IEEE - CSULB Branch
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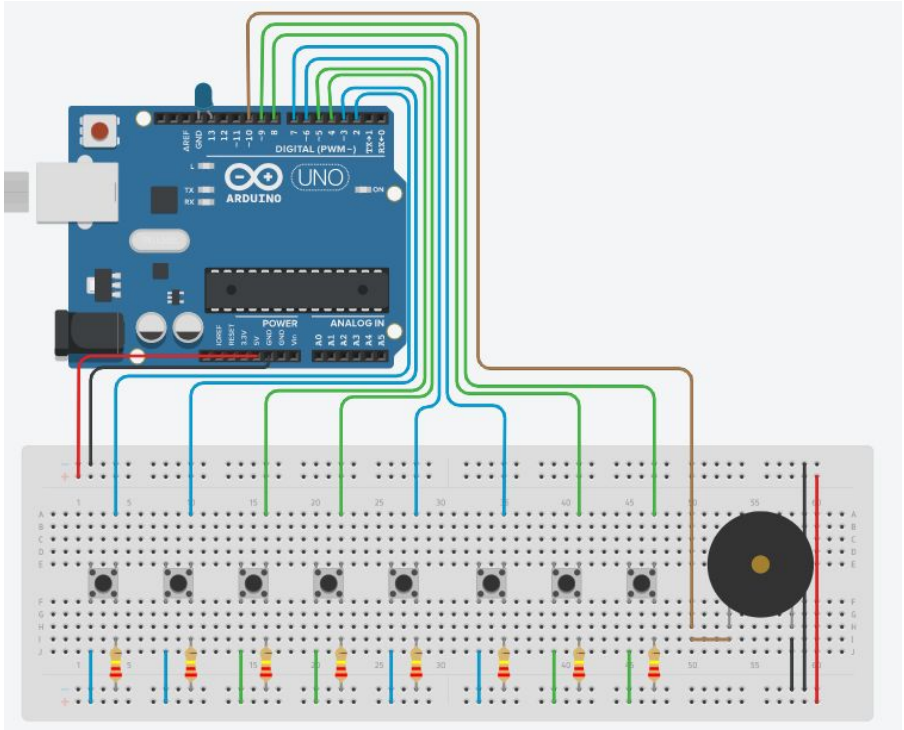
Agenda

- Project
- Kirchhoff's Laws
- Voltage Division
- Current Division
- OP Amp (Operational Amplifier)
- Switches
- Speakers

Project- Arduino Piano

- Sound Reactive Arduino Floor Piano
- Modules used
  - Arduino Uno/nano
- Components
  - Resistors
  - Jumper wires
  - Piezo

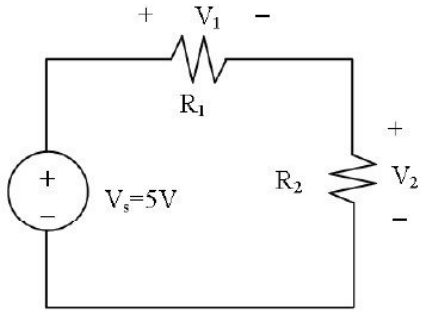


Voltage Division

- What is Voltage Division
- A way to determine the voltage for a component within a circuit
- Notice resistors are in series
  - V1 is the voltage for R1
  - V2 is the voltage for R2
  - Recall kirchoff's law of voltages, -Vs+V1+V2=0
  - Or V1+V2=Vs

$$V_1 = \frac{R_1}{R_1 + R_2} V_S$$

$$V_2 = \frac{R_2}{R_1 + R_2} V_S$$

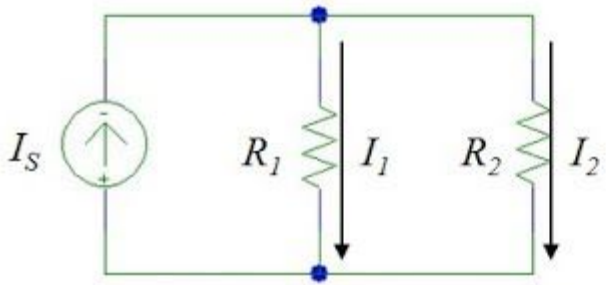


Current Division

- What is Current Division
  - A way to determine the voltage for a component within a circuit
  - Notice resistors are in parallel
    - I1 is the current for R1
    - I2 is the current for R2
    - Recall kirchoff's law of current at top node, -Is+I1+I2=0
    - Or I1+I2=Is

Current Division Rule

- To calculate the current going through each resistor, use the following equations:

