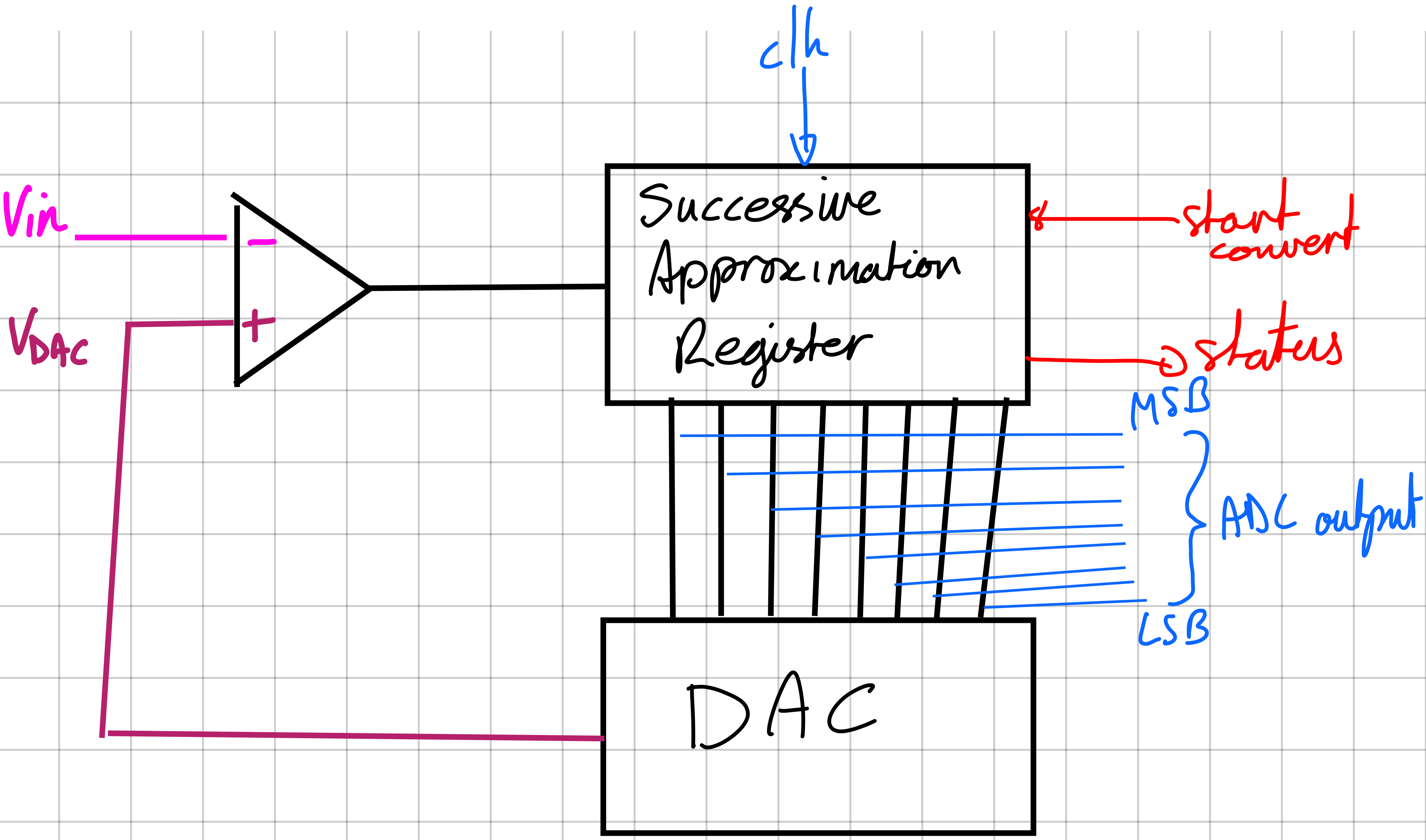
25 September 2013

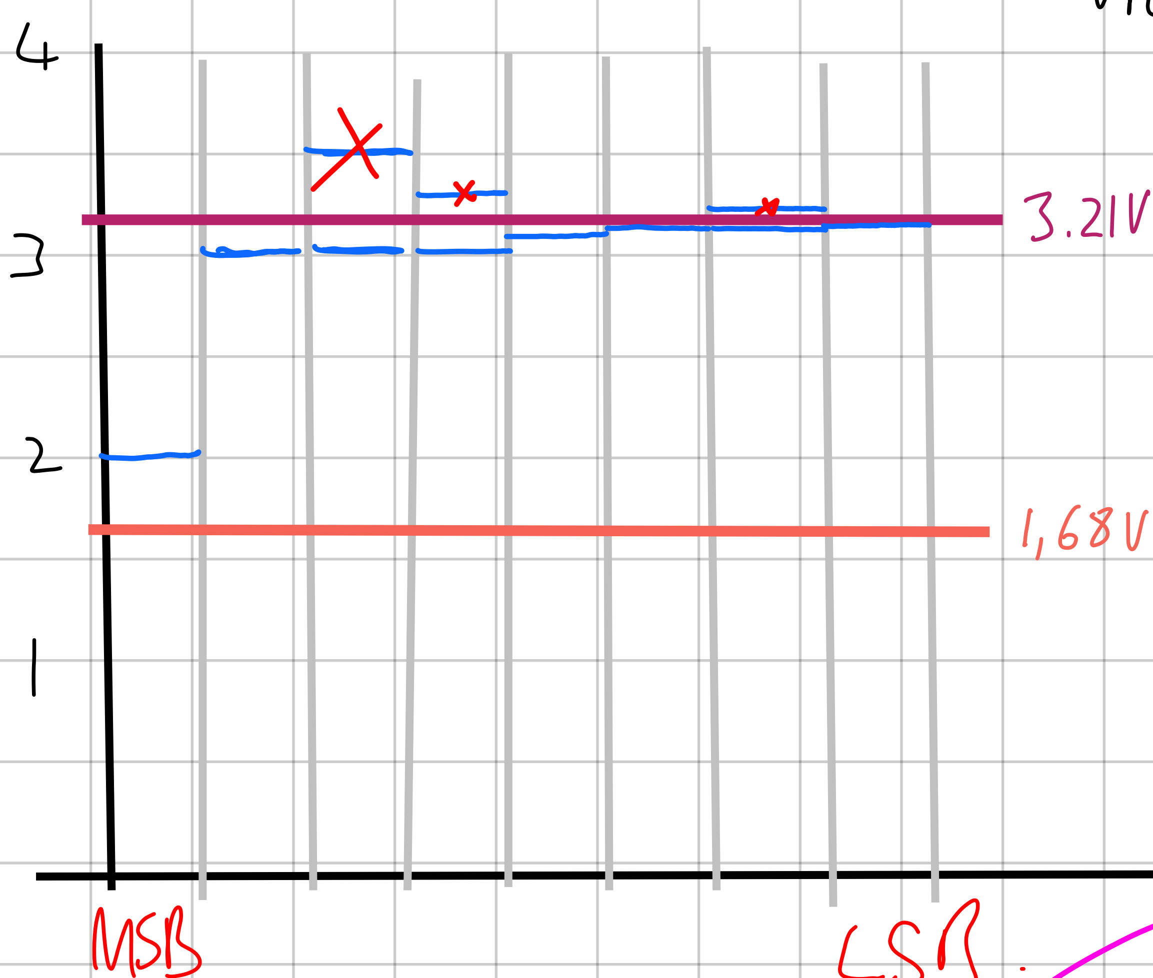
- ADC
  - Flash or parallel
  - Successive approximation

