



Thapar Institute of Engineering & Technology  
(Deemed to be University)  
Bhadson Road, Patiala, Punjab, Pin-147004  
Contact No. : +91-175-2393201  
Email : info@thapar.edu

## **Engineering Design Project-II (UTA 024)**

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**THAPAR INSTITUTE**  
OF ENGINEERING & TECHNOLOGY  
(Deemed to be University)

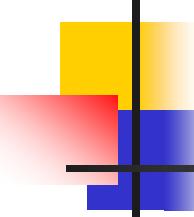


# **Engineering Design Project-II**

## **(UTA 024)**

# **Buggy Lab**

**Dr. Amit Mishra**



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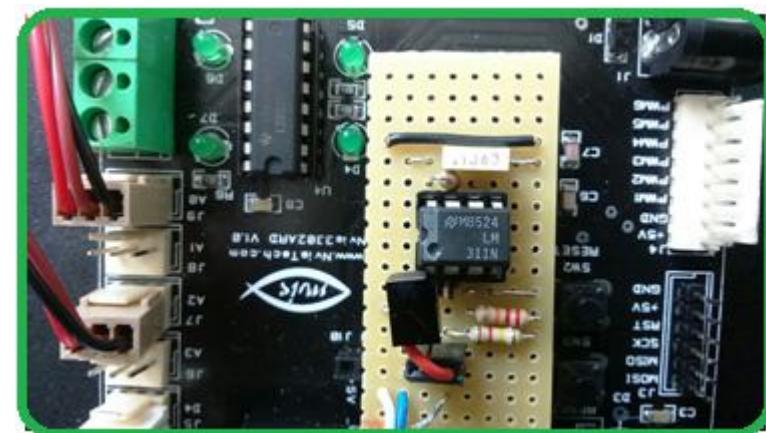
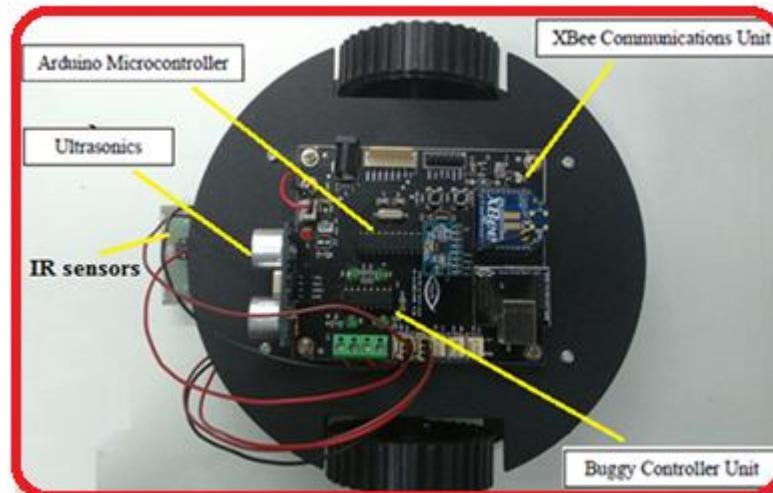
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- **Objective**
- **Receiver Circuit schematic diagram**
- **Component list**
- **Design Specification and selection of components**
- **Receiver Circuit on PCB**
- **Receiver Circuit testing**
- **Reference**

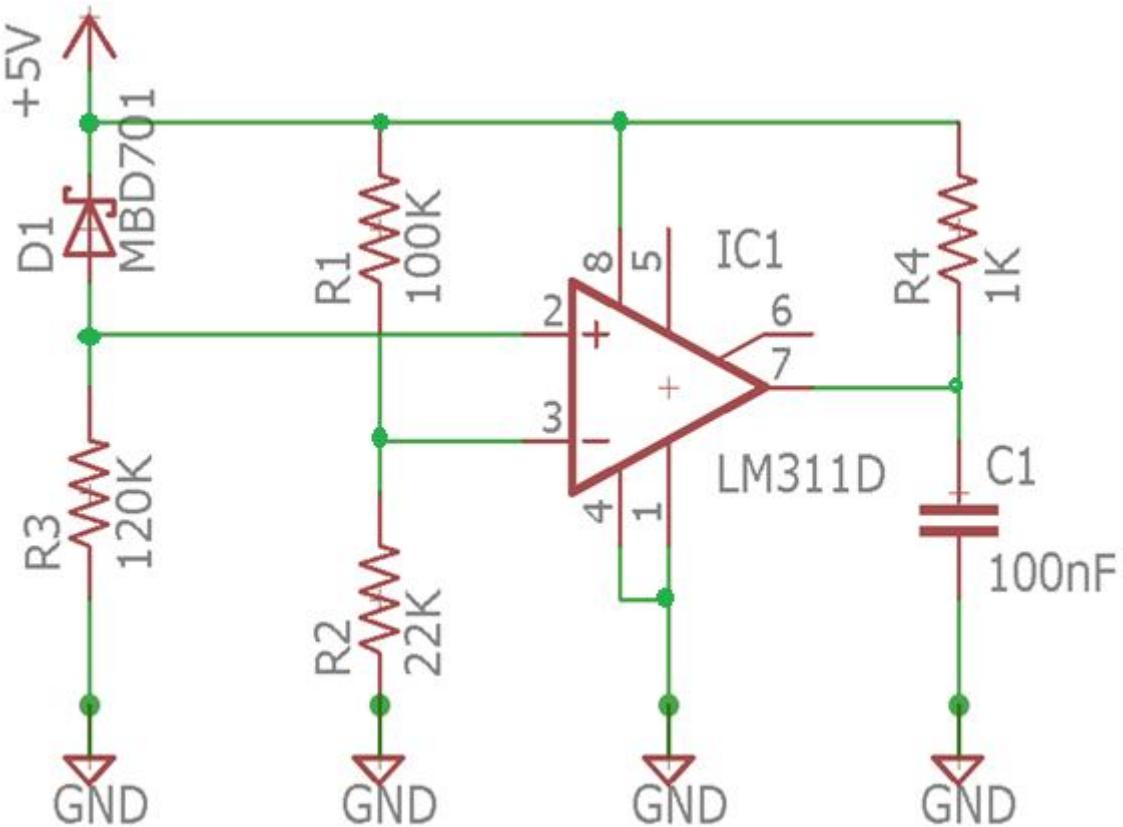
# Objective

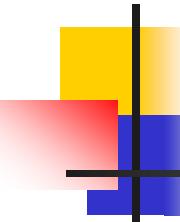
**Design and testing of receiver circuit which can sense the signal of IR pulse from a specific gantry and able to recognize it based on respective pulse width.**

- ❖ To solder IR receiver circuit on a general purpose PCB.
- ❖ To test the combined module of IR transmitter and receiver circuits on Buggy Track with Gantry provision through supervisory control mode for Bronze and silver level.



