10.5 Current Arrow in West-East Orientation

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

Example:

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



10.6 Current Arrow in East-West Orientation

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

Example:

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



11 Resistors, Capacitors and Inductors

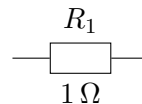
11.1 Resistor in West-East Orientation

`\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);
```



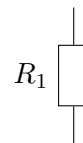
11.2 Resistor in North-South Orientation

`\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);
```



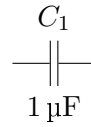
11.3 Capacitor in West-East Orientation

`\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);
```



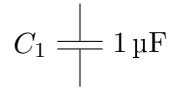
11.4 Capacitor in North-South Orientation

```
\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);
```



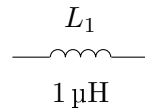
11.5 Inductor in West-East Orientation

```
\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);
```



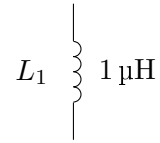
11.6 Inductor in North-South Orientation

```
\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);
```



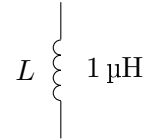
11.7 Inductor in North-South Orientation (Mirrored)

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

node endings: N: north, S: south

Example:

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



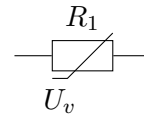
11.8 Varistor in West-East Orientation

```
\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);
```



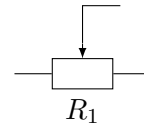
11.9 Potentiometer in West-East Orientation, North Connection

```
\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);
```



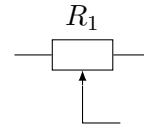
11.10 Potentiometer in West-East Orientation, South Connection

```
\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);
```



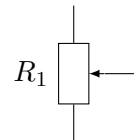
11.11 Potentiometer in North-South Orientation, East Connection

```
\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);
```



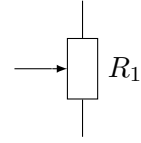
11.12 Potentiometer in North-South Orientation, West Connection

```
\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);
```



12 Transformer

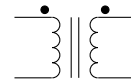
12.1 Transformer in North-South Orientation

```
\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);
```



13 Diodes

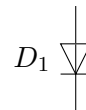
13.1 Diode In North-South Orientation

```
\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);
```



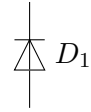
13.2 Diode in South-North Orientation

```
\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);
```



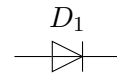
13.3 Diode in West-East Orientation

```
\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);
```



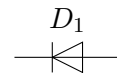
13.4 Diode in East-West Orientation

```
\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);
```



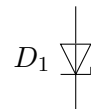
13.5 Zener Diode in North-South Orientation

```
\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);
```



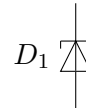
13.6 Zener Diode in South-North Orientation

`\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);
```



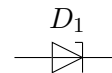
13.7 Zener Diode in West-East Orientation

`\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);
```



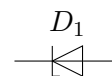
13.8 Zener Diode in East-West Orientation

`\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);
```



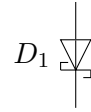
13.9 Schottky Diode in North-South Orientation

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

node endings: A: anode, C: cathode

Example:

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



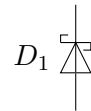
13.10 Schottky Diode in South-North Orientation

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

node endings: A: anode, C: cathode

Example:

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



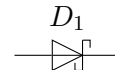
13.11 Schottky Diode in West-East Orientation

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

node endings: A: anode, C: cathode

Example:

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



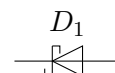
13.12 Schottky Diode in East-West Orientation

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

node endings: A: anode, C: cathode

Example:

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



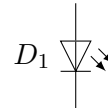
13.13 LED in North-South Orientation, Light in East Direction

`\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);
```



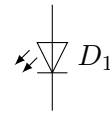
13.14 LED in North-South Orientation, Light in West Direction

`\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);
```



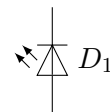
13.15 LED in South-North Orientation, Light in West Direction

`\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);
```



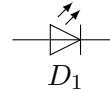
13.16 LED in West-East orientation, Light in North Direction

`\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);
```



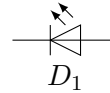
13.17 LED in East-West orientation, Light in North Direction

```
\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);
```



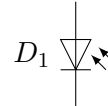
13.18 Photo Diode in North-South Orientation, Light from East

```
\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);
```



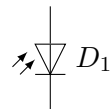
13.19 photo diode in North-South Orientation, Light from West

```
\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);
```



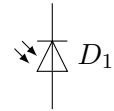
13.20 photo diode in South-North Orientation, Light from West

`\photodiodeSNW{name}{position}{text}`

node endings: A: anode, C: cathode

Example:

```
\photodiodeSNW{pd}{(0,0)}{$D_1$}
\draw (pdA) -- ++(0,-0.5) (pdC) -- ++(0,0.5);
```



