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A NOVEL SINGLE PHASE FIVE LEVEL INVERTER IN COUPLED INDUCTORS

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Abstract: Multilevel inverters are very critical in the modern days because of many uses and also due to the advantage of producing many ranges of voltages enabling a variety of functions such as power conditioning, lively filters and motor drives. The proposed multilevel inverter enables us to produce 5 tiers barring any phase shift. The proposed method uses pwm approach alongside with a feedback sign so whole circuit is applied in closed loop. The simulation is carried out using matlab. The effects are included to exhibit the overall performance of 5 degree inverter carried out in closed loop system
Keywords: Multilevel inverters, Inductors, pwm

I. INTRODUCTION

The multilevel inverters are turning into famous from the time when it used to be proposed. Multilevel inverter means the inverter in which greater than two tiers are used. The multilevel inverter has many advantages such as:-1) Simple building and handy implementation. 2)Less switching losses is compared with current system.3)The positive control of the switches is achieved.4) This inverter can produce output 5 stage voltages with solely one dc source, through which we can avoid the voltage balancing trouble in traditional multilevel inverters.5)The level of the output voltage is only 1/2 of the dc-link voltage in all conditions, leading to much decreased dv/dt.6)This inverter is primarily based on widely used three-arm power module and the voltage stresses on all power switches are same, making it very effortless to construct. Applications of this multilevel inverter encompass energetic filters, electricity conditioning and motor drives. In these current years it has been referred to that the use of multilevel inverters are increasing. In the before days there required the use of more wide variety of switches. In this technique it permits us to produce the output with decreased number of switches. Also we can notice that there is less dv/dt in the output side.Thus this approach is of great advantage. The dangers of the current approach are:

[1]The inverter plan is difficult to assemble and robust in operation.
[2]The furnish sources used in each bridge is doubled for every bridge. These hazards are overcome by way of the usage of feedback technique. The purposes consist of energy conditioning which is the technique of enhancing nice of energy delivered to electrical equipment. Thus it affords more safety in energy disturbances. For eg:- PC, VCR, oven, stereos It is used as two a two surge two safety system two by means of decreasing two magnitude of voltage spikes to safe level. It is also used as noise filters by way of blocking characteristic noise pattern and permit solely desired frequency to equipment. Another utility is motor drives.
The blessings of this are
[1]Smooth operation
[2]Acceleration control
[3]Different operating speed

The motor drives electrical power from the circuit and supplies it to the motor. Inverter makes use of modulation methods to create needed three segment ac voltage output for motor. The frequency can be attuned to match the need of process. The higher the frequency of output voltage is higher pace of motor. The 0.33 software is active filter. It uses amplifier. It improves the power quality. The inverter output voltage generate output contemporary that follows respective reference cutting-edge which contain harmonic and reactive aspect required via the load. Eg:radio, tv, cell phones

II. PROPOSED INVERTER TOPOLOGY

In the conventional multilevel inverter topologies, the multilevel inverter is used besides the remarks switch. So the Waveform received will be shi correct output voltage. So we endorse a new technique in which the waveform is now not shifted. As we see we have six switches and these switches are grew to become on and off according to the switching states.

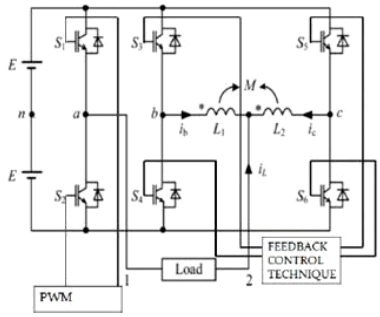


Fig. 1 Circuit diagram of proposed five level inverter

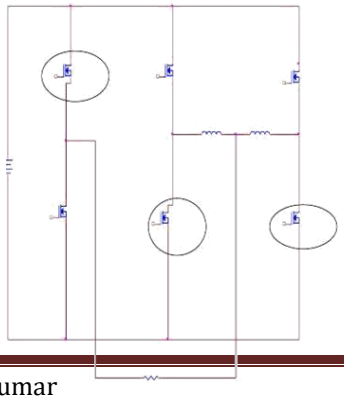
Switching states of switches:

S1	S3	S5	V0
1	0	0	+E
1	0	1	+E/2
1	1	0	+E/2
1	1	1	0
0	0	0	0
0	0	1	-E/2
0	1	0	-E/2
0	1	1	-E

III.PRINCIPLE OF OPERATION

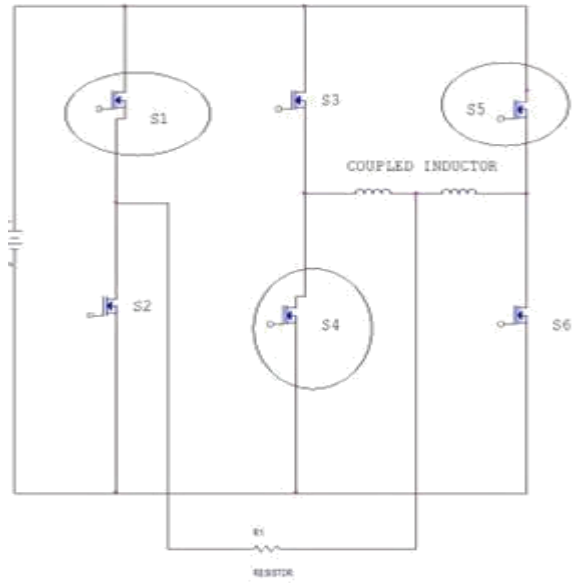
The standard of operation is explained through dissimilar modes:

MODE 1



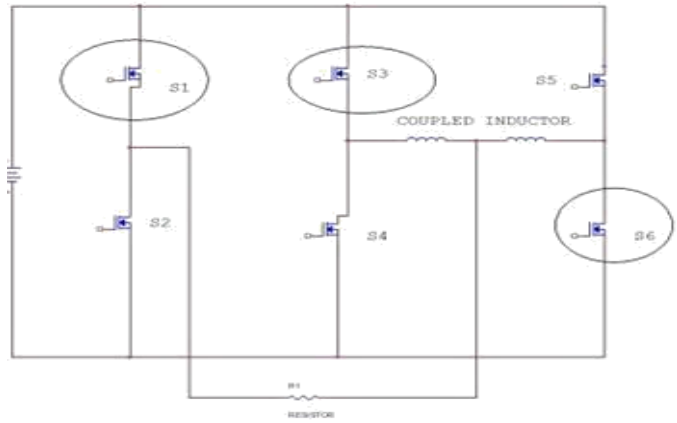
OUTPUT=Vdc
Vo=(U1-U2)/2
=(E-(-E-E))/2 =2E/2
=E

MODE 2



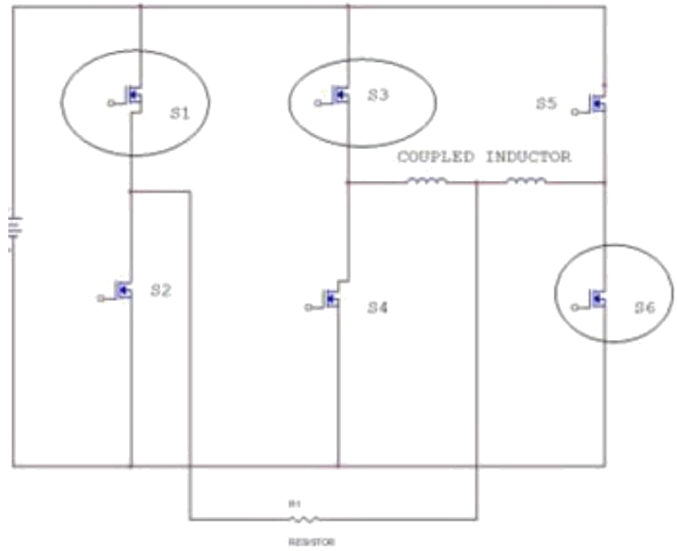
OUTPUT=Vdc/2
Vo=(U1-U2)/2
= (E-(-E+E))/2
=E/2

MODE 3



OUTPUT
Vo= E/2

MODE 4



OUTPUT
OUTPUT=Vdc
Vo=(U1-U2)/2
=0

OUTPUT=-E

Matlab simulink of proposed system

The figure indicates graph of proposed topology The proposed system consists of the circuit applied in closed loop. So an additional remarks sign is given to the circuit alongside with the PWM technique. So the waveform is received without transferring and correct output can be obtained. The obtained gadget is extra steady as we get suitable output.

