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“INVESTIGATIONS ON VARIOUS POWER ELECTRONIC CONVERTERS USING PWM TECHNIQUE”

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ABSTRACT: Power electronics deals with variety of converters that are used at power level rather than the signal level. The commonly used type of converters are DC to DC, DC to AC, AC to AC and Cycloconverters, these converter finds industrial applications. Pulse width modulation (PWM) is one of the techniques used in power electronic converters. This is the most preferred method since PWM offers many advantages. In this dissertation, the applications of PWM techniques on different types of power electronic converters are studied. The simulation is carried out using SIMULINK and MULTISIM. In the first part of this paper, the generations of PWM signal using different methods are explained. Using Multisim, different PWM generating circuits are analyzed and the results are discussed. The application of PWM converters like on dc to dc buck boost Converter, DC to DC mono-polar inverter, DC to AC bipolar inverter, half bridge inverter, full bridge inverter, cycloconverter, AC - DC -AC converter are simulated using simulink. These are explained and results are discussed. Lastly in this paper explains about simulation of power electronic converters on ac to ac converter is used for analysis of PWM, here ac voltage regulator operating on both uniform pulse width modulation and sinusoidal pulse width modulation principle under loading conditions. Matlab results of both PWM is verified. In this dissertation One more program is simulate i.e. for dc to ac converter is used and generate the PWM waveform. The matlab values for different carrier frequency verified and analysis the result.

Keywords: PWM(pulse width modulation), SPWM(sinusoidal pulse width modulation), UPWM(uniform pulse width modulation)

I.INTRODUCTION

Power electronics belongs partly to power engineering and partly to electronics engineers. Power electronics is a subject that concerns the application of electronic-principles into situation that are rated at power level rather than signal level. It may also be defined as a subject that deals with the apparatus and equipment working on the principle of electronics but rated power level rather than signal level. For example, semiconductor power switches such as Thyristors, GTOs etc. work on the principle of electronics but have the name power attached to them only as a description of their power ratings. The term ‘converter system’ general, is used to denote a static device that converts AC to DC, DC to AC, AC to AC, AC to DC. Conventional power controller based on thyristors, mercury arc rectifier, rheostat controller etc. have been replaced by power electronic controller using semiconductor devices, and new circuit topologies with their improved performance and their fall in prices have opened up wide field for the new application of power electronic converters.

A power electronic system consists of one or more power electronic converters. A power electronic converter is made up of some power semiconductor devices controlled by integrated circuit. The switching characteristic of power



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semiconductor devices permits a power electronic converter to shape the input power of one form to output power of some other form. Power electronic converters can be classified into four types 1)DC to DC 2)DC to AC 3)AC to AC 4) AC to DC

DC TO DC converter Dc choppers convert fixed dc input voltage to a controllable dc output voltage. The chopper circuits require forced, or load, commutation to turn off the thyristor. For lower power circuits, thyristors are replaced by power transistors.

DC TO AC converter :An inverter convert's fixed dc voltage to variable fixed ac voltage. The output may be variable voltage and variable frequency. **AC to AC Converter**: These Converter fixed ac input voltage into variable ac output voltage. These are of two types as under (a) ac voltage controller, (b)cycloconverter The cycloconverter after these converter input power at one frequency to output power at different frequency through one stage circuit conversion.AC to AC voltage converters operates on the AC mains essentially to regulate the output voltage

AC to DC Converter (Rectifier): This converter convert constant ac voltage to variable or fixed dc output voltage .These rectifier use line voltage for their commutation, as such these are also called line or natural commutated AC to DC Converter

Pulse Width Modulation PWM signals are pulse trains with fixed frequency and magnitude and variable pulse width. There is one pulse of fixed magnitude in every PWM period. However, the width of the pulses changes from pulse to pulse according to a modulating signal When a PWM signal is applied to the gate of a power transistor, it causes the turn on and turns off intervals of the transistor to change from one PWM period to another PWM period according to the same modulating signal. The frequency of a PWM signal must be much higher than that of the modulating signal, the fundamental frequency, such that the energy delivered to the motor and its load depends mostly on the modulating signal.

Pulse-width modulation (PWM) is a very efficient way of providing intermediate amounts of electrical power between fully on and fully off. A simple power switch with a typical power source provides full power only, when switched on. PWM is a comparatively-recent technique, made practical by modern electronic power switches.

In this paper main theme is PWM principles are used in different types of power electronic converters. The advantages of PWM techniques are used in power electronic converters ,for example in an rectifier the input power factor is less since transformer secondary current is not a pure sine wave this happens normally with RL or RLE load.In case of inverter circuit output voltage could be fixed or variable at a fixed or variable frequency. A variable output voltage can be obtained by varying the input dc voltage and maintaining the gain of inverter, which is normally accomplished by PWM control within the inverter. With the availability of high speed power semiconductor devices, the harmonics contents of output voltage can be minimized significantly by switching technique of PWM.In the case of chopper circuit harmonics are generated in the input and load side, and these harmonics can be reduced by input and output filter. A variable frequency chopper generates harmonics of variable frequency. But it is difficult to avoid by using filter so we can use PWM technique to avoid the harmonics in the output wave form. Hence different types of power electronic converter using PWM are studied.

