High Voltage Marx Generator

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Abstract- *A High voltage Marx generator has been developed by using power n channel mosfet as the switch. The objective of this generator is to generate short-pulses for many industrial applications. These pulses is a spike of voltage that suddenly rises in very short time to its peak and falls slowly to zero with respect to time axis. This generator can be used by small scale industries and academic institutions to demonstrate impulse voltages and also to perform testing on insulators of lower rating in laboratory.*

Keywords- Flyback transformer, Spark gap, Impulse voltage, Lightning

I. INTRODUCTION

High voltage equipments are often placed in open air and they are often exposed to lightning strike as well as surge voltage. They are sustaining high surge voltage during the lightning phenomena. Marx generator is commonly used to test the equipments and check the withstanding level. Marx generator is capable of producing lightning impulses voltage up to 25kv. This generator consists of multiple capacitors that are first charged in parallel through charging resistors by a high voltage, direct current source and then connected in series and discharged through a test object by a concurrent spark-over between the sphere gaps. Although the wave shapes of impulse voltages occurring in the system may vary extensively.

II. MARX GENERATOR BASICS

The Marx generator is a capacitive energy storage circuit which is charged to a given voltage level and then quickly discharged, delivering its energy quickly to a load at very high power levels. A typical Marx circuit uses resistors to charge N capacitors in parallel to a voltage V, as shown in Fig 1. When triggered, the first switch voltage drops which increases the voltages across the remaining switches, causing a chain reaction of self triggering. The capacitors are then momentarily switched into a series configuration, delivering a voltage pulse to the load that is theoretically n*V, depicted in Fig 2. The output switch is present to isolate the load while charging the Marx, and to insure full Marx erection before energy is transferred to the load. The charging resistors grade the output voltage from the charging supply during firing, providing electrical isolation. A number of capacitors are charged in parallel to a given voltage, V, and then connected in series by spark gap switches, ideally producing a number, n, of capacitors or stages.

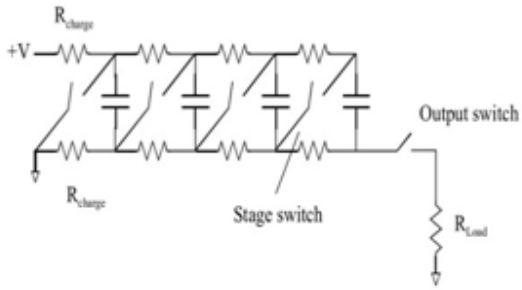


Figure 1. Marx generator charging circuit.

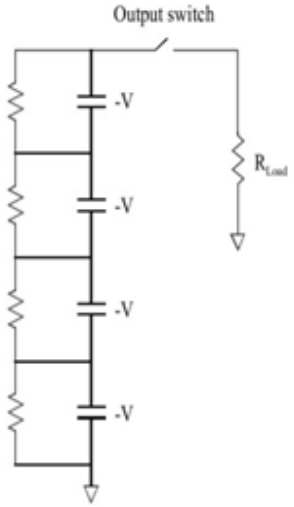
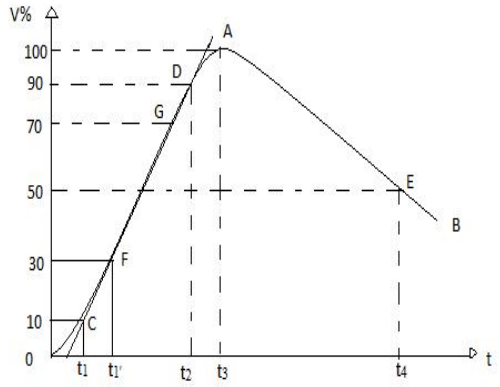


Figure 2. Marx generator discharging circuit.

III. STANDARD IMPULSE WAVE

As per IEC standards impulse voltage generators produces waves which can be impulse lightning and impulse switching, with 1.2-250μs standard front time and 50-2500μs for tail time.



Standard Lightning Voltage Impulse wave and its specifications

Front Time (T1): 1.2 μs ± 30%
Fall Time (T2): 50 μs ± 20%

Lightning overvoltage impulse wave can be characterised as double exponential waves given by the following equation –

$V=Vo[e(-\alpha t)- e(-\beta t)]$

This equation represents a unidirectional wave that quickly rises to peak value and slowly falls to zero value

IV. PROPOSED WORK

The supply is taken from AC supply mains and is stepped down to a desired voltage and then converted to DC supply at a desired level. This supply is given to voltage regulator to give a regulated supply to timer IC oscillator. Then an N-channel MOSFET is used which converts this signal of regulator back to power. The supply is then fed to the Flyback transformer. The output of Flyback will be in KV DC. Finally the supply from Flyback transformer is given to the RC network which is the MARX circuit. This MARX circuit boosts the voltage further which is equal to n*V. Where, 'n' is the number of stages of RC and 'V' is the supply voltage. A spark is produced at the end between two contacts. The spark produced between the end contacts is thus used for various applications such as insulation testing, etc.

V. CONCLUSION

Marx generators are effective systems for efficient voltage multiplication. This circuit gives higher dc output voltage from lower value of dc input voltage. With the increase in number of RC stages we get more higher voltage at output.

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