

Harmonic Reduction in Power System

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Abstract

The principle of this paper is to know the effects of harmonics in a power system and to minimise the effects of the power system harmonics. This distortion will result in low power quality and improved disturbances in power system. So this harmonic technique is used to improve the power quality. This improvement includes the simulation also. Inverter is used to transform a DC into AC, during this transformation; the harmonics will reduce the power quality a lot. The increase in power quality using a technique is explained in detail here.

Keywords: - harmonics, power quality, inverters, power system.

I. Introduction

The term harmonics referred to Power quality in ideal world would mean how pure the voltage is, how pure the current waveform is in its sinusoidal form. Power quality is very important to commercial and industrial power system designs. A perfect sinusoidal waveform must be without any kind of distortion. If there is any distortion in terms of current or voltage it will be called as harmonic distortion. This distortion can be due to many reasons.

Now - a - days, engineers try very hard to derive some methods to reduce the harmonic distortion. Because of the simple and conservative designs of power systems, harmonic distortion was less before. but now the harmonic distortion has increased very well due to the complex designs in the industry.

This project helps us to understand the effects of harmonics in power system and explains the way to reduce it. From this project we can also be able to know the important problems related with power quality and the disturbances to the power system. This project includes the techniques to reduce the harmonics and to improve the power quality. It also includes simulation for the same. This project also explains different types of inverters that are used in the Power System. During the transformation from DC to AC, harmonics affect the power quality a lot. How harmonic reduction will improve the power quality will be explained in detail as shown.

A. Cause of Power Quality Deterioration

Power system generates electrical energy to the end user. Power quality is a term which is associated with power system generation. Power quality is much important term that it is considered as a separate area of power engineering. There is so many reasons for the importance to the power quality. one main reason is, the users know about the power quality issues like sagging, interruptions and switching transients.

The power systems are connected using a network. Due to this integration if a failure exists in any one of the internal network it would result into unfavourable consequences to the whole power system. In addition to all this, with the microprocessor based controls, protective devices become more sensitive towards power quality variation than were the past generation protective devices.

The power systems have some disturbances, some of them are

- 1.) Transients
- 2.) Sagging
- 3.) Variations in voltage
- 4.) Harmonics

B. Harmonic Reduction in Inverters

We normally convert Direct current to Alternating current with the DC to AC inverters. When the output is alternating current, then the devices are called as AC to AC cycloconverters or DC to AC inverters, depending on the input. These inverters are such devices where the frequency and magnitude is either fixed or variable.

Inverters have a great application that it is used in UPS (uninterruptible power supply). UPS will use batteries and inverter when the power is not available. this UPS uses rectifier in it which is used to recharge the batteries when there is main power. The speed of AC motor is controlled by controlling the frequency and voltage of power supplied to the motor. this AC inverter is used in the variable frequency drives and induction motor to provide controlled power and to regulate the speed by changing the frequency of AC output respectively.

Types of Inverters:

There are three types of inverters

- Single Phase Inverters
- Three Phase Inverters

Single Phase Inverters:

This consists of four IGBT devices (also called power control devices) with two IGBTs are connected in series with each other and the other two are connected in series with each other. All the power controlling devices will have diodes which are connected in parallel with each other but they will be opposite in direction. Between the two IGBT devices and diodes there will be loads connected. This is the way they got connected, that is if the two IGBTs are switched off, then there will be a path for the load current to flow. if the second IGBT is switched on, the current will be carried towards the negative bus and through the parallel connected diodes. This second IGBT is switched off, the current have to travel through the parallel but opposite connected diode and reach the first IGBT. Here, controllers also will be used in order to control the switching on and off of the IGBT circuits. It will be commanded in such a way that when first IGBT is on, the second IGBT will be off and vice versa.

