

Introduction to Biomedical Electronics

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29 August 2009

IECEP Seminar Series

Authors Notes

- Under RA 9292 the field of Biomedical Instrumentation maintenance and management is assigned to ECE's.
- The field of Biomedical Engineering is a Diverse Field.
 - Requires additional training
- Biomedical Engineering carries with it the promise of “Doing no Harm” since we work with equipment used on patients.
 - Requires National Certification

Authors Notes

- The presentation is intended as an introduction to the field of Biomedical Equipment Technology but cannot serve as credentials in the practice of biomedical equipment technology maintenance and management.

Authors Notes

- Take up further studies under a BMES NCII TESDA program or a TESDA Accredited Biomedical Equipment Technology Program.

Contents

- Blood Pressure Sensing
- Bio Amplifiers
- Pulse Oximetry
- Carbon Dioxide Sensing
- X-ray Machine Basics
- Physiotherapy Ultrasound

Background

- Medicine is based on the study of the human anatomy.
- Thru out the history of modern medicine physics and medical science have been interlapping to create better ways of determining signs of diseases inside the human body.

Anatomy Review

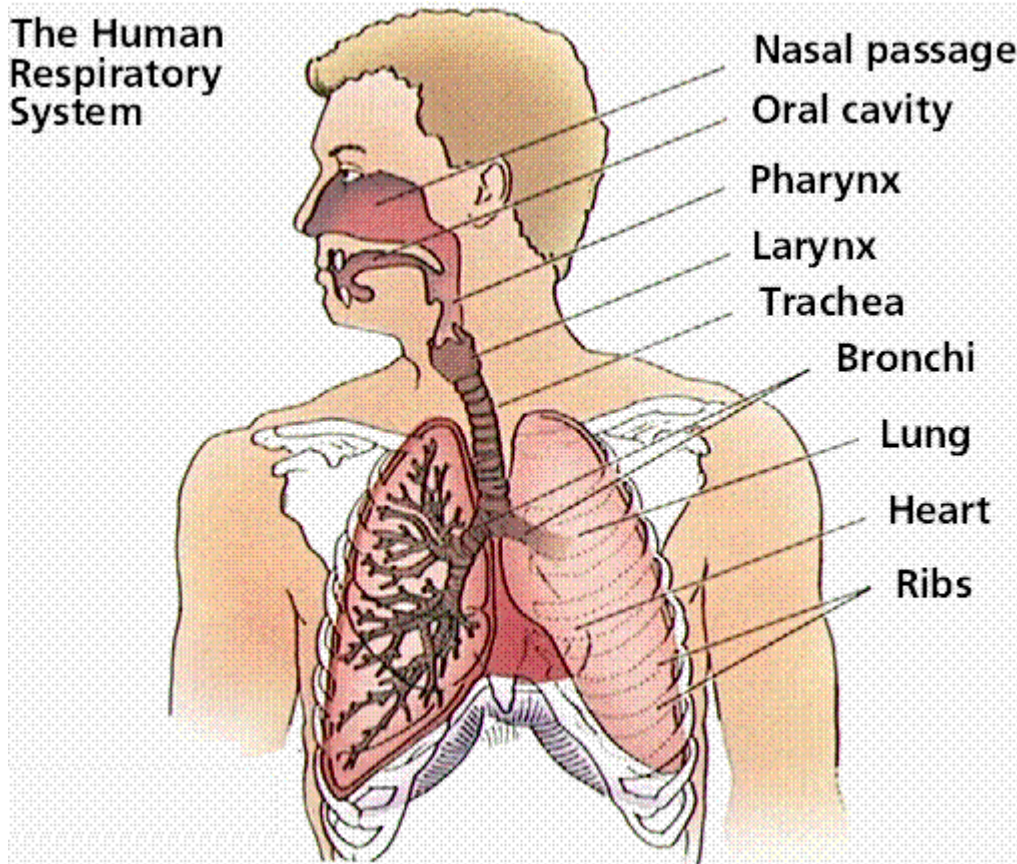
- Body Systems
 - Nervous System
 - Circulatory System
 - Respiratory System
 - Digestive System
 - Excretory System
 - Endocrine System
 - Skeletal System

Anatomy Review

- Body Systems
 - Nervous System
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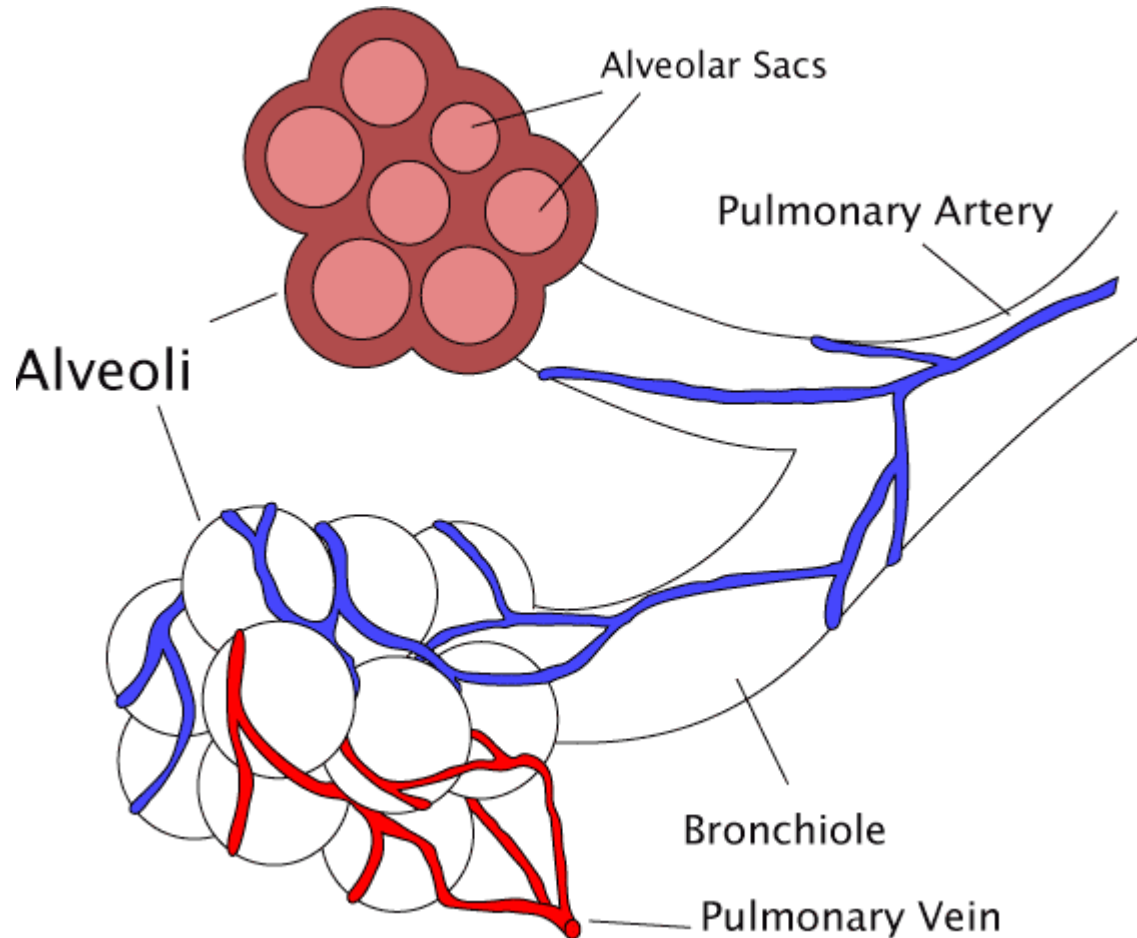
Anatomy Review

Respiratory System



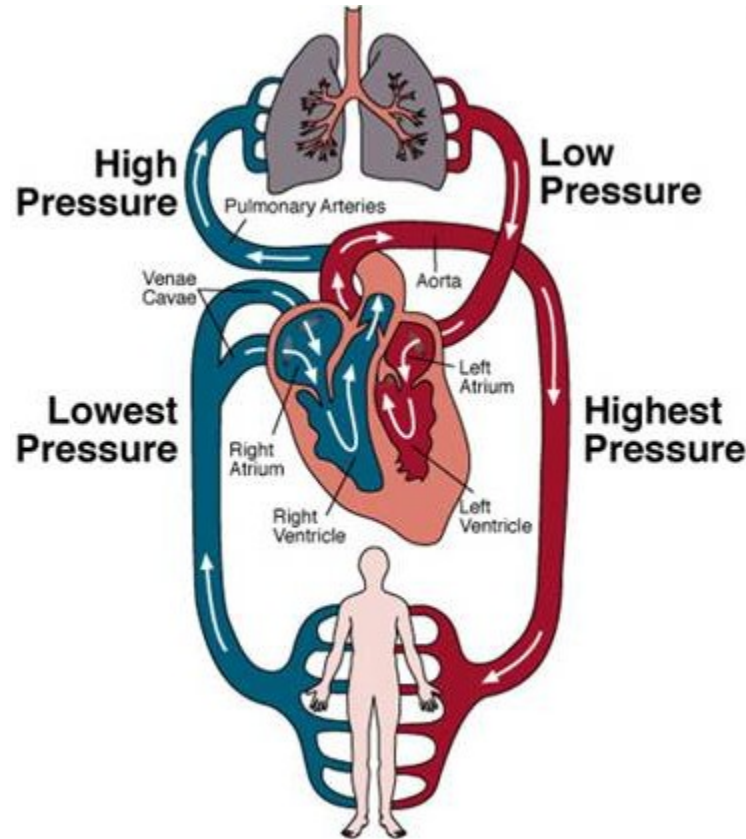
Anatomy Review

Respiratory System



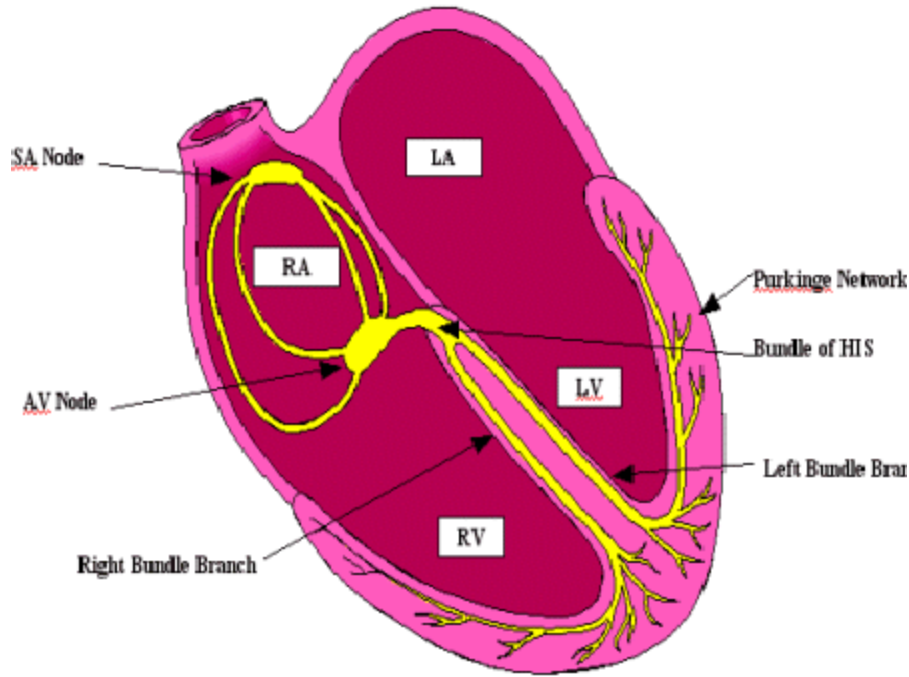
Anatomy Review

Circulatory System

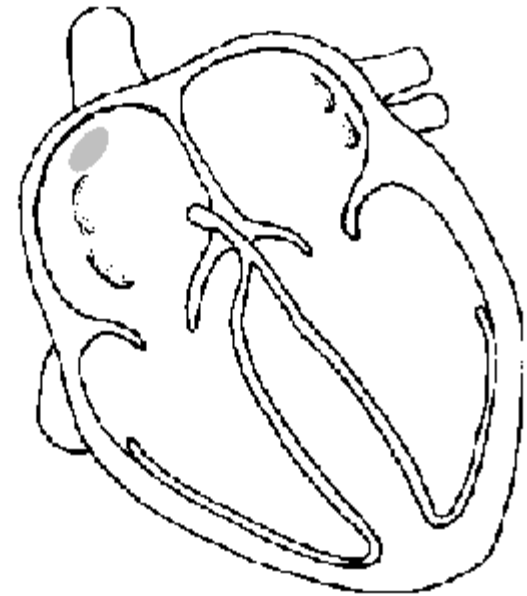


<http://www.williamsclass.com/SeventhScienceWork/ImagesCellBricks/OrganSystem.jpg>

