SLAC ILC Damping Ring Kicker High Availability Modulator R&D Program

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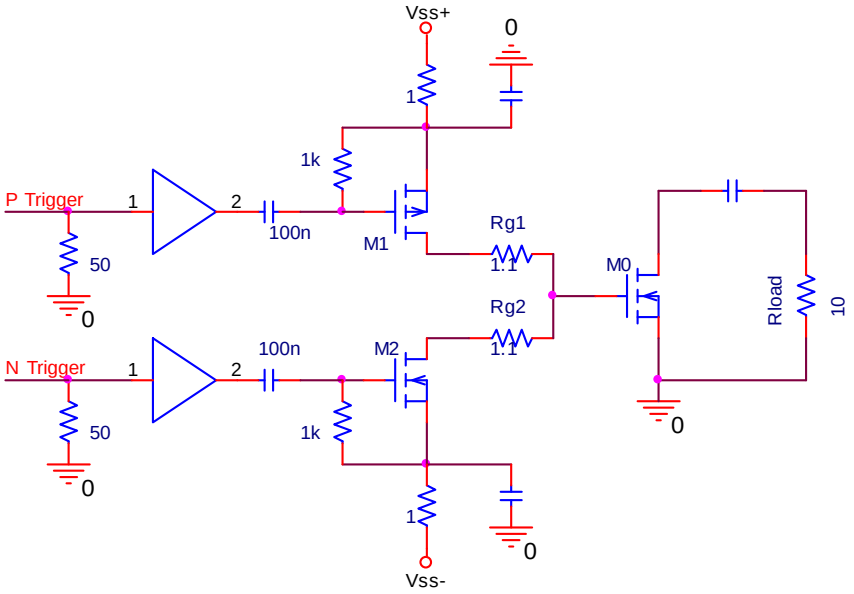
Overview

- SLAC program is investigating two approaches
  - MOSFET array (adder) topologies
  - DSRD (opening switch) topologies
- FY09 Program structure
- FY08 MOSFET array results
- FY08 DSRD (Krasnykh next talk)
  - Diagnostic development
  - MOSFET-based “pump”

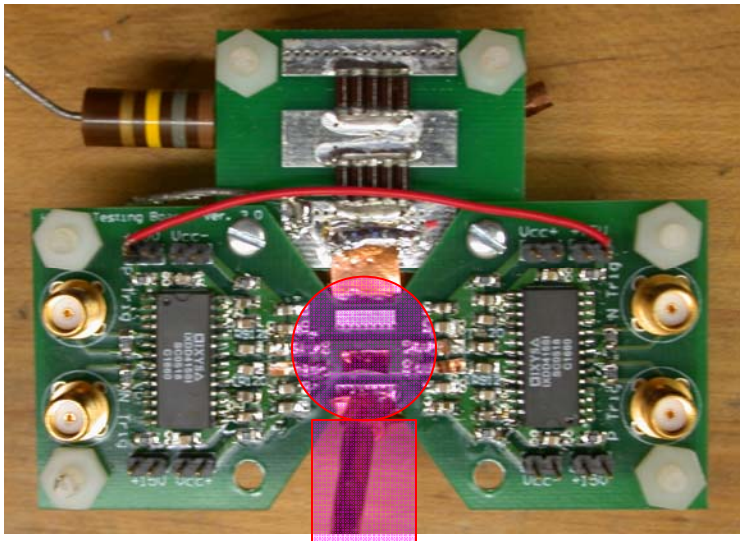
SLAC FY09 R&D Program

- MOSFET Array
  - Sub-system/Scale modulator
  - ¼ FTE
  - DOE-ILC funding, subject to CR
- DSRD
  - ATF2 kicker modulator
    - ±5 kV, 50 Ω, $T_{flattop}$ ~ 2 ns, T_r/T_f ~ 1 ns, 6 MHz
    - Developmental DSRD (T_{burst} thermally limited)
    - Deliver prototype to KEK end CY10
  - ¼ FTE
  - US-Japan funding