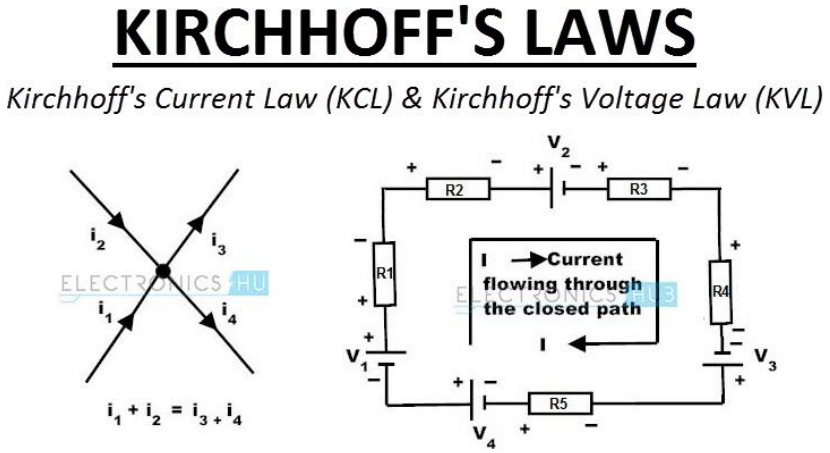


$$I_1 = \frac{R_2}{R_1 + R_2} I_S$$

$$I_2 = \frac{R_1}{R_1 + R_2} I_S$$

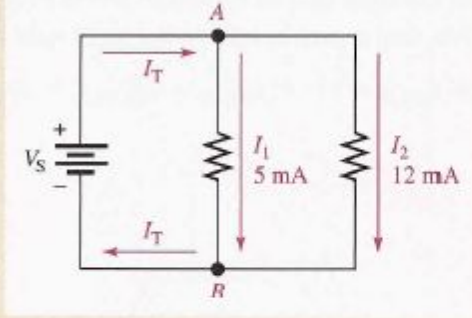
Kirchhoff’s Law - current

- What is Kirchhoff's Current Law
- The net sum of current going through a node is equal to 0.
- i1+i2-i3-i4=0
- Notice sign of corresponding current is related to direction of current arrow.
- i1 and i2 are going towards node
- i3 and i4 are going away from node
- i1 and i2 are positive, i3 and i4 are negative



Kirchhoff's Law of Current - Continued (Example)

- Apply Kirchhoff's law of Current at node A
  - iT-i1-i2=0
- Substitute the given values
  - iT-5-12=0
- Solve for iT
  - iT=17



The total current out of node A is the sum of the two branch currents. So the total current into node A is

$$I_T = I_1 + I_2 = 5\,\text{mA} + 12\,\text{mA} = \mathbf{17\,mA}$$

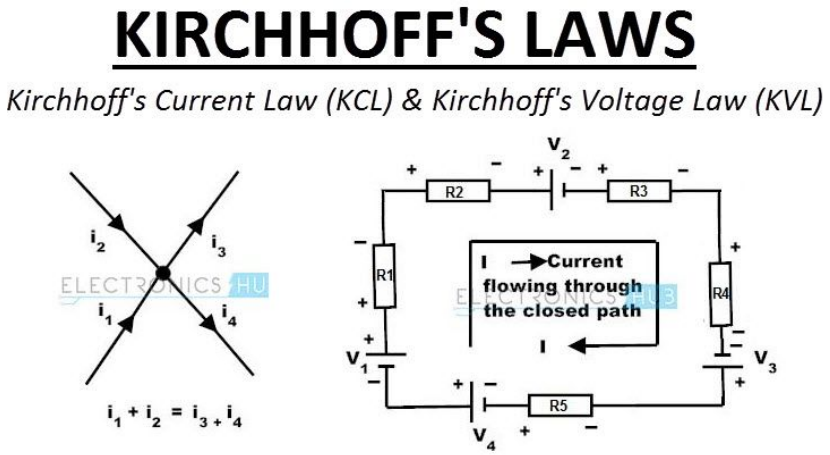
The total current entering node B is the sum of the two branch currents. So the total current out of node B is

$$I_T = I_1 + I_2 = 5\,\text{mA} + 12\,\text{mA} = \mathbf{17\,mA}$$

Note that this equation can be equivalently expressed as $I_T - I_1 - I_2 = 0$.

