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A Comprehensive Review on Advanced Power Converter Topologies for Photovoltaic Systems

A. Sivakumar*, Dr. L. Premalatha**,
*Research scholar,School of Electrical engineering, Vellore Institute of Technology, Chennai-127
**Professor, School of Electrical engineering,Vellore Institute of Technology, Chennai-127
(*sivakumar.a2015@vit.ac.in,**premalatha.l@vit.ac.in)
Corresponding author:premalatha.l@vit.ac.in

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Abstract

The introduction of renewable energy resources in the field of power generation plays a vital role due to the benefits like eco-friendly environment, technological developments, reduced implementation cost. Generally power converter topologies are used to convert the power produced by the green energy sources such as (solar (PV), wind, hydro geothermal) and also used to regulate the power flow, match the requirement of power necessity with grid. This creates the enormous development in the generation as well as distribution of power. The usage of advanced power converter topologies greatly increases the efficiency, power density of the whole electrical system with respect to suitable control method. The source may be with single or dual input port. In recent years so many converter topologies were proposed for the modern electric equipment's with the number of semiconductor devices, performance parameters of the specific converter. In this literature various type of power converter with PV source has been reviewed briefly. Based on the above analysis any one can choose the inverter and the specific application

Keywords: *DC–DC power conversion, Photovoltaic Cells, Converter*

1. Introduction

Renewable sources, for example, solar energy and wind are progressively utilized as a result of the natural characteristics and developments in energy industry andreduced assembling budget [4-6]. In any case, the discontinuous behavior of the energy resources and the unconventionality of load requirement create problem advancementin source generation [6-8]. In this manner, power converter with energy storage frameworks are generally used to change over the yield from the solar boards to coordinate the load requirement, to enhance the state qualities (stable, dynamic) of the renewable energy frameworks. Furthermore to give maximum power control, and incorporate the whole energy network to manage the irregularbehavior of the power source and the flightiness of load requirement. In conventional systems, the green energy is associated with the conventionalboost converter and afterward theenergy framework is associated with either supply end or the yield end of the conventional boost converter through a dual

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boost converter for energizing and releasing [17-18]. The fundamental drawback of these conventional arrangements is the low productivity because of the usage of the extra device for energy framework. Additionally, the multi-disciplinaryengineering may bring about expanded structure, reduced thickness, and generally highly economical.In traditional converter the duty cycle is directly proposed with gain of the converter. Because of higher duty cycle to maintain the higher efficiency become very hard for high voltage gain applications. In real time applications it produces extra voltage stresses so it requires the utilization of switches with a higher blocking voltage, in this way presenting more losses. In addition the parasitic segments present extra voltage spikes making the need to utilize devices with large voltage block, which additionally expands ability also. The need of converter device lesser voltage input has expanded in the most recent years

1.1. The physical arrangement of the PV system

The major parts of photovoltaic system is solar panels and specific converters like boos t converter and inverters and also with suitable control mechanism. The main work of the converter used here is for the highest yield and conversion of voltage at various levels. Only one solar cell has ability to produce 0.5 to 0.7without connecting load [56]. The connection between individual cells are in series and grouped to parallel .In order to increase the output power each panels are grouped as arrays[68]. Solar panels are generally isolated and without any isolation, the isolation between the converter system and transformer will greatly affects the performance the whole network.an experimental analysis with more than 300 cells for various power range which gives the system without transformer gives the more yield for example the cells from 58 to 64 Kg/KW with the efficiency of 97%.however the from the above results the non-isolated converter implementation in solar network will gives the highest output than the traditional one[87].

2. Issues to be solved in Solar Systems

The main drawback of PV energy system is the discharge of voltage in the series circuit which was obtained by the charging capacitors.to achieves high yield voltage it is mandatory to energize and de-energize for more times, this will greatly increase the counts of semiconductor elements. The main benefits of this issue is reduction in the inductive parts so the converter to be designed in dual segment structure .say for example the combination of large capacitive elements with DC converter [3].which in turns gives the higher voltage gain, output yield of moderate duty ratio [6].the basic concepts of energy management and various parameters analysis were depicted in the above paper. At the article [25][76] the coupled inductor based PV converter were presented this will gives the highest output yield with increase in duty ratio but the same time inductance(leakage) is the main problem in such kind of converters .which will leads to the highest losses and lowest performance. In article [57,85] the clamp circuit based power converters was proposed it will greatly reduce the losses, but the switch should be at lower rating irrespective of application.at the same time to achieve the efficiency of 95% almost voltage gain of 20was used in the article[19],but it is not acceptable which can be further modified by couple inductor with voltage clamp to bye-pass the inductance .one more article[71]

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which gives almost 98% only with voltage doubler circuit, withless than 0.6 duty ratio. Even though everybody have practical difficulties while selecting the correct converter, which should be based on the specific application and performance parameters .the possible questions, whichaddressed before the practical implementation

- Is it possible anon isolated DC converter can operate at larger voltage gain?
- How to get larger gain in converter not more than 70% of duty ratio?
- What kind of non-isolated converter topology is the exact solution of solar power system?
- How to reach higher efficiency of about more than 97% in an inverter from 1KW to higher power range?
- How to decrease the semiconductor switch cost by reducing switching losses?
- The materials on the devices like silicon will create any improvement in the electronics market?

The issues to be understood for the up and coming era of non-isolated boost converter are: gain increment acquiringlesser expenses and higheryield. The associations of DC-DC converter or power conditioning framework (PCS) with PV boards are masterminded in three ways [1]: (1) Module Integrated Inverter (MIC) with a central inverter; (2) Multistring PCS and (3) Centralized PCS. In MIC with central inverter design that is appeared in Fig. 1, the -DC converters are individual associated with each PV boards and afterward associated with unified inverter with DC transport in light of the idea of appropriated MPPT.

