IMPROVEMENT OF POWER QUALITY USING PWM TECHNIQUES

NIRAJ KUMAR , Associate professor R.K Gupta
Dept. of Electrical Engineering
Gyan Vihar School of Engg & Technology
Jaipur, Rajsthan
neeraj3614@gmail.com

Abstract- The main purpose of this paper is to improve the power quality by using PWM Techniques and also discussed the effect of harmonics. This paper is explain the power quality in term of definitions, causes and effect. To improve the fundamental peak voltage and harmonics reduction be use many configuration of PWM techniques. In addition detail comparison of all configuration in term of THD, FET and dominating harmonics element. The PWM technique is minimize the harmonics and also eliminate the harmonics. The PWM technique is represent by a simple algebraic equation. This paper result describe on the basis of MATLAB simulation

Index Terms - Power quality, PWM Technique, THD, Harmonics, FET.

1 INTRODUCTION

Power quality is a mechanism used to describe electric power that rotates an electric load and load's demand properly work with the electric power. With not a proper power, an electrical device or load may fail or not operate at all. There are many reason of poor quality power. Power quality refers mainly to maintenance of the ac waveform at rated frequency, undistorted balance at rated voltage.

Power quality is defined in different –different term by different-different people. There are many confusion in the meaning of 'power quality' not at least because power is a synonyms of 'electricity' in American English it also called energy transport per unit of time. In a simple word power quality is a set of electrical limits that permits a part of equipment to work in a manner without loss of performance [4].

Power quality is one of the important part in the present time .power quality performance is very thoughtful to the quality of power supply. Power quality problem is occurs between non-standard voltage and current or frequency. When the results are failure with the end use of equipments the major problem in power quality is voltage sag.

In the use of highly solid state switching device the power quality issues and problem are consider in these device. For non sinusoidal current flow through the transmission lines, distribution, wide spread of power semiconductor switches are utilized [1]. Mostly power electronic load is causes of voltage distortions, harmonics and distortion. There are many problem occurs causes of power quality like as system equipment does not work, computer data loss, memory loss of sensitive equipment such as computer, programming logic controls, and protection [1]. Most affecting part of distribution system is voltage sag and swell. It is also wide spread power quality issue affecting specially industries where involved losses can be reach very high values. Voltage sags are caused by faults elsewhere in the system. They have received special attention now because spectacular failure have highlighted the problem that result from the performance of computer controlled loads and adjustable speed drives during these voltage sags/swells. Sags/swells can cause components over heating or destruction. Sags/swells not only cause considerable productivity loss but there are also hard to control. Sag /swell are events of short duration but high impact. Voltage sag and swell is the 10% to 90% problem of power quality especially in industry [2]. The main causes of voltage sags are short circuits, lightning strokes, inrush currents, and swell can also occur due to single line to ground fault on the system, which can result in a temporary voltage will be rise on the phases [3].

II Types of power quality problem

Different people say gives different-different definition. Some definitions are defined here.

A. Voltage sags (or dips)

Voltage sag is occurs for short duration these duration is 0.5cycle to 1 minute and also reduction in rms voltage. In the normal voltage level will be decrease 10 to 90% of the nominal voltage.

I)Causes : whenever load end side draw heavy current suddenly than fault will be associated on transmission or distribution network, also fault in consumer's installation.

II) Consequences: Tripping of connectors and electromechanical relay based on micro controller these are (PSc, PLCs, etc) [4].

B. Long interruptions:

Total interruption in the electrical supply in the long time interval these durations are greater than 1 to 2 seconds.

I)Causes: component failure in power system network lines striking, poles, fire , human error, Failure of insulation.

II)Concequences: Stoppage of all component.