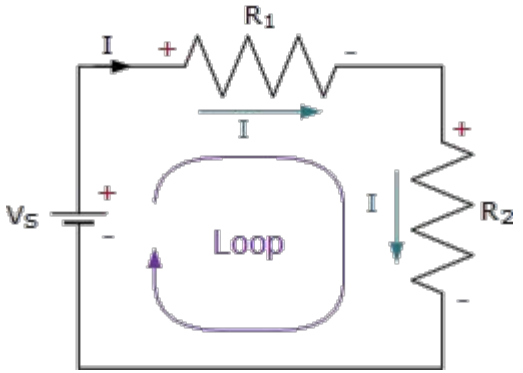
Kirchhoff’s Law - voltage

- What is Kirchhoff's Voltage Law
  - Voltage law
- The net sum of voltage going through closed loop is equal to 0.
- Ex:
- -v1+v2-v3+v4=0
- Notice sign of corresponding voltage is first sign seen going in clockwise direction.
- v1 and v3 are negative, v2 and v4 are positive



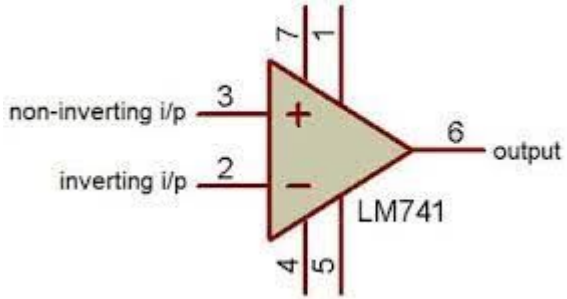
Kirchhoff's Law of Voltage - Continued (Example)

- Formula
  - Vs + (-IR1) + (-IR2) = 0
  - Vs = IR1 + IR2
- Factor
  - Vs = I(R1 + R2)
- Solve
  - Vs = IRt
  - Rt = R1 + R2
  - I = Vs / Rt = Vs / R1 +R2
  - Vr1 = IR1 = Vs (R1 / R1 + R2)
  - Vr2 = IR2 = Vs (R2 / R1 + R2)



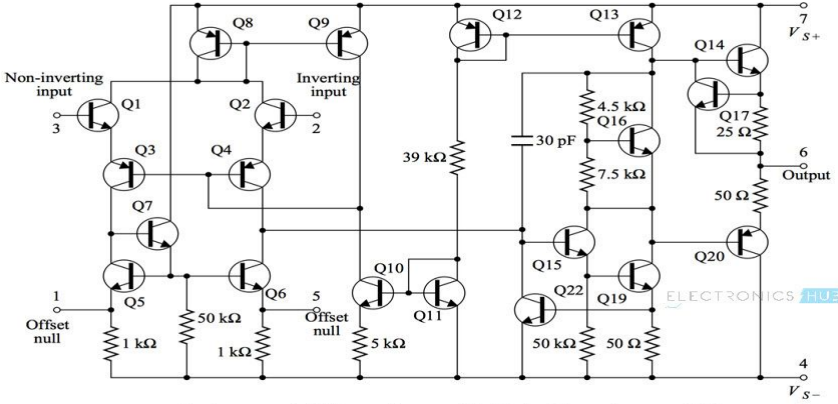
Operational Amplifier (OP Amp)

- What is an OP Amp
  - A voltage amplifying device
- What an OP Amp can do ?
  - It can amplify weak electric signals
  - Used with external feedback components
    - Resistors
    - Capacitor



Operational Amplifier (OP Amp) - Continued

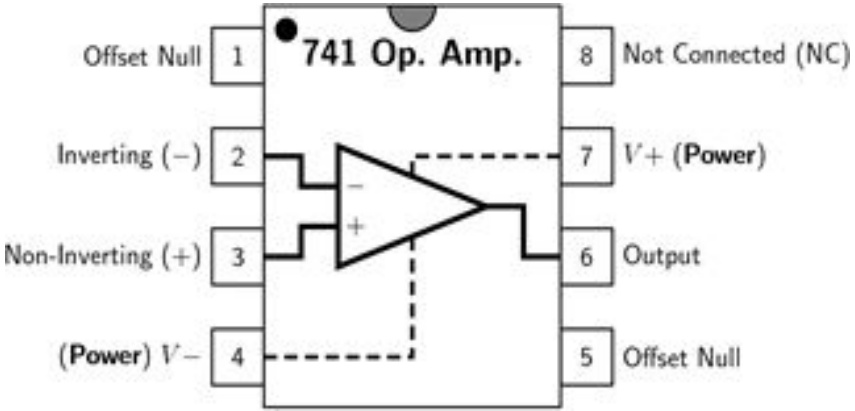
- LM741 IC Chip
  - 20 transistor
  - 11 resistor



