2B-08

High-Efficiency Full-Bridgeless PFC Power Supply Circuit

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1.Objective

AC-DC converter improvement

⇛ Efficiency

Decreasing Conduction loss

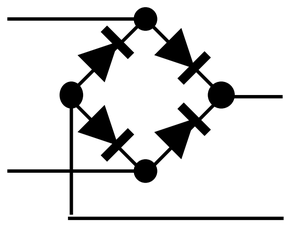
Diode brede → MOSFETs

Problem

Generating reverse current

2.Background

Diode Bridge



AC-CD converter usage

Good point

- Easier use
- Low cost

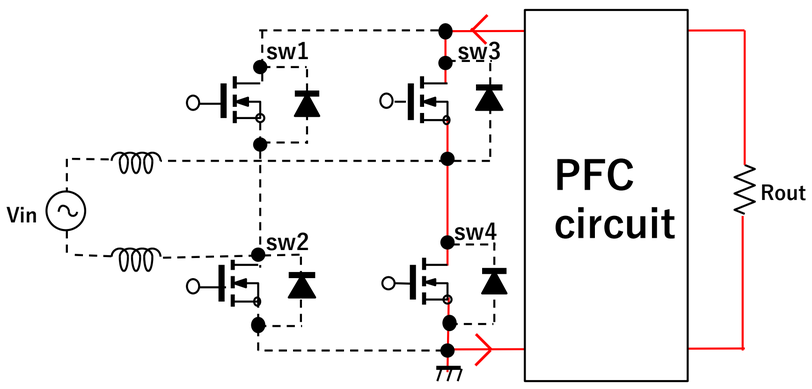
Bad point

- Constant Loss (conduction voltage 1V)

