RESEARCHING PROJECT

" SOIL PH METER DESIGN "

[5TH WEEK REPORT]

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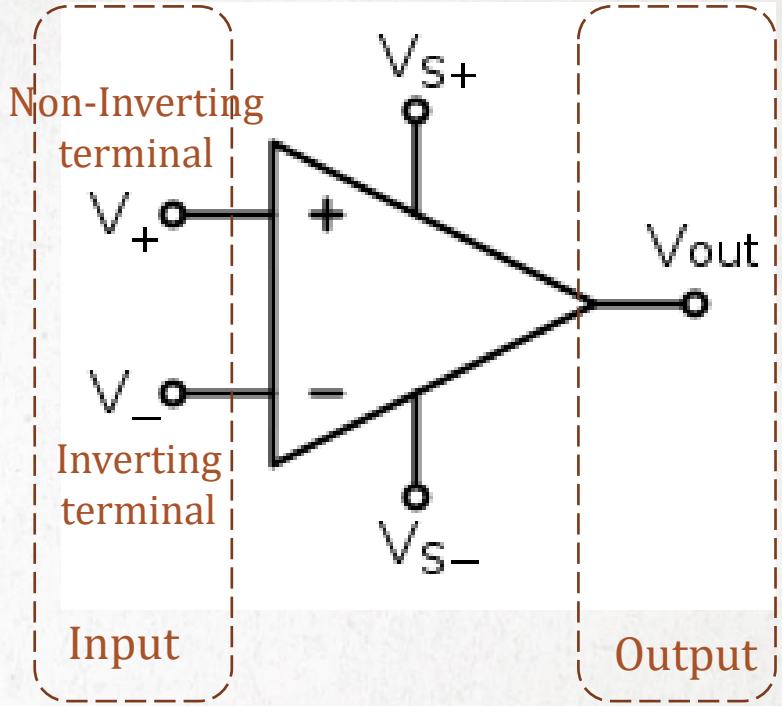
2019-2020

OUTLINE

- Operational amplifier Summary:
  - Inverting Op-Amp
  - Non-Inverting Op-Amp
  - Summing amplifier
  - Differential amplifier
  - Op-amp as Integrator
  - Op-amp as Differentiator
- Next step of project:
  - choosing Sensor and LCD
  - Design PCB
  - Testing hardware
  - Learn STM32 coding
  - Drawing Case for hardware
- Missing and difficulty

OPERATIONAL AMPLIFIER SUMMARY

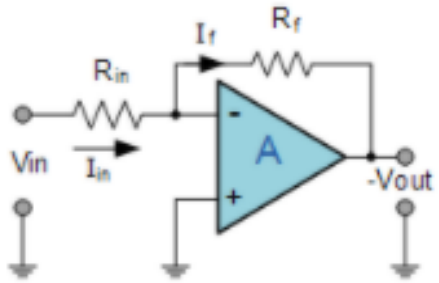
- OP-AMP can be ideal amplifier with infinite Gain and Bandwidth when used in the open-loop mode with typical DC gain of well over 100dB or 100,000.
- The basic of OP-AMP construction is of a 3 terminal device, with 2-inputs and 1-output.
- OP-AMP operate from either a dual positive (V_{s+}) and a corresponding negative(V_{s-})supply, and they can operate from a single DC supply voltage.
- The two main laws associated with the operational amplifier are that it has an infinite input impedance(Z=∞) resulting in "No current flowing into either of its two inputs" and zero input offset voltage V+ = V-.
- OP-AMP also has zero output impedance, (Z = 0).
- Op-amps sense the difference between the voltage signals applied to their two input terminals and then multiply it by some pre-determined Gain, (A).
- This Gain, (A) is often referred to as the amplifiers "Open-loop Gain".
- Op-amps can be connected into two basic configurations, **Inverting** and **Non-inverting**.



