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A MULTI-FUNCTION CONVERSION TECHNIQUE USING ACTIVE POWER FILTER FOR VEHICLE-TO-GRID APPLICATIONS WITH REGENERATIVE CONCEPT

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ABSTRACT

This paper deals with V2G applications, it gives three main functions like EV battery charging, grid-connection and reactive compensation, these are needs to energy control of the grid. Here, the bidirectional power flow in the converter helps to control the battery side as well as grid side. This proposed multi-function conversion technique enhance the whole system fulfillment with ANFIS controller and acquire reactive power compensation. The bidirectional cuk converter is implemented. Simulation and experimental results are verified.

Keywords—bidirectional cuk converter;ANFIS controller;reactive compensation;power factor improvement;V2G Vehicle-To-Grid Applications

I.INTRODUCTION

Electrical energy is the most efficient and popular form of energy and the neoteric society is heavily dependent on the electric supply. The life cannot be visualize without the supply of electricity. At the similar time the quality of the electric power supplied is also very important for the efficient functioning of the end user equipment.

It is achievable to absorb more than one operation state in a charger by accepting the power to flow bidirectionally. Usually, The two-way translation of active power between the charger and the grid is the bidirectional power transfer. The wide term of transmitting active power from the vehicle to the grid is called vehicle to grid (V2G). To realize the energy storage needs of the electric grid, the degeneration on the battery during this operation makes it less desirable by the auto manufacturers and consumers by the capability of plug-in vehicle (PEVs) potential. On the opposite hand, the on-board chargers can also deliver energy storage system operations such as reactive power compensation, voltage regulation, and power factor correction without the need of employing the battery with the grid and thereby securing its lifetime.

Plug-in hybrid electric vehicles (PHEVs) and battery electric vehicles (BEVs) have an advantage compared to hybrid electric vehicles (HEVs), i.e. a relation to the electric power grid acknowledge more opportunities. The vehicle can not only charge, but also discharge and thus inject energy into the grid. By charging and discharging 'on the right moment' the vehicles can help to match consumption and generation. The combustion engine can also bring electricity during peak hours, though this is not practical formany reasons.

Due to the increasingly larger energy problem and environmental pollution, electric vehicles (EVs) are evenly replacing conventional automobiles equipped with internal combustion engines.

In the existing system, for the bidirectional power flow the buck-boost converter is used. The charging and discharging of the battery done by this converter.

The disadvantage of the existing system is the reactive compensation and power factor is poor when compared to the proposed system.

