



Closed Loop Control of Multipulse Rectifier Using Novel Modulation Techniques

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ABSTRACT: This paper deals with strategy of closed loop control for 12 pulse rectifier with hybrid technology having two boost stage switches for regulation of output voltage. The output voltage is directly controlled by space vector modulation with the help of closed loop technology and input current is sinusoidal. The result shows the control strategy gives input current with high quality for all and also distorted, unbalanced main.

KEYWORDS: 12-pulse rectifier, closed-loop control, space-vector modulation.

I. INTRODUCTION

The More-electric aircraft (MEA) rectifier Systems are used to reduce the distortions in main voltage and disturbances in sensitive flight control equipment. This can be achieved only by using high input current quality of MEA system. To get regulated input current, number of pulses is increased using PWM technique. The losses in the Electromagnetic interference filter, the low efficiency and cooling effect, without any galvanic isolation of 12 pulse diode rectifier is because of high frequency range between 360 to 800 Hz. This can be achieved by using phase shift auto transformer which is denoted as main side line interface transformer that can be operated using medium switching frequency. With low complexity and higher pulse load capability is determined by using passive system. The Electromagnetic interference filter is not required in multi pulse rectifier. The elimination of low frequency harmonics is done by mutual cancellation and high frequency switching is not needed. However, the strength of the signal is reduced by low pass electromagnetic interference filter without any switching frequency harmonics. The displacement of main voltage and input current is determined by avoiding capacitive phase. A low power factor is fixed at particular load or it may be of 800 Hz high main frequency. Phase displacement is due to capacitors present in electromagnetic interference filter, which cannot be equaled by single directional pulse width modulation rectifier system.

To increase the pulse number from 12 pulse to 24 pulse, interphase reactors and diodes are used on DC side, while providing the AC side. Low power is produced by inductive components which can be obtained by 12 pulse rectifier. The transformer and four diode bridges are used to obtain 24 pulse system. Control circuit is eliminated by omitting active switches. i.e the characteristics of above system includes low complexity and high robustness. For voltage adaption, the characteristic of delta – delta and delta – star isolation transformer are used in 12 pulse topology. So that the voltage of 115V is converter to 28 V DC bus by generating two-phase-shifted three-phase diode rectifier input-voltage systems. In higher voltage system, the rated power of inductive components from 1.0 to ≈ 0.2 PO is reduced by replacing isolation transformer to phase shift auto transformer which results in less volume and lower weight topology.

Because of rectifiers, voltage output of multi pulse diode rectifiers is slewing. The supplied drive system rated for main voltage and load dependent of low voltage on DC side. It leads to large size of motor drive and inverter drive. By using active switches, dc voltage can be controlled. This can be obtained by using hybrid 12 pulse rectifier topology. Therefore, pulse number, current quality and controllability is increased. Fig 1 shows classification of 12 pulse diode rectifier system.

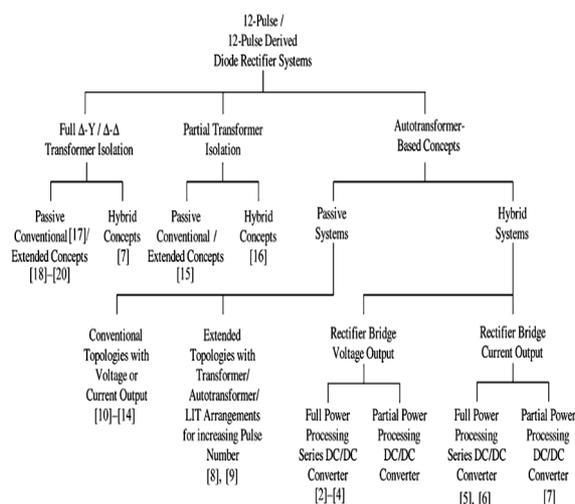


Fig 1. Classification of 12-pulse diode-rectifier systems.

