



REVIEW ARTICLE

Analysis of Recent Advances and Industrial Applications of PWM DC-DC Converters

Promince P. M

Individual Researcher, Kanyakumari, Tamil Nadu, India.

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ABSTRACT

This paper presents an inclusive review of recent advancements in PWM dc/dc converters. Pulse dc/dc converters are classified into two major groups galvanically isolated and galvanically non-isolated. The latter is further classified into buck, boost and boost-buck types. Galvanically isolated is classified into 5 major types such as forward, flyback, push-pull, half-bridge, bridge type. In this paper the advancements of Forward Converters without galvanic input-output separation, Forward Converters with galvanic input-output separation, Boost converter that steps up voltage, Push-pull converters and Cuk Converters have been discussed. These types of converters are mainly used for abridging power supply systems, segregating primary and secondary circuit and matching load with power supply.

Keywords: Forward Converters, Galvanically Isolated Forward Converter, Push–Pull Converters, Cuk Converters.

1. INTRODUCTION

Using the distributed generation, converters became common and more innovative converters are produced these days. Latest converters are fit for associating with in an excess of supply out of distributed generation at a similar time and whose power gets exchanged to the output at the same time. The foremost common DC/DC converters encountered in low power applications cannot be extended to high power transmission application because of poor execution those converters show. This paper briefly presents recent advancements in PWM DC/DC converters such as Forward Converters, Galvanically Isolated Forward Converter, Push–Pull (Symmetric) Converters, Cuk Converters.

2. FORWARD CONVERTERS

The estimation of power losses in high power bipolar transistors is investigated for many of the unremarkably encountered forms of power circuits [1].

The switch loses within the devices reach a considerable quantity in high frequency process and decline the potency and responsibleness of the system. A system of categorizing for snubbers is planned as a method of process snubber operation [2]. The dv/dt may be as high as $10 \text{ v}/\mu\text{s}$ and leads to switch break down and/or radial EMI Electromagnetic Interference. Four dc parameters absolutely characterize every sort of regulator [3]. This closed-loop parameters area unit associated with six transfer functions compatible to the open-loop circuit. Small-signal action of dc/dc converters is usually delineated by a collection of 4 transfer functions: output impedance, audio susceptibility, output-to-input current gain and input admittance. This paper shows however the transfer

*Corresponding author. Tel.: + 91 9600028618

Email address: promince@yahoo.co.in (Promince P.M.)

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functions of allPWM DC/DC converters may be disclosed in closed form [4]. No restriction exists in terms of circuit order or range of switch phases inside the period. When the outer loop is open, 2 more transfer functions area unit needed for entire classification, i.e., the control-to-output gain, and also the control-to-input trans-admittance. By means of the last 2 functions, and of the error-amplifier transfer-function, the closed-loop performance of the converter may be connected to open-loop responses. A review of the statics and kinetics of the Half-Bridge, Complementary-Control converter is planned in this paper [5]. Flyback-type AHB converters with essential characteristics like electrical phenomenon output filtering are valuable for multi-output or cost-sensitive utilization. This paper has conferred the careful design-oriented investigation of the changed asymmetrical half-bridge converter [6]. For single output application, on the other hand, the Forward-type AHB converter is better to the Fly-back type AHB converter. The limitations of the uneven half-bridge converter are examined [7], and totally is similar turn ratios are used to advance its performance. Totally dissimilar turn ratios, for the transformer can be selected to decrease the secondary-side conduction and switch loss. Two modifications of a soft-switched converter collectively with a completely unique asymmetrical PWM management have been anticipated [8]. Throughout this work, the output current and magnetizing current are considered as constant, and so insignificant to circuit operation. In this paper [9], the distinction of the output and magnetizing current is taken into consideration for obtaining the operation principle of the asymmetrical half-bridge forward mode converter. The energy reserved in inductor ought to be larger than the energy reserved within the junction capacitors for ZVS process. [10] Two duty cycle management laws are conferred for a stabilized 3-phase boost-type switch mode rectifier. The closed-form based examination and design is sometimes desired to realize comfortable imminent to design the system, which incorporates, make simpler the

structure, calibration of the controller, protection of the control schemes and also the reliance of the circuit element values.

