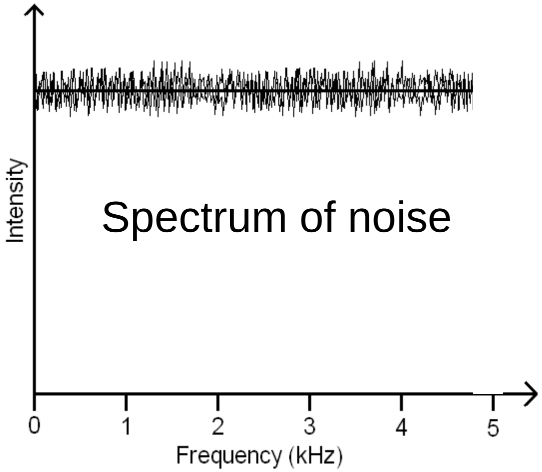
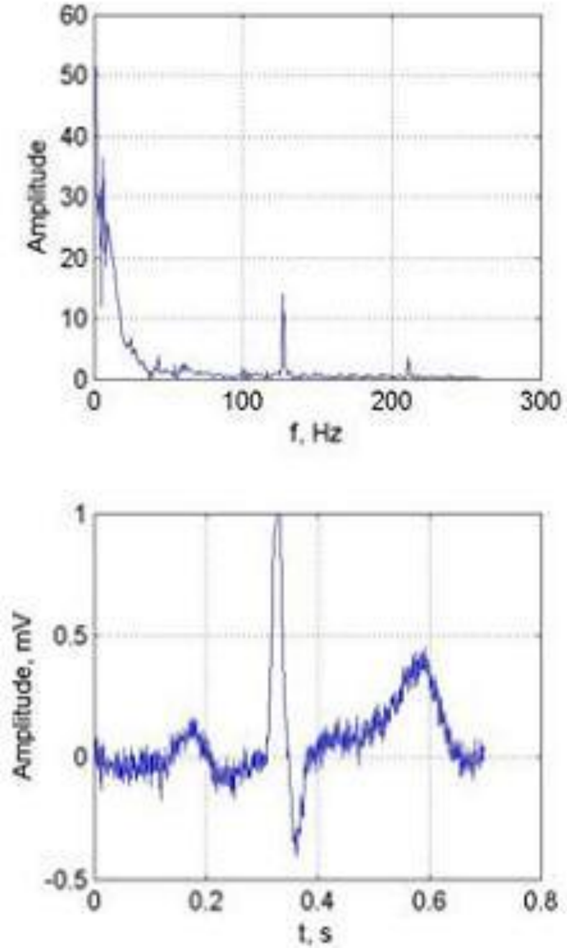
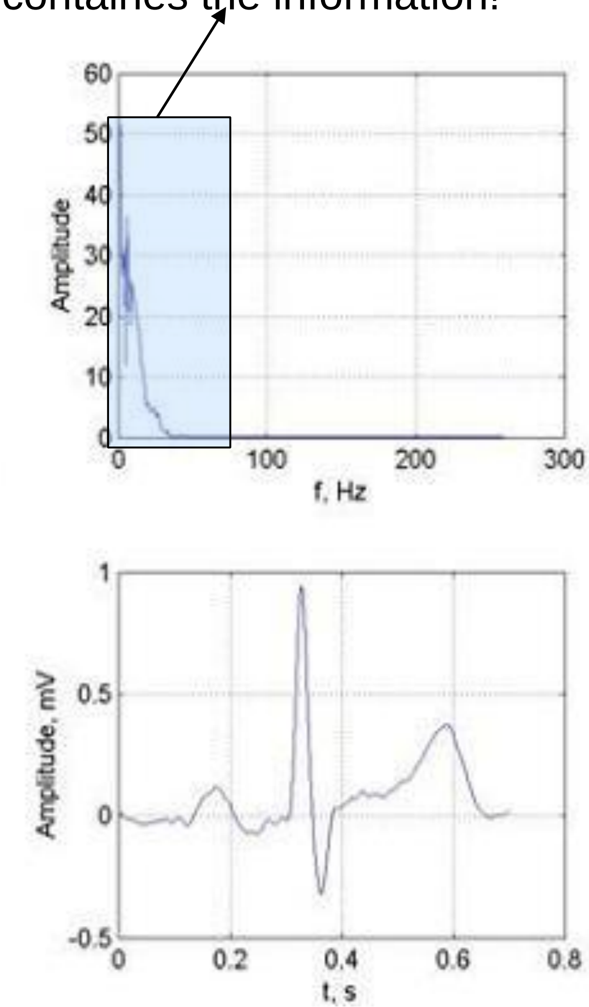
Analysis of amplifiers - Transfer function of amplifiers

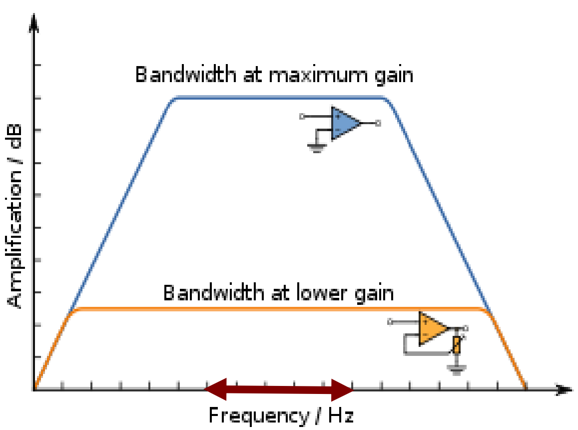
During analog signal transport at every stage noise will be added! → degradation

Just transport that part of the spectrum which containes the information!

