An Efficient Low-Noise Method to Charge Ultra-Capacitors

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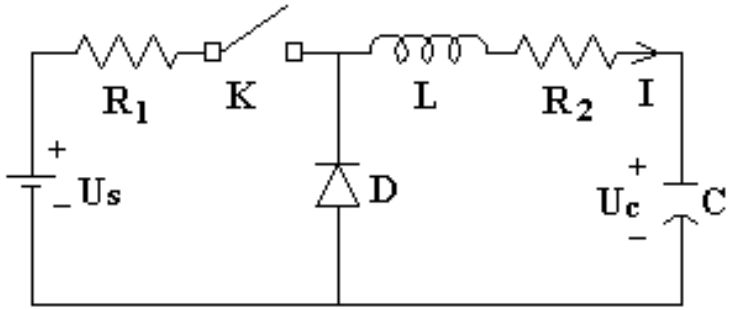
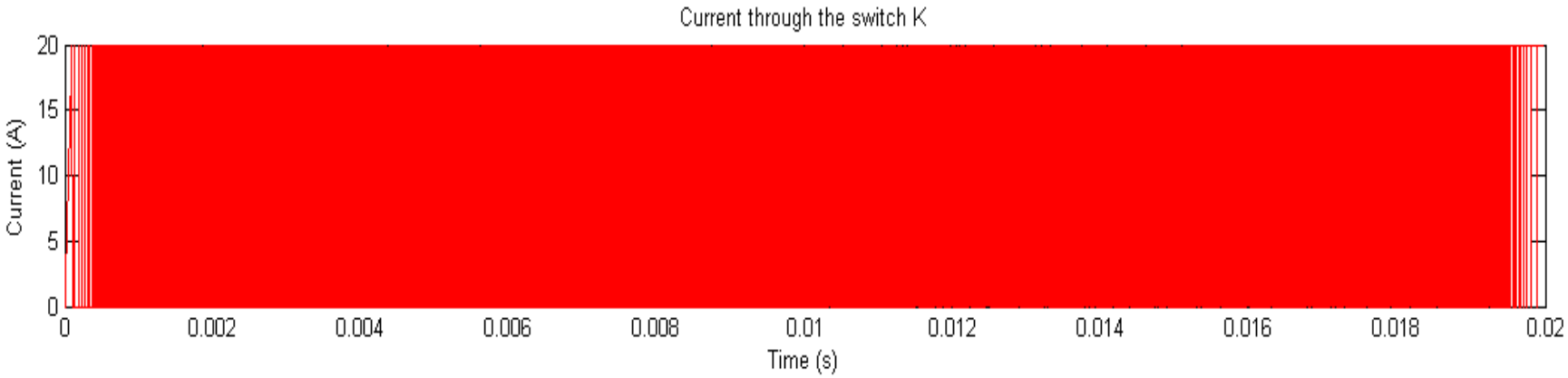
Traditional Charging Circuit

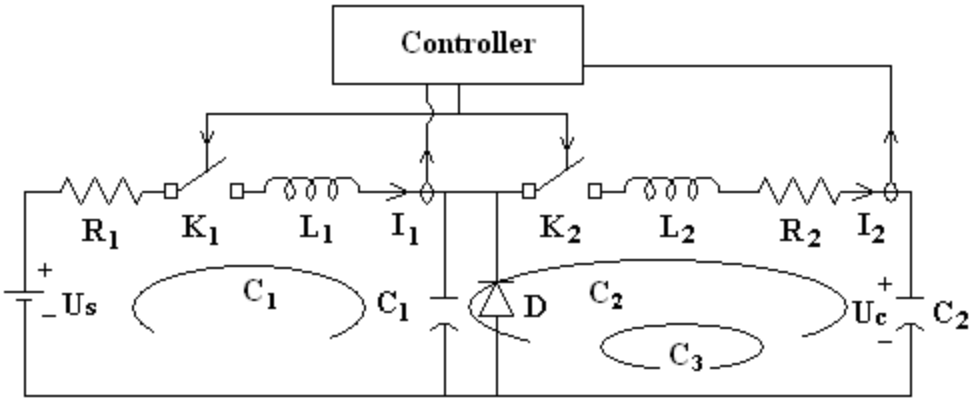


Current (A)	10	20	50	100	200	500
Efficiency (%)	99.7	99.5	98.9	97.9	96	90.6
Charging time (s)	40	20	8	4	2	0.8

