



SNS COLLEGE OF ENGINEERING

Kurumbapalayam (Po), Coimbatore – 641 107

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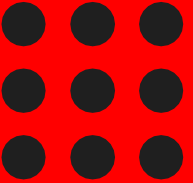
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE NAME : 19EE101-BASIC ELECTRICAL & ELECTRONICS ENGINEERING

I YEAR /I SEMESTER CSE & CST

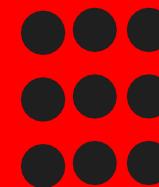
Unit 5: Linear and Digital Electronics

Topic : Introduction to Operational Amplifier





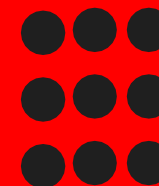
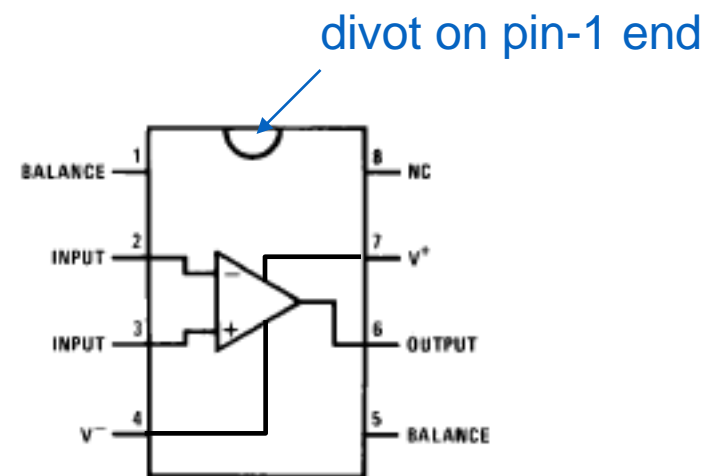
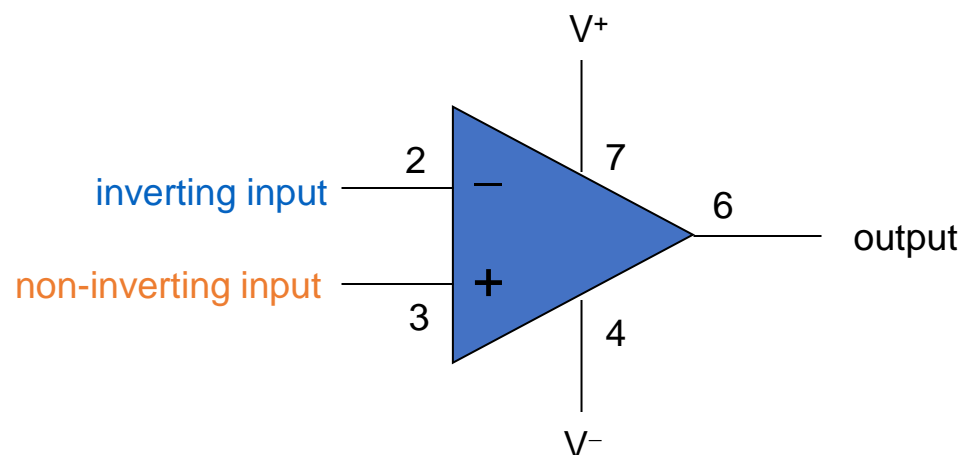
GRADUATE ATTRIBUTES





OPERATIONAL AMPLIFIER

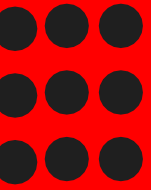
- Op-amps (amplifiers/buffers in general) are drawn as a triangle in a circuit schematic
- There are two inputs
 - **inverting** and **non-inverting**
- And one output
- Also power connections (note no explicit ground)





OPERATIONAL AMPLIFIER

- Infinite voltage gain
 - a voltage difference at the two inputs is magnified infinitely
 - in truth, something like 200,000 means difference between + terminal and – terminal is amplified by 200,000!
- Infinite input impedance
 - no current flows into inputs
 - in truth, about $10^{12} \Omega$ for FET input op-amps
- Zero output impedance
 - rock-solid independent of load
 - roughly true up to current maximum (usually 5–25 mA)
- Infinitely fast (infinite bandwidth)
 - in truth, limited to few MHz range
 - slew rate limited to 0.5–20 V/ μ s



