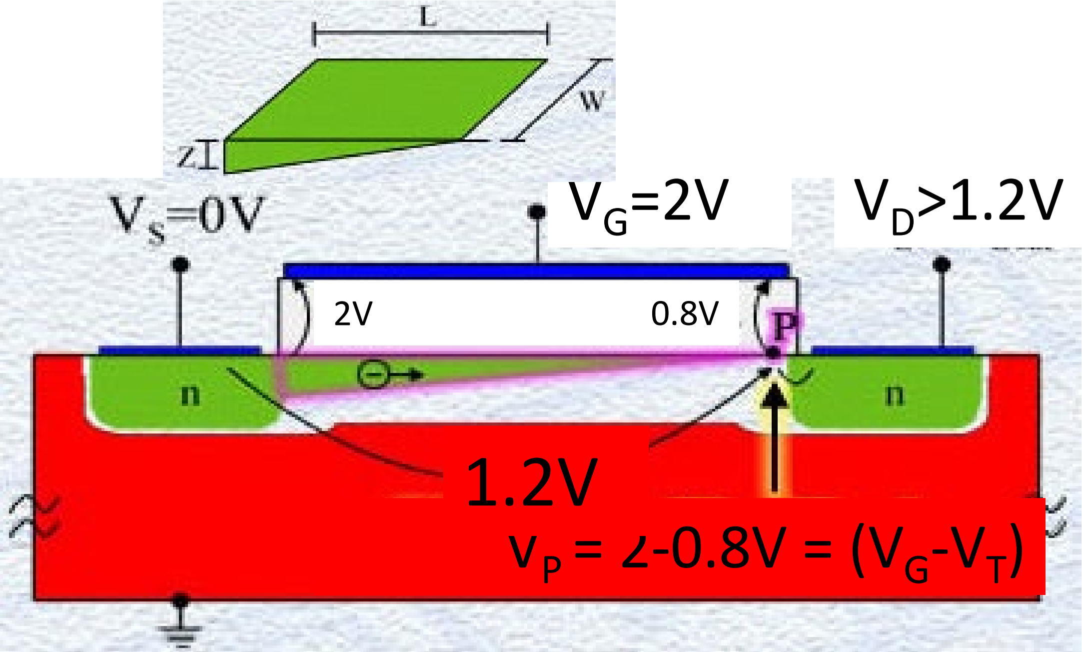
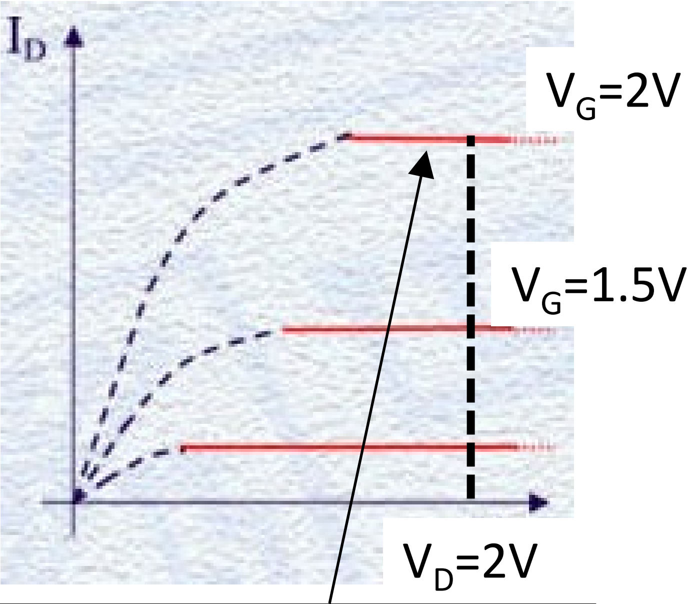
Recap of previous lesson : Transistors

V_T=0.8V



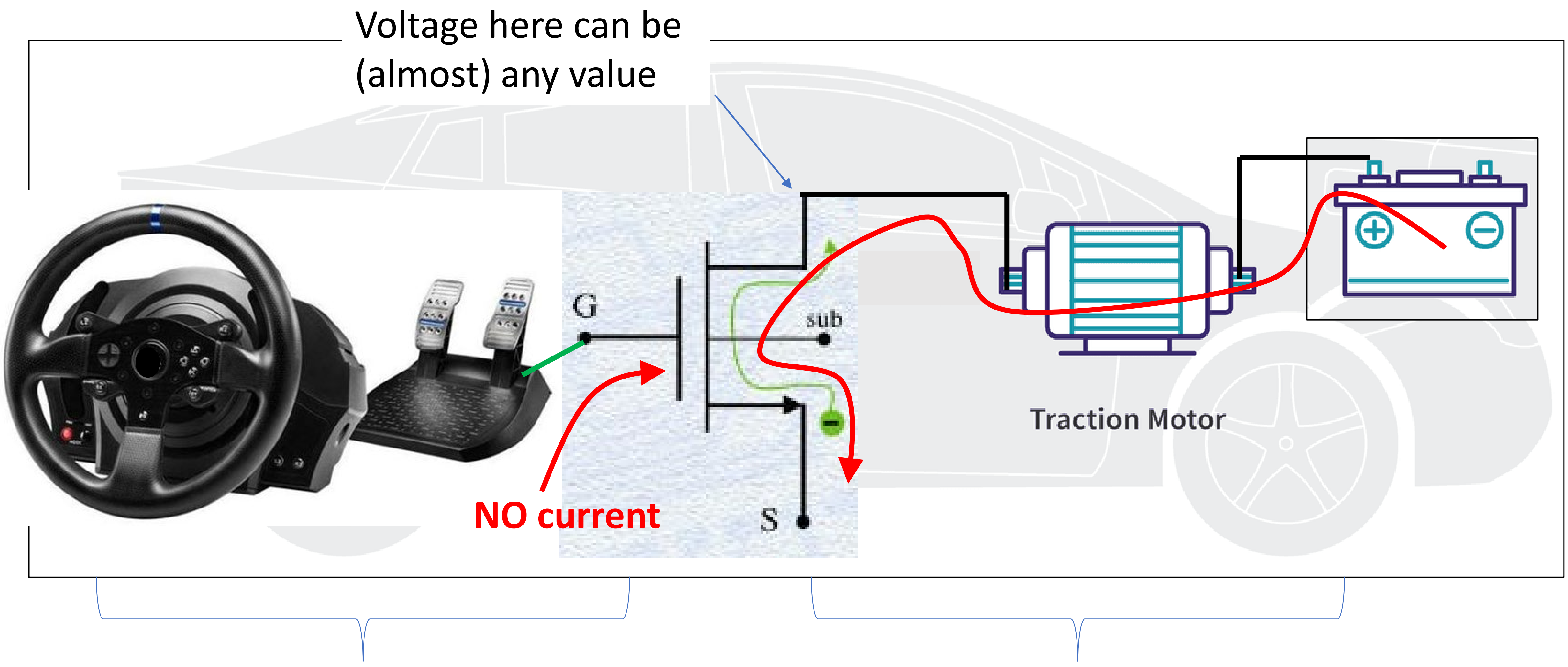


Costant current controlled by V_{Gate}

$$I = k(V_G - V_T)^2$$

A resistor below the oxide, whose voltage across is defined only by the Gate and whose current is delivered to a third contact