Heart and its Electrical Activity

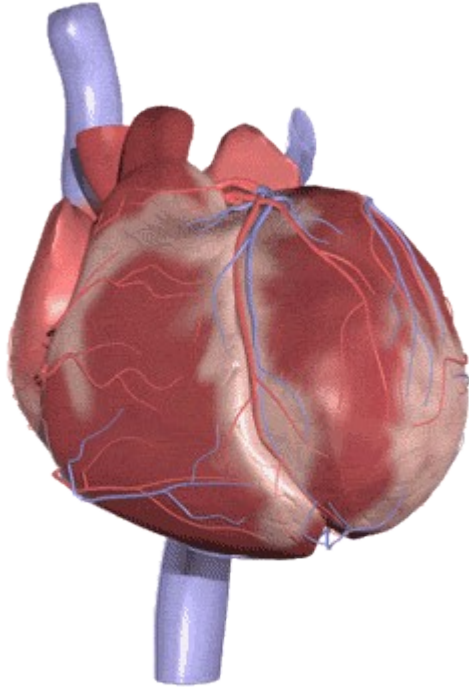


www.ambulancetechnicianstudy.co.uk/images/electricalHeart.gif

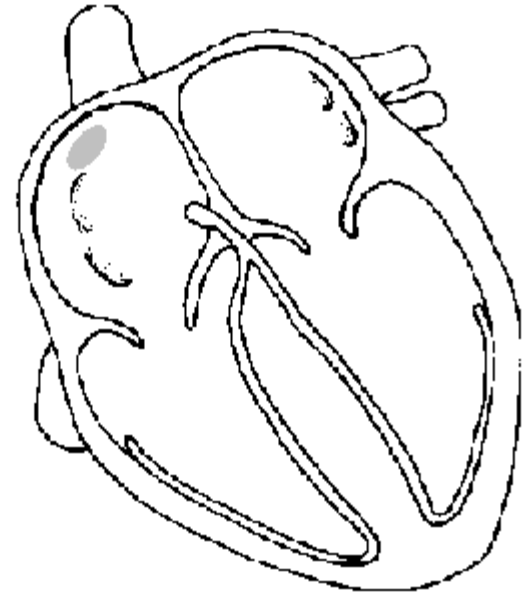


www.hillstrath.on.ca/moffatt/bio3a/circulation/pacemkry.gif

Heart and its Electrical Activity



http://www.primalpictures.com/uploads/RTE_Image/Beating_Heart_animation.gif



www.hillstrath.on.ca/moffatt/bio3a/circulation/pacemkry.gif

Background

- The earliest example of this was the development of the ECG and X-ray machines

Background ECG



http://www.electronicandyou.com/electronics-history/Hans_Christian_Oersted.jpg

Hans Christian Oersted



Mirror Galvanometer

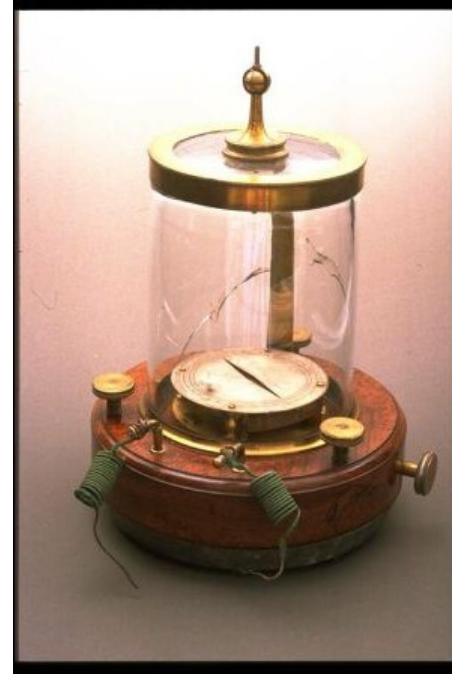
<http://www.psychologicalscience.org/observer/2008/0408/galvanometer.jpg>

Background ECG



Leopoldo Nobili

http://en.wikipedia.org/wiki/File:Leopoldo_Nobili.jpg

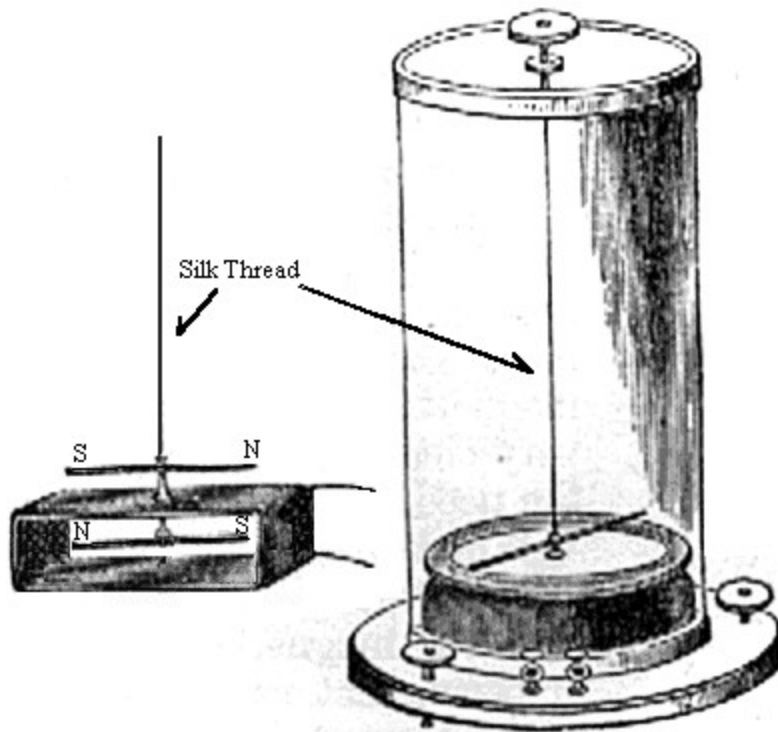


Astatic Galvanometer

http://www.jergym.hiedu.cz/~canovm/objevite/objev4/nob_soubory/nobili_galvanometer3.jpg

Background ECG

How an astatic galvanometer works



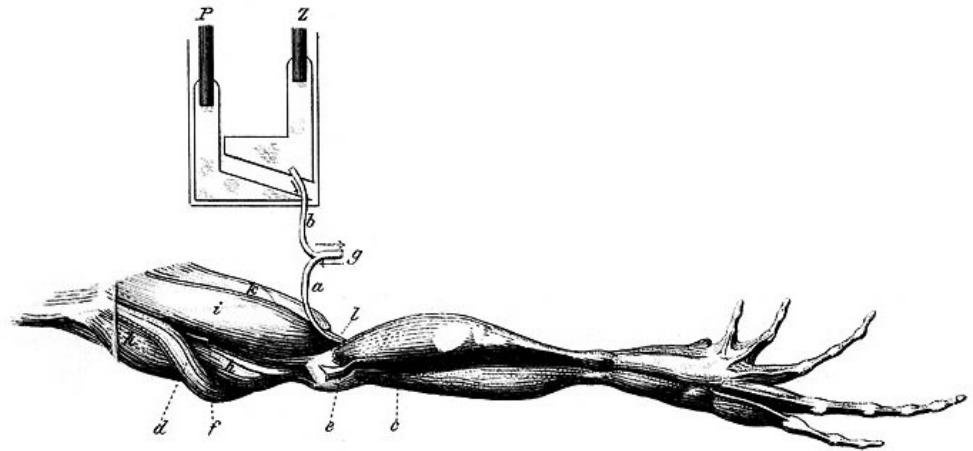
1. Two magnets cancel the effects of natural magnetism
2. Silk threads allow the device to move freely.
3. A glass enclosure enables the needle to move without the problem of air currents.
4. A knob on top allows to adjust the needle to the zero position.
5. Coils provide the path for current to flow in and cause the production of electromagnetic waves.

Background ECG



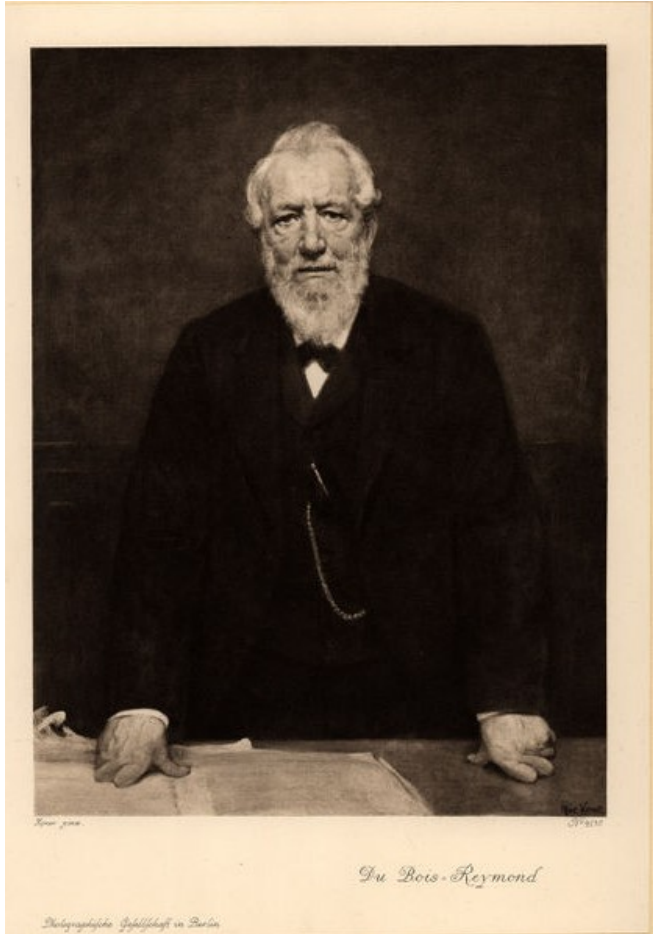
Carlo Matteucci

http://en.wikipedia.org/wiki/File:Carlo_Matteucci.jpeg



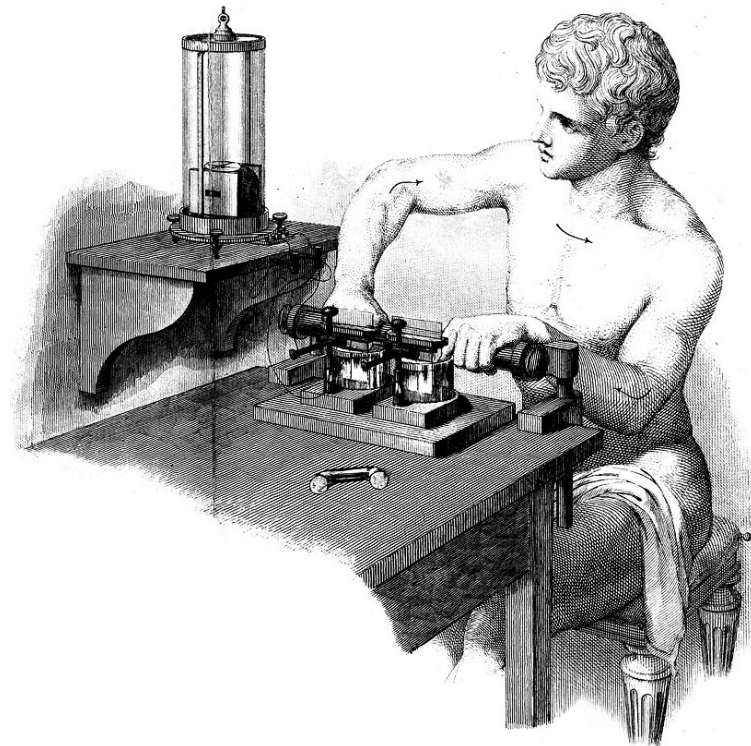
Rheoscopic frog

Background ECG

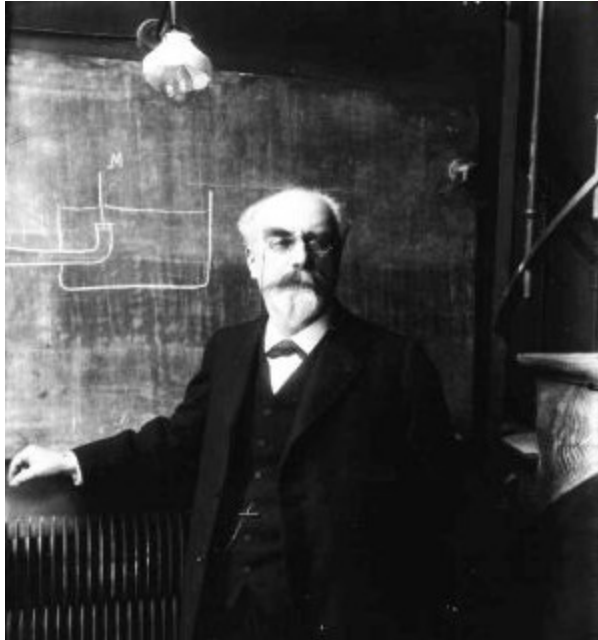


Emil du Bois-Reymond

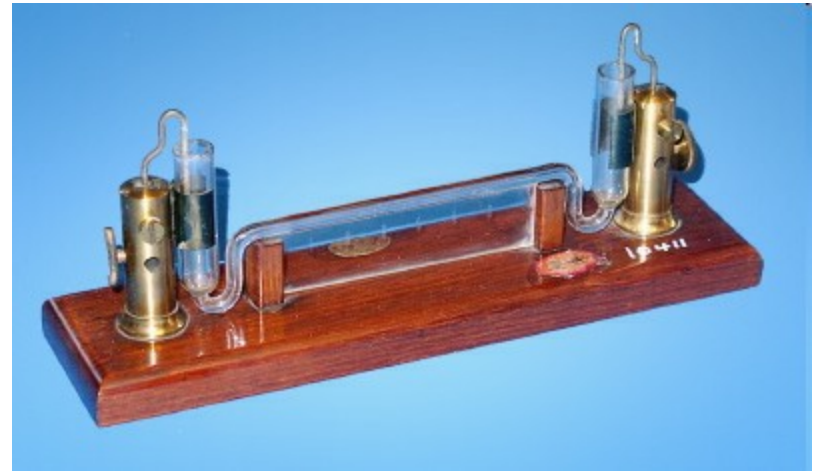
Experiments in Human Body Current



Background ECG



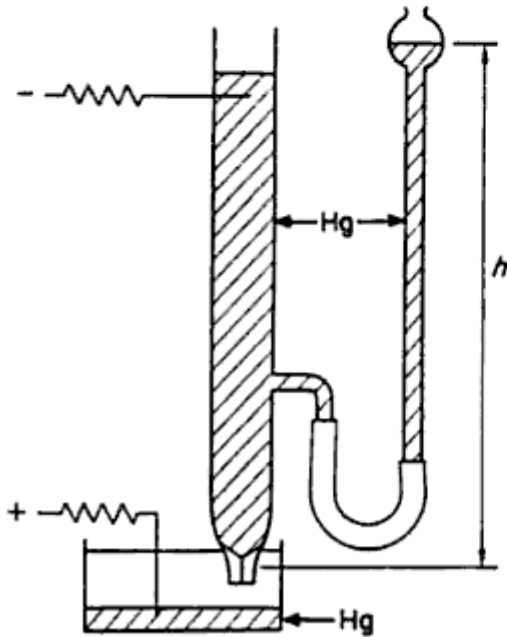
Gabriel Lippmann



Lippmann Mercury Capillarity Electrometer

http://people.clarkson.edu/~ekatz/scientists/einthoven_galvanoscope.jpg

Background ECG



- When the pulse of electricity arrives it changes the surface tension of the mercury and allows it to leap up a short distance in the capillary tube