II. PWM TECHNIQUES IN POWER ELECTRONIC CONVERTERS

PWM techniques are used in variety of power electronics converters like dc to dc converter, dc to ac etc. These are explained briefly

A. DC to DC The method presented in is used here and slightly adapted to preserve its general character and to expand it for use in more complex converters that do not have a PWM-switch as such shows four classical PWM converters: buck, boost, buck-boost, and Cuk converter. These converters have one active switch and one passive switch performing the switching action in the converter. The active switch is directly controlled for an external control signal. It is usually implemented with a bipolar or a field-effect transistor [5]. The passive switch is indirectly controlled by the state of the active switch and the circuit condition. It is usually implemented by a diode. Two switches can be combined into one network with three terminals *a*, *b*, and *c*, which stands for active, passive, and common respectively. This three-terminal network is called the PWM-switch. Since all other elements of the converters are supposed to be linear, the PWM-switch



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is the only nonlinear element and therefore responsible for the nonlinear behavior of the converters. The active and the passive switch operate like a single-pole double-throw switch. During the time interval DT , the passive switch is off and the active switch is on.

B. DC to AC (Pulse Width Modulation in Inverters)

Output voltage from an inverter can also be adjusted by exercising a control within the inverter itself. The most efficient method of doing this is by pulse-width modulation control used within an inverter. In this method, a fixed dc input voltage is given to the inverter and a controlled ac output voltage is obtained by adjusting the *on* and *off* periods of the inverter components [6]. This is the most popular method of controlling the output voltage and this method is termed as Pulse Width Modulation (PWM) Control.

C. Voltage and Current Source inverters:

Today voltage and current source inverter are widely used in electrical motor drives. In this drives, DC voltage or current are usually obtained by using rectifiers with phase control and line commutation converter. This type of rectifiers is the most used method in industrial applications. The most important disadvantages of classical rectifiers are: low order current harmonics generation on the AC line [10], lagging displacement factor establishment to the utility grid that in its turn consume an important amount of reactive power, unidirectional power transmission and large DC link filter. Besides, new limit has been applied by standards such as IEEE519- and IEC 6100-3-2/IEC 6100-3-4 that indicate the current harmonic limits of power electronic converters. To overcome these problems in past few years PWM rectifiers are presented. PWM rectifiers become more and more popular in industry application. There are several control strategies to control PWM rectifier such as Voltage oriented control (VOC) in which an internal current loop guarantees the high dynamics operation. This method largely depends on the quality of the applied current control strategy. Another control strategy is direct power control PWM rectifier control strategies can be studied based on the voltage and current. In these methods the vector of the line current is controlled by controlling the voltage drop on the line inductance.

D. AC to AC

Power conversion is accomplished by first rectifying the AC input voltage with a full bridge rectifier. After sufficient filtering using the DC link method, we are left with high current and low voltage DC signal. Then, using pulse width modulation and an H-bridge inverter, this DC signal is inverted into the desired sinusoidal signal at the load side. Very small and simplistic power converters are common, but there are a number of disadvantages. First efficiency, simplistic converters generate a lot of noise when compared to their output. Second disadvantage is their limited power availability. The third issue is accuracy of performance. Some precision electronic devices use the supply frequency for clocking or at least a relatively constant sine wave for some aspect of control.

III. GENERATION OF PWM SIGNAL

Pulse Width Modulation, is a method of controlling the amount of power to a load without having to dissipate any power in the load driver. Imagine a 10W light bulb load supplied from a battery. In this case the battery supplies 10W of power, and the light bulb converts this 10W into light and heat. No power is lost anywhere else in the circuit. If we wanted to dim the light bulb, so it only absorbed 5W of power, we could place a resistor in series which absorbed 5W, and then the light bulb could absorb the other 5W. This would work, but the power dissipated in the resistor not only makes it get very hot, but is wasted. The battery is still supplying 10W. An alternative way is to switch the light bulb on and off very quickly so that it is only on for half of the time. Then the *average* power taken by the light bulb is still only 5W, and the average power supplied by the battery is only supplying 5W also. If we wanted the bulb to take 6W, we could leave the switch on for a little longer than the time it was off, then a little more average power will be delivered to the bulb. This on-off switching is called PWM. The amount of power delivered to the load is proportional to the percentage of time that the load is switched on. In Case of speed controllers on this site, there is an explanation why PWM signals are used to drive speed controllers. It is the same reason as for the light bulb example above. Pulse Width Modulation (PWM) is a common technique for speed control which can overcome the problem of the poor starting performance of a motor. PWM for motor speed control works in a very similar way like bicycle riding. Instead of supplying a varying voltage to a motor, it is supplied with a fixed voltage value such as 12V which starts it spinning immediately. The voltage is then removed and the motor 'coasts'. By continuing this voltage on/off cycle with a varying duty cycle, the motor speed can be controlled.

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The waveforms in figure 1 help to explain the way in which this method of control operates. In each case the signal has maximum and minimum voltages of 12V and 0V.

1. In waveform a, the signal has a mark-space ratio of 1:1. With the signal at 12V for 50% of the time, the average voltage is 6V, so the motor runs at half its maximum speed.
2. In waveform b, the signal has a mark-space ratio of 3:1, which means that the output is at 12V for 75% of the time. This clearly gives an average output voltage of 9V, so the motor runs at 3/4 of its maximum speed.
3. In waveform c, the signal has a mark-space ratio is 1:3, giving an output signal that is 12V for just 25% of the time. The average output voltage of this signal is just 3V, so the motor runs at 1/4 of its maximum speed.

By varying the mark-space ratio of the signal over the full range, it is possible to obtain any desired average output voltage from 0V to 12V. The motor will work perfectly well, provided that the frequency of the pulsed signal is set correctly, a suitable frequency being 30Hz. Setting the frequency too low gives jerky operation, and setting it too high might increase the motor's impedance.

