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Power Factor Correction (PFC) Circuit for EV charger

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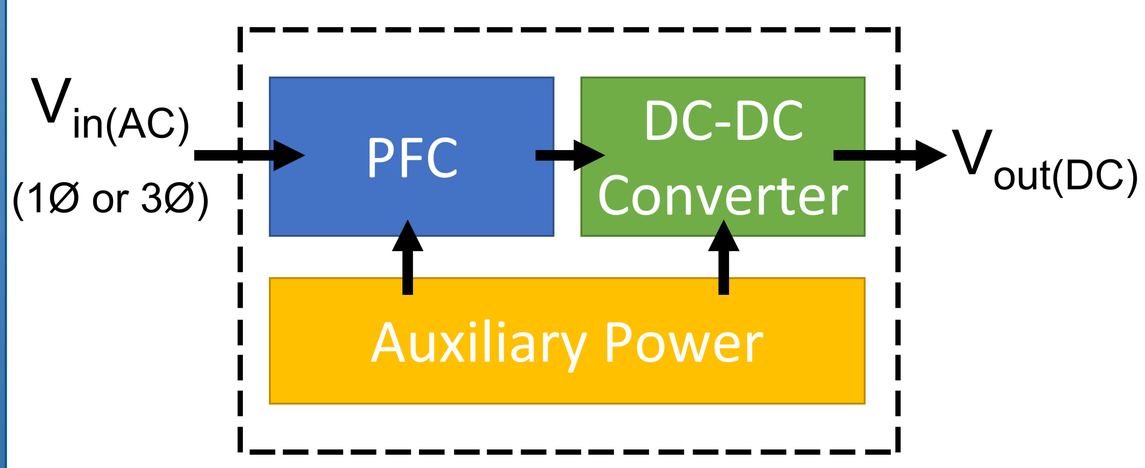
Introduction

- Onboard charger(OBC)is composed of a power factor correction(PFC) circuit, an isolated DC-DC Converter, and auxiliary power supplies.
- We will employ different power switches, including silicon-based power MOSFET ,IGBT, SiC, and GaN to compare the performance of PFC circuit.
- The PFC circuit is used to correct the distortion of the input current so as to improve the power factor and reduce the total harmonic distortion(THD).

