International Journal of Engineering Technology and Management Sciences
Website: ijetms.in Issue: 2 Volume No.7 March - April – 2023
DOI:10.46647/ijetms.2023.v07i02.001 ISSN: 2581-4621

A Simple Method To Fire 3 Phase Stepped Wave Bridge Inverter Using 555 Timer, Counter By JK Flip-Flop And Decoder By And Gate

Sukratu Chakraborty
Techno Engineering College Banipur., North 24 Parganas, West Bengal, India.
Orchid Id : 0000-0003-4654-3759

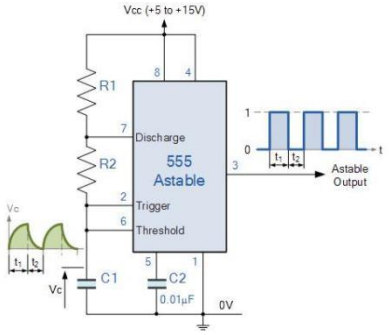
ABSTRACT
With the recent trend of economy where making one system is involved with lower cost devices used to make the same, this project involves no costly microcontroller or microprocessor IC or board for firing one 3 phase inverter in 180 degree mode. Rather simple 555 timer, JK Flipflop, AND gates, diodes used for firing one Transistorised 3 phase inverter in 180 degree conduction mode. The theoretical briffing with project circuits in MULTISIM and output are given in the following content.
Keywords -- 555 timer, JK Flip-flop, AND gate, Counter, Decoder, Diodes, Transistor, Inverter, 3 Phase.

1. Introduction: Three phase Inverter 180 degree mode of firing may be done by different methods like microcontrollers, microprocessors etc. costly devices. But here is one method by which we can fire 180 degree mode of 3 Phase Inverter by some easily available devices like 555 timer, JK Flip-flop, AND gates and Diodes. This method will cost less with respect to other possible methods.

2. Method: Here in thismethod 3 phase stepped wave bridge inverter is fired by one mod 6 counter followed by decoder which finally passes 5 volt firing signal to each of the 6 transistors of 3 phase bridge inverter for 180 degree conduction mode via 3 diodes for each transistor which continues conduction for 3 continuous 60 degree spanned firing pulses ie for total 180 degree span. The clock signal is taken from 555 timer astable multivibrator. For 50 Hz power frequency of inverter output we need 300 Hz clock signal which can be done by adjusting the resistance between discharge and trigger pin of 555 timer multivibrator. The method is successfully applied to show through simulation in MULTISIM simulator.

2.1. Astable Multivibrator Mode of 555 Timer IC [4]

Astable multivibrator is also called as Free Running Multivibrator. It has no stable states and continuously switches between the two states without application of any external trigger. The IC 555 can be made to work as an astable multivibrator with the addition of three external components: two resistors (R1 and R2) and a capacitor (C). The schematic of the IC 555 as an astable multivibrator along with the three external components is shown below.



On time $t_1 = 0.693(R1 + R2).C$
Off time $t_2 = 0.693 \times R2 \times C$

$T = 0.693(R1 + 2.R2).C$ and $f = 1/T$

Figure 1

International Journal of Engineering Technology and Management Sciences
Website: ijetms.in Issue: 2 Volume No.7 March - April – 2023
DOI:10.46647/ijetms.2023.v07i02.001 ISSN: 2581-4621

2.2. MULTISIM SIMULATER CIRCUIT OUTPUT OF THE CIRCUIT

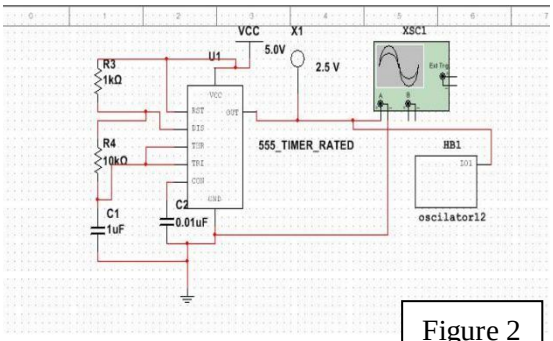


Figure 2

Figure 3

2.3. Asynchronous Counter[5]

An Asynchronous counter can count using Asynchronous clock input. Counters can be easily made using flip-flops. As the count depends on the clock signal, in case of an Asynchronous counter, changing state bits are provided as the clock signal to the subsequent flip-flops. Those Flip-flops are serially connected together, and the clock pulse ripples through the counter. Due to the ripple clock pulse, it's often called a ripple counter. An Asynchronous counter can count 2^n - 1 possible counting states.