3. GALVANICALLY ISOLATED FORWARD CONVERTER

Three innovative dc/dc converter topologies appropriate for eminent power-density high power utilizes are conferred in this paper [11]. All three circuitwork during a soft switched manner creating possible discount of device switch losses and a rise in switching frequency. The duplex galvanically secluded dual active bridge dc/dc converter has two symmetrical full bridges that produce phase shifted conversion square waves to the transformer's principle and derived side. The performance characteristics of a high-energy, high- power-density dc-to-dc converter supported the single-phase dual active bridge topology area unit outlined [12]. The DAB topology is extremely enticing as of its zero-voltages, duplex power flow, low element stresses and high-energy density options. A completely unique UPS style optimized for the applying of laptop backup has been presented [13]. The authors examined an off-line UPS style supported DAB topology. In this paper, the influence of section shift modulation on the DAB's performance is investigated for prime current operation [14]. The utilization of DAB converters for duplex energy delivery between an energy storage system and a dc grid are dealt with. This paper deals with a duplex isolated dc-dc converter appropriate for an energy storage scheme [15]. The authors adopt a DAB converter because of the interior circuit of the power conversion system between an ac grid and a dc voltage supply. A category of power conditioners including an intermediate variable high-frequency link construct is launched [16]. Cycloconverter-type, HFL converter diminishes the conversion quality by directly inserting a three-phase PWM cycloconverter to the derivative side of a transformer. This article describes a completely unique hybrid modulation theme for the process of an isolated high-frequency and high-energy direct-power-conversion (DPC) inverter [17]. The rectifier-type HFL (RHFL)

converter owns a configuration same as that of a traditional fixed-dc-link converter apart from the lack

of the dc-link filter. A high-frequency link 3-phase dc/ac inverter is anticipated through this paper for mega-watt diverge application as a probable alternate for the normal low-frequency power electronics inverter [18]. A completely unique hybrid modulation, pertained to Bridge III, more cut back its switch losses by permitting no switch on 2 of its 3 legs. These converters use a Z-source or a quasi-Z-source arrangement with 2 active switches to supply four quadrant processes which implies bipolar output voltage and duplex current operation [19]. The advantage of these converters is comparatively low even once a high duty cycle is employed for lashing their switches. Throughout this article [20], a standard cell stack has been conferred. It can be reconfigured into many sections with smaller cell count, each provision in secluded module within the DC-DC converter, leading to a high performance system. It establishes several input sources and alternative components.

4. BOOST CONVERTER

A procedure combining PWM management method and phase-shift (PS) management method is commenced [21]. In the case of applying of solar panels, it must be taken into consideration the reference voltage related to the solar battery, the switch frequency, the parameters of the own converter, etc [22]. The electrical device bank chiefly is employed as an energy buffer and these capacitors area a unit absolutely charged by high voltage power supply [23]. This paper has conferred an MPPT methodology that supported offline characterization of the MPP locus of a PV module [24]. Excessive range of cells and asynchronous association ought to be avoided among the cells, that ends up in the output voltage of the PV module is sometimes less than fifty. [25] A brand new current-fed isolated boost converter has been planned for low voltage and high current application such as fuel cells. The input current of the isolated converters area unit pulsed, that may be a fatal liability to the PV module according to the

