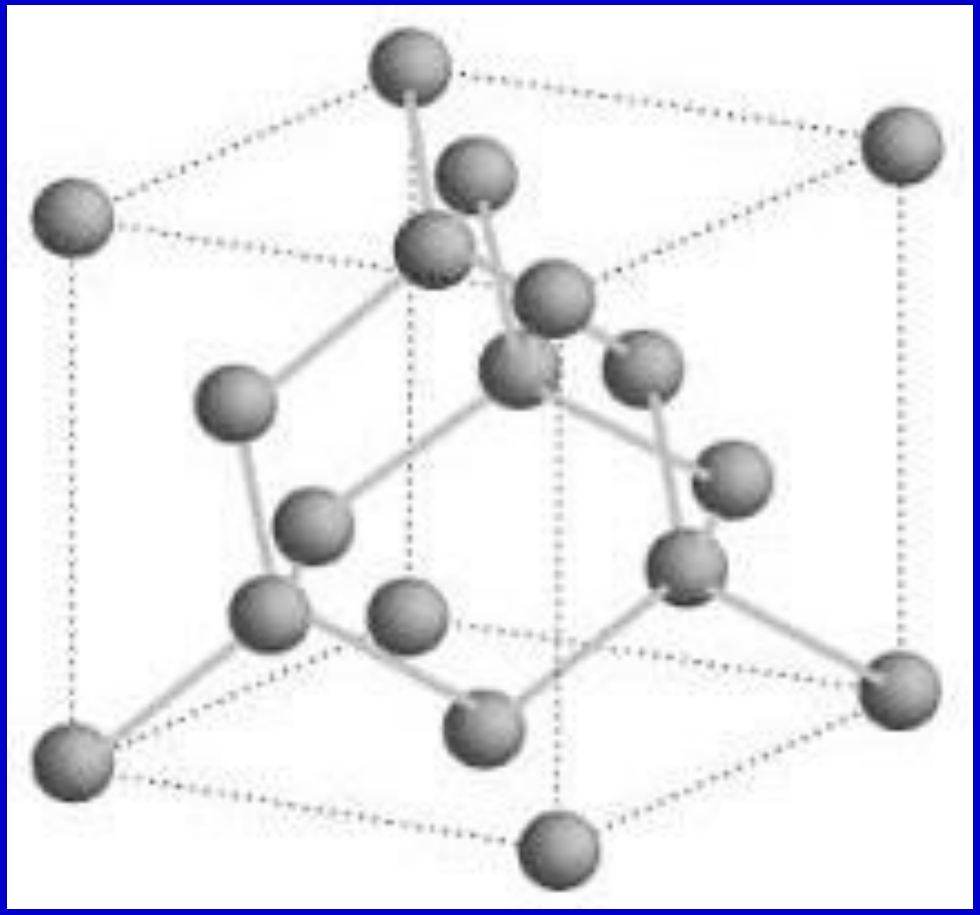
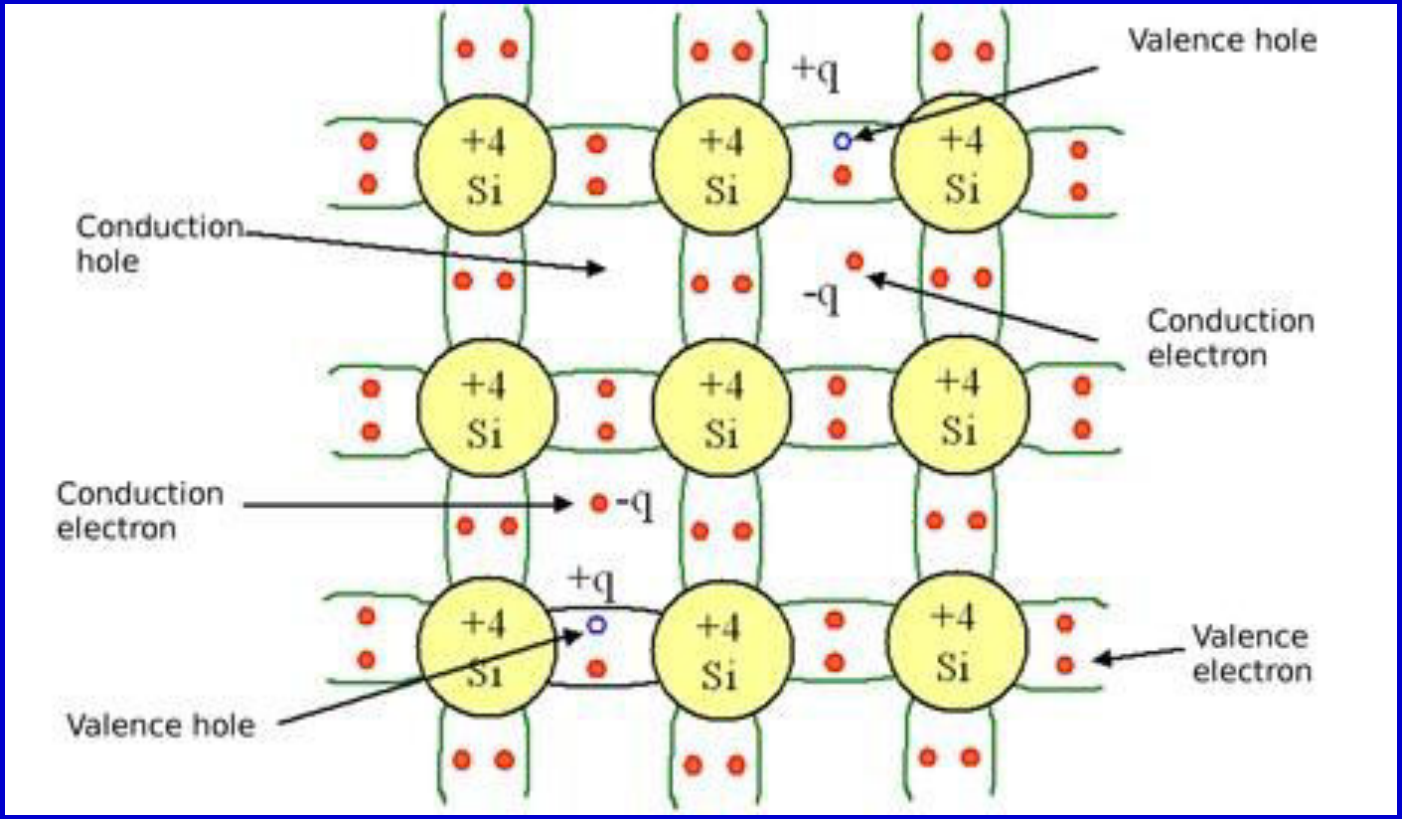
Interfacing

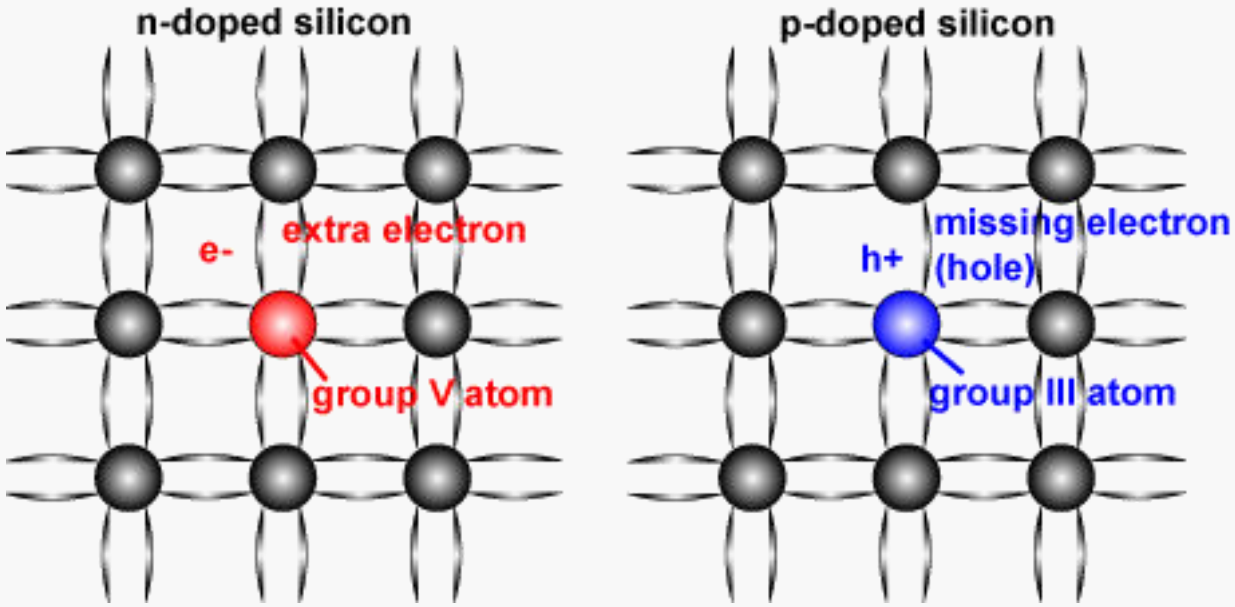
Δομή του κρυστάλλου πυριτίου (Si)



Δομή ημιαγωγού πυριτίου (Si)



Ημιαγωγοί Si με προσμίξεις



Τύπου n

Τύπου p

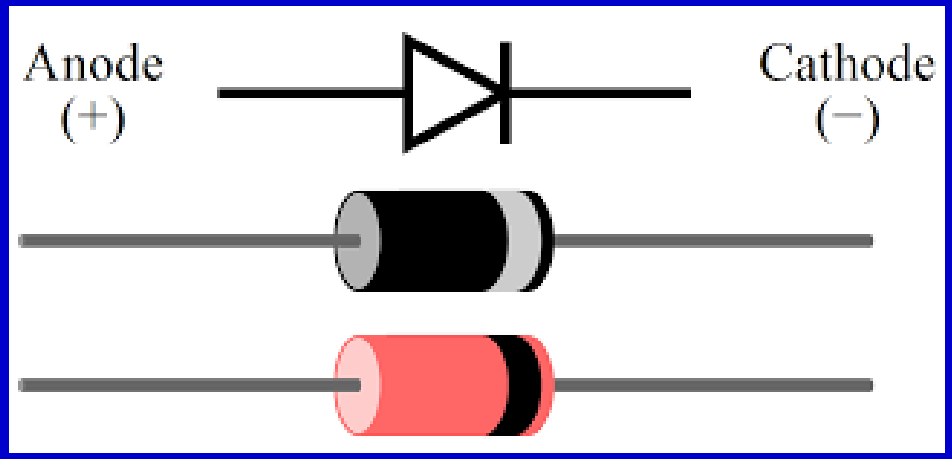
Ημιαγωγοί τύπου p και τύπου n

Για την δημιουργία ημιαγωγών τύπου n συγκρυσταλλόνονται πεντασθενή άτομα οπότε δημιουργείται περίσσεια ελευθέρων ηλεκτρονίων.
Για την δημιουργία ημιαγωγών τύπου p συγκρυσταλλώνονται τροσθσθενή άτομα οπότε δημιουργείται περίσσεια ηλεκτρονικών οπών.

DIODES

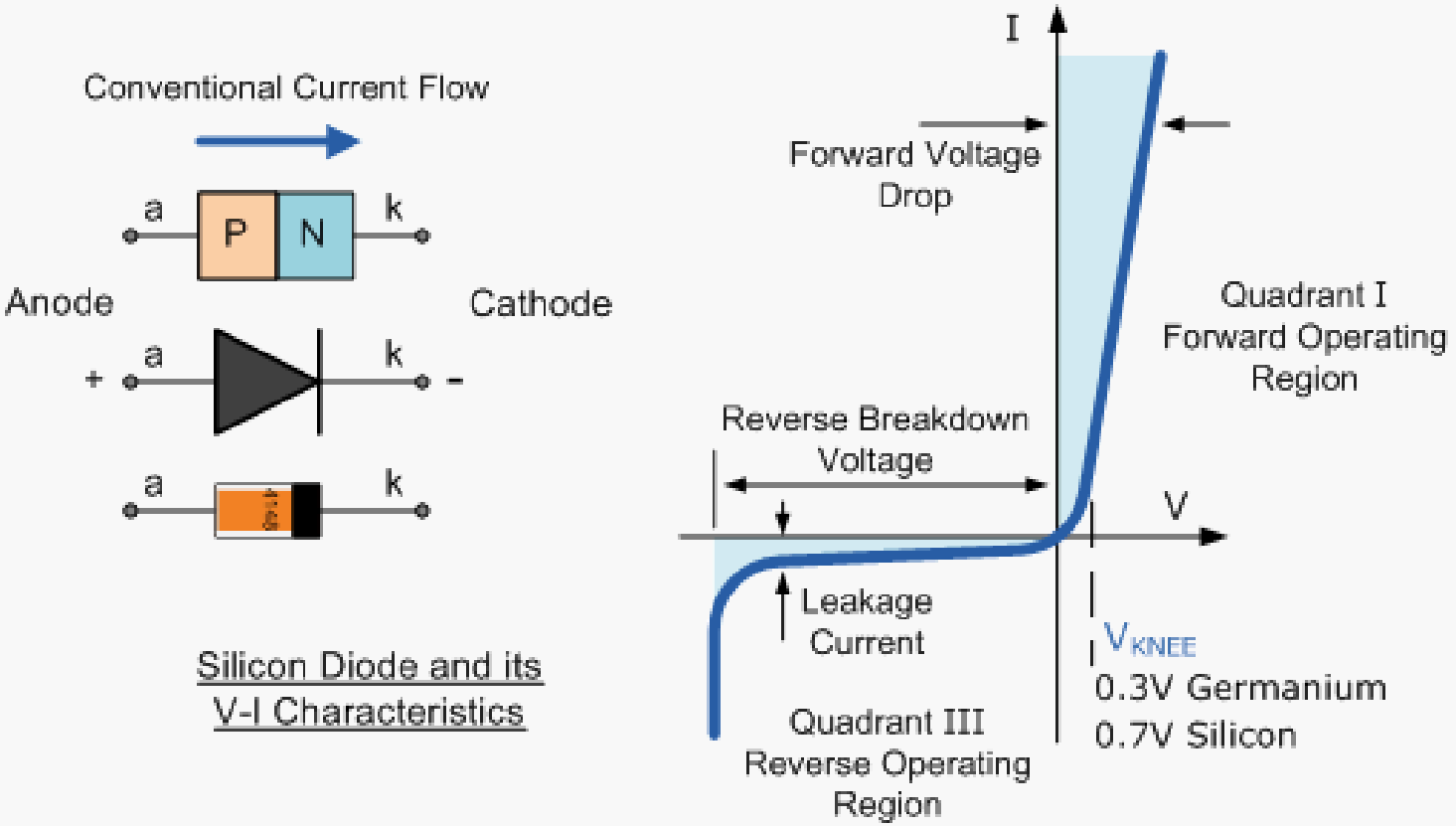
In electronics, a *diode* is a two-terminal electronic component that conducts primarily in one direction (asymmetric conductance); it has low (ideally zero) resistance to the flow of current in one direction, and high (ideally infinite) resistance in the other.

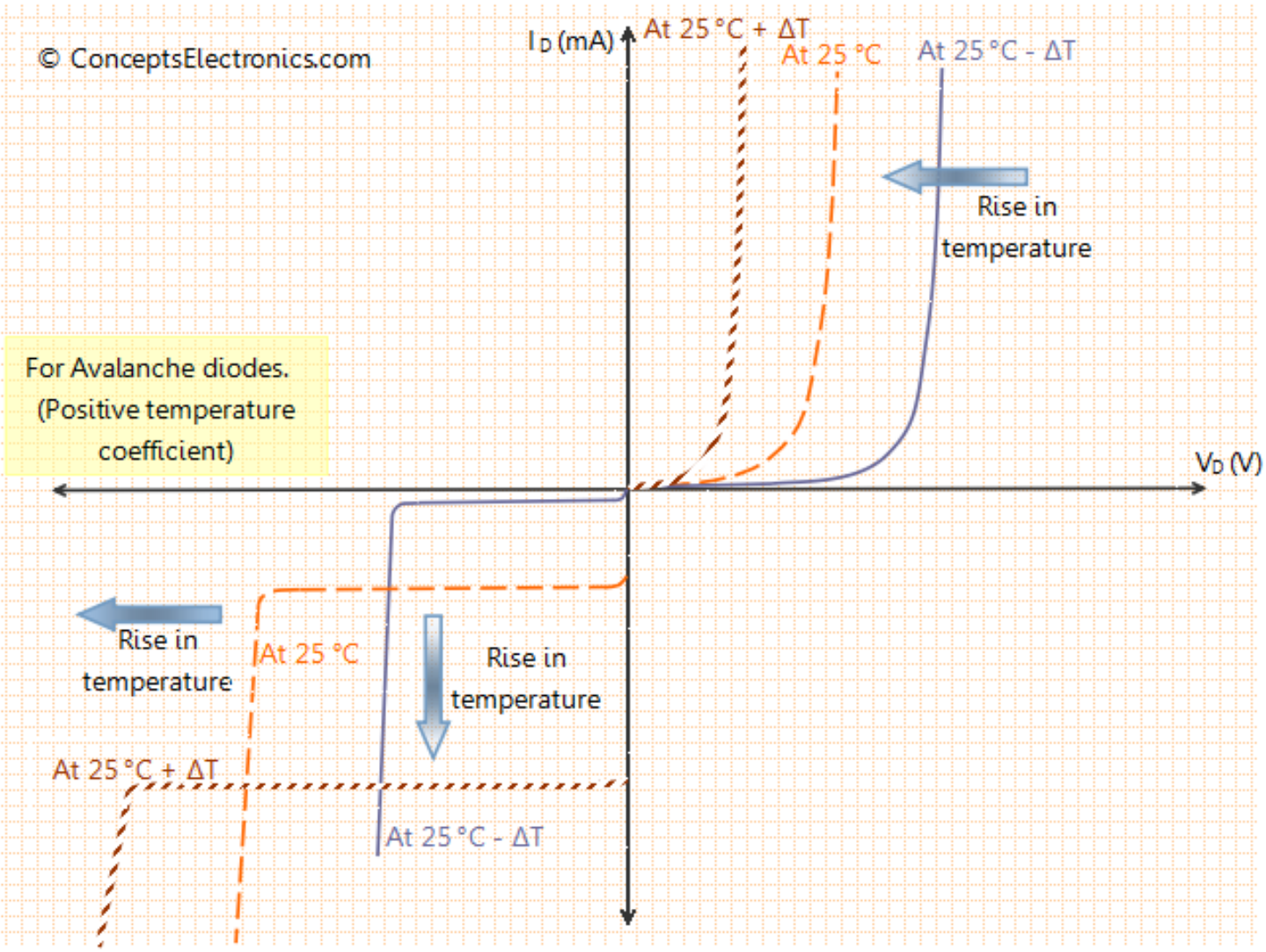
A *semiconductor diode*, the most common type today, is a crystalline piece of semiconductor material with a p-n junction connected to two electrical terminals.