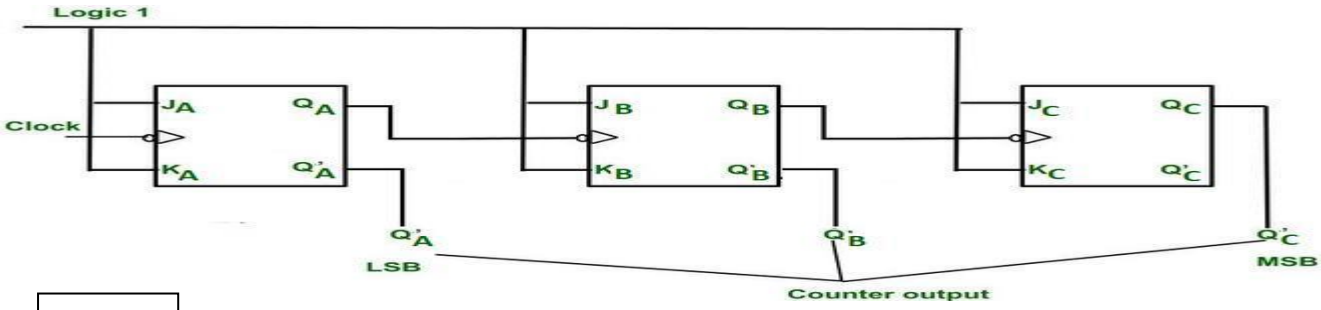


Figure 4

Table 1

Pulse	Q1	Q2	Q3	Q1'	Q2'	Q3'
1st	0	0	0	1	1	1
2nd	0	0	1	1	1	0
3rd	0	1	0	1	0	1
4th	0	1	1	1	0	0
5th	1	0	0	0	1	1
6th	1	0	1	0	1	0
7th	1	1	0	0	0	1
8th	1	1	1	0	0	0

2.4. 3 to 6 line decoder:

The 3 to 6 line decoder is also known as **Binary to Hex Decoder**. In a 3 to 6 line decoder, there is a total of 6 outputs, i.e., Y1, Y2, Y3, Y4, Y5, and Y6 and three inputs i.e., A0, A1, and A2. The block diagram and the truth table of the 3 to 6 line decoder are given below.

International Journal of Engineering Technology and Management Sciences
Website: ijetms.in Issue: 2 Volume No.7 March - April – 2023
DOI:10.46647/ijetms.2023.v07i02.001 ISSN: 2581-4621

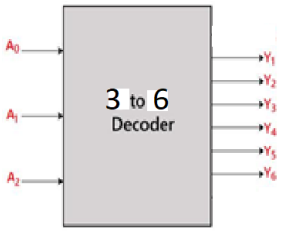


Figure 5

Table 2. Truth Table:

A0	A1	A2	Y1	Y2	Y3	Y4	Y5	Y6
1	1	1	1	0	0	0	0	0
1	1	0	0	1	0	0	0	0
1	0	1	0	0	1	0	0	0
1	0	0	0	0	0	1	0	0
0	1	1	0	0	0	0	1	0
0	1	0	0	0	0	0	0	1

Y1 = A0.A1.A2, Y2 = A0.A1.A2', Y3 = A0.A1'.A2, Y4 = A0.A1'.A2', Y5 = A0'.A1.A2, Y6 = A0'.A1.A2' .

