

Technical Review of Low Dropout Voltage Regulator Operation and Performance

Application Report

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ABSTRACT

This application report provides a technical review of low dropout (LDO) voltage regulators, and describes fundamental concepts including dropout voltage, quiescent current, and topologies. The report also includes detailed discussions of load/line regulation, efficiency, frequency response, range of stable ESR, and accuracy of LDO voltage regulators.

1 Dropout Voltage

Dropout voltage is the input-to-output differential voltage at which the circuit ceases to regulate against further reductions in input voltage; this point occurs when the input voltage approaches the output voltage. Figure 1 shows an example of a simple NMOS low dropout (LDO) voltage regulator.

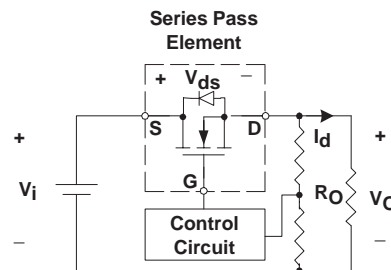


Figure 1. LDO Voltage Regulator

LDO operation can be explained using the NMOS series pass element I-V characteristics shown in Figure 2. NMOS devices are not widely used in LDO designs, but they simplify the explanation of LDO performance. Figure 2 (a) shows the two regions of operation—linear and saturation. In the linear region, the series pass element acts like a series resistor. In the saturation region, the device becomes a voltage-controlled current source. Voltage regulators usually operate in the saturation region.

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