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Engineering Design Project-II (UTA 024)

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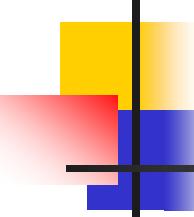


Engineering Design Project-II

(UTA 024)

Buggy Lab

Dr. Amit Mishra



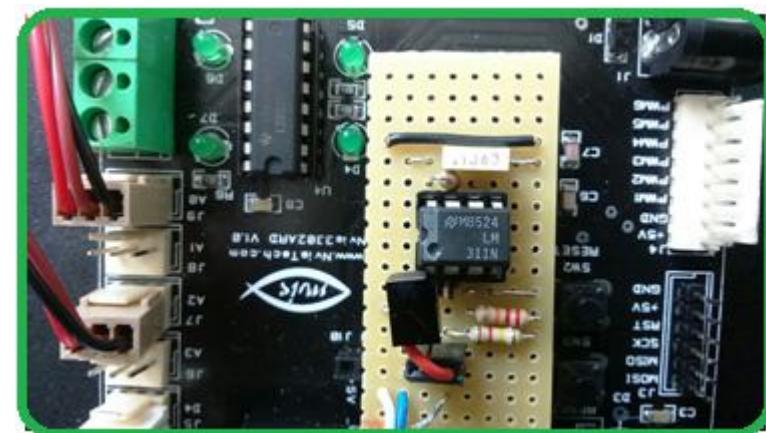
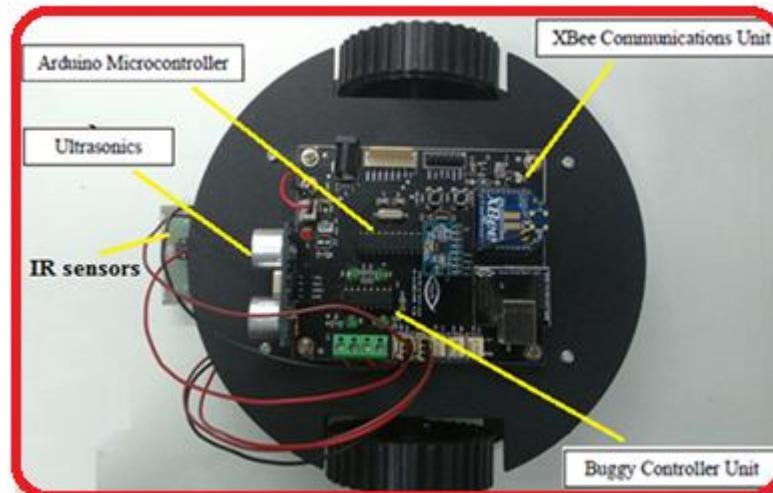
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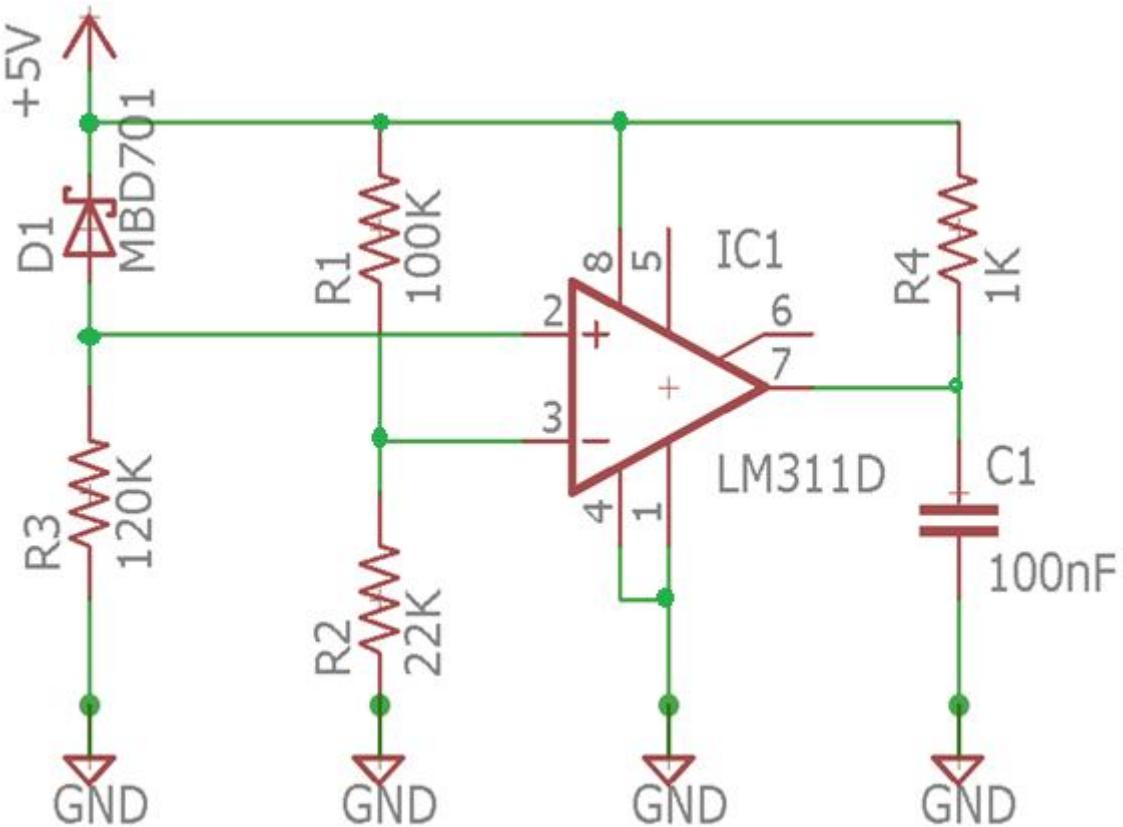
Objective

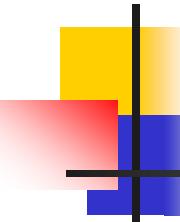
Design and testing of receiver circuit which can sense the signal of IR pulse from a specific gantry and able to recognize it based on respective pulse width.