Today

- single and dual slope
- DAC



$V_{ref} = 4V$; 8 bit DAC



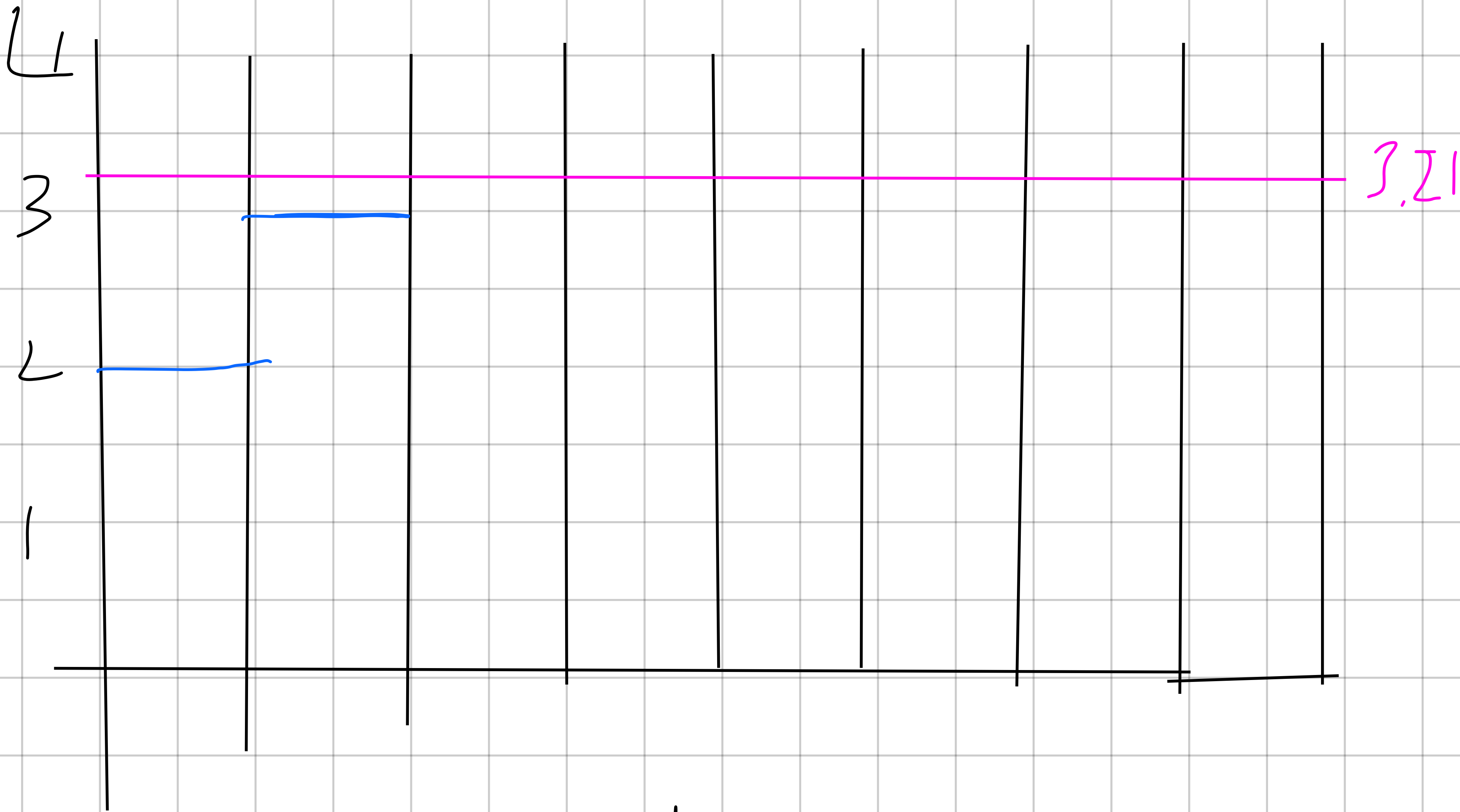
MSB LSB
11001101

MSB LSB
01101011

01101001

011010

01101100



$V_{ref} = 4V$ 8bit   256

$4/2^n = 4/2^8 = 15,63\,mV \approx 16\,mV$

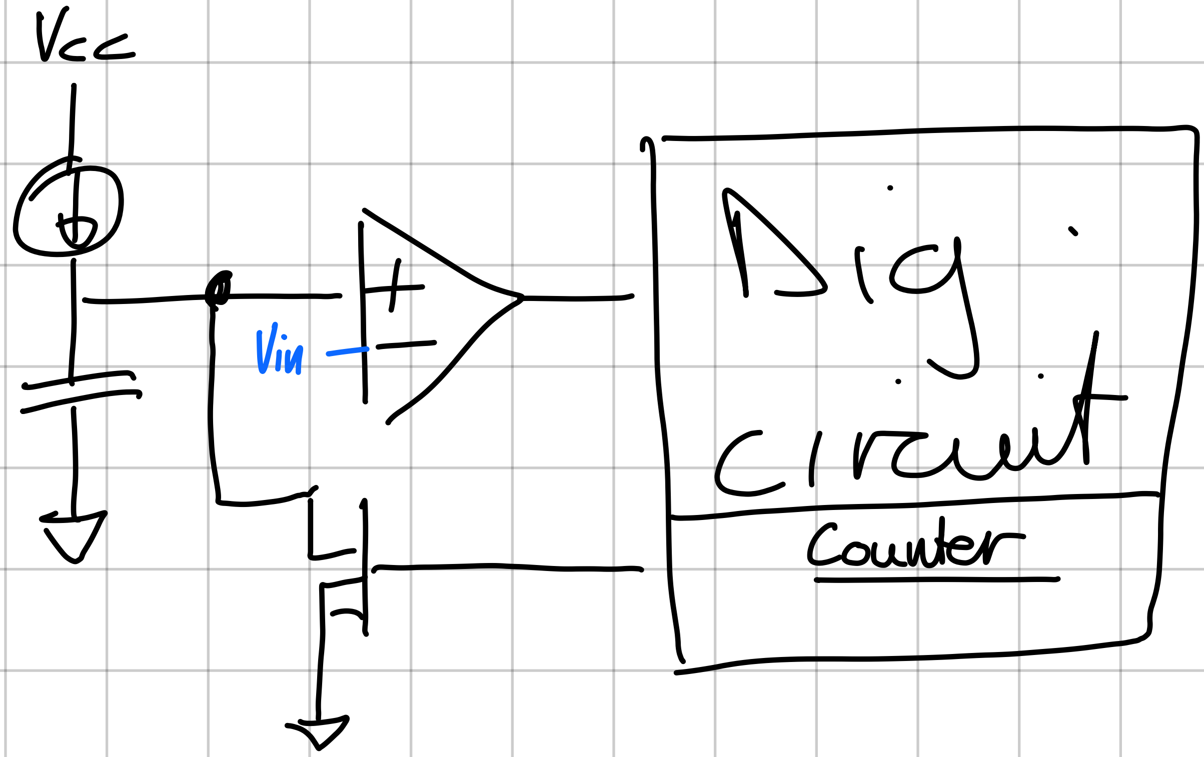
① $128 \times 15,63\,mV = 2,00064 \approx 2$