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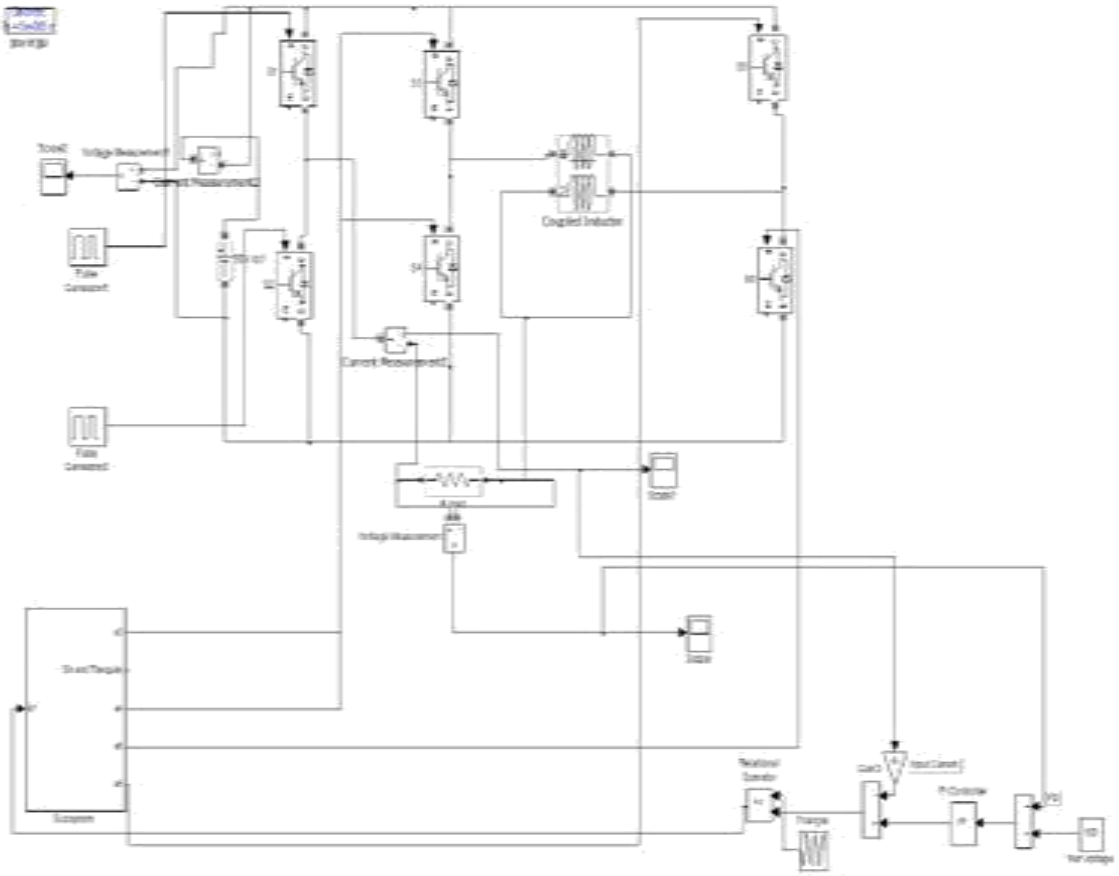


CASES FOR SELECTING SWITCHING STATES OF S1,S3,S5

The switching country of S1 is decided by means of the sign of u12ref (the reference of u12):
S1 is 1 if u12ref ≥0 and
S1 is zero if u12ref ≤ 0
To decide the switching states of (S3 , S5), the following four instances will be discussed:
Case I (+E < u12ref < + 2E):
U12 between +2E and +E.
Switching states are (S3, S5).
Switching states within each Ts can be:
1.(0, 0)↔(0, 1) (defined as SS1)or
2. (0, 0)↔(1, 0) (defined as SS2).
Case II (0 ≤ u12ref < +E)
u12 is between +E and 0 Switching states are (S3 , S5).
The switching states within each Ts can be:
1.(0, 1)↔(1, 1) (defined as SS3) or
2. (1, 0)↔(1, 1) (defined as SS4).
Case III (−E < u12ref ≤ 0)

u12 is between 0 and −E. Switching states are (S3 , S5).
The switching states within every Ts can be:
1. (0,0)↔(0, 1) (defined as SS1) or
2.(0,0)↔(1, 0) (defined as SS2).
Case IV (−2E < u12ref <− E)
Voltage u12 is between−E and−2E.
Switching states are (S3,S5)
The switching states inside every Ts can be :
1.(0, 1)↔(1, 1) (defined as SS3) or
2. (1, 0)↔(1, 1) (defined asSS4).
Thus the switching pattern for six switches can be bought from these cases.

