NOVATEUR PUBLICATIONS
INTERNATIONAL JOURNAL OF INNOVATIONS IN ENGINEERING RESEARCH AND TECHNOLOGY [IJIERT]
ISSN: 2394-3696
VOLUME 3, ISSUE 12, Dec.-2016

GENERATION OF HIGH VOLTAGE DC BY USING SINGLE PHASE AC SUPPLY A CASE STUDY

GOPALA REDDY. K.
Associate professor, Department of Electrical and Electronics Engineering, Vidyavardhaka College of Engineering, Mysuru, India

RASHMI S.
Associate professor, Department of Electrical and Electronics Engineering, Vidyavardhaka College of Engineering, Mysuru, India

LOKESH C.
Assistant Professor, Department of Electrical and Electronics Engineering, Vidyavardhaka College of Engineering, Mysuru, India

ARCHANA K.
Assistant Professor, Department of Electrical and Electronics Engineering, Vidyavardhaka College of Engineering, Mysuru, India

RESHMA V. P.
Assistant Professor, Department of Electrical and Electronics Engineering, Vidyavardhaka College of Engineering, Mysuru, India. #Tel +9590123454
Email: gopi_vvce@yahoo.com

IJIERT

ABSTRACT
The main concept of the project here is to generate a high voltage DC from a single phase AC with the help of the capacitors and diodes connected in a ladder network. This concept is often used in electronic appliances like the CRTs, TV picture tube, and oscilloscope and also in industrial appliances.

It is also possible to generate up to 10KV DC from this single phase supply, but owing to safety concerns and reasons, this system limits the generating voltage to a 2KV output by limiting the capacitor and diode multiplication factor to about 8.

This project uses a number of silicon diodes and a set of electrolytic capacitors wherein each stage, 2 capacitors are connected in series to withstand the peak voltage. Thus, the output from an 8-stage voltage multiplier can generate up to 2KV. As a standard millimeter is not possible to measure the output, and therefore, we are using a potential divider of 10:1 for measuring the output such that a 230V low voltage AC reading will get the 2KV high voltage DC.

The project can be implemented by generating a high voltage DC up to the range of 30-50 KV by increasing the number of stages. It can then be used for the required industrial and medical applications.

The project needs to be handled with utmost safety, care and precautions as touching any of the high voltage area even a millimeter could be fatal and may result in accidents.

KEYWORDS: Electrolytic capacitor, 8 stage voltage multiplier, Step up transformer

MOTIVATION
In the current scenario, there exists a huge demand for the production of high voltage, but unfortunately the conventional techniques are not meeting the present demand. Transformers

are being used for the production of high voltage AC which has to be rectified to DC. This method is both costly and bulky.
Our project could be efficient both the ways. Here we are generating high voltage DC using simple capacitors and diodes. With the increase in cascading very high voltages can be obtained.

OBJECTIVES

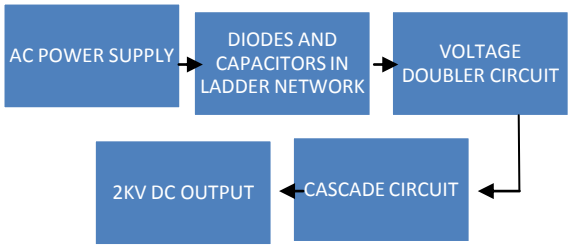
The objectives of this project are

- To produce HVDC upto 2KV using diodes and capacitors.
- To reduce cost and space.
- To eliminate heavy equipments.

PROJECT GOALS

The goal of this project is to generate high voltage DC upto 2Kv using diodes and capacitors. Although it is usual in Electronic Circuits to use a voltage transformer to increase a voltage, sometimes a suitable step-up transformer or a specially insulated transformer required for high voltage applications may not always be available. One alternative approach is to use a diode voltage multiplier circuit which increases or "steps-up" the voltage without the use of a transformer.

BLOCK DIAGRAM



BLOCKDIAGRAM DESCRIPTION

- HARDWARE COMPONENTS: Diode, Capacitors and voltmeter.
- The voltage is getting doubled in the doubler circuit, wherein the doubling is done in 5 staged cascaded circuit.
- Thus 2KV DC output is generated.
- This high voltage is measured by connecting two digital voltmeters in series.

WORKING

- During the negative half cycle of 230V AC, Diode D1 is forward biased and C1 is charged through it.D2 is blocked.
- During positive half cycle D2 conducts, C1 discharges through it and C2 charges. Voltage appears across C2.
- After few cycles voltage across C2 is doubled.
- By adding 5 stages 2KV voltage is obtained.

ADVANTAGES

- Low cost, utilizes less space and is portable.
- High voltage is generated.
- Upto 50kV can also be produced by increasing the number of stages.
- Minimum number of components are required.
- Components are easily available.
- Heavy equipments are not needed.
- Rectifiers are eliminated for AC to DC converters.

