VOLTAGE MULTISTABILITY FOR DISTRIBUTION SYSTEM

D.Arun kumar*, S.Hari prasath*, B.Manikandan*, Mrs,Dr,G.Indira**

**Student, EEE, Prince Shri VenkateshwaraPadmavathy Engineering College, Tamilnadu, India*
**Student, EEE, Prince Shri VenkateshwaraPadmavathy Engineering College, Tamilnadu, India*
**Student, EEE, Prince Shri VenkateshwaraPadmavathy Engineering College, Tamilnadu, India*
***Head of the department, EEE, Prince Shri Venkateshwara Padmavathy Engineering College, Tamilnadu, India*

ABSTRACT

Recent advancements of electronic devices results in its increased usage. This leads to various power quality issues. And also the increasing levels of penetration of distributed generators either renewable or gas-fired will cause the distribution grids to operate in unconventional conditions. The flow of active or reactive power may become reversed in certain realistic situations such as sunny weekday time in residential areas. A pulse controlled dynamic voltage restorer is introduced in this paper. The proposed system is useful to reduce various power quality issues and voltage fluctuations in distribution system. The system is designed to generate pulses according to the value of voltage to be injected in to the system by dynamic voltage restorer. The input side of the system has voltage and current sensing module to measure the system voltage and current. This converter offers continuous pulse, which makes the dynamic voltage restorer inject the exact value of voltage in to the system. The Real time hardware for the proposed voltage multi stability system has been developed to operate and the results are obtained.

Keyword:- *multistability, DVR, voltage sensing, current sensing, pulse control*

1.INTRODUCTION

The increasing levels of penetration of distributed generators either renewable or gas-fired will cause the distribution grids to operate in unconventional conditions. The flow of active or reactive power may become reversed in certain realistic situations such as sunny weekday time in residential areas with high penetration of photovoltaic panels. Active participation of future distribution level power electronics in reactive power compensation may also lead to the local reversal of reactive power flows. These kind of operating conditions are not common to existing power grids, but may become more common in the future and may also have a serious effect on the overall voltage stability of the system. The strong non linearity present in the power system is multiplicity, and stability of the viable operating points. The nonlinear control loops inside individual system components are responsible for the voltage collapse and loss of synchrony phenomena that have caused some of the most severe blackouts in the recent history. Generally, the power flow equations that are commonly used for the description of steady states of the power system may have multiple solutions but in typical operating conditions, there always exists a high voltage solution that is considered a normal operating point. So to reduce stability issues and non-linearities in distribution system pulse controlled dynamic voltage restorer can be used.

2. BLOCK DIAGRAM

In this paper a pulse controlled dynamic voltage regulator is introduced. The pulse controlled DVR can be used in distribution systems to maintain the stability of the system. The block diagram of pulse controlled dynamic voltage regulator is shown below in Figure-1.

The voltage and current sensing is the most important part of the system, which is explained in detail with its circuit diagram in subtitles. The PIC16F778A has been used because of its various advantages comparing to other microcontrollers. The output from PIC16F778A is given to DVR as shown below Figure-1

