TikZ tricks
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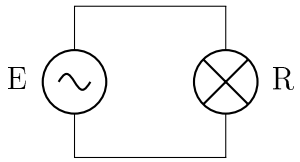
1 Basic circuits

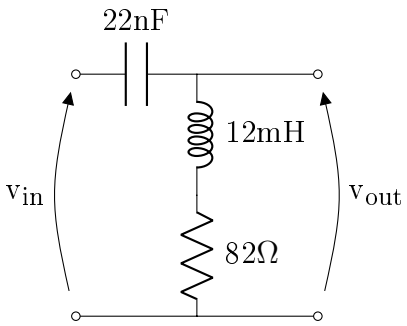
1.1 Voltage source and lamp




```
\begin{circuitikz}\draw
        (0,0) to [sinusoidal voltage source, l=$E$] (0,2)--(2,2) to [lamp, l=$R$] (2,0)
        ↪  --(0,0);
\end{circuitikz}
```

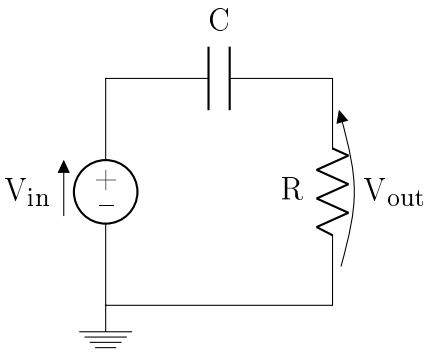
2 Filters

2.1 RLC - Out on RL



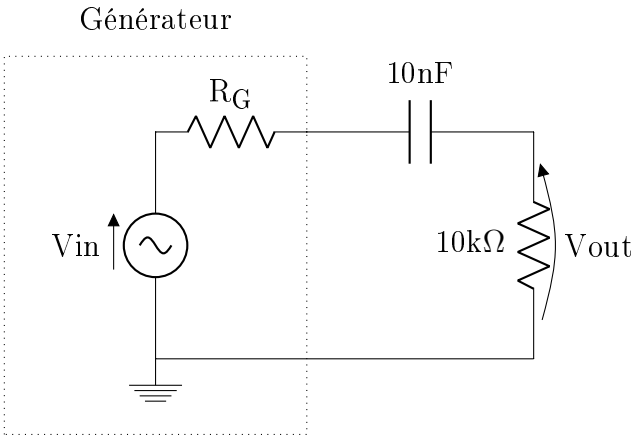

```
\begin{circuitikz}[scale=0.8]\draw
        (0,0) to [open, v^>=$v_{in}$,o-o] (0,4) to [C,l=$22nF$] (2,4) to [L,l=$12mH$]
        ↪  (2,2) to [R,l=$82\Omega$](2,0) to [short](0,0)
        (2,4) -- (4,4) to [open, v^<=$v_{out}$,o-o] (4,0) -- (2,0);
\end{circuitikz}
```

2.2 RC high-pass



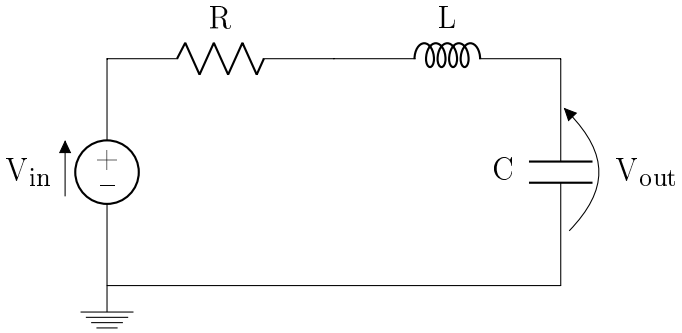
```
\begin{circuitikz} \draw
        (0,0)   node[ground]{}
        to[american voltage source, v=$V_{in}$, invert] (0,3)
        to[C, l=$C$] (3,3)
        (3,0) to[R, l=$R$, v=$V_{out}$] (3,3)
        (3,0)--(0,0);
\end{circuitikz}
```

2.3 RC high-pass with generator



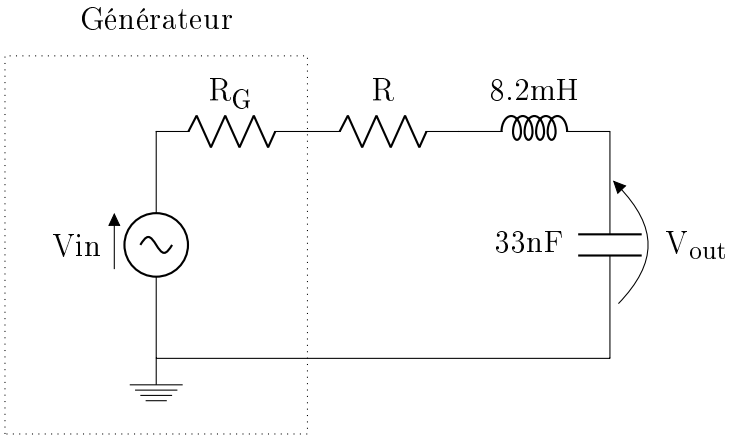

```
\begin{circuitikz} \draw
        (0,0)   node[ground]{}
        to[sinusoidal voltage source, v=$V{in}$] (0,3)
        to[R, l=$R_G$] (2,3)
        to[C, l=$10nF$] (5,3)
        (5,0) to[R, l=$10k\Omega$, v=$V{out}$] (5,3)
        (5,0)--(0,0)
        (0,4.5) node[] {Générateur};
\draw[dotted](-2,-1)--(-2,4)--(2,4)--(2,-1)--(-2,-1);
\end{circuitikz}
```

2.4 RLC - Out on C




```
\begin{circuitikz} \draw
        (0,0)   node[ground]{}
        to[american voltage source, v=$V_{in}$, invert] (0,3)
        to[R, l=$R$] (3,3)
        to[L, l=$L$] (6,3)
        (6,0) to[C, l=$C$, v=$V_{out}$] (6,3)
        (6,0)--(0,0);
\end{circuitikz}
```

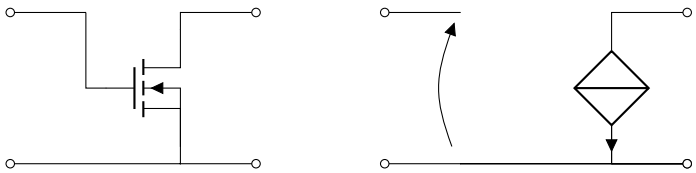
2.5 RLC with generator - Out on C




```
\begin{circuitikz} \draw
        (0,0)   node[ground]{}
        to[sinusoidal voltage source, v=$V{in}$] (0,3)
        to[R, l=$R_G$] (2,3)
        to[R, l=$R$] (4,3)
        to[L, l=$8.2mH$] (6,3)
        (6,0) to[C, l=$33nF$, v=$V_{out}$] (6,3)
        (6,0)--(0,0)
        (0,4.5) node[] {Générateur};
        \draw[dotted](-2,-1)--(-2,4)--(2,4)--(2,-1)--(-2,-1);
\end{circuitikz}
```

3 Transistors

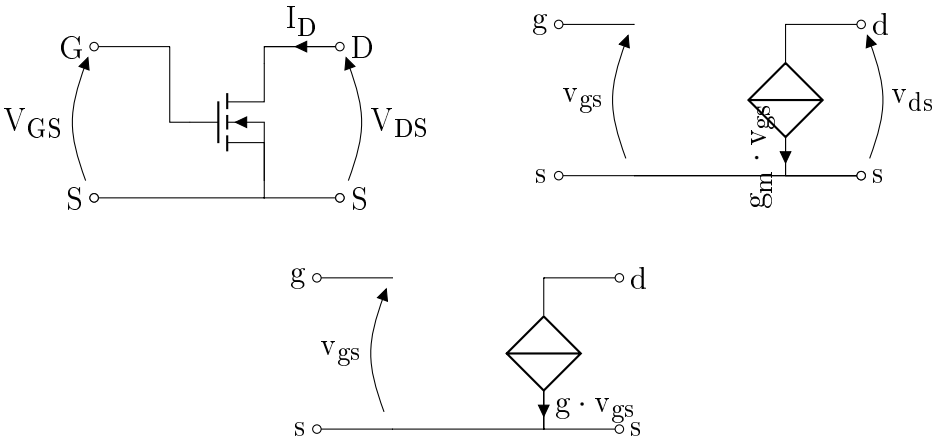
3.1 Alone



```
\begin{circuitikz} \draw
        (2.25, 1) node[nfet] (mos) {}
        (mos.D) -- (2.25, 2) to  [short, -o](3.25, 2)  node[anchor=west] {}
        ↪  %D
        (mos.S) -- (2.25, 0) to [short, -o](3.25, 0)  node[anchor=west] { }
        ↪  %S
        (mos.B) -- (mos.S)
        (2.25,0) to [short, -o](0,0)  node[anchor=east] {} %S
        (0,2)  node[anchor=east]{}[short, o-] to  (1,2) %G
        (1,2) -- (1,1) -- (mos.G)
        ;
\end{circuitikz}\hspace*{1cm}
\begin{circuitikz}\draw
        (0,0) node[anchor=east] {} %g
        to [short, o-] (1,0)
        to [open, v<={~}] (1,-2)
        to [short, -o] (4,-2)
        to [short, -o] (0,-2) node[anchor=east] {} %s
        (3,0) to [cI, i={~}] (3,-2)
        (3,-2) to [short, -o] (4,-2) node[anchor=west] {} %s
        (3,0) to [short, -o] (4,0)
```

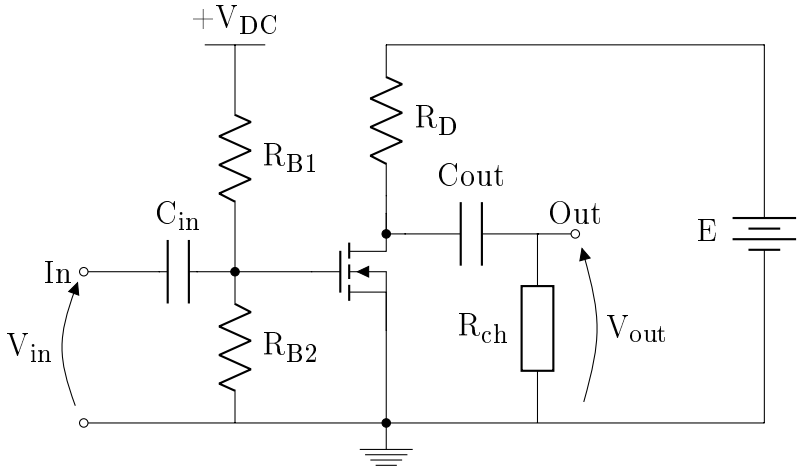
```
                    to node[anchor=west] {} (4,0) %d
;\end{circuitikz}
```

