Close Range High Voltage Multiplier Device

Ronit Rudra[1], Praneet Dutta[2]
1(VIT University, *ronit.rudra1995@gmail.com*)
2(VIT University, *praneetdutta93@yahoo.com*)

Abstract- This project has been implemented to create a sample, cheap and easy to make "Electroshock defensive device" .This is powered from a 9 volt DC source making use of basic electronic components. This voltage is multiplied through the Cockroft –Walton Voltage Multiplier Ladder.It generates a high voltage arc across its output electrodes ranging from 4.5KV to 75000KV.The output voltage is pulsating. Based on the prototype design this can be used for a plethora of applications. This must be handled with extreme precaution since misuse of device may lead to hazardous accidents.

Keywords- *555 Timer IC, Audio Transformer, Astable Multivibrator, Cockcroft Walton Voltage Multiplier Ladder*

*****

I. INTRODUCTION

This technology makes use of a pulsed high-voltage low-current electrical discharge .Our bodies muscle triggering mechanisms are countermanded by this. The recipient of this momentary high voltage is immobilized via two metal probes . These are connected by wires to the device body. The extreme current can lead to momentary paralysis . It is reported that applying electroshock devices to more sensitive parts of the body can lead to even greater loss of muscle function. It has For defensive purposes, the device can be used with maximum effect in bodily areas such as the upper shoulders, below the rib-cage and the upper hip These can immobilize the attacker for a sufficient duration..High voltages are used, but because most devices use a non-hazardous current (order of a few micro-volts), its use may not be lethal. Hence it is apt for the above mentioned purpose. The science behind the "shock" which the recipient experiences is caused by muscles twitching uncontrollably. This is reported as muscle spasms.

The internal working of the prototype is fairly straightforward, based on either an oscillator, resonant circuit (a power inverter), and step-up transformer or a diode-capacitor voltage multiplier to achieve an alternating high-voltage discharge or a continuous direct-current discharge. This is shown in the circuit diagram below.It may be powered by one or more batteries depending on manufacturer and model. The output voltages without external "load" (which would be the target's body) are claimed to be in the range of 50 kV up to 8 MV, .A more practical voltage range is in between 200 to 300 kV .The output current upon contact with the target will depend on various factors .These include target's resistance, skin type, moisture, bodily salinity, clothing, the electroshock weapon's internal circuitry(as mentioned above), discharge waveform, and battery conditions.

This circuit produces a very high voltage and extreme precaution must be taken to avoid getting a nasty shock. The transformer can produce over 1000 Volts and the 8-stage multiplier can produce up to 20,000 Volts.

II. REQUIRED COMPONENTS

The following components are essential for constructing the Taser:

S.No	Component	Specification	Units
1	Ceramic Capacitor	10nF/400V	16
2	Diode	1N4001	14
3	Electrolytic Capacitor	10nF	2
4	Timer IC	NE555	1
5	Bipolar Junction Transistor	BD679	1
6	Audio Transformer	230-12 V	1
7	Carbon Resistor	1K ohm 330 ohm 220 ohm	1 2 1
8	Battery	Lithium Ion 9 V	1

Apart from these components, suitable amounts of wiring are required. The circuit is first simulated on a breadboard . It is then ported to a Printed Circuit Board.

III. DESCRIPTION:

- **Ceramic Capacitor:** In this a ceramic material acts as the dielectric .It has a constant value. A Metallic Layer behaves as an electrode with two layers of metal behaving as the electrodes. The electrical behavior is dependant on the composition of this. Ceramic capacitors are divided into two application classes:
  1. *Class 1 ceramic capacitors* –These display high stability and low losses .These are mainly used for Resonant Circuit
  2. Class 2 ceramic capacitors offer high volumetric efficiency for buffer, by-pass and coupling applications.

The composition of the capacitor hence decides the relevant application it is used for.

- **1N4001 Diode:** The 1N4001 series is a family of silicon rectifier diodes. They are used mainly for general purpose applications .Another purpose is in AC adapters for household needs. . Blocking voltages (maximum voltage it can tolerate without conducting) varies from 50 to 100V.

- **Electrolytic Capacitor:** This makes use of an electrolyte as one of its plates. An electrolyte is a ionic conducting fluid which is used to generate a greater capacitance per unit volume than the other alternatives. All capacitors conduct alternating current (AC) and block direct current (DC).

