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Three Phase 6-Pulse Diode, Thyristor, Mosfet Based Convertor

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Abstract: ***In this paper a three phase 6-pulse convertor model is designed. The Synchronized 6-Pulse Generator block can be used to fire the six diode of a six-pulse converter. The output of the block is a vector of six pulses individually synchronized on the six diode voltages. DIODE, MOSFET and THYRISTOR are used as a controlled rectifier which reduces the total harmonics distortion in output current and voltage.***

Keywords: Converter, DIODE, MOSFET and THYRISTOR

I. INTRODUCTION

Few years ago different work was being done for total harmonic reduction through different concept and application. Different rectifiers are used for AC to DC or DC to AC conversion. Diode has been preferred for uncontrolled conversion while thyristors for the controlled conversion and for the analysis of total harmonic distortion for the controlled and uncontrolled conversion different loads are used like R, RL and RC. Power conversion devices that used for single phase and three phases from AC to DC or DC to AC are consists on the diodes and thyristors commonly. These rectifiers occur at zero crossing due to commutation or turn off; hence these are line commutated rectifiers. In this circuit the commutation circuit is not present. Because of absent of commutation circuits it becomes economical, But it draw the reactive power from the source so the power quality of the system becomes poor. To improve this problem and also reduce the harmonics in the system passive linear filters may be used. Three phase multi pulse rectifiers are used to overcome these problems by using different connection combination of three phase transformer. For low and medium power drive application three phase pulse width modulated rectifier are used. For power quality point of view these types of rectifiers are most preferable rectifiers. Hence they can present unity power factor and low harmonics distortion. For three phase high power conversion system series or parallel combination of a self commutated rectifiers and line commuted rectifiers are used for rectification and this types of rectifier are known as hybrid rectifiers.

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In this work a three phase 6-pulse convertor model is designed. In this paper DIODE, MOSFET and THYRISTOR are used as a controlled rectifier which reduces the total harmonics distortion in output current and voltage.

II. SIMULINK MODEL DESIGN

On the bases of rectifier we have designed three models by using

- Diode
- MOSFET
- THYRISTOR

A. DIODE

The Synchronized 6-Pulse Generator block can be used to fire the six diode of a six-pulse converter. The output of the block is a vector of six pulses individually synchronized on the six diode voltages.

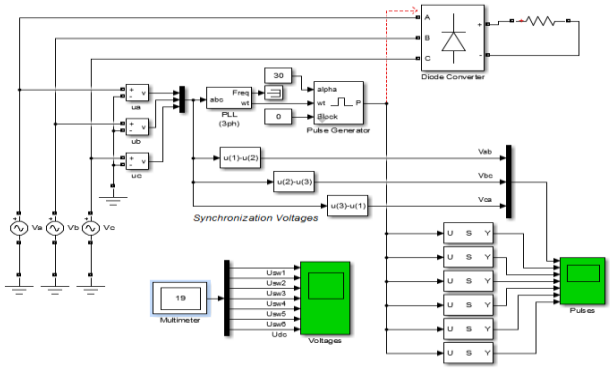

Figure 1: Diode Converter

The 6-pulse convertor uses a Pulse Generator block to fire the diode convertor bridge. The bridge is fed by a three-phase voltage source (200 V peak line-to-ground or 245 V RMS line-to-line) and it is connected to a resistive load.

B. MOSFET

The 6-pulse convertor uses a Pulse Generator block to fire the MOSFET convertor bridge. The bridge is fed by a three-phase voltage source (200 V peak line-to-ground or 245 V RMS line-to-line) and it is connected to a resistive load.