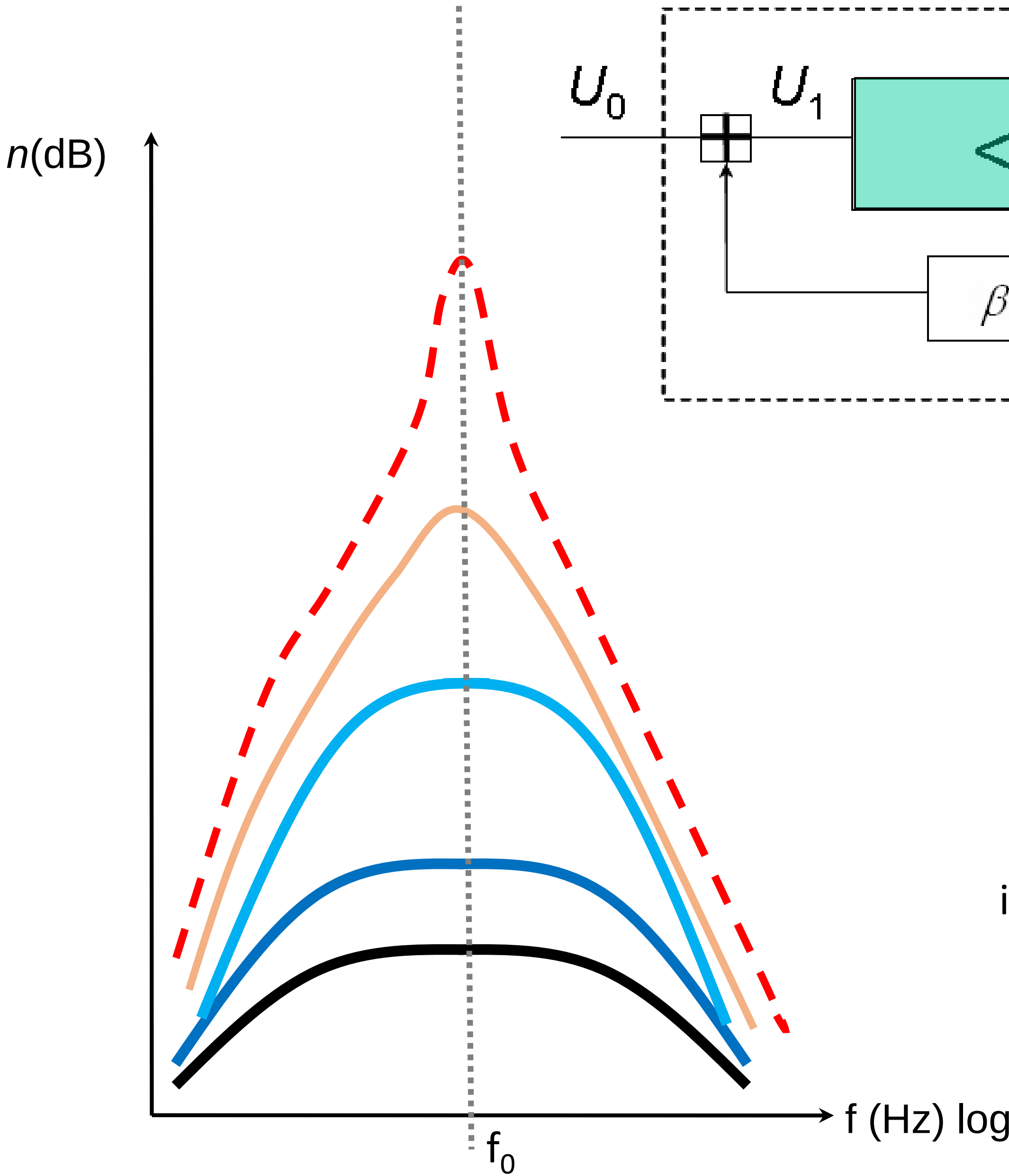


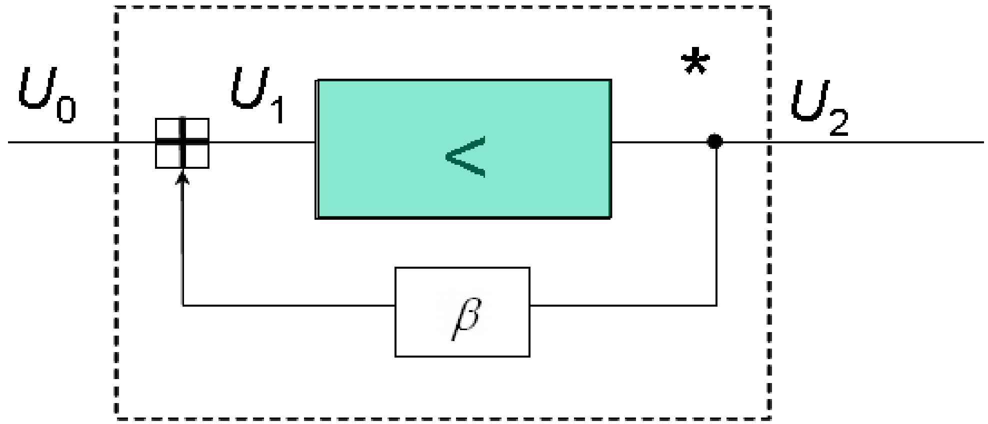






Positive feedback

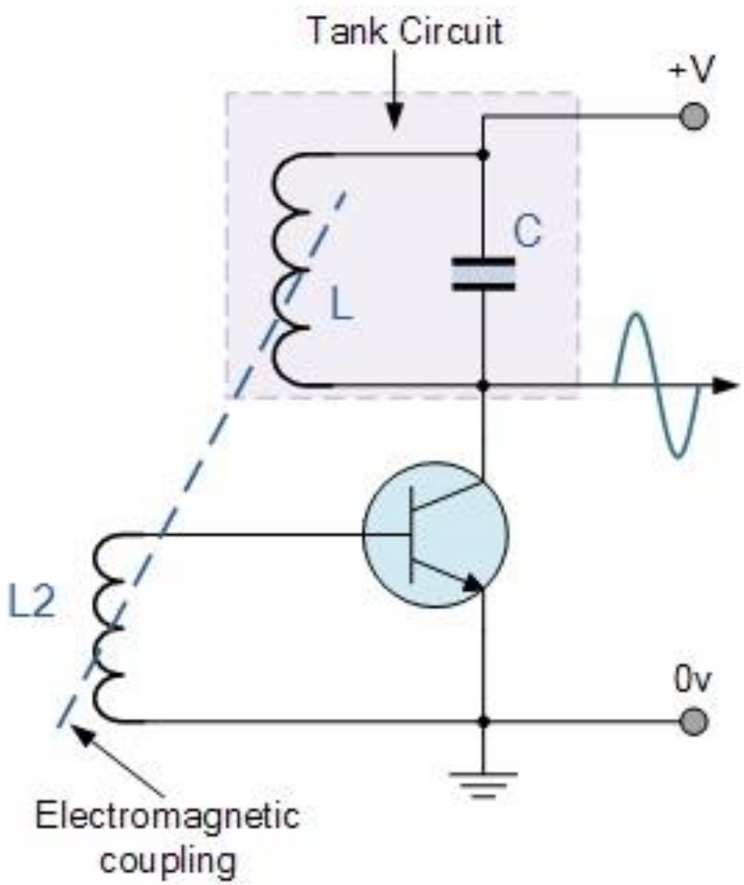


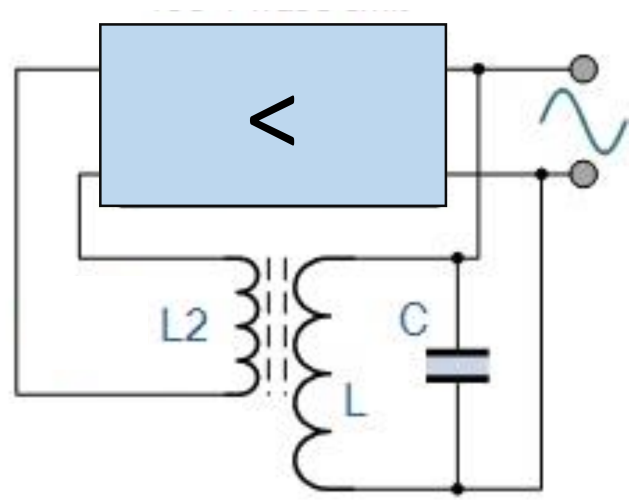


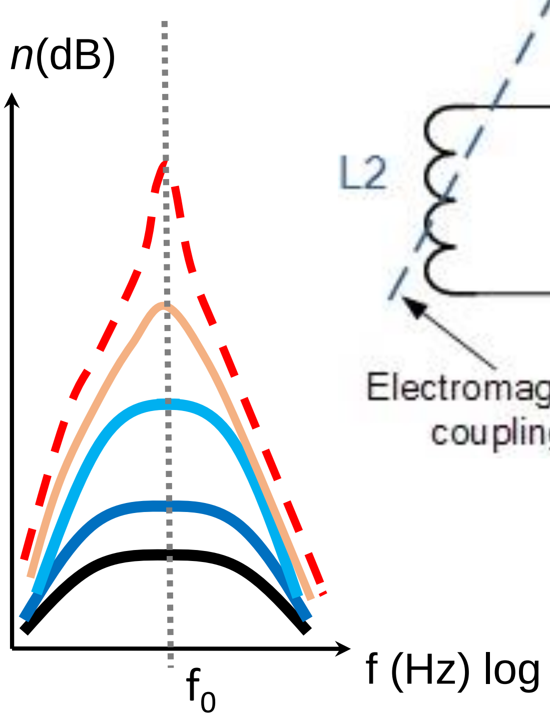
$$A_U^{*} = \frac{A_U}{1 - \beta A_U}$$

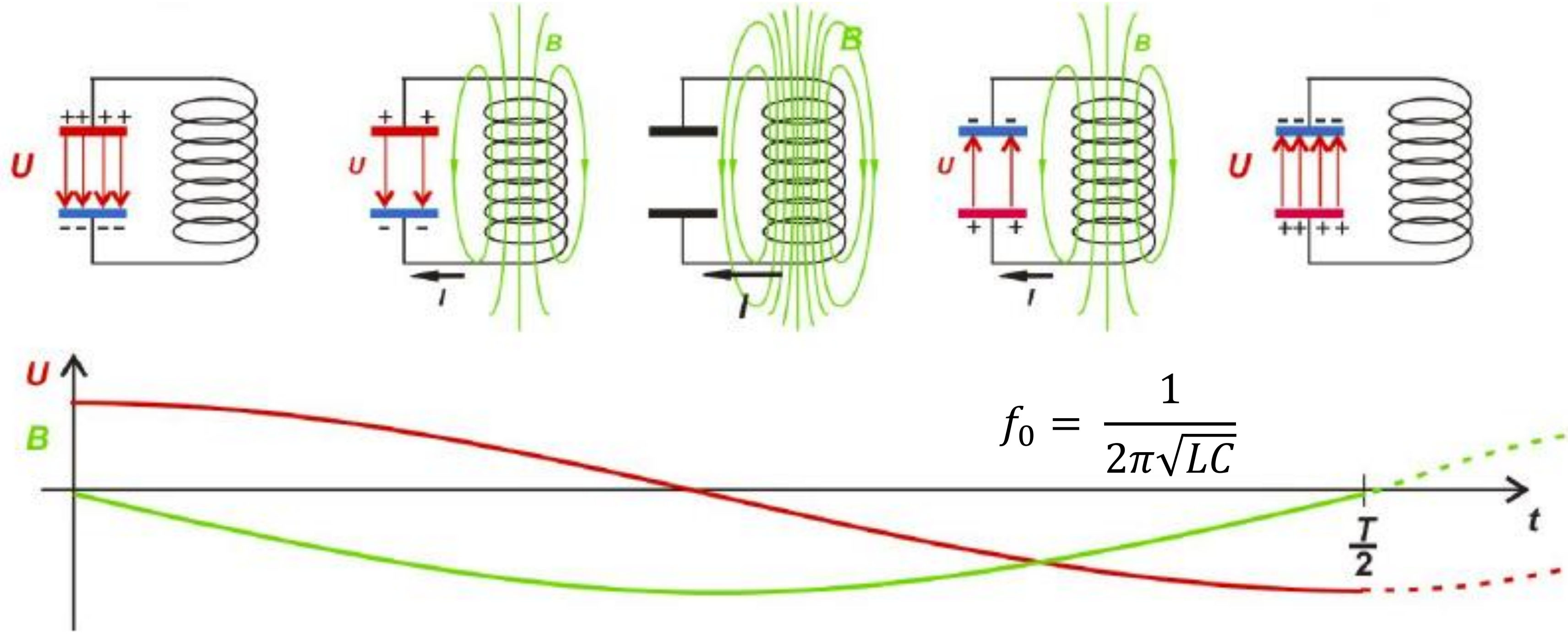
if βAu -> 1 then A_U^{*} -> ∞

We can insert frequency selective elements into the feedback loop to lock the system to a given (natural) frequency.

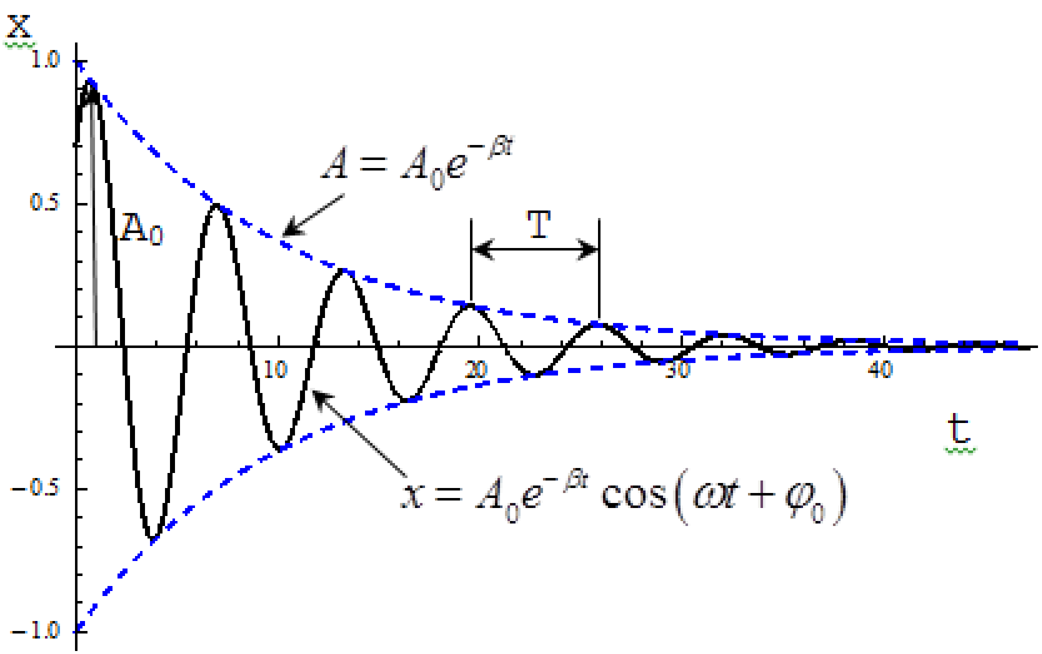


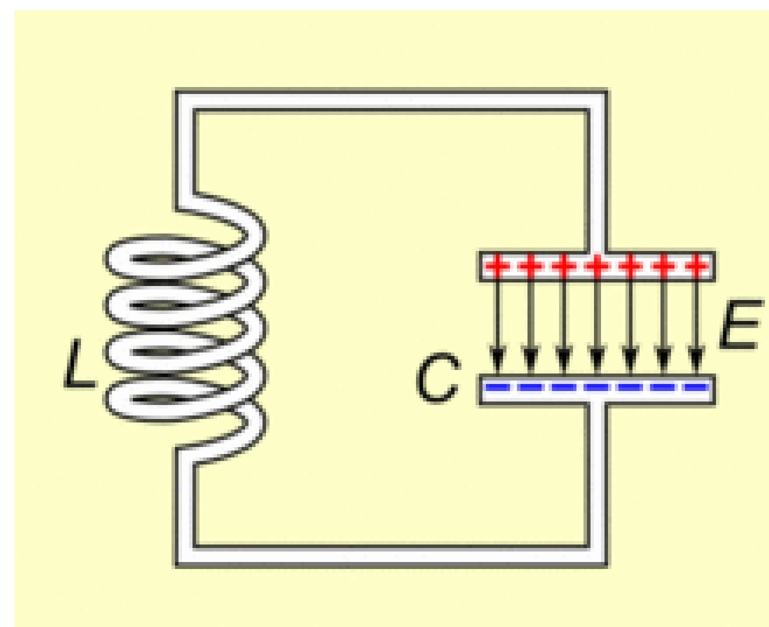




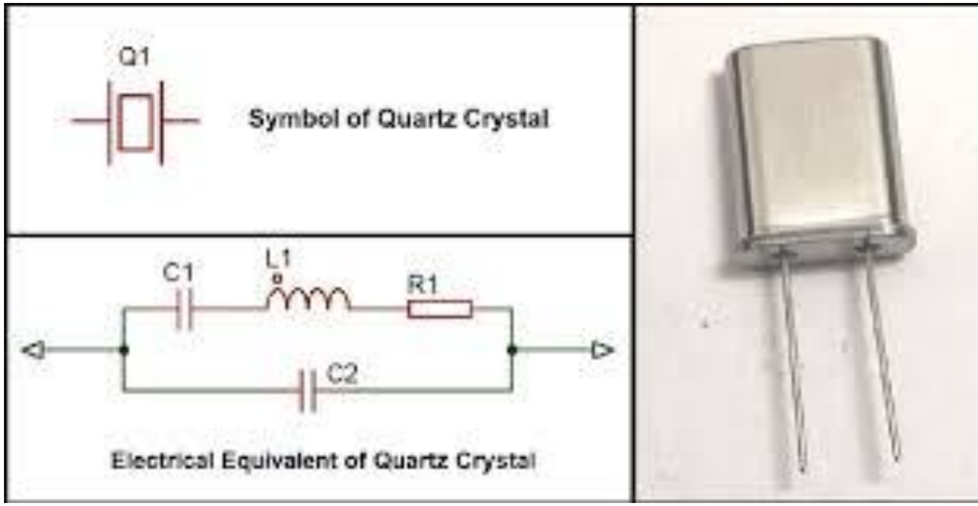


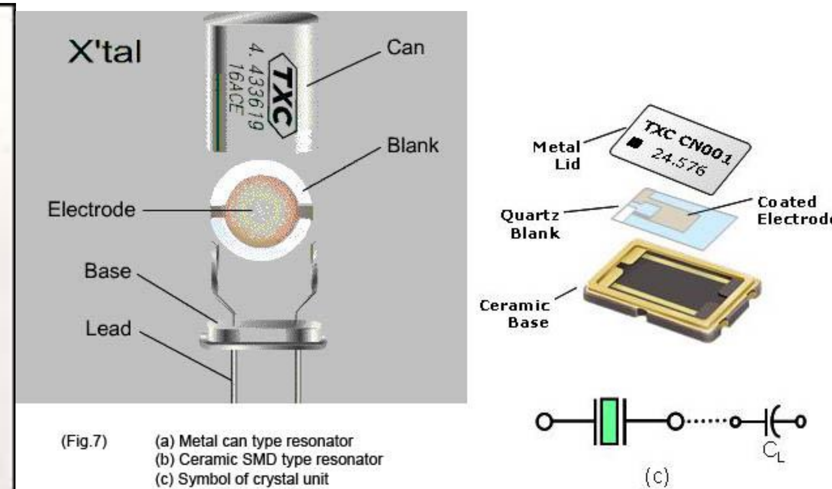
$$f_0 = \frac{1}{2\pi\sqrt{LC}}$$



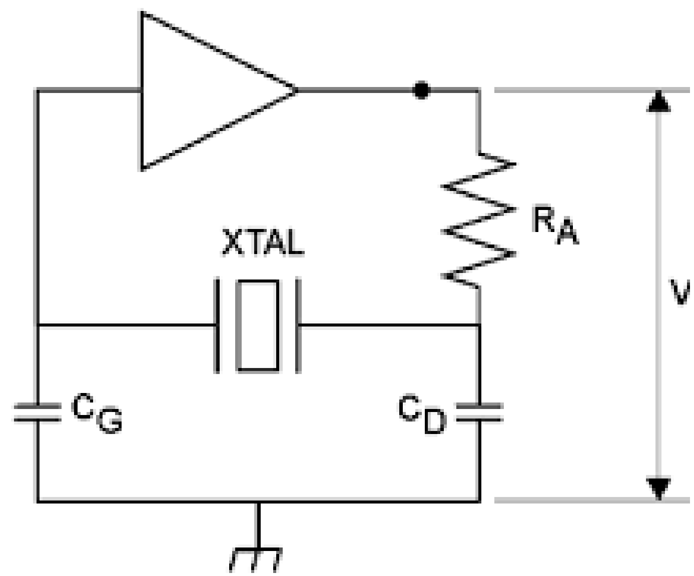


Quartz crystal-oscillator

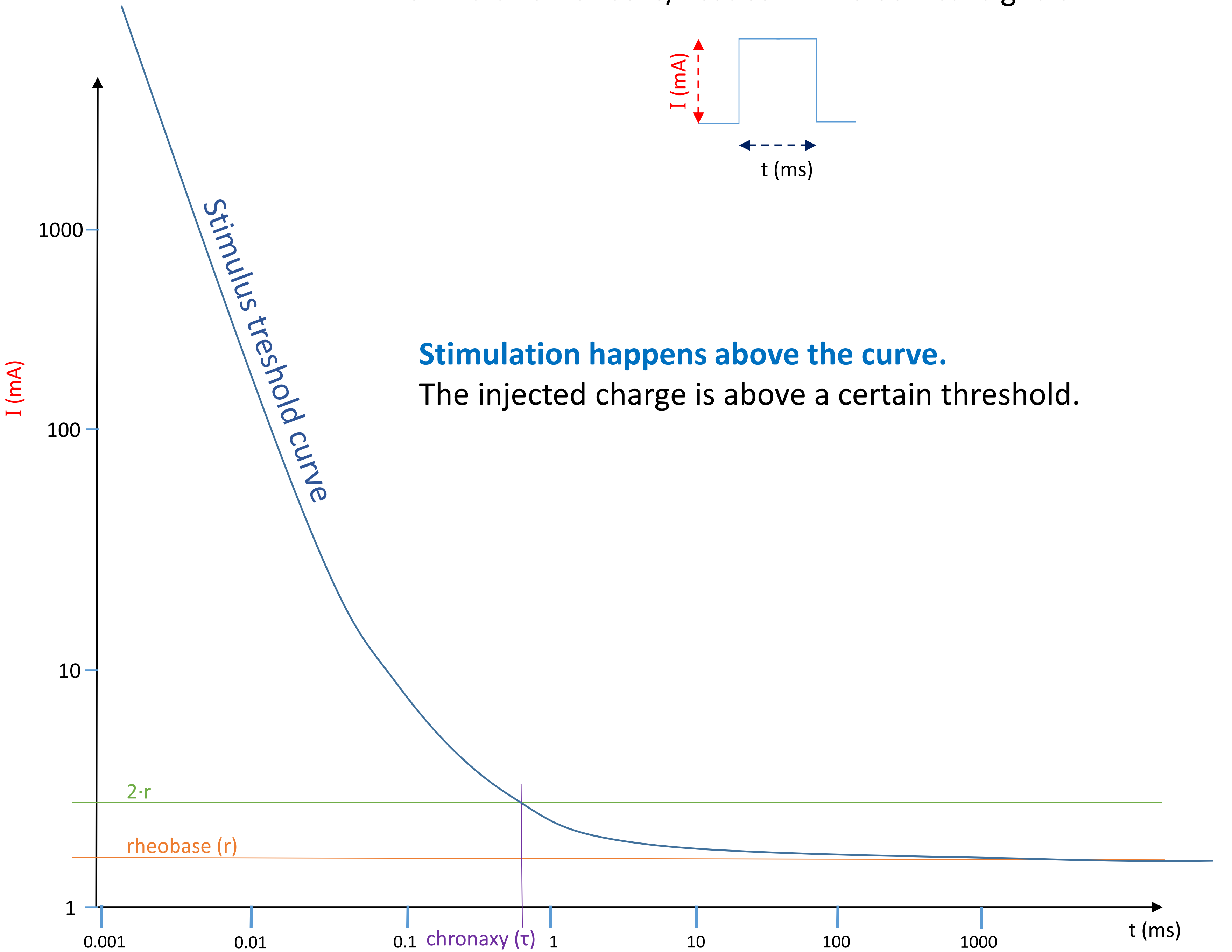




Piezoelectric effect makes the crystal act as a resonant element in the circuit.

