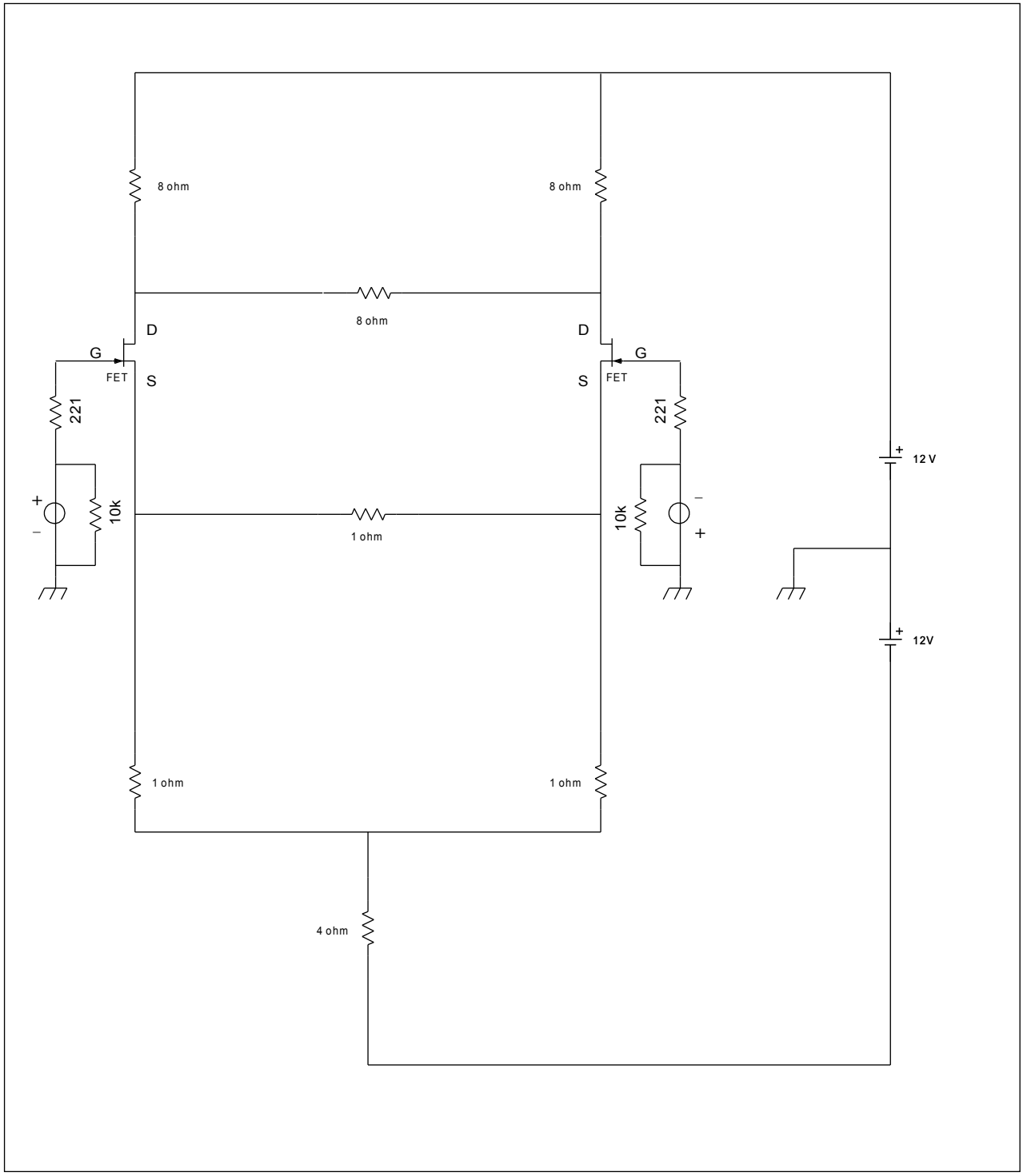