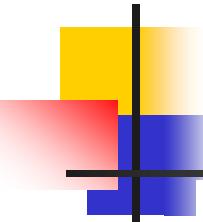
# Receiver circuit





# Component List

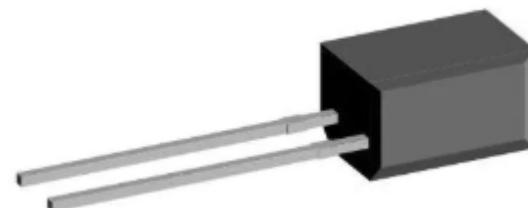
Sr. no	Component	Count	specification
1	Differential Comparator	01	LM311D
2	Photo diode	01	MBD 701 / BPW41N
3	Resistors	04	1k, 20k, 100k, 120k
4	Capacitor	01	100 nf
5	DC power supply	01	5V
6	PCB (small piece)	01	General purpose



# Components



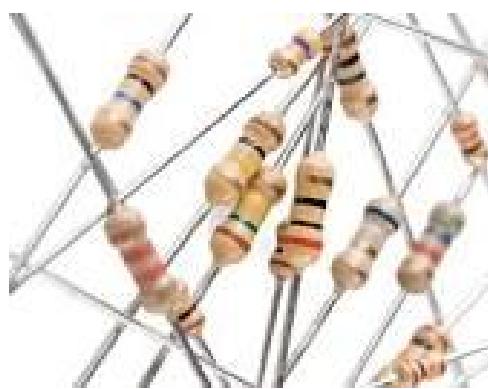
**LM311D**



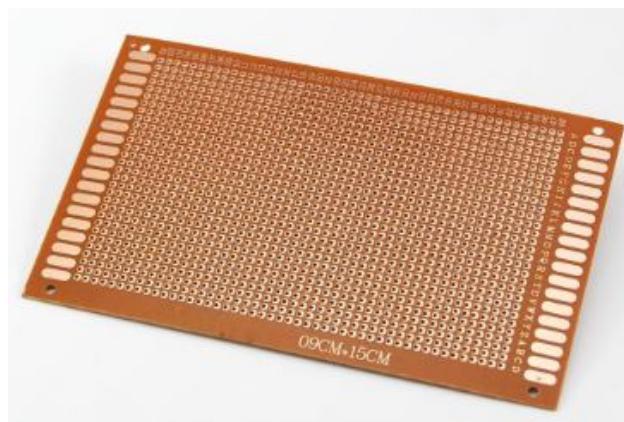
**BPW41N**



**Capacitor**

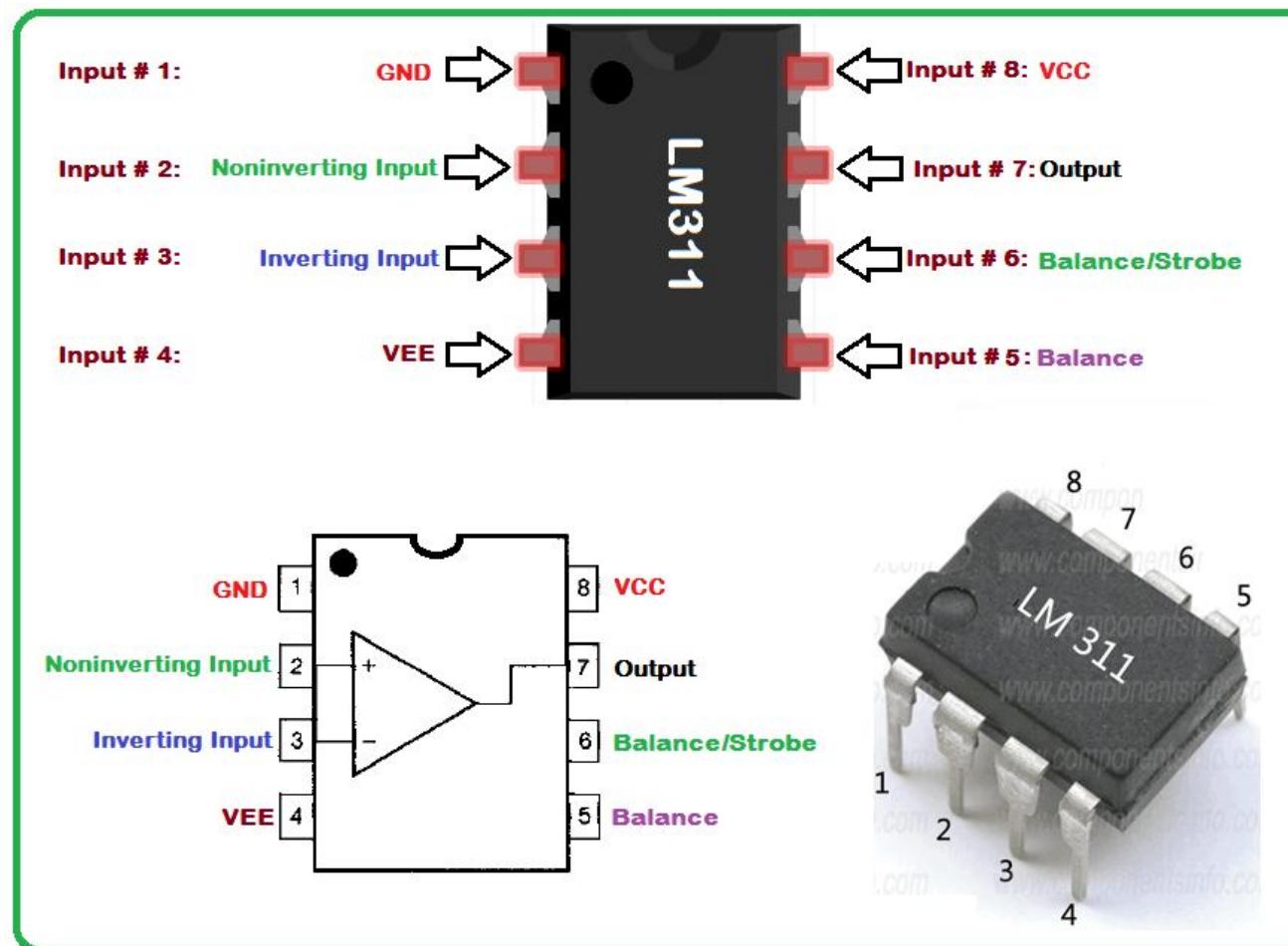


September 12, **Resistors**



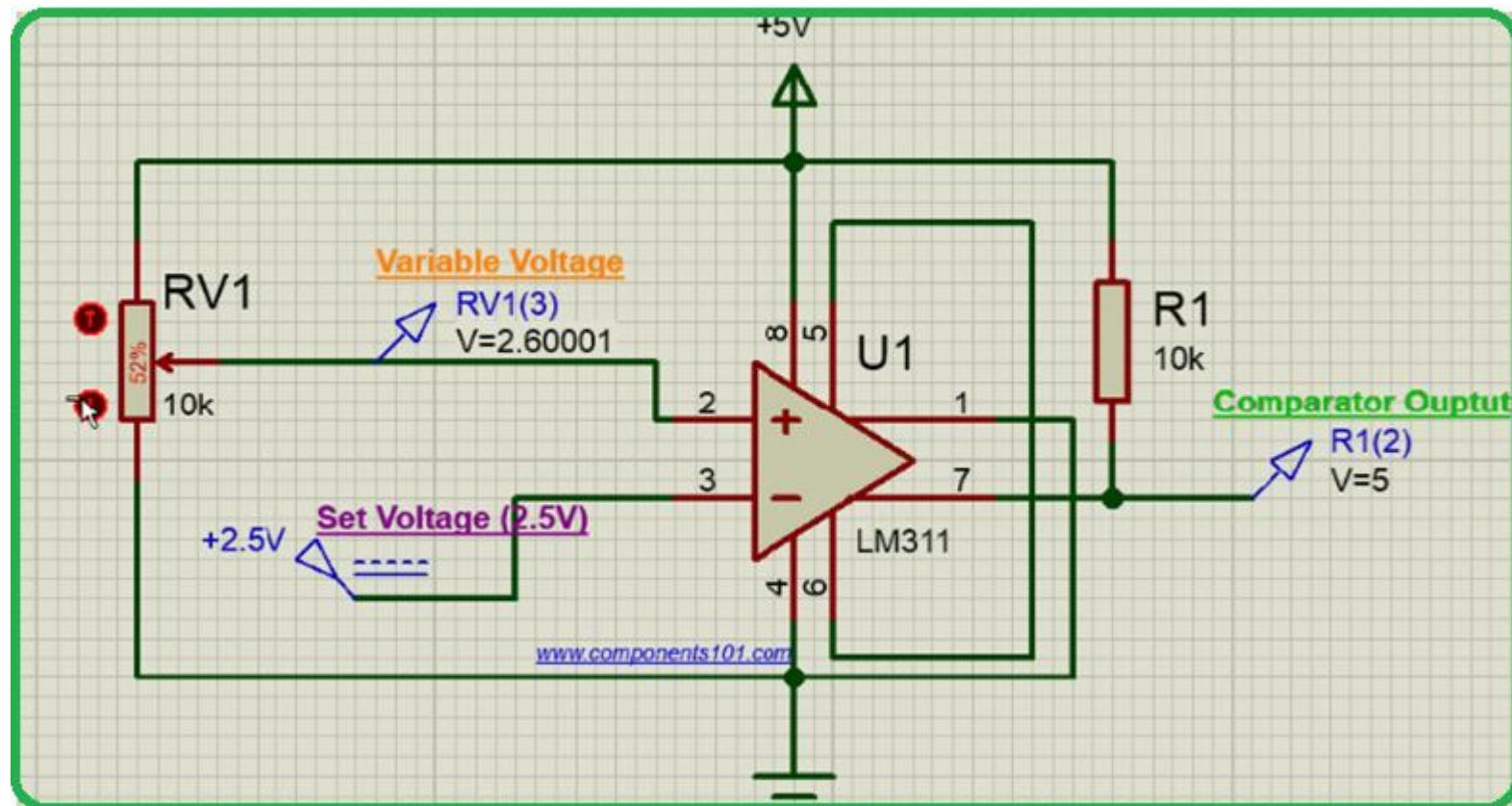
**PCB (small piece)** **Image source: Google**