OPERATIONAL AMPLIFIER SUMMARY

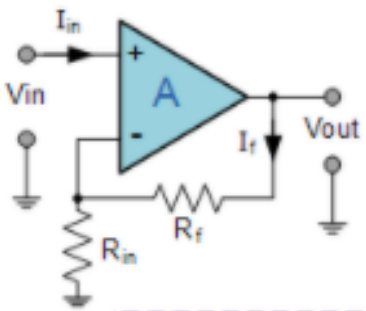
The Two Basic Operational Amplifier Circuits

Inverting Op-amp



$$A = \frac{Vout}{Vin} = -\frac{Rf}{Rin}$$

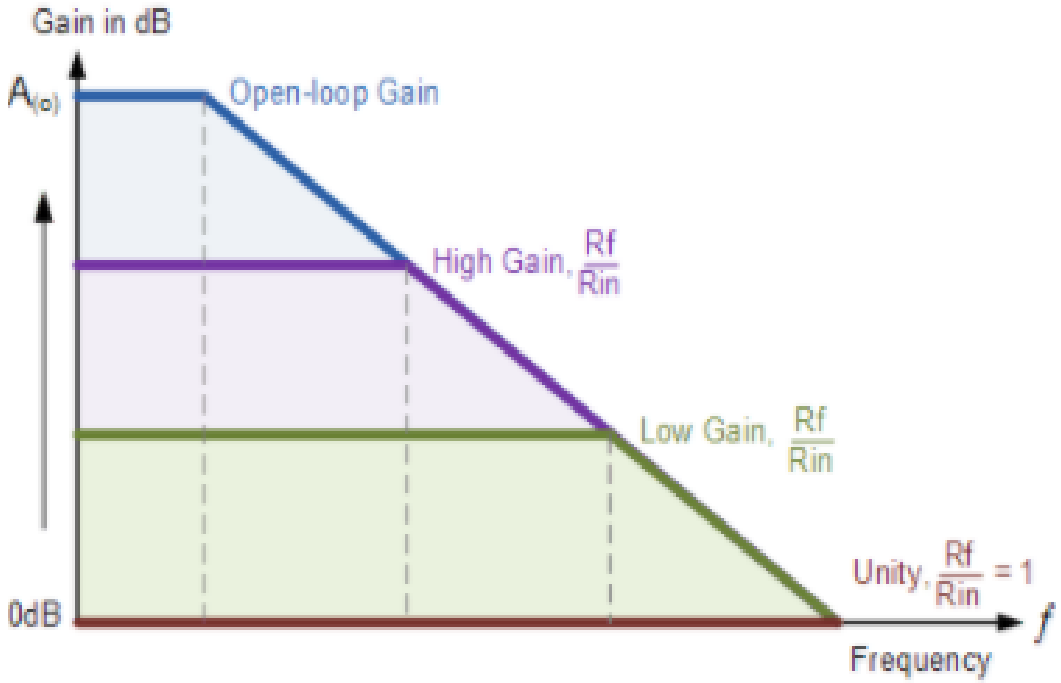
Non-inverting Op-amp



$$A = \frac{Vout}{Vin} = 1 + \frac{Rf}{Rin}$$

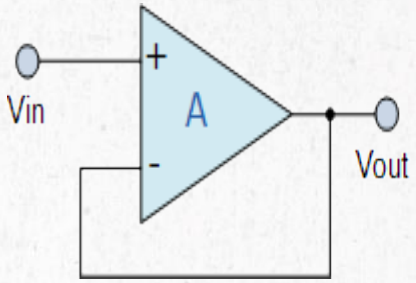
- For **negative feedback**, were the fed-back voltage is in "anti-phase" to the input the overall gain of the amplifier is reduced.
- For **positive feedback**, were the fed-back voltage is in "Phase" with the input the overall gain of the amplifier is increased.
- By connecting the output directly back to the negative input terminal, 100% feedback is achieved resulting in a **Voltage Follower** (buffer) circuit with a constant gain of 1 (Unity).
- Changing the fixed feedback resistor (Rf) for a Potentiometer, the circuit will have Adjustable Gain.

Operational Amplifier Gain



- The Open-loop gain called the **Gain Bandwidth Product**, or (GBP) can be very high and is a measure of how good an amplifier is.
- Very high GBP makes an operational amplifier circuit unstable as a micro volt input signal causes the output voltage to swing into saturation.
- By the use of a suitable feedback resistor, (Rf) the overall gain of the amplifier can be accurately controlled.