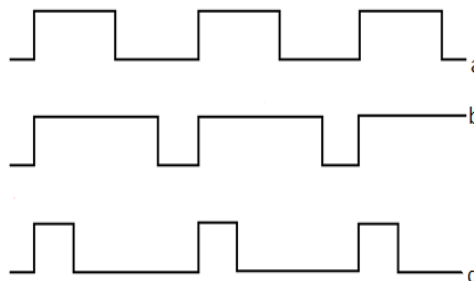


Fig 1. Pulse Width Modulation Wave Form

The concept of PWM inherently requires timing. Two 555 timer ICs and some potentiometers can be used to generate a PWM signal, and since PWM provides a digital, on/off signal, it is also easy to use a PC or micro-controller to create the signal; however this is beyond the scope of this article.

The Methods Of Generation Of PWM The PWM signals can be generated in a number of ways. There are several methods:

1. Analogue method ,2.Digital method ,3.Discrete IC ,4.Onboard microcontroller

1) Analogue method

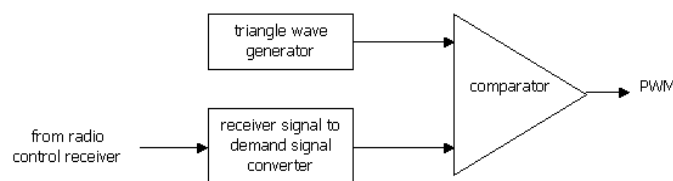


Fig 2 A block diagram of an analogue PWM generator

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We will now go through each of these stages and work out how to implement them. The comparator: We are starting at the output because this is the easy bit. The diagram below shows how comparing a ramping waveform with a DC level produces the PWM waveform that we require. The higher the DC level is, the wider the PWM pulses are. The DC level is the ‘demand signal’. The DC signal can range between the minimum and maximum voltages of the triangle wave.

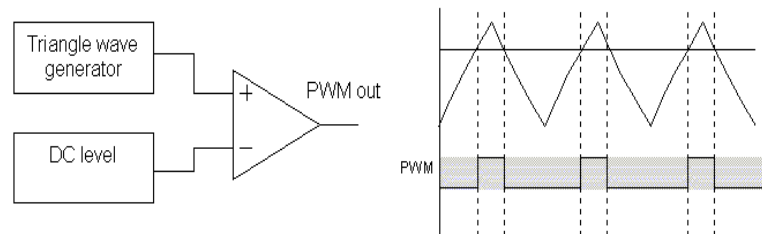


Fig 3. General circuit for PWM

When the triangle waveform voltage is greater than the DC level, the output of the op-amp swings high, and when it is lower, the output swings low.

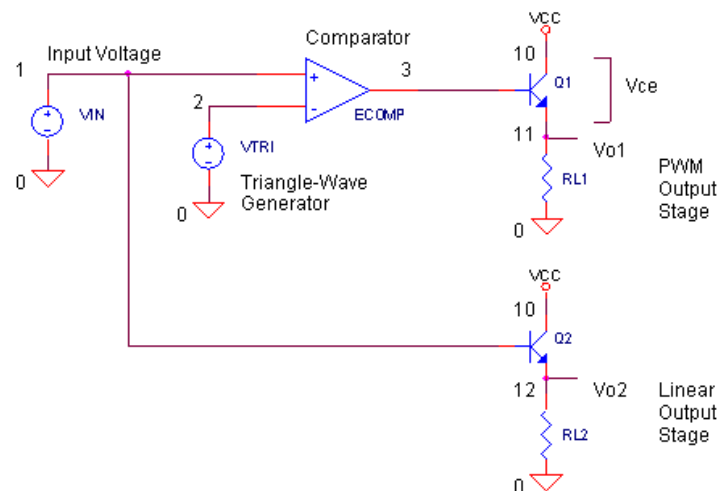


Fig 4. General PWM Circuit

One of the biggest problems with delivering power to a load (motor, heater, etc.) is in the power lost and heat dissipated in the output stage. And given the industry’s boom in battery-powered portable devices, power lost means a shorter battery life and heat dissipated implies larger more expensive components (power semiconductors and heat sinks). How can you reduce this wasted power? One clever method is a technique called Pulse Width Modulation (PWM). A conventional linear output stage applies a continuous voltage to a load. This can waste plenty of power (more below). On the other hand, PWM applies a pulse train of fixed amplitude and frequency, only the width is varied in proportion to an input voltage. The end result is that the *average* voltage at the load is the same as the input voltage; but with less wasted power in the output stage. How much advantage does PWM provide? After building a PWM system, we’ll face it off against a linear output stage.

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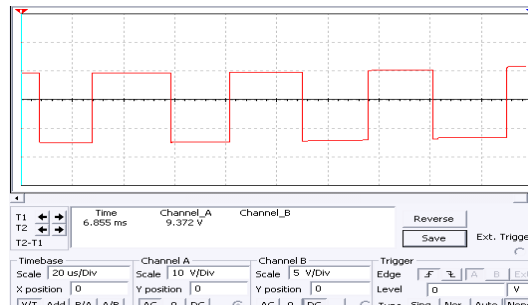


Fig 5 output of PWM Signal generation waveform

2. General-Purpose Pulse-Width Modulator Circuit Using Three Op Amps: A PWM circuit for such applications Figure 6. can be implemented with three op amps from a single quad-op-amp chip. The use of op amps allows a wide variety of applications. Low-power op amps can be used in a low-power system, for example, and high-frequency op amps can be used for a high-frequency PWM. The Figure 3.2 circuit also generates a triangular wave. This 3-op-amp circuit produces a triangular wave and a variable-pulse width output. The circuit consists of a triangle-wave generator (OPAMP 1) and OPAMP2) and a comparator (OPAMP 3). OPAMP 1 is configured as an integrator (or de-integrator), and OPAMP 2 as a comparator with hysteresis. At power-up, the comparator's output voltage is assumed to be zero. OPAMP 1's non-inverting input is biased at $V_{CC}/2$.

