What's New with LTspice?

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LTspice Blog
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NEW VIDEO: Creating and Working with Symbols

Markus Holtkamp walks you through the process of creating a symbol automatically using either a subcircuit definition in ASCII fomat or creating a schematic hierarchy. Hierarchical schematic drafting allows large circuits to be drafted in a single schematic, with component circuits presented in abstract, i.e. black boxes. www.linear.com/solutions/7723

SELECTED DEMO CIRCUITS

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

Linear Regulators

- **LT3045:** Low noise, high PSRR linear regulator (3.8V–20V to 3.3V at 500mA) www.linear.com/solutions/7413

Buck Regulators

- **LT8608:** 2MHz low EMI high voltage synchronous buck regulator (5.5V–42V to 5V at 1.5A) www.linear.com/solutions/7313
- **LT8630:** High efficiency µPower buck regulator (13V–100V to 12V at 600mA) www.linear.com/solutions/7678
- **LTC3864:** 60W PMOS step-down converter with 100% duty cycle capability (12V–60V to 12V at 5A) www.linear.com/solutions/7776
- **LTM4632:** Triple output ultrathin buck regulator for DDR-QDR4 (3.6V–15V to 1.5V at 3A, 0.75V at ±3A, 0.75V at 10mA) www.linear.com/solutions/7240
- **LTM4642:** Wide input voltage, high efficiency, dual buck regulator (4.5V–20V to 1.8V at 4A, 1.2V at 4A) www.linear.com/solutions/7210
- **LTM4650:** High efficiency dual 25A step-down regulator with output tracking (4.5V–15V to 1.5V at 25A & 1V at 25A) www.linear.com/solutions/7379
- **LTM4650-1:** High efficiency 8-phase 200A step-down regulator (4.5V–15V to 1V at 200A) www.linear.com/solutions/7381
- **LTM4677 & LTM4650:** High current, parallel µModule buck regulators with power system management (4.5V–16V to 1V at186A) www.linear.com/solutions/7353
- **LTM8064:** CVCC source/sink step-down regulator (7.5V–58V to 5V at ±6A) www.linear.com/solutions/7225

Buck-Boost, Boost, SEPIC & Inverting Regulators

- **LT8390:** High efficiency 250W buck-boost regulator (9V–36V to 12V at 25A) www.linear.com/solutions/7645
- **LTM8049:** ±12V SEPIC & inverting regulator (2.8V–18V to 12V at 1A & -12V at 1A) www.linear.com/solutions/7610

Isolated Converters

- **LT3752-1/LT8311:** 200W active clamp forward converter with synchronous rectification (150V–400V to 12V at 16.7A) www.linear.com/solutions/4956
- **LT3752/LT8311:** Active clamp forward converter with synchronous rectification (36V–72V to 12V at 12A) www.linear.com/solutions/4698
- **LT3753/LT1431:** 80W active clamp non-synchronous forward converter for PoE (10V–54V to 54V at 1.5A) www.linear.com/solutions/5885
- **LT8303:** µPower no-opto isolated flyback converter (36V–72V to 5V at 0.65A–0.84A) www.linear.com/solutions/7500
- **LT8304:** µPower no-opto isolated flyback converter (18V–72V to 5V at 2A) www.linear.com/solutions/7297

LED Drivers

- **LT3922:** Low EMI, high efficiency boost LED driver (4V–28V to 34V LED at330mA) www.linear.com/solutions/7425
- **LT8391:** High efficiency 50W buck-boost LED driver (4V–60V to 25V LED at 2A) www.linear.com/solutions/7277

Op Amps

- **LT6018/LT1678:** Low impedance source, high common mode range amplifier www.linear.com/LT6018
- **LTC6362:** Baseband design example for a low power IQ modulator www.linear.com/solutions/7116

SELECT 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

- **LT8609B:** 42V, 2A/3A peak synchronous step-down regulator with 2.5µA quiescent current www.linear.com/LT8609

- **LTC3884:** Dual output PolyPhase® step-down controller with sub-milliohm DCR sensing and digital power system management www.linear.com/LTC3884

Buck-Boost, Boost, SEPIC & Inverting Regulators

- **LTC3130:** 25V, 600mA buck-boost DC/DC converter with 1.6µA quiescent current www.linear.com/LTC3130
- **LTC3896:** 150V low IQ, synchronous inverting DC/DC controller www.linear.com/LTC3896
- **LTC3897:** PolyPhase synchronous boost controller with input/ output protection www.linear.com/LTC3897
- **LTC7813:** Low IQ, 60V synchronous boost + buck controller www.linear.com/LTC7813

Energy Harvesting

- **LTC3107:** Ultralow voltage energy harvester and primary battery life extender www.linear.com/LTC3107

