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MODIFIED TIME SHARING SWITCHING TECHNIQUE FOR MULTIPLE INPUT DC-DC CONVERTER FED PMDC DRIVE

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Abstract: In this paper a switching strategy for multiple-input converters (MICs) fed PMDC motor is presented and analysed. MICs have been identified to provide a cost-effective approach for energy harvesting in hybrid systems, and for power distribution in micro- and nano grids. Photo voltaic cell and fuel cell is given as multiple inputs to the buck boost converter. In output we are giving a permanent magnet dc motor. A PI controller is shown to regulate the MIC's operating point. The analysis is verified by simulations

keywords: Multiple Input Converter(MIC), PV Cell, Fuel Cell, PI Controller,PMDC Drive

I.INTRODUCTION

The global population has grown considerably over the past two decades and will continue to grow at an increasing rate based on historical trends. Every year the addition of humans to this Earth will increase and the resources required to support them will also increase. Of the resources, one of the most vital to support the technological advancing population is energy. The energy crisis became transparent in the late 1900's and birthed the desire to find additional energy resources to meet rising energy demands. One option was to increase generation of currently used energy sources such as nuclear, fossil fuel, etc. And the other was to explore new renewable energy alternatives. Many different renewable energy sources have emerged as feasible solutions and each one of them has their own positive and negative attributes. As a whole, renewable energy sources all share the fact that their fuel is primarily free and they produce minimal to no waste. Thesefactors are the main incentive for countries to begin incorporating renewables into their energy portfolio.

The paper introduce a switching strategy that modifies the time-sharing concept, alleviates the difficulties associated with controlling multiple switching functions for conventional timesharing MICs, and, thus, permits more input legs to be utilized. The switching-function coupling in time-sharing MICs leads to a common assumption used in MIC analysis, which is that various input voltages are unequal; the equal-input-voltage case usually renders the analysis invalid .The switching strategy presented here eliminates the aforementioned requirement, and thereby permits inclusion of the equal-input-voltage case in MIC analysis. This is an important advantage in energy harvesting applications in which multiple sources with equal output voltages can be expected; it is also of significant benefit when MICs are used as active distribution nodes—also called power routing interfaces in intelligent dc–dc distribution systems for microgrids.

A Multiple-input (MI) converter is a circuit that accommodates input of more than one energy source and provides at least one output. Such technology can find application in residential, aerospace, automotive, portable electronics and any other application where there is the possibility of using more than one source. By diversifying the energy source, alternative energy can be better utilized, reliability can be increased, and the most readily available energy sources (whatever they are at a given location, time of day, or cost) can be taken advantage.

Identification of multiple input dc-dc converter feasible topologies, and lists some basic rules that allows determining if a given single-input converter can be expanded into a multiple-input circuit. Multiple-input converter have been proposed as a cost-effective and flexible way to interface various sources and, in some cases, energy-storage devices, with a load.

However, MICs are not devoid of operational issues. Oneof these issues is found in time-multiplexing MICs: switching function coupling i.e., most switching functions directly depend on each other .With conventional time-sharing switching, all switching functions have to share a fixed time interval (period sharing). As the number of input legs in an MIC increases, it becomes more difficult to practically generate switching functions that can share a fixed switching period. In addition, using multiple switches to simultaneously stabilize an MIC's output voltage makes the closed-loop MIC a multipleinput single-output system. Consequently, controller analysis may require more sophisticated multiple-input multiple-output (MIMO) control design tools and added components in order to ensure robustness.This paper introduces a switching strategy that modifies thetime-sharing concept, alleviates the difficulties associated with controlling multiple switching functions for conventional timesharing MICs, and, thus, permits more input legs to be utilized. The method of generating switching functions presented here is of special importance—but not limited to—MICs whose effective switching functions are coupled, Here in this paper buck-boost converter is used[1]-[7]

The scheme presented here uses toggle flip-flops and logicgates to eliminate any coupling that may exist among variousswitching functions in an MIC. Rather, the switching functions now depend on a common switching function (CSF). Individualduty ratios of input-leg switches are integer multiples of the common duty ratio (CDR), which is the duty ratio of the CSF. Thus, the output voltage can be stabilized by employing theCDR.

