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To Implement EAC Technique AC –AC Converter

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ABSTRACT: The Ac voltage controllers are used to obtain variable output ac voltage from fixed ac voltage. In convention, Phase angle control and Integral cycle control have been extensively used in this type of controllers. These techniques have some inherent disadvantages like low power factor with respect to the firing angle and also the presence of lower order harmonic contents. This paper explores the technique, which improves the power factor and reduces the harmonics. It has its applications in domestic and industrial heating, starting and speed control of single phase, three phase ac drives. The implementation of extinction angle control technique (EAC) Moreover the performance evaluation of the proposed technique has been analyzed while supplying for both static and dynamic loads. Thus the difficulty caused by the conventional techniques in the ac voltage controllers to obtain variable ac voltage can be reduced to an appreciable extent using the proposed scheme.

KEYWORDS: AC/AC converters; Extinction Angle Control (EAC); Power Factor (PF); THD; static load; dynamic load.

I. INTRODUCTION

The Phase-angle control (PAC) and Integral-cycle control are the conventional techniques that have been extensively employed in this type of regulators for many applications. Such techniques offer some advantages as simplicity and the ability of controlling large amount of power economically. However, they suffer from inherent disadvantages such as retardation of the firing angle causes lagging power factor at the input side especially at large firing angles and high low order harmonic content in both of load and supply sides. Moreover, a discontinuity of power flow appears at both input and output sides. Trying to solve this problem with simple ac voltage converters is an almost impossible task. Thus, the present paper describes a simple scheme to generate a variable ac voltage directly from the line with few commutations at each period. This is achieved by using the extinction angle control (EAC) control technique to control the extinction angle by making use of forced commutation nature of the switches while introducing a freewheeling path in parallel with the load terminals.

This paper is concerned with study of ac/ac converter applied to a static load and a dynamic load using the proposed technique.[1]

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II. PROPOSED APPROACH

The circuit configuration of the ac/ac converter is shown in Fig.1. It consists of two controlled IGBT switches with two diode bridge rectifiers fed to a dynamic load. The static load considered is a RL load and dynamic load considered here is a single phase capaci

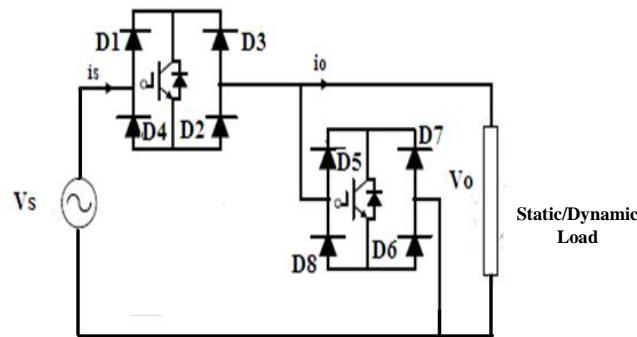


Figure 1. Proposed configuration of AC/AC converter with static/dynamic load.

the load current to discharge the stored energy of the inductance.[2]

A. Extinction Angle Control

The principle of Extinction Angle Control (EAC) is to start the conduction at the zero crossing of the supply voltage and forced commutated at certain angle at certain angle before the next zero crossing occurs. The switching pulses are shown in Fig.2 synchronized with the supply voltage and the output voltage is controlled by varying the extinction angle β . The conduction begins when switch S1 is turned on at $\omega t=0$ and is turned off by force commutation at $\omega t= \pi-\beta$.

The freewheeling path for the load current must be provided from $\omega t=\pi-\beta$ to $\omega t=\pi$ by the switch S2 to discharge the stored energy of the inductance. Thus the fundamental component of input current leads the input voltage and the power factor is leading. [4]

The average output voltage is given by,

$$V_o = \frac{V_m}{\pi} [\cos(\pi - \beta) + 1] \quad (1)$$

The rms output voltage is given by,

$$V_{o,\text{rms}} = \frac{V_m}{\sqrt{2\pi}} \left[\sqrt{\left\{ (\pi - \beta) - \frac{\sin 2(\pi - \beta)}{2} \right\}} \right] \quad (2)$$