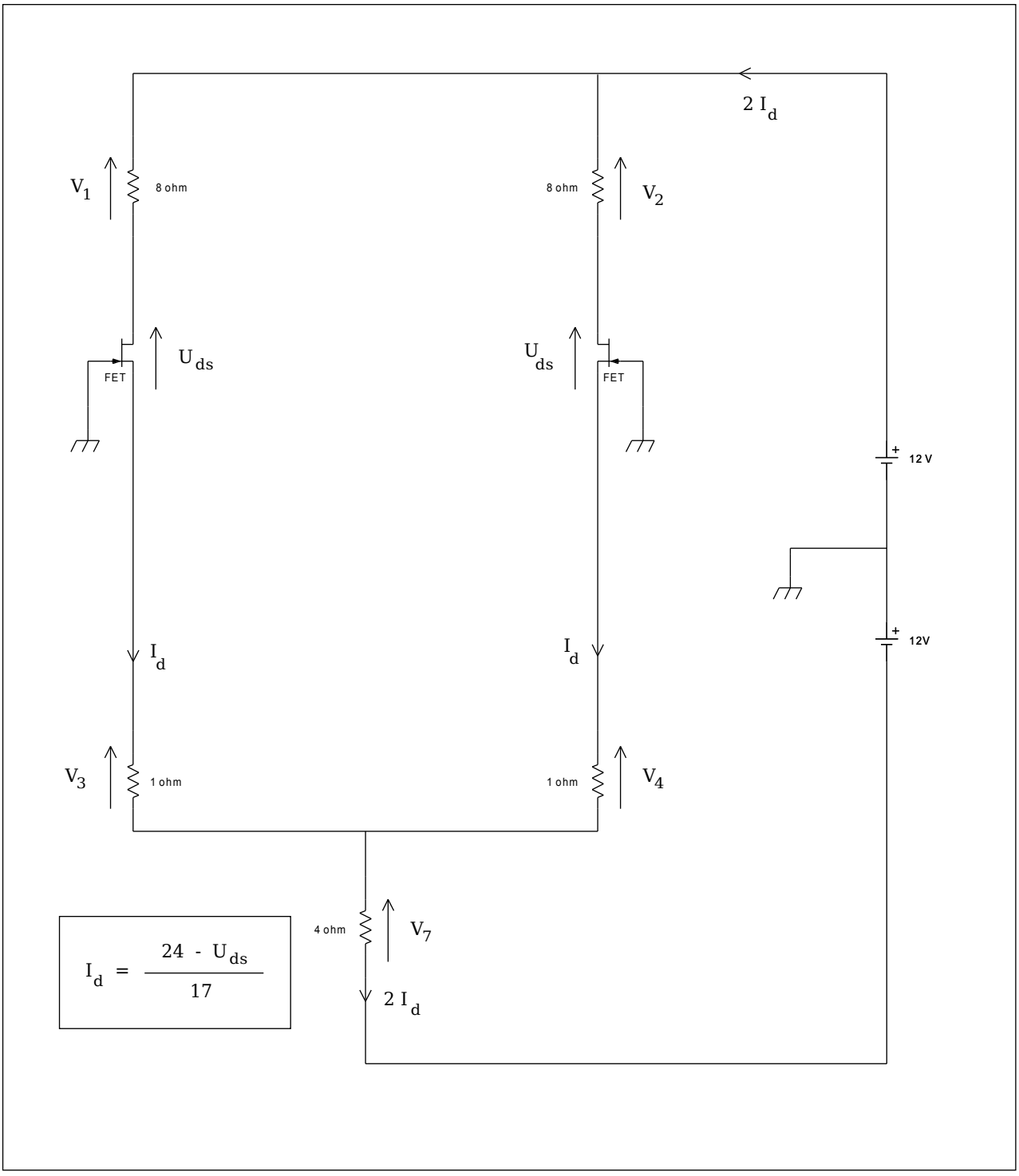
Son of Zen