Lippmann Electrometer

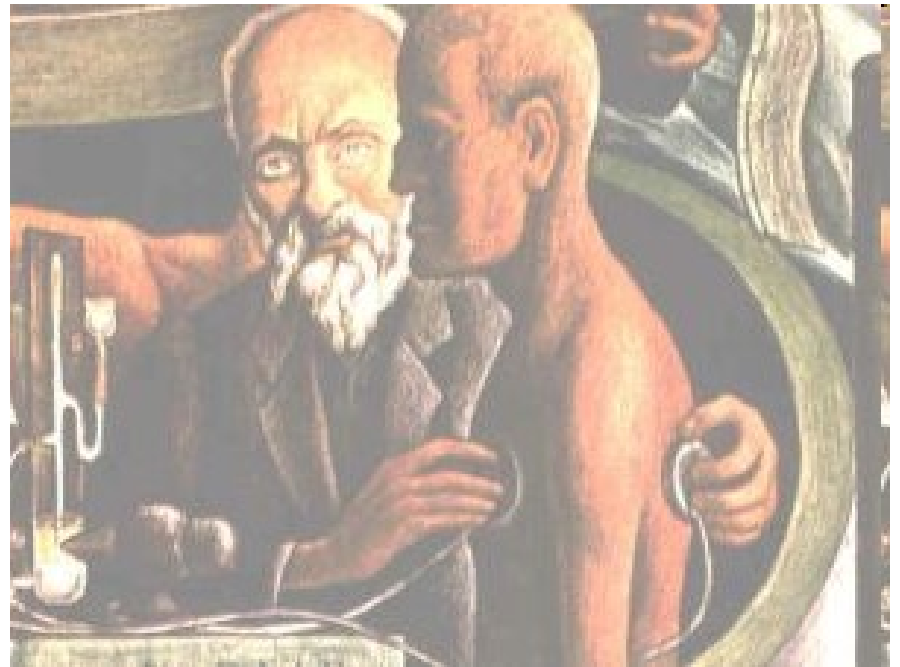
Figure 5 Principles and Applications
of Electrochemistry 4th Edition

, D. R. Crow, Page 72

Background ECG



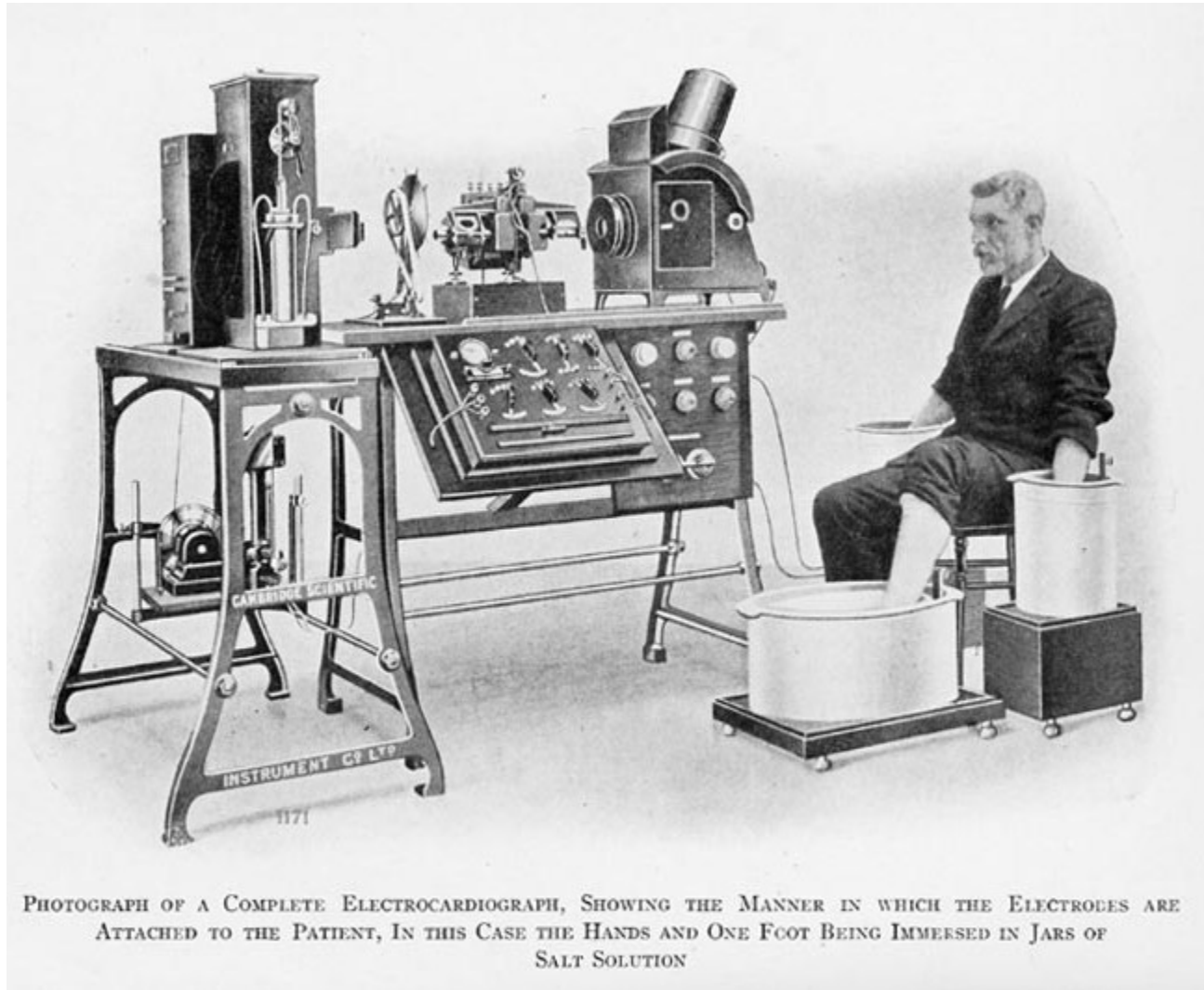
August Waller and his
Dog and test subject
Jimmy



Edwin Besterman at St. Mary's Hospital in
London testing Waller's ECG

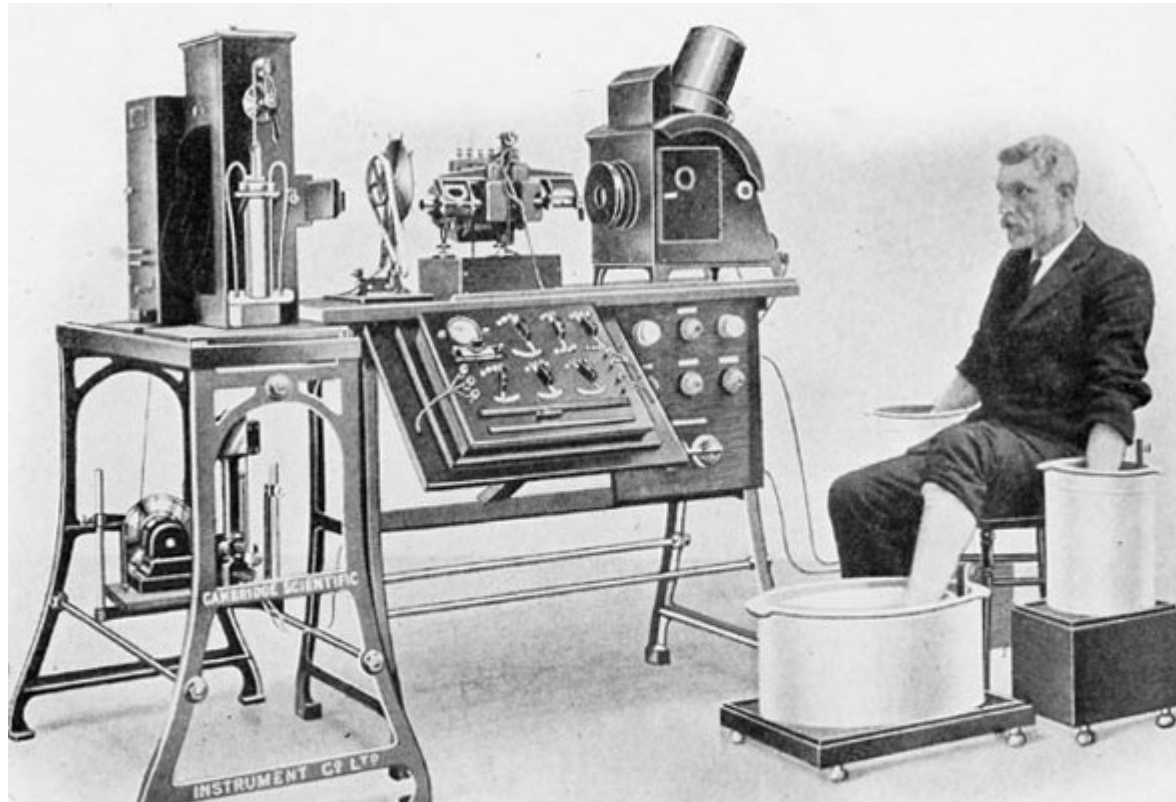
<http://chem.ch.huji.ac.il/history/waller.html>

Background ECG



String
Galvanometer

Background ECG



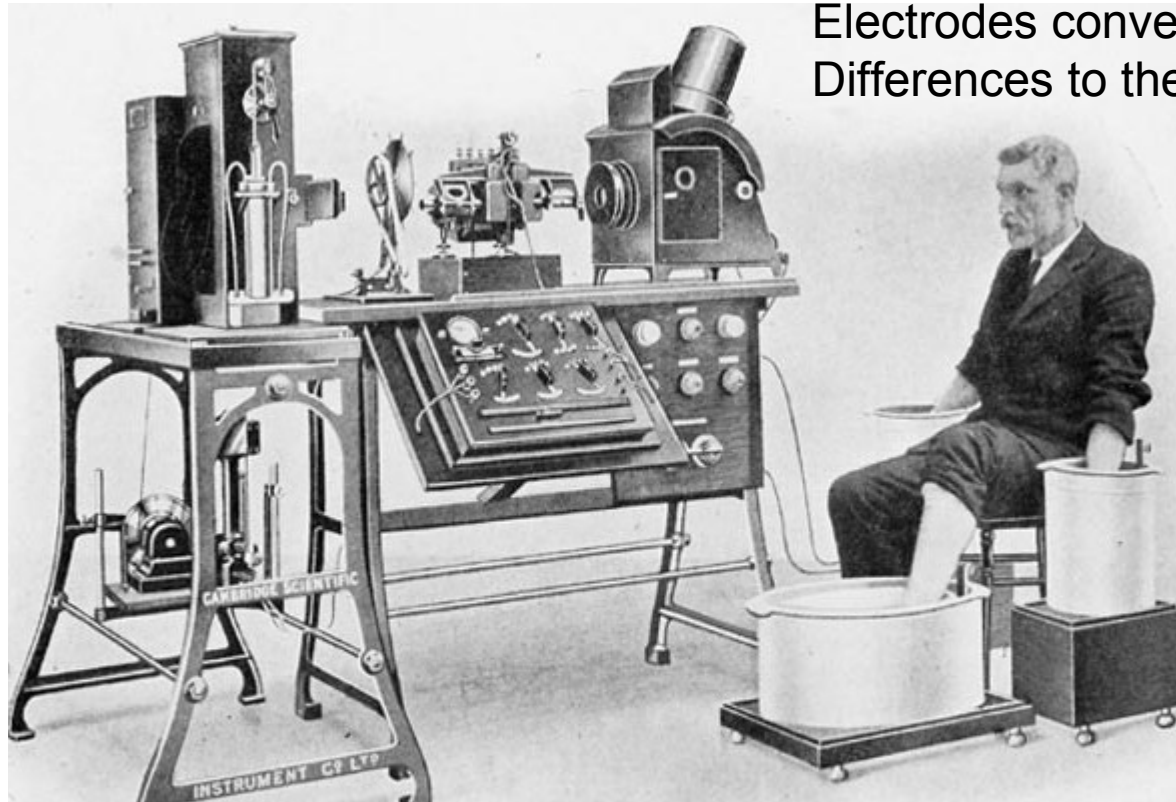
(A)

