

WEBENCH® Design Center Tools

Today's Agenda



WEBENCH® Road Map & Vision – 10 minutes



WEBENCH® Power Designer: Optimize Rails, Simulate, Share Designs, Coupons, & Leads – 50 minutes



WEBENCH® Visualizer: A Great Selling Tool – 10 minutes



**WEBENCH® System Power Architect :
FPGA, Processor, Hot Swap, Isolation, LDOs, Filters - 30**



WEBENCH® FET Selection & Design Optimization – 20

WEBENCH® Tool Industry Awards

- 2011 EDN “Innovation of the Year”
 - WEBENCH FPGA Power Architect
- 2010 Electronic Design “Year’s Best - Power”
 - WEBENCH LED Architect
- 2009 EDN “Innovation of the Year”
 - WEBENCH Power/LED Designer
- 2008 Electronic Products “Product of the Year”
 - WEBENCH Sensor Designer
- 2006 IEC “DesignVision” Award
 - WEBENCH Designer
- 2005 EDN “Innovation of the Year”
 - WEBENCH Active Filter Designer
- 2001 EDN “Innovation of the Year”
 - WEBENCH 3.0
- 2000 Electronic Products “Product of the Year”
 - WEBENCH 1.0



WEBENCH® Mission

Instant
Ease of Use

WEBENCH® tools enable rapid comparison, selection, optimization, and prototyping for end to end analog system designs in the shortest time possible

Eco-System
Accelerates
Growth

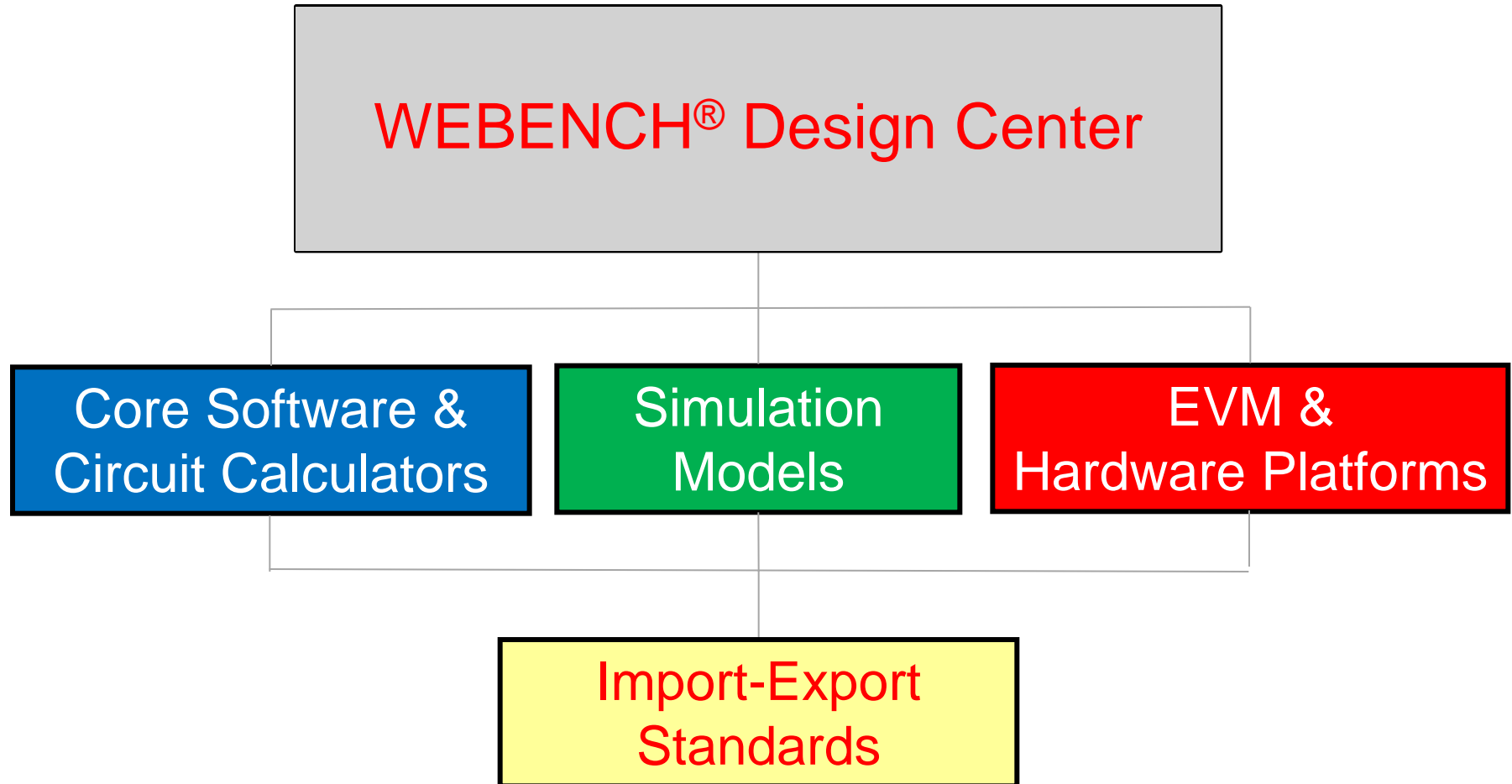
Partner with industry leading component, subsystem, and supply partners to expand resources and gain share. Deliver superior performance solutions at the lowest cost in the shortest time possible

Customers
Come First

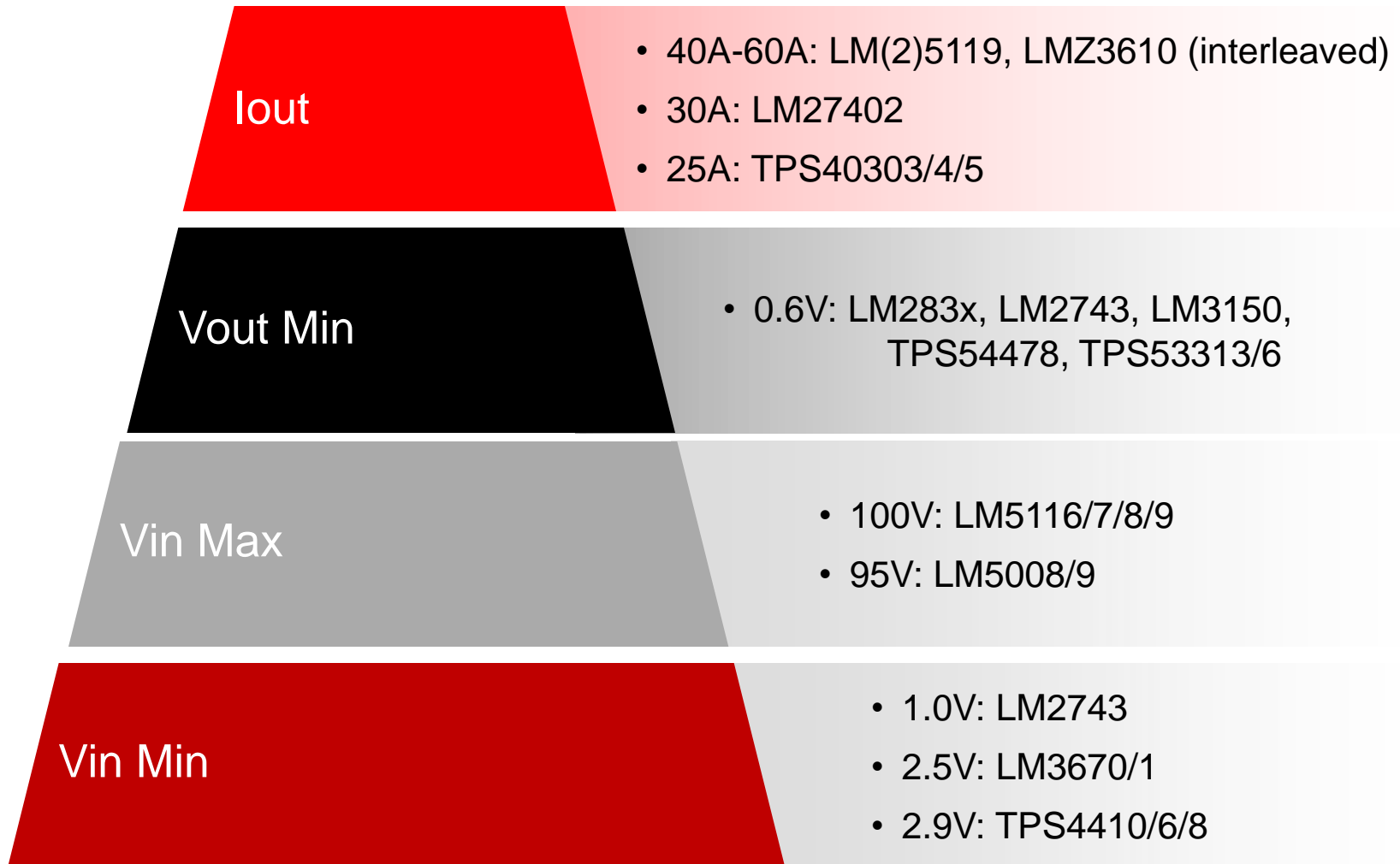
Build loyal customer relationships by enabling new value in their products. Accelerate customers to market with useful design knowledge and timely advice.

