A Control Technique on Novel PWM Inverter Based on Single Stage Switched Capacitor Module

P. Lakshmi Sravani, S. Sruthi

Abstract*: *There is a disadvantage with a two stage switched capacitor module multi level inverter with the end goal the switches of subsequent level like H connect perseveres which are through higher voltage stress. To determine the issue, in this paper, we proposed a module that guarantees pinnacle reverse voltage among all switches which is limited to dc voltage source for cascaded multilevel inverter. This module is called single stage switched capacitor module (S3 CM). Nine voltage levels are created with just a one dc source, two joined capacitors. Thus, quantity of isolated dc sources was fundamentally decreased contrasted with cascaded H-bridge. What's more, voltage gain increase by two is accomplished. A similar investigation averse the ongoing methodology uncovers the proposed S3 CM module accomplishes decrease in number of switches. And furthermore switching states of inverter will be controlled by utilizing closed loop PI controller.

Key words:* *Closed loop PI controller, pinnacle reverse voltage, reduced number of switches, switched capacitor module.

I. INTRODUCTION

These days, utilizing non conventional sources of energy viz. Photovoltaic clusters which were consolidated to electrical vehicles, unified power flow controllers, engine drives, distributed generation frameworks, which turned out to be significant research fields. So for all the above applications, we use non conventional sources of energy for getting appropriate air conditioning waveform. These DC air conditioning power converters have a significant job which includes CSI and VSI. Clearly, because of less unwavering quality, high blocking voltage, and extra expenses for planning a cumbersome filter in the yield of the customary two-level inverters, analysts are happy that they can supply new dc air conditioning converter setups that are found in both multilevel VSI's or Z source impedance[3]-[9]. Thus, the above components are fundamentally ready for creating staircase waveform for voltage along with adequate yield consonant range, high caliber. Be that as it may, conventional kinds of all those converters are continually experiencing and require many circuit gadgets, isolated sources of dc voltage, and especially adjusting the charge control of capacitors because of conceivable utilization of them rather than isolated dc sources.

Aside from these negative marks, the output voltage amplitude should not be more than the dc kink scalar superposition sizes, which implies that the boosting property is neglected. As of late, numerous designs of the created MLVSIs have been prescribed in the writing to diminish the previously mentioned mishaps of the regular ones [10]-[28]. With respect to fundamental idea of MLVSIs we will produce 7 levels of voltage as output by utilizing only a capacitor in parallel and 1 dc source by using modulation techniques.[12]-[13]. Likewise, we can also create more levels of voltage as output using coasted capacitors and 1 dc source by utilizing equivalent control of hardware foe flying capacitor multi level VSI.[14]-[16]. Moreover, we use stuffed U cell called 5 PUC prescribed in [17] to remove voltage sensors in the process of balancing charge. This can create just 5 levels of voltage as output using only 1 dc source and 6 switches.

In HV applications, cascaded H bridge connected multilevel inverters are generally used because of flexibility [1]. On the other hand, there are late endeavors to supplant H-connect by building up modules which are fit for creating more levels of voltage with decreased switches [2]. In the different modules, a module is exhibited in [3] which use a inverter like T type with extra control switches for 4 inconsistent sources of dc. Then again, [4] exhibited a T type square module includes 2 consecutive associated T-type inverters which can create seventeen number of levels with just twelve switches and four number of inconsistent dc sources. Comparable idea with decrease in further number of switches is proposed in [5], [6]. In any case, dissimilar to cascaded H bridge where all switches will be limited to their pinnacle reverse voltage inside one level of dc source and the recently settled module topologies involves a portion of switches for square voltage which is more noteworthy than one level in turnoff state, therefore gives with minimum fitting for HV applications.

In spite of different arrangement we can actualize associated switches to cook for PIV more prominent than a level, which will basically relinquish the number of switches decrease in contrast to H-connect. Switched-capacitor module is one more promising smaller module that is picking up notoriety in ongoing years, chiefly credited to its ability of voltage boost which made the decreased quantity in sources of dc [7],[8] conceivable .A creative switched capacitor module methodology as of late detailed in [9] is fit for producing nine levels of voltage using only one source of dc. Thus voltage gain is accomplished by making highest level of voltage 2 times the source of dc. Balancing voltage of capacitor will become easy as two capacitors will be coordinated with the end goal

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that their normal voltage is equivalent during activity.

II. LITERATURE REVIEW

Contemporary, [10]-[12] have displayed some diminished switch structures of the MLVSIs that can expand the voltage levels of output with commitment for different capacitors and sources of dc. The cost could extremely lessened from one self charge balance property in circuits from above cases. Since the charge balance system is alleviated. On basis of unbalances and symmetrical voltage sources of dc, different levels of voltage as output are gotten. Be that as it may, in spite of the fact that using capacitors will diminish sources od dc quantity required, no other mythologies have gaining highlights. On the other hand, switched capacitor multilevel inverters that are as of late developed, can be counted as an important contextual investigation for further diminishing the quantity of parts that are required and dc sources related with a property of boosting and ability for balancing of self-charge to included capacitors [13]-[20]. Thusly, propose a single dc source nine level SCMLI [14] for heavy recurrence applications. Not with standing, for any more improvement in the quantity of the output voltage levels, increasingly dynamic along with aloof circuit gadgets should be required. Additionally, the creators of[15]-[18] displayed