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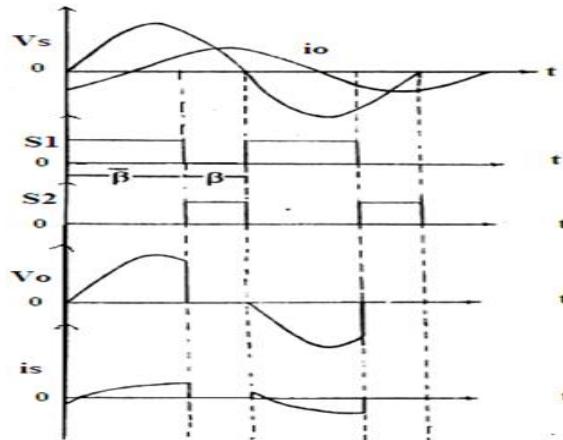


Figure 2. Input voltage, output current, switching pulses, output voltage and input current waveforms with extinction angle control.

III. PERFORMANCE CHARACTERISTICS OF AC/AC CONVERTER WITH STATIC LOAD USING EAC TECHNIQUE

The performance characteristics of an ac/ac converter applied to a static load using EAC technique is studied using MATLAB/Simulink package. The static RL load has the supply voltage of 230V, 50Hz with the switching frequency of 100Hz and the value of load resistance $R=50\Omega$ and $L=110mH$.[3]

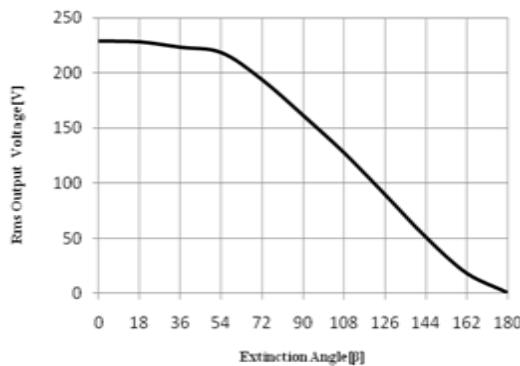


Figure 3. Variation of the rms output voltage with the extinction angle.

The Fig.3 shows the simulated variation of the rms values of the output voltage V_o with the extinction angle β . As the extinction angle increases the output voltage decreases.

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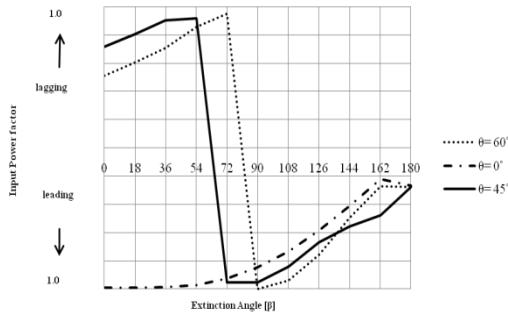


Figure 4. Variation of the input power factor with the extinction angle.

The Fig.4 shows the simulated variation of the input power factor with the extinction angle β over the complete range of control for three different load conditions namely a resistive load ($\theta=0^\circ$) and two inductive loads with load angles ($\theta=45^\circ, 60^\circ$) respectively. Thus it implies that as the extinction angle increases, the input power factor is improved gradually from its lagging value and it becomes leading after the extinction angle exceeds the load angle and also the input power factor gets more improved with the increase in the extinction angle. This feature gives more importance for EAC technique.[5]

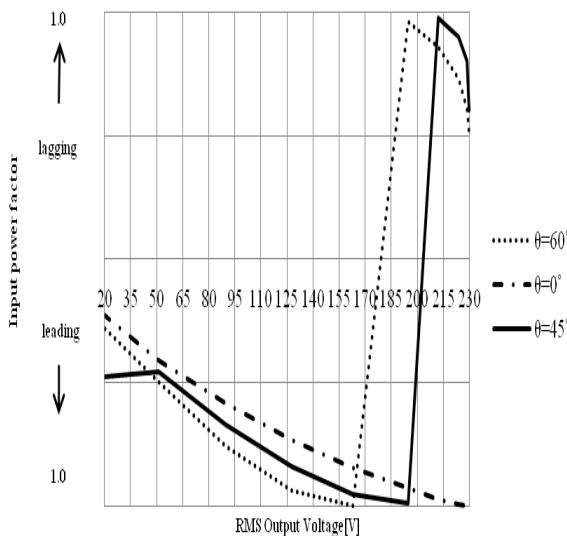


Figure 5. Variation of the input power factor with the rms output voltage.