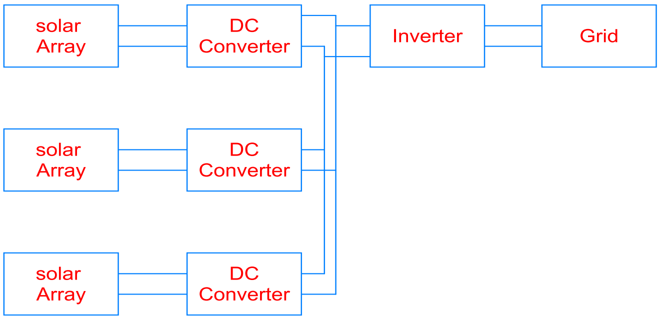

Figure 1. (MIC) with a central inverter

As each PV boards have its own MPPT controller so it can give high proficiency under fractional shaded condition. This design is perfect for housetop and Building-incorporated PV (BIPV) systems[28].Another sort of framework setup is multistring framework in which combine of DC converters and anintegrated inverter is actualized with individual solar panel as appeared in Fig. 2. In this setup MPPT controller are associated with string of PVs that corrupts Fig 3 Centralized PCS effectiveness of created power under fractional shading condition. Last setup are brought together PCS which is straightforward in structure as appeared in Fig. 3.In this central DC-DC converter is associated with numerous PV modules[41]. It has low assembling expense and high power limit. Because of string diodes there are a few losses in influence in this arrangement. By utilizing these designs it is additionally simple to amplify the power limit. Some design execution of expansive scale PV framework is clarified in [2].

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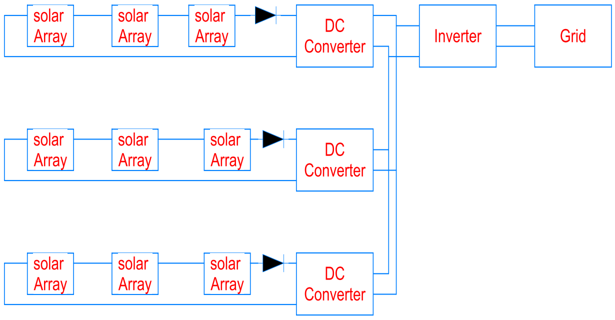

Figure 2. Multistring PCS

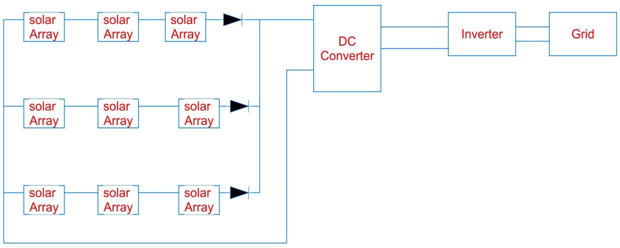

Figure 3. Centralized PCS

3. Review of Advanced Power Converter Topologies

Solar energy dual input buck boost DC Converter (Fig 4) is depicted in this paper. Among two inputs one is solar array another one is commercial AC line, both are combined with two inputs winding of the energy storage system. Efficiency of 85% with 0.85 power factor is obtained. Maximum power tracking with negligible detection error power is obtained [1]. DC–DC converter with MPPT control and power conditioning system, module protection, and PLC with PV module-integrated microsystem is proposed. Partial shadows, mismatching), electrical losses are reduced and maximum of 95% of efficiency is achieved. Detection of every PV module's electrical parameters to a central control via PLC for forecasting.100- to 200-Wp module is manufactured with 0.25–0.5

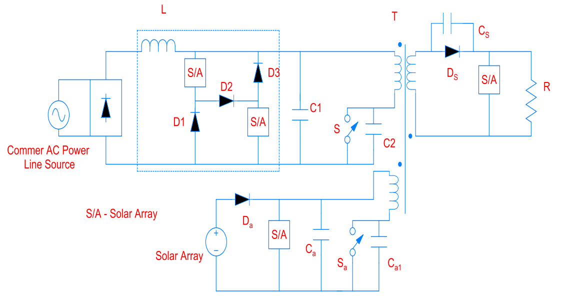

Figure 4. Buck–boost-type two-input dc–dc converter

euro/Wp[2].primary resistance based MPPT technique was proposed for the switched capacitor (SC) dc–dc converter (Fig 6) even with partial shading itself proposed. Which gives 20W power direct sunlight, 4W power during shaded condition (gives 8% extra battery backup time) [6]. ZVS, ZCSbased soft switchedDC voltage gain converter has been proposed with snubbercircuit, which greatly reduces thephysical losses of active semiconductor devices and losses due to reveres recovery issues [7].

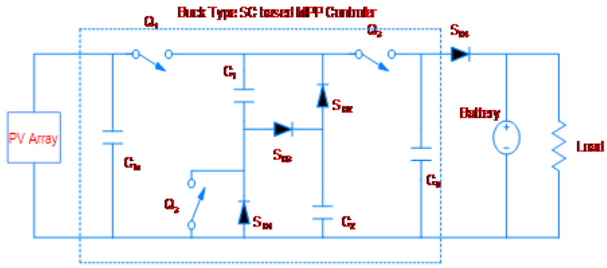

Figure 5.Fourth-order buck converter

The proposed non isolated, high gain interleaved transformer DC converter (Fig 7) is used to convert both energy produced by magnetic induction as well as capacitive energy simultaneously, with high gain and smaller inductive components.

