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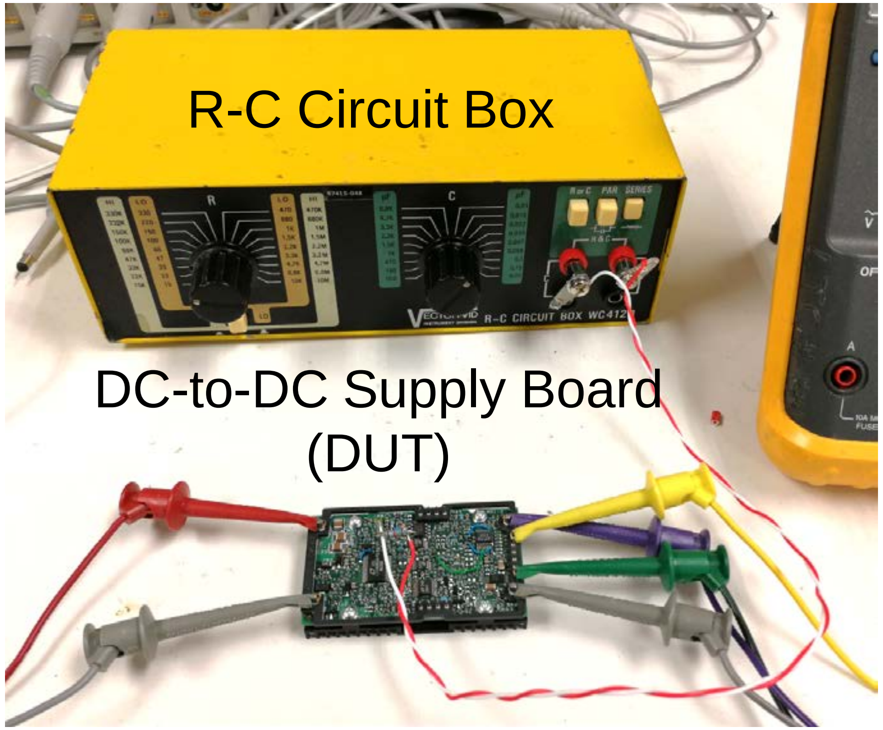
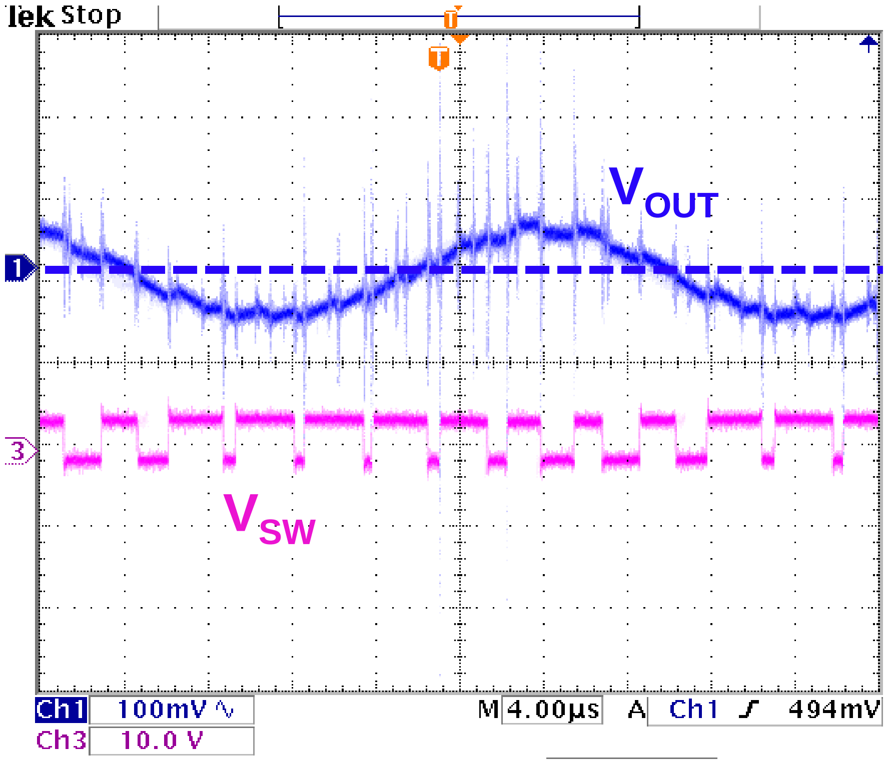
LTpowerCAD Design Tool 101

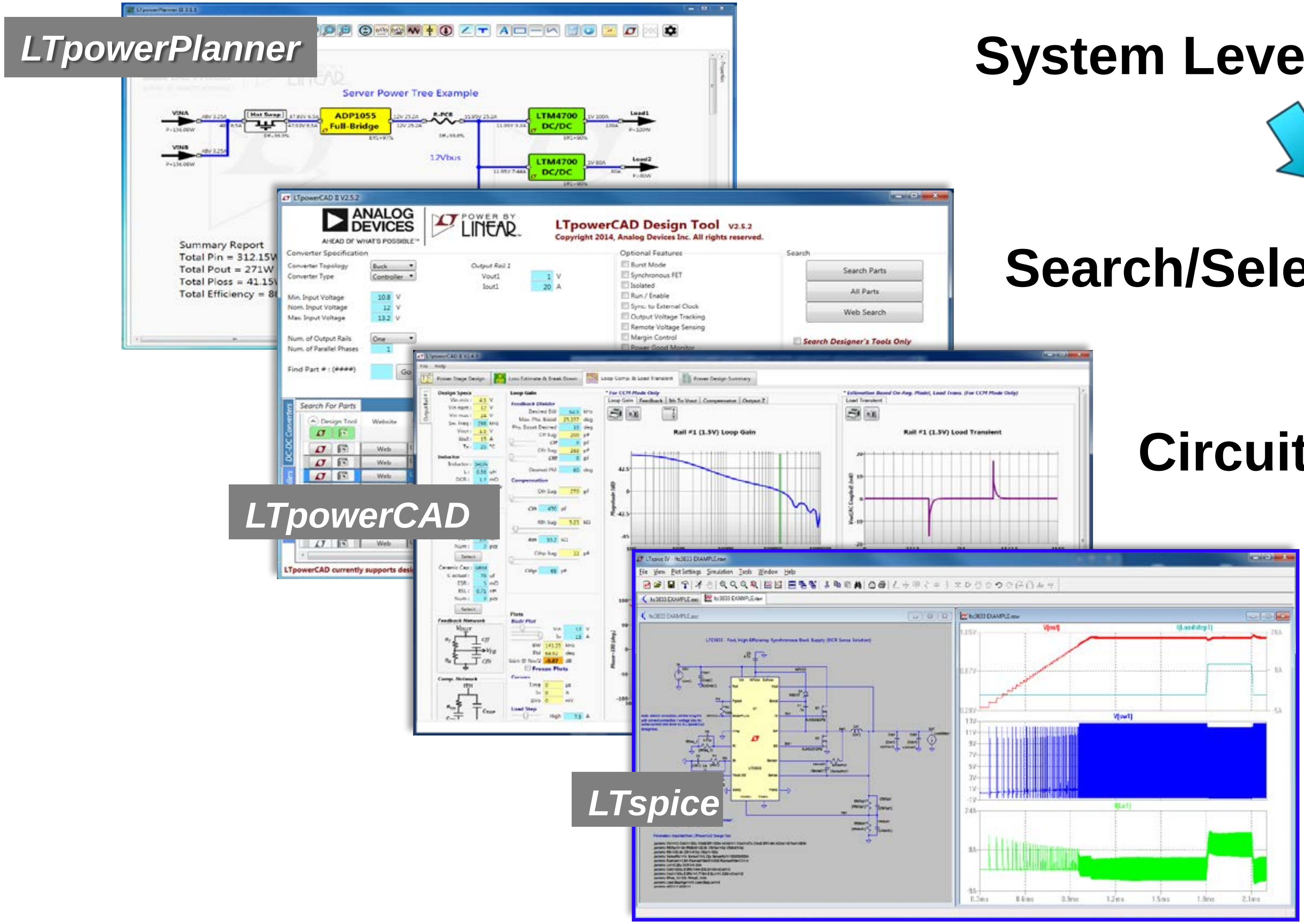
Power Supply Loop Design/Optimization in the Lab





- Manually adjust R and C values. Check loop or load transient.
- **Accurate, but time-consuming.**
- **How to support remote customers?**

Complete Power Design Flow with LT Tools …



System Level Power Tree

Search/Selection a Solution

Circuit Parameter Design

Simulation

Paper Design Is Difficult and Time Consuming …

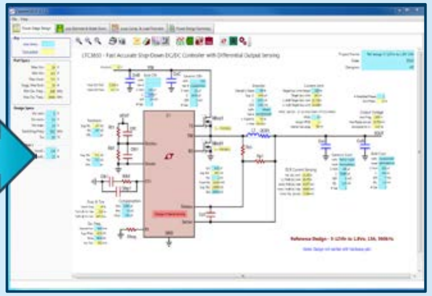
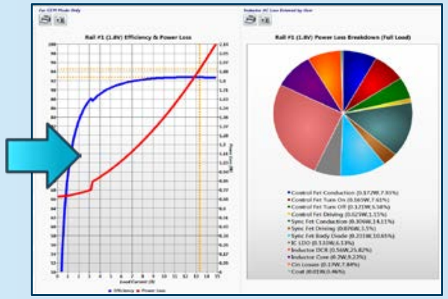
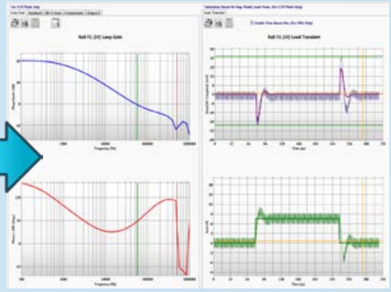
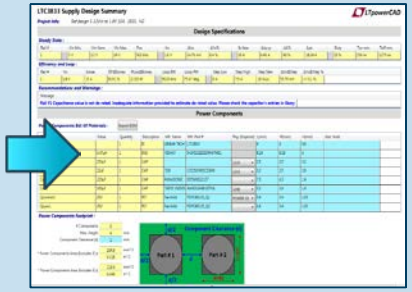
- Define supply specifications
- Decide topology
- Search for an IC **(time↑↑)**
- Calculate power components **(time↑↑, suboptimal)**
- Select components: L, C, FET **(time↑↑, suboptimal)**
- Estimate efficiency/loss **(difficult, inaccurate)**
- Guess/simulate loop compensation **(difficult, inaccurate)**
- Draft schematics

☹ Time consuming, difficult, suboptimal ...

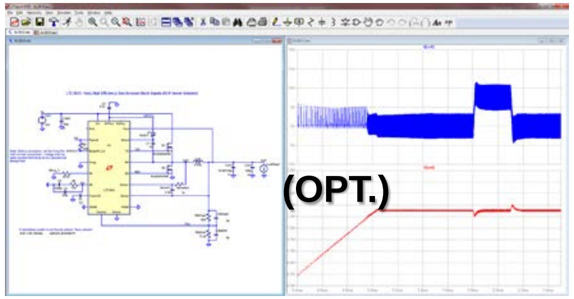
☹ Requires good power supply knowledge and skills

LTpowerCAD Design in 5 Simple Steps! Fast and Easy

Step 1	Step 2	Step 3	Step 4	Step 5
Find Solutions	*Power Stage Design*	*Efficiency and Loss*	*Loop and Transient*	*Summary, BOM, Size*

LTspice™



(OPT.)

- Free download at analog.com/LTpowerCAD
- Runs on Windows PC

Note for ADI users only: Install the program by **RUN Elevated** on an ADI PC.

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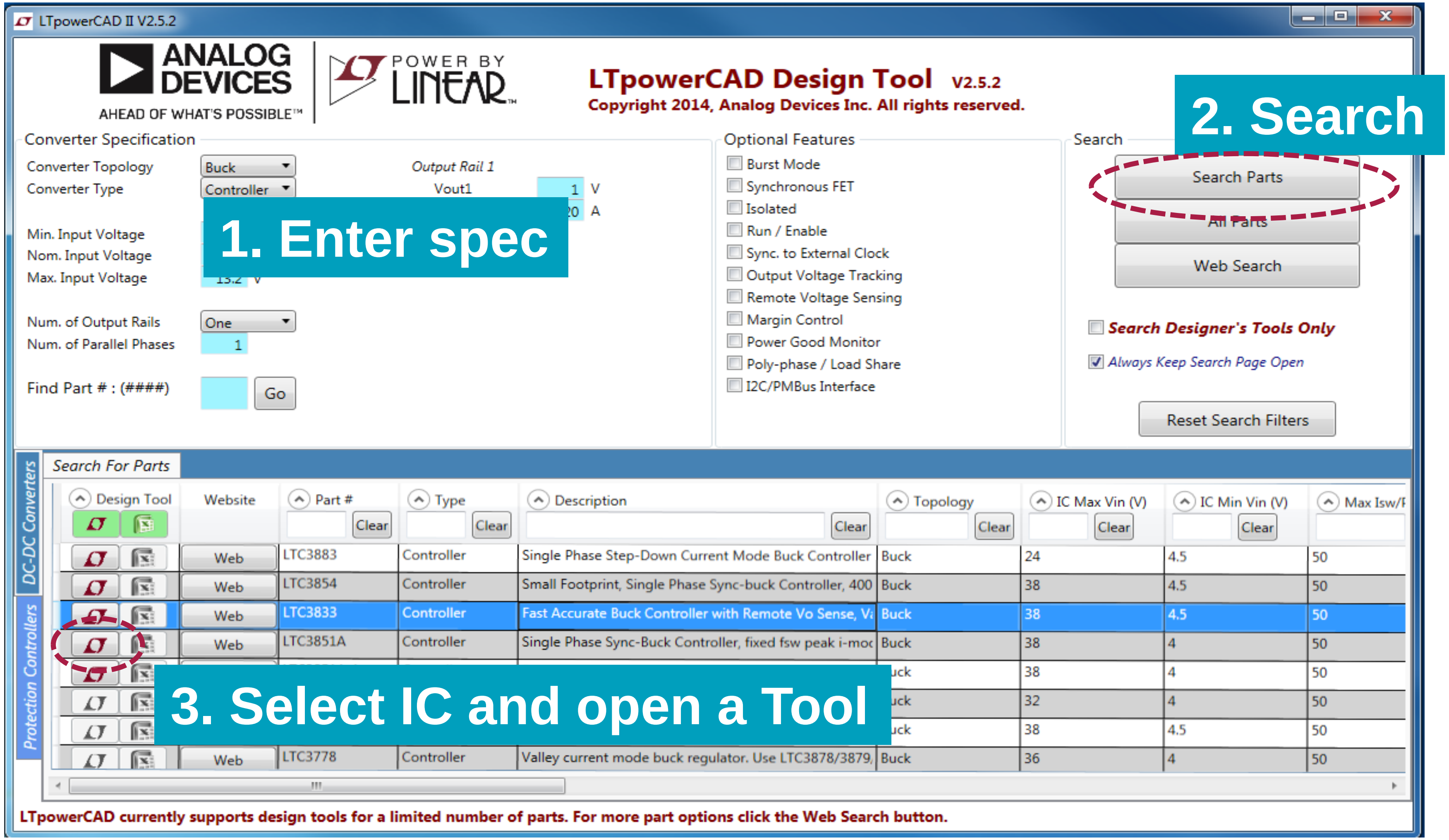
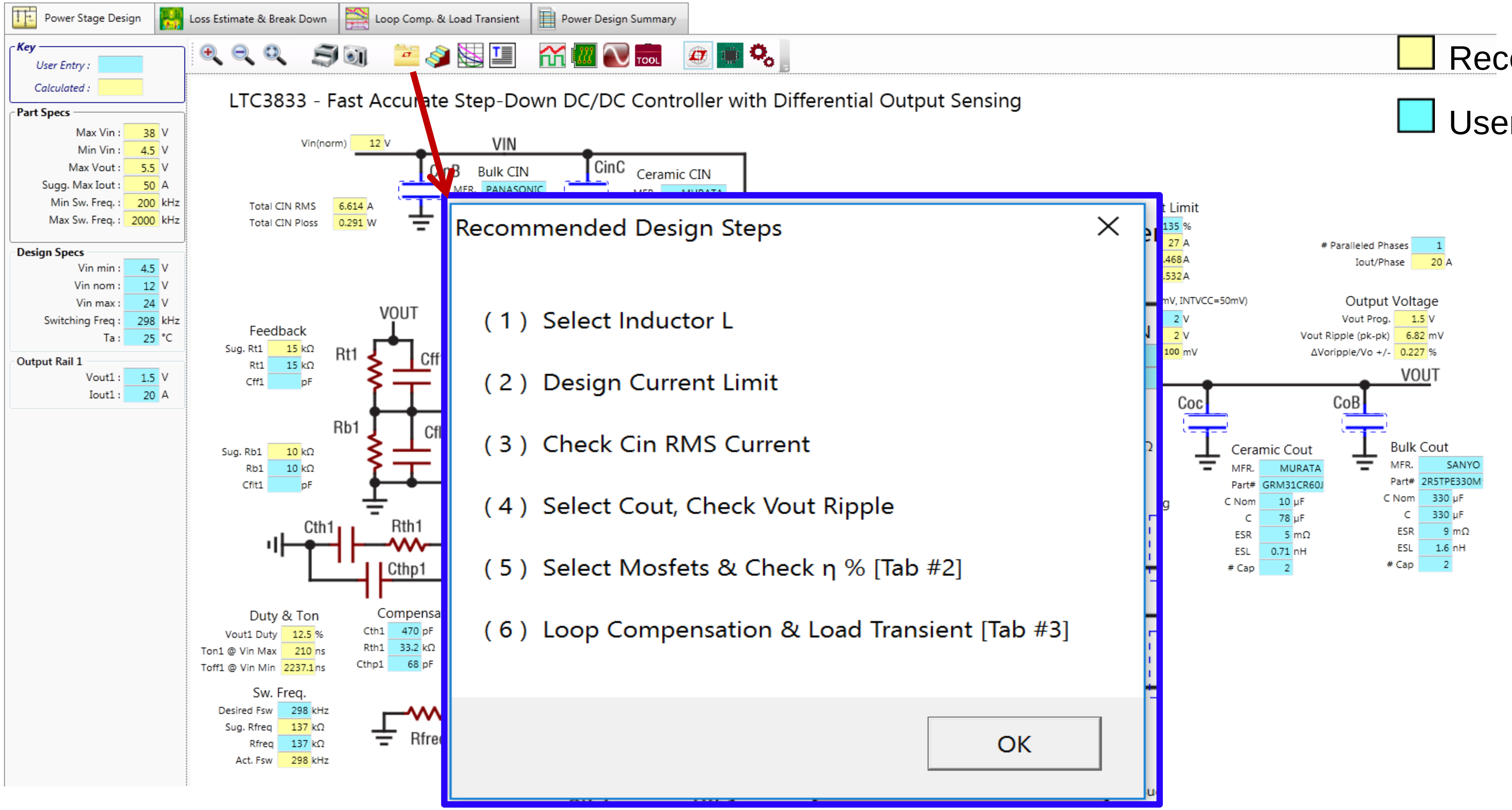
LTpowerCAD Main Window

