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DESIGNING AND SIMULATING A PWM INDUCTION MOTOR DRIVE POWERED BY AN INVERTER

#1DR.MUDDASANI SAMPATH KUMAR, ***Associate Professor,***
#2Mr.PURELLA SRAVAN KUMAR, ***Asst. Professor,***
Department of Electrical and Electronics Engineering,
Sree Chaitanya Institute Of Technological Sciences, Karimnagar, Ts.

ABSTRACT:

A three-phase pulse width modulation (PWM) inverter-fed induction motor drive is simulated in this work. A seven-switch, active current-shaping design is recommended for driving induction motors. Power for the inverter can be drawn from the boost converter's input. The power factor is improved by the boost converter as well. The boost converter allows the drive to function properly even with a weak input voltage.

Key Words - PWM, Boost Converter, VSI and Induction Motor.
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1.INTRODUCTION

PWM inverter systems have several applications. Electric drives, UPSs, high voltage DC transmission, active power filters, reactive power compensators, power systems, electric cars, alternative energy systems, and industrial processes employ them. The most common voltage source converter converts dc to ac. Diode rectifiers or batteries can supply dc power. The rectifier, DC-link, PWM inverter, control circuit, and load make up a standard voltage source PWM inverter. Most current voltage source inverters employ pulse width modulation techniques to produce AC voltages that are the proper size, frequency, and form as closely as possible to a sine wave. To construct and use the proper control algorithm, you must analyze the PWM inverter system's input-output characteristics for a design. Harmonic assessment and time domain analysis are essential to power exchange system study and simulation.

2.THREE PHASE PWM INVERTER

Three-phase PWM inverters are dc-ac converters, as seen in Figure 1. PWM inverters provide virtually sinusoidal power regulation. A 120o angle difference affects phase voltage and current. Three-phase PWM inverters allow several regulating signal patterns. This three-phase inverter has 8 modes. Each mode displays switch state. Modes other than 0 and 7 prevent current from reaching a load. Models 1–6 allow flow. Then, it can build two similar operation circuits: mode 1 is like modes 2 and 4, while mode 3 is like modes 5 and 6. Whether rectified or inverted, sinusoidal current form controls voltage by connecting the voltage source to an AC source through an inductance. Figure 2 shows single-phase to three-phase and three-phase-to-three-phase inverter-fed drive systems The pulse generator is presented for these systems.

Anti-parallel diodes in the three-phase bridge automatically achieve phase-leg-short when the inverter works. Due to this, gate waves can match a regular VSI. But the DC link switch must be on. PWM inverters let conducted and emitted EMI sounds into the system. A Line Impedance Stabilization Network was implemented after an EMI test. The inverter's input voltage waveform exhibited basic and high-frequency signals. High-frequency signals, or "ringing signals," are unwanted noise. Line Impedance Stabilization Network finds phone-ringing signals. The PWM inverter's switching parts generate the ringing sounds whether on or off.

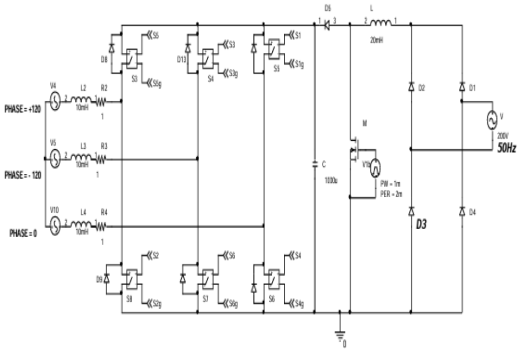


Fig. 1 Inverter conversion from one to three phases

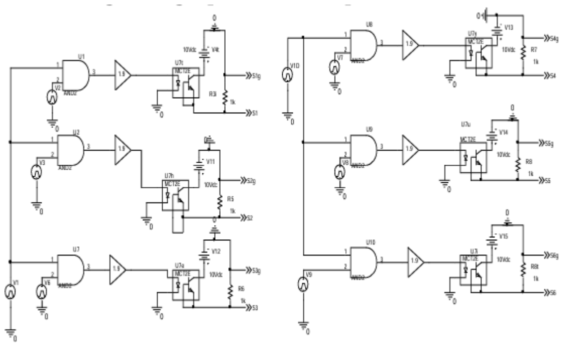


Fig. 2 pulse generators function

3.VOLTAGE SOURCE INVERTER

Figure 3 shows the three-phase inverter and boost converter three-phase rectifier circuit models. The star-connected induction motor's three-phase stator receives the output. Power gadgets are considered perfect since they conduct and form an open circuit at zero voltage. This is blocking mode. In a balanced three-phase system, these processes calculate phase voltages from line voltages. In a three-phase system with phase sequence abc, to write line voltages as phase voltages,

$$V_{ab} = V_{as} - V_{bs} \qquad (1)$$

$$V_{bc} = V_{bs} - V_{cs} \qquad (2)$$

$$V_{ca} = V_{cs} - V_{as} \qquad (3)$$

where Vab, Vbc, and Vca are line voltages and Vas, Vbs, and Vcs are phase voltages. Subtracting equation (3) yields equation (1).

