Design and Analysis of Electric Shock Gun with Cheapest Cost of Manufacturing

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Abstract

An electric shock gun is an in capacitate weapon used self-protection for criminals. Electric shock gun is a device to produce high voltage with low current. It is very chip in cost, reliable efficient and very effective. Internal circuit of electric shock contains oscillators, voltage multiplier, resonant circuit, and step up transformer or some diode- capacitors to achieve a pulsating DC high – voltage or continuous direct current discharge.
Keywords: Astable Multiplier, Voltage Doubler Circuit, Transformer, Battery

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I. INTRODUCTION

A. *What is a Stun Gun?*

The electric shock gun works on electric energy. It creates high voltage and give shock to human, up animal etc.

B. *Why it is used?*

A stun gun is a popular electric shock device used to immobilize an attacker without causing serious or permanent injury. They can be used as a deterrent to temporarily disable an attacker and provide you with a window of opportunity to escape to safety. Using a stun gun requires you to be within arm length of the attacker. You must touch the person with the stun gun to shock them.

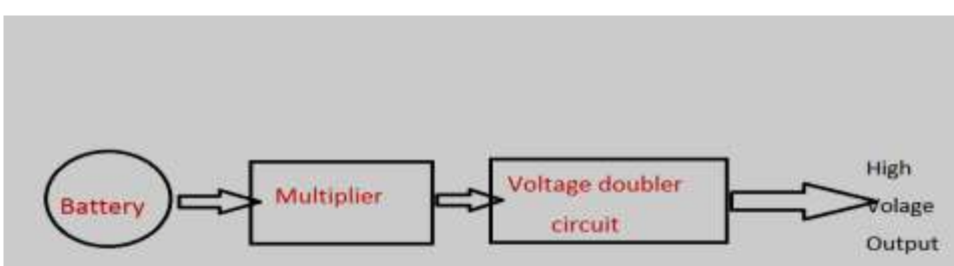
C. *Electric Shock Gun Effect*

A stun gun keys into the nervous system dumping energy into the muscles. This causes a loss of balance leaving the assailant disoriented and confused. Stun guns require direct contact. The longer you touch the attacker with the prongs of a stun gun, the longer the effects will last. The shock will not pass from person to person.

As a general rule, a one-half second contact can repel and startle the attacker, giving some pain and muscle contraction. One to two seconds can cause muscle spasms and a dazed mental state. Over three seconds can cause loss of balance and muscle control, mental confusion and disorientation. Realize that 3 seconds is quite a long time when in a physical struggle. Every person is different and will react differently to the effects of a stun gun. What may put one person down in 3 seconds could take 5 seconds on another person.

II. PRINCIPLE AND DESIGN

A. *Block Diagram*



This circuit contains battery, multiplier and voltage doubler circuit to produce high voltage with low current. 9 volt battery is used in this circuit as an input source and output, we can get as par design multiplier and voltage doubler circuit. We can get up to 200hz to a khz frequency and 500 volt to a few thousand voltage.

A astable multiplier is used for produce high frequency and voltage doubler circuit is used for producing high DC voltage.

B. Principle

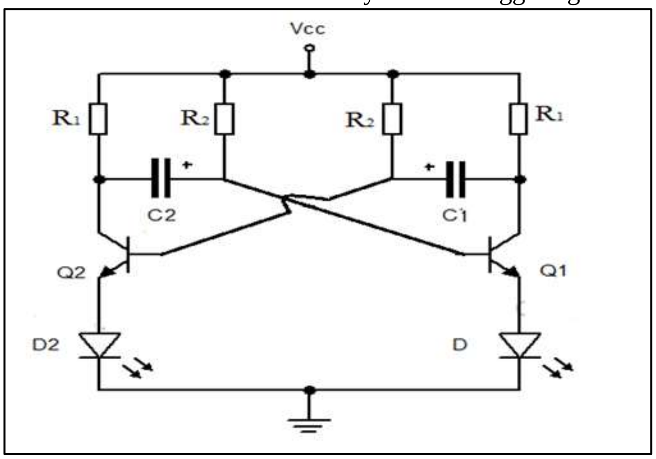
It is used to producing high voltage with low current by using of low power source.

