International Journal of Future Innovative Science and Engineering Research (IJFISER)
Volume - 2, Issue - I ISSN (Online): 2454- 1966

Research Manuscript Title

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March – 2016

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ABSTRACT

A buck–boost converter with high effectiveness and small output current to include the battery life of manageable devices. likewise, the hybrid buck–boost feed forward (HBBFF) technique is collective in this converter to achieve the fast line response. The new control topology minimizes the switching and transmission losses at the same time even when four switches are used. Therefore, over a wide input voltage range, the proposed buck–boost converter with minimizes switching loss akin to the buck or boost converter can reduce the transmission loss during the use of the reduced average inductor current (RAIC) technique. in addition, the proposed display utilizes pseudo current dynamic acceleration (PDA) techniques, to realize fast fleeting response when load changes between heavy load and light load. The switching frequency of the proposed converter is 1 MHz for 3.3-V input and 1.0–4.5-V output range application.

KEYWORDS: Charge pumps, dc–dc power converters, Fast line transient reaction, feed forward technique, non inverting buck–boost converter.

I.INTRODUCTION

The dc–dc buck–boost converter is extensively used in many applications, such as smart phones, PADs, laptop computers, and so on. As manageable devices are appropriate more popular, the need for high performance power management ICs for appropriate grater, for used Conventional inductor step-up switching regulators, e.g., the buck–boost converter, boost converter, Cuk converter, and SEPIC converter, utilize the power stored in an inductor and regulate the duty cycle to execute voltage level conversion. Therefore, the load may be connected to the inductor only when there is adequate power stored in the inductor.

In addition, it is known that conventional buck–boost converters endure from poor strength because of the right-half-plane zeroes (RHZs) in their transfer function, the transfer functions of their small signal models not only have RHZs but also have higher-order terms, thus making them much harder to control. even though a conventional switched-

capacitor converter has the advantages of light weight and small size, its power efficiency is low. The ideal efficiency η of a conventional double-voltage switched-capacitor can be expressed as

$$\eta = \frac{E_{\text{out}}}{E_{\text{in}}} = \frac{Q_T V_{\text{out}}}{2Q_T V_{\text{in}}} = \frac{V_{\text{out}}}{2V_{\text{in}}} \qquad \rightarrow(1)$$

Where, QT is the total stimulating charge.

When not in double-voltage mode, even if the control circuit of a conventional switched-capacitor converter were lossless, the power efficiency is still poor for a conventional effortless switched-capacitor voltage boost converters with synchronized outputs. In an attempt to overcome the drawbacks mentioned above, a high effectiveness flying-capacitor buck–boost converter is proposed in this brief. A double-voltage charge pump is designed to achieve high efficiency according to (1) for a conventional switched-capacitor converter, and the doubled voltage is sent to a LC filter to acts as a buck–boost converter. The proposed converter has a voltage boost ratio of $2D$. where D is the duty cycle of the control switching waveform. To realize faster transient response, a new pseudo current dynamic acceleration technique, which is based on the derivative of the output energy is proposed. This technique does not involve a large-ESR capacitor and is not affected by LESL. The proposed flying-capacitor boost–buck converter which adopts this pseudo current dynamic acceleration technique has a transient response time of only 2 μs.

The limitations of standard analog pulse width modulator (PWM) causes uncontrolled pulse skipping and significantly increased output voltage ripples when the converter operates in the transition region of the buck and boost modes .That is, a buffer region, which is buck–boost mode, it is required to provide a soft and steady transition between two modes . As shown in Fig. 1, the converter can operate in buck, buck–boost, and boost modes when the battery voltage decreases. Since the dc–dc converter has different operation modes, the system permanence, the output undulate, and the accuracy of the synchronized output voltage during mode conversion have to be guaranteed.