14 Transistors

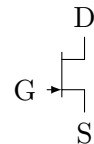
14.1 N-Channel JFET in North-South Orientation

`\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};
```



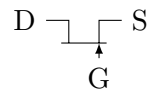
14.2 N-Channel JFET in West-East Orientation

`\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};
```



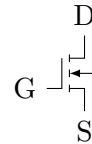
14.3 Enhancement-Mode N-Channel MOSFET in North-South Orientation

`\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};
```



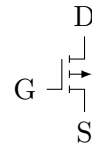
14.4 Enhancement-Mode P-Channel MOSFET in North-South Orientation

`\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};
```



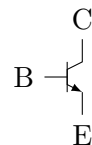
14.5 NPN Bipolar Junction Transistor in North-South Orientation

`\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};
```



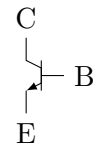
14.6 NPN Bipolar Junction Transistor in North-South Orientation (Mirrored)

`\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};
```



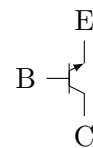
14.7 NPN Bipolar Junction Transistor in South-North Orientation

`\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};
```



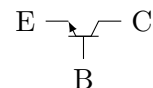
14.8 NPN Bipolar Junction Transistor in East-West Orientation

`\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};
```



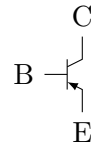
14.9 PNP Bipolar Junction Transistor in North-South Orientation

`\BJTnpNS{name}{position}`

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

Example:

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



15 Operational Amplifiers

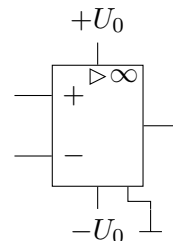
15.1 OP-AMP, Standardized Symbol

`\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)}
```



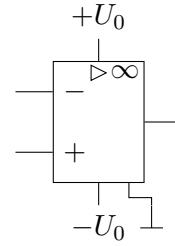
15.2 OP-AMP, Standardized Symbol, N-Input above P-Input

`\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)}
```



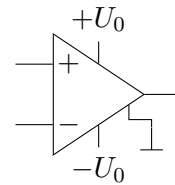
15.3 OP-AMP

`\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)}
```



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

`\opampInv{name}{position}`

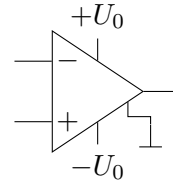
node endings: Out: output, InMinus: n-input, InPlus: p-input, UbattPlus: positive power supply, UbattMinus: negative power supply Gnd: ground

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)}

```



15.5 General Amplifier

```

\amplifier{name}{position}

```

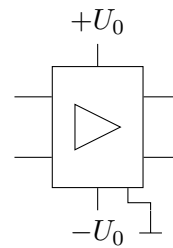
node endings: OutPlus: p-output OutMinus: n-output, InMinus: n-input, InPlus: p-input, UbattPlus: positive power supply, UbattMinus: negative power supply Gnd: ground

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)}

```



16 Amplifiers

16.1 Amplifier, Standardized Symbol

```

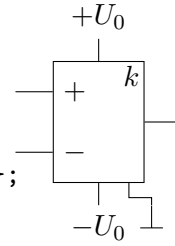
\ampNorm{name}{position}{amplification factor}

```

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}
```



17 Logic Gates

17.1 Inversion Symbol for Logic Gates Outputs

`\NOTcircle{name}{position}`

Example:

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



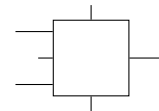
17.2 Logic Gate Symbol, IEC Standard

`\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);
```



17.3 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);
```



17.4 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);
```



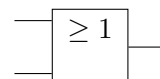
17.5 Logic OR Gate Symbol

`\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);
```



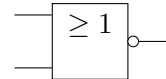
17.6 Logic NOR Gate Symbol

`\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);
```



17.7 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);
```



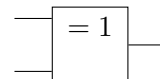
17.8 Logic XOR Gate Symbol

`\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);
```



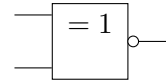
17.9 Logic XNOR Gate Symbol

`\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);
```



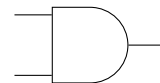
17.10 Logic AND Gate, ANSI Symbol

`\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);
```



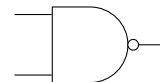
17.11 Logic NAND Gate, ANSI Symbol

`\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);
```



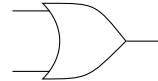
17.12 Logic OR Gate, ANSI Symbol

`\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);
```



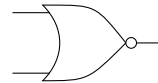
17.13 Logic NOR Gate, ANSI Symbol

`\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);
```



