Boost Rectifier Using SPWM Topology

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Abstract–AC-DC converters are commonly used for providing dc link voltage, adjustable speed drives, UPS application.PWM AC-DC voltage source converter is preferred because of its ability to deliver nearly sinusoidal current at unity power factor. The main objective by controlling of PWM AC-DC converters is to achvied unity power factor and minimum harmonic distortion in input line current. A single phase AC-DC converter is fabricated which will provided desired boosted up DC Voltage with minimum ripple, unity power factor at supply. Here SPWM technique is to used.

IndexTerms – Pulse Width Modulation, Boost rectifier, PWM Rectifier, THD, unity power factor

I. INTRODUCTION

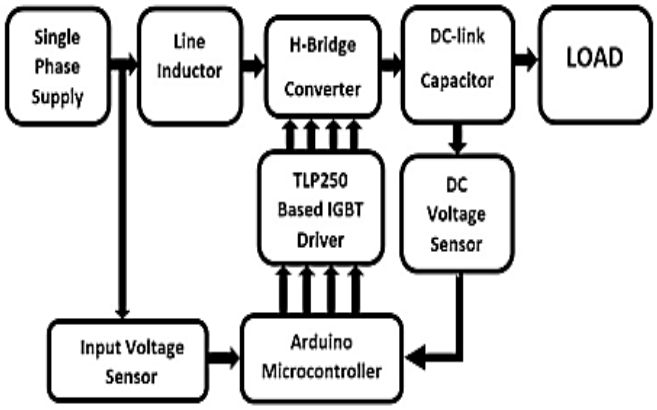
Many industrial applications make use of controllable DC power, such applications are steel rolling mills, paper mills, traction systems, high voltage DC transmission. Earlier diode bridge rectifiers are used to produce constant DC output voltage and thyristor rectifier are used to produce variable dc output voltage. The main disadvantages of these line commutated converter is the generation of harmonics in input current and reactive power. Harmonics have a negative effect on operation of electrical system and therefore we have to pay attention to their generation and control.

Single phase AC-DC converters are widely used in electrical and electronics appliances such as computers, televisions, battery chargers, UPS etc. Conventionally AC-DC conversion has been dominated by diode bridge rectifier or phase controlled rectifier, but due to non-linear loads, non-sinusoidal input currents is drawn and which injects harmonics in supply lines and resulting in poor power factor at supply side, high THD in current and low efficiency of the system. Presence of harmonics in system causes several problems such as poor power factor, power losses, increased voltage distortion, overheating, noise etc.

The Main Advantages of Single Phase PWM Rectifier:-

1) Bidirectional power flow
2) Sinusoidal input current
3) Adjustable power factor
4) Adjustment of dc-link voltage

II. BLOCK DIAGRAM AND POWER CIRCUIT



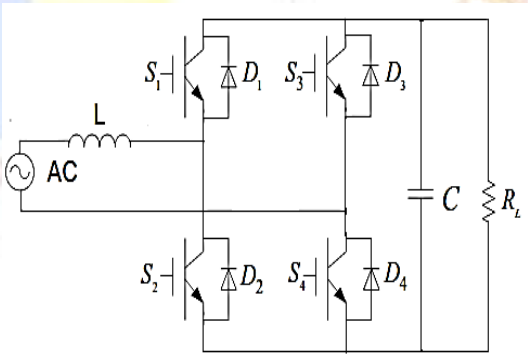


Fig 1-Block Diagram of PWM RectifierFig 2-Single Phase PWM boost Rectifier

The complete block diagram of PWM Rectifier in Shown in Fig-1 and Power Circuit For Single Phase boost Rectifier in shown in Fig-2.In this circuit diagram ofFigure-2 when Vac have positive half, the switch S1 and S4 is ON and current passes through Inductor (L) which stores the energy. When the S1 and S4 is off and S2, S3 is on then this inductor adds voltage to the source by –L di/dt and voltage across capacitor get boosted.

