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A SURVEY ON RIPPLE REDUCTION IN SINGLE STAGE SINGLE SWITCH HIGH POWER FACTOR CONSTANT CURRENT SWITCH MODE POWER SUPPLY

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Abstract: Constant current power supply is an important area of study and research for researchers, as it covers a wide application which includes industrial, commercial, residential and public lighting area. Like any other technology, technology of Constant current power supply is also upgrading continuously and have both pros and cons, like earlier low power factor power supplies were used, but now high power factor power supplies are more preferred. Ripple in load current is a significant issue in HPF type single stage single switch constant current power supplies. Researchers have done a lot of study and applied various approaches to reduce this low frequency ripple, as ripple causes serious health issues and application problem.

In this paper, a survey is done on various approaches to reduce the ripple effect in Single Stage Single Switch High Power Factor Constant Current Switch Mode Power Supply.

Index Terms **- Flickering, Constant Current, Ripple cancellation, High Power Factor**

I. INTRODUCTION

Due to high efficiency and better lifespan, single stage single switch high power factor constant current switch mode power supply are in high demand. It has wide applications which includes commercial, residential, professional, industrial lighting area, and a trade-off is required among design, cost, efficiency and space to optimize the required application. HPF type single stage and single switch constant current power supplies have several advantages, but also inherent with a major problem of flicker [1-2]. Flicker is low frequency current ripple in the output which have adverse effect on human health such as migraine, eye strain, and impaired visual performance and so on. It is important to consider the flicker effects during video cameras recording, where the images are cut with several black lines and it is not easy to shoot videos. The major concern is raised by Professional photographers, display showroom of electronic manufacturer and CCTV industry where they need to offer clear image recording 24X7 to their customer so that a clear image can be obtained from recorded file when it is desired by end customer or concern authorities.

II. RIPPLE CANCELLATION TECHNIQUE IN SINGLE STAGE AC-DC LED DRIVER

Fang, Peng, et al. [3] in his paper had proposed a ripple cancellation approach. The idea of the proposed solution of the author is shown in Figure 1.

The important considerations for the proposed solution are:

- As, average value of V_{O1}>V_{O3}, so major part of the delivered power to output is from PFC converter.
- V_{O3}, the output voltage of RCC, contains AC component having low frequency which can cancel the low frequency output voltage ripple from PFC output V_{O1}, and the sum of these two voltages are allow frequency ripple free DC voltages

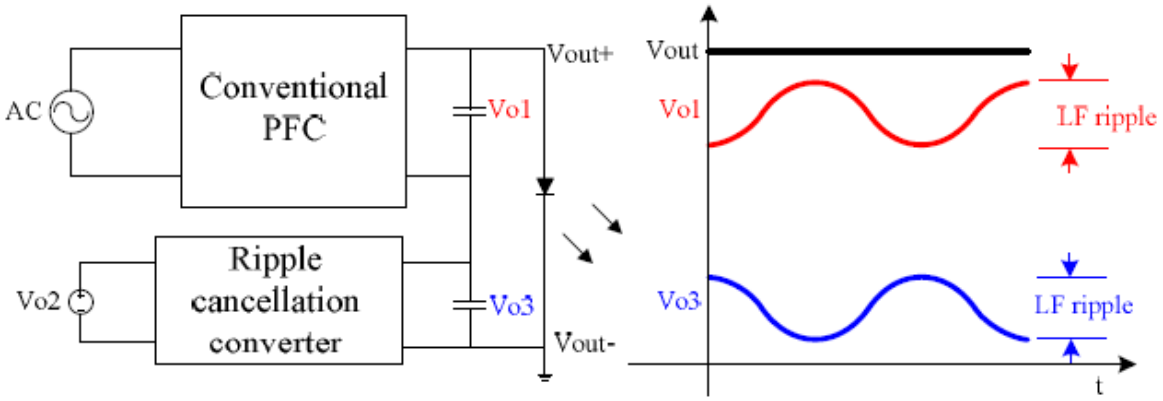

Figure 1 Design concept proposed by Fang, Peng, et al

Figure 2 shows the circuit implementation of the Fang, Peng, et al.

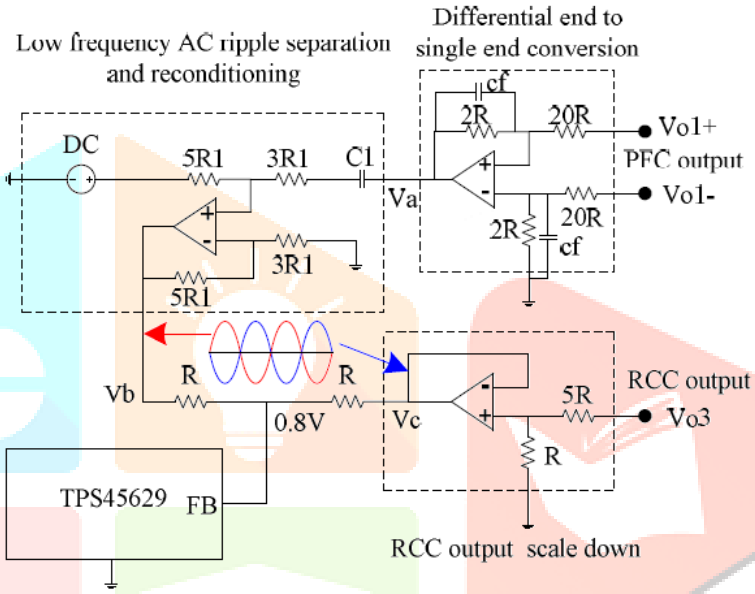

Figure 2 Circuit implementation of low frequency ripple sensing and conditioning circuit by Fang, Peng, et al

