What's New with LTspice?

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SOATHERM SUPPORT FOR PCB AND HEAT SINK THERMAL MODELS by Dan Eddleman

Typically, a circuit designer uses the LTspice® SOAtherm-NMOS symbol standalone to verify that a particular MOSFET's SOA (Safe Operating Area) is suitable for a given application; no additional heat sink or PCB thermal model is necessary. However, in some particularly demanding applications, especially those where high power transients last longer than 10 milliseconds, it may be desirable to take advantage of the extra thermal capacity and dissipation provided by a heat sink or the PCB. Previously, this was implemented by connecting a resistor-capacitor network to the SOAtherm-NMOS model's Tc pin. Now, with the SOAtherm-PCB and SOA-HeatSink symbols, it is possible to model heat sink and PCB thermal behavior by specifying a few physical parameters rather than calculating an array of component values from formulas. www.linear.com/solutions/7415

SELECTED DEMO CIRCUITS

For a complete list of examples, please visit www.linear.com/democircuits.

Linear Regulators

- **LT3066:** 3.3V supply with 497mA precision current limit (3.6V–45V to 3.3V at 450mA) www.linear.com/solutions/7178
- **LT3091:** Negative LDO with 1.6A current limit (−1.5V to −36V input, −2.5V output at 1.5A) www.linear.com/solutions/5977

Buck Regulators

- **LT8601:** Triple automotive buck regulator (5.5V–42V to 5V at 1.0A, 3.3V at 2.0A, 1.8V at 1A) www.linear.com/solutions/7157
- **LT8641:** 2MHz µPower ultralow EMI buck converter (5.5V–65V to 5V at 3.5A) www.linear.com/solutions/7183
- **LTC3649:** Holdup circuit using a buck regulator with input boost capabilities (5.5V–60V to 5V at 4A, 8V holdup) www.linear.com/solutions/7412
- **LTM®8003:** Low EMI buck µModule® regulator (6V–40V to 5V at 3.5A) www.linear.com/solutions/7352

Boost Converter

- **LT8335:** 12V boost converter (3V–10V to 12V at 275mA) www.linear.com/solutions/7426

Inverting Regulators

- **LTC3630:** Positive to negative converter with variable output www.linear.com/solutions/5936
- **LTC7149:** Inverting buck regulator with output voltage control (3.4V–50V input, 2.5 to −10V output at 2A) www.linear.com/solutions/7229

Isolated Converter

- **LTM8068:** 2kVAC isolated low noise µModule regulator with post LDO regulator (4.5V–40V to 5.6V at 460mA, 5V at 300mA) www.linear.com/solutions/7169

LED Driver

- **LT3909:** 2-string, 2MHz LED driver for 10-white-LED strings (7V–36V to 35V LED & 40mA) www.linear.com/solutions/5978

Op Amps

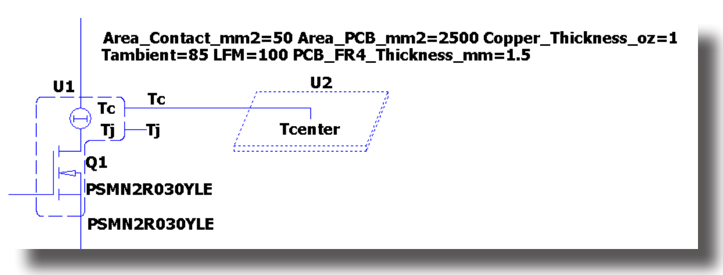
- **LT6201:** Single-ended to differential amplifier SAR ADC www.linear.com/solutions/7600
- **LTC6244:** 60kHz, positive and negative peak detector www.linear.com/solutions/7161
- **LTC6362:** Low power I/Q modulator driver www.linear.com/solutions/7116

Filter

- **LTC1068:** 8th order linear phase bandpass filter www.linear.com/solutions/7217

Reference

- **LT6703-2:** AC line overcurrent indicator www.linear.com/solutions/7181



The SOAtherm-PCB and SOA-HeatSink symbols make it possible to model heat sink and PCB thermal behavior by specifying a few physical parameters rather than calculating an array of component values from formulas.

SELECTED MODELS

To search the LTspice library for a particular device model, press F2. To update to the current version, choose Sync Release from the Tools menu.

