Analog Electronics

Unit 1

Introduction to Analog Signal Processing

NOTE

These slides do NOT include all the contents of Analog Electronics course. They have to be completed with notes taken in class by the student. This is not the material of an online course.

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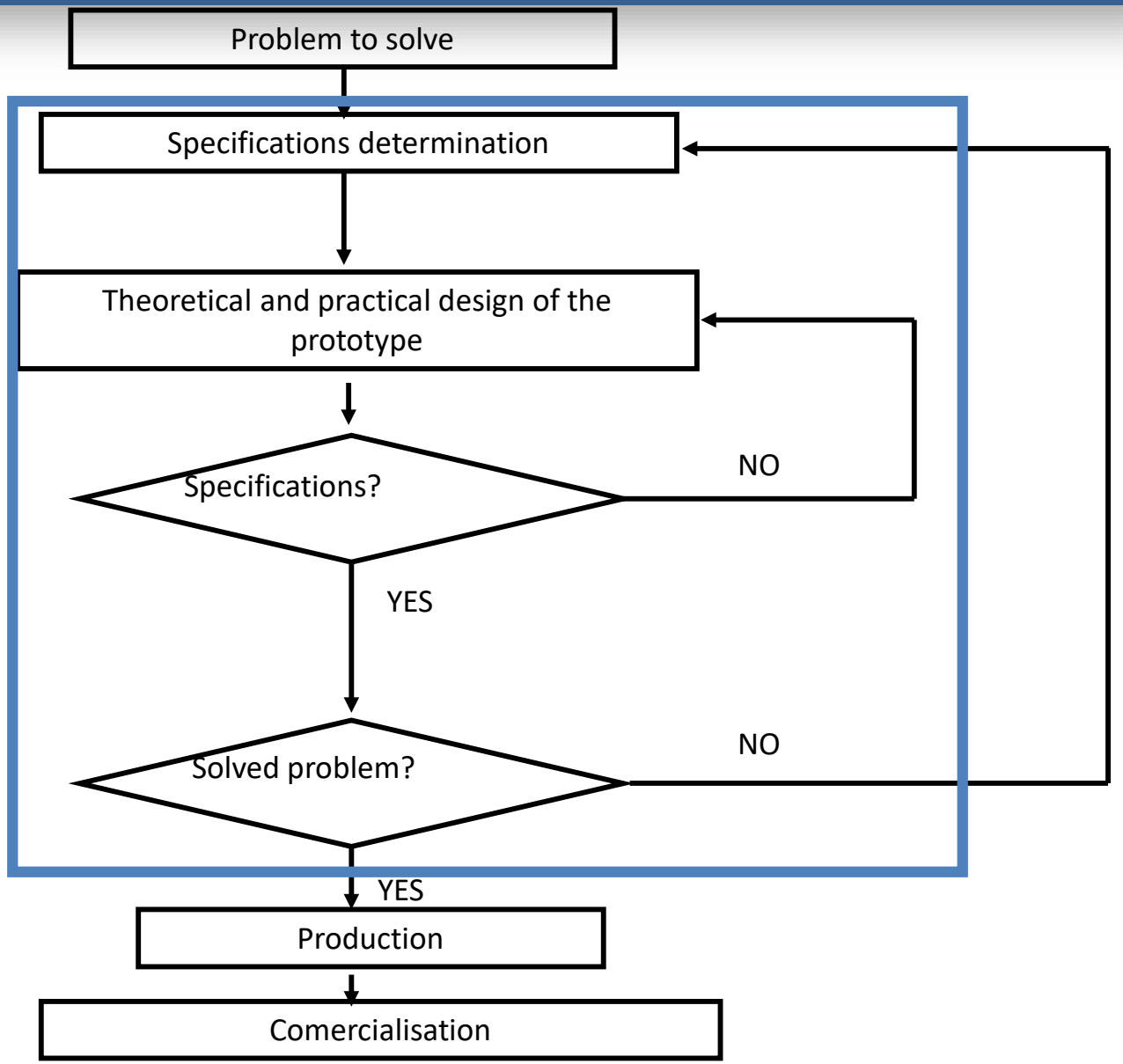
1.1 Design and *Top-down* analysis

Design of an electronic device

1.1 Design and *Top-down* analysis

Top-down

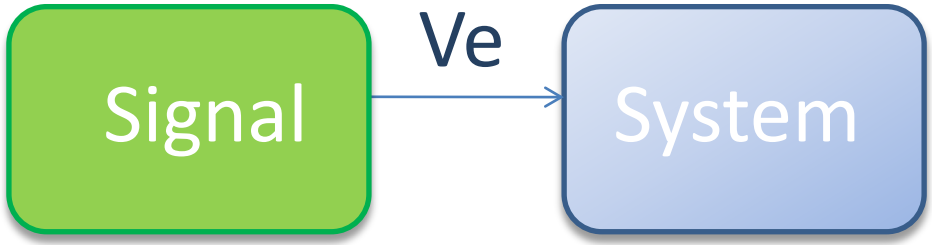


1.1 Design and *Top-down* analysis

Determination of the specifications

Signal Characterization

- Differential, pseudo-differential or single-ended
- Floating or grounded
- Elevated or non-elevated bandwidth
- Small or big level
- Small or big amplitude
- Current or voltage
- Small or big output impedance