Start a New Supply Design

Design Step 1: Enter Spec, Search a Part



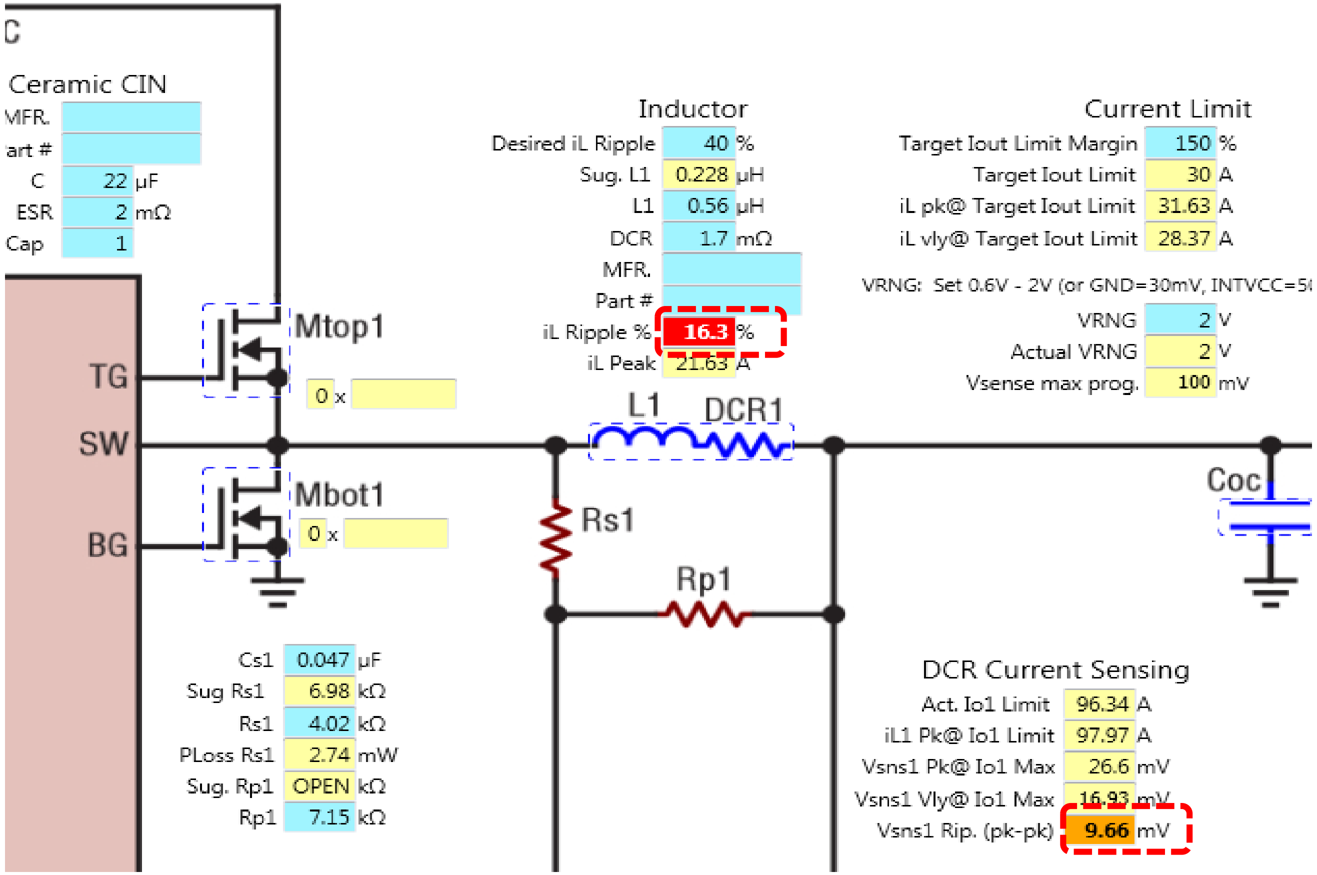
Step 2: Power Stage Design (fs, L, C, etc.)



Recommended / Calculated

User Entered

Step 2: Power Stage Smart Warnings



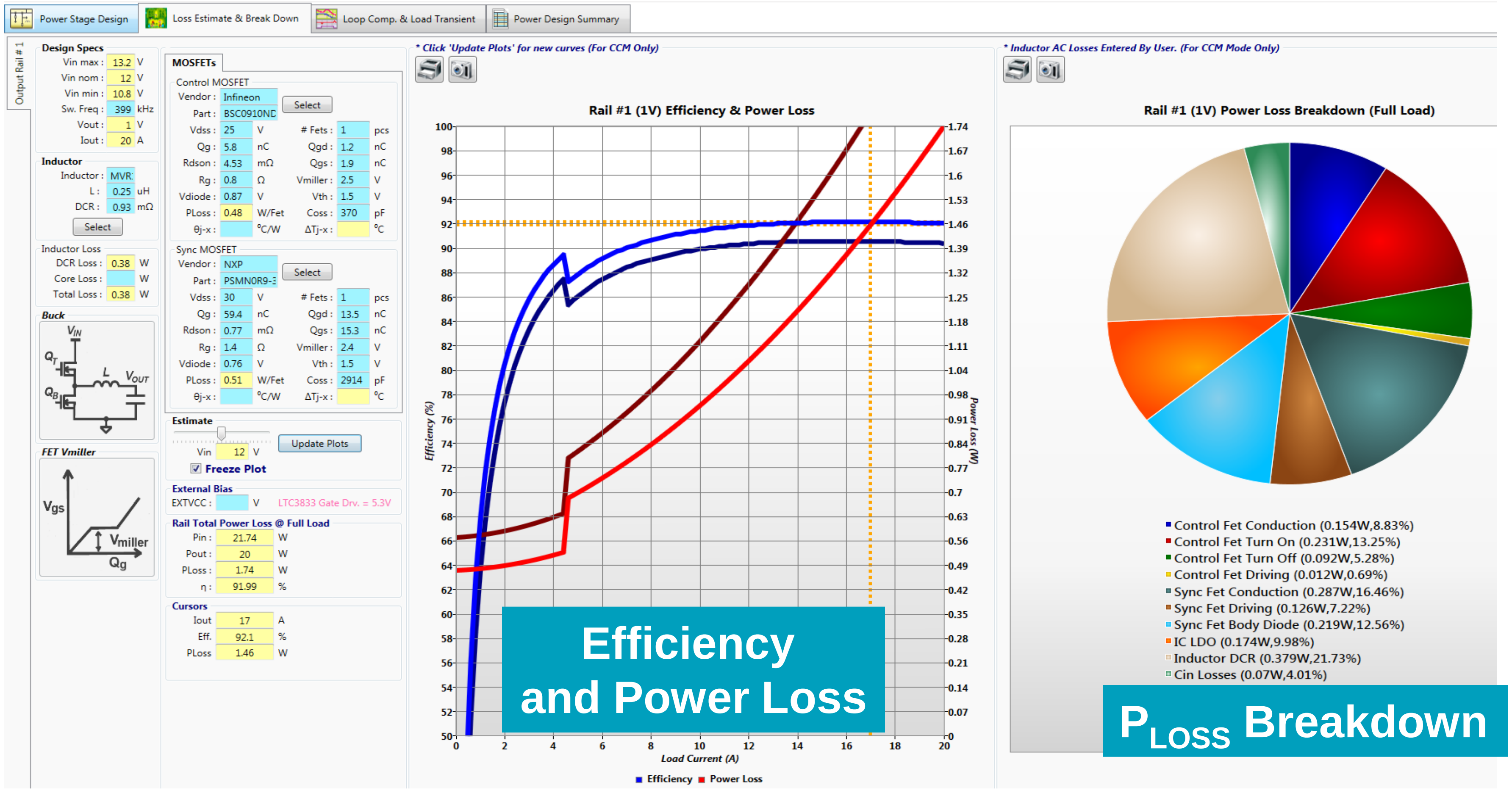
Strong warning (Hard)

Soft warning

- Warning levels are set by apps engineers for different products.

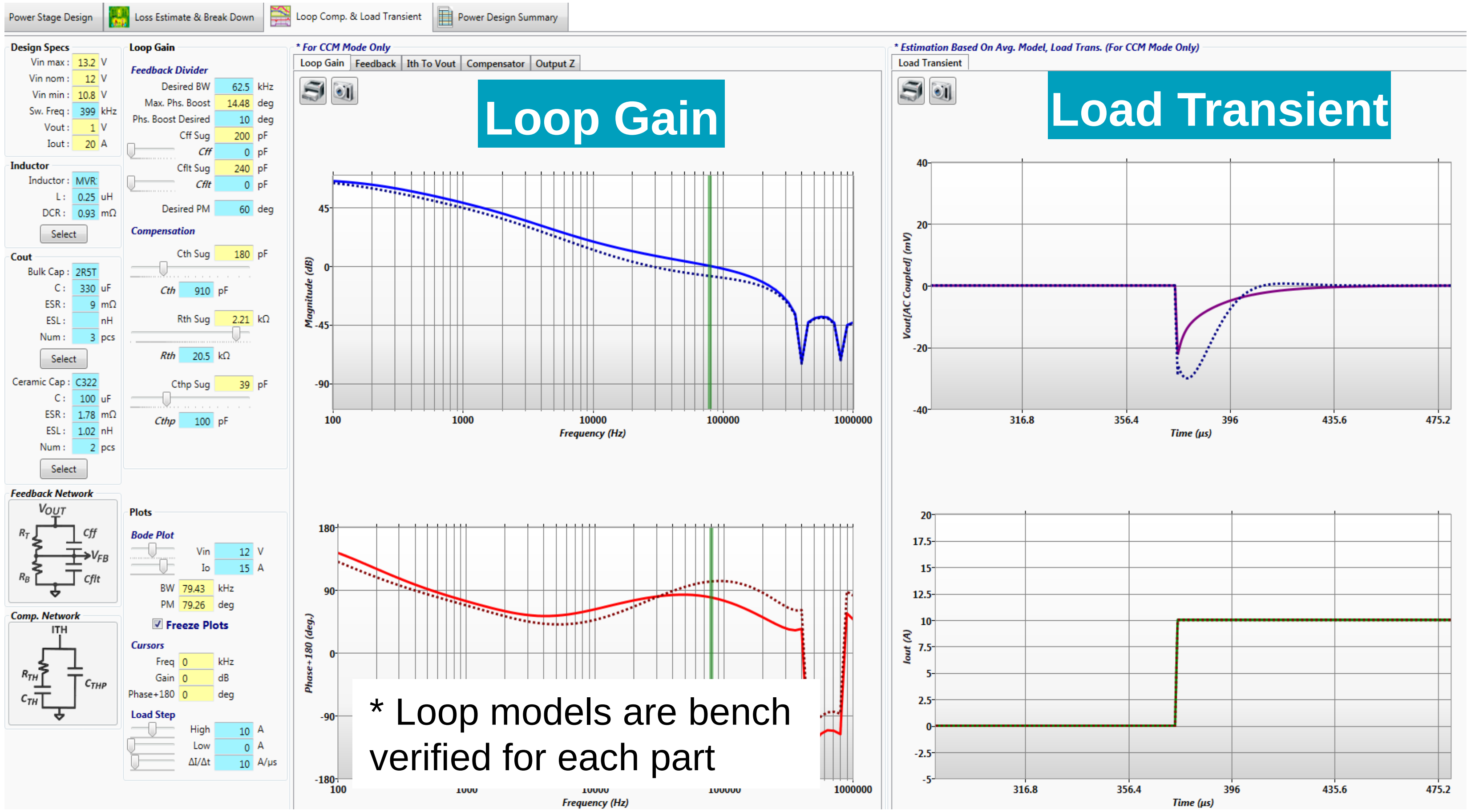
Automatic warnings guide to proper values

