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FERRANTI EFFECT DEMONSTRATION AND CALCULATION OF ABCD PARAMETERS

Azhar Inamdar
Department of electrical Engineering, YSPM'YTC, Satara, INDIA

Snehal Gaikwad
Department of electrical Engineering, YSPM'YTC, Satara, INDIA

Pournima Shedge
Department of electrical Engineering, YSPM'YTC, Satara, INDIA

ABSTRACT

It is necessary to calculate the voltage, current and power at any point on a transmission line provided the values at one point are known. We are aware that in three phase circuit problems it is sufficient to compute results in one phase and subsequently predict results in the other two phases by exploiting the three phase symmetry. Although the lines are not spaced equilaterally and not transposed, the resulting asymmetry is slight and the phases are considered to be balanced. As such the transmission line calculations are also carried out on per phase basis. For that purpose in the transmission line demo panel we will be designed to –To study the performance of the line.

INTRODUCTION

Transmission line performance is governed by its four parameters series resistance, inductance, shunt capacitance and conductance .All these parameters are distributed over the length of the line .The insulation of the line is seldom perfect and leakage currents flow over surface of the insulators especially during bad weather. This leakage is simulated by shunt conductance. The shunt conductance is in parallel with the system capacitance .Generally the leakage currents are small and the shunt conductance is ignored in calculation. Transmission lines may be classified as short, medium and long. In general for high voltage transmission generally above 66KV overhead transmission line the performance of transmission line cannot be easily determined in an efficient way and less cost. even though if we do so then it will cause abnormal operation in our system and also current to go high value. In this paper we have approached a way to find performance of transmission line. We have divided the line into four different sections of a π-network each containing R,L and C. The values of R,L and C are taken as according to the standard approximate values for high voltage transmission. Hence, we have adopted the 220KV line into per phase basis and made a prototype model of it for single phase.

METHODOLOGY

A transmission line model has been prepared on per phase basis having length 400kms and voltage 220kv. Parameters will be considered as lumped. Four stages each representing 100kms are cascaded to make 400kms length. The demo panel consist of digital voltmeter, ammeter, indicating lamps, circuit breakers. The panel is protected by MCB's from abnormal conditions.

A. TRANSMISSION LINE MODEL

Transmission line of 400kms, 220kv is modelled with four models. Cascaded each representing 100kms having following parameters.R=4.7Ω,C=0.47µf,L=110mH [2]. With current capacity 1 Ampere.

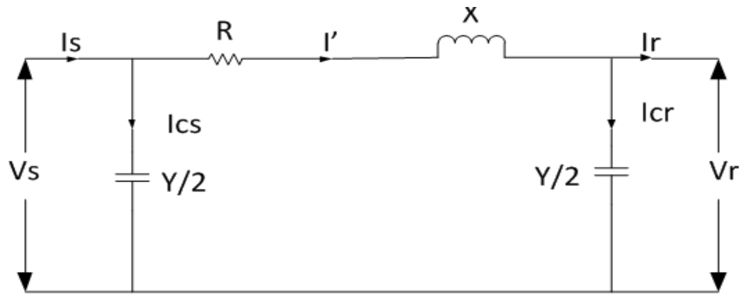

Fig.1:Medium transmission line

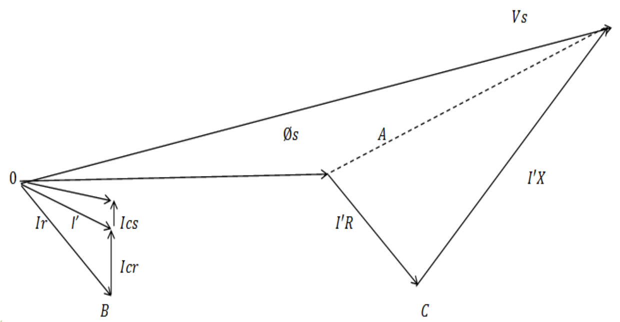

Fig.2:Phasor diagram for nominal π circuit

We have prepared a single phase prototype model to show performance of short, medium and long transmission line. We can select any type of transmission line for analysis just by adding or removing the sections. Each section consists of lumped parameters for 100KM line. The performance of a transmission line such as Ferranti effect and ABCD parameters will be different for different transmission lines.