DIODES

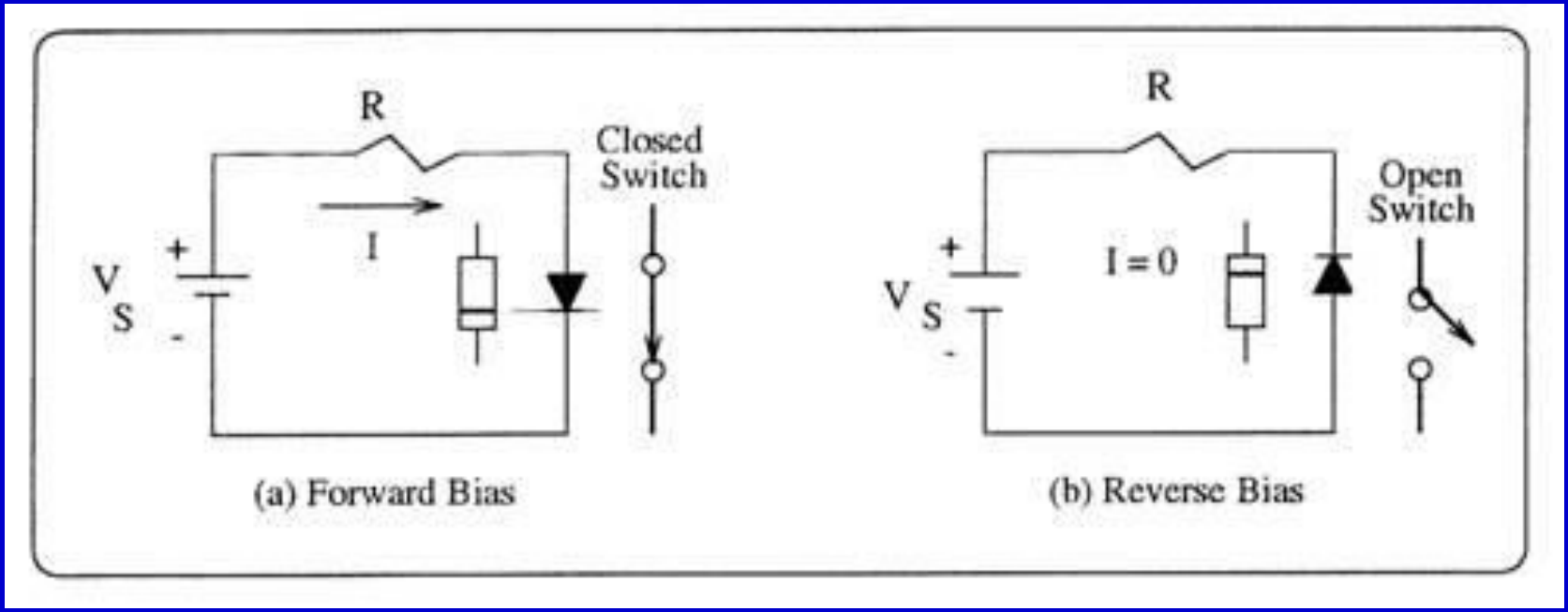
Χαρακτηριστική καμπύλη διόδου



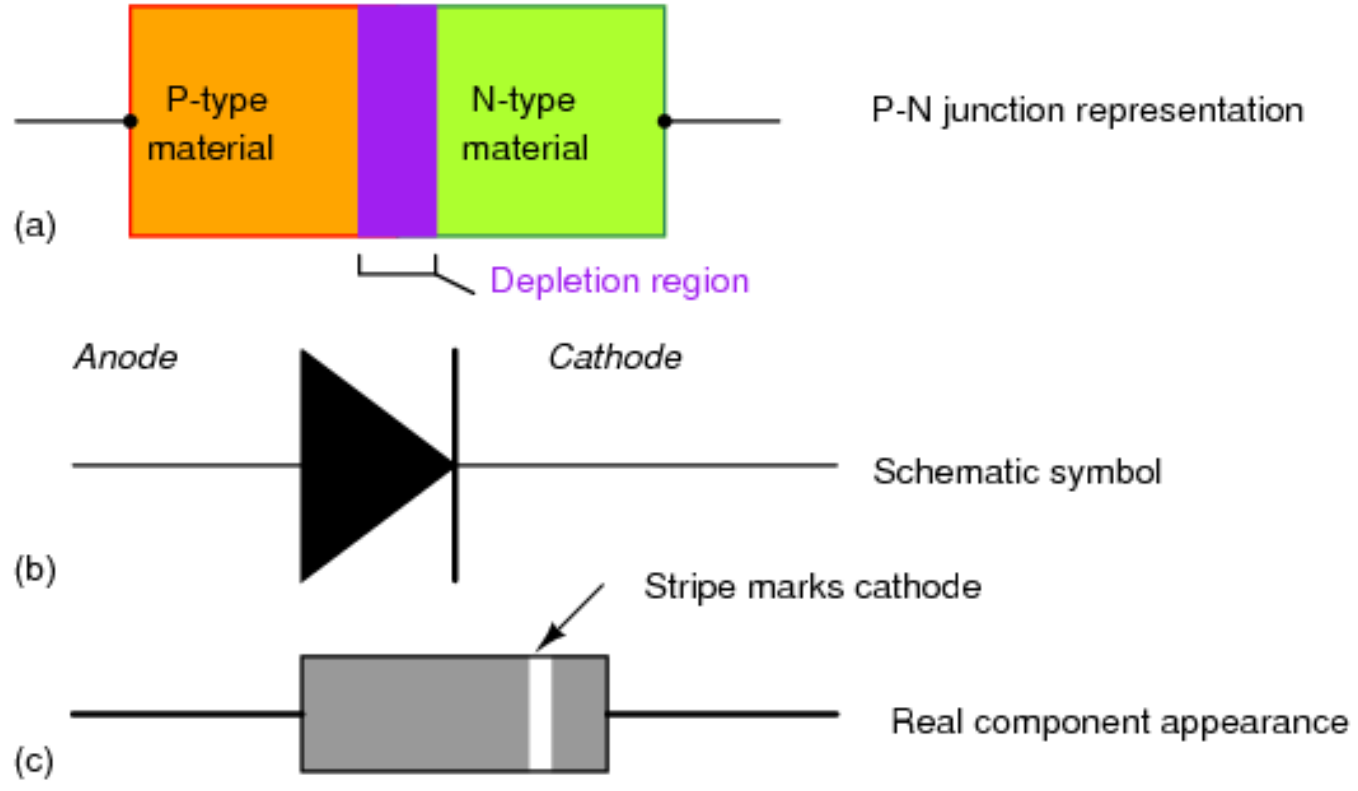


Effect of temperature on avalanche diodes

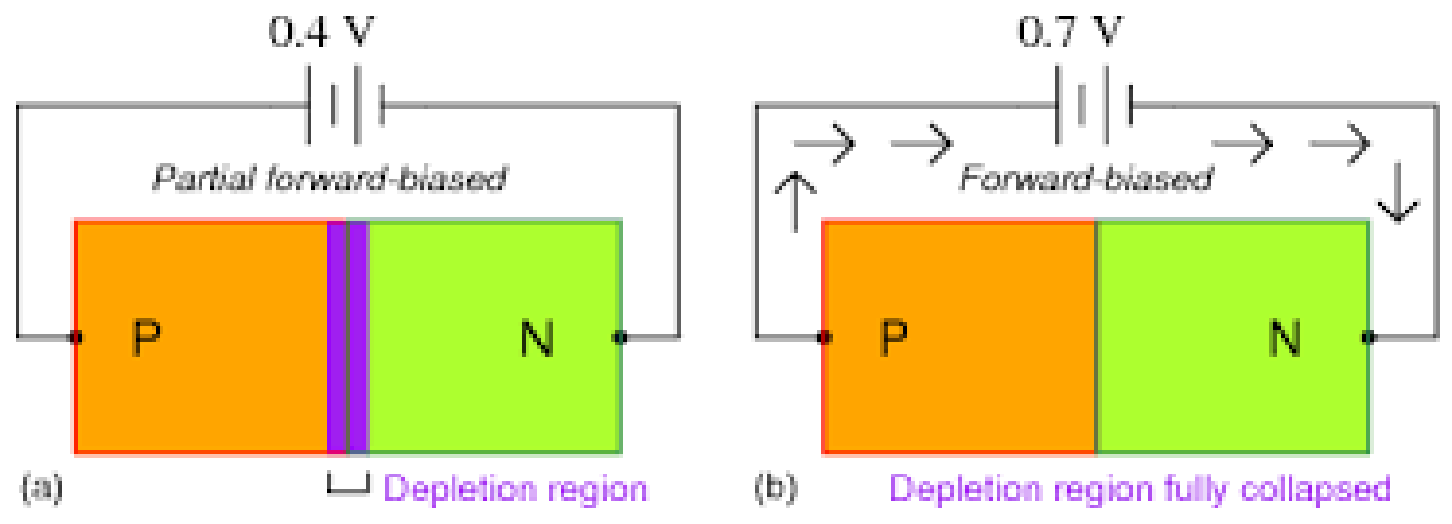
Ορθή και ανάστροφη πόλωση διόδου



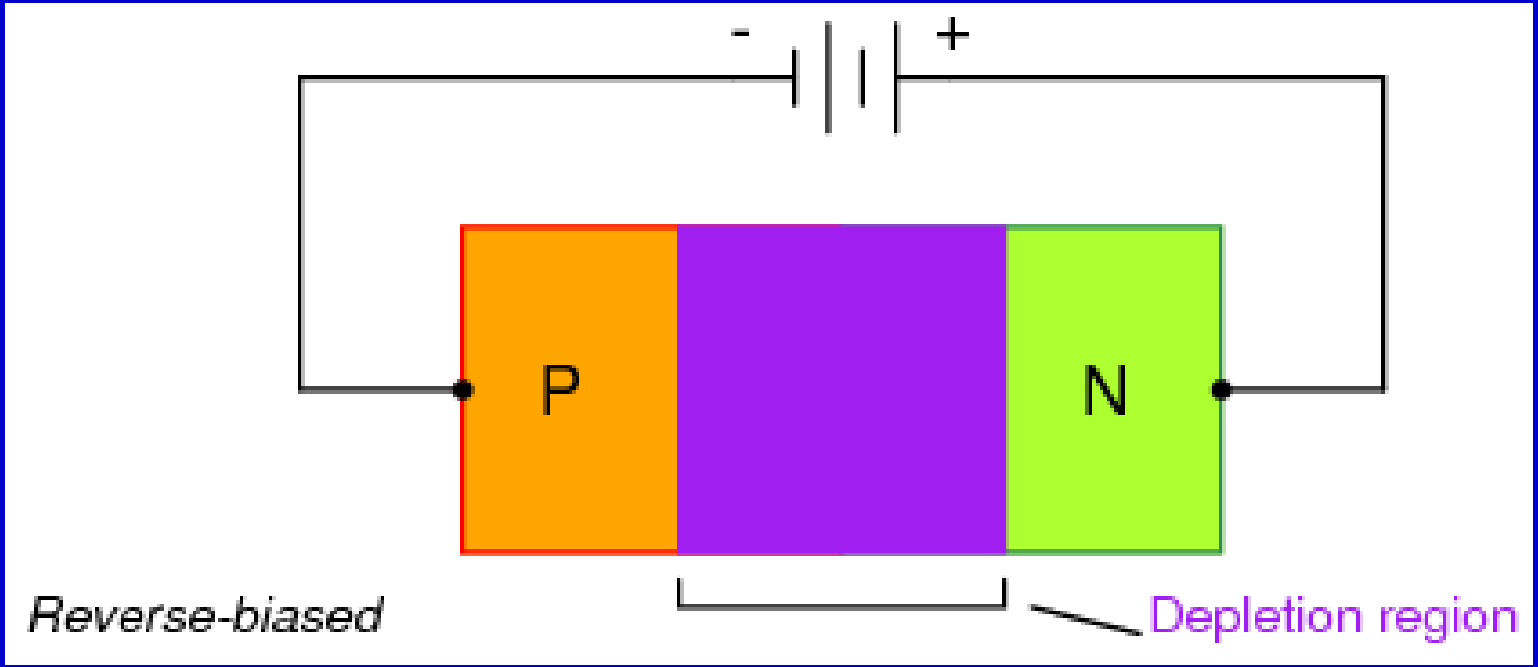
Semiconductor Diode



Diode forward bias



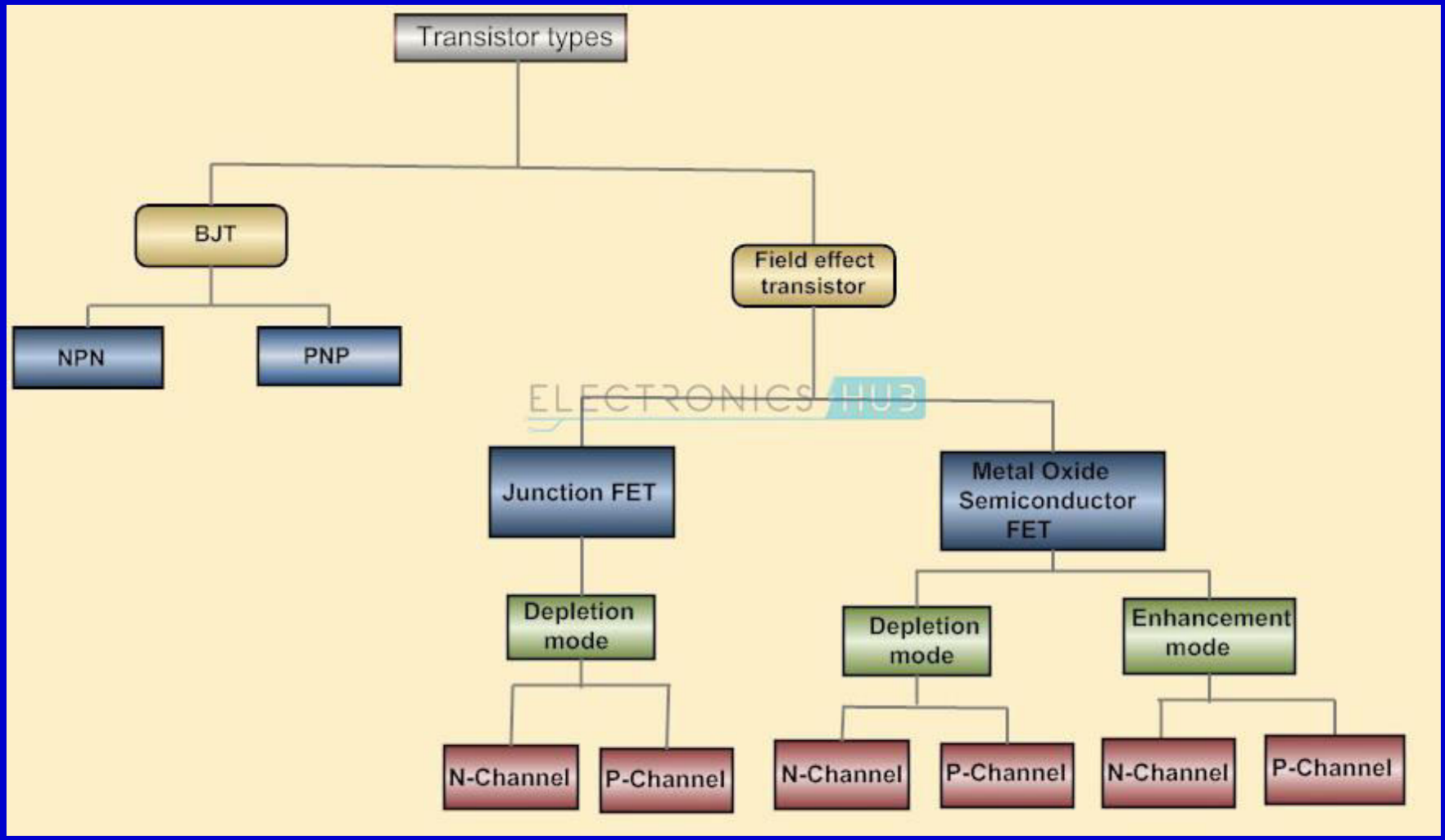
Diode reverse bias



Δίοδος 1N4004

Max forward current 1A
Max reverse voltage 400 V

Τύποι τρανζίστορ

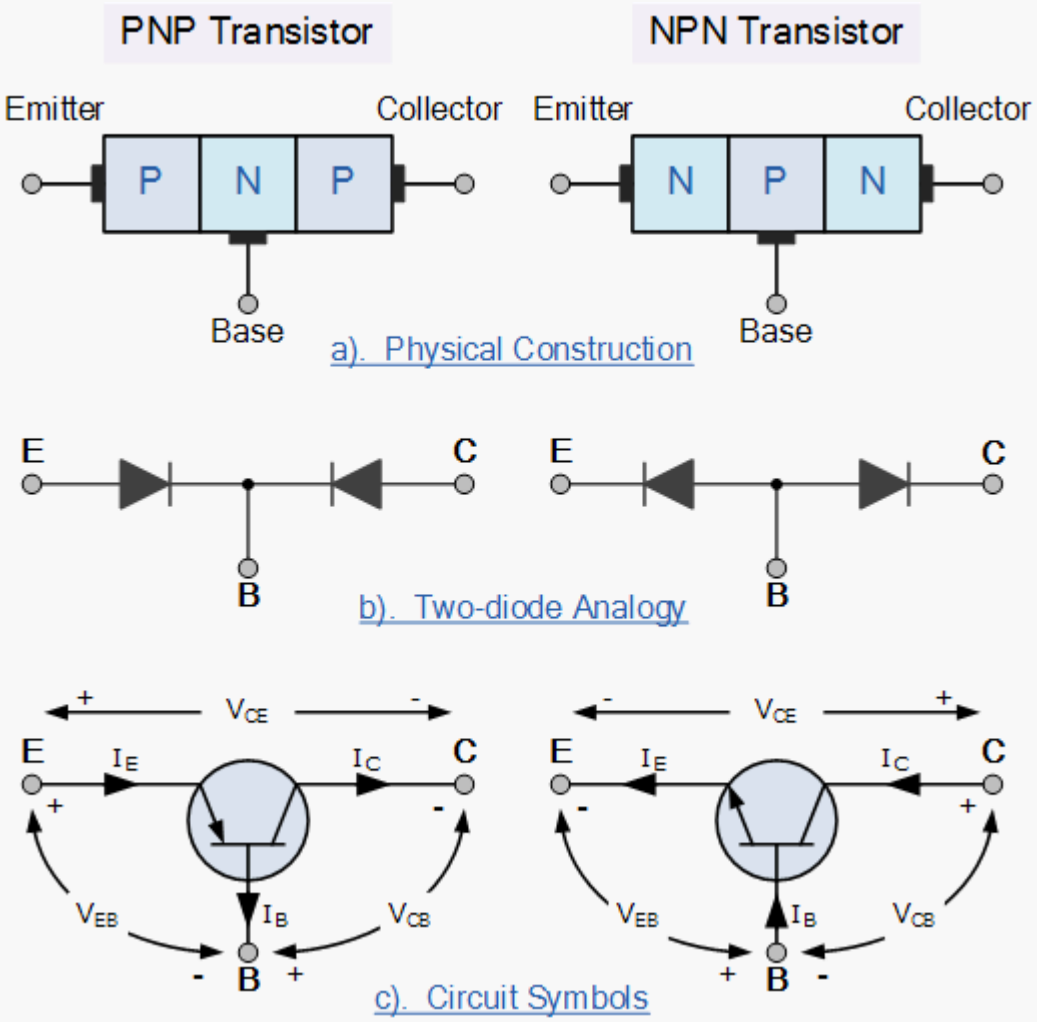


Bipolar transistor

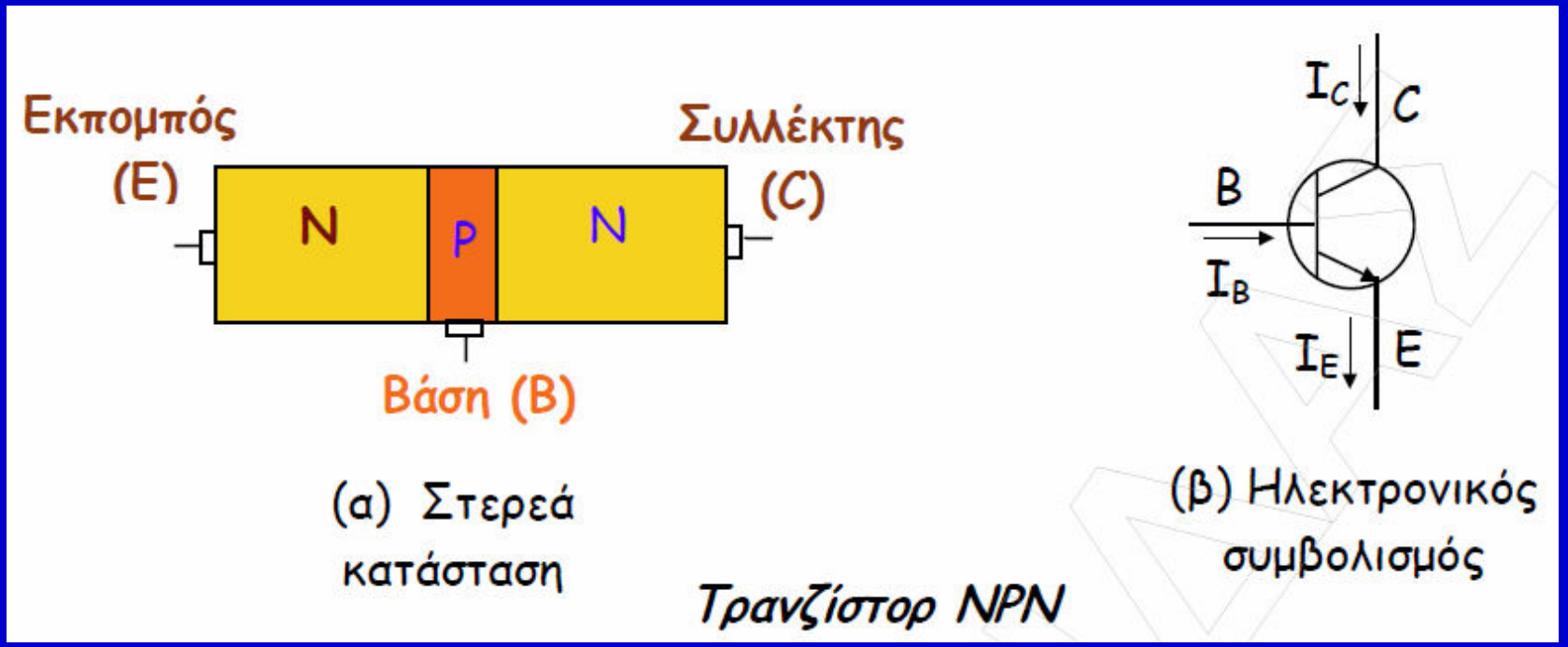
A **bipolar transistor** (**bipolar junction transistor** or **BJT**) is a type of transistor that uses both electron and hole charge carriers. In contrast, unipolar transistors, such as field-effect transistors, only use one kind of charge carrier. For their operation, BJTs are manufactured in two types, npn and pnp and are available as individual components, or fabricated in integrated circuits, often in large numbers.
The basic function of a BJT is to amplify current. This allows BJT to be used as amplifiers or switches, giving them wide applicability in electronic equipment, including computers, televisions, mobile phones, audio amplifiers, industrial control, and radio transmitters.