C. Design

There are two main parts for design of circuit…
1) Astable multiplier
2) Voltage doubler circuit

D. Astable Multiplier Details

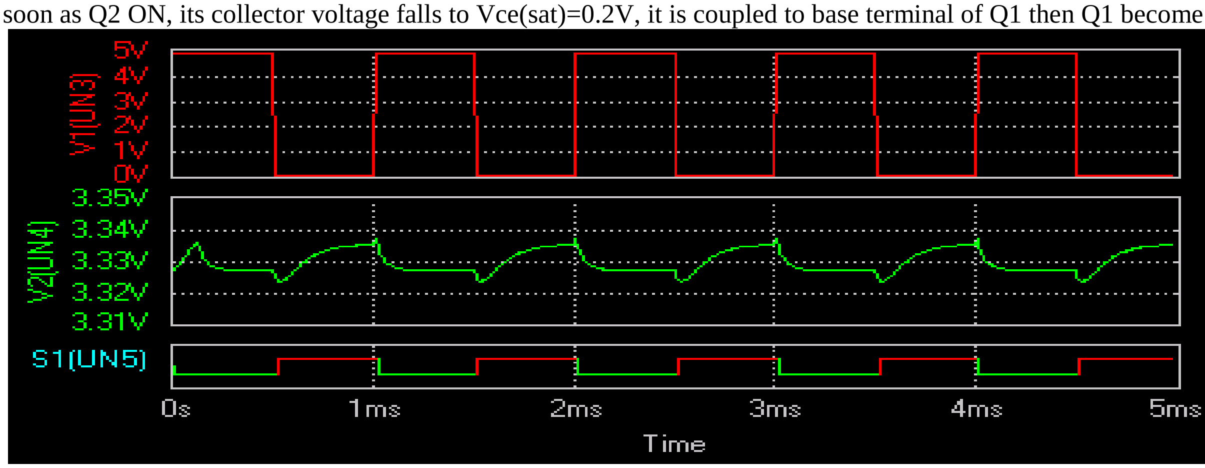
Transistorized Astable Multivibrator is a cross coupled transistor network capable of producing sharp continuous square wave. It is free running oscillator or simply a regenerative switching circuit using positive feedback. Astable Multivibrator switches continuously between its two unstable states without the need for any external triggering.



(Astable multiplier)

E. Working Principle

– anyone of the transistors Q1 or Q2 turns ON due to parameter variation or due to some switching transients, let it be Q1.
– Then the collector voltage of Q1=Vce(sat)=0.2V, it is cross coupled to base terminal of Q2 through C1, then Q2 remain in OFF state.
– During Q1 ON, the current path through R1 charges the capacitor C1, the capacitor C1 voltage is coupled to base of transistor Q2.
– While charging of C1, when the capacitor voltage exceeds 0.7V, Q2 become turns ON.
– As soon as Q2 ON, its collector voltage falls to Vce(sat)=0.2V, it is coupled to base terminal of Q1 then Q1 become OFF.



(output waveform)