Recap of previous lesson : Power amplification



Very little power in

Huge power out

ELECTRONIC SYSTEMS and TECHNOLOGIES

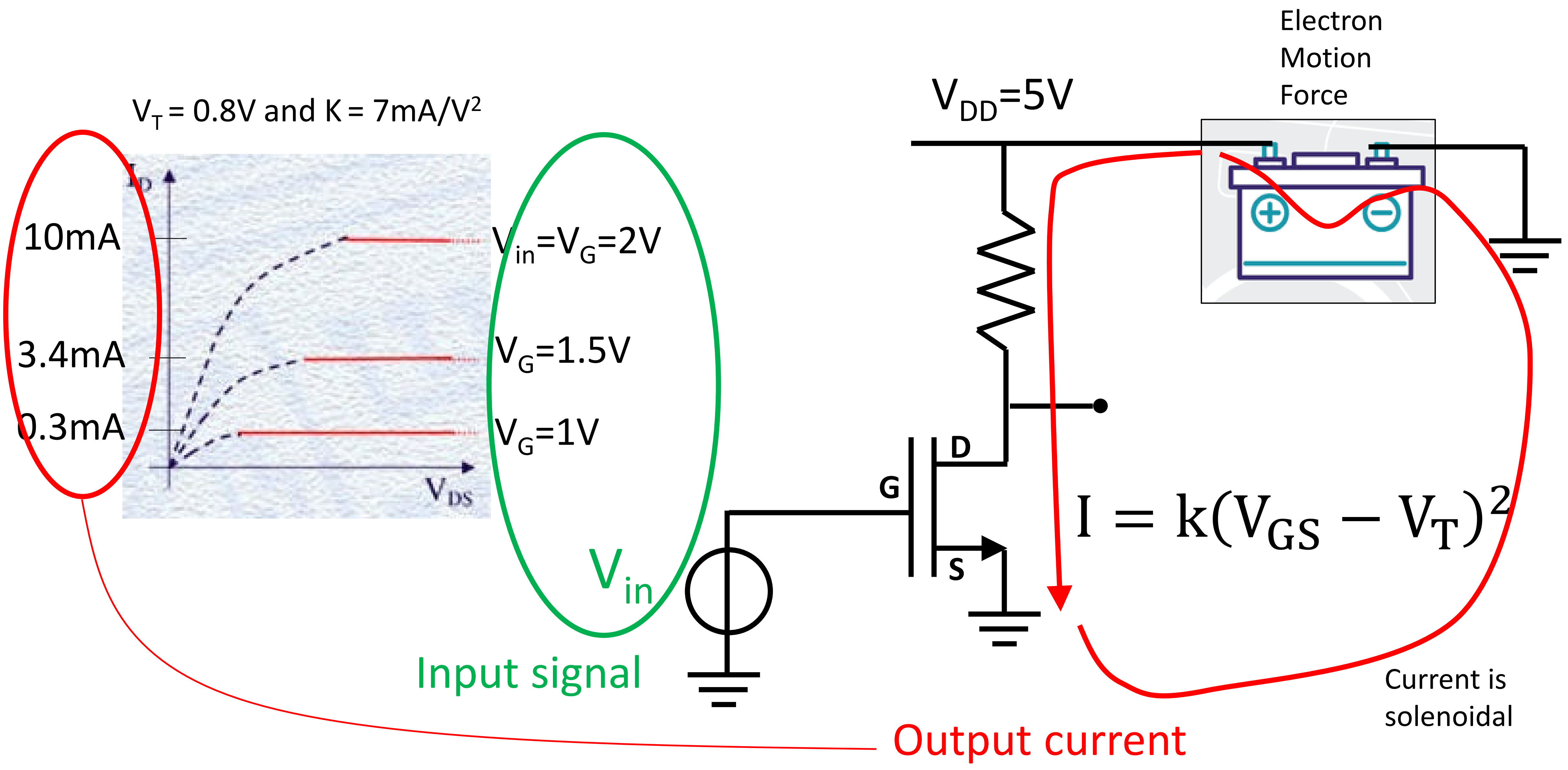
Master in Management Engineering

Prof. Marco Sampietro

GROUND CONCEPTS ON ELECTRONICS

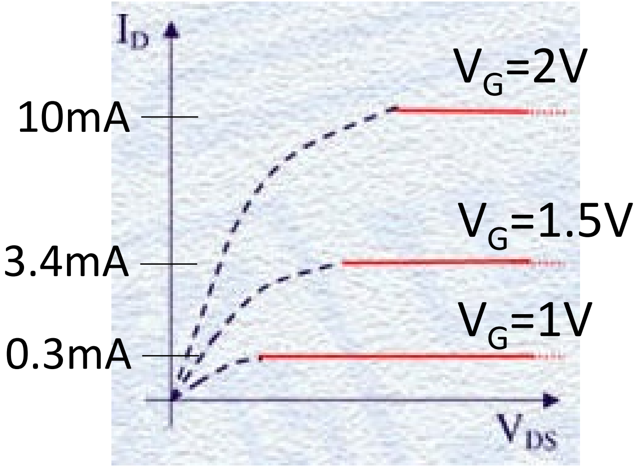
Signals, amplification & power

The use of a TRANSISTOR in a circuit

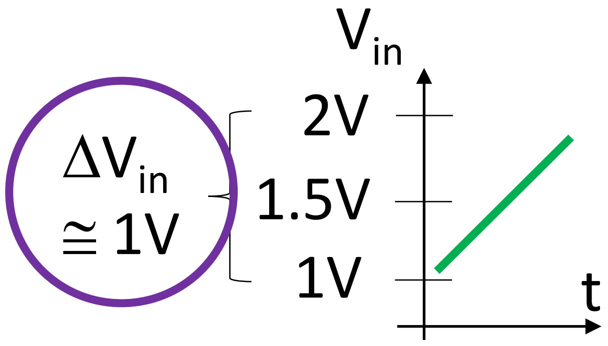


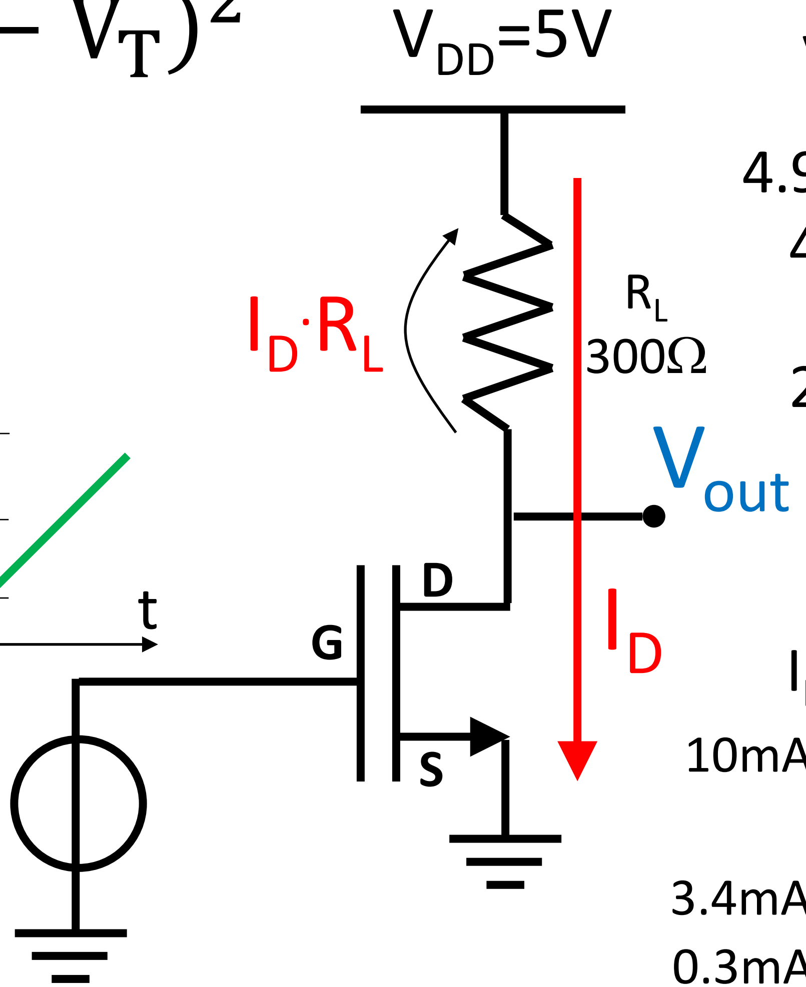
Transfer of a Voltage from Gate to Drain