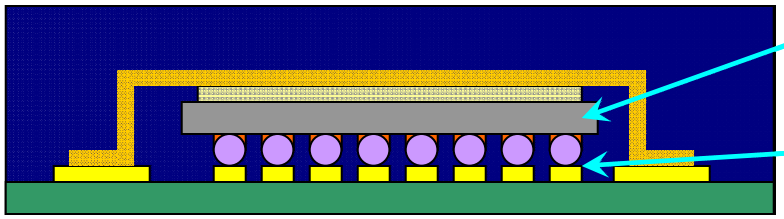
MOSFET/Driver Hybrid



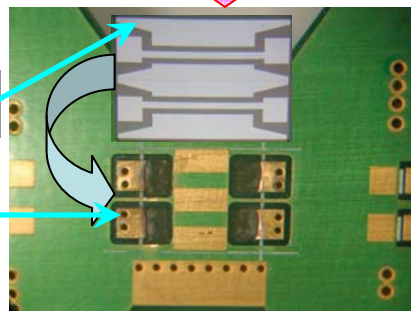
Circuit diagram



FET mounted on back side of PCB

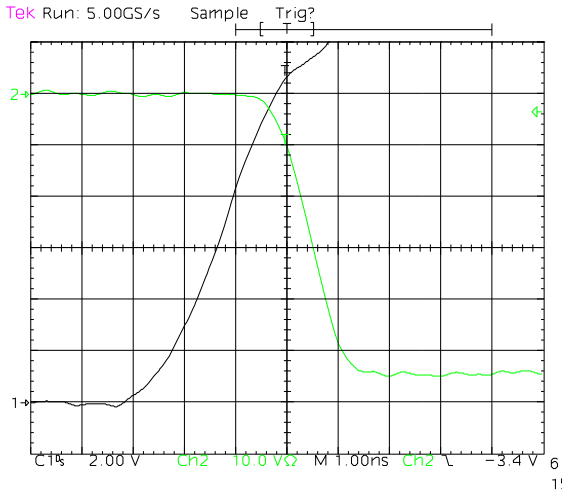


Flip-Chip assembly

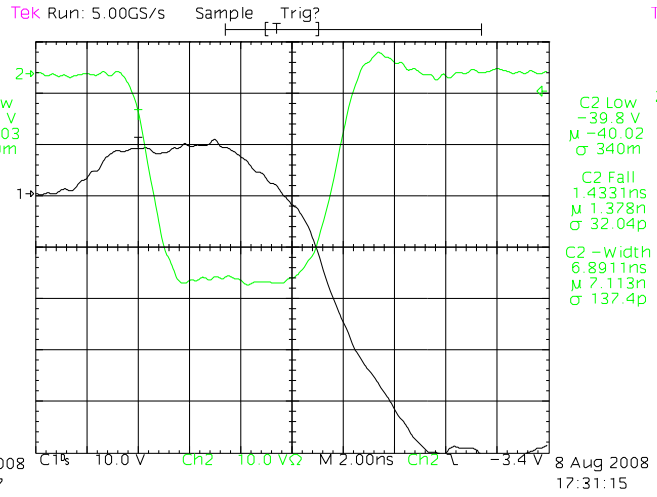


1200 V, 48 A MOSFET Hybrid Prototype Results

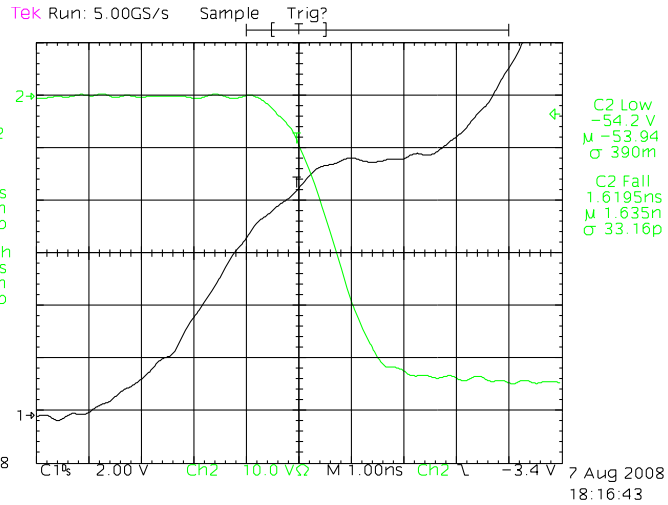
Fastest switching speed: 1.2 ns **Shortest pulse width (FWHM): 7.1 ns** **Excellent gate control**



