Light Technology Institute [LTI]
Group Light and Plasma Technologies
Engesserstr. 13
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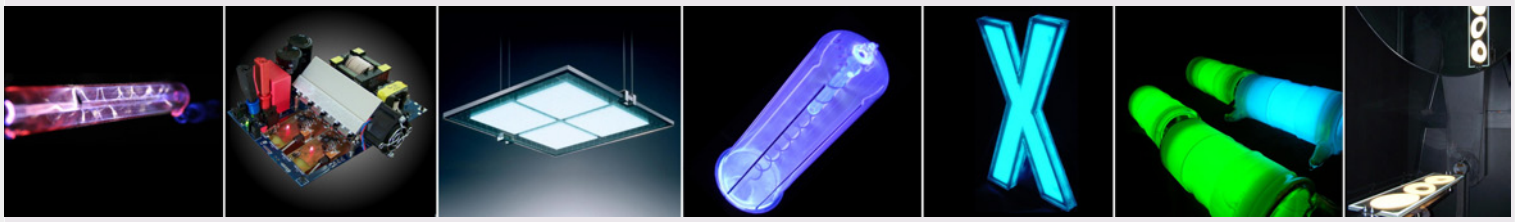
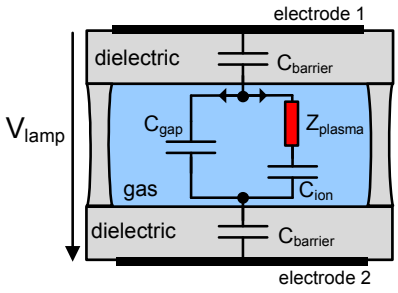
Single Period Sinusoidal Pulse Generator for Efficient Drive of Dielectric Barrier Discharges