Grow TI Analog revenue at 2X the industry rate

WEBENCH® Development Vision



Coverage of WEBENCH Enabled Parts (Buck Switchers)



Immediate WEBENCH® Queue

Device	Vin	Vout	Iout	
TPS54062	4.7–60V	0.8–58V	0.05A	
TPS54325	4.5–18V	0.76–5.5V	3A	
TPS63020	1.8–5.5V	1.2–5.5V	3A	Buck-Boost
TPS40170	4.5–60V	0.6–50V	25A	
TLV62080/ TPS62080	2.5–5.5V	0.5–4V	1.2A	
TPS62080A	2.3–6V	0.5–4V	1.2A	
TPS62081	2.3–6V	1.8V	1.2A	
TPS62082	2.3–6V	3.3V	1.2A	
TLV62130	4–17V	0.9–5V	3A	
TLV62150	4–17V	0.9–5V	1A	
TPS51225/A/B/C	5.5–24V	3.3V & 5V	10A	
TPS54326	4.5–18V	0.76–5.5V	3A	Eco-Mode

Today's Agenda



WEBENCH® Road Map & Vision – 10 minutes



WEBENCH® Power Designer: Optimize Rails, Simulate, Share Designs, Coupons, & Leads – 50 minutes



WEBENCH® Visualizer: A Great Selling Tool – 10 minutes



**WEBENCH® System Power Architect :
FPGA, Processor, Hot Swap, Isolation, LDOs, Filters - 30**



WEBENCH® FET Selection & Design Optimization – 20

WEBENCH® Tools on TI.com

 **TEXAS INSTRUMENTS**

[Samples & Purchase Cart](#) | [About TI](#) | [TI Worldwide: United States](#) | [繁体中文](#) | [日本語](#) | [my.TI Login](#)

[Products](#) [Applications](#) [Design Support](#) [Sample & Buy](#) [All Searches](#) [GO](#)

CODE NAME: WOLVERINE

The world's lowest power MCU platform



Power Reference Design Library

[Learn more](#)



TI's C5535 eZdsp for fast, easy-to-use development

[Learn more](#)



Products

TI and National Semiconductor Products

- > Amplifiers & Linear
- > Audio
- > Broadband RF/IF & Digital Radio
- > Clocks & Timers
- > Data Converters
- > DLP & MEMS
- > High-Reliability Products
- > Interface
- > Logic
- > Power Management
- > Processors
 - ARM
 - Digital Signal Processors (DSP)
 - Microcontrollers (MCU)
- > Switches & Multiplexers
- > Temperature Sensors & Control ICs
- > Wireless Connectivity

Applications

- > Automotive and Transportation
- > Communications & Telecom
- > Computers & Peripherals
- > Consumer Electronics
- > Energy and Lighting
- > Industrial
- > Medical
- > Security
- > Space, Avionics and Defense
- > Video & Imaging

Featured Markets

- > Motor Drive & Control
- > Industrial Automation
- > LED Lighting
- > Smart Grid Solutions
- > Touch Product Solutions

Design Support

> **TI E2E™ Community** 
engineer.to.engineer, solving problems

[Forums](#) | [Videos](#) | [Blogs](#)

- > Technical Documents
- > Contact Technical Support
- > Quality, Reliability, Packaging & Eco-Info
- > Training & Events
 - Technology Days
- > TI University Program
- > Developer & Design House Network
- > TI Technical Articles

Sample & Buy

- > Samples & Purchase Cart
- > Pricing & Availability
- > Buy EVMs, Kits & Software
- > Semiconductor Distributors

Tools and Software

- > Analog
- > Digital Signal Processors & ARM Microprocessors
- > Microcontrollers (MCU)

WEBENCH® Designer

[Power](#) [FPGA/µP](#) [Sensors](#) [LED](#)

Enter your power supply requirements:

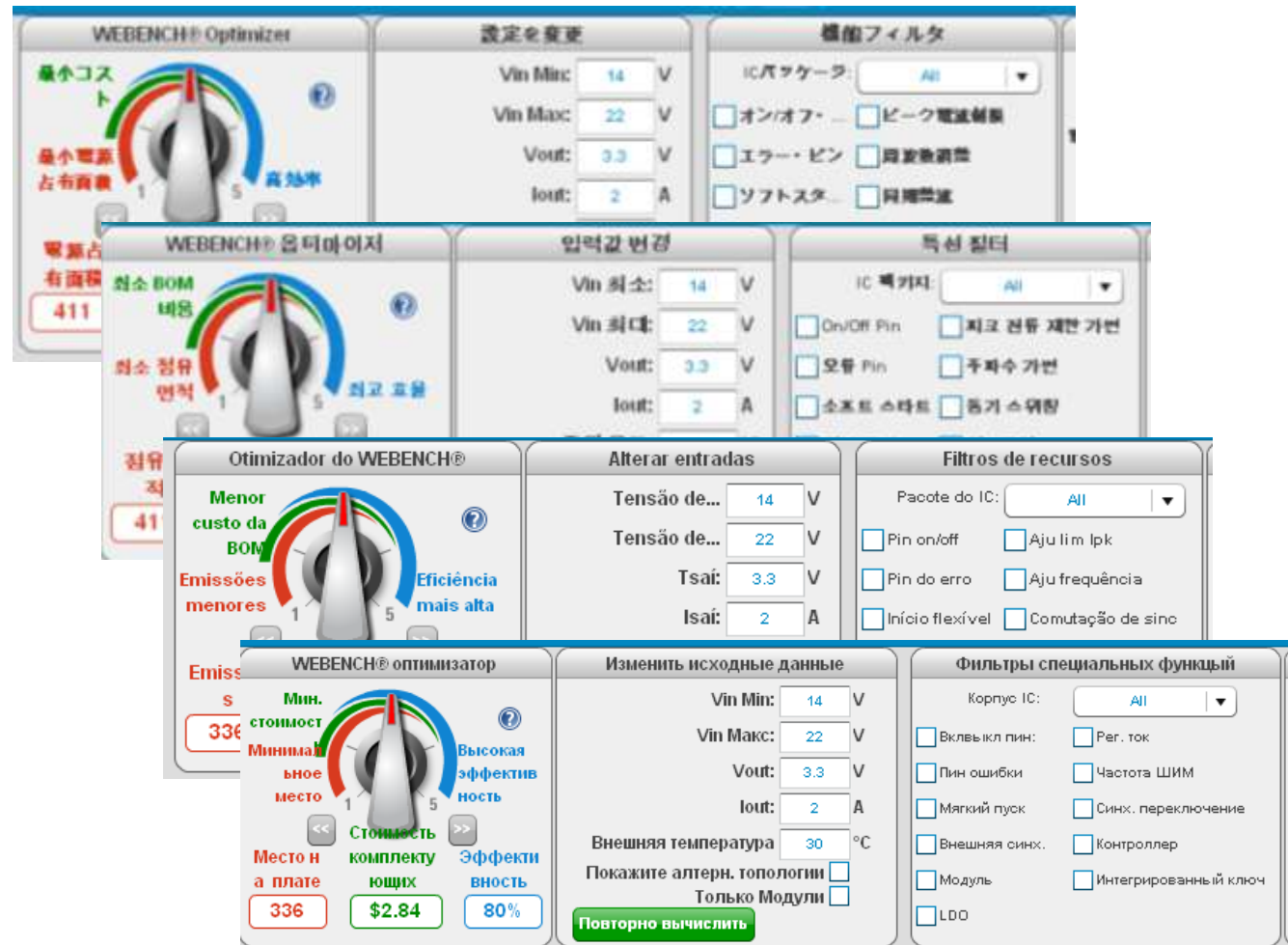
	Min	Max
Vin	<input type="text" value="14.0"/> V	<input type="text" value="22.0"/> V
	Vout	Iout
Output	<input type="text" value="3.3"/> V	<input type="text" value="2.0"/> A
Ambient Temp	<input type="text" value="30"/> °C	

Multiple Loads
[Power Architect](#)

Single Output
[Start Design](#)

WEBENCH® Designer is Multi-Lingual

- English
- Japanese
- Simplified Chinese
- Traditional Chinese
- Korean
- Portuguese
- Russian



WEBENCH® Start Panel

WEBENCH® Designer

Power

FPGA/μP

Sensors

LED

Enter your power supply requirements:

	Min		Max	
Vin	<input type="text" value="14.0"/>	V	<input type="text" value="22.0"/>	V
	Vout		Iout	
Output	<input type="text" value="3.3"/>	V	<input type="text" value="2.0"/>	A
Ambient Temp			<input type="text" value="30"/>	°C