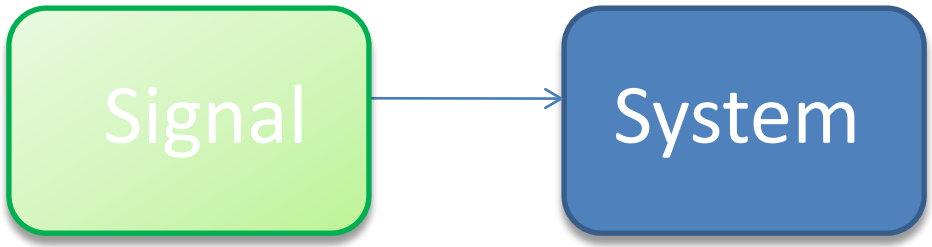


1.1 Design and *Top-down* analysis

Determination of the specifications

Characterization of the processing system

- Input-output ratio (transfer function)
- Input topology
- Input and output impedances
- Quadripole model
- Errors
- Dynamic features

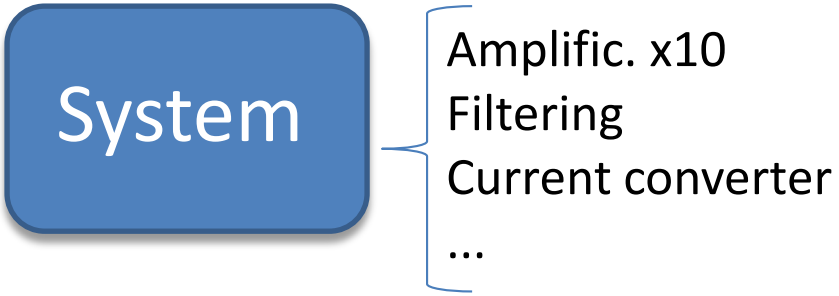


Units 3 and 4

1.1 Design and *Top-down* analysis

Functional blocks definition

- Amplification, attenuation
- Summing function
- Converters V → I y I → V
- Filters
- Logarithmic converters
- Impedance match

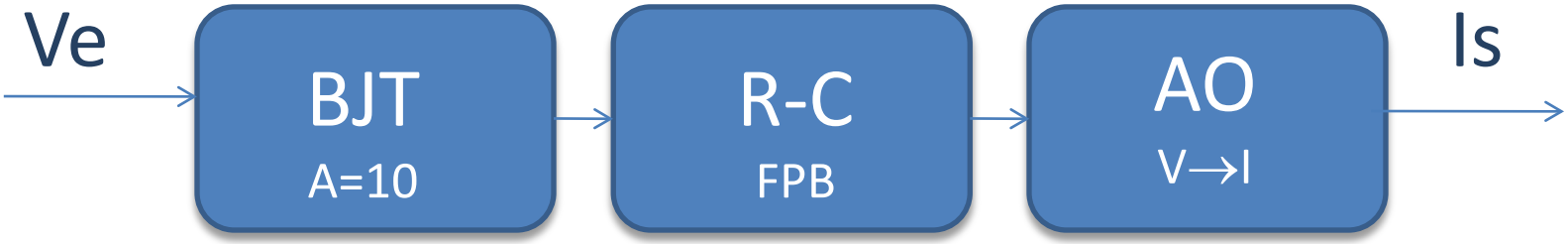


Unit 5

1.1 Design and *Top-down* analysis

Blocks design. Choose components

- Passive Components R-L-C
- Transistors: BJT, JFET, MOSFET
- Operational amplifiers (OA)
- Specific integrated circuits (ICs)

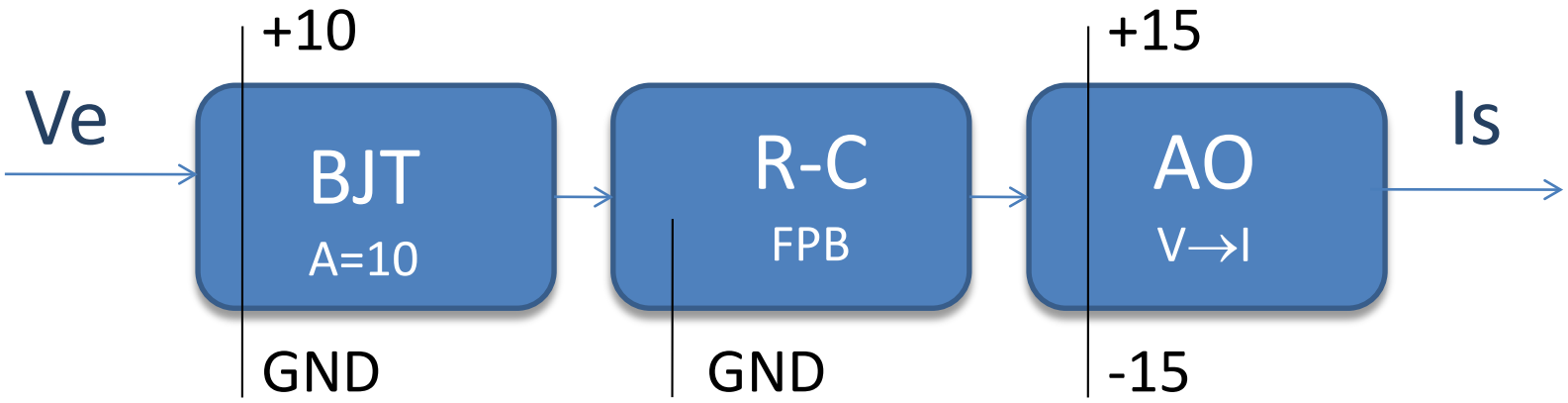


Units 7 and 8

1.1 Design and *Top-down* analysis

Consumption and supply.