Set-Up and Basic Operation Mode

Michael Meisser, Mark Paravia, Wolfgang Heering, Rainer Kling

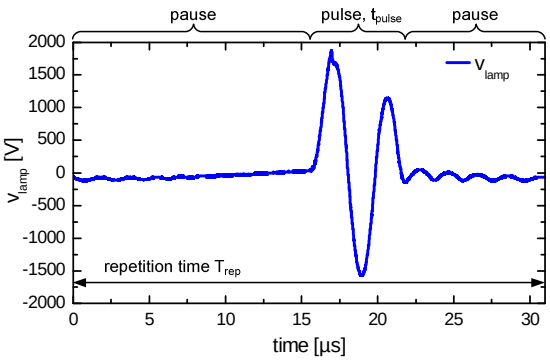


Introduction to Dielectric Barrier Discharge (DBD) Lamps

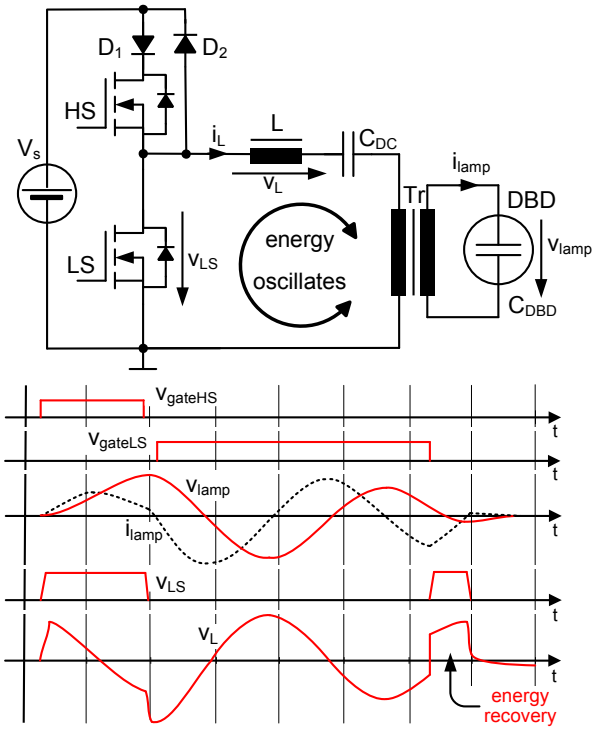


- capacitive load, low power factor (PF)
- ignition voltage several kilovolts

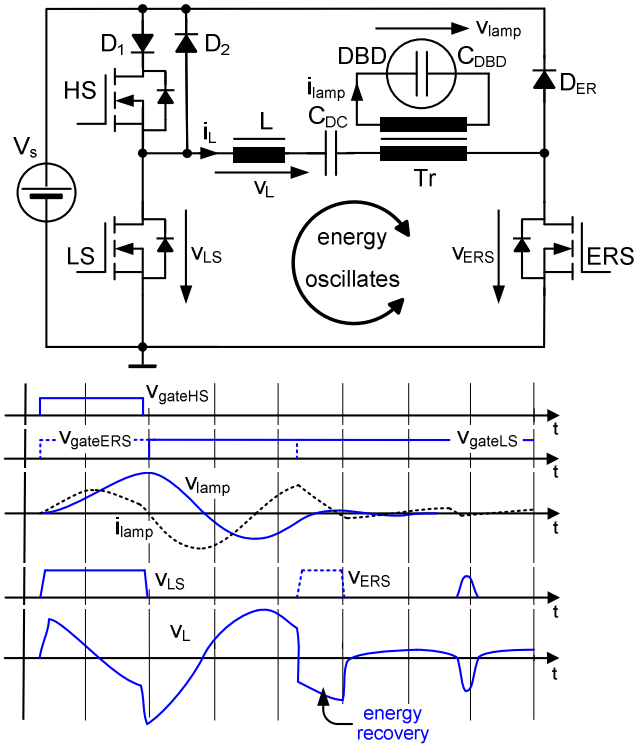
- pulsed operation
  - high plasma efficiency
  - homogeneous appearance
- standard 3-half-wave pulse
  - 1st ignition efficient
  - 2nd required for charge reset
  - 3rd inefficient, poor power factor



Sinusoidal Pulse Topology



Single Period Sinusoidal Pulse Topology



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Problems and Enhancements

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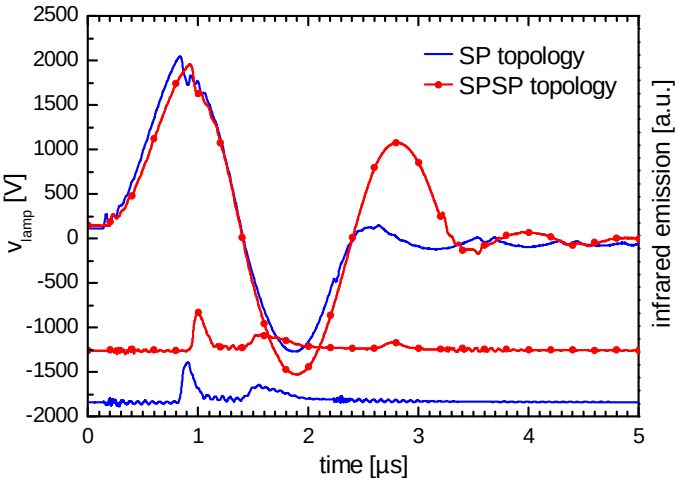
Comparision of Topology Waveforms



SP Topology

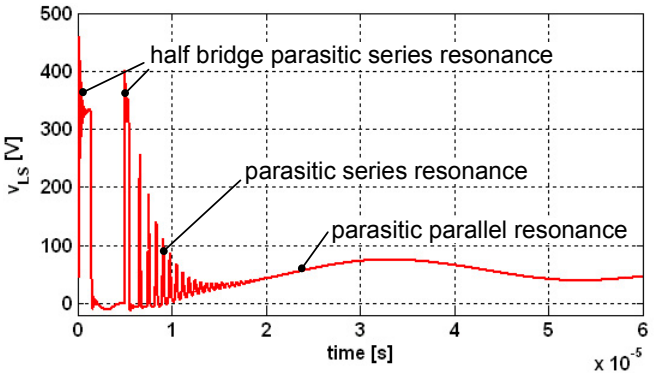
	1.HW	2.HW	3.HW	total
PF	16%	11%	9%	10.6%
S [VA]	612	580	278	1721
P [W]	97	62	24	183
η_{ECG}	0.81	η_{sys} [lm/W]		9.5