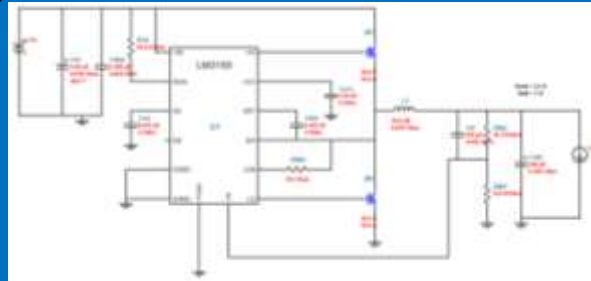
Multiple Loads

Single Output

Power Architect

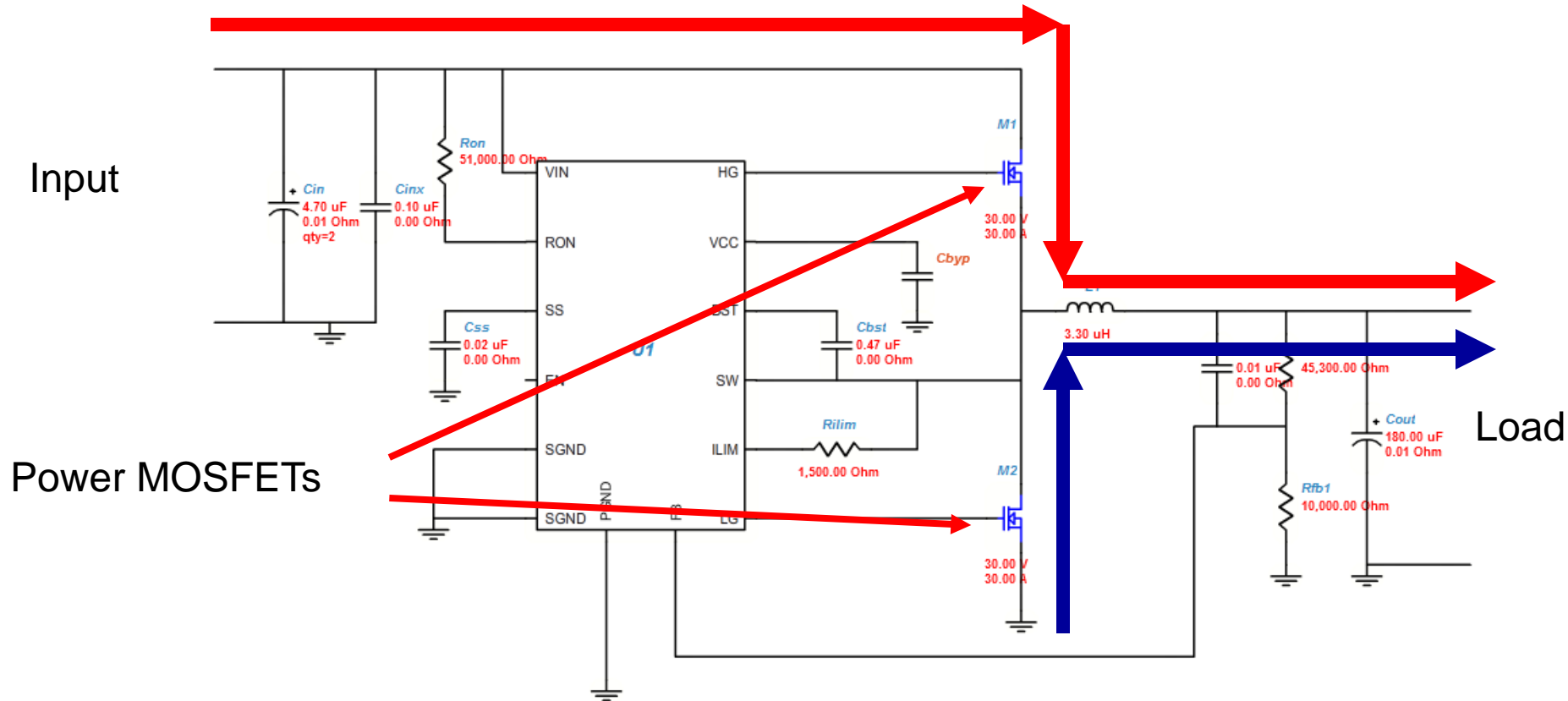
Start Design

The Foundation Is Mathematics



WEBENCH® Designer Tools

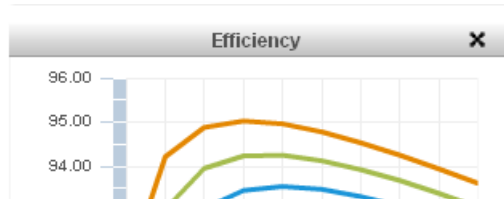
Schematic – Synchronous Buck Controller



Current Path with High Side Switch On

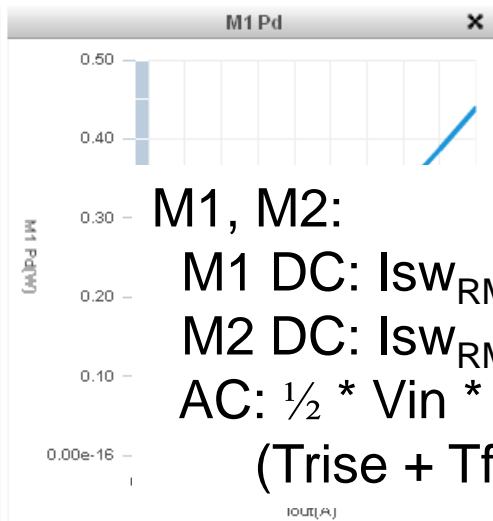
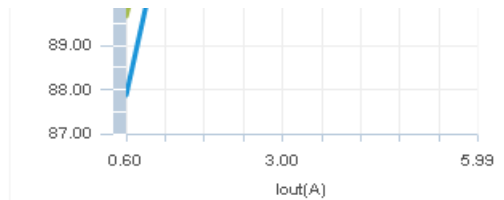
Current Path with High Side Switch Off

Visualize Behavior – Power Dissipation



$$\text{Efficiency} = P_{\text{out}} / P_{\text{in}}$$

$$P_{\text{in}} = V_{\text{out}} * I_{\text{out}} + P_{\text{diss}}$$

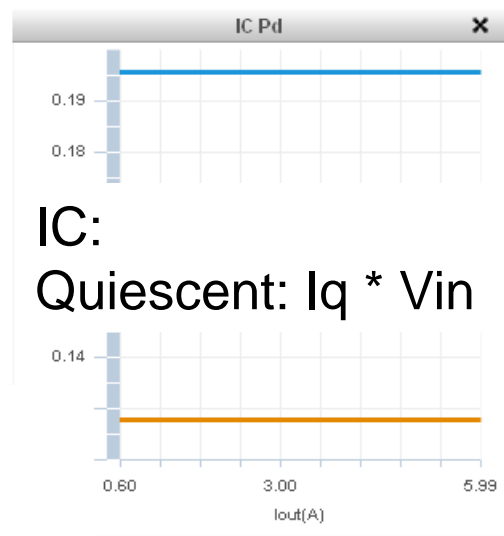
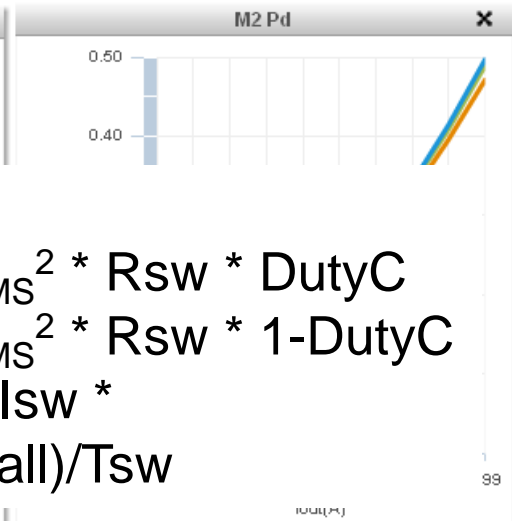


M1, M2:

$$\text{M1 DC: } I_{\text{sw_RMS}}^2 * R_{\text{sw}} * \text{DutyC}$$

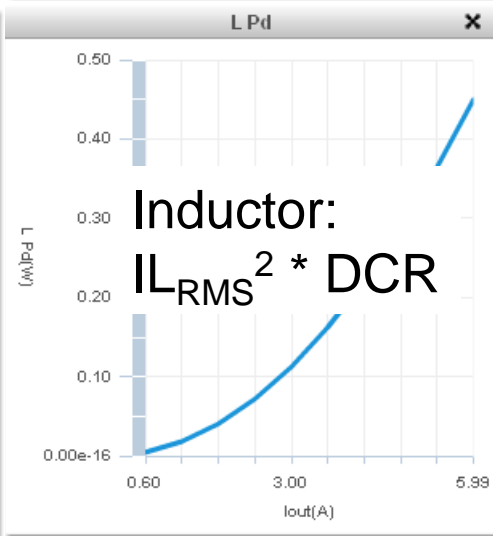
$$\text{M2 DC: } I_{\text{sw_RMS}}^2 * R_{\text{sw}} * 1 - \text{DutyC}$$

$$\text{AC: } \frac{1}{2} * V_{\text{in}} * I_{\text{sw}} * (\text{Trise} + \text{Tfall}) / T_{\text{sw}}$$



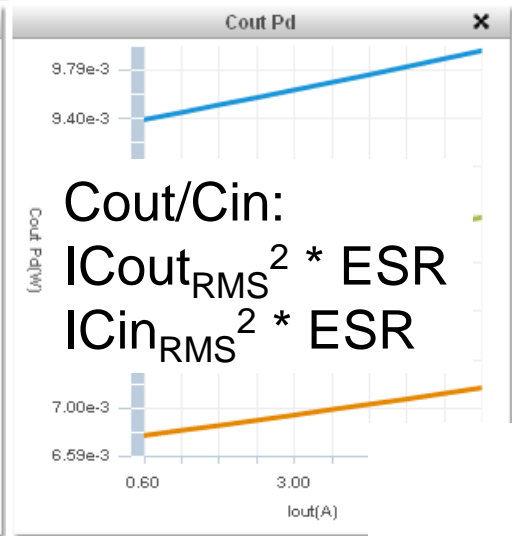
IC:

$$\text{Quiescent: } I_{\text{q}} * V_{\text{in}}$$



Inductor:

$$I_{\text{L_RMS}}^2 * \text{DCR}$$



Cout/Cin:

$$I_{\text{Cout_RMS}}^2 * \text{ESR}$$

$$I_{\text{Cin_RMS}}^2 * \text{ESR}$$

WEBENCH Design Optimization



Optimization Setting	Frequency	Component Selection	Summary
1 – Smallest footprint	Highest	<ul style="list-style-type: none"> • Smallest footprint • Don't care about cost 	Smallest size but lowest efficiency
2 – Lowest cost	High	<ul style="list-style-type: none"> • Lowest cost 	High frequency means smaller / cheaper components
3 – Balanced	Medium	<ul style="list-style-type: none"> • In stock • Low cost 	Balanced approach using IC's middle frequency
4 – High efficiency	Low	<ul style="list-style-type: none"> • Low DCR, ESR, Vf • Low cost 	Higher efficiency, with low cost but larger parts
5 – Highest efficiency	Lowest	<ul style="list-style-type: none"> • Lowest DCR, ESR, Vf • Don't care about cost 	Highest efficiency but largest parts

Optimization Summary

- **To get high efficiency (lean toward 5)**
 - Decrease frequency to reduce AC losses
 - Choose components with low resistance
- **To get small footprint (lean toward 1)**
 - Increase frequency to reduce inductor size
 - Choose components with small footprint
- **Cost (usually 2)**
 - Smaller components usually cheaper