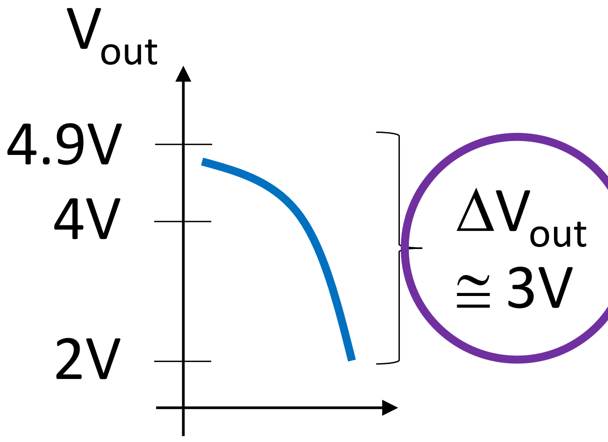
V_T=0.8V and K=7mA/V^2

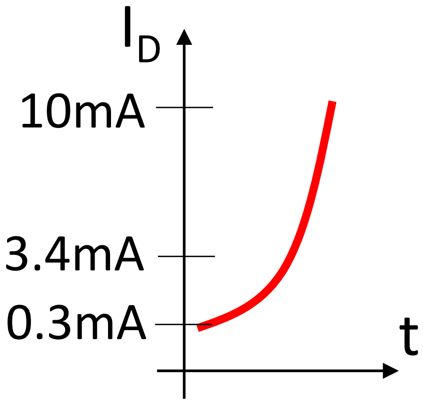


$$I = k(V_{GS} - V_T)^2$$





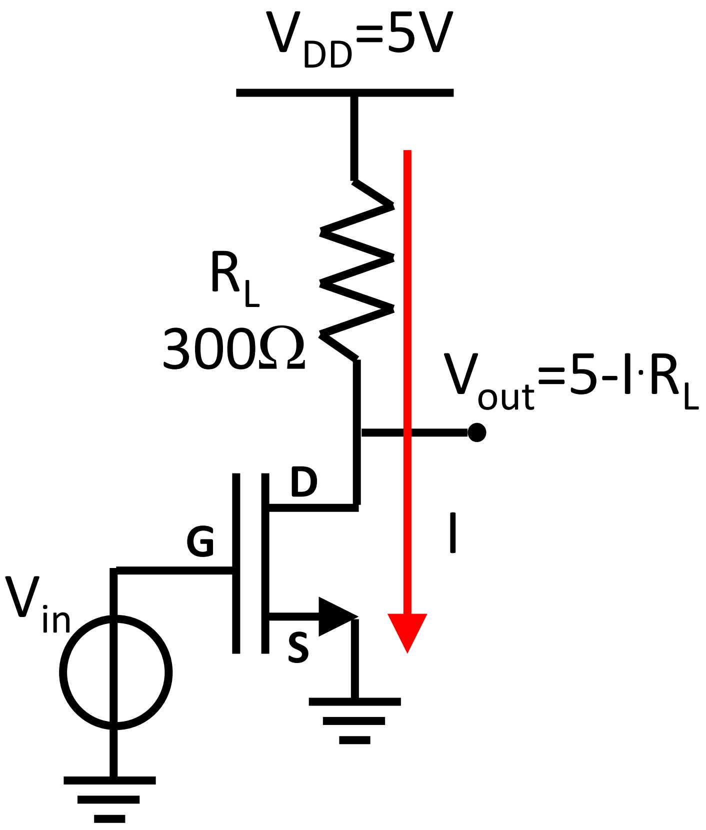




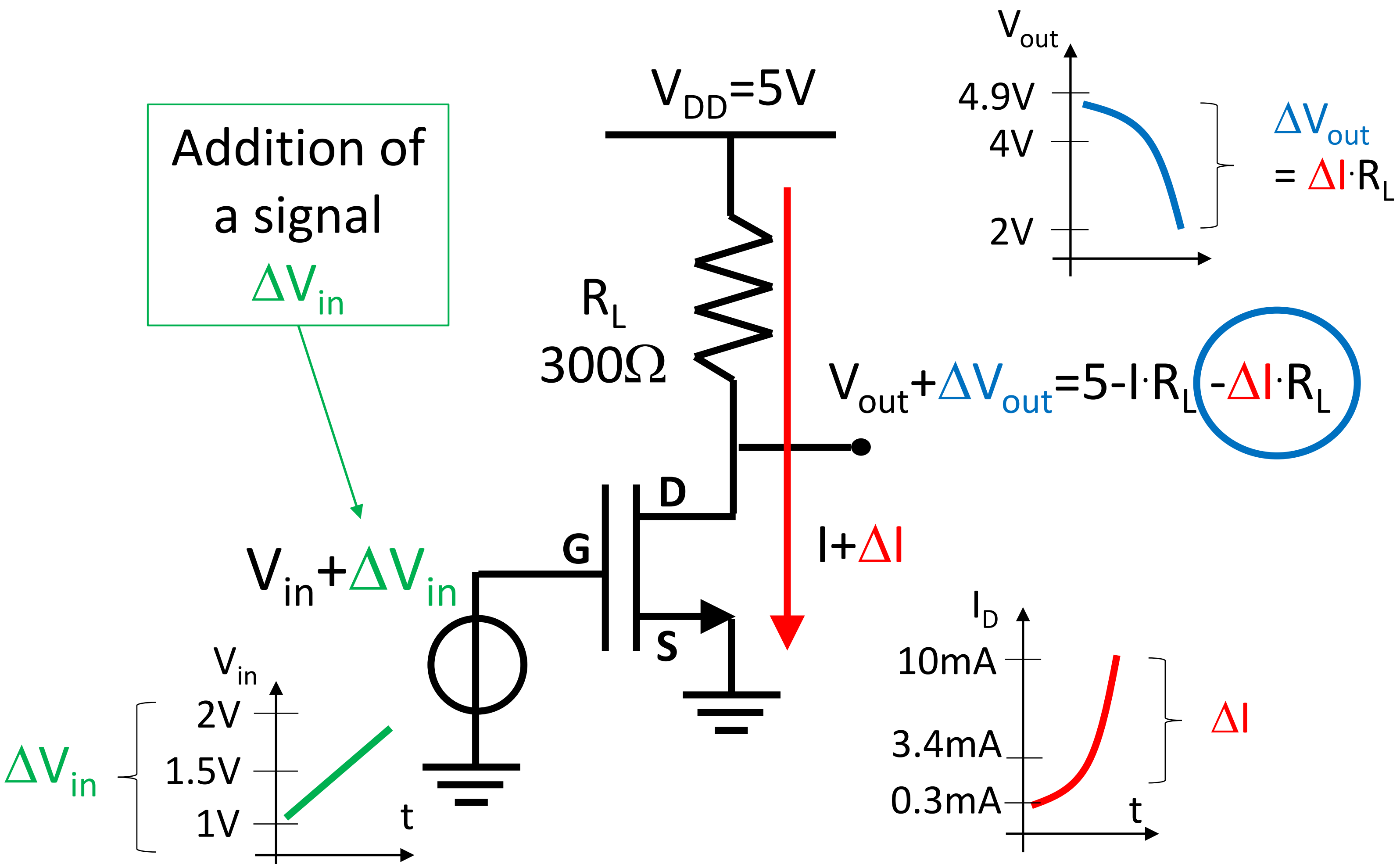
VOLTAGE GAIN

$$G = \frac{\Delta V_{out}}{\Delta V_{in}} \cong -3$$

Polarisation and signal variations

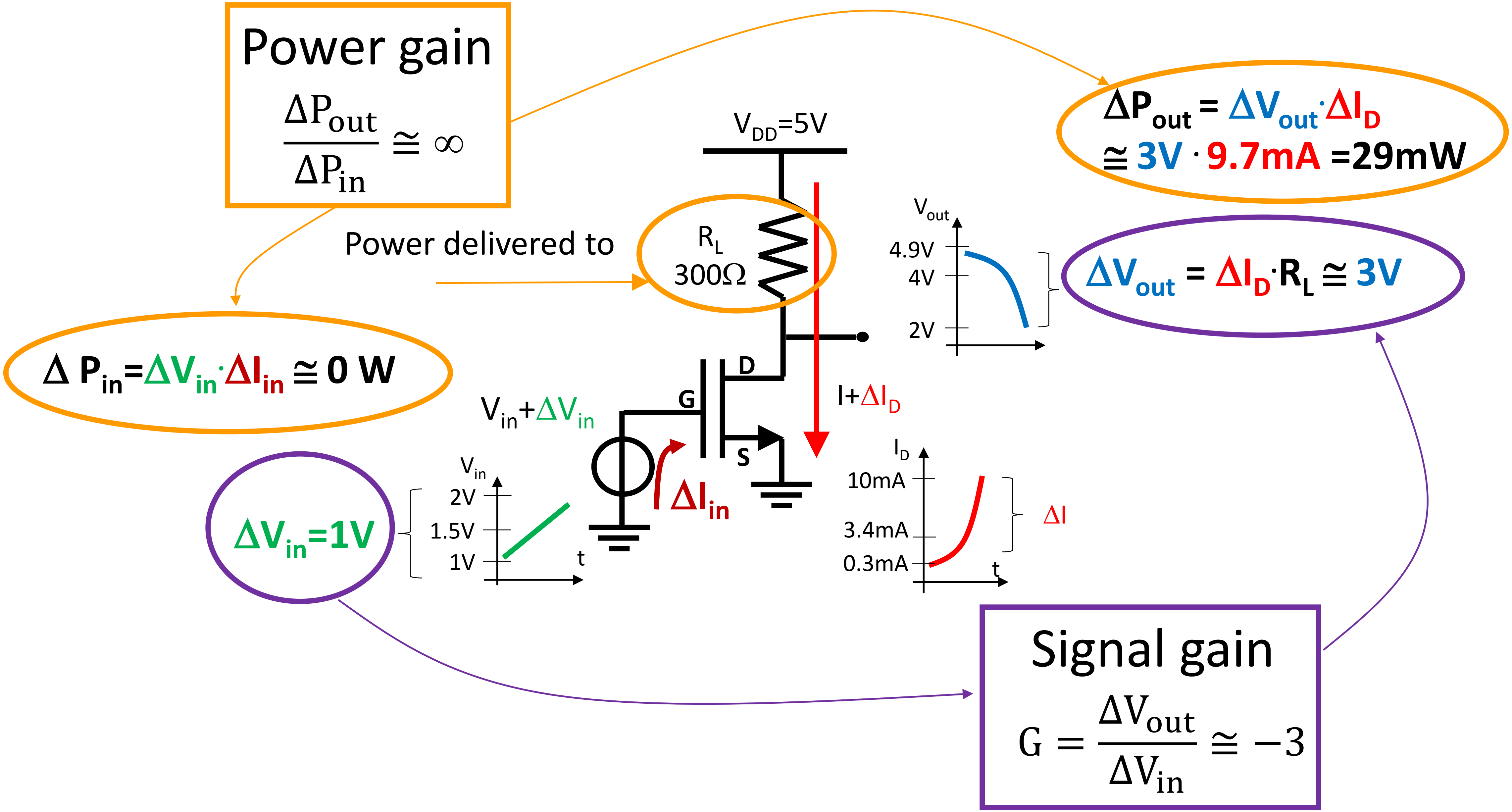


Starting condition