# LM311-Differential Comparator IC



# Working principle

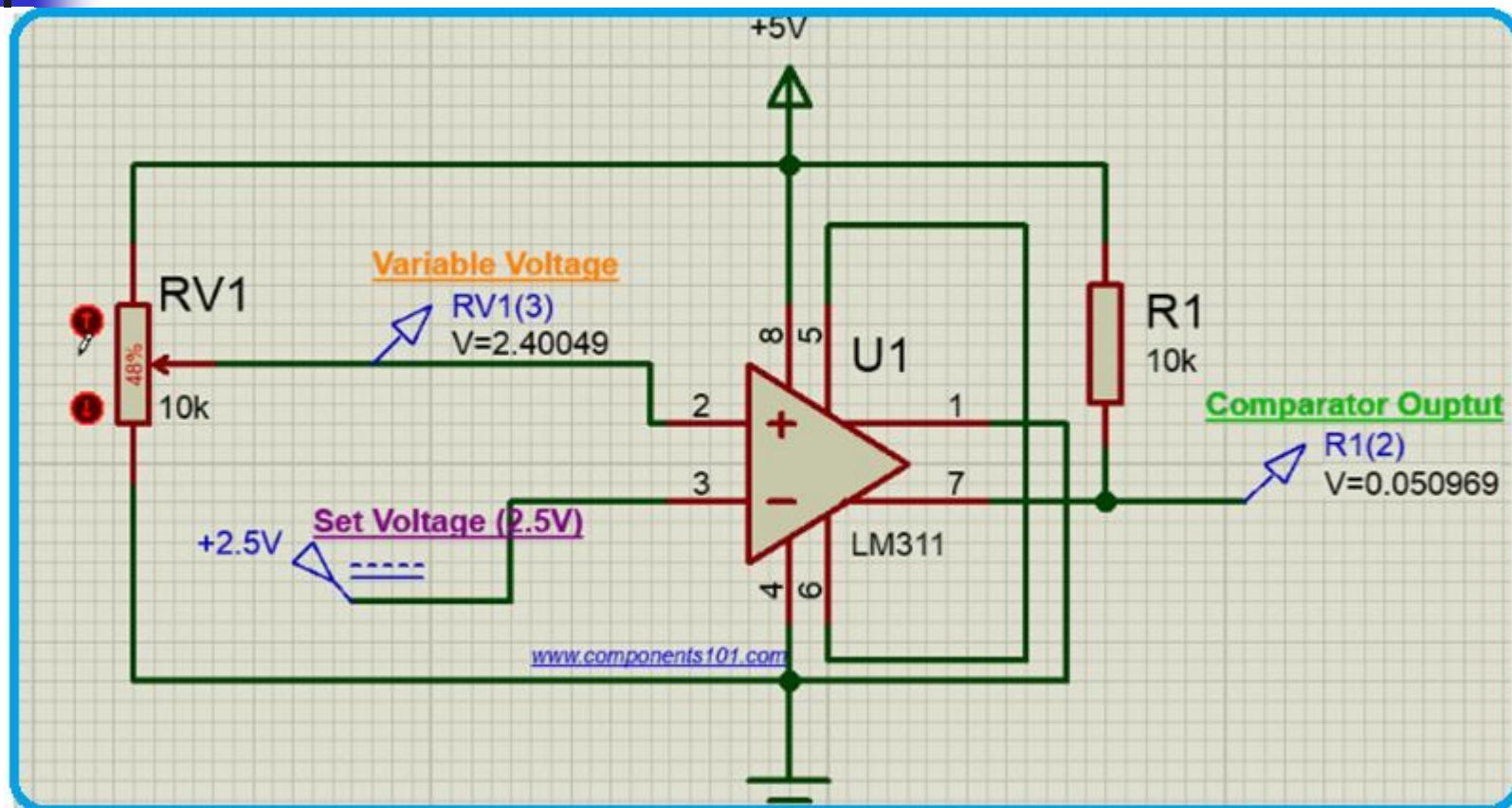
Output voltage stays high when **pin 2** has higher voltage than **pin 3** and vice versa.



Source: <https://components101.com/ics/lm311-differential-comparator-ic>

# Continued...

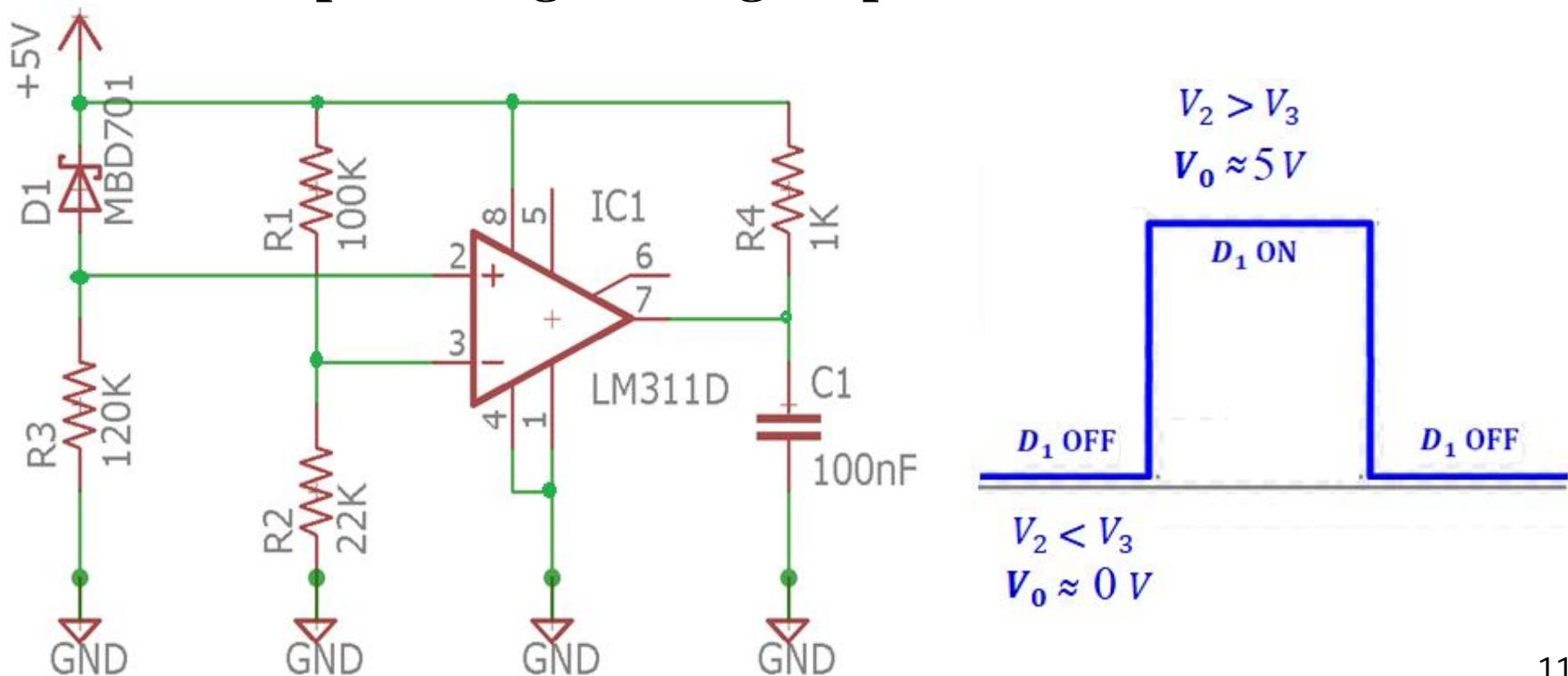
Output voltage stays low when **pin 2** has lower voltage than **pin 3** and vice versa.