Διακριτά διπολικά τρανζίστορ

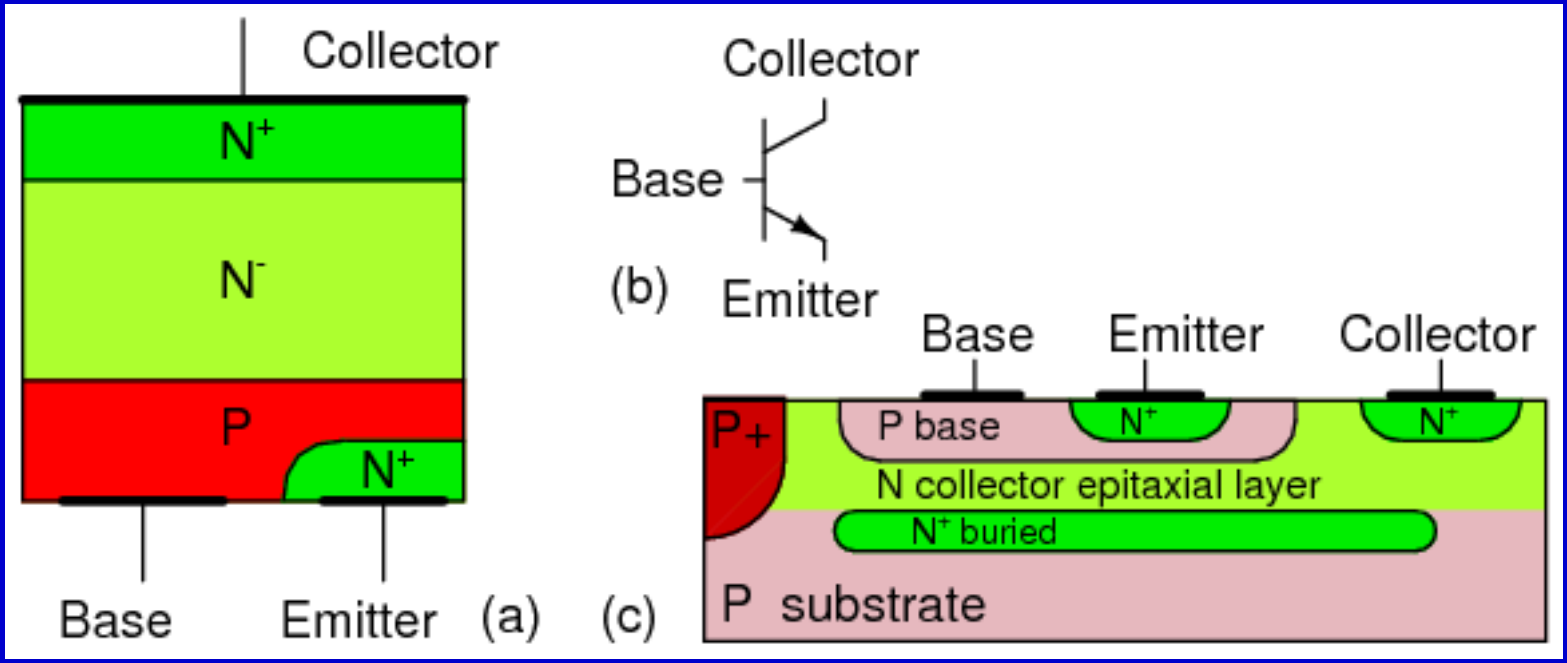
Διπολικά τρανζίστορ



Bipolar transistor npn

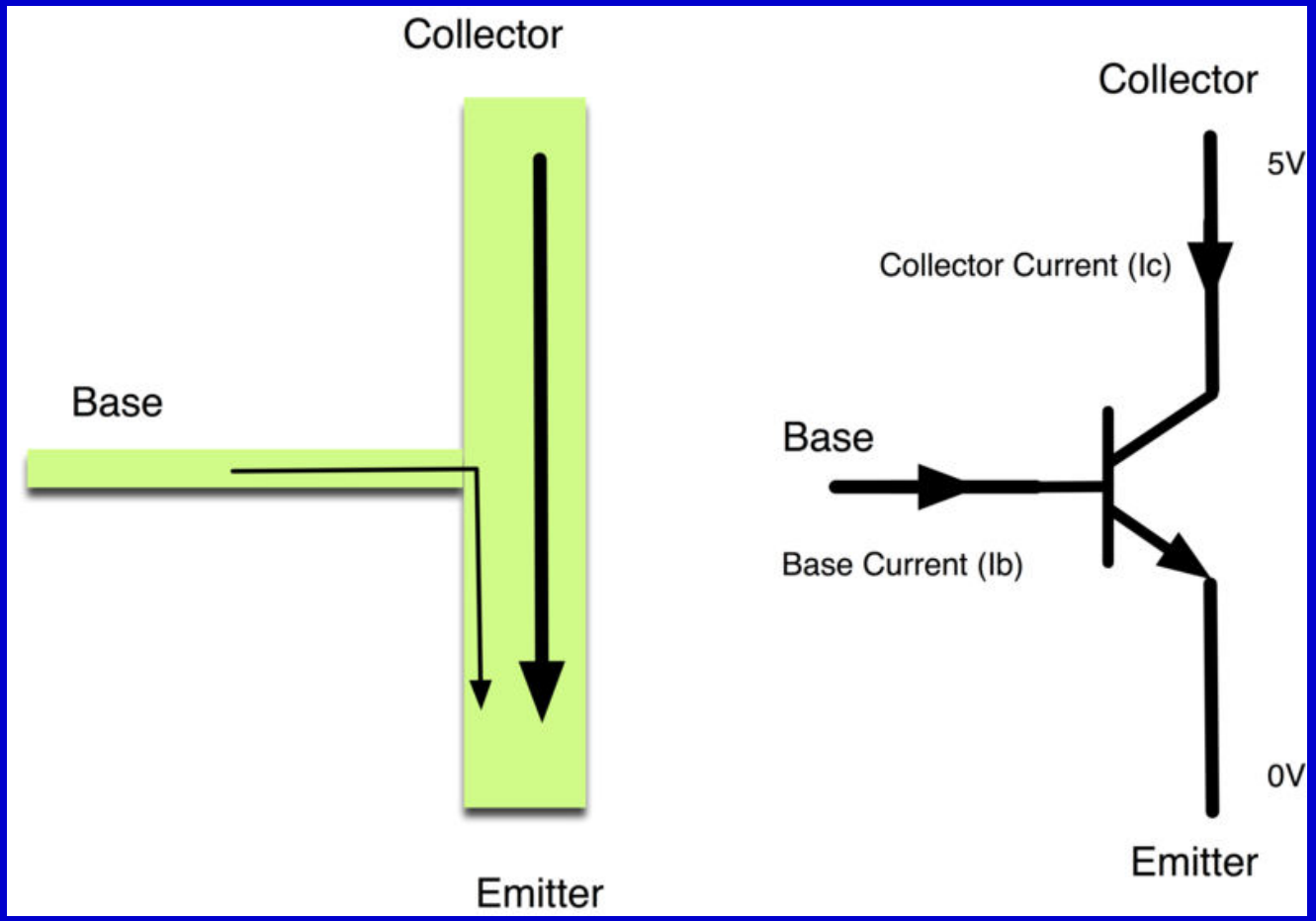


Bipolar transistor npn

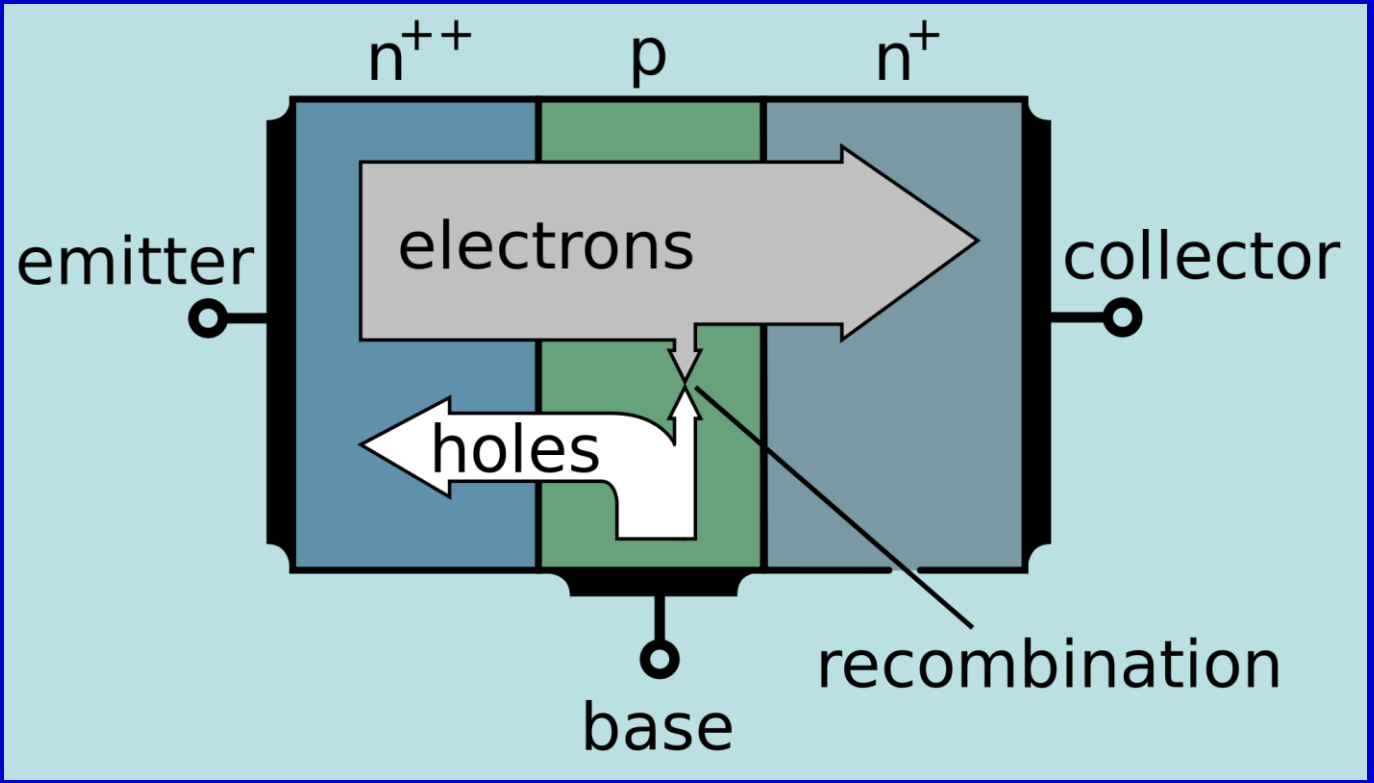


Bipolar junction transistor: (a) discrete device cross-section, (b) schematic symbol, (c) integrated circuit cross-section.

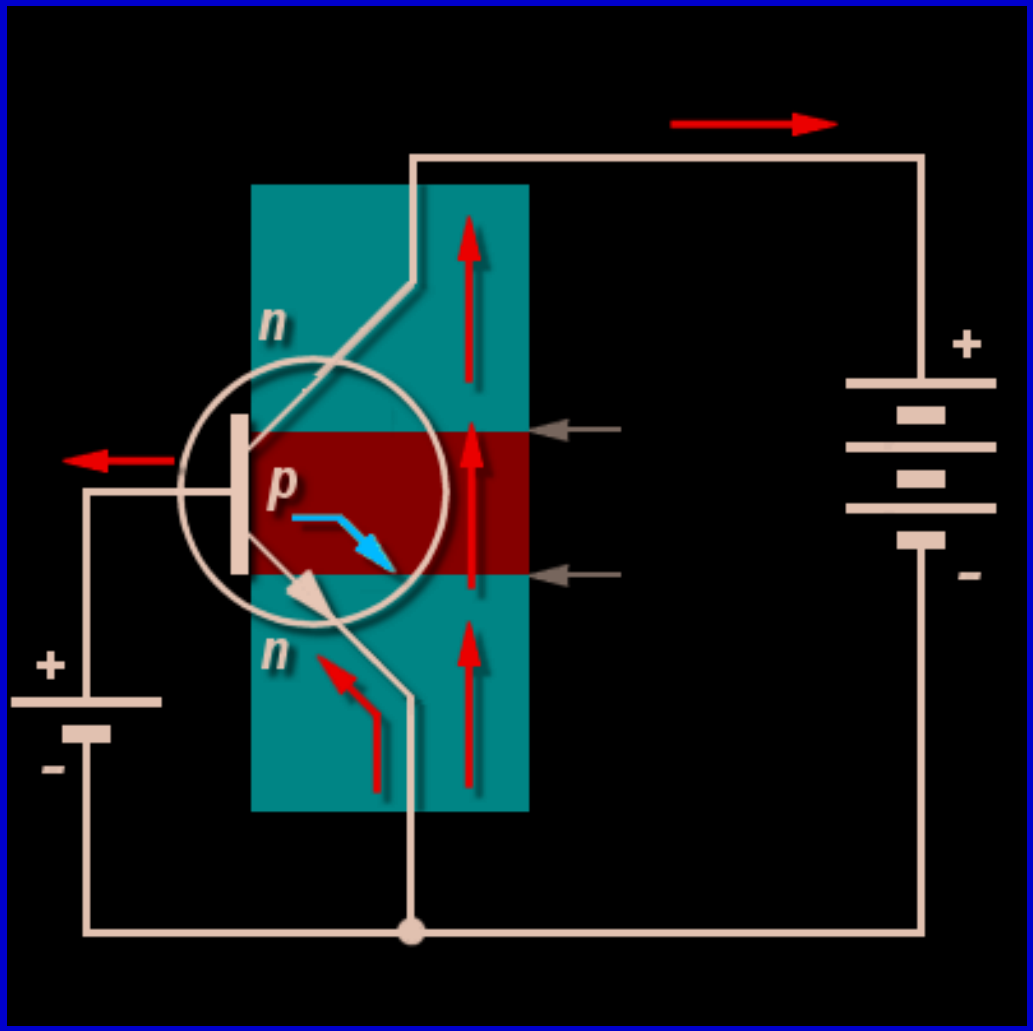
Λειτουργία του τρανζίστορ npn



Λειτουργία του τρανζίστορ npn



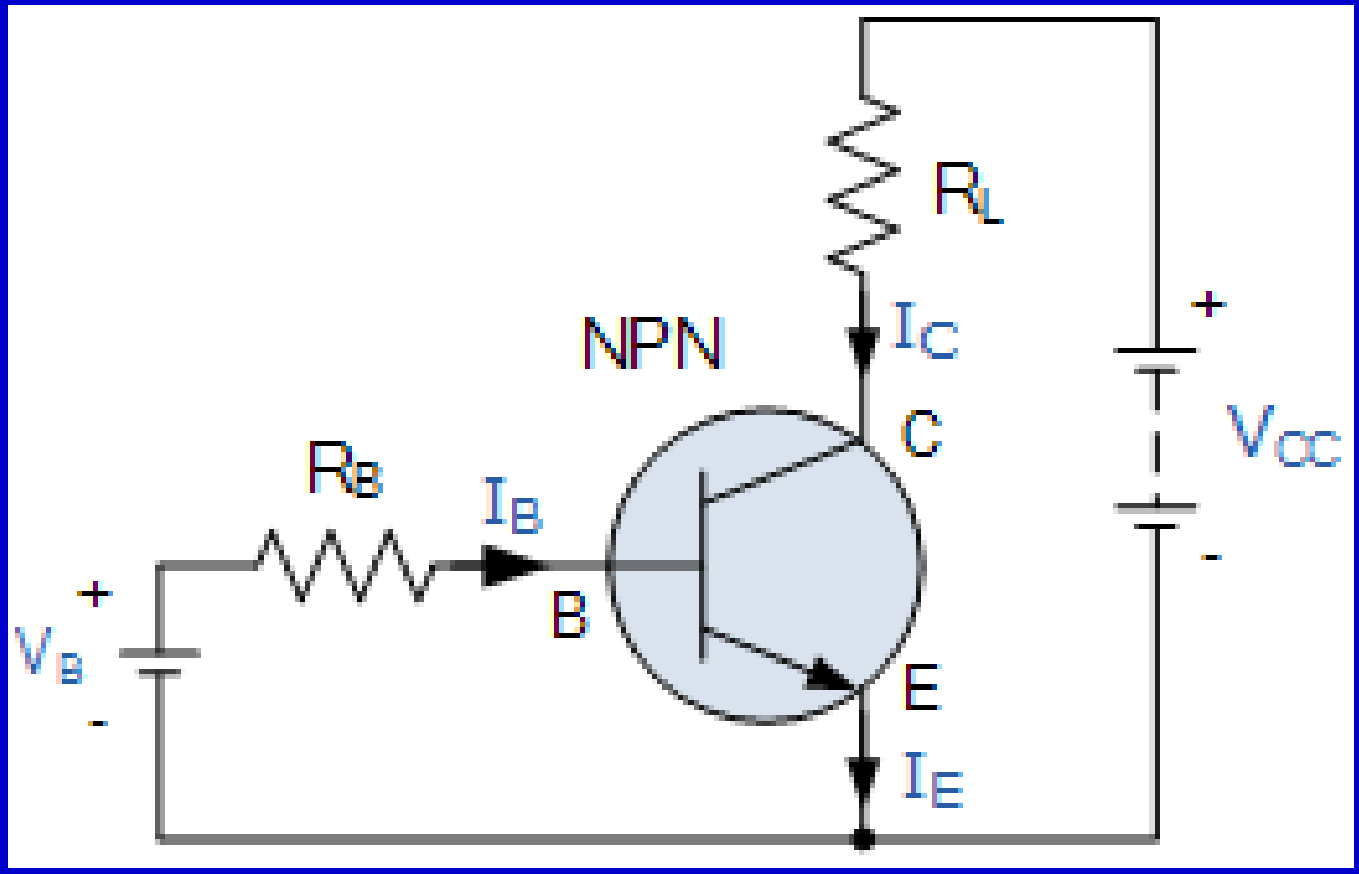
Λειτουργία του τρανζίστορ npn σε συνδεσμολογία κοινού εκπομπού