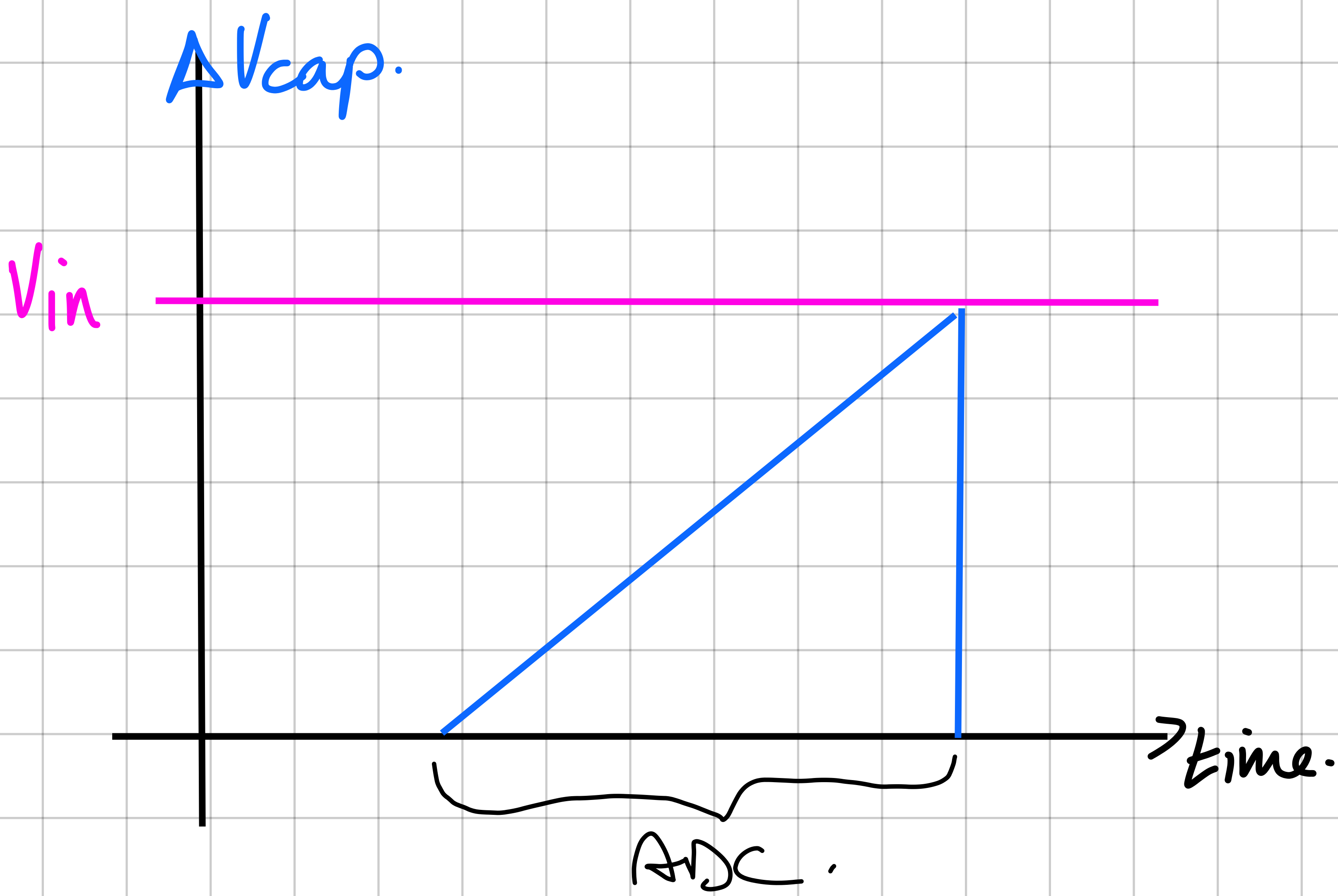
② $(128+64) \times 15.63 \approx 3V$

③ $(128+64+32) \times 15.63 \approx 3,5V$ ✗

4 $(128+64+16) \times 15.63 \approx 3,25V$

Single and dual slope ADC





$$V_{In} = V_{CAP} = (I/C)\,\Delta t$$

$$(I/C) = \text{const} \quad \therefore \; V_{in} \propto \Delta t$$

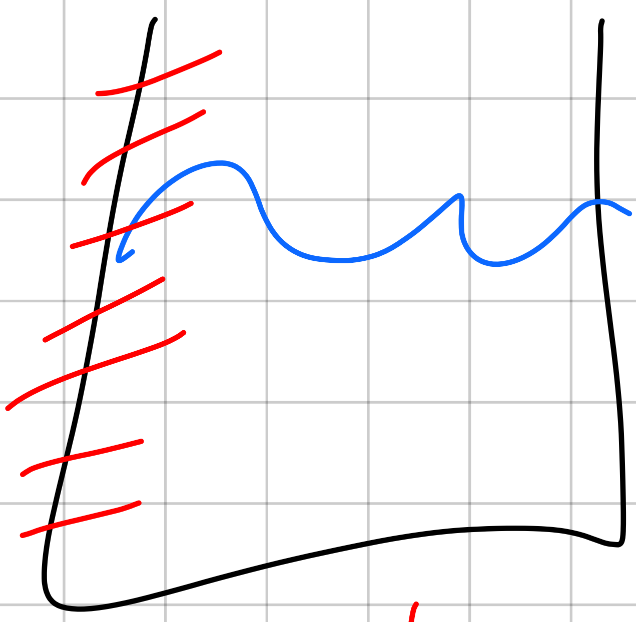
0b1001011 → 7 bits.

3,45 V.

what is V_{ref}?

$V_{ref} \simeq 5,88\ V$

11 bit ADC



Tank full = 10 l.

