High Voltage Bucking Regulator

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This circuit is basically the classic bucking regulator, except it uses a TMOS N-channel Power FET for the chopper and creates its own supply for the gate control.

The pulse width modulator can be just about any standard IC or circuit available for this purpose. Its output pulse drives the LED side (via a current limiting resistor) of opto-isolator U1. This isolation is necessary because the gate drive circuit power supply goes up and down with the voltage at point A.

The unique aspect of this circuit is how it generates a separate supply for the gate circuit, which must be greater than V_{DD}. When power is applied, C2 charges up, through D2, to + 12 V. At this time, Q1 is OFF and the voltage at point A is just below zero. When the pulse modulated signal is applied, the opto-isolator transistor, Q2 and Q3 supply a signal to Q1 that turns it ON. The voltage at point A then goes to V_{DD}, C2 back-biases D2, and the voltage at point B goes to 12 V above V_{DD}.

After Q1 is turned ON, current starts to flow through L1 into C1, increasing until Q1 turns OFF. The current still wants to flow through L1, so the voltage at point A moves toward negative infinity, but is clamped by D1 to just below zero. Current flows less and less into C1 until Q1 turns ON again. Q2 and Q3 drive Q1's gate between the voltages at point A and B, which is always a 12 V swing, so V_{GS} max. is never exceeded.

For proper operation, the +12 V supply has to be established before the pulse width modulator signal is applied.