3.2 Alone with voltage and current



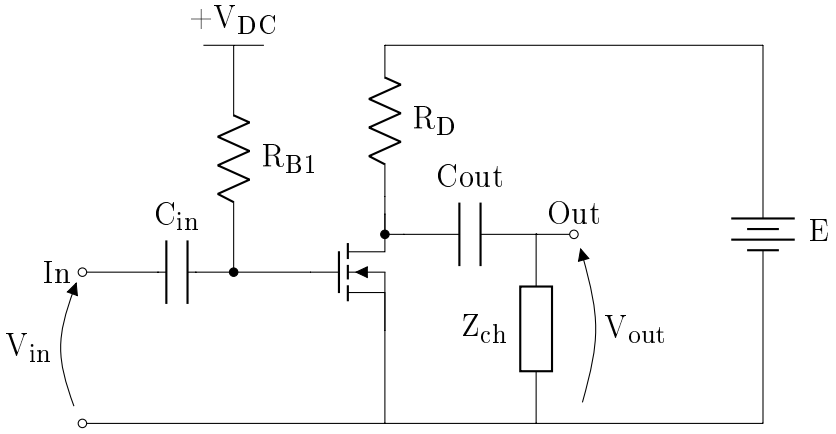

```
\begin{circuitikz} \draw
        (2.25, 1) node[nfet] (mos) {}
        (mos.D) -- (2.25, 2) to  [short, -o, i<=$I_D$](3.25, 2)  node[anchor=west] {D}
        ↪  %D
        (mos.S) -- (2.25, 0) to [short, -o](3.25, 0)  node[anchor=west] {S}
        ↪  %S
        (mos.B) -- (mos.S)
        (2.25,0) to [short, -o](0,0)  node[anchor=east] {S} %S
        (0,2)  node[anchor=east]{G}[short, o-] to  (1,2) %G
        (1,2) -- (1,1) -- (mos.G)
        (0,0) [open,v^>=$V_{GS}$] to (0,2)
        (3.25,0) [open,v>=$V_{DS}$] to (3.25,2)
;\end{circuitikz}\hspace*{1cm}
\begin{circuitikz}\draw
        (0,0) node[anchor=east] {g} %g
        to [short, o-] (1,0)
        to [open, v<=$v_{gs}$] (1,-2)
        to [short, -o] (4,-2)
        to [short, -o] (0,-2) node[anchor=east] {s} %s
        (3,0) to [cI, i_=\rotatebox{90}{$g_m\cdot v_{gs}$}] (3,-2)
        (3,-2) to [short, -o] (4,-2) node[anchor=west] {s} %s
        (3,0) to [short, -o] (4,0)
        to node[anchor=west] {d} (4,0) %d
        (4.0,-2) [open,v>=$v_{ds}$] to (4.0,0)
;\end{circuitikz}

\begin{circuitikz}\draw
        (0,0) node[anchor=east] {g}
        to [short, o-] (1,0)
        to [open, v<=$v_{gs}$] (1,-2)
        to [short, -o] (0,-2)
        to  (0,-2) node[anchor=east] {s}
        (3,0) to [cI=$ g \cdot v_{gs}$] (3,-2)
        (3,-2) to [short, -o] (4,-2) node[anchor=west] {s}
        (3,0) to [short, -o] (4,0)
        to node[anchor=west] {d} (4,0)
        (1,-2) -- (3,-2)
;\end{circuitikz}
```

3.3 Full common source



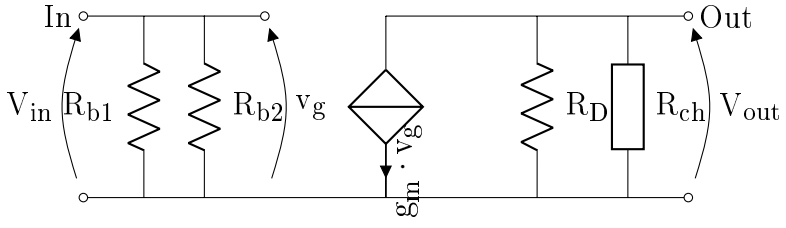

```
\begin{circuitikz}[scale=1]\draw
(0,1) to [short,o-] (9,1)
(4,6) to [short] (9,6)
(0,3) node[anchor=east] {In} to [short,o-] (1,3)
(0,3) node[anchor=south]{} to [open, v_<=$V_{in}$]  (0,1)
(1,3) to [C=$C_{in}$ ](1.5,3)
(1.5,3) to [short,-*] (2,3) node[anchor=south west]{}

(2,6) node[anchor=south ] (alim) {$+V_{DC}$}
(1.6,6) -- (2.4,6) %bar under the label
(2,3) to [R, l_=$R_{B1}$](2,6)
(2,3) to [R=$R_{B2}$](2,1)
(4,3) node[nfet] (mos) {}
(mos.G) to [short] (2,3)
(mos.D) to (4,4) to [R, l_=$R_D$] (4, 6)
(mos.D) to [short,-*](4,3.5)  to [short] (4.25,3.5)
(mos.S) to [short] (4,1)% to [short, -o](2,0)  node[anchor=west] {S}
(mos.S) -- (mos.B) %source to bulk connection

(4.25,3.5) node[anchor=south]{} to [C, l^=$C{out}$] (6,3.5) to
↪  [short](6,3.5)node[anchor=south]{} to [short,-o](6.5,3.5)node [anchor=south]
↪  {Out}
(6,3.5) to [generic, l_=$R_{ch}$] (6,1)
(6.5,3.5) to [open,v^<=$V_{out}$] (6.5,1)
(9,6) to [battery, l_=$E$](9,1)
(4,1) node[circ]{}
(4,1) node[ground]{}
;\end{circuitikz}
```

3.4 Common source - Direct polarisation




```
\begin{circuitikz}[scale=1]\draw
        (0,1) to [short,o-] (9,1)
        (4,6) to [short] (9,6)
        (0,3) node[anchor=east] {In} to [short,o-] (1,3)
        (0,3) to [open, v_<=$V_{in}$]  (0,1)
        (1,3) to [C=$C_{in}$ ](1.5,3)
        (1.5,3) to [short,-*] (2,3)
        (2,6) node[anchor=south ] (alim) {$+V_{DC}$}
        (1.6,6) -- (2.4,6) %bar under the label
        (2,3) to [R, l_=$R_{B1}$](2,6)
        (4,3) node[nfet] (mos) {}
        (mos.G) to [short] (2,3)
        (mos.D) to (4,4) to [R, l_=$R_D$] (4, 6)
        (mos.D) to [short,-*](4,3.5)  to [short] (4.25,3.5)
        (mos.S) to [short] (4,1)% to [short, -o](2,0)  node[anchor=west] {S}
        (mos.S) -- (mos.B) %source to bulk connection

        (4.25,3.5) to [C, l^=$C{out}$] (6,3.5) to  [short](6,3.5) to [short,-o](6.5,3.5)node
        ↪  [anchor=south] {Out}
        (6,3.5) to [generic, l_=$Z_{ch}$] (6,1)
        (6.5,3.5) to [open,v^<=$V_{out}$] (6.5,1)
        (9,6) to [battery, l=$E$](9,1)
;\end{circuitikz}
```

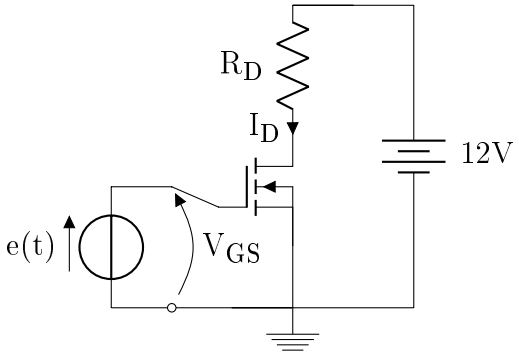
3.5 Common source - small signal




```
\begin{circuitikz}[scale=0.8]\draw
        (1,0) to [short,o-o] (11,0)
        (1,3) node[anchor=east] {In} to [short,o-] (1,3)
        (1,3) to [open, v_<=$V_{in}$]  (1,0)
        (1,3) to [short] (3,3)
        (2,3) to [R, l_=$R_{b1}$](2,0)
        (3,3) to [R=$R_{b2}$](3,0)
        (3,3) to [short,-o](4,3) node [anchor=west] {}
        (4,3) to [open, v^<=$v_{g}$](4,0)
        (6,3) to [cI=\rotatebox{90}{$g_m \cdot v_{g}$}] (6,0)
```

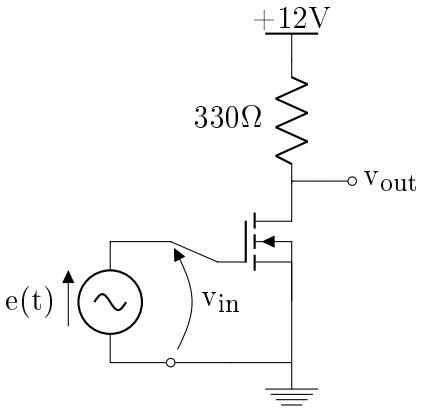
```
        (8.5,0) to [R,l_=$R_D$] (8.5,3)
        (10,3) to [generic, l=$R_{ch}$] (10,0)
        (6,3) to [short,-o] (11,3) node [anchor=west] {Out}
        (11,3) to [open, v^<=$V_{out}$](11,0)
;\end{circuitikz}
```