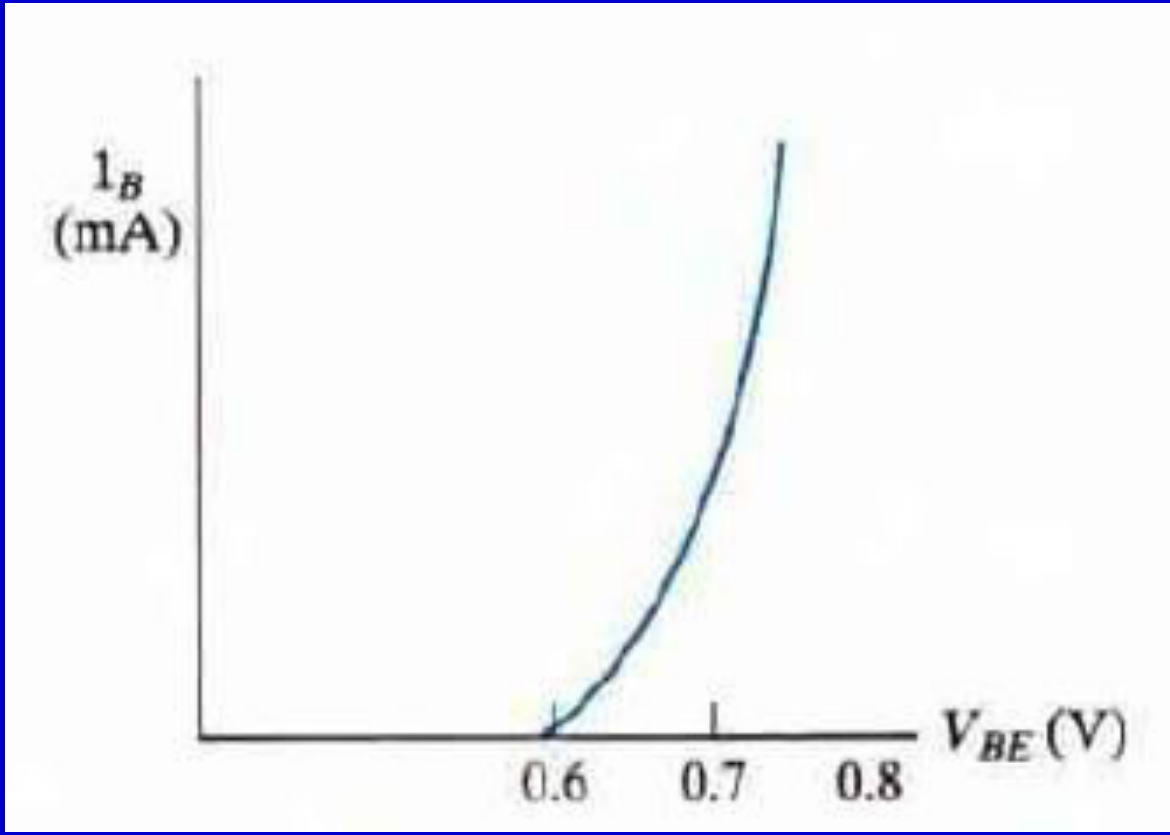
Bipolar transistor operating modes

Active Region–the transistor operates as an amplifier and Ic = β*Ib
Saturation–the transistor is “Fully-ON” operating as a switch and Ic=I(saturation)
Cut-off–the transistor is “Fully-OFF” operating as a switch and Ic = 0

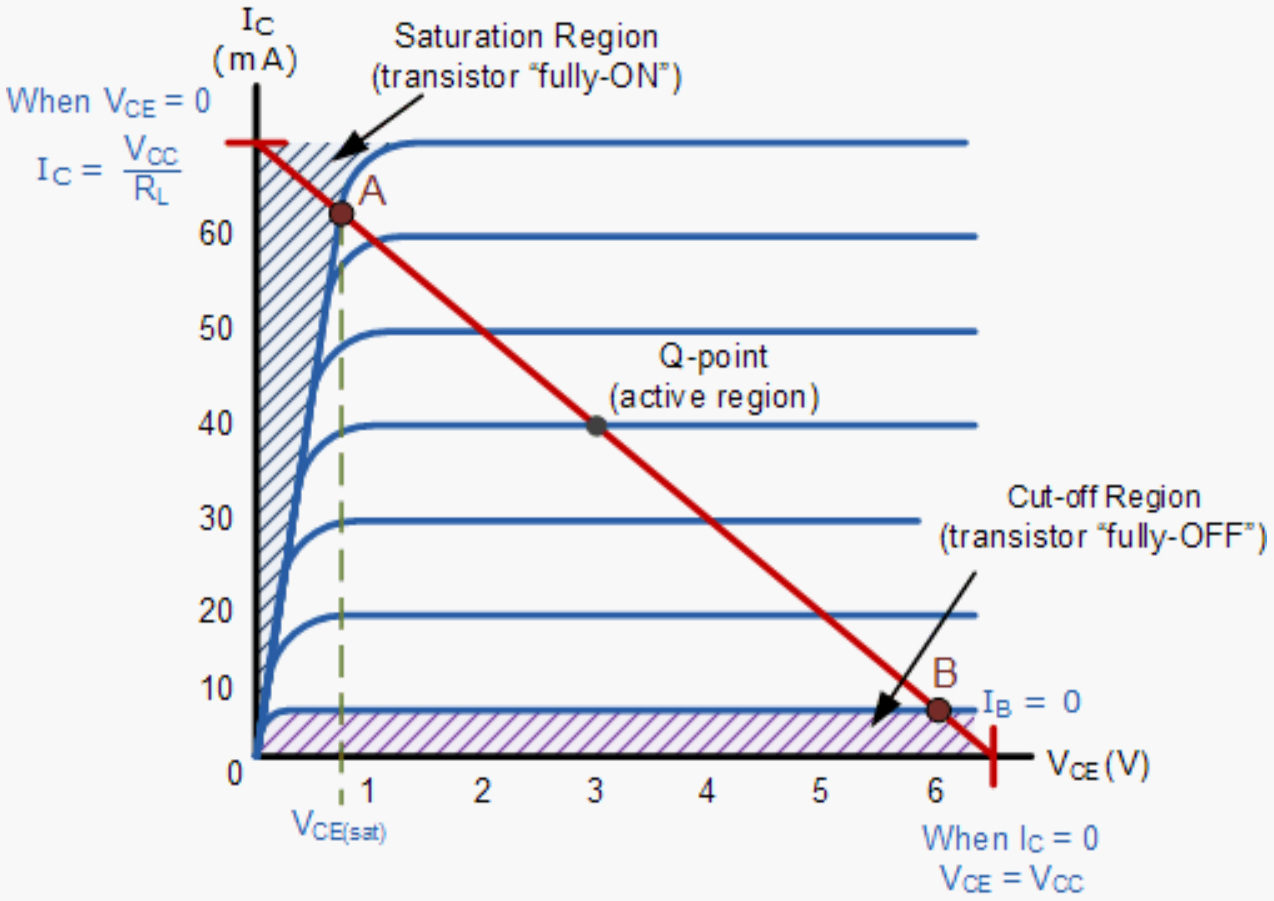
Τρανζίστορ npn σε συνδεσμολογία κοινού εκπομπού



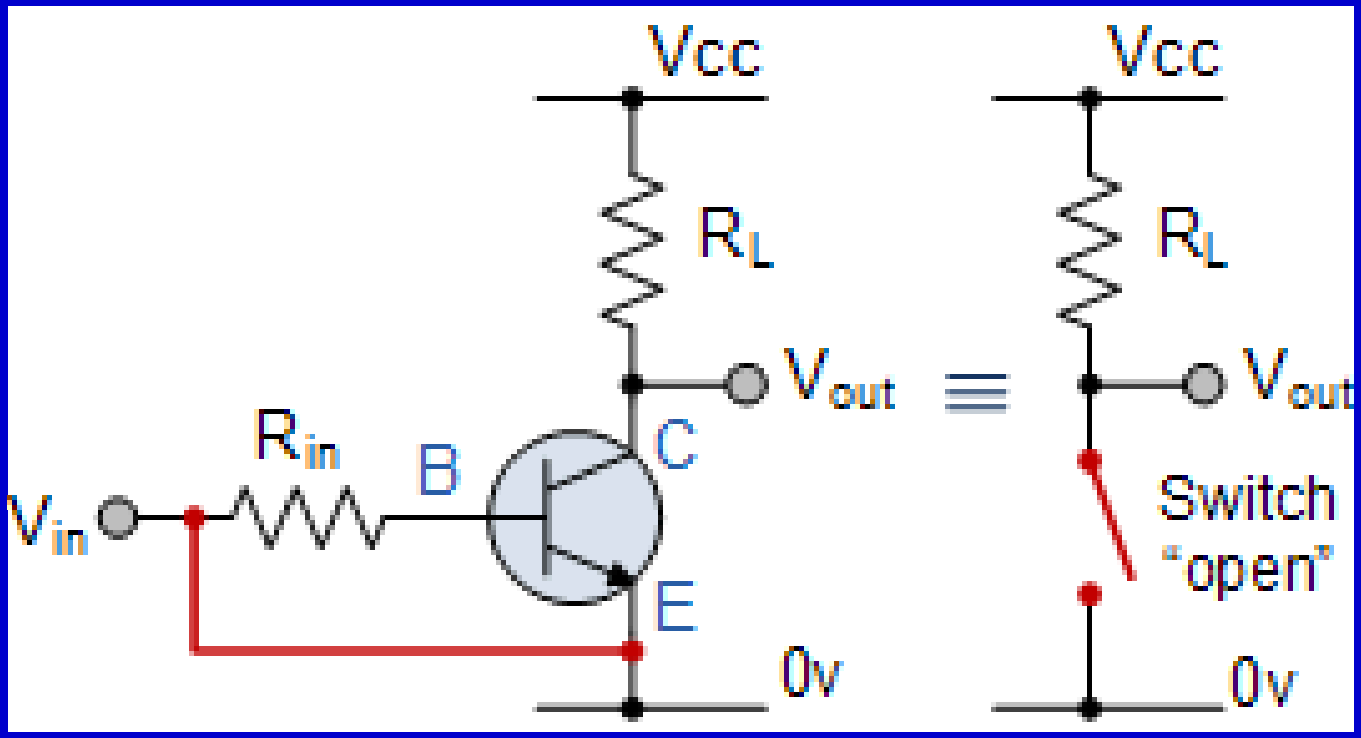
Χαρακτηριστικές καμπύλες διπολικού τρανζίστορ npn



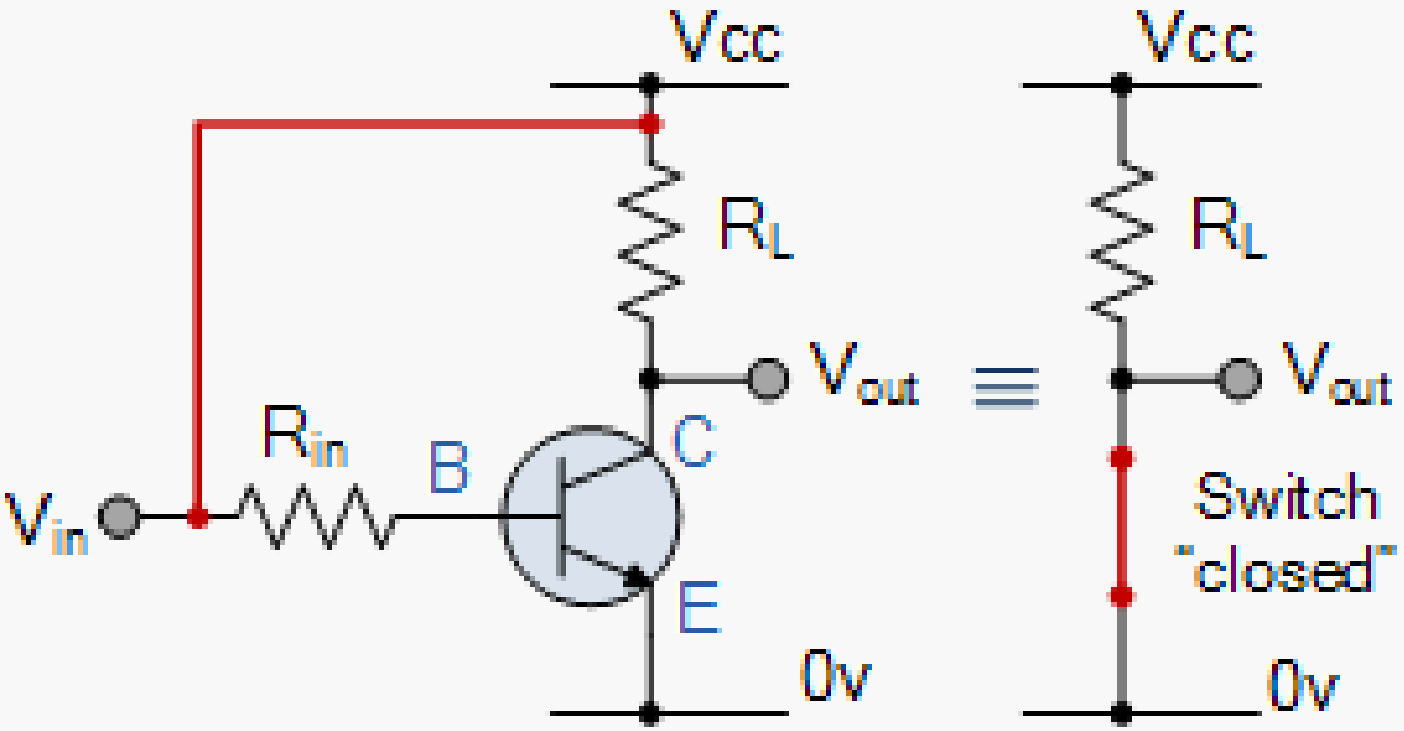
Χαρακτηριστικές καμπύλες διπολικού τρανζίστορ npn



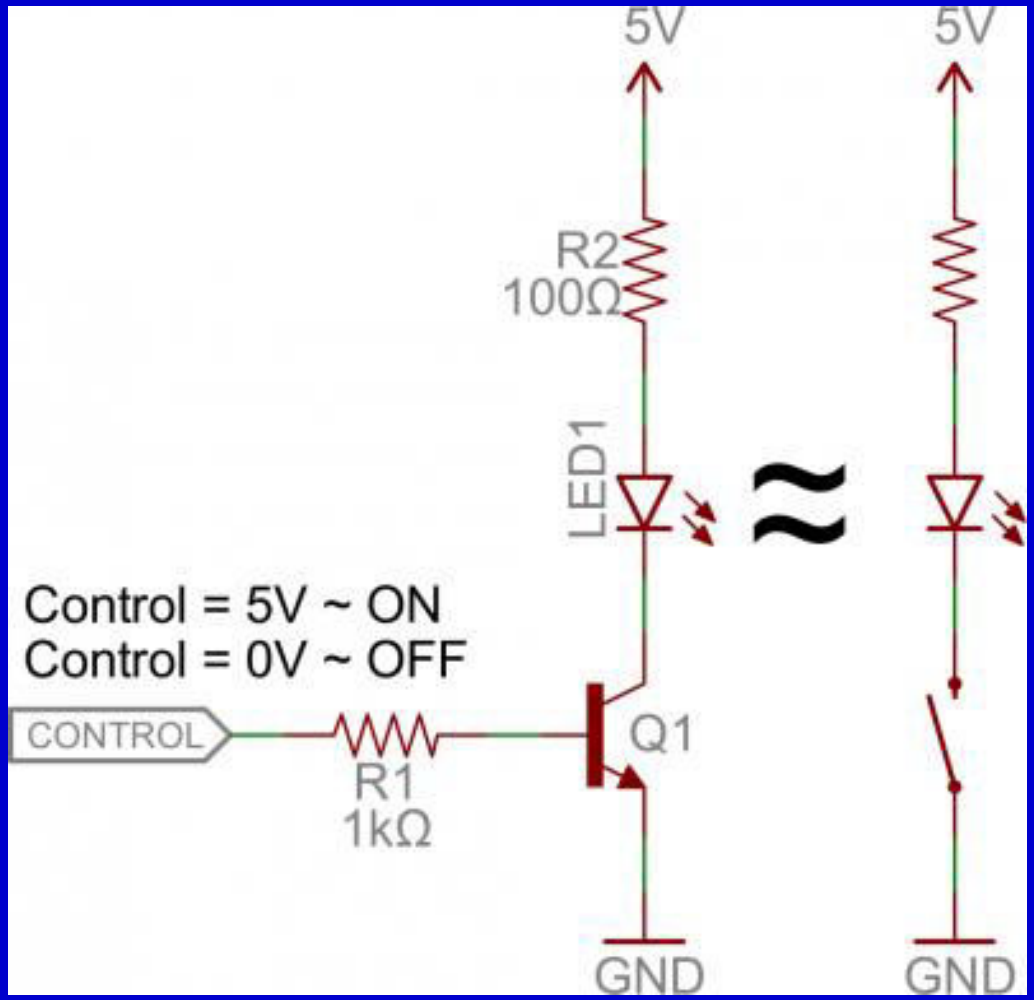
Transistor npn as a switch (Off)



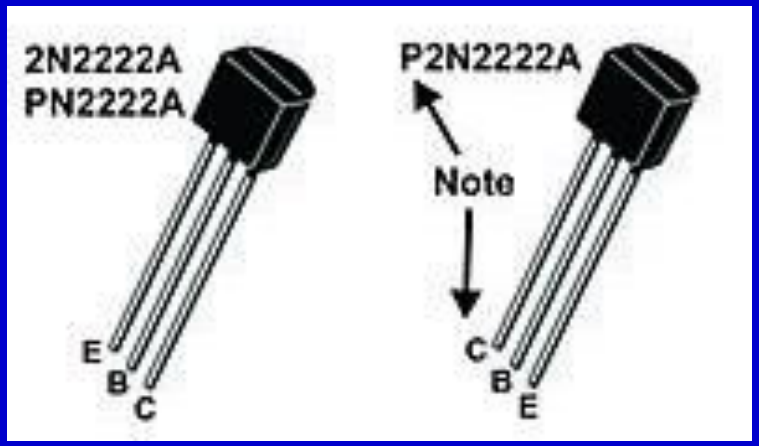
Transistor npn as a switch (on)



Driving a LED using a npn transistor as a switch



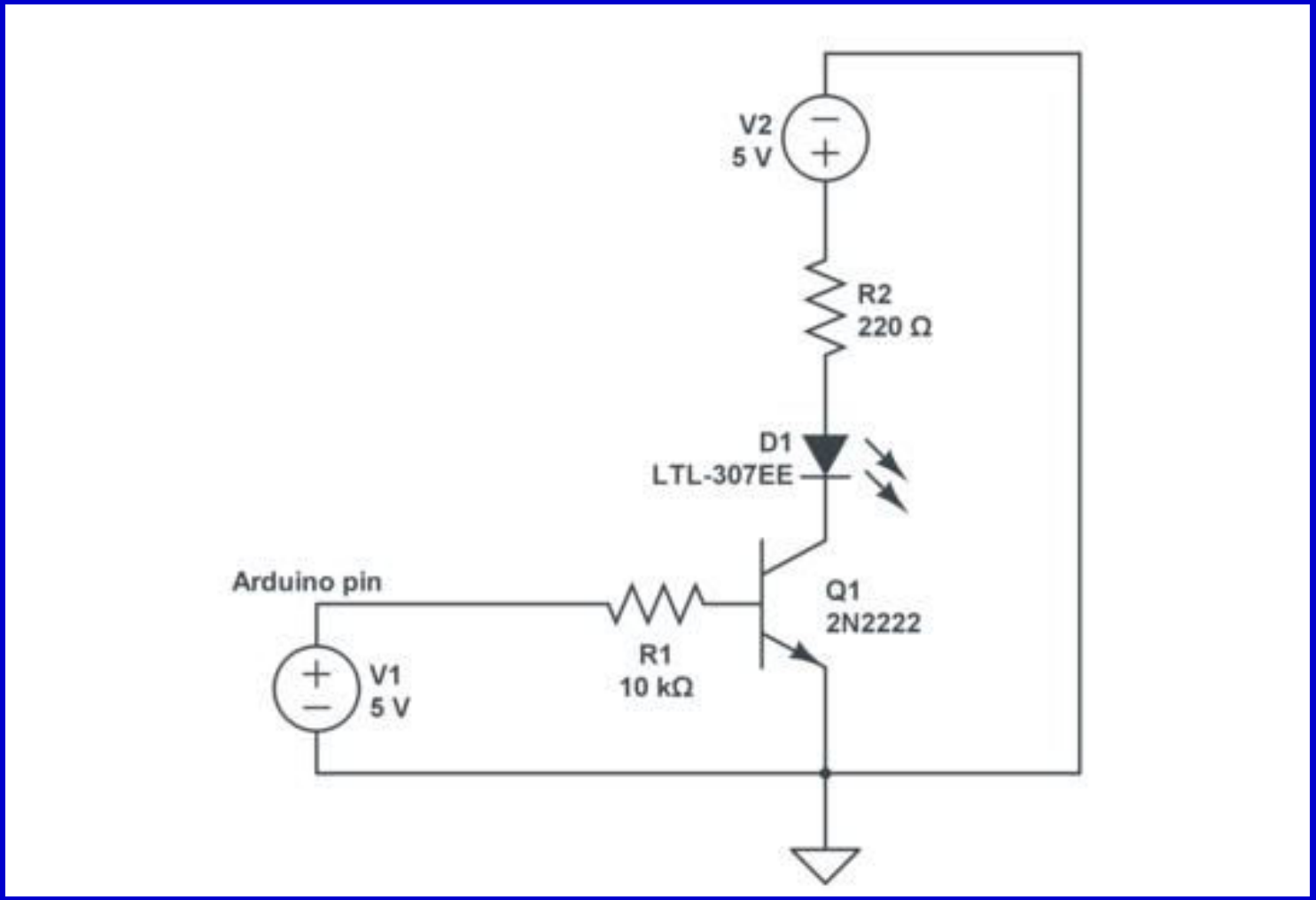
Τρανζίστορ 2N2222A (npn)



