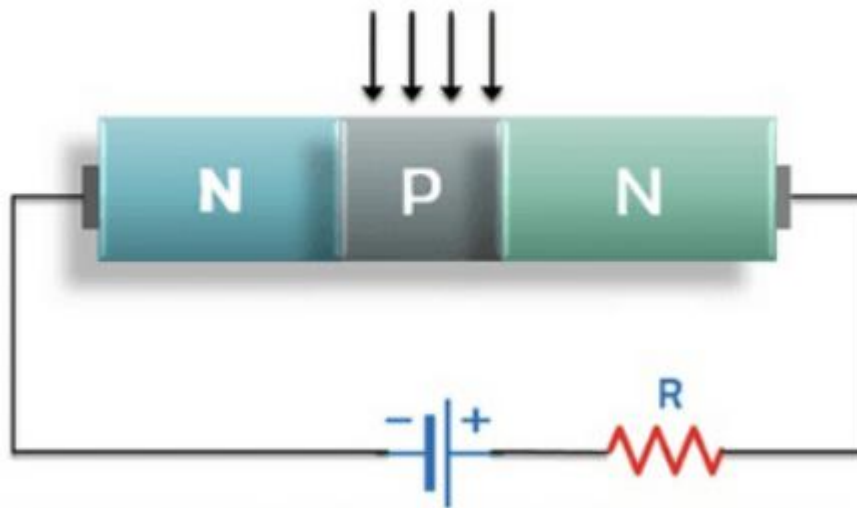
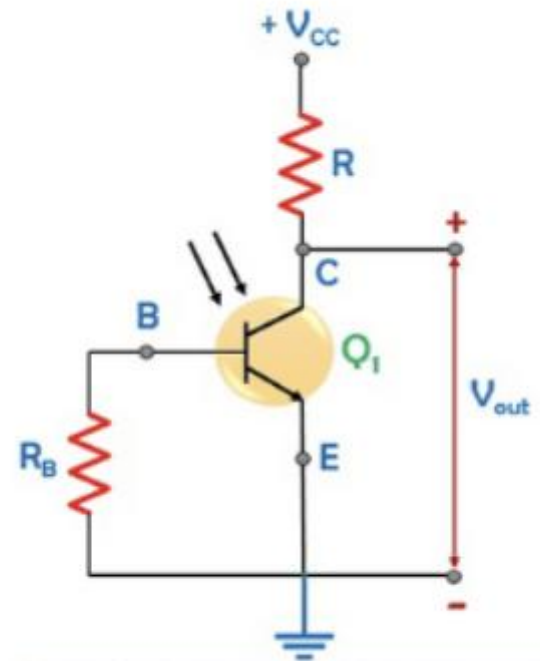


PHOTO TRANSISTOR

What is a Phototransistor?



Working structure of Phototransistor



Circuit of Phototransistor

PHOTO TRANSISTOR

•Phototransistor Definition:

- A phototransistor is defined as a semiconductor device with a light-sensitive base region, designed specifically for detecting and amplifying light signals

•Working Principle:

Phototransistors work by replacing the base current with light intensity, allowing them to function in switching and amplification applications.

