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THE DISCONTINUOUS PULSE WIDTH MODULATION FOR A THREE PHSE HFPDCL INVERTER CONNECTED TO INDUCTION MOTOR

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ABSTRACT: This paper presents a discontinuous PWM for a three phase HFPDCL inverter connected to the induction motor. The components of the HFPDCL inverter consist of high frequency dc/ac converter, high frequency transformer a rectifier and an output three phase inverter. The matrix converter is connected between the HFPDCL inverter and the induction motor to provide protection to the induction motor and the inverter. As this inverter does not require bulky DC-link capacitors, which eliminates them from the power stage of the converter and increases the power density and reliability of the HFPDCL inverter. To decrease the switching requirement of the inverter one predetermined phase of the output inverter clamps to the dc bus.

INTRODUCTION: HFPDCL inverter is suitable for applications such as solar energy, fuel cell energy, wind energy, energy storage vehicles and power quality [1]-[7]. The advantages are providing galvanic isolation, customizable turn ratio and small dc-link capacitor; which ultimately improves the power density as line frequency is eliminated by high frequency and also improves the reliability and performance of the HFPDCL inverter. There are three active stages in this inverter, which increases the switching loss of the inverter and a desired switching scheme is needed to be implemented to reduce the switching loss of the inverter. As the switching requirement is reduced the inverter generate high quality output waveforms. The proposed scheme is implemented based on the high frequency pulsating dc link feature of the inverter.

The schematic of HFPDCL inverter is shown in fig.1 consist of three active conversion stages: 1) a rectifier that generates bipolar pulses for the high frequency transformer 2) an ac/pulsating dc converter that rectifies the bipolar pulses at the secondary side of the HF transformer and 3) pulsating dc/ac converter that generates the desired line frequency sine wave waveforms.

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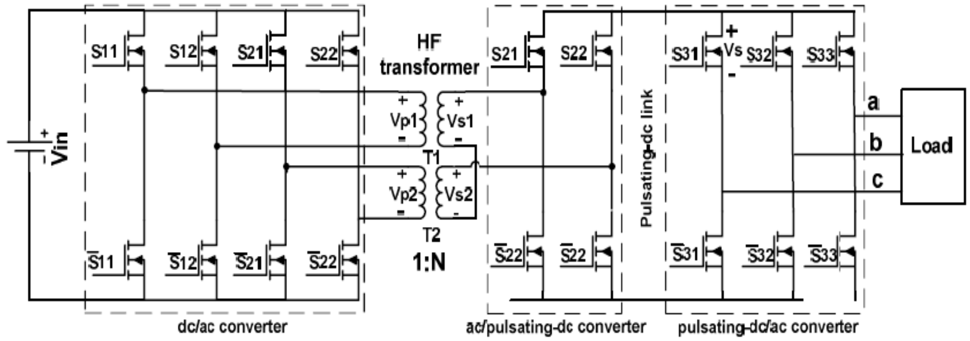

Fig 1: Schematic diagram of HFPDCL inverter

In addition to this schematic diagram it is further connected to thematrix converter and then to the induction motor. This increases the reliability and power density of the converter. The proposed scheme synchronizes in all the three conversion stages.

The comparison of the modulation signals and a triangle carrier waveforms develop the carrier based PWM modulation signals. Here discontinuous PWM scheme is proposed because it reduces the switching requirement of the inverter compared to the conventional continuous PWM. The proposed scheme decreases the switching loss and increase the efficiency of the inverter. Discontinuous PWM clamps one predetermined leg of the pulsating dc/ac converter to the dc-bus while the other legs of the converter operate at HF in a cyclic manner.

Since the nature of the dc link of the HFPDCL inverter is pulsating, the discontinuous PWM scheme that are presented for the fixed-dc link inverters are not suitable [8]-[18].

I. DISCONTINUOUS PWM FOR HFPDCL INVERTER

There are two groups in the modulation schemes of the inverters such as continuous PWM and discontinuous PWM. If the modulation signals are always in the boundary of the triangle carrier then this scheme is called continuous PWM. In the discontinuous PWM scheme at least one phase leg of the inverter clamps to the negative or the positive rail of the dc bus and also one predetermined phase leg of the inverter does not modulate during any given period of the line cycle.discontinuousPWM scheme at least one phase leg of the inverter clamps to the negative or the positive rail of the dc bus and also one predetermined phase leg of the inverter does not modulate during any given period of the line cycle.

