Using a Rogowski Coil for Device Evaluation with a Double-Pulse Circuit

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Device Evaluation Using Double-Pulse Technique

- Useful for switching energy measurements
- Single-shot technique allows testing at any temperature
- Ideal switch configuration is the half-bridge
  - Switch turn-on energy
  - Switch turn-off energy
- Additional performance of devices can be analyzed using a resonant test.
  - Diode forward recovery
  - Device conduction losses

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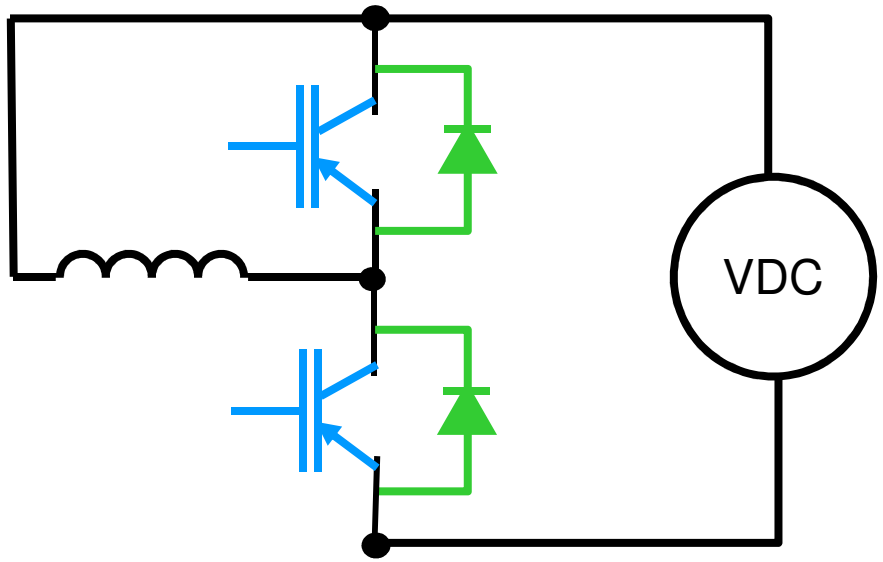
Double Pulse Topology

1) High-side Switch (IGBT or MOSFET)
2) High-side Diode
3) Low-side Switch (IGBT or MOSFET)
4) Low-side Diode
5) Inductor
6) Power Supply



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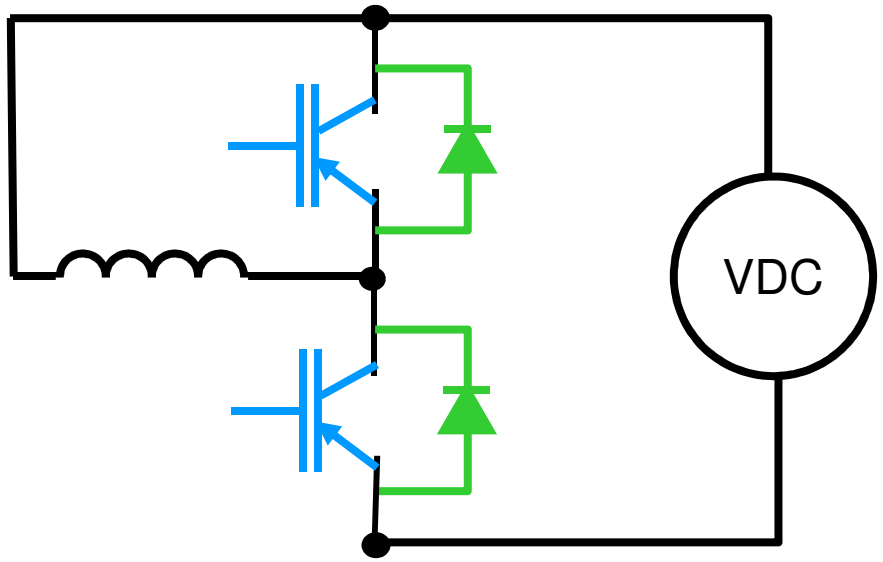
Double Pulse Concept