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II.PROPOSED SYSTEM CONCEPT

Block diagram

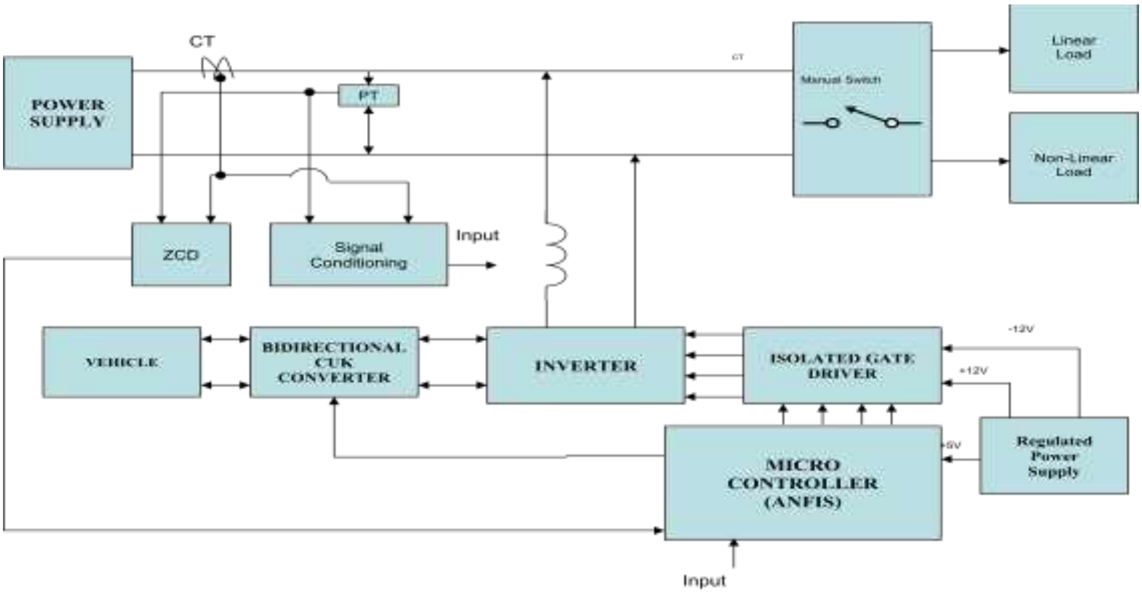

Fig. 1. **Block diagram of proposed system**

This is the proposed block diagram of this paper, here the main blocks are bidirectional cuk converter, inverter, ANFIS controller. From the EV, the energy is stored in battery and is fed to the bidirectional cuk converter, it is used for both side power flow and it will increase the voltage at the output side. The output voltage of the cuk converter fed to PWM inverter and it will change the DC to AC voltage and again this voltage fed back to supply line to inject the current for reactive compensation. And finally, it helps to correct the power factor.

Before distributed among the consumer, the power generated at the power system is in KV and it is step downed to several stages. In order to attain the resonance condition the reactive power compensation is essential. Here the current and potential transformers are used to sense the high current and voltage at the generating station. Then the sensed current and voltage range are fed into the zero cross detector which detects where the current and voltage are in in-phase are not. Simultaneously the signal conditioning is used to change the analog signal into digital signals which is acceptable by the microcontroller. 5v is the maximum input to the microcontroller and hence the signal conditioning converts the analog signal to digital equals to the capacity of analog signal. The supply power to microcontroller and isolated gate driver is provided by regulated power supply. The microcontroller gives the acceptable signal for the gaining of resonance condition to the isolated gate driver and bidirectional CUK converter, so that switches are triggered. Low power input are amplified to high current input for triggering. The MOSFET gate drives on to coupler which reduces the consumption of power by providing smaller. Thus the MOSFET attain the high current and that will be given to the battery from which voltage is extracted and that will be given to the CUK converter to boost it. Once the voltage is upgraded then it is forwarded to the inverter, for converting the voltage into AC signal and then fed to the micro-grid where the reactive power compensation is achieved. Power will be extracted from grid when maximum power flow is detected. The AC supply is converted into DC and it is stepped down using CUK converter and then stored in the battery.

III.PROPOSED CONVERTER CIRCUIT

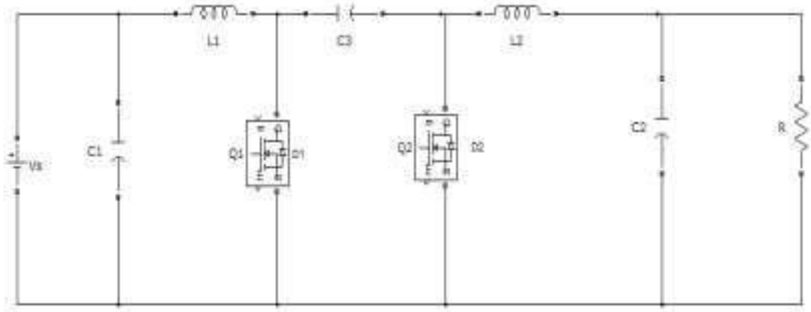

Fig. 2. **Proposed CUK converter**

A.MODES OF OPERATION

B.Mode 1 (FORWARD)

In this mode depending on the duty cycle switch Q1 and diode D2 enters into conduction whereas the switch Q2 and diode D1 are off all the time.

Interval 1 (Q1-on, D1-off ; Q2-off, D1-Off)

This mode is considered to be short circuited and Q1 is on , therefore the lower voltage battery charges the inductor and the inductor current goes on increasing till not the gate pulse is removed from the Q1 . Since in this mode the diode D2 is reversed biased and the switch Q2 is off, no current flows through the switch Q2.