the circuit

The DC circuit



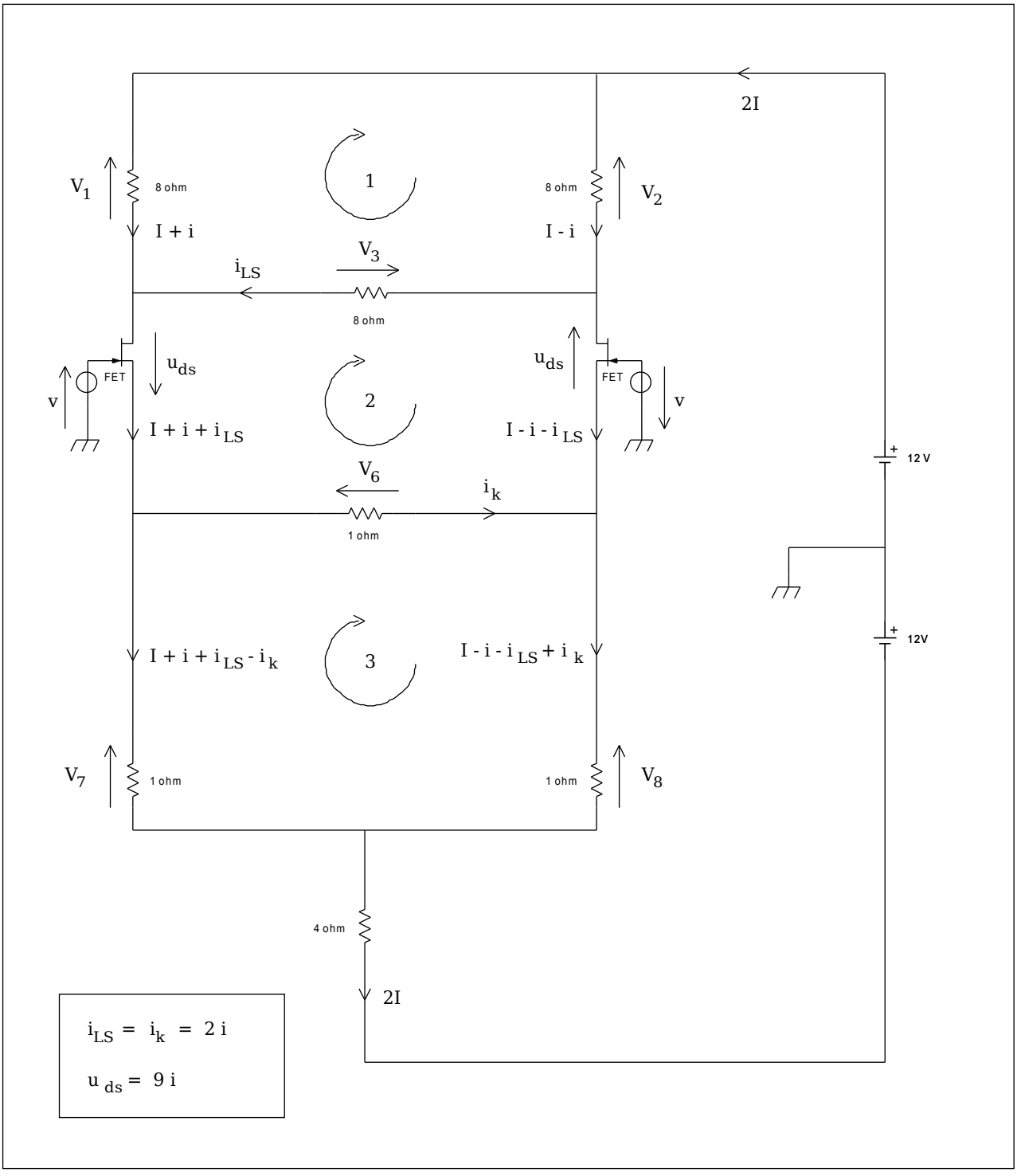
For each branch the following applies:

$$(8 \times I_d) + U_{ds} + (1 \times I_d) + (4 \times 2 I_d) = 24$$

$I_d = \frac{24 - U_{ds}}{17}$: the function of the DC load line for the fet

When I switch on the circuit I measure a current flow of 0.902 A in each branch. This current is called the bias current(Id = 0.902 A). From the equation above the bias current gives a voltage across the source and drain of 24 – 17 (0.902) = 8.666 V.
The point (8.666, 0.902) is also known as the operating point of the fet.

The AC circuit



Applying Kirchoff's voltage law:

circuit 1:

$V_1 - V_2 - V_3 = 0$

$8(I+i) - 8(I-i) - 8(i_{LS}) = 0$

$I + i - I + i - i_{LS} = 0$ $\qquad 2i = i_{LS}$

circuit 2:

$-u_{ds} + V_3 - u_{ds} + V_6 = 0$

$-2u_{ds} + 8i_{LS} + i_k = 0$ $\qquad 2u_{ds} = 8i_{LS} + i_k$

circuit 3:

$V_7 - V_6 - V_8 = 0$

$(I+i+i_{LS}-i_k) - (i_k) - (I-i-i_{LS}+i_k) = 0$

$2i + 2i_{LS} - 3i_k = 0$ $\qquad 3i_k = 2i + 2i_{LS}$

from circuit 1 and circuit 3:

$3i_k = 2i + 2i_{LS}$ and $2i = i_{LS}$ give: $i_k = i_{LS}$

from circuit 2 and circuit 1:

$2u_{ds} = 8i_{LS} + i_k$ and $2i = i_{LS}$ and $i_k = i_{LS}$ give: $u_{ds} = 9i$

$2i = i_{LS}$

The current through an 8 ohm resistor is half of what flows through the loudspeaker.

$i_k = i_{LS}$

The current through the horizontal 1 ohm resistor also flows through the loudspeaker.

$u_{ds} = 9i$

By definition u_{ds} points upward when i_d comes down the drain.
Here the drain current $i_d = 3i$, and gives an impedance of u_{ds}/i_d = -3 ohm

$$i_d = -\frac{1}{3}u_{ds}$$: the function of the AC load line for the fet.