1) Gate Drive Amplifier is Attached to the Low Side Switch
2) A double-pulse is applied, one long-pulse, one short-pulse
3) Current flow is created in the inductor when the switch is ON
4) Current flow is re-directed to high-side diode when switch is OFF
5) Voltage and Current is measured across the low-side switch.
6) Switching energy is the time-integral of the switch power (volts * current)



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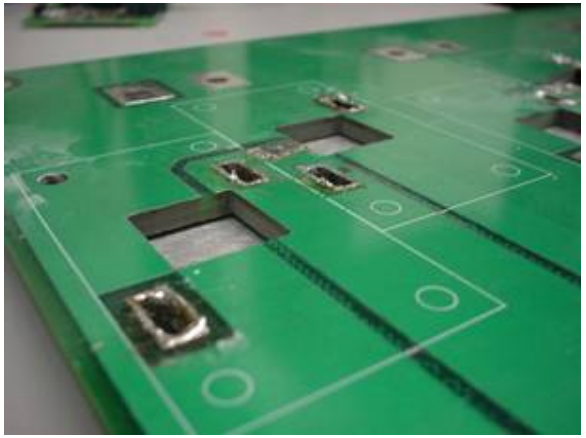
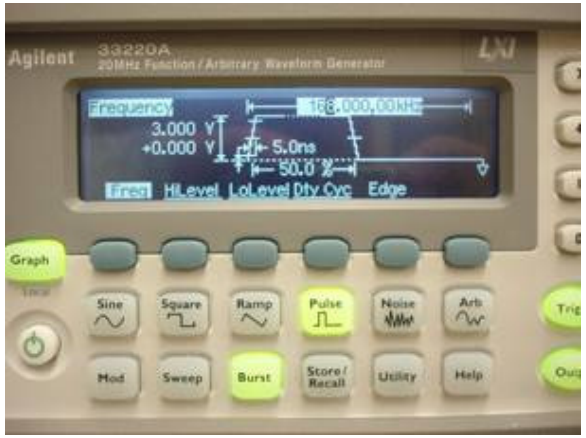
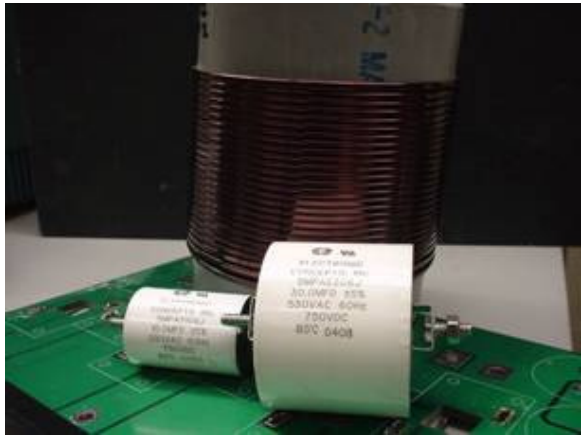
Test Hardware Setup