3.6 Common source simple




```
\ctikzset{tripoles/mos style/arrows}
\begin{circuitikz}[scale=0.8]\draw
        (0,0) to [V=$e(t)$] (0,2)
        (0,2) to [short] (1,2)
        (0,0) to (1,0)
        (1,2) to [open, v^<=$V_{GS}$](1,0)
        (1,0) to [short, o-] (2,0)
        (3,2) node[nigfete ] (mos) {}
        (3,0) to [short] (mos.S)
        (1,2) to [short] (mos.G)
        (2,0) to (3,0)
        (mos.D) to [short, i<=$I_D$](3,3)
        (3,3) to [R,l=$R_D$ ] (3,5)
        (3,5) to (4,5)
        (2,0) -- (5,0)
        (5,5) -- (3,5)
        (5,5) to [battery, l=$12V$] (5,0)
        (3,0) node[ground] {}
;\end{circuitikz}
```

3.7 Common source simple with v_{out}

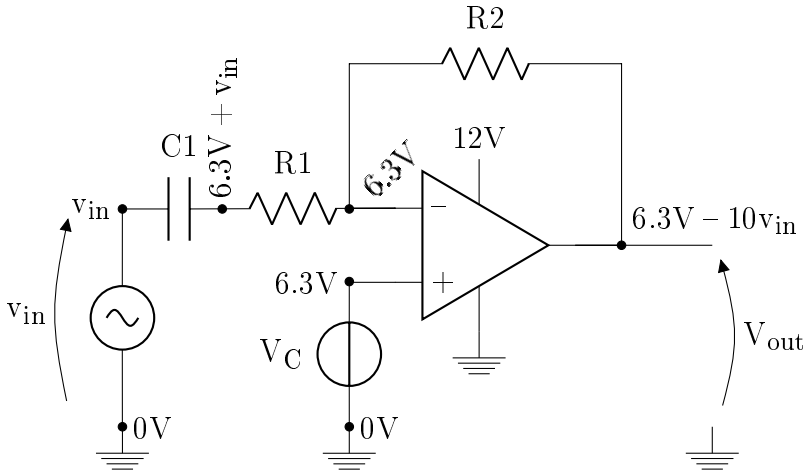



```
\begin{circuitikz}[scale=0.8] \draw
        (0,0) to [sV=$e(t)$] (0,2)
```

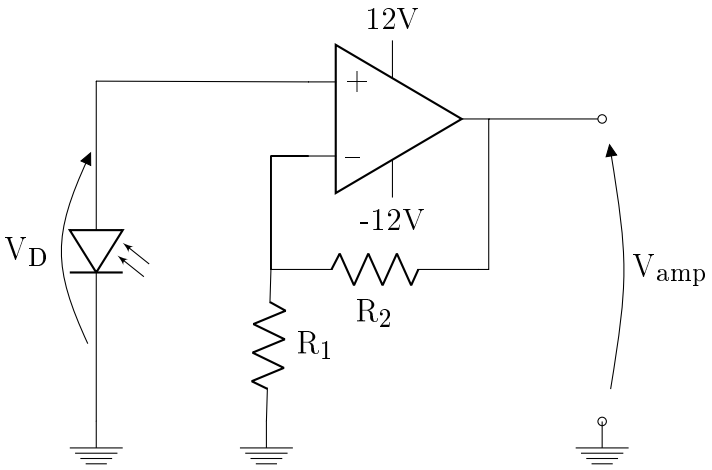
```
        (0,2) to [short] (1,2)
        (0,0) to (1,0)
        (1,2) to [open, v^<=$v_{in}$](1,0)
        (1,0) to [short, o-] (2,0)
        (3,2) node[nigfete ] (mos) {}
        (mos.S) to [short] (3,0)
        (1,2) to [short] (mos.G)
        (2,0) to (3,0)
        (mos.D) to [short](3,3) %, i<=$I_D$
        (3,3) to [R, l=$330\ohm$] (3,5)
        (3,3) to [short, -o](4,3)
        (4,3) node[anchor=west] {$v_{out}$}
        (3,5) node[rground, yscale=-1] (alim) {}
        (3,5.7) node {+12V}
        (3,0) node[ground] {}
;\end{circuitikz}
```

4 Operational amplifiers

4.1 Inverter with voltage and buffered offset



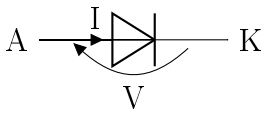

```
\begin{circuitikz} [scale=1.2]\draw
        (0,0) node[op amp] (opamp) {}
        (opamp.down) ++ (0,-0.5) node[ground]{} -- (opamp.down)
        (opamp.up) ++ (0,.5) node[above] {12V} -- (opamp.up)
        (opamp.-) -| (-1.5,2) to [R, l=$R2$] (1.5,2) |-  (opamp.out)
        (opamp.+) -| (-1.5,-0.4) to [european voltage source, l_=$V_{C}$,-*] (-1.5,-2)
        ↪  node[ground] {}
        (-4,-2) node[ground] {}  to [sV,*-*] (-4,0.4) |- ++(0.5,0) to [C,l=$C1$]
        ↪  ++(0.25,0) to [R,l=$R1$] (opamp.-)
        (-4,-2) node[anchor=west] {$0V$}
        (-1.5,-2) node[anchor=west] {$0V$}
        (-2.9,0.4) node[circ]{}
        (-2.9,0.4) node[anchor=south]{\rotatebox{90}{$6.3V+v_{in}$}}
        (-1.5,0.4) node[circ]{}
        (-1.5,0.4) node[anchor=south west]{\rotatebox{42}{$6.3V$}}
        (-1.5,-0.4) node[circ]{}
        (-1.5,-0.4) node[anchor=east]{$6.3V$}
        (1.5,0) node[circ]{}
        (1.5,0) node[anchor=south west]{$6.3V-10v_{in}$}
        (opamp.out) to (2.5,0)
        (2.5,-2) node[ground] {} to [open, v>=$V_{out}$] (2.5,0)
        (-4.5,-2) to [open, v^>=$v_{in}$] (-4.5,0.5)
        (-4,0.4) node[anchor=east] {$v_{in}$}
;\end{circuitikz}
```




```
\begin{circuitikz}\draw
        (0,4.5) to [photodiode,v_<=$V_D$, ] (0,0) node [ground] {}
        (4,4) node[op amp, yscale=-1] (opamp) {}
        (opamp.down) ++ (0,+0.5) node[above] {12V} -- (opamp.down)
        (opamp.up) ++ (0,-0.5) node[below] {-12V} -- (opamp.up)
        (opamp.-) -| ++(-0.5,-1.5) to [R, l_=$R_2$] ++(2.75,0) -|  (opamp.out)
        (opamp.-) -| ++(-0.5,-1.5) to [R, l=$R_1$] (2.25,0) node[ground] {}
        (opamp.+) to [short](0,4.5)
        (opamp.out) to [short] ++(1.5,0) node (A) {}
        to [open, v^<=$V_{amp}$, o-o] ++(0,-4) node [ground]{}
        ;
\end{circuitikz}
```

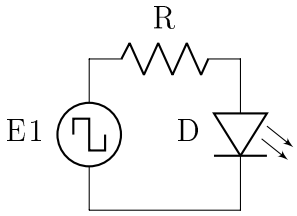
5 Diodes

5.1 Alone



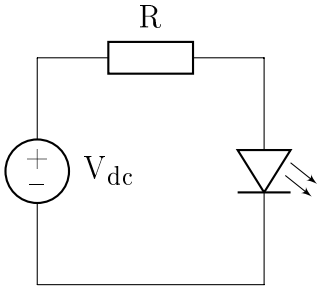

```
\begin{circuitikz}\draw
        (0,0) node[anchor=east] {A} to [short,i>^=$I$] (1.5,0)
        (0,0) to [Do, v<=$V$] (2.5,0) node [anchor=west]{K}
;\end{circuitikz}
```

5.2 Pulsed LED



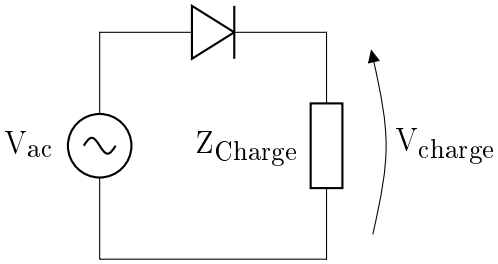

```
\begin{circuitikz}\draw
        (0,0) to [square voltage source, l=$E1$] (0,2) to [R, l=$R$] (2,2) to [led,
        ↪  l_=$D$](2,0) --(0,0)
        ;
\end{circuitikz}
```

5.3 LED



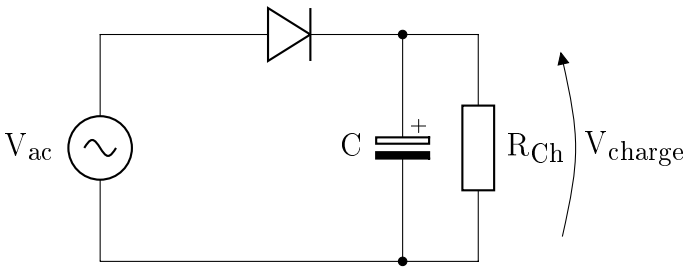

```
\begin{circuitikz}\draw
        (0,3) to [american voltage source, l=$V_{dc}$] (0,0)
        (0,3) to [european resistor, l^=$R$] (3,3)
        to [leDo] (3,0) -- (0,0)
;\end{circuitikz}
```

5.4 Load



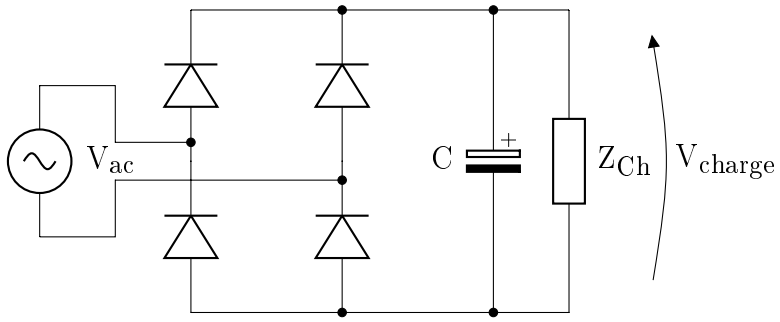

```
\begin{circuitikz}\draw
        (0,0) to [sV, l=$V_{ac}$] (0,3)
        to [Do] (3,3)
        to [european resistor,l_=$Z_{Charge}$] (3,0) to (0,0)
        (3.5,3) to [open, v^<=$V_{charge}$] (3.5,0)
;\end{circuitikz}
```

