A System-Level Power Architecture Design Tool

Modern electronic systems have an increasing level of complexity. There can be a large number of power rails and supply solutions on a system board to power many different loads. Before choosing or designing each individual power supply, the system hardware engineer first needs to understand the system power needs and then architect the system power tree accordingly to optimize the power management system efficiency, size and cost. Due to the complexity of the system, sometimes system-level power optimization is not a trivial task. An intuitive system-level design tool addresses this need.

Henry Zhang, Applications Engineering Manager, and Tim Kozono, Applications Engineer, Linear Technology Corporation, USA

The LTpowerPlanner program is a system-level power tree design tool to help system designers plan, design and optimize a power management system. It provides an intuitive graphic user interface (GUI) to greatly simplify system-level design tasks.

The LTpowerPlanner tool helps users to

■ draw a "power tree" type system block diagram
■ calculate/estimate total system input power, output power, power loss, efficiency and board size
■ compare different power architectures for system-level optimization
■ interface with the LTpowerCAD supply design tool and with the LTspice circuit simulation tool
■ intuitively document and present the system solution.

The design tool is part of the LTpowerCAD design tool program. To open the LTpowerPlanner tool, users can click the "System Design" icon on the LTpowerCAD main page, as shown in Figure 1. The LTpowerCAD program is an off-line program running on a Windows PC and is available for free download.

Three basic design steps
To get started, here are three basic steps to use the LTpowerPlanner design tool.

Step 1 - drawing a system power tree

Figure 2 shows an example of using the LTpowerPlanner tool to draw a simple system power tree. There are three types of key components in a power tree: input

power source, power supply converter and load device. The power source component only has an output terminal and the load component only has an

input terminal. As to each converter component, the left side terminal is a power input terminal, and the right side terminal, is a power output terminal. The

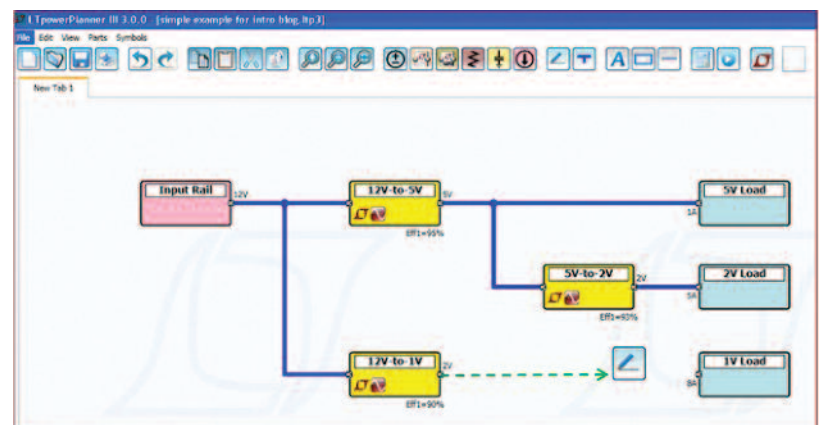**Figure 1:** Click the "system design" icon to open ltpowerplanner tool

Figure 2: Drawing a system power tree

converter component can have multiple output rails to represent a multi-channel power supply. Similarly, the load component can have multiple input rail terminals. The user can place these components first, then connect the components with power wires from left to right, which is the default

current/power flow direction.

Step 2 - updating component parameters

The user can double click on each component to update its key power parameters in its "Properties" window,

such as input voltage range, output voltage, maximum load current, etc. The user also may enter the expected efficiency and estimated size for each power converter component for a system calculation (see Figure 3).

Step 3 -running a system calculation

After a user completes the power tree and updates all key parameters, the user can run a system calculation. Based on the entered parameters for each component, the program calculates and displays the following values in its on-screen "Summary Report:" total system input power, output power, power loss, efficiency and the sum of the converter PC board areas. As shown in Figure 4, each component terminal also displays its input or output voltage and current. Each converter's efficiency and power loss are displayed under the converter. Each load and power source's power level is shown as well. This GUI interface provides a very intuitive display with lots of details of the system power tree.