Step 3: Efficiency Optimization



Real-Time Estimations for Optimum η%

Step 4: Loop and Transient Design



Real-Time Loop and Transient Optimization

Step 5: Design Summary, BOM, Size

Loss Estimate & Break Down | Loop Comp. & Load Transient | Power Design Summary

Print Summary Report

Summary Report

LTC3833 Supply Design Summary

Project Info: *Ref Design 12Vin to 1V/20A, 10/2014, H.Z.*

Design Specifications

Performance Summary

Steady State :

Rail #	Vin Min.	Vin Nom.	Vin Max.	Fsw	Vo	ΔVo rip. p-p	ΔVo rip.%	Io Max	ΔiLp-p	ΔiL%	iLpk
1	10.8 V	12 V	13.2 V	399 kHz	1 V	7.82 mV	0.4 %	20 A	9.19 A	45.9 %	24.59 A

Efficiency and Loop :

Rail #	Vo	Iomax	Eff.@Iomax	PLoss@Iomax	Loop BW	Loop PM	Step Low	Step High	Step Slew	ΔVo@Step	ΔVo@Step %
1	1 V	20 A	91.99 %	1.741 W	79.43 kHz	79.26 deg	0 A	10 A	10 A/µs	22.1 mV	+/-2.2 %

Recommendations and Warnings :

Message

Power Components

BOM

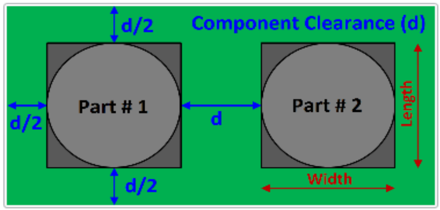
Power Components Bill Of Materials : Export BOM

Ref. Des.	Value	Quantity	Description	Mfr. Name	Mfr. Part #	Pkg. (Imperial)	L(mm)	W(mm)	H(mm)	User Note
U1		1	IC	LINEAR TECH	LTC3833		4	3	0.8	
Lo1	0.25µH	1	IND	COILCRAFT	MVR1251T-251		11.5	9.75	5.1	
Cinb1	180µF	1	CAP	PANASONIC	16SVP180MX	F8	10.3	10.3	7.9	
Cinc1 Cinc2	47µF	2	CAP	MURATA	GRM32ER61C476KE15	1210	3.2	2.5	1.7	
Cob1 Cob2 Cob3	330µF	3	CAP	SANYO	2R5TPE330M9	D2E	7.3	4.3	1.8	
Coc1 Coc2	100µF	2	CAP	TDK	C3225X5R0J107M	1210	3.2	2.5	1.7	
Qcontrol1	25V	1	FET	Infineon	BSC0910NDI_Q1		6.35	5.35	1.1	
Qsync1	30V	1	FET	NXP	PSMN0R9-30YLD		6	5	1.7	

Power Components Footprint :

Solution Size

# Components	12	
Max. Height	7.9	mm
Component Clearance (d)	1	mm
* Power Components Area (Excludes ICs)	541.5	mm^2
	0.839	in^2
* Power Components Area (Includes ICs)	561.5	mm^2
	0.87	in^2



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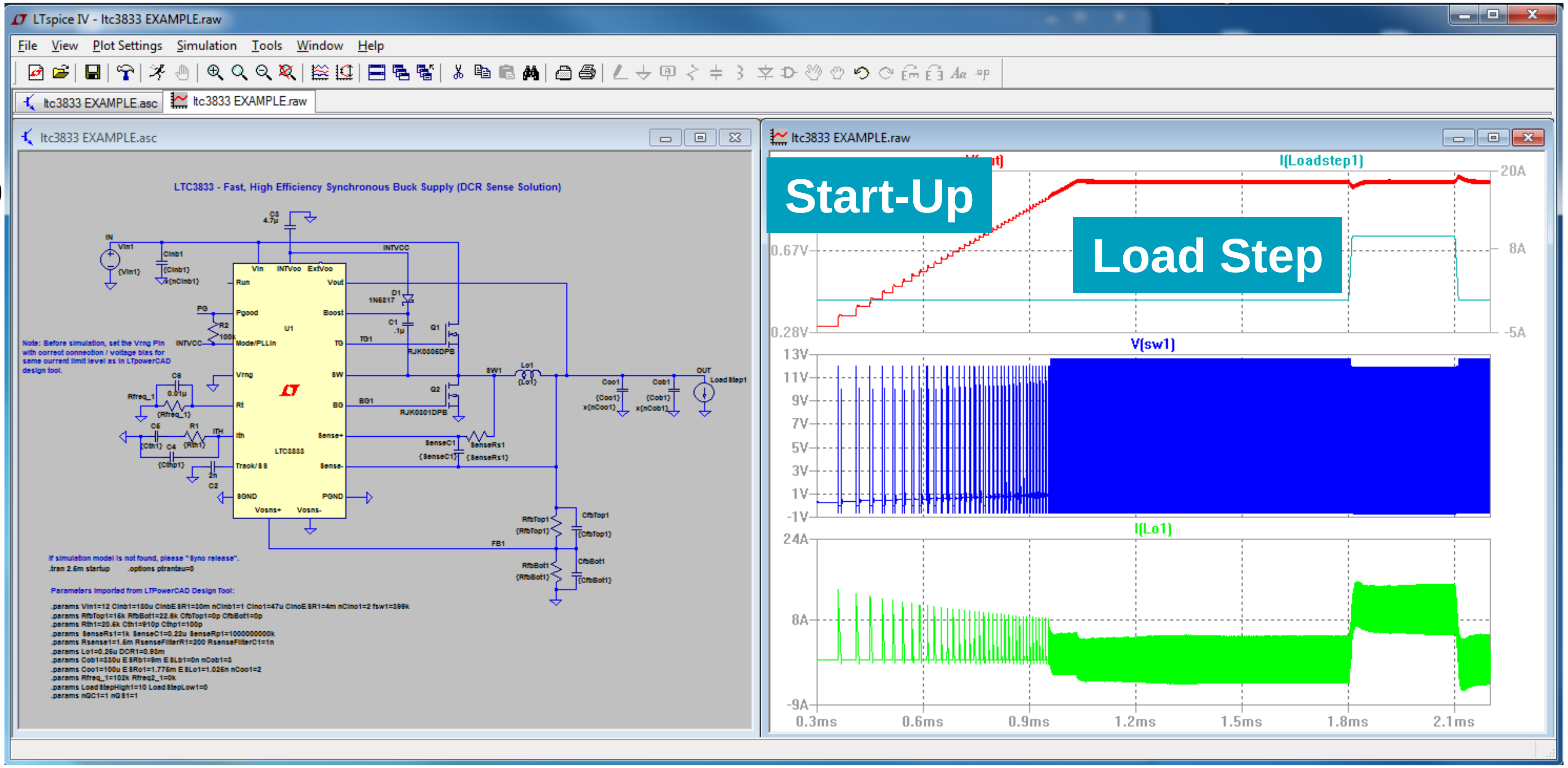
(Optional) Step 6: Export to LTspice Simulation

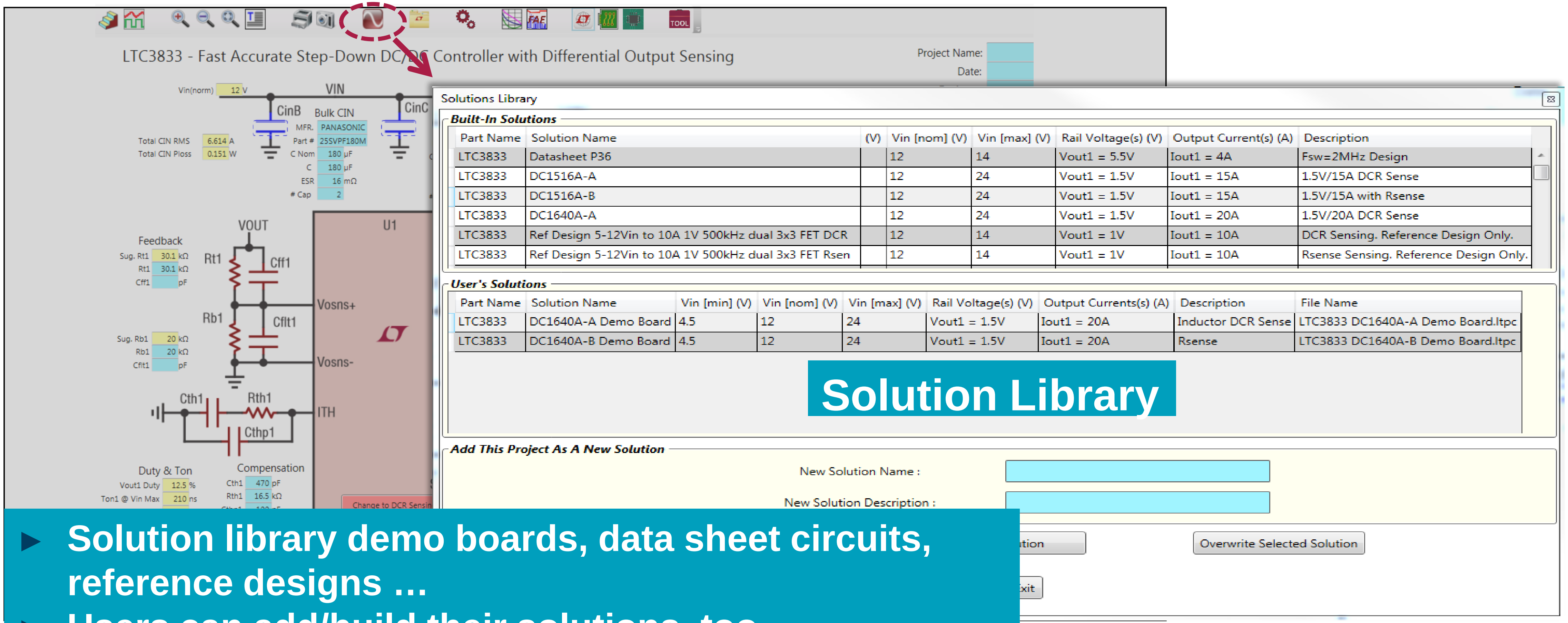
(on Schematic Page)



* Key LTpowerCAD design tool values are exported to LTspice

LTspice Simulation for Detailed Waveforms

Design Shortcut: Leveraging Existing Solutions

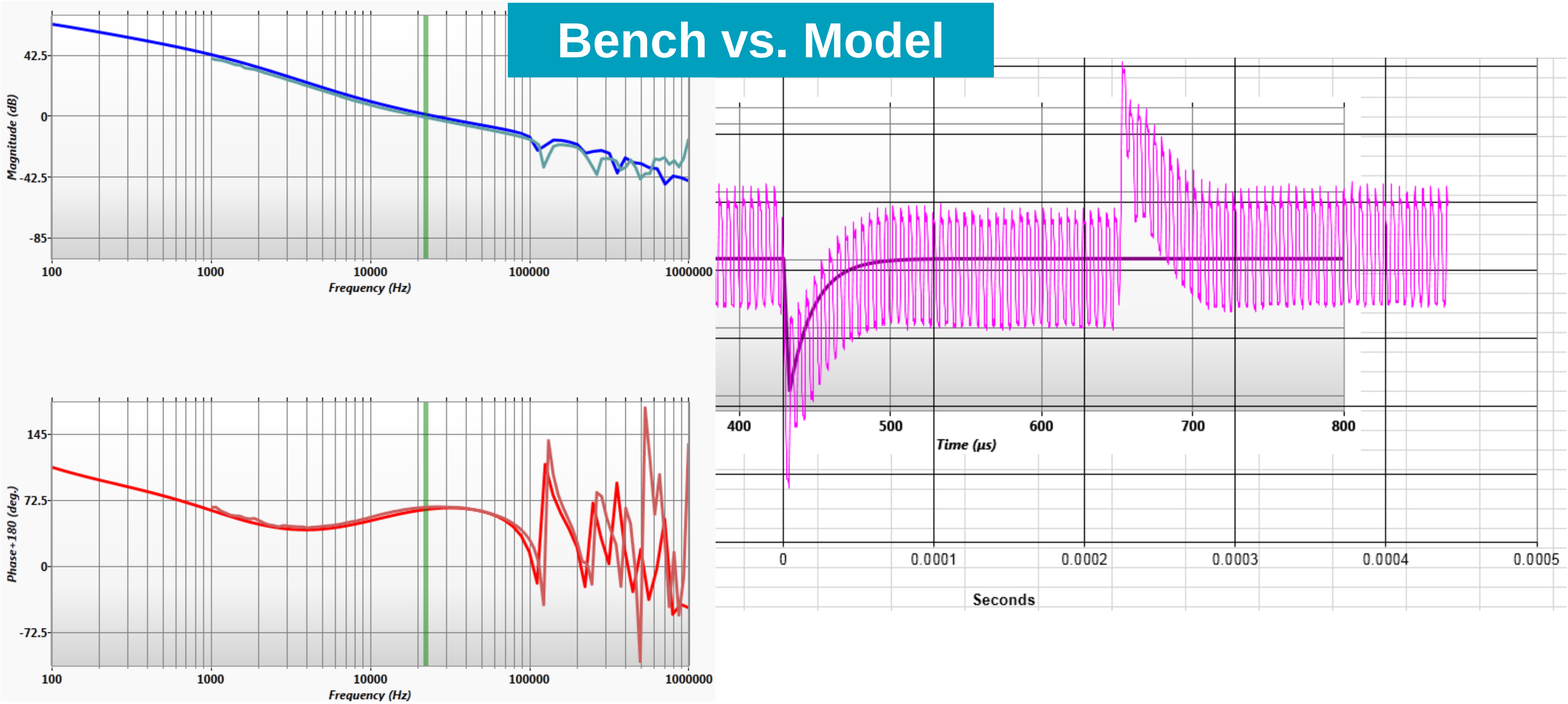


- Solution library demo boards, data sheet circuits, reference designs …
- Users can add/build their solutions, too.
- Quick start point of a new design!