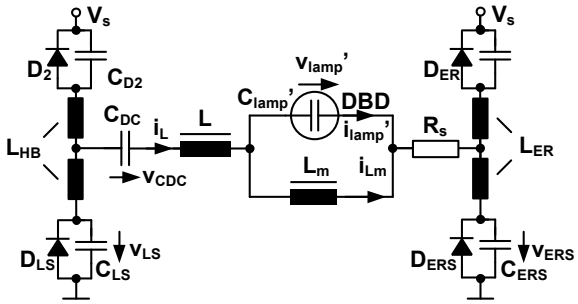
SPSP Topology

	1.HW	2.HW	total
PF	16%	9%	12.3%
S [VA]	738	435	1242
P [W]	115	40	153
η_{ECG}	0.765	η_{sys} [lm/W]	10.7

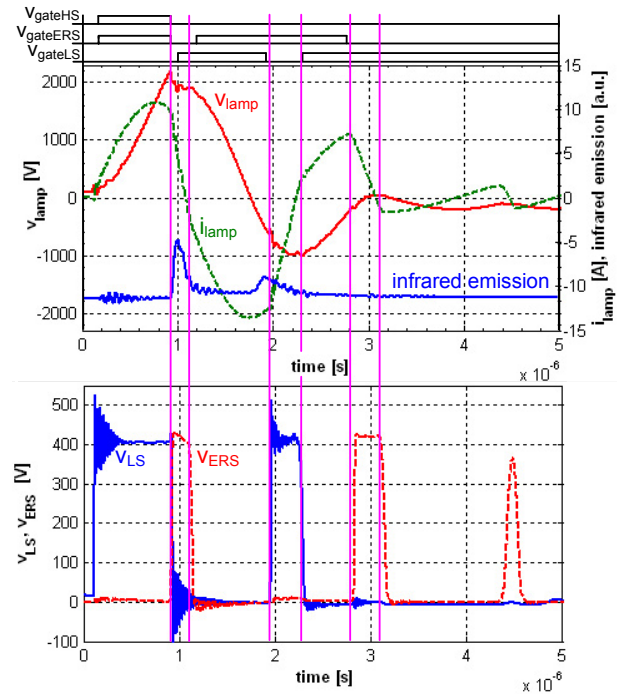
- enhanced power factor & system efficiency

Parasitic Resonances



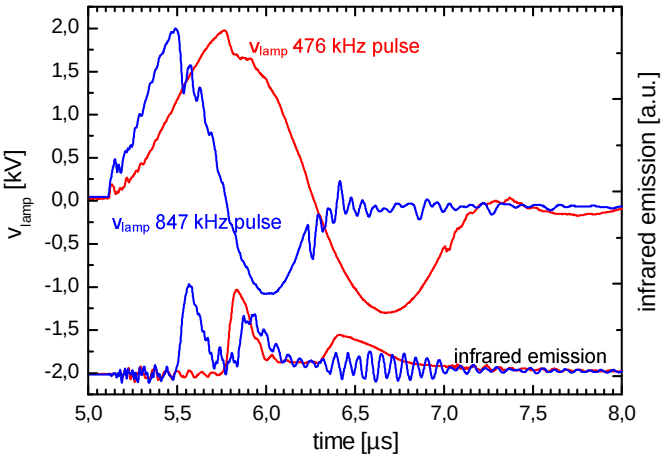


Pulse Enhancement: Current Cut-off



Pulse Frequency Enhancement

- higher pulse frequency to reduce “tail current” losses
- low lamp pressure (p_{Xe} =125 mbar) no loss reduction



- 847 kHz pulse: LS = MOSFET, η_{ECG} = 66.7 %, η_{lamp} = 12.9 lm/W
- 476 kHz pulse: LS = IGBT, η_{ECG} = 80 %, η_{lamp} = 13.3 lm/W