- ❖ 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.



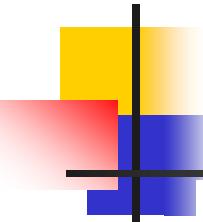
Receiver circuit





Component List

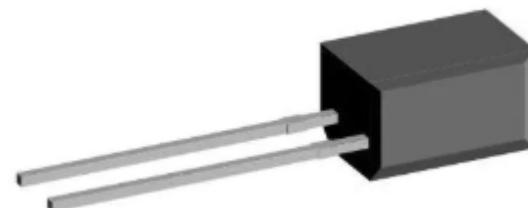
Sr. no	Component	Count	specification
1	Differential Comparator	01	LM311D
2	Photo diode	01	MBD 701 / BPW41N
3	Resistors	04	1k, 20k, 100k, 120k
4	Capacitor	01	100 nf
5	DC power supply	01	5V
6	PCB (small piece)	01	General purpose



Components



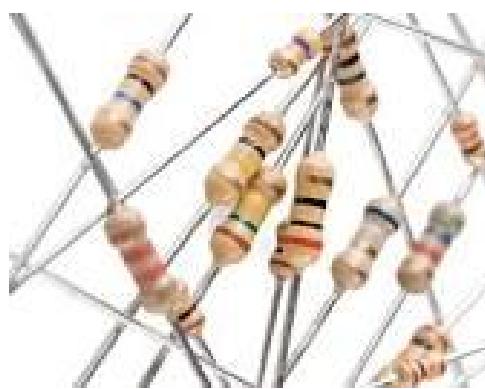
LM311D



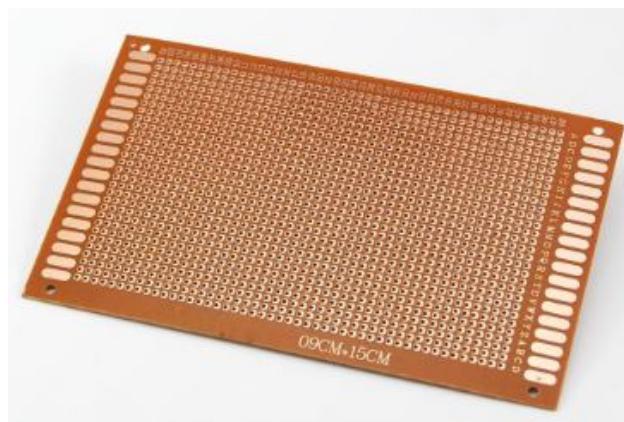
BPW41N



Capacitor

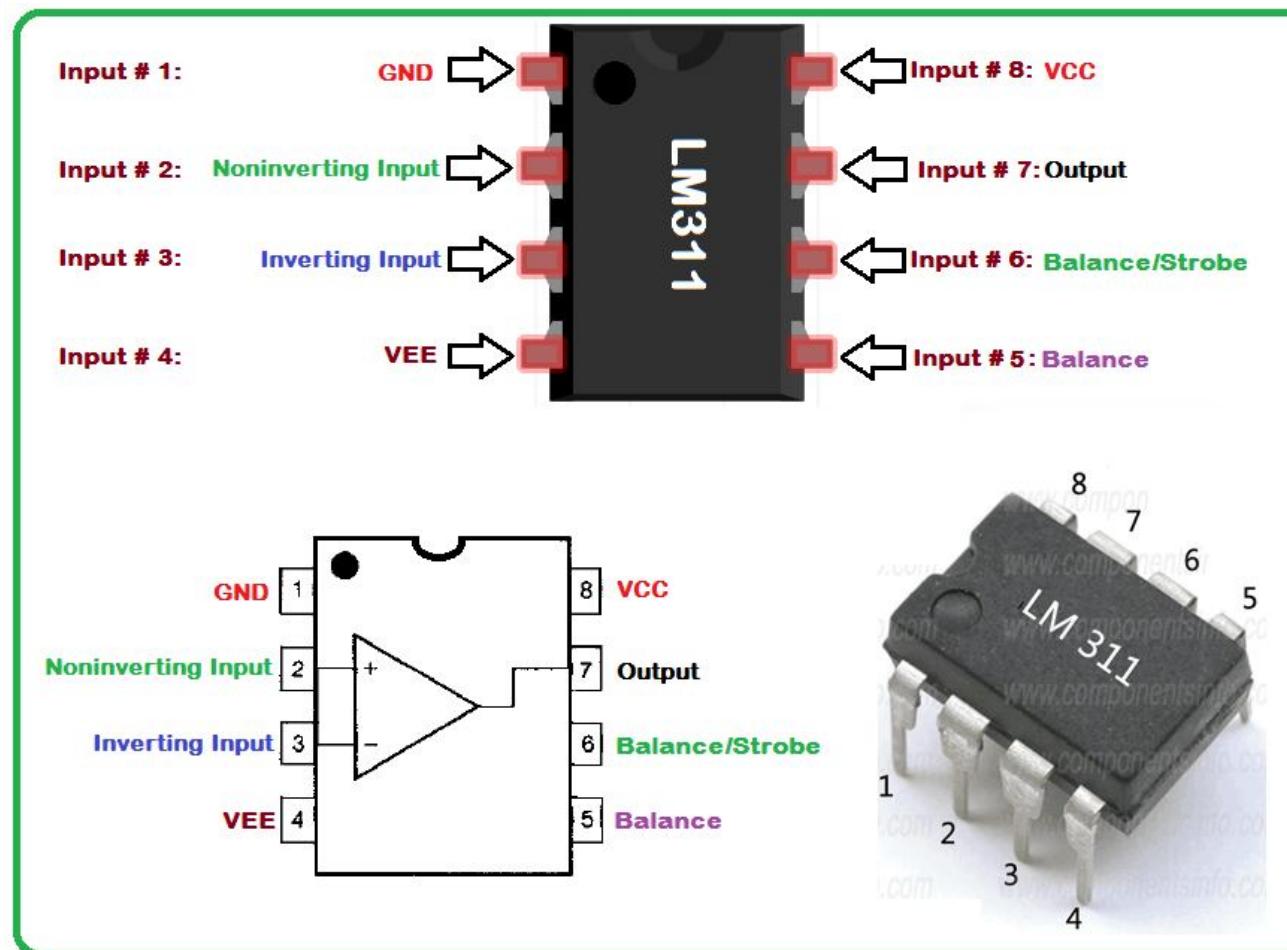


September 12, **Resistors**



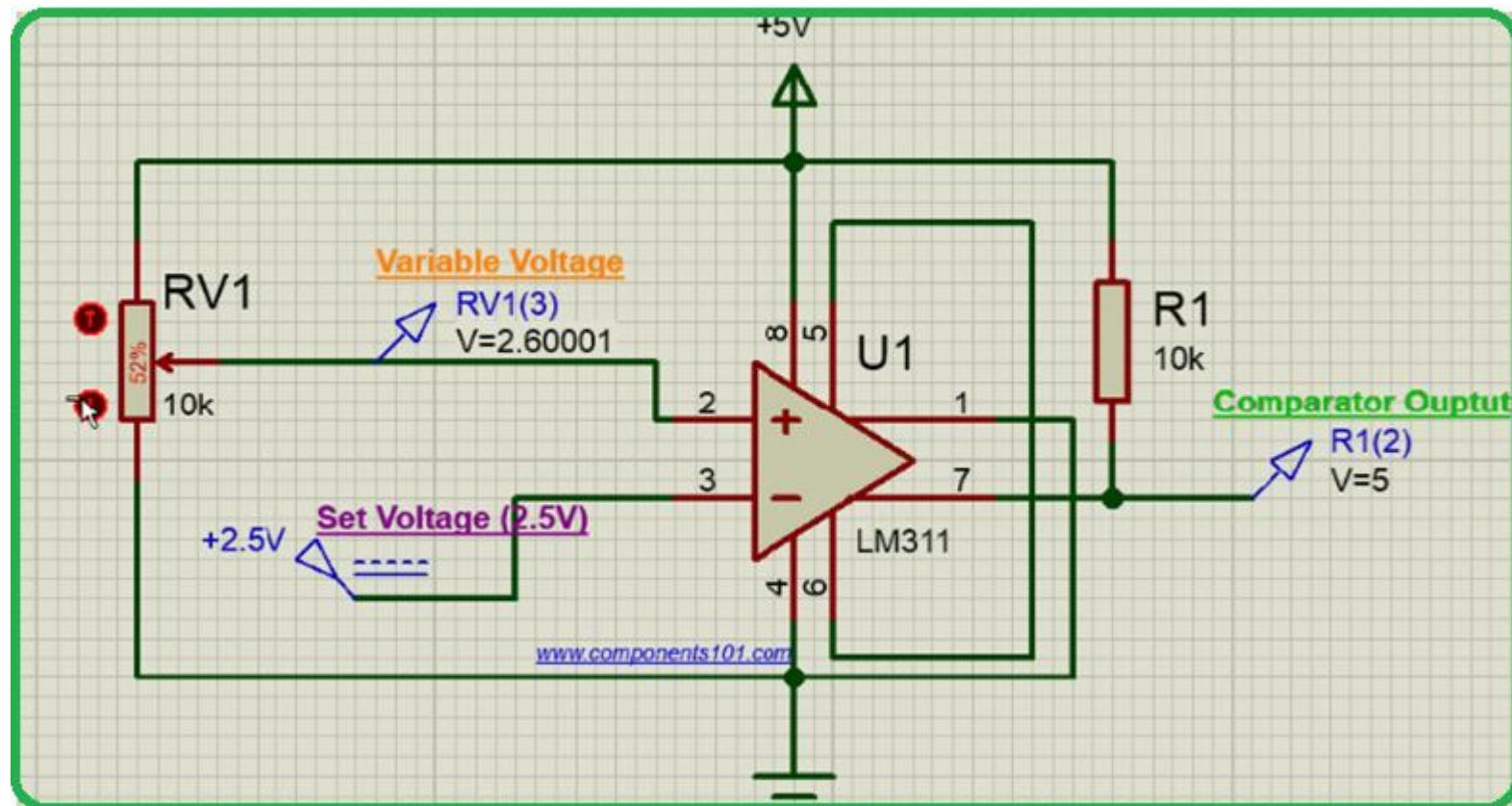
PCB (small piece) **Image source: Google**

