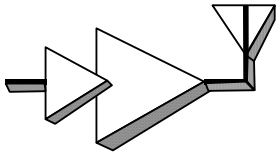


A New Inverse Class E Power Amplifier Topology

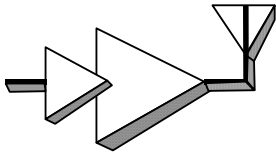
Jukka Typpö and Morten Olavsbråten

Department of Electronics and Telecommunications
Norwegian University of Science and Technology

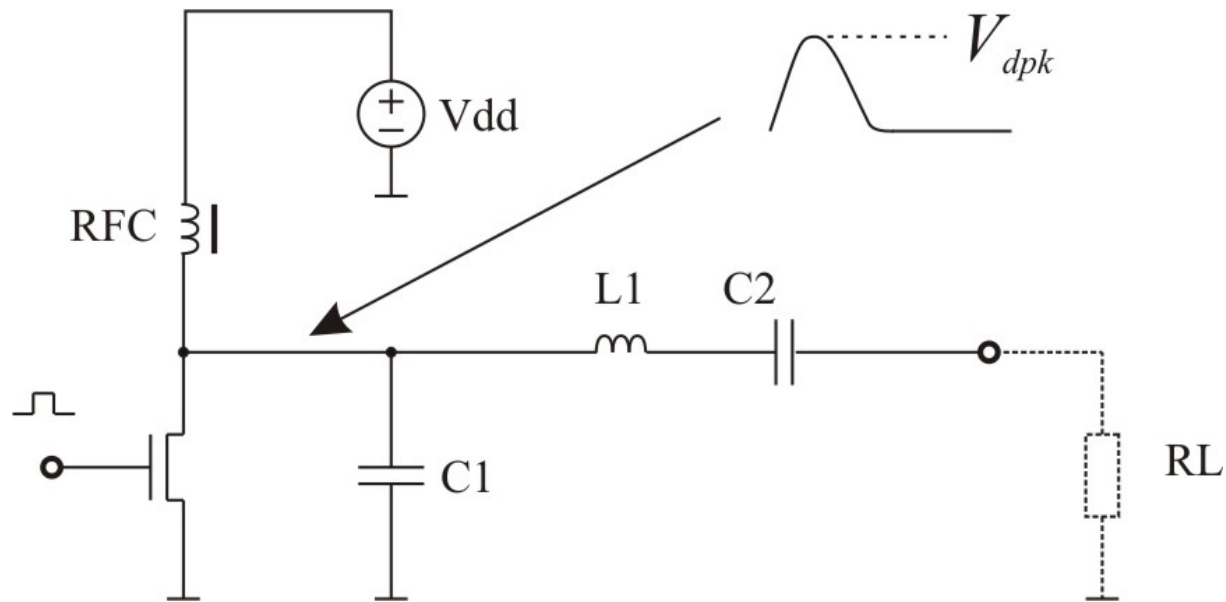


Outline

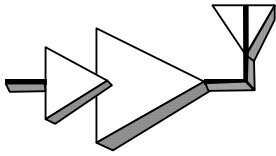
- Class E, Inverse Class E
- Choke-free Inverse Class E
- Potential benefits
- Expected problems
- Simulated waveforms
- Conclusion