(Polarisation or Bias)



The <u>information</u> is contained in the variations with respect to the initial steady situation

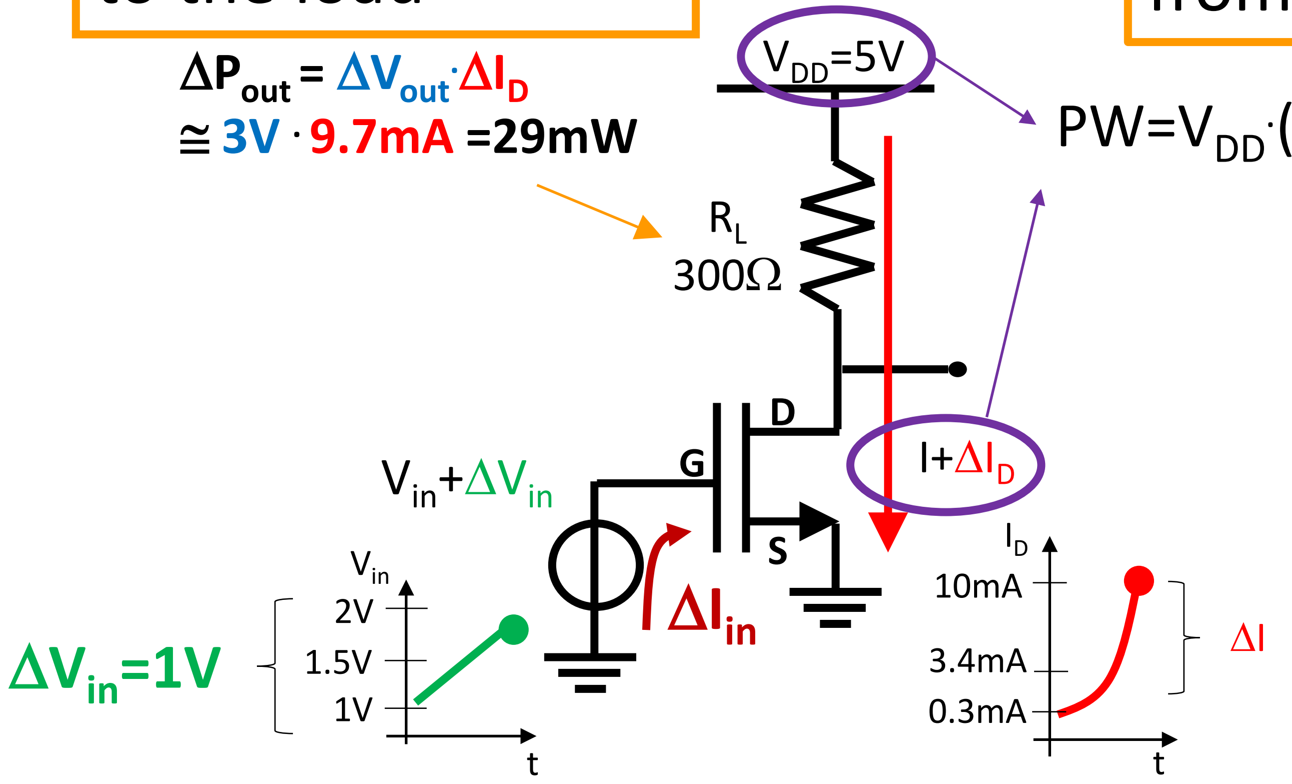
Signal Gain and Power Gain



Power Delivered and Power Consumed

Power delivered to the load

$\Delta P_{out} = \Delta V_{out} \cdot \Delta I_D$
$\cong 3V \cdot 9.7mA = 29mW$



Power absorbed from the Power Supply

$PW = V_{DD} \cdot (I+\Delta I) \cong 5V \cdot 10mA =$ **50mW**

- partly delivered to the Load (29mW)
- partly dissipated as Heat in the transistor (21mW)

The higher is V_{DD}, the higher is the consumption and the dissipation

Charge consumption and battery capacity

3.8V

The current is necessary
for the telephone
to function

1350mAh

If you use a steady current of 1350 mA, the battery will last for 1 hour

Exercise 1 :