- Determine the levels of supply voltage
- Calculation of the total consumed current
- Choose a supply system (net, batteries…)
- Factors: space, volume, weight, disponibility, price...



Unit 9

1.1 Design and *Top-down* analysis

Theoretical analysis of the system
Static (errors) and dynamic (frequency response) features

- Analytical analysis or computer simulation (workbench, Pspice, Proteus)
- Compare theoretical features with the initial specifications of the system
- Redesign the system (or a specific block) if the specifications are not fulfilled

Units 5, 6, 7 and 8

1.1 Design and *Top-down* analysis

Experimental analysis of the system
Static (errors) and dynamic (frequency response) features

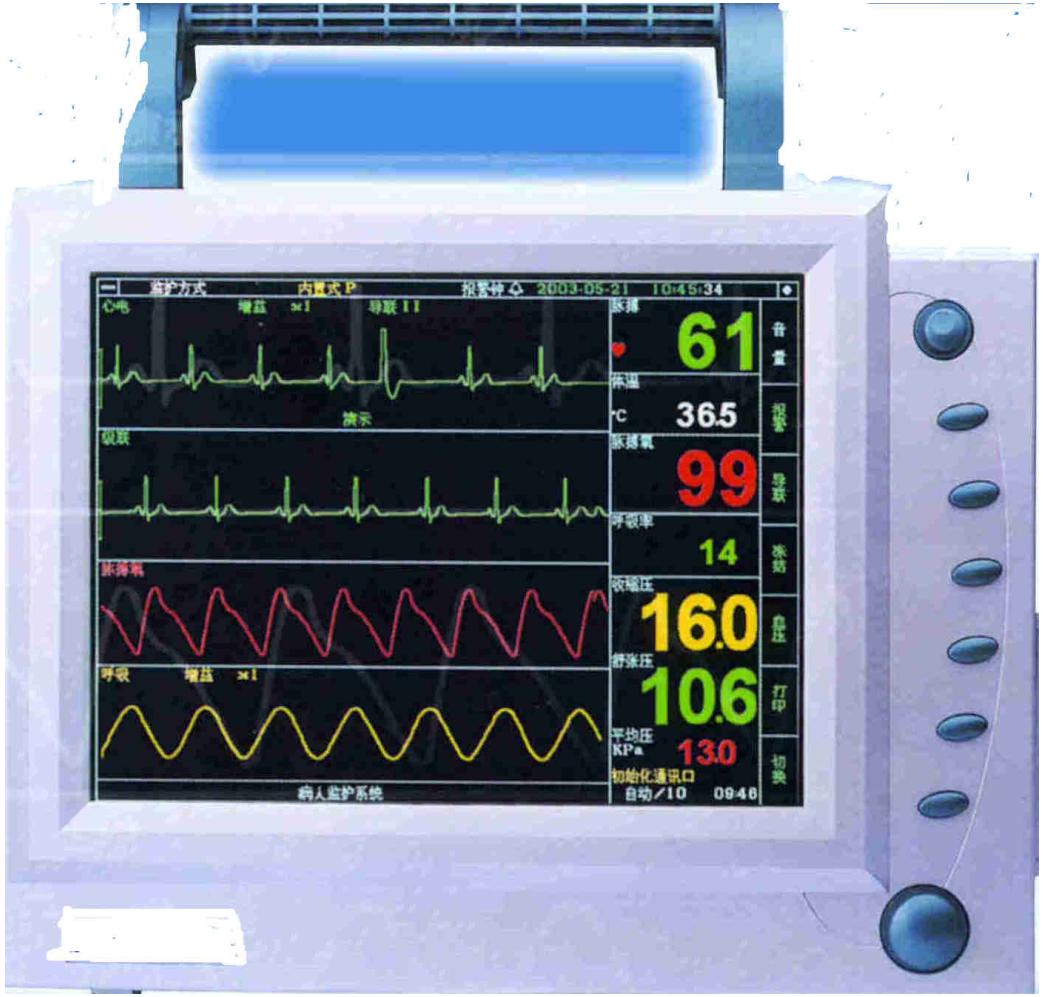
- Assemble the circuit (Proto-board, PCB)
- Block after block
- Are the specifications fulfilled?
- Does the circuit solve the initial problem?

