Linear Integrated Circuits & Applications Lab

A MINIPROJECT REPORT

ON

Regulated Dual Power Supply

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1. INTRODUCTION

Dual power supply units are common equipment in electrical engineering and electronics. They supply positive polarity (+Vcc) as well as negative polarity (-Vcc, not connected to ground) and ground potential. In particular cases like Op-Amps, both the positive and negative rails are required for the proper operation of the circuit.

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2. BLOCK DIAGRAM

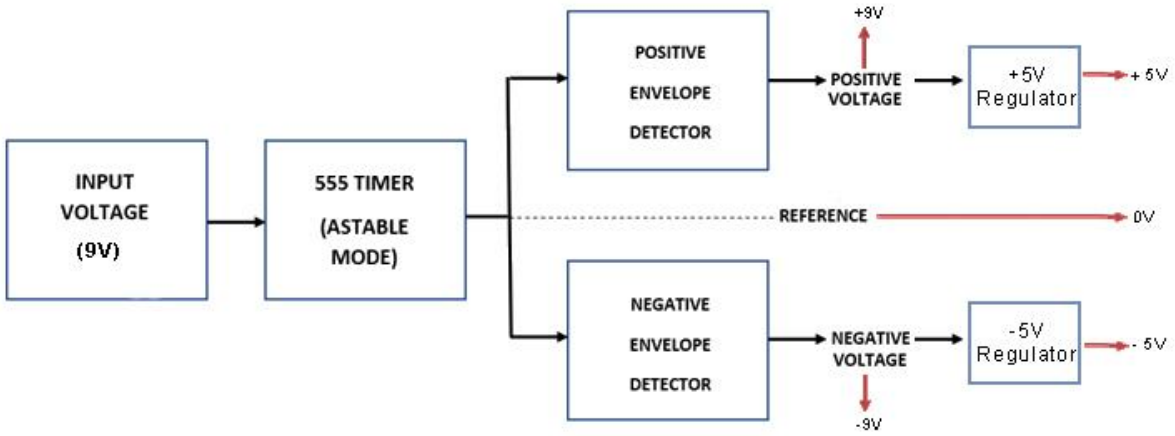

Fig 2-1 Block diagram

The circuit is configured to work as an astable multivibrator. The circuit can provide 3 to 15V dual supply from a single power source. The circuit can be used at any place where a low current dual power supply is required. The input voltage is 3 to 15V DC. The output current of the circuit is 50mA.

A DC voltage between 3V to 15V is applied to the circuit configuration. A capacitor is connected parallel to input to block any unnecessary signals. This voltage is used to power the 555 timer. As it is designed to work as an astable multivibrator no additional input is required and provides high frequency signals at the output pin with amplitude equal to the applied voltage.

A diode and capacitor is used to act as envelope detector. There are two envelope detectors designed to obtain the positive and negative peaks of the output signal respectively. The diodes are placed such that it does not allow the output signal to flow back into the timer. The output capacitor rapidly charge and discharge with respect to the positive and negative peaks of the output signal. A reference voltage (common ground) is formed by considering the midpoint voltage of the output signal.

Further, these outputs are connected to IC7805 and IC7905 to provide a rectified output of +5V and -5V. The output voltage is verified using multimeter.