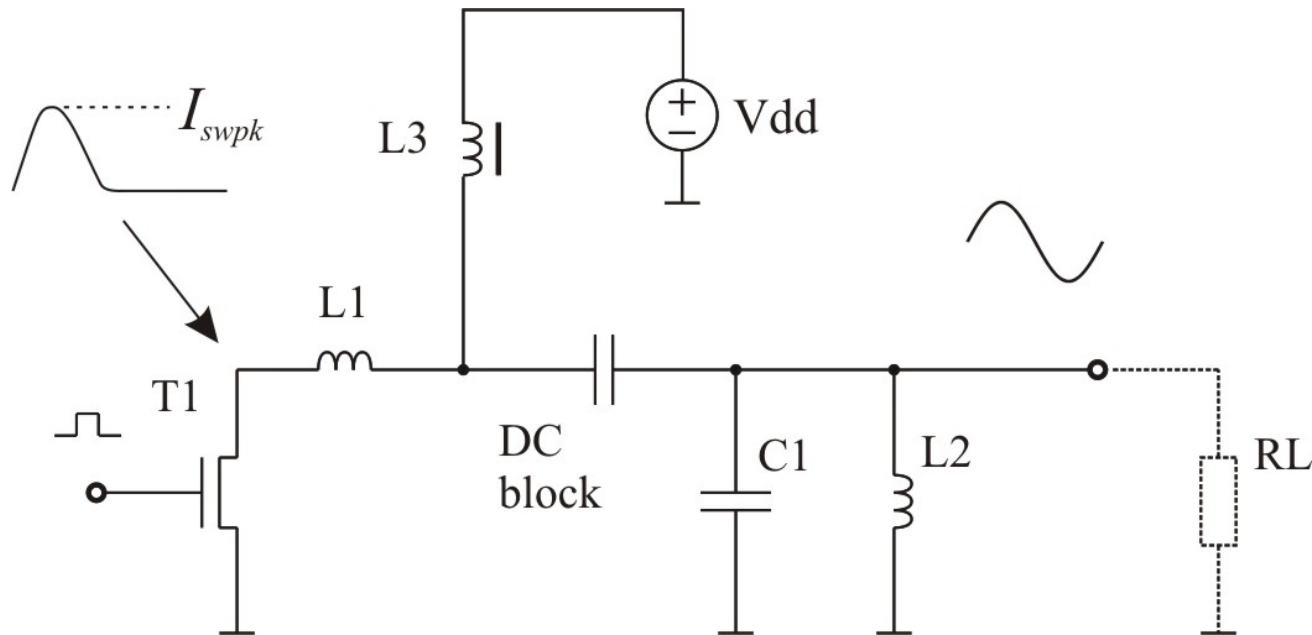
Class E Amplifier



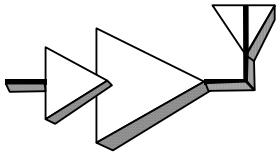
N. & A. Sokal, 1975



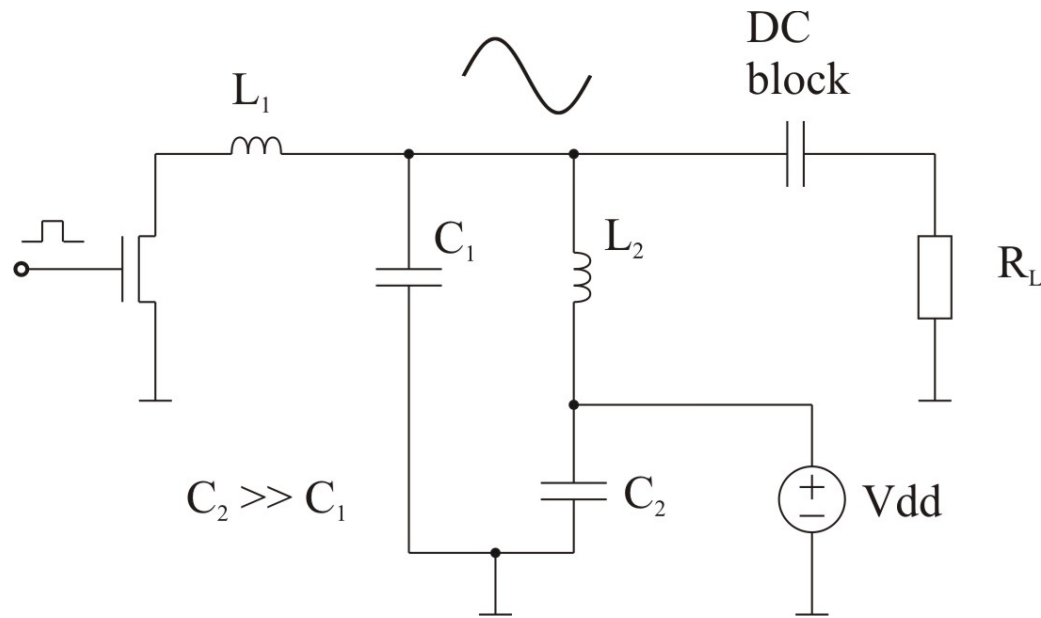
Inverse Class E Amplifier



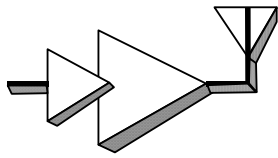
Brabetz, Fusco, 2004



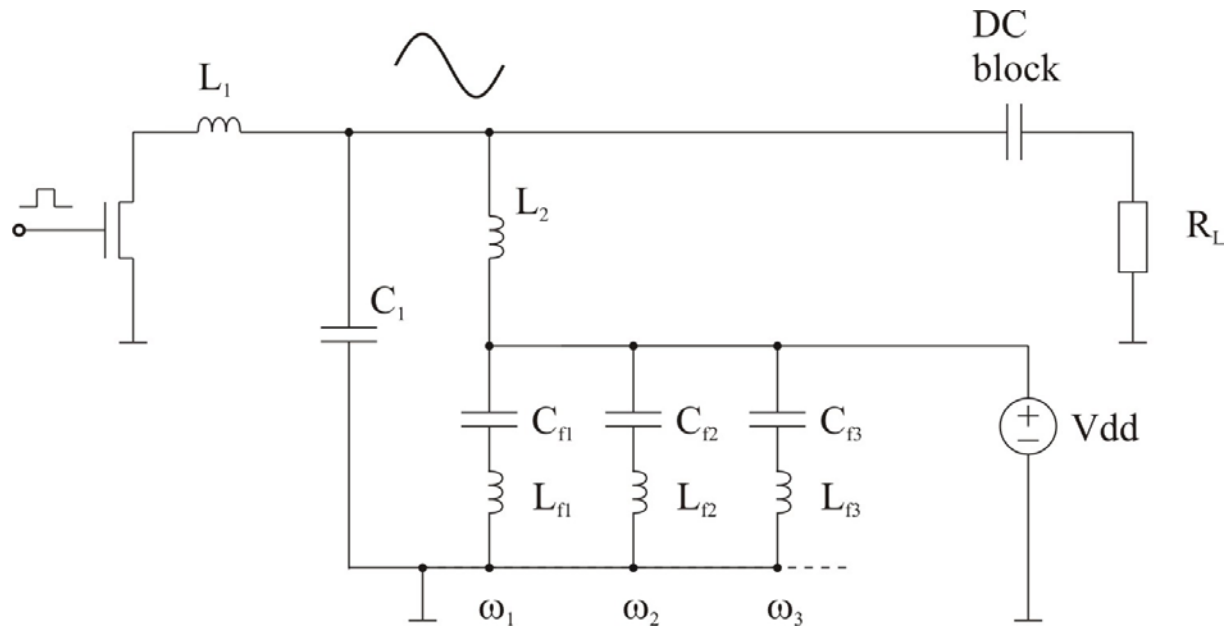
Choke-free Inverse Class E Amplifier



GB0810017.4, June 2008

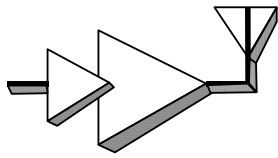