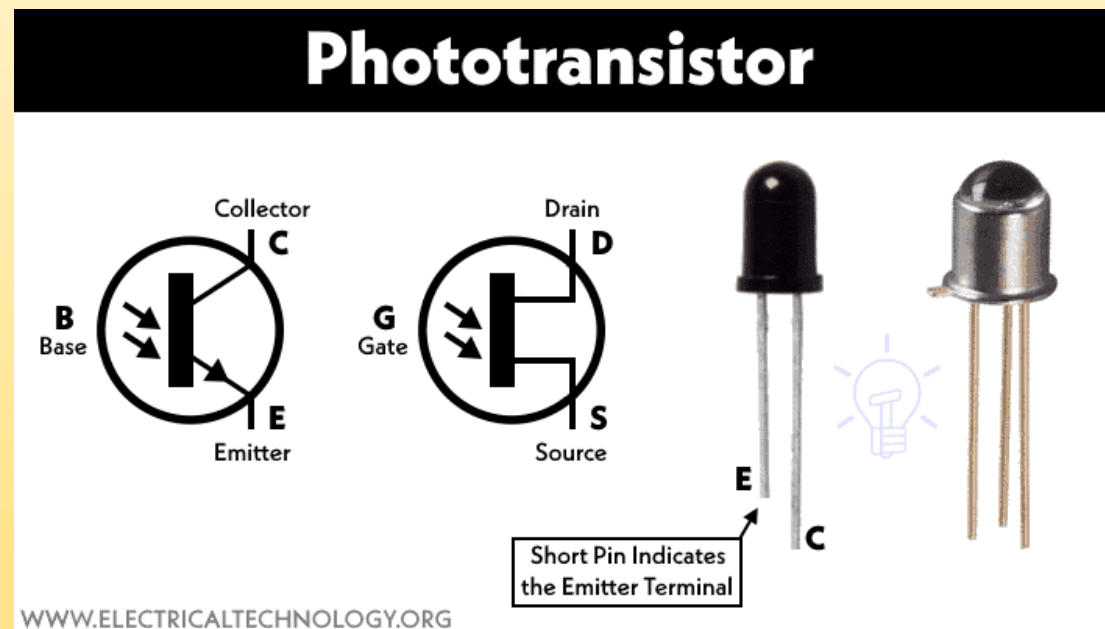
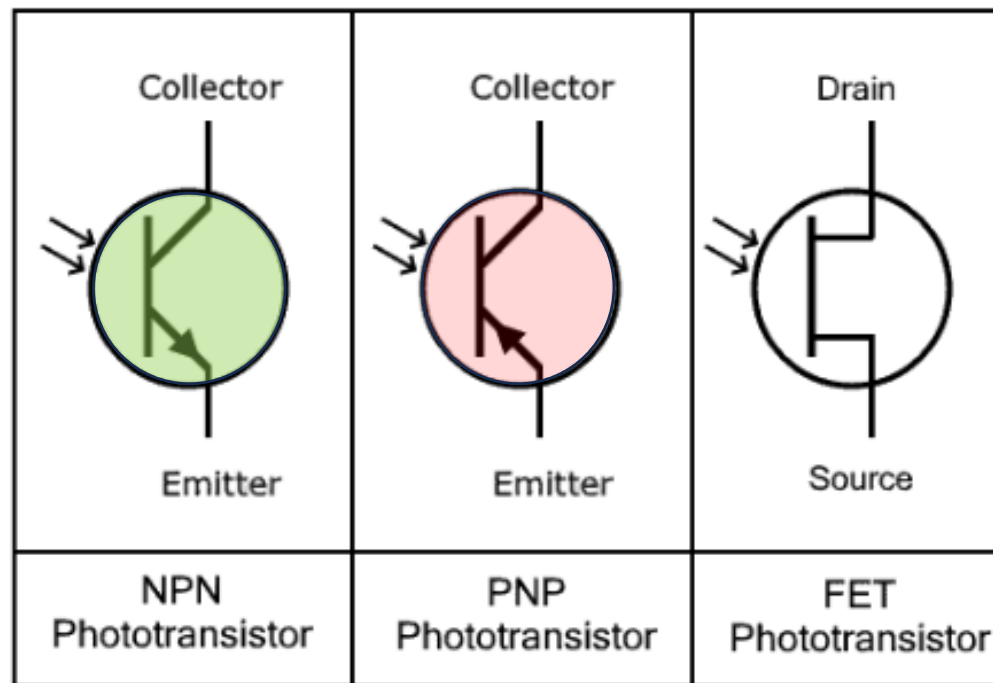


PHOTO TRANSISTOR

- The construction of a phototransistor is similar to any normal transistor except for the missing base terminal and the wide light-sensitive base region. Commonly bipolar phototransistor is used.