5.5 Load and C in parallel



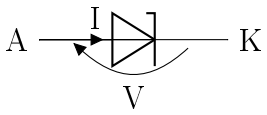

```
\begin{circuitikz}\draw
        (0,0) to [sV, l=$V_{ac}$] (0,3)
        to [Do] (5,3)
        to [european resistor,l=$R_{Ch}$] (5,0) to (0,0)
        (4,3) to [eC,l_=$C$, *-*] (4,0)
        (6,3) to [open, v^<=$V_{charge}$] (6,0)
;\end{circuitikz}
```

5.6 Full-wave rectifier with C and load



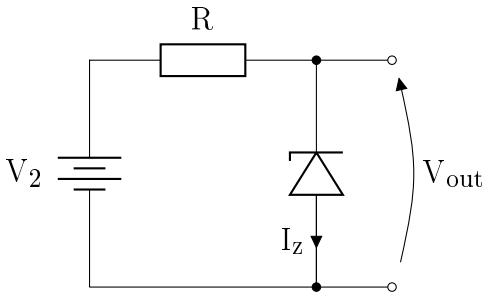

```
\begin{circuitikz}\draw
        (-2,1) to [sV, l_=$V_{ac}$] (-2,3)
        (-2,1) to (-1,1) to (-1,1.75) to [short,-*](2,1.75)
        (-2,3) to (-1,3) to (-1,2.25) to [short,-*](0,2.25)
        (0,0) to [Do] (0,2) to [Do](0,4)
        (2,0) to [Do,*-] (2,2) to [Do, -*](2,4)
        (0,4) to [short](5,4)
        (0,0) to [short](2,0)
        (5,4) to [european resistor,l=$Z_{Ch}$] (5,0) to (2,0)
        (4,4) to [eC,l_=$C$, *-*] (4,0)
        (6,4) to [open, v^<=$V_{charge}$] (6,0)
;\end{circuitikz}
```

5.7 Zener alone



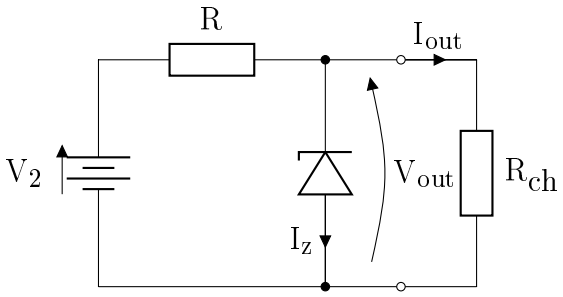

```
\begin{circuitikz}\draw
        (0,0) node[anchor=east] {A} to [short,i>^=$I$] (1.5,0)
        (0,0) to [zDo, v<=$V$] (2.5,0) node [anchor=west]{K}
;\end{circuitikz}
```

5.8 Zener - DC source




```
\begin{circuitikz}\draw
        (0,0) to [battery, invert, l=$V_{2}$] (0,3)
        to [european resistor,l=$R$] (3,3)
        (3,0) to [zDo, i<=$I_z$] (3,3)
        (3,0) to (0,0)
        (3,0) to [short,*-o] (4,0)
        (3,3) to [short,*-o] (4,3)
        (4,3) to [open,v^<=$V_{out}\equiv -V(Fig\ref{fig:zenerconv})$] (4,0)
;\end{circuitikz}
```

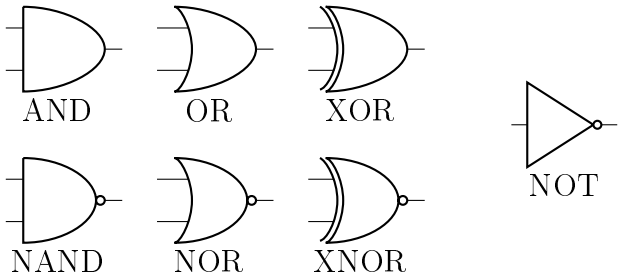
5.9 Zener - DC source and load




```
\begin{circuitikz}\draw
        (0,3) to [battery, v_<=$V_{2}$] (0,0)
        (0,3) to [european resistor,l=$R$] (3,3)
        (3,0) to [zDo, i<=$I_z$] (3,3)
        (3,0) to (0,0)
        (3,0) to [short,*-o] (4,0) to (5,0)
        (3,3) to [short,*-o] (4,3) to [short, i=$I_{out}$] (5,3)
        (5,3) to [european resistor,l=$R_{\mbox{ch}}$] (5,0)
        (3.5,3) to [open,v^<=$V_{out}$] (3.5,0)
;\end{circuitikz}
```

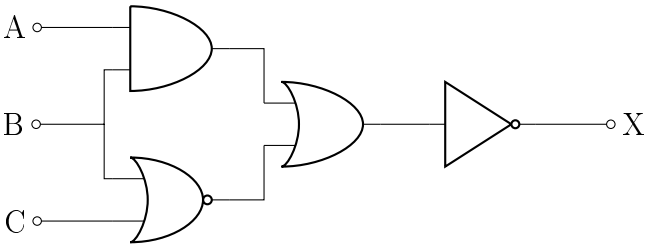
6 Logic

6.1 Gates



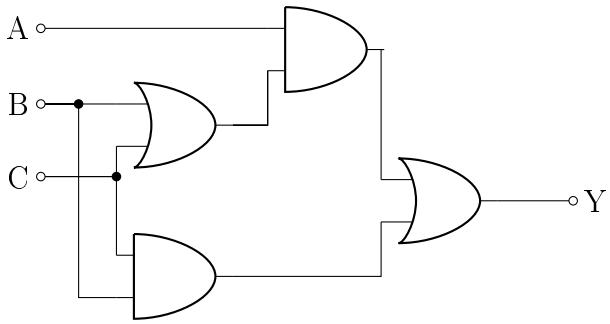

```
\begin{circuitikz} \draw
        (0,0) node [american nand port]{}
        (-0.7,-0.8) node  {NAND}

        (2,0) node [american nor port] {}
        (2-0.7,-0.8) node  {NOR}

        (4,0) node [american xnor port] {}
        (4-0.7,-0.8) node  {XNOR}

        (0,2) node [american and port] {}
        (-0.7,2-0.8) node  {AND}

        (2,2) node [american or port] {}
        (2-0.7,2-0.8) node  {OR}

        (4,2) node [american xor port] {}
        (4-0.7,2-0.8) node  {XOR}

        (6,1) node [american not port] {}
        (6.7-0.7,1-0.8) node  {NOT}
;\end{circuitikz}
```

6.2 Circuit 1



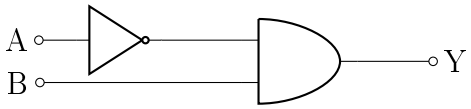

```
\begin{circuitikz} \draw
        (0,0) node [american nor port] (nor) {}
        (nor.in 2) -- ++(-1,0) node [ocirc] {} node [anchor=east] {C}
        (nor.in 1) -|  (-1.5,1)
        (0,2) node [american and port] (and){}
        (and.in 2) -| (-1.5,1) to [short, -o] (-2.4,1) node [anchor=east] {B}
        (and.in 1)        -- ++(-1,0) node [ocirc] {} node [anchor=east] {A}
        (2,1) node [american or port] (or){}
        (and.out) -| (or.in 1)
        (nor.out) -| (or.in 2)
        (3.5,1) node [american not port] (not){}
        (or.out) -- (not.in)
        (not.out) -- ++(1,0) node [ocirc] {} node [anchor=west] {X}
;\end{circuitikz}
```

6.3 Voter



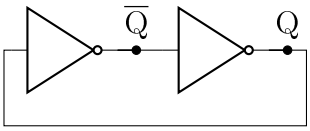

```
\begin{circuitikz} \draw
        (0,0) node [american and port] (and1) {}
        (and1.in 2) -- ++(-0.5,0) |- node [circ] {} ++(-0.5,2.56) node [ocirc] (B) {}
        ↪  node [anchor=east] {B}
        (0,2) node [american or port] (or){}
        (or.in 1) -- ++(-0.5,0) |- (B)
        (or.in 2) |- node [circ] {} ++(-1,-0.4) node [ocirc] (C) {} node [anchor=east]
        ↪  {C}
        (and1.in 1) |- (C)
        (2,3) node [american and port] (and2) {}
        (or.out) -| (and2.in 2)
        (and2.in 1) -- ++(-3,0)  node [ocirc] (A) {} node [anchor=east] {A}
        (or.out) -| (and2.in 2)
        (3.5,1) node [american or port] (and3){}
        (and2.out) -| (and3.in 1)
        (and1.out) -| (and3.in 2)
        (and3.out) -- ++(1,0) node [ocirc] {} node [anchor=west] {Y}
;\end{circuitikz}
```

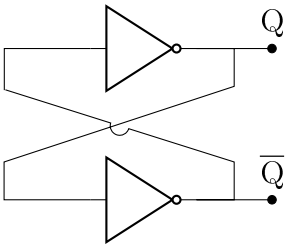
6.4 Circuit 2




```
\begin{circuitikz} \draw
        (0,0.72) node [american and port] (and1) {}
        (-3,1) node [american not port, scale=0.8] (not){}
        (and1.in 1) -|   (not.out)
        (not.in) |-  ++(-0.5,0) node [ocirc] (A) {} node [anchor=east] {A}
        (and1.in 2) |- ++(-2.66,0) node [ocirc] (B) {} node [anchor=east] {B}
        (and1.out) -- ++(1,0) node [ocirc] (Y) {} node [anchor=west] {Y}
;\end{circuitikz}
```

