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APEC 2025

Enhanced Modeling of LLC Resonant Converters with Analytical Considerations

Improving Accuracy and Design Reliability through Parasitic Capacitance Considerations
Dong Jiao, Zhengming Hou, and Jih-Sheng (Jason) Lai

Introduction & Motivation

Parasitic capacitance effects are widely used in the design of power electronic systems. However, the lack of an accurate model for parasitic capacitance in LLC resonant converters can lead to significant errors in the prediction of the converter's performance, especially in the high-frequency range.

The proposed model provides a more accurate and reliable prediction of the converter's performance, especially in the high-frequency range.

The proposed model can be used to design and optimize the converter's performance, especially in the high-frequency range.

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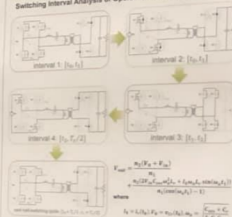
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Key Equations & Implementation

Switching Interval Analysis of Operation Above Resonance



Mathematical Correction for Cases Near Resonance

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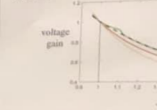
Simulation & Results

Accuracy Comparison

- STA Model vs. FEA: Reduced gain prediction error.
- Improved deadline estimation and accuracy.
- Traditional method of deadline estimation.

Gain & ZVS Predictions

- Incorporate parasitic effects directly into the waveforms.



Conclusion and Future Work

Key Contributions

- Provides a more realistic LLC resonant converter model.
- Derives more accurate gain curves and parasitic effects.
- Higher efficiency and robust soft-switching performance.

Future Directions

- Apply STA modeling approach to other resonant converter topologies.
- Conduct extensive experimental validation over a wide load range.
- Explore advanced control algorithms for improved performance.

Key References

- [1] F. G. O. and M. C. C. "A New Analytical Model for the Design of LLC Resonant Converters." *IEEE Transactions on Power Electronics*, vol. 30, no. 1, pp. 1-12, 2015.
- [2] J. H. Lai, J. S. Lai, and J. S. Lai. "A New Analytical Model for the Design of LLC Resonant Converters." *IEEE Transactions on Power Electronics*, vol. 30, no. 1, pp. 1-12, 2015.
- [3] J. H. Lai, J. S. Lai, and J. S. Lai. "A New Analytical Model for the Design of LLC Resonant Converters." *IEEE Transactions on Power Electronics*, vol. 30, no. 1, pp. 1-12, 2015.



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