ISSN 2320-9984

Volume 4 Issue 2 | June 2016

ISSN: 2320-9984 (Online)

International Journal of Modern Engineering & Management Research

Website: www.ijmemr.org

Study of the Characteristics of Impulse Voltage Generator Evaluate the Effect of Variation by Simulation in Different Experimental Situations

Ashish Shrivas
Research Scholar
Department of Electrical Engineering
Jabalpur Engineering College
Jabalpur (M.P.), [INDIA]
Email: ashishshrivas83@gmail.com

Abstract—*According to national and international standards electrical equipment should be tested by a standard 1.2µs±30%/50µs±20% impulse voltage. The paper contains fixed ratio of (C_1 & C_2) generator capacitor and load capacitor. In this paper the resistance front controlled (R.F.C.) circuit and Inductance front controlled (I.F.C.) circuit is analyzed to obtain the standard wave shape. Impulse voltage waveforms obtain for load having considerable amount of inductance. It was found that there is a range of inductive load for which standard front time can be obtain by modified inductance front controlled circuit.*

Keywords:—*Analysis of Impulse, Voltage Generator, Effect of Variation***.**

1. INTRODUCTION

A unidirectional voltage which rises rapidly to a maximum value and falls slowly to zero without appreciable oscillations is known as Impulse voltage. In it the maximum value is called the peak value of the impulse and the impulse voltage is specified by this value. In this wave shape small oscillations are tolerated, provided that their amplitude is less than 5% of the peak value of the impulse voltage. In case of oscillations in the wave shape, a mean curve should be considered. If an impulse voltage develops without causing flash over or punctures, it is called a full impulse voltage. If flash over or puncture occurs thus causing a sudden collapse of the impulse voltage, it is called chopped impulse voltage.

A full impulse voltage is characterized by its peak value and its two time intervals, the wave front and wave tail time interval which are defined as:

1. Wave Front Time Interval

The wave front time of an impulse wave is the time taken by the wave to reach to its maximum value starting from zero value.

2. Wave Tail Time Interval

The nominal wave tail time is measured between the nominal starting point and the point on the wave tail where the voltage is 50% of the peak value.

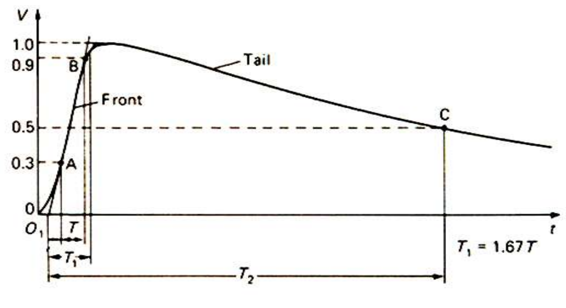

Figure 1: *Full impulse voltage wave form with T_1/T_2*

A standard wave shape is specified by (1.2µs±30%/50µs±20%). For most of the cases, there is no problem to meet this required wave shape with the actual test laboratory equipment.

Equivalent Circuit Diagrams of Multi Stage Impulse Voltage Generator

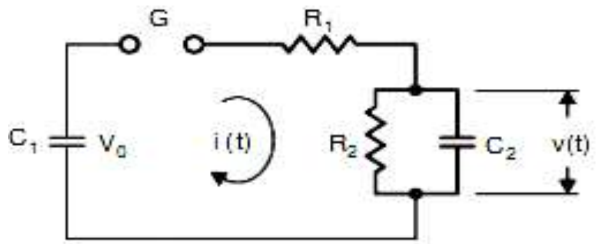

Figure. 2 Two simplified but more practical forms of impulse voltage generator circuits

The circuits are widely used and differ only in the position of the wave tail Control resistance R_2. When R_2 is on the load side of R_1, the two resistances form a potential divider which reduces the output voltage but when R_2 is on the generator side of R_1, this particular loss of output voltage is absent.

The impulse voltage generator capacitor C_1 is charged through a charging resistance (not shown) to a D.C. voltage V_0 and then discharged by flashing over the switching gap with a pulse of suitable value. The desired impulse voltage appears across the load capacitance C_2. The value of the circuit elements determines the shape of the output impulse voltage. The circuit parameters can be evaluated for achieving a particular wave shape of the impulse voltage by analysis of these circuits.