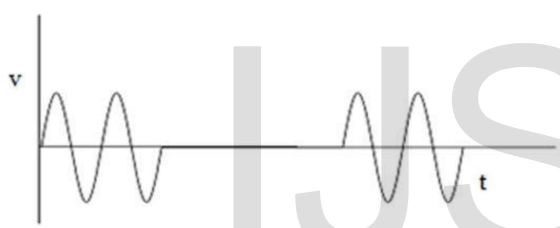


Fig 1 Long interruption

C. Voltage Spike

It is very fast changing of voltage for durations from a few microseconds to few milliseconds. These changes reach thousand of volts, in low voltage [4].

I)Causes :Lightning arrestors is natural phenomena, switching problem, power factor correction capacitor, sudden remove of heavy load.

II)Concequences: Damage of equipment and out of insulation on materials, data processing errors ,electromagnetic interference or information losses.

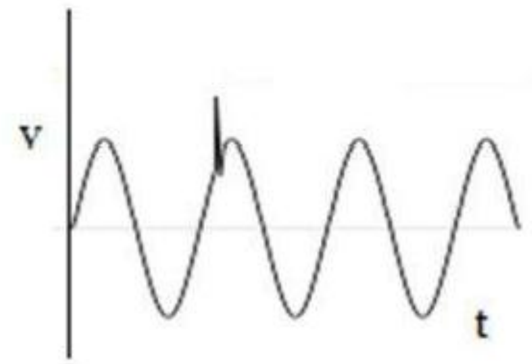


Fig 2 Voltage spike

D .Voltage swell

This voltage is momentary increase at power frequency with the duration of more than one cycle less than few seconds is called voltage swell.

I)Causes:Start/ stop of heavy Loads, badly regulated transformers.

II)Concequences: flickering of lighting and screens, data loss, damage of sensitive equipment, if the voltage will be more high.

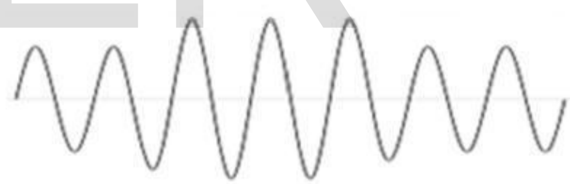


Fig 3 voltage swell

E. Harmonic distortion:

In the voltage or current waveform is distorted in a period. Their waveform is the sum of different sine wave with different magnitude and phase that are multiples of power-system frequency.

I)Causes:- Arc furnaces electric machines working above the magnetic saturation, welding machines, rectifiers, All non linear loads, switch power supplies, high efficiency lighting.

II)Consequences: neutral overloading in 3 phase systems, overheating of all cables and equipment, loss of efficiency in electrical machines, electromagnetic interference with communication system, tripping of thermal protection, errors in measures when using average reading meters.

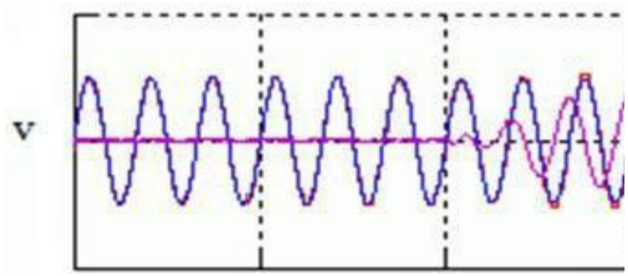


Fig 4 Harmonic distortion

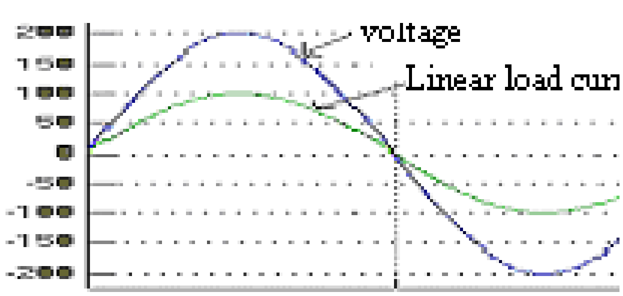
F. Voltage fluctuation

It is a type of series random voltage variations. The Variation does not excess the range of 0.9 to 1.1p.u. the Oscillation occurs in voltage and amplitude modulated by a signal with frequency of 0to 30HZ.