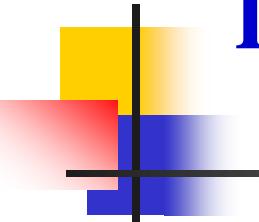


Source: <https://components101.com/ics/lm311-differential-comparator-ic>

## Continued...

The **basic function** of a comparator circuit is to **compare** two voltage levels at its input pins and **produce an output** to show which input voltage has **higher potential** than the **other**.





# **Design Specification and Selection of components**

- ❖ Selection criterion for **differential comparator**.
- ❖ Selection of a **photodiode**



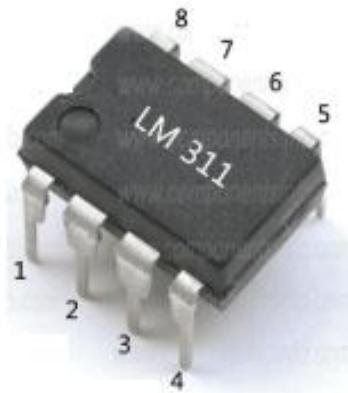
# Selection criterion of Differential Comparator



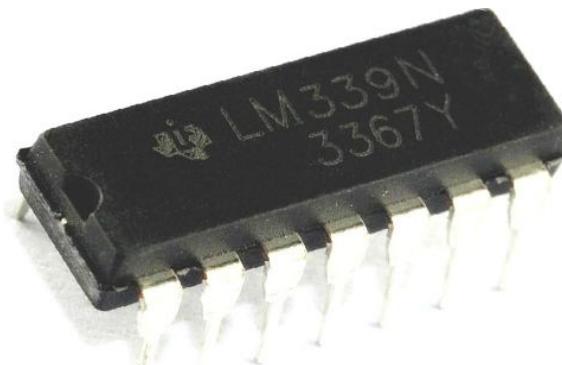
# Options available

- ❖ LM 311
- ❖ LP 311
- ❖ LM 339
- ❖ LM324

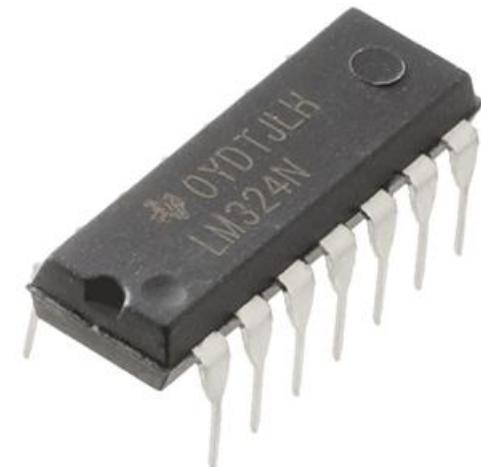
LM 311



LM 339



LM324

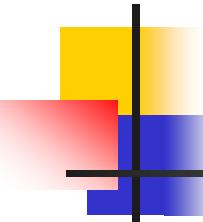


**LM311:** Mono comparator, 5V, power hungry IC, 5mA.

**LP311:** Mono comparator, 5V, power efficient 300 $\mu$ A—much better for battery and experimental applications.

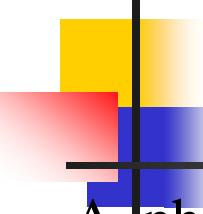
**LM339:** Quad comparator, 2 ~ 36V, 800 $\mu$ A

**LM324:** Quad comparator,  $\pm 1.5V$  to  $\pm 16V$ , 700 $\mu$ A



## Selection criterion of Photo Diode





## Selection criterion of Photo Diode

A photodiode is a semiconductor device that converts light into an electrical current,

### Requirements:

- ❖ The photodiode **should be designed** primarily for high-efficiency UHF and VHF detector applications such as **900 nm to 950 nm** IR emitters.
- ❖ The photodiode can be readily **adaptable** to many other **fast switching RF** and digital applications.
- ❖ The photodiode must be supplied in an inexpensive plastic package for **low-cost, high-volume consumer** and industrial/commercial requirements.

# Options available

- ❖ **MBD701 schottkey diode**
- ❖ **BPW41N silicon PIN diode**



## FEATURES: BPW41N

Package type: **leaded**

Dimensions (in mm): **5x4x6.8**

Radiant sensitive area (in mm square): **7.5**

Matched with **940 nm** emitter

Fast response time:

## FEATURES: MBD701

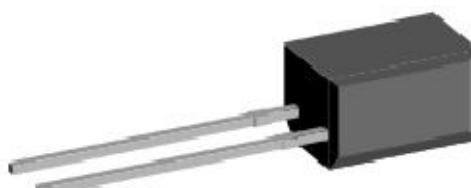
Package type: **leaded**

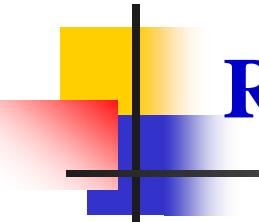
Dimensions (in mm): **5.21x5.33x4.19**

Matched with **940 nm** emitter

High Reverse Voltage: up to **70 V**

Low Reverse Leakage: **200 nA** (Max)

