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

240 \( V_{ac} \)

FCML and Active Flying Capacitor Voltage Balancing

6-Level Buck-Type FCML PFC Rectifier
- Reduced magnets volume
- High FOM switches

Control Schematic

Experimental Verification

Power Factor
- Target 0.97
- Passive Balancing 0.88
- Active Balancing 0.97+

References:

Rod Bayliss III  Email: rodbay@berkeley.edu

Hardware

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

Control Schematic

12-level FCML Converter  Inductor  Output Capacitors

TI C2000 DSP (F28379D)