

REVIEW ON VARIOUS TOPOLOGIES USED FOR DECOUPLING OF FLUCTUATING POWER IN SINGLE PHASE AC CIRCUITS

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Abstract - Single-phase AC-DC or DC-AC systems are subject to harmonic distortion caused by known dual-line frequency fluctuation power. Electrical equipments may break down, fail impulsively or not operate at all. There are many reasons of poor quality of power. This problem can be facilitated by mounting electrolytic capacitors with volume to DC link. However, passive filtering approaches inevitably lead to low energy density and limited system life. An alternative approach is to use active power decomposition called as decoupling, so that the energy for better system performance can be directed to other power storage devices. All existing active methods need to place extra energy storage devices like inductors, or film capacitors in the system to store the fluctuating energy. This leads to an increase in component costs. In the proposed design, we use a symmetrical half-bridge circuit that uses the minimum passive components to absorb surge power with inductors with only two lower capacitance and two switches being used.

Key Words: Electronic convertors, Decoupling, Active Power, MPPT

1. INTRODUCTION

Electronic power convertors are extremely common in residential and industrial power and conversion systems. Examples of applications are power factor correction units (PFC) for consumer power supplies, integrated chargers for hybrid electric vehicles, and photovoltaic (PV) converters of rating 5 kV (or less).

A well-known problem with such systems is that the power on the AC side contains a fluctuating power that changes to a double base frequency. These juddering effects weaken system performance due to distorted PFC input current, battery overheating and maximum Power Point tracking efficiency (MPPT). A highly predictable way to mitigate the negative effects is to use a large electrolytic capacitor in direct current to act as a shock absorber for the AC pulse power. These electrolytic capacitors have a high equivalent series resistance (ESR) and a low pulse current capacity and are relatively short for a lifetime, nominal voltage and current.

In order to achieve a simple and compact design and to overcome the limits of the frontal topology, this project proposes new topology allowing performing active power decomposition i.e. decoupling. Two similar film capacitors are used, and then the midpoint is connected in series with the DC link, which is then connected to another phase via a small filter inductor. The dc-link capacitors may not only provide a high-voltage dc bus to support ac/dc or dc/ac conversion, but can also absorb the system ripple power. The extra symmetric half-bridge circuit can also be easily controlled as the voltage of the two film capacitors is sinusoidal

In today's world, some methods of decoupling active power have been proposed and implemented to deal with this problem. The fundamental principle underlying them is often implemented by introducing an additional active circuit into the system, so that the residual power can be transferred from the DC link. And associated components providing increased life, for example inductors and film capacitors, more efficiently and cost-effectively. Fig. 1 (a) shows an active method that uses an inductor for active storage of ripple energy.

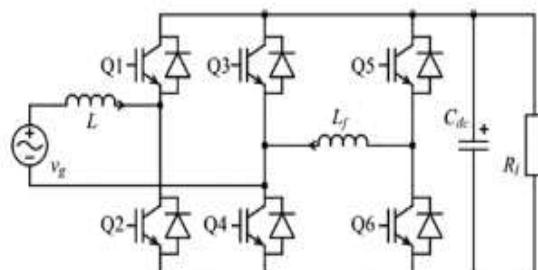


Fig.1 (a)

This, however, is controlled by the current use of a sinusoidal current Inductor transmitted by modulating the added third switching leg. A similar type of concept is shown in Figure 1 (a), wherein in the last transition to the third arm and with the health movement the diode of one active component and in this case the current Inductor can control the changed sinusoidal order to destroy this portion of the corrugations. Even if they are for the most part used coils to

be bold and faithful to the loss of great power, which were both in demand at low power density with power elements, the full piqued is placed with Inductor power, and therefore better work can be compared between.

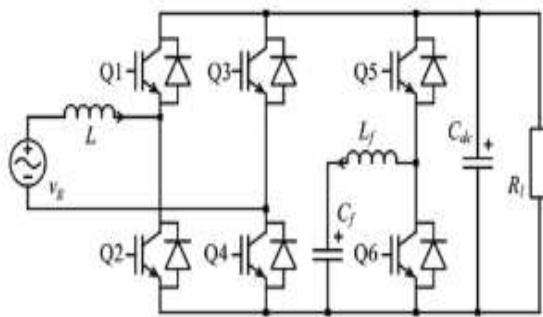


Fig.1 (b)

If the inductor coil is exchanged with the foil capacitor, the ripple power can be corrected by controlling the voltage of the foil capacitor, as shown in Figure 1(b). In addition, these waveforms contain higher harmonics that are difficult to track and control in highly suppressed second-order systems. Use the exact same circuit configuration. Research by Wang et al.

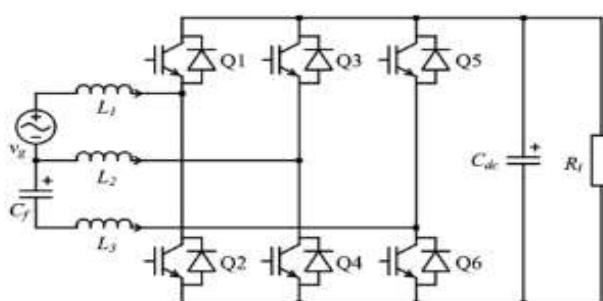


Fig.1(c)

A technique where dc offset voltage is introduced near to capacitor in connection to the capacitor for the purpose of reduction in lower order harmonics and it may also facilitate the closed loop design of the controller. Nevertheless, since the capacitor voltage does never goes down to zero, it will not get fully discharged, which implies that the film capacitor is not fully utilized. The similar type of concept was used in capacitive ripple power decoupling had order and can facilitate the construction of the controller's closed circuit. However, since the voltage of the capacitor never drops to zero, it will not be completely discharged, which means that the capacitor of the film is not used completely. A similar type of concept is used in the capacitive rupture of the pulsation power observed in several articles cited

The most modern techniques proposed for the active power separation method are shown in Figure 1 (c) and in the

circuit diagram. The entered half bridge forms a complete bridge circuit, with one foot of the complete bridge rectifier, in which case the capacitor voltage of the film can be controlled sinusoid ally and solves all the difficulties mentioned above. Although effective in compensating wave power, this topology does not apply in some cases, for example in the correction of the energy factor and the deployment of bridge-based inverters, because the energy flow is unidirectional.