switched-capacitor cell (SC) which can help the output voltage throughout the arrangement parallelly by change of capacitor and 2 switches. New arrangements of switched capacitor module were recommended with the idea from above cases [15]-[20]. For example, with this cascaded association of a few switched capacitor cells associated with customary total H-connect cell, we will unevenly and uniformly expand levels of voltage quantity[15]-[16]. A summed up SCMLI has been additionally been introduced in [17] where the regular total H-connect cell had been evacuated. In any case, the adequacy of [17] has been constrained because of the way that lone the lopsided adaptation of the dc voltage sources has been given. Despite what might be expected, we can symmetrically accomplish 13 levels of output voltage levels with two separate sources of DC are incorporated and arrangement associations of these 2 switched capacitor cells on both sides of upgraded H-connected module in [19]. In this module 4 capacitors, 4 power diodes and 14 power switches are used. Furthermore, according to the hilter kilter plan of this structure, 49-level of the output voltage is produced with six capacitors, eighteen power switches. So as to achieve more levels of voltage as output[20], we additionally display twofold uneven design to charge all capacitors in switched capacitor module on the basis of upgraded emphasizement so that in proposed S3CM the PIV across all switches must be equivalent to 2Vdc, except the two switches, those are S9, S10 except the two switches, those are S9 and S10 .the will block only half Vdc. With purely switches with low voltage rating, which can arrange parallel strategy. Here, voltages of capacitors are forced to maintain limited output power, ripple losses of capacitor and higher values of the dc source's magnitude.

III. EXISTING SYSTEM

An inventive switched-capacitor module (SCM) topology as of late detailed in [9] is fit for creating more than 9 levels of voltage with only 1 dc source. Gain of voltage is approved by accomplishing greatest level of voltage 2 times the source of dc. By incorporating 2 capacitors in such a way, the voltage is equal throughout the task. By this we will balance voltage of capacitor easily. The switched capacitor module is 2 level modules. This circuit contains switched capacitor in stage 1 and full bridge in stage 2 represented in Fig.1. But in the second stage full bridge switches has to resist the voltage two times the source of dc. On the off chance this system is used in HV applications. To guarantee the pinnacle reverse voltage among the switches is limited to Vdc the switches S7 S10 S5 are arranged as 2 associated switches. Here we use 15 no of switches and diode in each switched capacitor module. This activity is used to set up an elective methodology, named as single stage switched capacitor module that settled the disadvantages of Fig. 1, simultaneously holding every one of its advantages. In proposed S3CM, the pinnacle reverse voltage among the switches is limited to Vdc.

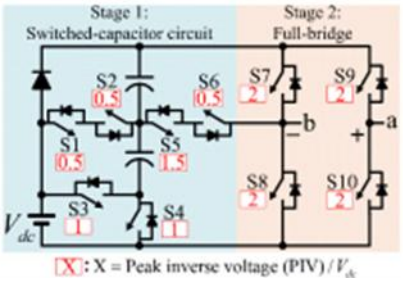

Fig.1. Switched-capacitor topology

IV. PROPOSED SYSTEM

The purpose of this activity is creating another module that will remove drawbacks in fig 2 called as single stage switched capacitor module ,along with retaining all the benefits of it. In the proposed S3 CM the PIV across the switches are within and equal to the dc source voltage, Vdc

A. Proposed S3CM methodology

We will produce 9 levels of voltage with this proposed S3CM methodology. As shown in Fig.2. It consists of 2 capacitors, 1 source of dc and 12 switches, 2 capacitors and one dc source .we can also increase the number of levels and also output voltage by connecting N multiple modules in cascade. It is sure that we can accomplish the output voltage up to 2Vdc. By using this module any switches connected in series are not needed in HV applications

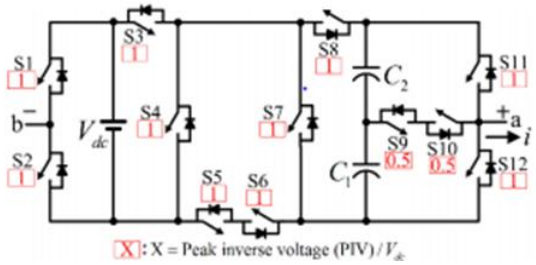

Fig.2. Basic module for proposed single stage switched capacitor methodology used (S3CM) for cascaded multilevel inverter.

The detailed analysis of circuit the states of switching for proposed system shown in fig.2. Similar study about cascaded MLI along with proposed S3 CM, the SCM [9], and full bridge showed in fig. 4. By good analysis, the bearing capacity of voltage across switches in this circuit should be limited to Vdc. So, we should consider two series-connected switches to S5, S7, and S10 for the SCM module shown in (Fig. 1).

