

Single Gate Driver System for DC Circuit Breakers

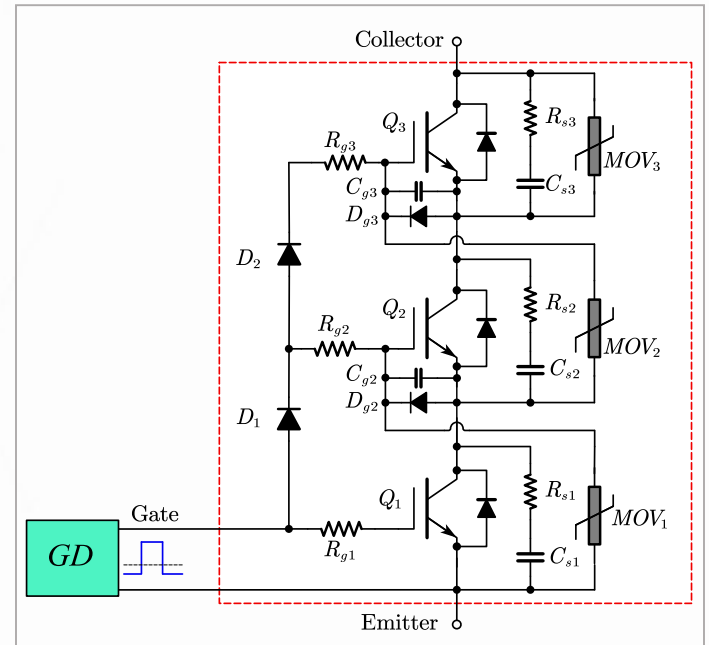
VTIP 21-078: “Single Gate Driver Based Gate Control of Series Power Semiconductor Devices in DC Circuit Breaker Applications”

THE CHALLENGE

Single power semiconductor devices cannot meet the voltage demands for the solid-state switch in medium voltage DC circuit breakers (DCCBs) due to limitations in their voltage blocking capabilities. As a result, commercially available devices are often connected in series to meet the final clamping voltage target. Voltage balancing across these series connected devices is the most challenging issue that needs to be addressed in the gate driver design. Currently, solid-state circuit breakers (SSCBs) and hybrid circuit breakers (HCBs) use individual gate driver ICs, fiber-optic receivers, and isolated power supplies for each device, increasing the cost and reducing the reliability.

OUR SOLUTION

Researchers at Virginia Tech have developed a novel single gate driver circuit design that works with semiconductor devices in DC circuit breaker applications and is simple and cost effective in addition to being more compact and robust than other existing approaches. Surge protection devices are used in the gate control loop to discharge the upper device(s) gate capacitance while also balancing device voltage at the turn-off instance. Additionally, due to the turn-off delay between each device, the dv/dt of total clamping voltage is also reduced, which is helpful for the paralleled mechanical switch in HCBs.



Circuit diagram for the proposed solid-state circuit breaker structure using only one gate driver IC.

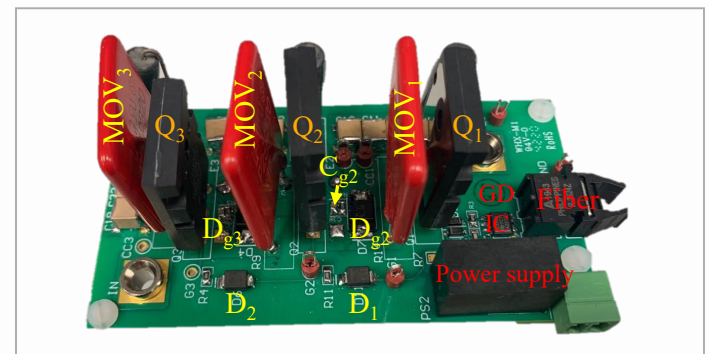


Photo of a circuit board utilizing the above design. Three insulated gate bipolar transistors (IGBTs) are connected in series and driven with the proposed single gate driver.



CONTACT:

Rozzy Finn

rozzy@vt.edu

540-231-1566