2. SIMULATION METHOD

Analysis of basic impulse voltage generator circuit for a Different Loading Conditions.

The Analysis of this research is to build a MATLAB Simulink Model of Marx impulse voltage generator which can generate the standard impulse wave with the different loading conditions.

Standard wave shape can be obtained easily by varying R_1 and R_2 for a capacitive load having ratio C_1/C_2 = 66.66µF. But for the same ratio of C_1/C_2 along with inductive load the standard wave cannot be obtained particularly front time.

CASE:1

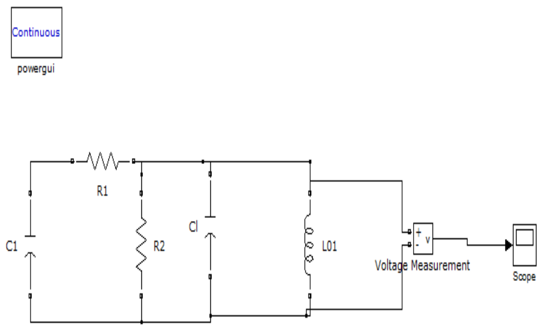

Figure 3: Simulation

Table 1: Resistance Front controlled Circuit

SL. No.	L_{01}	Resistance $R_1(\Omega)$	Resistance $R_2(\Omega)$	Front time T_1(µs)	Tail time T_2 (µs)	Maximum Output Voltage (KV)
1	4500	60	10,000	2.07	31	958
2	6500	60	10,000	2.07	40	963
3	8000	60	10,000	2.07	44	966
4	10100	60	10,000	2.07	51	958
5	13500	60	10,000	2.07	60	975

Analysis of Modified Impulse voltage generator (having inductance in parallel to R_1

The simulation analysis of modified circuit, with L_d. connected in parallel to R_1 is much more effective in getting standard front time in case of load having medium inductance

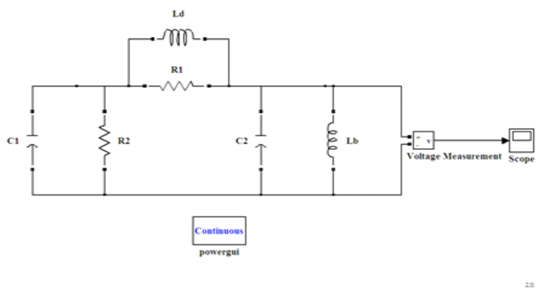

Figure 4: Simulation Circuit

The circuit of impulse voltage generator having loaded with medium inductance is analysed mathematically as well as by simulation. It is found that standard tail time can be obtained for the existing values of parameters, but for the same ratio C /C_2 =66.66µF tail time can be obtained and the front time cannot be obtain t_1= 2.07 µH if inductance L_d is connected in parallel with R_1,while other parameters are keeping constant.

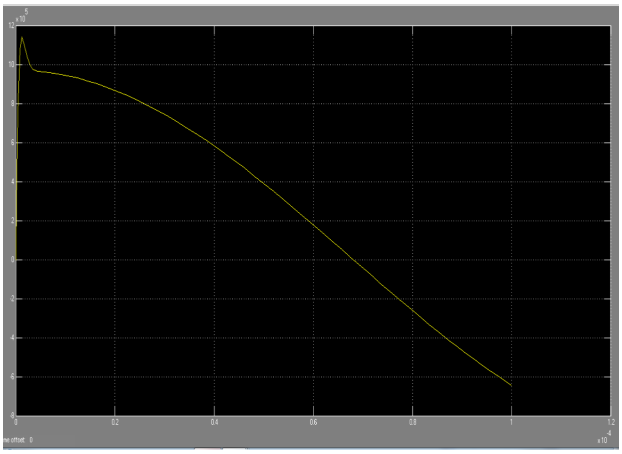

Figure 5: Modified Impulse voltage generator (having inductance in parallel to R1)

Measured values of front time and tail time (in presence of inductance) C_1/ c_2 = 66.66µH.