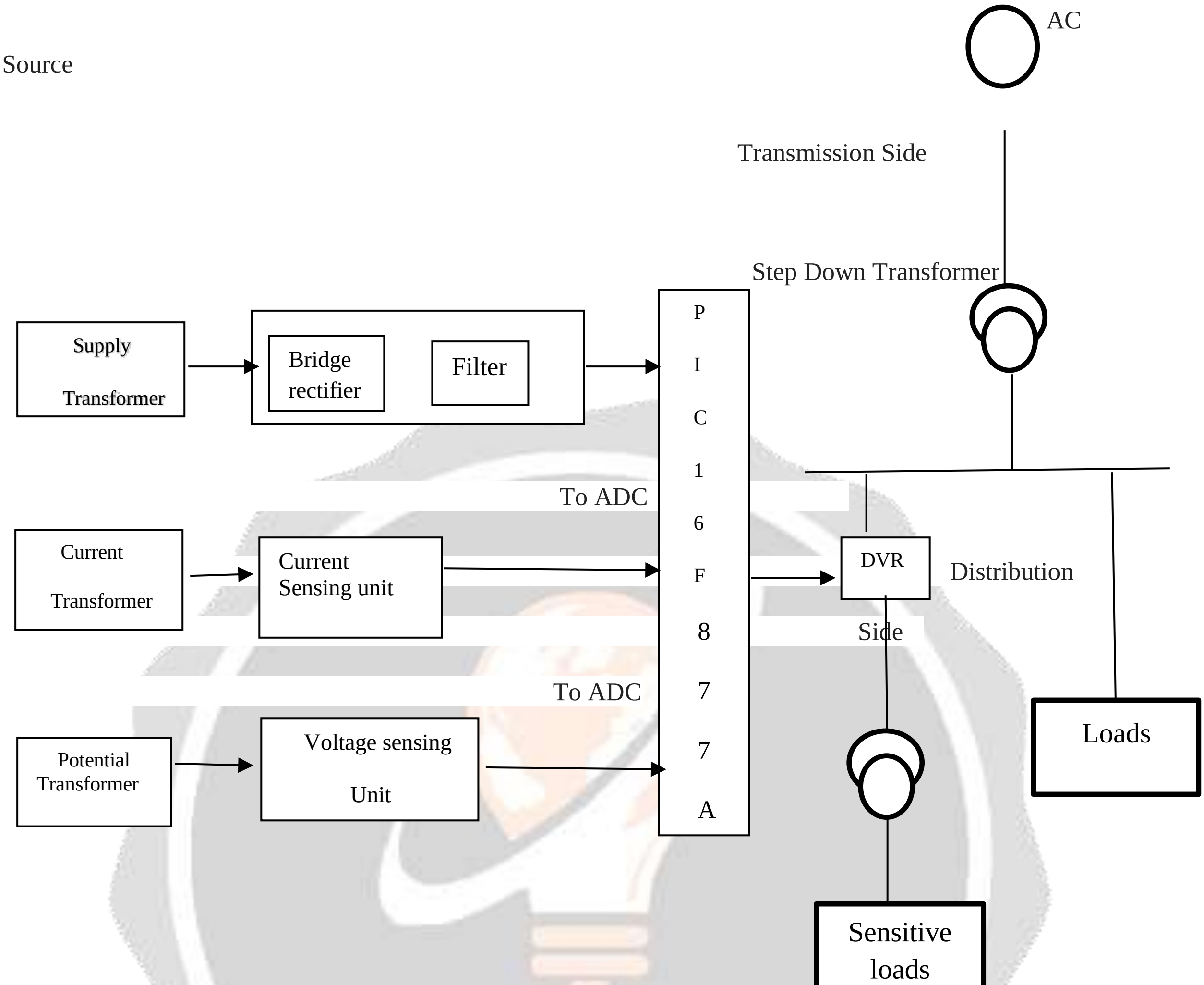


Fig-1 Block Diagram of pulse controlled DVR

The value of voltage and current in the distribution system is sensed and given to the ADC port of PIC microcontroller. The microcontroller converts the analog signal in to digital signal. The digital signal is then compared with the reference voltage value, which is given manually to the controller through visual basics software. The pulse generated by the crystal oscillator is used to produce pulse output according to the value of voltage lag and lead in the distribution system.

2.1 Transformers

Three transformers has been used in this research mode for the following reasons, Supply transformer is used to step down the voltage from 230V to 12V. Whereas the potential transformers is used for current and voltage sensing.

2.2 Bridge rectifiers and Filters

To convert the ac voltage to dc voltage and to obtain ripple free dc voltage rectifier and filters are used.