3. CIRCUIT DESIGN

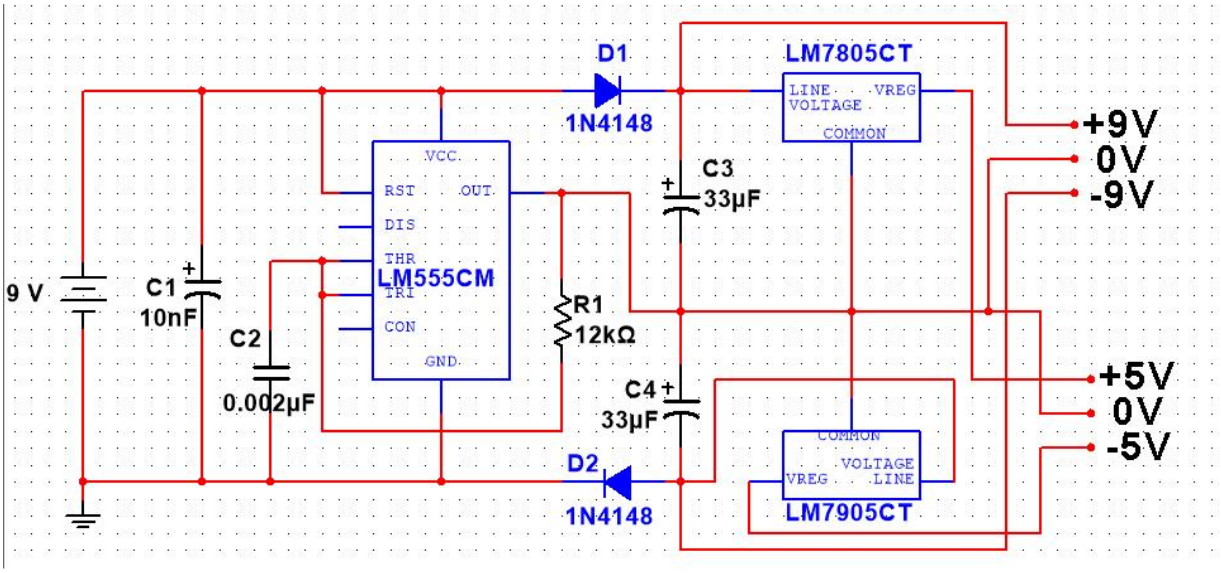

Figure 3-1: Circuit diagram

ON-time period of the 555-timer is given by

$$T_{on} = 0.693 \times R_1 \times C_2 \quad \text{3-1}$$

In the circuit,

$$R_1 = 12\text{k}\Omega \quad \text{and} \quad C_2 = 0.002\mu\text{F}$$

Therefore,

$$T_{on} = 16.63\mu s$$

We have,

$$T_{on} = T_{off}$$

Duty cycle is,

$$\frac{T_{on}}{T_{on} + T_{off}} = 50\%$$

$$\frac{T_{on}}{T_{on} + T_{off}} = 50\% \quad \text{3-2}$$

$$T = T_{on} + T_{off} = 33.26\mu s$$

Frequency is calculated by the formula,

$$F = \frac{1}{T} \quad \text{3-3}$$

Therefore,

$$F = 30.066k\ H_z$$

Expected Waveforms

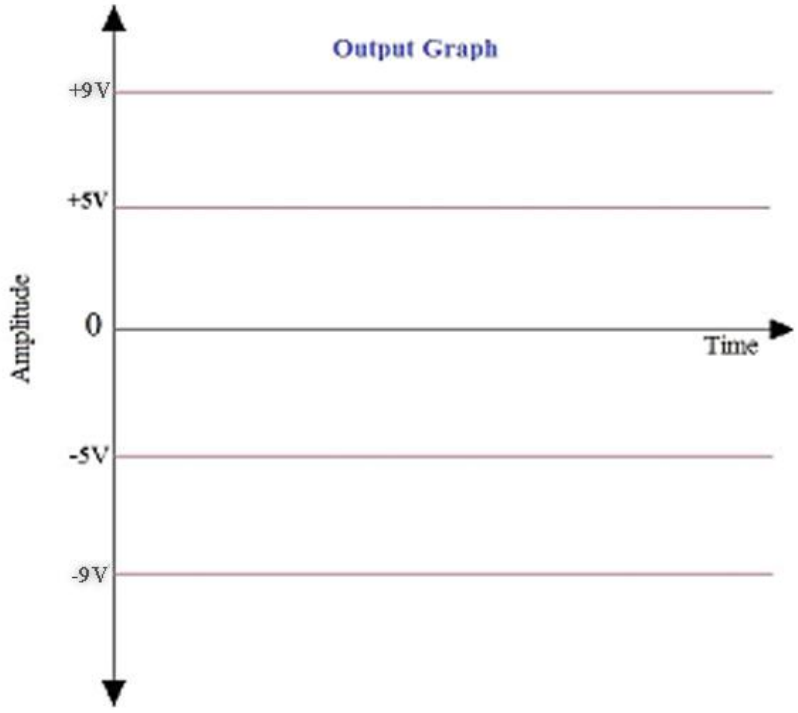

Figure 3-2: Output graph

Table 3-1Components List

SL. No	Components	ID
1	Battery	9V
2	Timer	NE555
3	Positive Voltage Regulator	IC7805
4	Negative Voltage Regulator	IC7905
5	Switching Diode	1N4148
6	Resistors	12kΩ
7	Electrolytic Capacitors	10nF, 33µF
8	Capacitor	0.002µF
9	Board	Perfboard