$$V_{ab} - V_{ca} = 2V_{as} - (V_{bs} + V_{cs}) \qquad (4)$$

Balanced three-phase systems have no three-phase sum:

$$V_{as} + V_{bs} + V_{cs} = 0 \qquad (5)$$

Equation (5) in formula (4) shows that Vab and Vca have distinct line voltages.

$$V_{ab} - V_{ca} = 3V_{as} \qquad (6)$$

The phase determines the voltage.

$$V_{as} = \frac{V_{ab} - V_{ca}}{3} \qquad (7)$$

Phase values for b and c are similar.

$$V_{bs} = \frac{V_{bc} - V_{ab}}{3} \qquad (8)$$

$$V_{cs} = \frac{V_{ca} - V_{bc}}{3} \qquad (9)$$

Phase voltages are practically sinusoidal and stepped six times. They last 120 electrical degrees and come from line and line-to-line voltages. Fourier components of these regular voltage waves look like this:

$$V_{ab}(t) = \frac{2\sqrt{3}}{\pi} V_{dc}\left(\sin \omega_s t - \frac{1}{5} \sin 5\omega_s t + \frac{1}{7} \sin 7\omega_s t - \ldots \right) \quad (10)$$

$$V_{bc}(t) = \frac{2\sqrt{3}}{\pi} V_{dc}\left\{ \sin(\omega_s t - 120^\circ) - \frac{1}{5} \sin(5\omega_s t - 120^\circ) + \frac{1}{7} \sin(7\omega_s t - 120^\circ \ldots \right\} \quad (11)$$

$$V_{ca}(t) = \frac{2\sqrt{3}}{\pi} V_{dc}\left\{ \sin(\omega_s t - 120^\circ) - \frac{1}{5} \sin(5\omega_s t - 120^\circ) + \frac{1}{7} \sin(7\omega_s t - 120^\circ \ldots \right\}$$
$$(12)$$

The phase voltages are Vdc and 30 degrees from the line voltages. simply the basic element of inverter-fed ac motor drives generates power, thus you simply need to test it in steady state. The fundamental six-stepped waveform rms phase voltage is:

$$V_{ph} = \frac{V_{as}}{\sqrt{2}} = \frac{2}{\pi} \cdot \frac{V_{dc}}{\sqrt{2}} = 0.45\ V_{dc} \quad (13)$$

Whatever control is employed for the induction motor drive, input values remain constant. When border circumstances are matched, steady-state performance can be assessed. PWM voltage sources are used to test steady-state induction motor drive systems. PWM can be made using the sine-triangle, trapezoidal-triangle, space vector, sampled-asymmetric technique modulation, and more. The boundary-matching method is useful for calculating the steady-state current vector without a dynamic simulation because it works for half-wave and full-wave. 1. R4 1; 2. D1 MUR150 R3 1; 3. S4 L2 10mH s4 s1; 4. D2 MUR150 0; 3. L3 10mH s3; 4. S1 0 s6; 5. D3 MUR150 C 1000u; 6. R2 1 s5; 7. M1 IRFP460 D5 3 1 V1b 1 2 0; 5. D Phase = -120 PW = 100u, PER = 2m, TD = 1m, PHASE = 0 + + S6 0 L4 10mH 1 2 s2, MUR150 L 20Mh.

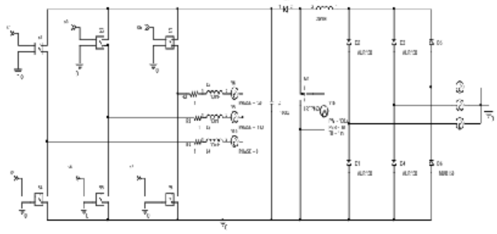


Fig. 3 Three-phase rectifier power system

4. **SIMULATION RESULTS**

A diode rectifier converts low-voltage AC to DC in a three-phase inverter-fed drive. The boost converter corrects it. A three-phase PWM inverter converts DC to AC with variable voltage and frequency. The PWM inverter powers the three-phase induction motor.