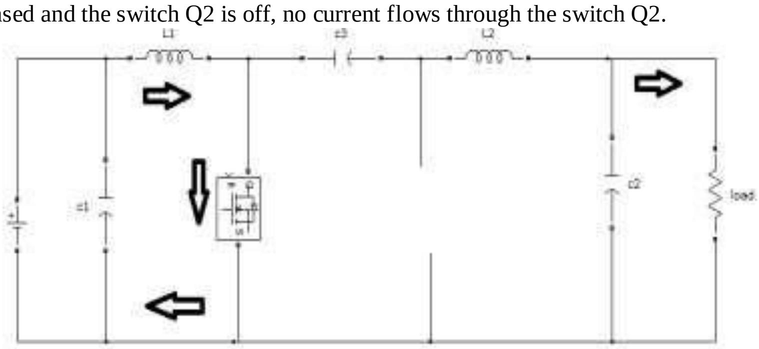

Fig. 3. **Mode 1 (Forward)-Interval 1 Operation**

Interval 2 (Q1-off, D1-off; Q2-off, D2-on):

In this mode Q2 and Q1 both are off and this mode is considered to be open circuited. Now since the current flowing through the inductor cannot change spontaneously, the polarity of the voltage across it reverses and hence it starts acting in series with the input voltage. Therefore the diode D2 is forward biased and the output capacitor C2 is charged to a higher voltage by the inductor current. Therefore the output voltage boosts up.

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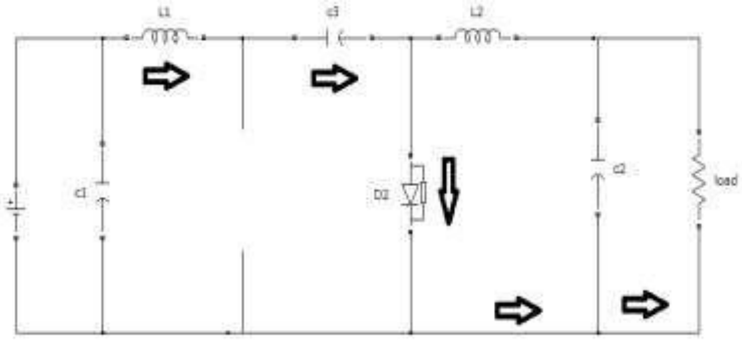

Fig. 4. **Mode 1 (Forward)-Interval 2 Operation**

C.Mode 2 (REVERSE)

In this mode depending on the duty cycle switch Q2 and diode D1 enters into conduction whereas the switch Q1 and diode D2 are off all the time. Depending on the conduction of the switch Q2 and diode D1, this mode can further be divided into two interval.

Interval 1 (Q2-on, D2-off; Q1-off, D1-Off):

In this mode Q2 is on and Q1 is off and hence the equivalent circuit is as shown in the Fig below. The higher voltage battery will charge the inductor and the output capacitor will get scored by it.

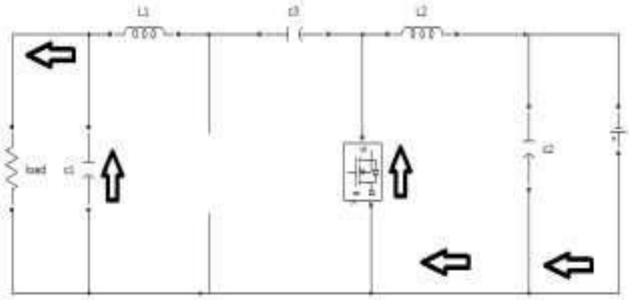

Fig. 5. **Mode 2 (Reverse)-Interval 1 Operation**

Interval 2 (Q2-off, D2-off; Q1-off, D1-on): In this mode Q2 and Q1 both are off. Again since the inductor current cannot switch instantaneously, it gets discharged through the freewheeling diode D1. The voltage beyond the load is stepped down as compared to the input voltage.