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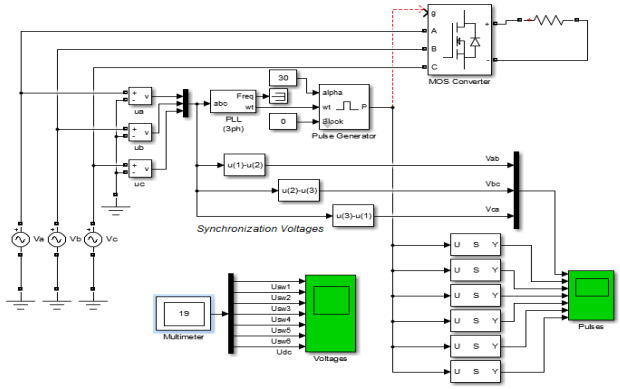

Figure 2: MOSFET Converter

C. THYRISTOR

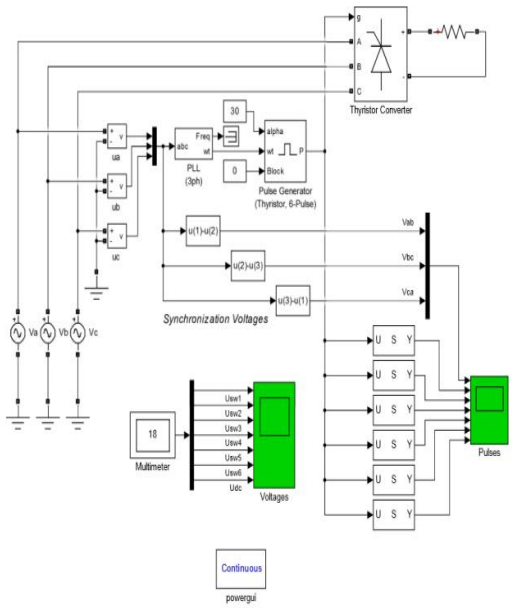

Figure 3: THYRISTOR Converter

The 6-pulse convertor uses a Pulse Generator block to fire the THYRISTOR convertor bridge. The bridge is fed by a three-phase voltage source (200 V peak line-to-ground or 245 V RMS line-to-line) and it is connected to a resistive load.

III. RESULTS

A. Inputs and Outputs

alpha_deg

Input 1 is the alpha firing signal, in degrees. This input can be connected to a Constant block, or it can be connected to a controller system to control the pulses of the generator.

AB, BC, CA

Inputs 2, 3, and 4 are the phase-to-phase synchronization voltages Vab, Vbc, and Vca. The synchronization voltages should be in phase with the three phase-phase voltages at the converter AC terminals. Synchronization voltages are normally derived at the primary windings of the converter transformer. If the converter is connected to the delta winding of a Wye/Delta transformer, the synchronization voltages should be the phase-to-ground voltages of the primary windings.

Freq

Available only with the discrete version of the Synchronized 6-Pulse Generator. This input should be connected to a Constant block containing the fundamental frequency, in hertz, or to a PLL tracking the frequency of the system.

Block

Input 5 allows you to block the operation of the generator. The pulses are disabled when the applied signal is greater than zero.

Pulses

The output contains the six pulse signals.

- DIODE as Converter

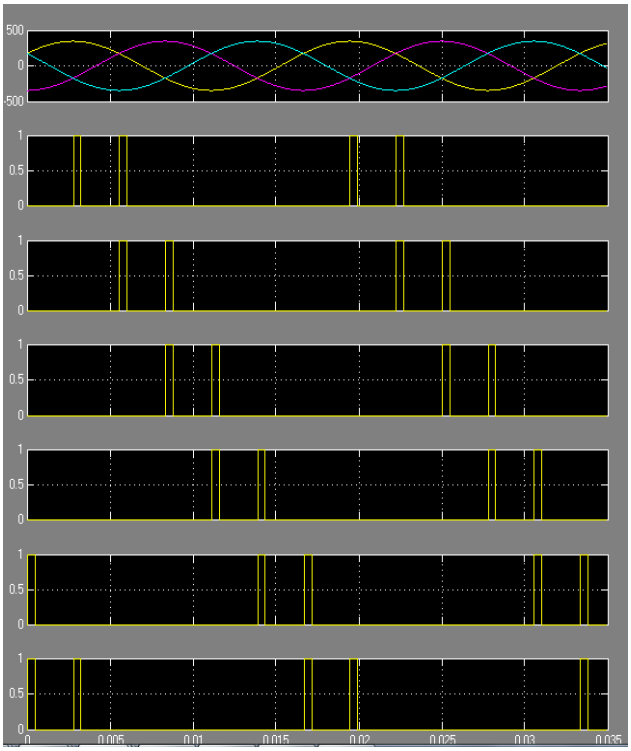

Figure 4: The Synchronization of the Six Pulses (Diode)

The output of the Pulse Generator block is a vector of six pulses individually synchronized on the six diode voltages. The pulses are generated alpha degrees after the increasing zero crossings of the diode commutation voltages.