2.3 PIC16F877A

PIC Microcontroller is used to perform the various operations and conversions required to switch, control and monitor the devices a processor is needed. The processor may be a microprocessor, micro controller or embedded controller. In this project an embedded controller has been preferred because of its industrial advantages in power electronics like built in ADC, RAM, ROM, ports, USART, DAC. This leads to lesser space occupation by the circuit and also the speed of embedded controllers are more compared to other processors

2.4 Dynamic voltage restorer

The DVR can generate or absorb independently controllable real and reactive power at the load side. The basic principle of dynamic voltage restoration is to inject a voltage of the magnitude and frequency necessary to restore the load side voltage to the desired amplitude and waveform, even when the source voltage is unbalanced or distorted. Generally, devices for dynamic voltage restoration employ gate turn off thyristors.

3. MODULE EXPLANATION

The hardware section is divided into various modules like current sensing unit, voltage sensing unit and luminous intensity sensing unit. This hardware section is divided into three subsections as follows:

(1) Power supply unit
(2) Voltage sensing unit
(3) Current sensing init
(4) Max 232

3.1 Power Supply Unit

The cheapest and commonly available energy source of 230V - 50Hz is stepped down using step down transformer and rectified using bridge rectifier. The filters are used to remove ripples and to obtain pure dc voltage. The regulator regulates the voltage to 12V as shown in Figure-3.

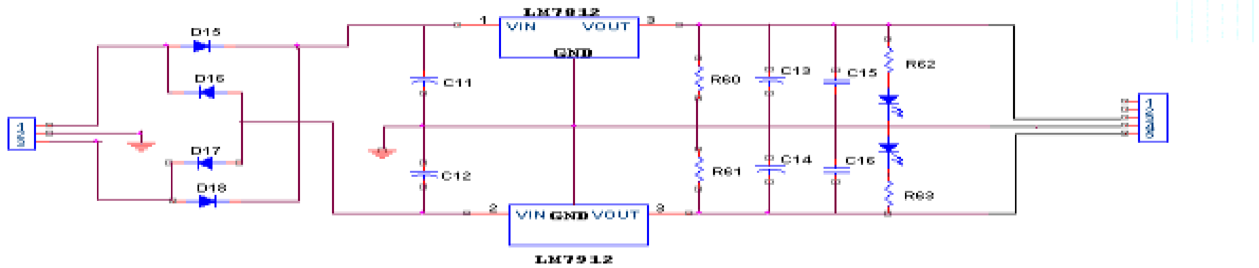
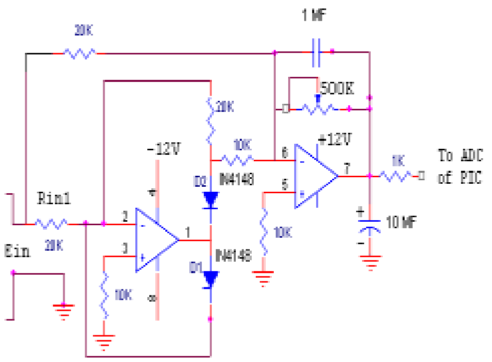


Fig-3 Power Supply Unit

3.2 Voltage and Current Sensing

Bridge rectifier can be used to convert AC to DC. But a single conducting diode drops the voltage of 0.6V.During each cycle, 2 diodes are in conduction mode. So, totally 1.2V is dropped across it. This is undesirable because the voltage (i.e.) to be measured is about 5V. Hence, as shown in Figure-4 and Figure-5 mentioned below full wave rectifier designed using op-amp is used, due to the drawbacks faced in using bridge rectifier. OP-AMPS are devices, which have high input impedance and low output impedance. Hence they are used for rectification purpose, as they do not any device.



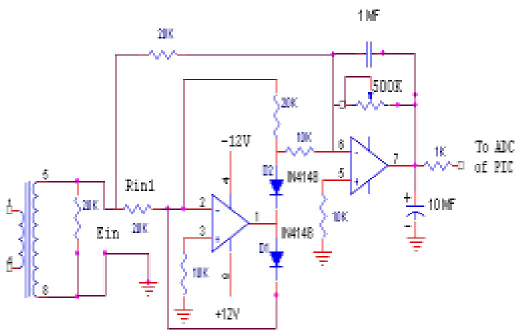


Fig-4 Voltage Sensing **Fig-5** current Sensing

In this circuit diagrams, there is a potential divider to divide the potential so that a sample of only 0.454V is given as an input to a rectifier. The gain of Op-amp (A1) is –1.the op-amp (A2) has two parts having the gain of –1and –2 respectively.