Internal Circuitry of 741 Op-Amp IC

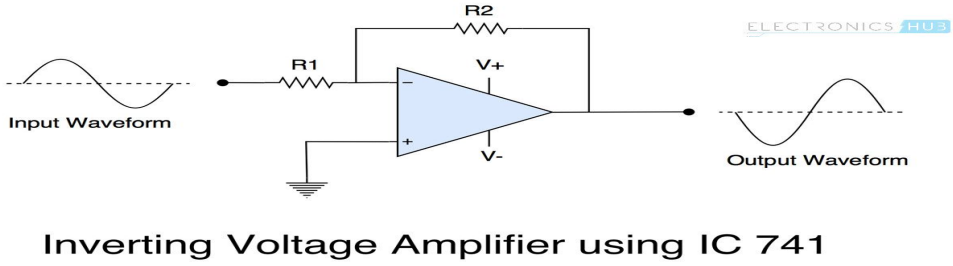
Operational Amplifier (OP Amp) - Continued

- Pin Configuration
  - 8-Pin layout
  - Notice there are two inputs, inverting input(pin 2), and non-inverting input(pin 3)

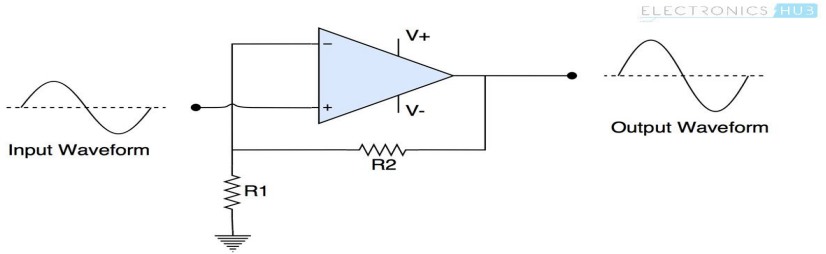


Operational Amplifier (OP Amp) - Continued

- Formulas
  - Inverting Amplifier Circuit Using 741 Op Amp
    - (AV) = -(R2 / R1)
  - Non-Inverting Amplifier Circuit Using 741 Op Amp
    - (AV) = 1 + (R2 / R1)



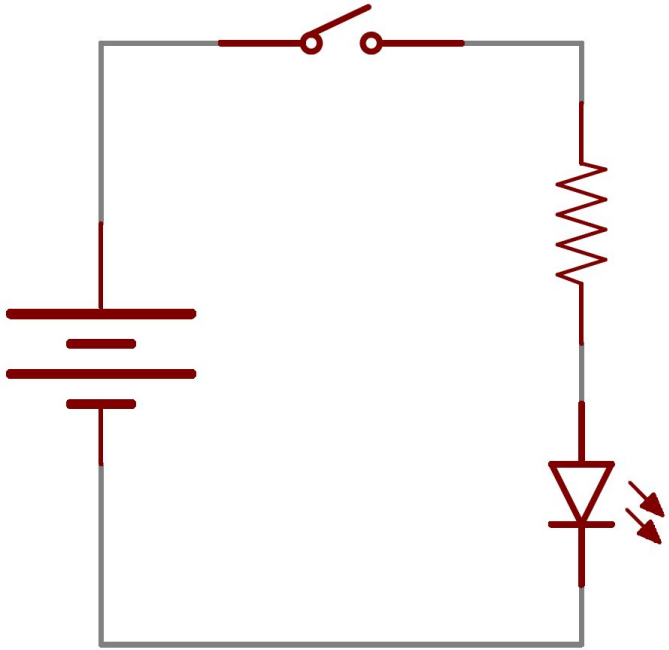
Inverting Voltage Amplifier using IC 741



Non-Inverting Voltage Amplifier using IC 741

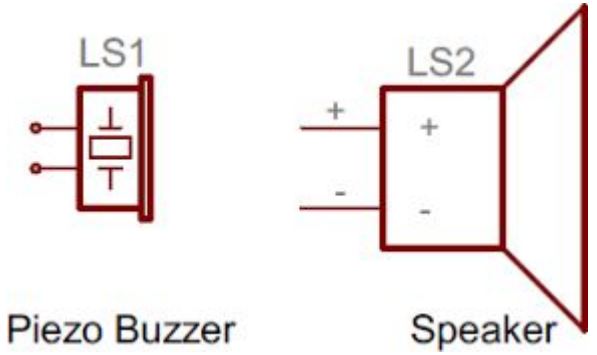
Switches (Push-Buttons)

- When a switch is closed, current is allowed to go through the pathway to allow the led diode to turn on
- When a switch is open, no current is able to go through the pathway, so the led diode is off.
- A switch is open or closed by pushing down on the button



Speakers

- What are speakers?
  - one of the most common output devices used by listeners
  - Produces audio output
  - convert electromagnetic waves into sound waves
  - Receive audio input
    - Digital
    - Analog



Speakers-continued

- How speakers work
  - 

References

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