Figures 4 and 5 illustrate line-to-line and phase voltages, respectively. Figure 6 and Table 1 illustrate the single-phase to three-phase inverter's Fourier spectrum and data. Figures 7 and 8 demonstrate three-phase to three-phase inverter phase voltage and current curves. Figure 9 and Table 2 demonstrate this inverter system's Fourier spectrum and data.

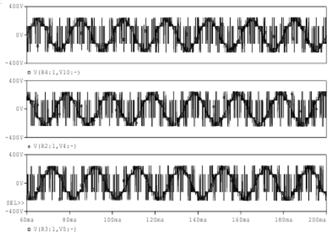


Fig. 4 phase-out voltage

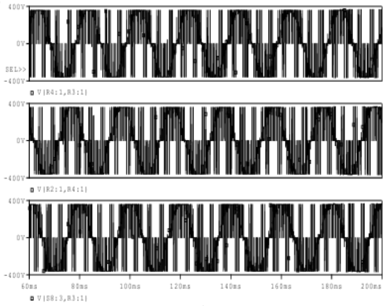


Fig. 5 volts from output lines

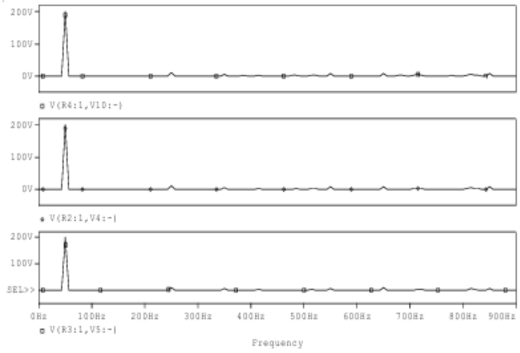
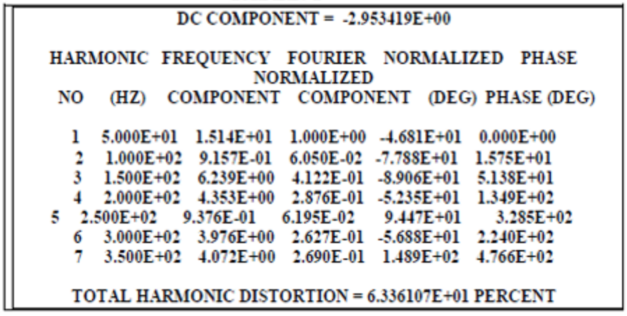


Fig. 6 The Fourier Transform

TABLE.1



DC COMPONENT = -2.953419E+00

HARMONIC NO	FREQUENCY (HZ)	FOURIER COMPONENT	NORMALIZED COMPONENT	PHASE (DEG)	NORMALIZED PHASE (DEG)
1	5.000E+01	1.514E+01	1.000E+00	-4.681E+01	0.000E+00
2	1.000E+02	9.157E-01	6.050E-02	-7.788E+01	1.575E+01
3	1.500E+02	6.239E+00	4.122E-01	-8.906E+01	5.138E+01
4	2.000E+02	4.353E+00	2.876E-01	-5.235E+01	1.349E+02
5	2.500E+02	9.376E-01	6.195E-02	9.447E+01	3.285E+02
6	3.000E+02	3.976E+00	2.627E-01	-5.688E+01	2.240E+02
7	3.500E+02	4.072E+00	2.690E-01	1.489E+02	4.766E+02