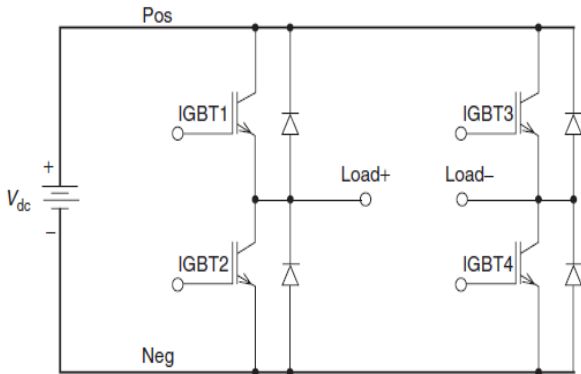


Figure 1: Single Phase Inverter.

C.Three Phase Inverters:

There will be a phase shift of 180 degrees between the legs of the single phase inverter, whereas there will be a phase shift of 120 degrees in a single phase inverter. The phase shift in three phase inverter eliminates the odd harmonics from the three legs of inverter, where as it eliminates even harmonics if the output is pure AC. to modulate output of a three phase inverter, the output amplitude is reduced by a factor with respect to input voltage.

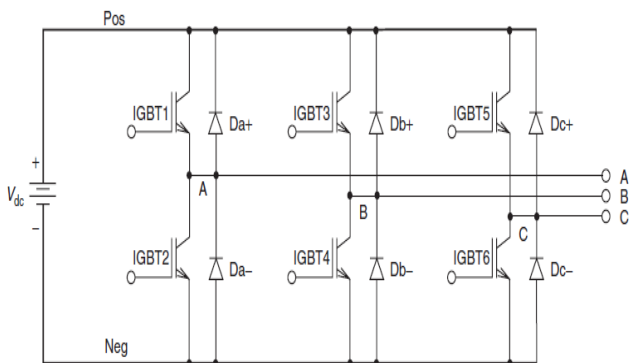


Figure 2: Three Phase Inverter

**D. Method for Harmonic Reduction in Inverters
 Pulse Width Modulation Technique**

Single phase inverter block diagram with a high frequency filter which is used to remove the harmonics from the output waveform. Here, ac output is VO while input dc voltage is Vdc.

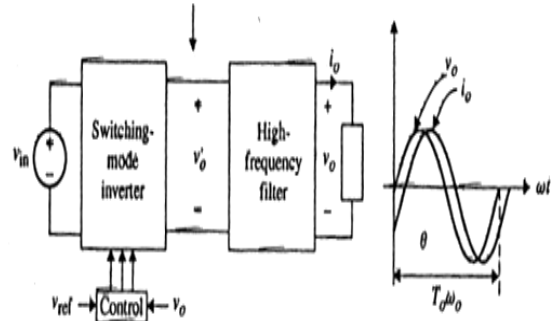


Figure 3: Single Phase Inverter with filter

Figure shows output waveforms that gets produced based on the Pulse width modulation technique when it is employed.

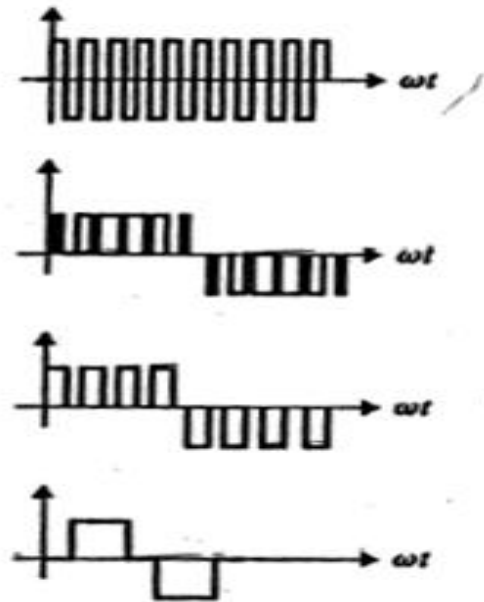


Figure 4: Output waveforms Produced Based on PWM Technique

In single phase inverter, output voltage is controlled by the varying width of the output. This particular process of controlling the output voltage in order to reduce the harmonics is called as Pulse width modulation.

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