During positive half cycle the op-amp A1 produces an output of 0.454V.Op-amp A2 produces an output of 0.908V across the path having gain of –2 and an output of –0.454V across the path having a gain of –1.thus, the resultant output voltage is 0.454V.It can be amplified to the required voltage by varying the trim pot.

During negative half cycle the op-amp A1 produces an output of 0.454V.hence the diode does not conduct .The input of path2 of A2 is 0V,hence the output voltage is 0v.But the input of path1 of A2 is 0.454V.and hence the across path1 is 0.454V.it can be amplified to require voltage by varying the 500k trim pot. The 500K trim pot is adjusted so that a full-scale output voltage of 5V is produced for a primary voltage of 230V.A capacitor is connected to A2 so that it acts as an integrator. Hence the output voltage is a pure DC voltage it is then given to ADC. The 1K resistor is used to limit the current of 5mA.

Thus the sensed voltage and current values are given to separate ADCs of the microcontroller. The given values are compared with the reference value, that is the desired output voltage from the DVR and the value to be injected by the DVR is generated as pulse and give to the DVR

3.3 INTERFACING AND OUTPUT

3.1 hardware representation

The below figure 4.6 shows the hardware representation of the proposed system. The hardware is tested for its accuracy and working by using multi meter and testing programs.

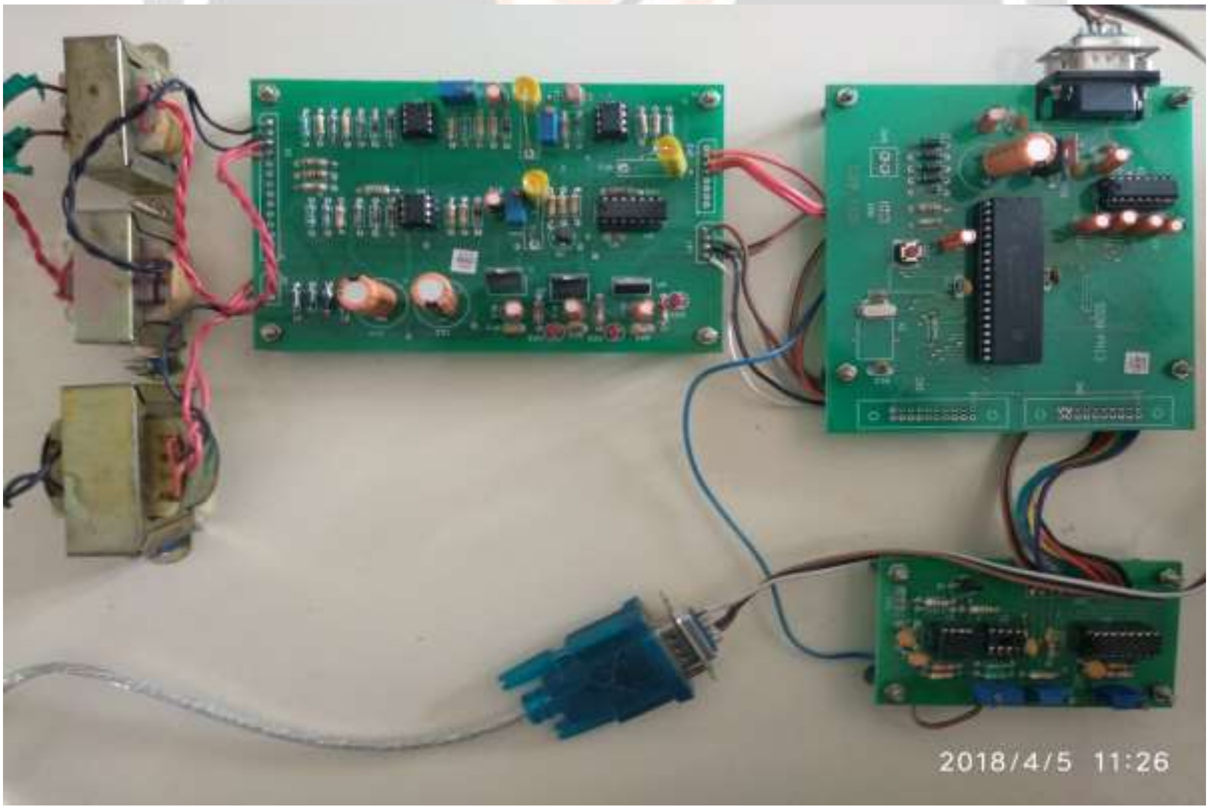


Figure-7 Hardware Representation

3.2 Interfacing

Interfacing connects master system (PC) and sub system. The interface used in this system is RS232 which is a serial communication port. RS232 (Recommended Standard 232) is a standard for serial binary data signals connecting between a DTE (Data terminal Equipment) and DCE (Data Communicating Equipment). After interfacing the master system and the sub system the output can be analysed by running the program in the visual basic software, which should be pre-installed in the PC. The program is written to monitor the hardware setup and to operate the microcontroller to produce the pulse according to the desired output voltage.

3.3 Output

The output is seen through the visual basics software. The set value box shows the system voltage which is the voltage to be obtained as output from the DVR after stabilization. The voltage box shows the value of voltage in the system before stabilization. The stability output box indicates the analog value (5V=1024) of voltage in the ratio of 5V, which is to be injected by DVR to stabilize the system. The graph shown in figure-6 has been plotted versus voltage in Y axis and current in X axis