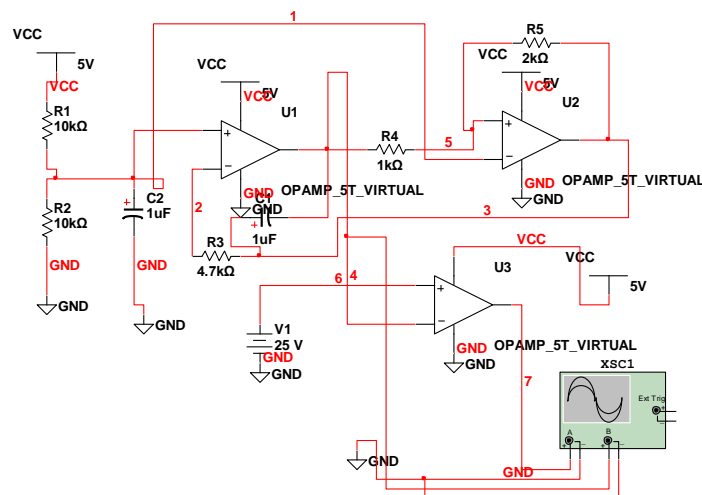


Fig 6 .General-Purpose Pulse-Width Modulator Circuit Using Three Op Amps

A virtual connection between the inverting and non-inverting inputs allows a constant current through R equal to $I = V_{CC}/2R$, which charges the capacitor C. Thus, the OPAMP 1 integrator output increases linearly with time. When it reaches $0.75V_{CC}$, the comparator output (OPAMP 2) changes to its maximum output voltage (V_{CC}). At that point the integrator begins to de-integrate, causing the output voltage to decrease linearly. When it reaches $0.25V_{CC}$ the comparator output voltage changes to zero, and the cycle repeats. Thus, the integrator output is a triangular wave that swings between the levels of $\frac{1}{4} V_{CC}$ and $\frac{3}{4}V_{CC}$. OPAMP 3 compares the triangular wave against the dc level V_{IN} . Its output is a square wave, with a duty cycle that varies from 0% to 100% as V_{IN} varies from $\frac{1}{4} V_{CC}$ to $\frac{3}{4} V_{CC}$ Figure 6. Frequency is determined by R, C, R1, and R2:

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$$f = \frac{R2}{4RCR1} \dots\dots\dots(1) \text{ where } R2 > R1$$



Fig 7. Output Of Three Op Amps

The ratio of R2 and R1 affects the operating frequency and the amplitude of the triangular wave. Given that V_{TH} is the triangular wave's maximum voltage and V_{TL} is its minimum voltage, the amplitude swing is $V_{TH} = VCC(R_1 + R_2) / 2R_2$ and $V_{TL} = VCC(R_1 - R_2) / 2R_2$ (2) where $R_2 > R_1$. The triangular wave's peak-to-peak voltage (the difference in its maximum and minimum voltages) is centered at the $VCC/2$ bias voltage generated by R3 and R4. The circuit configuration shown allows the PWM to operate on a single supply. Use micro power op amps and larger resistors (R and R1 - R4) for low-power applications, and high-frequency op amps for higher-frequency applications. (The quad op amp shown comes in a single package.)

IV. SIMULATION OF TYPES PWM CONVERTERS USING SIMULINK

1 DC to AC Monopole Inverter

$$V_2 \text{ fundamental} = m \cdot V_{dc} \quad V_{\text{peak}} = 0.8 \cdot 400 = 320 \text{ V}$$

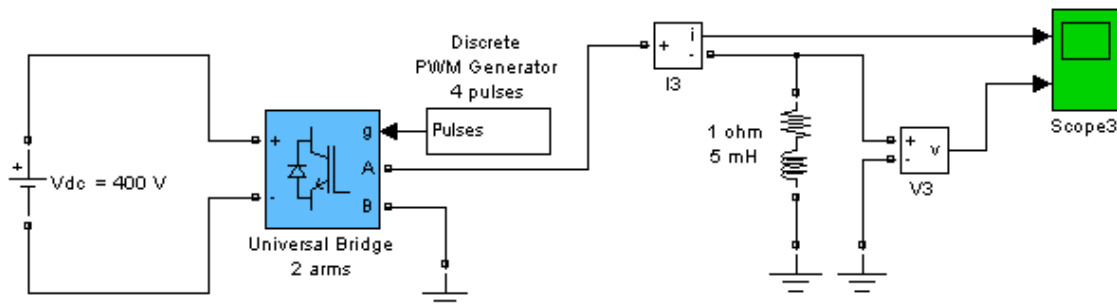


Fig 8. DC/AC, Monopole Converter

The system consists of dc to ac Monopolar PWM inverter. The converters are controlled in open loop with the Discrete PWM Generator block available in the Extras/Discrete Control Blocks library. The converter circuits use the DC voltage ($V_{dc} = 400V$), carrier frequency (1080 Hz) and modulation index ($m = 0.8$), DC to DC, converter (two-arm: four-switches) is as shown in fig 4.3 In order to allow further signal processing, signals displayed on the Scope blocks

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(sampled at simulation sampling rate of 3240 samples/cycle) are stored in single variables named 'psb1phPWM2_str' (structures with time) Run the simulation and observe the following two waveforms on the Scope blocks current into the load (trace 1), voltage generated by the PWM converter (trace 2). Once the simulation is completed, open the Powergui and select 'FFT Analysis' to display the 0 - 5000 Hz frequency spectrum of signals saved in the first circuit 'psb1phPWMx_str' structures. The FFT will be performed on a 2-cycle window starting at $t = \{0.1 - 2/60\}$ (last 2 cycles of recording). For each circuit select Input labeled 'V inverter'. Click on Display and observe the frequency spectrum of last 2 cycles. The fundamental component of V inverter (DC component in case of circuit 1) is displayed above the spectrum window. Compare the magnitude of the fundamental or DC component of the inverter voltage with the theoretical values given in the circuit.