II.CIRCUIT DIAGRAM

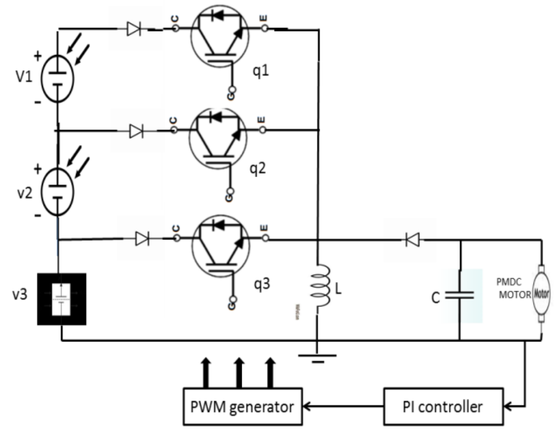

Fig 1 Schematic shows the circuit diagram of the proposed system

In the fig.2.1 the permanent magnet dc motor is controlled by the multiple input dc-dc converter, where the switching pulse to the converter is given by the PI controller .The block diagram consist of input dc source PV cell and fuel cell, a multiple input Converter, a PMDC motor and a PI controller.

In this diagram used a PV cell as DC input source. Photovoltaic (PV) solar energy is one of the green energy sources which can play an important role in reducing greenhouse gas emissions, the storage of fossil fuel and global warming, among various renewable energy sources. ThisPV cell provides required to amount of dc supply the converter. Another input is the fuel cell. fuel cells can produce electricity continually for as long as these inputs are supplied

Multiple input buck-boost converter is capable of interfacing sources of different voltage-current characteristics to a common load, while achieving a low part count. With multiple input, the energy sources is diversified to increase reliability and utilization of renewable energy sources.The inputs are diversified through a forward-conducting-bidirectional-blocking switch[8]-[23].

III.SWITCHING STATERGY

The proposed switching technique relies on generating a CSF at a higher switching frequency that is an integer multiple, N, of the desired MIC switching frequency. Frequency division is then performed on the CSF using logic gates and toggle flip flops; the number of toggle flip-flops NT is a binary logarithm of N. That is,

$$N=2^{N_T} \quad (1)$$

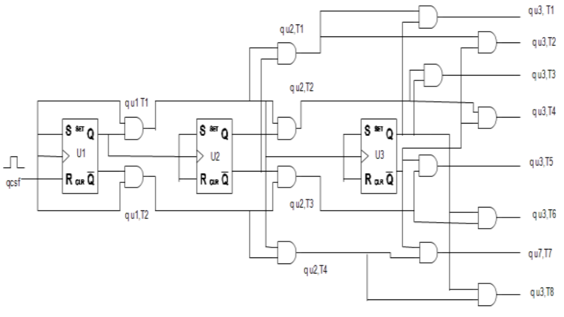

fig.2 schematic showing frequency-division operation

Fig.2Shows eight switching pulses that are recombined to yield three switching functions, for an equal number of corresponding MIC input legs.

That is,

$$\sum j = N = 8, \sum i = M = 3 \qquad (2)$$

Where M is the total number of i input legs, and N is the total number of j-switching pulses generated by frequency division. Note that with the arrangement shown in Fig. 2, two flip-flops (U1 and U2) may be utilized; then

$N = 4$, and switching pulses qU2,T1 through qU2,T 4 are available for recombination. Similarly, if just one flip-flop (U1) is used, then $N = 2$, and switching pulses (qU1,T1 and qU1,T 2) are available for recombination. It is assumed that each input leg has only one active switch, which is forward-conducting bidirectional-blocking (FCBB). This switching strategy also permits switching pulses to be omitted, as illustrated in Fig. 3, where qU3,T 5 is not connected to the OR gate. As a result, seven CSF pulses are shared in the ratio 2:2:3 to produce q1 ,q2 , and q3 respectively. That is, two switching pulses are channeled to switch 1 and switch 2, respectively, while three switching pulses are channeled to switch 3. Henceforth, where necessary, $\overline{N}$ will be used in a more general sense to represent the total number of switching pulses—out of a possible N—that are actually utilized. We define a share factor

$$\beta i=\frac{N_i}{N} \qquad (3)$$

whereNi is the number of switching (CSF) pulses that are channeled to the input leg i. In similar fashion, more toggle flip-flops can be used to further divide the CSF's frequency,

in which case, the CSF must be supplied at a corresponding higher frequency in order to maintain the same fundamental switching frequency, f, of individual MIC input-leg switches. The power drawn from each source is a function of the CDR, its respective share factor β, and the corresponding input voltage.