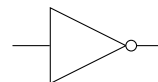
17.14 Logic NOT Gate, ANSI Symbol

`\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);
```



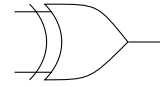
17.15 Logic XOR Gate, ANSI Symbol

`\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);
```



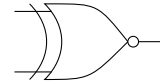
17.16 Logic XNOR Gate, ANSI Symbol

```
\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);
```



18 Flip-Flops

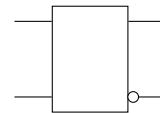
18.1 General Flip-Flop Symbol

```
\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);
```



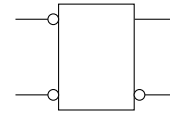
18.2 General Flip-Flop Symbol for Negative Logic

```
\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);
```



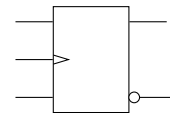
18.3 Flip-Flop Changing on Rising Edge

```
\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);
```



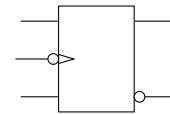
18.4 Flip-Flop Changing on Falling Edge

```
\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);
```



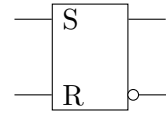
18.5 RS Flip-Flop

```
\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);
```



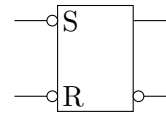
18.6 RS NAND Flip-Flop (Negative Logic)

```
\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);
```



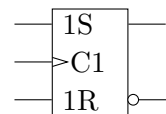
18.7 RS Flip-Flop Changing on Rising Edge

```
\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);
```



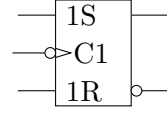
18.8 RS Flip-Flop Changing on Falling Edge

```
\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);
```



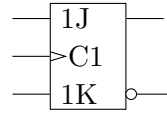
18.9 JK Flip-Flop Changing on Rising Edge

`\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);
```



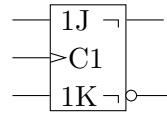
18.10 JK Master-Slave Flip-Flop

`\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);
```



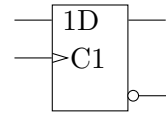
18.11 D Flip-Flop Changing on Rising Edge

`\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);
```



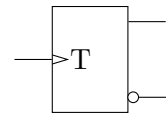
18.12 T Flip-Flop Changing on Rising Edge

`\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);
```



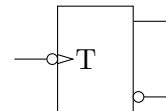
18.13 T Flip-Flop Changing on Falling Edge

`\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);
```



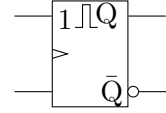
18.14 Monoflop

`\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);
```



18.15 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);
```



18.16 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);
```



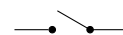
18.17 Switch, East-West Direction

```
\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);
```



18.18 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);
```



18.19 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);
```



18.20 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);
```



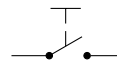
18.21 Pushbutton, West-East Direction

`\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);
```



18.22 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);
```



19 Miscellaneous

19.1 Ground as Symbol

```
\gnd{position}
```

Example:

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



19.2 Ground as Continued Drawing

```
\gndNow
```

Example:

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



19.3 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};
```



19.4 Junction (Black Filled Circle)

`\junction{name}`

Example:

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

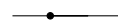


19.5 Junction in the Middle of a Path

`\junction{name}`

Example:

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



19.6 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);
```



19.7 Midway Connection Node

`\mnode{name}`

Example:

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



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

`\node{name}`

Example:

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



19.9 Speaker

`\speakerWE{name}{position}`

node endings: N: north, S: south,

Example:

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



19.10 Buzzer

`\piezobuzzerWE{name}{position}`

node endings: N: north, S: south,

Example:

```
\piezobuzzerWE{bz}{(0,0)}  
\draw (bzN) -- ++(0,0.5) (bzS) -- ++(0,-0.5);
```



19.11 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);
```



19.12 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);
```



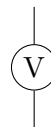
19.13 Voltmeter

`\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);
```



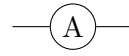
19.14 Ammeter

`\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);
```



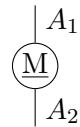
19.15 Brushless DC Electric Motor

```
\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);
```



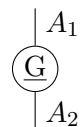
19.16 Brushless DC Electric Generator

```
\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);
```



19.17 Brushes for Electric Motors and Generators

```
\brushes{position}
```

Only useful in combination with motors or generators.

Example:

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



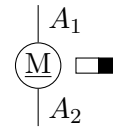
19.18 Brushless DC Electric Motor with Permanent Magnet

`\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);
```



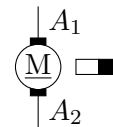
19.19 DC Electric Motor with Permanent Magnet

`\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);
```



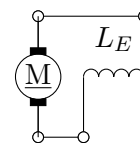
19.20 Shunt DC Electric Motor

`\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);
```



19.21 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);
```