Choke-free Inverse Class E Amplifier

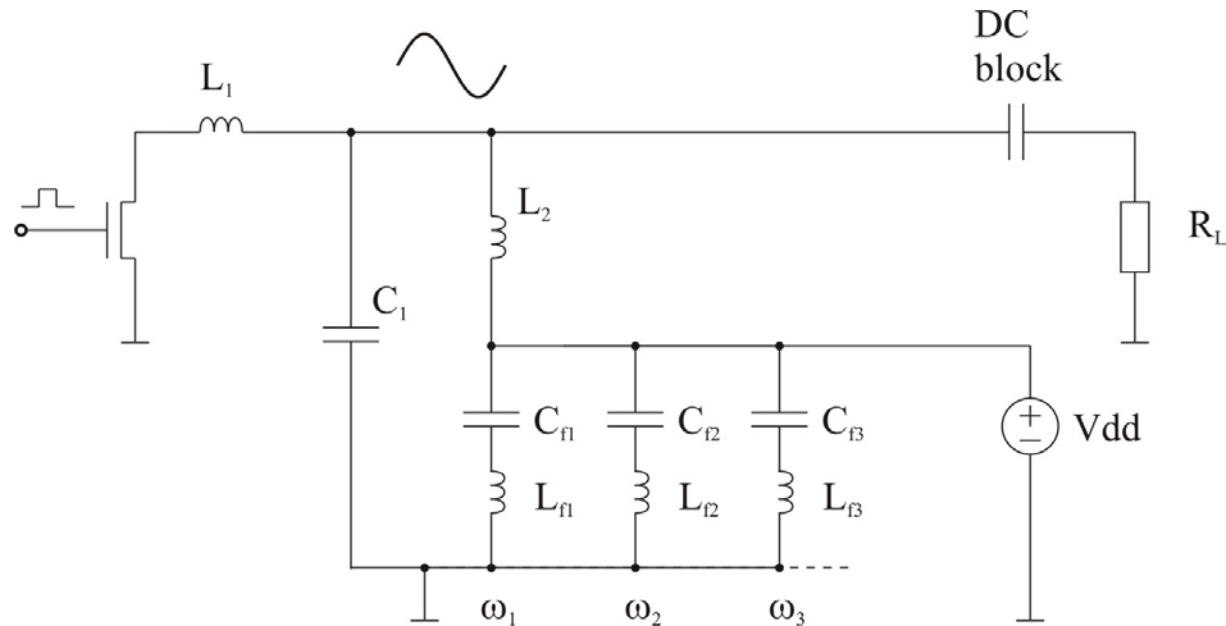


Keeping the VDD node in low impedance

GB0810017.4, June 2008

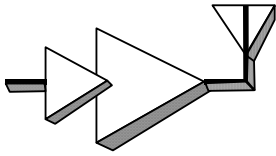


Choke-free Inverse Class E Amplifier



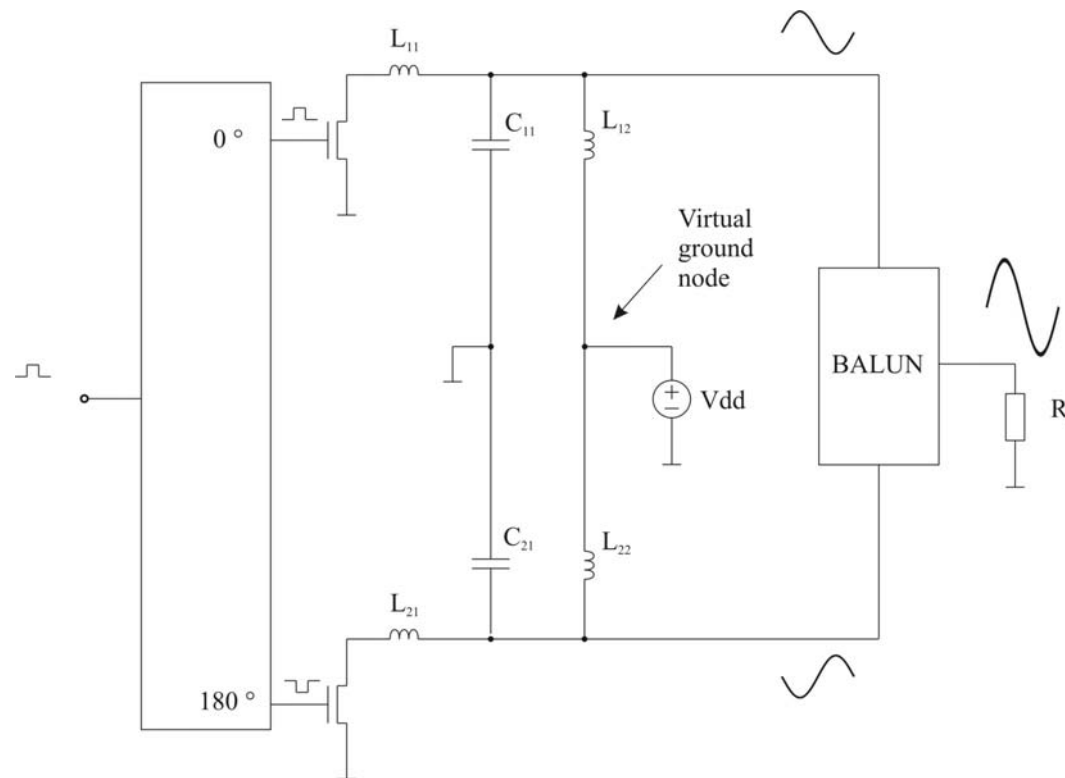
Keeping the VDD node in low impedance
Using the self resonance of MIM capacitor fingers?

GB0810017.4, June 2008

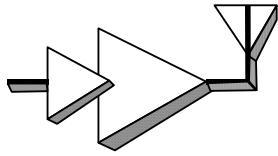


Choke-free Inverse Class E Amplifier

Differential configuration: outphasing the odd harmonics



GB0810017.4, June 2008



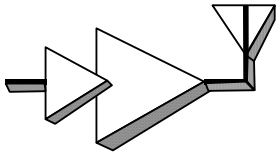
Choke-free Inverse Class E Amplifier

Typical component values:

-100mW, 433 MHz, VDD=5V:
5.66nH 3.08nH 48.85pF

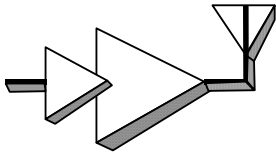
-100mW, 870 MHz, VDD= 2.5V:
3.65nH 1.99nH 18.87pF