These parameters are at odds with each other and need to be balanced for a designer's needs

WEBENCH® Design And Prototyping

1. Choose a Part



Enter Specifications



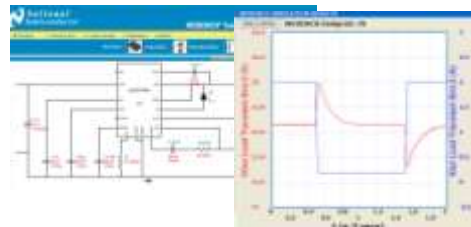
Select Part

2. Create a Design

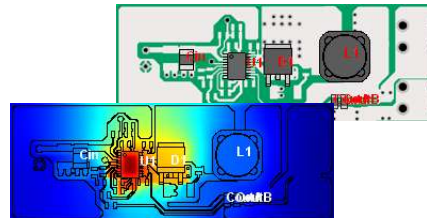


Optimize for Footprint and Efficiency, Use Graphs to Visualize Design

3. Analyze a Design



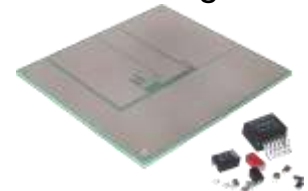
Generate Schematic/
Electrical Analysis



Generate Layout/
Thermal Analysis

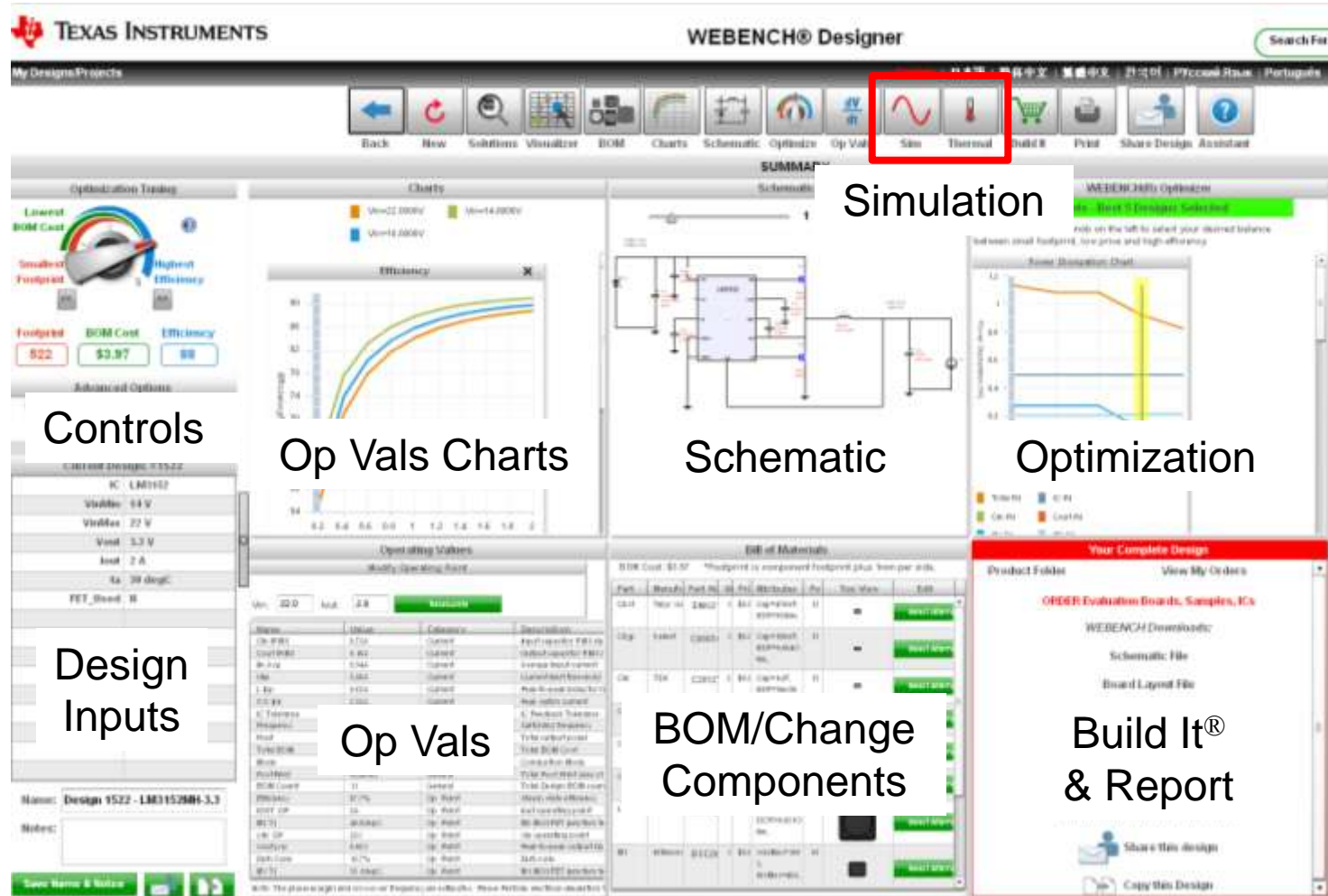
4. Build It!

Custom Prototype Kit
Overnight



Prototype

The WEBENCH® Designer Dashboard



Easy Design Optimization & Tuning

WEBENCH Optimizer
Knob



Optimization Tuning

Lowest BOM Cost

Smallest Footprint

Highest Efficiency

1 5

<< >>

Footprint BOM Cost Efficiency

432 \$2.83 79

Advanced Options

User Preferred Frequency: ☐

Frequency:

200KHz < 600 KHz < 1000KHz

Soft Start Time (ms):

1ms < 1 ms < 25ms

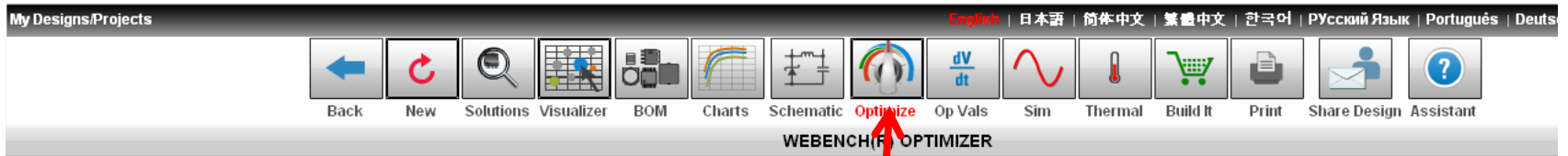
Update

⚡

User entry parameters:
Frequency
Soft start time



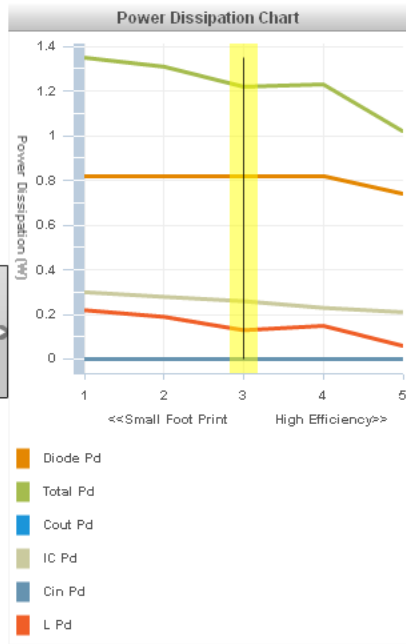
Key Optimization Parameters Graphed



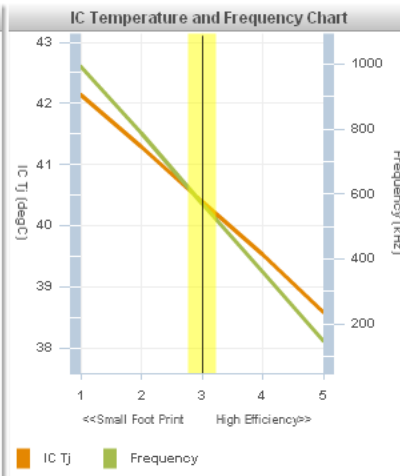
25 Designs Complete - Best 5 Designs Selected