II. OPEN LOOP CONTROL

The output of voltage and current in diode bridges have to be differentiated in hybrid autotransformer rectifier units. Therefore, the main side current is fascinated by inductors which are connected in series or autotransformer input units. On dc side, only the switches which are active is employed that allows passive smoothing replacement and slenderizing components of inductive elements by high frequency current or voltage. It affects dc-dc converters which allow dc output voltage control to some constant value. Moreover, to have sinusoidal main current, the output voltage or current of rectifier have to be regulated. Therefore, the difficulty of the control is restricted and hence the implementation of DC-DC converter is done.

The proposed system includes current output produced by Diode Bridge in hybrid autotransformer rectifier unit. The necessity of interphase reactors for autotransformer rectifier unit is to support the distinguish of output voltage of diode bridge and to slenderize dc currents which are replaced by DC-DC boost converter that are parallelly connected at output side. This helps in system reduction and also control in output voltage. The output currents of bridge rectifier is minimized to some constant value but higher pulses are not required. For triangular DC current. The dc current of triangular modulation is obtained by 12 Pulse system topology, that had shown increment of pulse number. With the help of electronic interphase reactor and electronic inductor, the achievement of triangular wave shaping current is done. In this the observer can obtain its output power. By using passive rectifier bridge, the higher efficiency of overall system and power conversion performance have been determined.

The 12 pulse rectifier topology is determined by the concept of conventional isolated transformer and not analysed by hybrid Automatic Transformer Rectifier Units.

The voltage source pulse width modulation with inverter stage is determined by direct output voltage of hybrid ATRU. The proposed system is obtained by connecting three active switches for each diode bridge to center point of output voltage. The 24 pulse system will behave like the characteristics in three phase diode bridges. The 12 pulse auto transformer and combination of two discontinuous conduction mode. There is no feedback in the open loop control. The constant rectifier voltage of duty cycle modulation is obtained by immediate shunt connection of diode bridge output of one active switches. The fifth and seventh harmonics of bridge current input is cancelled by using auto transformer as in conventional 12 pulse topology. This result in low value of high amplitude transfer voltage ratio. The inductor in ac side and discontinuous conduction mode in auto transformer be realized with ferrite core. The limitation of circuit capability is obtained with the help of EMI filter containing high attenuation and large size.

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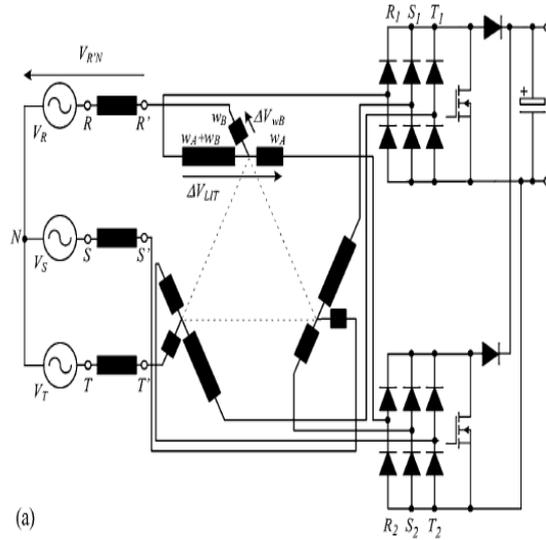


Fig 2. Impressed/modulated diode-bridge output current and impressed ac-side voltage

The continuous conduction mode (CCM) can be obtained by controlling output voltage in 12 pulse conventional system. Compared to 12 pulse automatic transformer rectifier unit there is no improvement in main behavior. Moreover the sinusoidal shaping is not achieved in main behavior as compared to automatic transformer rectifier unit. The sinusoidal shaping can be achieved by arranging the active switch which present at diode bridge output and duty cycle of triangular modulation. Therefore the required voltage output is twice the value of passive operation. But this is not advantage for driver topology which requires high power. Moreover a boost diode is arranged at the output current path which results in less conduction losses.

