RELIABILITY EVALUATION OF MPPT BASED INTERLEAVED BOOST CONVERTER FOR PV SYSTEM

A

Major Project Report

Submitted in partial fulfillment of the

requirements for the award of the degree of

BACHELOR OF TECHNOLOGY

In

ELECTRICAL AND ELECTRONICS ENGINEERING

SUBMITTED BY

P.MANISAI	18S45A0239
S.RASHMITHA	18S45A0252
P.SHIRISHA	18S45A0247
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Under the Esteemed Guidance of

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ABSTRACT

The demand for power supply and depletion of the conventional energy sources are increasing drastically. So, to overcome this problem, the best alternative power generation for conventional fossil fuel is Photovoltaic solar cell-based system because of its advantage of pollution free and its availability in abundance with free of cost. In the MPPT based PV system the converters are the most sensitive part. Therefore, to provide uninterrupted power supply without compromising the quality of power, reliability evaluation of interleaved boost converter becomes necessary. MATLAB/Simulink is used for the simulation studies and to determine the power losses of various components of the converter which is used in calculating the failure rates and reliability of the interleaved boost converter. Reliability studies of IBC have not been studied much. However there exists few literature in which reliability expression has been developed using Markov technique which is a more complex method as compare to Reliability Block Diagram (RBD). Therefore, this paper proposes reliability modeling and reliability evaluation of Interleaved boost converter in MPPT based photo-voltaic system by using simple RBD method.

CONCLUSION

The modeling of Interleaved boost converter is discussed stepwise along with its simulation results with the help of MATLAB/SIMULINK. The failure rates of each component of IBC and the whole IBC are determined. The RBD model is developed for a conventional boost converter and IBC and those are a series system and a parallel system respectively. With the help of this RBD the overall reliability evaluation and MTTF calculation are done for the IBC used in grid connected PV system. The interleaved boost converter acts as a power converter and MPP tracker as well because of its high reliable nature.

VEHICLE-TO-GRID TECHNOLOGY IN A MICRO-GRID USING DC FAST CHARGING ARCHITECTURE

A

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ABSTRACT

Electric Vehicle (EV) batteries can be utilized as potential energy storage devices in micro-grids. They can help in micro-grid energy management by storing energy when there is surplus (Grid-To-Vehicle, G2V) and supplying energy back to the grid (Vehicle-To-Grid, V2G) when there is demand for it. Proper infrastructure and control systems have to be developed in order to realize this concept. Architecture for implementing a V2G-G2V system in a micro-grid using level-3 fast charging of EVs is presented in this paper. A micro-grid test system is modelled which has a dc fast charging station for interfacing the EVs. Simulation studies are carried out to demonstrate V2G-G2V power transfer. Test results show active power regulation in the micro-grid by EV batteries through G2V-V2G modes of operation. The charging station design ensures minimal harmonic distortion of grid injected current and the controller gives good dynamic performance in terms of dc bus voltage stability.

CONCLUSION

Modeling and design of a V2G system in a micro-grid using dc fast charging architecture is presented in this paper. A dc fast charging station with off-board chargers and a grid connected inverter is designed to interface EVs to the microgrid. The control system designed for this power electronic interface allows bi-directional power transfer between EVs and the grid. The simulation results show a smooth power transfer between the EVs and the grid, and the quality of grid injected current from the EVs adheres to the relevant standards. The designed controller gives good dynamic performance in terms of dc bus voltage stability and in tracking the changed active power reference. Active power regulation aspects of the microgrid are considered in this work, and the proposed V2G system can be utilized for several other services like reactive power control and frequency regulation. Design of a supervisory controller which gives command signals to the individual EV charger controllers is suggested for future research.