Table 2 : Analysis Results obtained from the models.

S.No.	L0(µh)	L2 (µh)	R1 (Ω)	R2(Ω)	T1(µs)	T2(µs)
1	4500	60	60	10,000	1.28	40.24
2	4600	60	60	10,000	1.28	40.68
3	5500	60	60	50,000	1.30	44.71
4	6500	60	60	10,000	1.27	48.26
5	8000	60	60	10,000	1.27	53.47
6	9500	60	60	10,000	1.26	58.18
7	10,000	60	60	10,000	1.26	59.67
8	10100	60	60	10,000	1.26	59.97
9	14000	60	60	10,000	1.29	70
10	14000	60	60	2000	1.29	65
11	14000	60	60	15,00	1.29	64
12	14000	60	60	1000	1.29	60

The tail time can also be obtained within limit by decreasing R2

3. CONCLUSION

The Simulation analysis of Resistance front controlled circuit (R.F.C.) show that the standard front time cannot be obtained for the load inductance from **6500µH to 13500µH**.The simulation analysis of Inductance front controlled (I.F.C.) circuit show that wave front time can be obtained for an inductive load ranging from **4500µH to 10100µH** In this circuit now the tail time can also be obtained within limit by varying R2 for an inductive load vary from **10500µH to 14,000 µH**

REFERENCES:

[1] Kuffel, E., Z aengl, W.S., Kuffel, J.: High voltage Engineering fundamentals. Newness Publications, second edition, 2000.

[2] Naidu, M.S., Kamaraju, V.: High voltage Engineering. Tata Mc Graw Hill publications, fourth edition, 2006.

[3] Swaffield, D.J., Lewin, P.L., Dao, N. L., Hallstrom, J. K.: Lightning impulse wave shapes: Defining the true origin and its impact on parameter evaluation. In: 15th International Symposium on High Voltage Engineering, Ljubjana, Slovenia, 27 - 31 Aug 2007.

[4] International Electro technical standards IEC60060- 1

[5] Neuber, A.A., Chen generator driven reflex triode system for high power microwave generation. In: IEEE transactions on plasma science, volume 39, No.5, May 2011.

[6] Marty Ahrens, "Lightning Fires and Lightning Strikes," National Fire Protection Association, Fire Analysis

and Research Division, pp. 1 (June 2013).

[7] R. B. Standler, "Protection of Electronic Circuits from Over voltages, John Wiley & Sons, 1989; pp. 87-91, 109-110, 387-388.

[8] P. Richman, “Single Output, Voltage and Current Surge Generation for Testing Electronic Systems,” IEEE 1983 Electromagnetic Compatibility Symposium, pp. 47-51, 1983.

[9] American National Standard C62.41-1980, IEEE Guide for Surge Voltages in Low- Voltage AC Power Circuits.

[10] J. Wiesinger, *Mess- und Proftechnik* 104 (1983) 1102-1105.

[11] M. S. Naidu and V. Kamaraju, “High Voltage Engineering second edition”, McGraw-Hill, New York, 1996.

[12] Zhang Renyu, Chen Changyu, Wang Changchang. “High-voltage Testing Technology”, Beijing, China: Tsinghua University Press, 2003.

[13] A. B. Kopcyntsef, “Simulation of impulse property of grounding device,” Elektpitestvo, no. 5, pp. 31–35, 1958. Russian.

[14] Zhang Jinyu, Guan Zhicheng, “High-voltage Test”, Beijin, China: China Electric Power Press, 1996.

[15] J. L. He, R. Zeng, Y. P. Tu, et al, “Laboratory investigation of impulse characteristics of transmission tower grounding devices,” IEEE Transaction on Power Delivery, vol.18, no.3, pp.994-1001, 2003.

[16] He Jinliang, Zeng Rong, “Grounding Technology in Power System ”, Beijin, China: Science Press, 2007 [20] F. P. Dawalibi, Wei Xiong, Jinxi Ma, “Transient performance of substation structures and associated grounding systems”, IEEE Transaction on Industry Applications, vol.31, no.3, pp.520-526, 1995