characteristics of PV cell. Therefore, massive input filters are needed. The slender turn-off amount of the standard boost converters limits their applications in high increase DC-DC conversion [26]. This study has successfully developed a high increase converter with a coupled-inductor and has been applied well for a PEMFC system and a standard battery [27]. Adopted method cause terribly massive input current ripple, which is not the well-liked result for the PV module. New schemes of transformer less ac-dc and dc-converters with a diode-capacitor voltage multiplier factor have been conferred and analyzed [28]. Current spike exists in some ordinary switched capacitor converters and are exclusively restricted in tiny power rating. A family of switched-capacitor resonant circuits mistreatment solely 2 transistors is conferred [29]. Downside of current spike may be solved by adding tiny resonant electrical device asynchronous with the switched capacitor. This manuscript recommends a soft-switched dc-dc converter mistreatment, voltage multiplier factor cells for high-step of application [30]. The converter needs four drive signals, and this may increase the drive circuit and management complication. This dissertation examines a completely unique current-control theme for a hybrid 12-pulse rectifier using An LIT ranging from the fundamental theory of process, the space-vector modulation(SVM) and closed loop control configuration that permits a right away management of the input current space vector[31]. It has many drawbacks such as indistinct input currents, uninhibited output voltage and soaring mass due to the attendance of the autotransformer and of an inter-phase reactor. This paper introduces a method to realize optimal dead times in dc-dc converters with synchronous rectifiers while not recognizing any of the power-stage signals aside from the output voltage [32]. This methodology desires regulated input and output voltages. The MEPT methodology is employed throughout this article to revamp the primary-to-secondary switches' dead-time factor in a secluded topology to cut back the switches' diodes physical phenomenon during commutation and to cut back body diodes physical phenomenon and reverse-recovery connected losses so as to enhance efficiency

[33]. The pertinence for point converters was not practiced. A brand new low value cell converter system for residential application has been conferred in this paper [34]. High discharge inductance within the electrical device ends up in hassle like voltages pikes and magnetism noise. Mistreatment of the resonance between the transformer discharge inductor and also the clamp capacitor throughout the operation of the clamp branch, the loss of switch turn-off is reduced, and also the efficiency is enhanced [35]. The single-phase circuits face severe parts stress and tainted efficiency for higher power levels. In three-phase, switch-mode enhanced significantly [36]. Small leakage inductance is needed within the three-phase transformer implementation. The principle operation of a brand new three-phase series resonant converter is delineate systematically, intimately for switch frequencies and capable of the resonant frequency; switch frequencies are larger than the resonant frequency [37]. The series resonant converter leads to an increase at the quantity of reactive parts. This paper is planned for applying the asymmetrical duty cycle to the three-phase dc/dc pulse-width modulation isolated converter [38]. Zero-voltage Switching actions are restricted in higher load condition. In this paper, a 3-phase transformer-isolated dc/dc converter utilizing phase-shift (PS) modulation is anticipated [39]. The six-leg converter needs switches and management circuit quality. This article depicts design for a full-bridge step-up converter meant for power supplies that accepts a three-phase electrical device rather than a single-phase one [40]. The planned converter demonstrates drawbacks like higher tally of switches, exaggerated power and negative feedback circuit quality, and thus condensed application responsibility.

5. PUSH-PULL CONVERTERS

It [41] reveals the aptitude of the GTO thyristor power circuit to supply freelance fast response management of real and reactive power. The utilization of the multi-winding transformer creates the conversion system expensive and fewer reliable. This article [42] has delineated the MMCC family with concentration on classification, language and

appliance. The SSBC-based battery energy storage system requires variety of galvanically-isolated battery section, the tally is capable that of the H-bridge converters. This article [43] has conferred in depth examination and experimental confirmation of PWM management of the DAB. PWM of 1 HB output and coincident PWM of each bridge are coated. The present flowing within the dc buses contains high ripples; thus applicable filtering circuits' area unit is necessary. This type of converter [44] is very appropriate for craft HVDC power provide system and UPS system. It does not provide complete investigation regarding totally different operation modes to seek out the optimized region. All through this paper [45], a complicated winding-coupled duplex dc/dc converter has been planned for isolated high step-up/step-down conversion that options ZVS soft-switching feat for all the ability switches. The link between duty cycle and phase-shift quantitative relation in numerous operation modes was not revealed and delivery difficulties with PPS converters. A winning appliance of the active clamping theory to the current-fed push-pull converter has been attained through imitation and testing [46]. The secondary-side diodes are arduous switched, causing soaring reverse recovery current. The planned converter [47] has ZVS active switches. Switch frequency of the active-clamp switch is 6 times over that of main switches, that restricts the switching frequency of the system. ZVS operation is accomplished mistreatment of the input DC voltage because of the driving power together with the resonant voltage and the ZVS signals [48]. The operational frequency of the converter cannot be restricted by mistreatment external reactive parts like switched variable capacitors. It uses the secondary discharge inductance because the resonant component and also the converter desires no high letter of the alphabet resonant circuit, therefore the separate resonant electrical device is not required [49]. It cannot regulate output voltage by pulse-width modulation (PWM) methodology. This converter [50] can reach a gentle state with little ripple input current, which is very appropriate for unregulated dc-dc conversion from a low-tension and high-current supply. Output voltage cannot be synchronized.