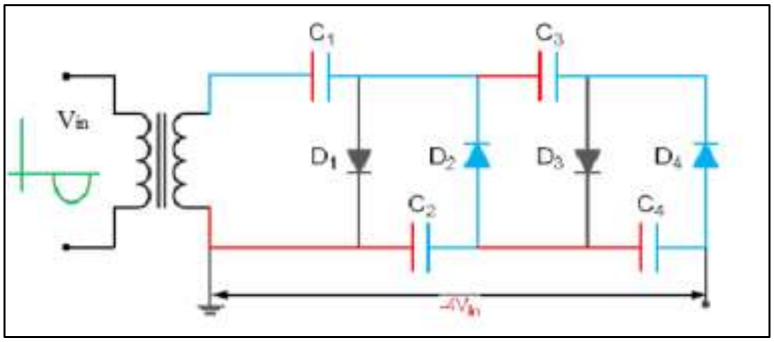
F. Design

F= $\frac{1.45}{(A_1+2R_2)c}$

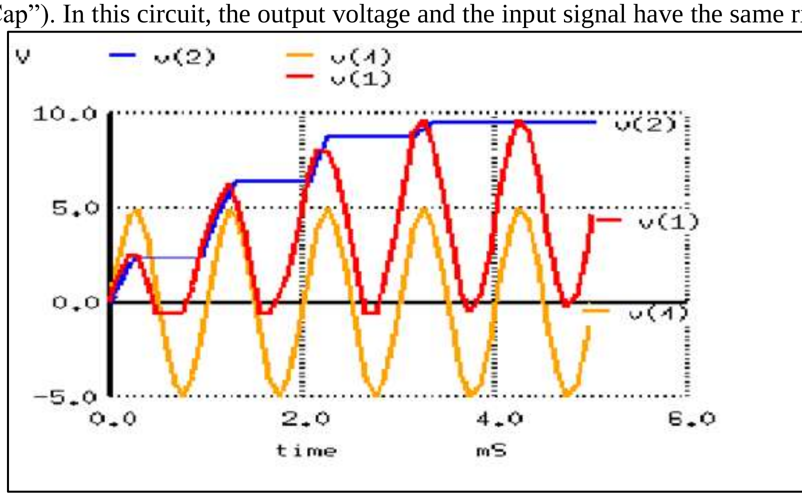
Duty cycle = $\frac{R_1+R_2}{R_1+2R_2} \times 100$

Where:
R1 and R2 resistance
C coupling capacitor
F frequency

G. Voltage Multiplier Circuit Details



A voltage doubler circuit is used for producing low AC power to high DC voltage.
The Voltage Multiplier circuits are based
Cockcroft-Walton (C-W) principle for increasing voltage level instead of using conventional transformer rectifier assembly. In this paper the voltage Multiplier circuits; voltage quadruple circuits are constructed for achieving -500volt
Voltage Doublers - Figure shows a half-wave voltage doubler circuit. It functions as follows. On the negative.
Half cycle of the input voltage, capacitor C1 charges, through rectifier CR1, to a voltage of Vm. On the positive half-cycle, the input voltage, in series with the voltage of C1 (VC1 = Vm), charges capacitor C2 through rectifier CR2 to the desired output voltage of 2 Vm. Capacitor C1, which aides in the charging of a capacitor C2, sees alternating current ("AC Cap") while C2 sees only direct current ("DC Cap"). In this circuit, the output voltage and the input signal have the same ripple frequency.



(Example of Output Waveform of Voltage Doubler Circuit)

Although half-wave and full-wave multiplier circuits can provide equivalent output voltages, there are some fundamental differences that should be considered. First, the full-wave circuit has the advantage of higher output ripple frequency (twice that of the half-wave circuit). In addition, the full-wave circuit provides better voltage regulation than the half-wave circuit, since the latter relies upon one capacitor (C1 in figure 2.) to provide the charging energy to a single DC load capacitor (C2 in figure 2.). The full-wave circuit, however, requires that the secondary side of the transformer be capable of withstanding high voltages (approximately 1/2 of the output voltage). For this reason, the half-wave multiplier is usually the preferred circuit when high voltage outputs (V0 = kV) are required.