2.5. Three Phase Bridge Inverter Explained

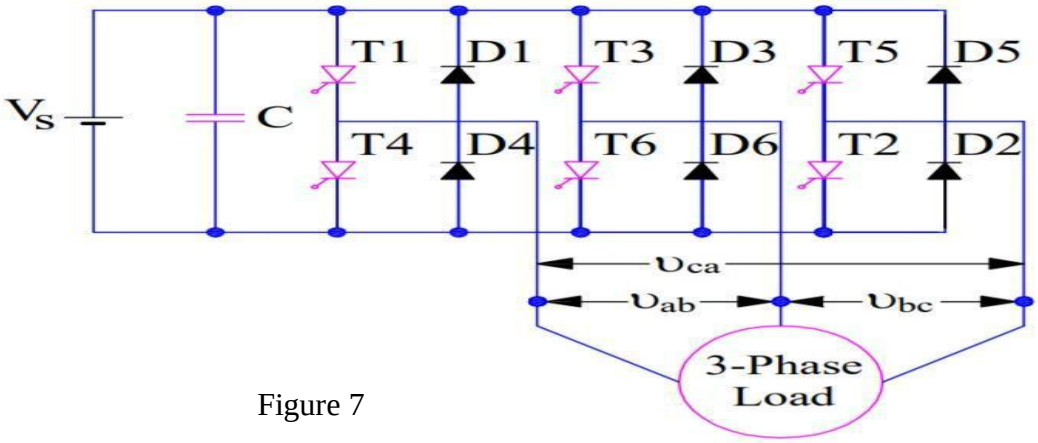


Figure 7

Working Principle of Three Phase Bridge Inverter:[2]

There are two possible patterns of conduction of Transistors used in the practical circuit. In one pattern, each transistor conducts for 180° and in other, each transistor conducts for 120°. But in both these patters the gating signals are applied and removed at 60° interval of the output voltage waveform. Therefore, both these models require a six step bridge inverter.

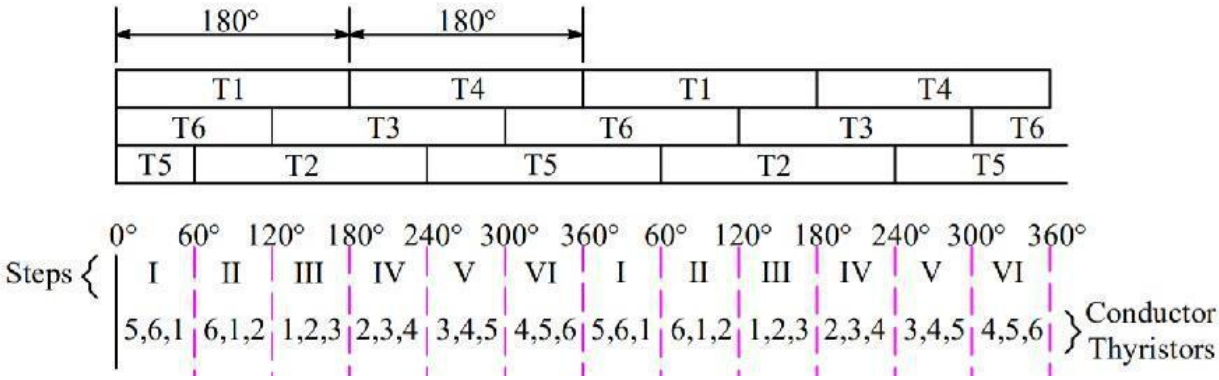


Figure 8

International Journal of Engineering Technology and Management Sciences
Website: ijetms.in Issue: 2 Volume No.7 March - April – 2023
DOI:10.46647/ijetms.2023.v07i02.001 ISSN: 2581-4621

3.1. 3 BIT MOD 6 ASYNCHRONOUS COUNTER USING JK FLIPFLOP AND DECODER CIRCUIT USED IN MULTISIM SIMULATION:

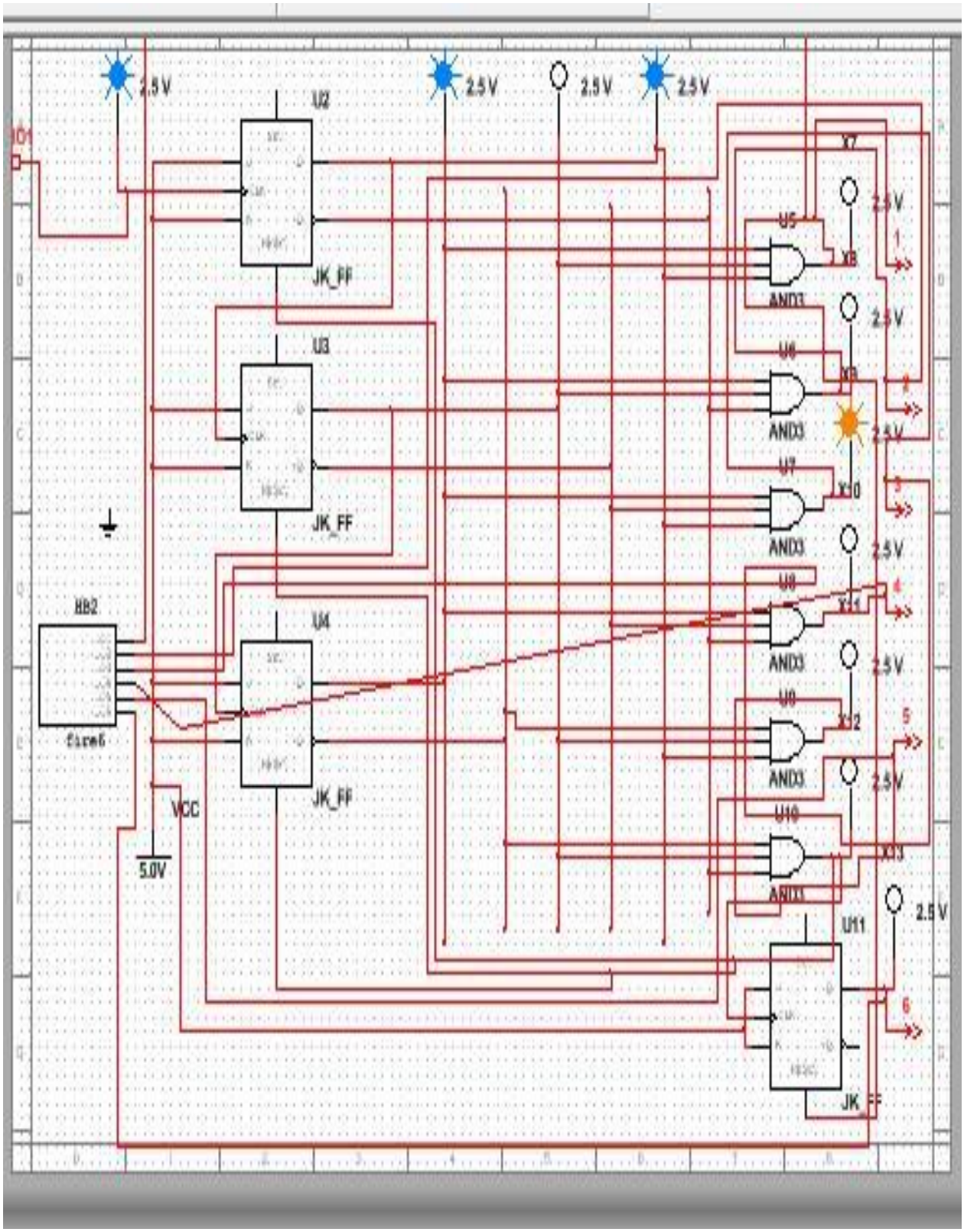


Figure 6

International Journal of Engineering Technology and Management Sciences
Website: ijetms.in Issue: 2 Volume No.7 March - April – 2023
DOI:10.46647/ijetms.2023.v07i02.001 ISSN: 2581-4621

