

# Five Level inverter based Single Phase to Three Phase Converter

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**Abstract** – This paper proposes a five level inverter based single phase supply to three phase supply conversion system. This converter is able to run any three phase equipment from a single phase supply. Lower distortion of the output ensure about better performance and lower ripple in equipments output. Using capacitor based voltage divider system in inverter reduces the number of switches and improves the system efficiency. This converter allows to run three phase equipment at the same frequency of single phase.

**Key Words:** Rectifier, PWM, THD, Inverter, Isolation transformer

## 1. INTRODUCTION

Nowadays most of electrical equipments are operated by AC power. Starting current of a three phase motor is less than a same rating single phase motor starting current. Three phase motor are preferred more than a single phase motor in industrial application due to its low ripple in output and better performance. For heavy duty and higher power rating three phase motors are used. It is very difficult to get three phase supply in everywhere. In some rural area where low density of consumers presents typically the three phase power is not supplied due to higher installation cost and maintenance cost of transmission line. In this type of cases and in some remote area single phase power is supplied. In this type of condition to run three phase equipments this proposed converter should be applicable. This converter is based on rectifier, filter, and inverter system. To run an induction motor from inverter Total Harmonics Distortion (THD) should be lower for better performance and lower ripple in mechanical output of the motor. To reduce THD mainly Pulse width modulation (PWM) and multilevel topology is used in this project. By using both topologies in this project THD should decrease better and output waveform should be sinusoidal. Three phase Inverter is builded by the combination of three single phase inverters which are connected with the three phase load by a isolated winding three phase transformer. Without using isolation transformer it is very difficult to get the neutral point because all the inverters -ve terminal are not in same potential at every instant of time so no common terminal should be find out. By using isolation transformer all the primary windings should be separated but the secondary can be connected in star. Transformer is not only works as a isolation device it is also working as a filter by its inductive

effect. Reference signal of PWM generator is taken from the single phase source so the output should be same as the input frequency.

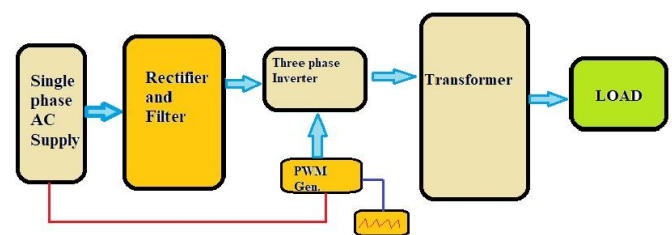


Fig -1: Block Diagram of the system

## 2. WORKING OF THE SYSTEM

This proposed system is based on single phase AC to DC conversion and DC to three phase AC conversion. Single phase AC supply by using bridge rectifier converted to DC and it is filtered for better performance. From the rectifier output by the help of three inverter it is converted into three phase AC. Three inverter are supplied ac power to primary winding of isolation transformer. In isolation transformer all three primary windings are isolated. So all the three inverter should be isolated. It is possible to connect the secondary winding and load in star or delta to supply three phase power to the load. For transformer inductive effect it is working as a filter which makes output more accurate.

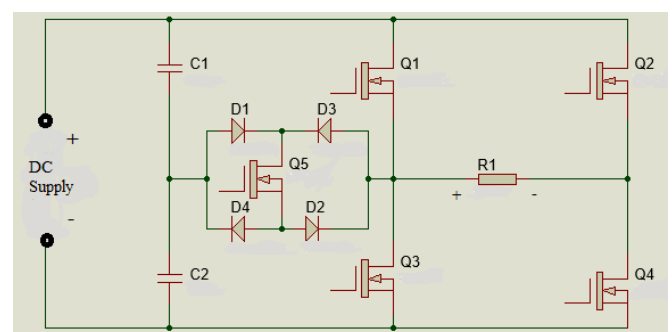


Fig -2: Schematic diagram of the inverter/phase

Inverter is designed by combination of three single phase inverter. Switch of inverters are controlled by PWM generator. PWM generator is designed by comparison of triangular wave and input sine wave.

For three different phases three PWM generator are used. Phase 1 PWM generator reference signal is taken from the input Single phase AC. For Phase2 and phase3 reference signal is also taken from the input side but using 120 degree 240 degree phase delay respectively. Inverter output is divided on five voltage level 0,  $V_{DC}/2$ ,  $V_{DC}$ ,  $-V_{DC}/2$ ,  $-V_{DC}$ . To divide input voltage in two equal part a series connected capacitor bank is used. When supply voltage is  $V_{DC}$  voltage drop across each capacitor will be  $V_{DC}/2$ . Diode bridge makes current flow through adjacent switch bidirectional.