I)Causes: Frequently start/stop of electric motors, Oscillating loads, arc furnace.

II) Consequences: the most important is the flickering of lighting and screens.

Voltage quality is the variation of the voltage from the ideal. It is a single frequency sine wave of constant amplitude and frequency. Current quality is also concerned with the variation of the current from the ideal case. It is again a single frequency sine wave of constant amplitude and frequency. Current sine wave is in phase with voltage.



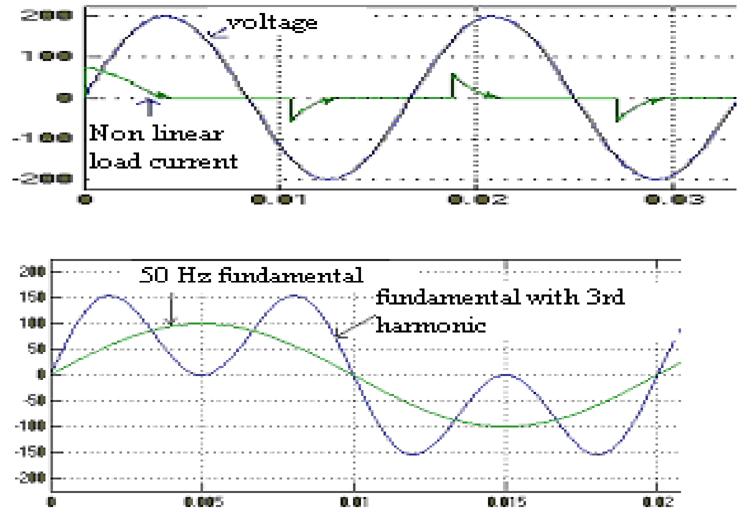


Fig 6 Waveform shape (a) Voltage and current waveform for linear load (b) Voltage and current waveform for non linear load (c) waveform with symmetric harmonic component.

III) INTRODUCE ABOUT HARMONICS

Nowadays due to increase the usage of non-linear load its main reason is harmonics. Non-linear load is a type of load in which current is not proportional to the applied voltage. Different non-linear loads will have different voltage –current characteristics.

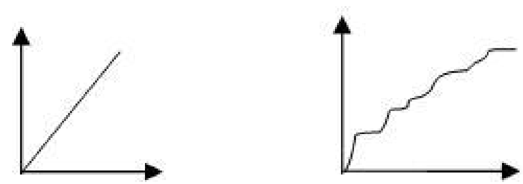


Fig 7 Comparison of linear and non-linear VI characteristics

In this graph a slight increase voltage can cause the current to double. Distorted wave is the sum of pure sine wave in which frequency of each sinusoid is an integer multiple of fundamental frequency (50Hz). Earlier odd harmonics components (3^{rd} , 5^{th} , 7^{th}) are the most effective of the system.

A Voltage and current distortion

Source of harmonic current waveform is distorted because of the non-linear loads. Distorted currents passing through the linear circuits so voltage distortion will be occur. There have no control on the load in the over voltage distortion.

In the power system the same load in two different locations in two different voltage distortion value.

B. Even Harmonics

Even harmonics (2nd , 4th , 6th) are likely occurs in electrical system. Non linear loads normally generate odd harmonics. When positive and negative half cycle waveform is in similar shape in the non-linear load. Fourier series contain only odd harmonics.

C. Odd harmonics

Odd harmonics (3rd , 5th &7th) is common in power system. It is not controlled. Each odd harmonics is arranged with a harmonics sequence component (positive, negative, and zero) . phase sequence is very important because its effect of the harmonics on the operation of electric equipment.