Laboratory experiments

1.2 Program

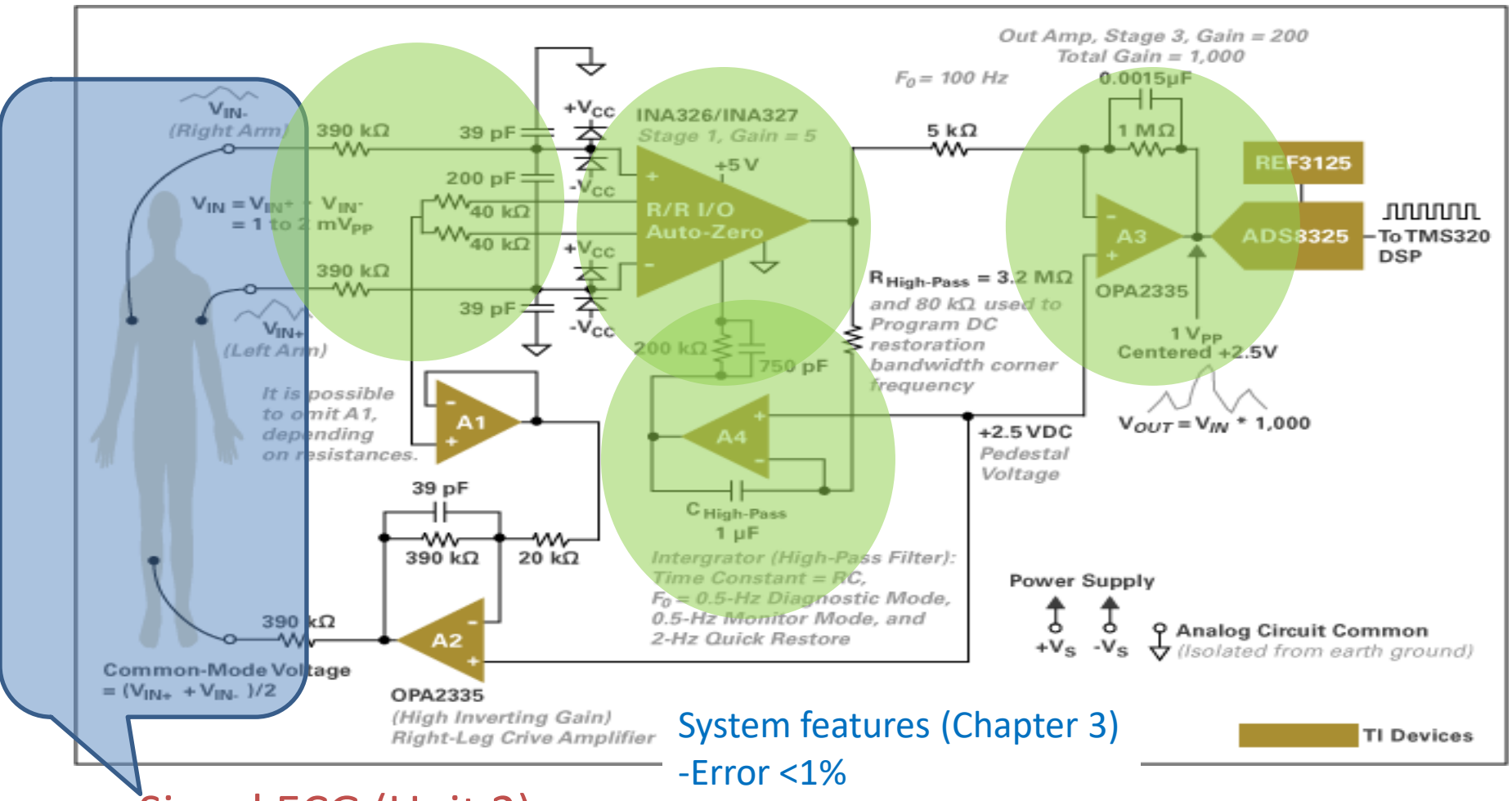
Unit 1. Introduction to analog signal processing
Unit 2. Characterization of analog signals (Phase 1)
Unit 3. Characterization of the static features of analog processing systems (Phase 2)
Unit 4. Characterization of the dynamic features of analog processing systems (Phase 2)
Unit 5. Functional Blocks (Phase 3)
Unit 6. Real Operational Amplifier (OA) (Phase 5)
Unit 7. Operational Amplifier (OA) and linear applications (Phase 4)
Unit 8. Non Linear applications based on OA (Phase 4)
Unit 9. Power supply (Phase 5)

Example



Example

Functions (Chapter 4)



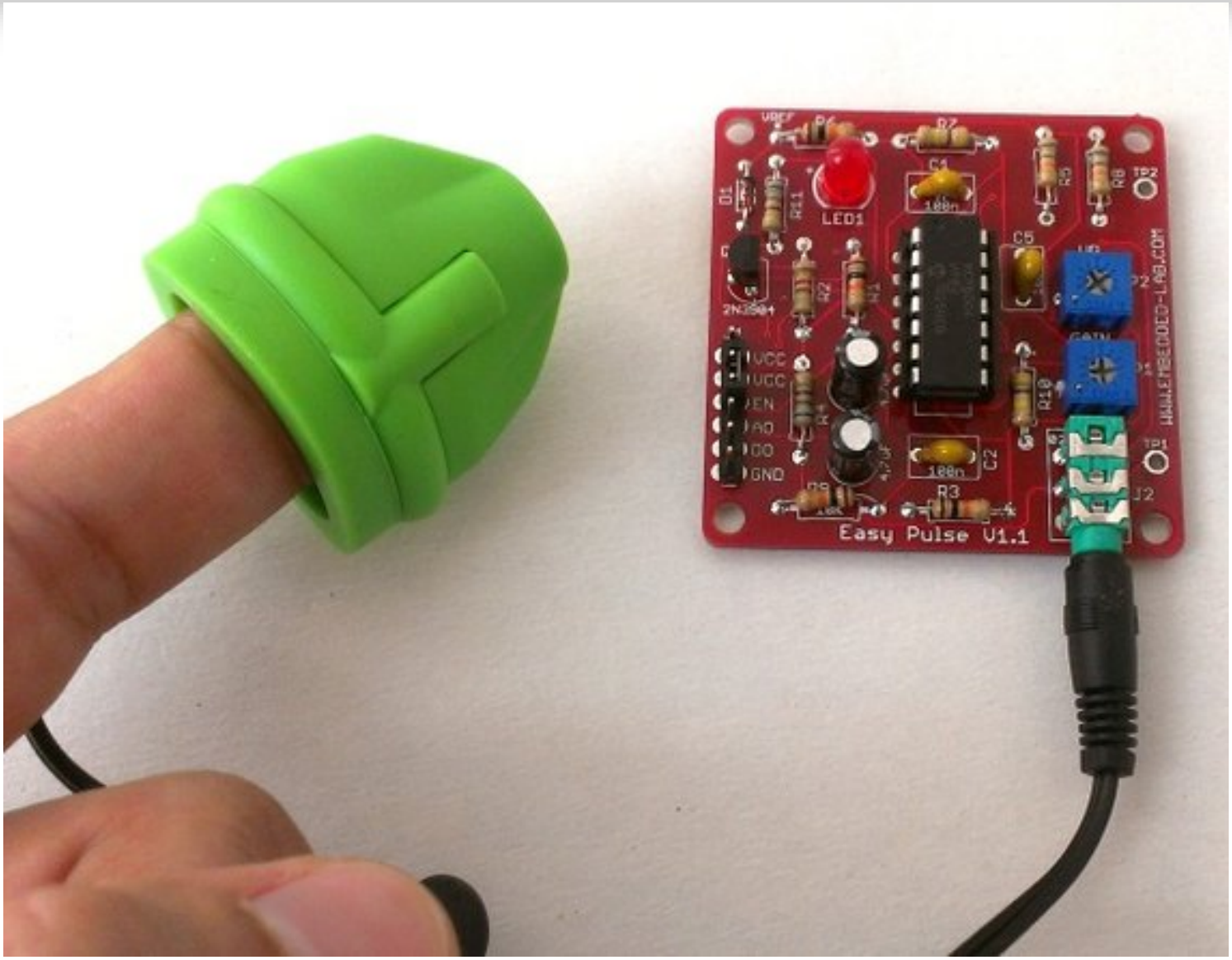
Signal ECG (Unit 2)