- **555 Timer IC:** It is an integrated circuit (chip) used in a variety of timer, pulse generation and oscillator applications. The 555 is used to provide time delays and as an oscillator of varying pulse on and off times. Derivatives provide up to four timing circuits in one package.

- **BD679:** The BD 679 darlington transistor consists of two transistors in a single package. The upper transistor is a small signal transistor .Its collector and base leads come out of the package. The collector lead is common to both the transistors. When a voltage is applied to the base of the device, a current is induced and hence starts flowing into this turns the top transistor ON. It is with relative ease that current can be delivered into the base. Delivering the current into the base is exactly the same as lifting the base a small amount with your finger. This effect is amplified by the transistor to the emitter and lifts the emitter. The emitter is hence amplified by 100 times the signal that was initially provided.
  This "pulling-up" effect is transferred to the base of the base of the power transistor and it is equivalent to raising the base with 100 times more force than you exerted on the external base.
  The power transistor inside the device PULLS DOWN very strongly on the bottom of the LOAD RESISTOR and this allows a higher voltage to appear across the LOAD. The result is the load is activated.

- **Transformer 12-230:** A transformer is a static electric device. Energy is transferred in the device by inductive coupling between its winding circuits. A varying magnetic flux in the transformers core is caused by varying current in the primary winding .This leads to a varying magnetic flux in the secondary winding causing a secondary emf to be generated.. Here transformers is used to vary the relative voltage of circuit. It multiplies the voltage by a factor equal to 230/12.

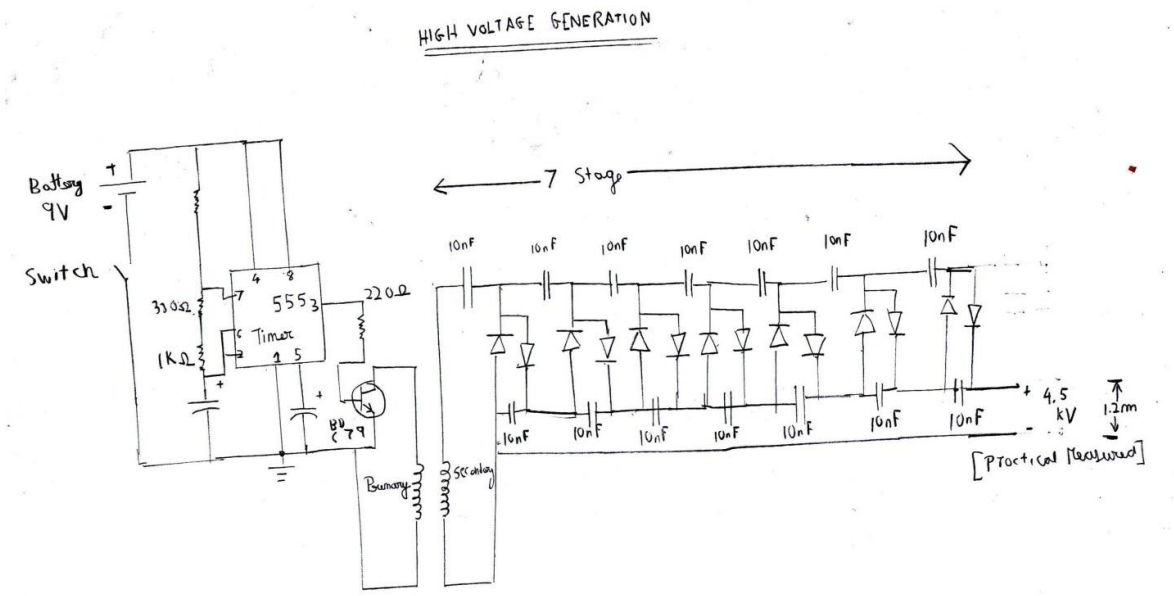
- **Cockcroft-Walton generator:** This Cockcroft-Walton voltage multiplier was part of one of the early particle accelerators responsible for the development of the atomic bomb. Built in 1937. It is an electric circuit which generates a high DC voltage from a low AC voltage or a pulsing DC input. It was named after the British and Irish physicists John Douglas Cockcroft and Ernest Thomas Sinton Walton. In 1932 this circuit formed the basis of the design which was used to power their particle accelerator, performing the first artificial nuclear disintegration in history. Today Cockcroft-Walton circuits are still used in particle accelerators, but also in many everyday electronic devices that require high voltages. The main advantage of this over transformers for voltage multiplication is that it makes the need for heavy core and the bulk of Insulating material redundant.