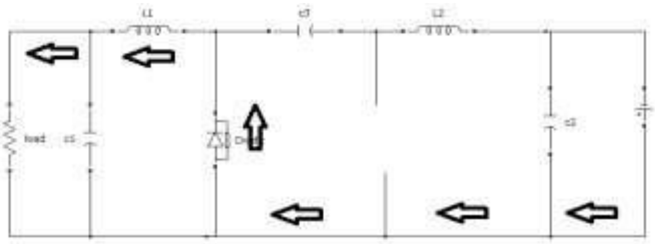

Fig. 6. **Mode 2 (Reverse)-Interval 2 Operation**

PROPOSED SYSTEM SIMULATION DIAGRAM

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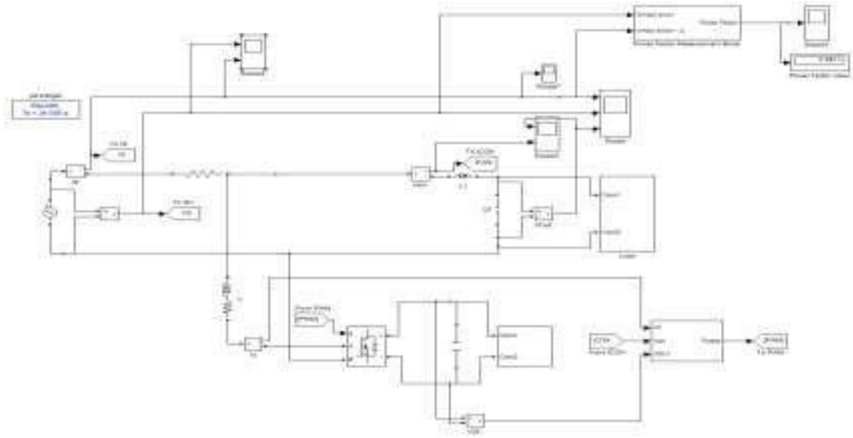

Fig. 7. **Proposed system simulation diagram**

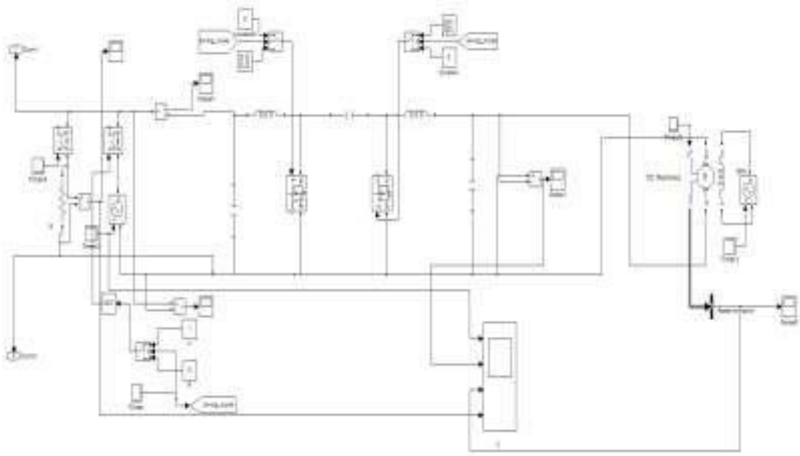

Fig. 8. **Motoring unit of subsystem**

REGENERATIVE BRAKING

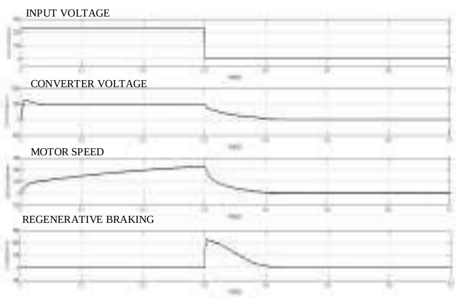

Fig.9.Regenerative concept

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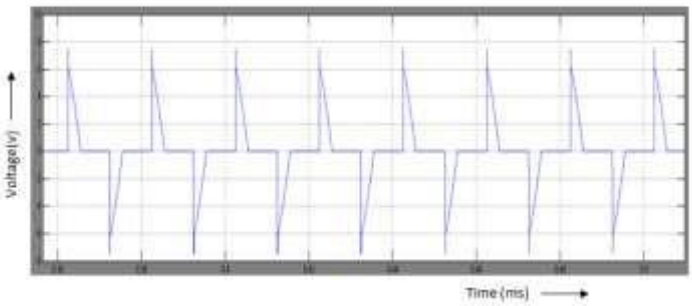