Standard cascaded MLI which is cascade H bridge uses both switched capacitor module methodologies in [9] and S3CM methodology show minimum number of switches for guaranteed. Additionally, both topologies show a similar number of dc sources, which are likewise altogether not exactly cascaded full bridge to all levels of voltage. Additionally it is good to emphasize that the cascaded full bridge and the S3CM module do not requires diode in its hardware, while N number of diodes
Should be compulsory in the SCM topology [9]. Table 1 show the all equations when module are compared. Now some itemized examinations between proposed S3 CM module and SCM module in [9] shown in Fig. 5. It was proved that capacitor switching sequences in S3CM were indistinguishable from those in[9]. In first half cycle discharging of C1 takes place for more extended time. Where in second half cycle discharging of c2 takes more drawn out time. Irrespective of equivalent releasing times at uniform air conditioning voltage is under thought. This suggests that their equivalent normal voltages, as like [9]. The quantity of semiconductor gadgets which is conducting and the quantity of transitions switching between the two modules are likewise considering for a power change proficiency correlation reason. Now we Consider that PIV across switches are in and equal to Vdc, the proposed S3 CM has minimum conducting switches which are 1.5Vdc, 2Vdc, - 1.5Vdc and - 2Vdc, showing minimum conduction loss. Plus, it likewise exhibits minimum number of switches or diode commutations to all voltage level transitions, with the exception of when the change is among Vdc and 1.5Vdc.when output voltage is 0V the 2 zero states represents all the more switching transitions. The proposed S3 CM module displays an aggregate with 56switching-transitions which are more than one basic cycle, and as restrict sum of 88switching- transitions in the SCM module [9], that connotes bit of leeway of minimum switching loss.

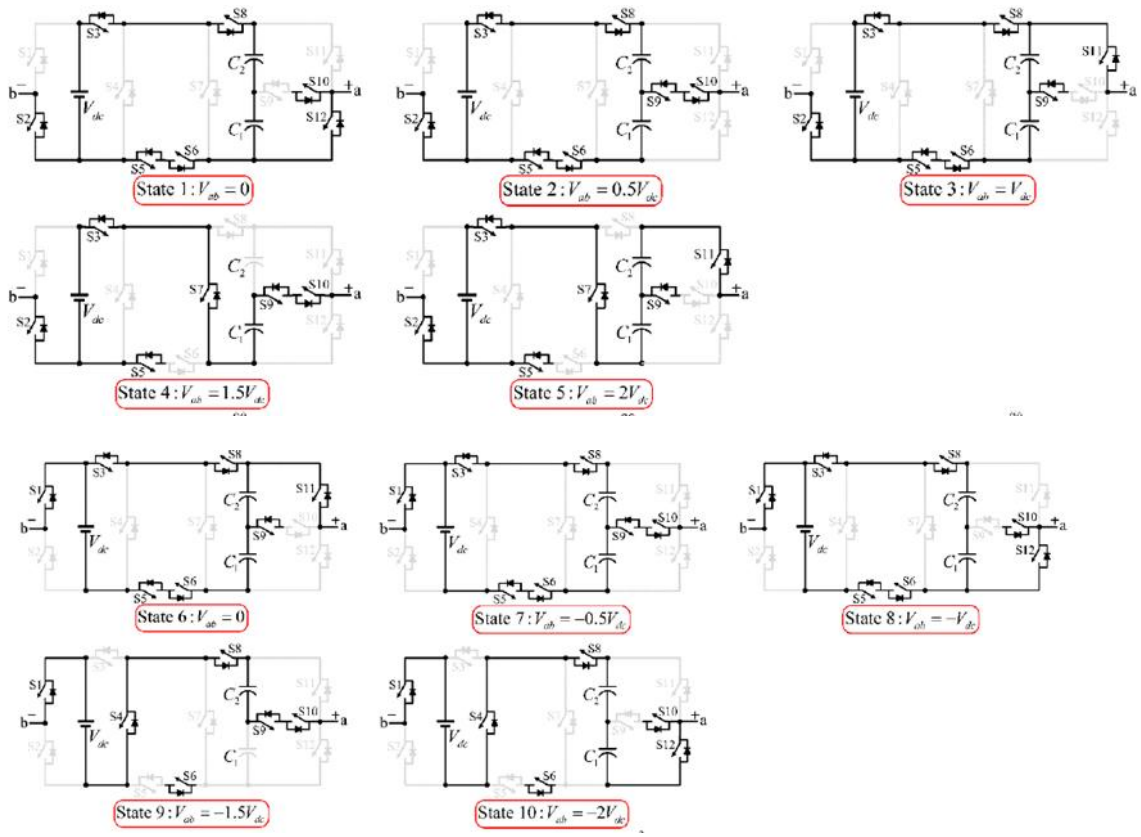

Fig.3. Proposed S3CM module switching states.

Table- I: Cascaded MLI equations comparing Modules with PIV across Switches in and equal to the Dc Source, Vdc

	Proposed S^3CM	SCM in [9]	H-Bridge
Levels	8N+1	8N+1	2N+1
Switches	12N	15N	4N
Diodes	-	N	-
DC sources	N	N	N
Capacitors	2N	2N	-
Voltage gain	2	2	1

B. Switched capacitor

Circuit part is used for discrete-time signal handling. It works by moving charges into and out of capacitors when switches are opened and shut. For the most part, non-covering sign are utilized to control the switches, with the goal that not all switches are closed all the while. Filters actualized with these components are named "switched-capacitor filters", and depend just on the proportions between capacitances. This makes them considerably more reasonable for use inside incorporated circuits, where precisely determined resistors and capacitors are not conservative to build.