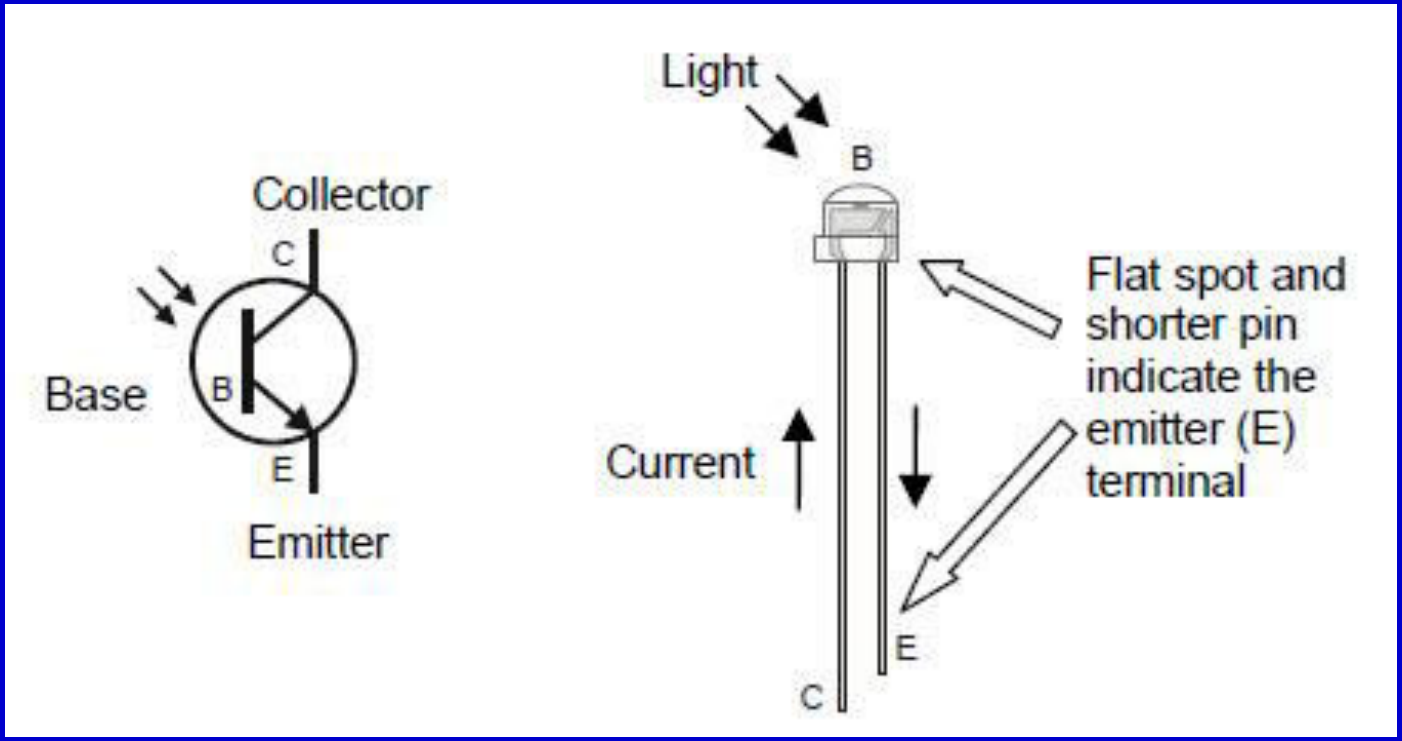
Manufacturer	V_{ce}	I_c	P_D	f_T
ST Microelectronics 2N2222A	40 V	800 mA	500 mW/1.8 W	300 MHz

2N2222A has a beta or current gain (h_{FE}) of at least 100 in optimal conditions.

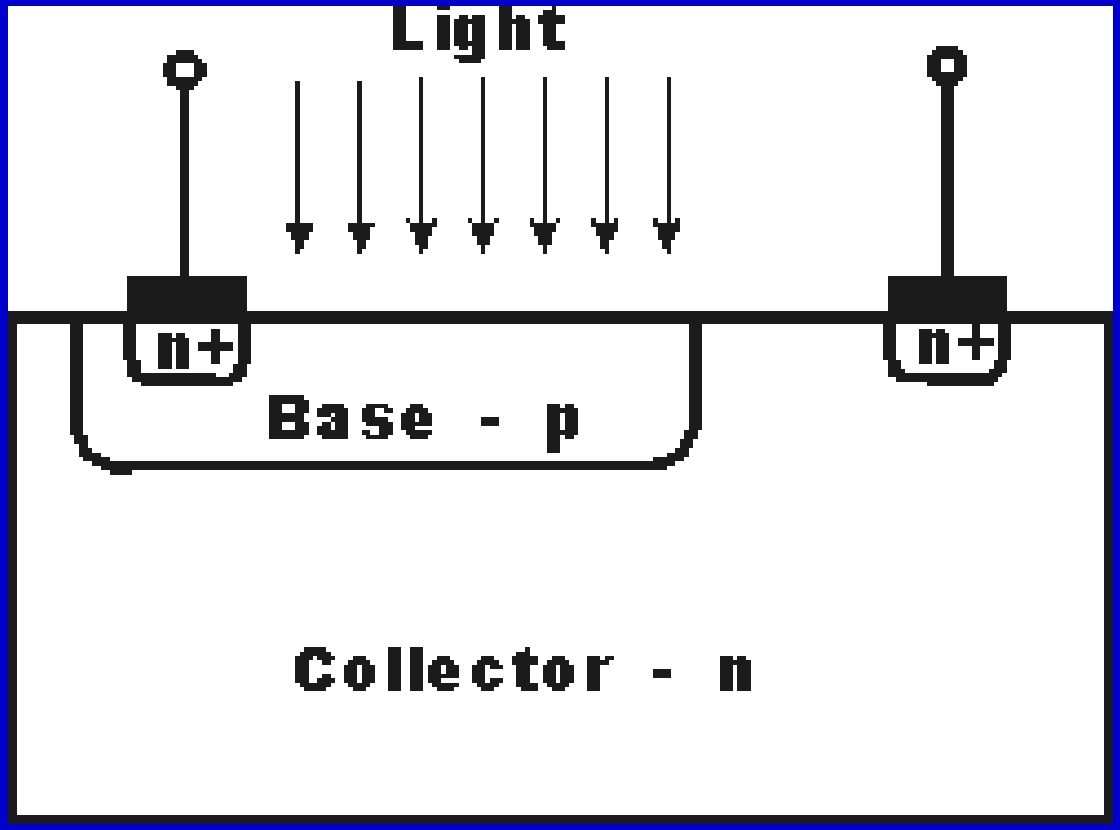
Οδήγηση LED από το Arduino με τρανζίστορ 2N2222



Phototransistor



Phototransistor



Optocoupler

In electronics, an optocoupler, also called an opto-isolator, or photocoupler is a component that transfers electrical signals between two isolated circuits by using light. Opto-isolators prevent high voltages from affecting the system receiving the signal. Commercially available opto-isolators withstand input-to-output voltages up to 10 KV and voltage transients with speeds up to 10 kV/μs.

Types of optocouplers

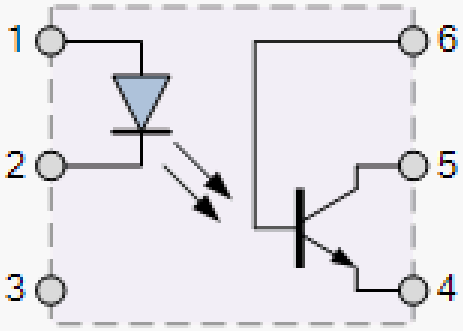


Photo-transistor

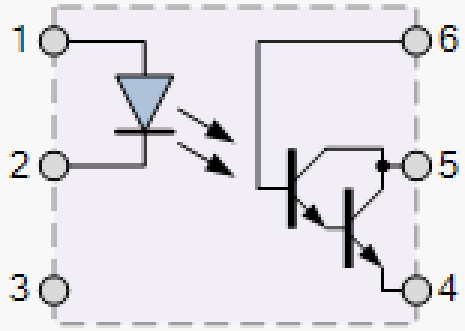


Photo-darlington

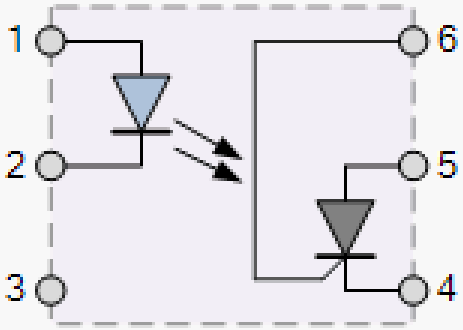


Photo-SCR

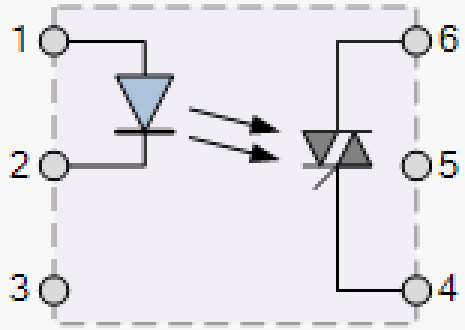
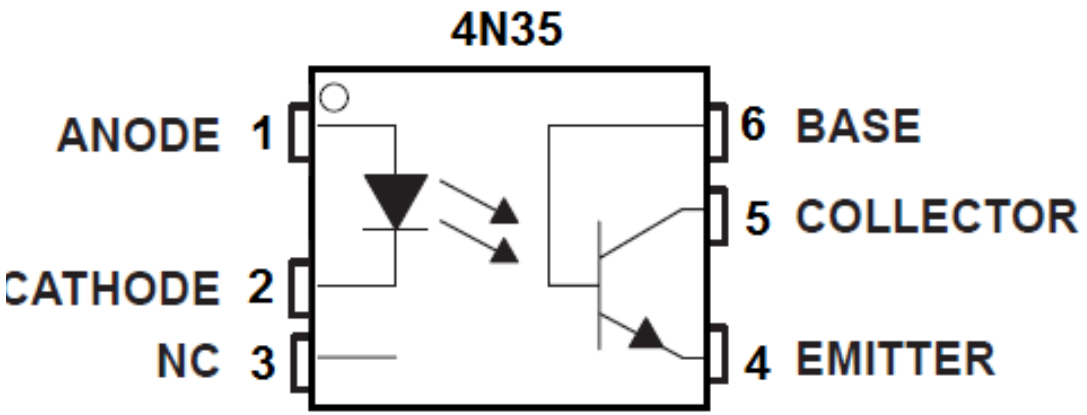


Photo-TRIAC

Opto coupler 4N35

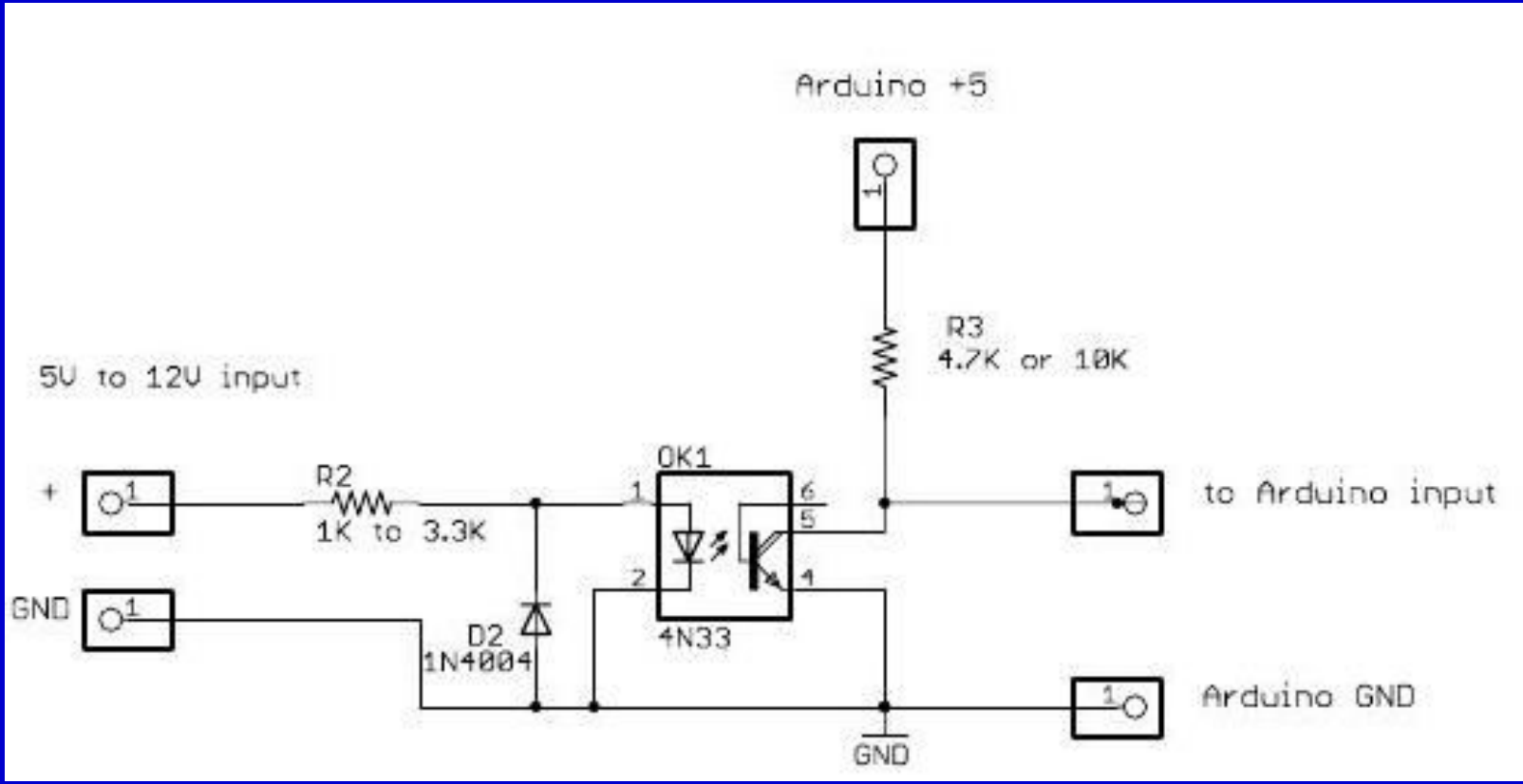


Specifications του opto-coupler 4N35

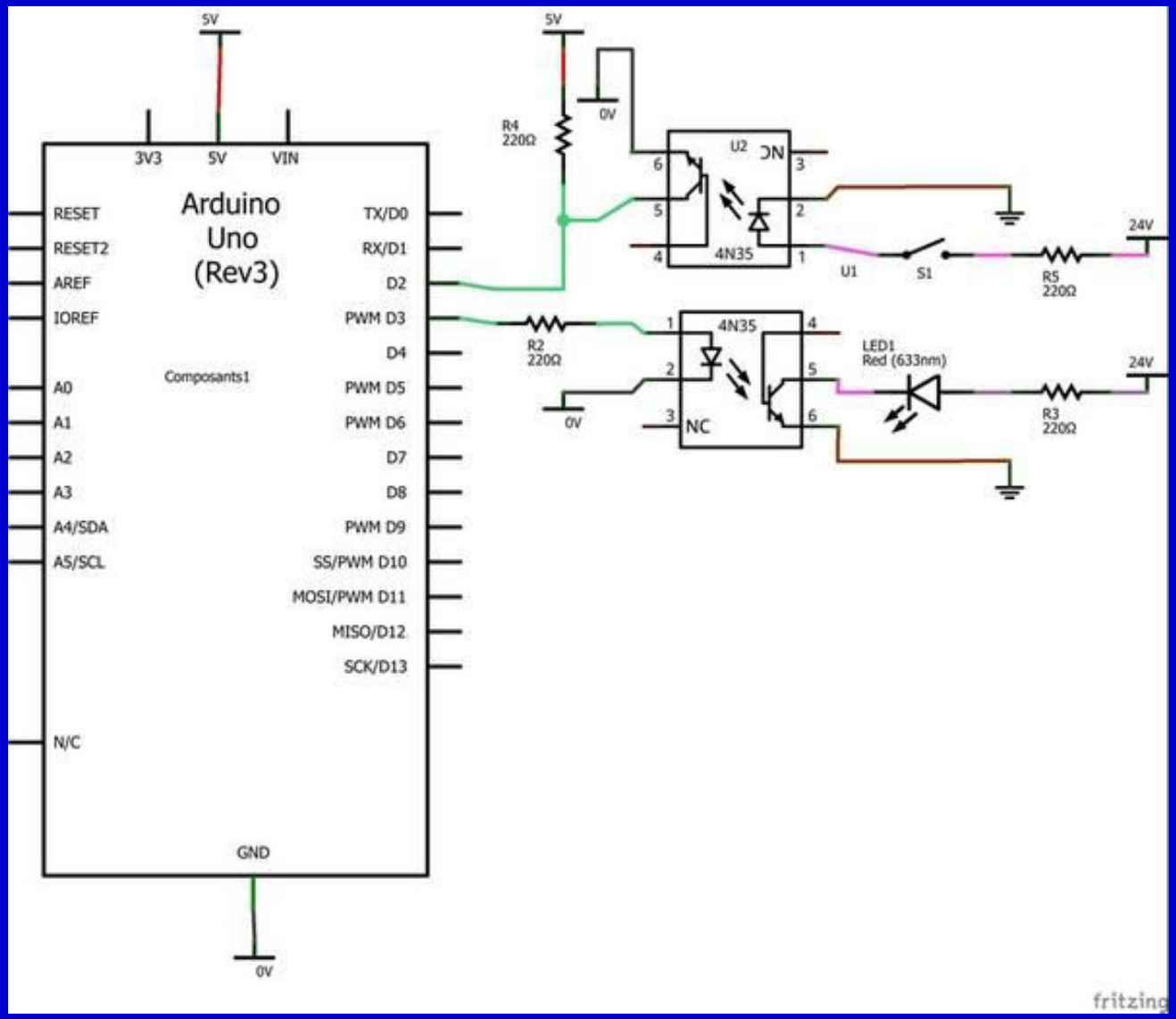
Voltage: **30V**
Isolation Voltage (RMS): **3550Vrms**
CTRmin: **100%**
t (ON) / t (OFF) , **3us/3us**
IF: max **60mA**
IC: max **100mA**