Harmonics	Component
1	Positive
3	Zero
5	Negative
7	Positive
9	Zero
11	Negative
13	Positive

TABLE 1 Harmonics and their corresponding sequence component

IV RESULT

There are many method to improved the power quality by PWM converter. All the PWM techniques has been simulated in MATLAB Software and show the result by waveform its FET. The different configuration of the PWM technique like Multi pulse PWM, Unipolar PWM

Parameter	Peak fundamental	THD %	Dominating Harmonics
Square Wave	1.261Vdc	48.3	3rd ,5th ,7th
Multi Pulse PWM	1.245Vdc	38.5	3rd ,5th ,7th
Uni polar PWM	.866Vdc	3.76	43rd and 45th
Trapeozoidal PWM	1.05Vdc	38.5	3rd ,5th ,7th
Selective Harmonics	1.18Vdc	4.8	27th
Modified PWM	.866Vdc	3.76	43rd and 45th
Ac PWM	1.10Vdc	22.35	19th ,21st

TABLE 2 Comparison of PWM Techniques

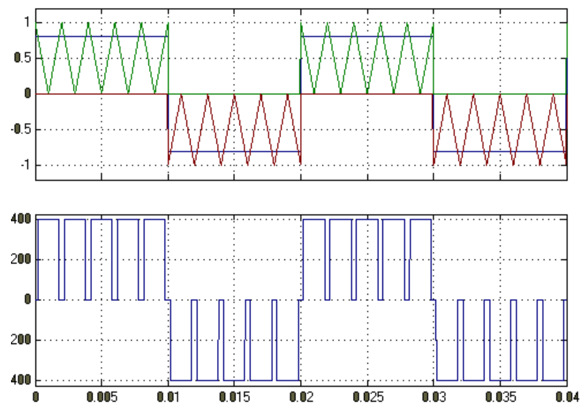


Fig 9(a) Multi pulse PWM i/p & o/p waveform

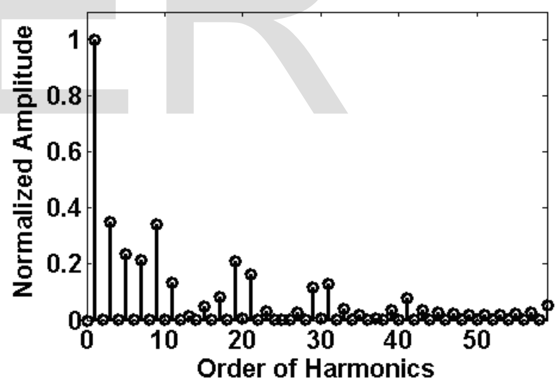


Fig 9(b) FET of multi pulse PWM Scheme

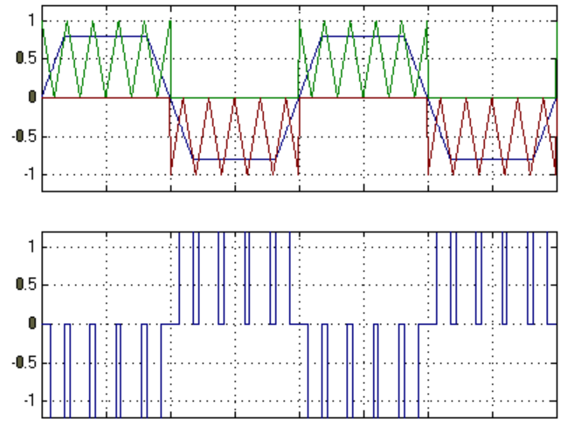


Fig 10(a) Trapezoidal PWM i/p &o/p Waveform

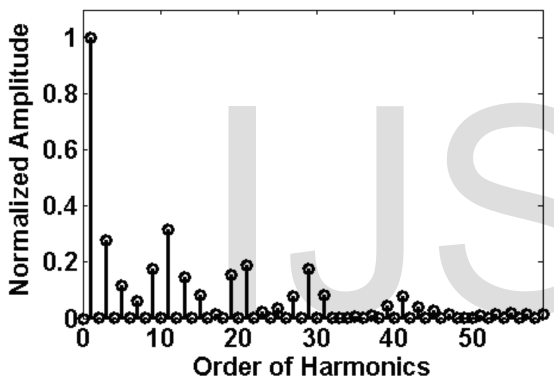