LM311-Differential Comparator IC



Working principle

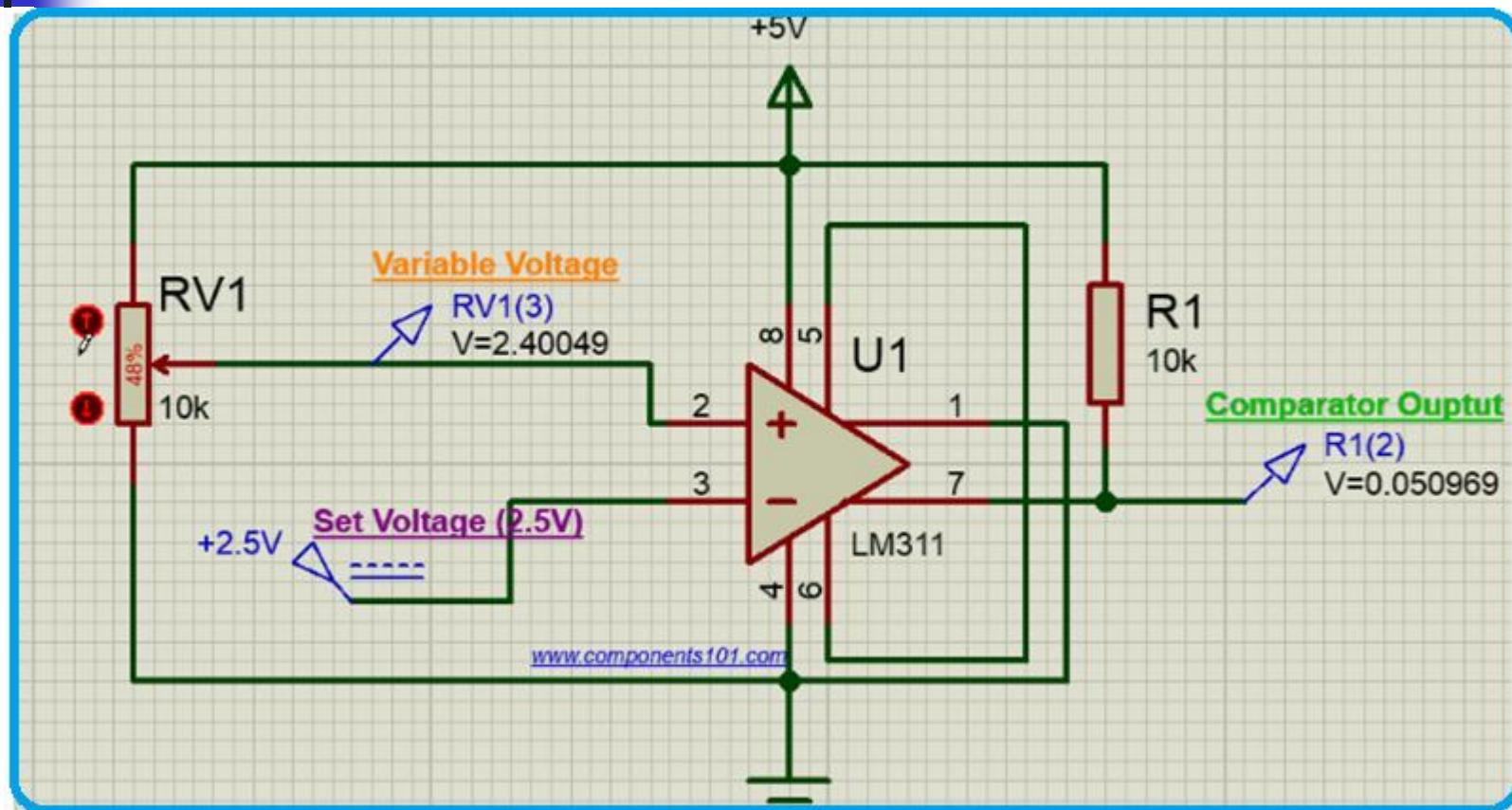
Output voltage stays high when **pin 2** has higher voltage than **pin 3** and vice versa.



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

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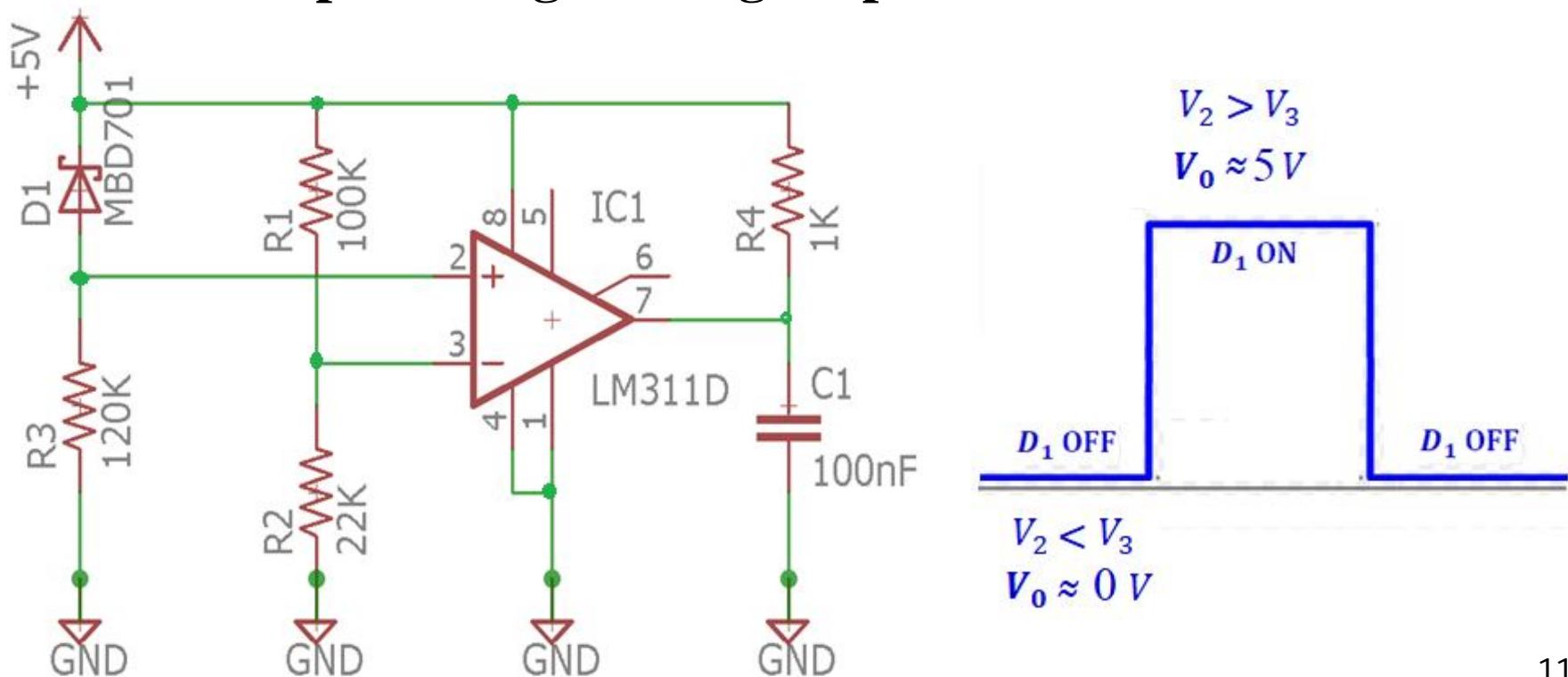
Output voltage stays low when **pin 2** has lower voltage than **pin 3** and vice versa.