This paper presents the hybrid buck–boost feed forward (HBBFF) technique incorporated in the buck–boost converter to normalize the output voltage with fast line transient response. High quality line regulation is sure to get small output voltage variation in case of the input voltage variation. That is the HBBFF technique can get better the static and dynamic performance of the buck–boost converter without being affected by the large variation of the battery voltage. The hybrid buck–boost feed forward (feedback technology) technique is incorporated in this converter to realize fast line response. The new control topology minimizes the switching and conduction losses at the same time even when four switches are used, a wide input voltage range; the proposed buck–boost converter with minimum switching loss like the buck or boost converter Can reduce the conduction loss through the use of the reduced average inductor current (RAIC) technique.

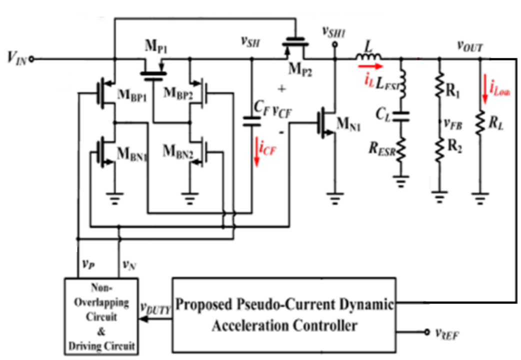

Fig.1.The flying-capacitor buck–boost converter with the Pseudo Current Dynamic Acceleration controller.

II. CIRCUIT DESCRIPTIONS

To proposed flying-capacitor buck–boost converter with the pseudo current dynamic acceleration controller is shown in Fig. 1. The power phase contains five power MOS switches (MP1, MP2, MBP1, MBN1, and MN1*)*, two control MOS switches (MBP2 and MBN2*)*, one charge pump capacitor (*CF)* and a second order filter (*L* and *CL)*. The size of MP1, MP2, and MBP1 is 48 000 μm/0.5 μm, the size of MN1 and MBN1 is 22 000 μm/0.5 μm, the size of MBP2 is 800 μm/0.5 μm, and the size of MBN2 is 400 μm/0.5 μm. The predictable pseudo current dynamic acceleration controller is at the lower part of Fig. 1. The operating principles are described in detail below.

A. FLYING-CAPACITOR BUCK–BOOST CONVERTER

The explanation why the proposed converter is named flying-capacitor buck–boost converter can be pragmatic, as shown in Fig. 1. The flying capacitor *CF* should be large enough to maintain the voltage across itself. The inductance *L* and output capacitor *CL* comprise a second order filter. The five power switches are MP1, MP2, MBP1, MBN1, and MN1, and the control switches MBP2 and MBN2 perform voltage levels shift to turn MP1 ON or OFF.There are no RHZs in the transfer function of the proposed converter. In difference, a conventional buck–boost converter has RHZs in continuous-conduction-mode. This indicates that the dynamic actions of the proposed converter is improved that a conventional buck–boost converter.

B. PSEUDOCURRENT DYNAMIC ACCELERATION CONTROL SCHEME

It is collected of a non overlapping circuit and driving circuit, a digital circuit, a pulse width modulator (PWM), a PID compensator, and the pseudocurrent dynamic ramp circuit, which consists of a differentiator, a filter, and a ramp generator.

Non overlapping circuit: The circuit is generate a key building block of switched capacitor circuits, the standard non overlapping circuit used straightforward inverter of realize delay for high to reasonable frequencies.

Ramp Generator: A ramp generator is a function generator, that increases as a output voltage up to a specific value.

PID Controller: A Proportional Integral Derivative controller is a control loop feedback mechanism that is continuously calculates a fault values as the difference between a calculated process variable and a preferred set point.

Filter: The function of to remove not needed frequency component from the signal to improve hunted ones, or together.

Differentiator: It is a circuit that is considered such that the output of the circuit is in the region of directly comparative to the speed and modify of the input.

Driving circuit: It is used for control the another circuits or mechanism, such as a high power transistor. Drawbacks of the available process these are the problems faced such as Low fleeting response, Low efficiency, Presence of losses and reduce the life time of the components.