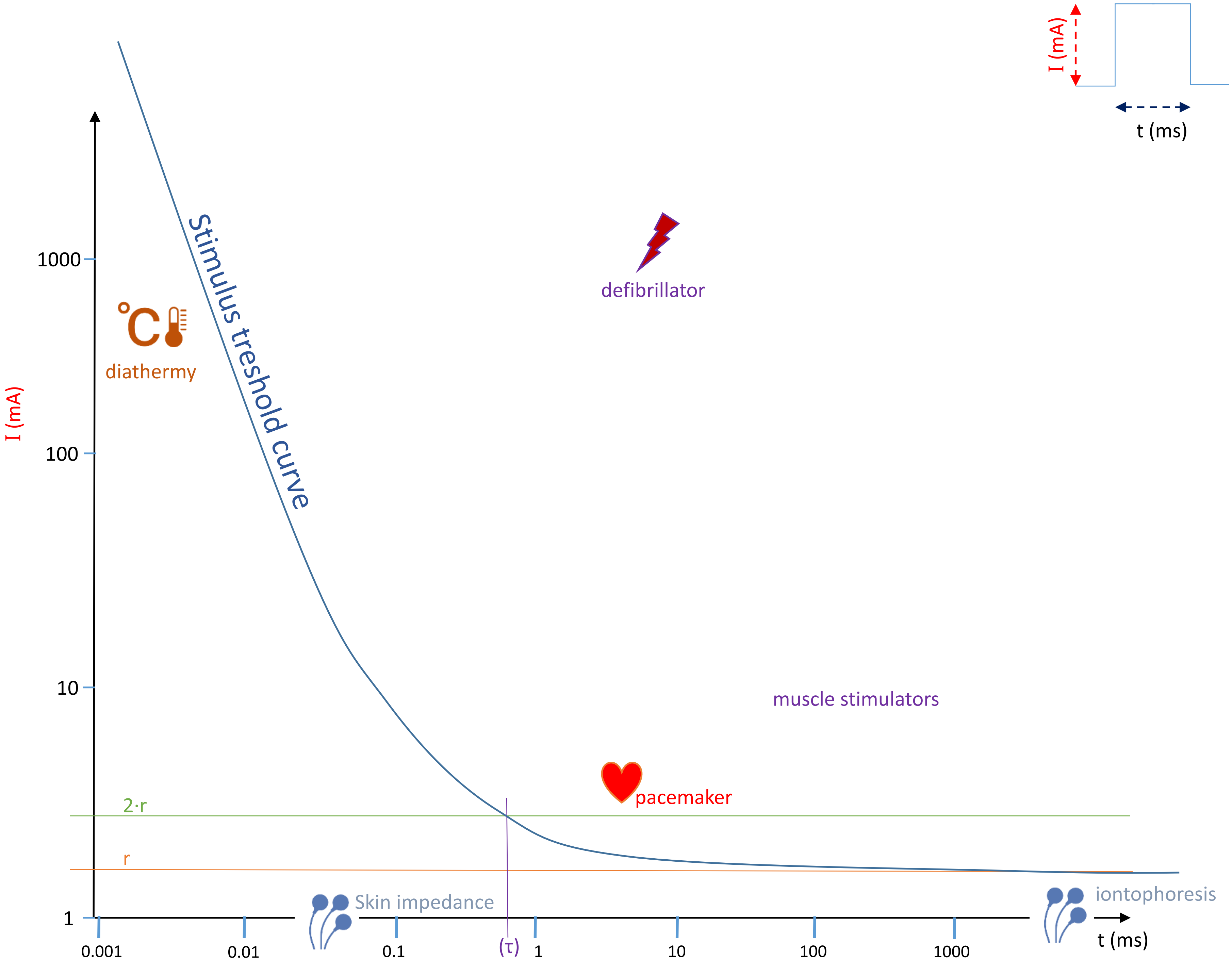


Stimulation of cells/tissues with electrical signals



Stimulation happens above the curve.

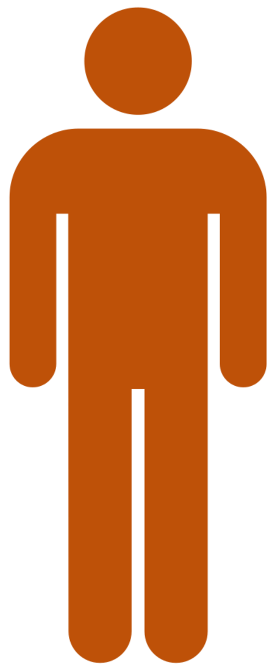
The injected charge is above a certain threshold.

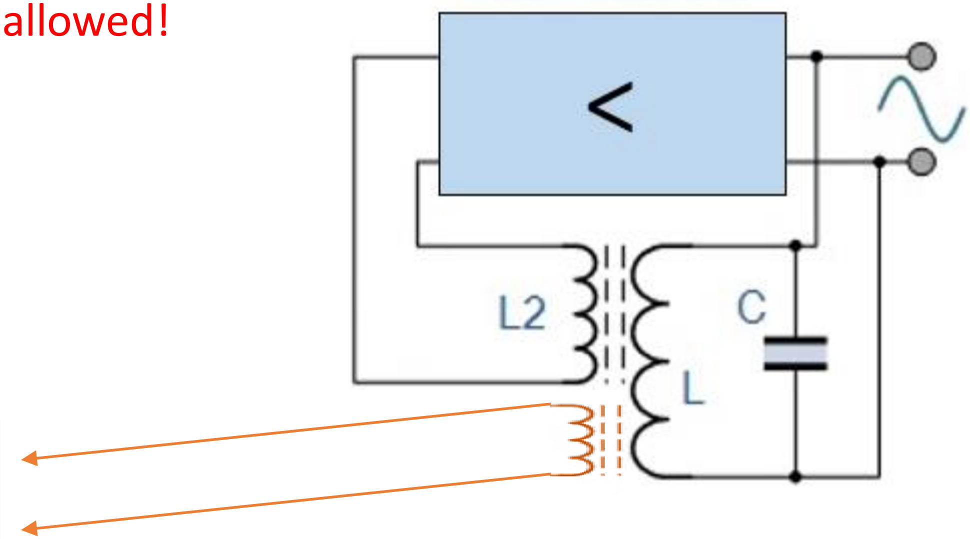


I (mA)
t (ms)
1000
100
10
1
I (mA)
Stimulus treshold curve
defibrillator
diathermy
muscle stimulators
pacemaker
2·r
r
Skin impedance
iontophoresis
0.001
0.01
0.1
(τ)
1
10
100
1000
t (ms)

The output power goes to the patient circuit.

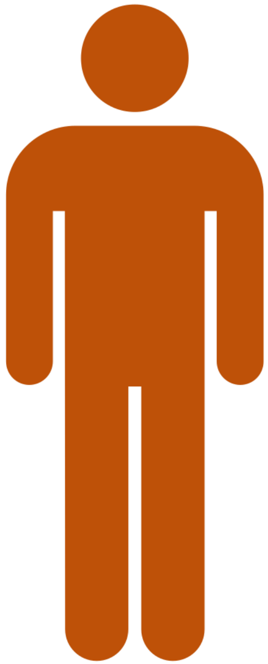
NO direct galvanic contant is allowed!
(safety rule)