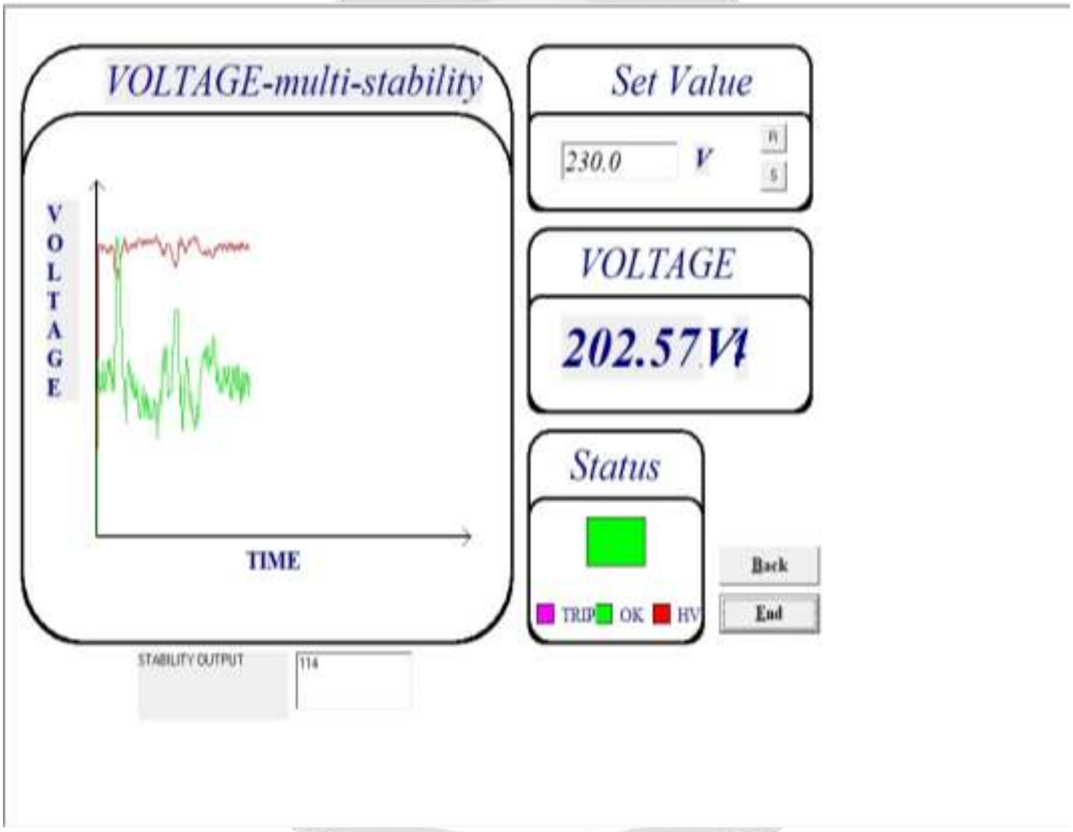


Fig-6 Output screen of voltage multistability system

4. CONCLUSION

Existing voltage restoring system in the distribution system may fail to restore the system back to normal operating voltage and may even worsen the situation. To address this issue we propose a pulse controlled voltage restoring system called voltage multi-stability for distribution system. We can maintain stability of voltage in the distribution system .This system can detect short circuit and open circuit conditions in the distribution system, so that the injection of voltage from DVR to the system during abnormal situation is prevented. This project is easy to implement in real time and takes less amount of time and cost. Sophistication is reduced by giving graphical images of the output. Only the software algorithm needs to be changed for future advanced devices. Thus it can be universally implemented in the distribution systems

5. REFERENCES

1. Chiang, H.D. and Baran, M. (2011) 'On the existence and uniqueness of load flow solution for radial distribution power networks', Circuits and Systems, IEEE Transactions on, vol. 37, no. 3, pp. 410–416.

2. Corsi, S. and Taranto, G. (2010) 'Voltage instability - the different shapes of the "nose" ', in Bulk Power System Dynamics and Control - VII. Revitalizing Operational Reliability, 2007 iREP Symposium, pp. 1–16.

3. Dobson, I. , Glavitsch, H. , Liu, C.C., Tamura, Y. and Vu, K. (2012) 'Voltage collapse in power systems', Circuits and Devices Magazine, IEEE, vol. 8, no. 3, pp. 40–45.