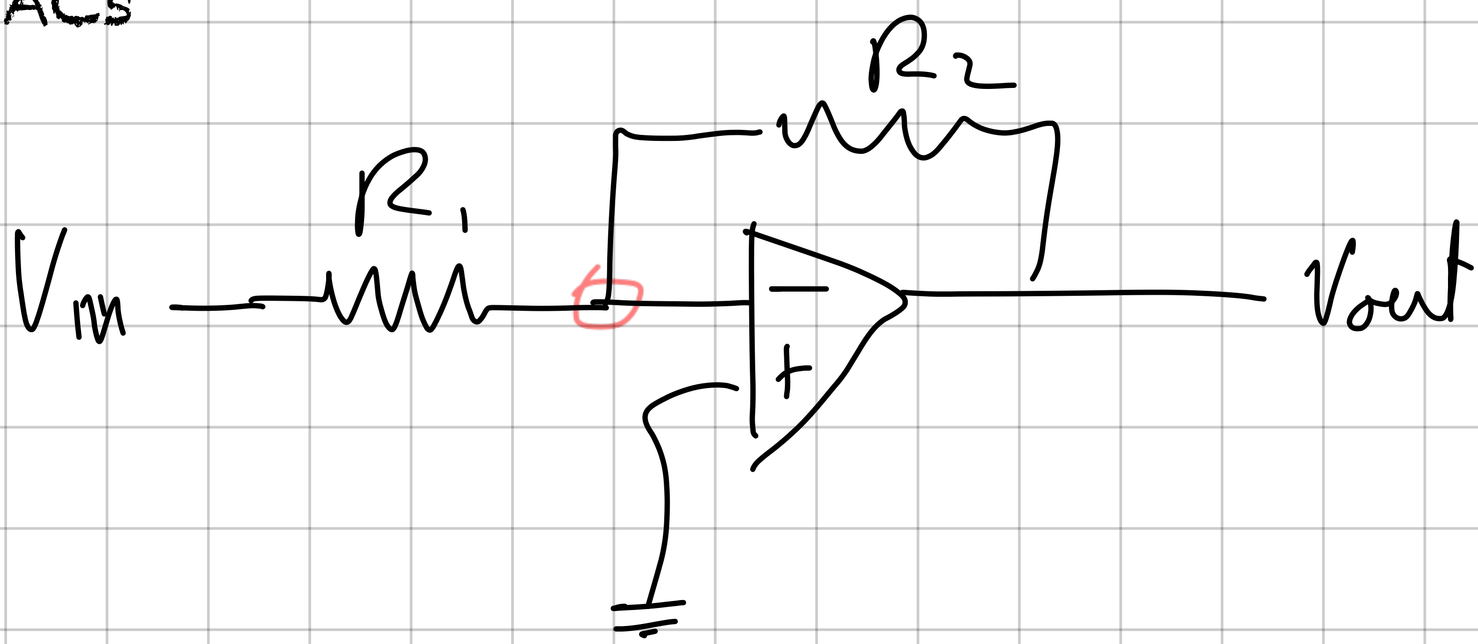
$V_{ref} = 2,5\ V$.

ADC ≃ 0,87 V

how much water is in the tank?

tank ≃ 3,56 l.