H. Voltage Multiplier Circuit Design

1) Transformer Specification

2 ×N× Vmax = output voltage (Vo)
Where,
N = no. of stages
Vmax = peak output voltage
Vrms = Vmax ÷1.414

KVA rating of Supply = Vo * Io

2) Capacitor Specification

The value of capacitors used is inversely proportional to the frequency of input signal. So, the capacitors are rated for 2Vmax. For voltage quadruple circuits: 2× Vmax = Vo/N

$$\text{Noptimum} = \sqrt{((\text{Vmax} \times f \times c) \div I)}$$

C = (Noptimum^2 × I) ÷ (Vmax × f)

3) Diode Specification

The maximum reverse voltage across a diode is called peak inverse voltage and the reverse voltage seen by each diode is 2×Vm, so it's a general practice to select a device with PIV rating of 2 × Vmax. From the 230V /12KV transformer Peak output will come up to 12 × 1.414kV = 16.96kV, so twice of it will give nearly 35 kV. So we have taken diode of 40 kV for safety purpose and also for extending the range, as such rating diodes was unavailable so it has been connected two power diodes of 20 kV to make it equivalent to 40kV. Each is having a reverse blocking resistance in the range of mega ohms.

So, the leakage current flowing through each diode is of the order of =100uA. Thus, resistor while designing of Static Equalizing Circuit for voltage quadruple,

Therefore R = V/I

Calculation of Output Voltage

Vout = (2 × N × Vmax) − ΔV − δV

Where,

Vout = output voltage of N stage voltage multiplier

N = no. of stages (it is no. of capacitor divided by 2)

Vmax = maximum or peak input voltage

ΔV = resultant drop across the capacitors

δV = ripples voltage (peak to peak)

Now,

Resultant voltage drop across capacitors when load is connected is given by following equation

$$\Delta v = (\frac{i}{f \times c} \times \{((2 \times n^3) \div 3) + (n^2 \div 2) - (n - 6)\})$$