Fig.10.Line current without compensation

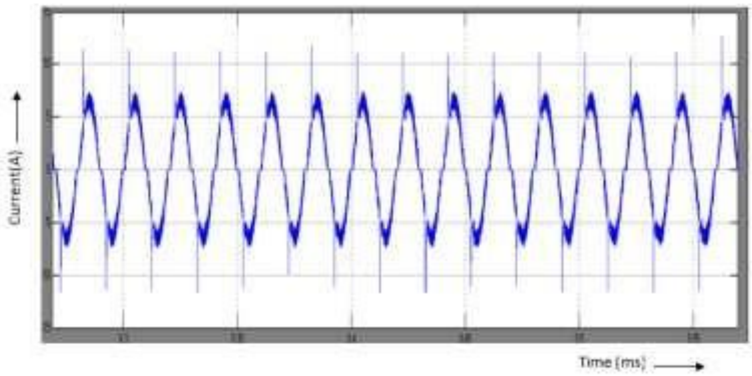

Fig.11.Line current with compensation

The proposed system simulation circuit output waveforms are shown above.The motoring unit output waveforms are shown in fig.9.In this subsystem1,CUK converter is connected to the motor and the regenerative is implemented here and that energy is increased or decreased by the bidirectional converter and again that current is given to the line by inverter for compensation purpose. The output of with compensation and without compensation is shown in fig.10and fig.11. Finally, the power factor improvement by this simulation cricuit is 0.943. It is higer than the existing system value.

IV.CONTROLLER

WHAT IS ANFIS?

The phrase ANFIS obtain its name from adaptive neuro-fuzzy inference system. *Using a given input/output data set, the toolbox function ANFIS constructs using either a back propagation algorithm alone or in combination with a least squares type of method a fuzzy inference system (FIS) whose membership function parameters are tuned (adjusted). This alteration allows your fuzzy systems to enroll from the data they are modelling*

The ANFIS controller is used in proposed system It is widely used for controlling the non-linear system. As this is the best controller as compared to conventional PID controller and other controller.

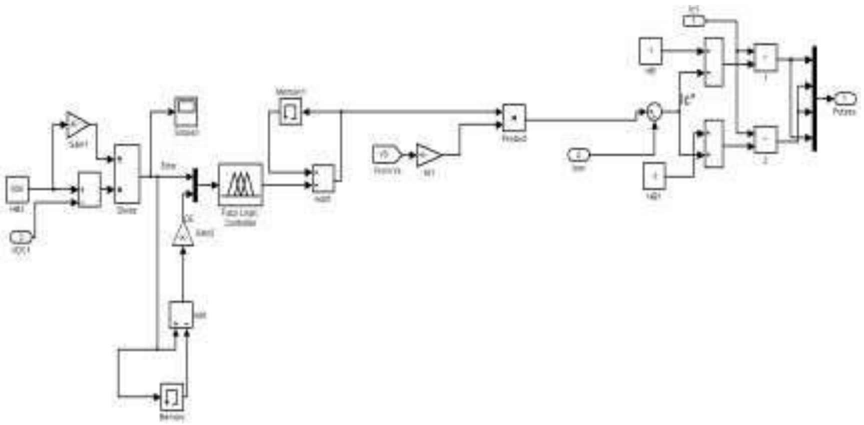

Fig.12.ANFIS controller

The controller used in proposed system is shown above. The ANFIS controller in the simulation circuit, it will create the ANFIS Model structure its by giving the dataset to the controller and it also create the rules itself with the help of dataset.

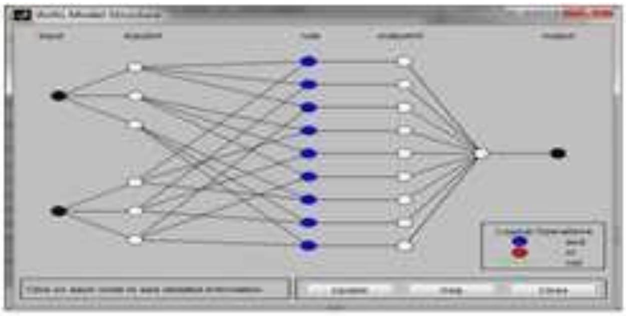

Fig.13.ANFIS model structure

The ANFIS model structure is taken from the simulation result while the ANFIS controller dataset is generated.