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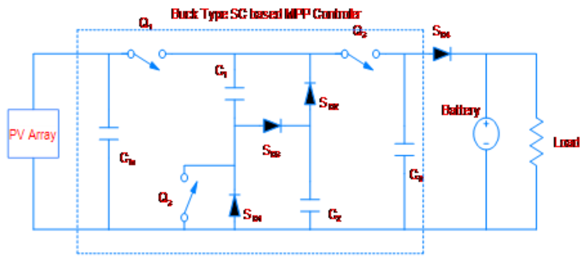

Figure 6. .Switched capacitor dc–dc converter

Due to that error in supply current and physical losses,stresses on semiconductor devices arecontinued at a lesser level with a peak efficiency of 97.4% [8]. The combination of multi supply DC converter shows the optimum interconnection of multifunction solar sub cells using power electronic circuits to extract higher solar energy MPPT with Swarm optimization analogy has been applied for cost and complexity reduction[9].minimal processing of power MPPT based dc converter was presented exclusively to achieve greater efficiency and minimization of current ripple [10]. Dual input based (battery+PV) Mono inductor-hybrid output boost converter with feed forward control to achieve reduced topology with minimal cost of external components. Flash-memory embedded micro-computer enabled technology provides efficiency of 89% [11]. Transistor, magnetic, capacitive elements based switched-inductor boost proposed for the energy storage in an economical way withthe maximum conversion efficiency of 59% [12]. A Boost converter with FLC to achieve energy harvesting and queen bee algorithm with increased efficiency was proposed.

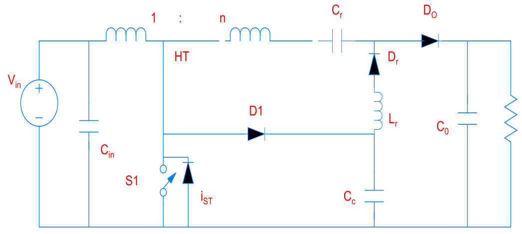

Figure7.Hybrid transformer dc–dc converter

Duty ratio of the converter is easily achieved by FLC and also scaling factor tuning also has been done with the help of queen bee algorithm [13]. Mono inductor hybrid output hybrid input boost converter (Fig 8) with two inputs like PV, rechargeable battery is utilized with pulse width modulation control which produces the constant regulated output voltage [14].

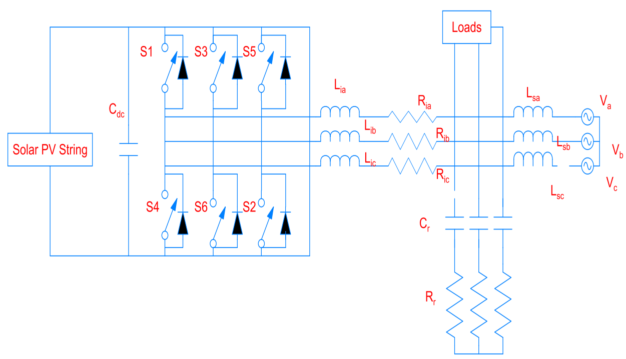

Figure8. Single-inductor dual-input dual-output dc–dc converter

Primary source as wind turbine and photovoltaic and storage system as hydrogen and battery with modified FLC with neural networks is proposed for the energy management system, and also dc/dc power converters and three-phase inverter based electrical network is utilized for the grid interconnection, which can achieve nearly 68.1% of efficiency [15].

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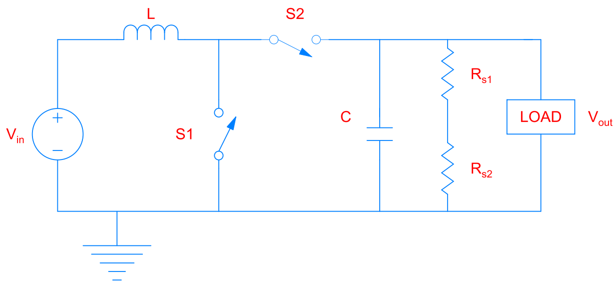

Figure 9. Single-stage, dual purpose, three-phase converter

Solar energy feed single-stage, dual purpose, three-phase converter (Fig 9) with grid interfaced PI based MPPT Controller (incremental conductance). Elimination of harmonics, current balancing in grid, has been perfectly achieved throughout the circuit operation [16]. two-step start up procedure based large gain boost converter(Fig 10) was proposed with adaptive peak-inductor-current control, power efficiency is up to 90.6%, is achieved for load voltage of 1.6 with respect to 1.2 V input voltage[17]. Two-stage inverter to eliminate double-frequency is proposed with comprehensive component modeling based on the performance analysis technique Pareto frontier and multi objective optimization. Peak efficiency below 2% points of today market micro inverters [18]. Solar energy as the renewable energy source and battery and super capacitor units integrated energy storage systems proposed for the regulated voltage,power loss prediction, and harmonic elimination for the energy storage system and the super capacitor [19]. Voltage doubler based topology based two-output asymmetric buck converter (Fig 11) with seven-level inverter, to convert the voltage of seven-level AC voltage. This Produces the AC Load current in phase with the load voltage of the system [20]. Virtual model of grid-tie interfaced modular