Ripple voltage (peak to peak) given by

$$\delta v = \frac{i \times n \times (n+1)}{4 \times f \times c}$$

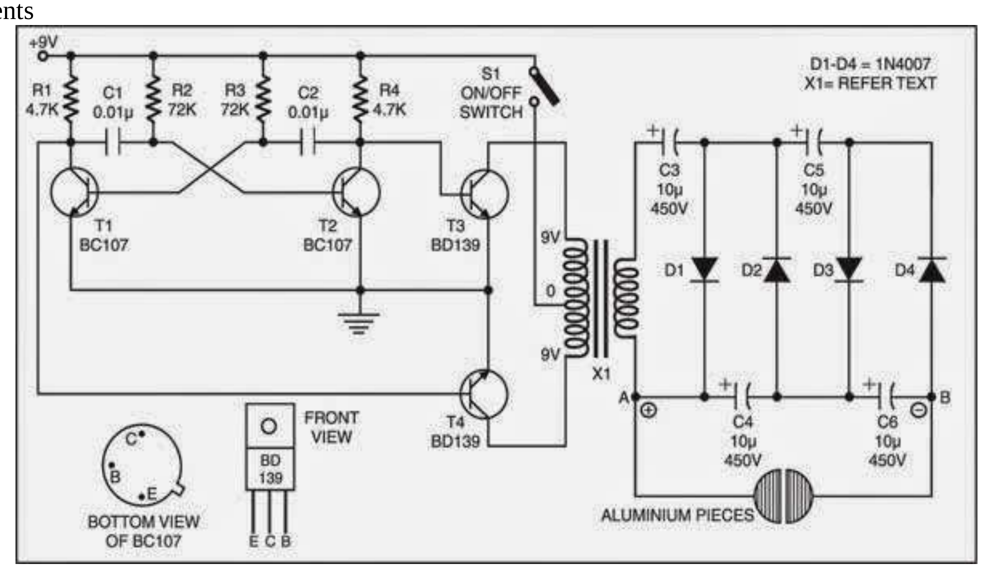
Now, Regulation of Voltage = ΔV/ 2 Vmax

Percentage Ripple = δV / 2 Vmax

Vout = 2 × N ×Vmax

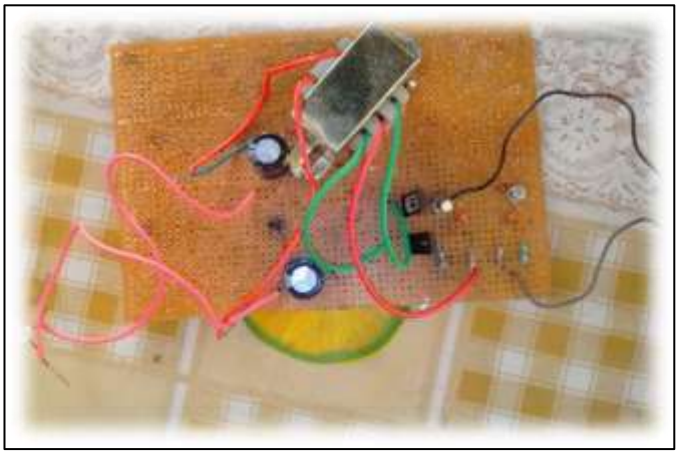
By using this design steps.

Value of components

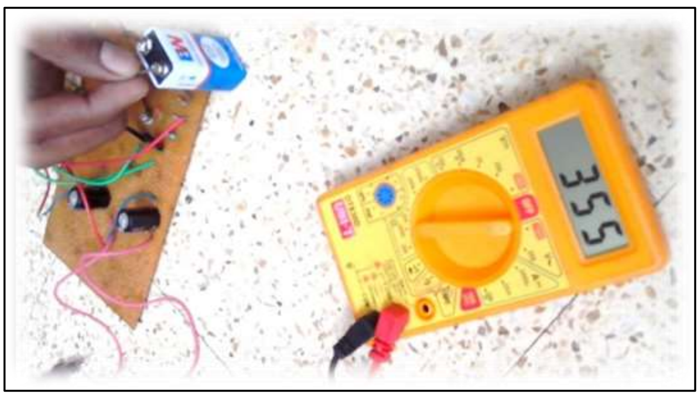


(Circuit of electric shock gun)

A stun gun design when maximum output voltage 650volt, 1 amp. Current, 1030 frequency. Noptimum 2 find capacitor, diode value, and net output of stun gun.



SR.NO	NAME OF PARTS	SPECIFICATION	NOS
1	Capacitors	0.01	2
2	Capacitors	10, 450V	4
3	Resistance	4.7K	2
4	Resistance	68K	2
5	Transistor	BC 107	2
6	Transistor	BC 139	2
7	Transformer	9V- 0- 9V	1
8	Diodes	1N4007	4
9	Push Switch	_	1



Output voltage data at different voltage rating..

Stage	Output voltage	δv	Δv	Net output voltage
1	650 v	48 v	97 v	505 v
3	1951.32 v	97 v	213 v	1641.3 v
4	2601.76 v	121 v	485 v	1995.75 v

III. Application

- It can be used for security purpose for individuals from intruders.
- It can be used as protection from animals.
- It can be used as modern warfare equipment.
- It is also use medial propose.

IV. Conclusion

The stun gun's discharge is very impressive. The spark is highly visible and each discharge produces a sharp, resounding crack. The circuit can teach you much about voltage-multiplying circuits and power supply design. But don't ever forget that the stun gun is not a toy. It can cause much damage to both you and others. Never leave it lying around where children, pets, or anyone unfamiliar with how to use it can handle it. It's a good idea to remove the battery before storing the stun gun.

V. OUTCOMES

A. *Outcome of Projects*

- Circuit totally electrical base
- Simply find all problem
- Analysis circuit and block diagram
- Fine element and how to work in our project
- Solution taken to all problem in simple form
- To reduce voltage level but reduce it effected on use any one man/animal for protection
- By use new design of stun gun (on electrical base) to reduce
- Easy to produce high voltage
- Easy to operate
- Increasing minor current output
- $V_{out} = (2V_{in} + 1.414)$ S, where S is the number of stages
- Pluses produce by using astable multiplier

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