Voltage Multipliers, Inc.

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Construction of a high DC loop gain and High Bandwidth High Voltage Op-Amp using Two Opto-couplers in a Push-Pull Configuration

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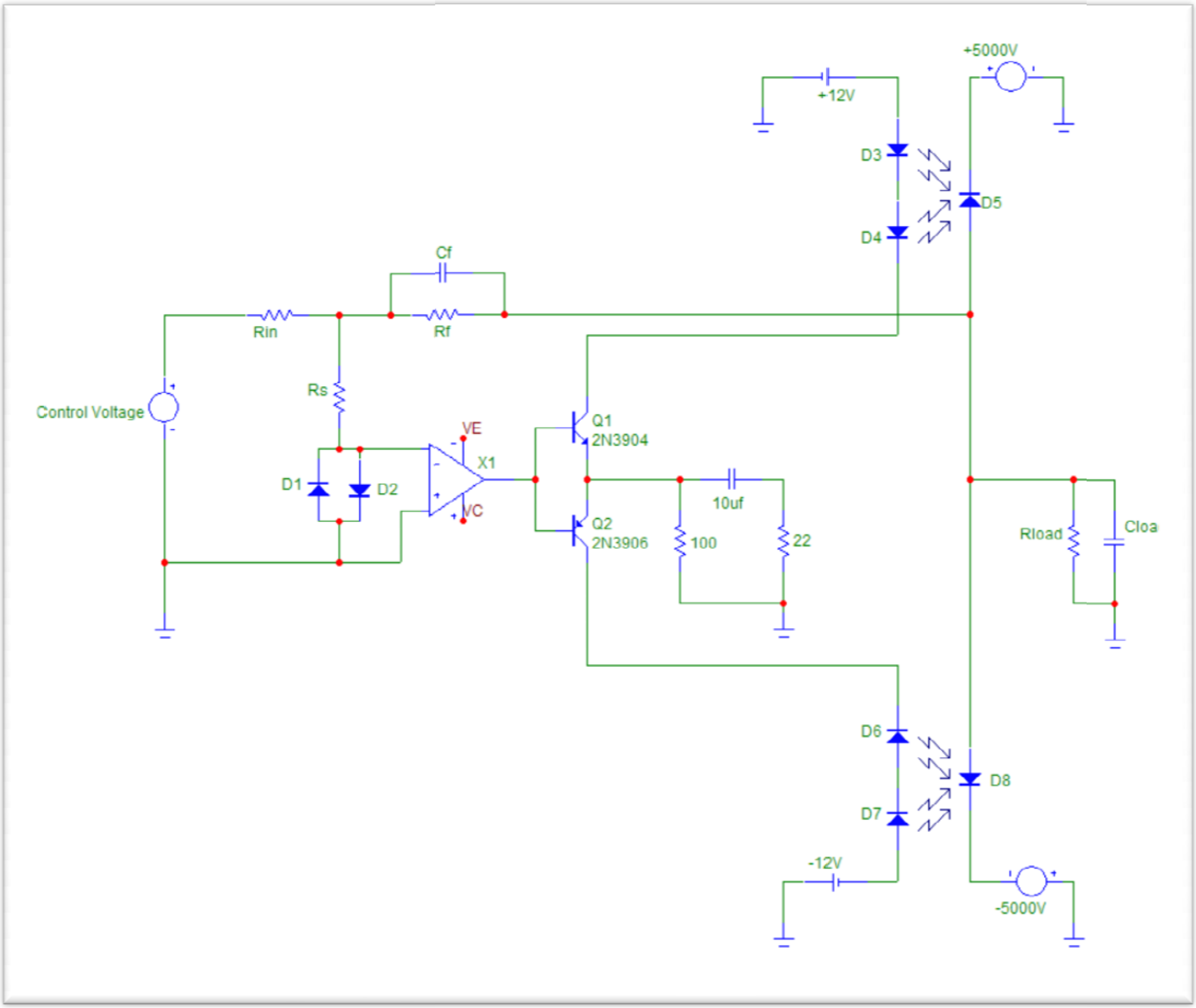
VMI's line of uniquely designed optically coupled diodes allow the construction of high isolation voltage linear amplification circuits having tens of thousands of volts of output swing and bandwidths of nearly 5kHz depending on the capacitance of the load. Each optocoupler can be considered an optically isolated transistor having very high voltage capability and linear current transfer ratio.

Using a pair of these optocouplers in a push-pull configuration (see below circuit diagram) an amplifier may be constructed having a high DC loop gain and a bandwidth constrained primarily by the capacitance and current of the load. Referring to the below circuit diagram, the amplifier structure is similar to a common Op-Amp, but in this case, differential output currents are optically coupled to a pair of optocoupler cells in series across high voltage rails.



Differential currents from a complimentary transistor pair drive the optocoupler's LEDs producing complimentary photocurrents in the reverse biased optocoupler output diodes. Gain of the optically isolated output stage is set by the ratio of Rf / Rin, inverting the input voltage to the Op-Amp. The feedback resistor (Rf) should be made as large a practical so as to reduce its loading affect on the output stage thereby leaving more current available for the load.

Inverted gain configuration places the input signal and output feedback at virtual ground, simplifying protection of the Op-Amp to a pair of clamp diodes to ground.

A small series resistance, Rs, may also be inserted in the inverting input to further improve arc protection.

Due to the very high impedance of these circuits, Op-Amps used for this application should have FET inputs and reasonable bandwidth to support circuit response compensation.

Cf, the compensation capacitor, must be finessed to optimize stability, reduce ringing, and improve frequency response. Often it can be a combination of distributed capacitance of the feedback resistor and controlled layout parasitic capacitance. One should take care to keep Cf a low value in order to prevent enough charge building up in the capacitor to damage the low voltage portion of the circuit.

A boost in slew rate may be achieved as shown through the use of a speed-up network in shunt with the example current limiting resistor of 100 ohms.

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