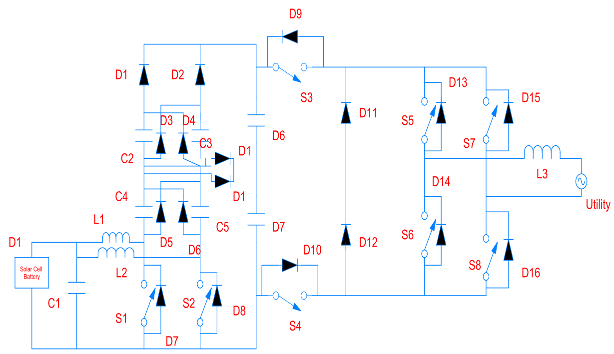

Figure10 .two-step start up boost dc–dc converter

Multilevel inverter based distributed control system for solar energy systems with fault-tolerance ability [21]. An IOL (Input–Output Linearization Controller) controller based Dc to Dc MPPT is proposed with conversion between the duty ratio and the applied voltage [22]. This paper reports the novel multiphase oriented newly proposed power factor corrected nonlinear boost converter. Polyphone operation viably empowers higher working frequency, which thus empowers smaller reactive parts to be chosen [23]. A definite linear analysis of modified current fed double bridge converter (Fig 12) was displayed. The designed converter is appropriate for an energymanagement component between aDC to AC converter and energy storage systems. Modeling procedure is utilized to determine the mathematical model of the system [24]. Two-Stage Solar Photovoltaic-Based method is proposed for MPPT and controlled battery charger during specific voltage level maintenance .by using this method they achieved maximum power extraction, overcharge protection of the battery, adequate voltage boosting [25].A high gain converter and a line commutated

DC to AC converter based hybrid controller technique is proposed to achieve the constant dc- link voltage by fixing the firing angles , by adjusting the duty ratio maximum power will be extracted, deliver of constant power with low capacity battery bank[26].

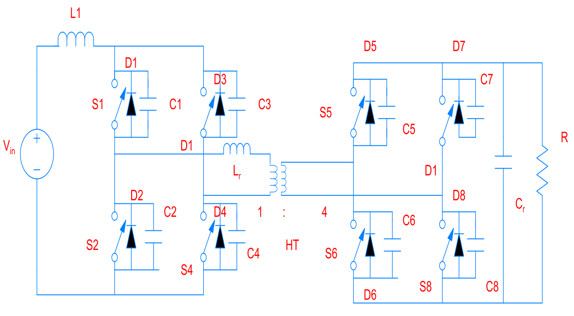

Figure 11. Dual-output DC–DC asymmetric buck converter

Integrated Asymmetric interleaved three dc–dc buck converters control technique is proposed for harmonic elimination, ripple minimization under asymmetric conditions [27]. A high frequency transformer feed full bridge isolatedmono directional DC converter with voltage elevator circuit is developed to achieve ZVS on entire range of load variations [28].Integrated ZVS boost DC converter (Fig 13) with PV system for medium-voltage (MV) dc-bus is proposed to produce gain of 0.92 at 0.65 duty cycle, using only one step-up transformer [29]. .multiple energy sources fed triple port dual side DC boost converter with the advantages of lesser semiconductor devices with ZCS is realized with the help of resonant circuit [30]. Coupled inductor integrated buck–boost converter using small signal analysis it achieves improved stability, efficiency, ripple minimization also achieved [31].

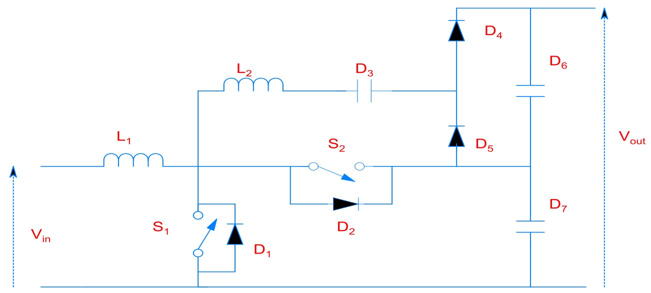

Figure 12. Double dynamic bridge dc/dc converter

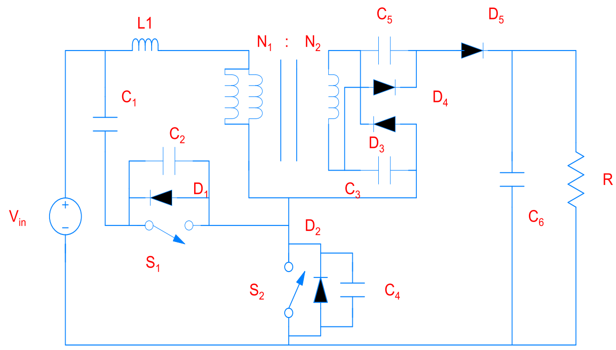

Figure13. Interleaved boost dc–dc converter

The study of a high gain DC converter as a regulating mechanism for energy management system with Sic transistors was proposed in real time evaluation [32]. The novel control strategy of the system utilized to, supervise the power flow between distributed power generation systems [33].review of various topologies of power converters has been proposed [34] ZigBee wireless communication module enabled integrated controller based PV energy system for monitoring and supervision of various parameters for each module by using sampling technique[35].

The proposed high gain boost converter (Fig 14) give higher output voltage with reduced duty ratio, voltage ripple is eliminated with active clamp controller soft turn on of the switches with the help of MOSFET is achieved [36]. Fast and finite-time convergence based dual sliding mode

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approach for the high gain converter and the VSI is designed for standalone PV System to protect the system over heating, under various environmental conditions [37]. Multi sensor system powered thermoelectric energy-harvesting generator for pest management programs in crops with appropriate measured data is proposed with solar PV systems [38]. 3φ PV inverter with front-end high efficiency boost converter based scheme for grid connected PV System drawing of excess energy from the PV source is greatly reduced by RPT Technique, and also the overall efficiency of the 94% is achieved [39]. Non isolated high efficiency boost converter are proposed with two input sources and input source to provide continuous current, this versatility of the converter achieve a gain of 20 during continuous input current flow [40]. Cross-sourceenergy (either AC or DC) based buck–boost conversion for providing dc output without any limitations, further more MPPT with AIB achieve 98.5% efficiency [41]. A parallel arrangements of single PV module with high gain converter with MPPT capability for the distributed system was proposed .Multi string topology with the above converter gives the extra from 9-23% under solar irradiations [42].