System features (Chapter 3)

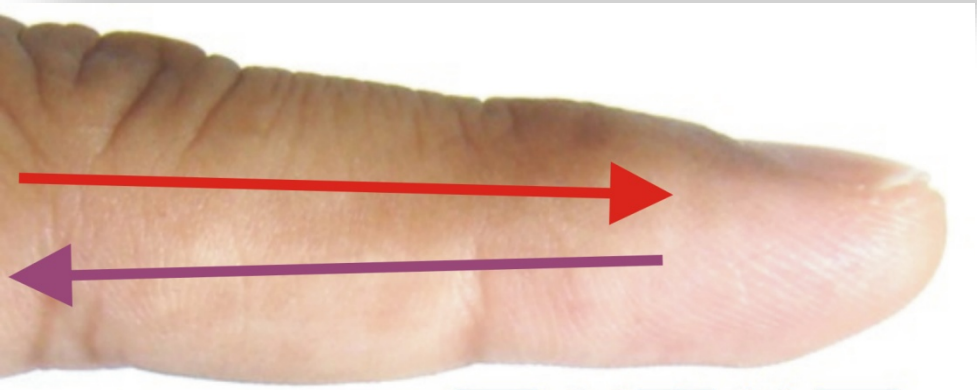
-Error <1%

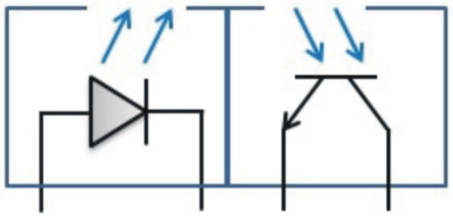
-Bandwidth 0.1 – 100 Hz

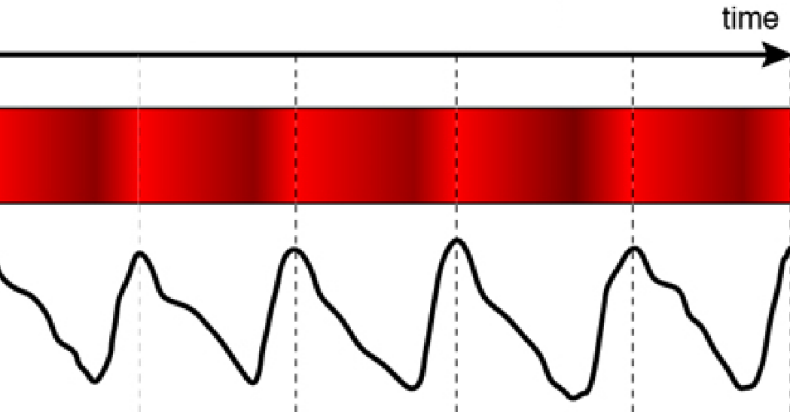
Example



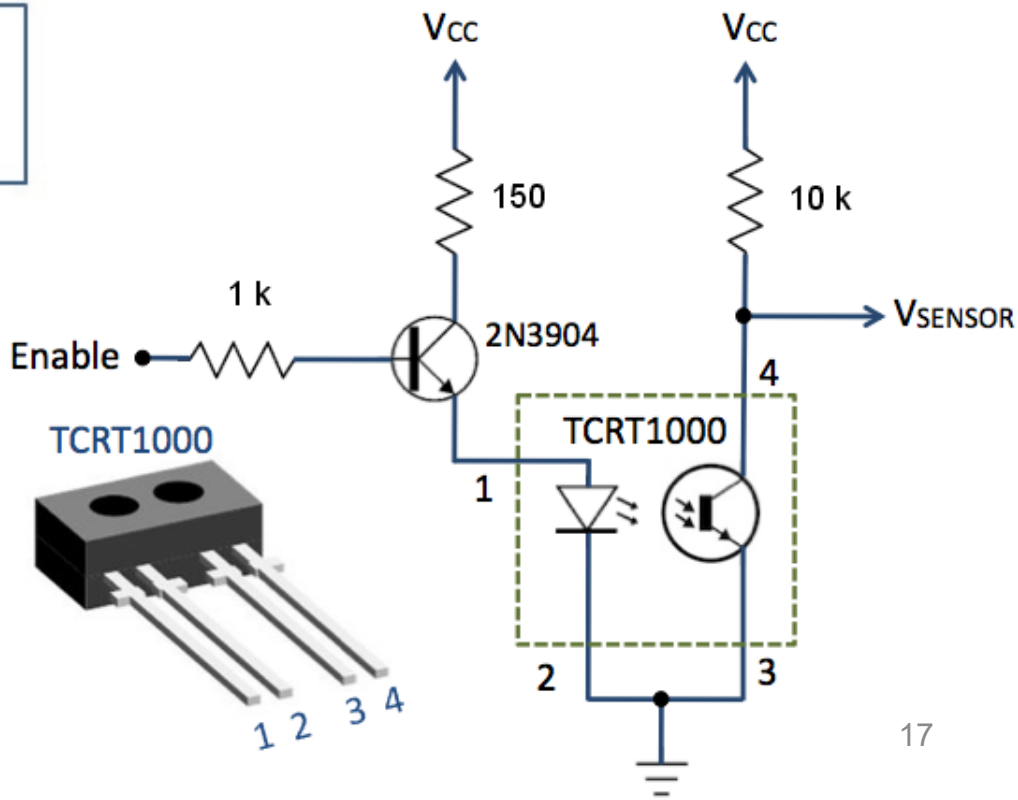
Example





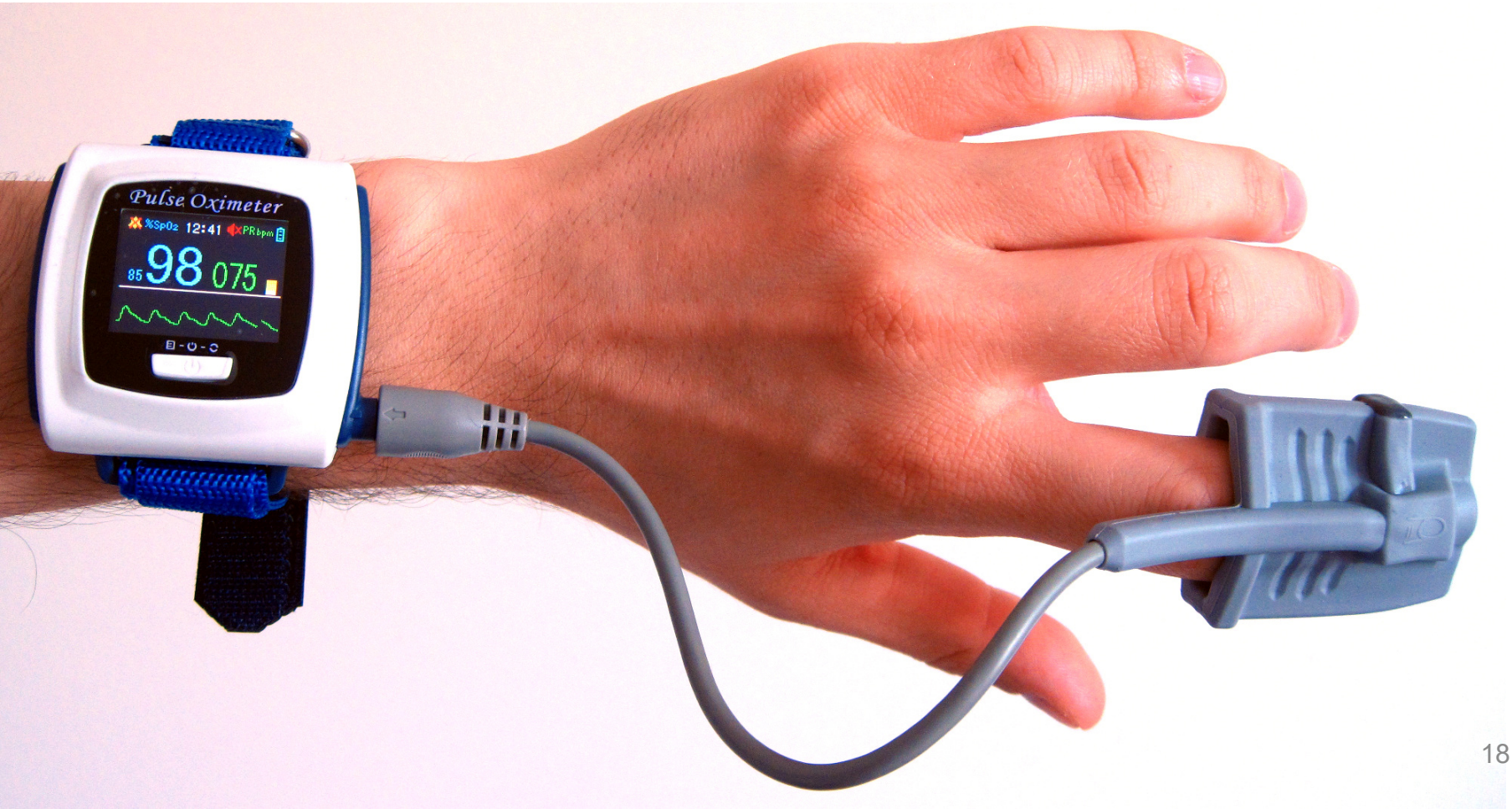


Unit 2. Analog signals



