



**Course: EE215**

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**— Project Title —**

**FUNCTION GENERATOR**

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## **Abstract**

In today's rapidly advancing technological landscape, the ability to generate precise and stable frequencies is of utmost importance in various fields such as electronics, telecommunications, and scientific research. A frequency generator, also known as a signal generator, plays a crucial role in providing controlled and accurate signals of different frequencies. This device serves as a valuable tool for testing, calibration, troubleshooting, and experimental analysis. By producing waveforms with specific frequencies, amplitudes, and shapes, a frequency generator empowers engineers, researchers, and enthusiasts to explore the behavior of electronic circuits, evaluate system performance, and validate the functionality of electronic devices. In this project report, we delve into the design, operation, and applications of a frequency generator, highlighting its significance in modern-day engineering and scientific endeavors.

## **Introduction**

A frequency generator is a crucial device in the field of electronics and signal processing, serving as a versatile tool for generating precise and controlled frequencies. With its ability to produce a wide range of waveforms, the frequency generator finds applications in various industries, including telecommunications, research laboratories, and engineering. This article provides an in-depth exploration of frequency generators, highlighting their design, functionality, and applications.

At its core, a frequency generator is an electronic instrument that generates electrical signals with specific frequencies. These signals can take the form of sine waves, square waves, triangle waves, or other complex waveforms. The generator allows users to set the frequency, amplitude, and other parameters to match their specific requirements. This level of control is crucial in many applications, such as testing electronic circuits, calibrating instruments, and analyzing system behavior.

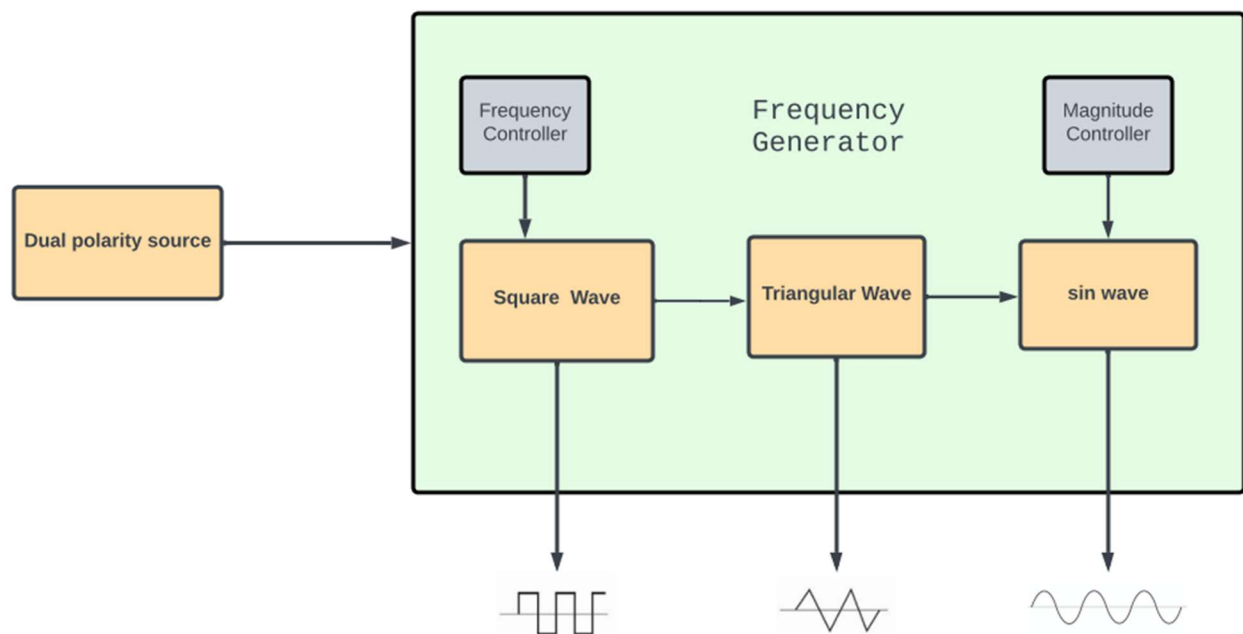
The operation of a frequency generator relies on a stable oscillator circuit that generates a continuous signal. This signal is then shaped and amplified to produce the desired waveform. The generator provides precise frequency control through its internal oscillator circuitry, allowing users to generate frequencies ranging from a few hertz to several megahertz or even gigahertz. Additionally, some advanced frequency generators offer the capability to modulate the generated waveform, enabling functions such as amplitude modulation (AM), frequency modulation (FM), and phase modulation (PM).