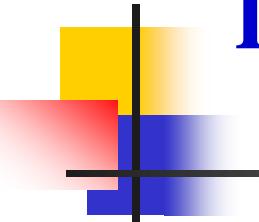


Source: <https://components101.com/ics/lm311-differential-comparator-ic>

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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**.



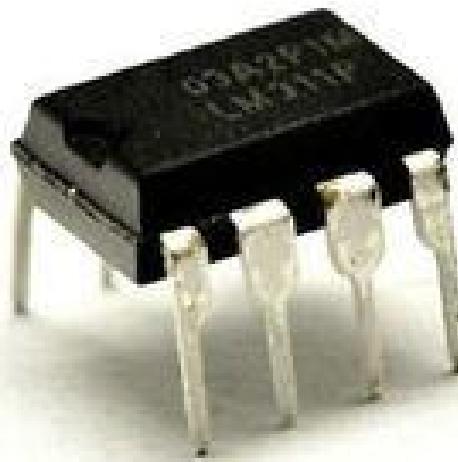


Design Specification and Selection of components

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



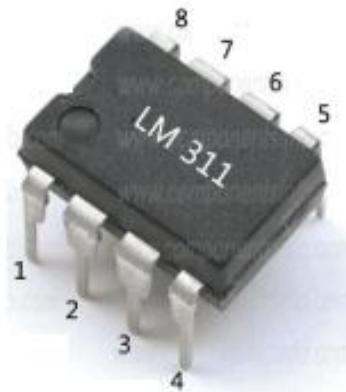
Selection criterion of Differential Comparator



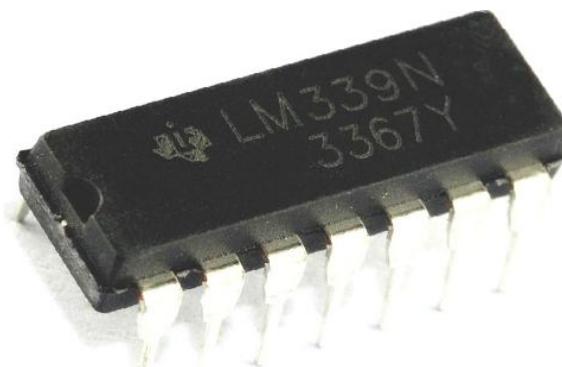
Options available

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

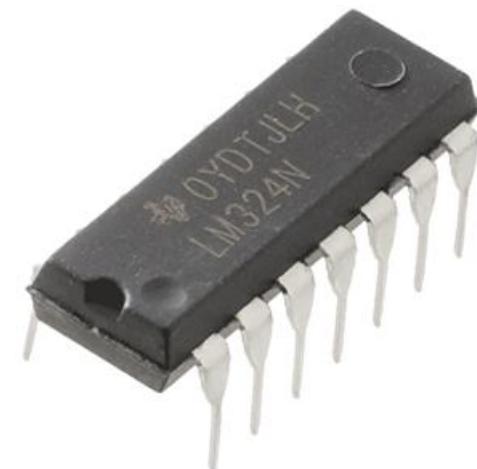
LM 311



LM 339



LM324



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

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

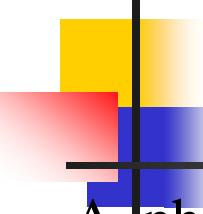
LM339: Quad comparator, 2 ~ 36V, 800 μ A

LM324: Quad comparator, $\pm 1.5V$ to $\pm 16V$, 700 μ 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