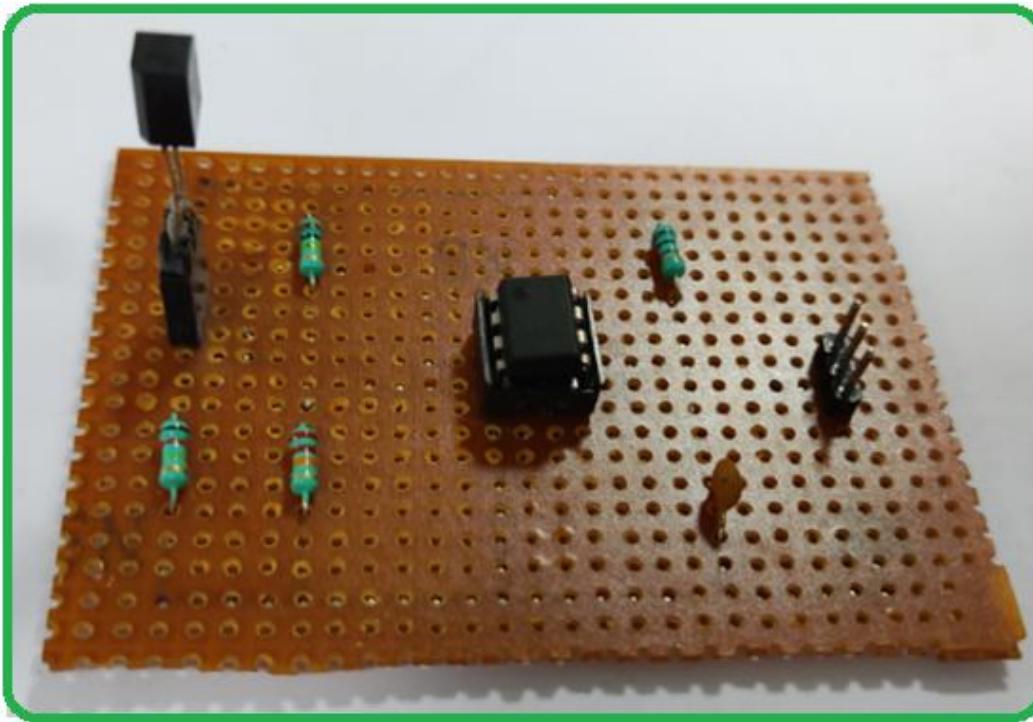
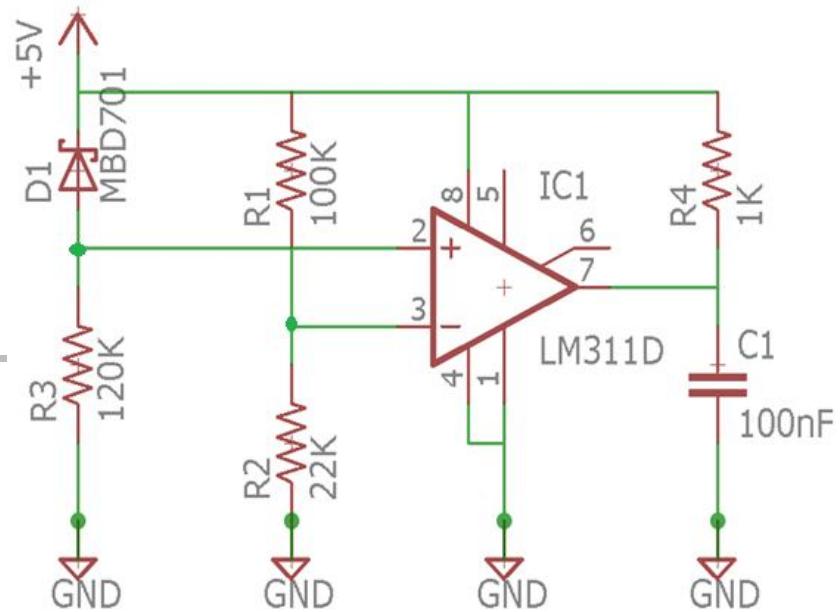
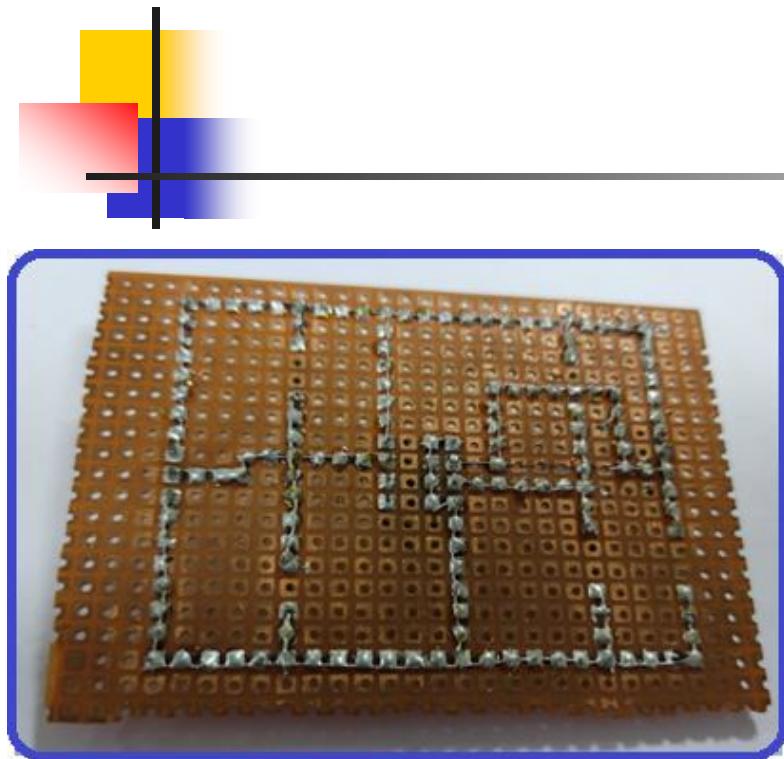