V_{DS}=1kV, R_{Load}=27 ohm, I_D=33 A



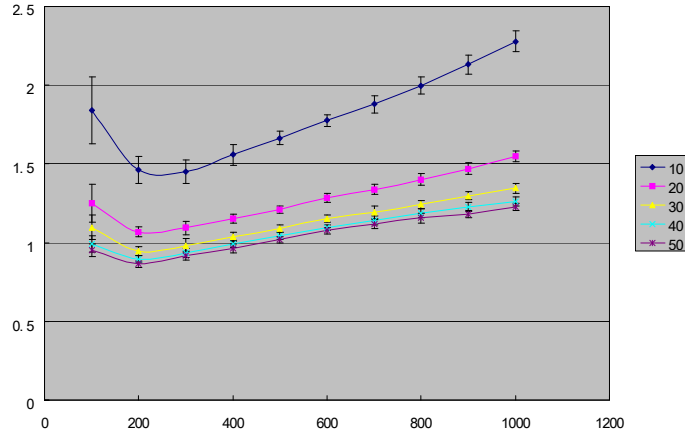
V_{DS}=1kV, R_{Load}=10 ohm, I_D=68 A



V_{DS}=1kV, R_{Load}=27 ohm, I_D=33 A

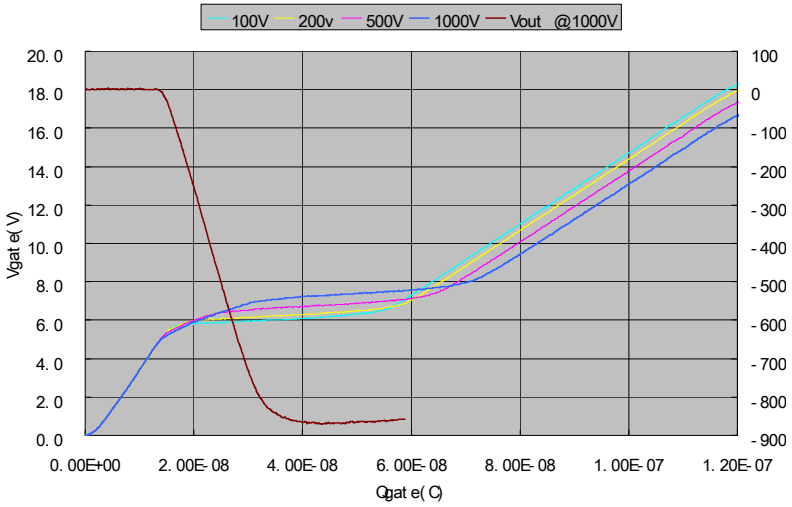
Hybrid Prototype Results

Switching Speed



MOSFET switching speed dependence on driver voltage (current) and MOSFET charge voltage (load current)

Switching Characteristics



MOSFET gate voltage and switching dependence on gate charge

FY09 MOSFET Program

- Transmission line adder
  - 4-stage demonstration
  - Verify hybrid risetime can be preserved through adder structure
- Advanced hybrid development
  - Optimize driver for short (<5 ns) output pulse
  - Improve hybrid construction
  - Select optimum MOSFET (voltage, current, speed)
- “Scale” modulators
  - Parallel arrays of hybrids for low Z modules
  - Bi-polar adder

Summary

- FY08 Results
  - Modest progress (funding limitations)
  - Ultra-fast switching: hybrid circuit achieves fundamental MOSFET limit w/ excellent control
  - High bandwidth HV diagnostics (Krasnykh)
  - DSRD “pump” development (Krasnykh)
- FY09 Program
  - “Scaled” inductive adder assemblies
  - Prototype DSRD modulator for ATF2