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23ECT203 - LINEAR INTEGRATED CIRCUITS

General operational amplifier
stages -and internal circuit
diagrams of IC 741

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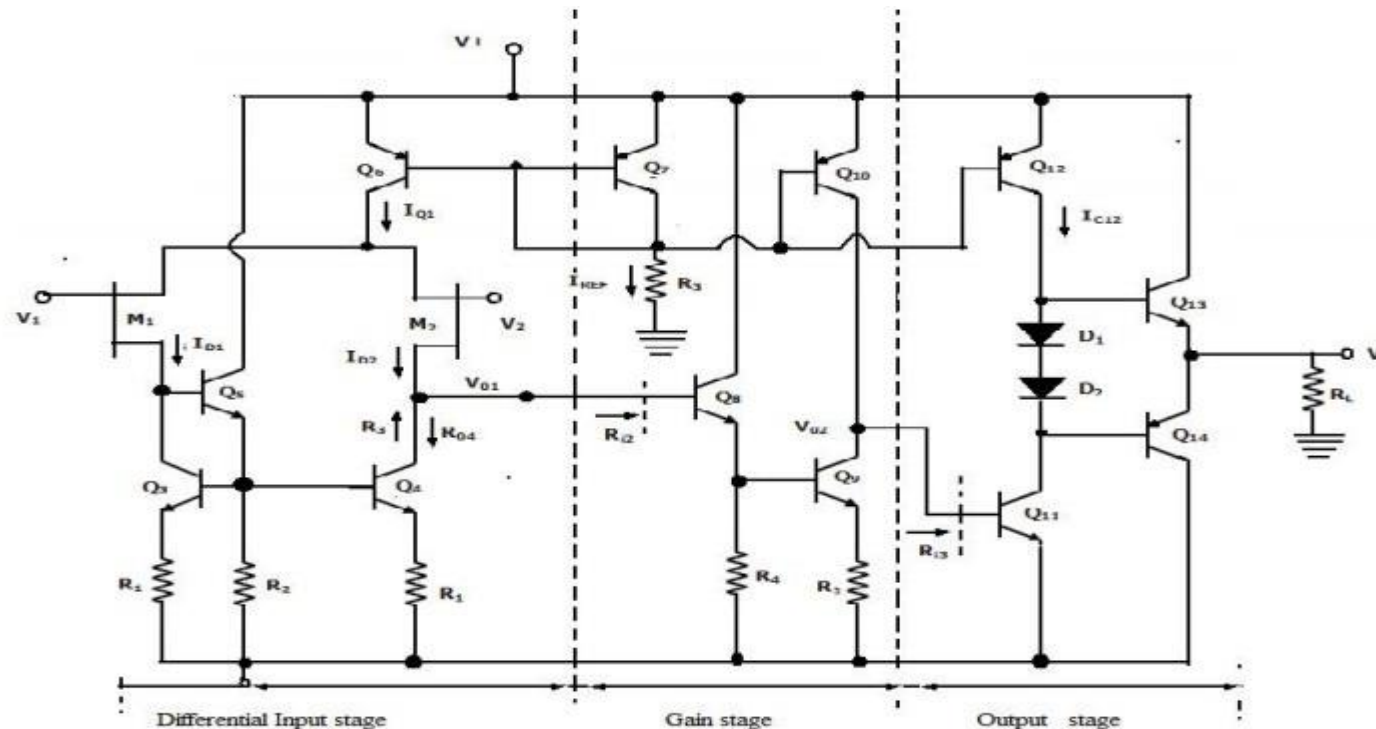
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A typical IC 741 is constructed with a circuit that is included with 11 resistors and 20 transistors. All these transistors and resistors are assimilated and connected as a single monolithic chip. With the below-portrayed image, the component's internal connections can be easily understood.





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- Here, for the transistors, Q1 and Q2, the inverting and non-inverting inputs are connected correspondingly. Both the Q1 and Q2 transistors function as NPN emitters where these outputs are connected to a couple of Q3 and Q4 transistors. These Q3 and Q4 operate as common-base amplifiers. This type of configuration isolates the inputs that have a connection with Q3 and Q4 and so eliminates likely signal feedback which might take place.
- The voltage fluctuations that take place at the operational amplifier inputs might show an impact on the internal circuit current flow and also impacts the effective functional range of any transistor that is in the circuit. So, to eliminate this from taking place, there has been the implementation of two current mirrors. The transistor pairs (Q8, Q9) and (Q12, Q13) are connected in a way to form mirror circuits.





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- As Q8 and Q12 transistors are the regulating transistors, they set the voltage level at the EB junction for their corresponding pair of the transistor. This voltage level can be accurately regulated to some decimals of millivolts and this accuracy permits only necessary current flow to the circuit.
- One mirror circuit which is developed by Q8 and Q9 is fed to the input circuit whereas the other mirror circuit developed by Q12 and Q13 is fed to the output circuit. Also, the other mirror circuit which is the third one formed by Q10 and Q11 functions as an increased impedance connection between the -ve supply and input. This connection offers a reference level of voltage showing no loading effect on the input circuit.





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- The transistor Q6 together with 4.5K and 7.5K resistors will be developed into a voltage level shifter circuit that decreases the voltage level from the amplifier circuit at the input section by V_{in} before it gets passed to the next circuit. This is achieved to eliminate any kind of signal variations at the output amplifier section. Whereas Q22, Q15, and Q19 transistors are designed to function as class A amplifier and the Q14, Q20, and Q17 transistors develop as output phase of the 741 Op Amp.
- In order to remove any kind of abnormalities at the input phase of the differential circuit, then Q5, Q6, and Q7 transistors are employed to form a configuration that has Offset null +ve and -ve and levels inverting and non-inverting inputs correspondingly.





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- **Input stage**

- A differential amplifier that provides the majority of the voltage gain and sets the input resistance

- **Intermediate stage**

- A differential amplifier that provides additional amplification to achieve the required gain

- **Output stage**

- An emitter-follower or source follower that provides current gain and low output resistance





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- The input stage amplifies the voltage difference between the inverting and non-inverting terminals.
- The intermediate stage provides additional amplification to ensure the required gain is achieved.
- The output stage provides the final amplification and usually has a push-pull configuration.





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Thank
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