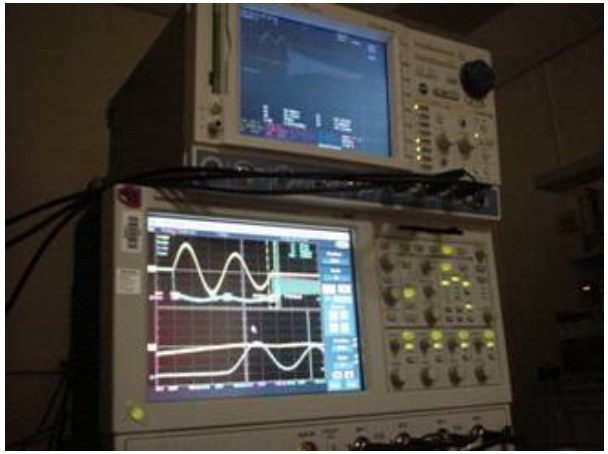
DC Power Bus



Single-Shot Pulse Source



Inductive Load



Oscilloscope

DC Power Supply

Gate Drive Amplifier

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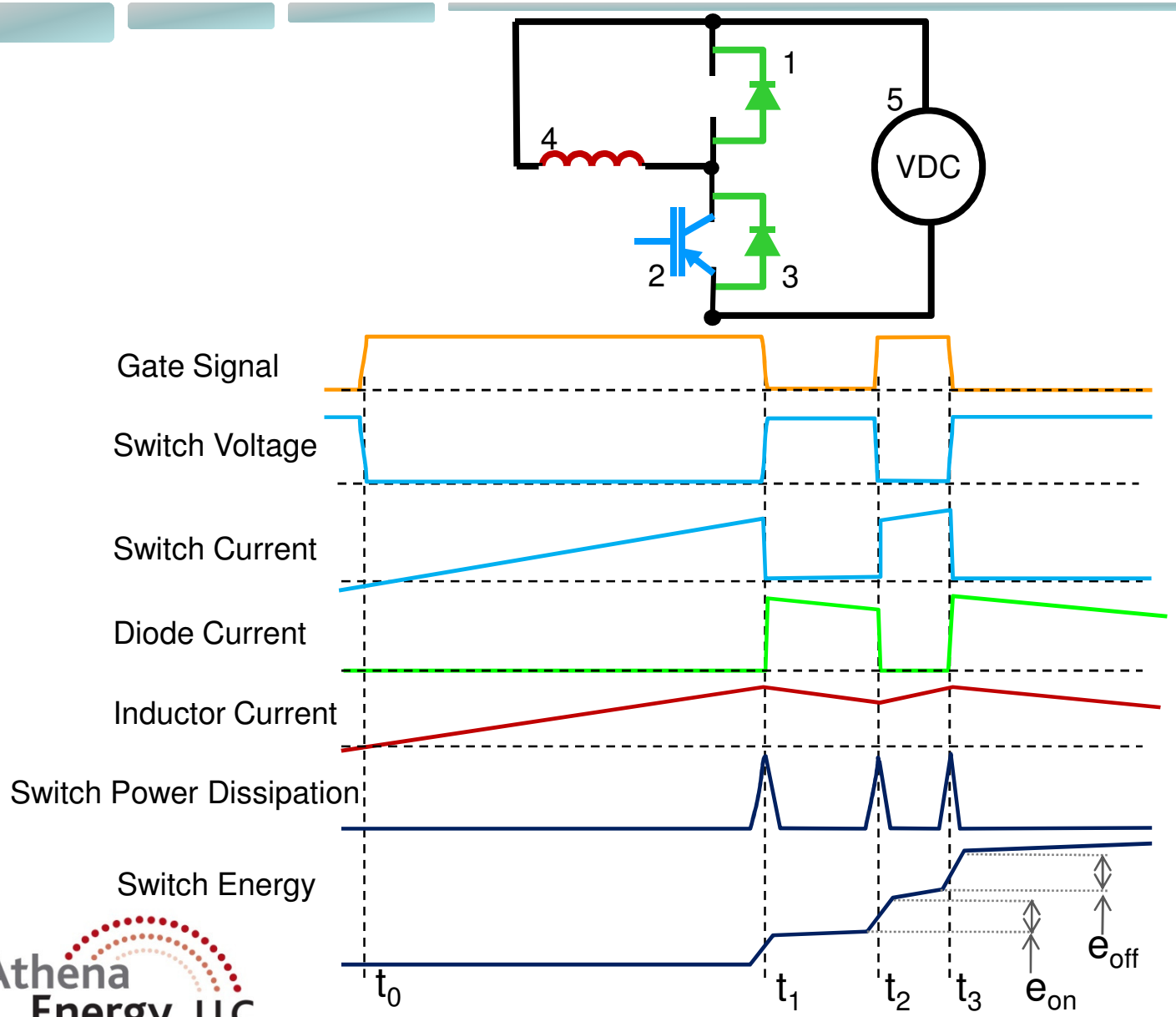
Double Pulse Switching: Operation



From t_0 to t_1, switch 2 closes and current is built up in the inductor 4 as a function of time and voltage

From t_1 to t_2 switch 2 opens and current stops flowing thru switch 2. Instead the inductor current flows to diode, 1.

From t_2 to t_3 switch 2 closes and current is transferred from diode 1 back to switch 2

From t_3 to t_{end} switch 2 opens and current is transferred back to diode 1, freewheeling until it dissipates to zero.