CONSTANT POWER GENERATION USING MODIFIED MPPT P&O TO OVER COME OVER VOLTAGE ON SOLAR POWER PLANT

A

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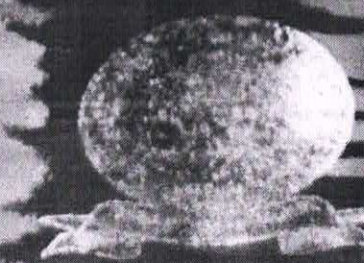

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ABSTRACT

Indonesia is a tropical country that has the privilege of gaining sunshine year-round so that the utilization of solar energy as a solar power plant can be a potential power plant to be developed. One of the problems in the solar power plant system is the power instability generated by the solar panels because it relies heavily on irradiance and relatively low energy conversion efficiency. To solve this problem, the Maximum control of Power Point Tracking (MPPT) is required by the Perturb and Observe (P&O) methods. This P&O MPPT control makes solar PV operate at the MPP point so that the solar PV output power is maximized. However, the MPPT P&O control that works at the MPP point makes the output voltage to the load is also maximum that causes overvoltage. This paper, therefore, discusses the modification of the MPPT Perturb and Observe (P&O) algorithm for Constant Power Generation (CPG) that combines MPPT P&O with the power control settings to the maximum limit of solar PV. This method can set up 2 operating conditions of the solar PV namely MPPT mode and CPG mode. The MPPT mode works when the solar PV output power is smaller than the reference power to maximize solar PV output power. However when the solar PV output power is more than or equal to the reference power then the CPG mode works to limit the solar panel's output power. Based on the simulated results of this MPPT-CPG control shows the load output voltage response can be kept constant 48 V with less than 5% error that has been verified using a variety of irradiance and reference power.

CHAPTER-5

CONCLUSION

In this paper, we propose the MPPT P&O-CPG method to be able to control solar panels that work on 2 conditions i.e. in MPPT operations and CPG operations to avoid overvoltage on the load. This MPPT P&O-CPG method has been evaluated through a PSIM simulation. Simulated results indicate that the MPPT mode is identified when the load requirements are greater or equal to the solar power panel (PPV < = Pref) and the voltage on the output side of the < 48V. While CPG mode is identified when the power requirements of the solar panel are greater than the load power (PPV > Pref) and the voltage at > 48V output. The performance of the MPPT P&O-CPG method is proven to avoid excess voltage with a control error limit of ± 5% of the rating voltage on the load although it is still overshot during mode switching due to irradiance fluctuations.

REDUCED SWITCH CASCADED MULTI LEVEL INVERTER WITH NEW SELECTIVE HARMONIC ELIMINATION CONTROL FOR STANDALONE RENEWABLE ENERGY SYSTEM

A

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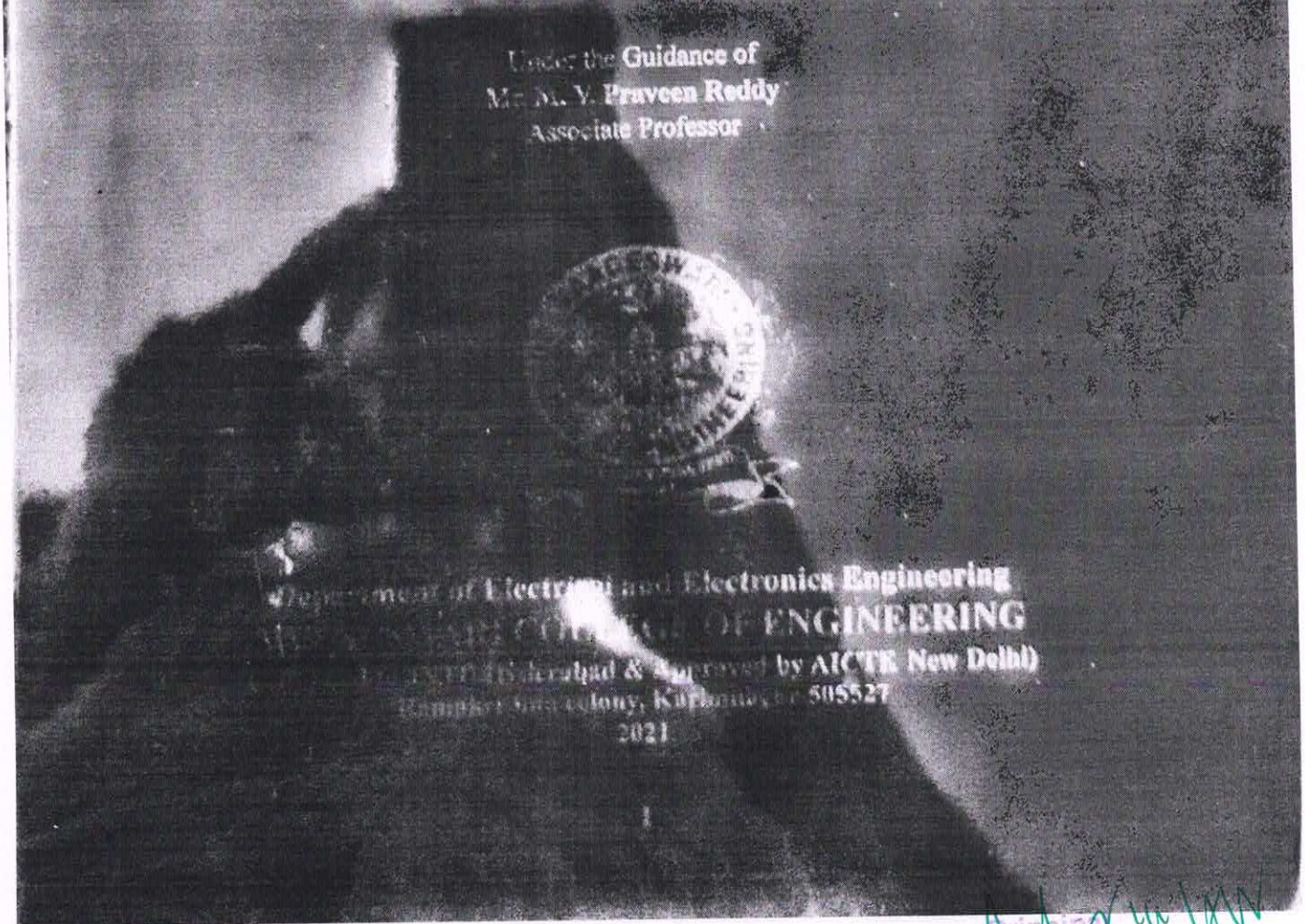