III. PRINCIPLE OF SINUSOIDAL PULSE WIDTH MODULATION

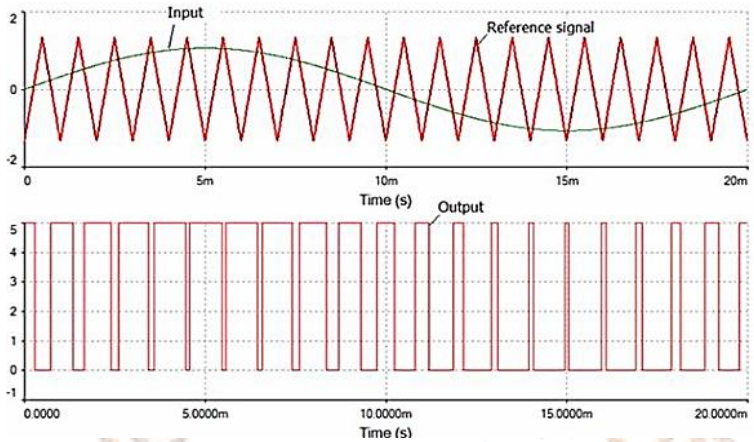


Fig 3-Principle of Sinusoidal Pulse width Modulated Rectifier

From the available PWM techniques, sinusoidal pulse width modulation method is selected for switching of IGBTs.In this method, reference is compared with carrier signal. Input Sine signal of voltage is selected as reference signal and triangular signal is selected as carrier signal. Input Sine signal of voltage is selected as reference signal and triangular signal is selected as carrier signal. Comparison of sin-triangular signal and generated pulses are shown in Fig-3 respectively.

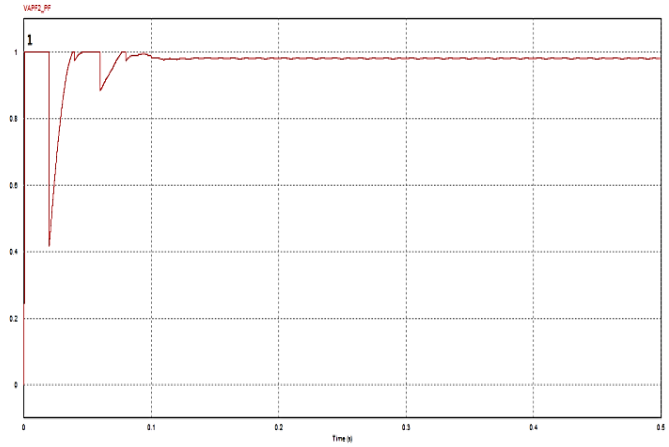
APPLICATION OF SINGLE PHASE PWM RECTIFIER

- Adjustable Speed Drives (ASD)
- UPS application
- HVDC transmission
- Battery chargers
- Steel rolling mills, paper mills etc.

IV.SIMULATION RESULTS OF SINGLE PHASE BOOST RECTIFIER

Rating of rectifier:-

1) **AC Voltage E:-24V, 50HZ**
2) **Load:-500ohm Restive**
3) **The Capacitor on DC side:-470uF**
4) **Input line Inductance:-5mH**
5) **Modulation Index:-0.8**
6) **Output DC Voltage:-36V**