3.2. TRANSISTORISED 3 PHASE TRANSISTORISED BRIDGE INVERTER WITH STAR CONNECTED LOAD. USED FOR SIMULATION IN MULTISIM.

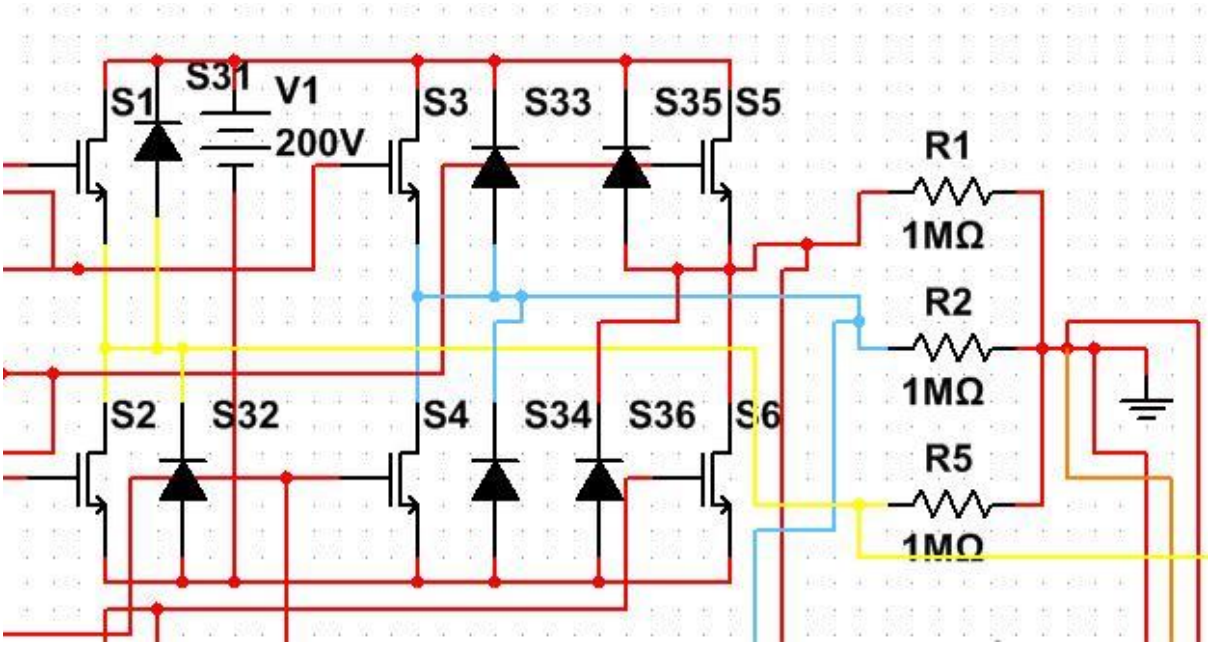


Figure 9

3.3. MULTISIM 3 PHASE INVERTER CIRCUIT WITH FIRING PULSES GIVEN THROUGH DIODES SO THAT FIRING PULSES DOES NOT COLIDE TOGATHER.