Frequency generators find extensive applications in various industries. In telecommunications, they are used to generate carrier signals for testing and calibrating communication systems. Engineers rely on frequency generators to simulate real-world signals, assess system performance, and troubleshoot issues. In research and development, frequency generators aid in the design and testing of electronic circuits and components. They enable researchers to study

the response of circuits under different frequencies, analyze signal processing algorithms, and synthesize custom waveforms for experimental analysis.

In addition to their utility in telecommunications and research, frequency generators are also employed in audio and video applications. They are used in audio equipment testing, where they generate audio signals for audio processing and analysis. Frequency generators are also instrumental in video production, where they help calibrate video displays and ensure accurate color representation. With technological advancements, frequency generators have evolved to offer enhanced features and capabilities. Modern frequency generators often incorporate digital signal processing (DSP) technology, enabling more precise waveform generation and advanced modulation techniques. Some generators even provide arbitrary waveform synthesis (AWS), allowing users to create custom waveforms with complex shapes and varying frequencies.

### Block Diagram



## Dual polarity Source:

### Components:

7815 regulator IC

7915 regulators IC

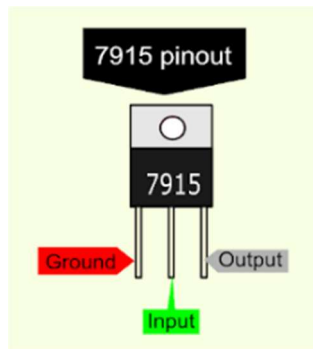
2200 uF capacitor

0.1uF capacitor

bridge rectifier (using 1n4007)

center tapped transformerDual polarity power supply is created mostly to power up operational amplifier circuits and other circuits that require dual supply voltage. The voltage is adjustable, requires a few parts, and easy to build. The circuit utilizes 7815 regulator for the positive supply while 7915 voltage regulator for the negative supply.

The monolithic IC 7815 positive voltage regulator is designed for use in several ways of applications including on board regulation. It makes use of internal current limiting, safe area compensation and thermal shutdown. It can produce output currents in excess of 1 Amp

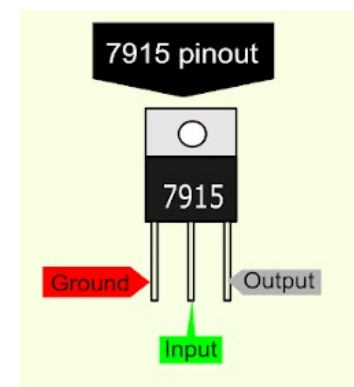


with enough heat sinking. It can be used with external components to obtain flexible voltages and currents, although it is designed primarily as a fixed voltage regulator. The negative voltage regulator 7915 employs the same features as with 7815 which makes it also notably rough for any operating conditions.

The rating of the transformer's primary depends on the region of the supplied voltage. To allow losses on both regulators, the secondary coil should be 18 volts at 1 amp rating. Since the circuit might operate under 120, 220 or 240 volts, it's a prerequisite for the circuit to be enclosed in a case where fans or heat sinks were usually required.

Your circuit is a dual polarity source that utilizes a combination of components to provide positive and negative voltages for powering electronic devices. At its core, the circuit consists of two voltage regulators, the 7815 and 7915, along with supporting components such as capacitors, a bridge rectifier, and a center-tapped transformer.