Employing an increased number of toggle flip-flops provides more flexibility when performing power budgeting. As illustrated in Figs.3,the order of recombination is irrelevant, and can be done arbitrarily as long as the desired duty ratios are maintained for their respective input-leg switches

Here the figure shows clearly that the effective duty ratios of switches 1, 2, and 3 are all multiples of the CDR and are given by

$$D_{1eff}=\beta_1 D_{CSF} \qquad (4)$$

$$D_{2eff}=\beta_2 D_{CSF} \qquad (5)$$

$$D_{3eff}=\beta_3 D_{CSF} \qquad (6)$$

where$\beta_1 N$=$\beta_2 N$=2, $\beta_3 N$=3, and the fundamental frequency f of each MIC input-leg switch is then one-eighth the switching frequency of the CSF fCSF. In general,

$$D_{ieff}=\beta_i D_{CSF} \qquad (7)$$

$$f=\frac{f_{CSF}}{N} \qquad (8)$$

That is, with the switching strategy presented, the effective duty ratio of an input-leg switch becomes the product of its corresponding share factor βi and the CDR DCSF

IV.ANALYSIS OF AN MIC WITH THE PROPOSED SWITCHING STRATEGY

Here in the figure shows the switching pulses for IGBTs in the multiple input buck-boost converter. This eliminate the presence of the aforementioned interaction among switching-functions when using a conventional switching scheme.

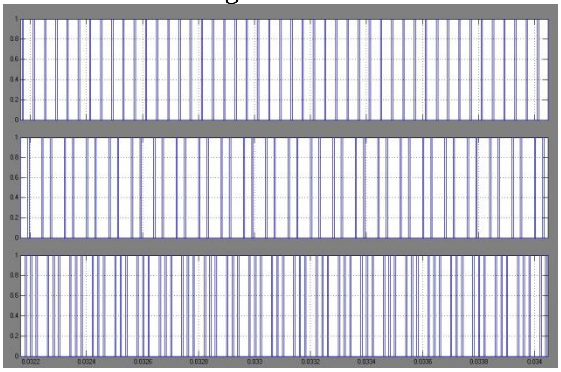

Fig .3 shows the switching pulses for IGBTs

One of the main advantagesof the proposed switching strategy over the conventional approach, which does not allow the possibility of having equal-input voltages ,a common situation in energy harvesting applications. Being able to control MICs with the equal-input-voltage case is also essential in order to realize active power distribution nodes for microgrids. For instance, without this presented switching strategy, it may be impossible to implement the intelligent microgrid distribution architecture presented in using power routing interfaces in a simple manner. The regulation with changes in input voltages that do not stem from total loss or restoration of power;

V.DESIGN PROCEDURE

A. Design Parameter
Closed-loop parameters
Input voltages v_1=10 v_2=15,v_3=20
Inductance L = 480 μH,
Capacitance C = 1.5 mF
Common switching function frequency
fCSF = 100kHz,
N_T= 2
Frequency f = 25 kHz
Share factor$\beta 1 = 0.5, \beta 2 = \beta 3 = 0.25$.

B. Share factor
Share factor is obtained by

$$\beta i = \frac{N_i}{N}$$

whereNi is the number of switching (CSF) pulses that are channeled to the input leg i.

C. Frequency
Total frequency is obtained by dividing the frequency of common switching function by the number of switching pulses

$$f = \frac{f_{CSF}}{N}$$

VI.SIMULATION RESULT

Simulation verification is provided here to verify the proposed switching technique in closed-loop operations
Fig 4 shows the simulated circuit diagram in matlab