Energy is measured by integrating the product of current and voltage

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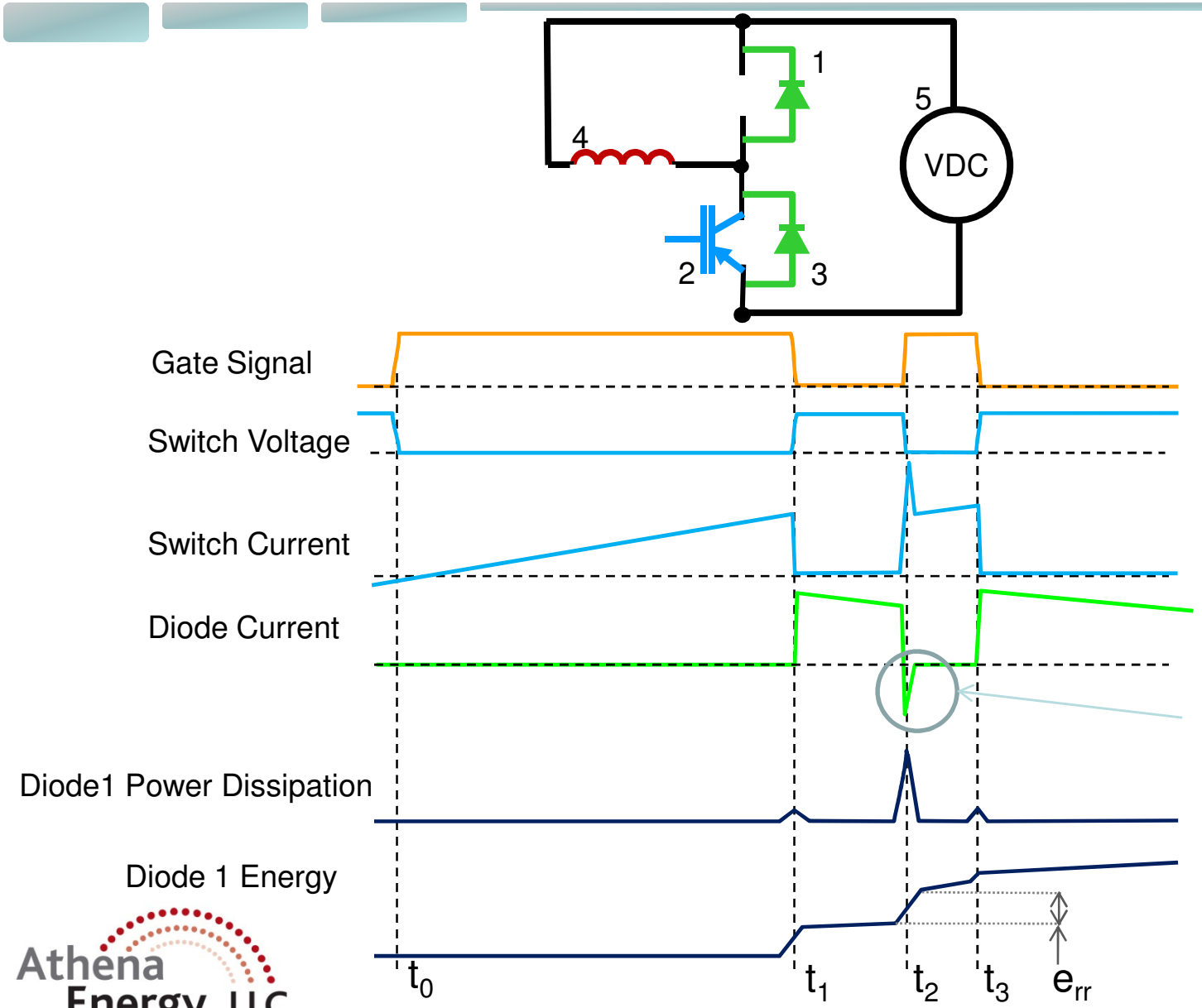
Double Pulse Switching: Diode Recovery



During t_2 switch 2 closes and current is transferred from diode 1 to switch 2. This causes diode reverse recovery.

Diode recovery is measured as a function of time (trr) and magnitude (Irr).

Diode recovery and a resulting oscillation can also be observed if the diode is snappy (i.e. Turn-off di/dt is excessive).

Switching power can be determined by product of diode voltage and current during t_2

Switching energy can be determined by integral of diode power

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