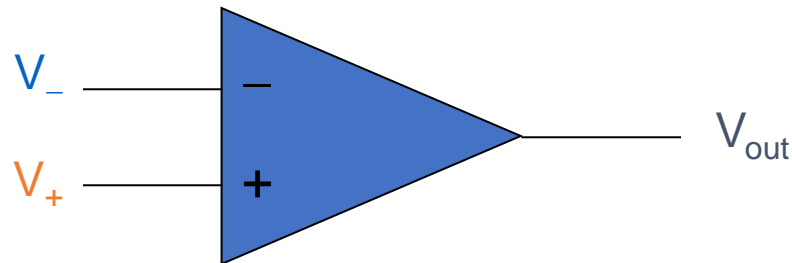


OPERATIONAL AMPLIFIER WITHOUT FEEDBACK

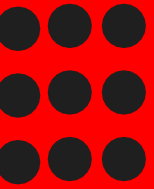
- The internal op-amp formula is:

$$V_{\text{out}} = \text{gain} \times (V_{+} - V_{-})$$

- So if V_{+} is greater than V_{-} , the output goes positive
- If V_{-} is greater than V_{+} , the output goes negative



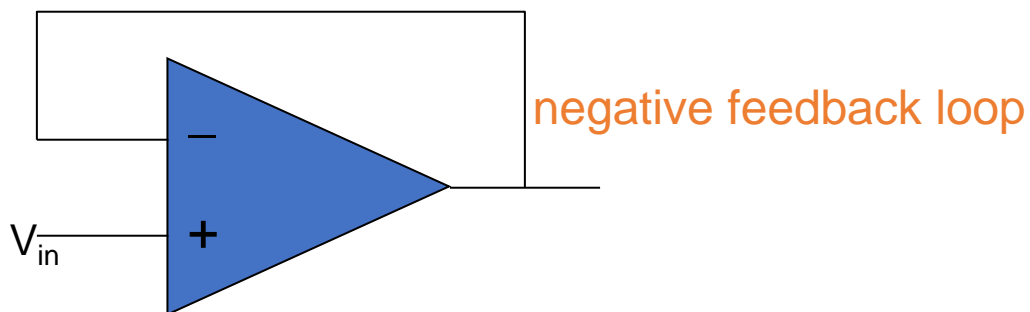
- A **gain** of 200,000 makes this device (as illustrated here) practically useless





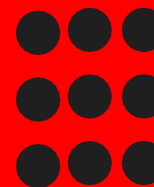
OPERATIONAL AMPLIFIER WITH NEGATIVE FEEDBACK

- Infinite gain would be useless except in the self-regulated negative feedback regime
 - **negative feedback** seems bad, and **positive** good—but in electronics **positive feedback** means runaway or oscillation, and **negative feedback** leads to stability
- Imagine hooking the output to the inverting terminal:
- If the output is less than V_{in} , it shoots positive
- If the output is greater than V_{in} , it shoots negative
 - result is that output quickly forces itself to be exactly V_{in}

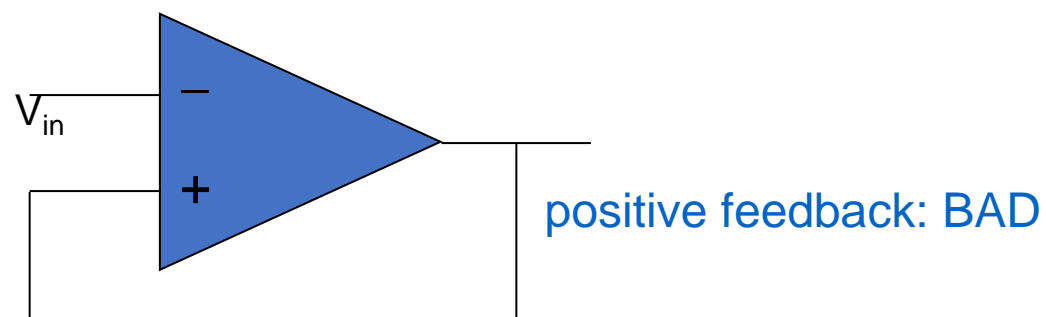




OPERATIONAL AMPLIFIER



- In the configuration below, if the + input is even a smidge higher than V_{in} , the output goes way positive
- This makes the + terminal even *more* positive than V_{in} , making the situation worse
- This system will immediately “rail” at the supply voltage
 - could rail either direction, depending on initial offset





REFERENCES

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3. Mehta V K, Mehta Rohit, “Principles of Electrical Engineering and Electronics”, S.Chand & Company Ltd, (2010)- UNIT I and II
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THANK YOU