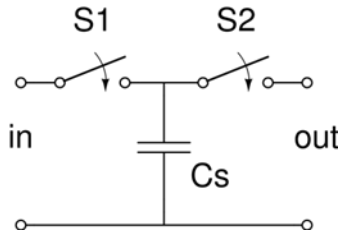

Fig.4. Circuit of switched capacitor.

V. SIMULATION RESULTS

A. Case 1 (R load)

In case 1, Only R Load is connected to the multilevel inverter and its steady state voltage and current are observed.

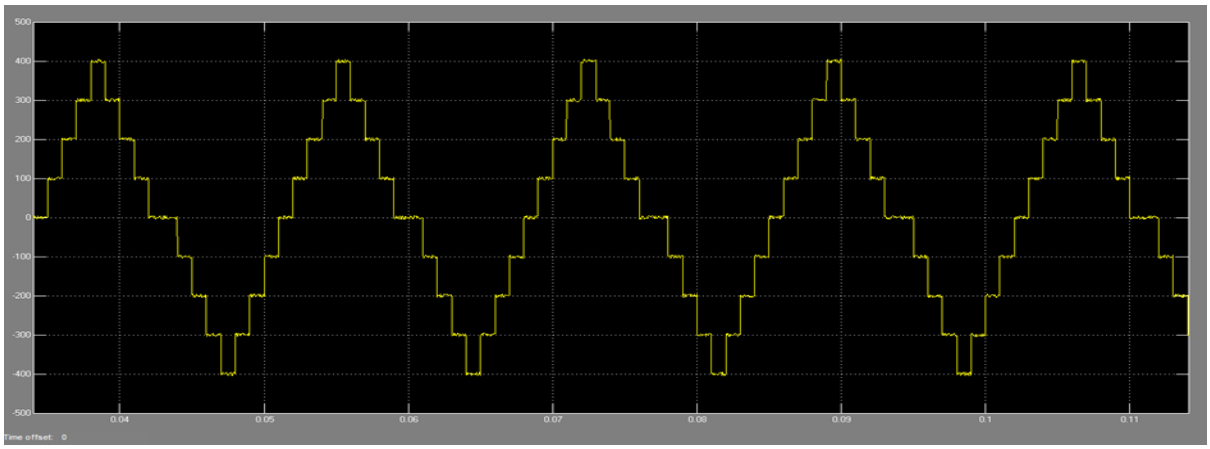

Fig.5. Steady state voltage wave form for single s3cm (9 level) for R load

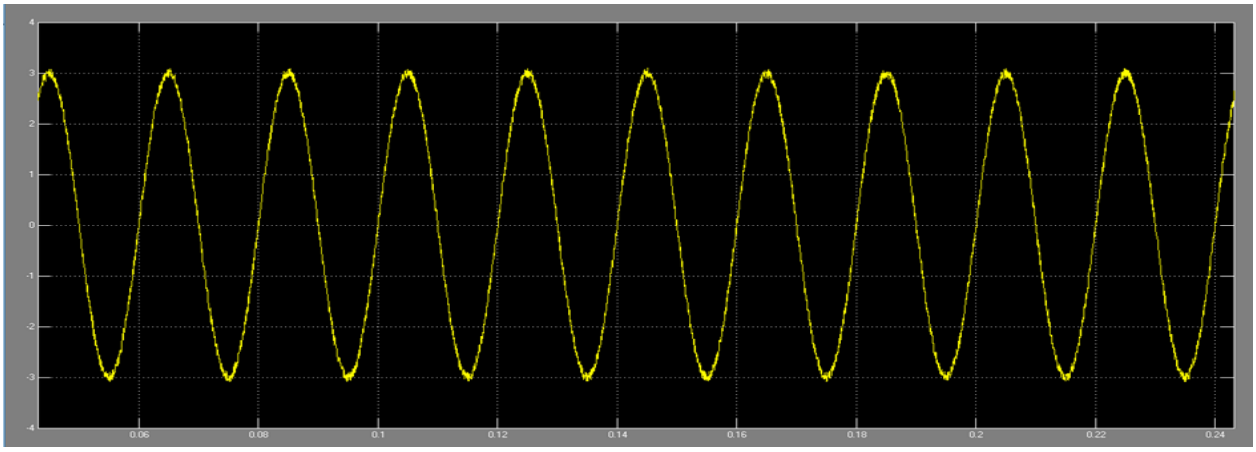

Fig.6. Steady state current waveform for single S3CM (9 level) for R load

B. Case 2 (RL load)

In case 2, variable R-L Load is connected to the multilevel inverter and its steady state voltage and current are observed by step change of load.