Accurate, Bench Verified Models

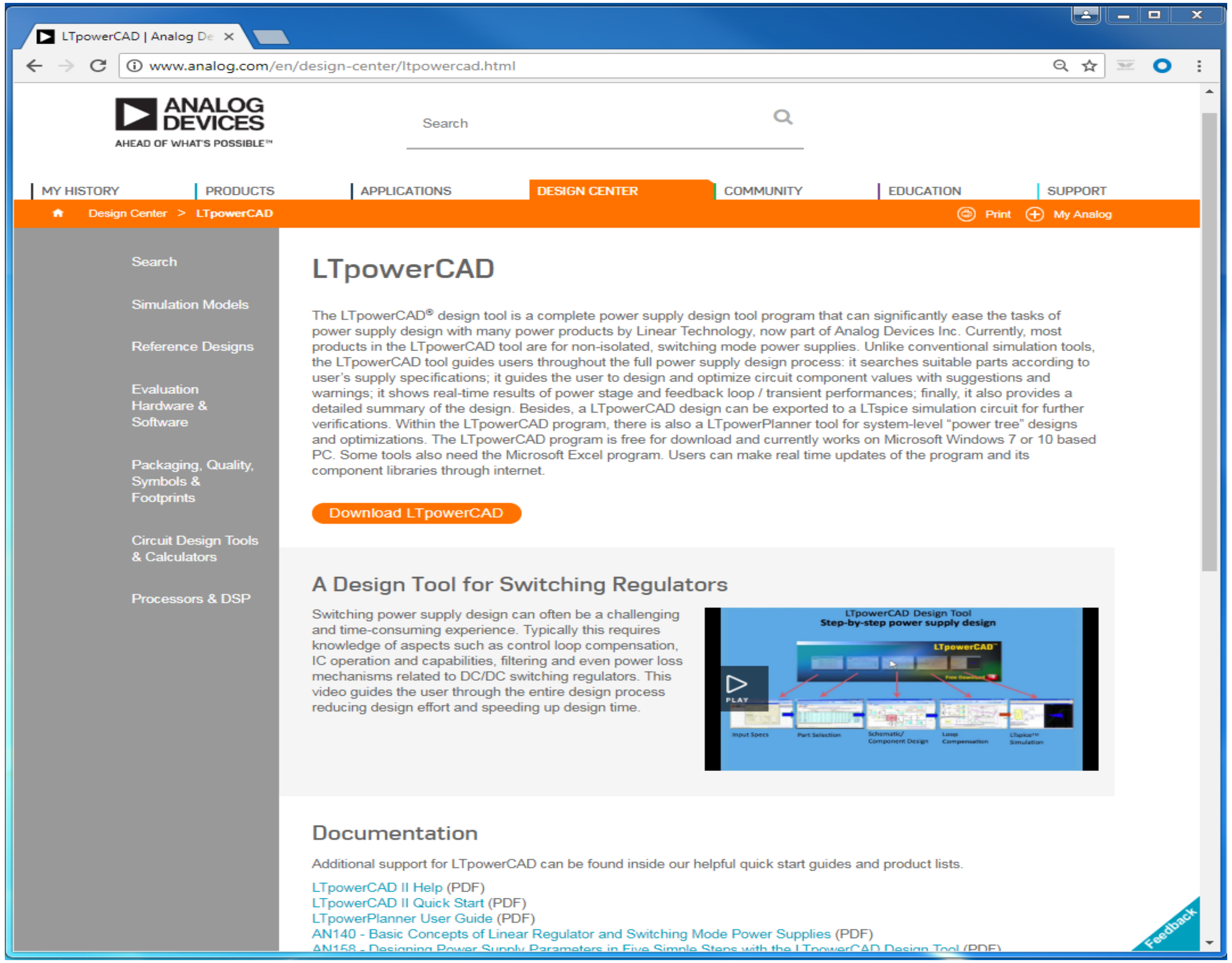
LTpowerCAD Bench Verification Report (on a Standard Demo Board)

Duty ~ 35%
V_{OUT}: 12 V at 10 A resistive load
V_{in} = 36 V C_{OUT} bulk: 4× 150 µF, 12 mΩ   VFB: 499 kΩ||22 pF +35.7 kΩ
f_{sw} = 120 kHz C_{OUT} ceramic: 4× 35 V 10 µF 1206   Comp: (1.5 kΩ +10 nF)||610 pF



Other Tools in LTpowerCAD

Webpage: analog.com/LTpowerCAD



- ▸Free download
- ▸Quick-start guide
- ▸Articles and videos

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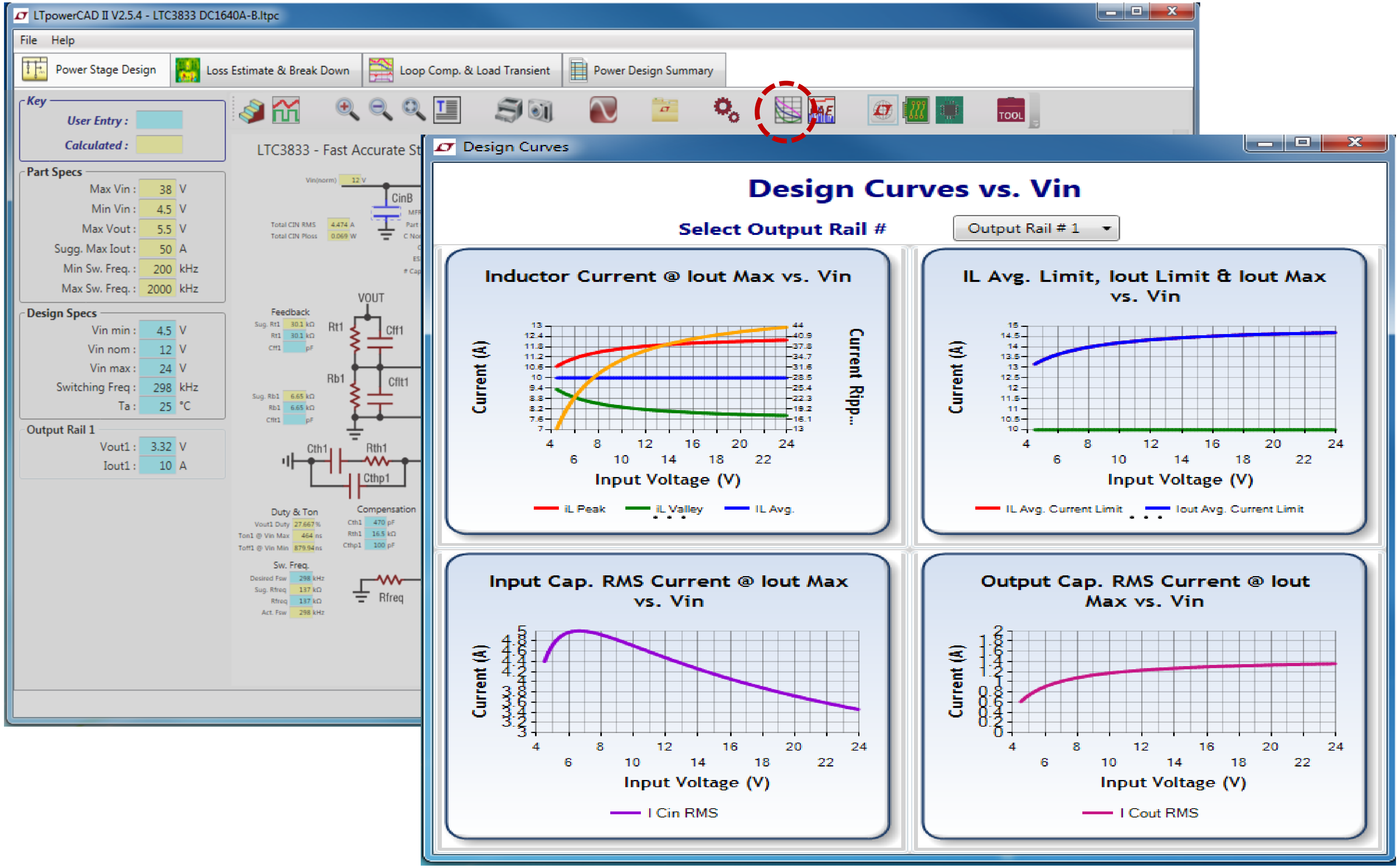
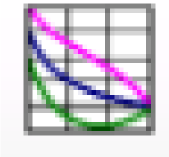
Advanced Features …

Design Curves (for Wide V_{IN} Range)





- Check the design in the full V_{IN} range.
- Check the worst case.

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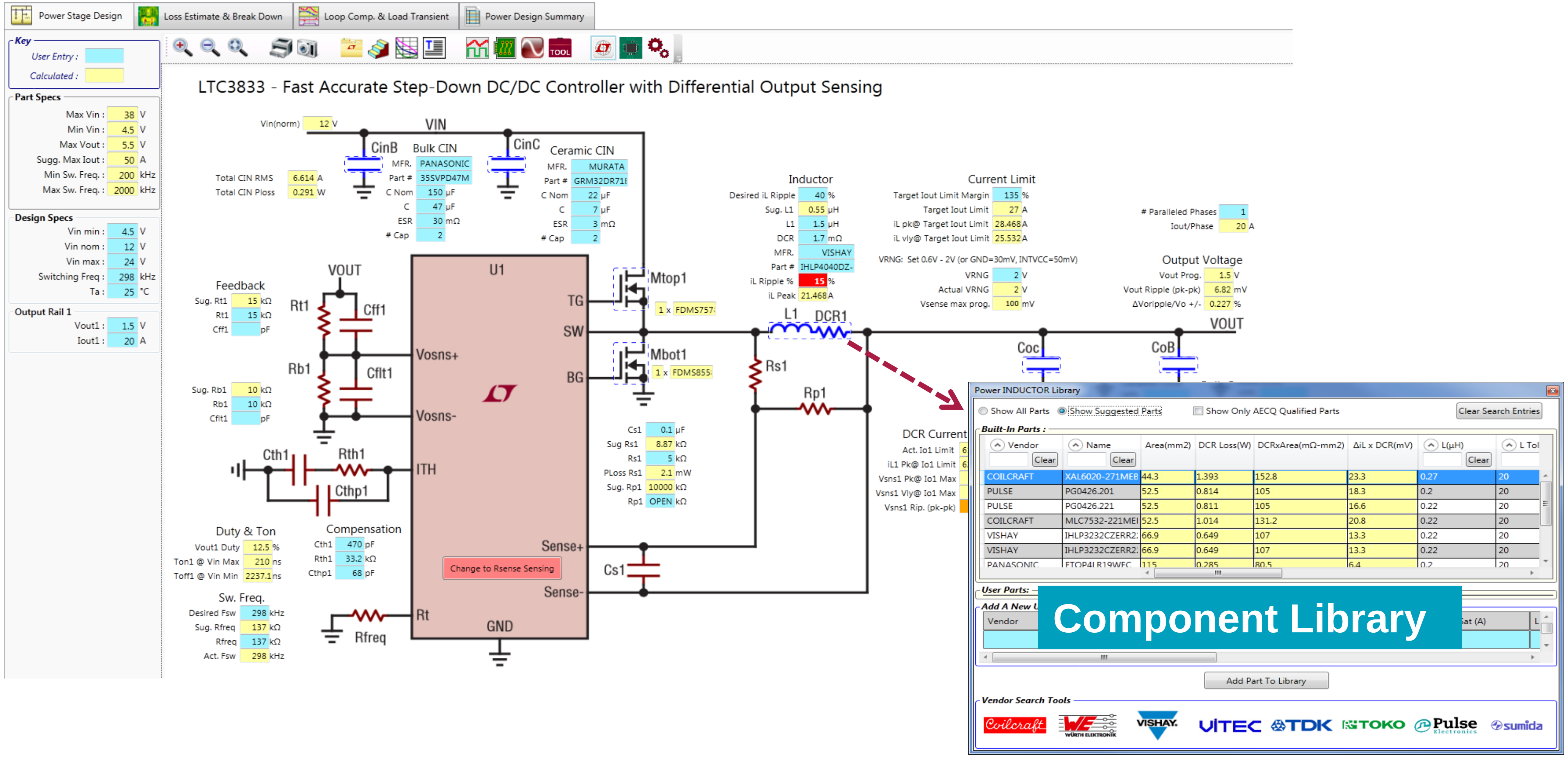
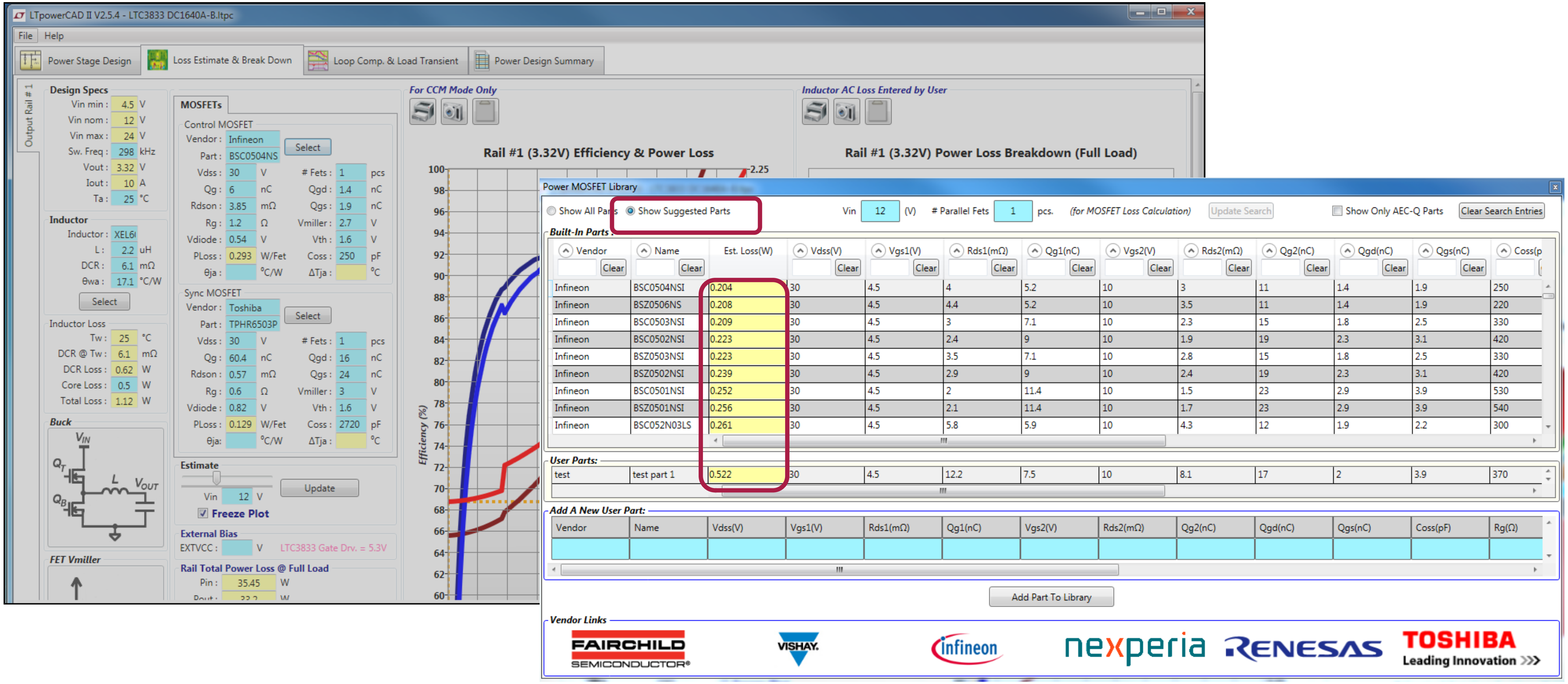
Power Stage Design: Component Libraries