DACs

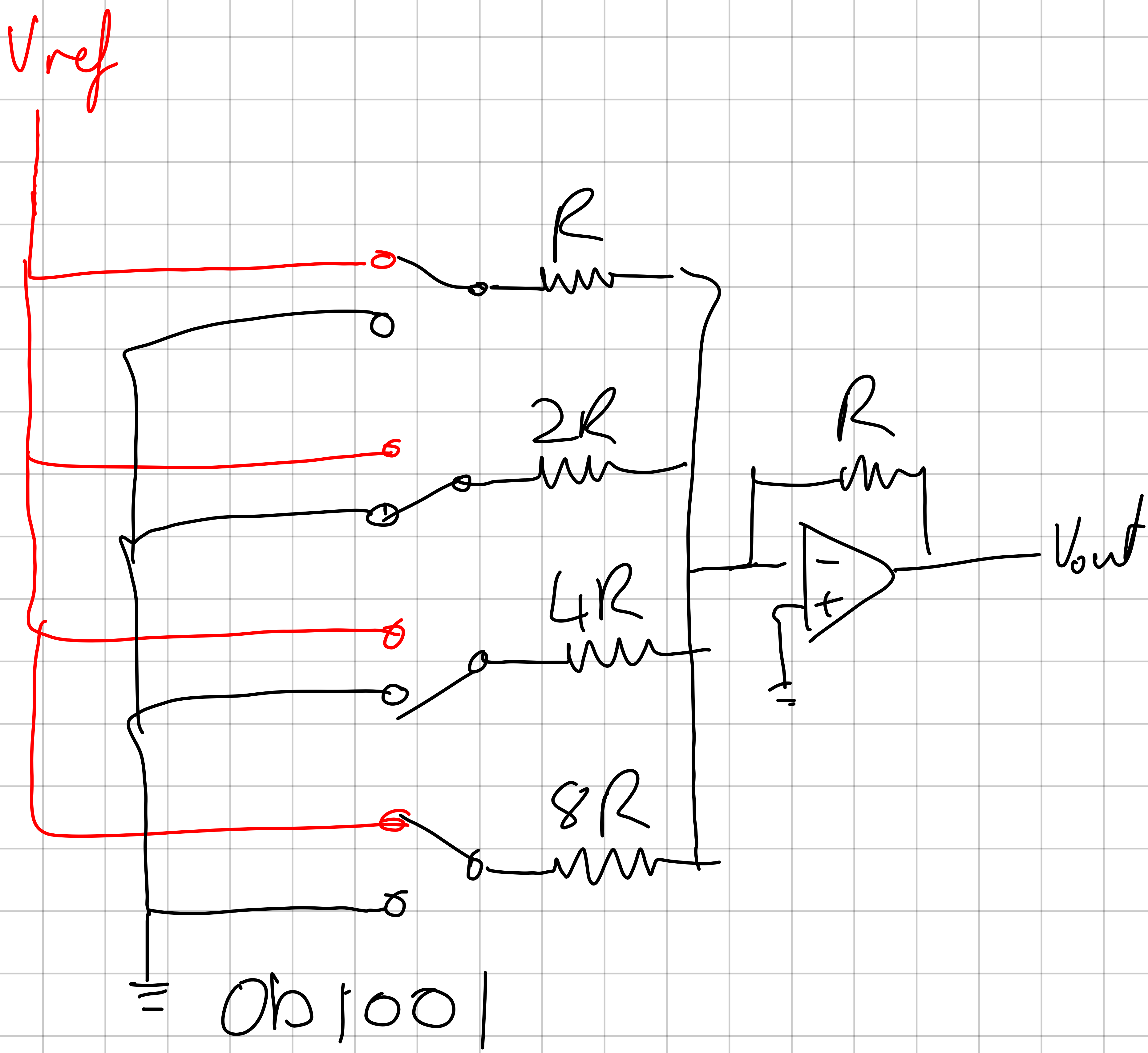


−ve input ≈ 0 V.

