1 phase to 3 phase convertor

Jadhav Ashish Chandrashekhar, Gandule Anil Ashok, Waghmode Harshvardhan Rajkumar and Salgar Yogesh Digambar

Department of Electrical Engineering, SVERI's College of Engineering (Poly.), Pandharpur

Third Year Diploma Students

Abstract:

A phase converter is a device that converts electric power provided as single phase to multiple phase or vice versa. The majority of phase converters are used to produce three-phase electric power from a single-phase source, thus allowing the operation of three-phase equipment at a site that only has single-phase electrical service. Phase converters are used where three-phase service is not available from the utility, or is too costly to install due to a remote location

Keywords:

1. Special Education needs
2. Training
3. Traction system
4. Single phase to three phase

Introduction:

A single-phase to three-phase drive system composed of two parallel single-phase rectifiers, a three-phase inverter and an induction Motor was proposed. The system combines two parallel rectifiers without the use of transformers. Several solutions have been proposed when the objective is to supply a three-phase motor from single-phase ac mains. It is quite common to have only a single phase power grid in residential, commercial, manufacturing, and mainly in rural areas, while the adjustable speed drives may request a three phase power grid. Single-phase to three-phase ac–dc–ac conversion usually employs a full-bridge topology, which implies in ten power switches. This converter is denoted here as conventional topology. Parallel converters have been used to improve the power capability, reliability, efficiency, and redundancy. Parallel converter techniques can be employed to improve the performance of active power filters, uninterruptible power supplies (UPS), fault tolerance of doubly fed induction generators, and three-phase drives. Usually the operation of converters in parallel requires a transformer for isolation. However, weight, size, and cost associated with the transformer may make such a solution undesirable. When an isolation transformer is not used, the reduction of circulating currents among different converter stages is an important objective in the system design. In this paper, a single-phase to three-phase drive system composed of two parallel single-phase rectifiers and a three phase inverter is proposed. The proposed system is conceived to operate where the single-phase utility grid is the unique option available. Compared to the conventional topology, the proposed system permits to reduce the rectifier switch currents, the total harmonic distortion (THD) of the grid

current with same switching frequency or the switching frequency with same THD of the grid current, and to increase the fault tolerance characteristics. In addition, the losses of the proposed system may be lower than that of the conventional counterpart. The aforementioned benefits justify the initial investment of the proposed system, due to the increase of number of switches.

Literature Review:

The non-sinusoidal nature of the input current drawn by the rectifiers increases reactive power, input current harmonics and input voltage distortion. This can be over come by using number of passive and active current wave shaping techniques suggested in the literature. But the passive power factor correction techniques have the disadvantages like large size of reactive elements, power factor improvement for a narrow operating region, large output dc voltage ripple Active current wave shaping techniques overcome these disadvantages and significantly improve the performance of rectifiers. Hysteresis current control is a simple active current wave shaping technique that gives close to unity power factor operation while delivering near sinusoidal currents. But when applied for three-phase rectifier requires three such identical stages of single-phase rectifiers . Three-phase diode rectifiers using discontinuous conduction of rectifier input current with a single boost switch gives close to unity power factor at constant turnon time and frequency of the boost switch . Current control technique may use continuous conduction mode or discontinuous conduction mode. The popular continuous mode of conduction with switch mode rectifiers are hysteresis current control with constant hysteresis window, Bang hysteresis current control and constant switching frequency current control with error triangulation . Discontinuous mode of conduction operates with constant switching frequency and variable turn-on time using one or two switches. In EAC it should yield the same area for the discontinuous current pulse as that of the area under reference input current in every switching period. Thus the criterion yields grater accuracy for single-phase rectifiers since it has a freedom to vary the turn-on time . Several dedicated power factor controller integrated circuits such as Microlinear's *ML*4812 and Unitrode *UC* 2854 are currently available. Zheren Lai proposed a family of constant switching frequency Pulse-Width-Modulated controllers for power factor correction that uses continuous conduction mode. For PF improvement the different techniques used are just touched upon. Each method is having its own advantages and drawbacks. Depending on the application in hand and the cost one has to select the method. The methods are Phase Angle Control (PAC), Asymmetrical Angle Control (AAC), Extinction Angle Control (EAC), Symmetrical

Methodology:

A digital phase converter creates a three phase power supply from a single phase supply. A digital signal processor (DSP) is used to control power electronic devices to generate a third voltage, which along with the single-voltage from the supply creates a balanced three-phase power supply.

AC power from the utility is converted to DC, then back to AC. The power switching devices used in this process are insulated gate bipolar transistors (IGBT).