The figures below display the synchronization of the six pulses for an alpha angle of 30 degrees. The pulses are generated exactly at the zero crossings of the three line-to-line synchronization voltages.

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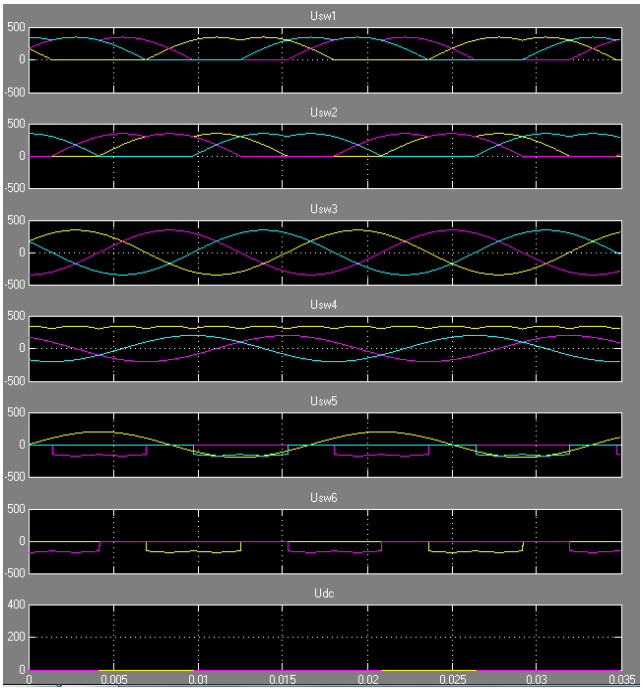

Figure 5: The Synchronization of the Six Voltages (Diode)

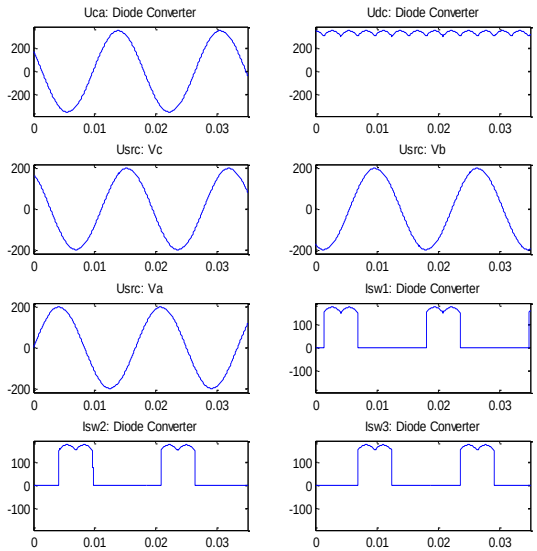

Figure 6: The Synchronization of The Six Voltages (Diode)

Figure 5 and 6 shows the step by step conversion of AC voltage to DC. The AC three phase Voltage is shown as Usw3 in three different colours.

- MOSFET as Converter

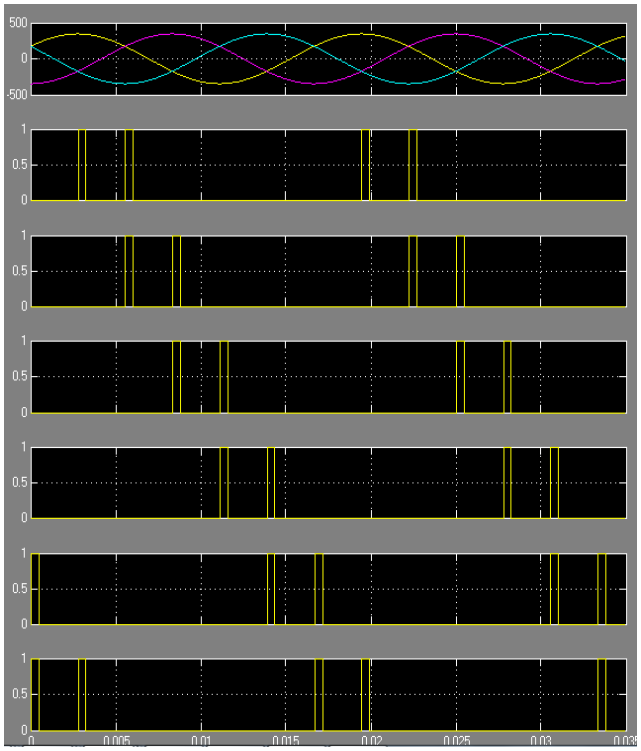

Figure 7: The Synchronization of The Six Pulses (MOSFET)