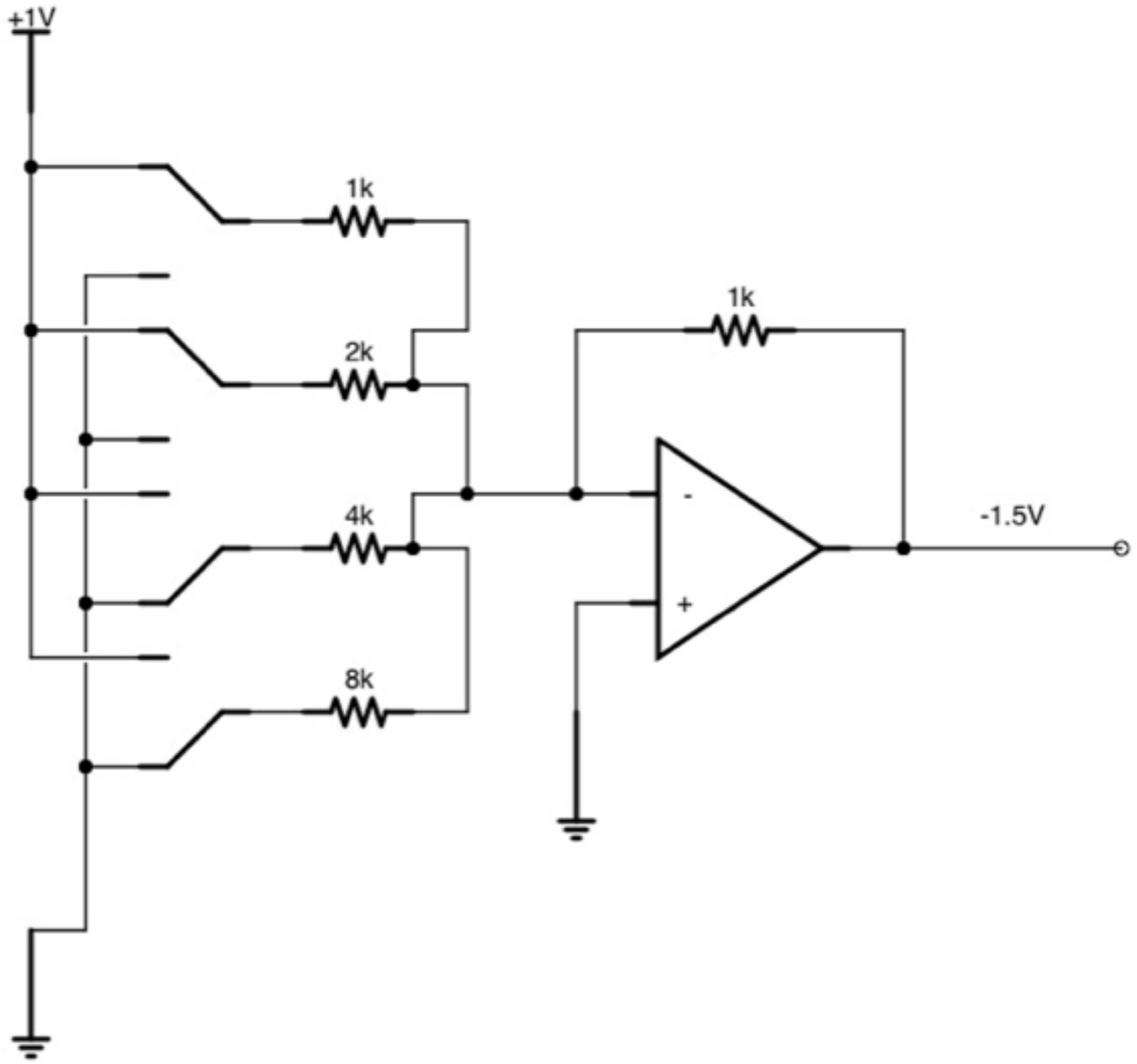
$$V\ gain = V_{out}/V_{in} = -\frac{R_2}{R_1}$$