OPERATIONAL AMPLIFIER SUMMARY

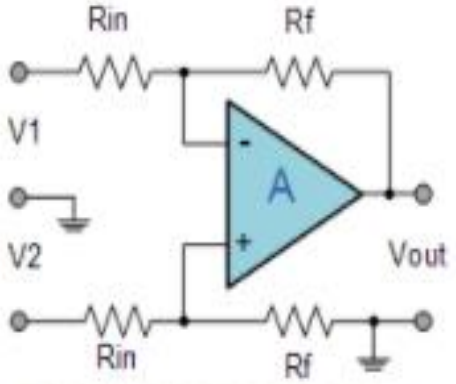


Vout = Vin
Voltage Gain = +1

DIFFERENTIAL AND SUMMING AMPLIFIER

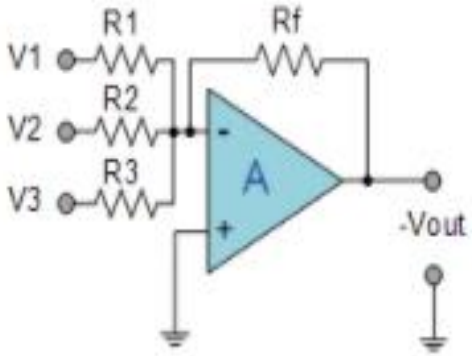
Differential and Summing Amplifiers

Differential Op-amp



$$Vout = \frac{Rf}{Rin}(V2 - V1)$$

Summing Op-amp



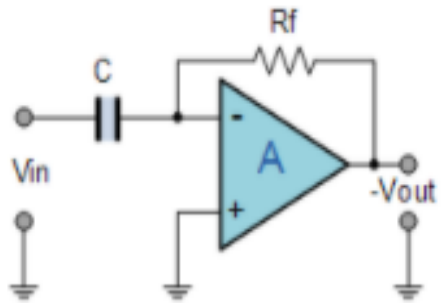
$$Vout = -\left(\frac{Rf}{R1}V1 + \frac{Rf}{R2}V2 + \frac{Rf}{R3}V3\right)$$

- By adding more input resistors to either the inverting or non-inverting inputs **Voltage Adders** or **Summers** can be made.
- Voltage follower op-amps can be added to the inputs of Differential amplifiers to produce high impedance Instrumentation amplifiers.
- The **Differential Amplifier** produces an output that is proportional to the difference between the two input voltages.

OPERATIONAL AMPLIFIER SUMMARY

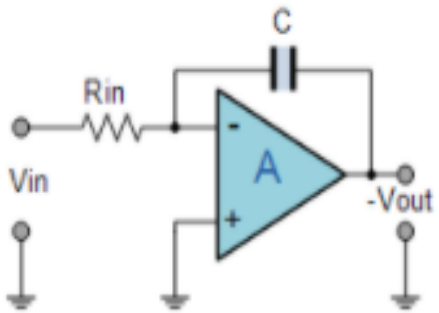
Differentiator and Integrator Operational Amplifier Circuits