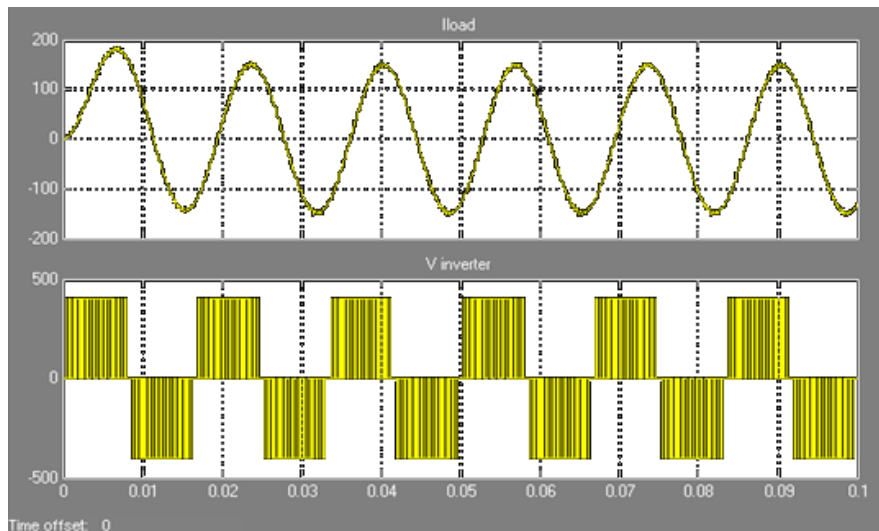


Fig 9. DC/AC, Monopole Converter output wave form

Compare also the harmonic contents in the inverter voltage for the two-switch and four-switch DC to AC inverters. for the four-switch inverter harmonics are lower and appear at double of carrier frequency (maximum of 40% at $2 \times 1080 \pm 60$ Hz) As a result, the current is "cleaner" for the four-switch inverter. If you now perform a FFT on the signal I load you will notice that the THD of load current is 7.3% for the two-switch inverter as compared to only 2% for the four-switch inverter.

2. DC to AC bipolar Inverter : V_3 fundamental: $= m \cdot V_{dc}$ V peak $= 0.8 \cdot 400 = 320$ V

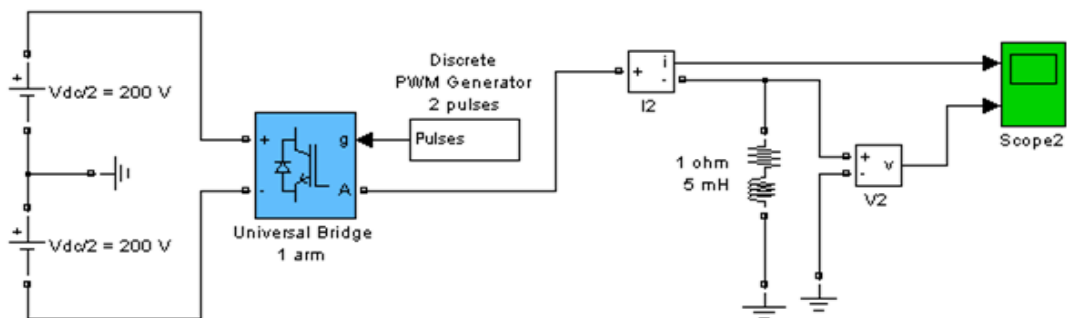


Fig 10. DC/AC, bipolar Converter

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The system consists of dc to ac bipolar PWM inverter . The inverter are controlled in open loop with the Discrete PWM Generator block available in the Extras/Discrete Control Blocks library. The converter circuits use the DC voltage ($V_{dc} = 400V$), carrier frequency (1080 Hz) and modulation index ($m = 0.8$),DC to AC, two-quadrant converter (one -arm: two-switches) is as shown in fig. In order to allow further signal processing, signals displayed on the Scope blocks (sampled at simulation sampling rate of 3240 samples/cycle) are stored in single variables named 'psb1phPWM3_str' (structures with time)Run the simulation and observe the following two waveforms on the Scope blocks current into the load (trace 1), voltage generated by the PWM converter (trace 2)