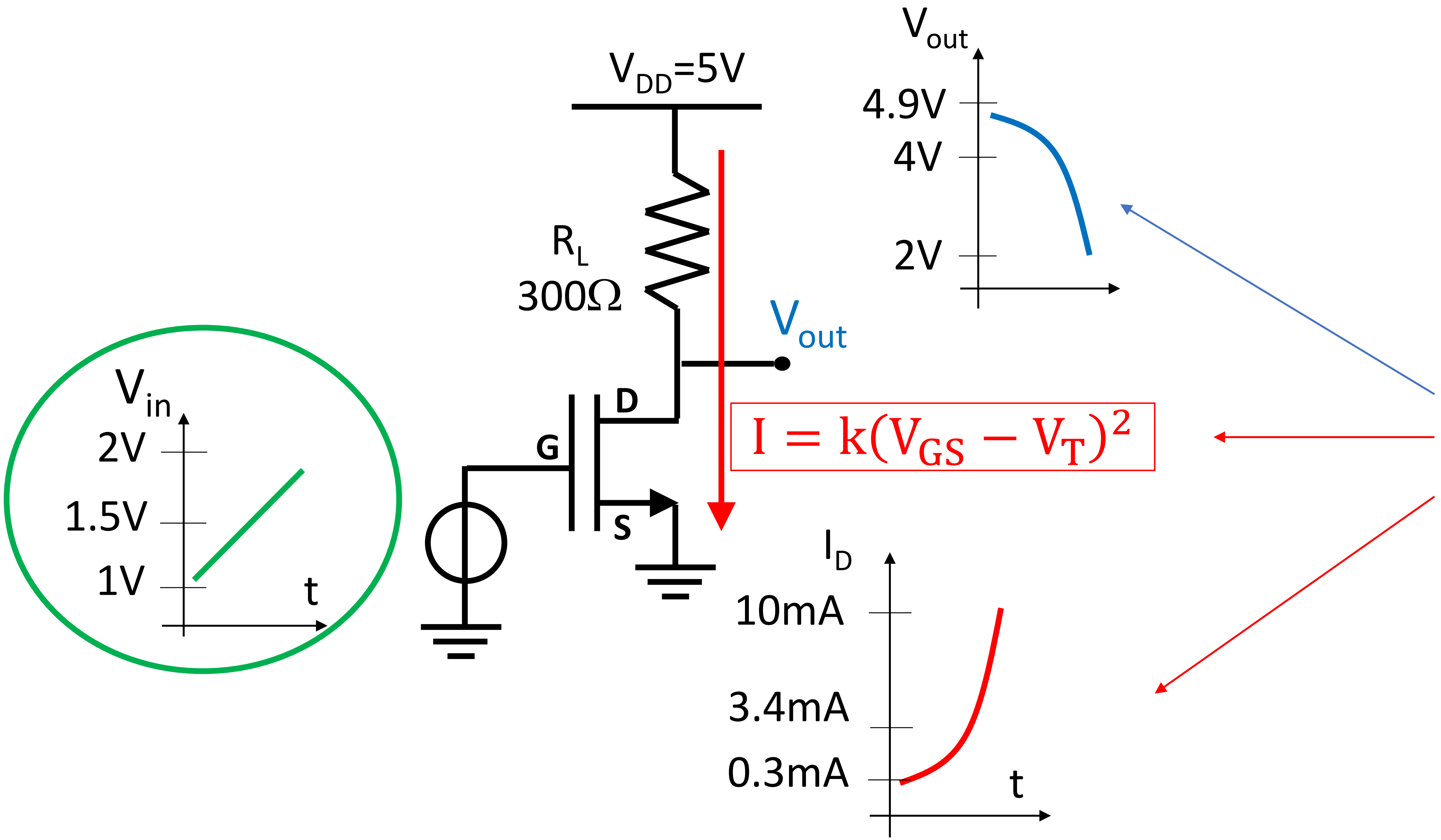
If the steady current consumption is 6mA, how long would the battery last ?

Exercise 2

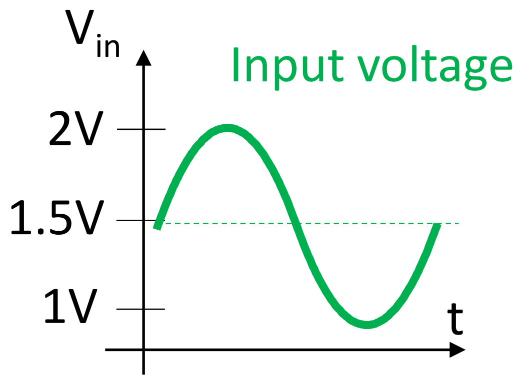
You are the chief designer of the next generation of satellites for earth survey. Your team of mechanical engineers have designed a solar cell panel that is always (24h/day) directed toward the sun. They also defined the maximum area of the solar cell panel, of $20 m^2$.

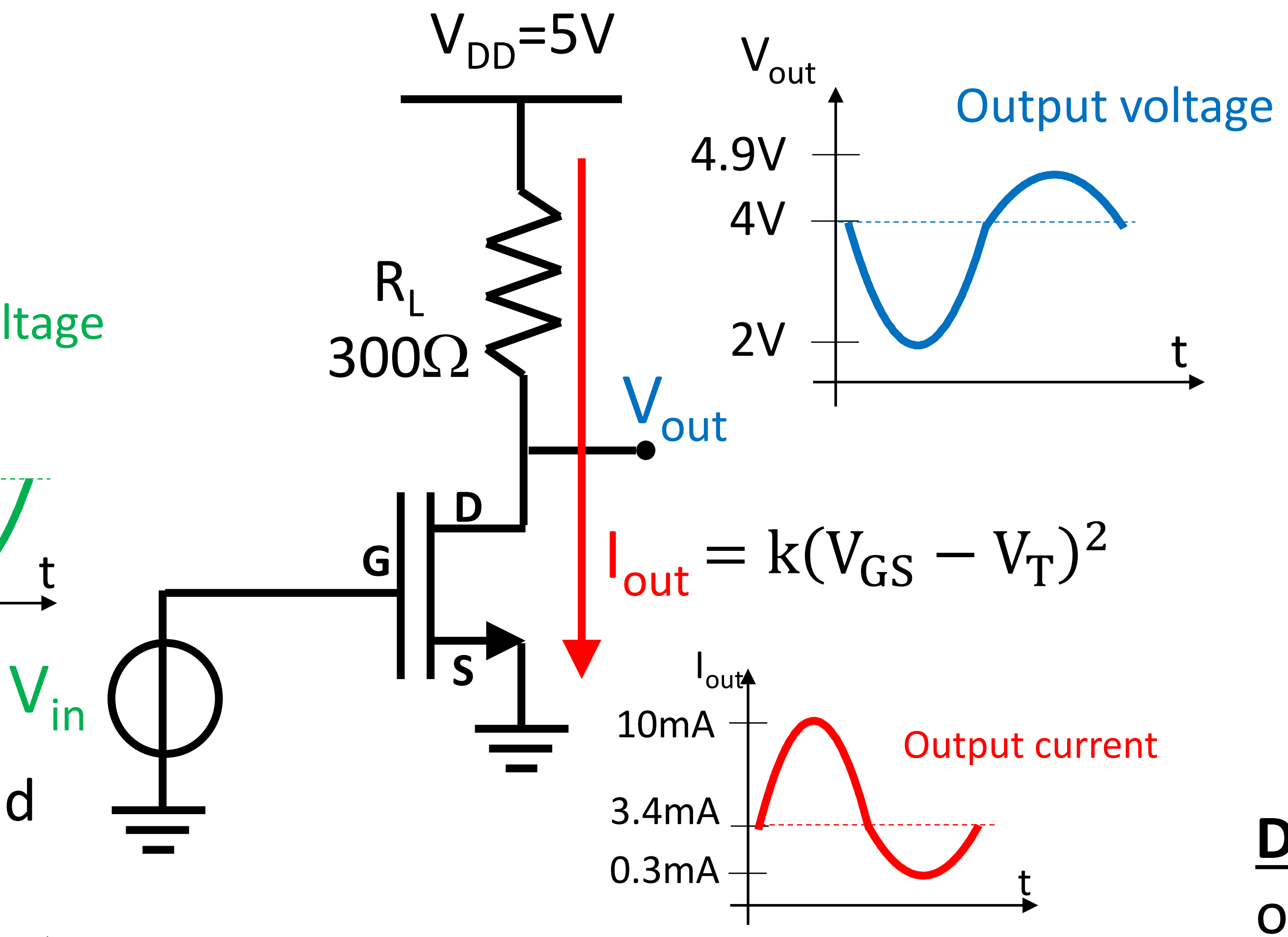
Find how much electric power you will have available for all your electronic instrumentation and the transmission of data to the base station.