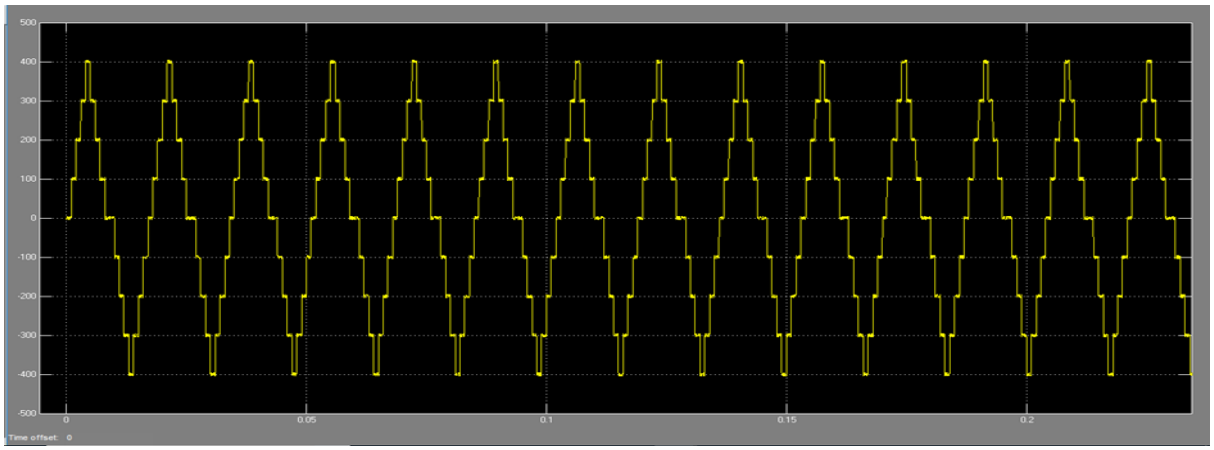

Fig.7. Voltage Waveform for step load change for RL load

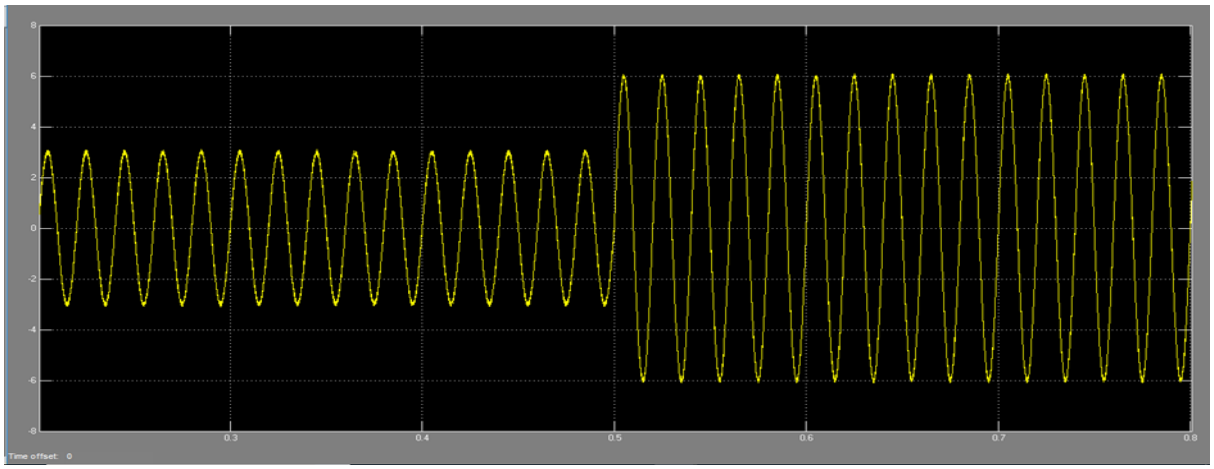

Fig.8. Current waveform for step load change for RL load

C. Modulation index for R load

In this case, the modulation index was varied from' m=1' to' m=0.2' with R load connected and steady voltage and current are observed.