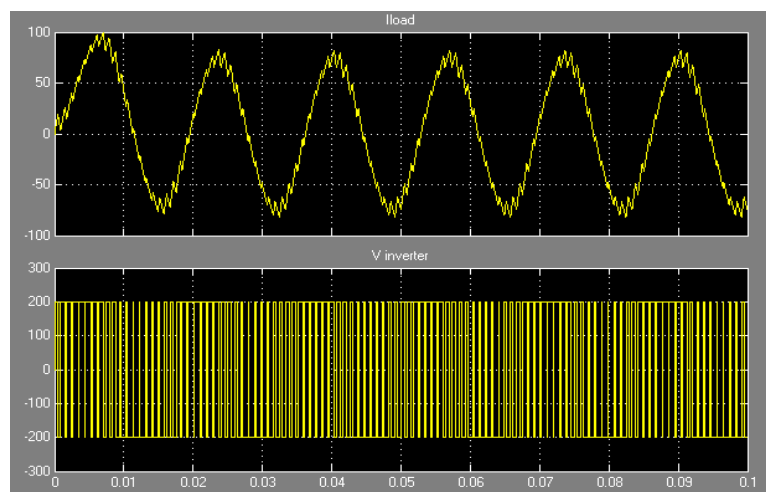


Fig 11. output of DC/AC, bipolar Converter

V. SIMULATION AND RESULT OF PWM CONVERTER

In this paper we consider two types of power electronic converter AC to AC converter, DC to AC converter for analysis of the PWM by using mat lab software in ac to ac converter there are two types ac voltage controller and cyclo converter in our project we can concentrate on the ac voltage controller and analyze the programed for the sinusoidal and uniform PWM for ac signal and compares the output result of both the waveform. Second part we simulate program for voltage source inverter with sinusoidal PWM and Analysis matlab result for different carrier frequency.

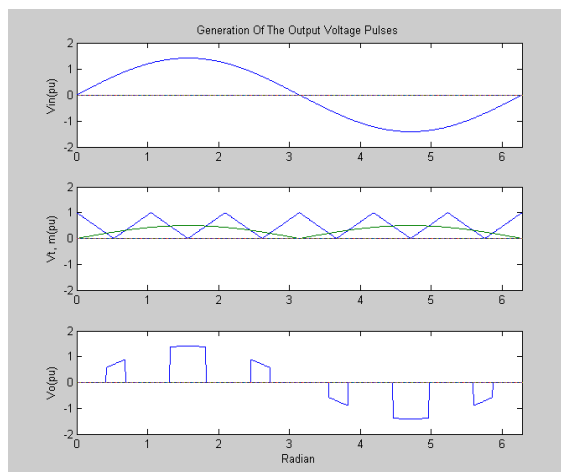


Fig 12 .a. output waveform sinusoidal PWM

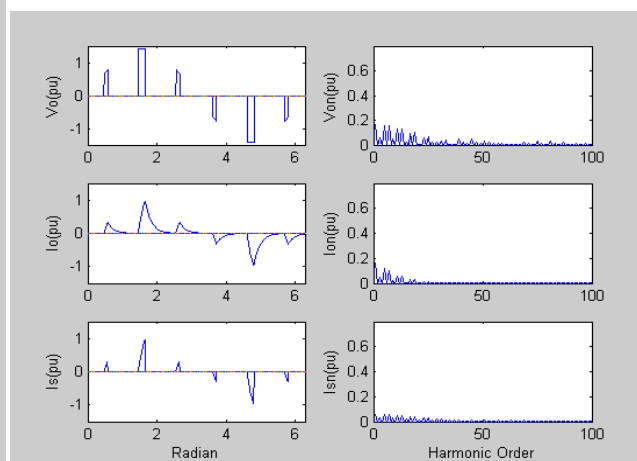


Fig.12. b harmonic order of sinusoidal PWM



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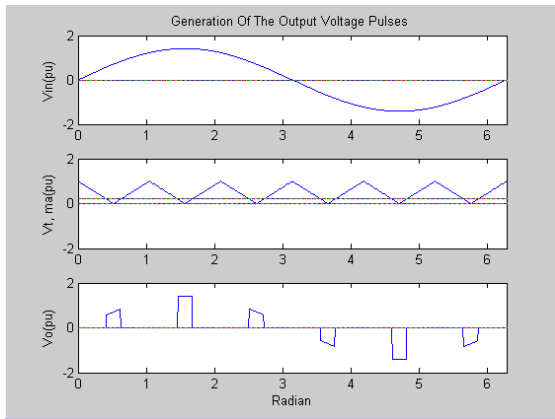


Fig 13.a Output waveform uniform PWM

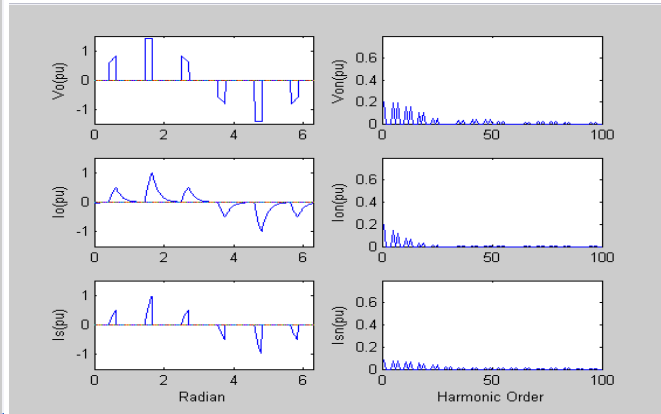


Fig 13.b harmonic order of uniform PWM

Table 1.comparison of mat lab values of both the PWM

| Parameter specification | Mat lab values of sinusoidal pulse width modulation (SPWM) | Mat lab values of Uniform pulse width modulation (UPWM) |
|-------------------------------------------------------------|------------------------------------------------------------|---------------------------------------------------------|
| The rms Value of the Output Voltage Vo | 0.644 | 0.44 |
| The rms Value of the output voltage fundamental component = | 0.4152 | 0.20 |
| The RMS value of the load current is CORMS | 0.4435 | 0.292 |
| The RMS value of the supply current is CSRMS | 0.2951 | 0.230 |
| Performance parameters are THDVo | 1.1868 | 2.00 |
| THDio | 0.3752 | 1.062 |
| THDIS | 1.3591 | 2.301 |
| PF | 0.1589 | 0.0192 |