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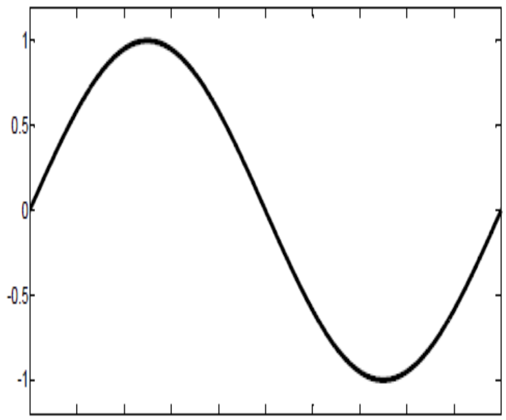
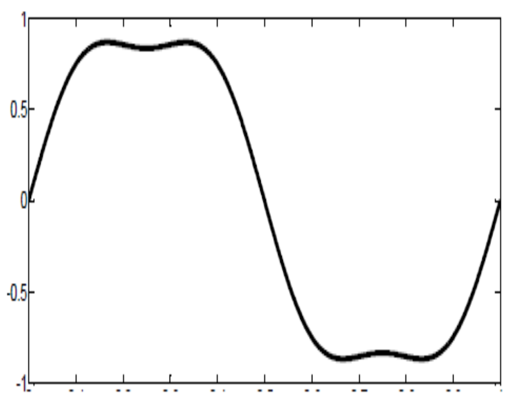


(a)



(b)

Fig 2: The modulation signals of :a)SPWM, b)THIPWM

The degree of freedom given by an isolated neutral star-connected load allows to inject any zero sequence signals to the reference signals is used to vary the duty cycle of the switches of the output pulsating-dc/ac converter. Also this degree of freedom reduces the switching requirement and yields high quality output waveforms. Because of its simplicity the conventional sine PWM (SPWM) has gained wide application. But its dc-bus rail utilization is low. The third harmonic injection PWM (THIPWM) and space-vector PWM (SVPWM) helps to inject a zero sequence signals to increase the dc-bus utilization but they do not decrease the switching requirement of the inverter. Fig 2 shows the modulation signals of SPWM and THIPWM.Thus one phase leg of the inverter clamps to the dc bus and other two phase legs operate at high frequency at any given time [19]-[24]. This is suitable for conventional fixed dc-link, because the nature of the dc-link waveform of the HFPDCL inverter is pulsating. Fig 3 shows the pulse placement and generation of waveforms.

II. MATRIX CONVERTER

The matrix converter have several advantages over the traditional rectifier-inverter type frequency converters. It provides sinusoidal input and output waveforms, with minimal high order harmonics and no sub-harmonics. It has inherent bi-directional energy flow capability and the input power factor can be fully controlled.

The matrix converter has nine bi-directional switches that allow any output phase to be connected to any input phase. Fig 3.shows the circuit scheme of matrix converter. The input terminals of the converter are connected to a three phase voltage-fed system usually the grid, while the output terminals are connected to a

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current-fed system like an induction motor.

The input filter act as an interface between the matrix converter and an AC mains. Its basic feature is to avoid significant changes of the input voltage of the converter during each PWM cycle and to prevent unwanted harmonic current from flowing into AC mains.

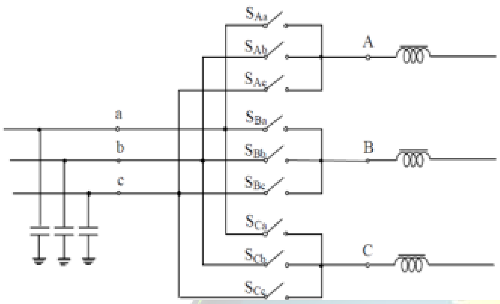

Fig 3: circuit scheme of matrix converter

III. SIMULTION RESULT

The simulation result for the discontinuous PWM for a three phase HFPDCL inverter connected to the induction motor is given.Fig 4.shows the modelling of matrix converter. The fig 5.shows the simulation of HFPDCL inverter connected to the induction motor. The fig 6.shows the output voltage and current waveform of HFPDCL inverter connected to the induction motor.