The output of the Pulse Generator block is a vector of six pulses individually synchronized on the six diode voltages. The pulses are generated alpha degrees after the increasing zero crossings of the diode commutation voltages.

The figures below display the synchronizartion of the six pulses for an alpha angle of 30 degrees. The pulses are generated exactly at the zero crossings of the three line-to-line synchronization voltages.

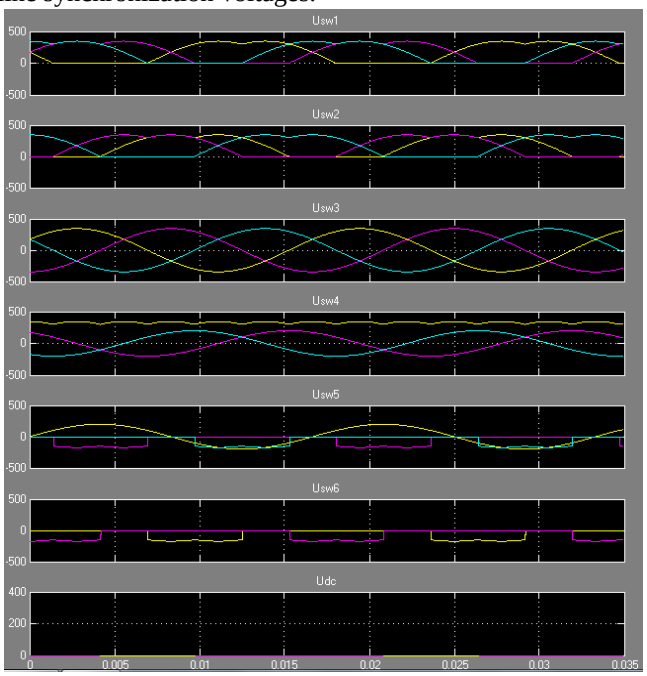

Figure 8: The Synchronization of the Six Voltages (MOSFET)

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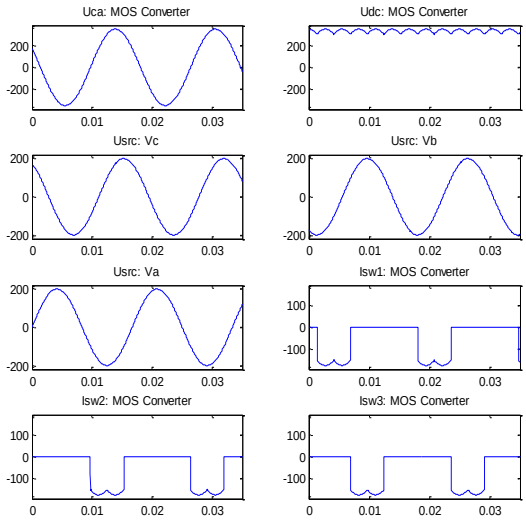

Figure 9: he Synchronization of the Six Voltages (MOSFET)

Figure 8 and 9 shows the step by step conversion of AC voltage to DC. Under the effect of the ripples at low or subsynchronous frequency, the valves could be conducted more than six times during one cycle of the ripples, which means the cycle of the ripple is much longer than one conducting time intervals of the valves. As a result, the change rate of the alternating current amplitude under the effect of the low or subsynchronous ripple is so small during each conducting time intervals of the valves, that the amplitude of the alternating current can be seemed as a constant.