CTR: current transfer ratio

Κύκλωμα εισόδου στο Arduino με χρήση Optocoupler



Είσοδος, έξοδος από το Arduino με Optocoupler



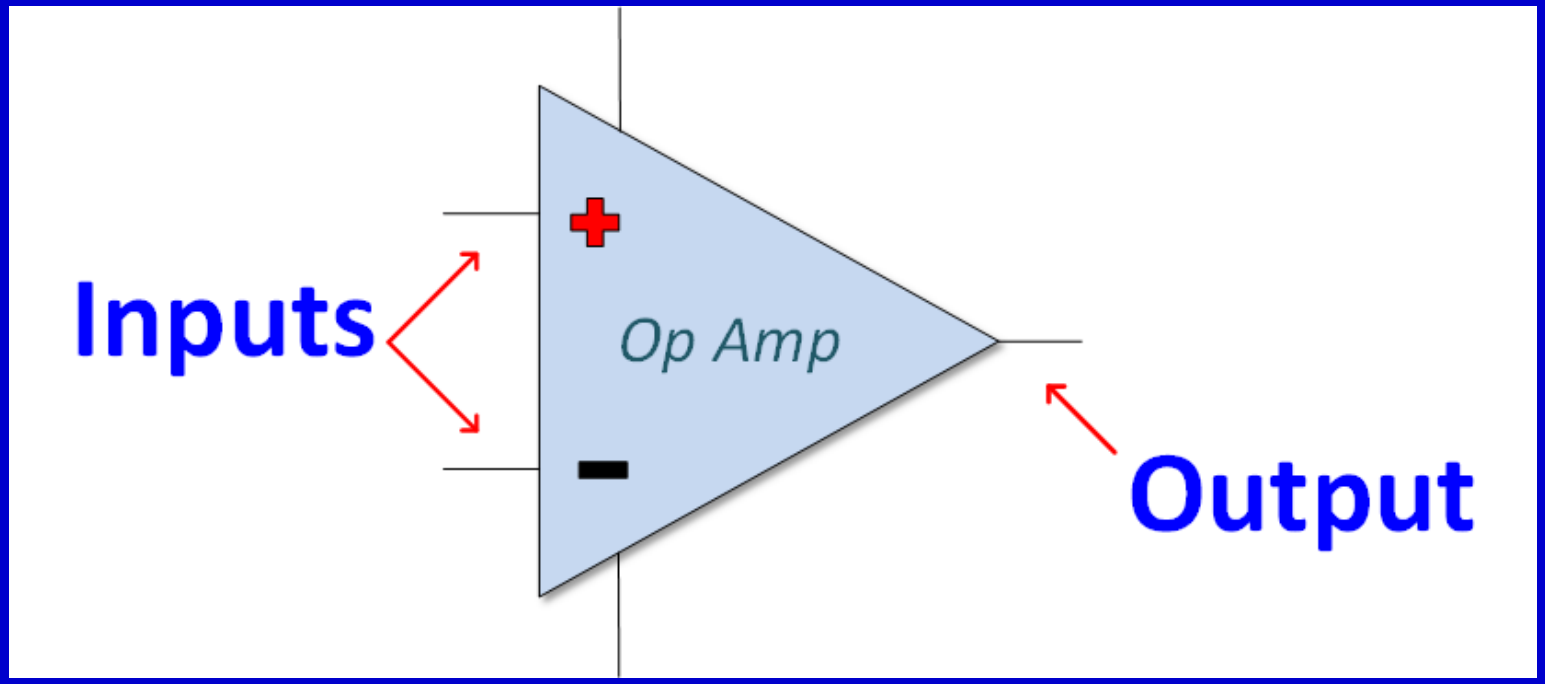
Operational Amplifiers

Operational Amplifiers

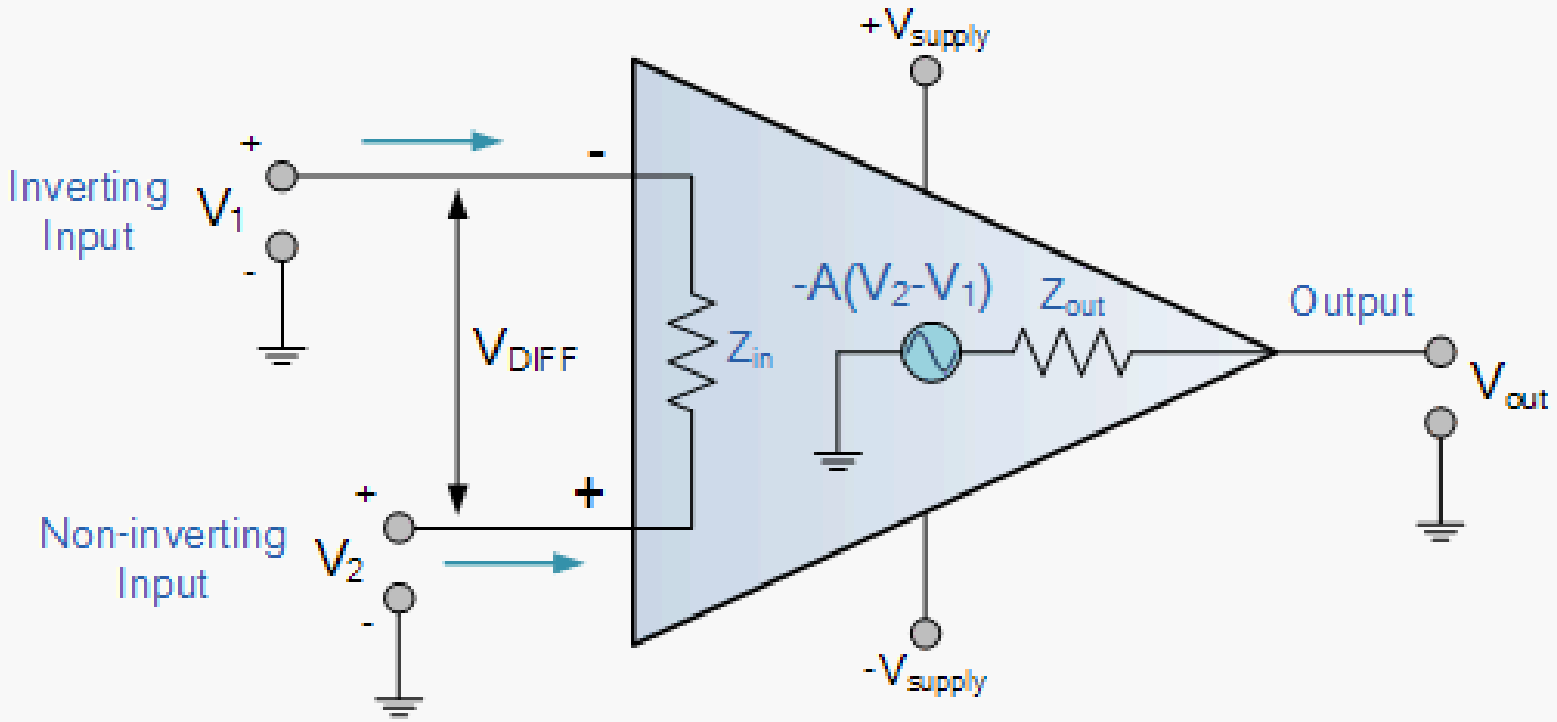
Operational amplifiers are linear devices that have all the properties required for nearly ideal DC amplification and are therefore used extensively in signal conditioning, filtering or to perform mathematical operations such as add, subtract, integration and differentiation.

An **Operational Amplifier**, or op-amp for short, is fundamentally a voltage amplifying device designed to be used with external feedback components such as resistors and capacitors between its output and input terminals.

Operational Amplifier



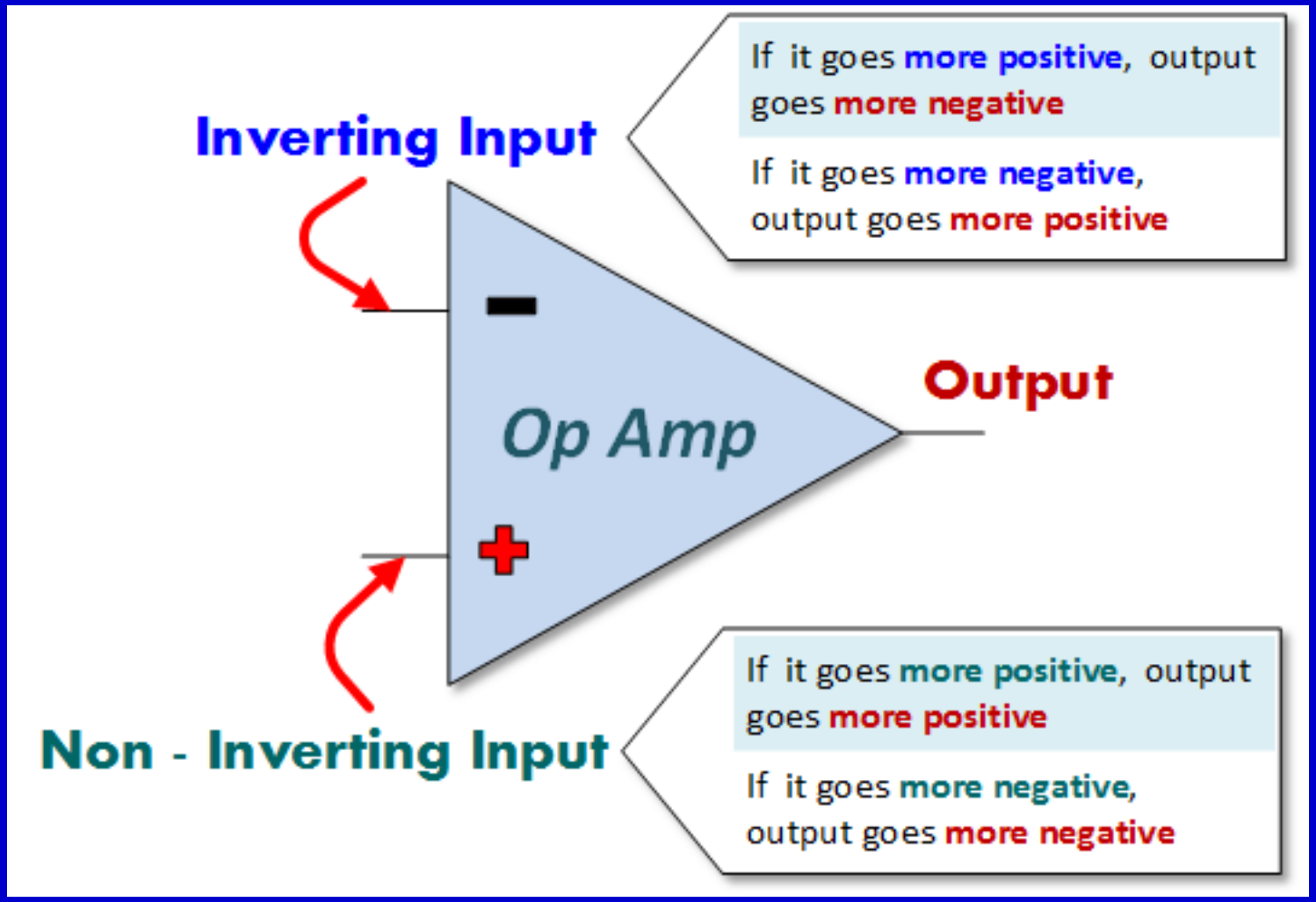
Equivalent Circuit of an Ideal Operational Amplifier



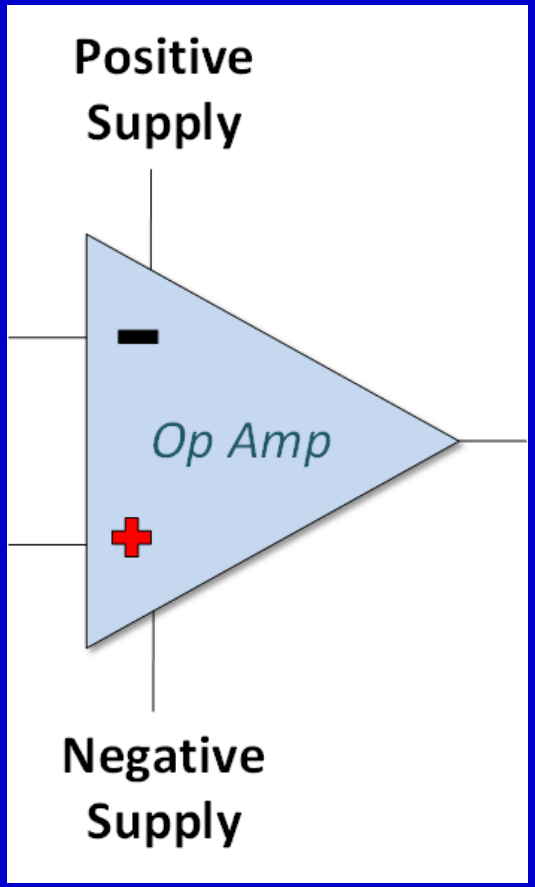
What the output of an Op Amp does

The output responds to an input by raising or lowering its voltage ***until the voltage at the inputs are equal***. This is done by connecting the op amp in such a way that **feedback** is provided to one of the inputs.
In a sense, the device works to create a balance.

Operational amplifier inputs



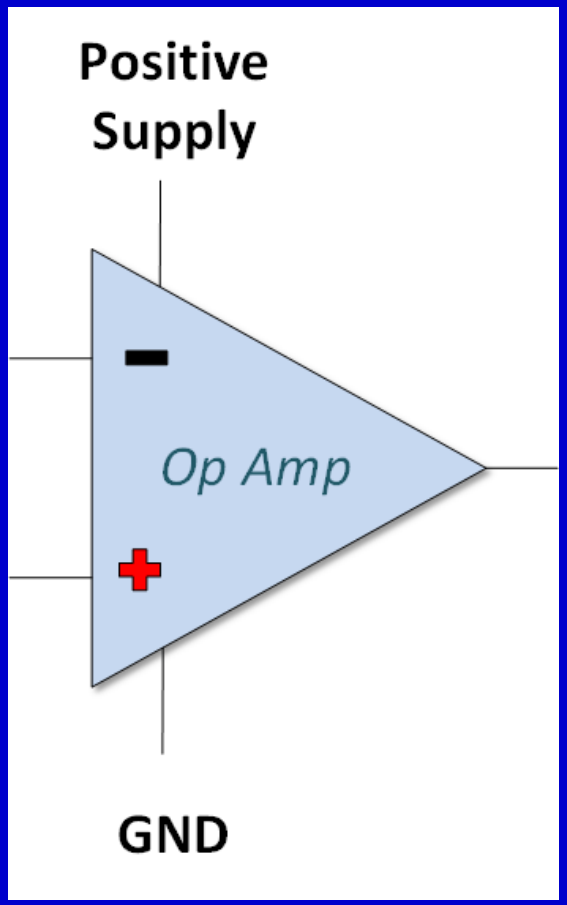
Bi-polar Op Amp



The Bi-Polar Op Amp is the style that is the most commonly featured in various sample schematics found on the internet. For power, it is designed to receive both a positive and negative voltage.

It is extremely useful if you need to provide an output that indicates a difference that is less than zero volts.

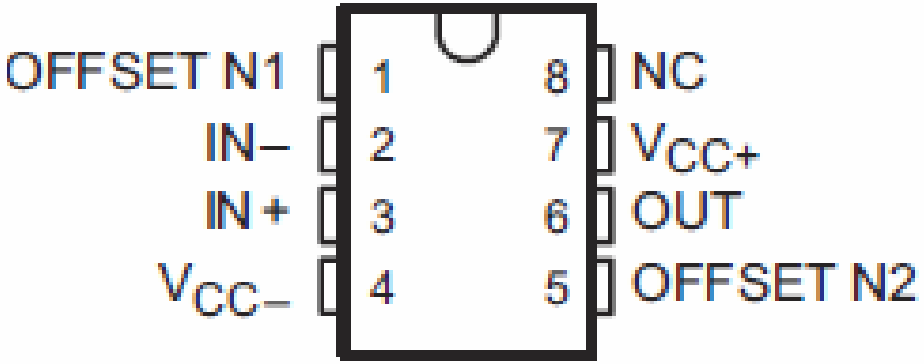
Uni-polar Op Amp



The uni-polar op amp is one where there is a power input and a ground connection. The power supply will be positive in most cases.

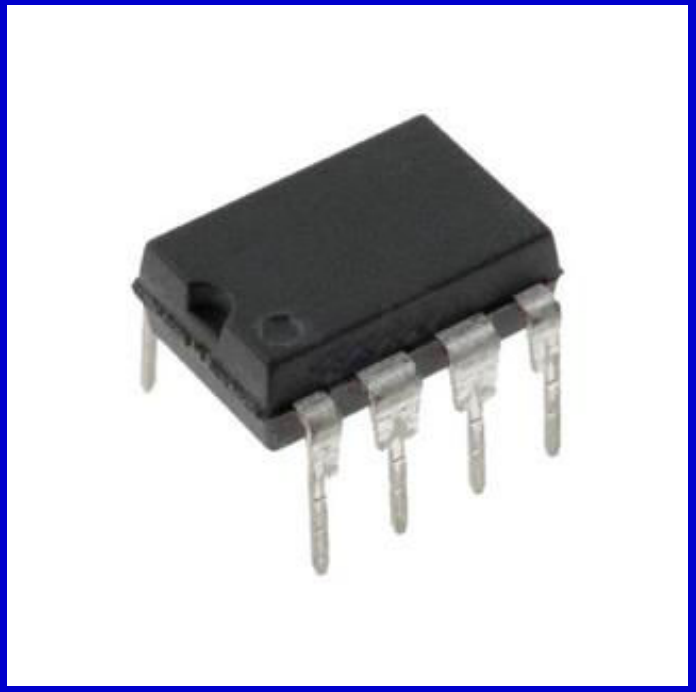
It is the op amp which is mostly integrated into a microcontroller application.

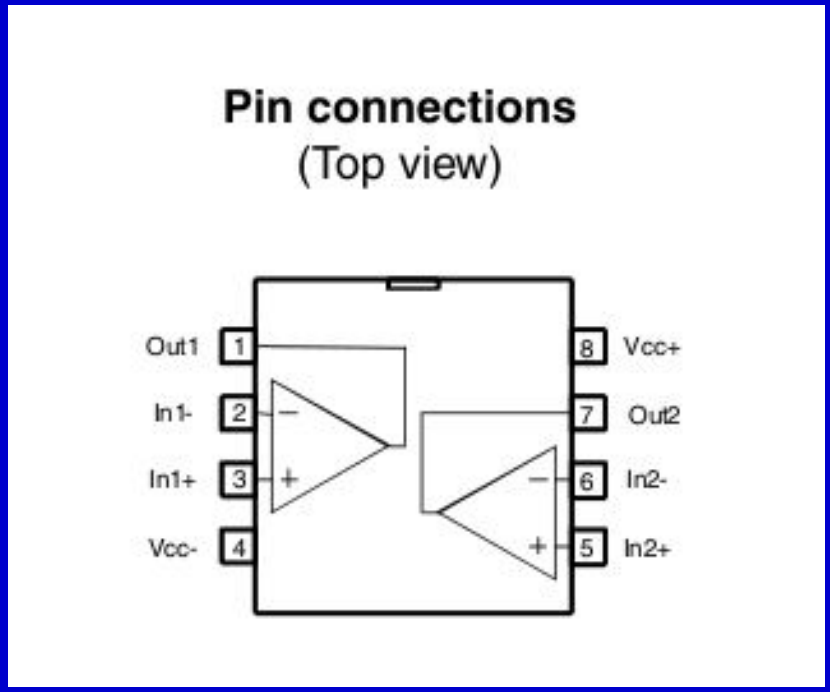
Operational amplifier UA741



Transmission band frequency 1MHz
Supply voltage 3...18V DC

Dual Operational Amplifier LM358N





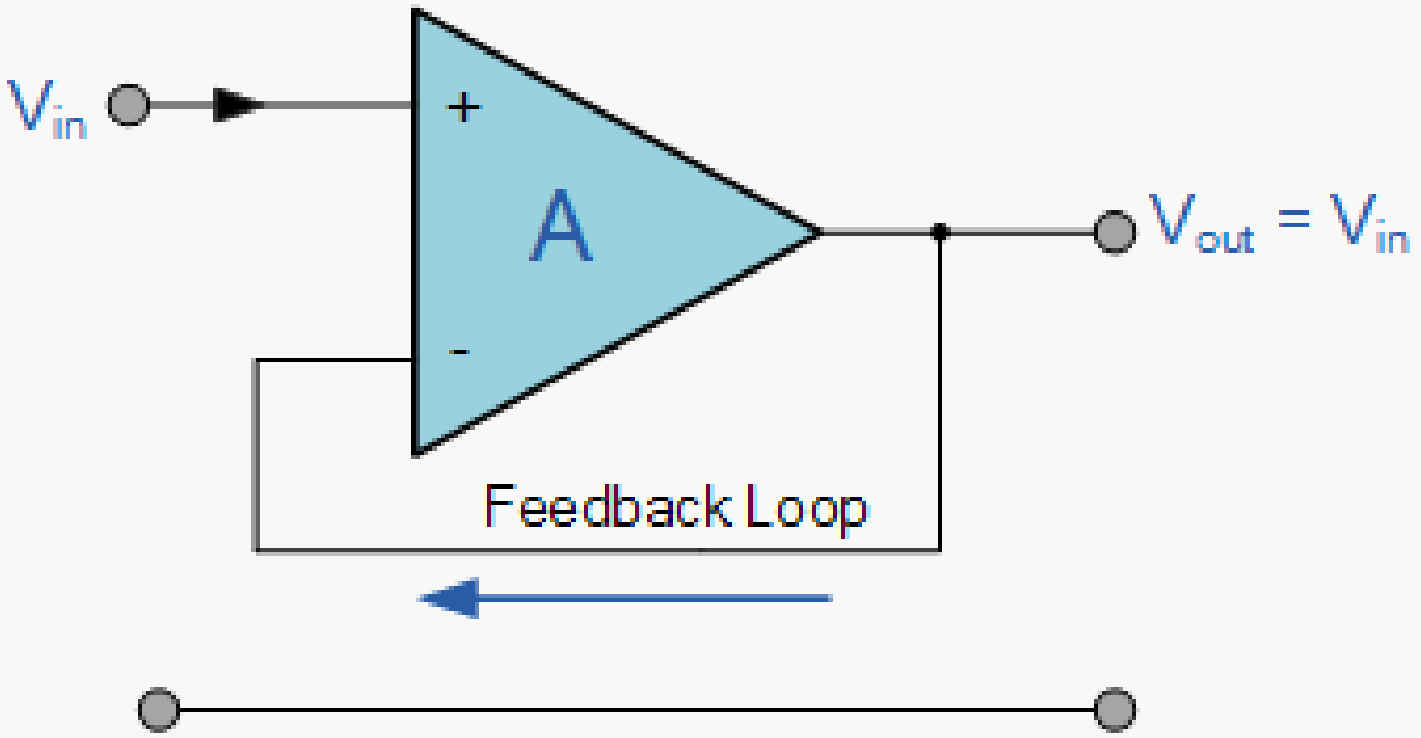
Transmission band frequency 1MHz
Supply voltage 3...32V DC