The Fig.5 shows the simulated variation of the input power factor with the rms output voltage for the same loading conditions as in Fig.4. As the rms output voltage decreases (i.e., the extinction angle increases), the supply power factor is improved gradually from its lagging value and becomes leading after the extinction angle exceeds the load angle and goes more leading as the extinction angle increases.[6]

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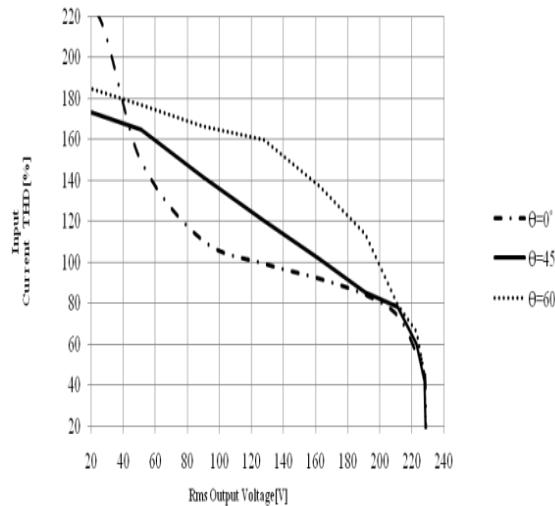


Figure 6. Variation of the Input current THD with the output voltage.

The Fig.6 shows the simulated variation of the input current THD with the rms output voltage for different load conditions. As the extinction angle increases, the rms output voltage decreases. This in turn results in increasing the THD of supply current. This doesn't affect the leading nature of power factor.[7]

A. Simulation waveformss with EAC technique



Figure 7. Voltage and Current waveforms with EAC technique

The Fig.7 shows the simulated input and output voltage and current waveforms respectively of the proposed scheme of ac/ac converter fed to the induction motor.[8]

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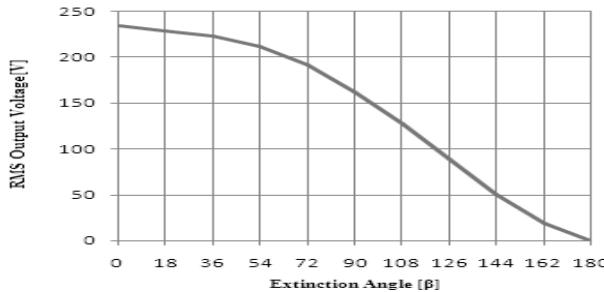


Figure 8. Variation of the rms output voltage with the extinction angle

Fig.8 shows the simulated variation of the extinction angle with the output voltage. As the extinction angle increases the output voltage gets decreased.

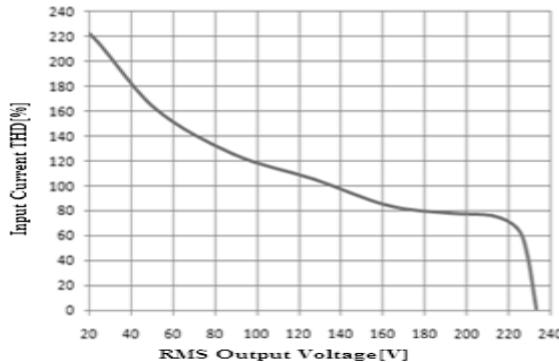


Figure 9. Variation of the Input current THD with the output voltage

Fig 9. Show the simulated variation of the input current THD with the rms output voltage. As the extinction angle increases, the rms output voltage decreases .This in turn results in increasing the THD of supply current. This doesn't affect the leading nature of power factor.

IV CONCLUSION

The proposed AC/AC converter has different configuration compared to the conventional converter. The need for this configuration is to improve the reliability, decrease the switching losses and to enhance the converter efficiency. The proposed control technique EAC has some improvement over input power factor and the input current THD.

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