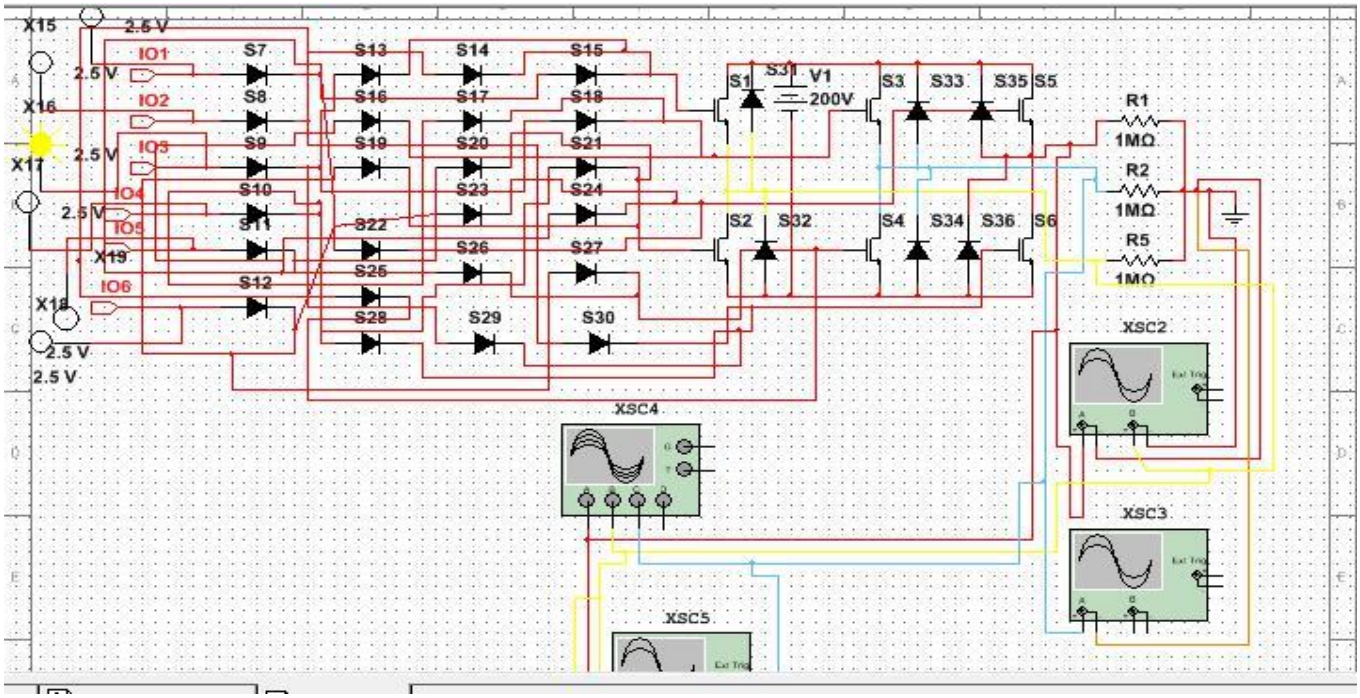


Figure 10

International Journal of Engineering Technology and Management Sciences
Website: ijetms.in Issue: 2 Volume No.7 March - April – 2023
DOI:10.46647/ijetms.2023.v07i02.001 ISSN: 2581-4621