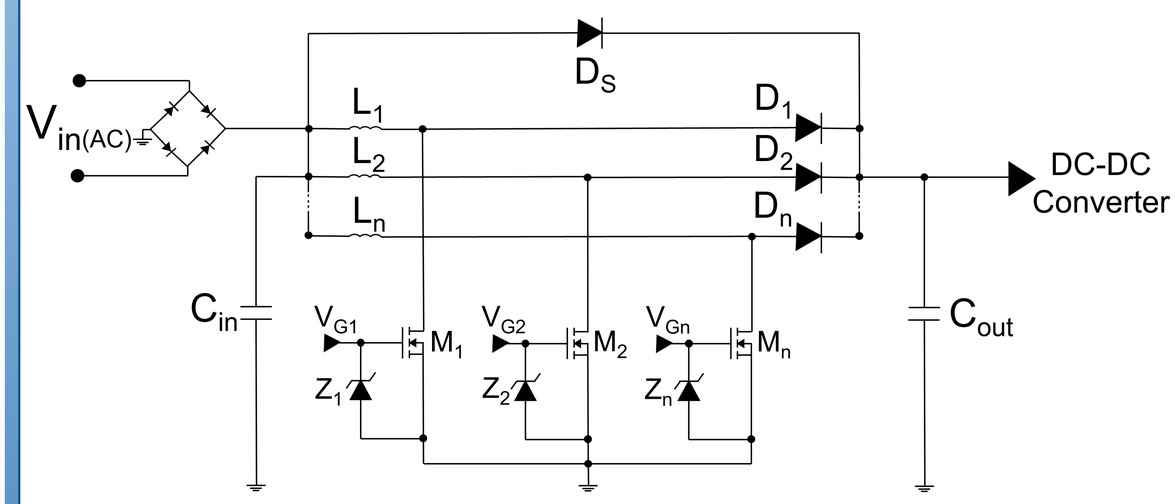
OBC

Main Power Stage Block Diagram



System Architecture

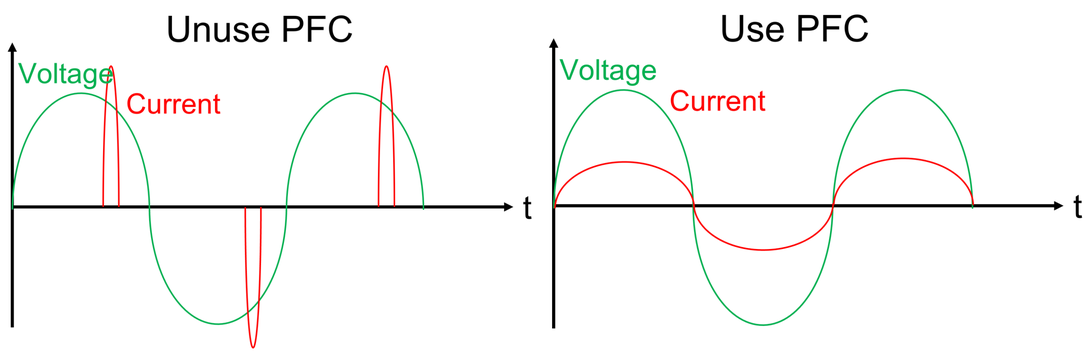
Active Boost Interleaved PFC Converter schematic



- The PFC circuit uses active boost interleaved PFC converter.
- It can phase-shift each set of switches by an angle, increasing the total current frequency, it can reducing the size of the inductor and capacitor.
- Hanging a diode on it can solve the problem of the diode being burned out by a large current when the power is first turned on.

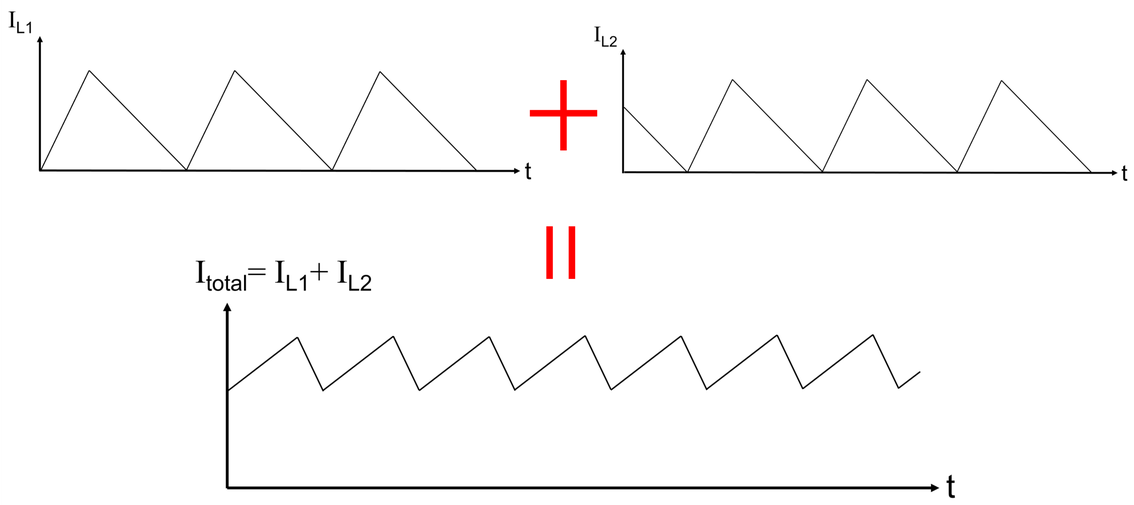
Characteristics

- The following describe the difference in waveform between use and unuse PFC circuits:



- Using the PFC circuit can make the current phase close to the voltage and improve the power factor.

- The following is an example of a two-stage active boost interleaved PFC converter with switches driven 180° difference of phase:



- Use a fixed frequency to switch M1 and M2, the on time of M2 is 180° later than the on time of M1, which can increase the frequency of the total current.

Device Selections

Component	Type	Withstand Voltage
rectifier diode	STTH16L06C-Y	600 V
bypass diode(D_s)	STTH30L06-Y	600 V
PFC diode(D_1,D_2,…,D_n)	STPSC20065-Y	650 V
TVS diode(Z_1,Z_2,…,Z_n)	SM4TY	32.5 V
power MOSFET	STW62N65M5	650 V
IGBT	STGB30H65FB	650 V
SiC power MOSFET	SCTH35N65G2V-7AG	650 V

- Various power switches will be used to select the best value for cost and performance.

Reference

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- [2] J. Lu, A. Mallik and A. Khaligh, "Dynamic Strategy for Efficiency Estimation in a CCM-Operated Front-End PFC Converter for Electric Vehicle Onboard Charger," in IEEE Transactions on Transportation Electrification, vol. 3, no. 3, pp. 545-553, Sept. 2017, doi: 10.
- [3] Pham Phu Hieu et al., "DSP based digital control techniques for Interleaved Boost PFC converter," 2017 IEEE 3rd International Future Energy Electronics Conference and ECCE Asia (IFEEC 2017 - ECCE Asia), 2017, pp. 456-459, doi: 10.
- [4] ST Microelectronics, “Electric vehicle (EV) ecosystem”, June 2018 - Printed in United Kingdom