## Receiver circuit on PCB

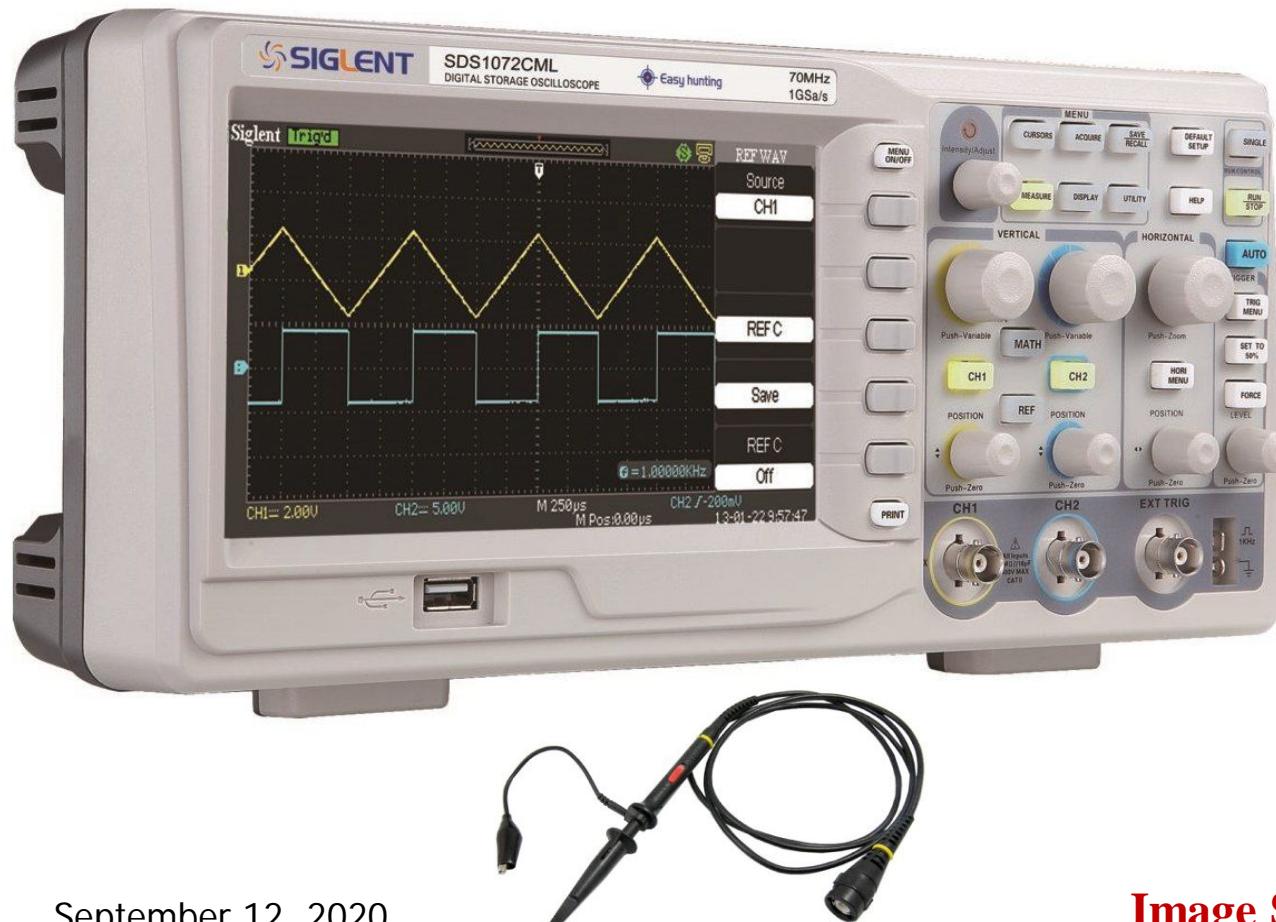


# Receiver circuit on PCB



September 12, 2020

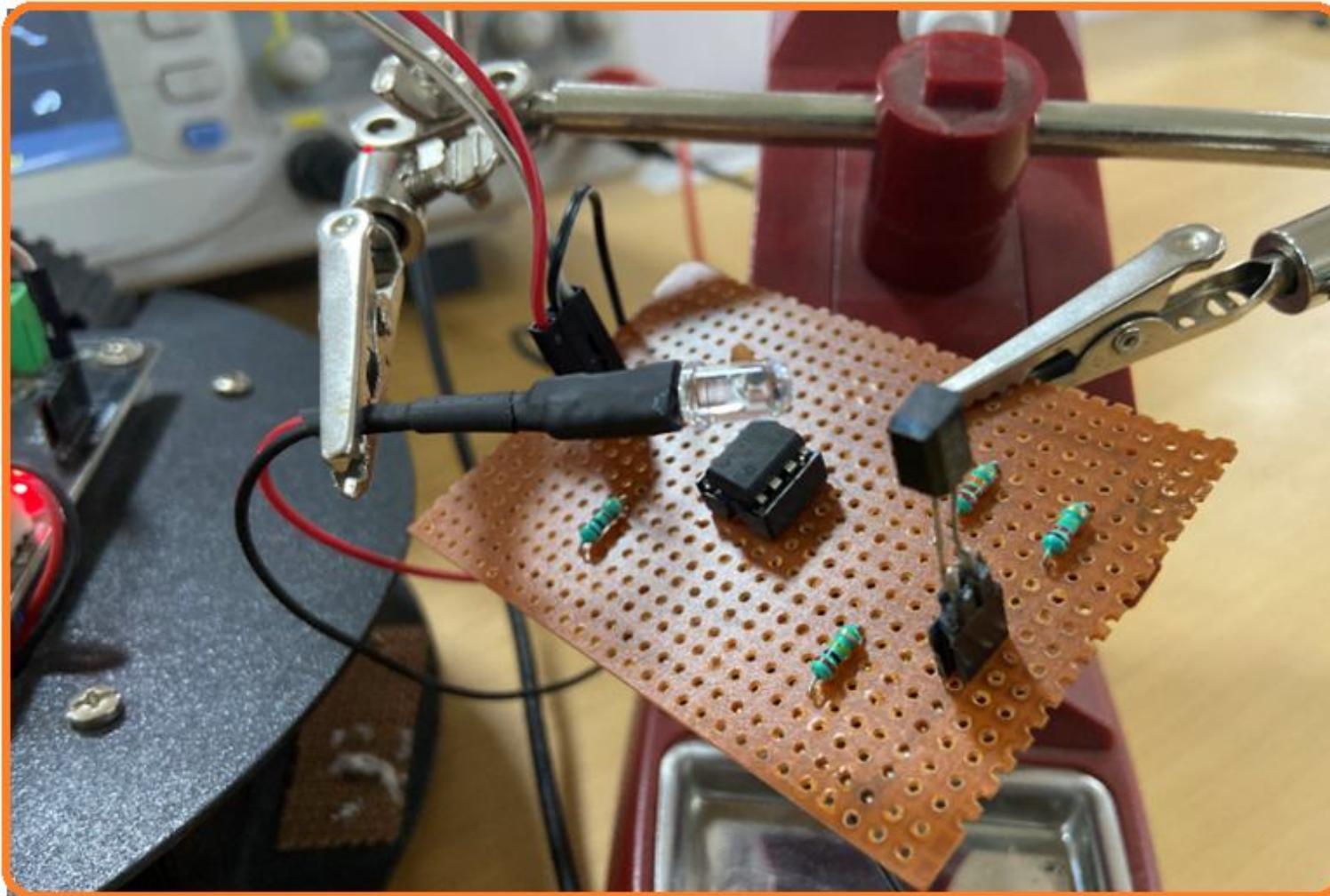
# Receiver circuit Testing



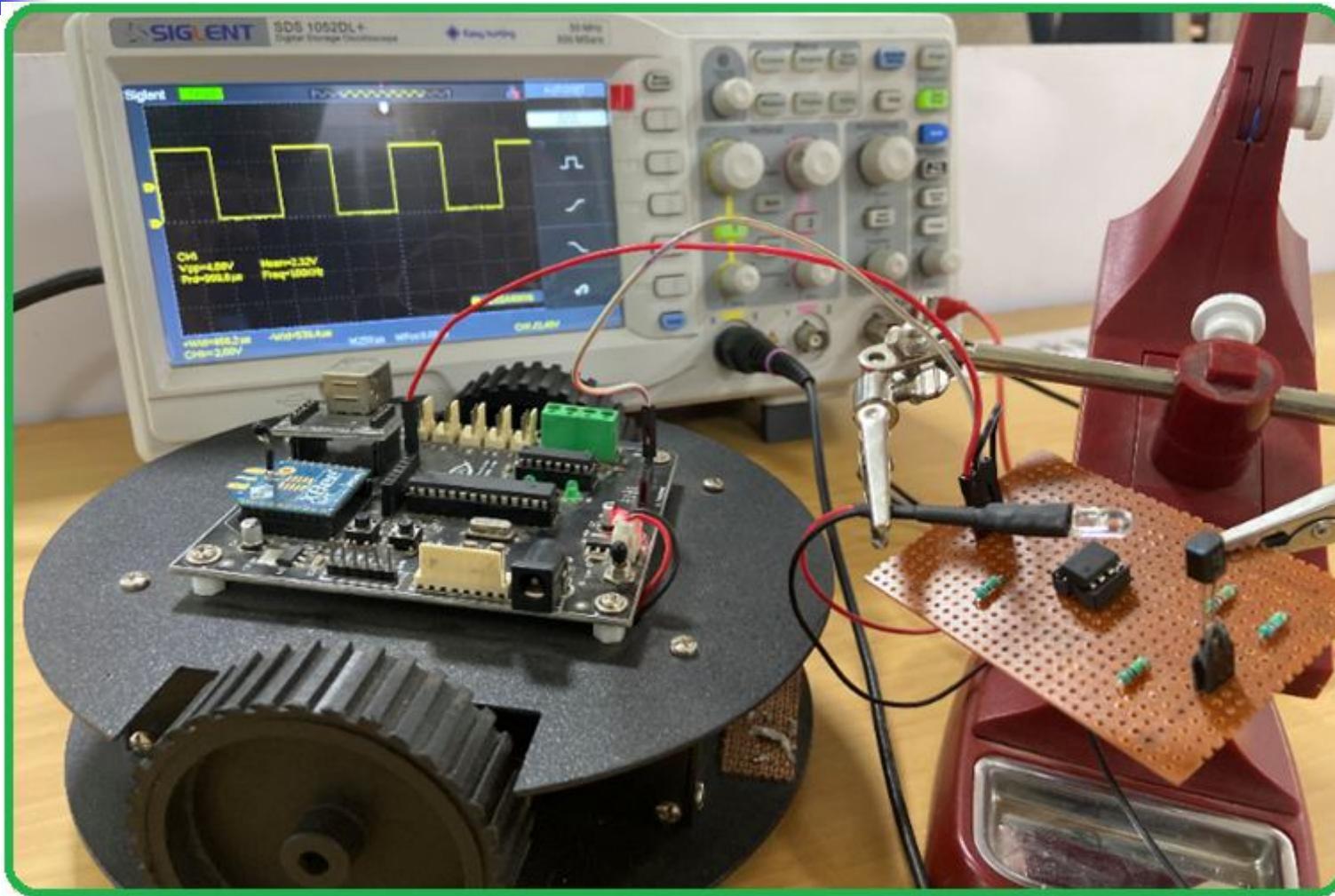
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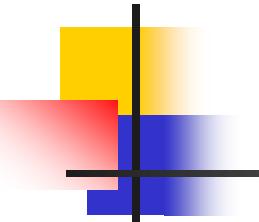
**Image Source: Google** 20

## Testing: Receiver Circuit



## Continued...





## References

- ❖ <https://www.onsemi.com/pub/Collateral/MBD701-D.PDF>
- ❖ <https://www.mouser.in/datasheet/2/427/bpw41n-279864.pdf>
- ❖ <https://www.mouser.in/datasheet/2/427/bpw41n-1766793.pdf>
- ❖ <https://www.homemade-circuits.com/comparators-using-ic-741-ic-311-ic-339/>
- ❖ <https://components101.com/ics/lm311-differential-comparator-ic>



# Thanks !

# Difference between a Comparator and Op Amp

The **IC 741** is an ideal example of a single op amp, and the IC **LM311** can be considered a good example of a single comparator.

Although an **op amp** and a **comparator** both can be configured to compare **differential signals** at their input pins, the **main differences** between the two counterparts are:

- ❖ In powered condition, the output of an op amp will be either **positive** or **negative**, depending on the **input pin voltage** levels, but can **never** be open. In contrast, a comparator output can be either **open** or grounded (negative), or **floating**.
- ❖ An op amp output can work **without** any **pull up** or **pull down** resistors, but a comparator will always require an **external pull-up** or **pull down** resistor to enable the output stage to work normally.
- ❖ An op amp can be used to build **high gain** amplifier circuits, a comparator **cannot** be used for such applications.
- ❖ The output **switching response** of an op amp is usually slower compared to a comparator IC.