3.4. OUTPUT WAVE OF PHASE VOLTAGE OF 3 PHASE BRIDGE INVERTER MADE IN MULTISIM:

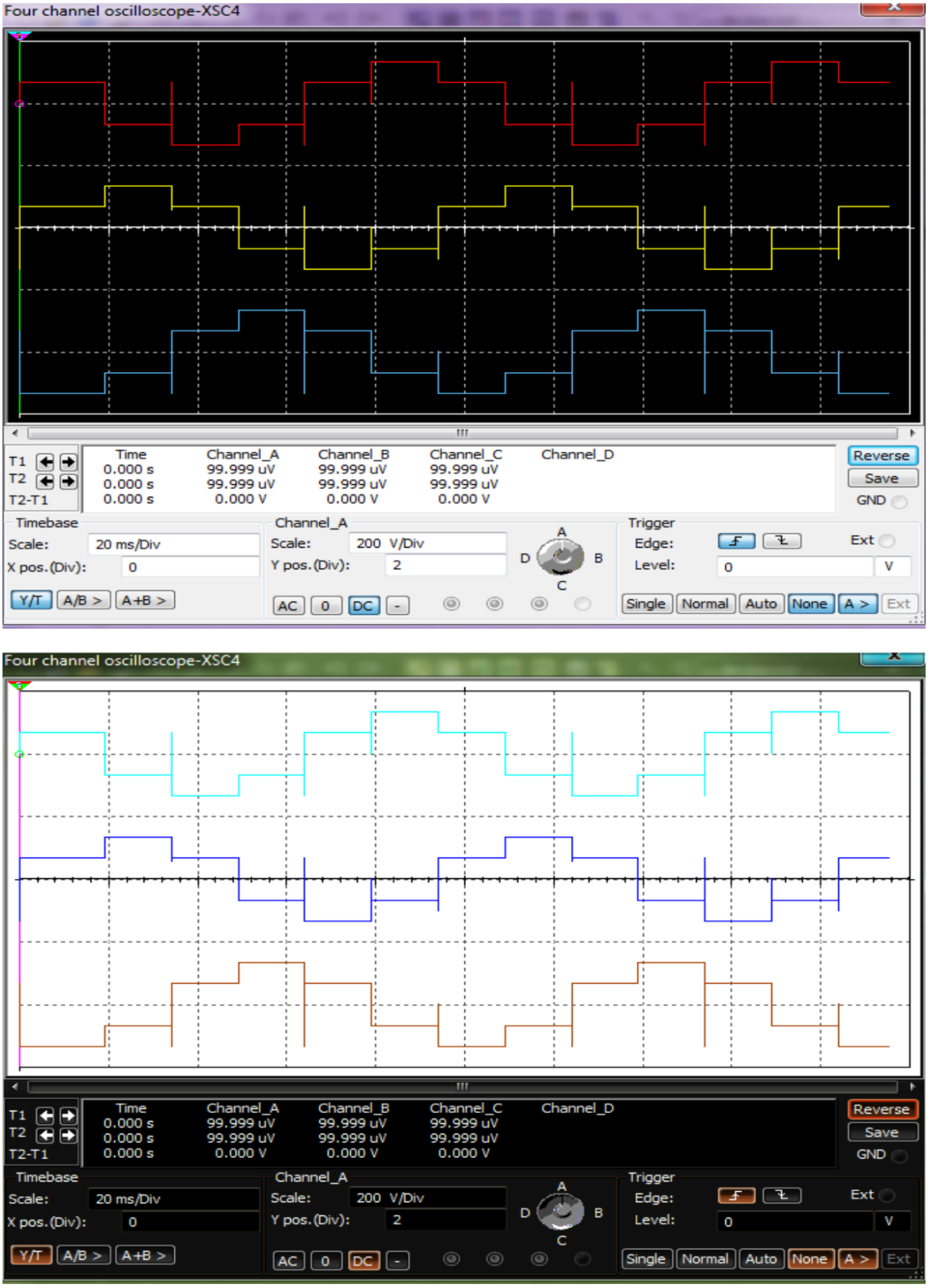


Figure 11

International Journal of Engineering Technology and Management Sciences
Website: ijetms.in Issue: 2 Volume No.7 March - April – 2023
DOI:10.46647/ijetms.2023.v07i02.001 ISSN: 2581-4621