Symbol of Phototransistor



PHOTO TRANSISTOR

•Phototransistor Working:

In a phototransistor, light acts like the base current.

1. When **no light** is falling on it:

1. No base current → No collector-emitter current → Transistor is **OFF**.

2. When **light hits the base region**:

1. Light generates **electron-hole pairs** in the base (via the **photoelectric effect**).
2. These charge carriers **act like a base current**.
3. This “photocurrent” **triggers the transistor**, just like a small electrical base current would.

3. The tiny light-induced base current causes a **much larger current** to flow from **collector to emitter**.

- **More light → more base current → more collector current**
- This means the output current is **amplified** based on light intensity.

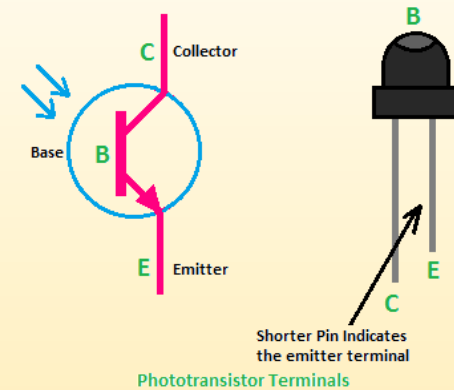




PHOTO TRANSISTOR

•Phototransistor Construction

•The construction of a phototransistor is similar to any normal transistor except for the missing base terminal and the wide light-sensitive base region. Commonly bipolar phototransistor is used.

1. **Light (photons)** enters the phototransistor through a lens or transparent window.
2. These photons hit the **base region** of the transistor, generating **electron-hole pairs**.
3. This causes an increase in base current, which in turn controls a much larger current between the collector and emitter.
4. The output current is proportional to the intensity of the light falling on it.