6. ĆUK CONVERTERS

In this article [51] the optimal matching circumstances between the cell array, the storage batteries and also the load are considered. This method solely approximates the situation of the MPP because it is essentially related to specific seclusion and load setting. A group of low-priced high-efficiency three-phase high-power-factor rectifiers is attained. Another power switch may be established to enhance the present wave shape further [52]. The input current is rhythmical and an additional tiny LC filter ought to be used to filter the high-frequency harmonics of the input current. A soft switch active snubbed circuit [53] is commenced here which provides zero-voltage switch for the central switch. A further step down DC-DC converter is needed to be surged with the PFC stage. An additional converter diminishes the efficiency and will increase the system value. The buck converter with LC input filter operational in discontinuous electrical device voltage mode has intrinsic power issue adjustment properties and continuous input current [54]. The article presents a depth investigation of the converter operation during this mode resulting in standard state. Soft-switching condition is not accomplished for the switch and additionally floating gate driver is needed. In this paper [55], the novel image circuit topology of an active 3-phase PFC power converter employing a 3-phase diode rectifier and 4 IGBTs boost converter, its management theme for utility connected three-phase AC mains and an engine coupled AC power source are conferred. In the converter, the input current is rhythmical and an extra tiny LC filter ought to be applied to filter the high-frequency harmonics of the input current. This paper [56] describes a brand new study of low-priced harmonic-injection methodology for single-switch three-phase discontinuous-conduction-mode (DCM) boost rectifiers. A further step down DC-DC converter is required to be gushed with the PFC stage. An extra converter reduces the efficiency and will increase the system value. The planned converter [57] is shared with a 3 phase AC/DC buck-boost converter and a DC/DC forward converter to realize unity power issue, low THD and

adjustable DC output voltage. It needs four active switches and additionally soft-switching condition is not attained for the switches. As a result of the inherent nonlinearity, the slippery mode management has been used to modulate and manage the planned converter, for nonlinear and linear loads, with converter investigational results in accord with those foreseen hypothetically[58]. While ac output voltage management needs management of each boost converters, therefore the load voltage is restricted indirectly and huge capacitance area unit is connected across the output. Power balance management strategy for inductor current sharing and achieving each PFC and quick output regulation for 2parallel-connected 3-phase 3-switch AC to DC converter mistreatment, isolated single-phase Ćuk rectifier component has been conferred all through this paper[59]. The planned arrangement includes six Ćuk converters with six rectifiers: 2 single-switch single-diode Ćuk converters with 2 rectifiers for every section. This all contributes to the price, management quality and also the responsible ness of the system, additionally to the utilization of high capacitance across the load. This article [60] crams the variable frequency control of the ZVS2-inductor boost converter, supported variable of the circuit parameters such as the temporal arrangement issue or the delay angle. The downside of the converter is high, voltage stresses on switch appliances especially for high-input voltage.

7. CONCLUSION

In this paper, a comparative investigation of different converters such as Forward Converters, Galvanically Isolated Forward Converters, Push-Pull (Symmetric) Converters, Ćuk Converters has been examined. These converters intended to address the difficulties to accomplish a higher voltage with low DC input and less number of components has been conversed. On the whole, this paper helps in appropriate characterization of DC-DC Converters which are all utilized as a part of high power applications. The advantages and the limitations of the converters are specified to identify the performance of the converter. This analysis will facilitate analysts to

design converters with appropriate limits and decrease of semiconductor elements.

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