$I_{in} = V_{in}/R_1$

$V_{out} = G\,V_{in} = -R_2 I_{in} = -V_{in} R_2/R_1$

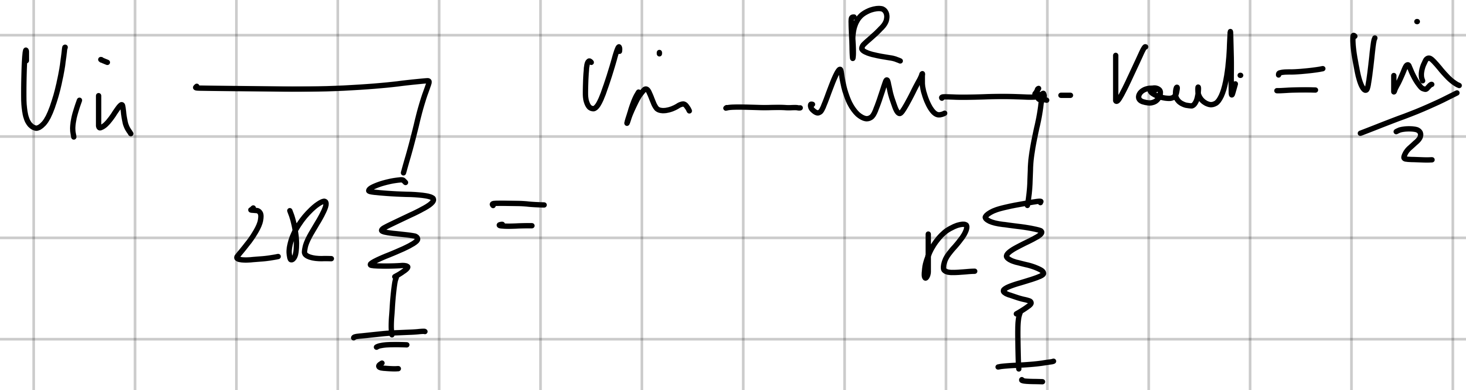


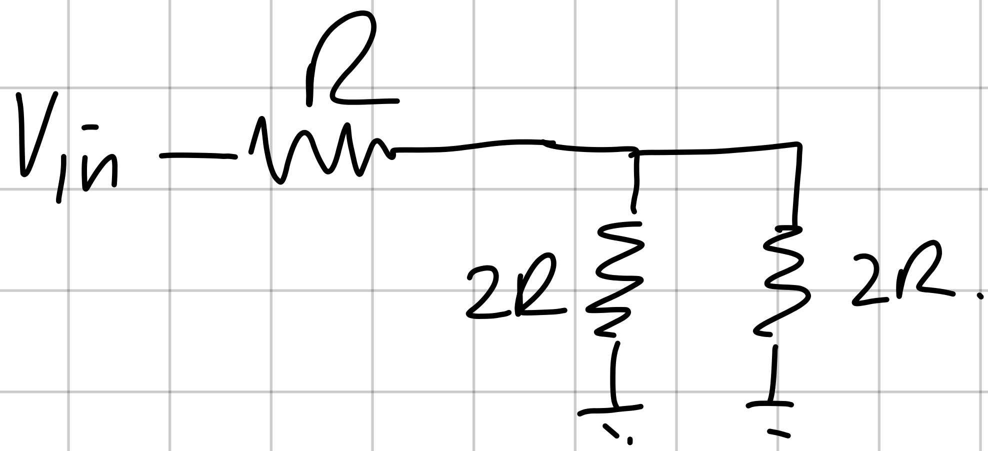
$$I = V_{ref}/R + V_{ref}/8R = \frac{9 \cdot V_{ref}}{8R}.$$