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ABSTRACT

Recently multilevel inverters (MLIs) have received wide attention from industry and academia, as they are changing into a viable technology for diverse applications. To produce high-quality output using less switch count, development of novel reduced switch MLI (RS MLI) topologies has been a focus of current research theme. This paper presents design and control of a switched-diode dual source single switch MLI (SDDS MLI). The generalized SDDS MLI is first designed using an asymmetric basic unit. Proposed SDDS MLI requires less switch count and driver circuit count compared to the few recently developed RS MLI topologies. To improve the voltage quality by eliminating targeted low-order harmonics, a modified version of fish swarm optimization (FSO) algorithm is examined for computing optimum switching angles required to control the SDDS MLI. Moreover, suitability and superiority of the derived algorithm are established by comparing with traditional selective harmonic elimination (SHE) techniques. The developed topology is investigated through several MATLAB simulations as well as experimental tests in the laboratory applying the modified control approach.

CHAPTER VII
CONCLUSION

The developed SDDS MLI can be a good solution for integrating it with RESs and for generating higher voltage steps using the reduced number of switches. To produce higher voltage levels in the output, operation of the SDDS MLI was analyzed with more than one LCBU. With regard to switch count, dc source count, TSV, and losses, comprehensive comparisons were done between the proposed MLI and well-known MLI topologies presented in [6], [7], [14], [15], [17]–[23]. For a single-phase SDDS MLI, optimized switching angles were calculated using the modified SHE algorithm derived from the FSO and PSO. The enhancement in voltage quality was achieved at the expense of increasing running time. In a three-phase application, instead of 3rd harmonic the next non-triplen harmonic can be targeted for elimination. The test results at different modulation indices, under different loading conditions as well as at different frequencies, validate the developed single-phase MLI topology and SHE control technique. The proposed MLI working was also validated under the high frequency and higher level operation case-studies. The harmonic profile of computer simulation and experiments were verified by comparison with different PWM control techniques and standard grid codes as well. On the horizon, the thorough investigation with RES integration/fluctuating dc source will be considered.