NON-Linearity of the signal amplification



Transfer of a SINUSOIDAL signal from Gate to Drain





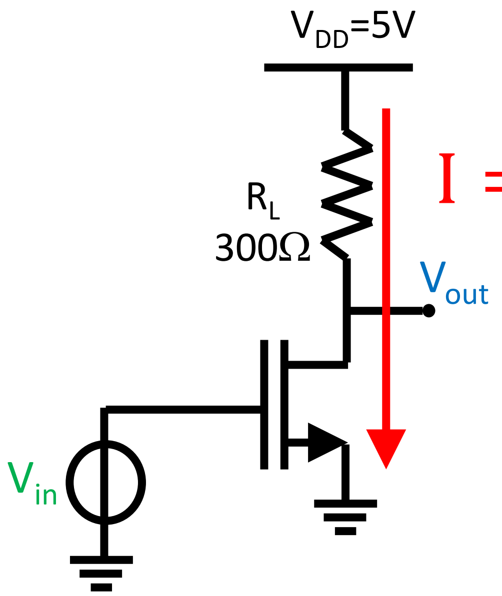
Perfect sinusoid at the input

$v_{in}=v_{gs}=A \cdot \sin(\omega t)$

<u>Distorted</u> output voltage

<u>Distorted</u> output current

Signal distortion and generation of harmonics



$$I = k(V_{GS} - V_T)^2$$

$$v_{in} = v_{gs} = A \cdot \sin(\omega t)$$

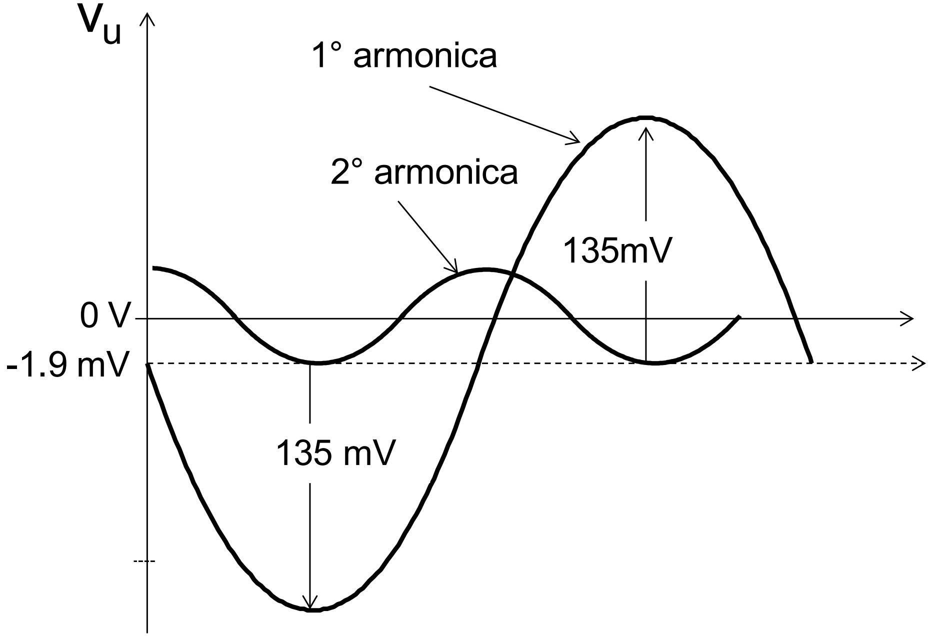
$$I = k(A \cdot \sin(\omega t) - V_T)^2$$