TOTAL HARMONIC DISTORTION = 6.336107E+01 PERCENT

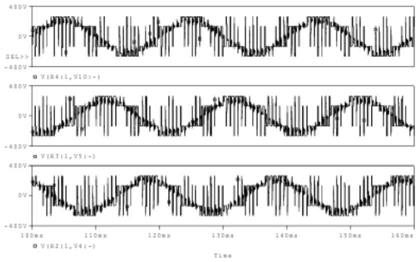


Fig. 7 Output voltage waveform

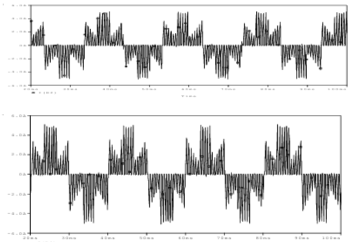


Fig. 8 current output pattern

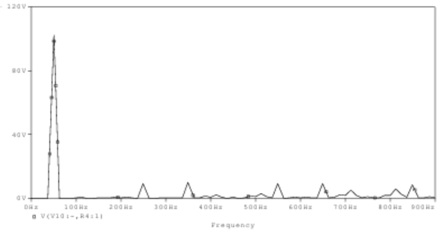
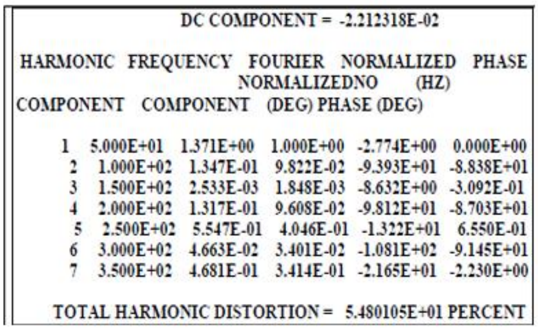


Fig. 9 The Fourier Transform

TABLE.2



DC COMPONENT = -2.212318E-02

HARMONIC NO	FREQUENCY (HZ)	FOURIER COMPONENT	NORMALIZED COMPONENT	PHASE (DEG)	NORMALIZED PHASE (DEG)
1	5.000E+01	1.371E+00	1.000E+00	-2.774E+00	0.000E+00
2	1.000E+02	1.347E-01	9.822E-02	-9.393E+01	-8.838E+01
3	1.500E+02	2.533E-03	1.848E-03	-8.632E+00	-3.092E-01
4	2.000E+02	1.317E-01	9.608E-02	-9.812E+01	-8.703E+01
5	2.500E+02	5.547E-01	4.046E-01	-1.322E+01	6.550E-01
6	3.000E+02	4.663E-02	3.401E-02	-1.081E+02	-9.145E+01
7	3.500E+02	4.681E-01	3.414E-01	-2.165E+01	-2.230E+00

TOTAL HARMONIC DISTORTION = 5.480105E+01 PERCENT

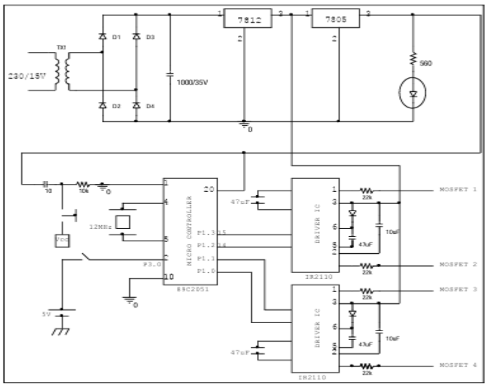


Fig. 10. control system

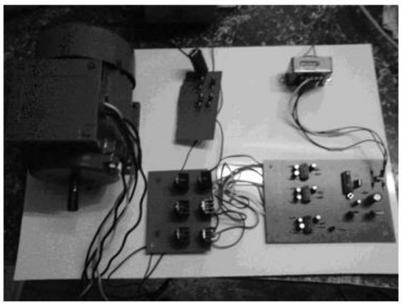


Fig 11. hardware item

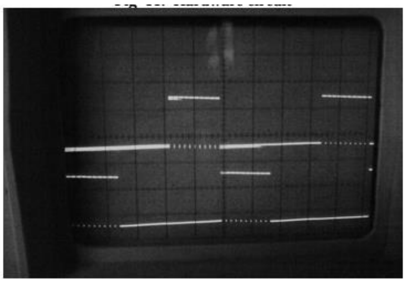


Fig 12. waves driving oscillograms

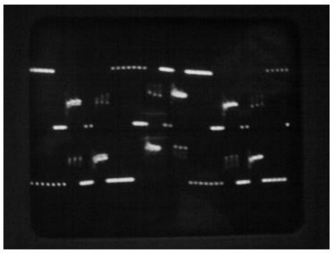


Fig 13. Phase voltage oscillogram

5.CONCLUSION

They created circuit models for single-phase-to-three-phase and three-phase-to-three-phase inverter systems. A voltage source inverter-fed induction motor drive was studied. The circuit model shows three-phase PWM inverter-fed induction motor driving. Simulation and experiment results for the single-phase to three-phase inverter system and third-phase to three-phase system are shown. The frequency spectrums for these situations are given. Three-phase to three-phase inverter systems had 5% harmonic distortion, compared to 6.3% for single-phase systems. A boost converter was recommended for an inverter-fed induction motor driving system to remedy low input voltage in this study. Testing and fabrication employ an induction motor arrangement with a 1 KW generator. Both simulated and actual findings are identical..

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