IV.MATHEMATICAL CALCULATIONS

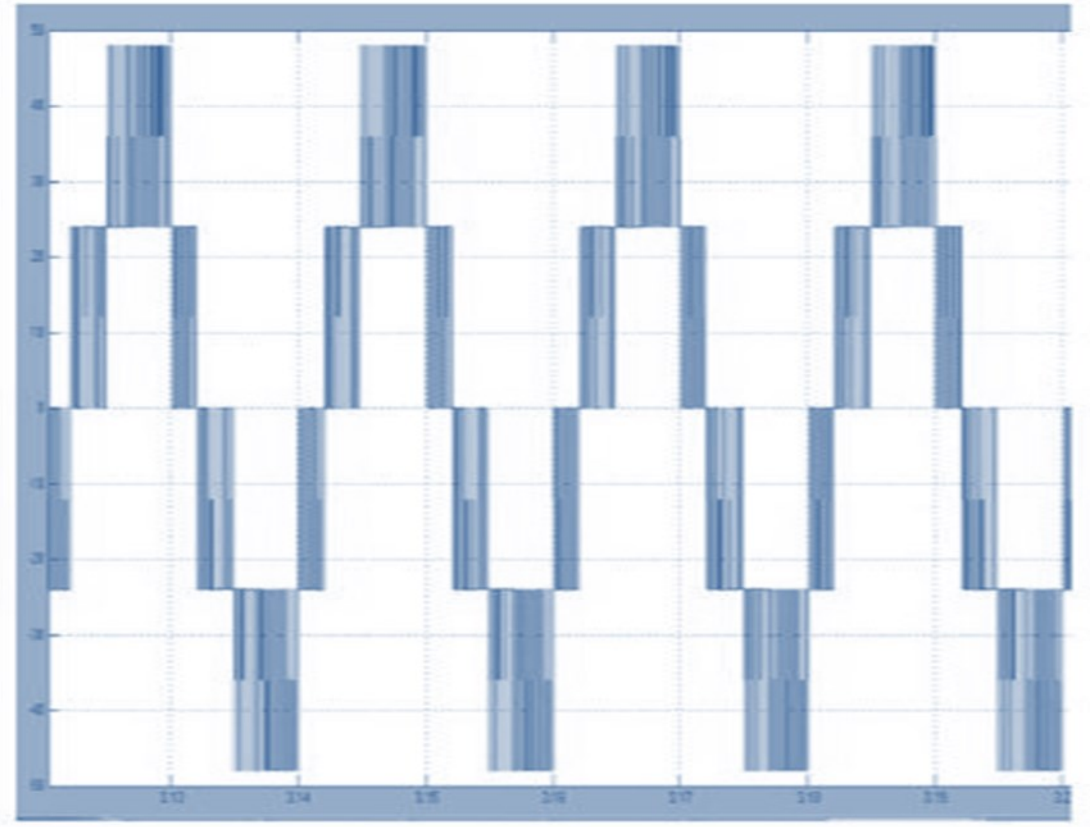
If the two coupled inductors are with the same range of turns or bought with the aid of a center-tapped inductor. The leakage inductances of the two inductors are Lσ1 and Lσ2, respectively. Assuming that Lσ1 = Lσ2 = Lσ, the voltage equations of the coupled inductors can be expressed as follows:
(M + Lσ)dib/dt − Mdic =ubn − u2 ……..(1)
dt
(M + Lσ)dic/dt − Mdib = ucn − u2……..(2)
Dt
Meanwhile, according to Kirchhoff's current law,we obtain:
ib + ic + iL = 0 ..... (3)
From (1) to (3), the following equation can be derived:
u2 = (ubn + ucn + Lσ diL /dt) .....(4)
2
Generally, the leakage inductance can be designed to be very small and (4) can be rewritten as
u2n = (ubn + ucn) ……..(5)
2
Therefore output voltage u12 is
U12 = u1 − u2 = u1 − (ubn + ucn)
2

V. MATHEMATICAL DESIGN

INDUCTANCE VALUE
M=(Ts*E)/(IL)
=(20*10^-6*48)/(1)
=0.96*10^-3
=~1*10^-3
DESIGN FOR SWITCH S1 &S2
FREQUENCY = 50HZ
TIME PERIOD = (1)/(50)
= 20Ms
PULSE WIDTH = Ton/Ts
=(10*10^-3)/(20*10^-3)
=50Ms
DELAY FOR S1 = 0Ms
(delay is 0 as its first switch)
DELAY FOR S2 = 10Ms
(delay is Ton of S1 is S2)
WHERE

M-Mutual inductance
M= (Ts*E)/(IL)
Ts-Time period
E- Output voltage
E=(U1-U2)/2
I- Current
L- Self inductance
F-Frequency
F=1/Ts
Ts-Time period
Ts=Ton+Toff
Ton-On time of switch PW-pulse width
PW=(Ton)/(Ton+Toff)

V1.SIMULATION RESULTS



The five levels of voltage are at 0,25,50,-25,-50 volts. The input voltage is 48v

VII. CONCLUSION

This paper proposed a novel single-phase five-level inverter based on coupled inductors. This inverter can output five-level voltage with only one dc source, no split of the dc voltage capacitor, absolutely averting the voltage balancing problem. The proposed approach which encompass pwm and feedback technique allow us to get 5 stages of voltage with no shift of waveforms. The voltage stresses on all the energy switches are the same and only four switches are operated at high frequency. Operation mechanism of this inverter used to be analyzed and the optimized switching patterns had been also presented to decrease the passive component.

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