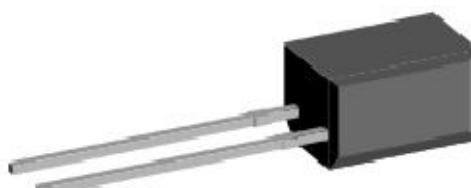
Package type: **leaded**

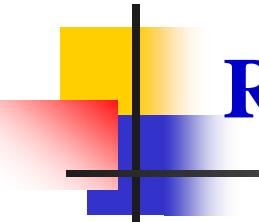
Dimensions (in mm): **5.21x5.33x4.19**

Matched with **940 nm** emitter

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

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

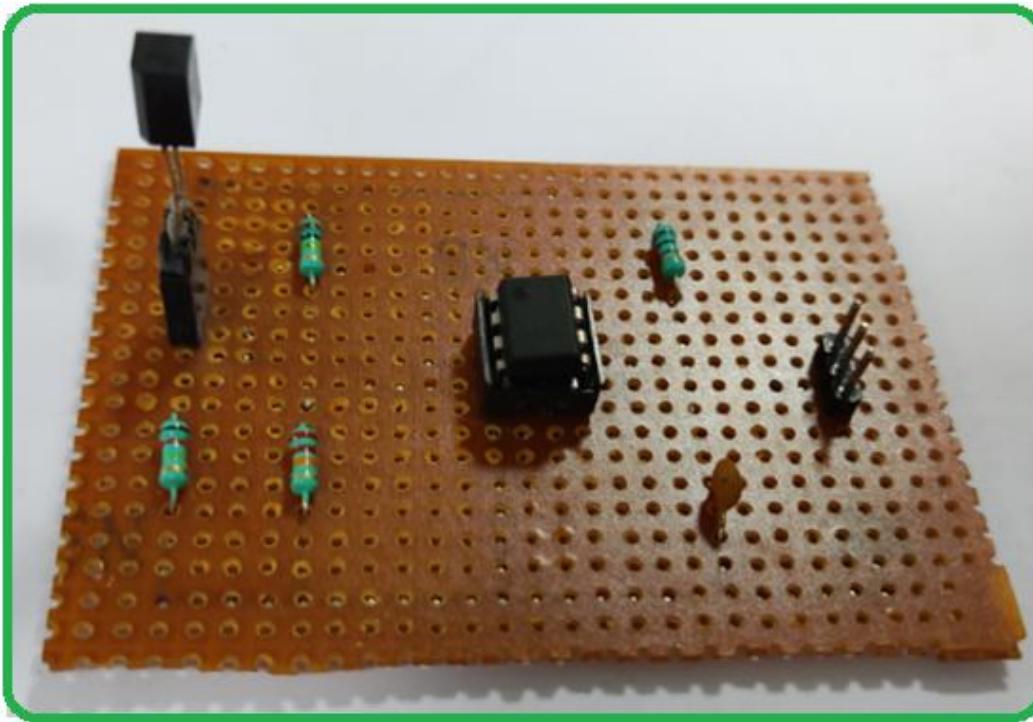
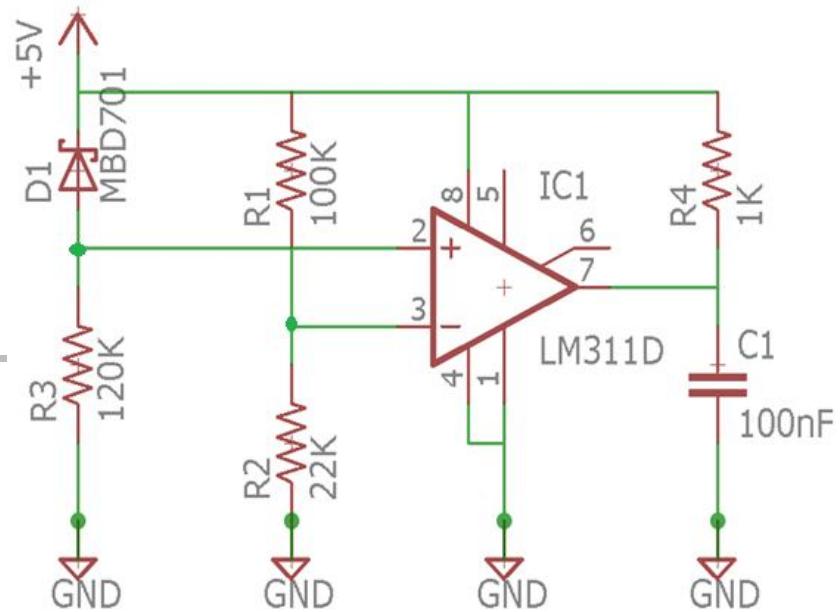
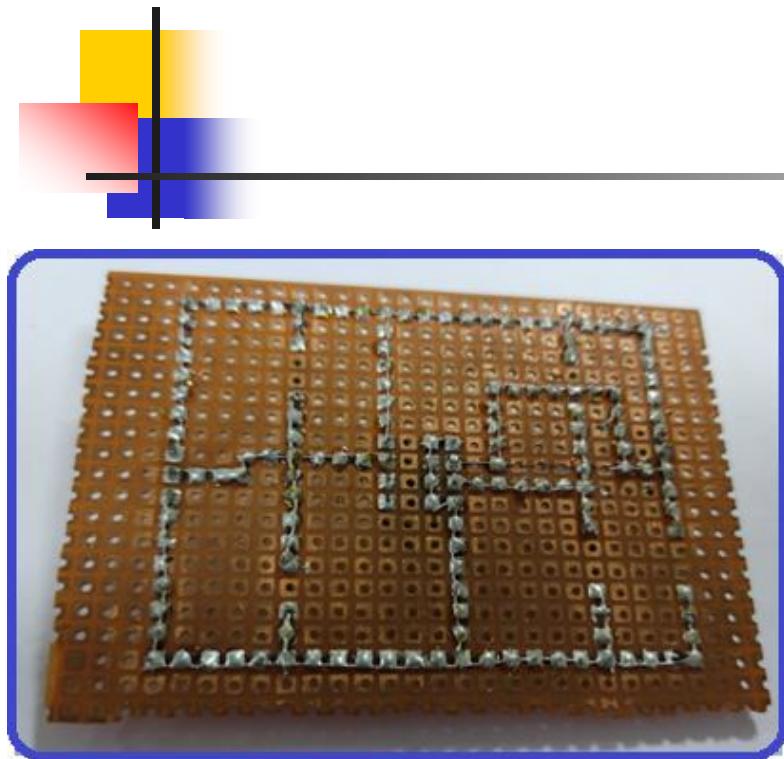