Buck Regulators

- **LT3668:** 40V 400mA step-down switching regulator with dual fault protected tracking LDOs www.linear.com/LT3668
- **LT8608:** 42V, 1.5A synchronous step-down regulator with 2.5µA quiescent current www.linear.com/product/LT8608
- **LTM4642:** 20V input, dual 4A or single 8A DC/DC µModule step-down regulator www.linear.com/LTM4642
- **LTM8053:** 40V input, 3.5A/6A step-down µModule regulator www.linear.com/LTM8053
- **LTM8064:** 58V input, 6A CVCC step-down µModule regulator www.linear.com/LTM8064

Buck or Boost Controller

- **LTC3871:** Bidirectional PolyPhase® synchronous buck or boost controller www.linear.com/LTC3871

Isolated Flyback Converter

- **LT8304:** 100V input µPower no-opto isolated flyback converter with 150V/2A switch www.linear.com/LT8304

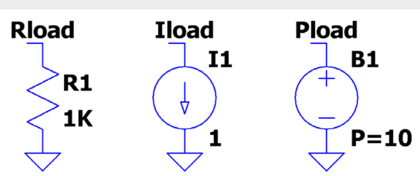
Hot Swap, Surge Stopper & Protection Controllers

- **LTC4236:** Dual ideal diode-OR and single hot swap controller with current monitor www.linear.com/LTC4236
- **LTC4367:** 100V overvoltage, undervoltage and reverse supply protection controller www.linear.com/LTC4367
- **LTC4380:** Low quiescent current surge stopper www.linear.com/LTC4380 ■

Power User Tip

MODELING CONSTANT POWER LOADS IN LTSPICE

There are several types of constant loads used in simulating a power supply system: constant resistance, constant current and constant power loads. For instance, a constant current load dynamically adjusts its resistance as the load voltage varies, such that the load current remains constant, I = V/R. Constant resistance and constant current loads are available as dedicated symbols in LTspice, while a constant power load is available via the arbitrary behavioral source.

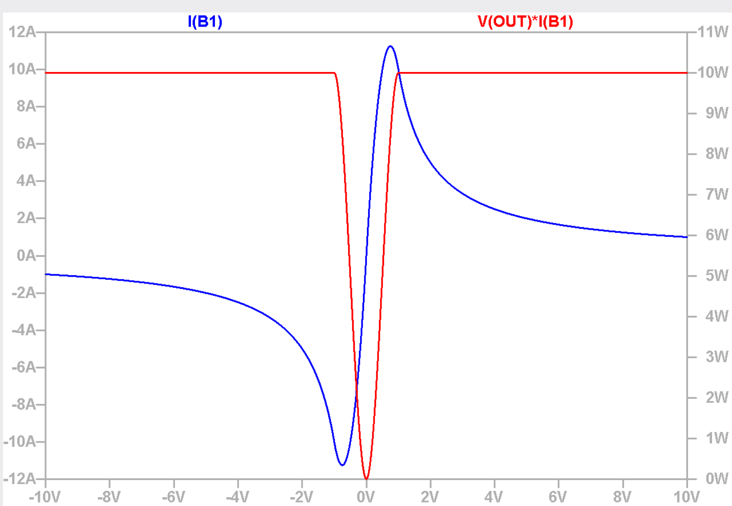


Constant resistance, constant current and constant power loads

A constant power load is designed to dynamically adjust the load current inversely with the load voltage so that the load power is constant, P = VI. It is this inverse property of a constant power load that is often useful in stability analysis of simulations like those of a switching mode power supply.

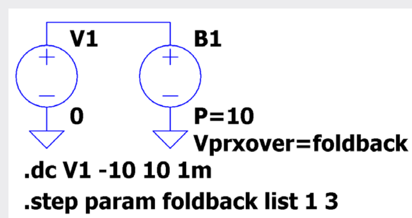
Normally, arbitrary behavioral voltage and current sources are defined by the syntax of V=<expression> or I=<expression>. However, you can modify either of these behavioral source symbol attributes to define a constant power load, P=<expression>. It does not matter which arbitrary (current or voltage) sources symbol you use for the expression, since the *syntax* (V, I or P) describes the behavior, not the symbol.

In the schematic shown, a DC source sweep analysis is performed to plot the characteristic curves. Shown here are the current and instantaneous power in the constant power load, B1, vs voltage. (To plot instantaneous power, Alt-Left Click a symbol.)



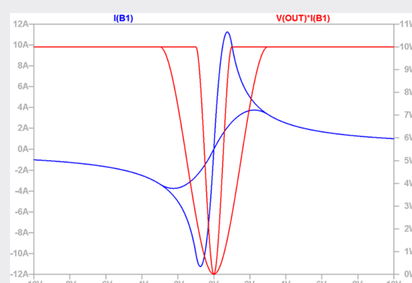
DC source sweep analysis of a constant power load, B1. Output current (blue trace) and instantaneous output power (red trace) vs output voltage. Note that the smooth transition at zero volts avoids infinite current draw.

Notice that the waveform shows the constant power load smoothly transitioning from a constant power load to zero watts at zero volts. This prevents the constant power load from drawing infinite load current as it nears zero output voltage. This foldback point is by default set to 1V, but can be modified by using the vprxover parameter.



Schematic of a constant power load using a DC source sweep analysis and a .step command of the vprxover parameter of 1V and 3V

The schematic above uses the .step command to perform repeat simulations of the vprxover parameter with waveform results shown here for comparison.



Waveform of constant power load with vpxover parameter of 1V and 3V

Happy simulations!