Goal

- Decreasing switching loss and conduction Loss

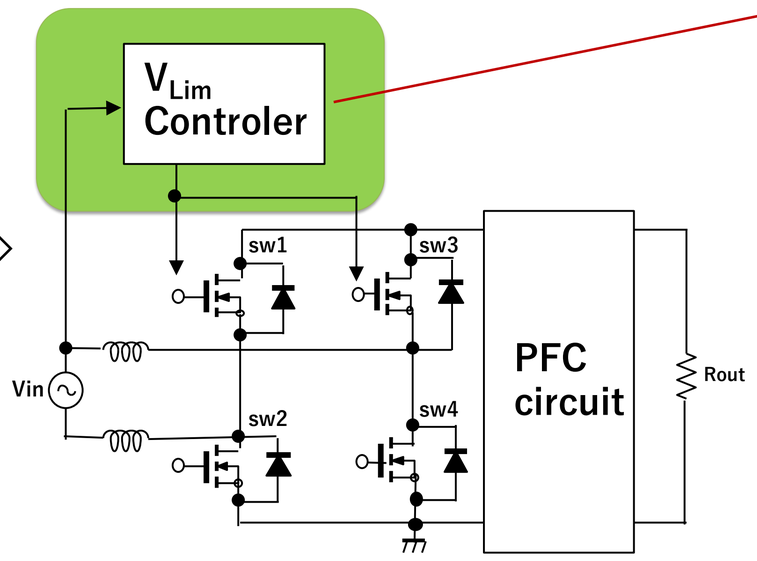
3.Proposed Circuit



Only normal switching

→ Not Boost

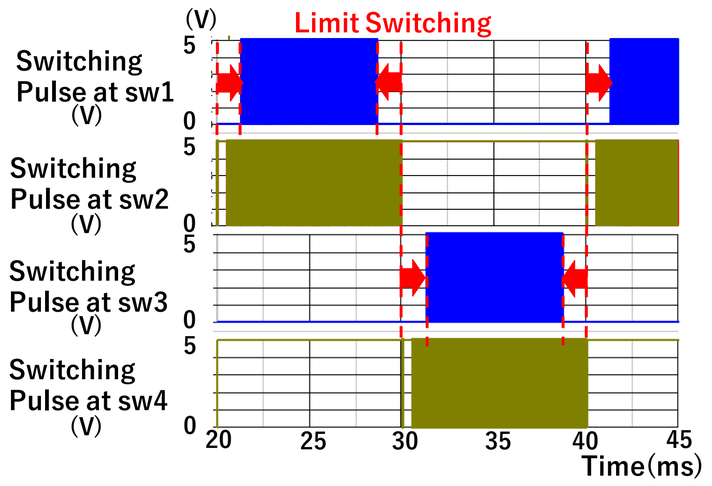
Because reverse current generate!



Full-Bridgeless PFC

PFC: Power Factor Correction

Limit switching operation (Vlim)

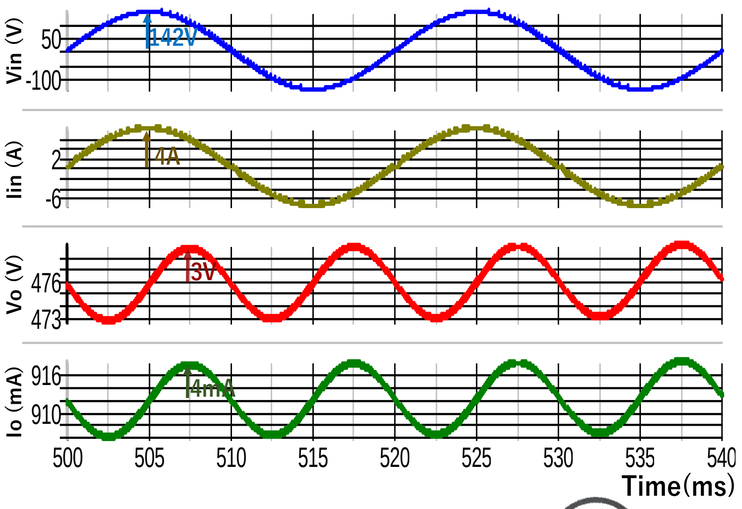


Switching limits by Vin value

➡ **Add safety time**

4.Simulation Result

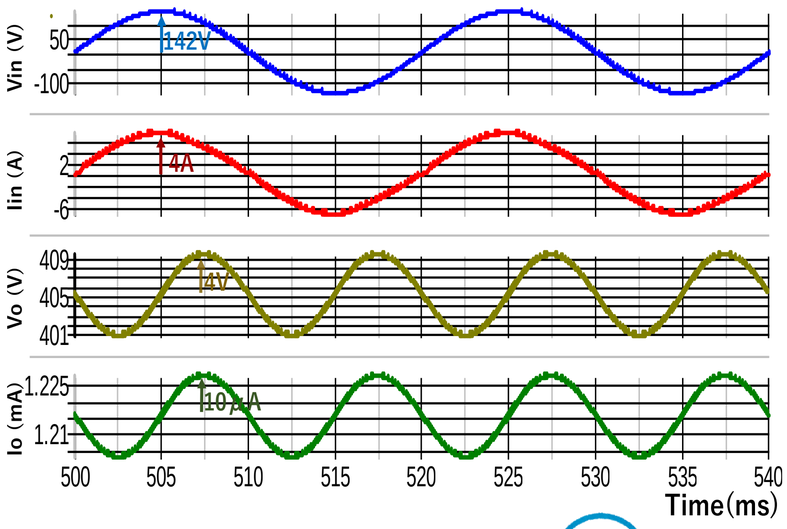
Conventional PFC



Efficiency 94.2%

Bad!

