Piezoelectric transformers: Control

Zsurzsan, Tiberiu-Gabriel; Andersen, Michael A. E.; Andersen, Nils Axel; Zhang, Zhe

Publication date: 2017

Document Version
Peer reviewed version

Link back to DTU Orbit

Citation (APA):
Piezoelectric transformers: Control

Gabriel Zsurzsan, Michael A.E. Andersen, Nils Axel Andersen, Zhe Zhang
DTU will develop and create value using the natural sciences and the technical sciences to benefit society.

H.C. Ørsted, founder of DTU in 1829
Technical University of Denmark - DTU
Technical University of Denmark - DTU

5,895 human resources (FTEs)

- 21% researchers and educators (VIP)
- 43% in support functions
- 36% PhD fellows*

11,031 full-time students

- 28% BEng
- 32% MSc
- 40% BSc

*Employees only
DTU Electrical Engineering

Power engineering
Automation, control, and robotics
Biomedical engineering, CMR, ultrasound
Antennas & microwave tech.
Acoustics
Hearing systems
Power electronics & IC design
Electronics group
Electronics group

- Is research leader within:
  - Switch-mode (class D) Audio power amplifiers
    - 3 spin-off’s: B&O ICEpower & TI Denmark & Merus Audio
    - Highest output power IC class-D amplifier chip ever
  - High efficiency fuel cell power converters
    - Has the highest efficiency (> 98%) fuel-cell power converter ever
  - VHF power converters

- Provides unique solutions to the collaborating companies
- One of the most innovative groups at DTU:
  - 46 inventions
  - Start-up companies:
    - ICEpower (former Bang & Olufsen ICEpower)
    - Texas Instruments DK (former Toccata)
    - Upcon Technology
    - Merus Audio
    - Nordic Power Converters
    - Senserna
    - Nordic Firefly
Electrical behaviour of piezos

- Capacitive behavior
- Inductive behavior
- Resistive behavior
Inductive behaviour of piezos

- Intro
- Capacitive behavior
- **Inductive behavior**
- Resistive behavior
- Conclusions
Piezoelectric transformers
Self-oscillating PT-based SMPS
Control block
SO Principle

- Voltage
- Current
- Zero crossing
- Edge detect
- Delay
- High – side
- Low – side

Frequency (log)
Impedance (log)

Capacitive
Inductive
Resistive
Resistive
Capacitive

Phase
Bidirectional operation
Modular design
Why inductorless?
MRI testing
MRI testing

SNR degradation of 10dB
Conclusions

*PT-based SMPS control method:*

- Simple method for minimizing hard-switching losses
- Fast control to track and maintain self-oscillation
Thank you for your attention!