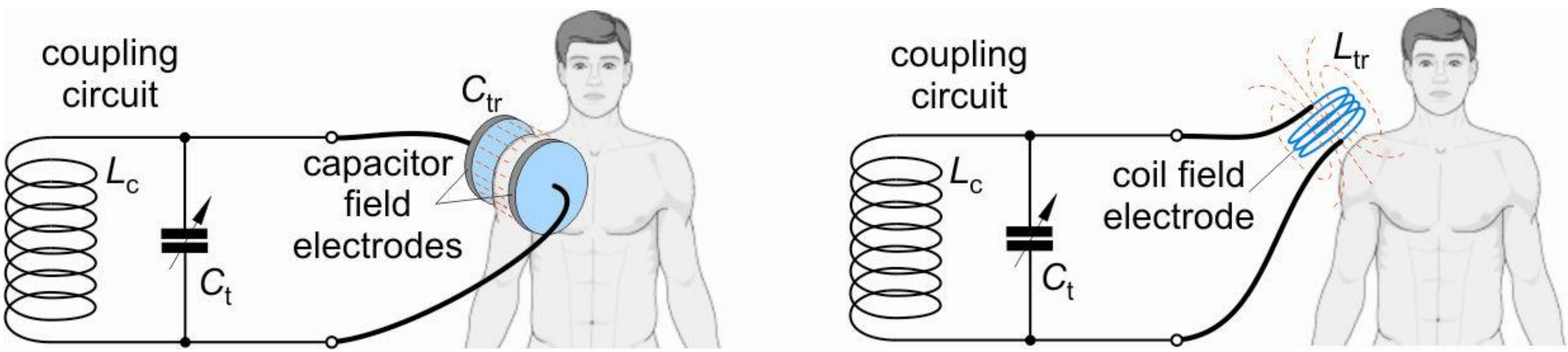


A usual way is the magnetic coupling into the patient-circuit

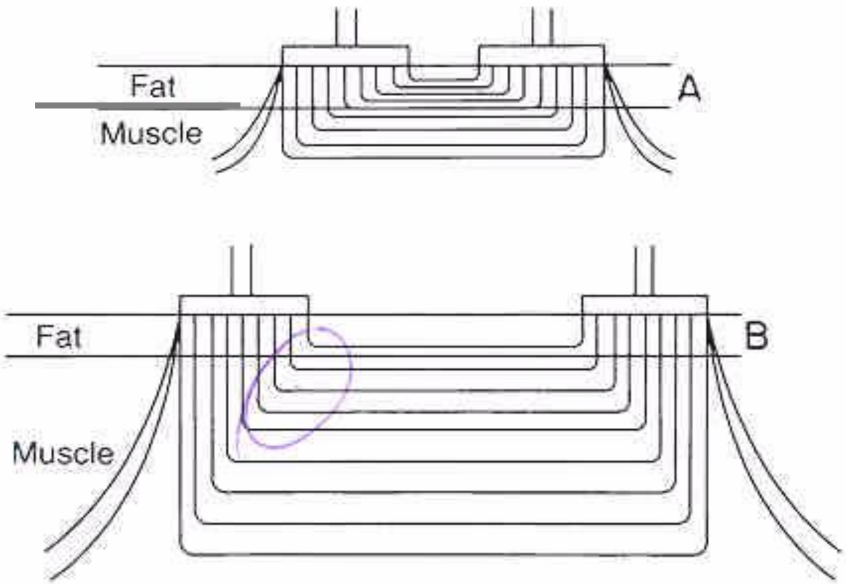
Patient circuits

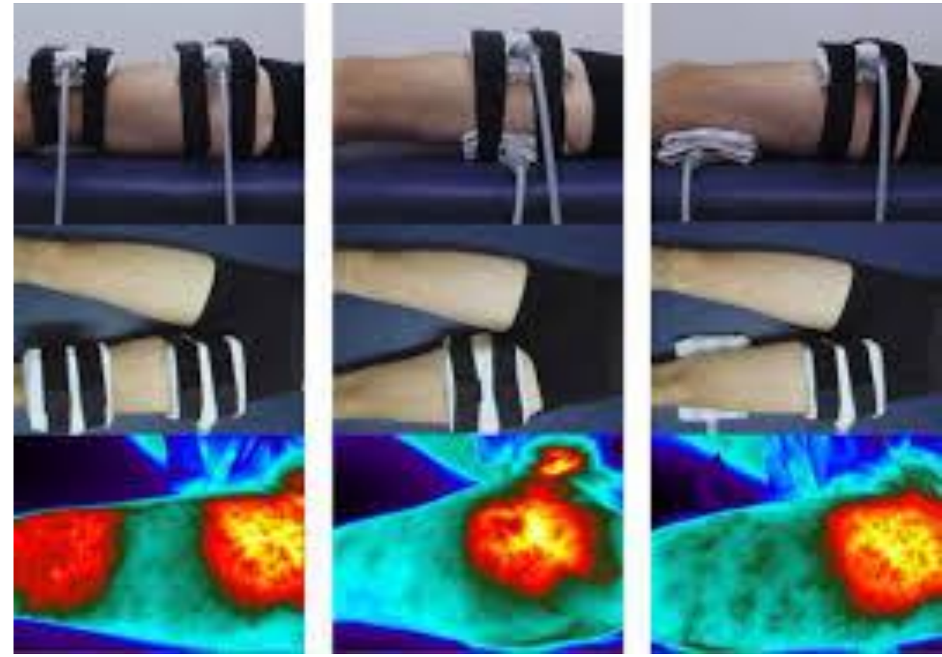


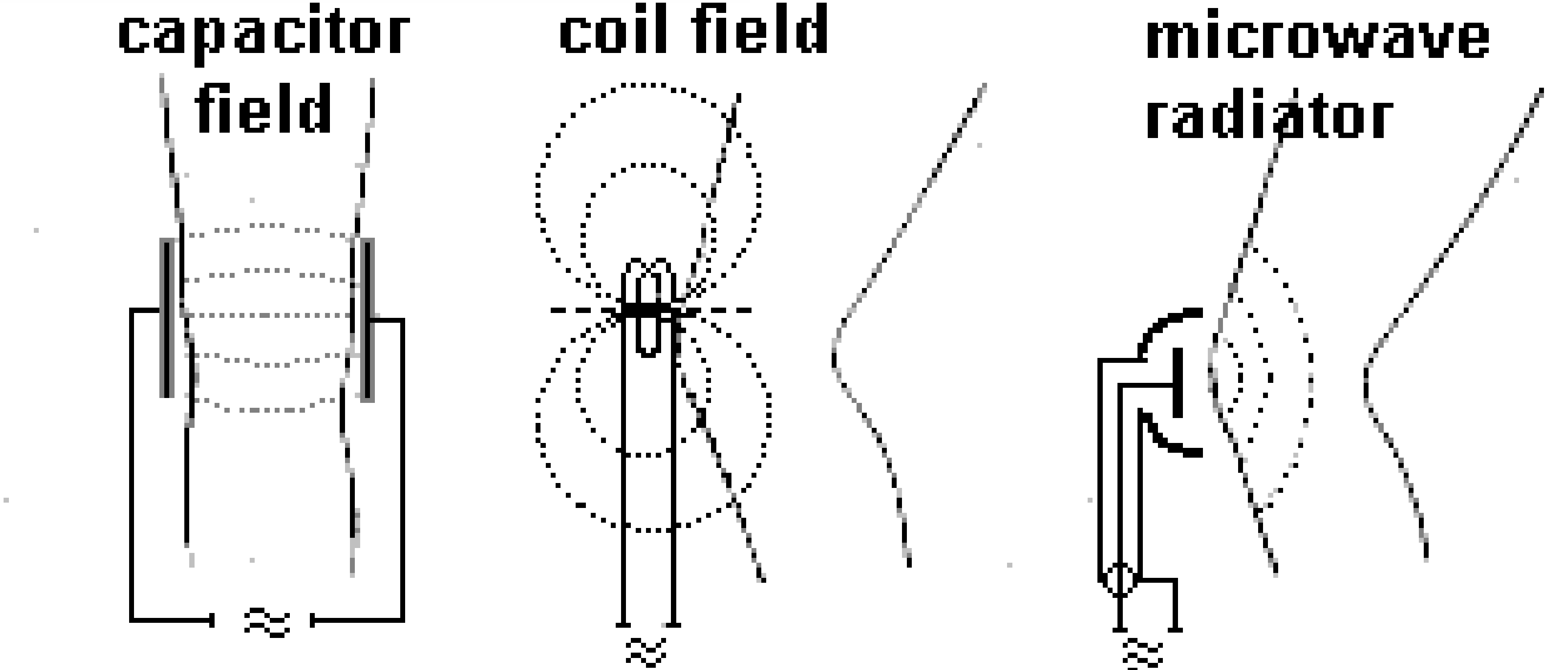
name	frequency	wavelength
Short wave	27,12 MHz	11,1 m
dm-waves	433 MHz	6,9 dm
microwaves	2,4 GHz	1,25 dm



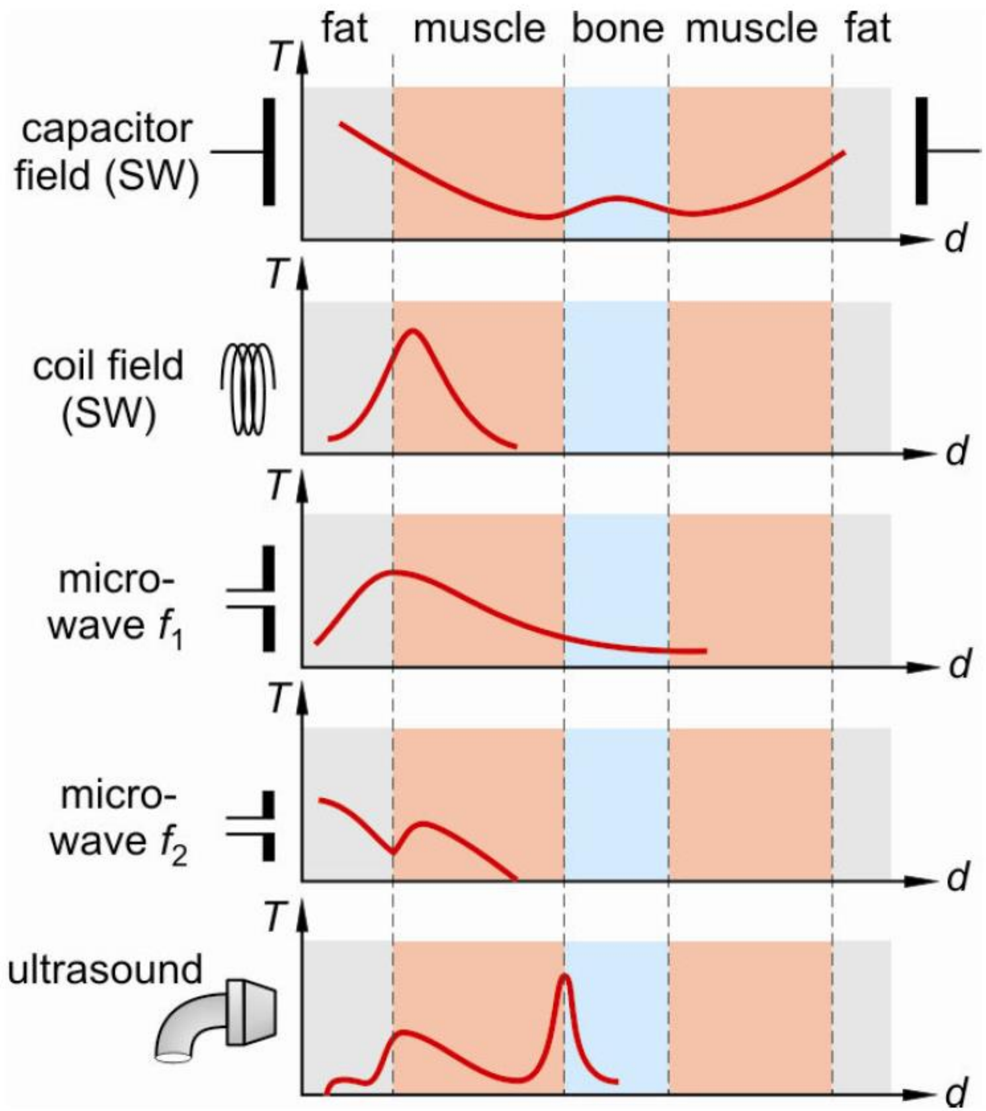
Resonance needed for optimal coupling -> tuning required (autotune)


Fat
Muscle
A
Fat
Muscle
B

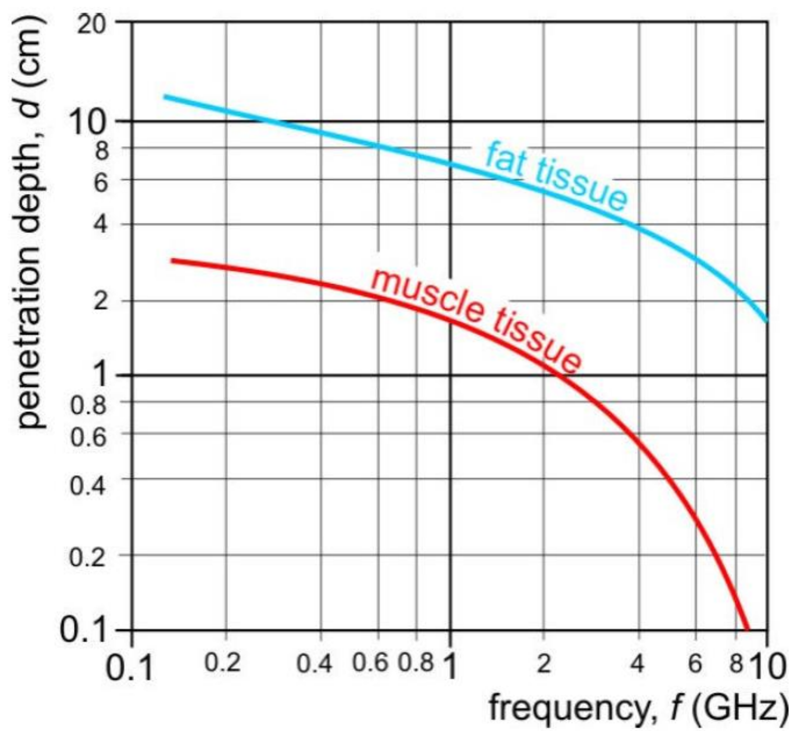



capacitor field
coil field
microwave radiator

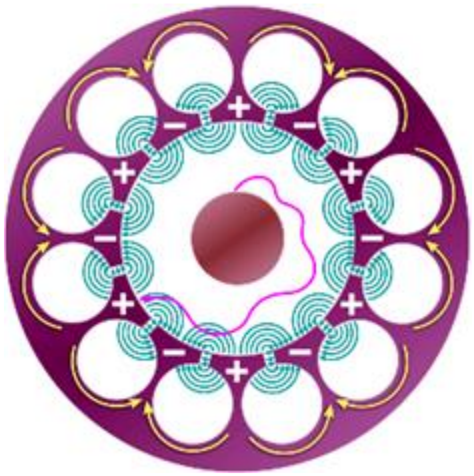
$$Q = \frac{U^2}{R} \cdot t = \frac{U^2}{\rho \frac{l}{A}} \cdot t = \sigma \frac{U^2}{l^2} \cdot l \cdot A \cdot t = \sigma \cdot E^2 \cdot V \cdot t$$

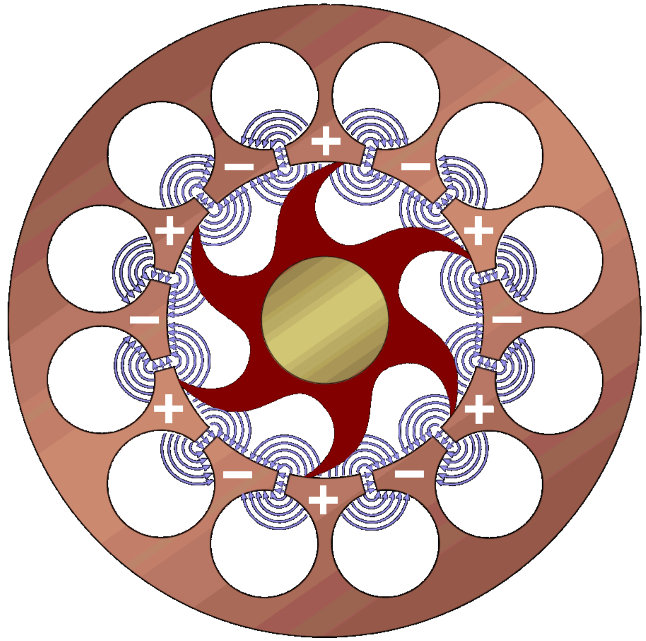


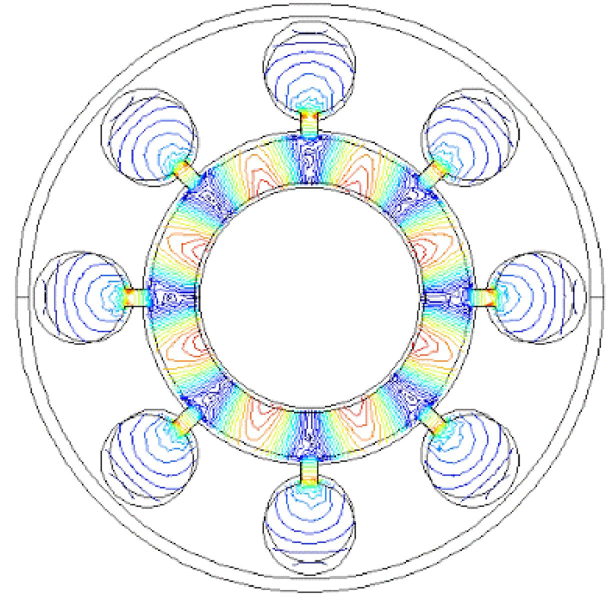
frequency	σ_{fat} (mS/cm)	σ_{muscle} (mS/cm)
300 MHz	2,7	9,0 – 9,9
1000 MHz	3,6	13,0 – 14,5