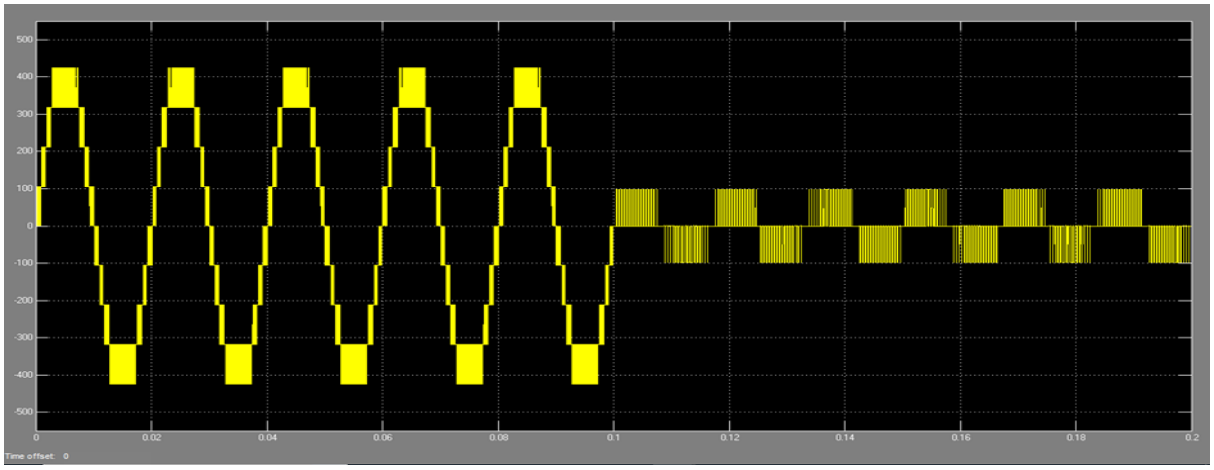

Fig.9. Simulated waveform for output voltage with SPWM for purely resistive load

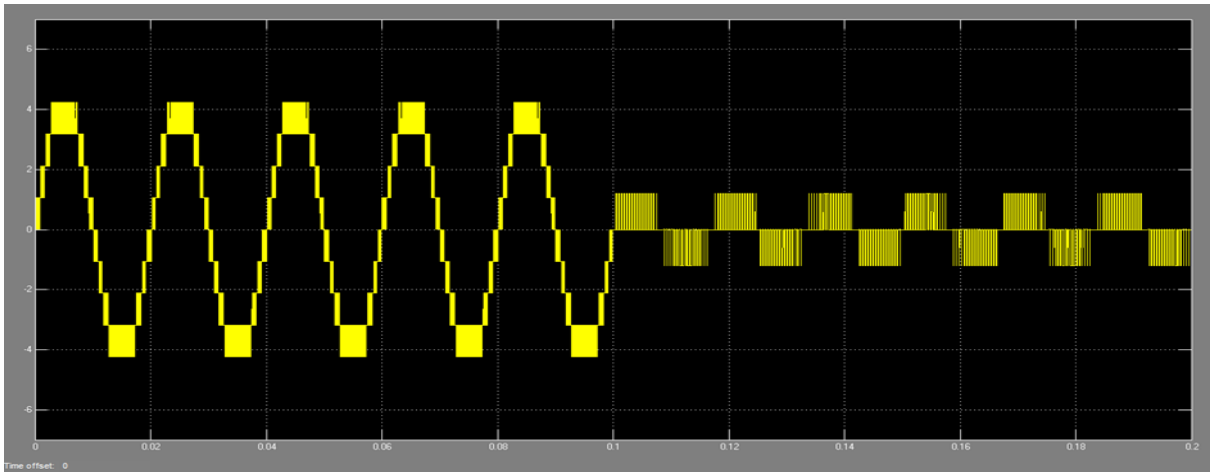

Fig.10. Simulated waveform for load current with SPWM for purely resistive load

D. Modulation index for RL load

In this case, modulation index was varied from ‘m=1’ to ‘m=0.2’ with variable R-L load connected and steady voltage and current are observed with step change of load.

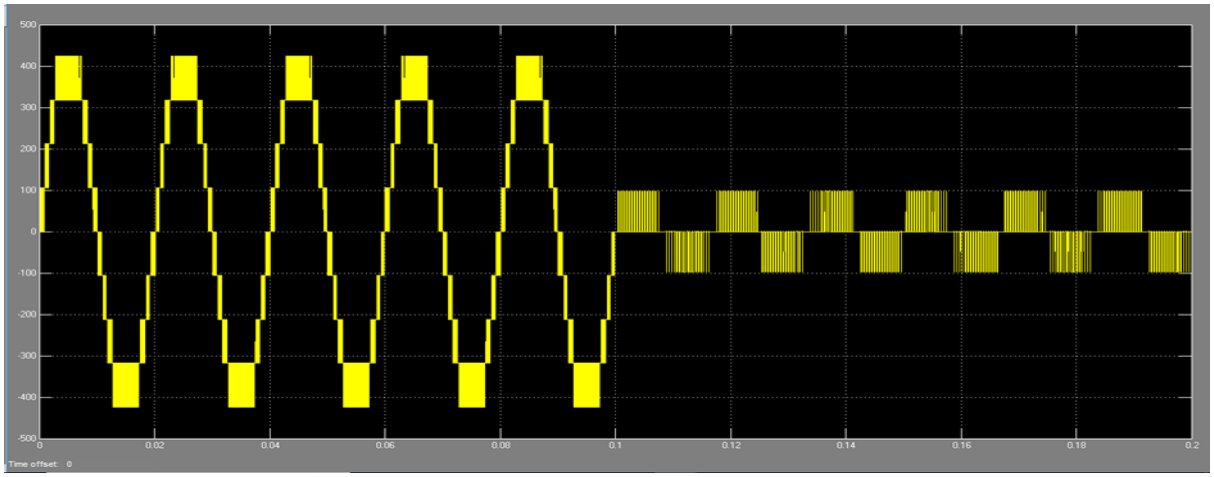

Fig.11. Simulated waveform for output voltage with SPWM for purely resistive-inductive load

