UCLA Rocket Project Electronics Workshop 1

2016/10/07

Lessons is this workshop

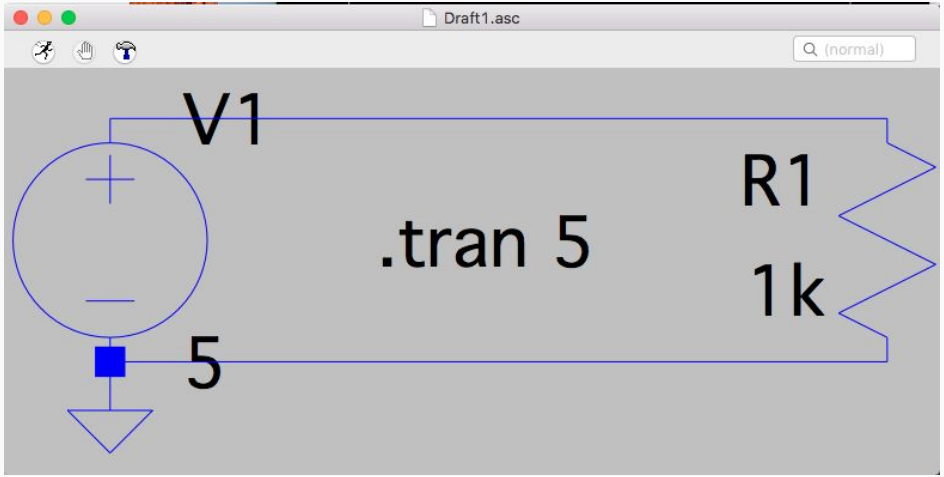
1. Basics electronics
2. Introduction to AVR programming
3. KiCad
4. Soldering
5. Arduino programming
6. Unix programming/Sockets in Unix

Digital electronics necessary concepts

1. Resistance
2. Power
3. Binary state of a pin
4. Capacitance
5. MOSFET/transistor
6. Operational Amplifier

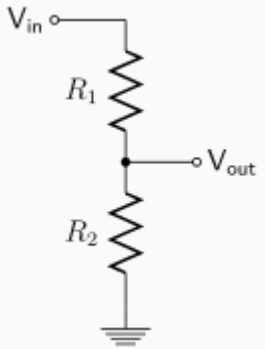
Tools available

Spice (numerical simulation) - graphical, cross-platform client: LTspice



1. Resistance - Voltage Divider

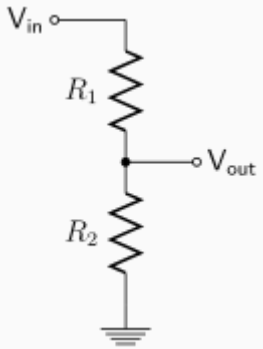
Finding Vout, Vin, R1, R2 for different configurations of given arguments



1. Resistance - Voltage Divider

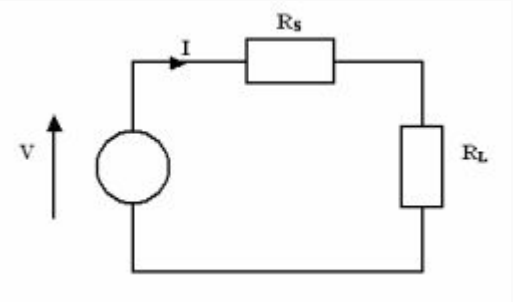
1. Vin = 5V, R1 = 1k, R2 = 4.7k; Vout = ?