Example

Unit 3. Analog systems

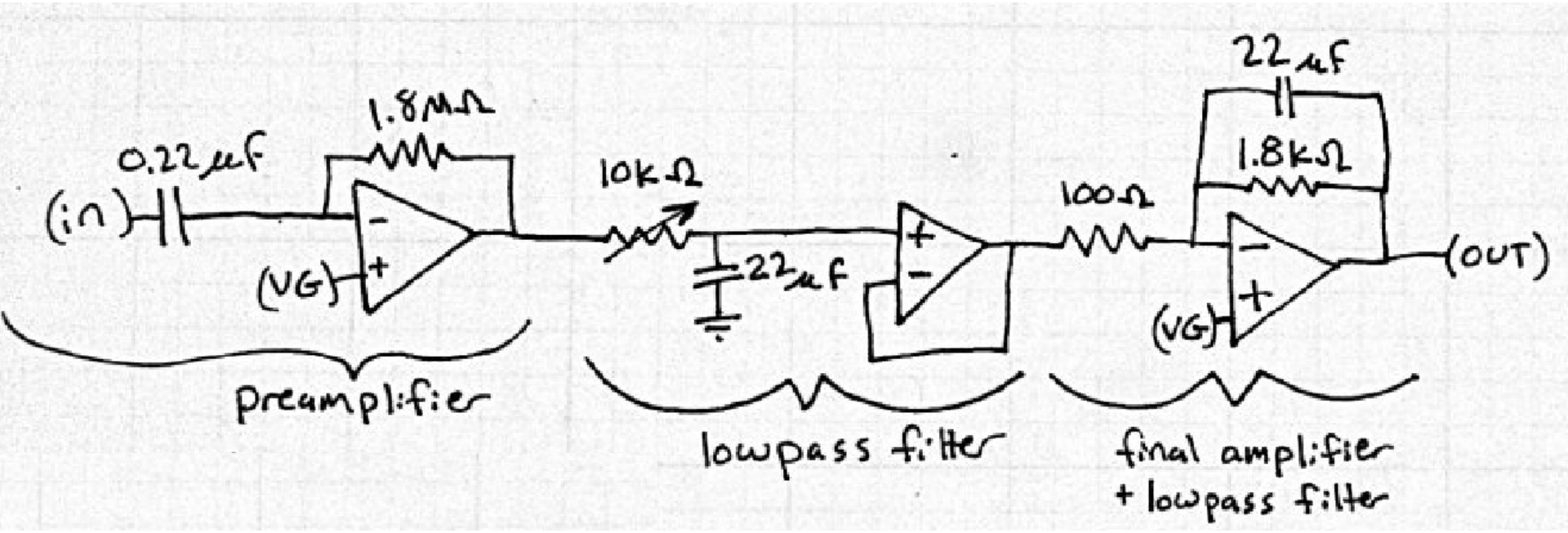


Example

Unit 5. Funcional blocks

Unit 7. Operational Amplifier (OA) and linear applications

Unit 8. Non Linear applications based on OA



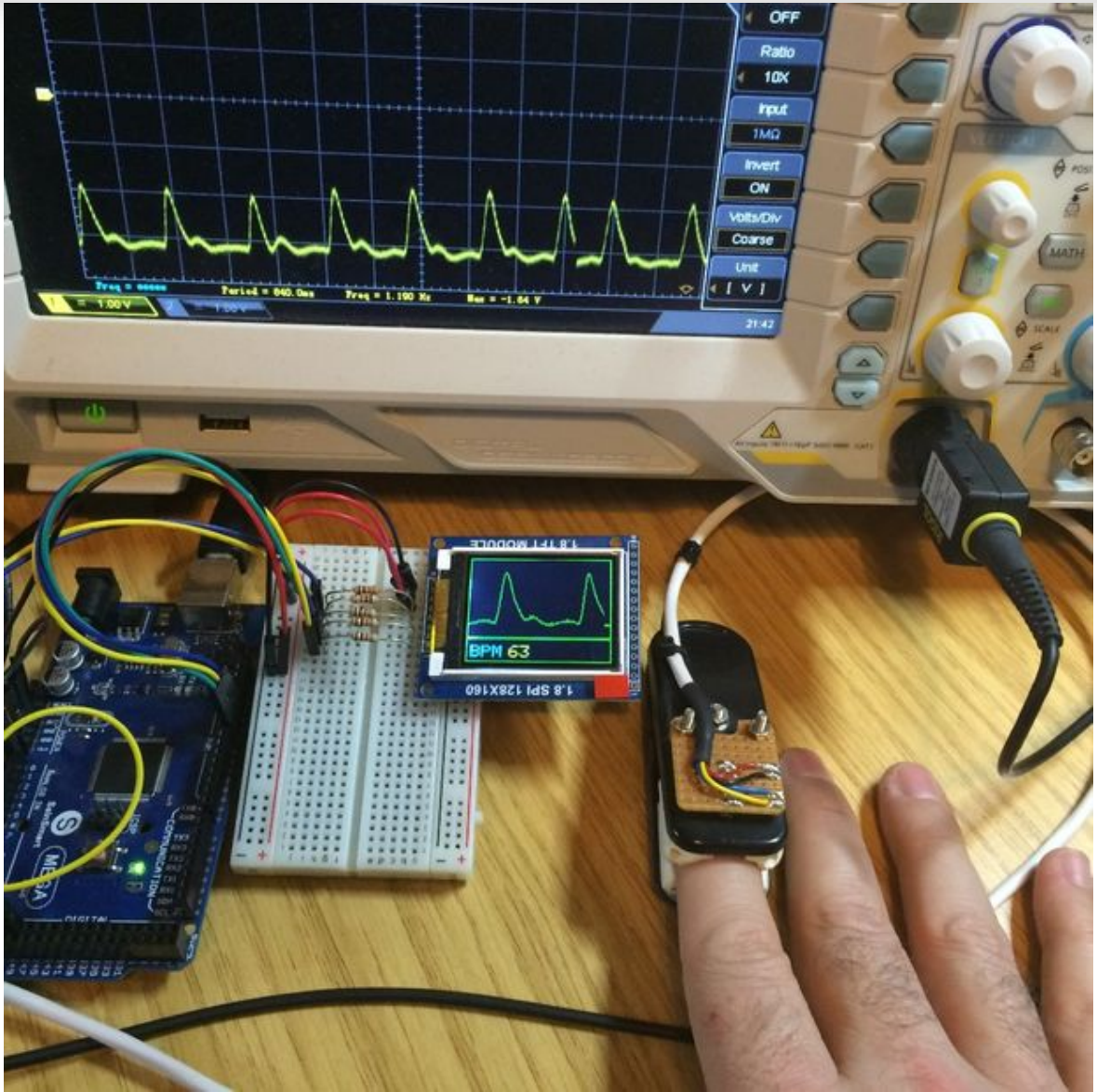
Example

Unit 9. Power supply

USB 2.0
5 V / 500 mA