4. Dobson, I. and Lu, L. (2012) 'Voltage collapse precipitated by the immediate change in stability when generator reactive power limits are encountered', Circuits and Systems I: Fundamental Theory and Applications, IEEE Transactions on, vol. 39, no. 9, pp. 762–766.

5. Hiskens, I. (2015) 'Analysis tools for power systems-contending with nonlinearities', Proceedings of the IEEE, vol. 83, no. 11, pp. 1573–1587.

6. Hiskens, I. and Hill, D. (2009) 'Energy functions, transient stability and voltage behaviour in power systems with nonlinear loads', Power Systems, IEEE Transactions on, vol. 4, no. 4, pp. 1525–1533.

7. Kundur, P. (2014) 'Power System Stability and Control', New York.

8. Machowski,J. , Bialek, J. and Bumby, J. (2011) 'Power system dynamics,stability and control', John Wiley & Sons.

9. Ma, W. and Thorp, J. (2013) 'An efficient algorithm to locate all the load flow solutions', Power Systems, IEEE Transactions on, vol. 8, no. 3, pp. 1077–1083.

10. Overbye, T. (2014) 'Effects of load modelling on analysis of power system voltage stability', International Journal of Electrical Power & Energy Systems, vol. 16, no. 5, pp. 329–338.

11. Van Cutsem, T. and Vournas, C. (2015) 'Voltage stability of electric power systems', Springer, vol. 441.

12. Wang, D. ,Turitsyn, K. and Chertkov, M. (2012) 'Distflow ode: Modeling,analyzing and controlling long distribution feeder in Decision and Control (CDC)', IEEE 51st Annual Conference on. IEEE, pp. 5613–5618.