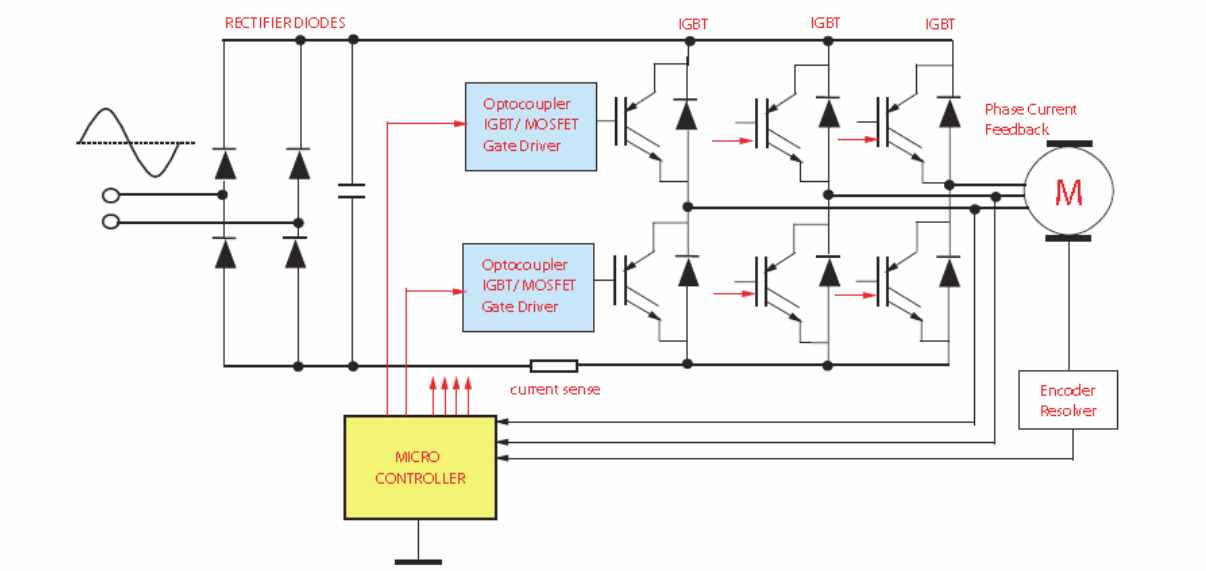
In one type of digital phase converter the input rectifier consists of IGBTs in series with inductors. The IGBTs are controlled by software in the DSP to draw current from the single-phase line in a sinusoidal fashion, charging capacitors on a constant voltage DC bus. Because the incoming current is sinusoidal, there are no significant harmonics generated back onto the line as there are with the rectifiers found in most VFDs. The controlled rectifier input allows power factor correction.

The output inverter consists of IGBTs that draw on the power of the DC bus to create an AC voltage. A voltage created by power switching devices like IGBTs is not sinusoidal. It is a pulse-width modulated (PWM) waveform very high in harmonic distortion. This PWM voltage is then passed through an inductor/capacitor filter system that produces a sine wave voltage with less than 3% total harmonic distortion (standards for computer grade power allow up to 5% THD). By contrast, VFDs generate a PWM voltage that limits their versatility and makes them unsuitable for many applications. Software in the DSP continually monitors and adjusts this generated voltage to produce a balanced three-phase output at all times. It also provides protective functions by shutting down in case of utility over-voltage and under-voltage or a fault. With the ability to adjust to changing conditions and maintain voltage balance, a digital phase converter can safely and efficiently operate virtually any type of three-phase equipment or any number of multiple loads.

Project Development:

We can use the number of transistor (IGBT) to convert 1 phase to 3 phase. Also we can use the various type of capacitor to reduse noise and losses due do which the improve the efficiency.

1. Circuit Diagram :



2. Observation :

- Understanding Differentiate between the constructional and operation features of uncontrolled and controlled converters
- Drawing the waveforms and calculate their average and RMS values of different variables associated with a single phase fully controlled half wave converter.
- Explaining the operating principle of a single phase fully controlled bridge converter.
- Identify the mode of operation of the converter (continuous or discontinuous) for a given load parameters and firing angle.
- Analyzing the converter operation in both continuous and discontinuous conduction mode and there by find out the average and RMS values of input/output, voltage/currents.
- Explaining the operation of the converter in the inverter mode.

Conclusion:

A single-phase to three-phase drive system composed of two parallel single-phase rectifiers, a three-phase inverter and an induction motor was proposed. The system combines two parallel rectifiers without the use of transformers. The system model and the control strategy, including the PWM technique, have been developed. The complete comparison between the proposed and standard configurations has been carried out in this paper. Compared to the conventional topology, the proposed system permits to reduce the rectifier switch currents, the *THD* of the grid current with same switching frequency or the switching frequency with same *THD* of the grid current and to increase the fault tolerance characteristics. In addition, the losses of the proposed system may be lower than that of the conventional counterpart. The initial investment of the proposed system (due to high number of semiconductor devices) cannot be considered a drawback, especially considering the scenario where the cited advantages justify such initial investment. The experimental results have shown that the system is controlled properly, even with transient and occurrence of fault.