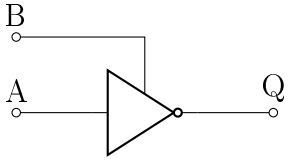
6.5 Bistable





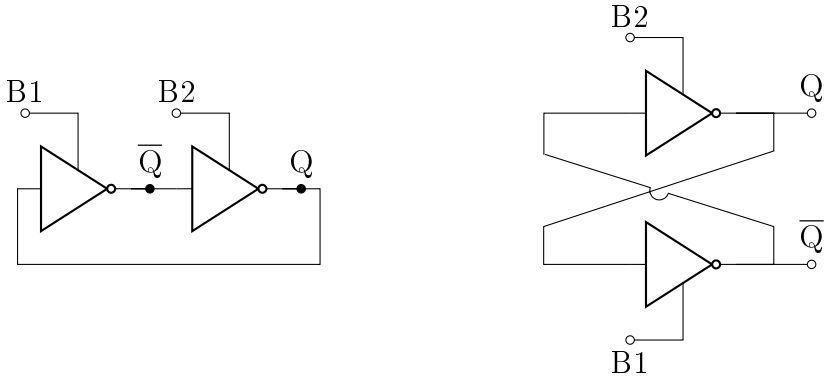

```
\begin{circuitikz} \draw
        (0,0) node [american not port] (not3) {}
        (2,0) node [american not port] (not4) {}
        (not3.out) -- (not4.in)
        (not4.out) -- ++(0.5,0) |- ++(-4,-1) |- (not3.in)
        (not3.out) |-  ++(0.25,0) node [circ] () {} node [anchor=south] {$\overline{Q}$}
        (not4.out) |-  ++(0.25,0) node [circ] () {} node [anchor=south] {$Q$}

        (8,1) node [american not port] (not1) {}
        (8,-1) node [american not port] (not2) {}
        (not1.out)  ++(0.5,-0.5)  coordinate (a-a) %coords of the crossing wire
        (not2.in)  ++(-1,0.5)  coordinate (a-b)

        (not1.in)++(-1.27,-0.5) node (in) {} % end of the wire with kinky bump
        (not2.out)-| ++(0.5,0.5) to  [kinky cross=(a-a)--(a-b), kinky crosses=left] (in)
        (not1.in)-| ++(-1.14,-0.55)
        (not2.out) -- ++(1,0) node [circ] () {} node [anchor=south] {$\overline{Q}$}

        (not1.out) -| ++(0.5,-0.5) -- ++(-3.043,-1) |- (not2.in)
        (not1.out) -- ++(1,0) node [circ] () {} node [anchor=south] {$Q$}
;\end{circuitikz}
```

6.6 Enable



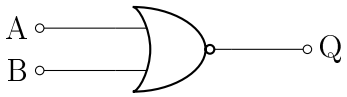

```
\begin{circuitikz} \draw
        (0,0) node [american not port] (not1) {}
        (not1)+(0,.25) |- ++(-1.7,1) node [ocirc] () {} node [anchor=south] {$B$}
        (not1.in) -- ++(-1,0) node [ocirc] () {} node [anchor=south] {$A$}
        (not1.out) -- ++(1,0) node [ocirc] () {} node [anchor=south] {$Q$}
;\end{circuitikz}
```

6.7 Bistable with enable



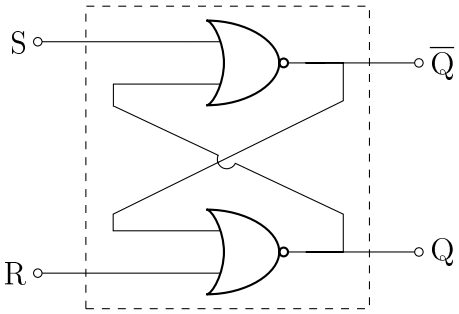

```
\begin{circuitikz} \draw
        (0,0) node [american not port] (not3) {}
        (not3)+(0,.25) |- ++(-0.7,1) node [ocirc] () {} node [anchor=south] {$B1$}
        (2,0) node [american not port] (not4) {}
        (not4)+(0,.25) |- ++(-0.7,1) node [ocirc] () {} node [anchor=south] {$B2$}
        (not3.out) -- (not4.in)
        (not4.out) -- ++(0.5,0) |- ++(-4,-1) |- (not3.in)
        (not3.out) |-  ++(0.25,0) node [circ] () {} node [anchor=south] {$\overline{Q}$}
        (not4.out) |-  ++(0.25,0) node [circ] () {} node [anchor=south] {$Q$}

        (8,1) node [american not port] (not1) {}
        (not1)+(0,0.25) |- ++(-0.7,1) node [ocirc] () {} node [anchor=south] {$B2$}
        (8,-1) node [american not port] (not2) {}
        (not2)+(0,-0.25) |- ++(-0.7,-1) node [ocirc] () {} node [anchor=north] {$B1$}
        (not1.out)  ++(0.5,-0.5)  coordinate (a-a) %coords of the crossing wire
        (not2.in)  ++(-1,0.5)  coordinate (a-b)

        (not1.in)++(-1.27,-0.5) node (in) {} % end of the wire with kinky bump
        (not2.out)-| ++(0.5,0.5) to  [kinky cross=(a-a)--(a-b), kinky crosses=left] (in)
        (not1.in)-| ++(-1.14,-0.55)
        (not2.out) -- ++(1,0) node [ocirc] () {} node [anchor=south] {$\overline{Q}$}

        (not1.out) -| ++(0.5,-0.5) -- ++(-3.043,-1) |- (not2.in)
        (not1.out) -- ++(1,0) node [ocirc] () {} node [anchor=south] {$Q$}
;\end{circuitikz}
```

6.8 NOR



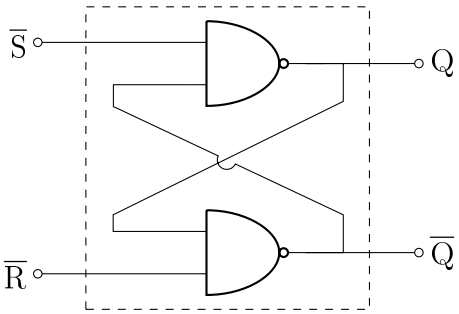

```
\begin{circuitikz} \draw
        (0,0) node [american nor port] (nor) {}
        (nor.in 1) -- ++(-1,0) node [ocirc] () {} node [anchor=east] {$A$}
        (nor.in 2) -- ++(-1,0) node [ocirc] () {} node [anchor=east] {$B$}
        (nor.out) -- ++(1,0) node [ocirc] () {} node [anchor=west] {$Q$}
;\end{circuitikz}
```

6.9 SR using NOR




```
\begin{circuitikz} \draw
        (0,1) node [american nor port] (nor1) {}
        (0,-1.5) node [american nor port] (nor2) {}
        (nor1.out)  ++(0.5,-0.5)  coordinate (a-a) %coords of the crossing wire
        (nor2.in 2)  ++(-1.5,0.5)  coordinate (a-b)

        (nor1.in 2)++(-1.135,-0.225) node (in) {} % end of the wire with kinky bump
        (nor2.out)-| ++(0.5,0.5) to  [kinky cross=(a-a)--(a-b), kinky crosses=left] (in)
        (nor1.in 2)-| ++(-1,-0.3)
        (nor1.out) -- ++(1.5,0) node [ocirc] () {} node [anchor=west] {$\overline{Q}$}

        (nor1.out) -| ++(0.5,-0.5) -- ++(-3.043,-1.5) |- (nor2.in 1)
        (nor2.out) -- ++(1.5,0) node [ocirc] () {} node [anchor=west] {$Q$}
        (nor1.out) |-  ++(0.25,0)

        (nor1.in 1) -- ++(-2,0) node [ocirc] () {} node [anchor=east] {$S$}
        (nor2.in 2) -- ++(-2,0) node [ocirc] () {} node [anchor=east] {$R$}
;\draw [dashed](-2.75,-2.25) rectangle (1,1.75);
\end{circuitikz}
```

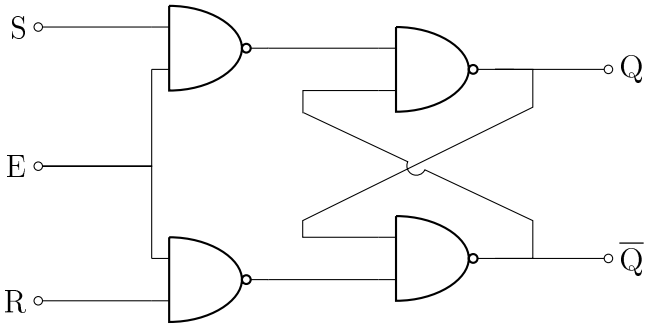
6.10 SR using NAND




```
\begin{circuitikz} \draw
        (0,1) node [american nand port] (nor1) {}
        (0,-1.5) node [american nand port] (nor2) {}
        (nor1.out)  ++(0.5,-0.5)  coordinate (a-a) %coords of the crossing wire
        (nor2.in 2)  ++(-1.5,0.5)  coordinate (a-b)

        (nor1.in 2)++(-1.135,-0.225) node (in) {} % end of the wire with kinky bump
        (nor2.out)-| ++(0.5,0.5) to  [kinky cross=(a-a)--(a-b), kinky crosses=left] (in)
        (nor1.in 2)-| ++(-1,-0.3)
        (nor1.out) -- ++(1.5,0) node [ocirc] () {} node [anchor=west] {$Q$}

        (nor1.out) -| ++(0.5,-0.5) -- ++(-3.043,-1.5) |- (nor2.in 1)
        (nor2.out) -- ++(1.5,0) node [ocirc] () {} node [anchor=west] {$\overline{Q}$}
        (nor1.out) |-  ++(0.25,0)

        (nor1.in 1) -- ++(-2,0) node [ocirc] () {} node [anchor=east] {$\overline{S}$}
        (nor2.in 2) -- ++(-2,0) node [ocirc] () {} node [anchor=east] {$\overline{R}$}
```

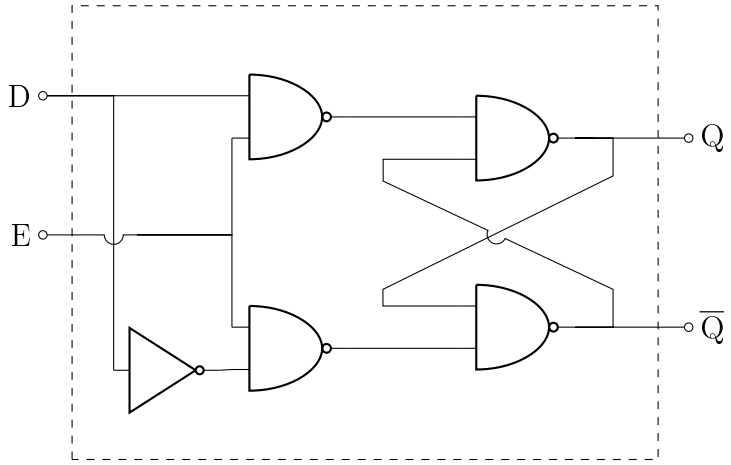
```
;
\draw [dashed](-2.75,-2.25) rectangle (1,1.75);
\end{circuitikz}
```