The 7815 regulator is a positive voltage regulator that maintains a constant output voltage of +15 volts. It takes the rectified and filtered AC voltage from the transformer and converts it to a stable positive DC voltage. The 2200 uF capacitor helps smooth out any ripples or fluctuations in



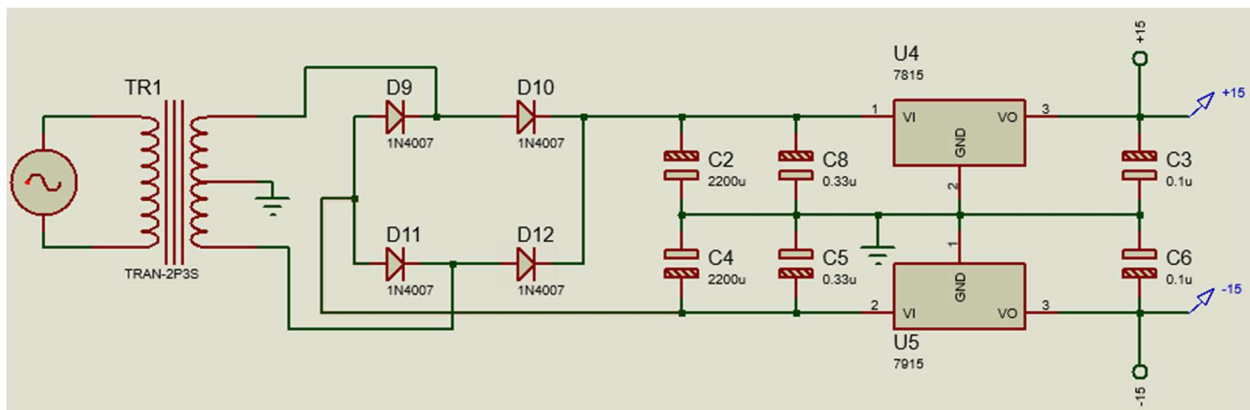
the DC output, ensuring a steady and reliable power supply. This positive voltage output can be used to power various electronic components or subsystems that require a regulated +15V supply

The 7915 regulator, on the other hand, is a negative voltage regulator that provides a constant output voltage of -15 volts. It operates similarly to the 7815 regulator but generates a negative DC voltage instead. The 0.1uF capacitor helps further stabilize the negative voltage output by reducing any noise or high-frequency disturbances. The negative voltage output from the 7915 regulator can be utilized to power circuits or devices that require a regulated -15V supply.

To generate the required AC voltage for the regulators, the circuit incorporates a bridge rectifier and a center-tapped transformer. The bridge rectifier converts the incoming AC voltage from the transformer into pulsating DC voltage. This rectification process ensures that both the positive and negative halves of the AC waveform are utilized. The center-tapped transformer facilitates the dual polarity output by providing two separate windings, one for each regulator, with a common center tap. This arrangement allows for the generation of both positive and negative voltages simultaneously.

Overall, your circuit provides a dual polarity source, offering regulated +15V and -15V outputs using the 7815 and 7915 regulators, respectively. By combining these regulators with capacitors, a bridge rectifier, and a center-tapped transformer, your circuit ensures stable and reliable power for various electronic applications requiring dual polarity supplies.

### Simulation:



## Components for function generator:

Following components were used in making the **Frequency Generator**:

100k Resistor X 10

5.1K resistor X 10

LM741 OP AMP X 5

100K potentiometer

1uF Capacitor X 5

Diode 1n4732A X 4

1.8K resistor

3.15K resistor

10K resistor

1n4007G diode X 8

10K potentiometer

1k resistor

1k resistor

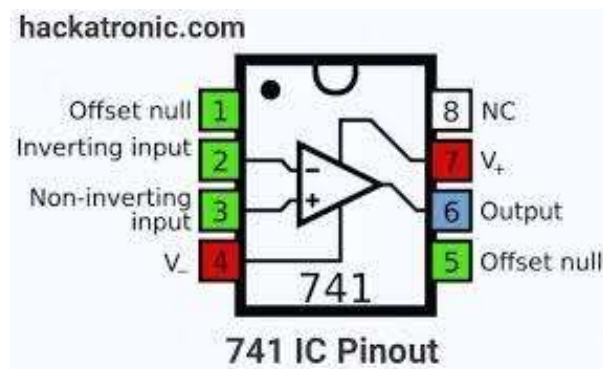
1n4007 Diode X 4

Capacitor 0.1uF X3

regulator 7815

regulator 7915

### 1. Op Amp IC LM741



### 2. Resistors

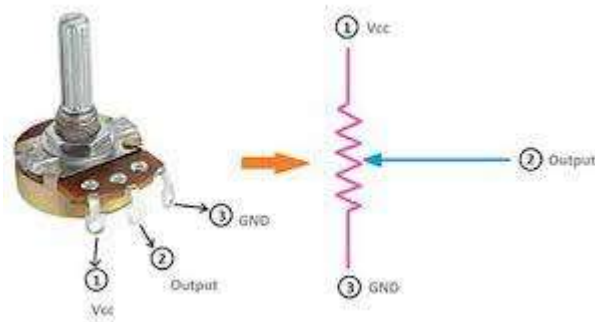




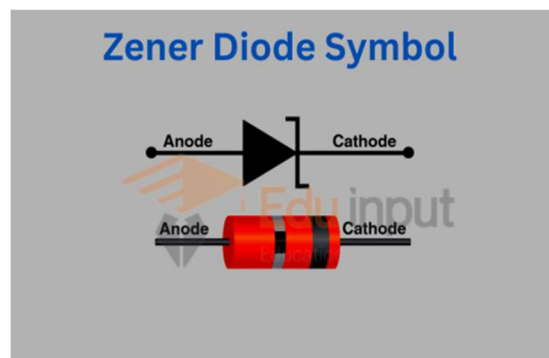
### 3. Capacitors



### 4. Potentiometer



### 5. Zener Diode





## 6. Jumper Wires



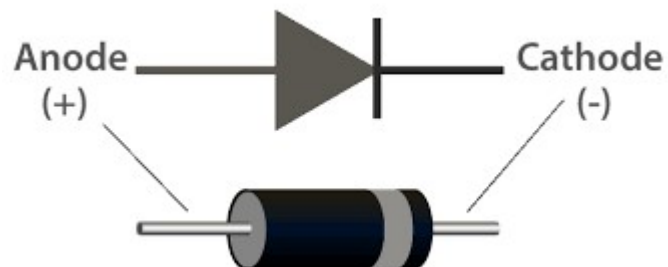
## 7. Oscilloscope



## 8. Power Supply



## 9. diode

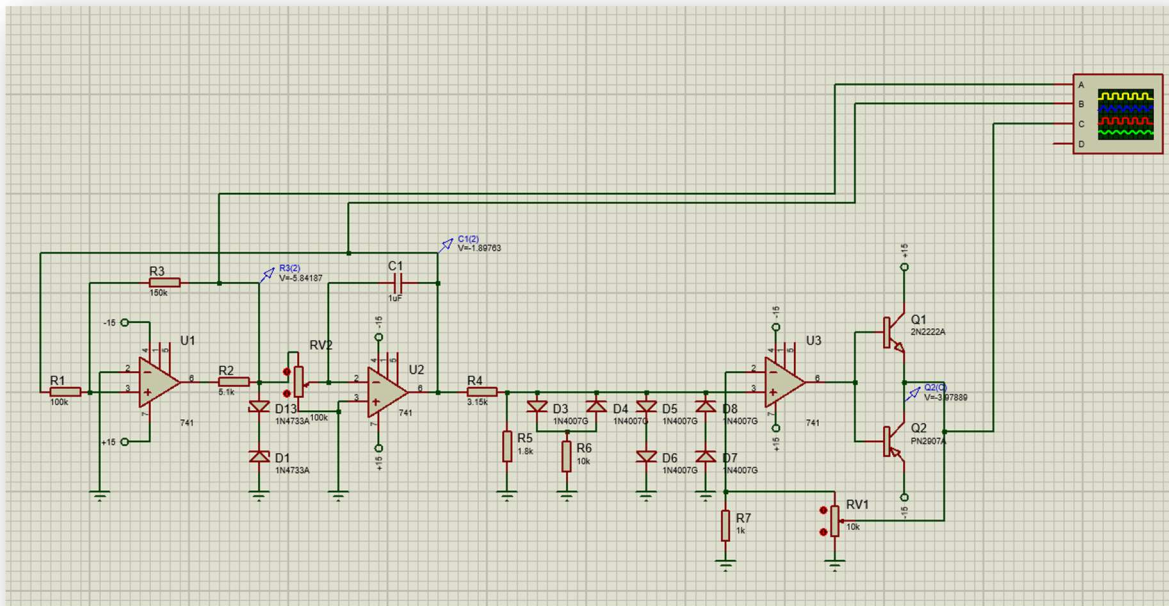


## Method:

We used Op amps that are the main key elements of the circuit. Two op amps IC LM741 were used and collected data from google and watched videos on YouTube to make a frequency generator.

- First an op amp IC741 was connected to the Bread board.
- For the square wave generation two resistors were connected to the non-inverting terminal of the op amp.
- Another resistor was connected to the inverting terminal of the op amp and a capacitor was also connected to the non-inverting terminal and this through the resistor was connected to the output.
- Then with the Dc power supply we applied positive and negative 12 V input to the op amp 7 and 4 respectively.
- Then Square wave was generated by connecting the output terminal to the prob of oscilloscope.