Fig.3:Actual Photo Of Model

The performance of a transmission line is mainly depend upon its active and reactive parts of power being transmitted through it. This can done by knowing the ABCD parameters. A single phase prototype model can be taken as a two port network. To find the ABCD parameters of a transmission line chosen on our prototype model, we have made an arrangement of microprocessor kit and LCD display to directly indicate the value of short circuit and open circuit parameters which are nothing but ABCD parameters.

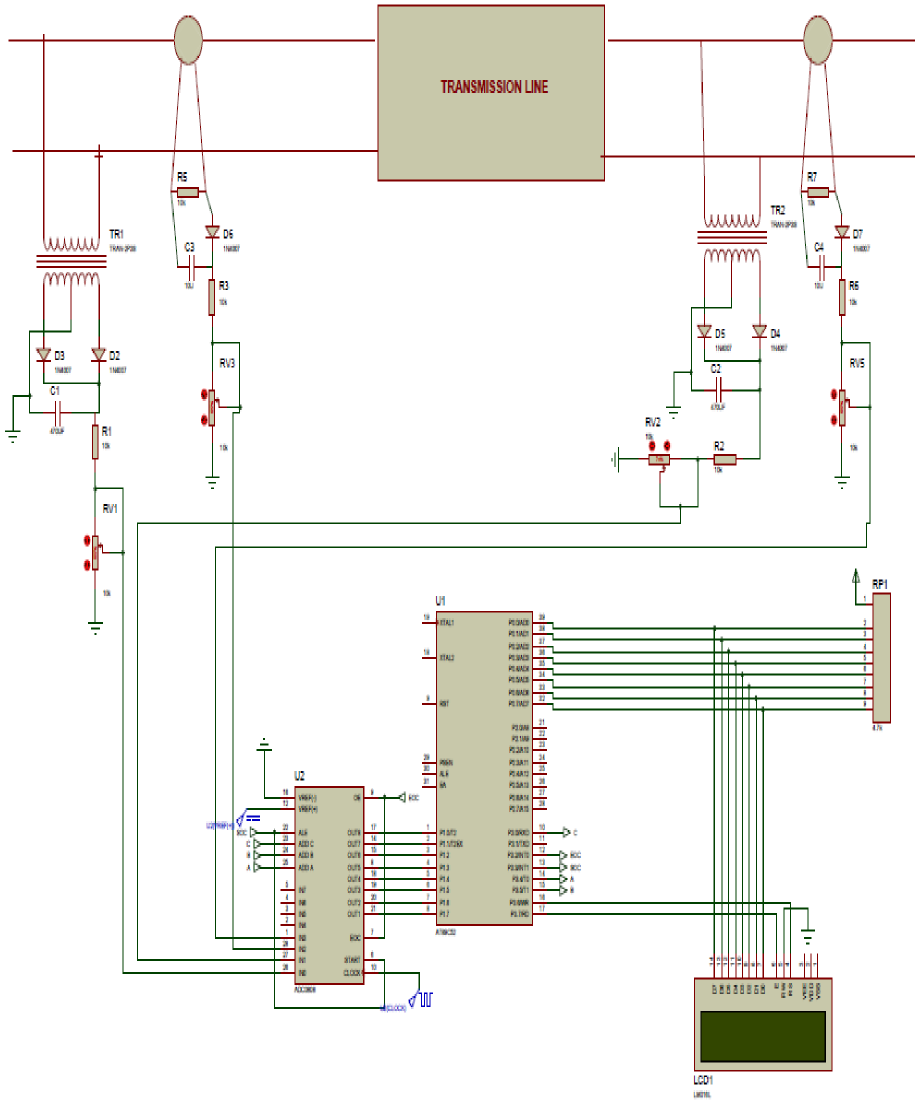

Fig.4:Microcontroller applied for ABCD parameters

PROPOSED SCHEME

The "Transmission Line Model" will be designed to demonstrate the fault clearing process on transmission lines using distance relay. The principle of this relay depends on the ratio of voltage to current changes and depends on the fault current and its power under fault condition. Distance relays are designed to operate according to impedance of the line up to the fault point (V/I). As the fault impedance is proportional to the distance of line, relay indicates he distance over which the fault has occurred.A transmission line model will be prepared on per phase basis having length 400kms and voltage 220kv. Parameters will be considered as lumped. Four stages each representing 100kms are cascaded to make 400kms length. Fault simulating switches will be provided to create fault condition. Impedance will be sensed by distance relay and given trip signal if fault impedance is within the operating range. The circuit breaker will isolate the transmission line from supply. The demo panel will consist of digital voltmeter, ammeter, indicating lamps, circuit breakers, timers. The panel will be protected by MCB's from abnormal conditions. The line resistance is usually small as compared to the line inductive reactance, Moreover the resistance drop MN is in Quadrature with OM and NP. Therefore the resistance can be neglecting in calculating the Ferranti effect.