6.11 SR with NAND and enable




```
\begin{circuitikz} \draw
        (0,1.28) node [american nand port] (nand1) {}
        (0,-1.5-0.28) node [american nand port] (nand2) {}

        (nand1.in 1) -- ++(-1.5,0) node [ocirc] () {} node [anchor=east] {$S$}
        (nand2.in 2) -- ++(-1.5,0) node [ocirc] () {} node [anchor=east] {$R$}

        (nand1.in 2) |- ++(-1.5,-1.28) coordinate (dot) node [ocirc] () {} node [anchor=east] {$E$}
        (nand2.in 1) |- (dot)

        (3,1) node [american nand port] (nor1) {}
        (3,-1.5) node [american nand port] (nor2) {}
        (nor1.out)  ++(0.5,-0.5)  coordinate (a-a) %coords of the crossing wire
        (nor2.in 2)  ++(-1.5,0.5)  coordinate (a-b)

        (nor1.in 2)++(-1.135,-0.225) node (in) {} % end of the wire with kinky bump
        (nor2.out)-| ++(0.5,0.5) to  [kinky cross=(a-a)--(a-b), kinky crosses=left] (in)
        (nor1.in 2)-| ++(-1,-0.3)
        (nor1.out) -- ++(1.5,0) node [ocirc] () {} node [anchor=west] {$Q$}

        (nor1.out) -| ++(0.5,-0.5) -- ++(-3.043,-1.5) |- (nor2.in 1)
        (nor2.out) -- ++(1.5,0) node [ocirc] () {} node [anchor=west] {$\overline{Q}$}
        (nor1.out) |-  ++(0.25,0)
        (nor1.in 1) -| (nand1.out)
        (nor2.in 2) -| (nand2.out)
;\end{circuitikz}
```

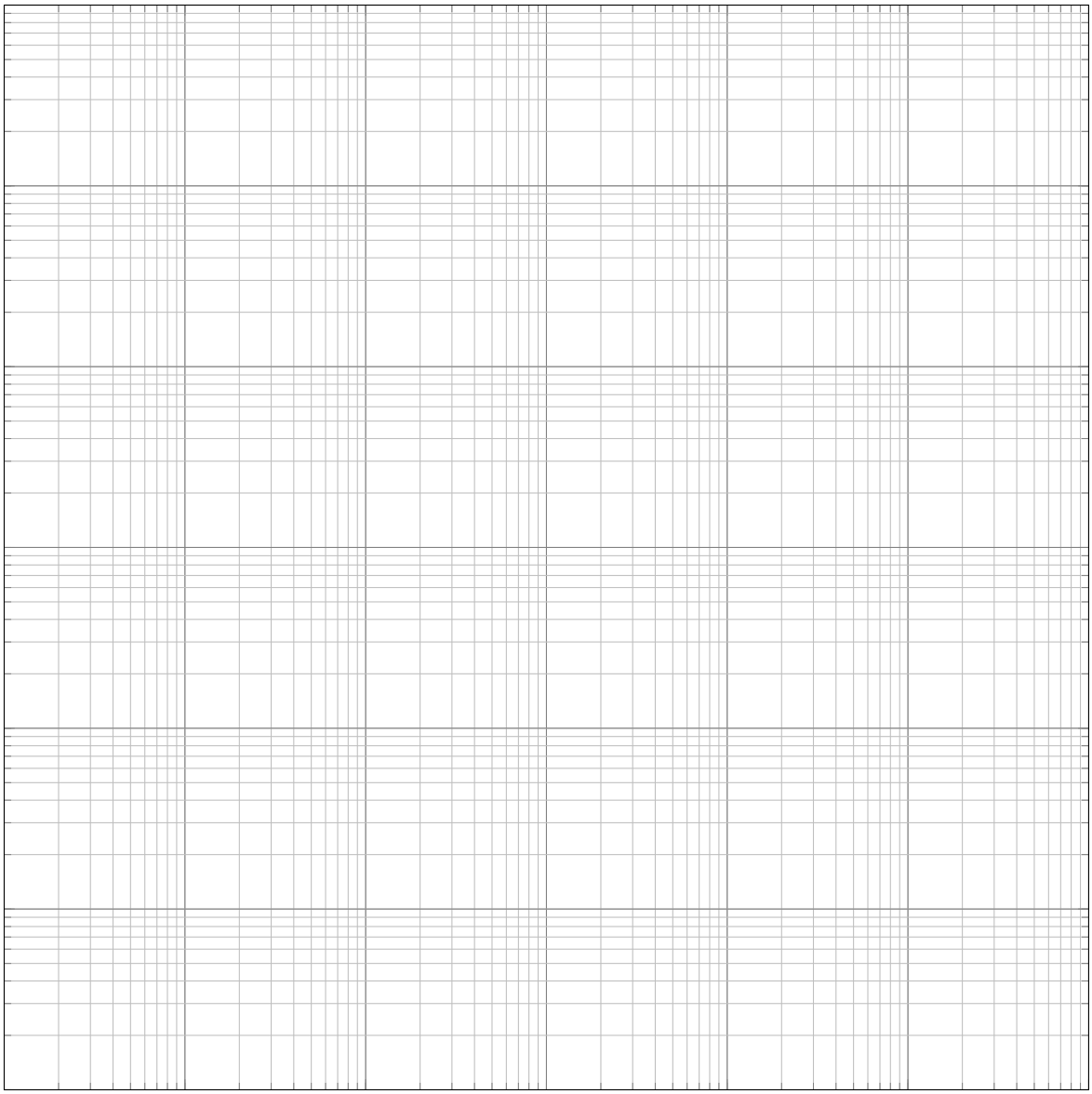
6.12 D latch




```
\begin{circuitikz} \draw
        (0,1.28) node [american nand port] (nand1) {}
        (0,-1.5-0.28) node [american nand port] (nand2) {}

        (nand1.in 1) -- ++(-2.5,0) node [ocirc] (D) {} node [anchor=east] {$D$}
        (-2.25,-2.07) node [american not port] (not) {}
        (D) -| (not.in)
        (not.out) --        (nand2.in 2)
        (D)++(0.94,0) coordinate (Dvert) %pour avoir seulement le segment vertical pour calculer
        ↪  l'intersection
        (nand1.in 2) |- ++(-1.25,-1.28) coordinate (dot)
        (dot) to [kinky cross=(Dvert)--(not.in), kinky crosses=left] ++(-1.25,0)node [ocirc] () {} node
        ↪  [anchor=east] {$E$}
        (nand2.in 1) |- (dot)

        (3,1) node [american nand port] (nor1) {}
        (3,-1.5) node [american nand port] (nor2) {}
        (nor1.out)  ++(0.5,-0.5)  coordinate (a-a) %coords of the crossing wire
        (nor2.in 2)  ++(-1.5,0.5)  coordinate (a-b)

        (nor1.in 2)++(-1.135,-0.225) node (in) {} % end of the wire with kinky bump
        (nor2.out)-| ++(0.5,0.5) to  [kinky cross=(a-a)--(a-b), kinky crosses=left] (in)
        (nor1.in 2)-| ++(-1,-0.3)
        (nor1.out) -- ++(1.5,0) node [ocirc] () {} node [anchor=west] {$Q$}

        (nor1.out) -| ++(0.5,-0.5) -- ++(-3.043,-1.5) |- (nor2.in 1)
        (nor2.out) -- ++(1.5,0) node [ocirc] () {} node [anchor=west] {$\overline{Q}$}
        (nor1.out) |-  ++(0.25,0)
        (nor1.in 1) -| (nand1.out)
        (nor2.in 2) -| (nand2.out)

;\draw [dashed](-3.5,-3.25) rectangle (4.25,2.75);
\end{circuitikz}
```

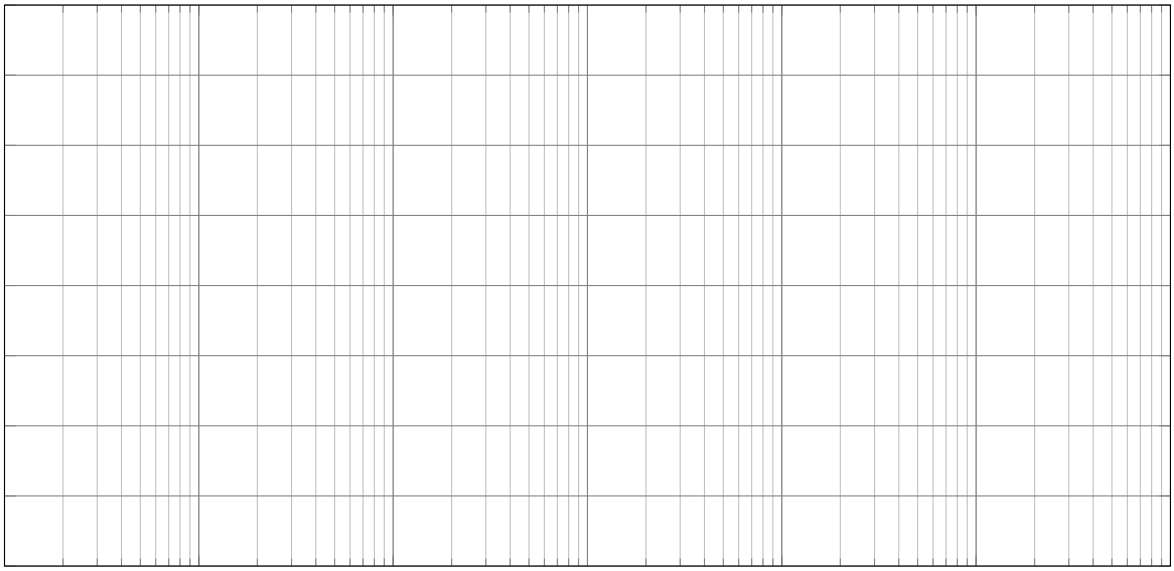
7 Graphs

7.1 Logarithmic axis



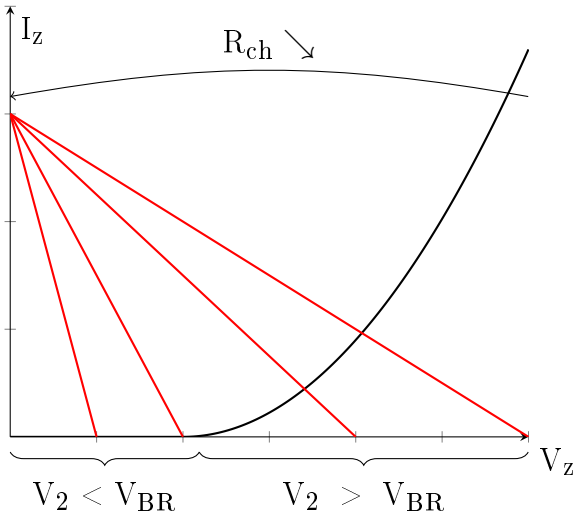
```
\begin{tikzpicture}
        \begin{loglogaxis}[
                xmin=1e-1, xmax=1e5,
                ymin=1e-1, ymax=1e5,
                yticklabels={,,},
                xticklabels={,,},
                grid=both,
                width=17cm,
                height=17cm,
                major grid style={black!50}
                ]
        \end{loglogaxis}
\end{tikzpicture}
```