POWER QUALITY IMPROVED EV CHARGER WITH BRIDGELESS CUK CONVERTER

A

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ABSTRACT

An improved bridgeless (BL) Cuk converter based EV (Electric Vehicle) battery charger with high power factor (PF) and increased efficiency, is designed and developed in this work. It provides low cost and high-power density-based charging solution for EV. This charger incorporates less number of devices operating over one switching cycle, which reduces the additional conduction loss incurred by a diode bridge rectifier of conventional charger. Hence, it improves the charger efficiency. The added advantage of proposed topology is that the unwanted capacitive coupling loop is removed, as well as unwanted conduction through the body diode of inactive switch in previously developed BL Cuk converter is avoided. This significantly improves the charger efficiency. For the constant current (CC) and constant voltage (CV) charging, the commands, are synchronized by a flyback converter. The proposed charger draws a sinusoidal current from AC mains along with the total harmonic distortion (THD) in supply current is reduced to the limits specified by the IEC 61000-3-2 guidelines. The improved efficiency and PQ indices of proposed charger, are investigated to demonstrate its satisfactory charging operation at all operating conditions.

CHAPTER-7

CONCLUSION:

An improved PQ based EV charger is proposed with BL Cuk converter consisting fewer number of conducting components over single switching cycle. The proposed PFC Cuk converter offers excellent PFC characteristics in DCM mode using single voltage feedback control. Therefore, the size of the charger is reduced. The added advantage of proposed topology is that the unwanted capacitive coupling loop is removed, as well as unwanted conduction through the body diode of inactive switch in previously developed BL Cuk converter is avoided. This significantly improves the charger efficiency. The proposed charger has shown satisfactory charging characteristics during steady state and over 50% variation in grid voltage. However, the PQ assessment of proposed charger is obtained as per the IEC 61000-3-2 guidelines over wide input voltage range. Therefore, the proposed charger offers the feasible EV charging alternative for improved power quality and efficiency.

MULTIFUNCTIONAL GRID-TIED PV SYSTEM USING MODIFIED KLMS CONTROL

A

major project report submitted in partial fulfillment of the requirements for the award of the degree of

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ABSTRACT

This paper deals with the modified kernel least mean square (KLMS) control strategy in double-stage, solar photovoltaic (PV) grid tied system to enhance the power quality at common coupling point (CCP). This proposed control algorithm has less oscillations, fast convergence, fast dynamic response and good steady state performance. A control strategy is used to extract the fundamental active current component of load and generates reference grid current for a DC-AC converter. The proposed modified KLMS control mitigates multiple power quality concerns such as harmonics reduction, unity power factor and load balancing. The dynamic performance of proposed system is confirmed into the MATLAB\Simulink environment. Test results on hardware implementation are presented at varying solar irradiation levels and load unbalancing. Test results are found satisfactory and total harmonic distortion (THD) of the grid currents are observed well within the IEEE-519 standard.

CHAPTER 7

CONCLUSION

The proposed modified KLMS based control scheme for double stage solar PV system, has been simulated in MATLAB\Simulink environment and simulated results are validated through the experimental prototype. The MPPT has extricated the peak power point successfully (nearly 100%) from the solar PV array under varying insolation levels. The proposed control effectively provides harmonics compensation, grid currents balancing and unity power factor in the grid tied system. This proposed modified KLMS control scheme has extracted the fundamental current component efficiently. Under the load unbalancing condition, the fundamental current component has shown faster convergence and less oscillations than LMS and LMF controls. Moreover, it has good steady state and dynamic performances than LMS and LMF controls. Moreover, the THD of grid currents, is meeting the IEEE-519 standard[12].

A NOVEL HIGH-GAIN DC-DC CONVERTER APPLIED IN FUEL CELL VEHICLES

A

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CERTIFICATE

Certified that this is a bonafide record of the major project work entitled, **"A NOVEL HIGH-GAIN DC-DC CONVERTER APPLIED IN FUEL CELL VEHICLES"**, submitted by following students to the department of Electrical & Electronics Engineering, in partial fulfillment of the requirements for the award of the Degree of **BACHELOR OF TECHNOLOGY**, and is a bonafide record of the work performed by

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ABSTRACT

The DC-DC converter for fuel cell vehicles should be characterized by high-gain, low voltage stress, small size and high-efficiency. However, conventional two-level, three-level and cascaded boost converters cannot meet the requirements. A new non-isolated DC-DC converter with switched-capacitor and switched-inductor is proposed in this project, which can obtain high-gain, wide input voltage range, low voltage stresses across components and common ground structure. In this project, the operating principle, component parameters design, and comparisons with other high-gain converters are analyzed. Moreover, the state-space averaging method and small-signal modelling method are adopted to obtain the dynamic model of converter. Finally, simulation and experimental results verify the effectiveness of the proposed topology. The input voltage of the experimental prototype ranges from 25V to 80V. The rated output voltage is 200V and rated power is 100W. The maximum efficiency is 93.1% under rated state. The proposed converter is suitable for fuel cell vehicles.