In open loop control, the duty cycle d_1 and d_2 of T_1 and T_2 the shaping of current is passive. That is consumption unbalanced current by the phases have a great influences on the shape of main current leads to less harmonics with high amplitude. In case of sinusoidal input current, the closed loop current is controlled. This sinusoidal input current is needed to ensure input current when distorted mains are present. The constant value is controlled by the above output voltage.

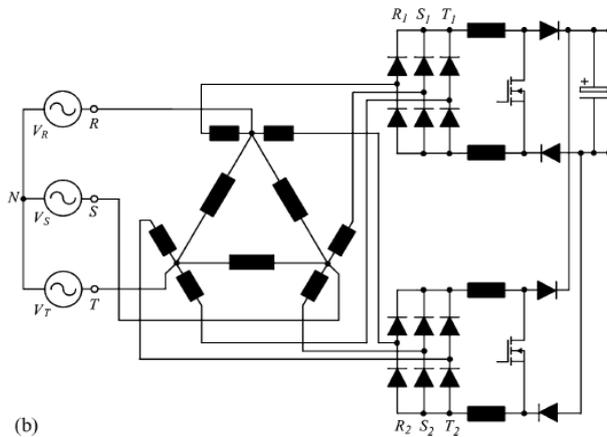


Fig 3. Impressed/modulated diode-bridge output

III.CLOSED LOOP CONTROL

In closed loop system, the output voltage is obtained using the direct control of space vector modulation technique. The closed loop system is analyzed and discussed in this paper. The results of measurements of the system is also shown with certain specifications. The operating method is based on SVM(space vector modulation). Controller implementation is also done. The simulation verifies performance and applicability in proposed system. The closed loop system includes diode bridge rectifier, inductor connected in series, transformers, SVPWM (space vector pulse width modulation) technique.

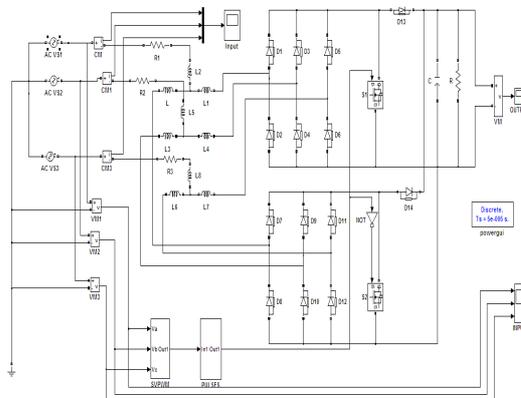


Fig 4.closed loop control of 12-pulse rectifier

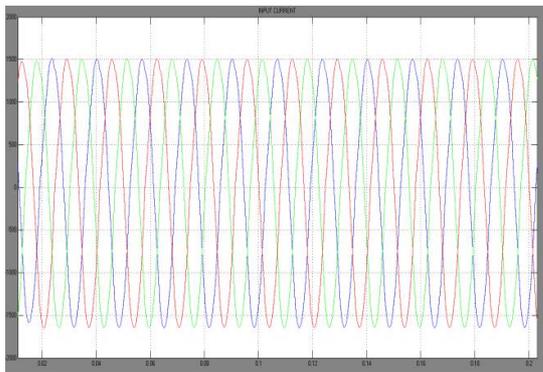


Fig5.Inputcurrentwaveform

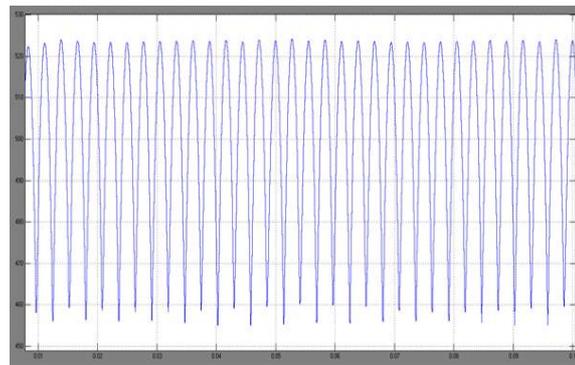


Fig 6. Closed Loop Output Voltage

In passive operation, the two switches S1 and S2 are in ON position and remaining switches are in OFF position. The figure 2 gives 12-pulse rectifier produces input current waveform with the THD of 6.5%. The input voltages of two 12 pulse rectifier are shifted by 30° where it is generated by LIT. 12-pulse operation results due to the 30° phase shift of the input voltages of the two rectifier stages, which is generated by the LIT. The LIT is assumed to have an ideal coupling of the related windings.