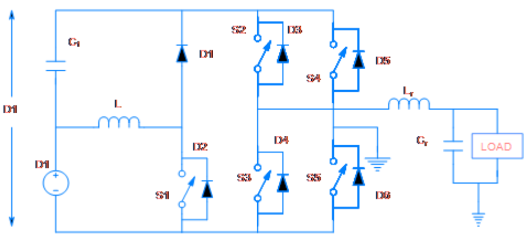

Figure 14.High step-up dc-to-dc converter

three-phase two-stage grid tied SPV is the first stage boost converter with MPPT feed the solar energy to the voltage source converter via DC link of the PV inverter which can highly reduce the switching losses and improve the dynamic responses with reference to IEEE-519 standard[43]. Differential power processing based a silicon-carbide (SiC)-based dc–dc cuk converter is proposed with MPPT. For the solar aircraft which is linked with lithium battery at a high frequency, high efficiency (>98%), small mass (0.604 kg) without electrolytic capacitors [44]. Modular multilevel converter with transformer instead of inductor to limit the circulating current, which produce nearly 60% of the device voltage rating, and also it helps to manipulate the duty ratio of each specific cell without calculations [45]. coupled inductor, intermediate capacitor, and leakage energy recovery scheme for , high gain DC converter for more boosting without reduction gain with highest efficiency of 96%[46].MPPT (ICM enabled) controlled zeta converter for BLDC motor load is developed for the water pumping system without any problem under dynamic conditions[47]. Wind energy fed half bridge transformer integrated boost converter while PV fed dual directional buck–boost converter is proposed with bidirectional converter for the Household Applications with efficient power management [48].The proposed integrated solar photo voltaic system buck boost converter and a full bridge inverter is introduced to reduce the circuit components, stress due to voltage across the dc link with simple control structure [49]. PV fed permanent magnet brushless DC motor for irrigation system with converter (landsman) for better power optimization, and also the static behavior of the system to be finer [50]. This paper proposes square-wave (quasi)ZVS DC converter based power regeneration circuit. The proposed topology gives low clamping voltage on switches, single external switch, constant duty cycle, simple structure [51].

two-stage PV inverter with LVRT control mainly strategy developed to prove the output quality of the waveform, safer circuit operation which can maintain the regulation of dc-link voltage ,elimination of second order dc-link voltage ripple[52]. high-voltage/high-power application based single-phase floating full-bridge three-level pulse width modulation was proposed to achieve dynamic losses reduction, ultra compact portable applications with the help of high-voltage silicon-carbide (*SiC*) power transistors[53]. In order to overcome the draw backs like overheating, overcharging/discharging, stability problem, turn off of battery are due to specific battery condition, in energy storage systems by using Fault prediction control in MLI [54]. Based on the merits like negligible forward energy path, broad range of applications, simple control mechanism anew DC to AC converter for a DC motor drive was proposed with lesser device time without electromagnetic interference [55]. Active buck–boost inverter (Fig 15) which contains full bridge and boost ac/ac was proposed with dual mode modulation at higher frequency to improve the efficiency of the system [56]. Integrated five levels U cells DC to AC Converter (Fig 16) with sensor-less voltage control proposed to achieve the low harmonic distortion, arbitrary power factor [57].

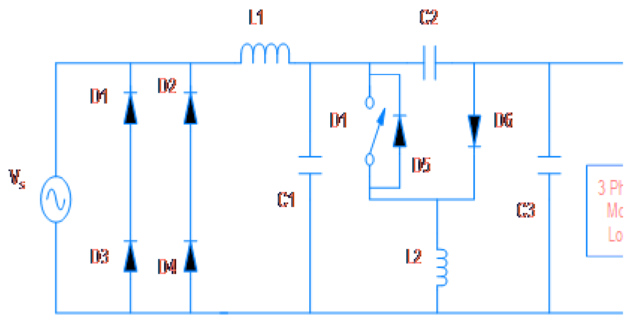

Figure15. Active buck–boost inverter

The prototype implementation and static and on timecharacteristics ofvertical input vertical output resonant converter for the DC Distribution Systems was proposed [58]. To regulate the power flow between solar inverter with Continuous Nonlinear Model Predictive Control was proposed to achieve the stability of the system [59]. performance analysis like ripple current output voltage between PV fed three phase DC to AC converter with DC link and full-scale inverter was analyzed with hardware results with satisfactory results in three-phase inverter over full scale inverter[60]. By harmonic phase feedback control harmonics and switching stress of the inverter (Fig17) gets reduced [61].

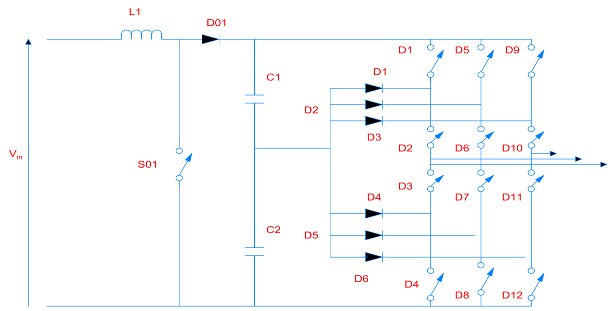

Figure16 .Five-level packed U-cell inverter

Proposed feed forward path based control mechanism for two-stage single-phase inverter achieves reduced input ripple current at steady state as well as dynamic states. Integrated the boost stage and the VSI stage based split-source inverter was proposed with three additional diodes, same number of active switches and also it produce lesser voltage stress and greater than 1.15 voltage gain[63].Implementation of high-frequency loops to avoid voltage overshoot for a Z-Source Inverters with protection as well as clamping circuit was proposed [64].Quasi inverter fed PMSG enabled flatness control algorithm to improving the efficiency of the system [65].