Non-inverting voltage follower

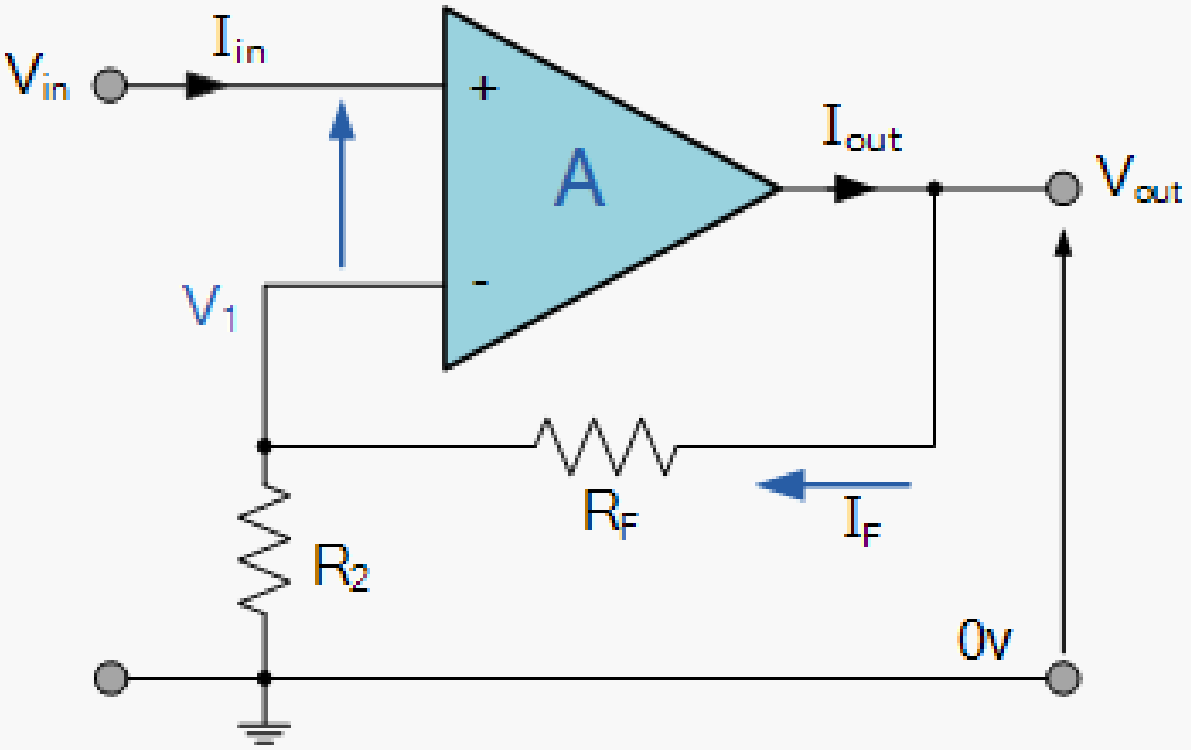
In this circuit, the output voltage will equal the input voltage. The benefit here has to do with the input impedance of the op amp. It has a very high input impedance and will not likely drag the output of the micro-controller (or other device down). More, depending on the Op Amp selected, the output of the Op Amp can have a much higher current handling capacity than the Arduino output.

Notice how the output is connected to inverting input. Thus, the output will respond to change in voltage at the non-inverting input by raising or lowering the voltage until both inputs are equal.

Non-inverting Voltage Follower



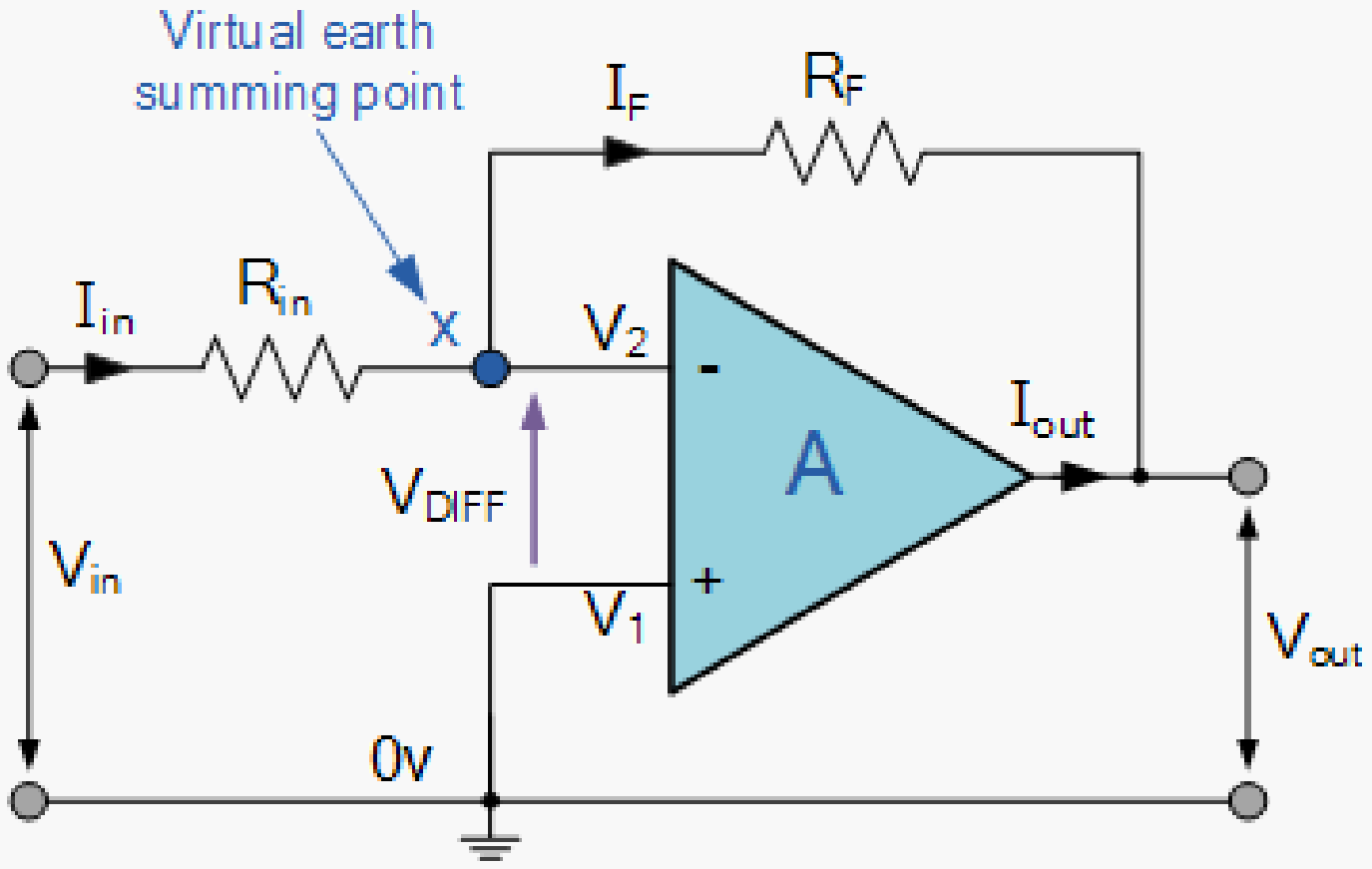
Non Inverting Operational Amplifier



Non Inverting Operational Amplifier Gain

$$A_{(v)} = 1 + \frac{R_F}{R_2}$$

Inverting Operational Amplifier

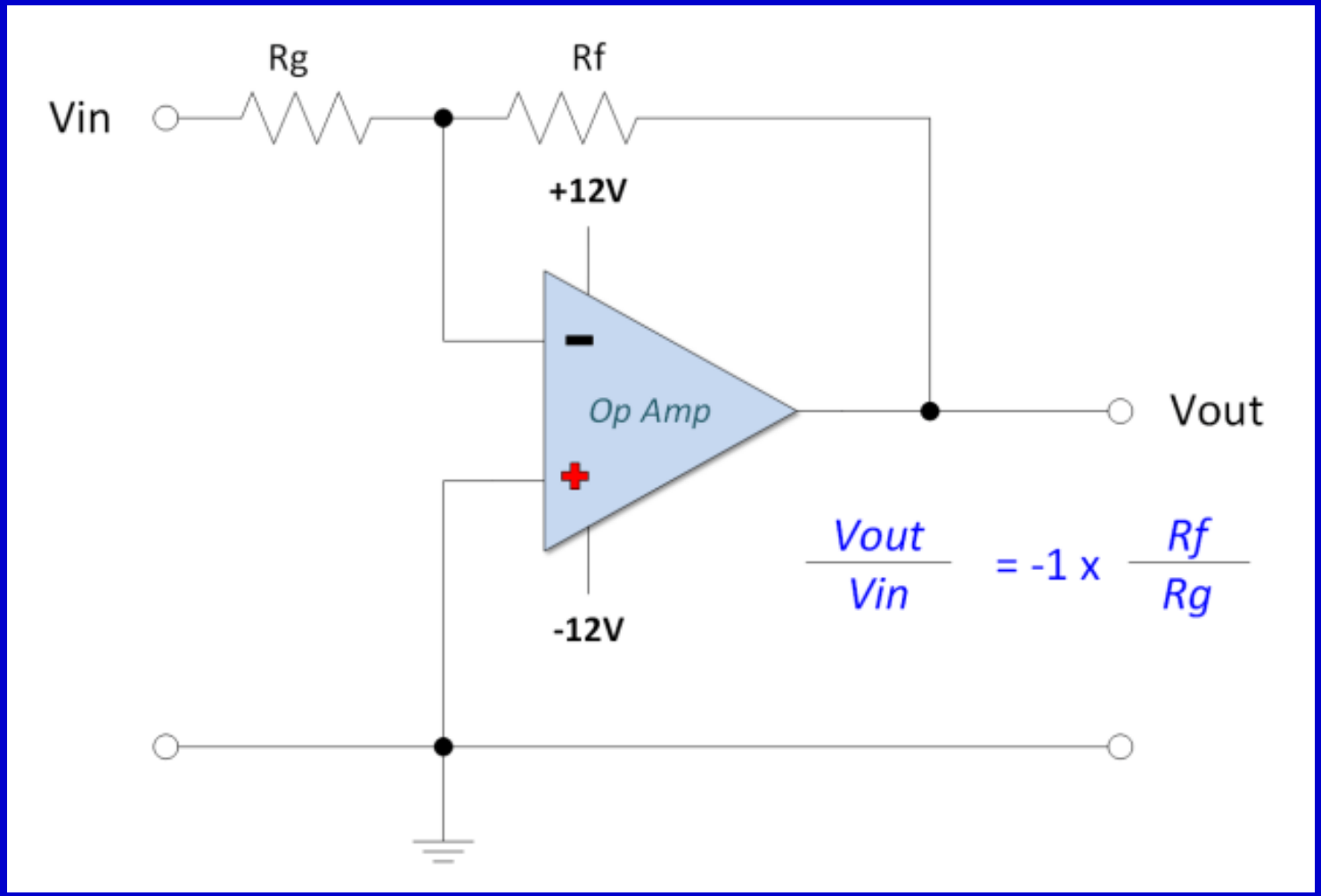


Inverting Operational Amplifier Gain

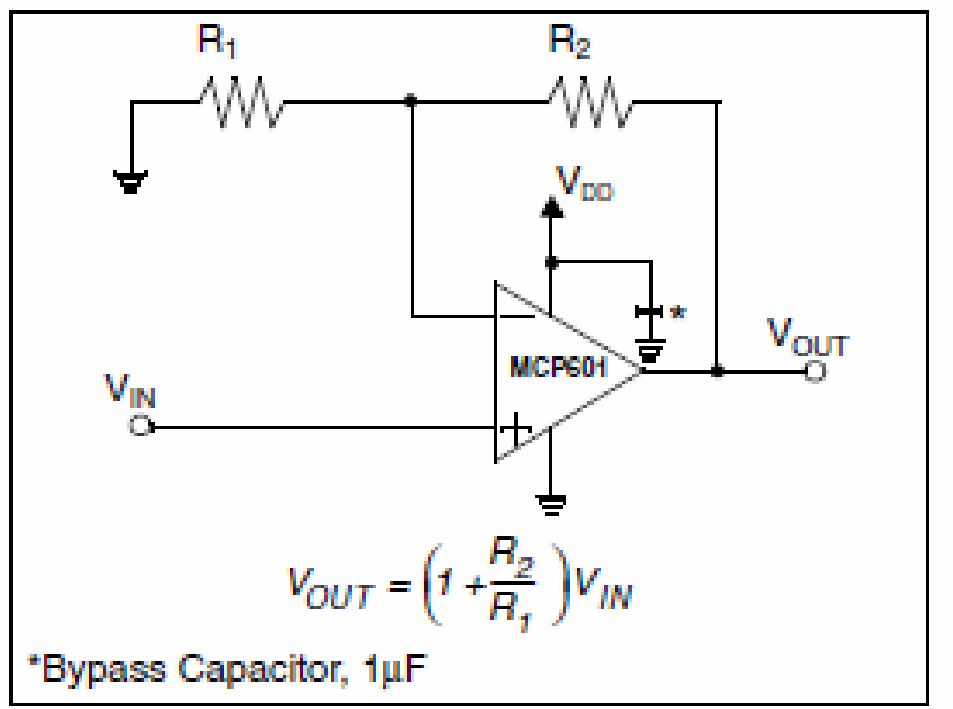
$$\text{Gain (Av)} = \frac{V_{out}}{V_{in}} = -\frac{R_f}{R_{in}}$$

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

Inverting Operational Amplifier

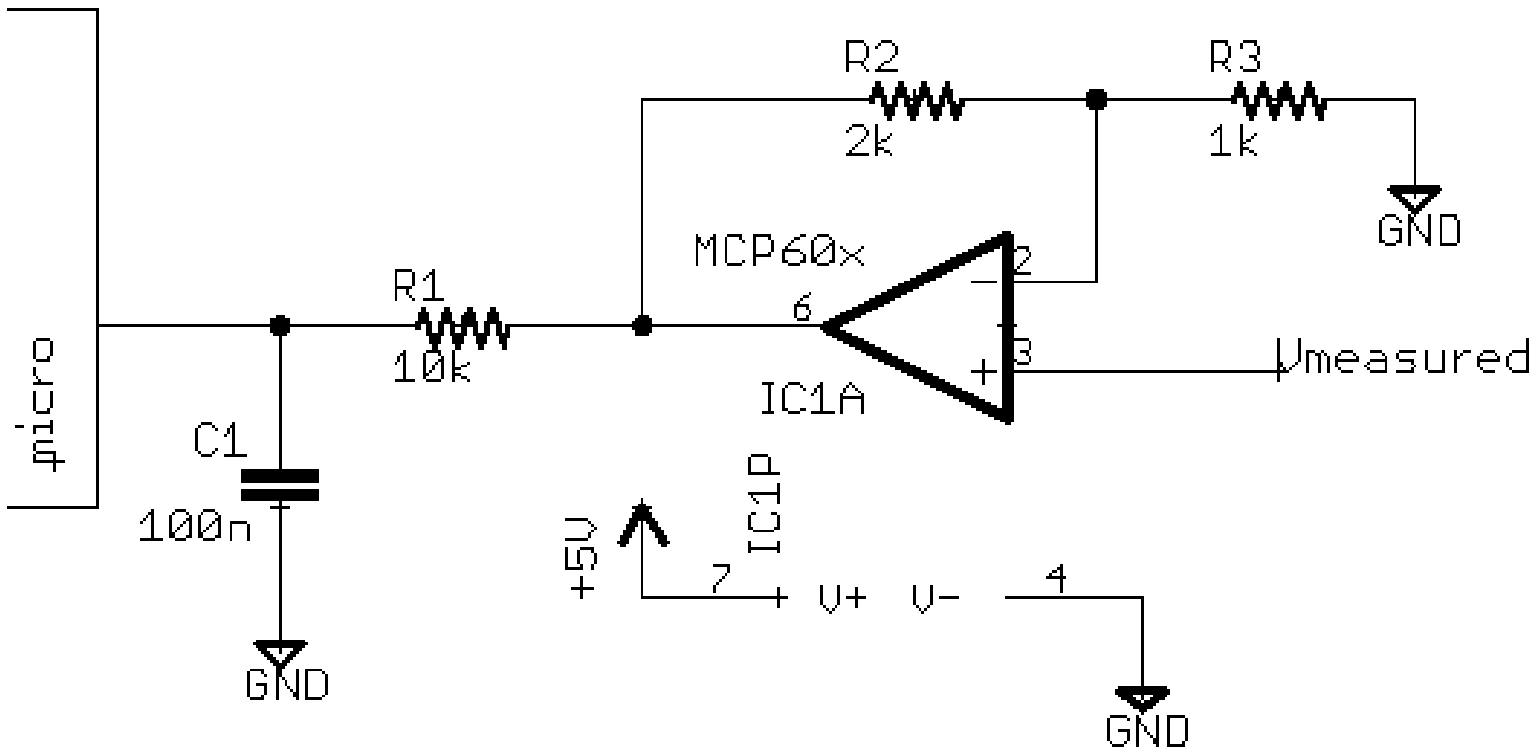


Non Inverting Operational Amplifier

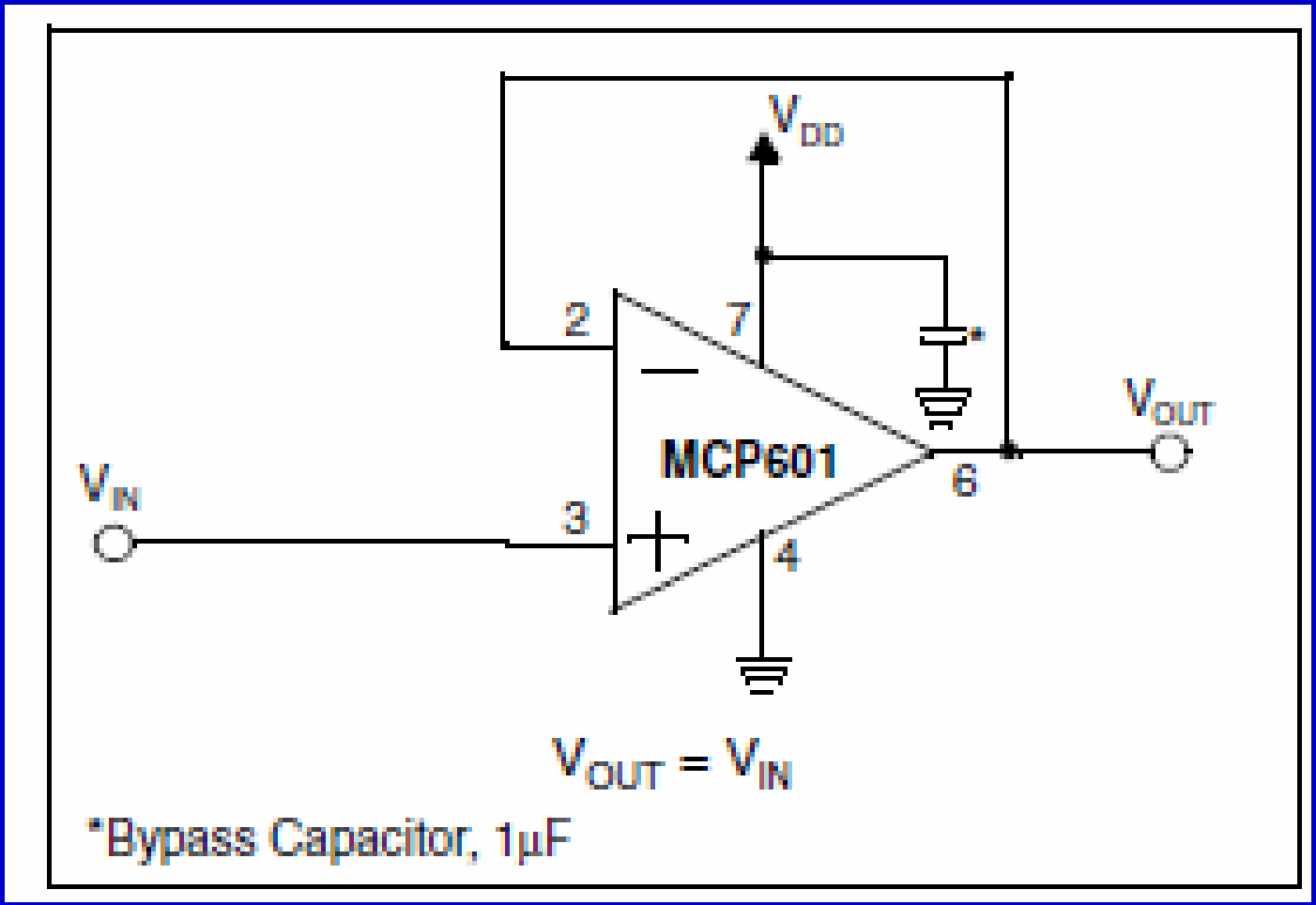


Typical values for these resistors in single supply circuits are above 2 KOhm for R2. The resistor R1, restrictions are dependent on the amount of gain desired versus the amount of amplifier noise and input offset voltage as specified in the product data sheet of the op amp.