Differentiator Op-amp



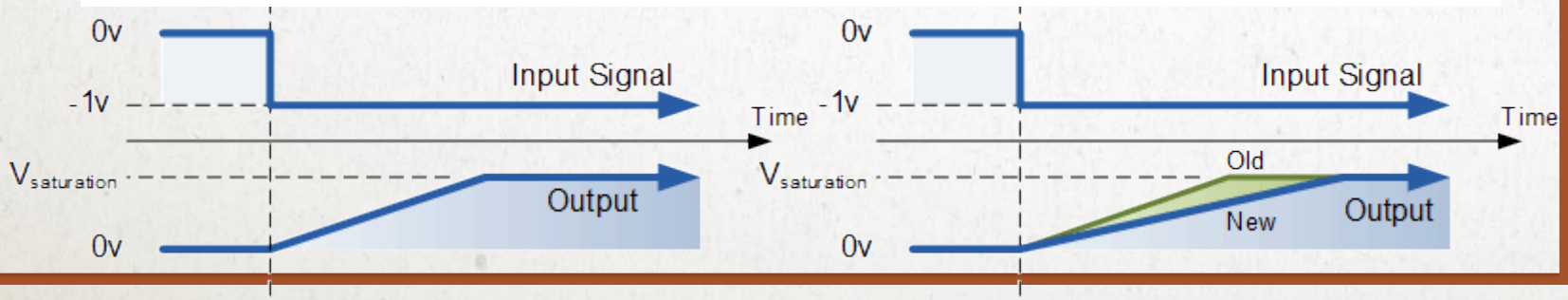
$$Vout = -Rf\,C\,\frac{dVin}{dt}$$

Integrator Op-amp

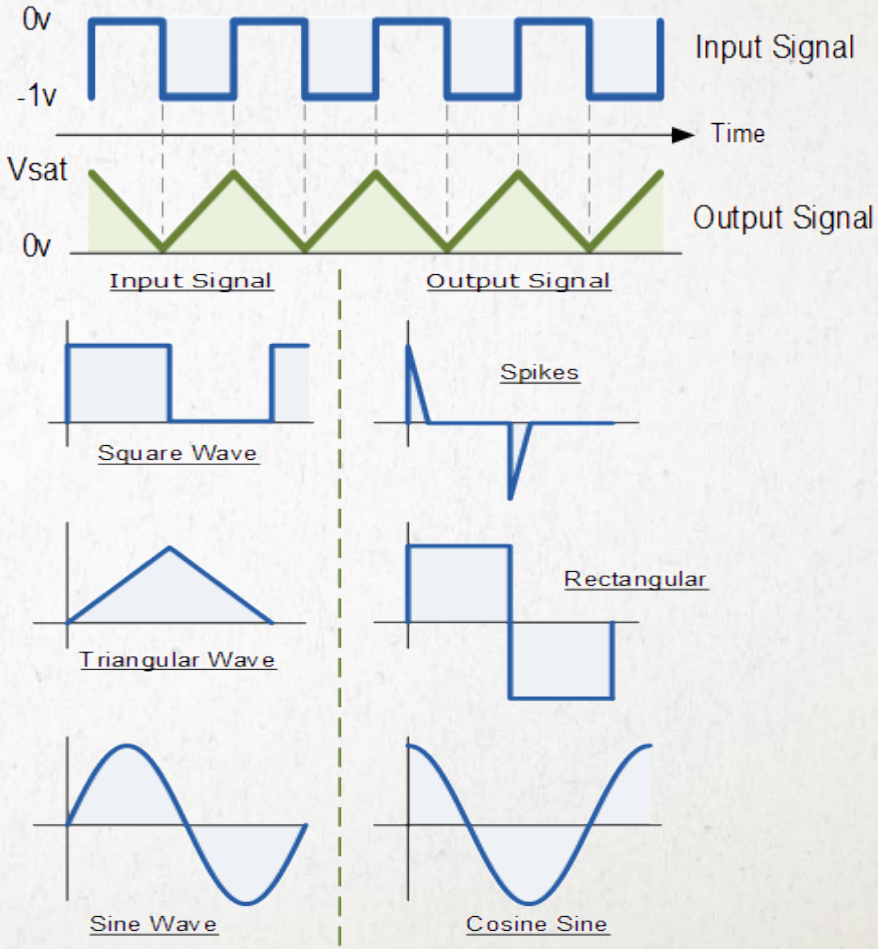


$$Vout = -\frac{1}{j\omega RinC}Vin$$

- The **Integrator Amplifier** produces an output that is the mathematical operation of integration.
- The **Differentiator Amplifier** produces an output that is the mathematical operation of differentiation.
- Both the Integrator and Differentiator Amplifiers have a resistor and capacitor connected across the op-amp and are affected by its RC time constant.