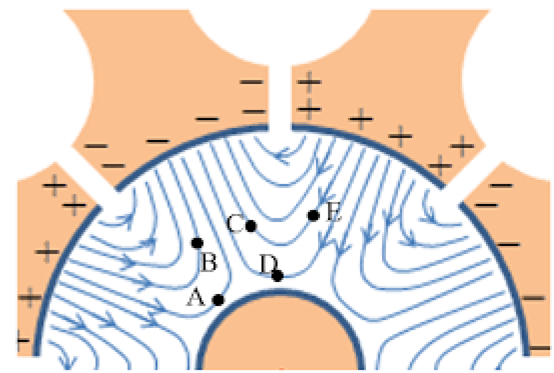
Penetration depth

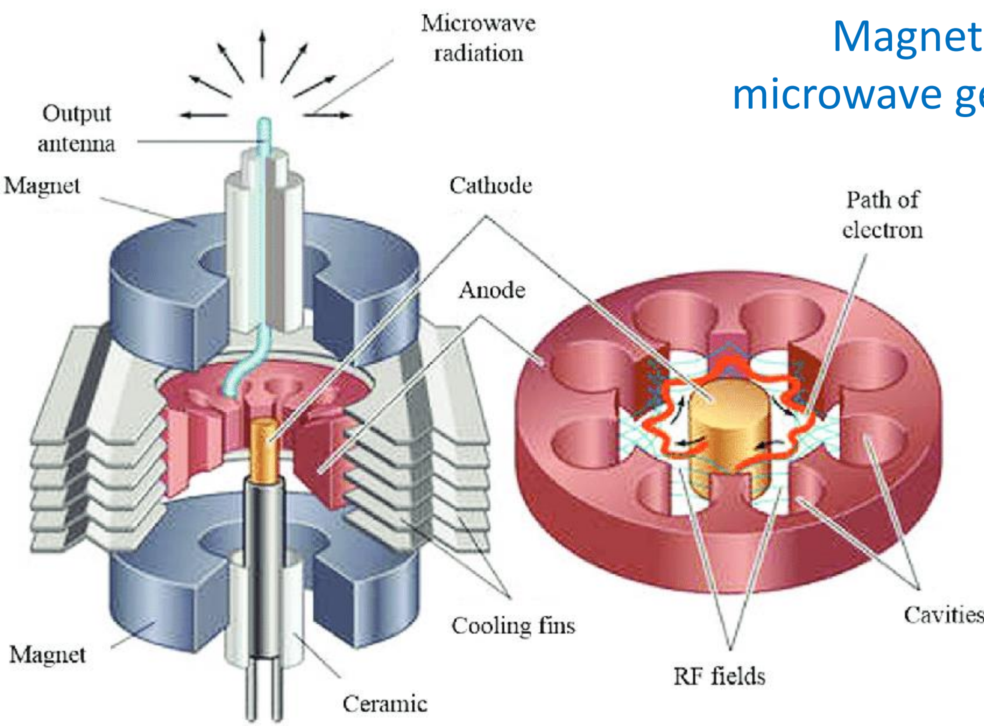


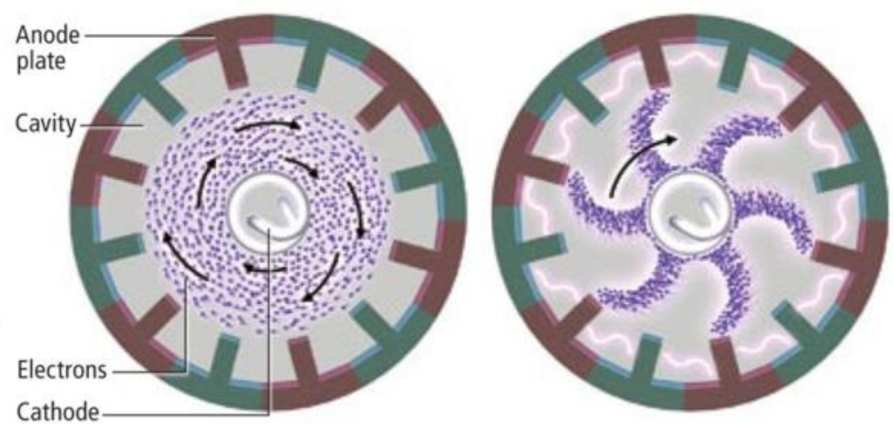




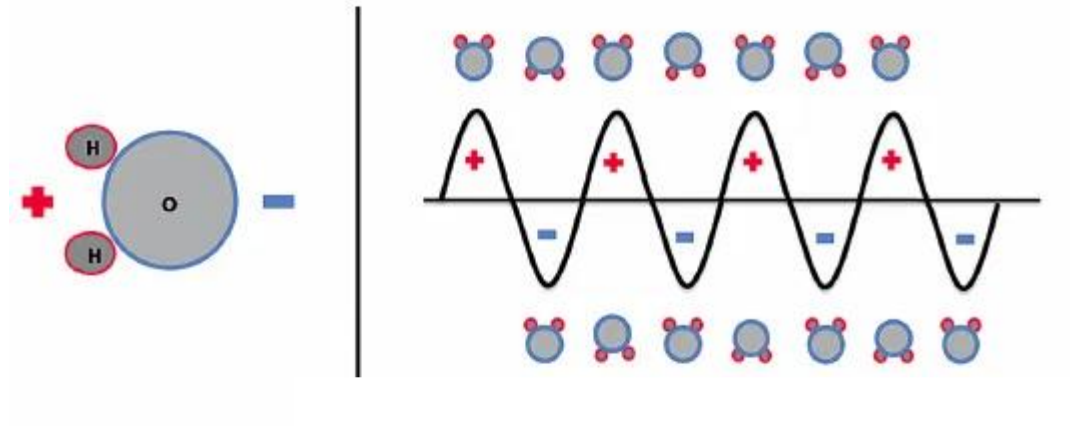
Magnetron microwave generator

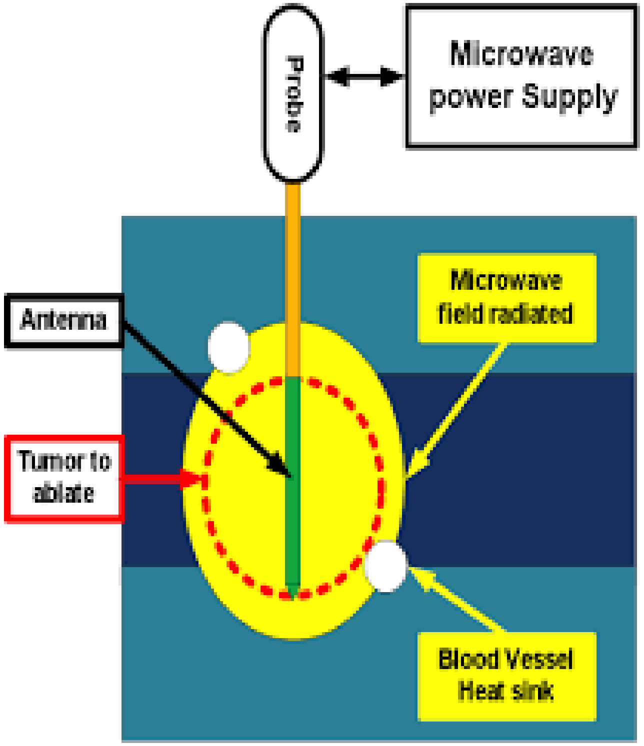


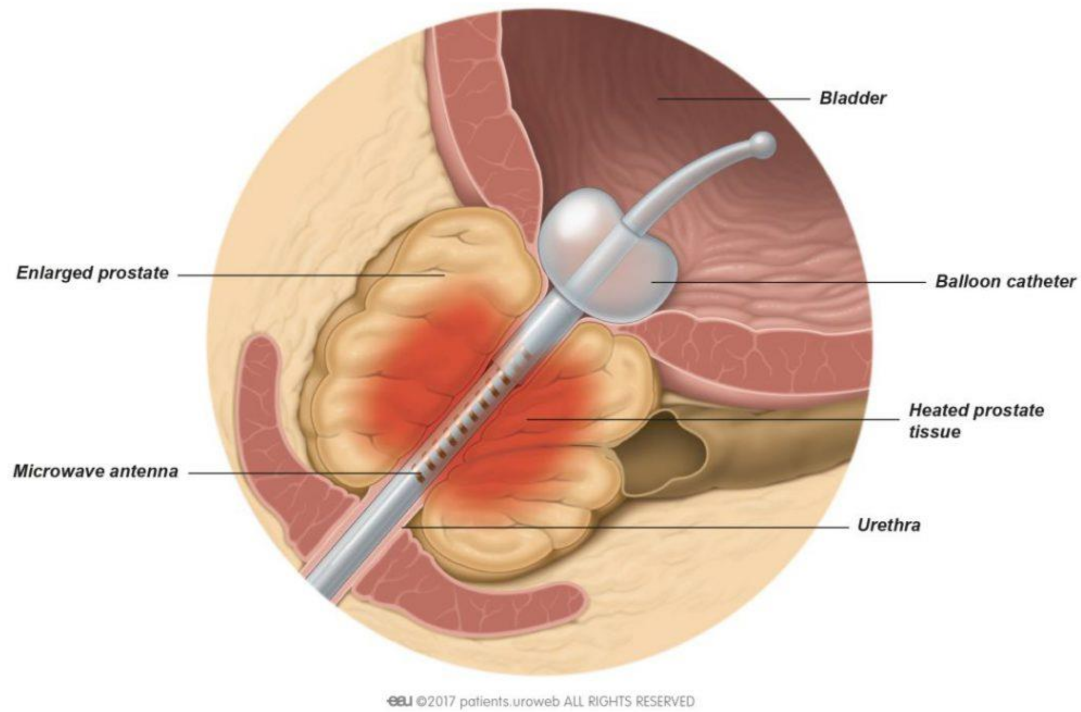





PHYSIOTHERM-


H
O
H


Probe
Microwave power Supply
Antenna
Microwave field radiated
Tumor to ablate
Blood Vessel Heat sink


Bladder
Enlarged prostate
Balloon catheter
Heated prostate tissue
Microwave antenna
Urethra
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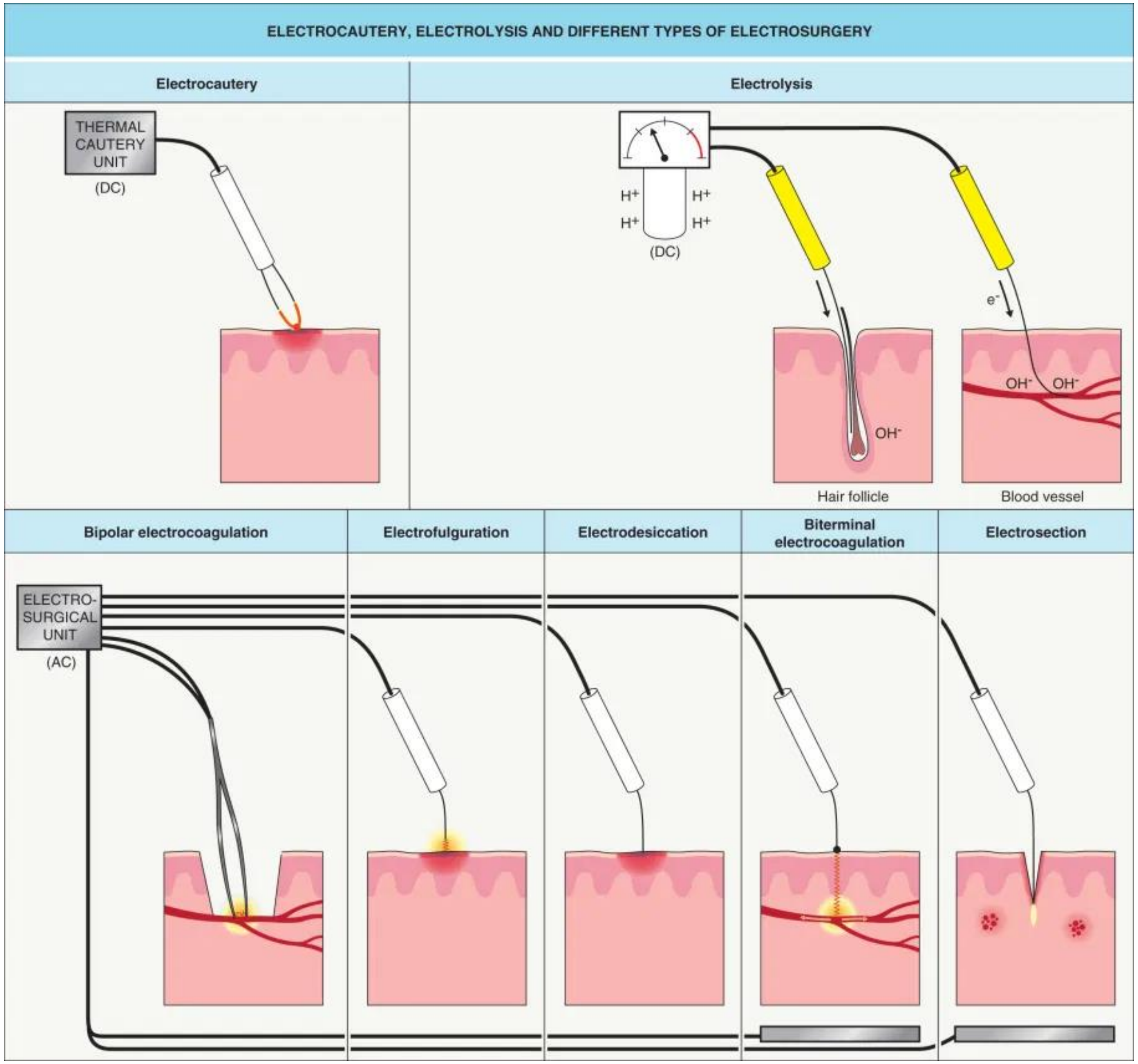
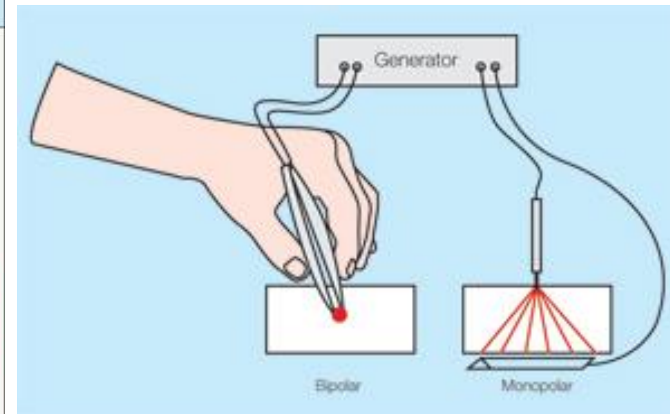
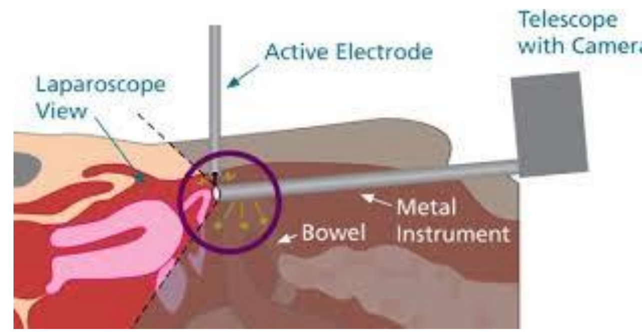
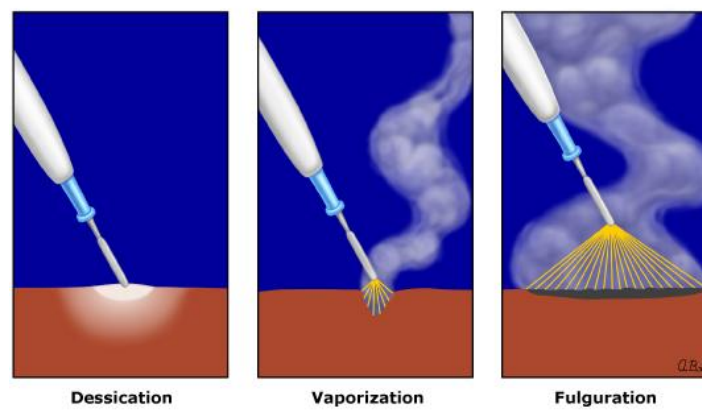
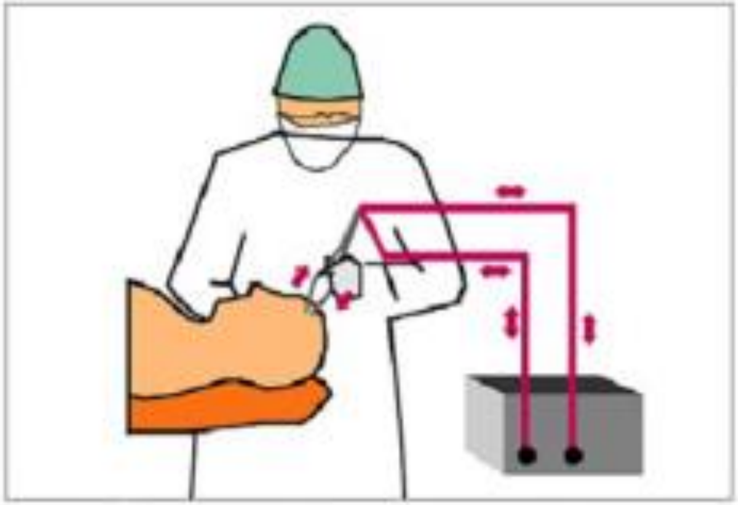