COMPONENT DESCRIPTION

1. Battery

Figure 3-3: 9V battery

The nine-volt battery, or 9-volt battery, is a common size of battery that was introduced for the early transistor radios. It has a rectangular prism shape with rounded edges and a polarized snap connector at the top. This type is commonly used in walkie-talkies, clocks and smoke detectors.The nine-volt battery format is commonly available in primary carbon-zinc and alkaline chemistry, in primary lithium iron disulfide, and in rechargeable form in nickel-cadmium, nickel-metal hydride and lithium-ion. Mercury-oxide batteries of this format, once common, have not been manufactured in many years due to their mercury content.

2. Positive Voltage Regulator

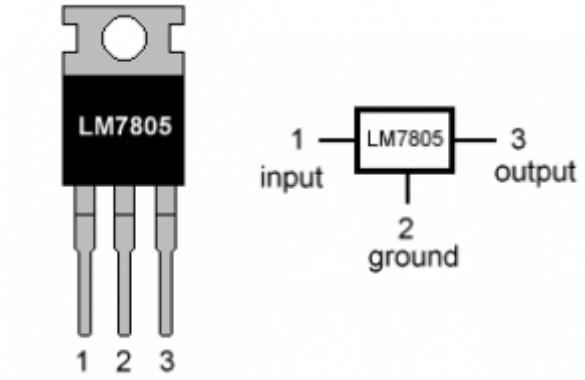

Figure 3-4: IC7805

Voltage sources in a circuit may have fluctuations resulting in not providing fixed voltage outputs. A voltage regulator IC maintains the output voltage at a constant value. 7805 IC, a member of 78xx series of fixed linear voltage regulators used to maintain such fluctuations, is a popular voltage regulator integrated circuit (IC). The xx in 78xx indicates the output

voltage it provides. 7805 IC provides +5 volts regulated power supply with provisions to add a heat sink.

3. NE555 Timer:

Figure 3-5: NE555 Timer

The above shown Fig. 3-3 is of NE555 timer. It is an integrated circuit used in a variety of timer, pulse generation, and oscillator applications. It can be used to provide time delays, as an oscillator, and as a flip-flop element. In astable mode, the 555 timer acts as an oscillator that generates a square wave.

4. Negative Voltage Regulator

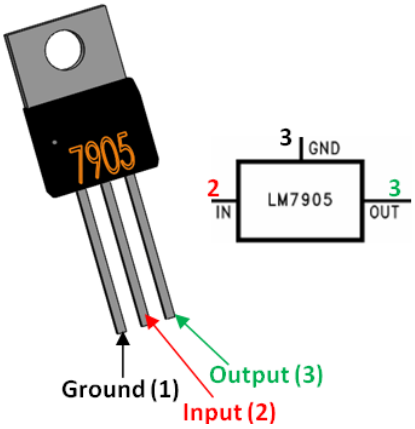

Figure 3-6: IC 7905

Voltage regulators are very common in electronic circuits. They provide a constant output voltage for a varied input voltage. In our case the 7905 IC is an negative 5V regulator, meaning it provides -5V as output. The name 7905 signifies two meaning, “79” means that it is a negative voltage regulator and “05” means that it provides 5V as output. So our 7905 will provide a -5V output voltage.The output current of this IC can go up to 1.5A, but the IC

suffers from heavy heat loss hence a Heat sink is recommended for projects that consume more current.

5. Switching Diode

Figure 3-7: 1N4148 Diode

The 1N4148 is a standard silicon switching signal diode. It is one of the most popular and long-lived switching diodes because of its dependable specifications and low cost. Its name follows the JEDEC nomenclature. The 1N4148 is useful in switching applications up to about 100 MHz with a reverse-recovery time of no more than 4 ns.