3.5. LINE VOLTAGE WAVE FORM.

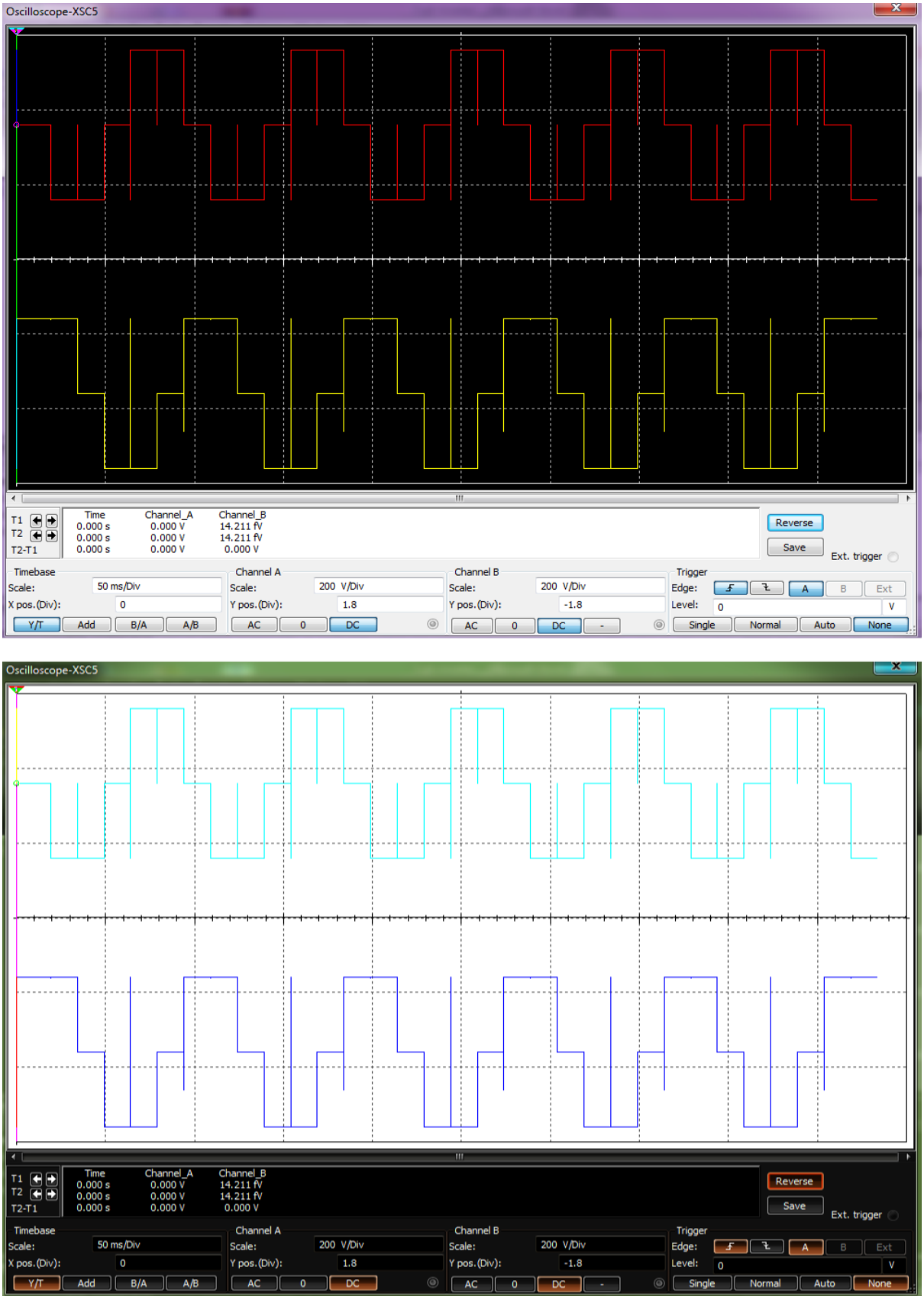


Figure 12

DOI:10.46647/ijetms.2023.v07i02.001 ISSN: 2581-4621

4. **Conclusion:** This method of firing is simple and less costly to make. This inverter may be used to drive electric motors, motors speed can be controlled by varying frequency of firing. The inverter can be fed from 24 volt DC supply and then suitably stepped up according to need by three phase transformer. Anywhere it can be used where back up for three phase supply is required. Provision for remotely control the inverter can also be done by RF kits transistors and relay arrangement.

5. Reference:

1. M Rammurty book on "Power electronics"
2. https://electricalbaba.com/three-phase-bridge-inverter/
3. google image.
4. https://www.electronics-tutorials.ws/waveforms/555_oscillator.html
5. https://www.geeksforgeeks.org/asynchronous-down-counter/
6. https://www.ni.com/en-in/support/downloads/software-products/download.multisim.html#312060
7. K. B. Naik, Bhim singh, P. Agrawal and A. K. Goel, "Firing Circuit for 3-Ø Variable Frequency Thyristor Bridge Inverter", IE (I) Journal-EI, Vol.-68, Feb., 1988.
8. Sen P. C., "Thyristor DC Drives", John Wiley and Sons, 2007
9. Power Electronics: Circuits, Devices, and Applications by Rashid.
10. Power Electronics by P. S. Bhimbra.
11. Power Electronics by Kanchandani & Singh.
12. Power Electronics: Converters, Applications And Design, Media Enhanced (With CD) by Ned Mohan, Tore M. Undeland, and William P. Robbins.
13. Principles Of Power Electronics (Paperback) by John G. Kassakian, Martin F. Schlecht, and George C. Verghese.
14. Mohan Kumar B.N; Rangaraju H.G. "Array Multiplier and CIA based FIR Filter for DSP applications". International Research Journal on Advanced Science Hub, 3, Special Issue ICEST 1S, 2021, 52-59. doi: 10.47392/irjash.2021.020
15. Soundharya B M; Yogeshwaran R; Tharanish Krishna A D; Vinitha V. "Automatic Check Post and E-Toll Payment System". International Research Journal on Advanced Science Hub, 3, Special Issue ICARD-2021 3S, 2021, 57-62. doi: 10.47392/irjash.2021.064
16. Ms. Nikita; Sandeep Kumar; Prabhakar Agarwal; Manisha Bharti. "Comparison of multi-class motor imagery classification methods for EEG signals". International Research Journal on Advanced Science Hub, 4, 12, 2022, 306-311. doi: 10.47392/irjash.2022.073
17. Power Electronics: Principles and Applications by Joseph Vithayathil
18. Power Electronics by S. Sivanagaraju.

6. **Declarations Requirement**

6.1 Study Limitations: Switching impulses in the output is there in the waveform.
6.2 Acknowledgments: none
6.3 Competing Interests: No conflict of interest in the working institute.
6.4 Warning for Hazard: No hazards.

7. About Author:

Mr. Sukratu Chakraborty working in Techno India Group as Asst. Professor for more than 10 years. The department belonging to is ECE. Academic qualification is B. Tech EE and M. Tech. Electrical Devices and Power Systems. Also published paper on power system jointly with co-partner and guide. Interested in self research on economic and emerging technologies.