ELECTROCAUTERY, ELECTROLYSIS AND DIFFERENT TYPES OF ELECTROSURGERY
Electrocautery
THERMAL CAUTERY UNIT
(DC)
Electrolysis
H+
H+
H+
H+
(DC)
e-
OH-
OH-
OH-
Hair follicle
Blood vessel
Bipolar electrocoagulation
Electrofulguration
Electrodesiccation
Biterminal electrocoagulation
Electrosection
ELECTRO-SURGICAL UNIT
(AC)

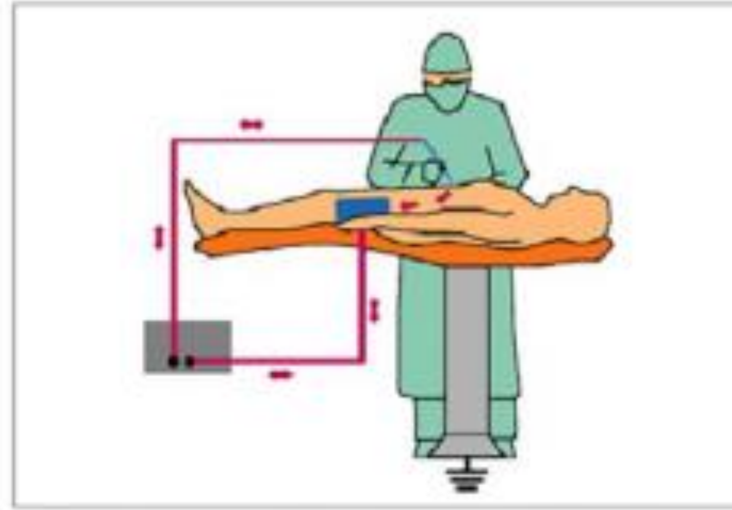

Generator
Bipolar
Monopolar


Telescope with Camera
Active Electrode
Laparoscope View
Metal Instrument
Bowel

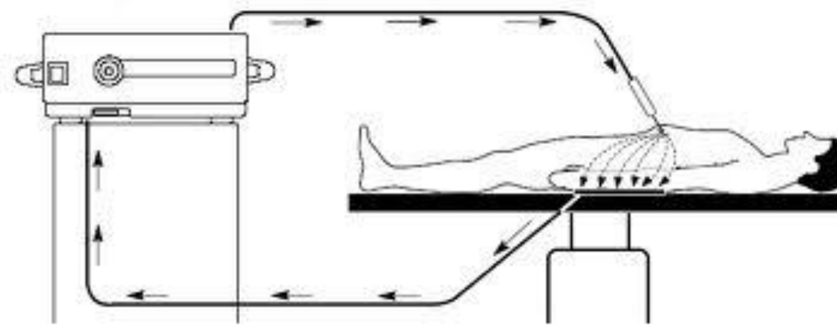

Dessication
Vaporization
Fulguration

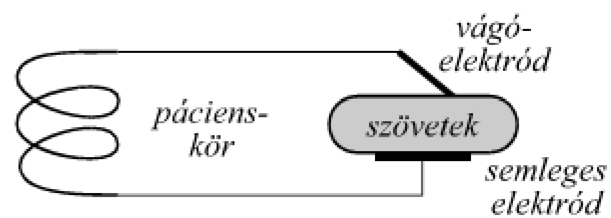


Bipolar



Monopolar





„Electrosurgery is currently used in over 80% of all surgical procedures, and is growing in popularity in dental surgery. **Electrosurgery also significantly reduces bleeding and provides the oral surgeon or dentist greater overall precision. ...”**

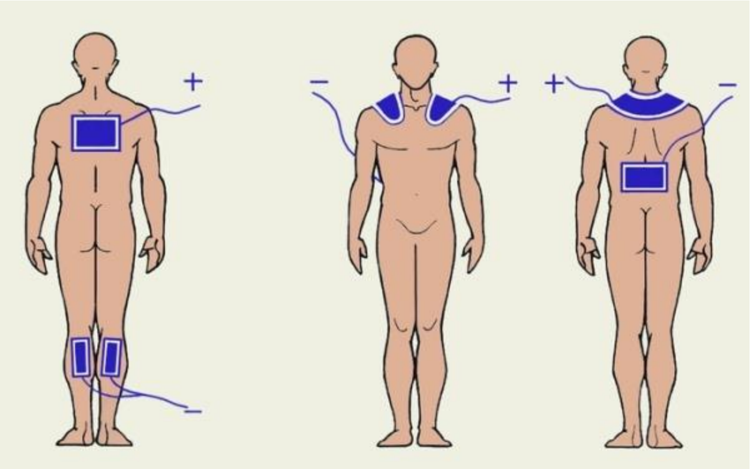
Advantages:

- High precision
- Immediate sterilization
- Reduced bleeding
- Analgesic effect

- Whitening

DC: f=0

Anode Cranial (downward treatment):
stimulus threshold increases
sympathic tone is decreased
Anode Caudal (upward treatment)
stimulus threshold decreases



Galvanotherapy: constant direct current

Cranial or Caudal anode

Effects: pain relief
modulation of stimulus threshold of motoric neurons
modulation of vasodilatation

Hidro-Galvanic Treatment

sympathicus activity (tone) decreases
vasodilatation in deep tissues

Iontophoreses: ionic drugs can be delivered through the skin into the tissues situated between two electrodes

pain reliefs,

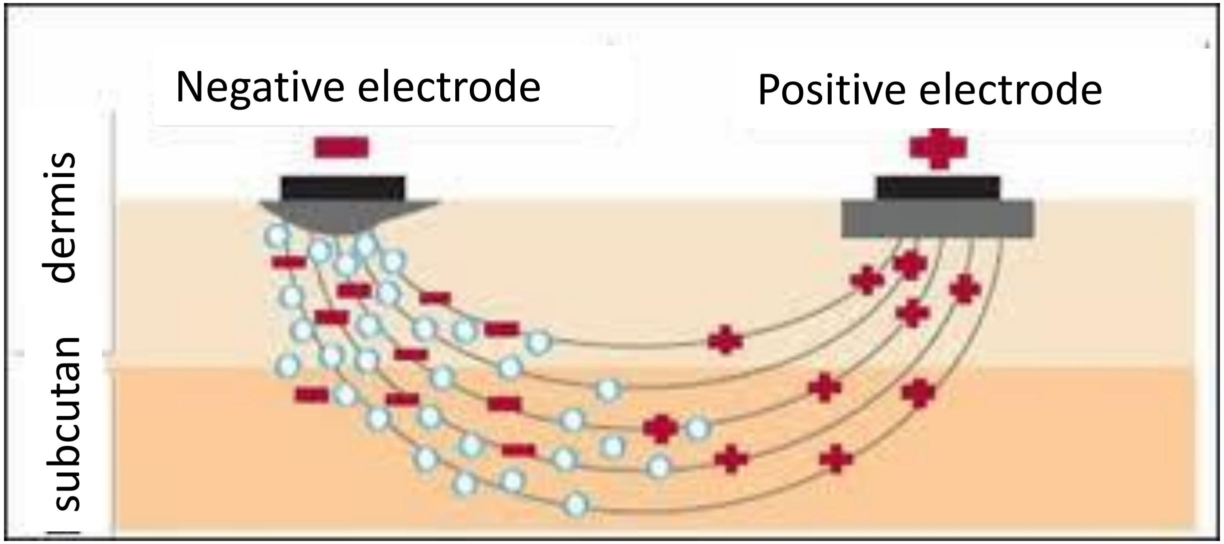
anty-inflammatory agents,

vasodilatators,

tissue softeners

Cathophorezis – e.g. steroidos, lidocain

Anophorezis – e.g.. Non-streroidal anti-inflammation drugs

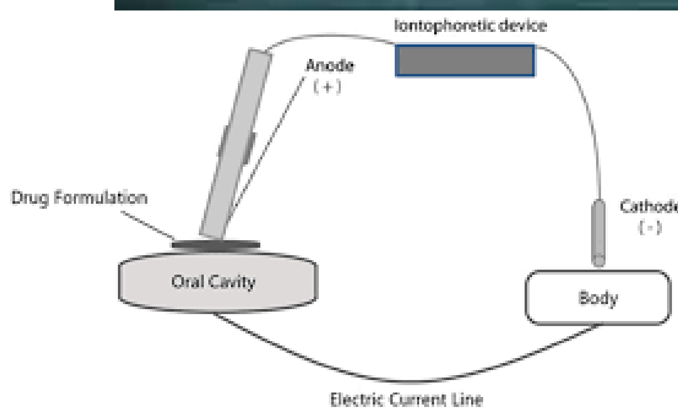


Iontophoreses :

Advantage: smaller quantity of drug, local treatment, delivery of non-absorbing drugs.

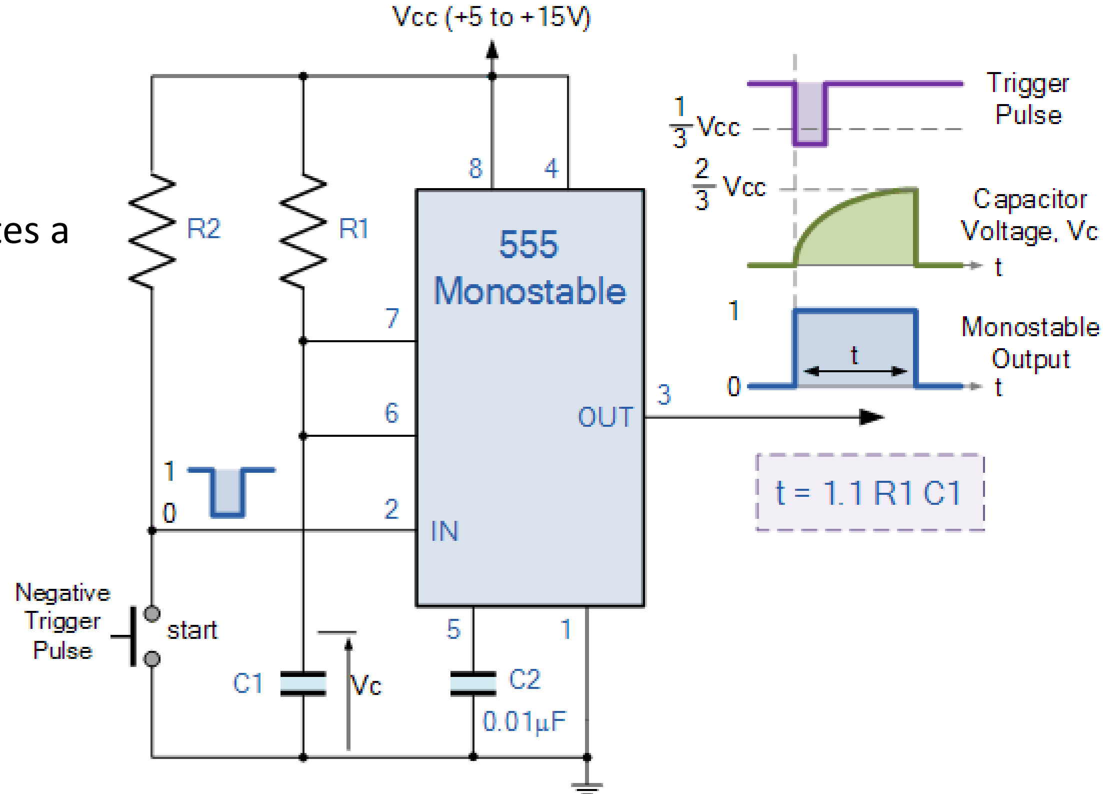
Disadvantage:

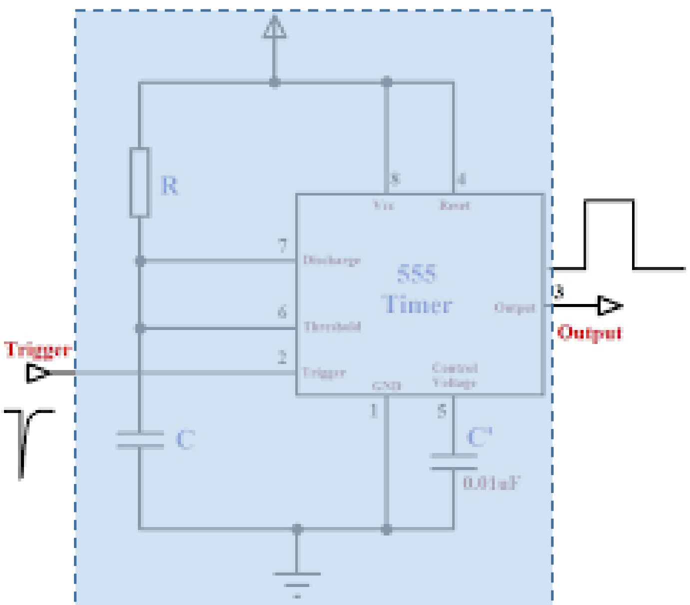
doses are uncertain



Pulse generators

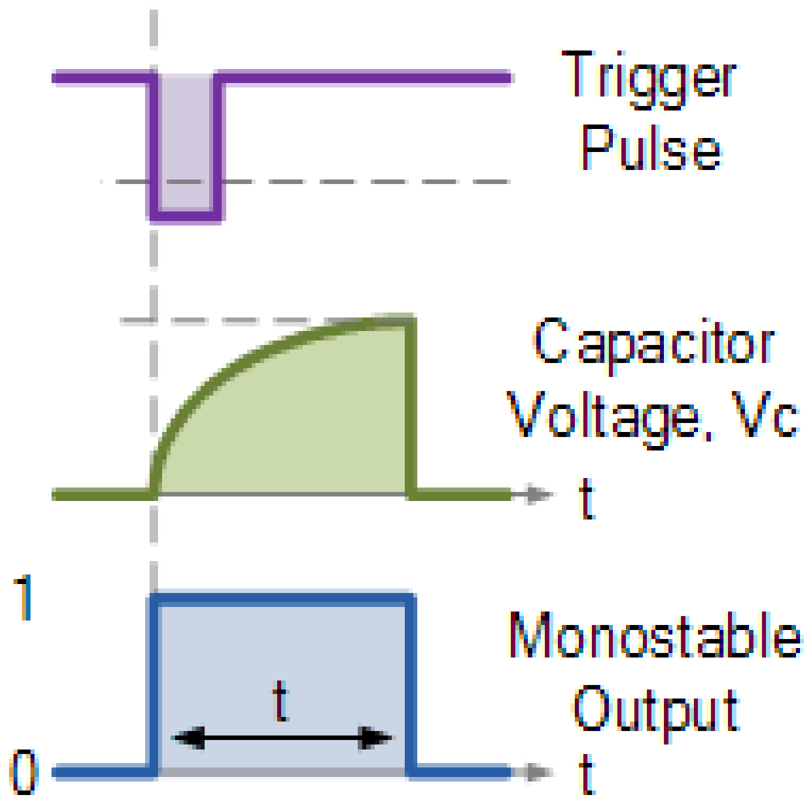
Trigger is an INPUT signal which generates a controlled voltage-duration pulse at the output of the monostable circuit.

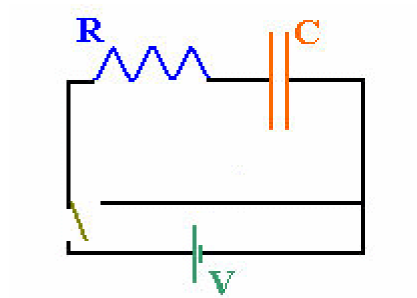




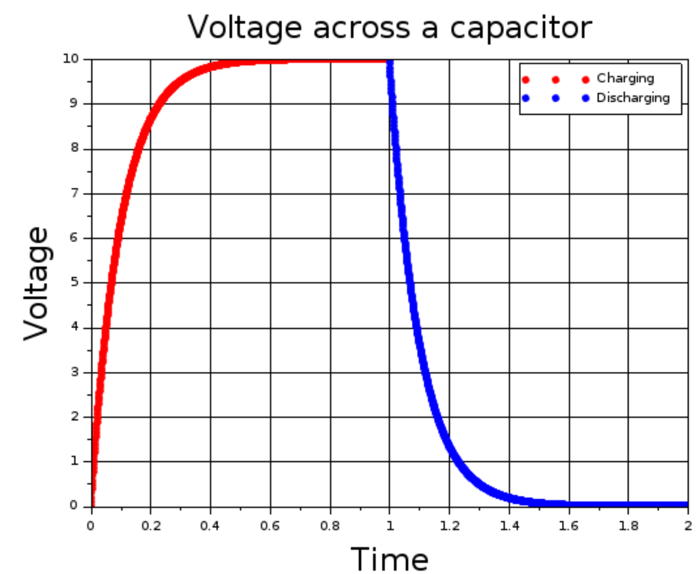
The **monostable** has ONE stable state, which is the inactive one.
The active output state is transient, and will be automatically switched off by the device without further external intervention.

The easiest/robust way to measure time is to charge or discharge a capacitor.

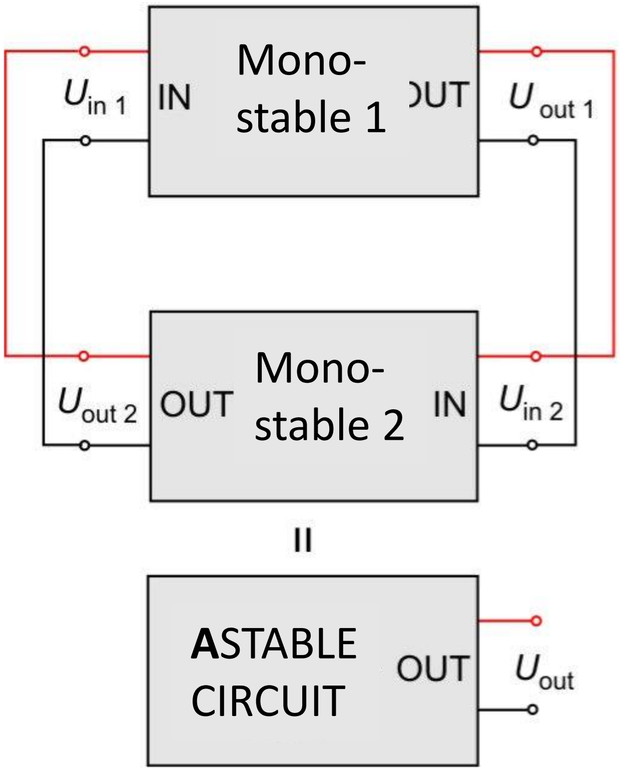


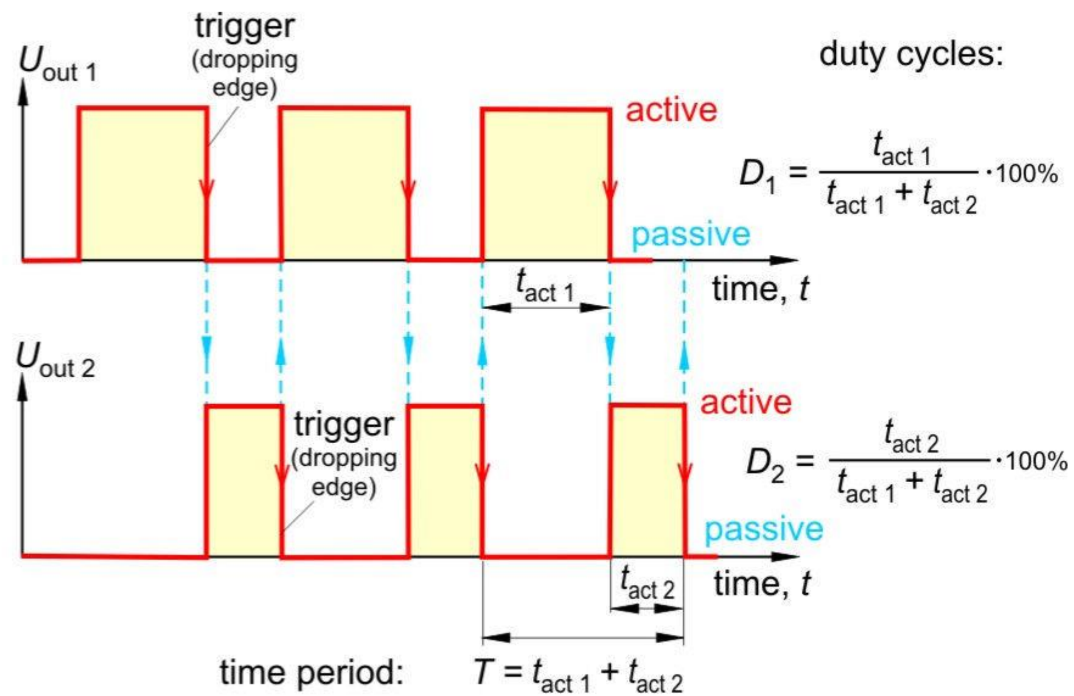


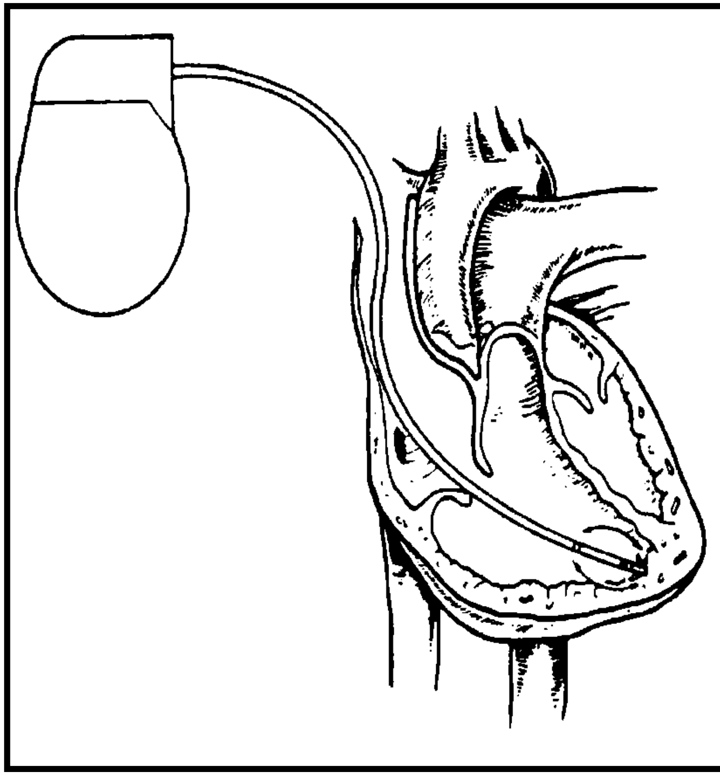
RC circuit charging or discharging

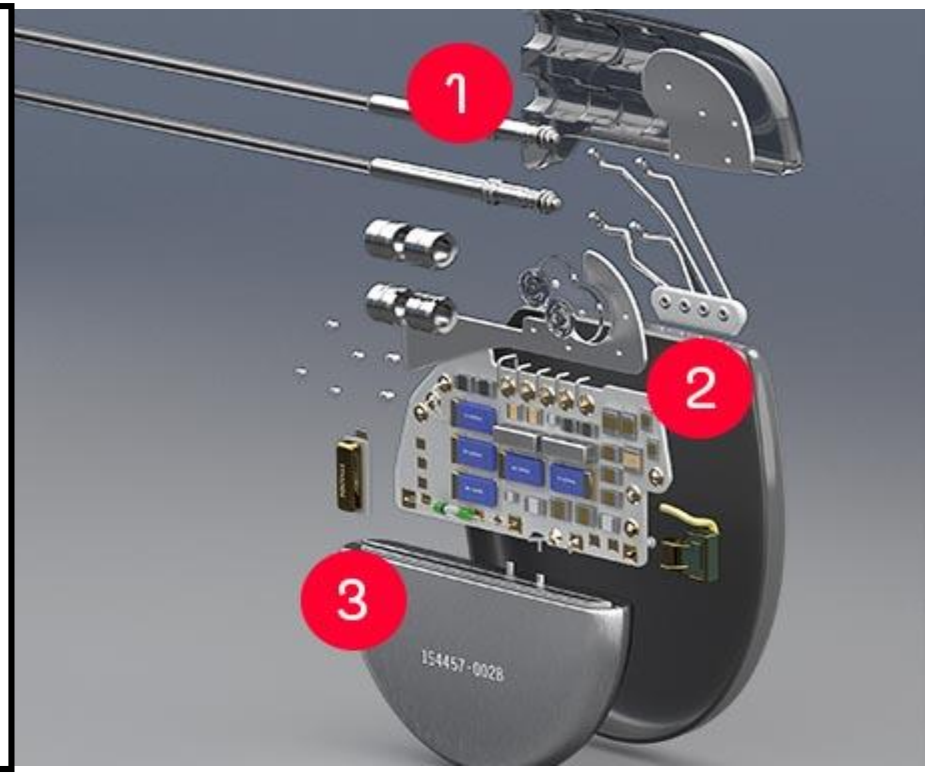


Astable circuit: generates a pulse train without external intervention, has no stable, persistent state.