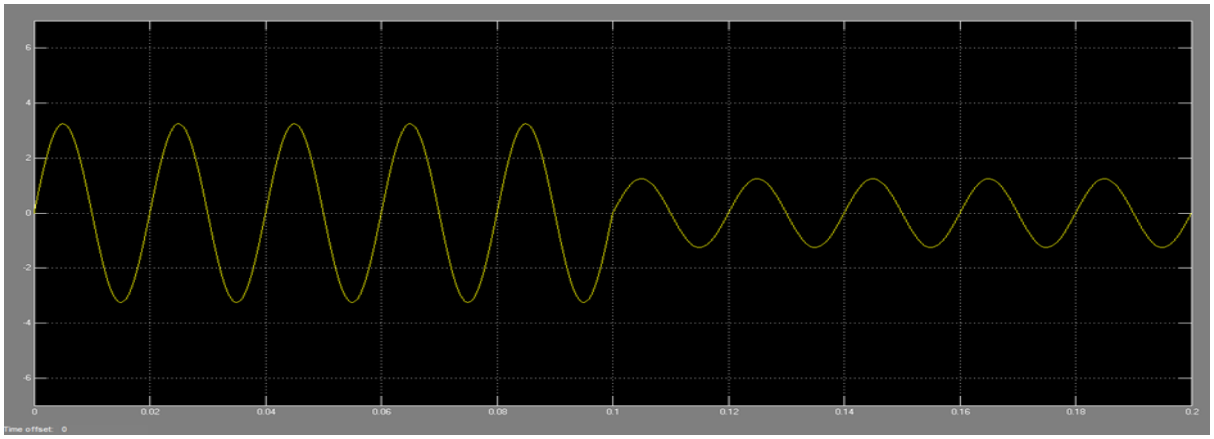

Fig.12. Simulated waveform for load current with SPWM for purely resistive-inductive load

E. S3CM multilevel inverter with PI controller

In this case PI controller is used to generate switching pulses in place of PWM and steady state voltages and currents are analyzed for R load and Variable R-L Load with different modulation index(m=1&m=0.2).

1) Extinctions case 1 (R load)

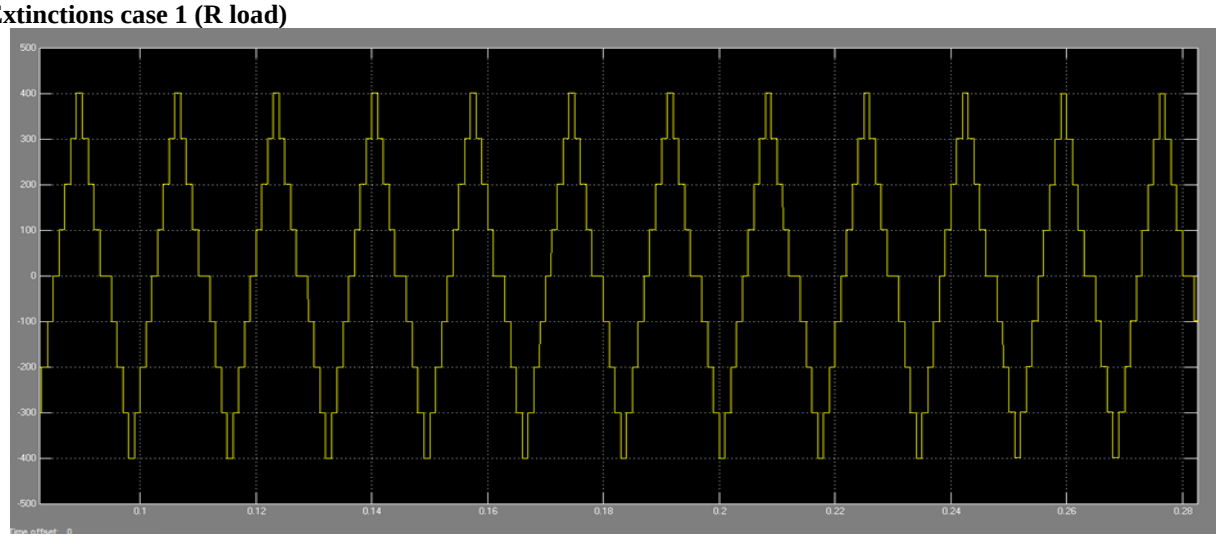

Fig.13. Voltage waveform for R load

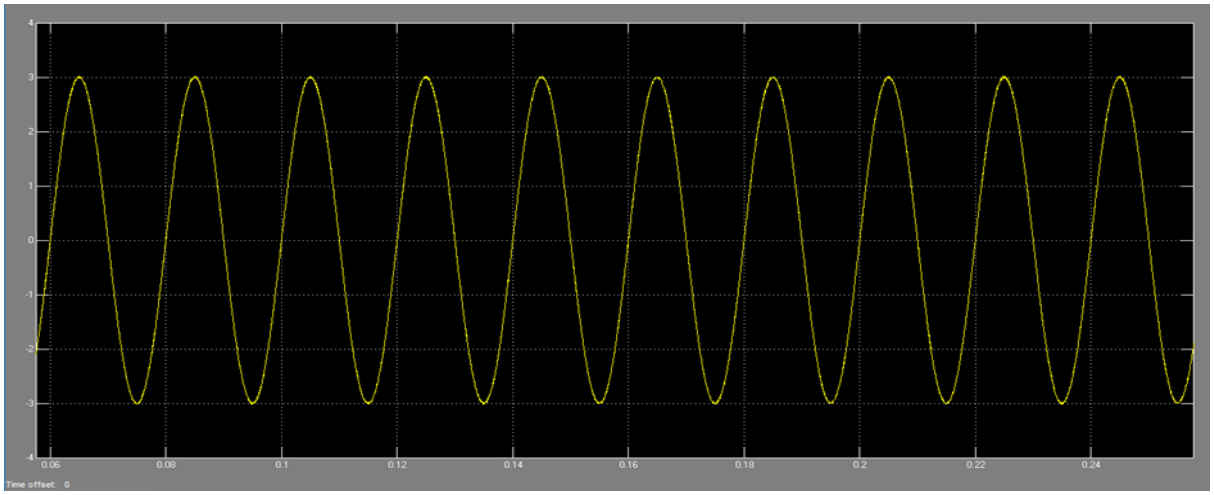

Fig.14. Current wave form for R load

2) Extensions case 2 (RL load)

