ENHANCING VOLTAGE STABILITY USING A DUAL BUCK AC-AC CONVERTER IN INVERTING AND NON-INVERTING MODES

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Abstract

An ac-ac buck-boost converter that can invert and non-invert is suggested. To counteract voltage drops, you may use the non-inverting operation, and to counteract voltage spikes, you can use the inverting operation. Therefore, the suggested converter can dynamically restore voltage and compensate for voltage sag and swell throughout a broad range. There is no need to worry about shoot-through since its fundamental switching cell is a one-way buck circuit. Without resorting to soft commutation methods or RC snubbers, it accomplishes safe commutation. Additionally, power MOSFETs may be utilised in this setup without the body diodes conducting; to further reduce reverse recovery concerns and applicable, current freewheeling external diodes with strong recovery capabilities can be used.

I INTRODUCTION

In order to enhance the power quality utilising DVR, the most common converters are dc-ac power conversions employing thyristor power controllers. These controllers take the input dc voltage and apply integral cycle or phase angle control to achieve the necessary output ac voltage. Low power factor, significant total harmonic distortion in source current, and reduced efficiency are some of the thyristor controllers' apparent drawbacks that have restricted their employment. A unique ac-ac converter with two buck-boost stages is suggested in this article. It was a hybrid design that integrated the features of buck-boost converters that do not invert and those that do, creating a single device. Not only does it include an inverting buck-boost action, but it also features a non-inverting buck operation, much like a buck converter. Moreover, it has an additional operation that allows one to acquire an output voltage that is either greater than the input voltage or lower than the input voltage, in phase or out of phase with the input voltage. As a result, the suggested converter is capable of compensating for voltage swell as well as sag in a DVR.The suggested converter doesn't have any open-circuit or short-circuit issues since its fundamental component is a unidirectional buck circuit. There are no issues with commutation, and it may be operated without lossy snubbers and soft commutation methods. Not only that, it is able to use MOSFETs without the necessary losses, reverse recovery problems, and conducting body diodes. We present a buck-boost ac-ac converter that can invert and not invert. When used as a dynamic voltage restorer, it effectively counteracts voltage sag and swell. It doesn't worry about shoot-through since its fundamental switching cell is a buck circuit that can only go in one way. Safe commutation is accomplished without the use of soft commutation methods or RC snubbers. You may employ power MOSFETs without conducting body diodes, and to reduce relevant loss and reverse recovery concerns, you can use external diodes with strong reverse recovery capabilities for current freewheeling. A 300-W prototype converter's theoretical analysis and experimental findings are presented in detail.

ii PROBLEM DEFINITION

In the modern electrical business, power quality is a key factor. Problems with the reliability and consistency of power and supply are just as essential as those with energy efficiency and the environment when it comes to the delivery of electrical power. Connected by extensive power transmission and distribution networks, modern electrical power systems increasingly consist of a web of interconnected producing units and load centres. Modern industries mostly focus on power quality. Because of the high rate of energy loss, which in turn causes monetary losses. More and more complex electrical and electronic devices are becoming increasingly vulnerable to disturbances and non-linear loads. Voltage sag, also known as voltage dip, is among the most prevalent and serious power quality issues. An uninterrupted power supply with a constant sinusoidal waveform at the rated voltage should be provided to consumers via the power distribution systems. A voltage increase at the load may be achieved by injecting reactive power at the PCC load. To meet the load needs, reactive power adjustment is crucial. In addition, by altering the electrical characteristics, these will make the system more compatible, which will enhance the distribution's reliability. In situations with small and high loads. The thyristor controller's drawbacks, which include a poor power factor, a high total harmonic distortion in the source current, and reduced efficiency, have restricted its usage in conventional DVRs.

III. MATRIX CONVERTER TOPOLOGY

The that generates an unconstrained voltage output system using an array of controlled bidirectional switches as its primary power components. It can function without big energy storage components and a dc connection circuit. There are a number of benefits to using a matrix converter instead of a standard power frequency converter that uses rectifiers and inverters. The input power factor can be completely regulated, it has an inherent capacity for bidirectional energy flow, and it produces sinusoidal waveforms for both the input and the output, with minimum higher order harmonics and no subharmonics. Finally, it doesn't need a lot of energy storage, so we can say goodbye to those cumbersome and eventually obsolete capacitors. A matrix converter's defining characteristics are its small and straightforward power circuit, Creating a voltage at the load that may have any amplitude and frequency, Currents received and sent in a sinusoidal pattern, Regeneration capability; operation with a power factor of one under all loads.