Limbs are
immersed in
Cold Water
With electrodes

Background ECG

(B)

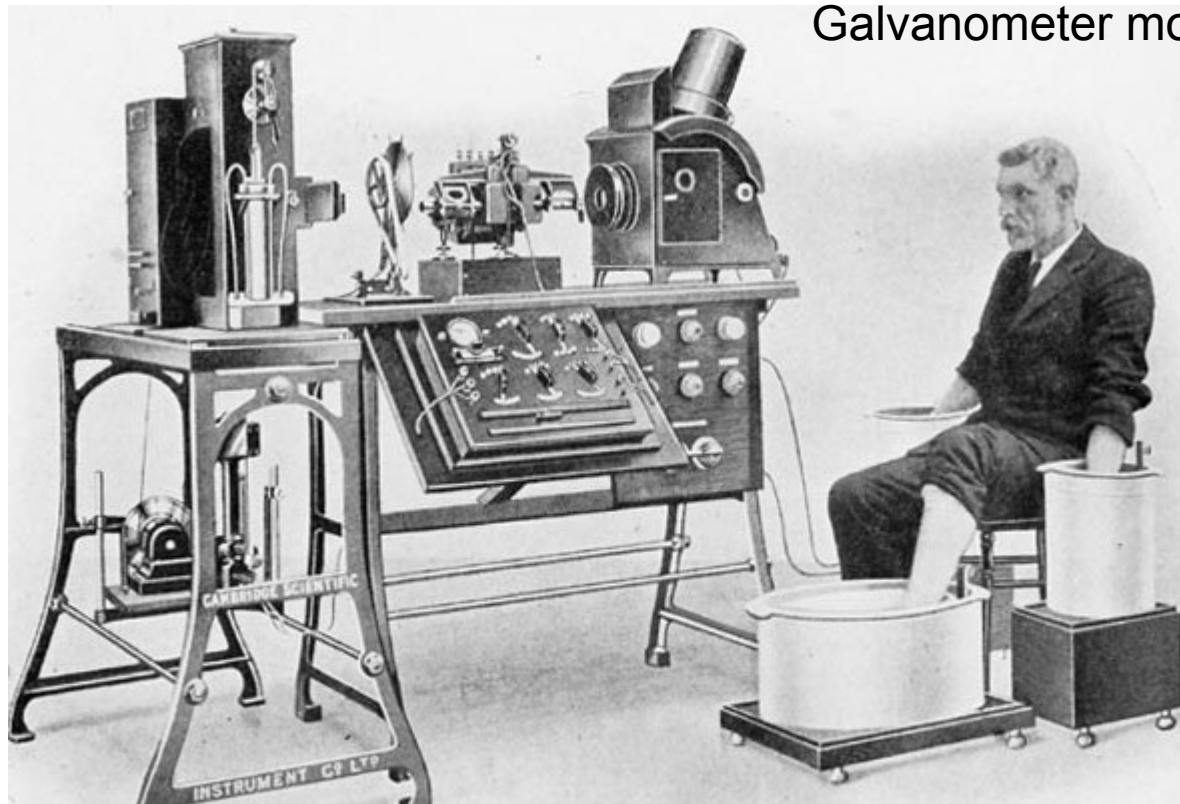
Electrodes convey potential
Differences to the galvanometer



Background ECG

(C)

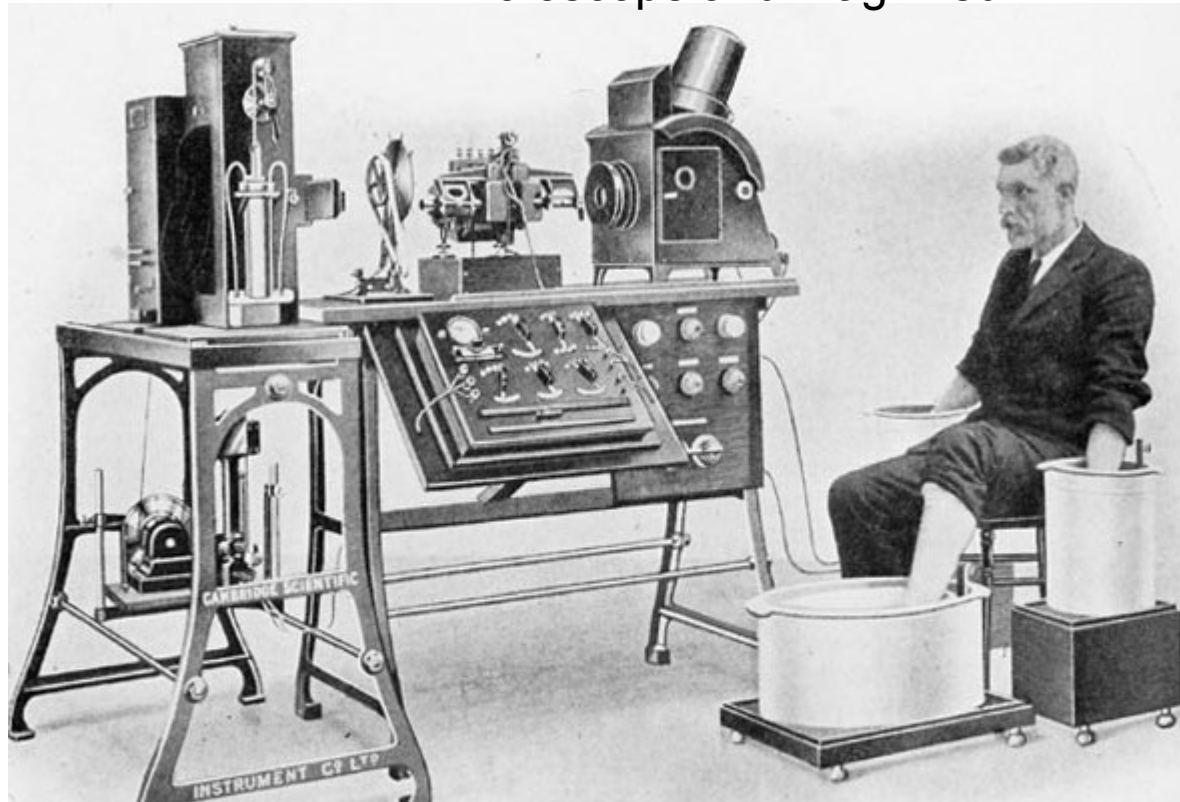
Galvanometer moves string



Background ECG

(D)

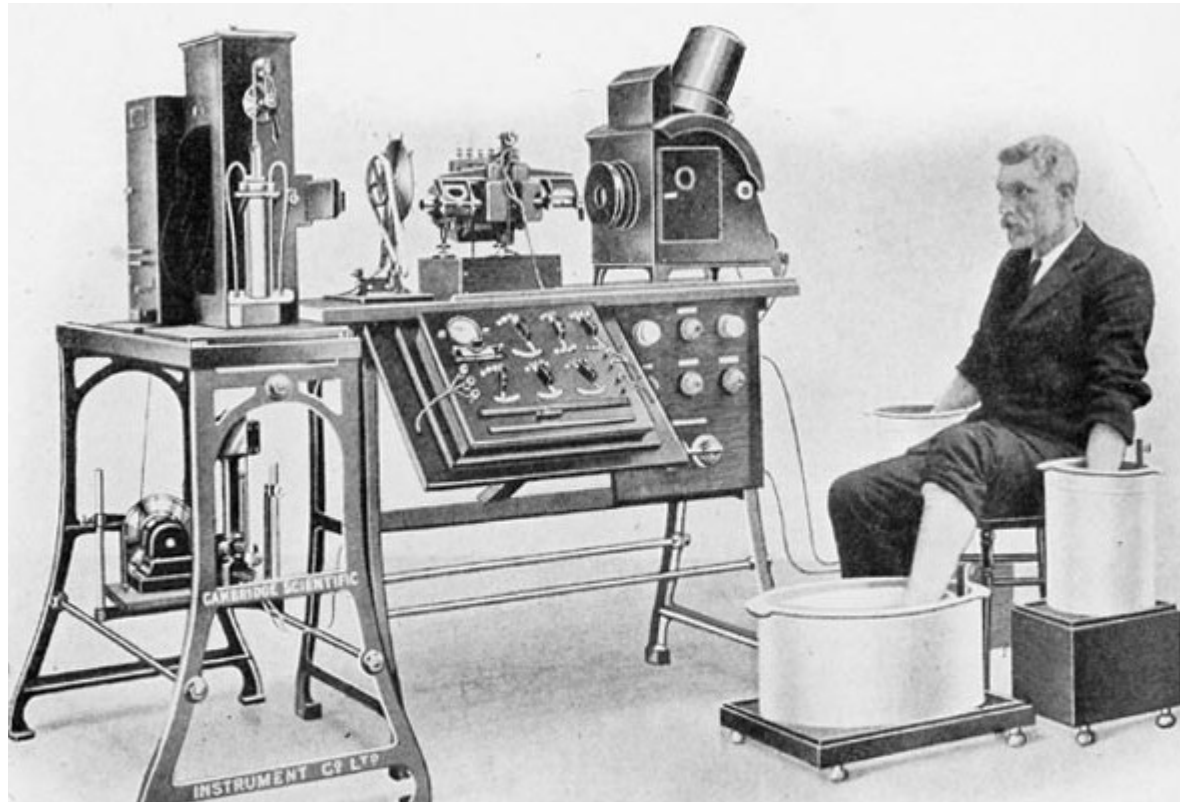
String movement is seen from a
Microscope and magnified



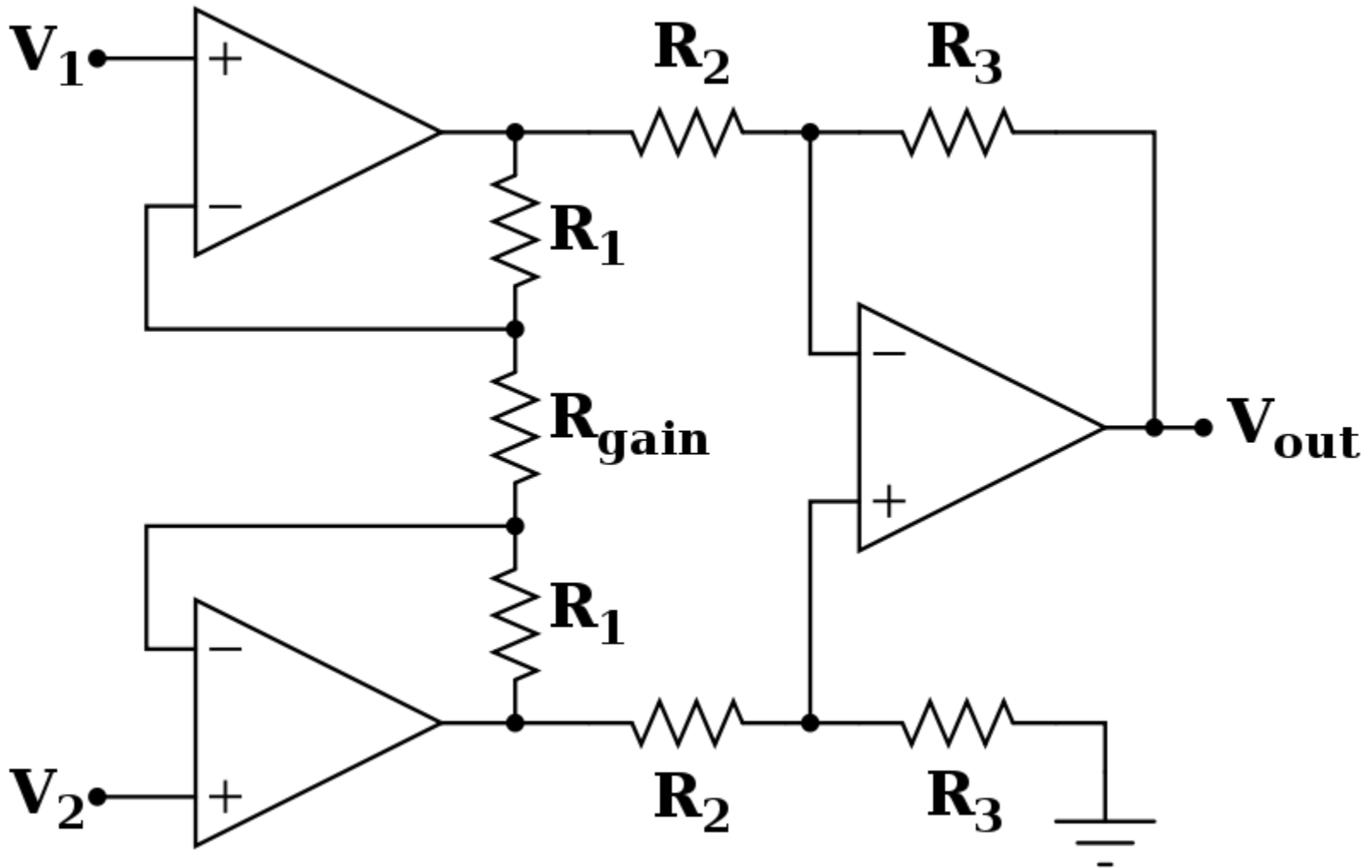
Background ECG

(E)