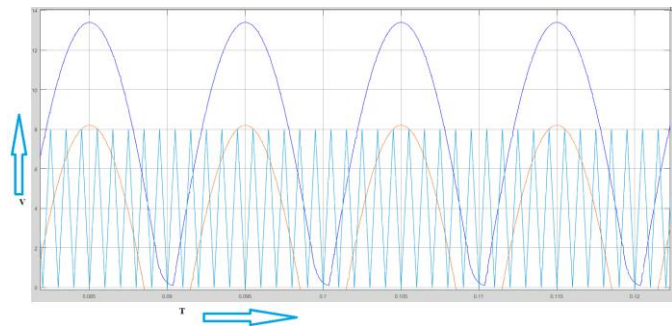


Fig -3: Input of PWM generator

Table -1: Pulse for different voltage generation

Sl.No	S1	S2	S3	S4	S5	Output Voltage (Volt)
1	0	0	1	1	0	0
2	0	0	0	1	1	$V_{DC}/2$
3	1	0	0	1	0	$V_{DC}$
4	0	1	0	0	1	$-V_{DC}/2$
5	0	1	1	0	0	$-V_{DC}$

### 3. RESULT AND DISCUSSION

Proposed single phase to three phase converter system is simulated in MATLAB "Simulink". This proposed converter is able to run a three phase motor from a single phase AC supply. It has been observed that in change in input frequency output frequency of the inverter changes. It should be better to use this converter for maximum 5Hp motor, otherwise a huge amount current should be drawn from the single phase supply. All the three phase magnitude are not balanced only the phase1 has higher magnitude because of ripple presents in the rectified output. Phase1 output has no phase difference with the input signal so due to ripple of rectified output only phase1 output is high. Output voltage and current both are in sinusoidal in nature. Though the Output of the inverter is stepped in nature and spike contain due to PWM but in transformer output it is like a sine wave. Basically when the load is not low due to transformer inductive effect output waveform is filtered. In this type of

converter most of the loads are three phase induction motors. If the THD value is too much high in output it will affect the output torque of the motor. THD analysis in a very essential part for DC to AC converter. One of the most effective way for THD analysis is FFT. After FFT of the output of the converter we get THD=13.41%. This THD is quite good to run an induction motor.

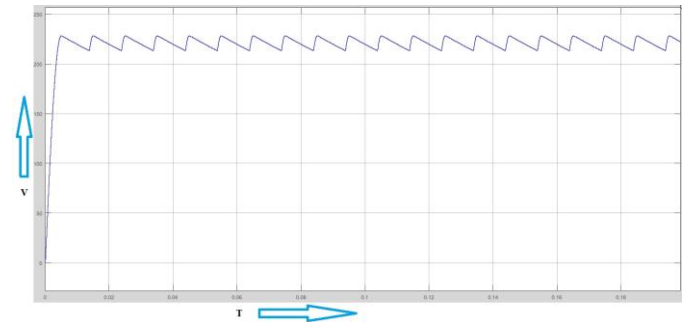


Fig -3: Voltage after rectification

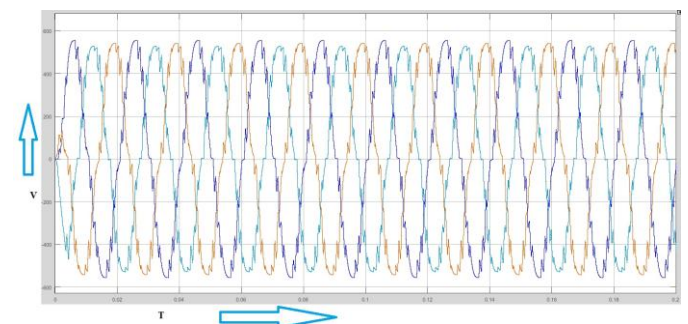


Fig -4: Output Voltage

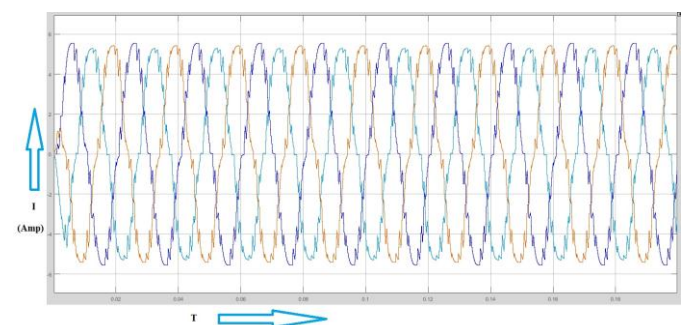


Fig -5: Output current

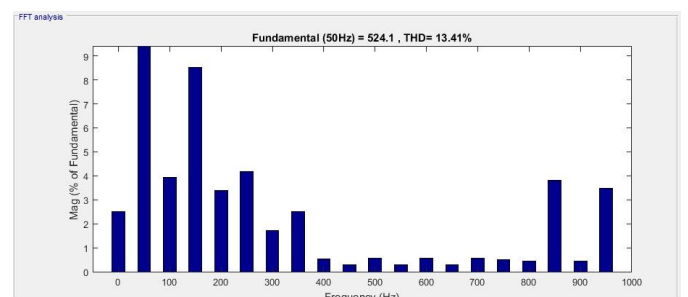


Fig -6: FFT analysis of output waveform

### 3. CONCLUSION

Single phase to three phase converter has been implemented by five level inverter and isolation transformer. Most of cases grid frequency is not same in all the times. Output of inverter can change by changing the grid frequency in the proposed topology. For Lower THD use of this equipment should be effective. In future THD can be decreased, Soft starting can be implemented to reduce starting current of motor. Most of cases converter output should feed to inductive load by connecting a capacitor bank with the load output should be filtered and power factor can be improved.

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### BIOGRAPHIES



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