The LTpowerPlanner tool can be used to compare different power architectures to achieve an optimum system solution. Figure 5 shows a simple example of comparing two slightly different power tree options A and B. In this case, the LTpowerPlanner tool shows that a small architectural change from option A to option B can quickly improve the system efficiency.

Example of an FPGA power tree
The planner tool can be used to draw much more complicated systems. An example is given in Figure 6. There are multi-output power converters and multi-input loads shown in this example. Multiple output terminals with the same voltage can be paralleled for current sharing as well. There are also resistive components available to represent voltage drop and power loss. Please see the LTpowerPlanner User Guide for details of the tool's advanced features and functions.

Although the LTpowerPlanner program is a generic system tool, it allows a user to link a power converter to existing design and simulation files generated by the LTpowerCAD supply design tool and the LTspice circuit simulation tool. To do so, in the converter "Properties" window, a user needs to link the converter to the specific files on their PC disk. After the links are established, users can directly open the linked LTpowerCAD design file or LTspice simulation file by clicking the
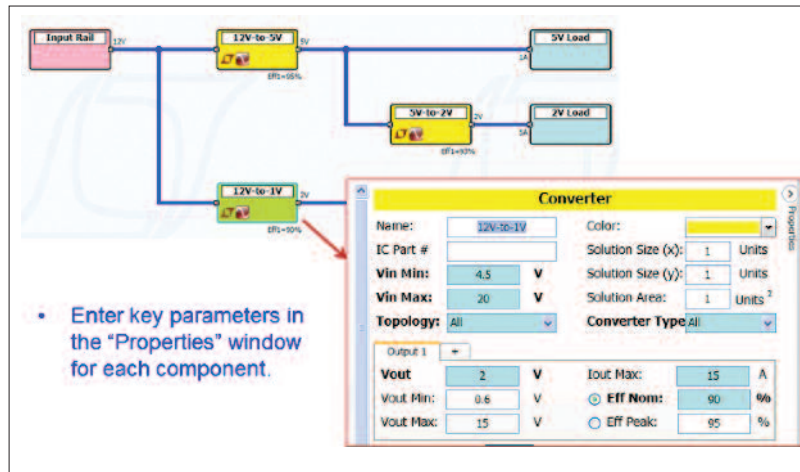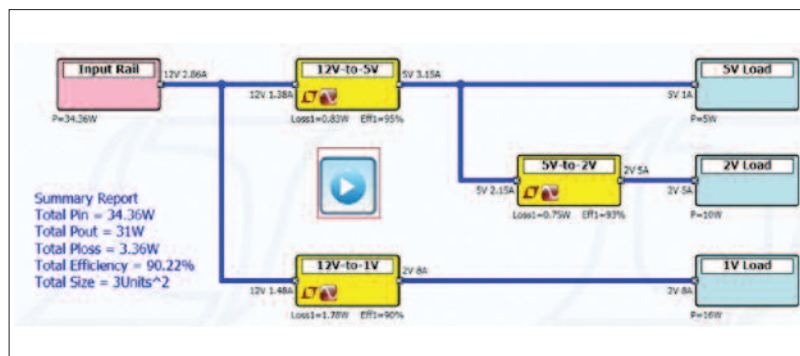