Receiver circuit on PCB

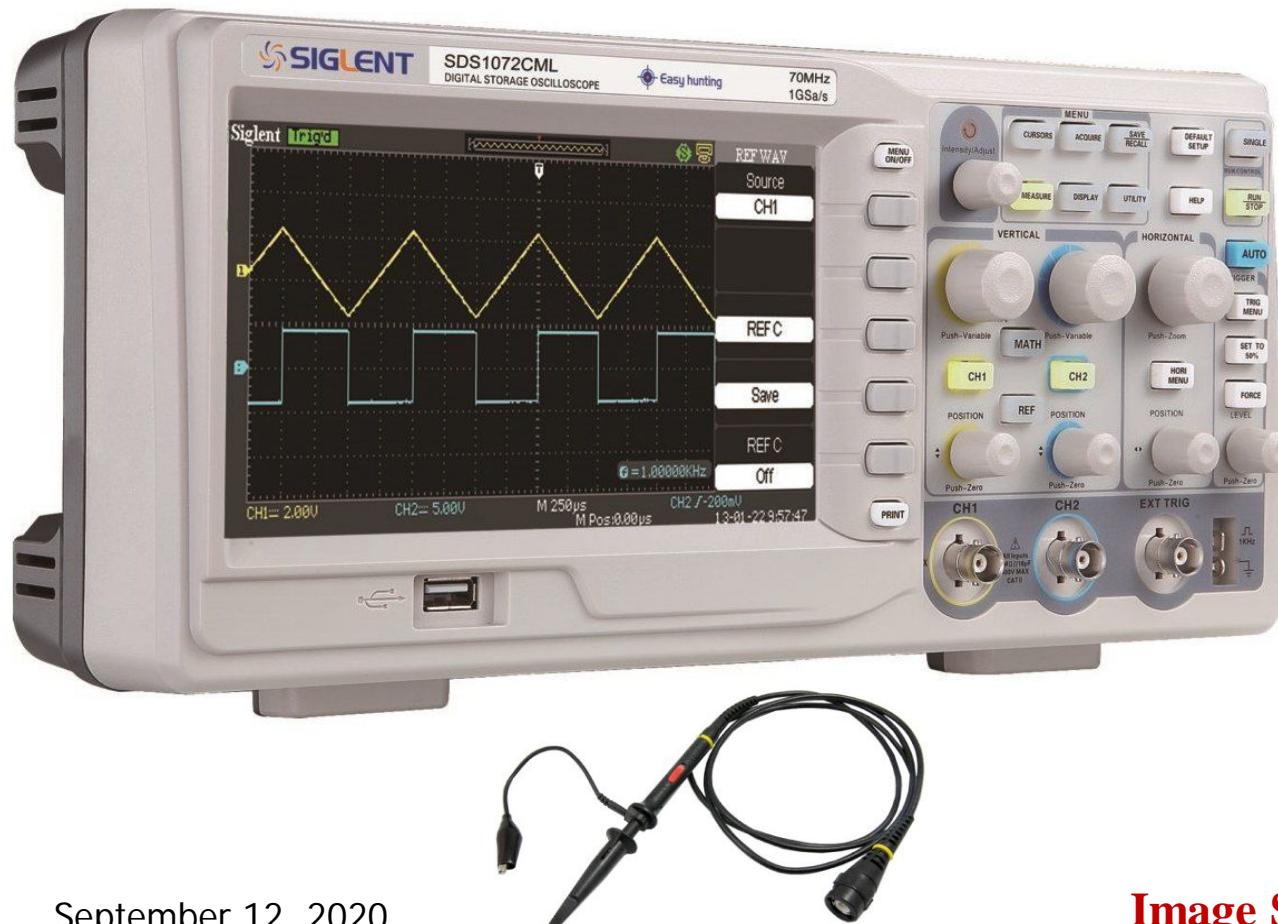


Receiver circuit on PCB



September 12, 2020

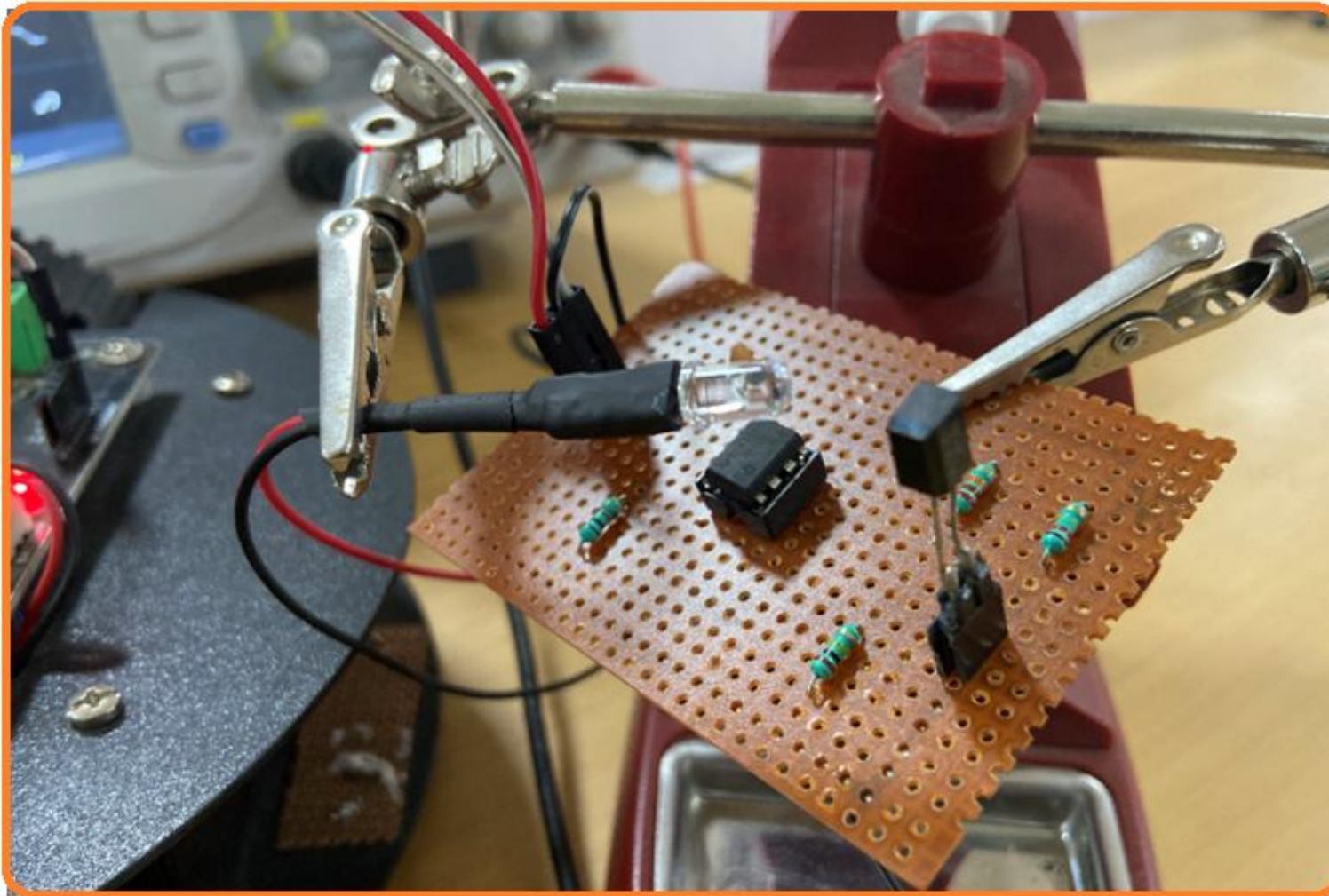
Receiver circuit Testing