Show Suggested Parts eases component selections

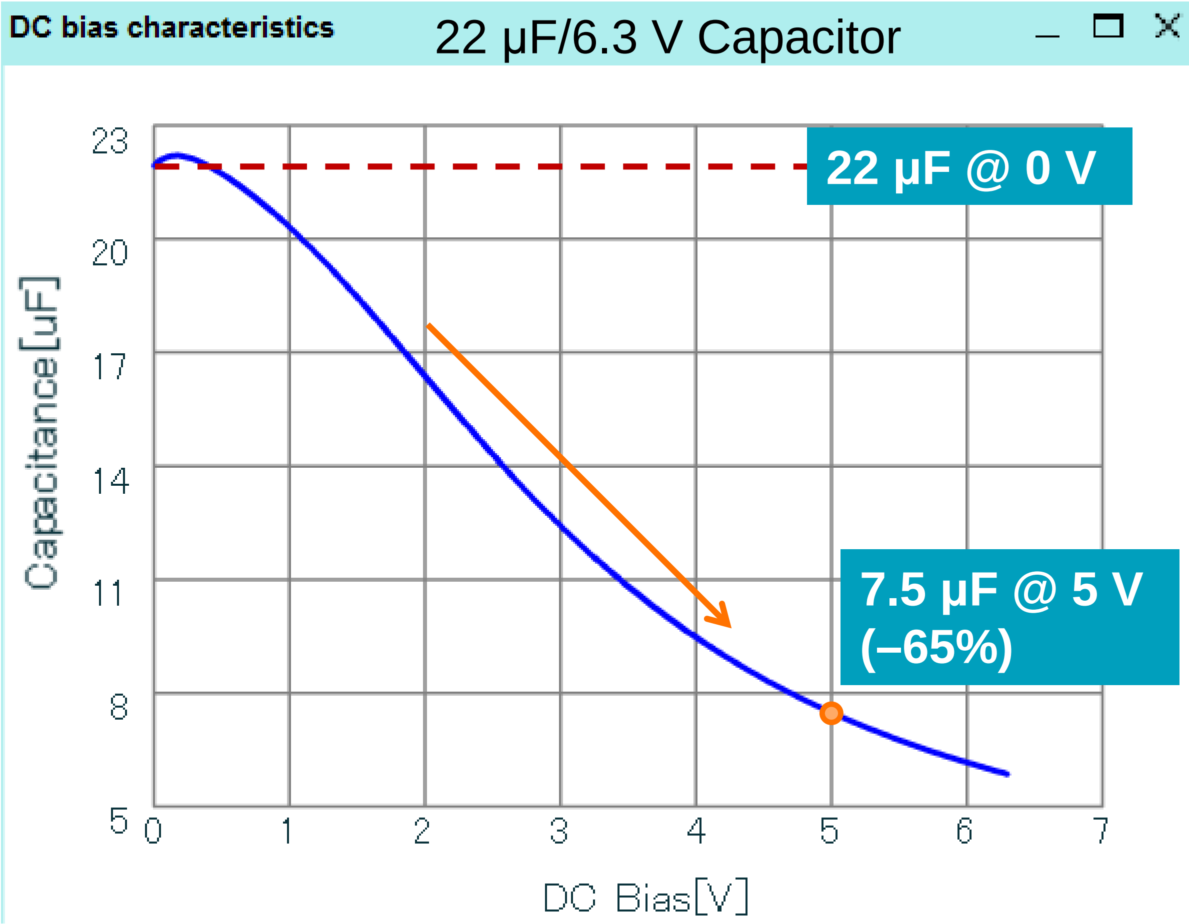
Component Library (Power MOSFET Example)



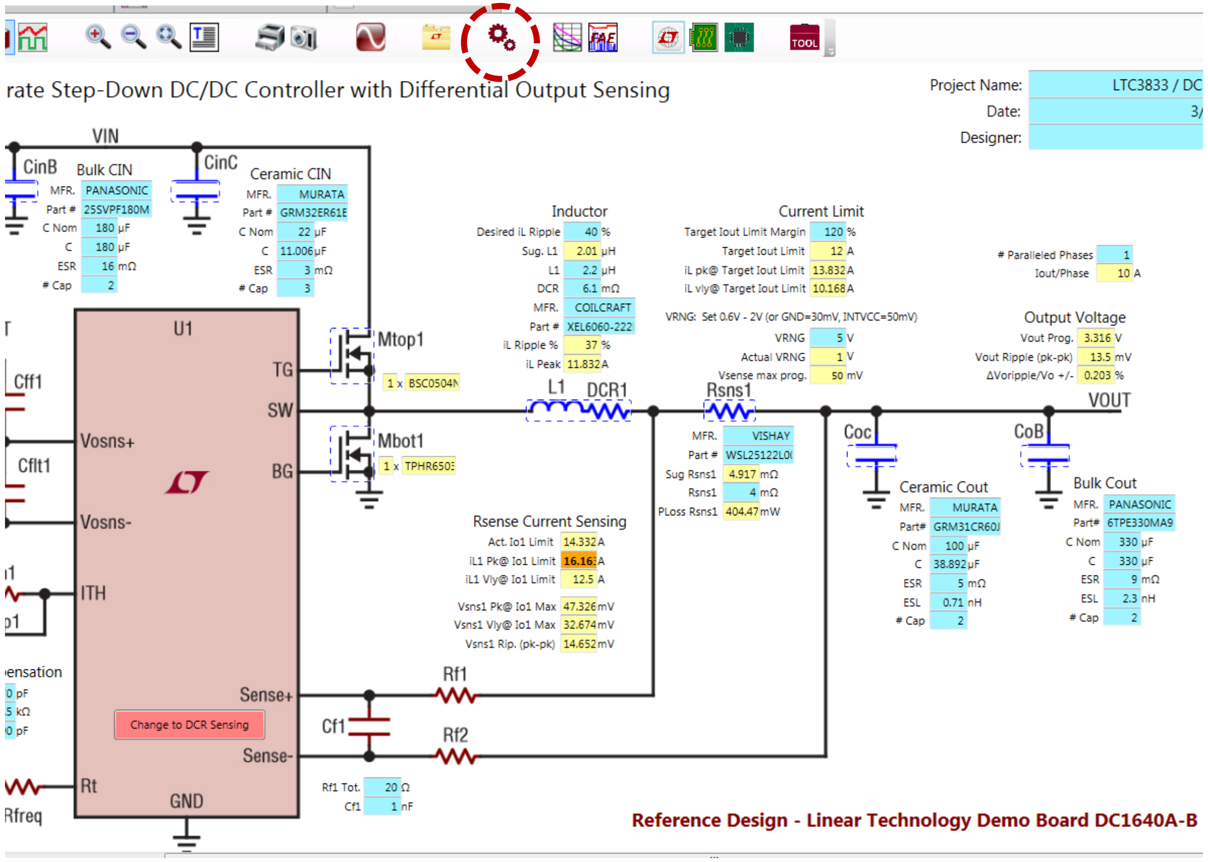
Show Suggested Parts—quick efficiency optimization

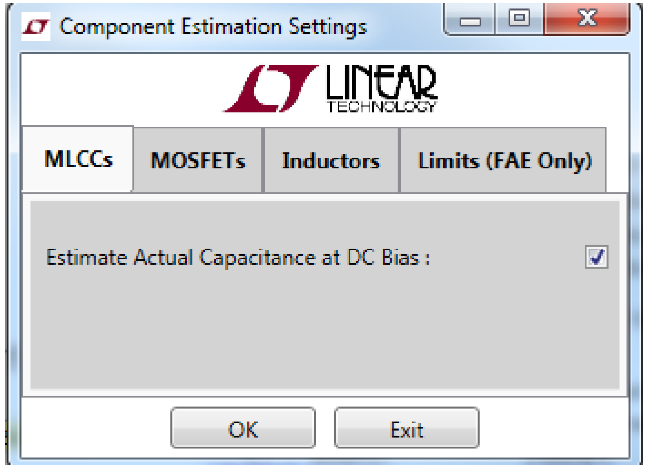
Ceramic Capacitor Derating vs. DC Bias

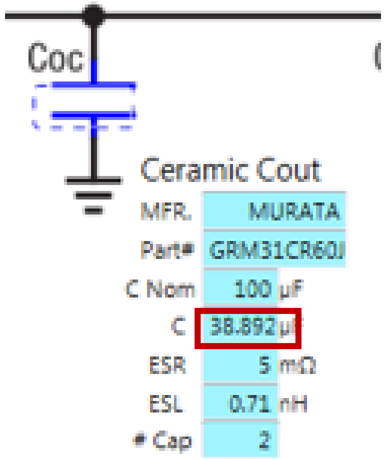
- MLCC: significant capacitance loss at V_{BIAS}
- How to design it in LTpowerCAD?



MLCC Auto Derating vs. DC Bias







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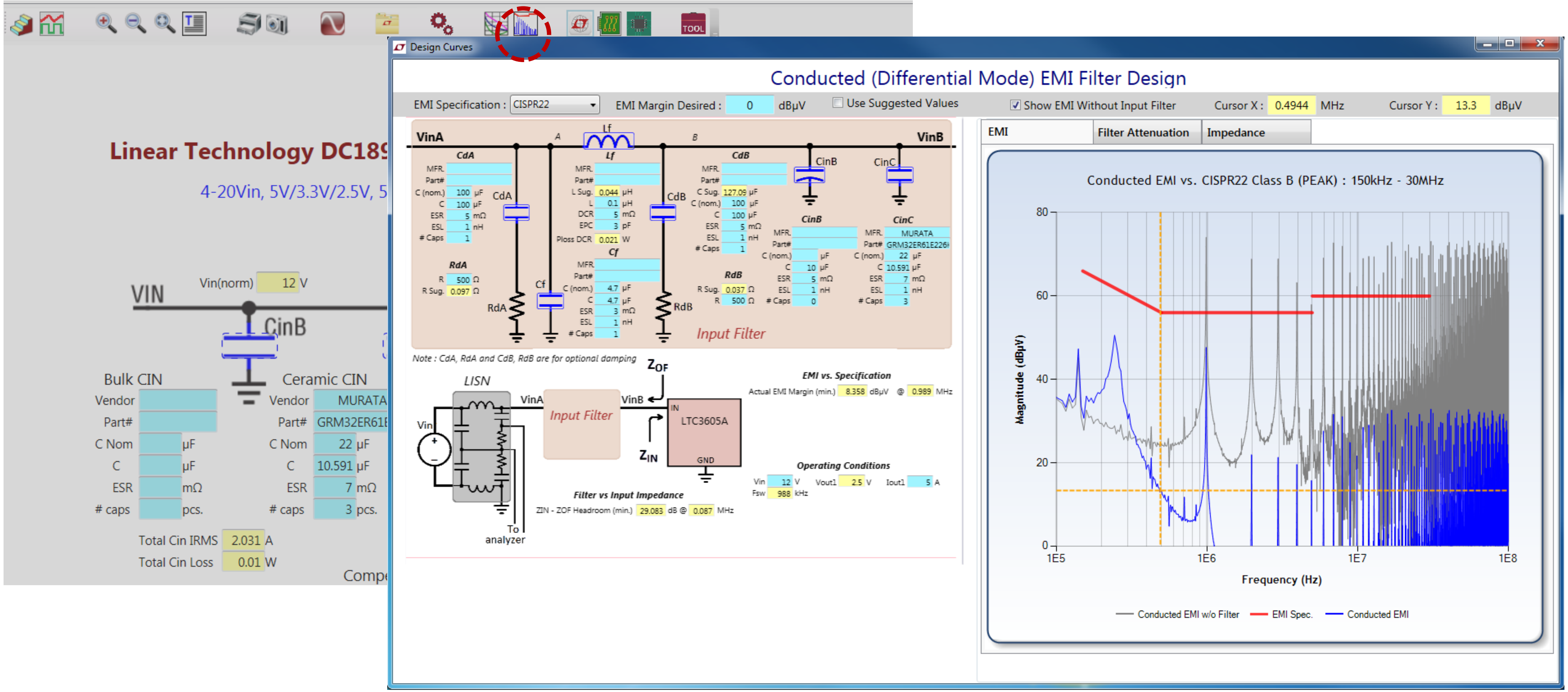
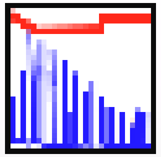
Input EMI Filter Design (Only for Differential Mode, Conducted EMI)

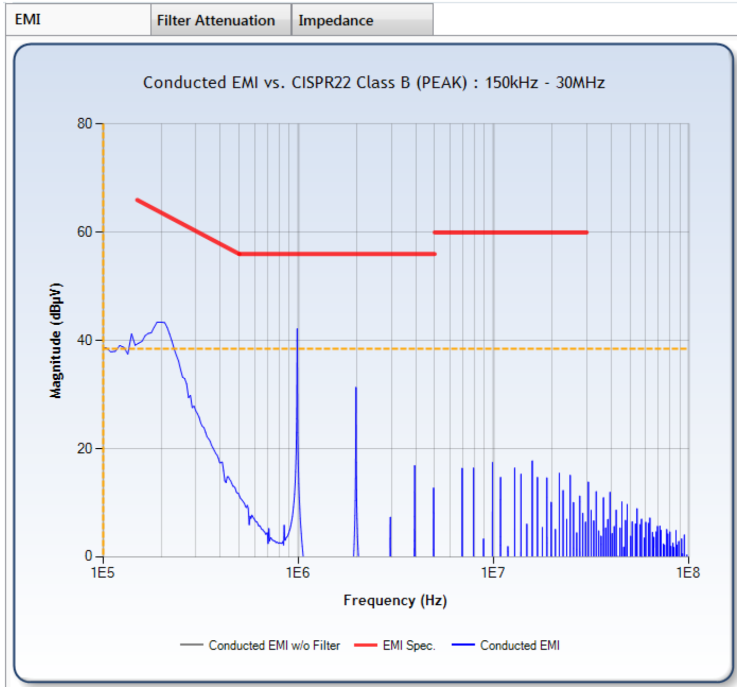




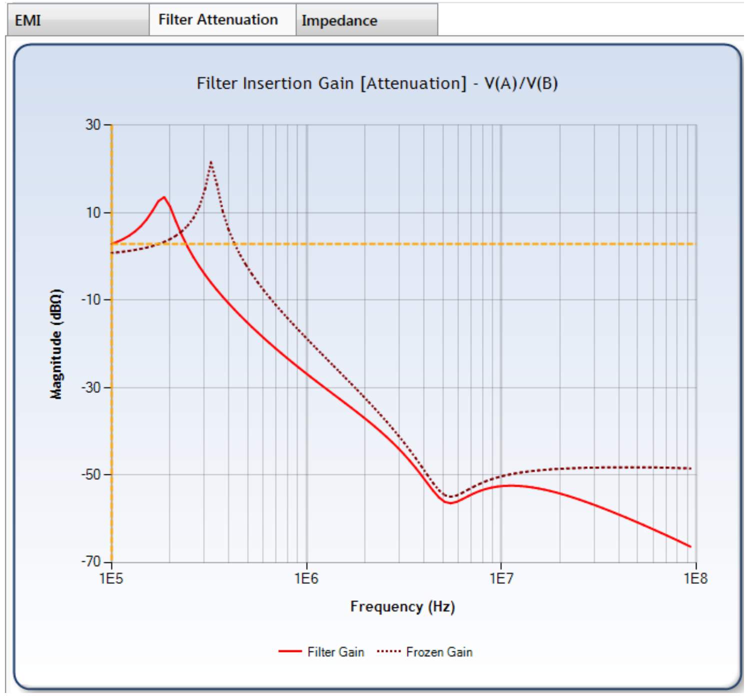
Released for buck and boost converters

Input EMI Filter Design Curves

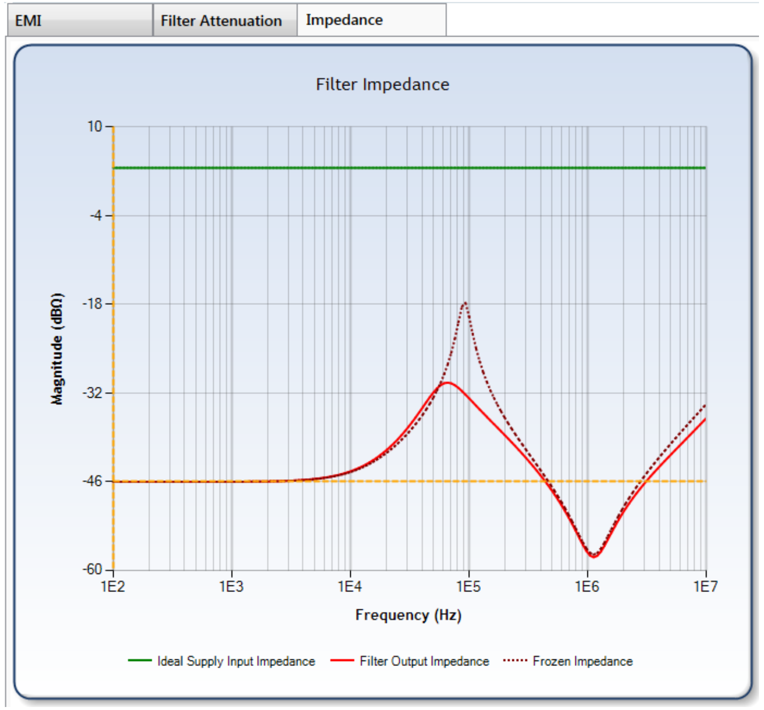
EMI Noise vs. Standard



Filter Insertion Gain (with Damping)