Figure 3: Updating key converter parameters

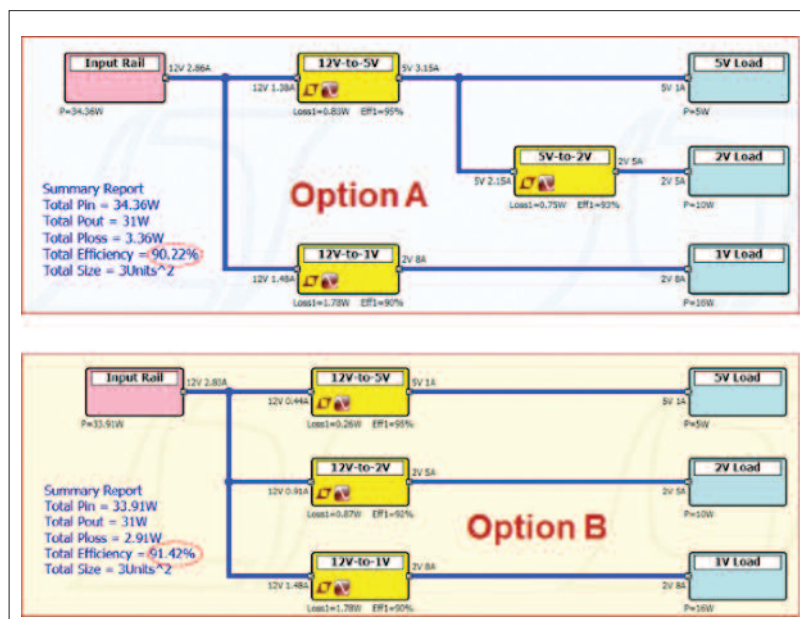

Figure 4: Running a system calculation

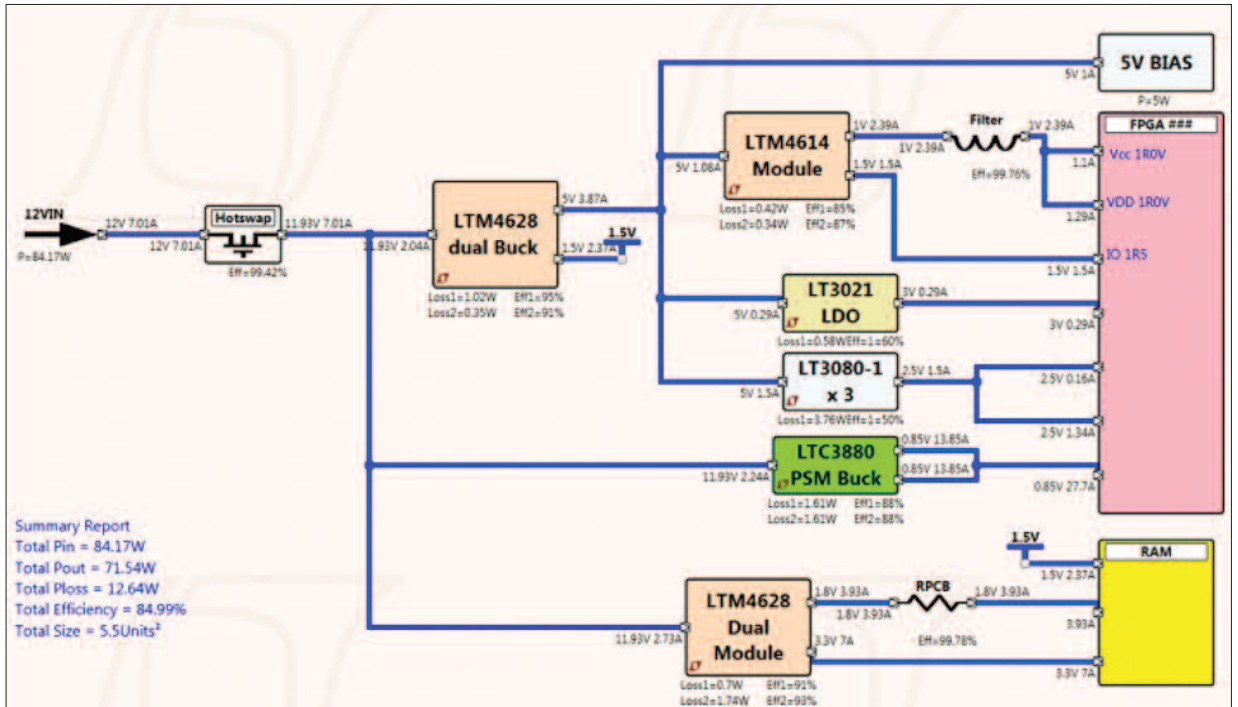**Figure 5: Comparing two power system architectures (A and B)**