C. TOPOLOGY OF THE BUCK–BOOST CONVERTER WITH THE RAIC TECHNIQUE

The conduction loss is four period that of a pure buck or a low-duty boost converter. The proposition of buck–boost converter not basically needs to at the same time reduce the conduction and switching losses but also needs to reduce the output ripple during the mode transition. The proposed buck–boost control scheme can successfully reduce the conduction loss through the use of the reduced normal inductor current (RAIC) technique for improving efficiency, in addition, the feed forward reimbursement can efficiently and rapidly reduce line uproar on the converter's output to improve line transient response for the design of the voltage mode voltage mode switching converters. The accomplishment of the feed forward technique simply varies the peak and valley voltages of the saw tooth signal with the input voltage in buck and boost converters.

D. THE HYBRID BUCK–BOOST FEED FORWARD

This paper presents the hybrid buck–boost feed forward (HBBFF) technique integrated in the buck–boost converter to regulate the output voltage with fast line transient response in fig.2. Good line regulation is definite to get little output voltage variation in case of the input voltage variation.

$$I_{\text{Load}} = I_{L,\text{avg}} \frac{(t_{AD}+t_{BD})}{(t_{AD}+t_{BD}+t_{AC})}$$

→(2)

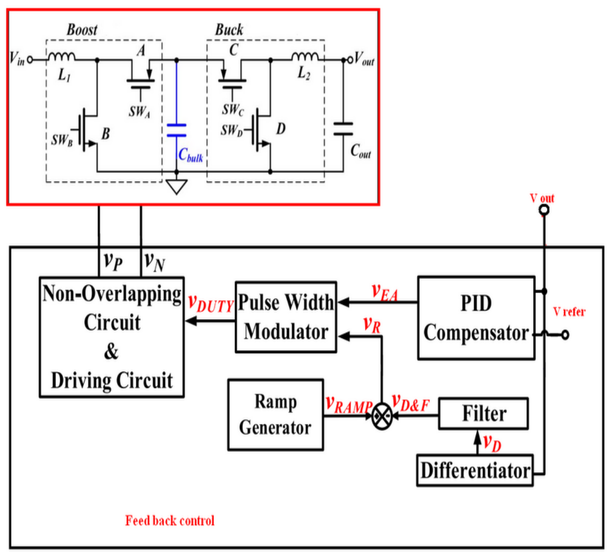

Fig.2. Proposed buck–boost converter with the RAIC and HBBFF techniques

That is, the HBBFF technique can improve the static and dynamic performance of the buck–boost converter without being affected by the large variation of the battery voltage. The designed buck–boost converter with the RAIC technique, the HBBFF technique and the mode detector to exhibit to the appearance of the buck–boost converter.

E. THE RAIC TECHNIQUE

The RAIC technique has lower average value without the undesired pulse skipping and large output voltage ripple as well as the power conversion efficiency can be better in the proximate-linear buffer section since the RAIC technique reduces the switching possibility of the four switches during one switching period. RAIC practice uses two switching cycles poised of one buck and one increase cycles to represent one regulation cycle when the supply voltage approaches to the output voltage. The switching loss can be reduced since only two switches are turned on/off in one switching cycle. Additionally the period of RAIC that only delivers power to the inductor is minimized and thus the average inductor current level, as shown in (2), can be close to the load current. In additional words, the RAIC technique can decrease the conduction loss since the difference between the average inductor current and the output load current is reduced.

III.CIRCUIT IMPLEMENTATION

The hybrid buck–boost feed forward (feedback technology) technique is incorporated in this converter to achieve fast line response a new control topology minimizes the switching and conduction losses at the same time even when four switches are used.