CONCLUSION

This paper presents a non-isolated DC-DC converter topology for fuel cell vehicles. The proposed converter can obtain high-gain and wide input voltage range. The voltage gain can reach $2(1-d)/(1-2d)$ and duty cycle $d<0.5$ while achieving high-gain. The voltage stresses across components are less than half of the output voltage, which is beneficial to reduce the size and cost of the converter. In addition, the circuit topology is a common ground structure, which can avoid EMI and safety problems. The converter can always maintain the stability of the output voltage by closed-loop control. There are not the voltage overshoot and impulse current during soft-start process by adopting the soft-start program. Under the rated state, the measured maximum efficiency of the prototype is 93.1%. The proposed converter is suitable for fuel cell vehicles.

FUEL CELL INTEGRATED UNIFIED POWER QUALITY CONDITIONER FOR VOLTAGE AND CURRENT REPARATION IN FOUR-WIRE DISTRIBUTION GRID

A

Major Project Report

Submitted in partial fulfillment of the

Requirements for the award of the Degree of

BACHELOR OF TECHNOLOGY

in

ELECTRICAL AND ELECTRONICS ENGINEERING

By

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ABSTRACT

Electrical and electronic devices when exposed to one or more power quality problems are prone to failure. This paper aims to enhance the quality of power in three-phase four-wire distribution grid using Fuel Cell Integrated Unified Power Quality Conditioner (FCI-UPQC). The proposed FCI-UPQC has four-leg converter on the shunt side and three-leg converter on the series side. A combination of a synchronous reference frame (SRF) and Instantaneous Reactive Power (IRP) theories are utilized to generate reference signals of the FCI-UPQC. Also, this paper proposes Adaptive Neuro-Fuzzy Inference System controller to maintain DC link voltage in the FCI-UPQC. The Adaptive Neuro-Fuzzy Inference System controller is designed like a sugeno fuzzy architecture and trained offline using data from the Proportional Integral (PI) controller. The obtained results proved that the proposed FCI-UPQC compensated power quality problems such as voltage sag, swell, harmonics, neutral current, source current imbalance in three-phase four-wire distribution grid. The presence of fuel cell in this work makes more effectiveness of the proposed system by providing real power support during supply interruption on the grid side

CONCLUSION

In this paper, a novel utility of FCI-UPQC as a compensating and interconnecting device for a 3-phase 4- wire distribution grid is extensively simulated in Matlab/Simulink. It was observed that the proposed FCIUPQC efficiently compensates the problem of load current and supply voltage imperfections with quick response and high reliability at the same time. The proposed system has an enhanced performance under unbalanced, non-linear and sensitive linear load conditions. It is important to note that the proposed system still having challenge to mitigate source current harmonics during source side disturbances and the type-2 ANFIS controlled FCI-UPQC is the another scope for the future work

A NEW MULTILEVEL INVERTER TOPOLOGY WITH REDUCED SWITCH COUNT

A

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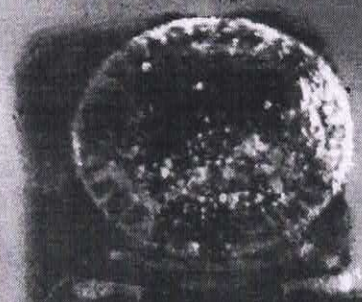

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ABSTRACT

Multilevel inverters are a new family of converters for dc-ac conversion for the medium and high voltage and power applications. In this paper, two new topologies for the staircase output voltage generations have been proposed with a lesser number of switch requirement. The rs topology requires three dc voltage sources and ten switches to synthesize 15 levels across the load. The extension of the rst topology has been proposed as the second topology, which consists of four dc voltage sources and 12 switches to achieve 25 levels at the output. Both topologies, apart from having lesser switch count, exhibit the merits in terms of reduced voltage stresses across the switches. In addition, a detailed comparative study of both topologies has been presented in this paper to demonstrate the features of the proposed topologies. Several experimental results have been included in this paper to validate the performances of the proposed topologies with different loading condition and dynamic changes in load and modulation indexes.