6. Resistors

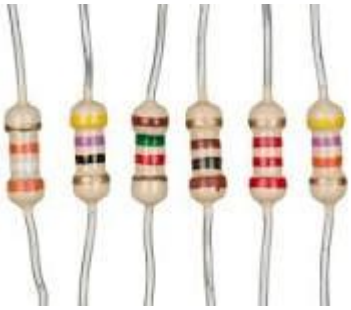

Figure 3-8: Resistors

A resistor, as shown in the figure 3.8, is a passive two-terminal electrical component that implements electrical resistance as a circuit element. In electronic circuits, resistors are used to reduce current flow, adjust signal levels, to divide voltages, bias active elements, and terminate transmission lines, among other uses. High-power resistors that can dissipate many

watts of electrical power as heat, may be used as part of motor controls, in power distribution systems, or as test loads for generators. Fixed resistors have resistances that only change slightly with temperature, time or operating voltage.

7. Electrolytic Capacitor

Figure 3-9: Electrolytic capacitor

An electrolytic capacitor is a polarized capacitor whose anode or positive plate is made of a metal that forms an insulating oxide layer through anodization. This oxide layer acts as the dielectric of the capacitor. A solid, liquid, or gel electrolyte covers the surface of this oxide layer, serving as the cathode or negative plate of the capacitor. Due to their very thin dielectric oxide layer and enlarged anode surface, electrolytic capacitors have a much higher capacitance-voltage (CV) product per unit volume than ceramic capacitors or film capacitors, and so can have large capacitance values. There are three families of electrolytic capacitor: aluminum electrolytic capacitors, tantalum electrolytic capacitors, and niobium electrolytic capacitors.

8. Capacitor

Figure 3-10: Capacitor

A ceramic capacitor is a fixed-value capacitor where the ceramic material acts as the dielectric. It is constructed of two or more alternating layers of ceramic and a metal layer acting as the electrodes. The composition of the ceramic material defines the electrical behavior and therefore applications.

9. Perfboard:

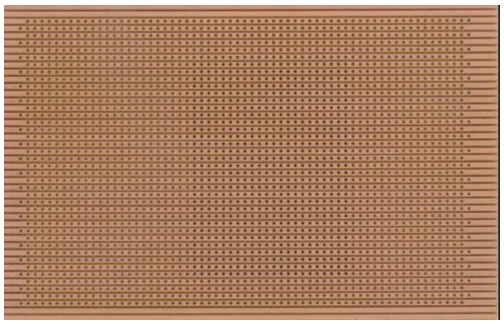

Figure 3-11: Perfboard

Perfboard is a material for prototyping electronic circuits (also called DOT PCB). It is a thin, rigid sheet with holes pre-drilled at standard intervals across a grid, usually a square grid of 0.1 inches (2.54 mm) spacing. These holes are ringed by round or square copper pads, though bare boards are also available. Inexpensive perfboard may have pads on only one side of the board, while better quality perfboard can have pads on both sides (plate-through holes). Since each pad is electrically isolated, the builder makes all connections with either wire wrap or miniature point to point wiring techniques. Discrete components are soldered to the prototype board such as resistors, capacitors, and integrated circuits.

4. TESTING SCHEME

Initially, the circuit is designed on breadboard using specific values of the components. The best values of the components are selected after testing. After getting the required output on the breadboard, the same circuit is done on the PCB. With the required materials layout is created by placing the components in proper positions. It is also verified that each trace is connected to the proper component pins or leads while designing. It is also ensured that there is no unnecessary short circuit. This verification methodology helped in getting required output.

- Ensure all connections are made properly.
- Apply a 9V battery as an input source to the circuit.
- Using a multi-meter, observe the output voltages at the output terminals.

5. PROJECT OUTCOME'S

The Regulated Dual Power Supply is designed and implemented successfully and final layout is shown in figure 5.1.

As expected, the circuit provides +9V, -9V, +5V and -5V at the output terminals when a 9V battery is used to power the circuit.

REFERENCES

[1] http://www.circuitdiagram.org/dual-power-supply-using-555-timer-ic.html

[2] http://www.learnerswings.com/2014/07/5v-0-5v-voltage-regulator-using-7805.html

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Evaluator	Signature
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