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To develop a simplified generation of the switching sequences and low cost based Multilevel Converters a control algorithm was developed [66]. To achieve the principle objectives like evenly distributed power and voltage sharing throughout the system cascadedwind energy feed integrated permanent magnet synchronous generator was proposed [67]. A primary-phase inverter with differential characteristics includes dual common boost converter with general source the ac loads of the both converters are directly connected to the load inside the grid-linked programs.

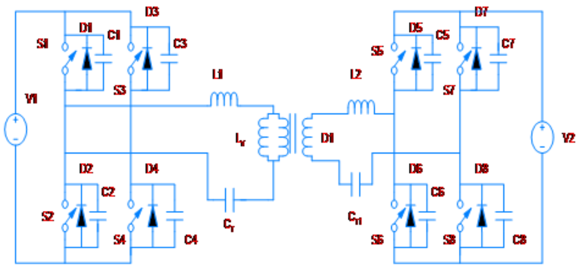

Figure17.Two-level, three-phase, back-to-back converter

The inverter has in the end been proven to have a distinct togo with the flow course for strength switch and a general mode course for transferring the same old second-order strength oscillation far away from the dc supply. This capability is known as power decoupling, which while carried out nicely, can also extend the lifespan of the dc source. Existing research associated with strength decoupling the use of a differential inverter have however focused on growing manipulate schemes with same storage capacitances assumed for the two standard converters. That is honestly no longer practical because the capacitances will range in exercise. It's far consequently the goal of this paper to nullify the DC to AC irregularities experienced with the aid of the differential inverter while storage mismatch occurs [68]. A trolley device fed by using aconstant voltage supply and using a PMSG is mentioned in this research work. A dual 3phase voltage supply DC to AC inverter is used as a method of power regulation. This converter isn't always geared up with any harmonic filters on neither the ac nor the dc side.

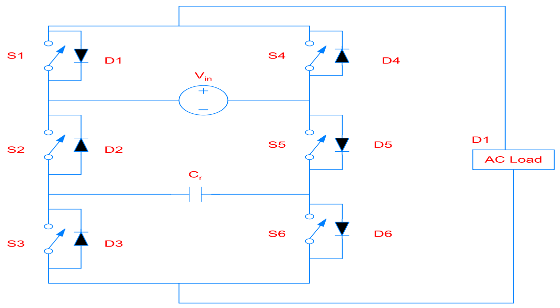

Figure18. Landsman converter

The mechanical a part of the DTS is modeled as a double oscillator in keeping with a power in an electric powered car. Various pulse width modulation strategies are implemented, a mono-segment-hysteresis loop control mechanism [69].In this article, at the primary, a novel decreased additives' SCC design was provided, that has to improve the ability and also can bypass the opposite current for inductive load via present strength of semiconductor devices. The capacitors voltage in this topology is balanced with the aid of binary asymmetrical algorithm. Subsequent, a brand new sub multilevel shape based totally on recommended SCC become developed, that could produce all of the supply periods on the load. In this topology, the traditionalH-bridge cell is used to reduce the sub harmonics; therefore, quantity of needed voltage controlled devices and other related additives are reduced. Later summation problem became supplied, that can apparent the wide variety of needed storage devices (capacitors) in every of gadgets that allows within the MLI to produce larger quantity of load voltage ranges with smaller count of device. Furthermore, complete analyses have been given, that show the variations in the voltage and uneven MLIs in comparison to a number of the newly offered topologies in all concern [70].

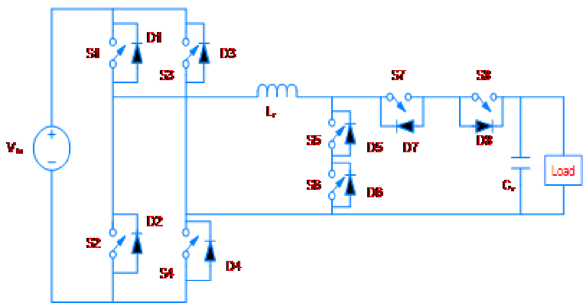

Figure19. Quazi ZSource Inverter

The adaptive integrated ZSC converter compared to hybrid ZSC has higher overall performance considering the fact that it is unbiased of the burden-structured variable that is because of theCCM mode in the adaptive integrated ZSC converterwhich can easily transfer the buck DCM mode. The self-control of both the voltages is executed for the developed device with in the boundary. But, the range of voltage gain may be widened with the aid of growing the wide variety of switched inductors.

