A Review of Simulation & Performance of Three Phase half Controlled Converter with Various Parameter

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Abstract— *This Paper present on power Electronics Converter Circuits modelling and Simulation and analysis of various parameters. This paper deals with the analysis and Simulation of three-phase ac to dc converter analyzed on the basis of performing parameters and simulated with different types of loads. A phase-controlled converter is an integral part of any power supply units which are used in the all Electrical equipments, also there are used in power electronics equipments. Single phase converters are also used to drive the D.C. motors.*

Keywords— Three-phase half controlled converter, D.C. motor, performing Parameters

I. INTRODUCTION

A rectifier is an electrical device that converts alternating current (AC) to direct current (DC), a process known as rectification. Rectifiers have many uses including as components of power supplies and as detectors of radio signals.

When only one diode is used to rectify AC (by blocking the negative or positive portion of the waveform), the difference between the term diode and the term rectifier is merely one of usage, i.e., the term rectifier describes a diode that is being used to convert AC to DC. Almost all rectifiers comprise a number of diodes in a specific arrangement for more efficiently converting AC to DC than is possible with only one diode.

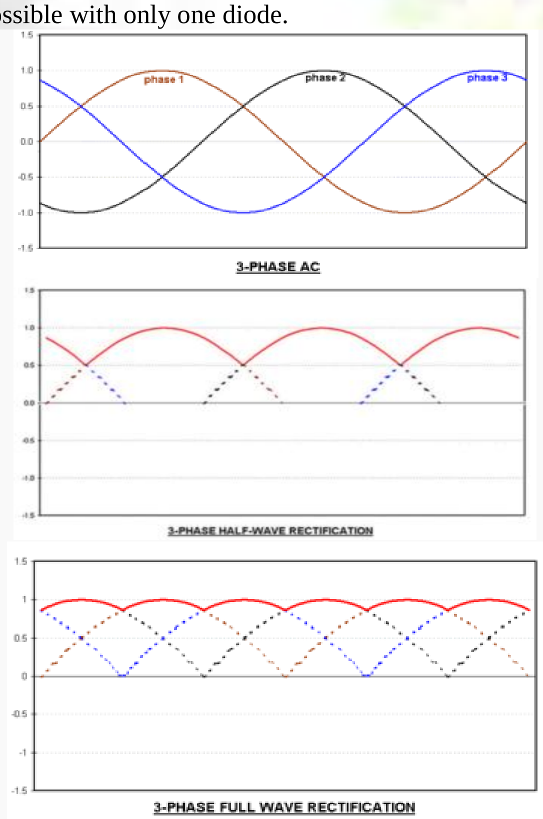

Fig. 1: 3-phase AC input, half & full wave rectified DC output waveforms

For three-phase AC, six diodes are used. Typically there are three pairs of diodes, each pair, though, is not the same kind of double diode that would be used for a full wave single-phase rectifier. Instead the pairs are in series (anode to cathode). Typically, commercially available double diodes have four terminals so the user can configure them as single-phase split supply use, for half a bridge, or for three-phase use.

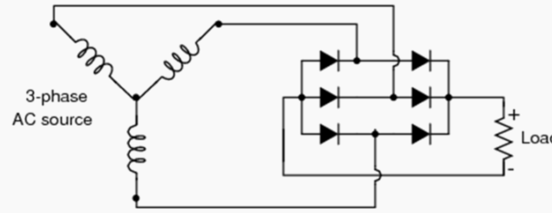

Fig. 2: Three-phase full-wave bridge rectifier circuit.

Each three-phase line connects between a pair of diodes: one to route power to the positive (+) side of the load, and the other to route power to the negative (-) side of the load. Polyphase systems with more than three phases are easily accommodated into a bridge rectifier scheme. Take for instance the six-phase bridge rectifier circuit in Figure below.

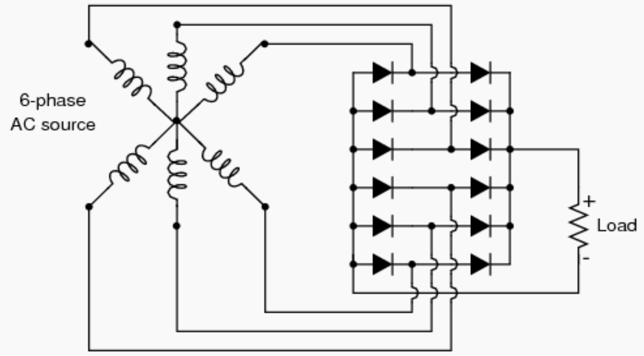

Fig. 3: Six-phase full-wave bridge rectifier circuit.

When polyphase AC is rectified, the phase-shifted pulses overlap each other to produce a DC output that is much “smoother” (has less AC content) than that produced by the rectification of single-phase AC. This is a decided advantage in high-power rectifier circuits, where the sheer physical size of filtering components would be prohibitive but low-noise DC power must be obtained.