2. LITERATURE REVIEW

2.1 IEEE paper on effective Use of Film Capacitors in Single-Phase PV-inverters by Active Power Decoupling by Fritz Schimpf and Lars Norum Norwegian University of Science and Technology, Norway

In this paper author has focused on the fluctuation problem arising in PV sales in which are affecting on lifetime of PV sales .To increase his reliability electrolytic capacitors have been replaced by film type capacitors .Mr. Fritz designed active circuit in interface PV invertors and DC link storage capacitors This proven that system utilized storage capacitor which massively reduces the ripples and overall Installation of capacitance value. With this technology he had proven comparison results between electrolytic capacitors and film type capacitor with lab proto-type results.

2.2 IEEE paper on Active Power Decoupling for High-Power Single-Phase PWM Rectifiers Hongbo Li, Kai Zhang, Hui Zhao, Shengfang Fan, and Jian Xiong IEEE TRANSACTIONS ON POWER ELECTRONICS, VOL. 28, NO. 3, MARCH 2013

This paper presents a topology study that evaluates the topologies used in AC / DC rectifiers for PHEV battery chargers. The topological investigation focuses on multiple power factors corrected transducers that offer high efficiency, high power factor, high density, and low cost. The experimental results are presented and interpreted for five prototype converters, converting the universal AC input voltage to 400 VDC.

2.3 IEEE paper on “Decoupling of Fluctuating Power in Single-Phase Systems Through a Symmetrical Half-Bridge Circuit” by Yi Tang, Member, IEEE, Frede Blaabjerg, Fellow, IEEE, Poh Chiang Loh, Senior Member, IEEE, Chi Jin, and Peng Wang, Member, IEEE,

In this paper Author has illustrated his research work and study on development of decoupling technology with various topologies. Mr, Yi Tang has focused his research on implementation of symmetric Half bridge circuit for active power decoupling. Mr.yang designed and implemented the system on the basis of facts and results and proven by using this technique the value of the capacitor have been reduced as compared to conventional methods.

2.4 Paper on Active power decoupling with reduced converter stress for single-phase power conversion and interfacing by B. sujatha IISB 2017

This paper explains topology is proposed to handle the single-phase power ripple. Analysis & theory of the topology which is performed using power balance equation and the phasor diagrams.

2.5 L. Huber, Y. Jang, and M. M. Jovanovic, "Performance evaluation of bridgeless PFC boost rectifiers," IEEE Trans. Power Electron., vol. 23, no. 3, pp. 1381–1390, May 2008.

In this article, we present a systematic review of PFC rectifiers (power factor correction boost), also known as dual amplification PFC rectifiers. A performance comparison is performed between the conventional PFC compressor and a representative member of the non-hybridized PFC compressor family. A loss analysis and an evaluation of the experimental efficiency for the CCM and DCM / CCM border operations are provided.

2.6 IEEE Paper on A high-performance single phase bridgeless interleaved PFC converter for plug-in hybrid electric vehicle battery chargers by F. Musavi, W. Eberle, and W. G. Dunford

In this paper, a new front end ac-dc bridgeless interleaved power factor correction topology is proposed for level II plug-in hybrid electric vehicle (PHEV) battery charging. The topology can achieve high efficiency, which is critical for minimizing the charger size, PHEV charging time and the amount and cost of electricity drawn from the utility.

2.7 IEEE Paper on Review of Battery Charger Topologies, Charging Power Levels, and Infrastructure for Plug-In Electric and Hybrid Vehicles by M.Yilmaz and P. T.Krein

This study examines implementation of decoupling for battery chargers, the levels of load capacity and the infrastructure of plug-in electric vehicles and hybrids. Chargers are divided into one-way or bi-directional power supplies on board.

2.8 IEEE Paper on "A review of single phase grid-connected inverters for photovoltaic modules by S. B. Kjaer, J. K. Pederson, and F. Blaabjerg

This review focuses on inverter technologies for connecting photovoltaic (PV) modules to a single-phase network. Invertors are categorized into four categories: 1) the number of cascading stages of energy treatment; 2) the type of power decoupling between the photovoltaic module (s) and the single-phase network; 3) whether they use a transformer or not; and 4) the type of power stage connected to the network. The main principle explained by the authors under this is paper is to verify that inverters for PV and grid applications must fulfill power quality, injection of dc

currents into the grid and &system grounding. In the research the role of power decoupling between the modules and the grid has been investigated. By the authors with results that the amplitude of the ripple across a PV module should not exceed 3.0 V in order to have a utilization efficiency of 98% at full generation.

3. CONCLUSION

This article attempts to evaluate all available techniques regarding the disconnection of current fluctuation techniques in single-phase systems with a balanced half-bridge circuit. The authors of the discussions also discussed the three different configurations of decoupling techniques for active energy. First, we conclude that a single-phase H bridge configuration is suitable for decoupling fluctuating systems.

4. REFERENCES

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