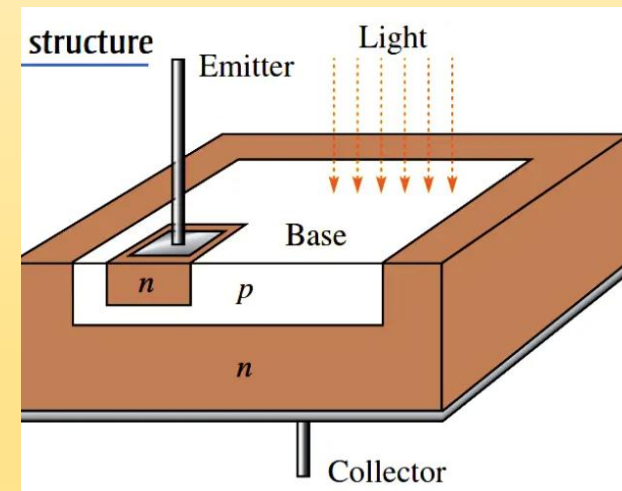


PHOTO TRANSISTOR

•Phototransistor Construction

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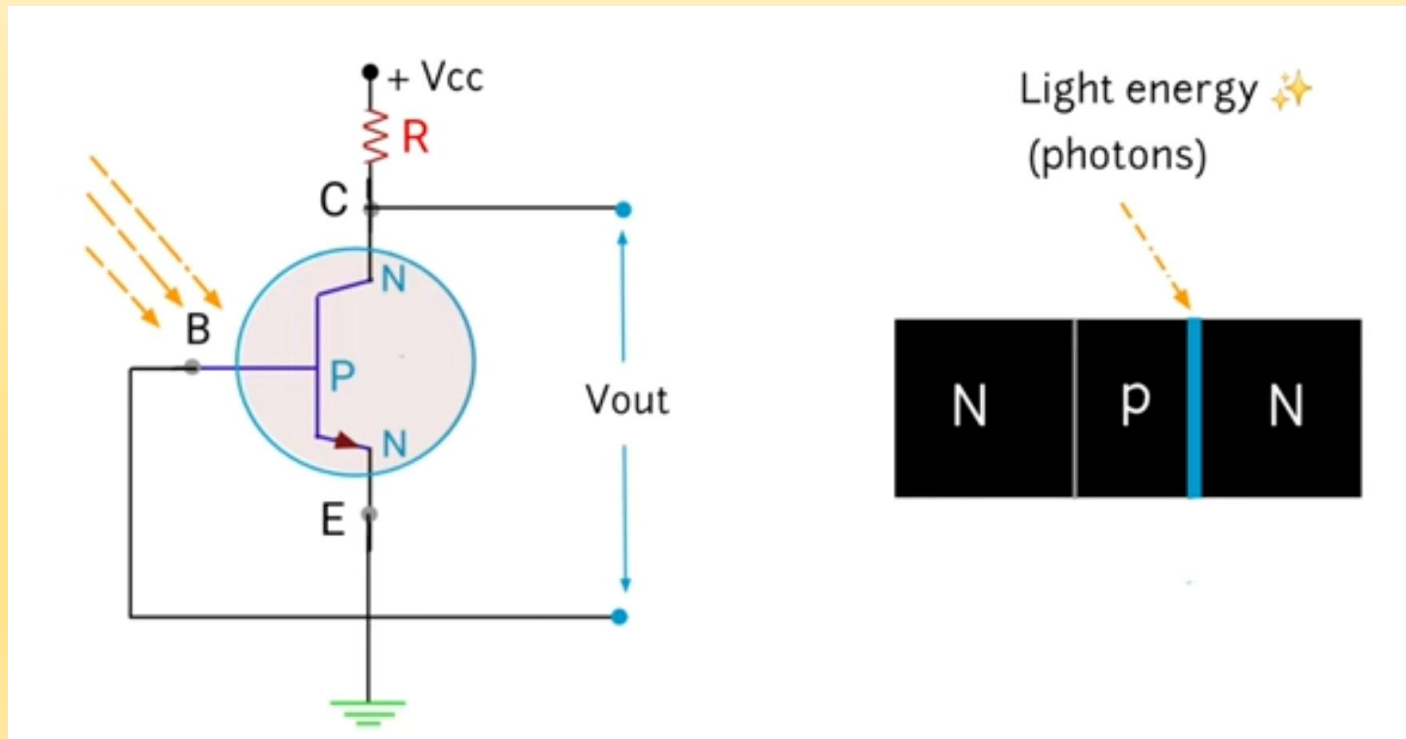
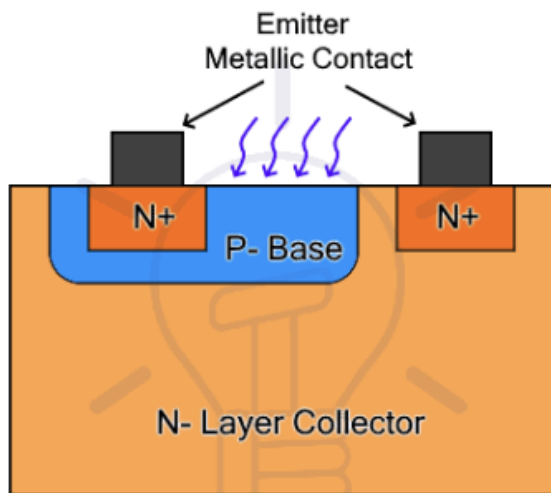


PHOTO TRANSISTOR

•Phototransistor Construction

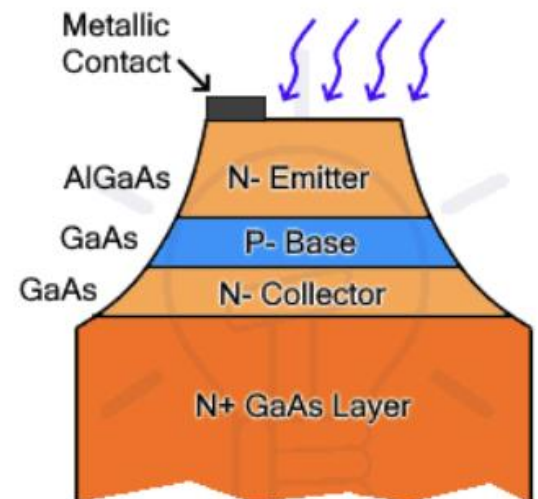
- There are two types of structures being used for phototransistors i.e. Homojunction and heterojunction design.