CHAPTER-5
CONCLUSION

This paper presents a new assembly of multilevel inverter topology with consideration of duced switch count. The proposed topology has been discussed in detail with the basic unit with 3S-15L nfiguration generating 15 levels, and the extension of the proposed topology with 4S-25L configuration to hieve 25 levels. Two generalized structures of the proposed topology have also been proposed. A detailed mparative study has been carried out with the proposed topology and recently reported topologies with three d four dc voltage sources. Finally, several experimental results prove the suitability and workability of the oposed topology with different types of loading combinations considering the change of modulation indexes.

LMMN Based Adaptive Control for Power Quality Improvement of Grid Intertie Wind-PV System

A

MAJOR Project Report

Submitted in partial fulfilment of the
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This is to certify that Major Project work entitled **"LMMN BASED ADAPTIVE CONTROL FOR POWER QUALITY IMPROVEMENT OF GRID INERTIE WIND-PV SYSTEM"** submitted by following students to the department of Electrical & Electronics Engineering, in partial fulfillment of the requirements for the award of the Degree of **Bachelor of Technology**, and is a bonafide record of the work performed by

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ABSTRACT

A new topology comprising of wind turbine driven synchronous generator (SG) and solar photovoltaic (PV) array for renewable energy harvesting, is proposed in this work. The stochastic inputs for proposed system, are agitated by the nonlinear time dependent parameters such as variable wind speed and changing solar insolation. The speed variations are absorbed using back to back interfaced power electronic converters (PECs) namely synchronous generator side converter (SGC) and utility grid side converter (UGC) with a common DC link where solar PV array is tied directly. The power injection into the utility grid, is levelled by the optimal utilization of PECs. The SGC uses vector control (VC) for speed control of SG and maintains unity power factor (UPF) at stator terminals. UGC acquires its switching pulses with proper application of least mean mixed norm (LMMN) control technique. The new application of LMMN control scheme is used for harmonics compensation and fundamental load component extraction. The DC link voltage is regulated using proportional integral (PI) controller. A prototype is developed and tested under different conditions of sudden changes in load, wind velocity variations as well as under varying solar PV insolation. The power sharing scheme proves to be effective. The power quality (PQ) issues are also addressed and mitigated effectively. The performance is exhibited for the validation of the proposed system and its control.

7.2 CONCLUSION:

A three-phase grid intertie wind-PV system with effective load compensation capability, is proposed and its suitability is justified through hardware validation on a developed prototype in the laboratory under various operating conditions such as changing wind velocity, variations in solar insolation and perturbation in nonlinear load. The parallel operation of solar PV array and wind driven SG, allows a possibility of load sharing. The fundamental extraction from the load currents, is successfully done with the application of LMMN adaptive filtering control. The load current fundamental component is extracted, moreover, the disturbances and harmonic content in grid currents are removed in order to improve the power quality at CPI. The aim of improving the voltage profile and reducing the harmonic content at the CPI, is attained successfully by implementing the LMMN adaptive control. The LMMN adaptive control schemes, leads to fast response and less mis adjustments. The maximum power is extracted effectively from solar PV array and wind turbine using P&O algorithm. Sensorless VC for speed control of SG, has resulted in low system cost and increased system reliability. Test results obtained under steady state and dynamic conditions, show the acceptability of control techniques. Moreover, the grid currents under the enforced conditions, have their THD below 5% confirming to the IEEE-519 standard.