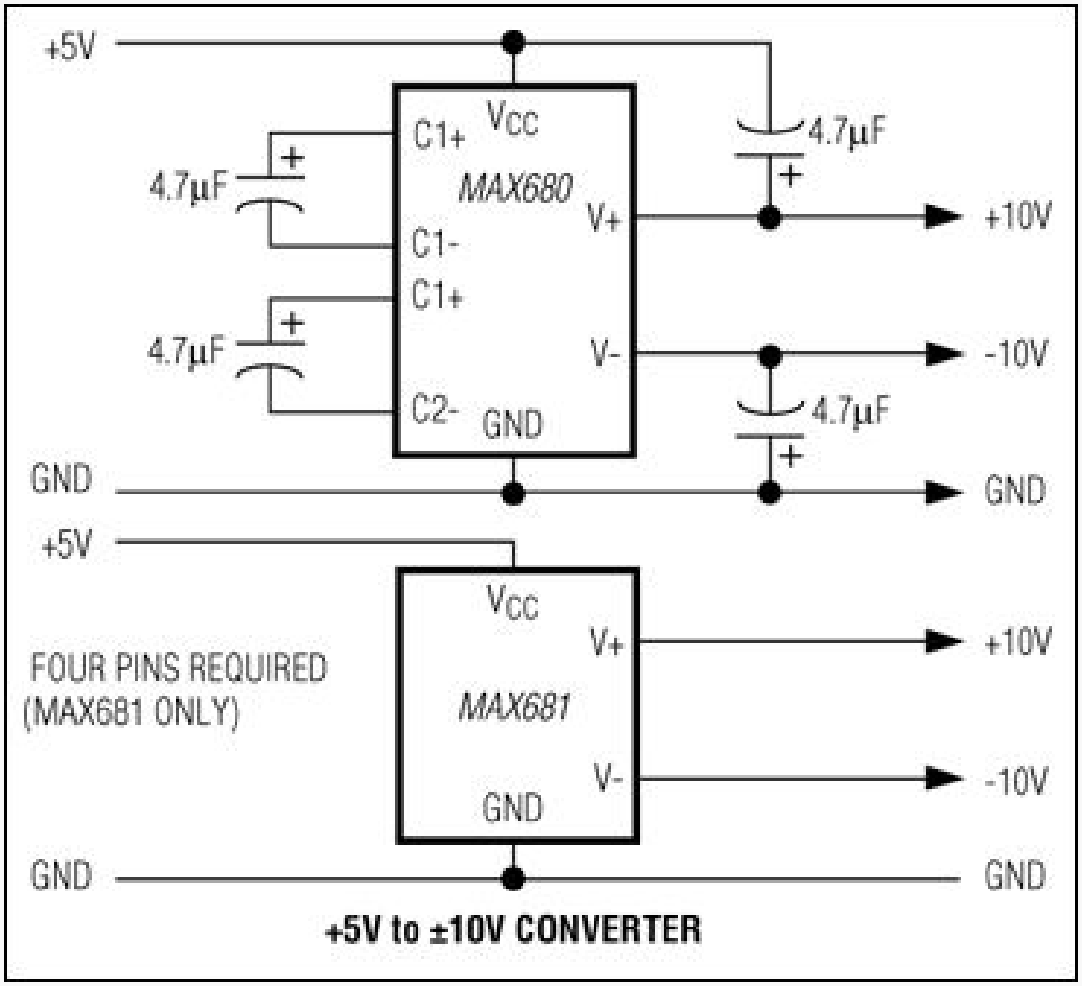
Measure a DC Voltage between 0 V and 1.7 V

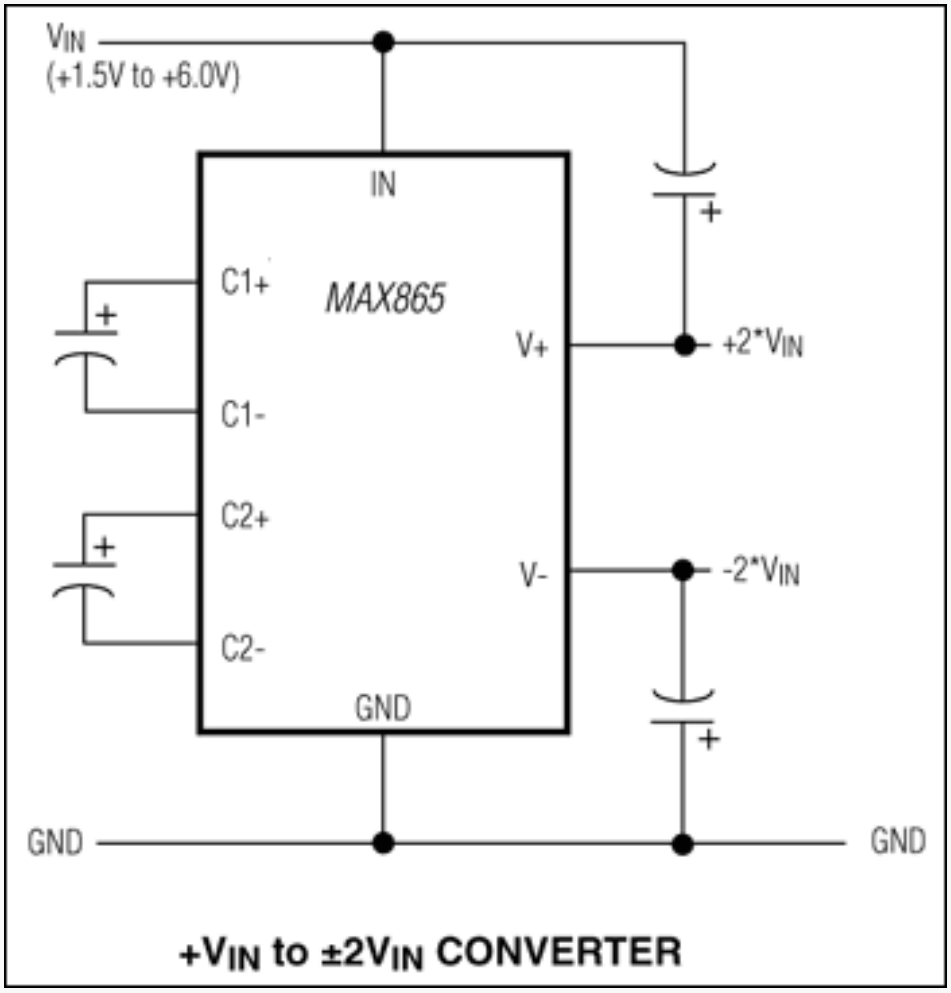


Buffer circuit



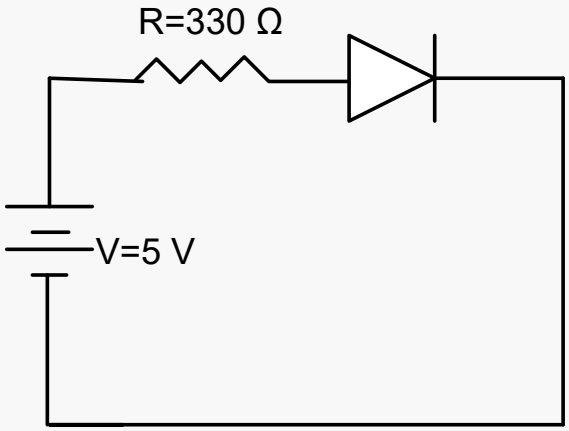
+5V to ±10V Voltage Converters

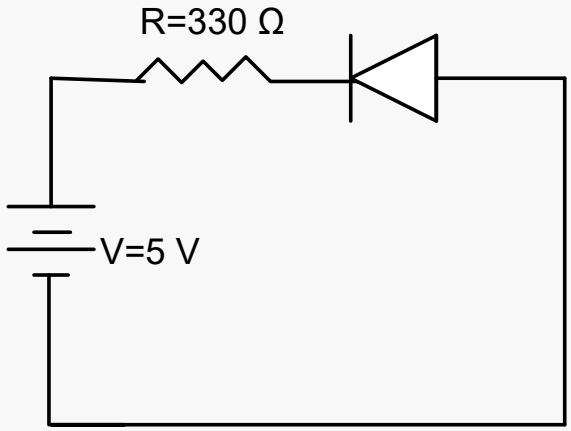




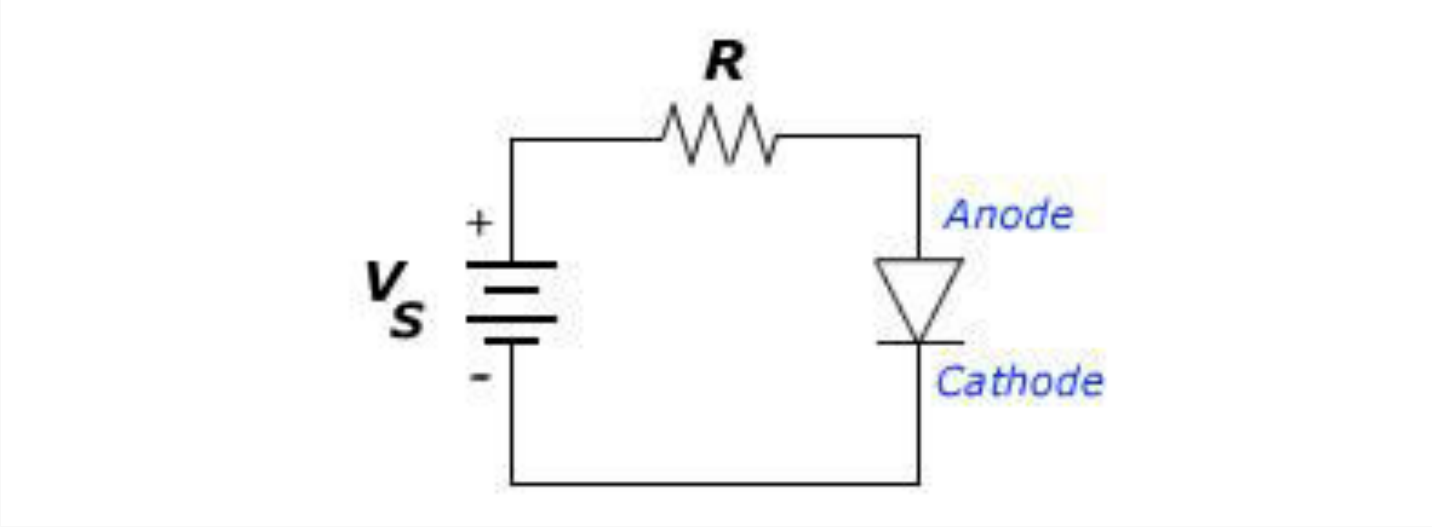
+V_{IN} to ±2V_{IN} CONVERTER

6.1. Στα κυκλώματα που δίδονται στην συνέχεια εντοπίστε την δίοδο που άγει και αυτή που δεν άγει.

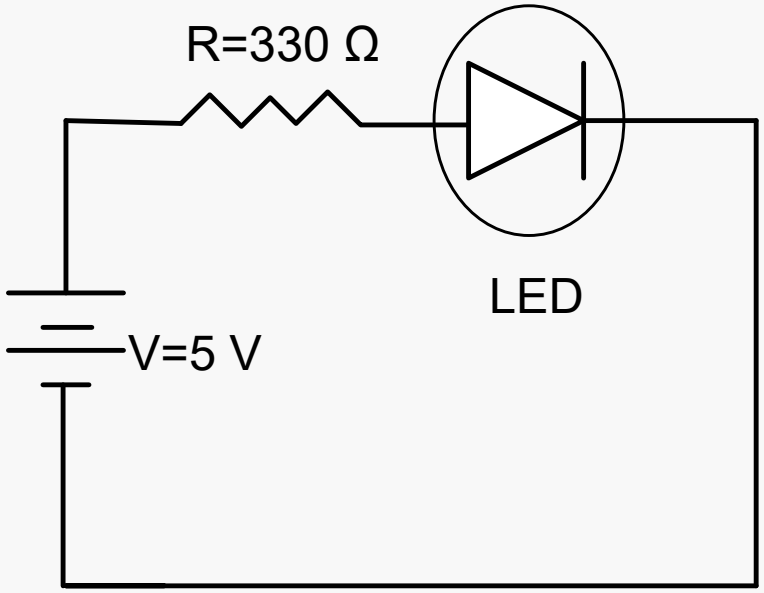




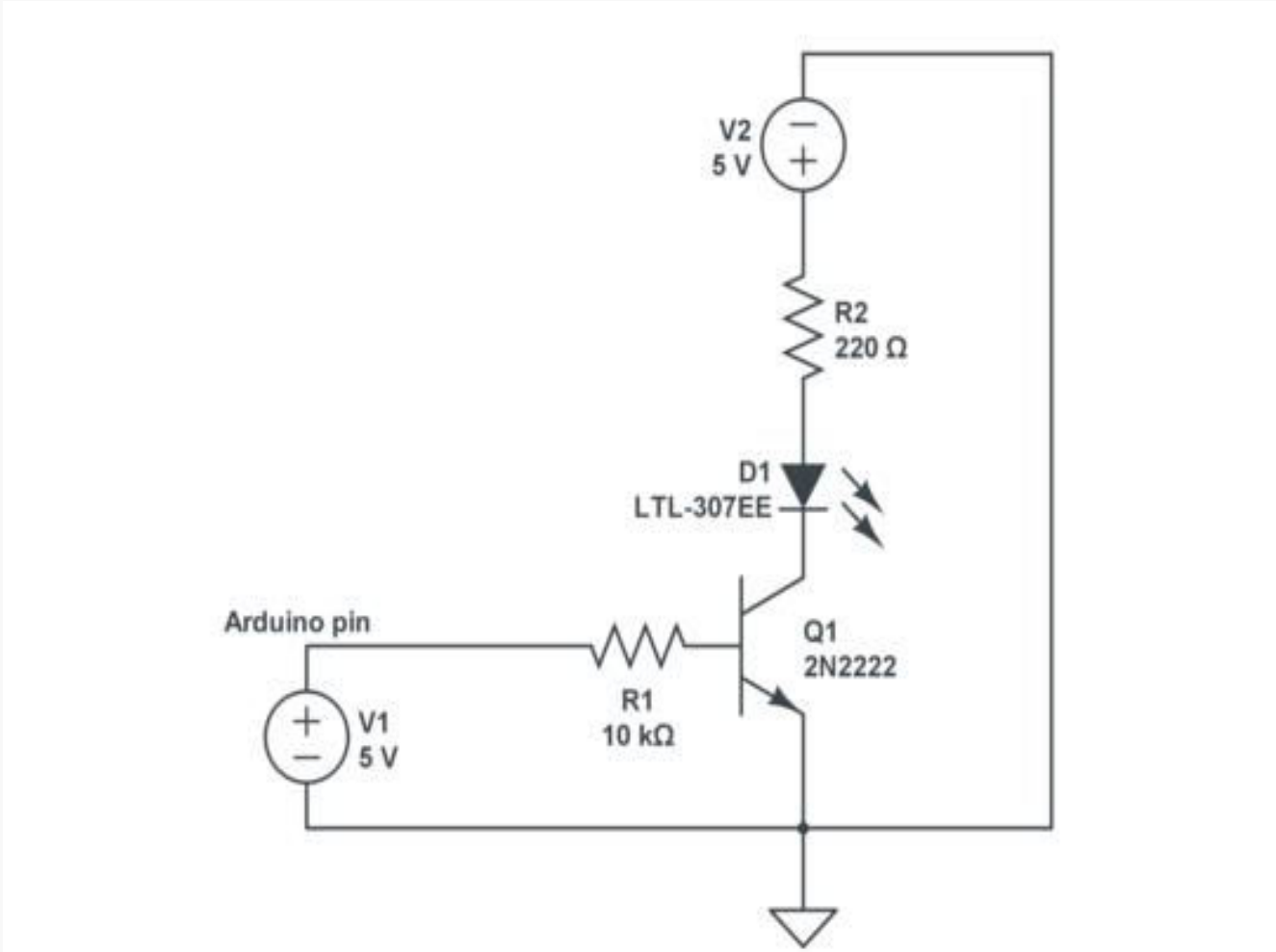
6.2. Να υπολογισθεί το ρεύμα που διαρρέει την δίοδο για R=330 Ohm όταν Vs=3.3 Volt. (Diode Voltage Drop Vd=0.7 V)



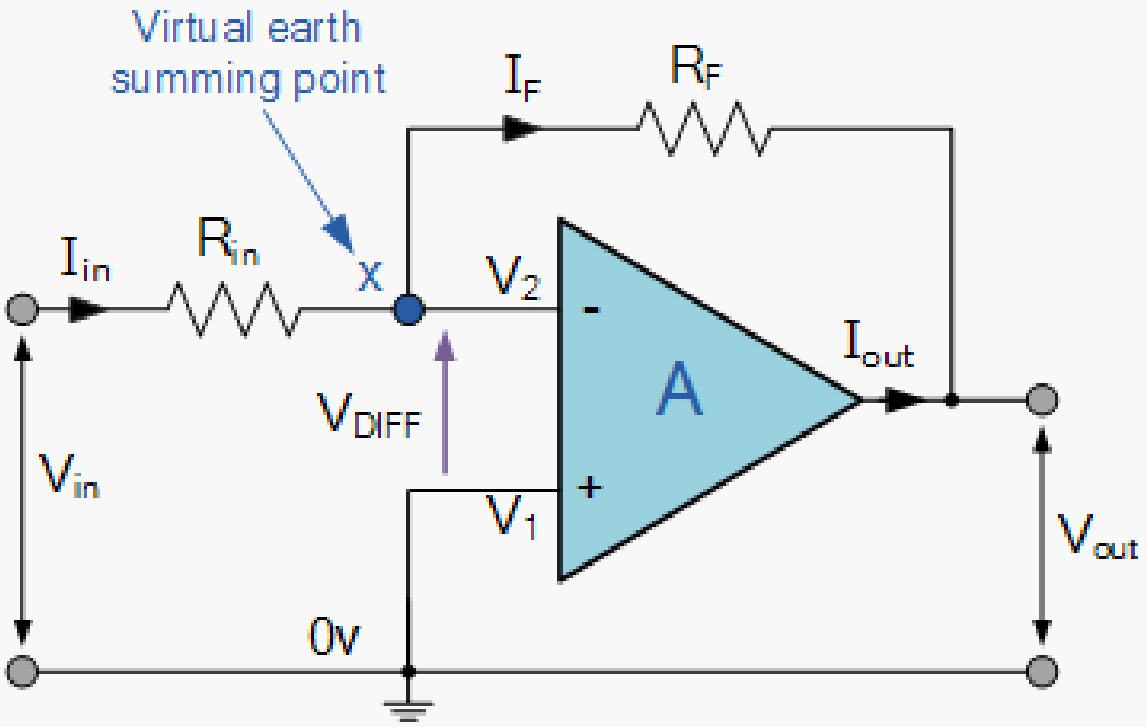
6.3. Να υπολογισθεί το ρεύμα που διαρρέει το LED για R=330 Ohm (Θεωρήστε το LED Voltage Drop Vd=2.0 V).



6.4. Στο κύκλωμα που δίδεται στην συνέχεια υποθέστε ότι το τρανζίστορ είναι στον κόρο και υπολογίστε το ρεύμα που διαρρέει την αντίσταση R2. Στην συνέχεια υπολογίστε το ρεύμα που διαρρέει την αντίσταση R1 και εξετάστε αν αυτό είναι αρκετό για να εισέλθει το τρανζίστορ στον κόρο.


V2
5 V
R2
220 Ω
D1
LTL-307EE
Arduino pin
Q1
2N2222
R1
10 kΩ
V1
5 V

6.5. Τι είδους ενισχυτής είναι αυτός που περιγράφεται στην συνέχεια. Υπολογίστε την ενίσχυσή του.



6.6. Τι είδους ενισχυτής είναι αυτός που περιγράφεται στην συνέχεια. Υπολογίστε την ενίσχυσή του.