Homojunction



Phototransistor

Heterojunction



Phototransistor Heterojunction Structure

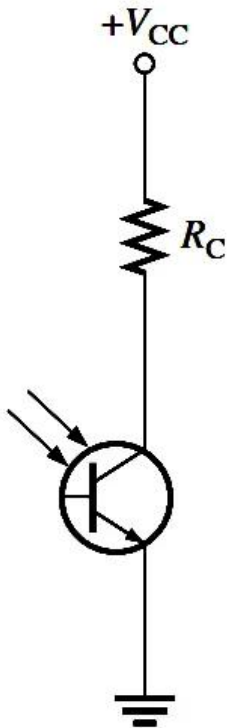


PHOTO TRANSISTOR

•Phototransistor characteristics

- Figure shows a phototransistor with a biasing circuit and typical collector characteristic curves.

Phototransistor circuit



Phototransistor collector characteristic curves

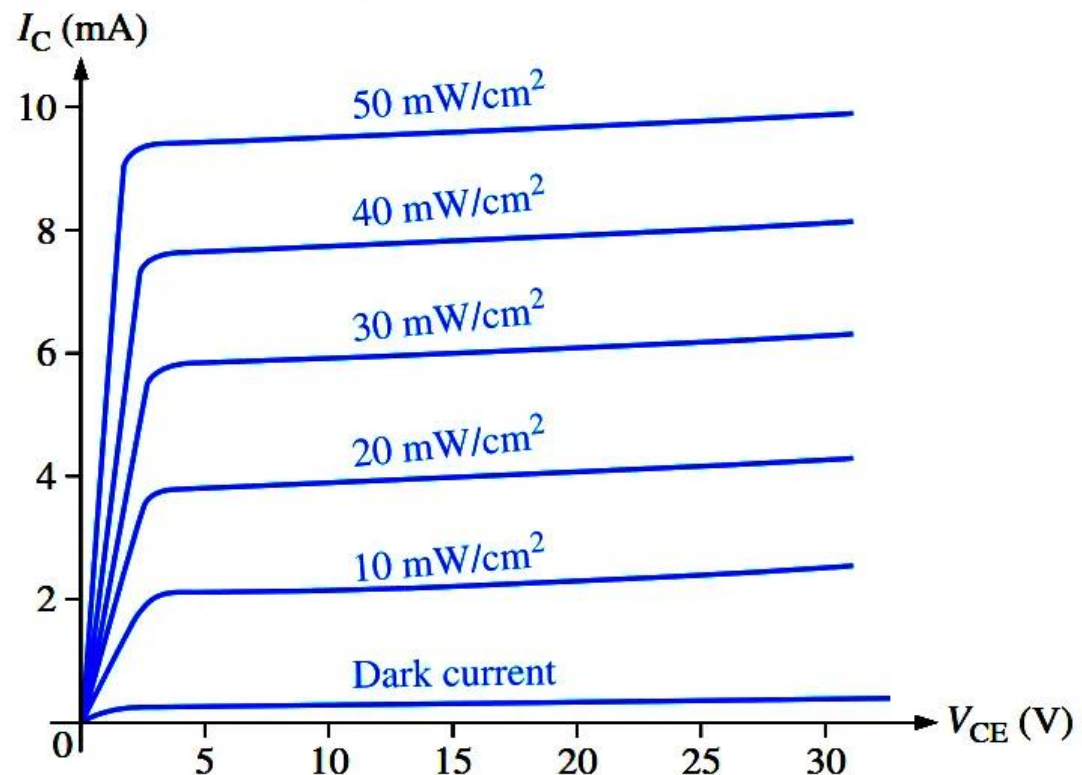




PHOTO TRANSISTOR

Modes of Operation

The phototransistor just like Bipolar Junction Transistor can operate in two modes

i.e linear or active mode or switch mode.