Turn the optimization knob on the left to select your desired balance between small footprint, low price and high efficiency

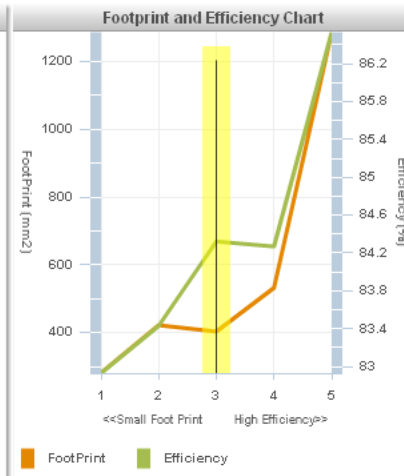
Optimize page



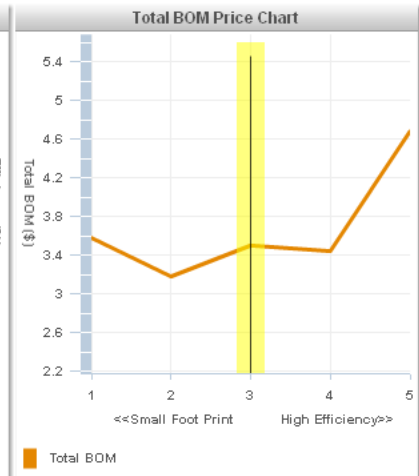
Power Dissipation
By Component



Frequency
IC Temperature



Footprint
Efficiency



BOM Cost

Continue To Improve Your Design: View and Change Your Bill Of Materials

Click Select Alternate To Change A Component

The screenshot shows the 'BILL OF MATERIALS' window in the TI Design Explorer. The table lists components with their manufacturers, part numbers, quantities, prices, attributes, footprints, and top views. Each row has a 'Select Alternate Part' button. A red box highlights the 'BOM' icon in the top toolbar, and a red arrow points from the text 'Click Select Alternate To Change A Component' to the 'Select Alternate Part' button for component L1.

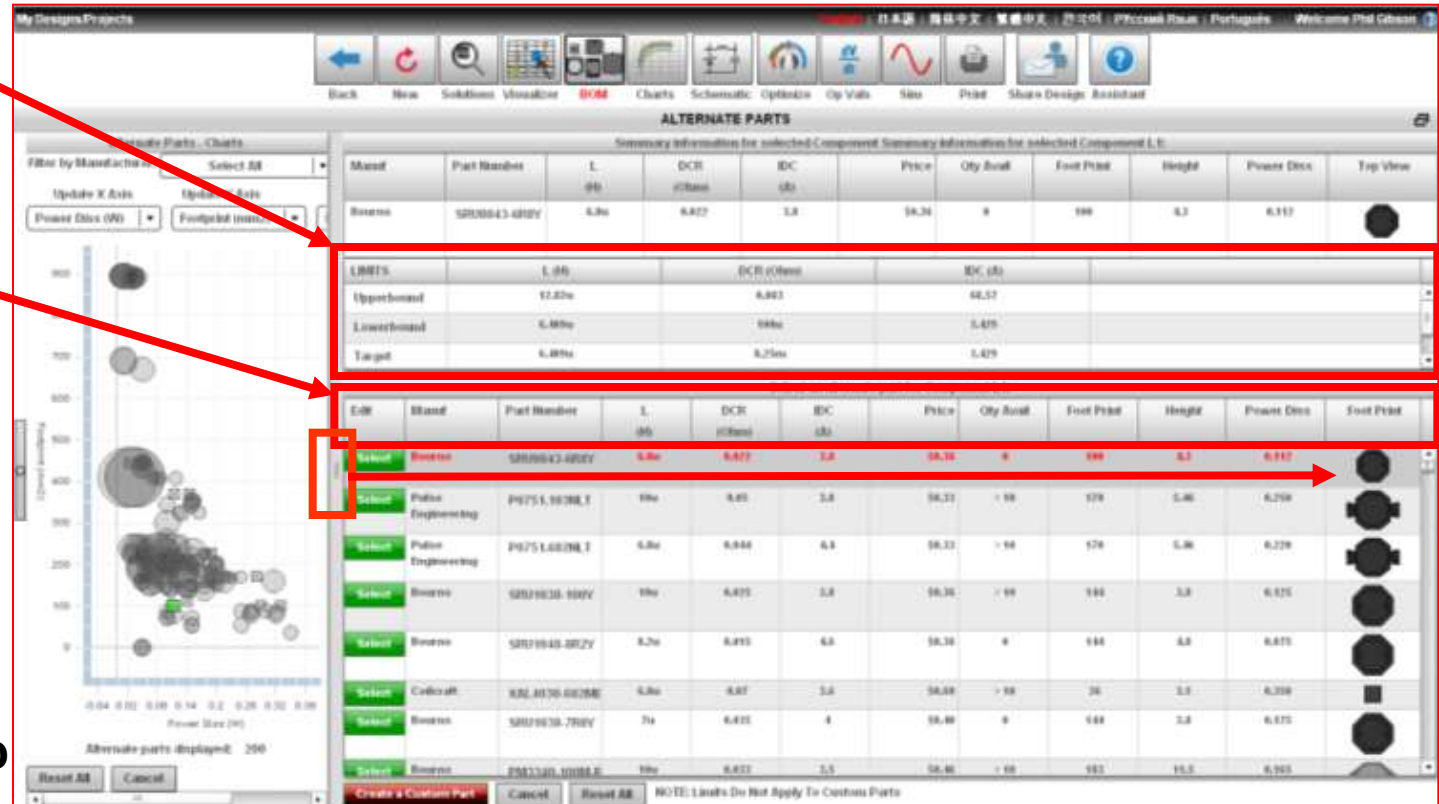
Part	Manufacturer	Part Number	Quantity	Price	Attributes	Footprint	Top View	Edit
Ch	Mohata	GRM155R71E333	1	\$0.81	Cap=33nF, ESR=40fms, VDC=25V	8	-	Select Alternate Part
Chyp	TDK	C2012Y5V1E105G	1	\$0.81	Cap=50nF, ESR=3mOhms, VDC=25V	13	-	Select Alternate Part
Cin	TDK	C5750X7R1H106	1	\$0.68	Cap=10uF, ESR=1mOhms, VDC=50V	68	-	Select Alternate Part
Ciso	Kemet	C8005C104K5RA	1	\$0.81	Cap=100nF, ESR=0.6640fms, VDC=50V	13	-	Select Alternate Part
Coat	TDK	C3225X5R0V1E105G	1	\$0.79	Cap=100nF, ESR=2mOhms, VDC=25V	23	-	Select Alternate Part
Coc	Mohata	GRM155R71E1E123	1	\$0.81	Cap=12nF, ESR=40fms, VDC=25V	-	-	Select Alternate Part
L1	Bourns	SRM043-GRDY	1	\$0.36	L=6.8uH, DCR=0.8270fms, IDC=3.3A	98	-	Select Alternate Part
RBb1	Vishay-Dale	CRCW0402970F8	1	\$0.81	Resistance=9700fms, Tolerance=1%, Power=0.803W	8	-	Select Alternate Part
RBb2	Vishay-Dale	CRCW04023K0F8	1	\$0.81	Resistance=3.09K0fms, Tolerance=1%, Power=0.803W	8	-	Select Alternate Part
Rss	Vishay-Dale	CRCW040246K0F8	1	\$0.81	Resistance=46.0K0fms, Tolerance=1%, Power=0.803W	8	-	Select Alternate Part
U1	Texas Instrument	LMF24220TL	1	\$2.88		75	-	