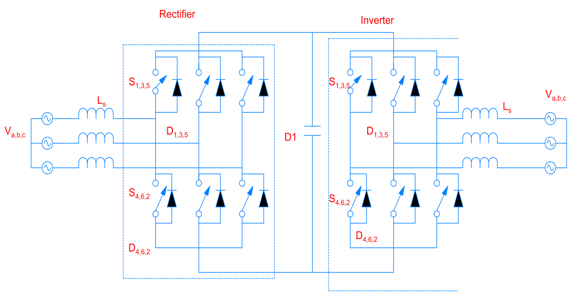

Figure 20. Bidirectional symmetrical DC–DC resonant converter

Although the general performance of the proposed converters are compromised in comparison to converter DC to AC converter and H bridge , the analysis explained in this article shows higher reliability and lengthy life span of the storage device, better device voltage improvement, and mono-level energy transfer for both topologies. Especially, the independent process with protection circuits is robust [71].A rising low-tool SF modulationtopology for Medium Voltage device that never compromise at the pleasant of load currents. The introduction of single cell for MLI topology calls for the subsequent changes: process to identify range N at every key factor isfee; the most reliable switching angles need to be allotted for every semiconductor elements with respect to subsequent standards: factorization tool fundamental frequency and keeping supply input voltage round their specific rating. An attitude-swapping scheme has been applied to keep sub module capacitor voltages around their nominal fee [72]. Solar fed sensor less integrated H-Bridge MLI has been developed and practically demonstrated. The practical exams on a seven-stage MLI with solar input gives the prediction analysis of developed work became contrast with the traditional gadget that gives the analysis of all sensors. [73].

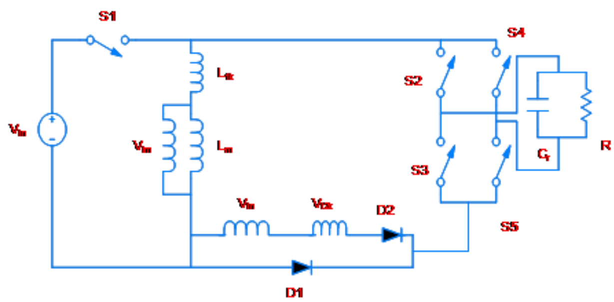

Figure 21. Single-stage conversion structures of Converters

This observes gives an advanced model of bipolar dc micro grids wherein anequal volt balancing method provides the imperative voltage sharing. The advanced dual dc micro grid is integrated with the grid of AC line the

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use of a DC to AC converter for which a brand new proper controller of voltage balancing.

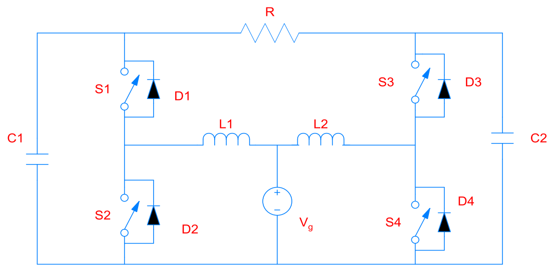

Figure 22.Grid-tied differential boost inverter

. A dual polar dual directional DC boost converter is proposed to give voltage control and equal voltage distribution throughout the system. A power management based sharing system is utilized to manage conditions of the converter[74].Power control enabled novel BLDC fed landsman topology is proposed for lower energy applications. The power is slightly adjusted to manage the speed over the entire operation via inverter. Electronics commutation happened in BLDC motor will greatly reduces the stress on the switches of the converter. Theperformance analysis of the converter is regulated in discontinuous ICM mode with voltage sensor (DC). [75].Dual bridge inverter topology with virtual capacitor bridge for an induction motor drive was proposed. Adaptive modulation based vector control approach is used to achieve the desired multilevel wave form. Voltage frequency tuned simple control algorithm developed to analyses the overall performance of the system.[76].Model predictive algorithm based twin bridge inverter with single virtual bridge was developed to eradicate the need of non-isolated transformer which in turn effectively decrease the physical structure ,external losses. Vector control algorithm tuned MPC was applied effectively to get the required output [77].This article shows the developed model of two stage DC to AC converter fed by solar energy with dc link connected capacitors. The proposed model is integrated with the digital control and the reduction of base frequency ripple without disturbing the actual source voltage.[78].The Quasi type Z source DC to AC converter is Proposed with economic analysis based on the structure of the device, integrated power management system and self-tuned power mechanism irrespective of number of stages for air craft applications [79].A high frequency DC to AC converter with Coupled inductor to provide poly segment ,poly section wave shape ,which gives the peak frequency load output, lesser stress on input voltage.[80].thecomparative analysis of passive and semiconductor elements based impedance source inverter is presented. The current ripple and voltage sag produced by the passive components addressed as a main problem. From the primary level to various levels has been analyzed for the various problem [81].voltage balancing based MLC is proposed with sensor less control. Theproposed system gives the decreased EMI and reduced size of component [82].the elimination of frond end DC converter with dual PV source is proposed the modified droop scheme is developed to reduce the synchronization problem, fluctuations in the live and island modes of the grid [83].the converter with fault control mechanism for hoist and cranes applications [84].To develop the features like efficiency and decrease the size passive component. Dual frequency resonant converter is proposed. The dual frequency modulation scheme also proposed to obtain the high density and high power devices [85].TSCS based energy management system is proposed to strengthen the voltage at machine terminal end .in order to decrease the components, modularreliability, and improvement in control structure. Coupled inductor based mono conversion system is proposed [86].a multiplexing technique based self-reliable controller is proposedfor wind energy conversion system. With the help of intelligent controller (comparisonof input voltage and demand) efficiencyimprovement, and reduction in THD also achieved [87].Artificial neural network (Elman) controlled energy storage system with SCIG is designed to predict the various parameters of the whole system [88]. wireless energy transfer mechanism adopted converter topology is proposed to obtain detailed mathematical analysis as well as various switching operation[89].modified inverter with double DC link enabled DC to DC control is designed to reduce the ripple and stabilize the overall system parts[90].A system with various DC sources input for an inverter with respect to utilization ratio of a switch is developed, themajor feature is to optimize the ripple minimization[91].the analysis of three degree H bride inverter with DC link is proposed to analyze the fluctuation study[92].Model predictive control(in continuous time) to monitor the yield voltage of the grid connected converter. The main aim of the primary controller is to supervise the overall performance of whole system. The proposed model is compared with traditional PI controller to obtain the features of the proposed system[93].A coupled inductor coupled nine degree primary segment DC to AC converter is designed and it is compared with traditional inverter at different levels[94].the combination of quadrant converter with multi-level inverter is developed to produce the five level inverter(current source).the new model is derived to reduces the passive component size and control technique[95].A grid connected synchro converter based power system is designed to analyze the fluctuations in the PV system[96].Mono cycle algorithm based voltage gain converter is proposed to extract the maximum power[97].multi-level inverter and commutated inverter(line) based hybrid voltage energy storage system is proposed to achieve the fault analysis in the bulk power system[98].