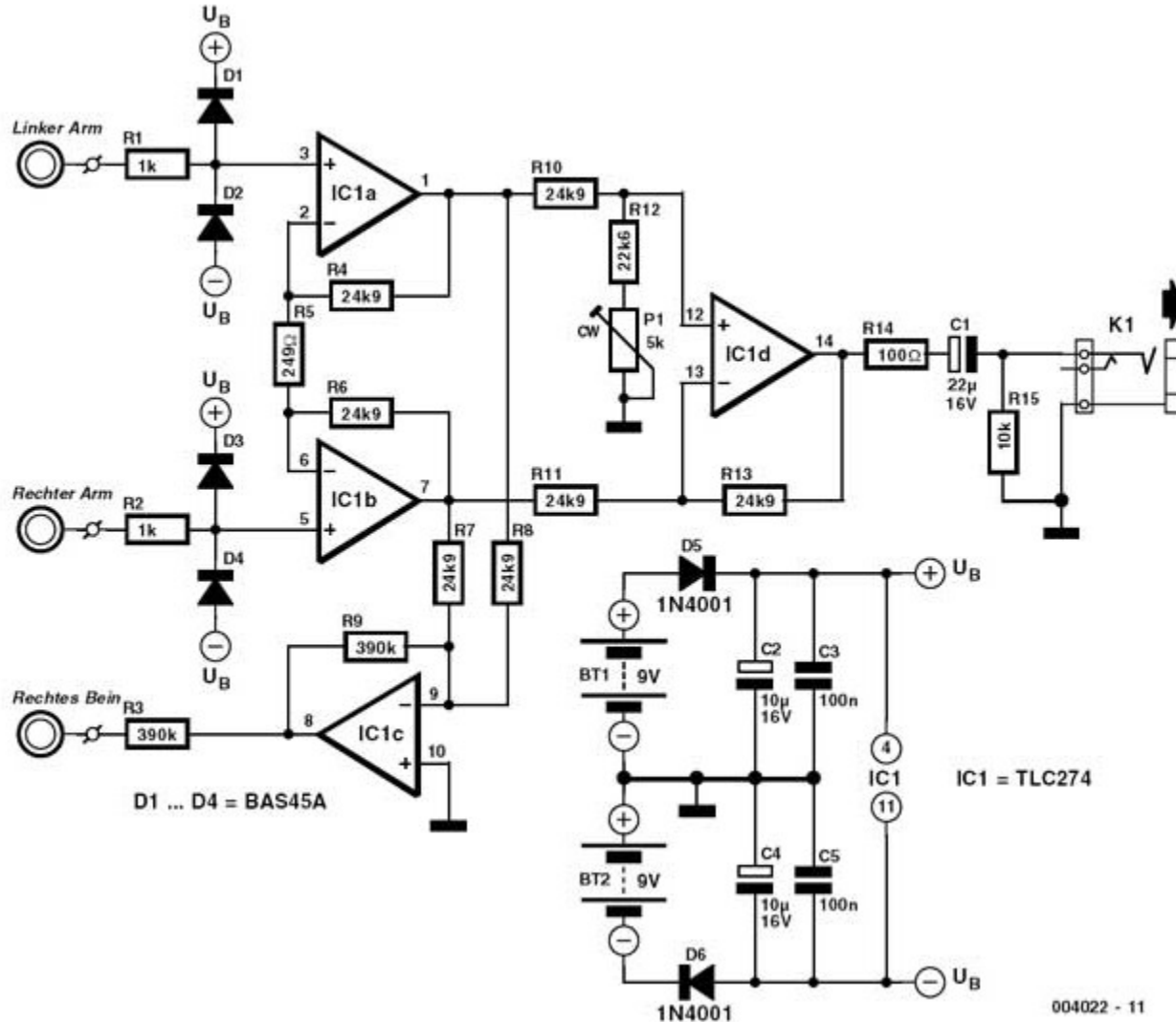
Photographic Paper moves across the
Output of the microscope and records the
Electrical Activity