APPLICATIONS

- To check breakdown strength of transformer oil.
- Used for metal cuttings.
- Used in bio-medical field.
- Used in industries.
- Used in electrolysis process.
- Used in electronic megger.
- Used in laser guns.
- Used in LCD.
- Used in cameras.
- Used in lighters.
- Used in electric fencing.
- Testing sparkplug.

FUTURE ENHANCEMENT

This project can be enhanced by increasing the number of stages and very high voltages can be produced. The usage of transformers can be replaced by this circuit. This can be implemented very cheaply with easily available components like diodes and capacitors. The circuit is also very simple and small that the disadvantages of bulky transformers can be eliminated and the voltage can be obtained very effectively and efficiently.

CONCLUSION

The constructed generator is a 5-stage voltage multiplier. The input is provided by a 0-280 V variac. The maximum output voltage is 2kV. The output voltage of the generator has a slow rise and fall times. On applying an input, theoutput voltage steadily increases and in general takes about one minute to reach its final value. Also, it takes several hours for the output voltage to fall to zero after the input is switched off, consequently the capacitors have to be discharged each time after using the generator. It can also be used in particle acceleration and gaseous discharge experiments.

REFERENCES

1) Abdel-Salam, M. (2000). *High Voltage Generation, in High Voltage Engineering: Theory and Practice Edited*

2) Davor, V.; Tomislay, S. and Tomisly, M. (2009). *Modification of the Cockroft-Walton Charge Pump by Using Switched Capacitors Techniques for Improved Performance Under Capacitve Loads, WSEAS Transactions on Circuits and Systems, vol. 8 no. 1, p.167.*

IJIERT

3) Fitzsimmons, W. A.; Anderson, L. W.; Riedhauser, C. E. and Vrtilek, J. M. (1976). *Experimental and Theoretical Investigation of the Nitrogen Laser, IEEE Journal of Quantum Electronics, vol. QE12, p.624.*

4) Gilgenback, R.M. (1988). *Low Voltage Models of Particle Accelerator Circuits, American Journal of Physics Vol. 56, No.9, p.822.*

5) Haibo, Z.; Akio, T. and Katsumi, U. (1994). *A Numerical Analysis Approach to Cockroft-Walton in Electron Microscope, Journal of Electron Microscopy, 43(1), p. 25.*

6) Hilbom, R.C. (1976). *An Inexpensive Reliable Higher-Power Molecular Nitrogen Laser, American Journal of Physics, Vol. 44, No. 12, p.1172.*

7) Horowitz, P. and Hill, W. (1982). *The Art of Electronics, Cambridge University Press Cambridge, p.39.*

8) Jones, M.H. (1985). *A Practical Introduction to Electronic Circuits. Cambridge University Press, Cambridge, page 109.*

9) Kazuhiro, T., Satoru, T., Tatsuo, N., Takashi, E., Tateiki, O. and Michio, S. (2006). *Design and Operation Verification of Integrated Battery Assembly Charger Using Cockroft- Walton Circuit, Journal of Asian Electric Vehicles, Vol. 2, No. 2, p.953.*

10) Kuffel, E., Zaengl, W. S. and Kuffel, J. (2000*). High Voltage Engineering, Butterworth-Heinemann, Oxford. Chapt. two*

11) D. Karaboga and B. Basturk, "*Artificial Bee Colony (ABC) Optimization Algorithm for Solving Constrained Optimization Problems". Berlin, Germany: Springer-Verlag, 2007, vol. LNAI 4529, pp. 789–798.*

12) C. Wang, M. H. Nehrir, "*Analytical Approaches for Optimal Placement of DG Sources in Power Systems", IEEE Trans. On Power Syst., Vol. 19, No. 4, November 2004; pp. 2068–2076.*

13) H. L. Willis, "*Analytical Methods and Rules of Thumb for Modelling DG-Distribution Interaction", IEEE PES Summer Meeting, vol. 3, Seattle, WA, July 2000, pp. 1643–1644.*

14) K. Mistry; R. Roy, "*CRPSO based optimal placement of multidistributed generation in radial distribution system", Power and Energy (PECon), 2012 IEEE International Conference on , vol., no., pp.852,857, 2-5 Dec. 2012.*

IJIERT

BIBLIOGRAPHY

GOPALA REDDY K

K. Gopala Reddy obtained his B.E and M.E degree from university of Mysore and MCA in IGNOU. He joined Vidyavardhaka college of Engg in the year 2007 as Lecturer, promoted as Senior grade lecturer in the year 2009, Asst. professor in the year 2011 and now he is working as Associate professor in Electrical & Electronics Engg Dept. till date. He has 20 years of experience in the field of teaching. He is a life member of ISTE and Institute of Engineers.He has published 10 papers in international conferences and 6 papers in international journals .He is doing his research work under the guidance of Dr. Ananthapadmanabha, Principal, NIEIT, Mysuru. His research title is "Optimal placement of DG in distribution system based on hybrid ABC-CSO to increase power quality".

IJIERT