Filter/Supply Impedance (with Damping)



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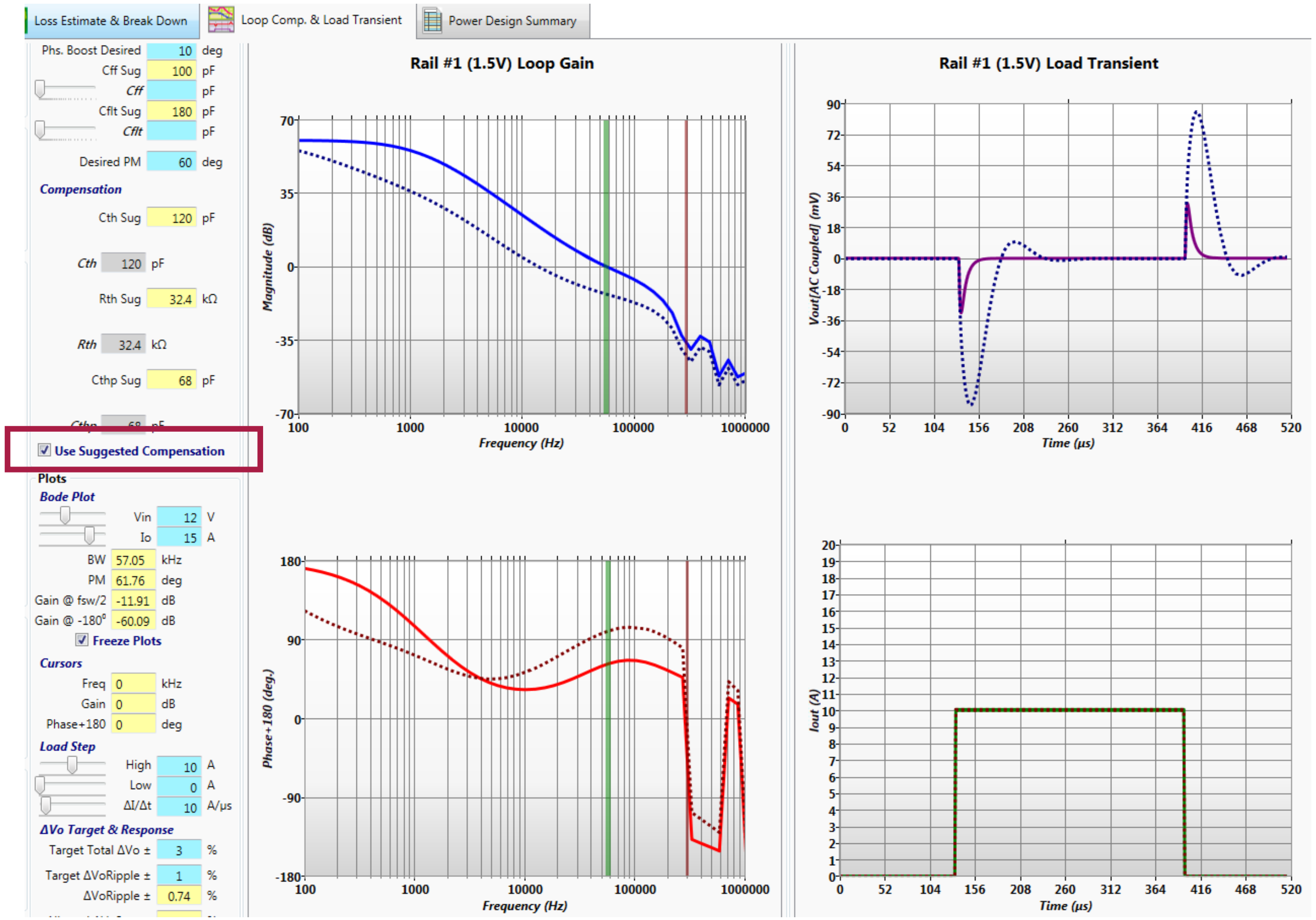
Auto Loop Compensation

One click



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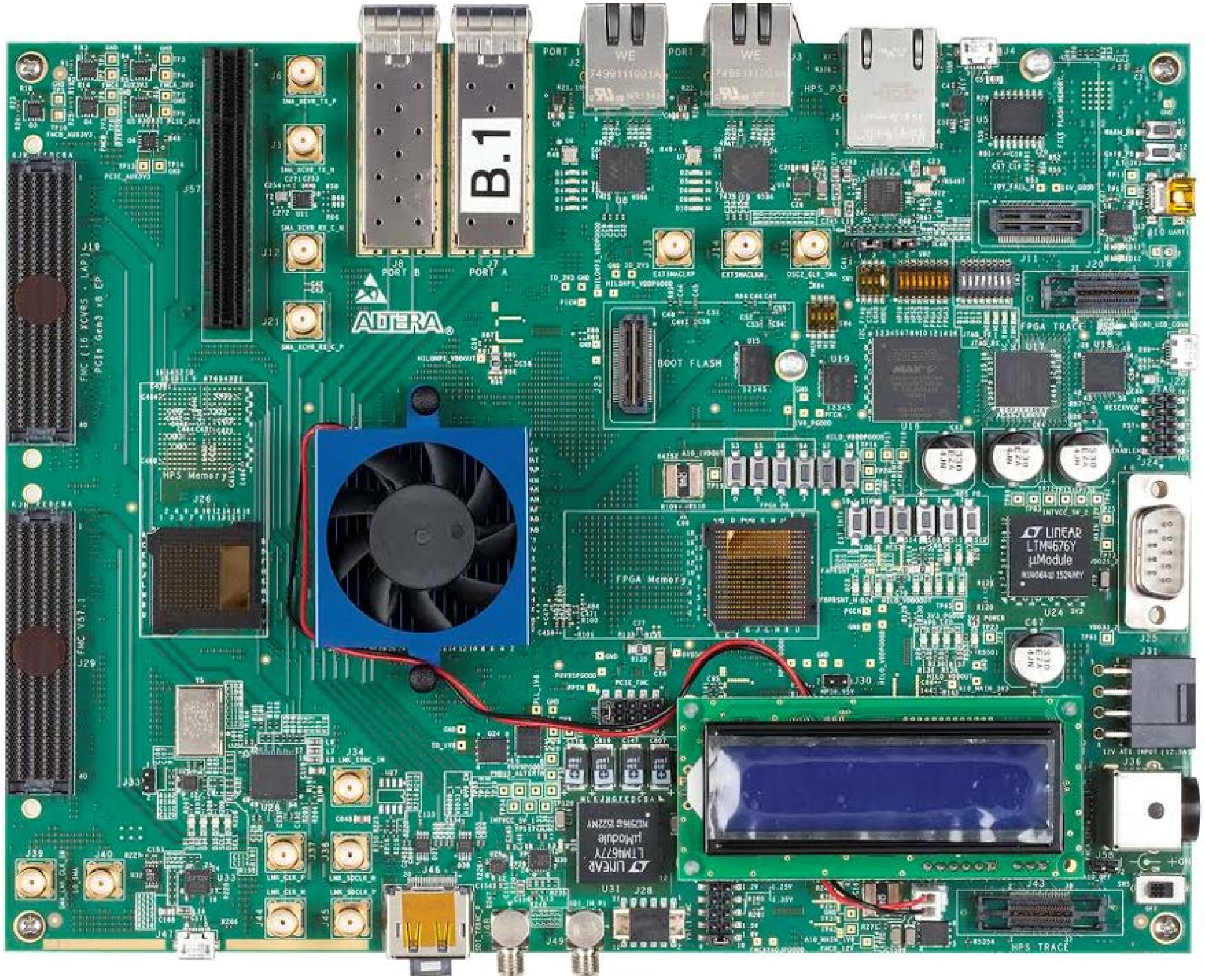
LTpowerPlanner® Design Tool
Brief Introduction

BY HENRY ZHANG AND TIM KOZONO
APPLICATIONS ENGINEERING
POWER PRODUCTS

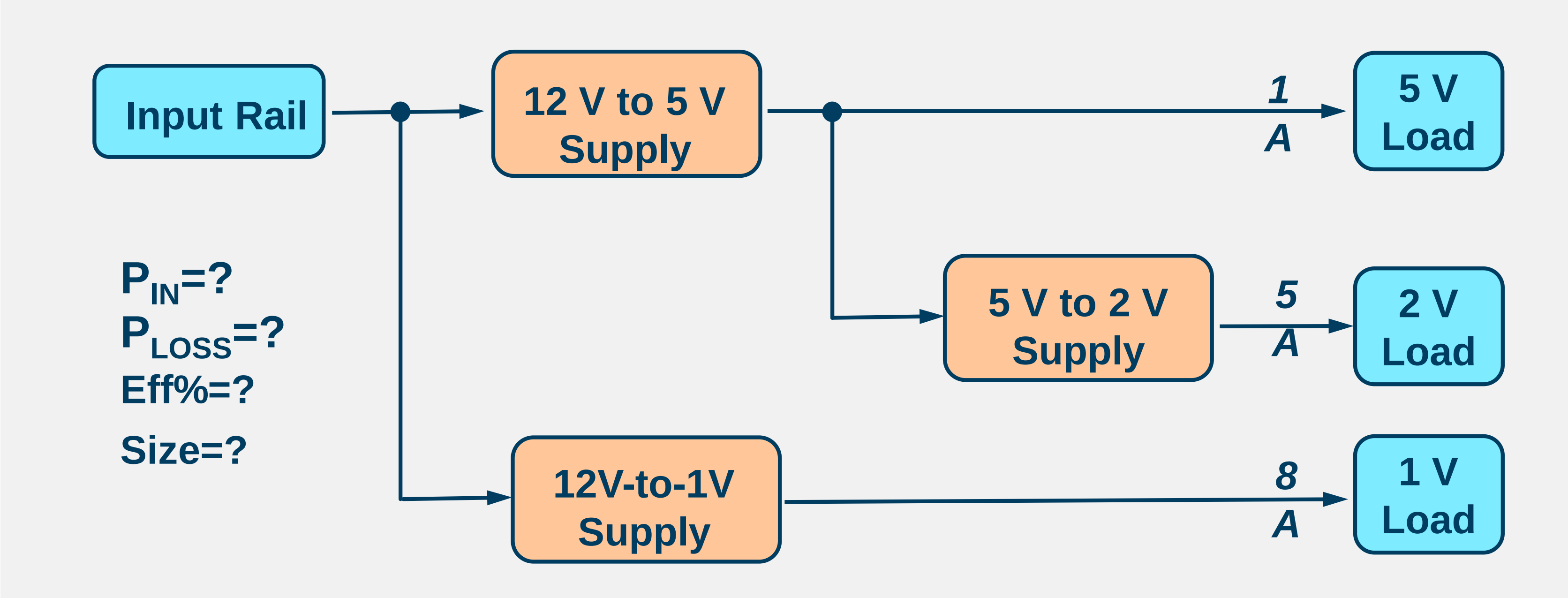
A System Board Example

- A modern electronic system usually has **many power supplies and loads.**
- A **power tree** drawing is needed.



A Power Management System Example

- A system designer needs to plan and development the entire power management system.
- System optimization: **total efficiency, loss, size, cost**, etc.



A system-level design and optimization tool is needed

LTpowerPlanner® Design Tool

A System-Level Power Planning Tool:

- **Create a system power tree diagram.**
- **Estimate total system power, efficiency, and size.**
- **Optional links to LTpowerCAD and LTspice Designs.**

- Available in the **LTpowerCAD package.**
- LTpowerCAD free download: analog.com/LTpowerCAD.
- Windows PC based.

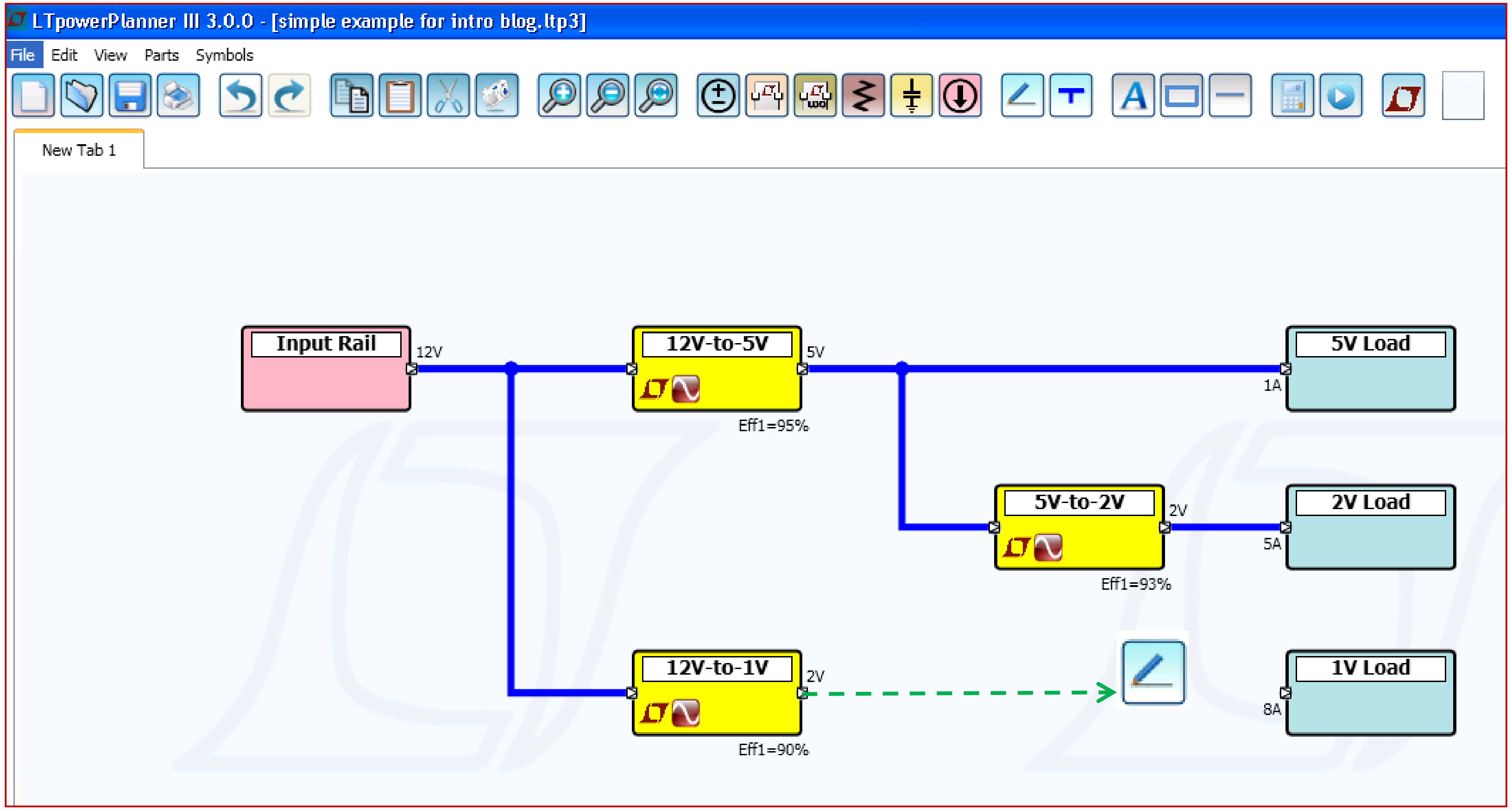
Why Use the LTpowerPlanner® Tool?