Bio amplifier



Modern Day ECG



Off Shoot Devices

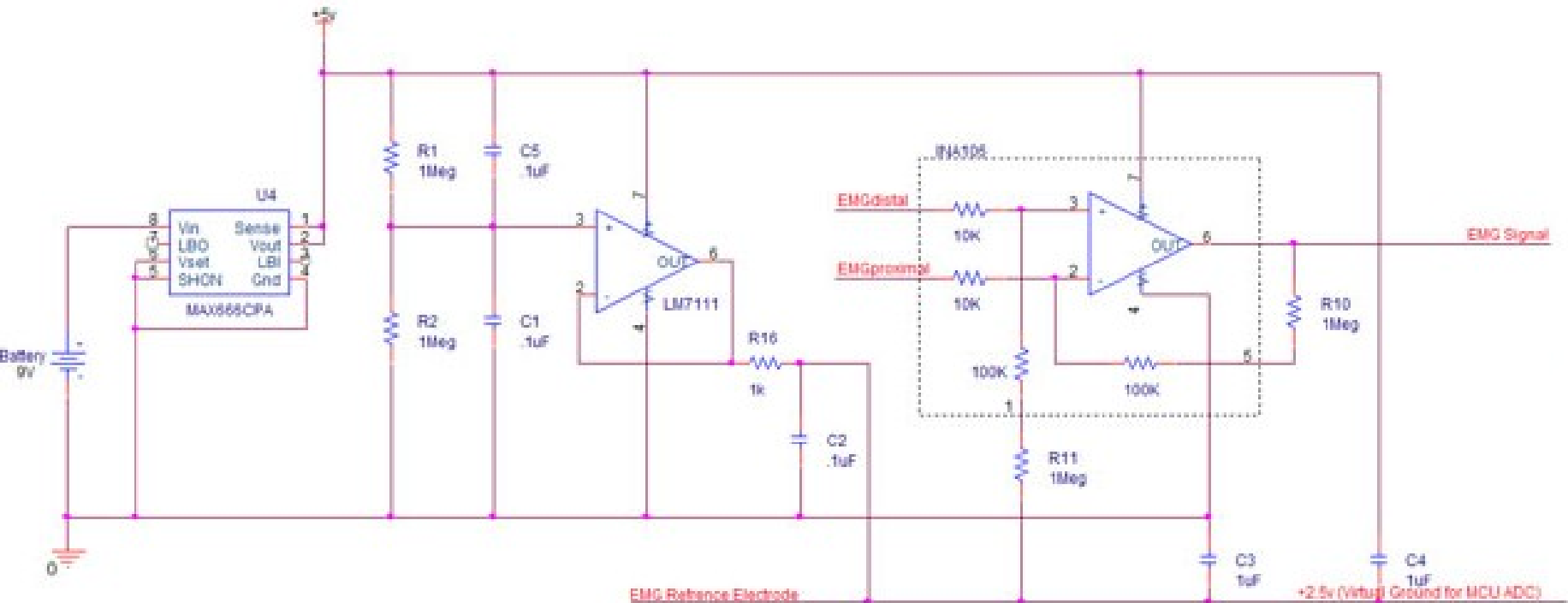
```
graph TD; A[EMG (Electromyograph)] --- B[ECG (Electrocardiograph)]; B --- C[EEG (Electroencephalograph)];
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EMG (Electromyograph)

ECG (Electrocardiograph)

EEG (Electroencephalograph)

EMG



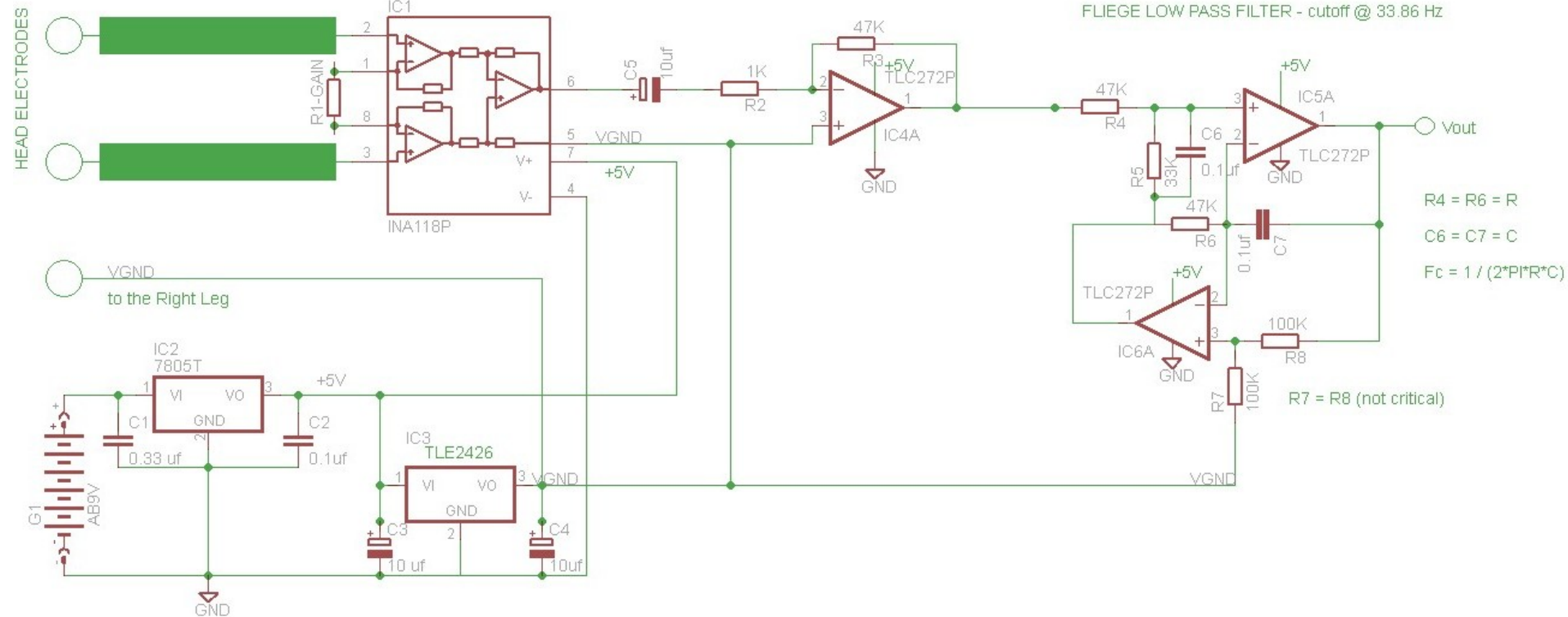
http://instruct1.cit.cornell.edu/courses/ee476/FinalProjects/s2005/bsm24_ajg47/website/website/diffamp.jpg

EEG

EEG SCHEMATIC

Shielded Electrode cables - connect shield to VGND

FLIEGE LOW PASS FILTER - cutoff @ 33.86 Hz



<http://teknomage.files.wordpress.com/2008/08/teknomage-eeeg-schematic.jpg>

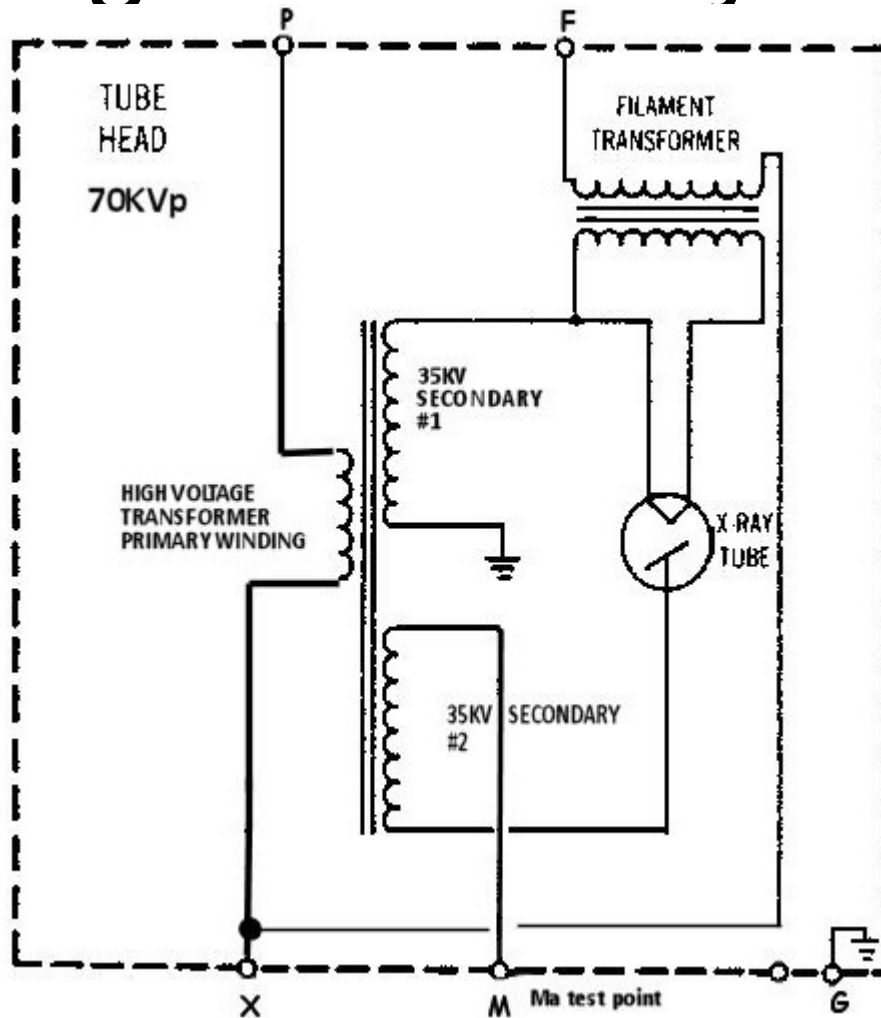
Self Check

- What is the difference between EMGs, EEG and EKGs amplifiers?

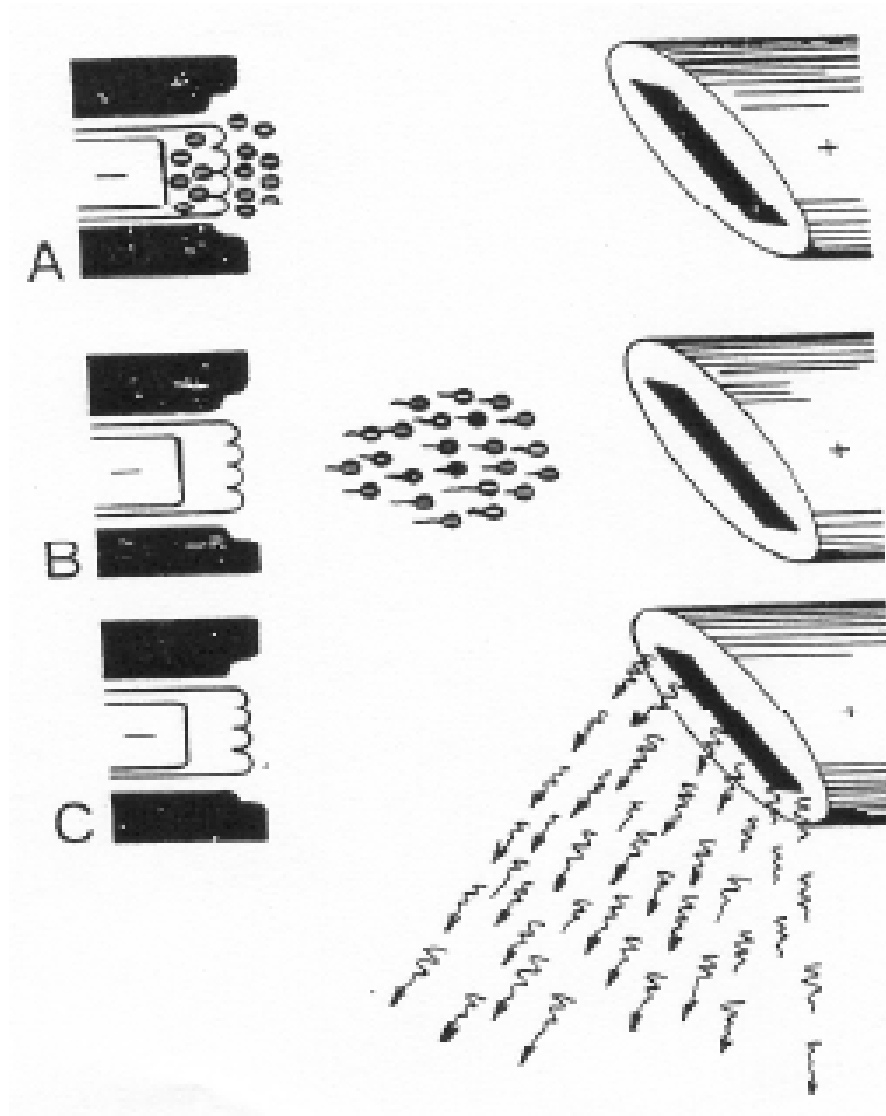