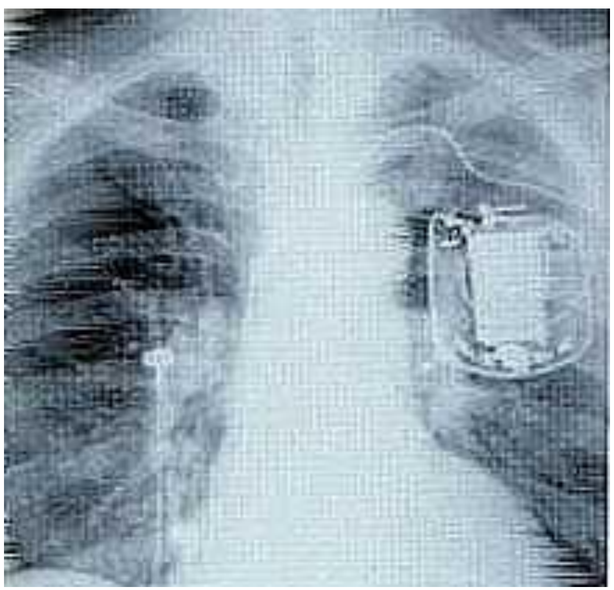







1
2
3

Pacemaker



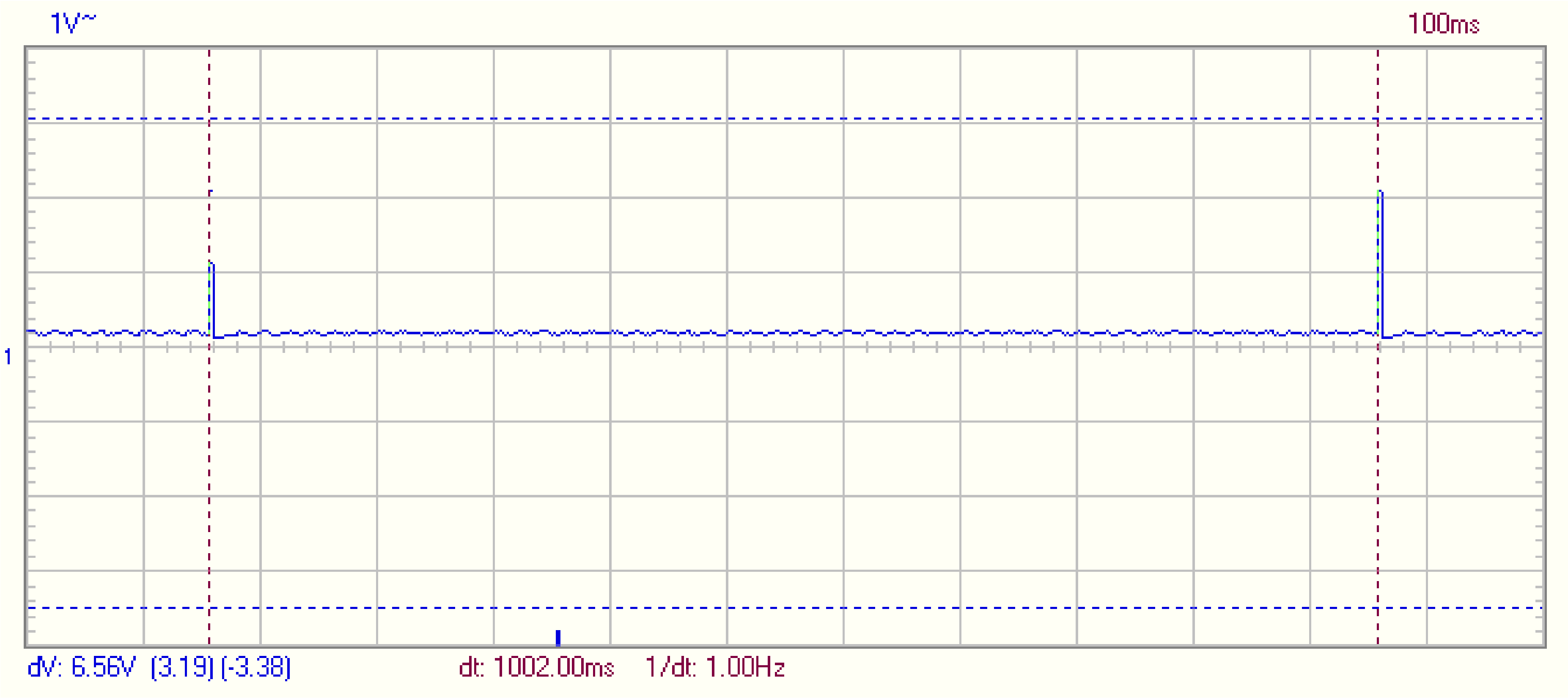

Enticos 4 SR
68505678
VVIR/AAIR
BIOTRONIK
Made in Germany
IS-1

Pacemaker

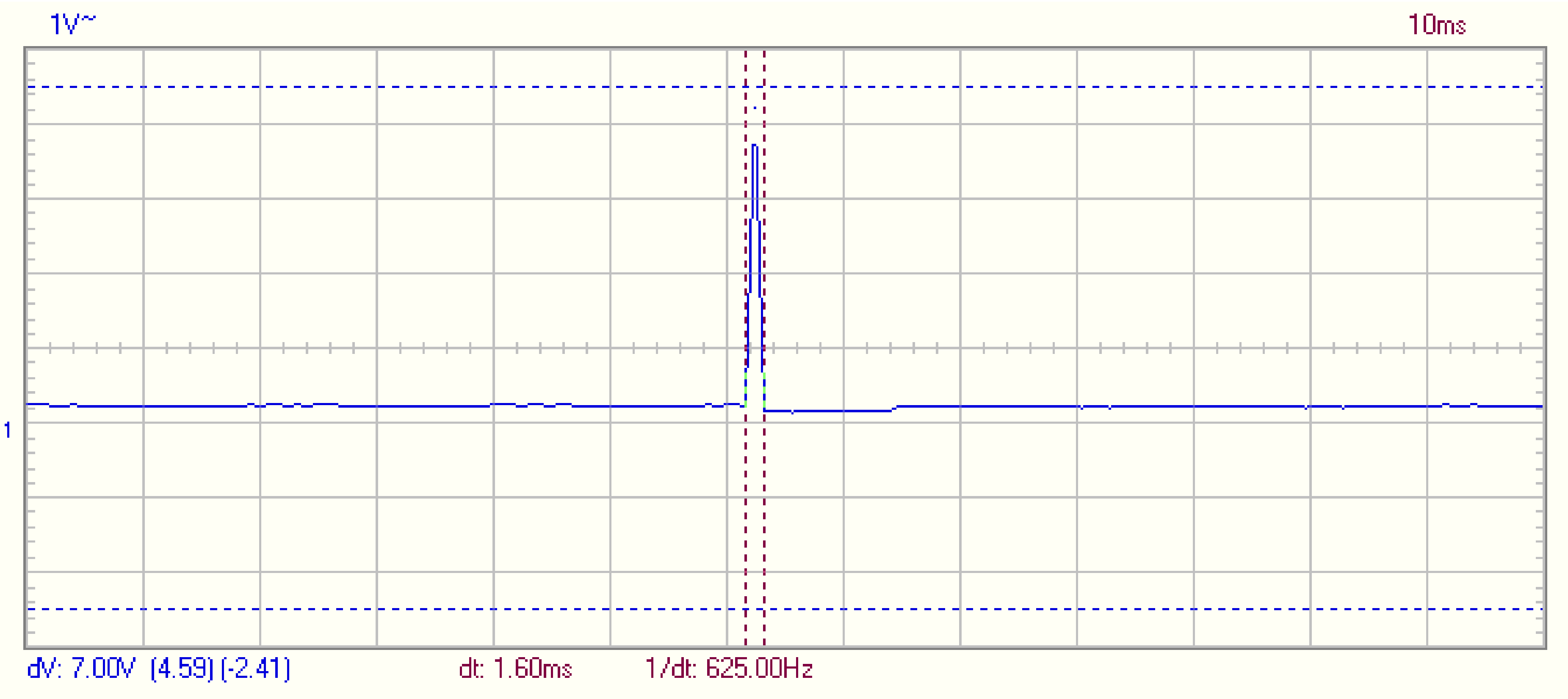
I.	II.	III.	IV.	V.
Chamber(s) Paced	Chamber(s) Sensed	Response to Sensing	Rate Modulation	Multisite Pacing
0 = None	0 = None	0 = None	0 = None	0 = None
A = Atrium	A = Atrium	I = Inhibited	R = Rate Modulation	A = Atrium
V = Ventricle	V = Ventricle	T = Triggered		V = Ventricle
D = Dual (A+V)	D = Dual (A+V)	D = Dual (I+T)		D =Dual (A+V)

Here we have: VVIR/AAIR

The time period is approx. 1s without regulation



Typical pulse duration is 1-2 ms



Calculation of pulse energy

Known voltage and tissue resistance, known pulse duration time

$$E = \frac{U^2}{R}\tau$$

$$Q = \frac{U}{R}\tau$$

P=U*I , I=U/R
$P=U^2/R$
R=P*t

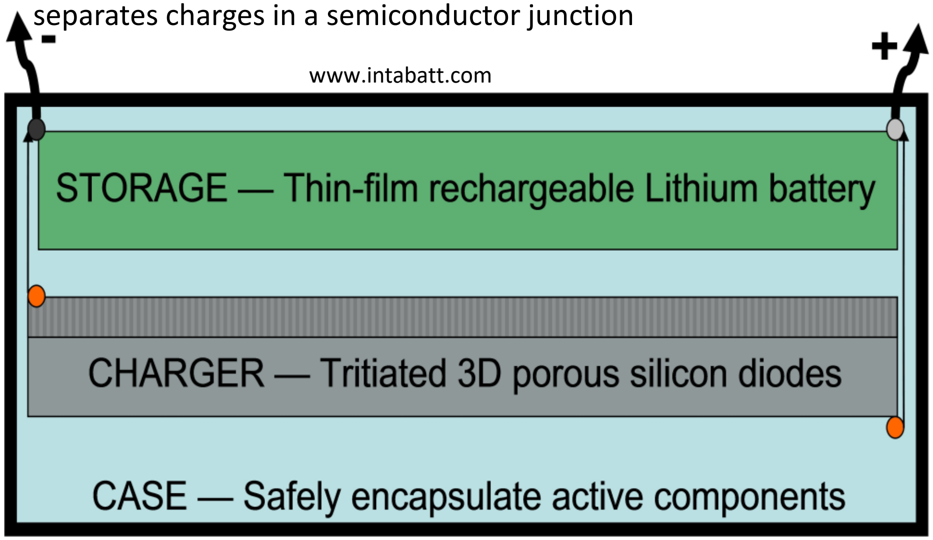
t=τ=R*C

Q=I*t

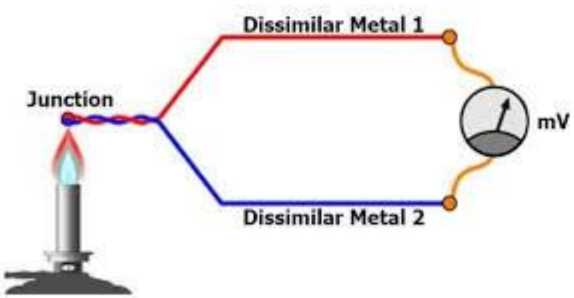
A LONG lasting battery is needed.
A battery change = exchange of the whole device = operation!

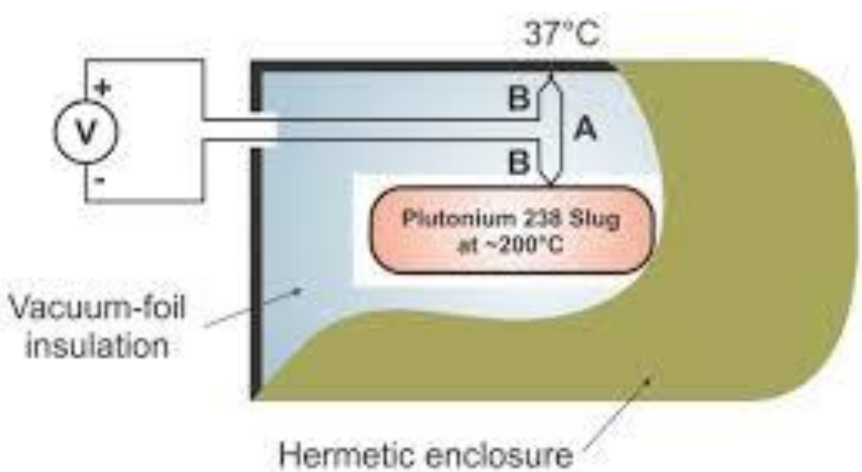
β-radiation powered cell.

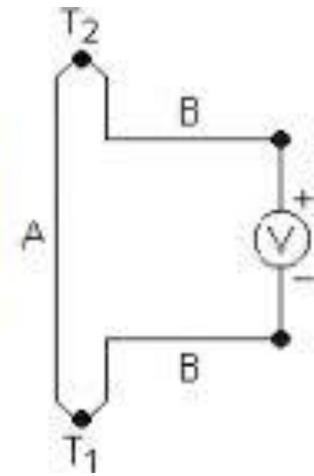
Betavoltaic cell: similar to photovoltaics, the ionization separates charges in a semiconductor junction



RTG : radioaktive thermoelectric generator

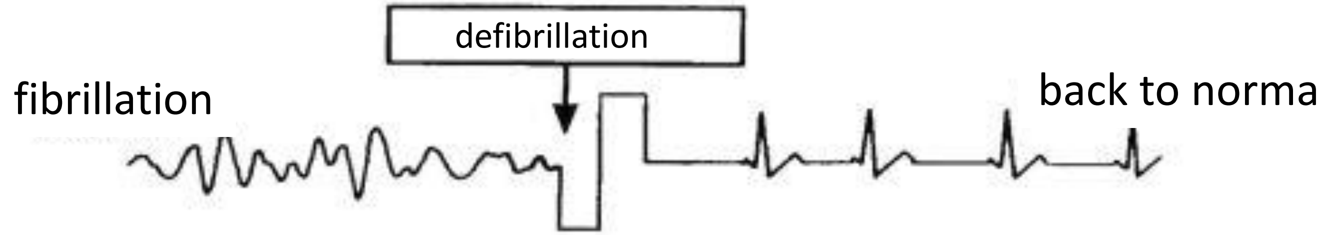


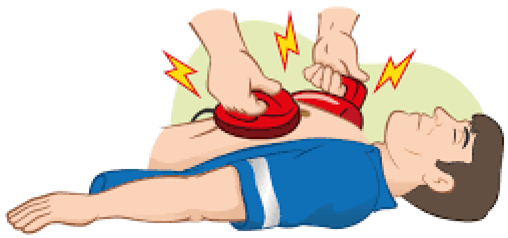


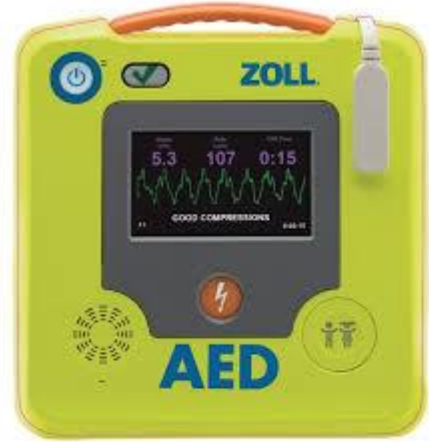


Defibrillator

(monostable)







AED: Automated External Defibrillator

Cardioverter

ICD: Implantable Cardioverter Defibrillator