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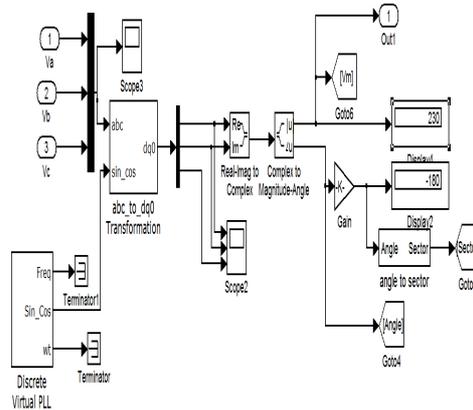


Fig 7 controller circuit of 12-pulse rectifier.

IV.SIMULATION AND RESULTS

Relevant input and output voltage waveforms are shown, for rated power and voltages, which are in agreement with the expected results. Fig 6 shows the open loop control of 12-pulse rectifier. Fig 9 shows the closed loop control of 12-pulse rectifier involving spvm.

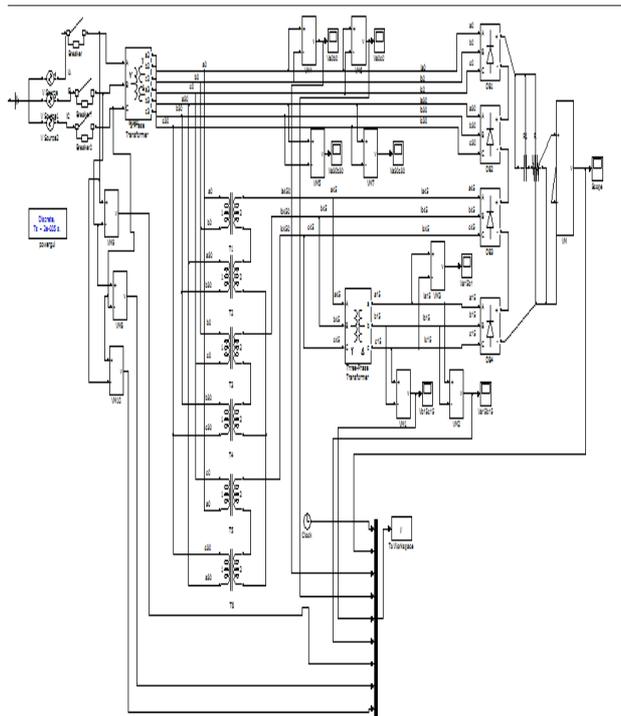


Fig 8 Simulation of 12 pulse rectifier

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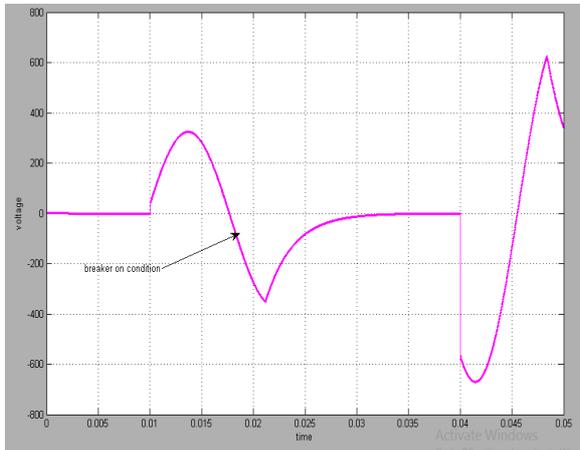


Fig9. Output voltage under breaker condition.