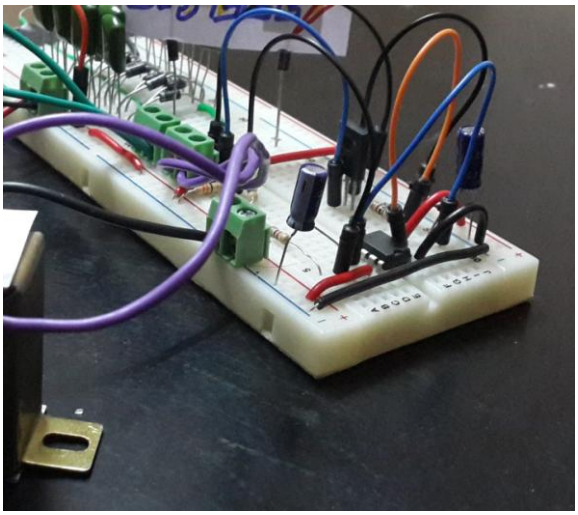
III. CIRCUIT FLOW

1. A DC input of 9 volts is provided to the 555 timer IC
2. The 555 timer IC converts the DC input into rectangular pulse AC signals. It behaves as an astable multivibrator whose frequency depends on the external circuit constants such as capacitors and resistors connected to its pins.
3. The AC output from the timer IC is fed to the base terminal of BD679 transistor.
4. The transistor amplifies the signal and the output is taken across the collector
5. This output is fed to the primary coil of the step up transformer.
6. The output from the secondary coil of the transformer is fed to COCKROFT-WALTON voltage multiplier ladder which further amplifies the voltage. A seven step ladder was used here as peak output was obtained with 7 stages.
7. The output from the multiplier ladder is taken across two electrodes separated by a distance approximately equal to 1.2 mm.
8. The output can be verified by the generation of an electric arc across electrodes due to the ionization of the surrounding air molecules, caused due to a very high potential difference. Practical measured voltage was 4.5 kV.

WARNING: EXTREME PRECAUTION MUST BE TAKEN WHILE HANDLING THE HIGH VOLTAGE IN THE CIRCUIT. THE HIGH VOLTAGE WILL LEAD TO SHOCKS AND CAUSE BURNS. IT IS ADVISIBLE TO HANDLE WITH INSULATING MATERIALS.

 ISSN: 2321-8169
2550 – 2552





IV. CONCLUSION

This project was aimed at designing a sample electroshock weapon using basic analog electronic circuits. An output voltage of 4.5kV was practically obtained. Although very small compared to commercial tasers which produce voltages in the order of 70 kV, the circuit effectively converts a low voltage DC source to a high voltage low current output. A lot can be learnt about voltage-multiplying circuits, timers and power supply design from this project.

V. ACKNOWLEDGEMENT

The success and final outcome of this project required a lot of guidance and assistance form many people and we are extremely fortunate to have received all of this .The successful completion would not have been possible without the valuable inputs from our mentors. We would like to thank Prof. Aarthi G and Prof Arulmozhivarman P for giving us an opportunity to take on this project and providing us with support and guidance.

VI. REFERENCES

[1] http://www.sentex.ca/~mec1995/circ/hv/stungun/stungun.html
[2] http://www.talkingelectronics.com/projects/50%20-%20555%20Circuits/50%20-%20555%20Circuits.html
[3] http://clarkson-uk.com/555-timer/ (program to find values for 555 timer oscillation)
[4] http://www.555-timer-circuits.com/stun-gun.html
[5] http://en.wikipedia.org/wiki/Electroshock_weapon
[6] http://en.wikipedia.org/wiki/555_timer_IC
[7] http://en.wikipedia.org/wiki/Cockroft%E2%80%93Walton_generator
[8] http://blazelabs.com/e-exp15.asp
[9] http://members.tm.net/lapointe/cockroft_walton.htm
[10] http://en.wikipedia.org/wiki/Ceramic_Capacitors
[11] http://en.wikipedia.org/wiki/ElectrolyticCapacitors
[12] http://talkingelectronics.com/projects
[13] http://eeecore.weebly.com/transformerssubstations.html