Table 2. for alpha-beta values of SPWM

| Alpha | Beta | Width (alpha-beta) |
|----------|----------|--------------------|
| 27.0000 | 33.6000 | 6.6000 |
| 84.0000 | 96.0000 | 12.0000 |
| 147.0000 | 153.0000 | 6.0000 |
| 207.0000 | 213.0000 | 6.6000 |
| 264.0000 | 276.0000 | 12.0000 |
| 327.0000 | 333.0000 | 6.0000 |

Table 3.for alpha-beta values of UPWM

| Alpha | Beta | Width (alpha-beta) |
|-------|------|--------------------|
| 24 | 36 | 12 |
| 84 | 96 | 12 |
| 144 | 156 | 12 |
| 204 | 216 | 12 |
| 264 | 276 | 12 |
| 324 | 336 | 12 |



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Finally from the analysis we can conclude that there is difference in pulse width in case of sinusoidal pulse width modulation (SPWM) as compare to uniform pulse width modulation (UPWM). width of pulse is constant in case of uniform pulse width modulation (UPWM) but it varies in sinusoidal pulse width modulation (SPWM) we observe the graph of both PWM is same but slight changes in modulation index of input voltage. As we compare the performance parameter value of uniform pulse width modulation (UPWM) and sinusoidal pulse width modulation (SPWM) total harmonic distortion is more in case of uniform pulse width modulation (UPWM) as compare to sinusoidal pulse width modulation (SPWM) hence from the performance parameter value we can chose sinusoidal pulse width modulation is better for ac voltage regulator can operate under different loading condition. Where in α =switching angle, β = displacement angle, $\beta - \alpha$ =width

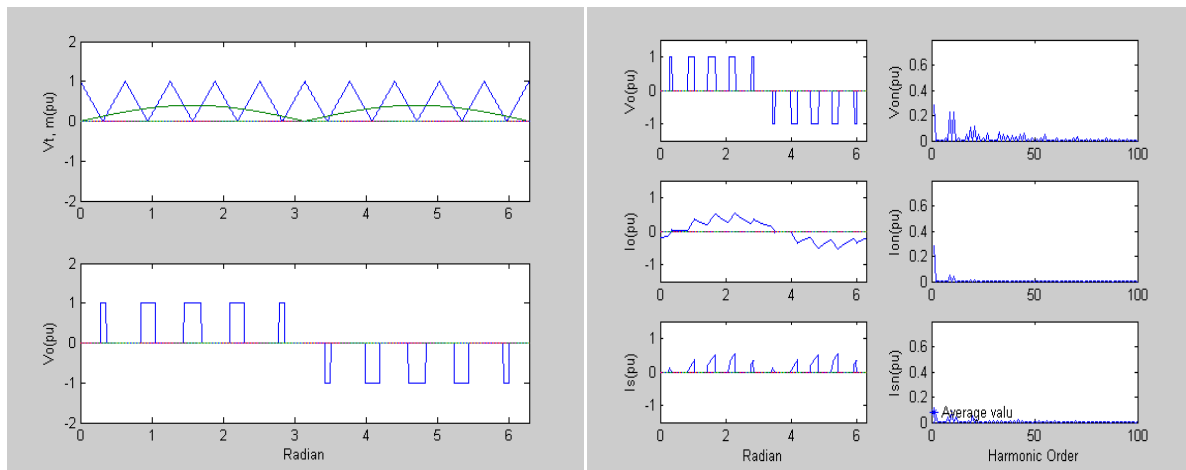


Fig 14.a.output wave form voltage source inverter with SPWM of carrier frequency 1000hz Fig 14.b output waveform of voltage carrier frequency 1000hz

Table 4 for Compare Mat lab Value for different carrier frequency

| Parameter specification | Mat lab values for carrier frequency 500hz | Mat lab values for carrier frequency 1000hz |
|-----------------------------------------------------------|--------------------------------------------|---------------------------------------------|
| The rms Value of the output Voltage Vo | 0.519 | 0.504 |
| The rms Value of the output voltage fundamental component | 0.2846 | 0.2816 |
| The RMS value of the load current CORMS | 0.295 | 0.2836 |
| The RMS value of the supply current is CSRMS | 0.1645 | 0.1550 |
| The Average value of the supply current is CSAV | 0.075 | 0.0715 |
| THDVo | 1.4947 | 1.4846 |
| THDIo | 0.2422 | 0.1208 |

from the mat lab value of voltage sources inverter we analyze increase the carrier frequency decrease the total harmonic distortion. Hence better to chose higher carrier frequency in for voltage source inverter with PWM output



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VI. CONCLUSION

This paper tries to explain about PWM techniques used in different types of power electronic converters. The objective of this dissertation work is to study PWM applications on various types of converters and to simulate using mat lab or multisim. Thus this study supports a researcher when makes experimental investigations. In this paper , the generations of PWM signals using different methods are explained. The application of PWM techniques to different type of converters are analyzed using mat lab and Multi SIM. Also a mat lab program is written to simulate uniform pulse width modulation (UPWM) And Sinusoidal Pulse Width Modulation (SPWM) of ac voltage regulator(ac to ac converter) and from performance parameter values such as total harmonic distortion of the output voltage, output current, supply current ,and input power factor compare these parameter values of both sinusoidal pulse width modulation (SPWM) and uniform pulse width modulation (UPWM). We conclude from these results total harmonic distortion is more in uniform pulse width modulation (UPWM) as compare to sinusoidal pulse width modulation SPWM. And also analyze voltage source inverter program for sinusoidal pulse width at the output waveform we conclude from this program for increase in carrier frequency the total harmonic distortion is decreases.