The Current Through the Switch



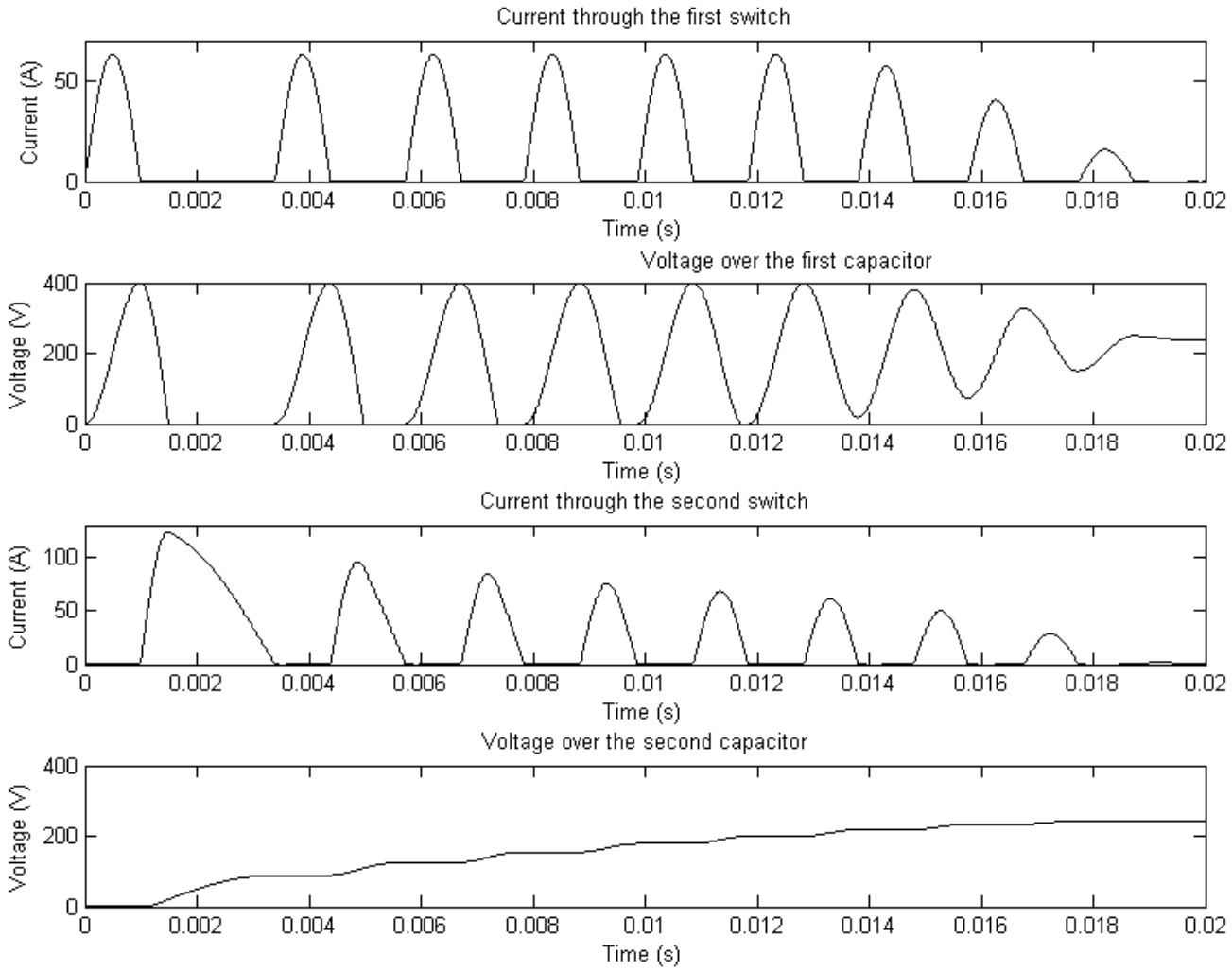
A Modified Charging Circuit



$I_1 \le 0$ $\quad$ K_1 off and K_2 on

$I_2 \le 0$ $\quad$ K_1 on and K_2 off

Currents and Voltages in the Charging Circuit

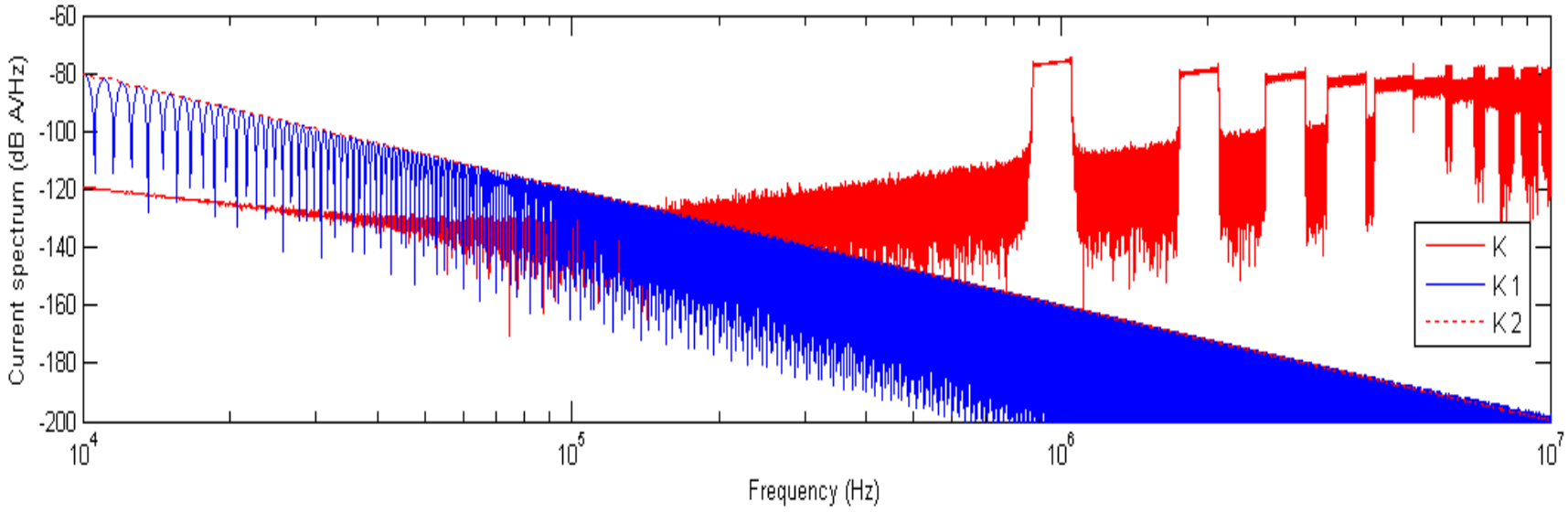


Charging Time and Efficiency

R2 (Ohm)	0.01	0.02	0.05	0.1	0.2
Efficiency (%)	98.7	98.1	96.1	93.0	87.3
Charging time(s)	12.7	12.7	12.8	12.9	12.94

L2 (H)	0.001	0.002	0.005	0.01
Efficiency (%)	98.1	98.4	98.8	99.0
Charging time(s)	12.7	15.9	22.2	29.3

Frequency Domain Representation of Current



K – Traditional Circuit
K1 – Modified Circuit, first switch
K2 – Modified Circuit, second switch

Project Proposal

- Build and test a prototype of this circuit that could be incorporated in an ultra-capacitor package.
  - Work with capacitor company to define requirements
  - Design and build a prototype using discrete components
  - Evaluate performance of prototype
  - Patent and/or publish results