DESIGN AND MODELLING OF A CSC CONVERTER WITH A VARIABLE DC LINK VOLTAGE TO DRIVE A BRUSHLESS DC MOTOR DRIVE

A

Major Project Report

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Certified that this is a bonafide record of the major project work entitled, **"DESIGN AND MODELLING OF A CSC CONVERTER WITH A VARIABLE DC LINK VOLTAGE TO DRIVE A BRUSHLESS DC MOTOR DRIVE"**, submitted by following students to the department of Electrical & Electronics Engineering, in partial fulfillment of the requirements for the award of the Degree of **BACHELOR OF TECHNOLOGY**, and is a bonafide record of the work performed by

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ABSTRACT

The exceptional performance, high reliability, ruggedness and the speed of the motor can be controlled over a wide range are prime reasons for BLDC drives to gain its importance over the last decade [1-3]. Its application area is also wider, as it is well suited for all power ranges. Medical analyzers, electric automotive and military applications are some of the key application areas of brushless dc motor in addition to household applications, motion control, industrial automation, ventilation, and air conditioning applications [4,5]. The BLDC motors eliminate the sparking, noise, electromagnetic interference (EMI) and maintenance problems associated with conventional DC motors, as these are synchronous machines, which have three sets of windings in the stator and a rotor made out of the permanent magnet. The rotors have a hall effect for position sensing. These enable easier commutation of the electronic commutator (VSI) feeding the motor.

CHAPTER 8

CONCLUSION

The project presents the design procedure of 500-watt CSCC with a variable output voltage (70 V – 200V), along with a performance analysis of BLDC motor fed by the designed CSCC. The analysis goes with testing of the motor for various DC link voltage and load torque. The static and dynamic performance of the machine is presented along with the IAE, ITAE and ripple factor. The analysis of canonical switching cell converter fed brushless DC drives shows that the CSCC would be a better choice of front end converter to feed BLDC drive to accompt it in multitude of applications.

A NOVEL SINGLE-STAGE BUCK BOOSTER TRANSFORMER LESS INVERTER FOR SINGE PHASE GRID CONNECTED SOLAR PV SYSTEM

A

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ABSTRACT

This project presents that a novel single-stage buck-boost transformerless inverter (BBTI) topology for single-phase grid-connected solar PV applications.In this topology,the input PV source shares the common ground with neutral of the grid which eliminates the leakage currents.Further,the proposed topology has the buck-boost ability which tracks the maximum power point even under the wide variation of input PV voltage .Another feature of the proposed topology is that is uses only one energy storage inductor which provides symmetric operation during both half cycles of grid.In addition, two out of five switches of the proposed topology operate at a line frequency ,thereby, it exhibits low switching losses and other three switches conduct in any mode of operation which incurs low conductions losses.A simple sine-triangle pulse width modulation strategy is proposed to control the proposed inverter topology is analyzed at all operating modes and explained in detail.Experiments are carried out on the 300W laboratory prototype and all the major results are included in the paper,which shows that the proposed system gives higher efficiency with lower THD in output current.

CHAPTER-7

CONCLUSION

7.1 CONCLUSION

A novel buck-boost transformerless inverter topology was proposed, analyzed and validated through experimental results. It has been verified that the BBTI topology injects zero leakage current and negligible DC current into the grid for grid-connected PV application. Due to the buck-boost property of the BBTI the maximum power point can be tracked for PV under the wide voltage variation. The BBTI was tested at the switching frequency of 10 kHz and it has been observed that the THD in current is 3.8% which is in good agreement with the IEEE standards.

STUDY OF A FIVE-LEVEL PWM RECTIFIER FED DC MOTOR DRIVE

A

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ABSTRACT

Phase-controlled rectifiers are simple and less expensive; and the efficiency of these rectifiers is, in general, above 95%. Controlled rectifiers are also called ac–dc converters and are used extensively in industrial applications, especially in variable-speed D.C motor drives, ranging from fractional horsepower to megawatt power level [1]. The harmonics current in power grids is mainly generated by a phase-controlled and diode rectifiers, the harmonics current in power systems has caused various problems, such as line current and voltage distortion and heating losses [2]. A five-level rectifier using sinusoidal pulse width modulation (SPWM) technique can reduce the harmonic current dramatically because the phase current is able to control. In this paper, a five-level SPWM rectifier fed D.C motor drive with PID controller is proposed, Figure 1 shows the power circuit diagram. The aim is to reduce THD and the rectifier cost [3]. SPWM technique to control the proposed topology is aimed to draw a nearly sinusoidal line current. The operation strategy of sinusoidal PWM technique is chosen to construct the switching signals. SPWM technique is a very popular method of controlling the output voltage for D.C motor drive,SPWM is a simple technique and has a good transient response [3, 4]. PID controller plays an important role in several live activities applications both industrial and home equipment operation. It considered being the most used, about 95%, especially in industrial applications since 1945 lasts to nowadays because of its simple construction, few parameters (only three) to be tuned and finally its very satisfied system results [5]. Control system application in field of industry usually used the PID controller as a combination of control loop feedback system. First of all, PID controller exam the system by computing the difference between the actual and desired value as an error quantity. The error signal will changed to its minimum value by the controller where it always trying to reduce the error value by controlling the system input or output. This process will be done by tuning the parameter of PID controller. Tuning the PID parameters means: verify the value of the proportional, integral and derivative gains (KP, KI and KD) as shown in Figure 2 [6].