The answer to this question is yes: especially in polyphase circuits. Through the creative use of transformers, sets of full-wave rectifiers may be paralleled in such a way that more than six pulses of DC are produced for three phases of AC. A 30^{o} phase shift is introduced from primary to secondary of a three-phase transformer when the winding configurations are not of the same type. In other words, a transformer connected either Y-Δ or Δ-Y will exhibit this 30^{o} phase shift, while a transformer connected Y-Y or Δ-Δ will not. This phenomenon may be exploited by having one transformer connected Y-Y feed a bridge rectifier, and have another transformer connected Y-Δ feed a second bridge rectifier, then parallel the DC outputs of both rectifiers. (Figure below) Since the ripple voltage waveforms of the two rectifiers' outputs are phase-shifted 30º from one another, their superposition results in less ripple than either rectifier output considered separately: 12 pulses per 360º instead of just six:

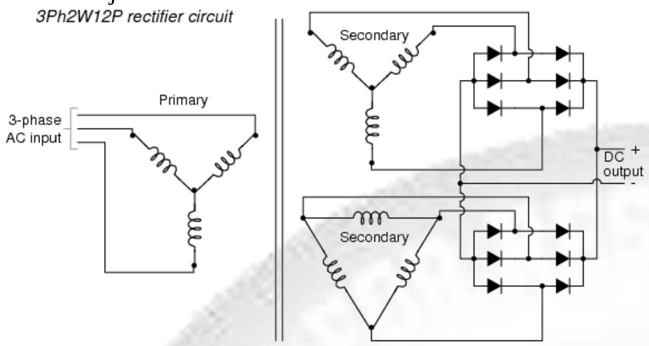

Fig. 4: Polyphase rectifier circuit: 3-phase 2-way 12-pulse (3Ph2W12P)

II. DC ELECTRIC MOTOR

Brushless DC electric motor (BLDC motors, BL motors) also known as electronically commutated motors (ECMs, EC motors) are synchronous motor that are powered by a DC electric source via an integrated inverter/switching power supply, which produces an AC electric signal to drive the motor. AC, alternating current, does not imply a sinusoidal waveform, but rather a bi-directional current with no restriction on waveform. Additional sensors and electronics control the inverter output amplitude and waveform (and therefore percent of DC bus usage/efficiency) and frequency (i.e. rotor speed).

Brushless motors may be described as stepper motors; however, the term stepper motor tends to be used for motors that are designed specifically to be operated in a mode where they are frequently stopped with the rotor in a defined angular position. This page describes more general brushless motor principles, though there is overlap.

A. Brushless Vs. Brushed Motors:

Brushed DC motors develop a maximum torque when stationary, linearly decreasing as velocity increases. Some limitations of brushed motors can be overcome by brushless motors; they include higher efficiency and a lower susceptibility to mechanical wear. These benefits come at the cost of potentially less rugged, more complex, and more expensive control electronics.

A typical brushless motor has permanent magnets which rotate around a fixed armature , eliminating problems associated with connecting current to the moving armature. An electronic controller replaces the brush/commutator assembly of the brushed DC motor, which continually switches the phase to the windings to keep the motor turning. The controller performs similar timed power distribution by using a solid-state circuit rather than the brush/commutator system.

The maximum power that can be applied to a brushless motor is limited almost exclusively by heat; too much heat weakens the magnets and may damage the winding's insulation.When converting electricity into mechanical power, brushless motors are more efficient than brushed motors. This improvement is largely due to the brushless motor's velocity being determined by the frequency at which the electricity is switched, not the voltage. Additional gains are due to the absence of brushes, which reduces mechanical energy loss due to friction. The enhanced efficiency is greatest in the no-load and low-load region of the motor's performance curve. Under high mechanical loads, brushless motors and high-quality brushed motors are comparable in efficiency.

B. Controller Implementations:

Because the controller must direct the rotor rotation, the controller requires some means of determining the rotor's orientation/position (relative to the stator coils.) Some designs use hall effect sencers or a rotary encoder to directly measure the rotor's position. Others measure the back EMF in the undriven coils to infer the rotor position, eliminating the need for separate Hall effect sensors, and therefore are often called sensorless controllers.In a Brushless DC motor, two coils are energized at a time with equal and opposite polarities, one pushes the rotor away from it while the other attracting the rotor towards it. This increases the overall torque capacity of the motor and use hall effect sencers .

A typical controller contains 3 bi-directional outputs (i.e. frequency controlled three phase output), which are controlled by a logic circuit. Simple controllers employ comparators to determine when the output phase should be advanced.Controllers that sense rotor position based on back-EMF have extra challenges in initiating motion because no back-EMF is produced when the rotor is stationary. This is usually accomplished by beginning rotation from an arbitrary phase, and then skipping to the correct phase if it is found to be wrong. This can cause the motor to run briefly backwards, adding even more complexity to the startup sequence. Other sensorless controllers are capable of measuring winding saturation caused by the position of the magnets to infer the rotor position.

C. Variations in Construction:

Brushless motors can be constructed in several different physical configurations: In the 'conventional' configuration, the permanent magnets are part of the rotor. Three stator windings surround the rotor. In the outrunner (or external-rotor) configuration, the radial-relationship between the coils and magnets is reversed; the stator coils form the center (core) of the motor, while the permanent magnets spin within an overhanging rotor which surrounds the core. The flat or axial flux type, used where there are space or shape limitations, uses stator and rotor plates, mounted face to face. Outrunners typically have more poles, set up in triplets to maintain the three groups of windings, and have a higher torque at low RPMs. In all brushless motors, the coils are stationary.

There are two common electrical winding configurations; the delta configuration connects three windings to each other (series circuits) in a triangle-like circuit, and power is applied at each of the connections. The Wye (Y-shaped) configuration, sometimes called a star winding, connects all of the windings to a central point (parallel circuits) and power is applied to the remaining end of each winding.

Although efficiency is greatly affected by the motor's construction, the Wye winding is normally more efficient. In delta-connected windings, half voltage is applied across the windings adjacent to the driven lead (compared to the winding directly between the driven leads), increasing resistive losses. In addition, windings can allow high-frequency parasitic electrical currents to circulate entirely within the motor. A Wye-connected winding does not contain a closed loop in which parasitic currents can flow, preventing such losses.

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