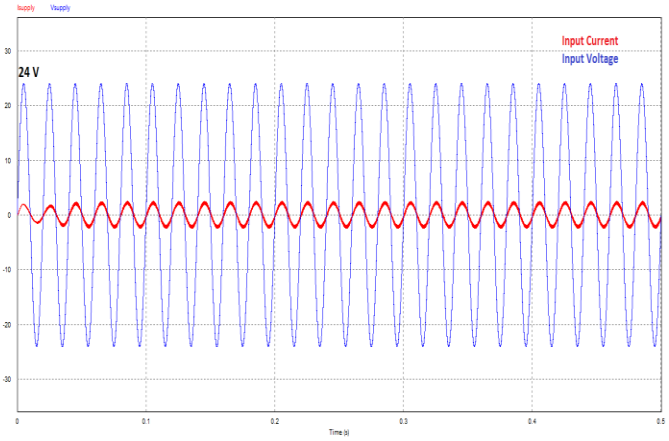


Fig 1:-Power Factor Fig 2:-Input Voltage & Input Current

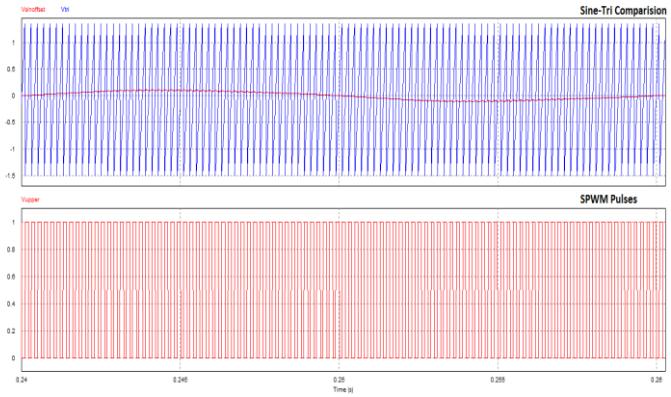


Fig 3:-PWM Generation

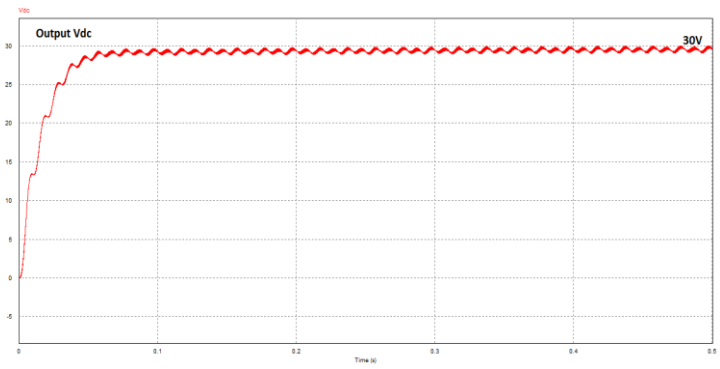


Fig 4:-Output Vdc

V. Hardware Results:-

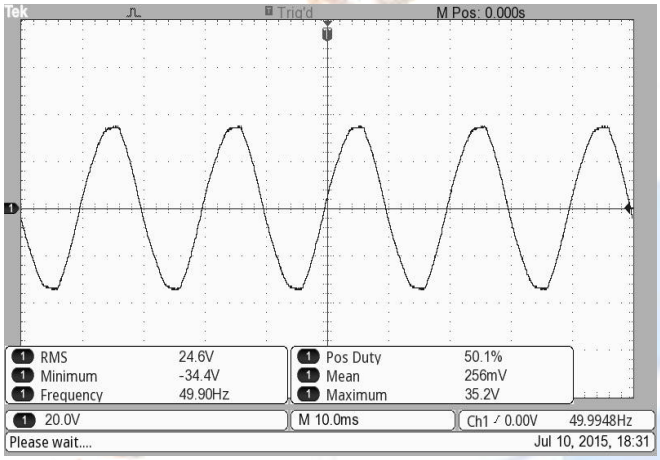


Fig 5:-Input Vac

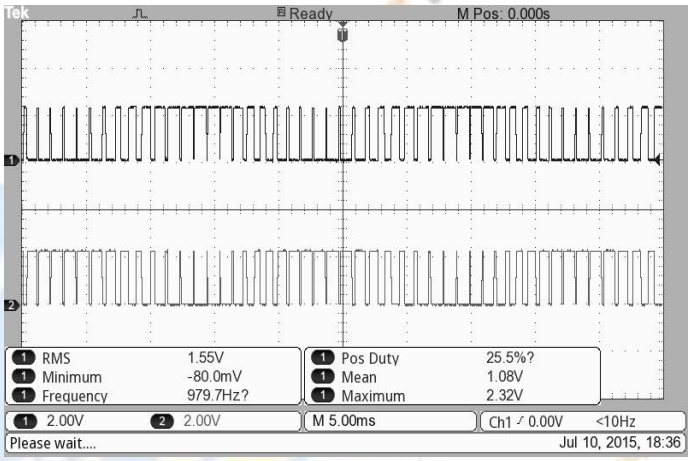
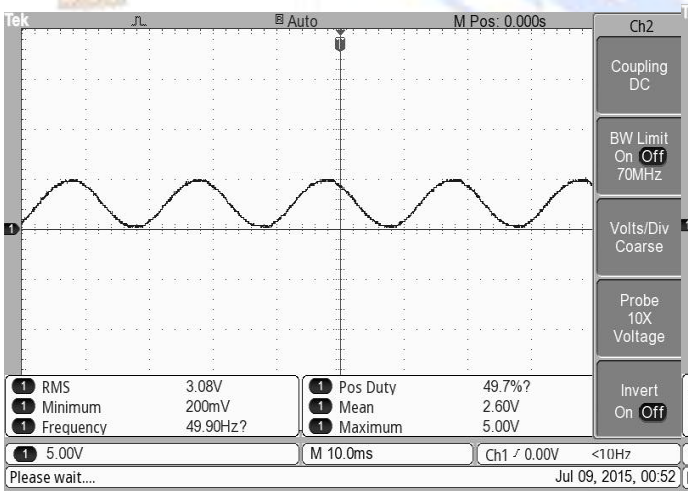


Fig 6:-SPWM Pulses



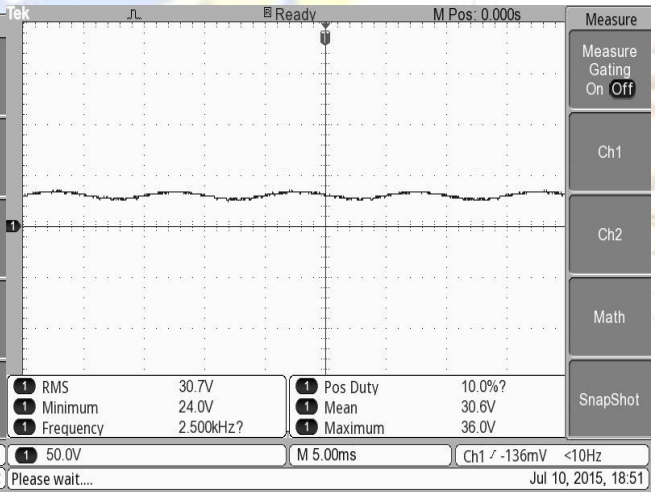


Fig 7:-AC Voltage Sensor

Fig 8:-Output DC Voltage

VI.CONCLUSION

The single phase PWM rectifier with closed loop controlling is simulated and it gives the appropriate results with R and RL load. The hardware of single phase rectifier is fabricated and satisfactory results obtained in open loop with Arduino Uno controller at switching frequency of 1 kHz.

VII.REFERENCES