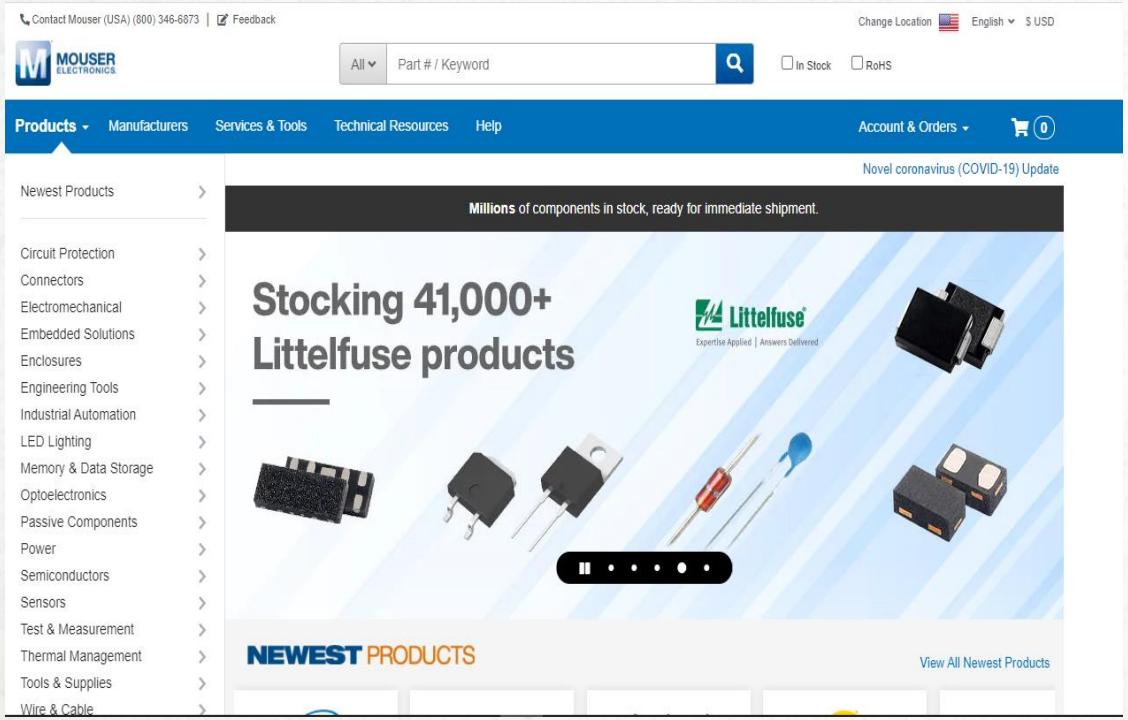


OPERATIONAL AMPLIFIER SUMMARY

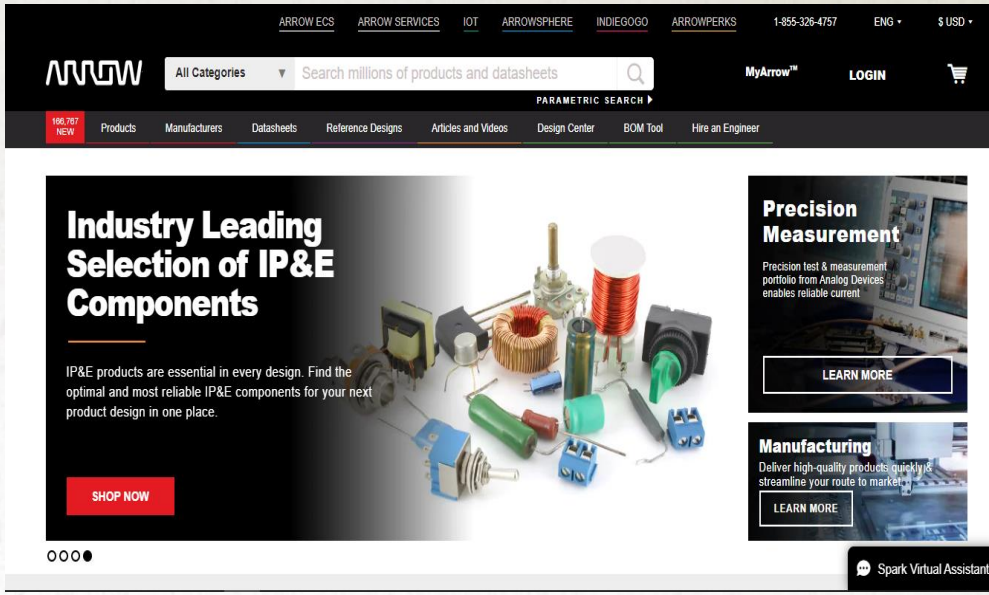


NEXT STEP OF PROJECT

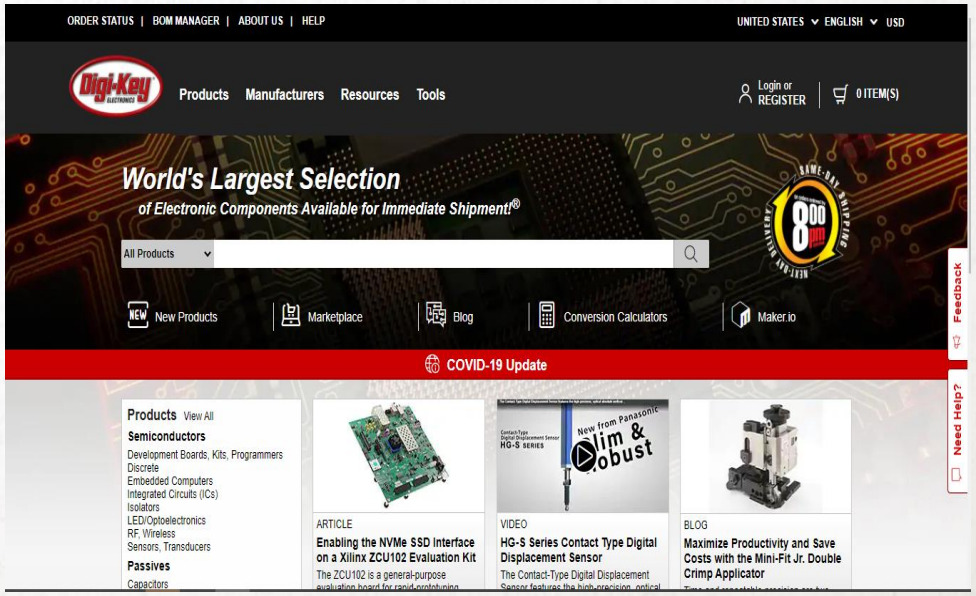
- **Choosing Sensor and LCD:**
  - Search company that produce PH meter
  - Search model of sensor
  - Read datasheet or spec of sensor
  - Search website for buy that sensor



https://www.mouser.com/



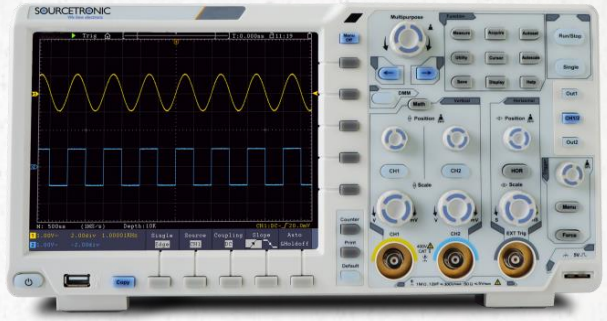
https://www.arrow.com/



https://www.digikey.com/

NEXT STEP OF PROJECT

- **Design PCB:**
  - Use KiCad for design PCB
  - Design an Amplifier and a filter Circuit
- **Testing Hardware:**
  - After finish of design PCB already we must test it in oscilloscope to make sure it work clearly or not.
- **Learn STM32 code:**
  - Use STM32CubeIDE 1.3.0
  - Learn how to use ADC of STM32
  - Learn how to use Display with STM32
  - Integrate code in STM32
- **Assemble and Install STM32 with Circuit on PCB:**
  - Testing STM32 with sensor and LCD
- **Drawing and print case for hardware:**
  - Use Fusion 360 for draw case.
  - Use 3D printer for print.



DIFFICULTY AND MISSING

- Difficulty :
  - Hard to research about PH sensor.
- Missing:
  - Lately work

PLANNING FOR 2ND MONTH

Week	Monday	Tuesday	Wednesday	Thursday	Friday	Goal
5th Week	Build Filter pH & LCD	Meeting Build Filter	Filter Build filter	Presentation Build Amp	Build Amplifier	Design Amplifier
6th Week	Build Amplifier	Meeting Learn stm32	Learn STM32 Test LCD/pH	Presentation Write Code	Write Code STM32	Start STM32
7th Week	Write Code STM32	Meeting Write Code	Write Code STM32	Presentation Write code	Finish STM32 Code	Finish STM32 Code
8th Week	Draw case for hardware	Meeting Draw case	Draw case for hardware	Presentation Draw case	Print 3D case	Build case Finish Job

Start : ***06/09/2020***

THANK YOU