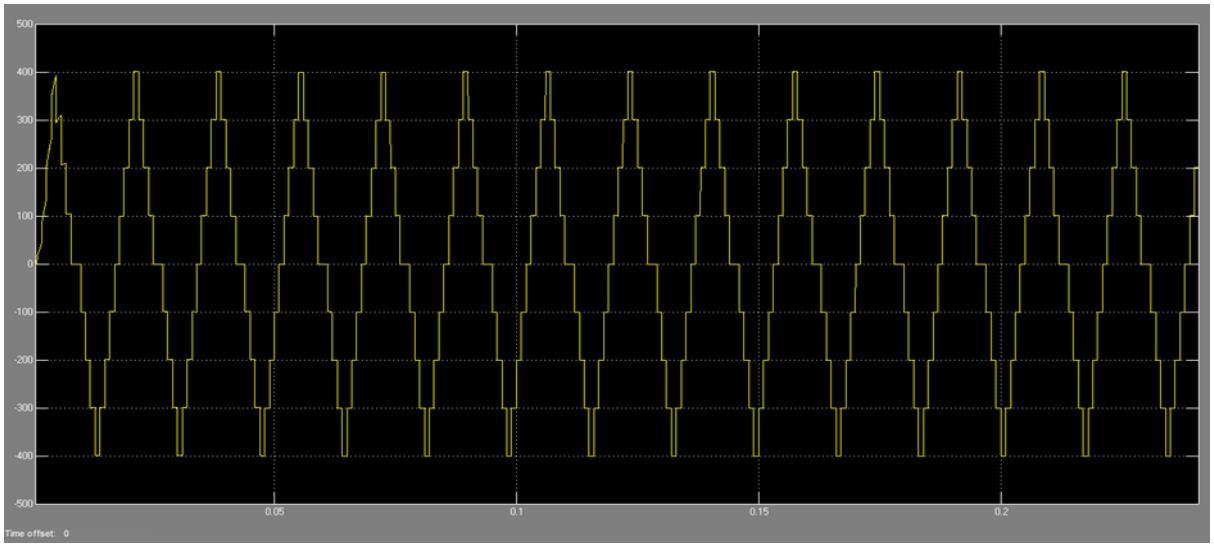

Fig.15. Voltage waveform for RL step load change

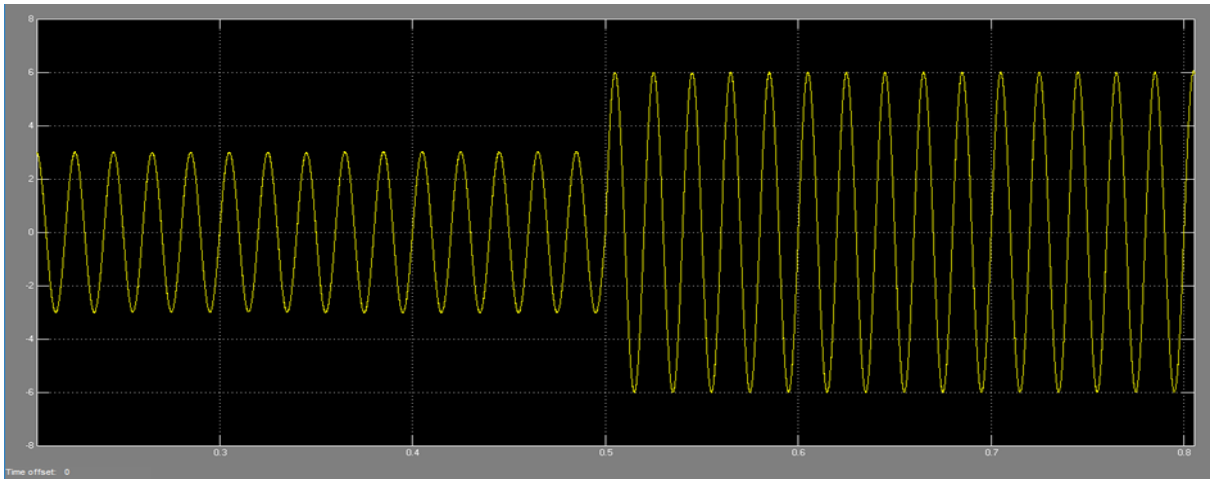

Fig.16. Current waveform for RL step load change

VI. CONCLUSION

In this paper, a inverter module with nine levels according to single stage switched capacitor circuit for cascaded multi level inverter is created. This proposed S3 CM module has voltage gain which requires 1 dc source. Voltage bearing capacity of switches is limited to Vdc is shown with the analysis of circuit. Hence, it is fit for creating more levels of voltage and high voltages that are 2 times the source of dc by utilizing switches which has minimum rating of voltage. The uses of reduced no of switches and also reduced dc sources are valid by comparing recent module of switched capacitor module with full bridge cascaded multi level inverter. Execution of the proposed topology is convincingly approved by means of tests, with all outcomes are in great concurrence with theoretical study. The improvements in proposed S3 CM module made it another appealing method for HVDC and HVAC power conversion systems.

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