[1]D. V. Garasiya, Santosh. C. Vora and P.N. Kapil, "Simulation, Design and Practical Realization of Single Phase PWM Boost Rectifier"Department of Electrical Engineering, Nirma University, Ahmedabad, India, pp 1-6.

[2]A. Mansoor, W. M. Grady,R. S. Thallam, M. T. Doyle, S. D. Krein, M. J. Samotyj, " Effect of Supply Voltage Harmonics on the Input Current of Single-phase Diode Bridge Rectifier Loads",IEEE Transactions on Power Delivery, Vol. 10, No. 3, July 1995 , pp 1416-1422.
[3]Bhim Singh, Brij N. Singh, Ambrish Chandra, Kamal Al-Haddad, Ashish Pandey, Dwarka P. Kothari ," A Review of Single-Phase Improved Power Quality AC–DC Converters,IEEE TRANSACTIONS ON INDUSTRIAL ELECTRONICS, VOL. 50, NO. 5, OCTOBER 2003.pp 962-981.
[4]K. Thiyagarajah, V. T. Ranganathan, B. S. Ramakrishna Iyengar, "A High Switching Frequency IGBT PWM Rectified Inverter System for AC Motor Drives Operating From Single Phase Supply", IEEE TRANSACTIONS ON POWER ELECTRONICS. VOL. 6, NO. 4. OCTOBER 1991, pp 576-584.