REFERENCES

- [1]. Michael A. boost, Phoivos D. Ziogas, "State-of-the-Art Carrier PWM Techniques: A Critical Evaluation" IEEE Transactions On Industry Applications", vol. 24, no. 2, March-April 1988.
- [2]. Hasan Komurcugil, , and Osman K'ukrer, "Lyapunov-Based Control for Three-Phase PWM AC/DC Voltage-Source Converters" IEEE Transactions On Power Electronics, vol. 13, no. 5, September 1998.
- [3]. Dariusz Czarkowski, , David V. Chudnovsky, , Gregory V. Chudnovsky, and Ivan W. Selesnick, "Solving the Optimal PWM Problem for Single-Phase Inverters" IEEE Transactions on circuits and systems fundamental theory and applications, vol. 49, no. 4, April 2002
- [4]. Pulse Width Modulation (PWM) Tutorial Copyright 2005 by Data dog Systems.
- [5]. Mauricio Rotella, Gonzalo Peñailillo, Javier Pereda, and Juan Dixon, "PWM Method to Eliminate Power Sources in a Non redundant 27-Level Inverter for Machine Drive Applications" IEEE Transactions on industrial Electronics, vol. 56, no. 1, January 2009.
- [6]. Leon M. Tolbert, Fang Zheng Peng, and Thomas G. Habetler, "Multilevel PWM Methods at Low Modulation Indices" IEEE Transactions on Power Electronics, vol. 15, no. 4, July 2000.
- [7]. Edwin van Dijk, Herman J. N. Spruijt, Dermot M. O'Sullivan, and J. Ben Klaassens' "PWM-Switch Modeling of DC-DC Converters" IEEE Transactions on Power Electronics, vol. 10, no. 6, November 1995.
- [8]. Dehong Xu, , Chuanhong Zhao, and Haifeng Fan "A PWM Plus Phase-Shift Control Bidirectional DC-DC Converter" IEEE Transactions On Power Electronics, vol. 19, no. 3, May 2004.
- [9]. Hooman Dehbonei Lawrence Borle Chem V Nayar "Optimal Voltage Harmonic Mitigation in Single-Phase Pulse Width Modulation" Centre for Renewable Energy and Sustainable Technologies Australia.
- [10]. S. Jeevananthan, R. Nandhakumar, P. Dananjayan "Inverted Sine Carrier for Fundamental Fortification in PWM Inverters and FPGA Based Implementations" serbian journal of electrical engineering vol. 4, no. 2, page 171-187 ,november 2007,
- [11]. A.E. Islam, *K.M. Rahman, M.A. Choudhury, S.J. Al-Kadry, M. Islam, S.M. Rahman and A.M. Rizwan "low-cost implementation of high-resolution PWM Scheme for adjustable speed drives" 3rd International Conference on Electrical & Computer Engineering ICECE 2004, pg 28-30 December 2004, Dhaka, Bangladesh.
- [12]. Hao Peng, Aleksandar Prodic', Eduard Alarcón, EE, and Dragan Maksimovic' "Modeling of Quantization Effects in Digitally Controlled DC-DC Converters" IEEE Transactions On Power Electronics, Vol. 22, no. 1, January 2007.
- [13]. J. A. A. Caseiro, A. M. S. Mendes "Performance analysis of three-phase PWM rectifiers for high power quality applications" University of Coimbra.
- [14]. Mahesh A. Patel, Ankit R. Patel, Dhaval R. Vyas and Ketul M. Patel "Use of PWM Techniques for Power Quality Improvement" International Journal of Recent Trends in Engineering, Vol. 1, No. 4, May 2009.
- [15]. J. Chelladurai, G. Saravana Ilango, C. Nagamani, and S. Senthil Kumar "Investigation of Various PWM Techniques for Shunt Active Filter" World Academy of Science, Engineering and Technology ,vol 39 2008
- [16]. Maurício Beltrão de Rossiter Corrêa, , Cursino Brandão Jacobina, Edison Roberto Cabral da Silva, and Antonio Marcus Nogueira Lima, "A General PWM Strategy for Four-Switch Three-Phase Inverters" IEEE Transactions on Power Electronics, vol. 21, no. 6, November 2006.
- [17]. Bryan G. Dobbs and Patrick L. Chapman, Member, IEEE "A Multiple-Input DC-DC Converter Topology" IEEE Power Electronics Letters, vol. 1, no. 1, March 2003.
- [18]. Joachim Holtz, "Pulsewidth Modulation-A Survey" IEEE Transactions On Industrial Electronics, vol. 39, no. 5, December 1992.
- [19]. L. Li D. Czarkowski Y. Liu P. Pillay "Multilevel Selective Harmonic Elimination PWM Technique in Series-Connected Voltage Inverters" Dept. of Electrical Engineering, Polytechnic University.
- [20]. Vladimir Kati_c and Du_san Graovac "A method of real analysis of ac/dc Converter line side harmonics" Series: Electronics and Energetic vol. 10, No.1, pp 107-123 ,1997.
- [21]. Zhong Du, Leon M. Tolbert, John N. Chiasson 'Harmonic Elimination for Multilevel Converter with Programmed PWM Method" The University of Tennessee.
- [22]. Muhammad H. Rashid "Power Electronics Circuits, Devices, and Applications "prentice hall of India private limited new Delhi, second edition 1993.



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