7.2 Semi-logarithmic axis



```
\begin{tikzpicture}
        \begin{axis}[
                xmode=log,
                xmin=1e-1, xmax=1e5,
                ymin=1, ymax=9,
                yticklabels={,,},
                xticklabels={,,},
                grid=both,
                width=17cm,
                height=9cm,
                major grid style={black!50}
                ]
        \end{axis}
\end{tikzpicture}
```

7.3 $I_Z(V_Z)$

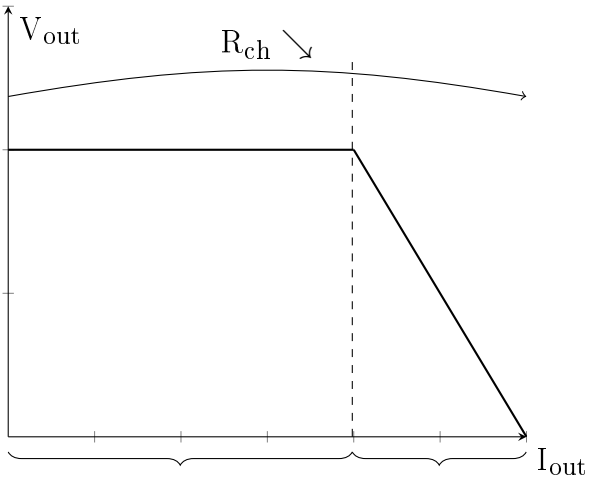



```
\begin{tikzpicture}
        \begin{axis}[ %title ={4Hz Sine  Wave},
```

```
    % width=7cm,
    % height=5cm,
    axis lines=middle,
    % ymin=-10,
    ymax=4,
    xlabel ={$V_z$},
    xticklabels={},
    yticklabels={},
    % ytick={-10,-8,-6,-5,-4,-3,-2,-1,1,2,3,4,5,6,8,10}
    ylabel ={$I_z$},
% grid=both,
% grid style={line width=.1pt, draw=black!60},
% major grid style={line width=.2pt,draw=black},
% ultra thick,
% minor tick num=5,
% enlargelimits={abs=0.5},
% axis line style={latex-latex},
yticklabel style={font=\normalsize,fill=white},
xlabel style={at={(ticklabel* cs:1)},anchor=north west},
% ylabel style={at={(ticklabel* cs:1)},anchor=south west},
    ]
    \addplot[%
    domain=1:3,
    thick,
    samples=100
    ]
    {0.9*(x-1)^2};
    % \addlegendentry{$V_{in}$}
    \addplot[%
    domain=0:1,
    thick,
    samples=100
    ]
    {0};
    \addplot[%
    red,
    domain=0:3,
    thick,
    samples=100
    ]
    {-x+3};
    \addplot[%
    red,
    domain=0:2,
    thick,
    samples=100
    ]
    {-1.5*x+3};
    \addplot[%
    red,
    domain=0:1,
    thick,
    samples=100
    ]
    {-3*x+3};
    \addplot[%
    red,
    domain=0:0.5,
    thick,
    samples=100
    ]
    {-6*x+3};
    \end{axis}
    % \draw[dashed] (4.55,0) -- (4.55,5);
    \draw[decorate, decoration={brace, amplitude=5pt}] ([yshift=-0.2cm]2.5,0)--
    ↪  node[below=0.25cm, text width=2cm, align=center]
     {$V_2 < V_{BR}$}([yshift=-0.2cm]0,0); % Pour avoir une accolade avec la pointe
     ↪  vers le bas, d'abord donner la coordonnee de droite.
    \draw[decorate, decoration={brace, amplitude=5pt}] ([yshift=-0.2cm]6.85,0)--
    ↪  node[below=0.25cm, text width=4cm, align=center]
```

```
            {$V_2 > V_{BR}$}([yshift=-0.2cm]2.5,0); % Pour avoir une accolade avec la pointe
            ↪  vers le bas, d'abord donner la coordonnee de droite.
    \draw [<-] (0,4.5) to [out=10,in=170] node[above]{$R_{ch} \searrow$} (6.85,4.5);
% Note that I had to replace the - by "to".  Notice how the angles work:
% •
% When the curves goes "out" of (0,0), you put a needle with one extremity
% on the starting point and the other one facing right and you turn it coun-
% terclockwise until it is tangent to the curve.  The angle by which you have
% to turn the needle gives you the "out" angle.
% •
% When the curves goes "in" at (2,1.5), you put a needle with one extremity
% on the arrival point and the other one facing right and you turn it coun-
% terclockwise until it is tangent to the curve.  The angle by which you have
% to turn the needle gives you the "in" angle.
% https://cremeronline.com/LaTeX/minimaltikz.pdf
% A very minimal introduction to TikZ, by Jacques Cremer
\end{tikzpicture}
```

7.4 $V_{out}(I_{out})$



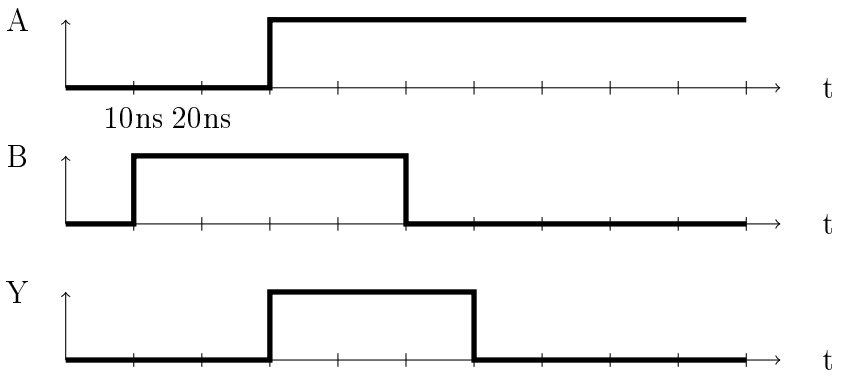
Grosse charge, I_{out} est donc faible et la Zener est en avalanche. La charge est régulée.

Diviseur résistif, la Zener est bloquante.

```
\begin{tikzpicture}
        \begin{axis}[ %title ={4Hz Sine  Wave},
        % width=7cm,
        % height=5cm,
        axis lines=middle,
        % ymin=-10,
        ymax=1.5,
        xlabel ={$I_{out}$},
        xticklabels={},
        yticklabels={},
        % ytick={-10,-8,-6,-5,-4,-3,-2,-1,1,2,3,4,5,6,8,10}
        ylabel ={$V_{out}$},
    % grid=both,
    % grid style={line width=.1pt, draw=black!60},
    % major grid style={line width=.2pt,draw=black},
    % ultra thick,
    % minor tick num=5,
    % enlargelimits={abs=0.5},
    % axis line style={latex-latex},
```

```
        yticklabel style={font=\normalsize,fill=white},
        xlabel style={at={(ticklabel* cs:1)},anchor=north west},
        % ylabel style={at={(ticklabel* cs:1)},anchor=south west},
            ]
            \addplot[%
            domain=0:2,
            thick,
            samples=100
            ]
            {1};
            % \addlegendentry{$V_{in}$}
            \addplot[%
            domain=2:3,
            thick,
            samples=100
            ]
            {-x+3};
            \end{axis}
            \draw[dashed] (4.55,0) -- (4.55,5);
            \draw[decorate, decoration={brace, amplitude=5pt}] ([yshift=-0.2cm]4.55,0)--
            ↪  node[below=0.25cm, text width=4cm]
             {Grosse charge, $I_{out}$ est donc faible et la Zener est en avalanche. La
             ↪  charge est régulée.}([yshift=-0.2cm]0,0); % Pour avoir une accolade avec la
             ↪  pointe vers le bas, d'abord donner la coordonnee de droite.
            \draw[decorate, decoration={brace, amplitude=5pt}] ([yshift=-0.2cm]6.85,0)--
            ↪  node[below=0.25cm, text width=2cm]
             {Diviseur résistif, la Zener est bloquante.}([yshift=-0.2cm]4.55,0); % Pour
             ↪  avoir une accolade avec la pointe vers le bas, d'abord donner la coordonnee
             ↪  de droite.
        \draw [->] (0,4.5) to [out=10,in=170] node[above]{$R_{ch} \searrow$} (6.85,4.5);
    % Note that I had to replace the - by "to".  Notice how the angles work:
    % •
    % When the curves goes "out" of (0,0), you put a needle with one extremity
    % on the starting point and the other one facing right and you turn it coun-
    % terclockwise until it is tangent to the curve.  The angle by which you have
    % to turn the needle gives you the "out" angle.
    % •
    % When the curves goes "in" at (2,1.5), you put a needle with one extremity
    % on the arrival point and the other one facing right and you turn it coun-
    % terclockwise until it is tangent to the curve.  The angle by which you have
    % to turn the needle gives you the "in" angle.
    % https://cremeronline.com/LaTeX/minimaltikz.pdf
    % A very minimal introduction to TikZ, by Jacques Cremer
    \end{tikzpicture}
```