Background X-ray Generators



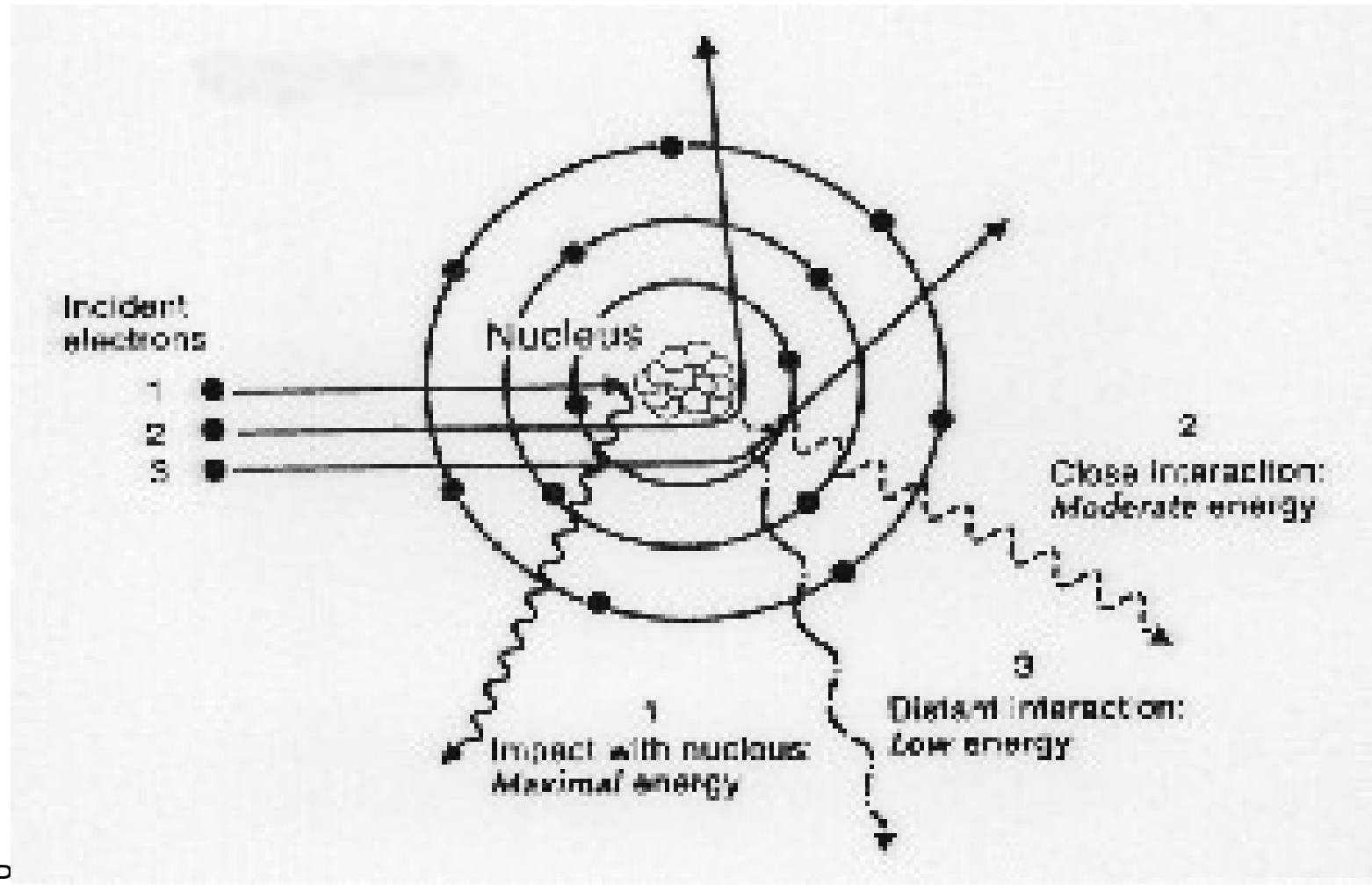
Background X-ray Generators



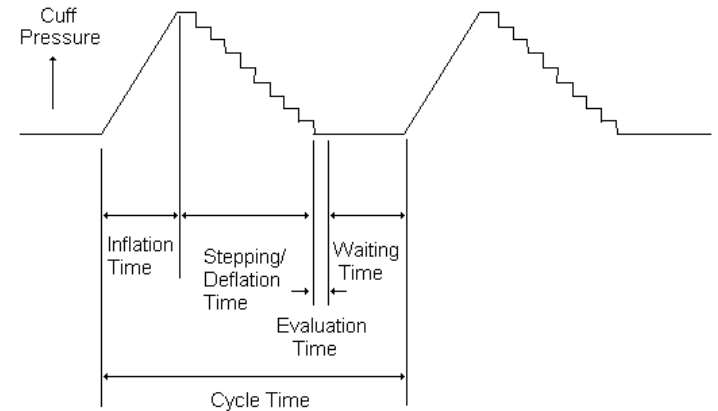
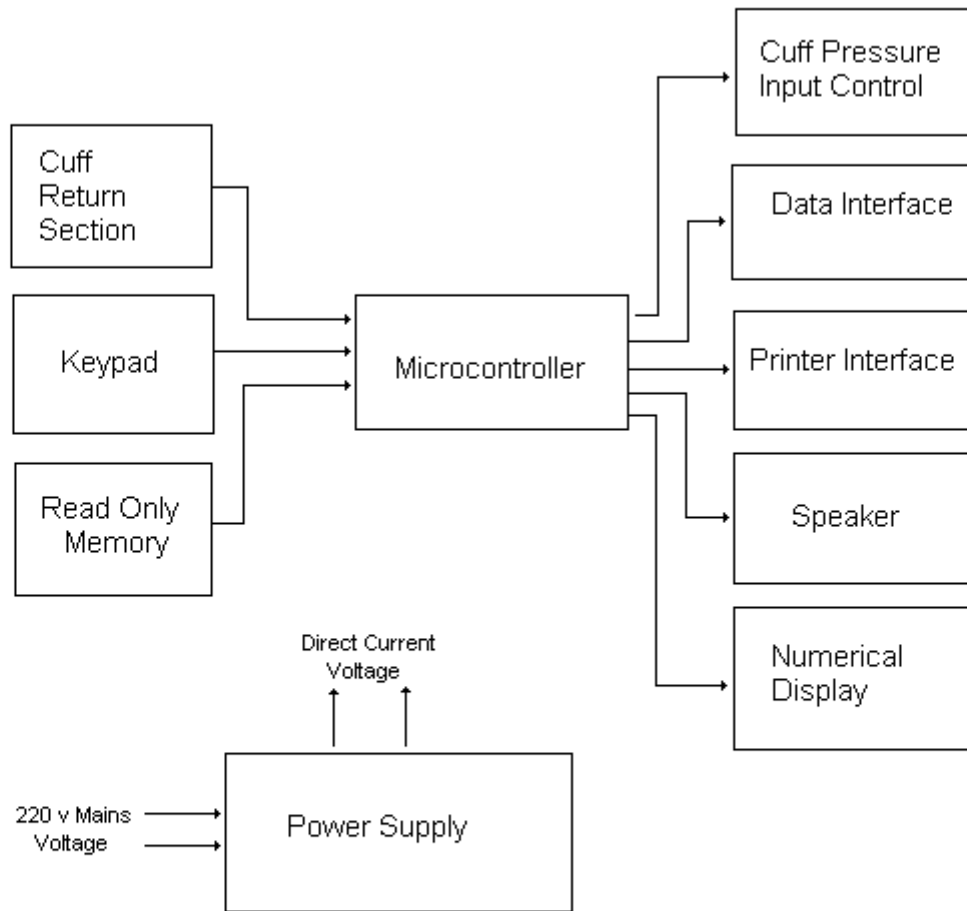
Background X-ray Generation



Electron Interaction



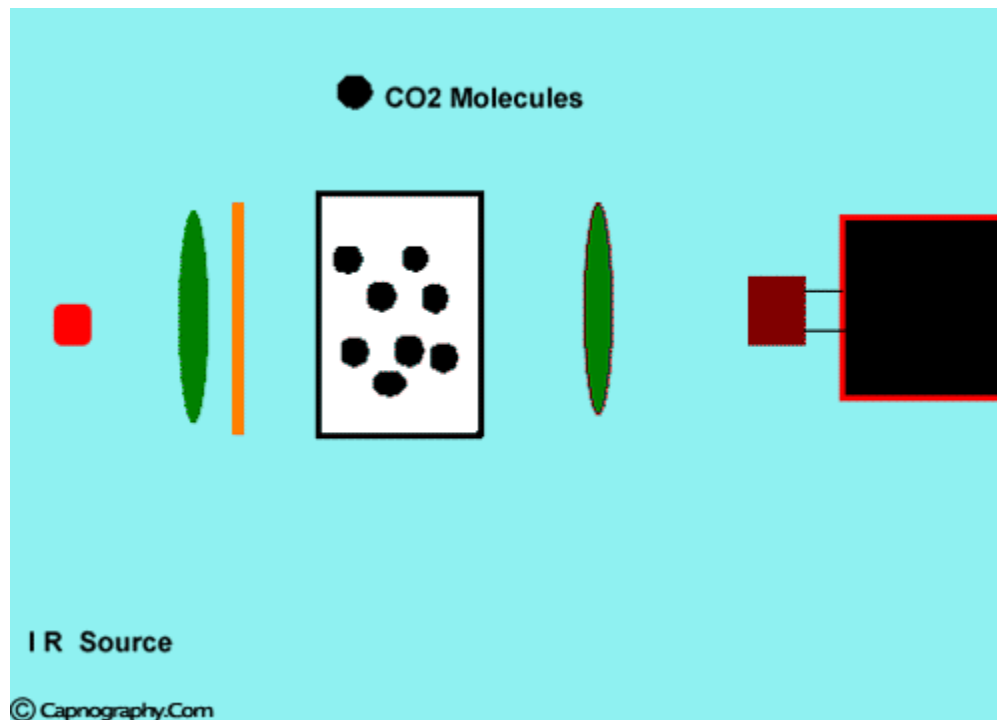
Blood Pressure Measurement



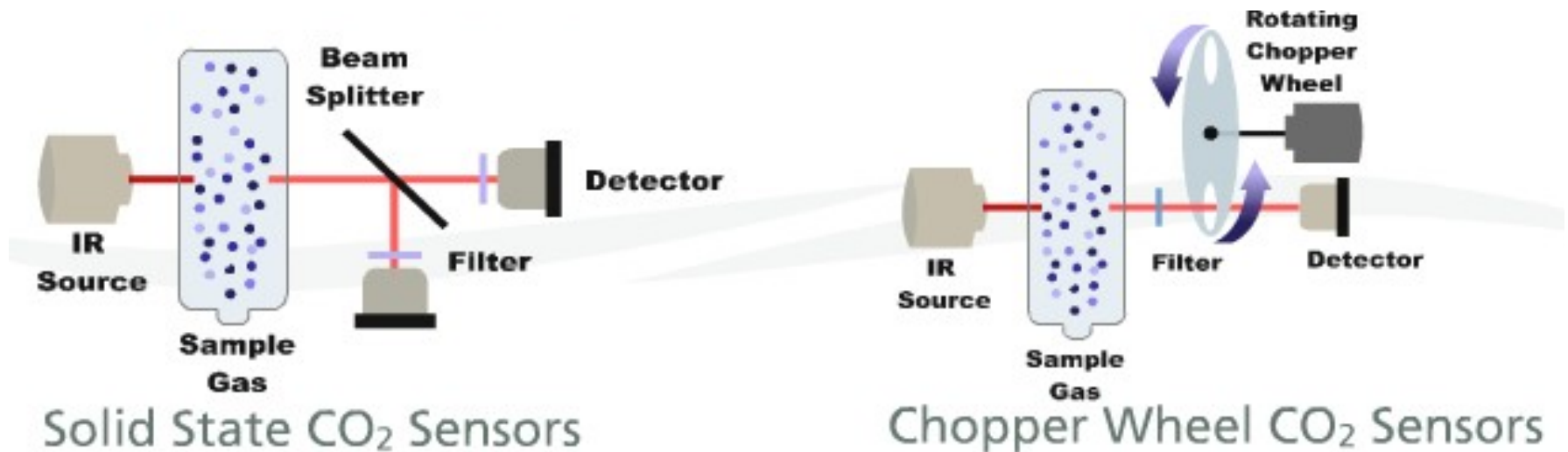
Pneumatic Pressure Graph & Microprocessor Operation



Capnograph

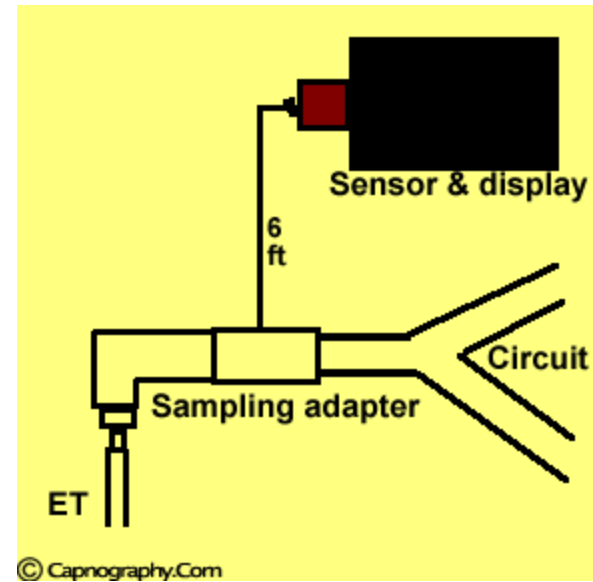
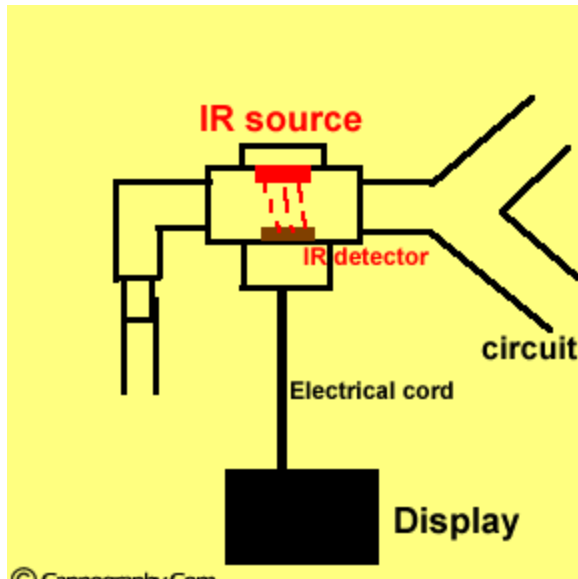


Capnograph



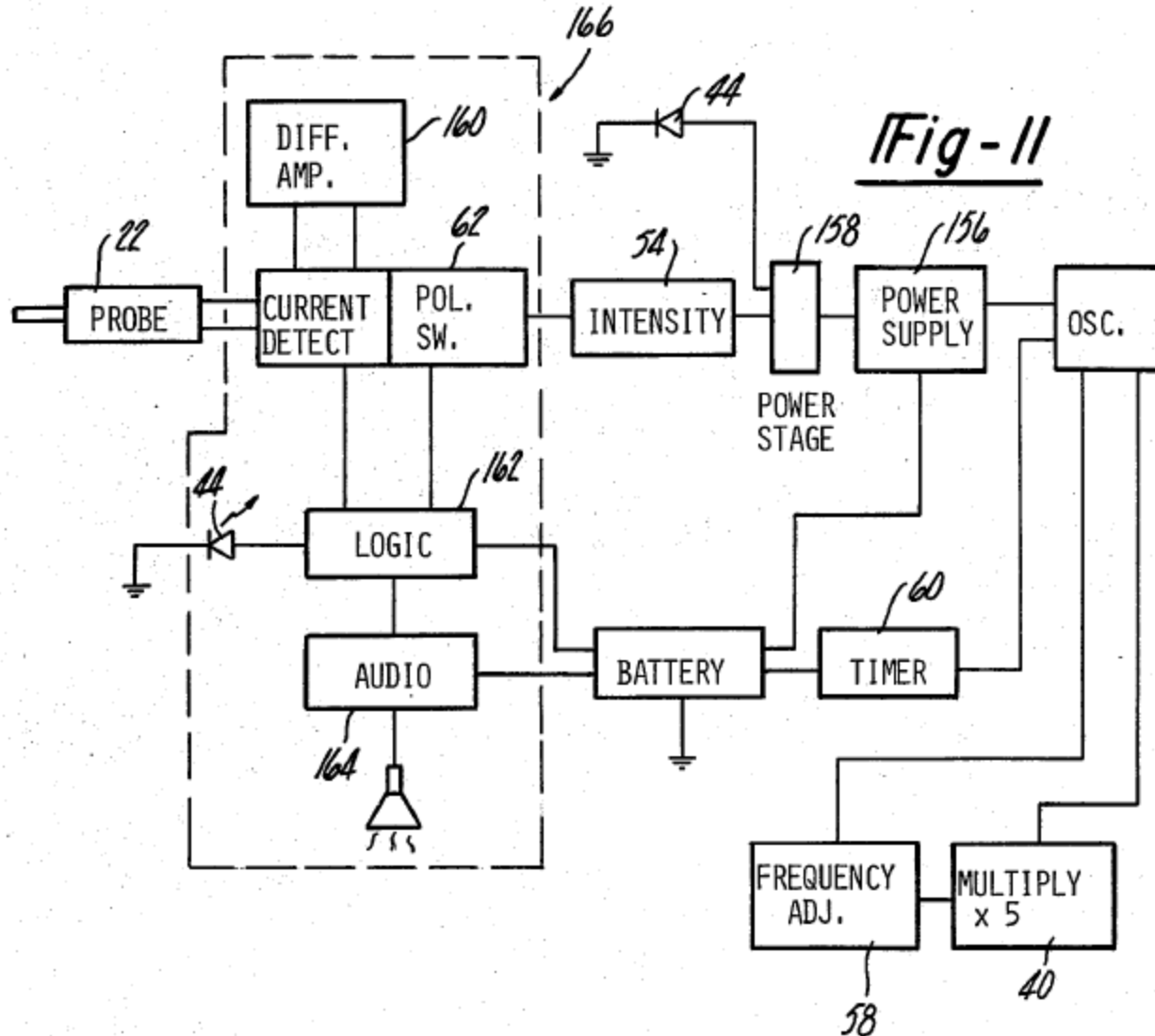
<http://elearning.respironics.com/scorm/scorm.aspx?unitid=20>

Capnograph

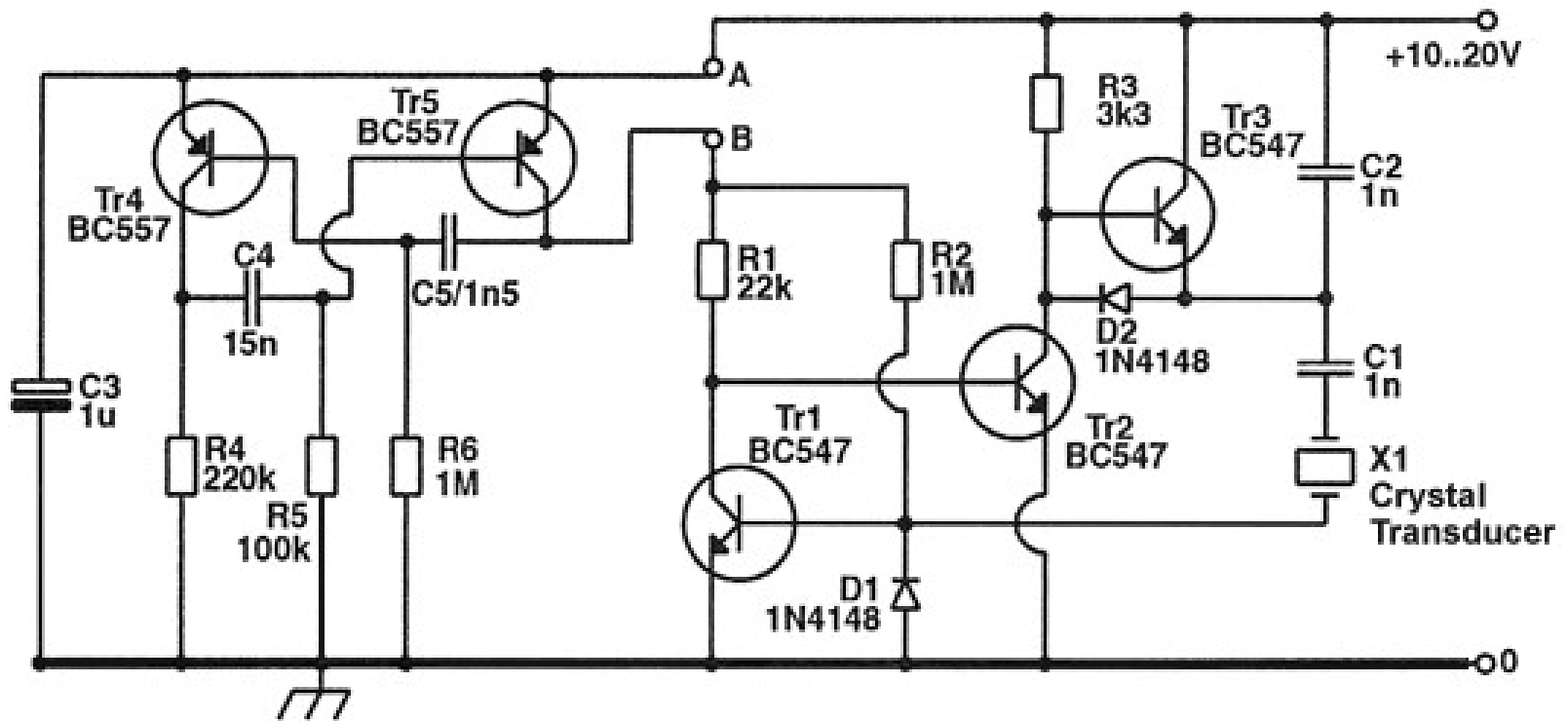


http://www.capnography.com/new/index.php?option=com_content&view=article&id=66&Itemid=91

Physiotherapy Ultrasound