IV ENHANCEMAENT TECHNIQUES

The energy required to run modern industrial civilisation is derived from finite natural resources [1,2]. We need to build additional renewable power plants—solar, wind, and biogas ideally—to meet the rising energy demand. Many experts in renewable energy claim that a compact "hybrid" electric powered equipment has many advantages over a single system. A reliable source of network-level strength may be provided by hybrid systems. Moreover, these systems can be utilised for expert energy solutions, such as telecommunication stations or hospital emergency rooms, as well as a robust backup strategy to the public grid in the event of blackouts or vulnerable grids, all thanks to their exceptionally high levels of performance, reliability, and long-term performance [3]. Energy electronic converters efficiently convert the incoming dc-dc/ac electricity, allowing renewable power resources to be utilised in conjunction with other applications. High power demands usually necessitate the use of a DC-to-DC converter. In bygone days, a hybrid system would have required two independent DC-DC converters to transform the two power sources. Using separate converters and controllers for each source significantly raises the cost of energy. The full device's efficiency is clearly affected by the numerous levels of power conversion, and the dependability of this cascaded connection is also in doubt, even if unique energy assets may be linked in a collection, like a multi-level machine [5]. Bypassing the aforementioned limitations is often accomplished by using dual-input DC-to-DC converters rather than several converters in parallel and synchronising them with a sophisticated analogue control loop. A cost-effective solution, an enhanced availability system via the use of modular additives, reliability, and flexibility are the notable benefits of using a dual input DC – DC converter instead of a single input dc-dc opposite number. (6, 7). With this in mind, a comprehensive literature review is conducted. [8] provides an outline of several power semiconductor switches and converter topologies, as well as information on how these converters work. [9] Uses three specific case studies to talk about modelling and management techniques for basic DC-DC converters. Methods for managing time domains as well as frequency domains are covered. Recent developments in power DC-DC converter topologies are detailed in [10] for use in exceptional applications such as renewable energy, high- and medium-voltage DC energy systems, telecommunications, and more. In addition, there is a methodical approach to the design and optimisation of different factors. To achieve the target voltage level on the grid output, many converter topologies are detailed in [11], including SEPIC (unmarried-ended number one-inductance converter), increase, greenback-improve, and flyback. Both the benefits and drawbacks of certain converters are discussed. For a DC-DC dollar converter used in maximum power factor tracking (MPPT) of a photovoltaic (PV) module, [12] compares the performance of a non-stop manipulate set version predictive controller with that of the standard PI controller. The article [13] compares and contrasts current and future designs of non-isolated DC-DC converters (such as Buck-enhance, Cuk, and Sepic) using a number of criteria that aid in selecting the most appropriate tool for renewable power packages based on a certain electrical rating. Theoretical considerations of a high-benefit, non-isolated DC-DC converter that integrates a quadratic boost converter with a mobile voltage multiplier are laid forth in [14]. multi-supply two dc-dc converter performance and assessment of bidirectional capabilities and unique storage element placement is covered in [15]. explains how to activate the bidirectional converter for improved voltage stability using a series of rules based on selectors and a proportional-indispensable controller. [17] provides a solution for the dynamic overall performance requirements associated with the SEPIC-Zeta converter and the battery's charging and discharging operating cycles. An effective DC-DC SEPIC converter that is entirely driven by solar energy is shown in [18]. The suggested cascade control approach may employ a single-stage non-remote DC-DC SEPIC converter to provide regulated output voltage and 80–99% MPPT all at once. This study uses a novel control method based on type-2 fuzzy neural controller (T2FNC) to improve the dynamic responsiveness of an ultra-high-rise Luo DC-DC converter in different operating contexts [19]. A simple sign model of the aforementioned four-quadrant Luo converter may be derived using the sign flow graph methodology, as proposed in [20]. When considering the parasitic elements (or non-idealities), such as the equal collection resistances (ESRs) of inductors and capacitors, the parasitic resistances of semiconductor devices (diode, MOSFET) during conductivity, and the forward fall of the diode, a less-than-ideal model of a DC-DC PWM dollar converter is presented in [21]. In [22], the authors describe and compare several quadratic Boost converters and talk about their consistent state and small signal dynamical behaviours. The image in [23] shows a dollar-raise controller that is programmed to automatically switch modes depending on the voltage supplied. An adaptive passivity-based controller was developed for a DC-DC dollar-improve converter with an unknown constant electrical demand in order to regulate the output voltage law [24]. [25] introduces a fresh approach to supplying rural areas with power by combining renewable sources with the grid. The significance of energy electronic converters in efficiently converting multi-enter dc-dc/ac power is also discussed in this study, along with renewable energy sources. [26] suggests a high-voltage, dual-input, direct-current (dc/dc) electronic converter that may take current continuously from input resources or a single source, making it an ideal choice for applications like as solar panels. The functioning of several multi-input DC/DC converters has been examined in [27–29]. Despite the abundance of research on DC-DC converters, there is a dearth of comprehensive analyses of twin-entry DC-DC converters' performance. With this in mind, this study reports the results of a comprehensive performance assessment of several twin-entry DC-DC converter topologies.

A. Structural Problems

Basic issues are the most genuine; disappointment is regularly quick and irreversible. Disappointments brought about by stream - incited vibration of warmth exchanger tubes over shadow all other basic disappointments. Cylinder to tube sheet joints disappointment is likewise a regular operational issue.

The other sort of auxiliary disappointment experienced in heat exchanger activity is spillage from darted joints. Breaks every now and again happen in spout ribs because of minute stacking of the joint brought about by warm extension of the interconnecting funneling. Now and again, non-temperature conveyance in the cylinder sheet or spread in different pass configuration initiates joint spillage. Supplanting of the spilling gaskets with one having increasingly suitable stacking and unwinding properties is generally the panacea for such auxiliary issues.

Fig 1 Block Diagram of Buck boost system

vii CONCLUSION

Like traditional dc-dc converters, the developed converter is operable with straightforward PWM control and does not suffer from shoot-through or dead time. Due to the elimination of reverse recovery problems and losses caused by the body diode, high speed MOSFETs may be used as switching devices, allowing for high frequency and efficiency operation. The suggested converter can achieve 97% efficiency at a switching frequency of 60 kHz, according to the experimental findings. It is possible to implement the matrix converter as a frequency step-up converter, as shown by these SPMC simulation results. Adding a low-pass filter to the output would guarantee the continuous waveforms needed for real-world applications, but this would need more effort. It seems that undesirable spikes of a fair size emerge while utilising with RL load as well, necessitating their eradication. Innovative commutation solutions could be able to resolve this.

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