Fig 10(b) FET Of Trapezoidal PWM scheme

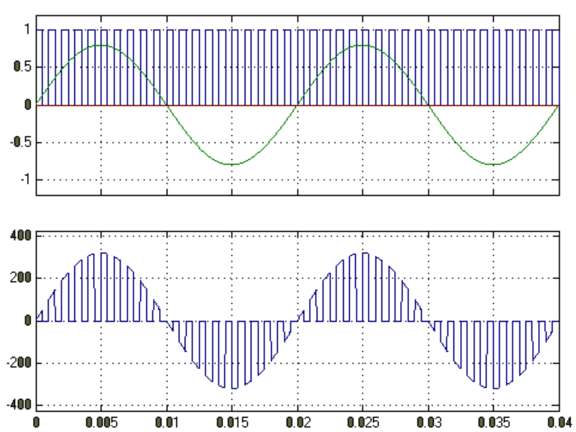


Fig 11(a) Ac Voltage i/p & O/p Waveform

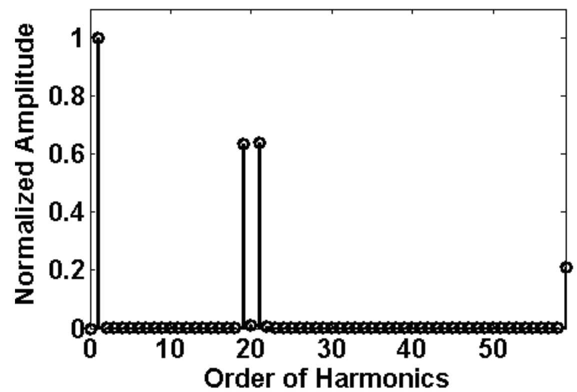


Fig 11(b) FET of AC Voltage PWM Scheme

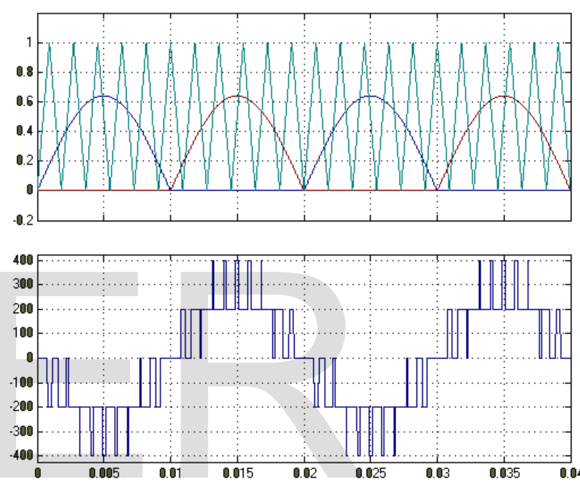


Fig 12(a) Unipolar PWM i/p & O/p Waveform

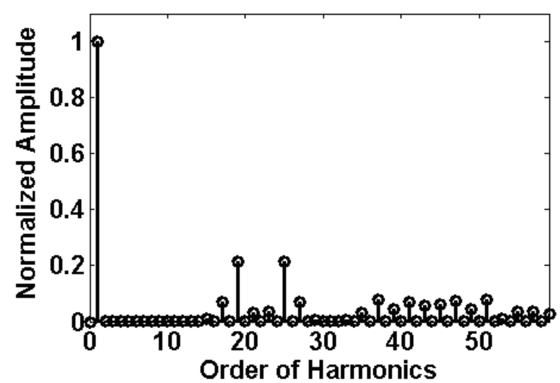


Fig 12(b) FET of Unipolar PWM Scheme

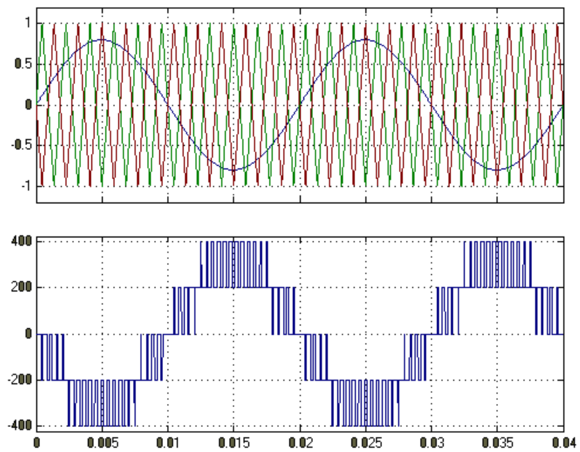


Fig 13(a) Modified SPWM i/p & o/p waveform

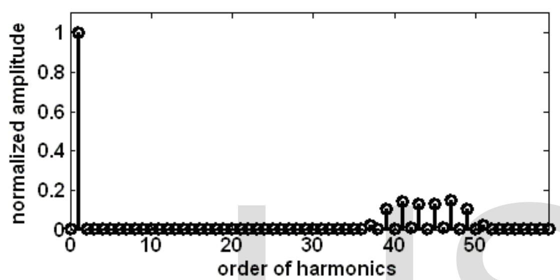


Fig 13(b) FET of modified PWM Scheme

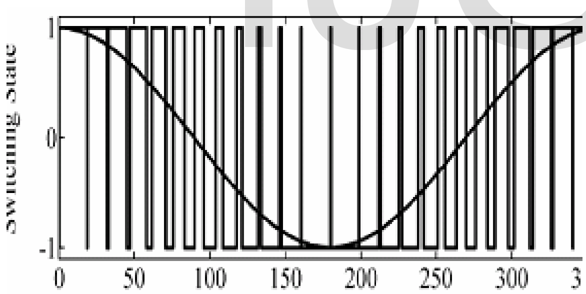


Fig 14(a) Selective harmonics elimination i/p & o/p waveform

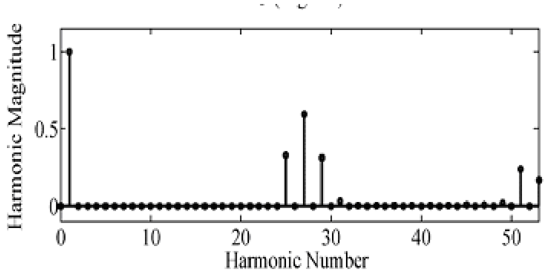


Fig 14(b) FET of selective harmonics elimination

PWM Scheme

V CONCULISION

There are many paper will be view in PWM and the simulated on the MAT LAB. PWM technique is very useful method of improving the power quality. There are many method will be consider here and discussed output waveform of these method.

Output of all PWM techniques are modified in all SPWM technique is the best method. The Peak fundamental output is 0.8 P.U. the THD is well below the limit is 3.79% and dominating harmonics lie between 43rd and 45th order of harmonics.

VI ACKNOWLEDGEMENT

The author wish thank to everyone who have directly or indirectly spotted for the completion of the work there valuable comments and suggestion has greatly improve the quality of paper.

REFERENCES

[1]. Chellali Benachaiba, Brahim Ferdi ―Voltage Quality Improvement Using DVR‖ Electrical Power Quality and Utilization, Journal Vol. XIV, No. 1, 2008.

[2]. Dash P.K., Panigrahi B.K., and Panda G., ―Power quality analysis using S-transform‖, IEEE Trans. On Power Delivery, vol. 18, no. 2, pp. 406–411, 2003.
.

[3] Bose, B.K. *" Modern Power Electronics and Drive System"*

[4]. Shalini Bajpai ―Power Quality Improvement Using Ac To Ac PWM Converter for Distribution Line‖ International Journal of Computational Engineering Research, Vol. 03, Issue 7, July 2013.

[5] W. Mack Grady, Surya Santoso, *"Understanding Power System Harmonics"* IEEE Power Engineering Review, November 2001.