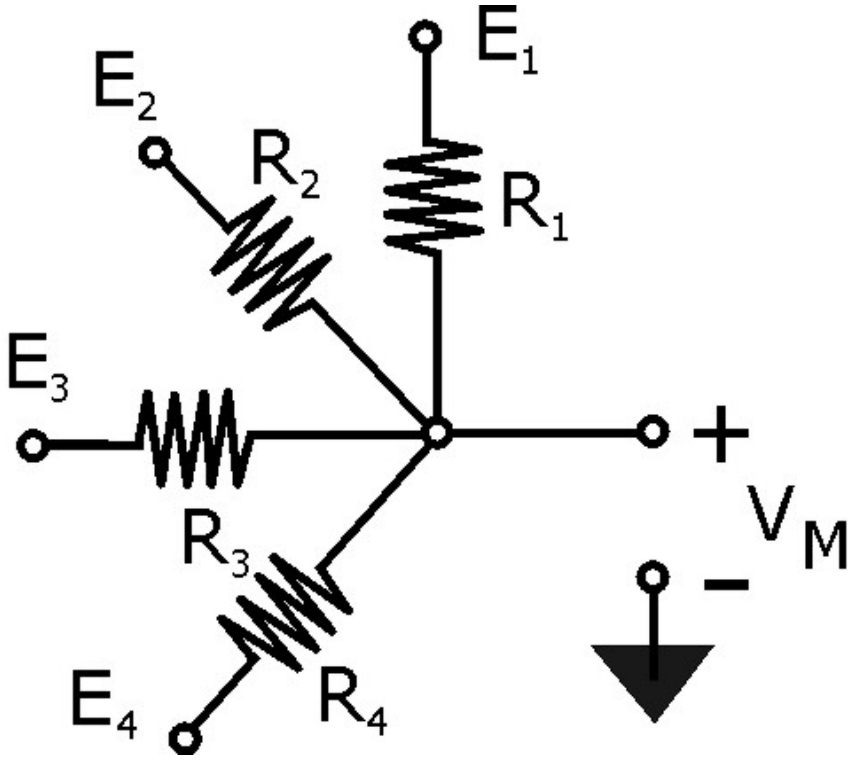
3 V / 160 mA·h

Example


OFF
Ratio
10X
Input
1MΩ
Invert
ON
Volts/Div
Coarse
Unit
[V]
MATH
BPM 63

Millman theorem

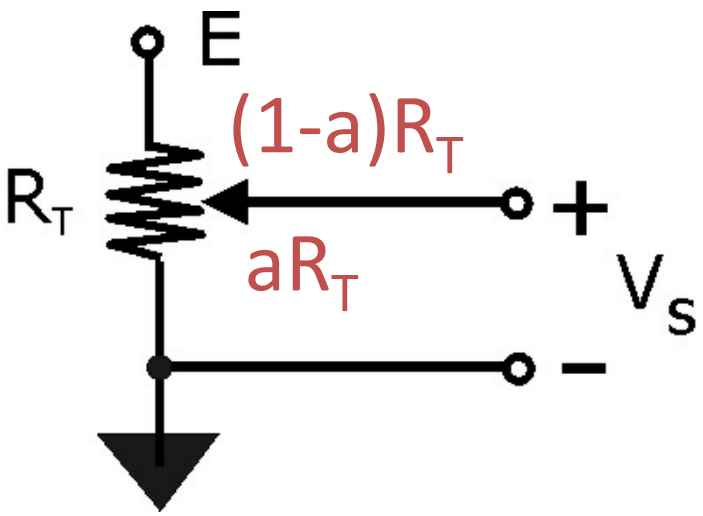
$$V_M = \frac{E_1/R_1 + E_2/R_2 + \ldots + E_n/R_n}{1/R_1 + 1/R_2 + \ldots + 1/R_n}$$



Particular case n=2:

$$V_M = \frac{E_1R_2 + E_2R_1}{R_1 + R_2}$$

Potentiometer



Exercise

For the circuit in the figure represent graphically the waveform of Vs if Ve is a sinusoidal wave of 1 V in amplitude and 50 Hz, R1=1 kΩ, R2=9 kΩ, R3=1 kΩ, the OA is supplied with ±15 V, and the Zener diode has the following features: Vz=5.6 V, V_γ=0.7 V.