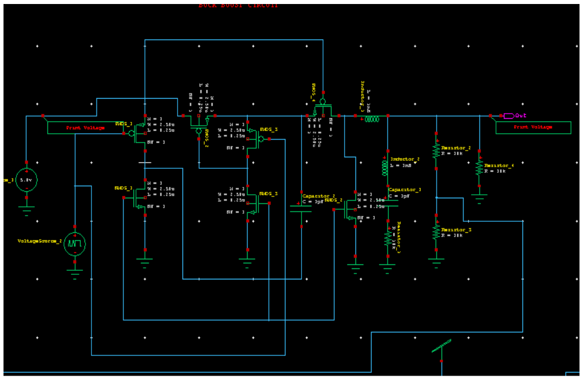

Fig.3. Circuit implementation for buck–boost converter with the PDA converter

A wide input voltage range, the proposed buck–boost converter with minimum switching loss like the buck or boost converter.

The buck or boost converter. It Can reduce the conduction loss through the use of the reduced average inductor current (RAIC) technique. And methodology used as Pseudo current dynamic acceleration (PDA) techniques is implemented to the

Buck-boost converter output is given as

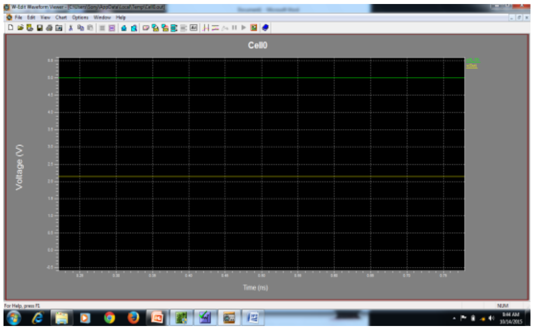

Fig 4.Result for buck–boost converter with the PDA converter

The proposed (HBBFF) technique integrated in the converter to regulate the output voltage with fast line transient response is designed as given below

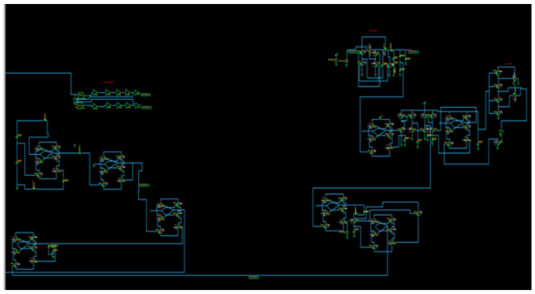

Fig.5. Proposed buck–boost converter with the RAIC and HBBFF techniques

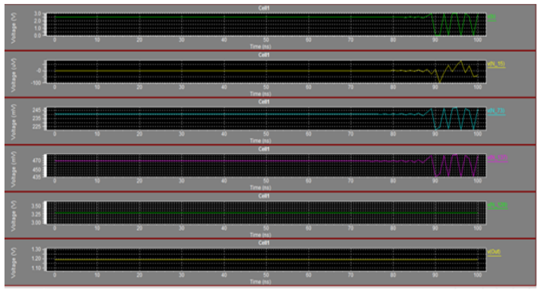

Fig.6. Simulation Results for buck–boost converter with the RAIC and HBBFF techniques

It is composed of a non overlapping circuit and driving circuit, a digital circuit, a pulse width modulator (PWM), a PID compensator, and the pseudo current dynamic ramp circuit, which consists of a differentiator, a filter, and a ramp generator.

IV.CONCLUSION

In this paper, to analyze different technique for PDA, HBBFF, RAIC, and a highly stable flying-capacitor buck–boost converter applying a new pseudo current dynamic acceleration technique is described in the input voltage is 3.3 V, the output voltage range is 1.0–4.5 V, and the operation frequency is 1 MHz. The boost ratio of the positive output voltage is 2*D* and the power translation good eminence organization reaches 90%, the duty cycle and the fleeting response time is only 2 μs, quite a few advantages contain reduced switching and decreased conduction losses of power switches due to the RAIC technique. The effectiveness is successfully enhanced and the HBBFF technique is incorporated in this converter to minimize the voltage disproportion at the output of error amplifier. As a result, a fast line transient response can be achieved with small dropout voltage at the output.

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