Evaluate and Select Alternate Components

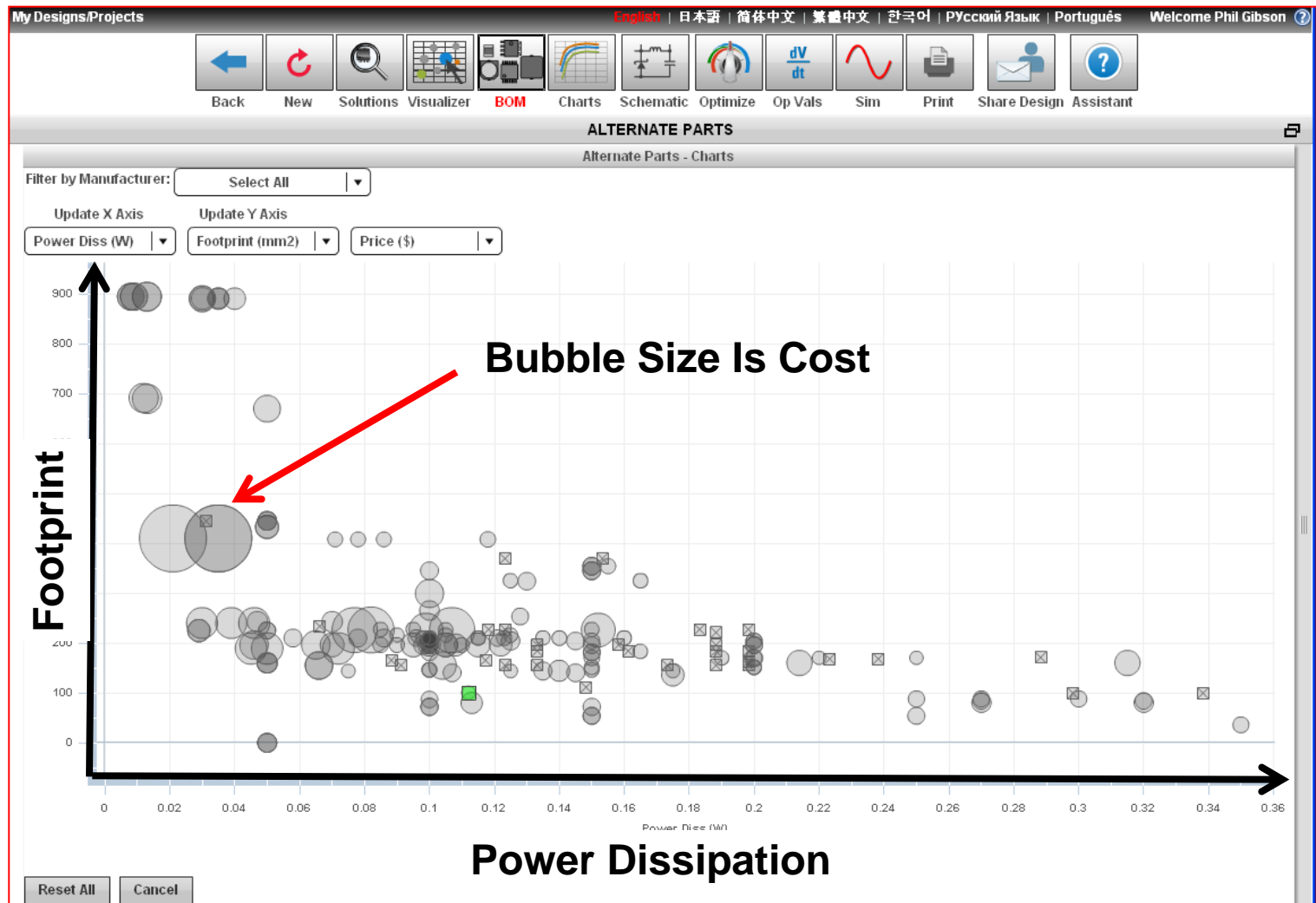
Parameter
Specification
Limits

Multiple
Column Sort

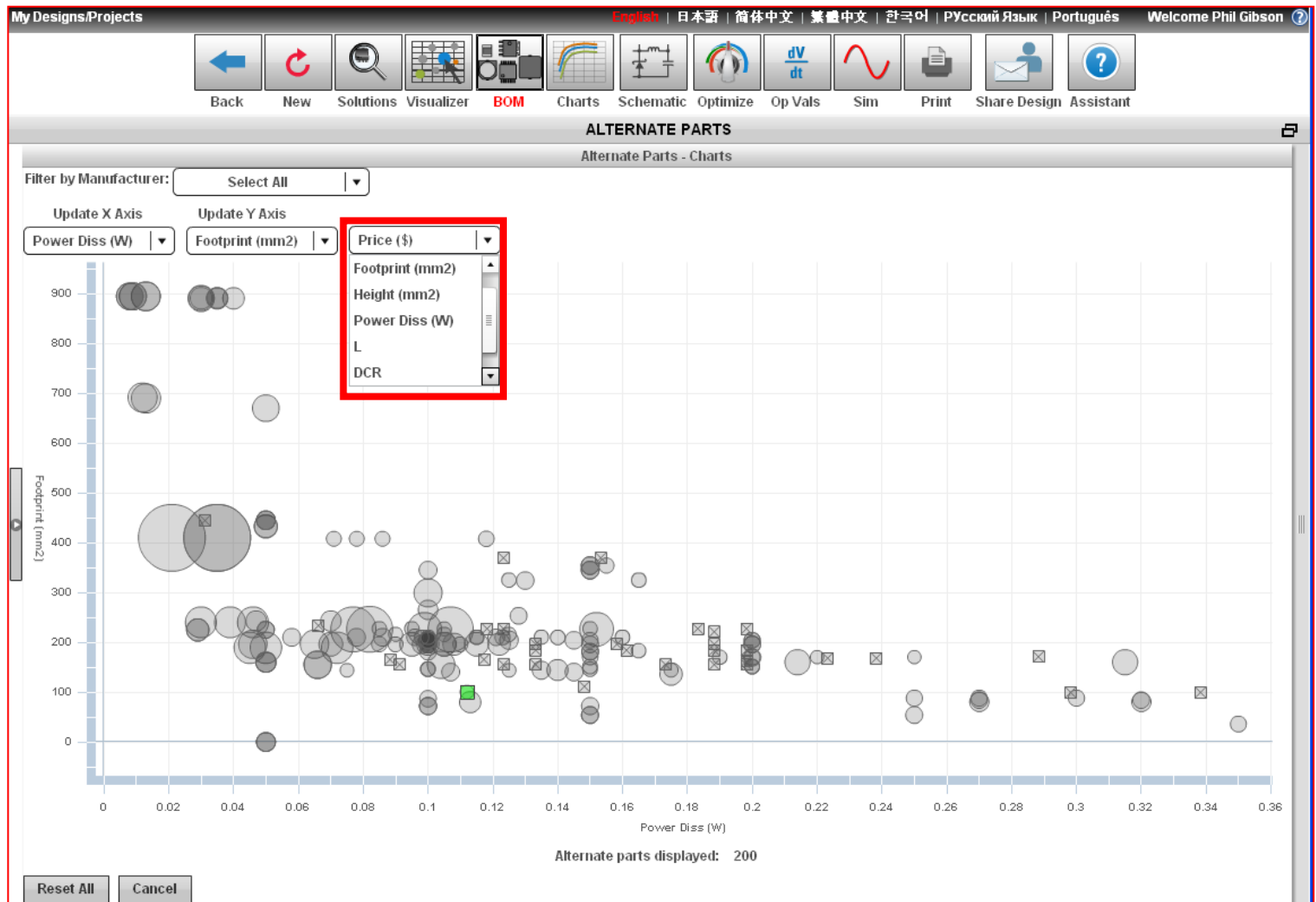
Component
Tradeoffs:
Footprint
P_{diss}
Price
Performance
V_{out} Ripple
Transient Resp
Loop Stability



