Power System

Piezoelectric Elevens

Amplifier

DC-DC

Microcontroller

Battery

Smallest Commercially Available:

High Voltage Supply (5 grams)

Battery

February 18, 2005
MicroGlider Site Visit
Piezo Amplifiers

- Common-source type amplifier
  - Driven by PWM from PIC Microcontroller
- Output range: 30 to 180V out (nominal)
- Future: push-pull style design
  - Significantly more complex (and heavier)
  - Higher output swing
  - More linear
  - Greater efficiency
Piezo DC-DC Converter

- Supplies high voltage to elevons from battery
- Boost converter supplies 30V, charge pump boosts it by 6x
- Linear Tech. LTC1615-1 provides power switch, regulation and control
- Component weight: 85 mg
Boost Converter Operation

Inductor equation mandates that the inductor voltage averages to zero in steady state:

\[ V = L \frac{di_L}{dt} \]

Inductor current passes through diode and charges capacitor to (regulated) 30V

30V square wave forms across diode
Converter Operation

Switch ON

- Inductor current ramps to 100mA (fixed limit)
- Charge is transferred from right to left capacitors

Switch OFF

- Inductor current ramps to zero, charging capacitor
- Charge transferred from left to right
Results

- 150-160V output at nominal 10 MΩ load
- 50-60% efficiency
- 80 kΩ output impedance
Future Developments

• Want higher voltage, greater efficiency and less weight:
  – Inductor: lower ESR and/or core loss
  – Diodes: lower forward drop and low leakage
  – Control and switch: other IC’s?

• Move to an integrated implementation
  – Much less weight (bare die)
  – Pure charge-pump design
  – Integrated capacitors
  – Example: 3V in 200V out, 200 kΩ output, 15-20 mg
  – Could be investigated in Follow-On
    • Enables lighter gliders and MFI