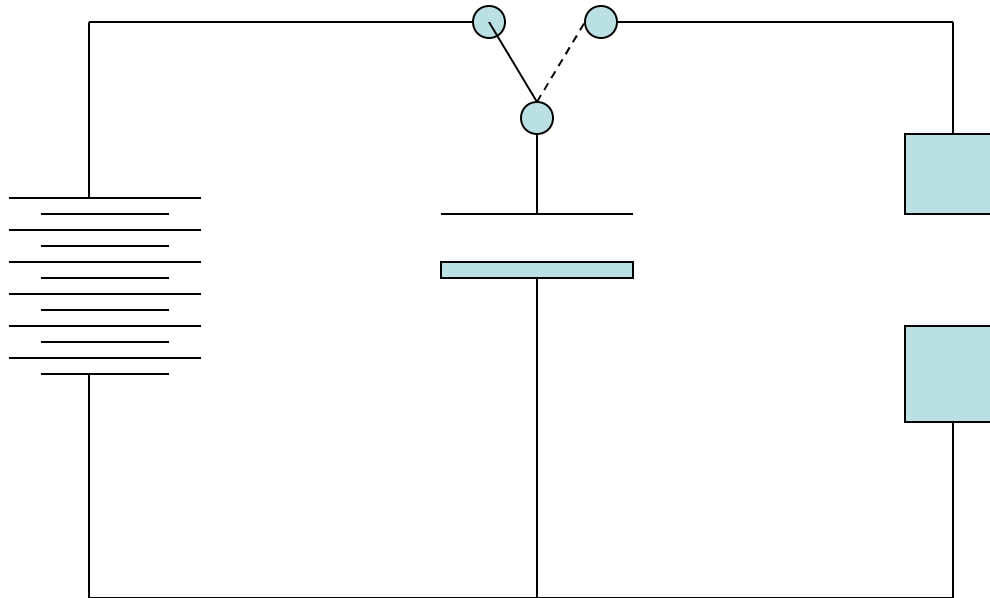


Physiotherapy Ultrasound

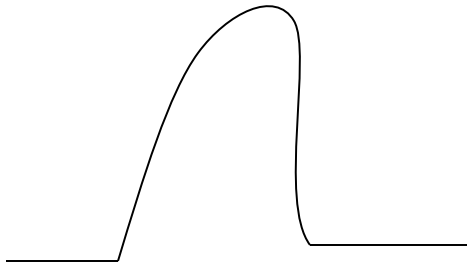


http://www.circuit-projects.com/cimg/500Hz_modulated_ultrasonic_transmitter.gif

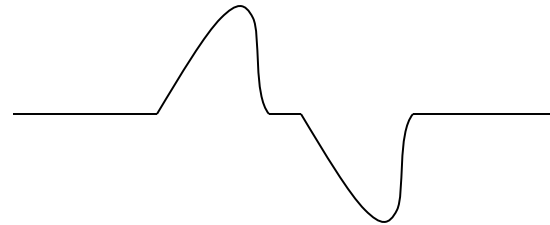
Defibrillator Basics



Defibrillator Output Signals

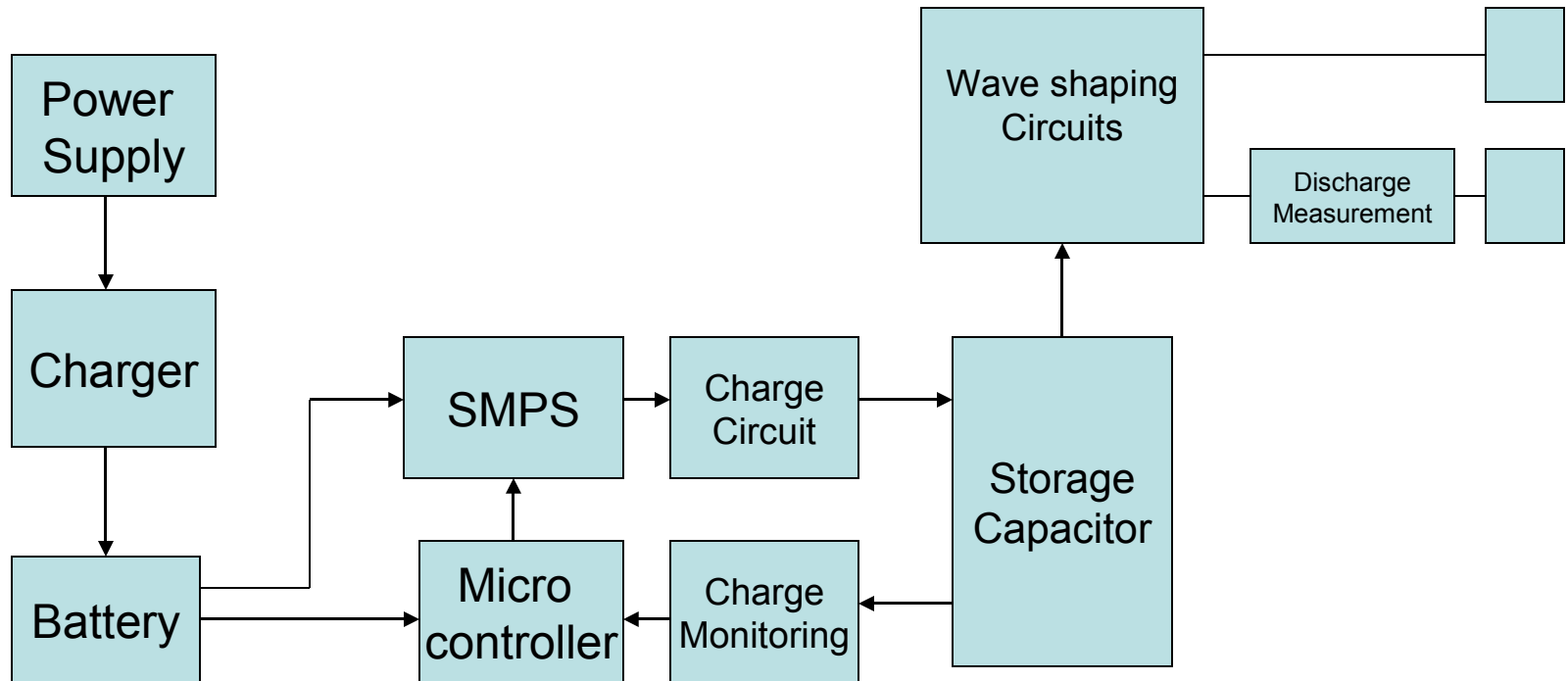


Monophasic



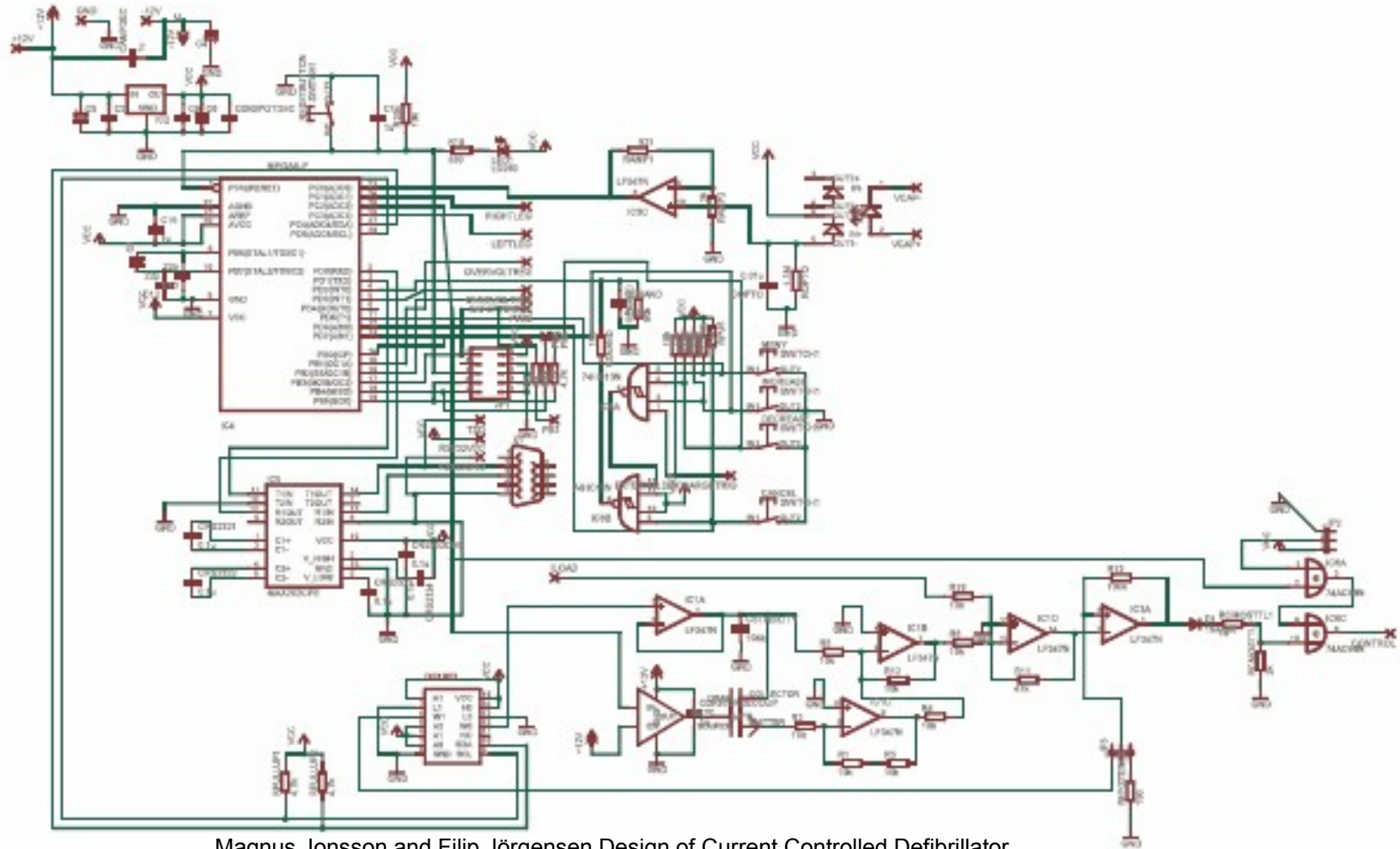
Biphasic

Example Defibrillator Block Diagram

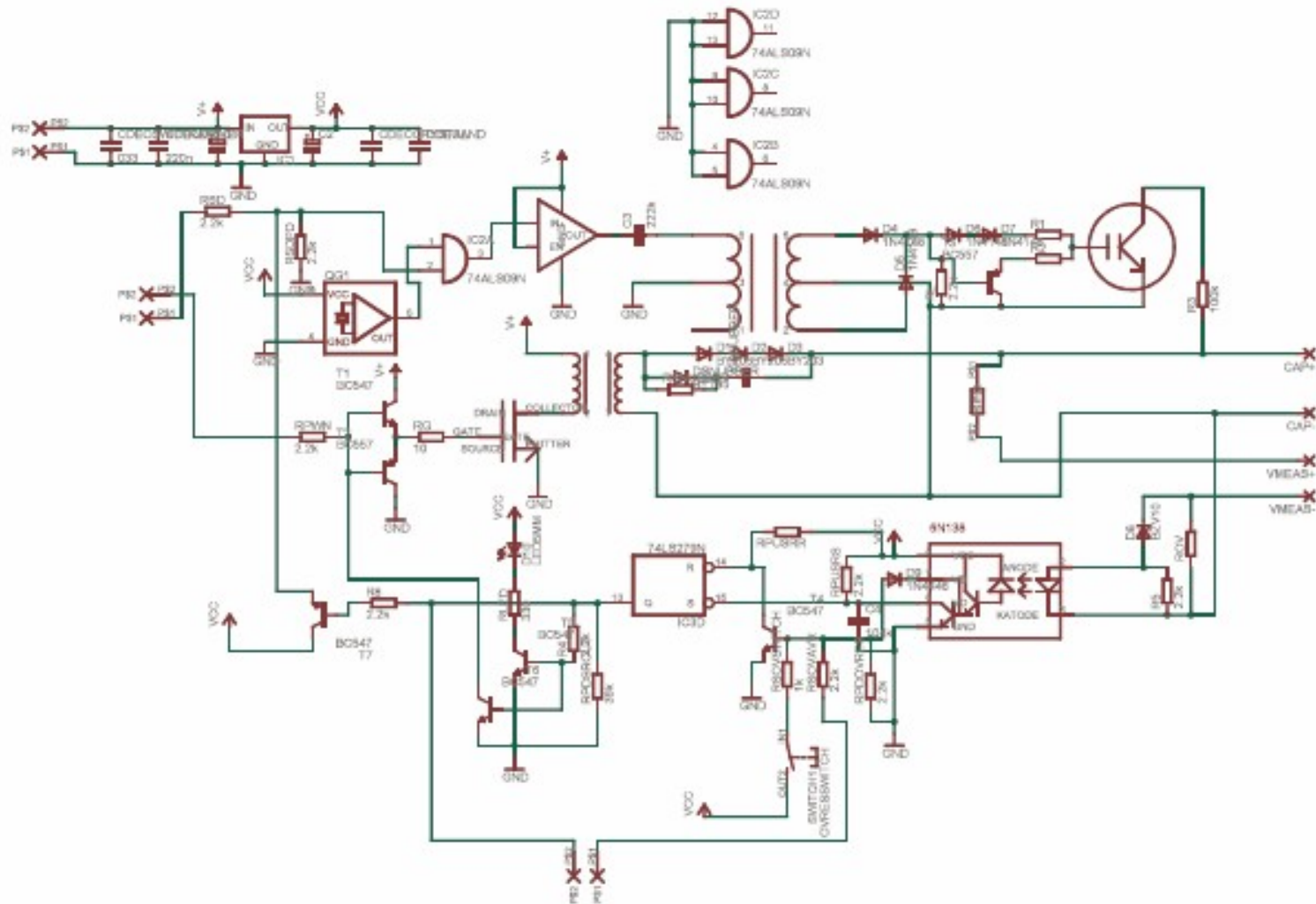


Controller Board

Sample Defibrillator Circuit



Sample Charging Defibrillator Circuit



End Notes

- The circuits contained in this slide set are only a few circuits compared to the hundreds of control, driver or measurement circuits employed in the field of medical electronics.
- The fundamentals of operation are the same but the details of how its done may differ.