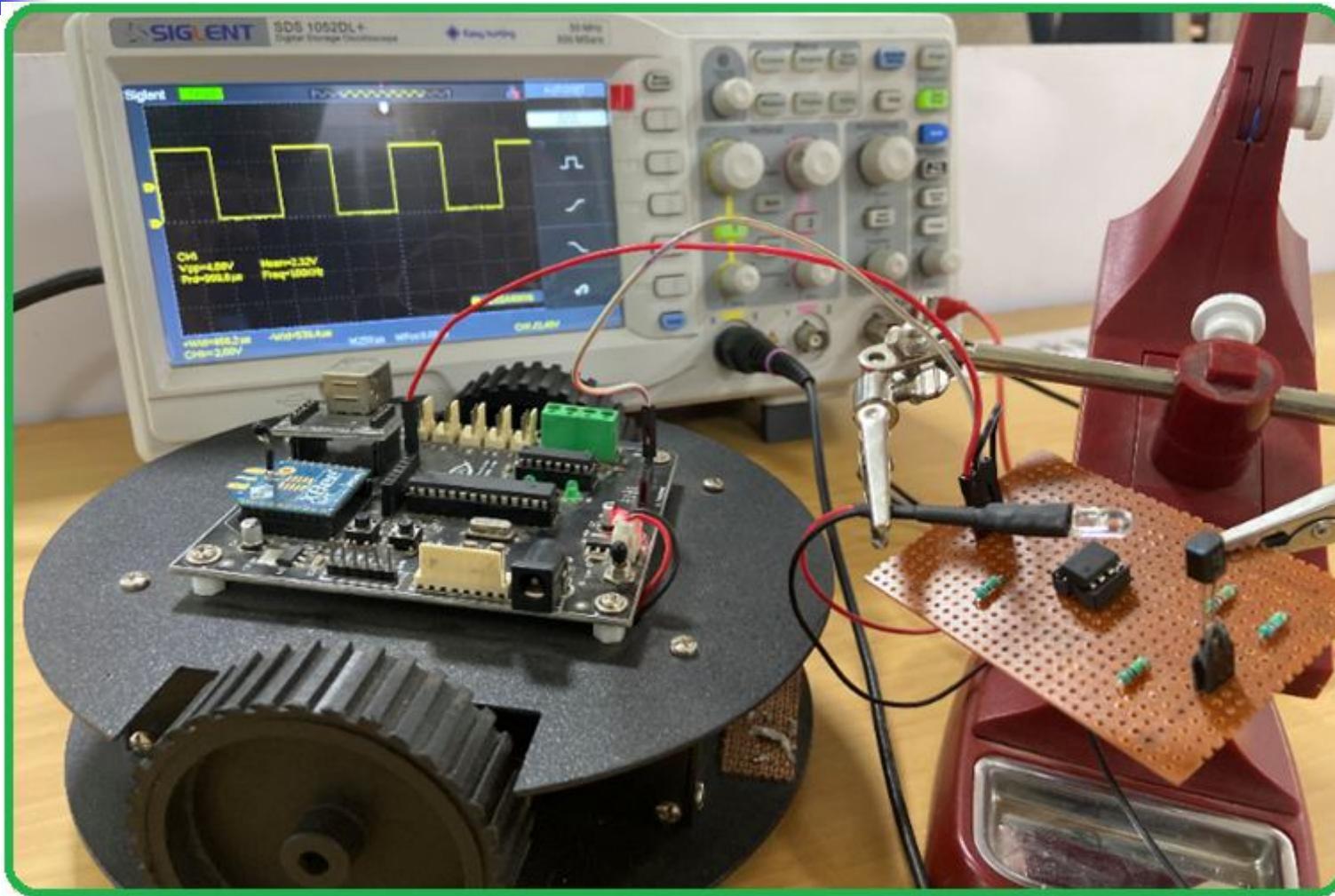
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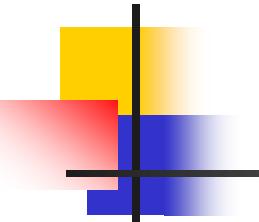
Image Source: Google 20

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.