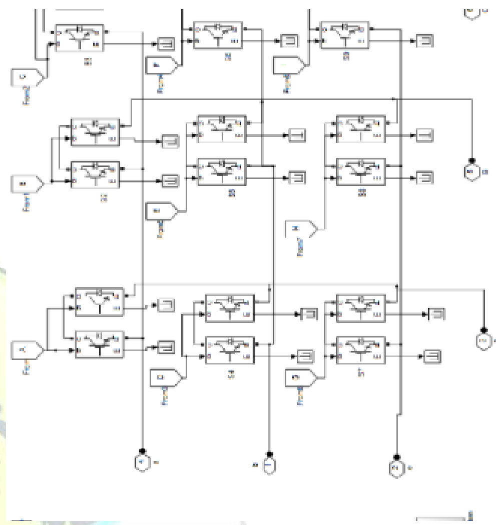

Fig 4: Modelling of matrix converter

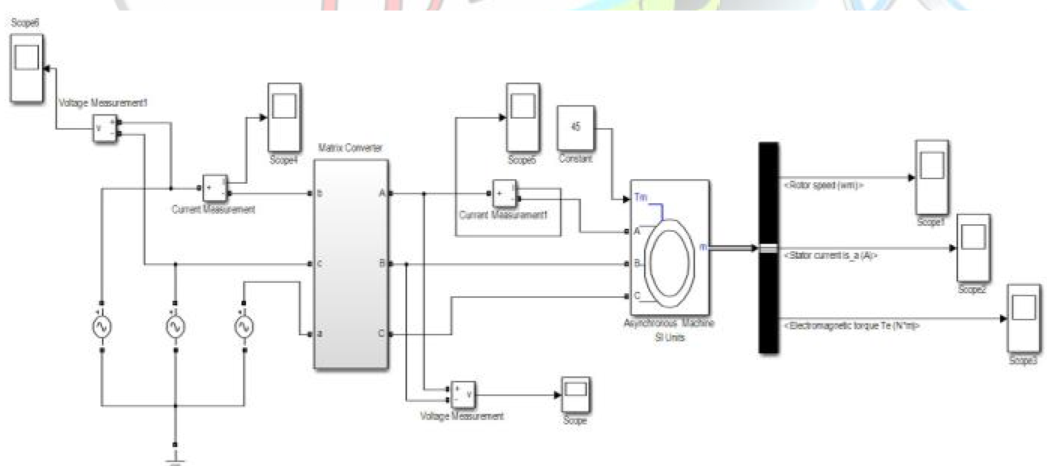

Fig 5: Simulation of HFPDCL inverter connected to induction motor

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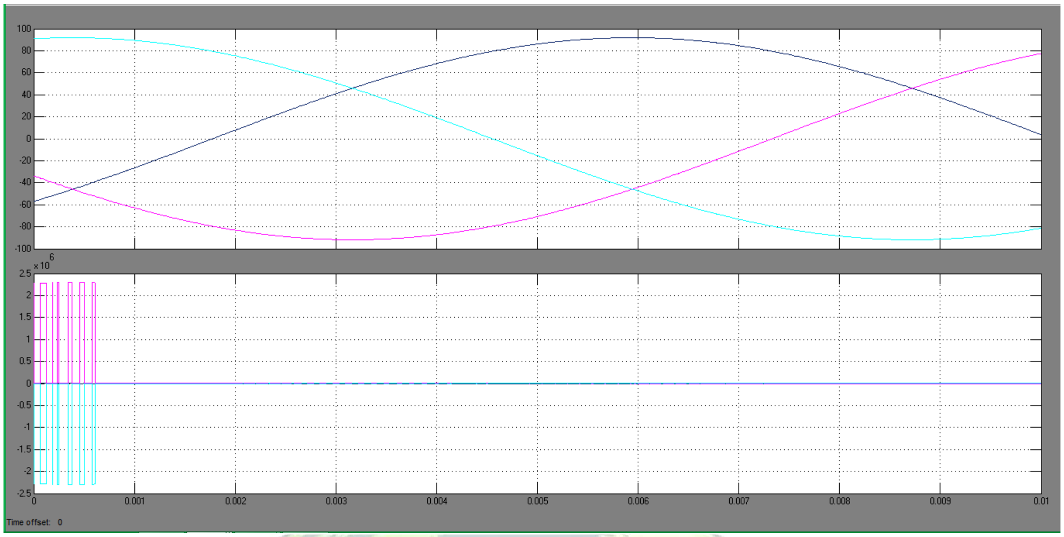

Fig 6: Output voltage and current waveform of HFPDCL inverter connected to induction motor

CONCLUSION

The discontinuous PWM for a three phase HFPDCL inverter connected to an induction motor is simulated using MATLAB Simulink. The main aim of this paper is to reduce switching losses and increase the efficiency of the inverter.

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