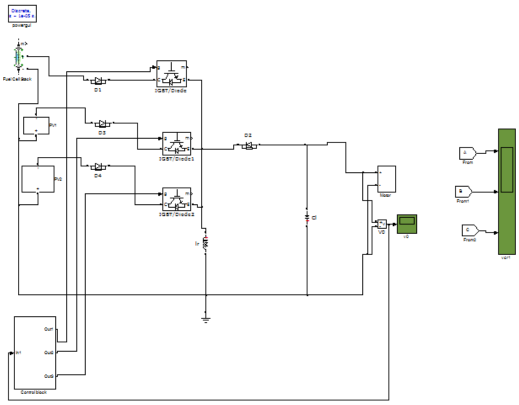

Fig. 4 shows the simulated circuit diagram

Here Fig.5shows the output voltage waveform

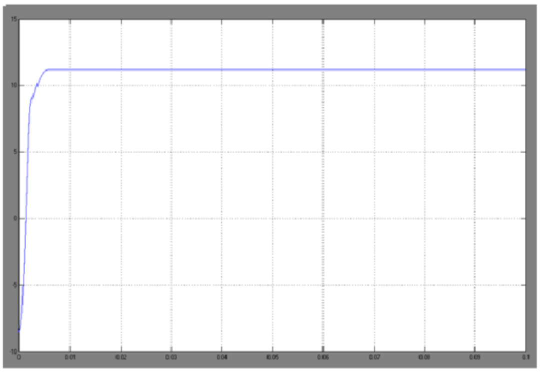

Fig.5 simulated output voltage waveform

Fig.6 shows the output torque waveform of PMDC motor

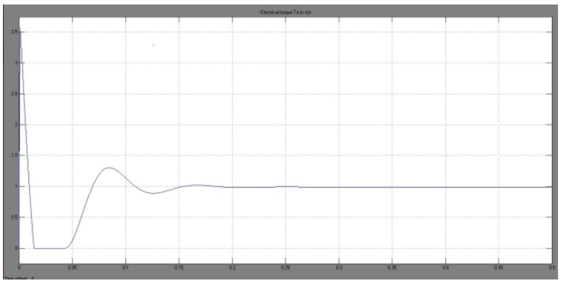

Fig.6 simulated torque waveform of PMDC motor

Fig.7 shows the speed waveform of PMDC motor .Here it is shown that after a particular time, the speed becomes constant

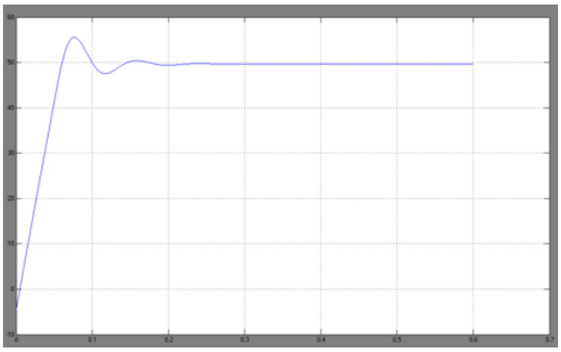

Fig .7 shows simulated speed waveform of PMDC motor

VII CONCLUSION

Here, a new switching strategy is presented for MICs fed PMDC motor. With this technique, all switching functions depend on a CSF; the effective duty ratio of the respective switching functions is integer multiples of the CDRDCSF, which is the duty ratio of the CSF. Consequently, the MIC can be reduced to an equivalent single-input converter for analysis, so that its output voltage can be regulated—over a wider range—by a single PI controller, with the CDR being the only control parameter. The proposed switching strategy is shown to be very simple; it achieves stabilization by implementing only one control circuit for all input legs. Moreover, the proposed switching strategy can be extended into digital implementation in a direct manner. The concept is demonstrated using an MIBB converter. Simulation are also provided to verify the analysis presented

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BIOGRAPHY

Dr.Govindaraj Thangavel born in Tiruppur , India in 1964. He received the B.E. degree from Coimbatore Institute of Technology, M.E. degree from PSG College of Technology and Ph.D. from Jadavpur University, Kolkatta,India in 1987, 1993 and 2010 respectively. His Biography is included in Who's Who in Science and Engineering 2011-2012 (11th Edition). Scientific Award of Excellence 2011 from American Biographical Institute (ABI). Outstandin Scientist of the 21st century by International Biographical centre of Cambridge, England 2011.

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Journal of Energy Oil and Gas Research,World Academy of Science, Engineering and Technology,Journal of Electrical and Control Engineering（JECE),Applied Computational Electromagnetics Society etc.. He has published 155 research papers in International/National Conferences and Journals. Organized 40 National / International Conferences/Seminars/Workshops. Received Best paper award for ICEESPEEE 09 conference paper. Coordinator for AICTE Sponsored SDP on special Drives,2011.Coordinator for AICTE Sponsored National Seminar on Computational Intelligence Techniques in Green Energy, 2011.Chief Coordinator and Investigator for AICTE sponsored MODROBS - Modernization of Electrical Machines Laboratory. Coordinator for AICTE Sponsored International Seminar on “Power Quality Issues in Renewable Energy Sources and Hybrid Generating System”, July 2013

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