- **Draw system power tree diagram**
- **Calculate** total **system power, efficiency,** and solution **size**
- **Document** system architecture and design solutions
- **Compare** different system solutions for optimum solution
- **Present** intuitive system solutions

LTpowerPlanner® Tool: Getting Started

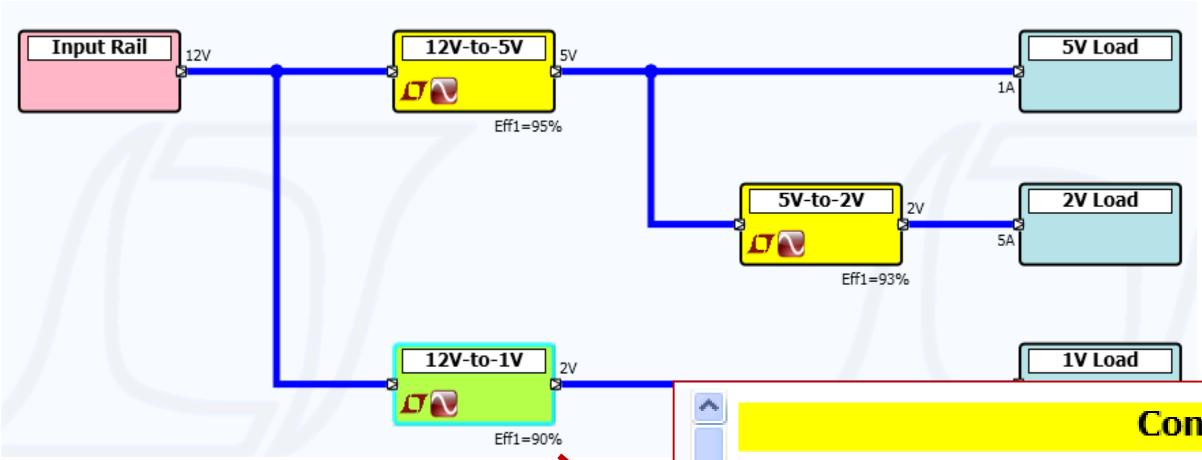
"**System Design**" in the LTpowerCAD package.

Step 1: Drawing a System Power Tree

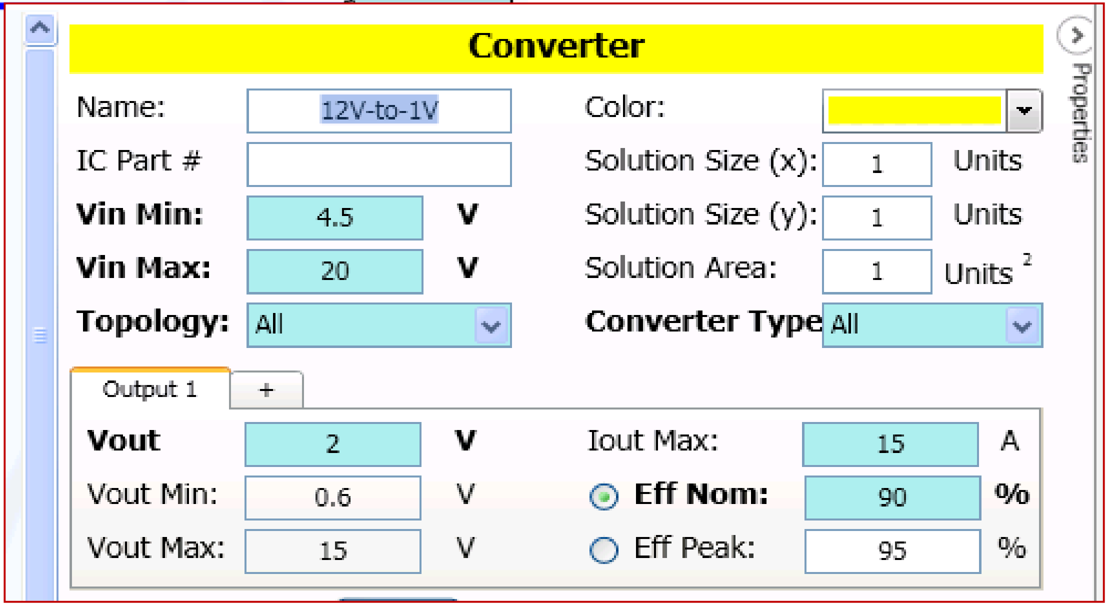


- Place input source, converter, and load components.
- Draw power wire connections (from left to right)

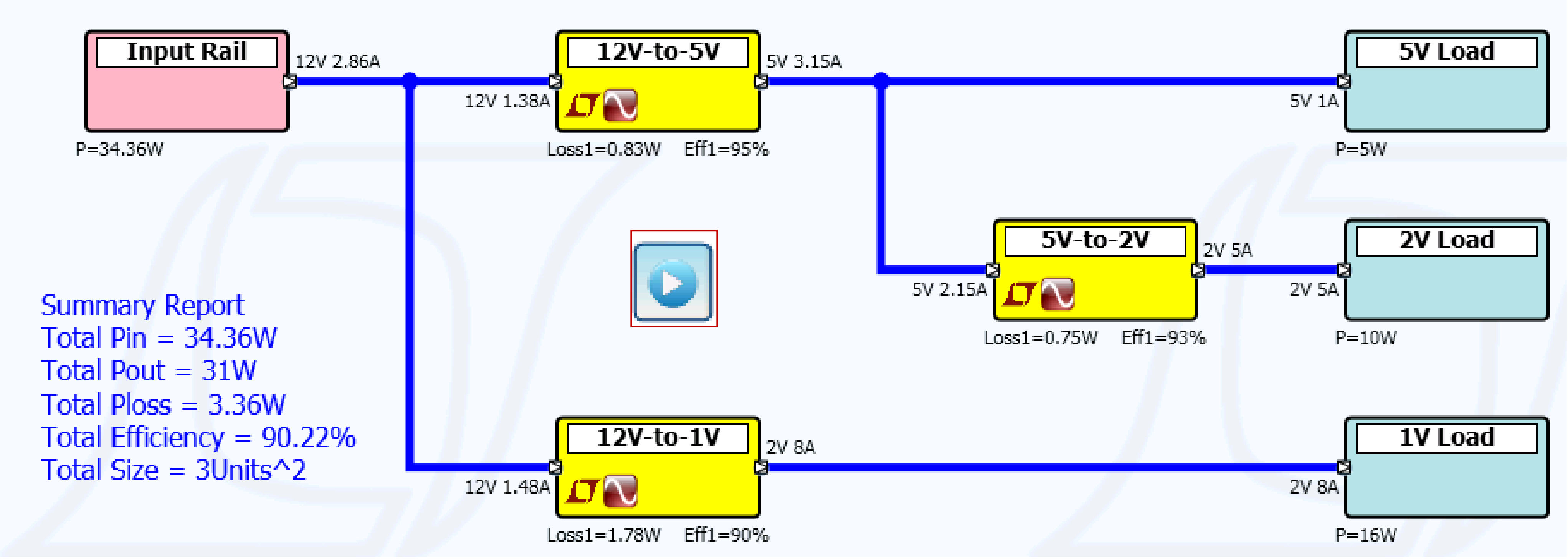
Step 2: Updating Parameters (For Input Source, Converters, and Loads)



- Enter key parameters in the **Properties** window for each *generic* part.

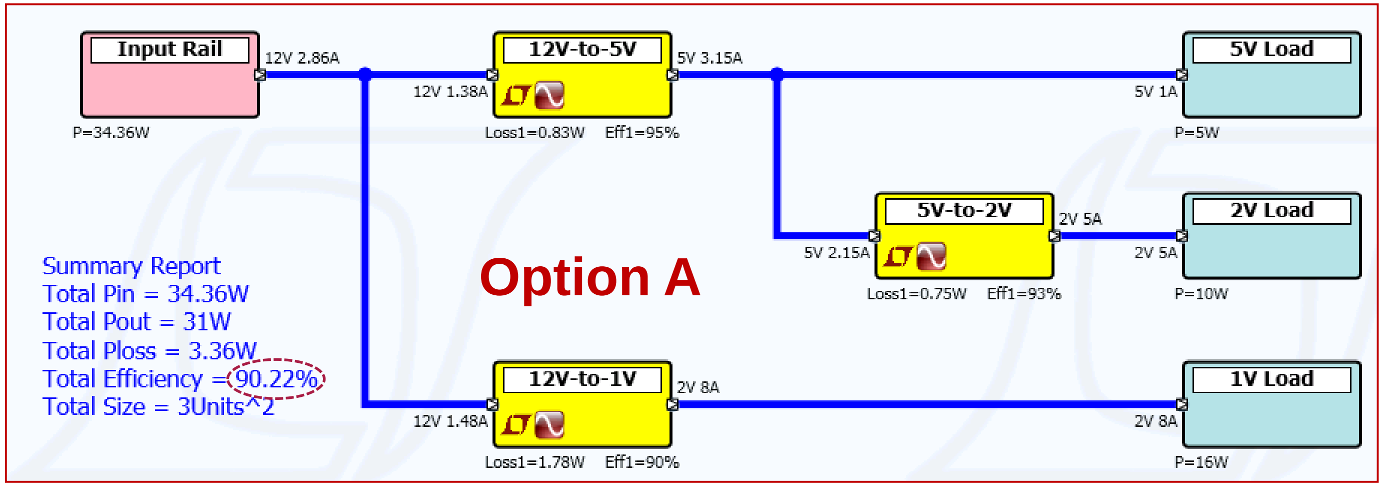


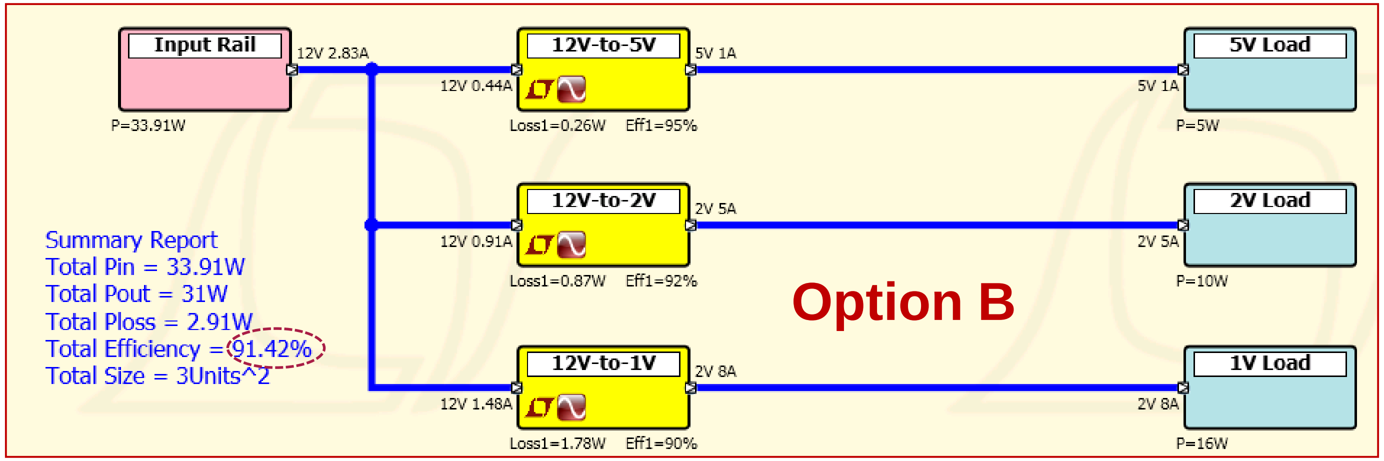
Step 3: Run Calculation



- Calculate total input power, output power, loss, efficiency, and size (based on user's entries of generic component parameters).