Table 1 Comparison of converters

Number of elements S,D	Number of Magnetic part	Turns of Transfor mer winding	Obtained Capacity	Efficien cy at practical level	Description
2, 5	1	3	1KW	85%	high power efficiency[1] power factor of 0.85 negligibly small detection error power

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1,1	2	-	30W	93—98%-	reduced the source current ripple[4] track maximum power (MP) at all solar insulations insufficient damping
3,4	-	-	4W,20W	80%	extra battery backup time[6] Easy to control power extraction even at partial shading
1,4	1	2	160W	96- 97.4%	smaller sized magnetic component high boost ratio[8] reduced input current ripple reduced conduction losses voltage stresses at low level
4,2	1	-	-	87.6%	Simple structure with single-inductor Regulated output voltage[14] maximized efficiency
6,6	-	-	1KW	93.5%	power quality improvement[16] harmonics compensation power factor correction to ideal
1s	1	-	200W	90.6% ,	power efficiency,[17] minimal start up voltage, minimal input voltage Voltage ripple improvement
2,10	2	1	600W	94%	High voltage conversion ratio;[20] High efficiency sinusoidal output current in phase with the load voltage
8,8	1	2	280W	96%	Higher step up voltage; High yield Cost efficient; Small input current
2,4	2	-	99.5KW	96.09%	High voltage gain;[29] High yield; Lesser stress on semiconductor devices;
4,2	1	-	-	95%	Each port at common terminal[36]; Simple topology; Reduced number of devices;

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3,2	1	2	100W	-	Modular structure;[49] Smart segments; Lesser device ratings;
4,2	1	3	2KW	-	Large range of variations in voltage switching at individual levels;[56] Tight load regulation; Reduced dimensions of
5	2	1	320W	-	Reduce source current ripple;[57] Multidirectional power flow from source to load; Ground frequency
5,1	1	3	8KW	90%	ZCS to all semiconductor devices;[61] Larger variations in power density; Highyield voltage
10s	2	5	2.5KW	-	Reduced source current ripple;[75] Power flow with ultimate uni directional control
3,2	1	2	25KW	91.3%	High step up voltage conversion ratio;[79] Relatively simple structure;
2,1	1	3	50W	-	ZCS for wide range of operation[85]
3,1	2	3	400W	92%	Continuous ripple free source current;[86] Ease of Parallel modulation
4,3	1	2	95W	-	Soft switching of all switches[97]

4. Conclusion

DC to DC converters to interface lesser-voltage higher-power supply to the primary supply shows the most elevated efficiency was accomplished in the full-bridge converter [36]. Non-isolated convertersinter allied inductor help converters with primary voltage gain and also converters hold lesser productivity, yet they large in structure, even the number of inactive parts is decreased [48]. Likewise gives efficient use of semiconductor switches, have higher voltage yield and are ready to operate in lesser value of D in contrast with all isolated converters [85]. High gain topologies are typically furnished with high voltage security

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structures. Few non-isolated topologies provides voltage sag security circuits are useless since capacitive segments and circuit arrangement are advanced to work under higher input voltage and low power[97].That requires lesser values for compelling RAC resistance and inter allied inductance dispersal to accomplish greater effectiveness of power transformation [20]. Larger supply current needs extensive region of core area inter allied inductors [35]. To maintain a strategic distance from the genuine results of the closeness impact a base conceivable individual layer count of inductor legitimately situated and integrated in segments [36]. In isolated and non-isolated voltage gain topologies extremely least number of elements and low power in the core parts can be accomplished, in opposition to for the most part acknowledged sees, through appropriate outline of magnetic parts [49].Oversizing the evaluated voltage of force changes prompts to a gradual increment of physical losses. Most astounding gain can be accomplished by utilizing semiconductor devices with lesser benefits of voltage swell. Control element in integrated topologies, contrasted with the semiconductor device utilized as a part of non-integrated ones, work at lesser estimations of successful streams [41]. This permits the utilization of switching device withefficient steady state and element rating while vertical working manner. The primary objective of integrated converters is to give a similar operation to all BJT. Indeed, the small distinction in operation may prompt to improper operation and lesser framework dependability. The routine converters like integrated power converters, the unique gain of productivity leads to unmistakable monetary impacts all through the converter life expectancy. The utilization of voltage gain converters can enhance the productivity of solar frameworks. Whenever planning particular converters the yield control hypothetically is not restricted [58]. Efficiency can be increased by switched-off at least one module, contingent upon light force. Utilization of silicon based semiconductor devices in load disposes of the switch retain ability issues, and subsequently permits diode switched off which leads to reduced power losses [88].the topologies' legitimacy demonstrates an expansive efficient use of silicon material in medium power applications. Industrially accessible silicon material permit specific decrease of losses in contrast with the parts of Si with comparative voltage swell [77].silicon based transistor not available in present situation, which provides reduced physical losses than the silicon based voltage controlled devices [90]..

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