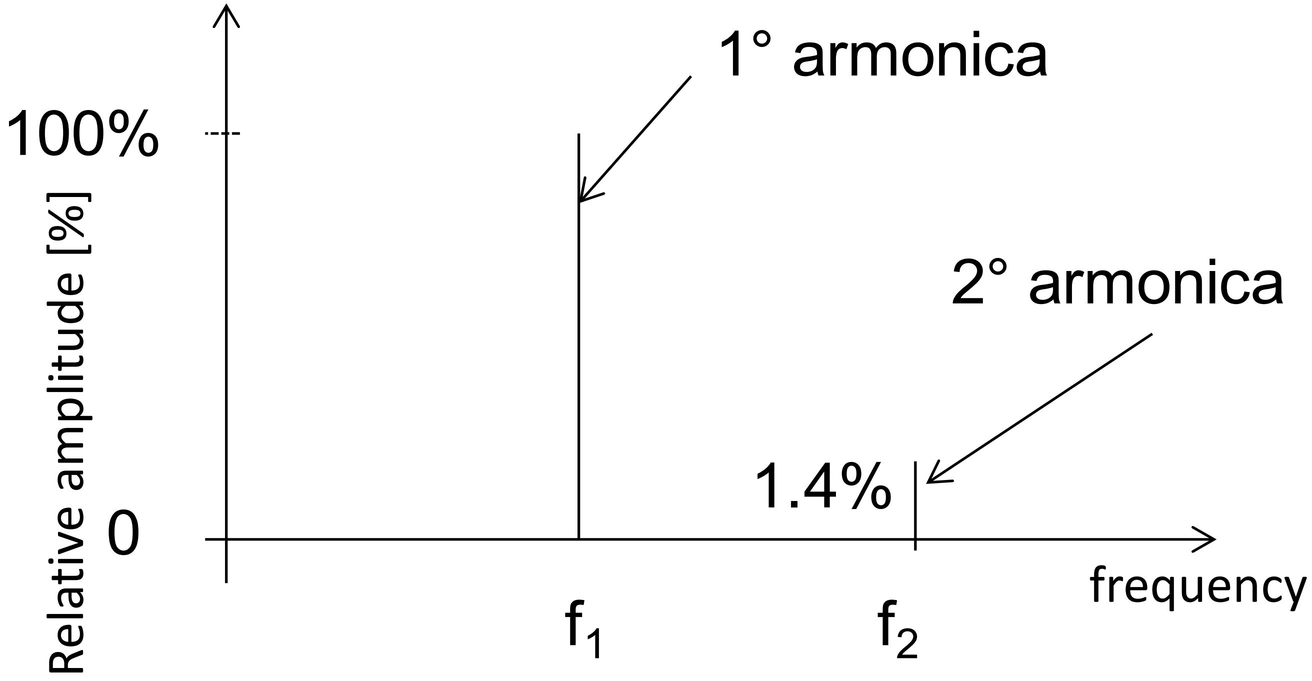
$$I = k[A^2 sin^2(\omega t) + V_T^2 - 2AV_T \sin(\omega t)]$$

$$\sin^2 \omega t = \frac{1 - \cos 2\omega t}{2}$$

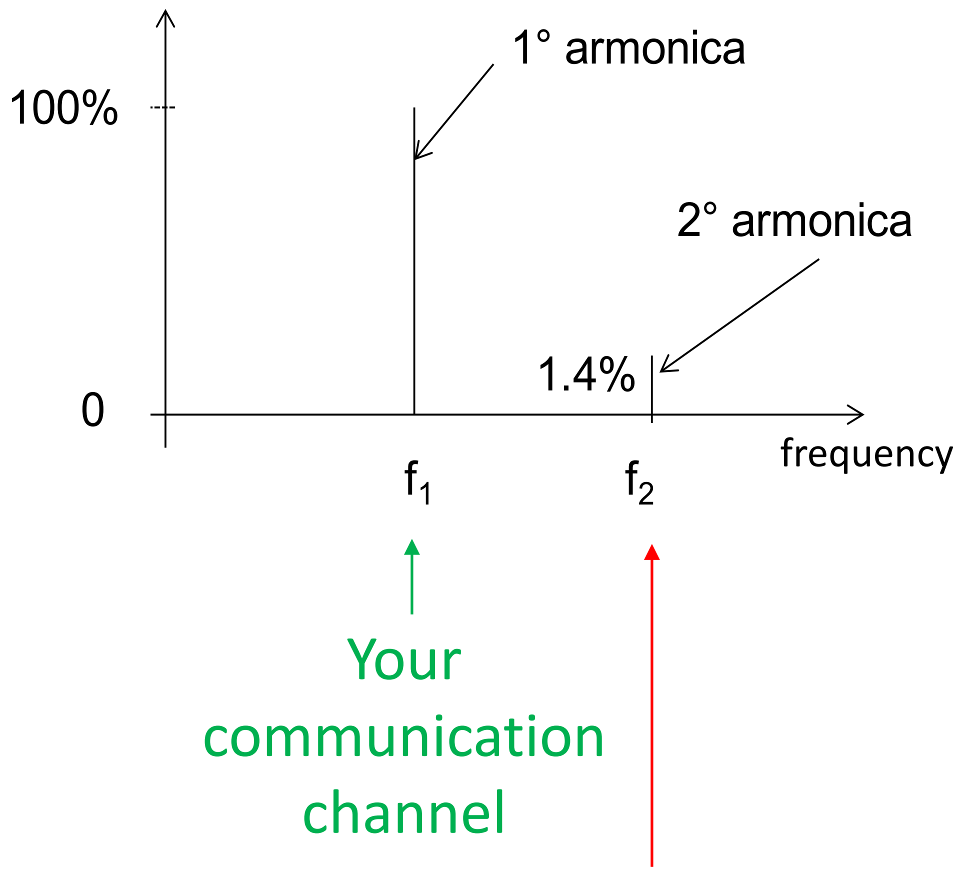
$$I = kV_T^2 + \frac{kA^2}{2} - 2kAV_T \sin(\omega t) - \frac{kA^2}{2} \cos(2\omega t)$$

Frequency spectrum : visualisation of harmonics





Practical consequences of harmonics generation



Your communication channel

…produces signals also in adjacent channel

POLITECNICO DI MILANO
Piazza Leonardo da Vinci, 32 - 20133 Milano
Tel. +39.02.2399.1 - http://www.polimi.it

New generation chips, the factory of the future in Novara

Ing. Luca Moiraghi

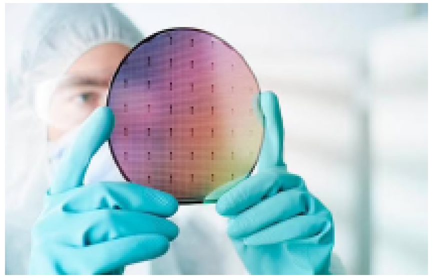
GlobalWafers
MEMC Electronic Materials S.p.A.

Friday, 4 March at 8.30, Building B12, ClassRoom L11, BOVISA CAMPUS

The global microchip crisis continues to bite. Europe has begun to organize itself with the Chips Act which will move over 40 billion euros between public and private funds. Italy is answering with an investment of 300 million for a plant capable of producing 300 mm diameter silicon wafers, a key component in today microelectronic supply chain for making those chips used, for example, in consumer electronics, automotive and increasingly also in health diagnostics.

The talk will introduce MEMC Electronic Materials Spa, a GlobalWafers company, an Italian excellence in the core materials for the electronic industry. The talk will start with a company description and then it will overview the fabrication process flow from crystal pulling to finished wafer shipment. The manufacturing strategies to deliver a steady supply of exceptionally pure silicon that meet customer requirements all other the world will end the seminar.

The seminar is open to public.
It is also part of the "ELECTRONIC SYSTEMS and TECHNOLOGIES" course in the Master of Management Engineering.



Friday talk

End of the lesson