V.HARDWARE

Fig.14.Photocopy of hardware prototype

The hardware model setup is shown in above fig.14.The hardware consists of CT and PT for measuring the line current and line voltage,the gate drive cricuit is used to gives the PWM pulse to the MOSFET of the CUK converter .From the converter ,the output voltage is buck or boost to the circuit.

VI.CONCLUSION

This paper presents a new multi-function conversion technique for vehicle-to-grid (V2G), including bi-directional convert topology ,reactive compensation application based on V2G. Here, the bidirectional CUK converter is implemented and the ANFIS controller is used here for best result when compared to other controller .The cuk converter based vehicle to grid provide a reliable bidirectional topology for compensating the reactive power in addition to that result proves that the layout is more reliable for multi function operation alone with reactive power compensation bi-directional transformation in V2G. Finally, simulations and experiments are carried out to verify the feasibility of the proposed circuit. The simulation and experimental results show that the design system can perform well in multi-function conversion including V2G energy bidirectional transformation and reactive power compensation.

REFERENCE

a) *Bojrup.M, P. Karlsson, M. Alakula, B.Simonsson "A Dual Purpose Battery Charger forElectric Vehicles"IEEE 0-78034489-8/98/$10.00 0 1998.*

b) *Czarnecki.L.S and P.M, Haley "Unbalanced power in four-wire systems and its reactive compensation," IEEE Trans. Power Del., vol. 30, no. 1, pp. 53-63, Feb. 2015 .*

c) *Guochun Xiao, Yunqing Pei, Kuang Li, Xu Yang and Zhaoan Wang," A Novel Control*

d) *Approach to the DC Active Power Filter Used in a Low Ripple and Large Stable/Pulse Power Supply" IEEE 0-78037754-0/03/$17.00 2003 .*

e) *Guo.X, W. Liu, X. Zhang, X. Sun, Z. Lu, & J. M. Guerrero, "Flexible control strategy for grid-connected inverter under unbalanced grid faults without PLL," IEEE Trans. Power Electron., vol. 30, no. 4, pp. 1773-1778, Apr.2015 .*

f) *Hu.Y, Z. Zhu and K. Liu, "Current control for dual three-phase permanent magnet synchronous motors accounting for current unbalance and harmonics," IEEE Trans. Emerg. Sel. Topics Power Electron., vol. 2, no. 2, pp. 272284,2014.*

g) *Kristien Clement-Nyns, Edwin Haesen, Johan Driesen" The impact of vehicle-to-grid on the distribution grid" Electric Power Systems Research 81 (2011) 185–192.*

h) *Ma, W. Chen, M. Liserre, F. Blaabjerg, "Power controllability of a three-phase converter with an unbalanced AC source," IEEE Trans. Power Electron., vol.30, no.3, pp.1591 –1604, Mar. 2015.*

i) *Shaohua.L, W. Xiuli, Y. Zhiqing, L. Tai, P. Zhong, "Circulating current suppressing strategy for MMC-HVDC based on nonideal proportional resonant controllers under unbalanced grid conditions," IEEE Trans. Power Electron., vol.30, no.1, pp.387-397, Jan 2015.*

j) *Wang, Lei, Chi-Seng Lam, and Man-Chung Wong. "An Unbalanced Control Strategy for a Thyristor Controlled LCCoupling Hybrid Active Power Filter (TCLC-HAPF) in Three-phase Three-wire Systems." IEEE Trans. Power Electronics, vol. 32,no. 2, Feb 2017.*

k) *Ying Fan , Weixia Zhu , Zhongbing Xue , Li Zhang , and Zhixiang Zou ",A MultiFunction Conversion Technique for Vehicle-to-Grid Applications". Energies 2015,8,7638-7653; doi:10.3390/en8087638*