7.5 Time graph 1

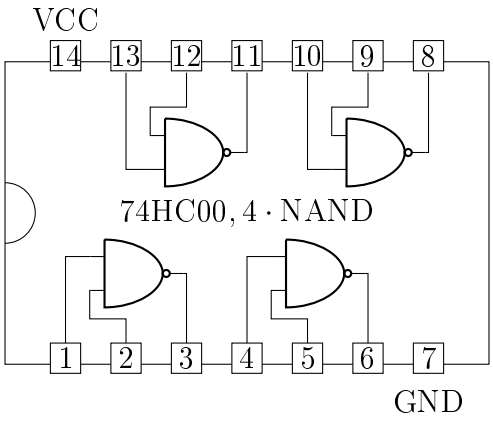



```
\usetikzlibrary{calc}
{
```

```
        \draw   [->]  (0,0) -- (0,1);
        \node [anchor=east] at (0,1) {A};
        \draw [->]( 0,0) -- (10.5,0);
        \node [anchor=west] at (10.5,0) {t};

        \foreach \x in {1,2,...,10} \draw (\x,-0.1) -- (\x,0.1);
        \foreach \x in {1,2,...,10} \draw (\x,-0.1-2) -- (\x,0.1-2);
        \foreach \x in {1,2,...,10} \draw (\x,-0.1-4) -- (\x,0.1-4);
        \node [anchor=north, inner sep=0pt, outer sep=0pt] at (1,0.25) {10ns};
        \node [anchor=north, inner sep=0pt, outer sep=0pt] at (2,0.25) {20ns};

        \draw [->] (0,-2) -- (0,1-2);
        \node [anchor=east] at (0,1-2) {B};
        \draw [->] (0,-2) -- (10.5,-2);
        \node [anchor=west] at (10.5,-2) {t};

        \draw [->] (0,-4) -- (0,1-4);
        \node [anchor=east] at (0,1-4) {Y};
        \draw [->] (0,-4) -- (10.5,-4);
        \node [anchor=west] at (10.5,-4) {t};

        \draw [line width=2pt] (0,0) -|(3,1) -| (10,1); %A
        \draw [line width=2pt] (0,0-2) -|(1,1-2) -| (5,0-2) -- (10,0-2); %B

        \draw [line width=2pt] (0,-4) -| (3,1-4) -|(6,0-4)--(10,0-4); %Y
}
\end{tikzpicture}
```

8 Miscellaneous

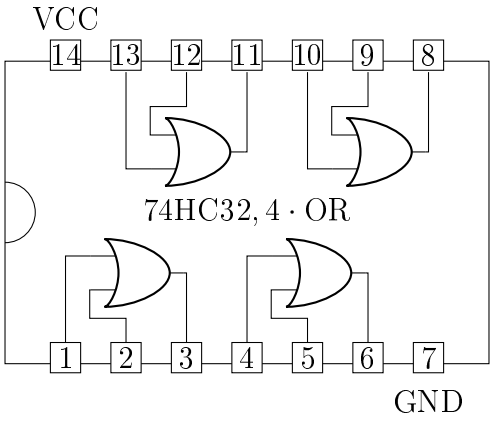
8.1 74HC00




```
\begin{circuitikz}[scale=0.8] \draw
        (4,2.5) node [anchor=center] {$74HC00, 4\cdot NAND$}
        (2.8,1.5) node [american nand port,scale=0.8] (nand1) {}
        (1,0) node (in11) {}
        (2,0) node (in12) {}
        (3,0) node (out1) {}
        (in11) |- (nand1.in 1)
        (in12) |- ++(-0.6,0.75)|- (nand1.in 2)
        (out1) |- (nand1.out)

        (2.8+3,1.5) node [american nand port,scale=0.8] (nand2) {}
        (1+3,0) node (in21) {}
        (2+3,0) node (in22) {}
        (3+3,0) node (out2) {}
        (in21) |- (nand2.in 1)
        (in22) |- ++(-0.6,0.75)|- (nand2.in 2)
```

```
        (out2) |- (nand2.out)


        (1+2.8,5-1.5) node [american nand port,scale=0.8] (nand3) {}
        (1+1,5) node (in31) {}
        (2+1,5) node (in32) {}
        (3+1,5) node (out3) {}
        (in31) |- (nand3.in 2)
        (in32) |- ++(-0.6,-0.75)|- (nand3.in 1)
        (out3) |- (nand3.out)

        (1+2.8+3,5-1.5) node [american nand port,scale=0.8] (nand4) {}
        (2+3,5) node (in41) {}
        (3+3,5) node (in42) {}
        (4+3,5) node (out4) {}
        (in41) |- (nand4.in 2)
        (in42) |- ++(-0.6,-0.75)|- (nand4.in 1)
        (out4) |- (nand4.out)

        (7,0-0.25) node [anchor=north](gnd) {GND}
        (1,5+0.35) node [anchor=south](vcc) {VCC}

;\draw (0,0)rectangle (8,5);
\foreach \x in {1,2,...,7} \filldraw [fill=white] (\x-0.25,-0.15) rectangle (\x+0.25,0.35) (\x,0.1) node
↪  {\x};
\foreach \x in {1,2,...,7} \filldraw [fill=white] (\x-0.25,5-0.15) rectangle (\x+0.25,5+0.35);
\foreach \x in {8,9,...,14} \draw (15-\x,5+0.1) node {\x};
\draw (0,2) arc[start angle=-90, end angle=90, radius=0.5];
\end{circuitikz}
```

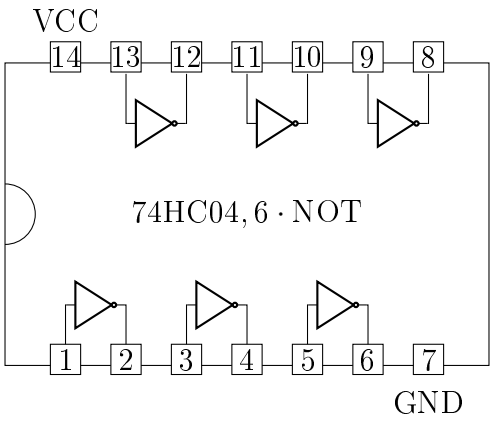
8.2 74HC32




```
\begin{circuitikz}[scale=0.8] \draw
        (4,2.5) node [anchor=center] {$74HC32, 4\cdot  OR$}
        (2.8,1.5) node [american or port,scale=0.8] (or1) {}
        (1,0) node (in11) {}
        (2,0) node (in12) {}
        (3,0) node (out1) {}
        (in11) |- (or1.in 1)
        (in12) |- ++(-0.6,0.75)|- (or1.in 2)
        (out1) |- (or1.out)

        (2.8+3,1.5) node [american or port,scale=0.8] (or2) {}
        (1+3,0) node (in21) {}
        (2+3,0) node (in22) {}
        (3+3,0) node (out2) {}
        (in21) |- (or2.in 1)
        (in22) |- ++(-0.6,0.75)|- (or2.in 2)
        (out2) |- (or2.out)
```

```
        (1+2.8,5-1.5) node [american or port,scale=0.8] (or3) {}
        (1+1,5) node (in31) {}
        (2+1,5) node (in32) {}
        (3+1,5) node (out3) {}
        (in31) |- (or3.in 2)
        (in32) |- ++(-0.6,-0.75)|- (or3.in 1)
        (out3) |- (or3.out)

        (1+2.8+3,5-1.5) node [american or port,scale=0.8] (or4) {}
        (2+3,5) node (in41) {}
        (3+3,5) node (in42) {}
        (4+3,5) node (out4) {}
        (in41) |- (or4.in 2)
        (in42) |- ++(-0.6,-0.75)|- (or4.in 1)
        (out4) |- (or4.out)

        (7,0-0.25) node [anchor=north](gnd) {GND}
        (1,5+0.35) node [anchor=south](vcc) {VCC}

;
\draw (0,0)rectangle (8,5);
\foreach \x in {1,2,...,7} \filldraw [fill=white] (\x-0.25,-0.15) rectangle (\x+0.25,0.35) (\x,0.1) node
↪  {\x};
\foreach \x in {1,2,...,7} \filldraw [fill=white] (\x-0.25,5-0.15) rectangle (\x+0.25,5+0.35);
\foreach \x in {8,9,...,14} \draw (15-\x,5+0.1) node {\x};
\draw (0,2) arc[start angle=-90, end angle=90, radius=0.5];
\end{circuitikz}
```

8.3 74HC04




```
\begin{circuitikz}[scale=0.8] \draw
        (4,2.5) node [anchor=center] {$74HC04, 6\cdot NOT$}
        (1.5,1) node [american not port,scale=0.55] (not1) {}
        (1,0) node (in11) {}
        (2,0) node (out1) {}
        (in11) |- (not1.in)
        (out1) |- (not1.out)

        (1.5+2,1) node [american not port,scale=0.55] (not2) {}
        (1+2,0) node (in21) {}
        (2+2,0) node (out2) {}
        (in21) |- (not2.in)
        (out2) |- (not2.out)

        (1.5+4,1) node [american not port,scale=0.55] (not5) {}
        (1+4,0) node (in51) {}
        (2+4,0) node (out5) {}
        (in51) |- (not5.in)
        (out5) |- (not5.out)
```

```
        (1+1.5,5-1) node [american not port,scale=0.55] (not3) {}
        (1+1,5) node (in31) {}
        (2+1,5) node (out3) {}
        (in31) |- (not3.in)
        (out3) |- (not3.out)

        (1+1.5+2,5-1) node [american not port,scale=0.55] (not4) {}
        (2+2,5) node (in41) {}
        (3+2,5) node (out4) {}
        (in41) |- (not4.in)
        (out4) |- (not4.out)

        (1+1.5+4,5-1) node [american not port,scale=0.55] (not6) {}
        (2+4,5) node (in61) {}
        (3+4,5) node (out6) {}
        (in61) |- (not6.in)
        (out6) |- (not6.out)

        (7,0-0.25) node [anchor=north](gnd) {GND}
        (1,5+0.35) node [anchor=south](vcc) {VCC}
;\draw (0,0)rectangle (8,5);
\foreach \x in {1,2,...,7} \filldraw [fill=white] (\x-0.25,-0.15) rectangle (\x+0.25,0.35) (\x,0.1) node
↪  {\x};
\foreach \x in {1,2,...,7} \filldraw [fill=white] (\x-0.25,5-0.15) rectangle (\x+0.25,5+0.35);
\foreach \x in {8,9,...,14} \draw (15-\x,5+0.1) node {\x};
\draw (0,2) arc[start angle=-90, end angle=90, radius=0.5];
\end{circuitikz}
```

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