

Enabling Buck-Type AC/DC Grid-Tied Rectifiers Using Flying Capacitor Multi-Level Converters with Advanced Control



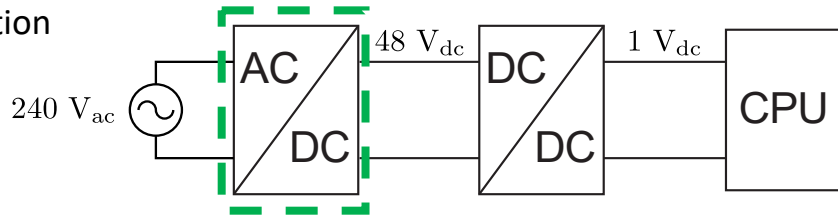
Motivation and Application

Data center power consumption
1%+ of global electricity demand
and growing [1]

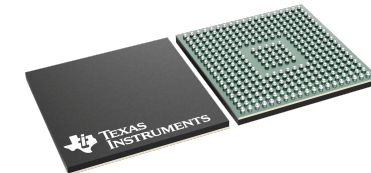
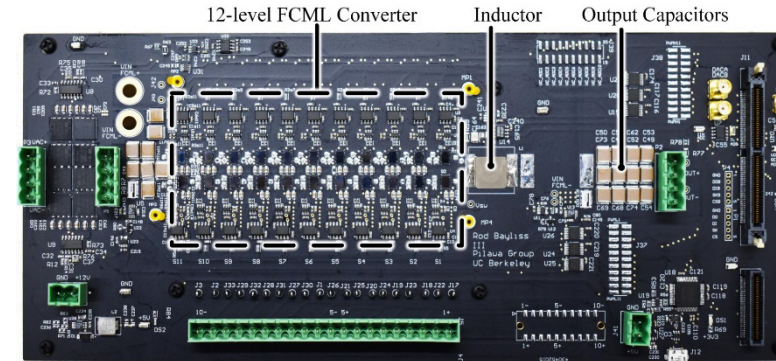


Single-stage rectification

- Increased efficiency
- Greater power density



Hardware



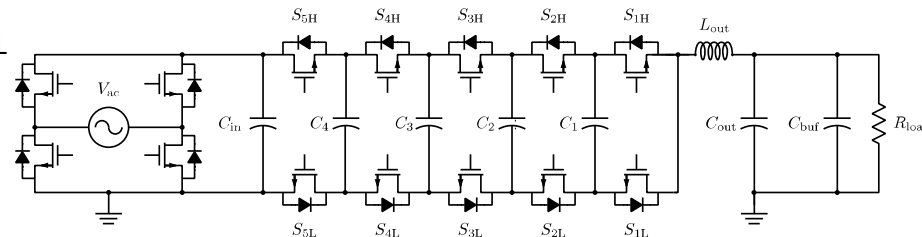
TI C2000 DSP (F28379D)

- 12-level prototype reconfigured as 5-level converter
- Flying capacitor voltages measured with non-isolated instrumentation amplifier

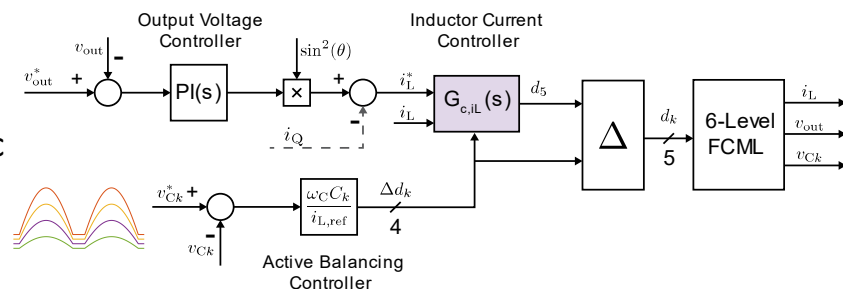
FCML and Active Flying Capacitor Voltage Balancing

6-Level Buck-Type FCML PFC Rectifier

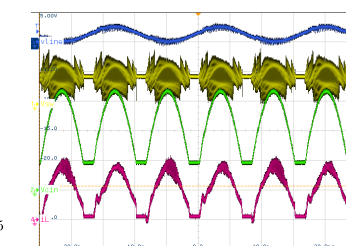
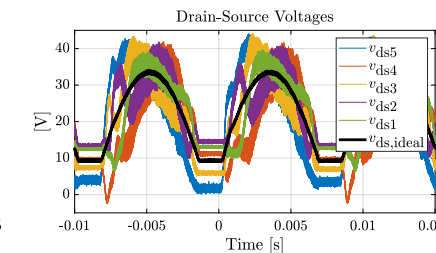
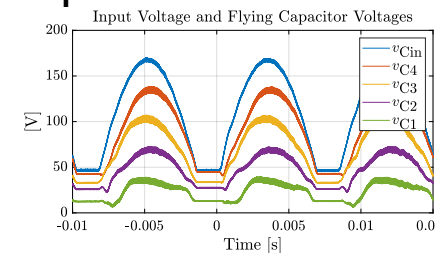
- Reduced magnetics volume
- High FOM switches



Control Schematic



Experimental Verification



Power Factor	
Target	0.97
Passive Balancing	0.88
Active Balancing	0.97+

- Switch voltage stress limited → low voltage switches ✓
- High power factor input current achieved ✓

References:
[1] N. Jones, "The Information Factories," Nature 2018

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