Hot Swap, Surge Stopper & Protection Controllers

- **LTC4368:** 100V UV/OV and reverse protection controller with bidirectional circuit breaker www.linear.com/LTC4368
- **LTC4420:** 18V dual input µPower PowerPath™ prioritizer with backup supply monitoring www.linear.com/LTC4420
- **LTM9100:** Anyside™ high voltage isolated switch controller with I²C command and telemetry www.linear.com/LTM9100

Op Amp

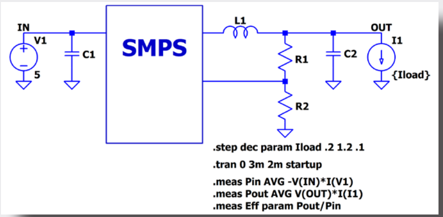
- **LTC6261:** 30MHz, 240µA power efficient rail-to-rail I/O op amps www.linear.com/LTC6261 ■

Power User Tip

USING .MEAS AND .STEP TO CALCULATE EFFICIENCY

Predicting the efficiency of an application is vital to evaluating design trade-offs of a switching mode power supply. Two useful tools, the `.step` and `.meas` commands, can be used to calculate and plot efficiency over a range of load currents.

To evaluate efficiency, clearly label your input and output voltage net as `IN` and `OUT`, respectively. Press **F4** to place net names. Replace your resistive load with a independent current source as shown below and define the value using a global variable `{Iload}`. Press **F2** and type `load2` in the search box to select and place the component. Edit the component value by right-clicking on the symbol and enter the variable `{Iload}`. Note the names of the input voltage source (`V1`) and the load current source (`I1`).



The `.step` command is useful for sweeping a variable across a range of values in a single simulation run. The variable can be temperature, a model parameter, a global parameter or in our case an independent source. These steps can be defined as linear, logarithmic or as a list of specific values.

Insert a `.step` command into your schematic as a SPICE directive and step the independent current source from a light load to maximum current load and define the step increments. (You can use the **S** hotkey to add and place a SPICE directive.)

Here, we step the independent current source, `I1`, from 0.2A to 1.2A in 0.1A increments using a global variable defined as `{Iload}`. The `param` directive is used here in the `.step` command to allow for the creation of this user-defined variable. Please see the help file (F1) for more details on `.step` command and `param` directive.

```
.step param Iload .2 1.2 .1
```

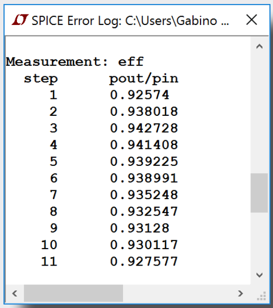
It is important to calculate efficiency when the circuit is operating in a steady state. To ensure this, simulate your circuit, and note when steady state is achieved for all conditions in the `.step` command, extending simulation stop time if needed. Use this observation to set the the "time to start saving data" and "stop time" to encompass a short duration within the observed steady state period. In the `.tran` statement below, we start to save data at 2ms and stop at 2.1ms.

```
.tran 0 2.1m 2m startup
```

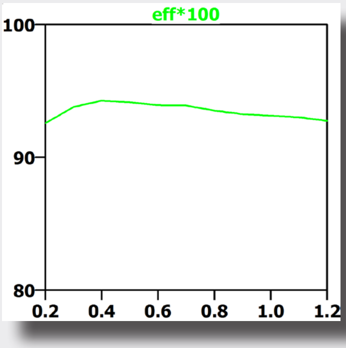
The `.meas` command is useful for measuring a range over the abscissa (as well as one point on the abscissa). Add the following expressions as a SPICE directive to calculate the average input power (`Pin`), average output power (`Pout`) and the efficiency (`Eff`). Please note the current direction convention for the input voltage source, `V1`, is *into* the device, hence the negative sign in the `Pin` calculation. The final expression calculates the efficiency using the `param` directive for clarity. Run your simulation. Please see the help file (F1) for more details on `.meas` command.

```
.meas Pin AVG -V(IN)*I(V1)
.meas Pout AVG V(OUT)*I(I1)
.meas Eff param Pout/Pin
```

Once the simulation completes, right-click one of the windows, select view and select Spice Error Log (or use the **Ctrl+L** hotkey). The Spice Error Log contains data points for the `.meas` statements to include the efficiency calculations.



One neat feature of LTspice is the ability to plot the stepped `.meas` data over the abscissa (`Iload`). To plot the data, right-click the error log and select the `Plot step'ed .meas data`, right-click on the blank screen to select `Add Trace` (or use **Ctrl+A**) and select `Eff`. This will display the efficiency calculation over stepped load current.



Of course, calculating efficiency is only one example. The `.meas` and `.step` commands can be combined in countless other ways to characterize your analog circuit designs.

Happy simulations!