Comparing Different Architectures

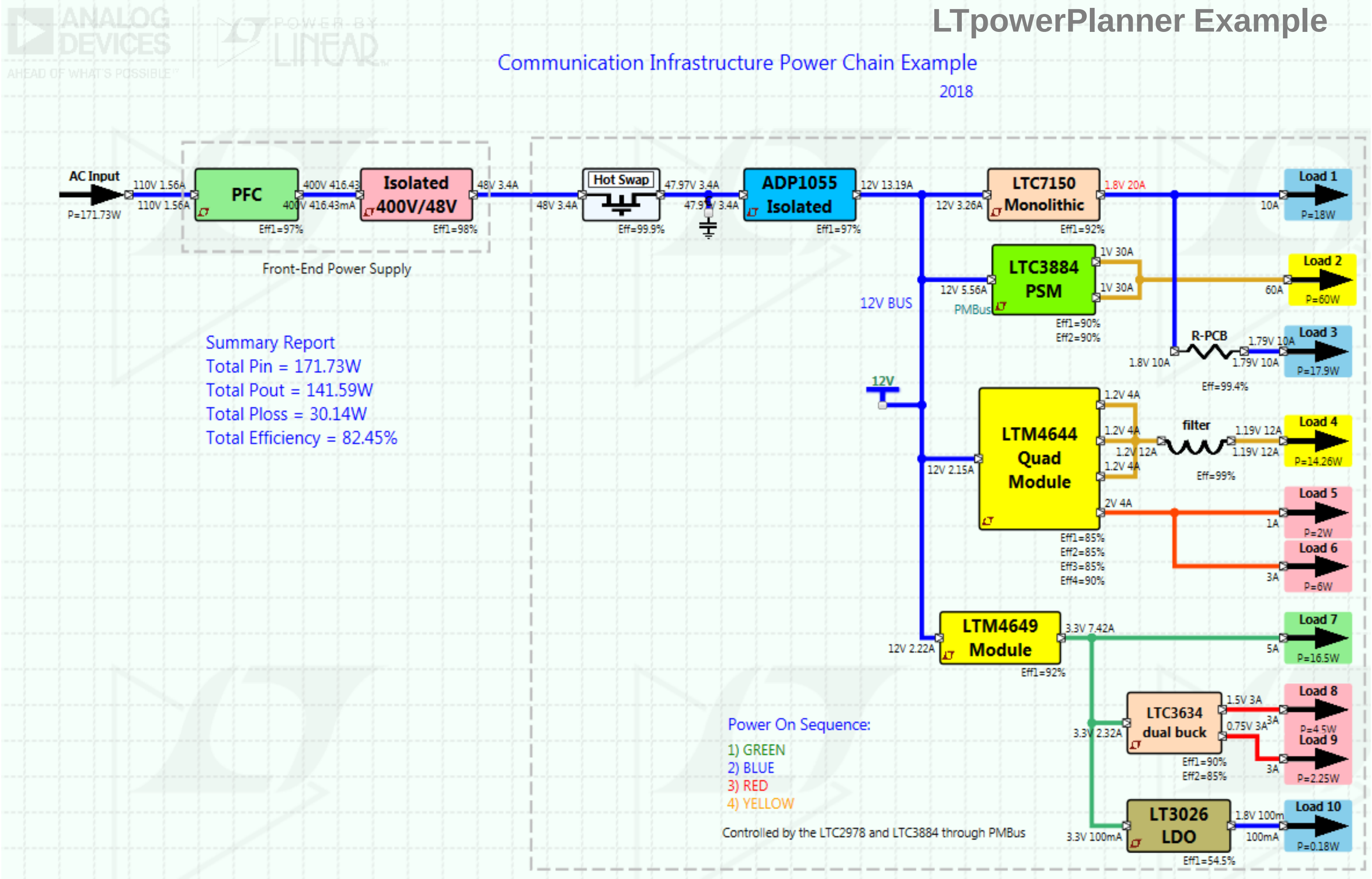




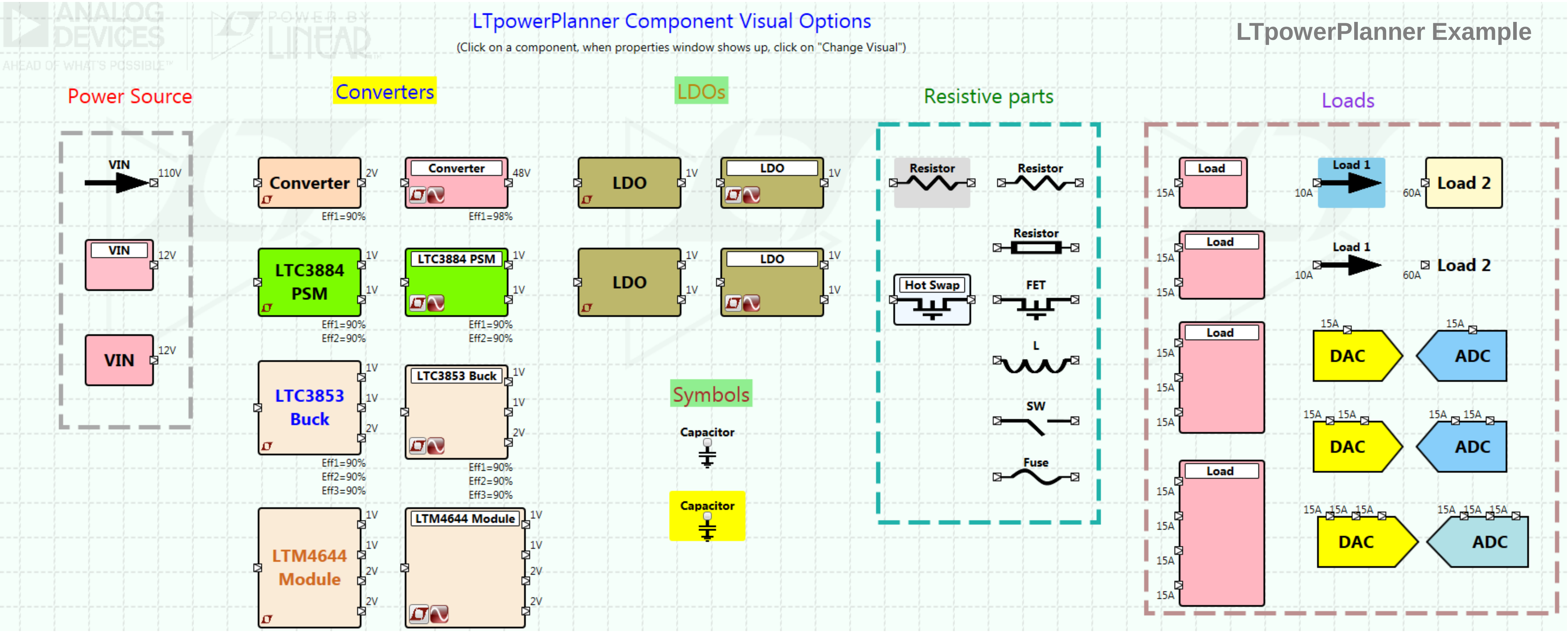
A quick power tree comparison for optimum design

A Communications System Power Tree Example

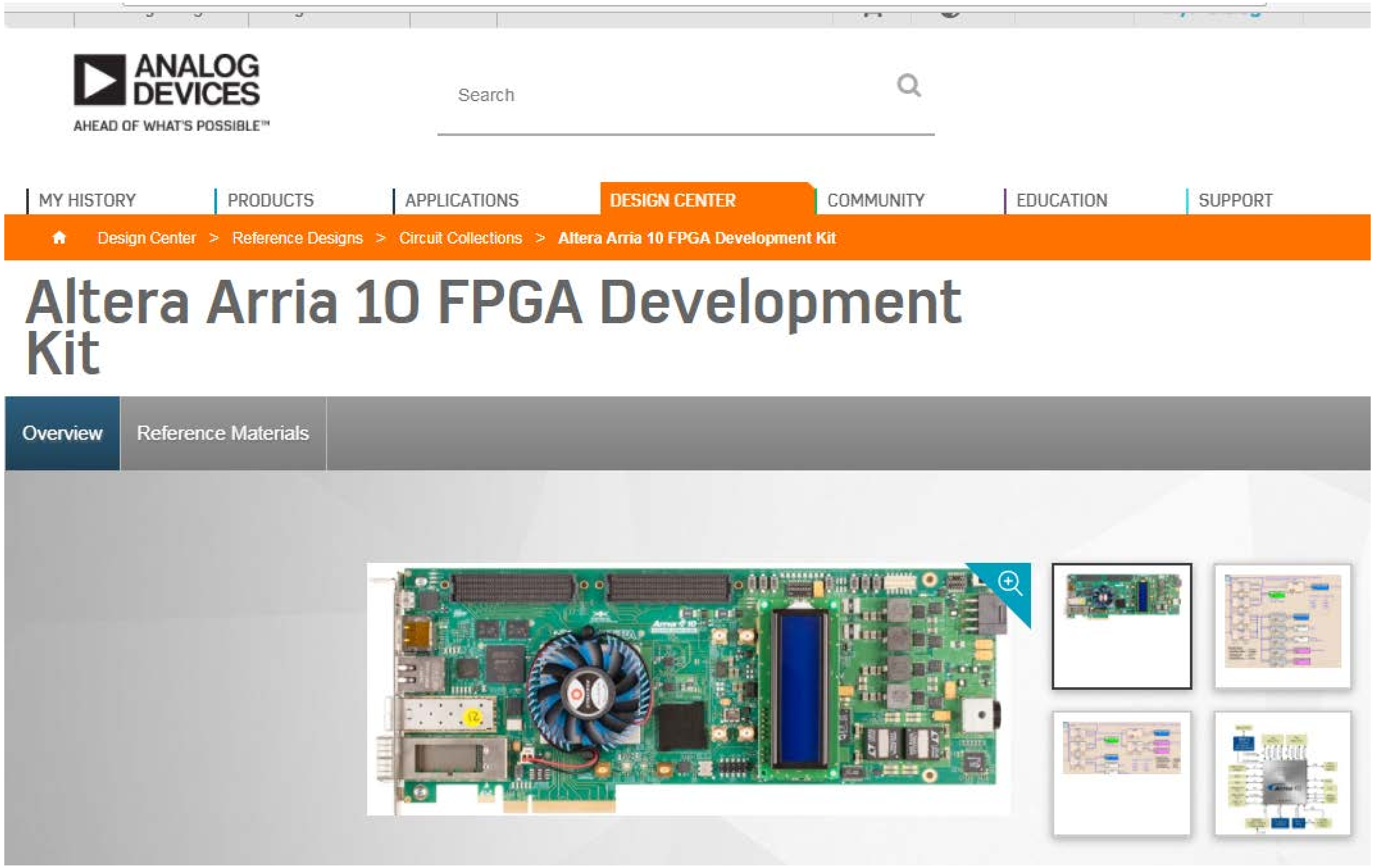
- Multichannel converters.
- Resistive component: R, L, FET, etc.
- Colored nets/loads to represent power-up/-down sequence.



LTpowerPlanner® Component Visual Options

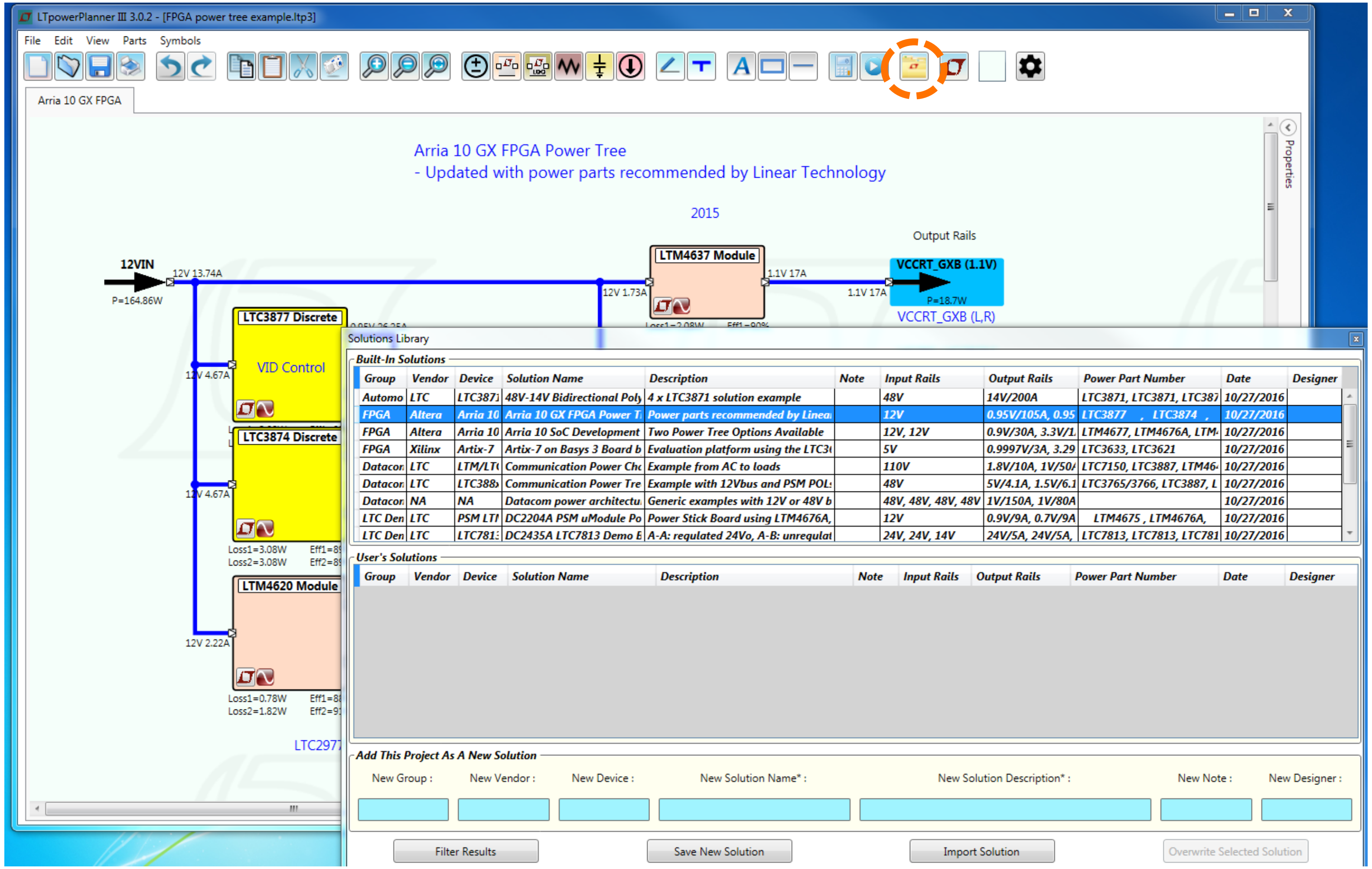


FPGA Reference Designs on analog.com



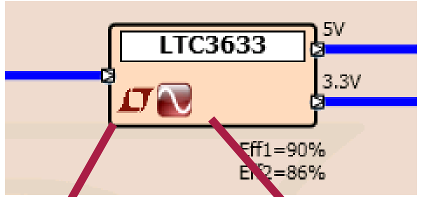
Many existing FPGA/processor reference power trees.

Solution Power Tree Example Library

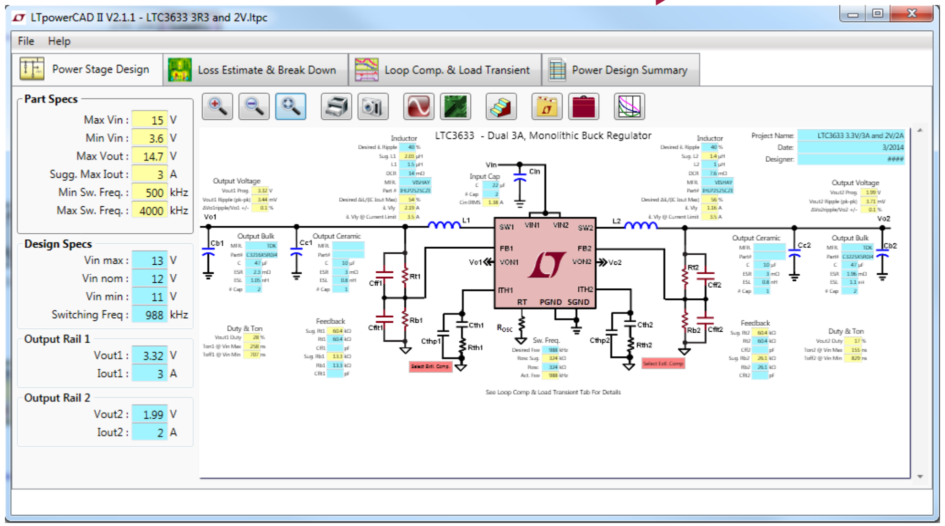


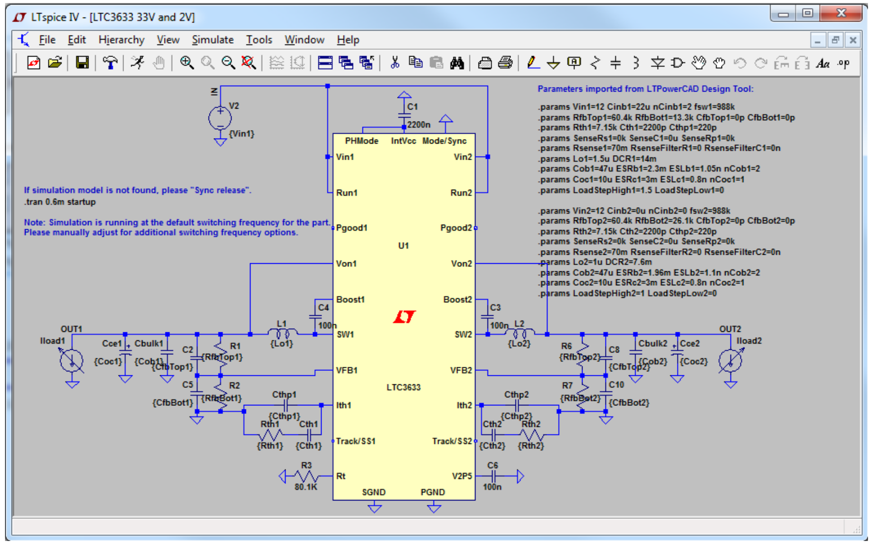
Some existing FPGA/processor reference power trees.

(Optional) Links to LTpowerCAD and LTspice



Click “Properties” to Link Existing Design Files





Leverage LTpowerCAD and LTspice tools to design each supply.

Summary

LTpowerPlanner tool helps you design a system with:

- Easy steps
- Intuitive GUI interface
- Short time
- Optimum system power solution

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LTPOWERCAD MAKES DESIGN

QUICK AND EASY

Questions and Suggestions?

Email : LTpowerCAD@analog.com

(formerly LTpowerCAD@linear.com)

Free Download at analog.com/LTpowerCAD