The resistors used for signal conditioning are within 0.5% tolerance in order to precisely set the AC ripple amplitude, Op Amps deal with 120Hz frequency signal, TLV274CDR (TI) is chosen in order to lower static power consumption and component cost.

As only a small portion of the output power is passed by RCC, the efficiency and BOM cost of the proposed solution is close to single stage LED Driver. The experimental results shows: efficiency can be achieved up to 85.5% for 35W, 50V/0.7A prototype. The low frequency LED ripple current has been greatly removed in the work, no compromise is made between achieving high power factor and the amount of energy storage capacitance used, near unity power factor is 1.3mA pk-pk, 120Hz ripple is recorded. Another advantage of the work is the independent operation between power Driver circuit of the RCC and the flyback PFC.

III. Decoupled Low Frequency Ripple Cancellation Based Approach

Barwar, Manish Kumar, et al. [4] had proposed RC method with an aim to eliminate the double line low frequency ripple and eliminate the electrolytic capacitor. The approach uses a multilevel converter topology maintaining UPF and minimizes the voltage stress across the switches. A simple single loop control is implemented for ripple free load voltage. This method decouples the output voltage control and multilevel converter, which further eliminates the impact of the load on converter and UPF. The performance of the controller has been evaluated and the peak efficiency of the converter has been calculated and observed as 89%.

Figure 3 shows the low frequency ripple pulsating DC to high frequency ripple pulsating DC by Barwar, Manish Kumar, et al. The figure also includes the voltage waveforms at important nodes. Here, firstly VIN is converted to a pulsating DC voltage VDC and also removes the double-line-low frequency current ripples. This stage consists of three steps of power conversion: a) H-bridge inverter module (DC to high frequency AC conversion) ; b) LC filter design and c) High frequency AC to Pulsating DC.

A method to minimize the ripple current while also maintain a small output capacitance is proposed in [5-6]. Another method is to use odd harmonics into the input current side to remove or reduce flicker issue [7].

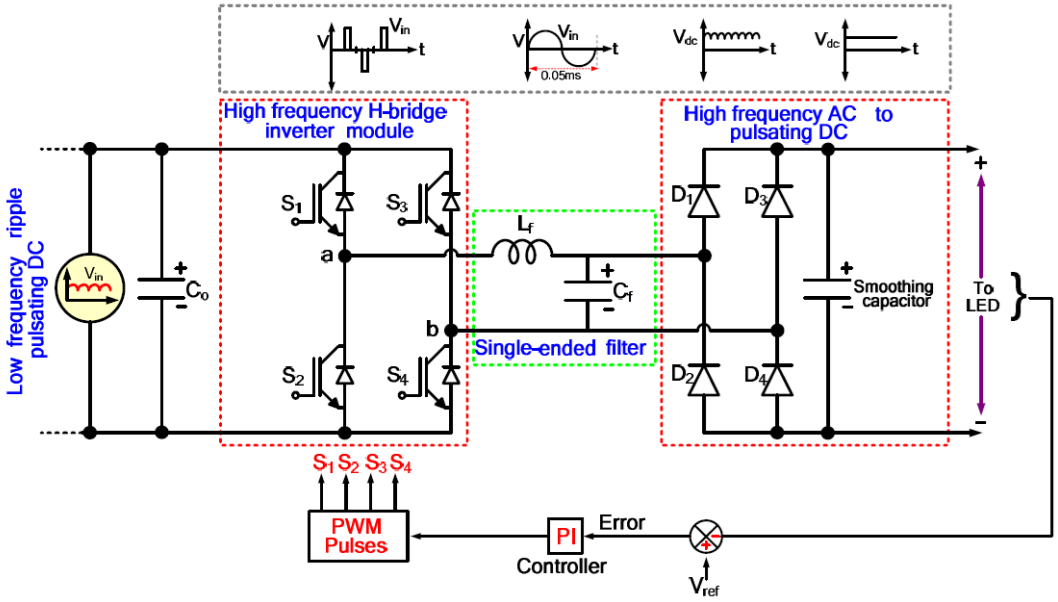

Figure 3 Low frequency ripple pulsating DC to high frequency ripple pulsating DCby Barwar, Manish Kumar, et al.

III. CONCLUSION

In this paper, various literatures are reviewed on ripple effects and its reduction or cancellation technique and found various approaches to reduce it. The study shows the flicker significantly affects human health and needs to optimize it without compromising design, cost and efficiency of the product. The important literatures are explained here. It can be concluded that every technique has some pros and cons (like cost issue, design complexity, etc.) and need to find some another optimization method to reduce ripple current in load.

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