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Analysis of Inductance Front Controlled Generator and Effect of Variation In Parameters by Simulation

Ashish Shrivas
M.E. Research Scholar
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 1.2/50μs impulse voltage. The conventional Marx circuit is analysed mathematically as well as by simulation method. Effect of parameters R_1, R_2 and ratio C_1/C_2 on front time and tail time have been analysed by Simulink. It was found that there is a particular range of ratio C_1/C_2 for the parameters of impulse generator under consideration.*

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 puncture, 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.

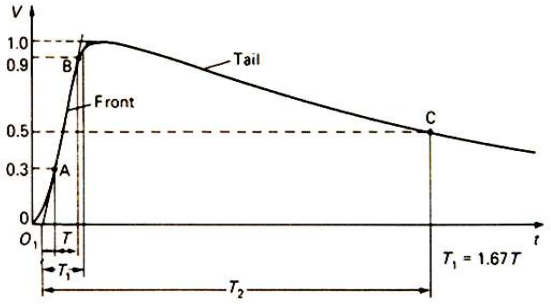

Figure 1. Full impulse voltage wave form with T_1/T_2

2. STANDARD WAVE SHAPE

A standard wave shape is specified by (1.2μs±30%/50μs±20%). 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 load having C_1/C_2 = 6 to 106. But for the same ratio of C_1/C_2 along with inductive load the standard wave cannot be obtained particularly front time. The simulation analysis of modified circuit, with Ld connected in parallel to R_1 is much more effective in getting standard front time in case of load having medium inductance.

CASE:1 Resistance Front controlled Circuit

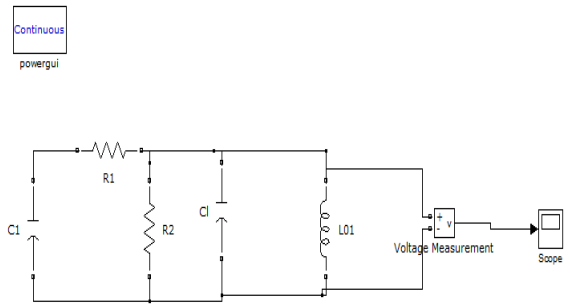

Figure 1: Simulation

Table 1: Resistance Front controlled Circuit

S.N.	L_0 (µH)	R_1 (Ω)	R_2(Ω)	T_1 (µs)	T_2 (µs)	V(t)
1	4500	60	10,000	2.07	31	958
2	4600	60	10,000	2.07	33	959
3	5500	60	50,000	2.07	38	961
4	13500	60	10,000	2.07	60	975
5	14000	60	10,000	2.07	62	976

Let Lo=6500µH, by keeping other parameter constant, corresponding wave tail time reaches to t2=40µs and output voltage also increases slightly

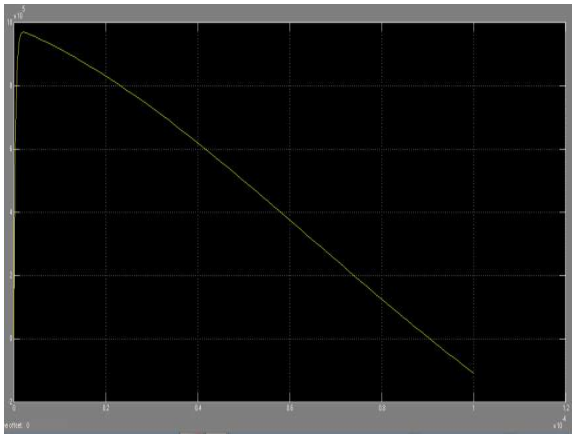

Figure 2: Modified Impulse Voltage Generator

Now when L_0=13500µH, by keeping other parameter constant, corresponding wave tail time increases to 60µs and output voltage also increase v(t)=975KV