Linear or Active Mode:

while operating in linear mode, the output current is directly proportional to the intensity of the incident light.

Switch Mode:

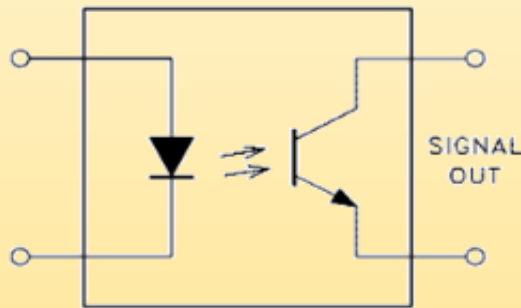
in switch mode operation, the phototransistor has two states i.e “Off” state and “On” state just like a switch.

This mode is usually used due to the non-linear response of the phototransistor to the light.

Typical applications of PHOTO TRANSISTOR

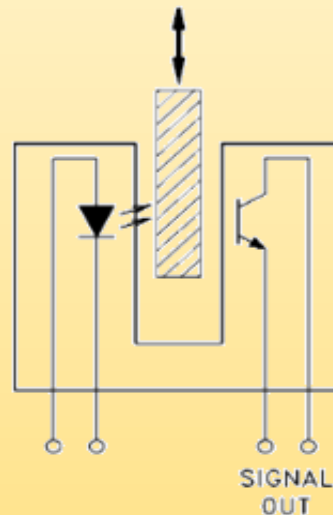
Applications

Phototransistors can be used as ambient light detectors. When used with a controllable light source, typically an IRED, they are often employed as the detector element for optoisolators and transmissive or reflective optical switches. Typical configurations include:



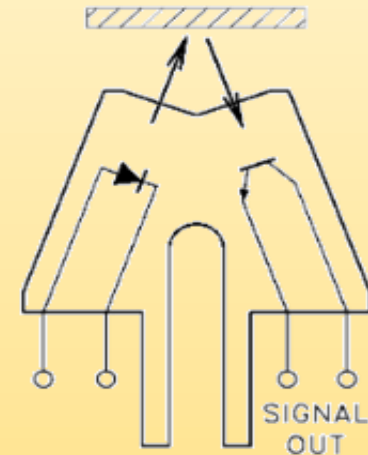
Optoisolator

The optoisolator is similar to a transformer in that the output is electronically isolated from the input.



Optical Switch

An object is detected when it enters the gap of the optical switch and blocks the light path between the emitter and detector.



Retro Sensor

The retro sensor detects the presence of an object by generating light and then looking for its reflectance off of the object to be sensed.



Typical applications of PHOTO TRANSISTOR

Type of Light Sensor	Advantages	Disadvantages
Photoresistor	<ul style="list-style-type: none"> ✓ Moderate response time ✓ Low cost ✓ Bi-directional 	<ul style="list-style-type: none"> ✓ Rugged in nature ✓ Resistance varies continually(analog)
Photodiode	<ul style="list-style-type: none"> ✓ Quicker response time ✓ Low cost ✓ Digital in nature 	<ul style="list-style-type: none"> ✓ Temperature sensitive ✓ Uni-directional
Phototransistor	<ul style="list-style-type: none"> ✓ Phototransistors produce a higher current than photo diodes. ✓ Phototransistors are relatively inexpensive, simple, and small enough to fit several of them onto a single integrated computer chip. ✓ Phototransistors are very fast and are capable of providing nearly instantaneous output. ✓ Phototransistors produce a voltage, that photo-resistors cannot do so. 	<ul style="list-style-type: none"> ✓ Phototransistors that are made of silicon are not capable of handling voltages over 1,000 Volts. ✓ Phototransistors are also more vulnerable to surges and spikes of electricity as well as electromagnetic energy. ✓ Phototransistors also do not allow electrons to move as freely as other devices do, such as electron tubes.