-100mW, 2,4 GHz, VDD=3,3V:
2.30nH 1.25nH 3.92pF



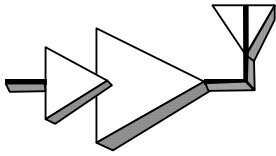
Potential benefits

- No bias choke
- DC block only if the load needs it
- Realizable component sizes
- Integrating the whole output network?
- Output power control through V_{dd}

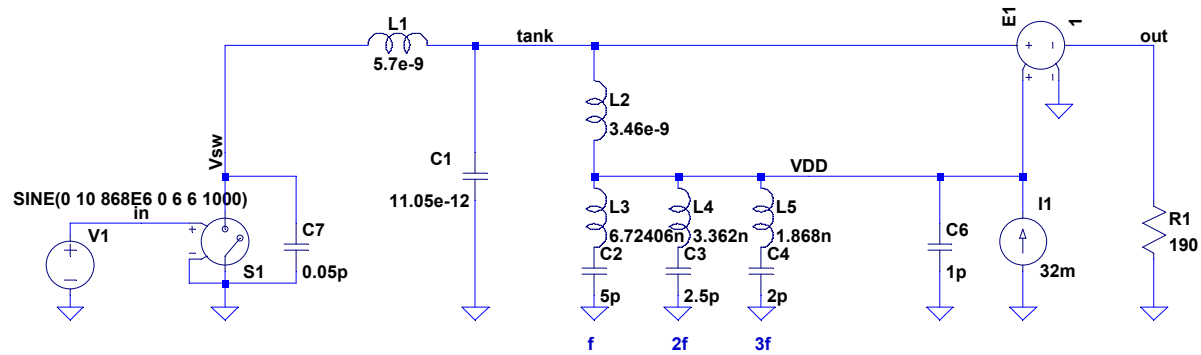
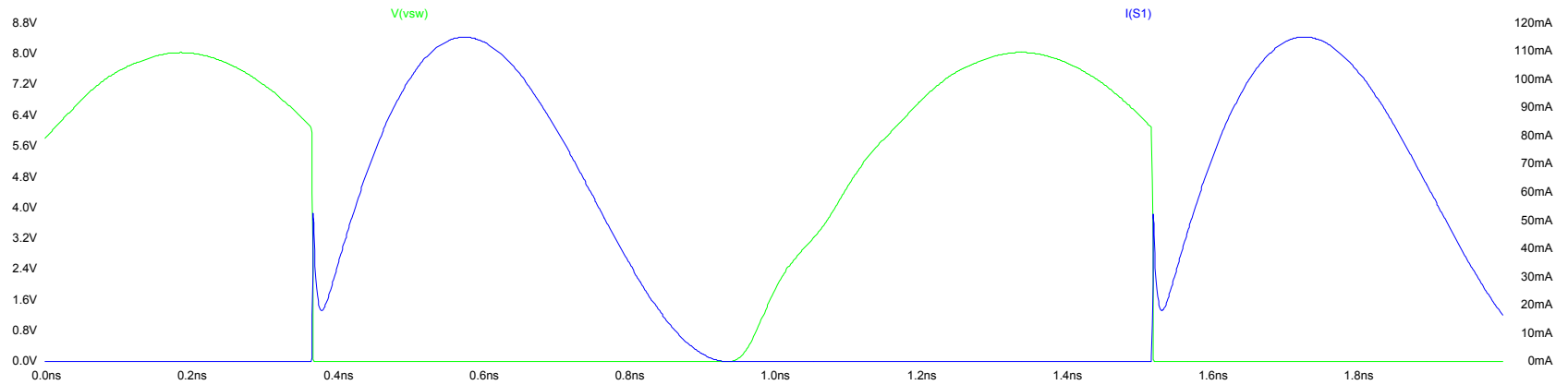


Expected problems

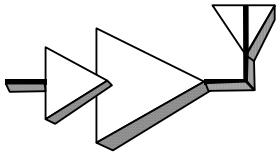
- High currents in the parallel resonator, low-loss passive components necessary
- Drain capacitance
 - Discharge current: $i_C = C_D V f$
 - Ringing with L1 when the switch is opened
- The switch channel must also sink the discharge current of the drain capacitor



Simulated waveforms



.model MYSW SW(Ron=0.1 Roff=100000 Vt=0 Vh=-.1)
.tran 0 50n 48n 1p



Conclusion

- Potential for full integration
- Still unproven
- Simulations with ideal switches exist
- Patent application GB0810017.4, June 2008