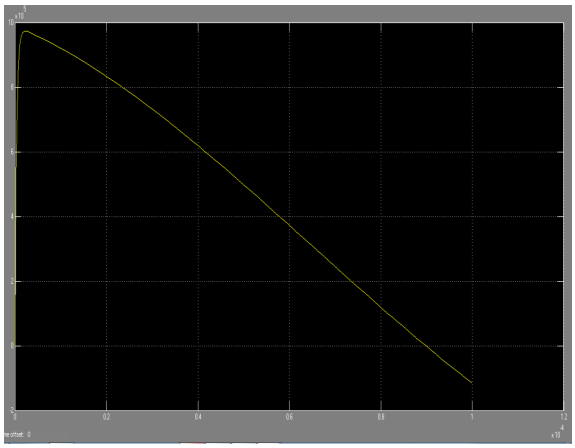

Figure 3: Modified Impulse voltage generator (L0=13500µH, by keeping other parameter constant)

CASE:2 Analysis of Modified Impulse voltage generator (having inductance in parallel to R1)

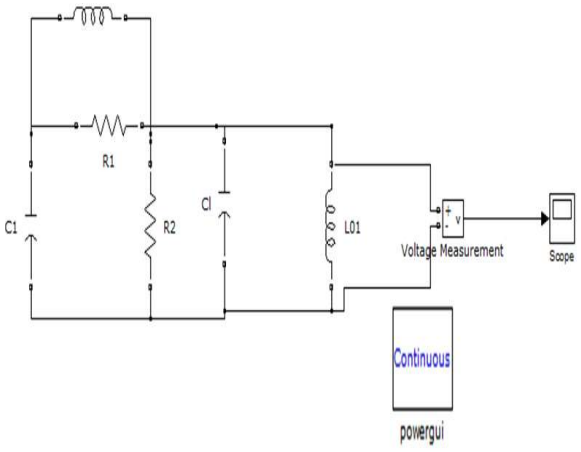

Figure 4: Simulation

Measured values of front time and tail time (in presence of inductance) $C_1 / C_2 = 66.66\mu F$

Table 2: Resistance Front Controlled Circuit Having Inductance in Parallel with R_1

S.N.	$L_0(\mu h)$	$L_1(\mu h)$	$R_1(\Omega)$	$R_1(\Omega)$	$T_1(\mu s)$	$T_2(\mu s)$
1	4500	60	60	10,000	1.28	40.24
2	4600	60	60	10,000	1.28	40.68
3	10100	60	60	10,000	1.26	59.97

Let L_o=6500µH, by keeping other parameter constant, corresponding wave tail time reaches to t_2=40µs and output voltage also increases slightly.

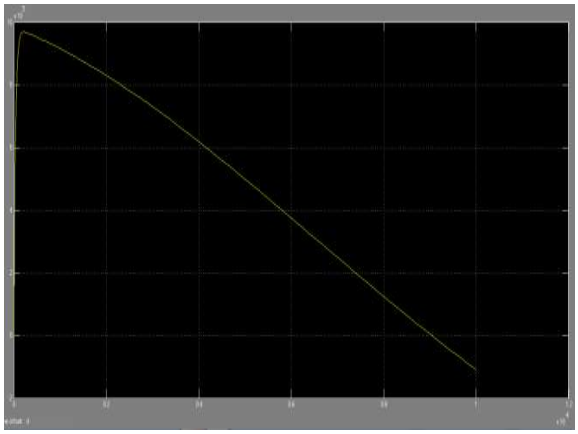

Figure 5: Modified Impulse Voltage Generator (having inductance in parallel to R1)

Now L_2 =60µh, L_2 =10100µh, R_1=60Ω R_2=10,000Ω, t_1=1.26µs, t_2=59.97µs

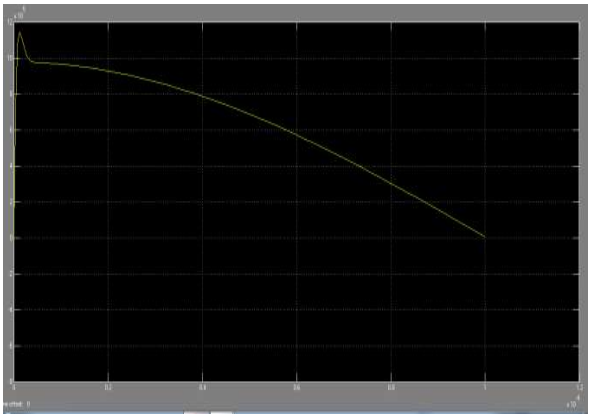

Figure 6: Modified Impulse voltage generator (having inductance in parallel to R_1

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 .

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