- THYRISTOR as Converter

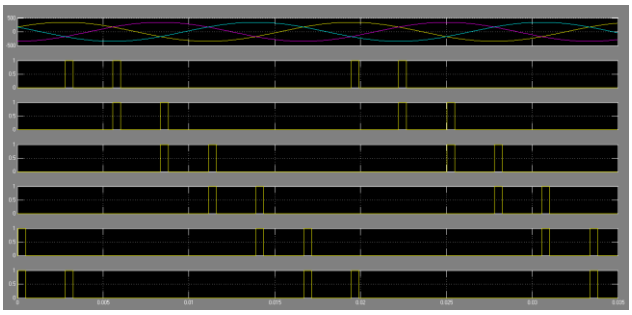

Figure 10: The Synchronization of the Six Pulses (THYRISTOR)

The output of the Pulse Generator block is a vector of six pulses individually synchronized on the six diode voltages. The pulses are generated alpha degrees after the increasing zero crossings of the diode commutation voltages.

The figures below display the synchronization of the six pulses for an alpha angle of 30 degrees. The pulses are generated exactly at the zero crossings of the three line-to-line synchronization voltages.

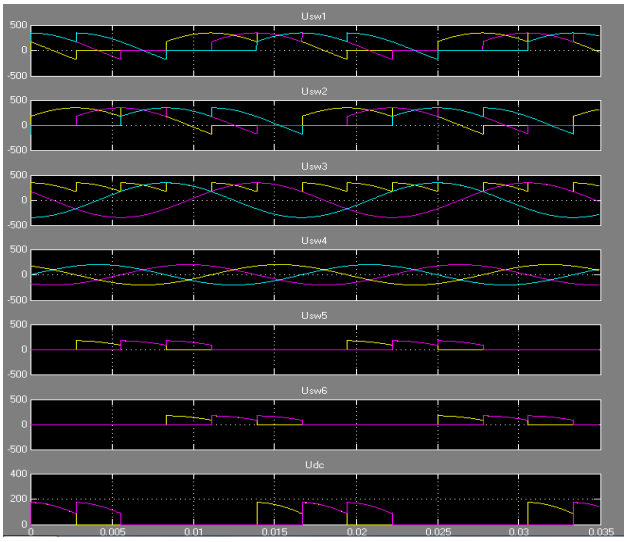

Figure 11: The Synchronization of the Six Voltages (Diode)

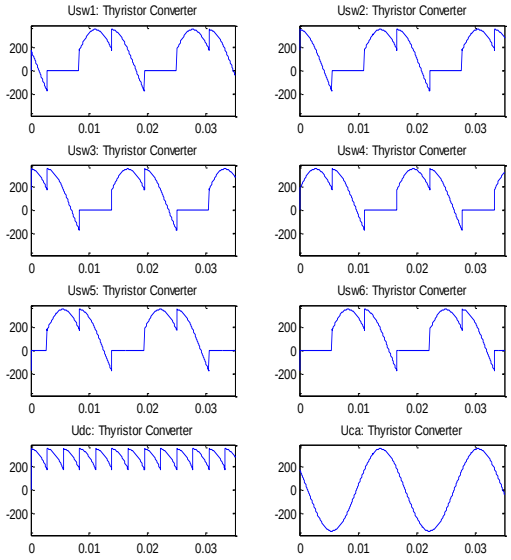

Figure 12: The Synchronization of the Six Voltages (THYRISTOR)

Figure 11 and 12 shows the step by step conversion of AC voltage to DC. Under the effect of the ripples at low or sub synchronous frequency, the valves could be conducted more than six times during one cycle of the ripples, which means the cycle of the ripple is much longer than one conducting time intervals of the valves. As a result, the change rate of the alternating current amplitude under the effect of the low or sub synchronous ripple is so small during each conducting time intervals of the valves, that the amplitude of the alternating current can be seemed as a constant.

IV. CONCLUSION

The system has been designed to analyze the synchronization of the six pulses AC-DC converter using diode mosfet and thyristors.

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Diode has been preferred for uncontrolled conversion while thyristors for the controlled conversion and for the analysis of total harmonic distortion for the controlled and uncontrolled conversion different loads. Power conversion devices that used for single phase and three phases from AC to DC or DC to AC are consists on the diodes and thyristors commonly. DIODE, MOSFET and THYRISTOR are used as a controlled rectifier which reduces the total harmonics distortion in output current and voltage.

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