OBSERVATIONS

By observing the readings on LCD display and calculating it we found the tabulations given as follows. We found that both values matched together approximately.

Line condition	Vs (volts)	Is (amp)	Vr (volts)	Ir (amp)
Open circuit	220	0.125	230	0
Short circuit	72	0.999	0	1.015

Type of line	Vs (volts)	Is (amp)	Vr (volts)	Ir (amp)
Medium Transmission Line	220	0.125	230	0
Long Transmission Line	200	0.249	230	0
With Connected Load	198	0.802	144	0.854
With load terminal shorted	72	0.999	0	1.015

CALCULATIONS

Consider the two sections for calculation of medium transmission line. Middle capacitance is lumped at both end and total resistance and inductance is given below
Theoretical Data (For Ferranti Effect)

$$R=8.4\Omega$$
$$L=220mH$$
$$C=1.88\mu f$$
$$XL=69.11\Omega$$
$$Z=R+jXL$$
$$=8.4+69.11j$$
$$=69.61<83.069°$$
$$Y=j2wc=j2\pi\ fc$$
$$= j2\pi\ 50\times1.88\times10^{-6}$$
$$=5.9061\times1090°$$
$$Vs=(1+\ )Vr+IrZ$$
$$=(1+)230+0$$
$$Vs=225.29<0.1457$$

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Vs=225.29 V

Is=Y(1+)Vr+(1+)Ir

=°(1+)230+0

Is= 0.13445 Amp

ABCD Parameters calculations (for medium transmission line)

Theoretically

A=1+=(1+)

A=0.9796

C=Y(1+)=°(1+)

C= 5.8458°=0.000584

B=Z=69.61<83.069°

D=A

Practically

A=220/230=0.9565

B=72/1.015=70.93

C=0.125/220=5.6818=0.000568

D=A

RESULTS

A.FOR FERRANTI EFFECT

Results	Vs	Is
Theoretically	225.292	0.13445
Practically	220	0.125

B. FOR ABCD PARAMETERS

Parameter	Theoretically	Practically
A	0.9796	0.9565
B	69.61	70.93
C	0.000584	0.000568
D	0.9796	0.9565

FUTURE SCOPE (FAULT SIMULATION)

Rotary switches SW1, SW2, and SW3 are used to simulate the phase to each fault at a distance 220kms, 300kms and 400kms from sending end. Fault will be sensed by distance protection. A timer will be started to count the time of fault persists for specific time. FAULT indication will be made on and trip signal will be initiated.

CONCLUSION

From our project "Ferranti effect demonstration" it is obvious to see the performance of short, medium and long transmission line. Also it has be seen that the Ferranti effect for medium transmission line during no-load or light load condition. In this case receiving end voltage is greater than sending voltage. In short transmission line the effect of shunt capacitance can be ignored and line is designated as short line. In medium and long transmission line the effect of shunt capacitance becomes more and more pronounced with increased in the length of line. In medium transmission line the shunt capacitance can be considered as lumped. By using "Transmission Line Performance" (nominal π circuit) we can easily find out the ABCD Parameters of medium transmission line. The effect of shunt capacitance in long transmission line is greater than medium transmission line.

REFERENCES

[1] S.Rao, "*Testing, Commissioning, Operation, Maintenance of Electrical Equipment" Khanna Technical Publication, New- Delhi (pp-276).*

[2] *www.lucas-nuelle.com(accessed-sept11,2014)*

[3] Pawar. S, Desai. O, Kalambe. M, Inamdar. A, Patil. K, Shete. S.(2015). *Experimental Determination And Analysis Of Transmission Line Performance. International Journal Of Innovations In Engineering Research And Technology [Ijiert], 2-7.*