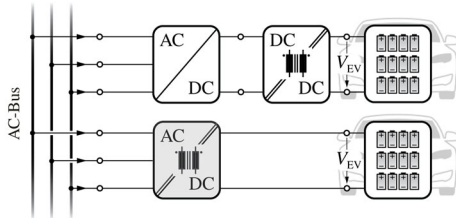


Novel Single-Stage Isolated 3- Φ /1- Φ AC Input EV On-Board Charger Employing Segmented Magnetic Shunt High Stray Inductance Transformers

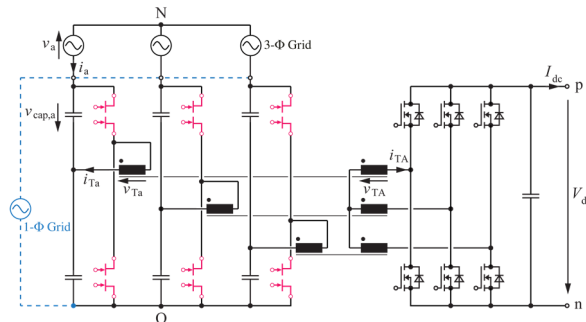
Daifei Zhang, Jerome Kaufmann, Jonas Huber, and Johann W. Kolar
Power Electronic Systems Laboratory, ETH Zurich, Switzerland

1. Single-Stage Isolated OBC

- Ac/dc isolated power conversion: Two- or Single-stage
- Two-stage: high component count / volume / losses



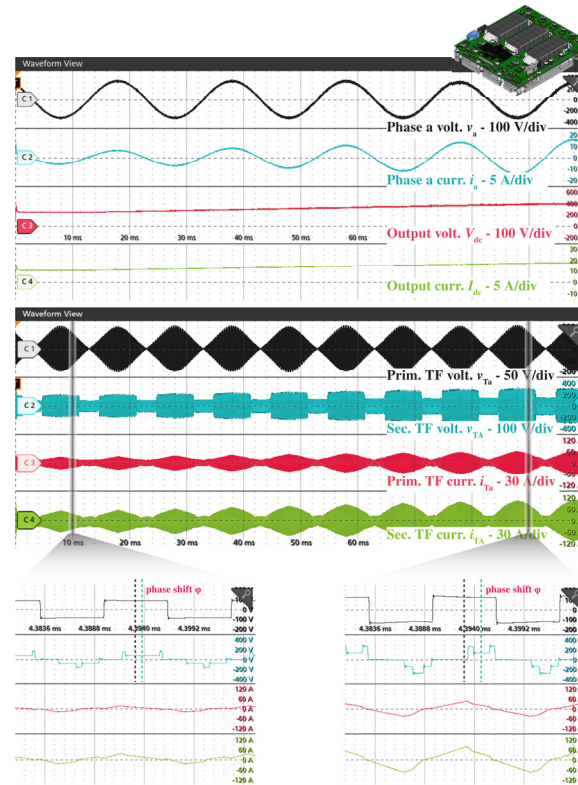
- Novel **single-stage** topology: **universal 3- Φ /1- Φ OBC**
- Phase-modular ac front-end: voltage stress on power transistors determined by **PHASE voltage amplitude**
- 600-V GaN monolithic bidirectional switches (MBDS) @ 400-V grid
- MV front-end: 6.5-kV SiC MBDS @ 4.16-kV grid



- Full rated power operation @ **3- Φ /1- Φ** mains
- Unity power factor / sinusoidal grid currents / bidirectional

2. Operating Principle & Experiments

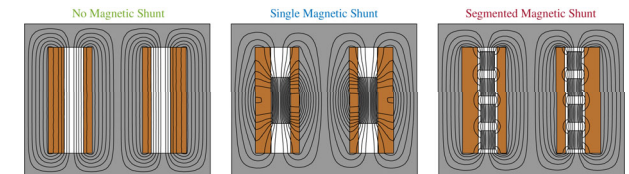
- **Synchronized** front-end switching @ **50%** duty cycle
- **DAB-type** back-end: power regulation w/ phase shift ϕ



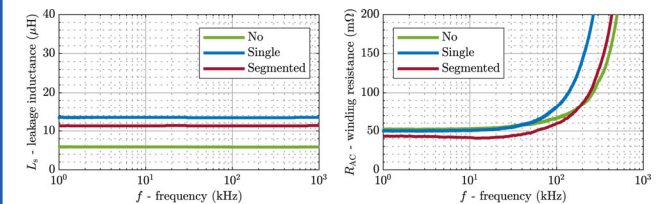
- 6.6-kW **8kW/L** demonstrator w/ **98%** peak efficiency

3. Segmented Magnetic Shunt High Stray Inductance Transformers

- Transformer with **integrated magnetic shunt**: reduced volume w/o additional magnetic components for leakage
- **Segmented** magnetic shunt: reduced high-frequency winding losses



- High stray inductance transformers w/ integrated ferrite shunt @ 6.6kW OBC



- Meas. stray inductance: **6 μ H \rightarrow 11 μ H**
- Meas. winding ac resistance: **108 m Ω \rightarrow 71 m Ω @ 150 kHz**