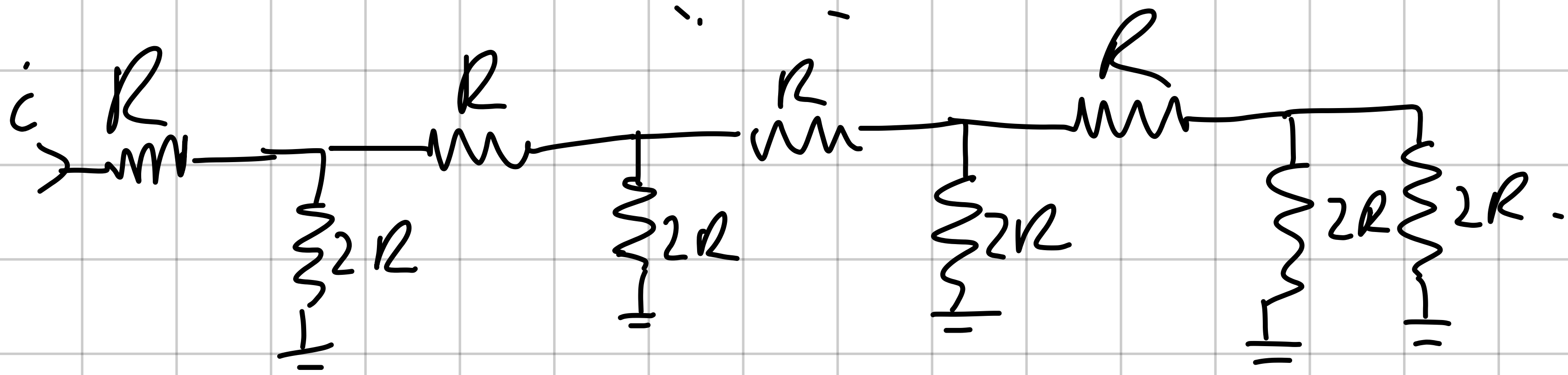


+1V
1k
2k
4k
8k
1k
-
+
-1.5V

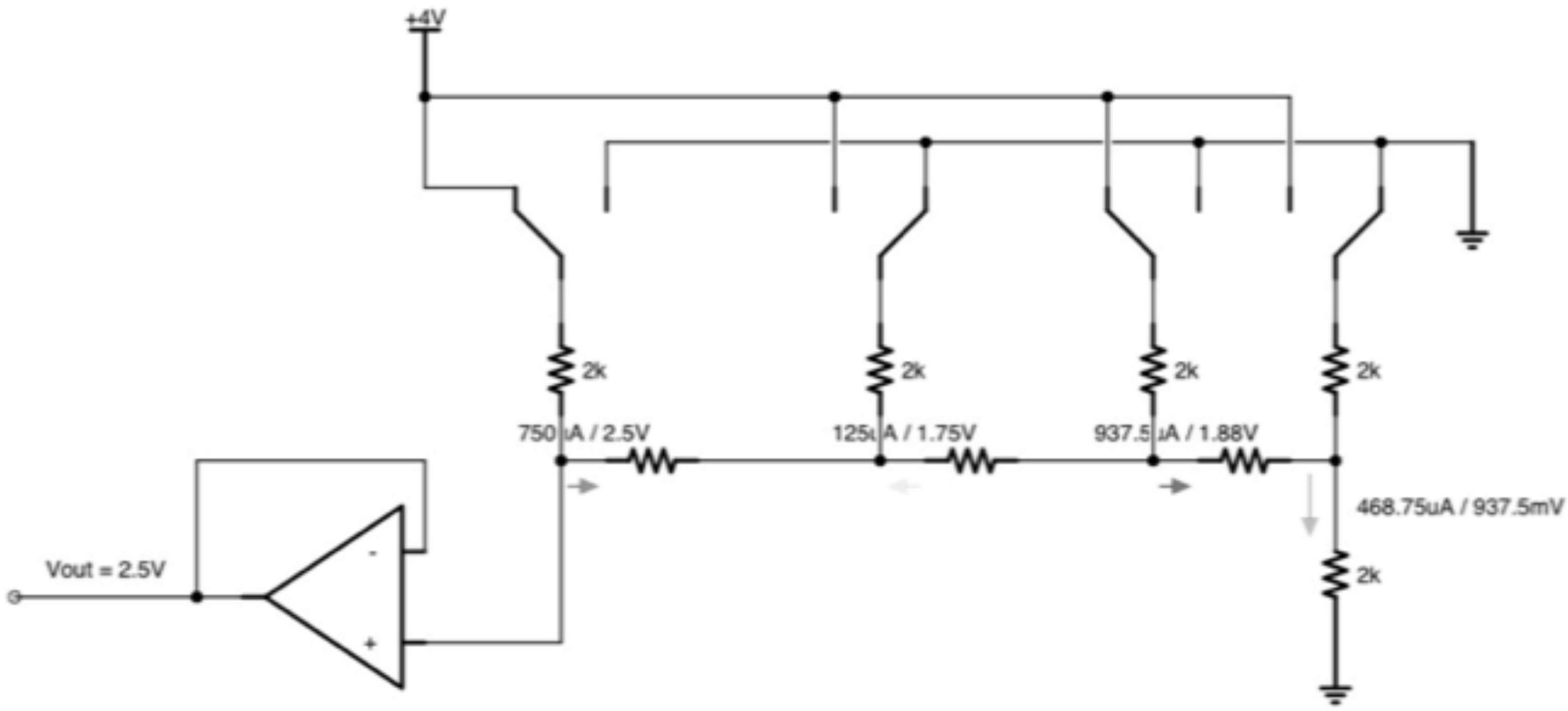
R-2R ladder DAC







Add images of simulated r-2r ladders etc



+4V
2k
2k
2k
2k
750uA / 2.5V
125uA / 1.75V
937.5uA / 1.88V
468.75uA / 937.5mV
2k
Vout = 2.5V

Software reliability
- watchdog timer
Started I/O