CHAPTER 6

CONCLUSIONS

The paper presents a study and modeling of a five level rectifier with SPWM technique as a DC motor driver. Several researches focused on constructing the circuit of multi-level rectifier with static load (RL). In this study the five level rectifier system has been tested with a dynamic load as a separately excited DC motor. The proposed system investigated in case of open loop system with A disturbance in load torque applied +- 20%from rated load torque and that's lead to dramatic variation in motor speed with respect to desired speed. Furthermore the effect of THD for input current was considered. PID controller is applied to the proposed system with the same disturbance in load torque and the results shows a constant output speed at desired speed with minimum response percentage error.

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ELECTRICAL AND ELECTRONICS ENGINEERING

Submitted by

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CERTIFICATE

Certified that this is a bonafide record of the major project work entitled, **"A GENERALIZED SWITCHED INDUCTOR CELL MODULAR MULTILEVEL INVERTER"**, submitted by following students to the department of Electrical & Electronics Engineering, in partial fulfillment of the requirements for the award of the Degree of **BACHELOR OF TECHNOLOGY**, and is a bonafide record of the work performed by

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The work embodied in this major project report has not been submitted to any other institution for the award of any degree.

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ABSTRACT

An interesting feature of Z-source inverter is to provide buck-boost ability in a single stage. However, this concept is most popular in conventional inverters. In a few multilevel inverters, Z-source is utilized to have higher gain along with retaining the advantages of multilevel inverter such as better EMI compatibility, low harmonic distortion, etc. However, the potential of the Z-source concept is not fully exploited in multilevel inverters. To widen the feasibility of Z-source concept in the multilevel inverter, a modular multilevel inverter is considered. In this paper, a generalized switched inductor cell is selected as a Z-source network for integration, however, other Z-source networks such as quasi boost network, quasi switched boost network, two winding coupled inductor network, three winding coupled inductor network, etc. may be used in place of switched inductor cell. The quantitative and qualitative analysis is done for the proposed converter in both the continuous current mode and discontinuous current mode. The analysis shows that a higher voltage gain can be achieved in the discontinuous current mode as compared to the continuous current mode. To control the proposed converter, two new modulation techniques are proposed i.e. full shoot through and upper shoot through/lower shoot through. Finally, the proposed converter is validated experimentally in both the modes and for different modulation techniques.

CHAPTER 7

CONCLUSION

A modular multilevel inverter is proposed which utilizes the Z-source concept. The switched inductor network is used as a boosting network in the generalized sense which helps in providing adequate voltage gain. To control SL-MMLI, two control techniques, i.e. FST and UST/LST, are proposed. The converter is validated in hardware for both the control techniques, operating modes and under different loading conditions. Based on the experimental and analytical study, the following conclusions are drawn:

1) In both the states, the SL-MMLI operates satisfactorily for both resistive and inductive load.

2) FST produces 75% THD in line to line voltage.

3) UST/LST generates only 41% THD in line to line voltage.

4) In DCM, higher voltage gain is achieved.

5) Due to Z-source integration, SL-MMLI produces 235 V in CCM as compared to 160 V in MMLI.

6) In DCM, SL-MMLI produces 280 V as compared to 160 V in MMLI.

7) The SL-MMLI has the lower component count, lower normalized voltage stress than the NPC and ANPC,

8) The SL-MMLI has better efficiency than the NPC and ANPC.