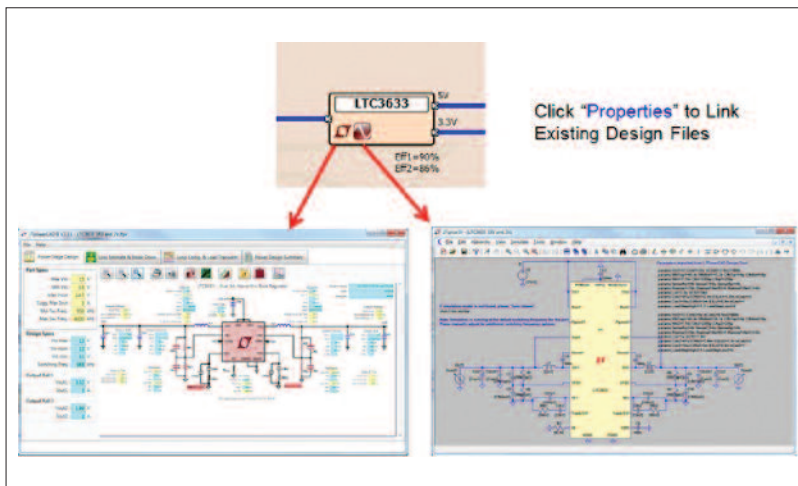**Figure 6:** An example FPGA power tree

Figure 7: Linking to existing LTpowerCAD and LTspice files
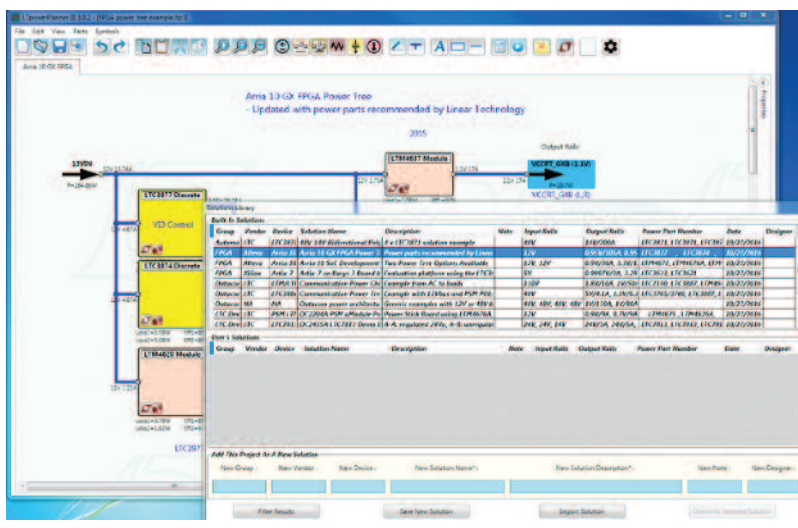

Figure 8: LTpowerPlanner Power Tree Solution Library

corresponding icons on the LTpowerPlanner converter as shown in Figure 7. This feature provides a convenient and systematic way to organize all the design files for a power management system.

Power tree solution library
There is also a built-in LTpowerPlanner power tree solution library to provide many reference power tree designs to users. As shown in Figure 8, by clicking the "Solution Library" soft key, users can leverage many existing solutions for applications such as FPGAs, processors, data communication and automotive systems, etc. These existing designs save engineers time to understand and design a similar power management system. Furthermore, users can also save their designs and build a user solution library for future use.

Conclusion
The LTpowerPlanner design tool can help system engineers to design and optimize a power management system in a very effective and intuitive way. Based on the user's inputs, the tool calculates total input power, output power, power loss, efficiency and physical size of the system. System designers can use this tool to draw, design, compare and optimize the power system tree. This tool also provides a nice and convenient way to document and present the system power architecture.