2. Vin = 12V, R1 + R2 = 10k, Vout = 3.3V; R1 = ?, R2 = ?



2. Power - Maximum Power

Maximum power dissipated in RL



2. Power - Maximum Power

$I = V/(Rs + RL)$

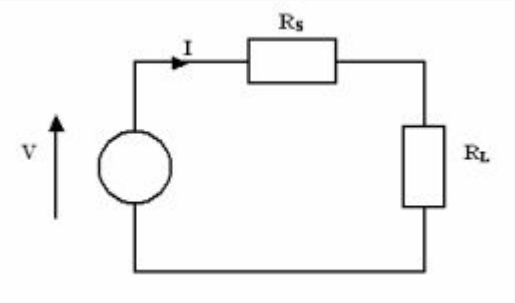
$PL = I^2 * RL$

$PL = V^2 * RL / (Rs + RL)^2$

$dPL/dRL = 0$ for PL max

$dPL/RL = 0 = 1 - 2 * RL / (RL + Rs)$

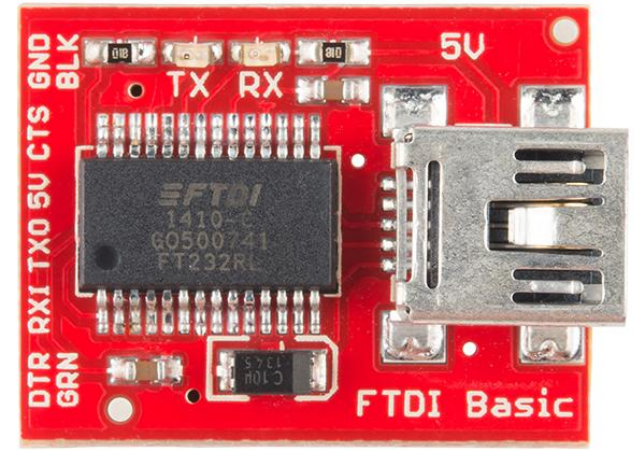
$2 * RL = RL + RS$ => **$RL = Rs$**



3. Binary State of a Pin

Digital Electronics Pin Types:

1. HIGH state (5V or 3.3V)
2. LOW state (Ground)
3. Information (time dependent changes between HIGH and LOW according to some information protocol [e.g. UART, SPI, I2C])

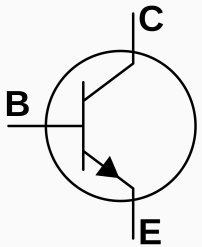


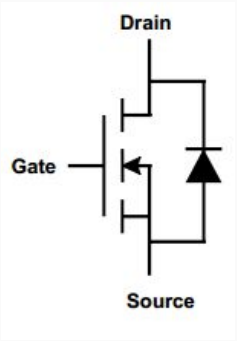
4. Capacitance - Backup Battery

1. In the world of digital electronics, transient response of a capacitor is uninteresting.
2. Microcontrollers, digital circuits, might have short large power consumption, which a chemical battery is not able to provide.
3. It is advisable to put a capacitor between Vcc and GND to provide the power during those spikes in power consumption.

5. MOSFET/Transistor

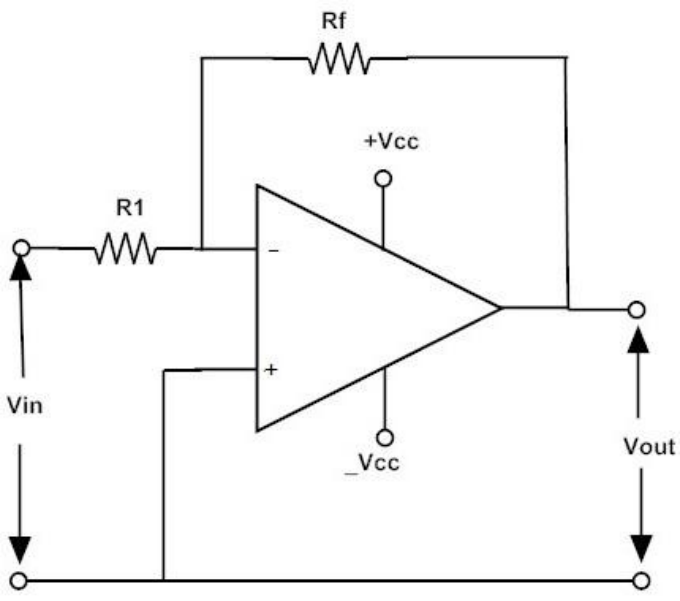
1. Transistor - current flow controller
   - ❏ Current flow from the collector (C) to the emitter (E) is proportional to current flow into the base (B) (in the range of operation)
   - ❏ Can be used to control large current flows using a small power source
2. MOSFET - electronic switch
   - ❏ “Binary” transistor - either full current flow from drain to source or no flow





6. Operational Amplifier

1. Ideal Operational Amplifier changes voltage on the output in order to make the voltage on the input lines (- +) become equal
   - ❏ Negative input (-) must be at GND voltage
   - ❏ Current flowing from the output to the negative input (-) must be equal to current flowing through R1 to the negative input (-)



Project plans for this year

1. Launch Box/Power box redesign (KiCad, Spice, AVR)
2. Visualization Software (Javascript)
3. Remote Rocket Arming (C/C++, AVR)
4. Test Sensing (C/C++, Javascript, Spice, AVR)
5. Ground Sensing (C/C++, Javascript, AVR)
6. Flight Model (C/C++, Python)
7. Payload collaboration (Radio, AVR)