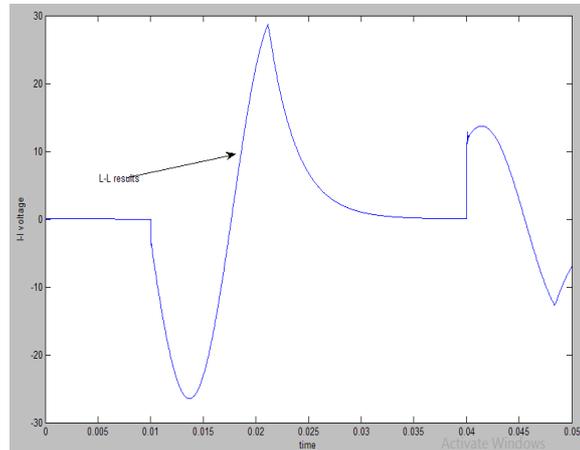


Fig 10. Output for line to line voltage.

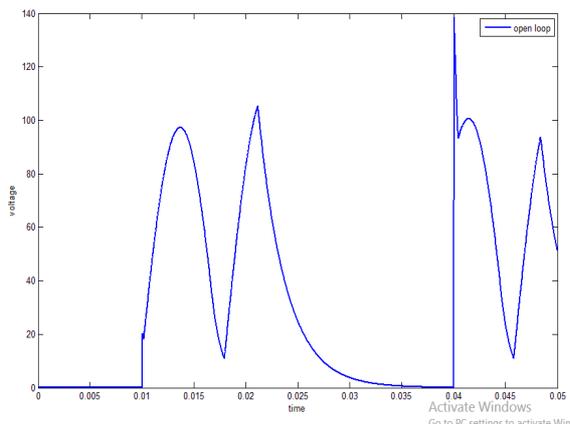


Fig 11. Output for transient time.

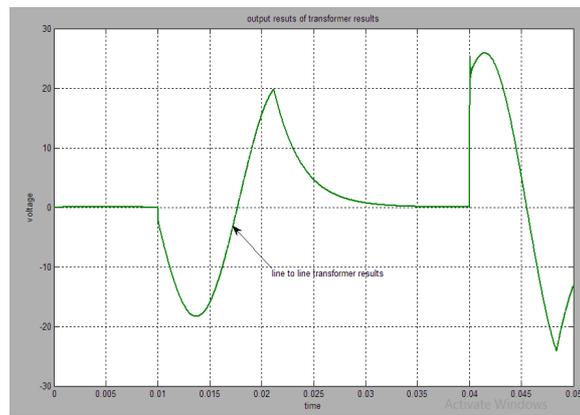


Fig 12. Output for transient time.

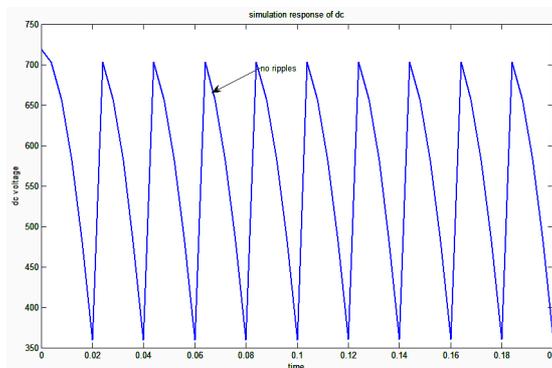


Fig 13. Simulation response for DC result.



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V. CONCLUSION

This project deals with the novel scheme of control for a 12-pulse rectifier by having an LIT which have SPVM. The SPVM (space vector modulation), control structure that are closed loop allows output voltage of direct control, basic operation principle are explained. The results and simulation of this control scheme are verified and presented. This current control scheme is a closed loop that allows main current, output voltage and gives high quality main current sinusoidal and also provides current magnitude controllability. Moreover, the power control is done directly and boost inductors will be investigated which are present in LIT.

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