- After that we generated triangular waves using an integrator circuit which consists of resistor and capacitor.
- The input resistor is connected to the input signal and capacitor is connected between the output and the inverting input of the op-am, and a feedback resistor connected from the inverting input to the circuit reference point (usually ground).
- Furthermore, we generated sine wave by connecting positive supply voltage (+Vcc) to the V+ pin of the 741 op-amp and negative supply voltage (-Vcc) to the V- pin.
- The 741 op-amp typically requires a dual power supply with symmetrical voltage values, such  $\pm 12$ .
- we connected the resistor R1 between the inverting input of the op-amp and the junction of the capacitor C1 and resistor R2 and connected the resistor R2 in series with the non-inverting input of the op-amp.
- Moreover we joined the resistor R3 in parallel with the series combination of R2 and the non-inverting input of the op-amp.
- Further the capacitor C1 was connected in series with junction of R1 and inverting input of the op-amp.
- In addition the input voltage was connected to the inverting input of the op-amp.
- After all we successfully generated sine wave by connecting the output to a load.

## Simulation:



## Result:

We were successfully able to generate sine waves, square wave, and triangular wave.

The following are the pictures of the resulting waves generated by the frequency generator.

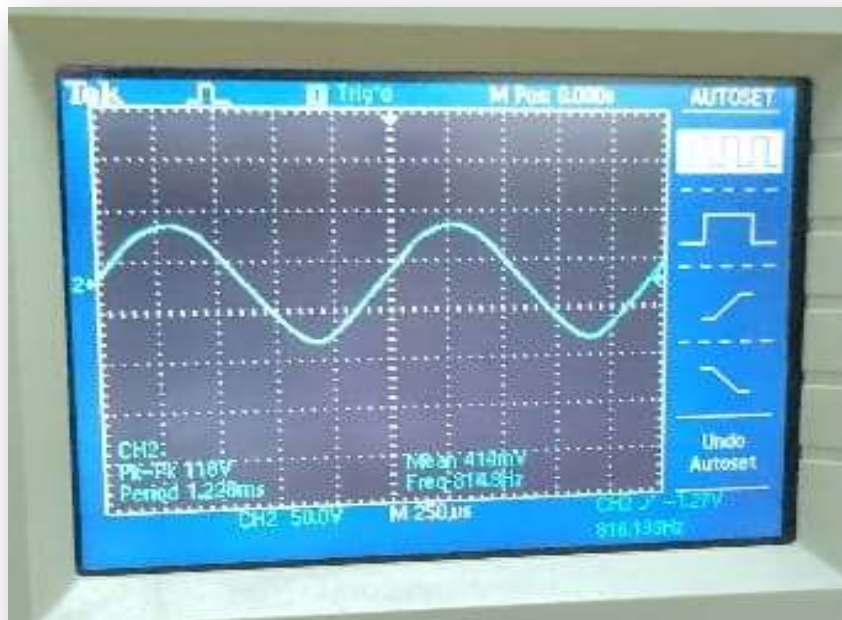
## Square wave:



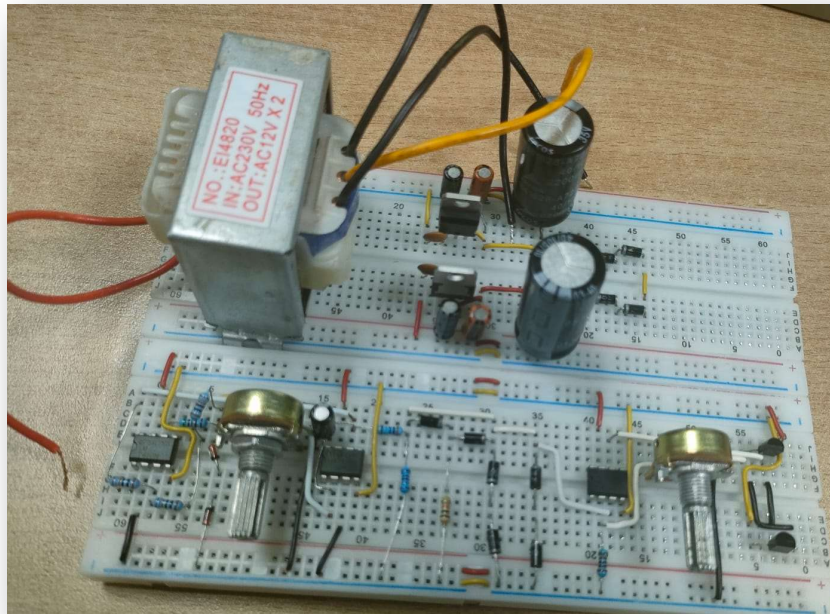
## Triangular wave:



## Sine Wave:



## Final product:



## Discussion:

Through the journey of making the experiment we faced a lot of difficulties as well as challenges.

Some of them are listed below:

- 1.The circuit was overall difficult to understand as well as to make as we were making it for the first time.
- 2.Few difficulties were faced due to errors in instruments.
- 3.A major problem was that we were not able to deal with a problem regarding capacitor that was barrier in our way of making a triangular wave.
- 4.One of the major problems was management of time due to classes.
- 5.The faulty potentiometer was causing problems due to which we were not able to make the sine wave for a long time, but in the end that faulty potentiometer was replaced by the correct one and the problem was solved.



## What did we learn from the Project?

- Teamwork.
- How to use an oscilloscope.
- Physical functions and operations of the Op amp.
- How to manage time.
- How to create a frequency/function generator.
- How to generate different types of waves.
- How to deal with the complexity of the circuits.
- How different components in the circuit behave.
- As an engineer what is the best solution to the problem.
- How to implement theoretical knowledge to physical problems.

## Conclusion:

In conclusion, the frequency generator project has successfully achieved its objectives of designing and implementing a versatile device capable of generating precise and controlled electrical signals of varying frequencies. The project involved a comprehensive study of signal generation techniques, circuit design principles, and programming concepts.

Through careful research and analysis, a suitable circuit architecture was selected and implemented, incorporating the necessary components and controls to generate a wide range of frequencies. The integration of microcontrollers or digital signal processors facilitated precise frequency control and allowed for user-friendly interface options.

The project's testing phase confirmed the functionality and accuracy of the frequency generator. Extensive experiments were conducted to measure the generated frequencies against reference standards, demonstrating the device's reliability and stability in generating consistent and accurate signals.

## References:

[1]: [https://en.wikipedia.org/wiki/Function\\_generator](https://en.wikipedia.org/wiki/Function_generator)

[2]: <https://ieeexplore.ieee.org/Xplore/home.jsp>