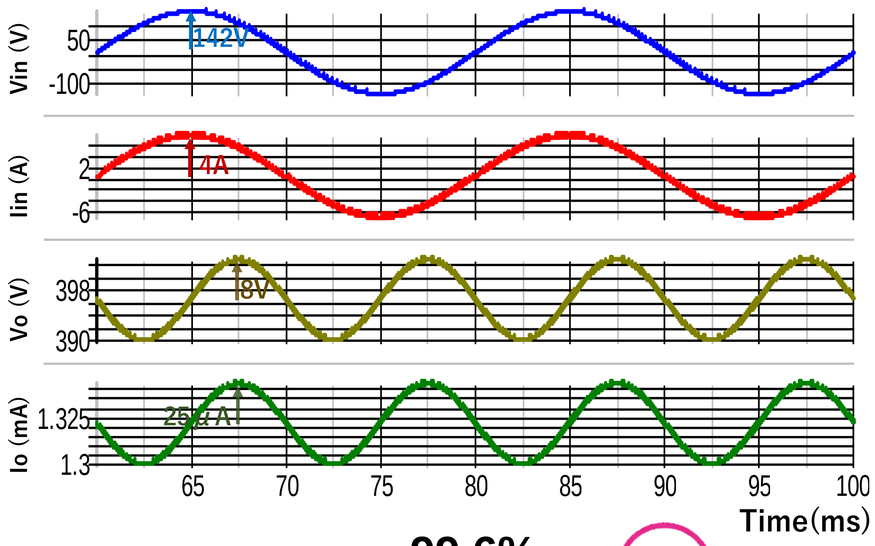
Half-Bridgeless PFC



97.2%

Good!

Full-Bridgeless PFC



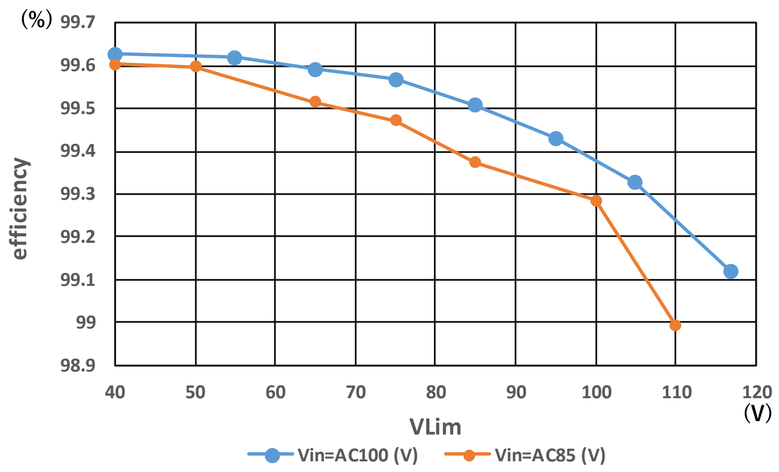
99.6%

Very good!

As replaced by MOSFETs, efficiency is increased.

Output increases gradually

5.Relation Vlim



Vlim smaller

→ generate reverse current

Not Boost Voltage!

Vlim larger

→Nearly Half-Bridgeless operation

Efficiency Down!

➡ Best point : Vlim 40~50V

6.Conclusion

- Change module in Bridge

  Diodes → MOSFETs

➡ Efficiency increases 5.0%

- Optimal Vlim choice

➡ Causes efficiency down !

Reference

[1] Y. Kobori, L. Xing, G. Hong, T. Shishime, M. Ohshima, H. Kobayashi, N. Takai, K. Niitsu, “Novel AC-DC Direct Converter Design with PFC”, International Conference on Power Electronics and Power Engineering, Phuket, Thailand (Dec. 2011).

[2] H. Kobayashi, T. Nabeshima (Editors), Handbook of Power Management Circuit, Pan Stanford Publisher (2016).

[3] N. Miki, N. Tsukiji, K. Asaishi, Y. Kobori, N. Takai, H. Kobayashi, “EMI Reduction Technique With Noise Spread Spectrum Using Swept Frequency Modulation for Hysteretic DC-DC Converters”, IEEE International Symposium on Intelligent Signal Processing and Communication Systems, Xiamen, China (Nov. 2017)