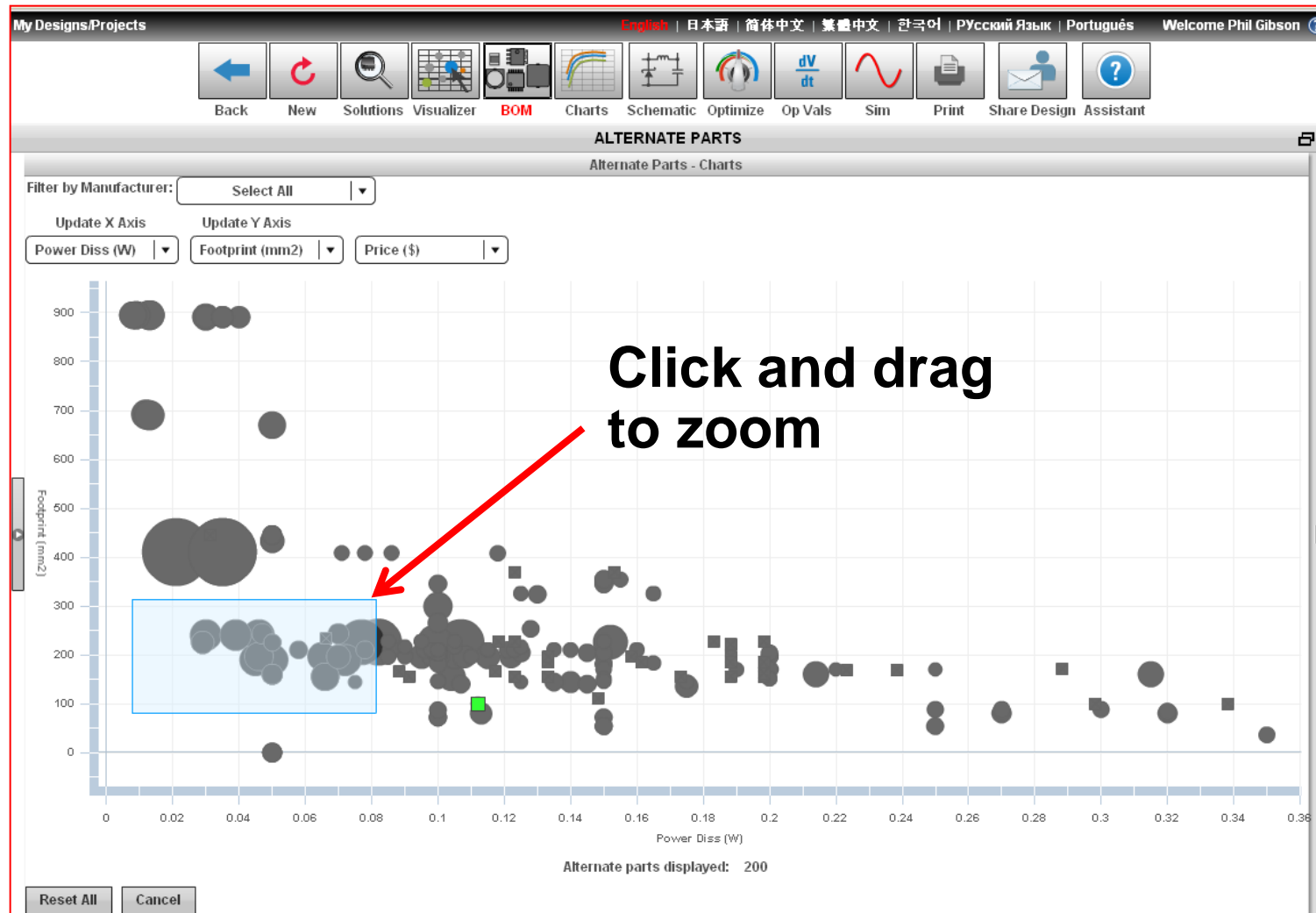
Evaluate Components - Inductor



Change Perspective - Inductor



Evaluate Components – Zoom to Highlight For More Detail



Select New Component

Filtered list
based on
zoom box

Click to
select a
component

Or create a
custom
component

My Designs/Projects

Back New Solutions Visualizer DCM Charts Schematic Optimizer Op Vals Sim Plot Share Design Assistant

ALTERNATE PARTS

Summary Information for selected Component Summary Information for selected Component L1:

Model	Part Number	L (in)	DCR (Ohm)	DC (uH)	Price	Qty Avail	Foot Print	Height	Power Diss	Top View
Bourns	SR010043-002V	6.8u	6.477	3.8	\$8.36	8	199	6.3	6.117	

LBMTS	L (in)	DCR (Ohm)	DC (uH)
Upperbound	12.87u	6.493	44.57
Lowerbound	6.49u	6.49u	3.475
Target	6.49u	6.25u	3.475

Select an alternate part for Component L1:

Edit	Brand	Part Number	L (in)	DCR (Ohm)	DC (uH)	Price	Qty Avail	Foot Print	Height	Power Diss	Foot Print
Select	Bourns	SR010043-002V	6.8u	6.477	3.8	\$8.36	8	199	6.3	6.117	
Select	Pulse Engineering	P075 L0038L1	19u	9.45	3.8	\$8.33	> 10	179	5.46	6.208	
Select	Pulse Engineering	P075 L0038L1	6.8u	6.844	4.8	\$8.33	> 10	179	5.46	6.228	
Select	Bourns	SR010038-000V	19u	6.475	3.8	\$8.36	> 10	199	3.3	6.125	
Select	Bourns	SR010040-002V	6.2u	6.475	4.8	\$8.36	8	199	6.3	6.175	
Select	Colecraft	KSL4038-0028E	6.8u	9.87	3.8	\$8.48	> 10	28	3.3	8.208	
Select	Bourns	SR010038-700V	7u	6.475	4	\$8.40	8	188	3.8	6.175	
Select	Bourns	SR010040-1000E	19u	6.477	3.5	\$8.46	> 10	193	15.5	6.165	

Alternate parts displayed: 250

Reset All Cancel

Create a Custom Part Cancel Reset All

NOTE: Leads Do Not Apply To Custom Parts

Your New BOM Is Updated And Simulation Is Only A Button Away

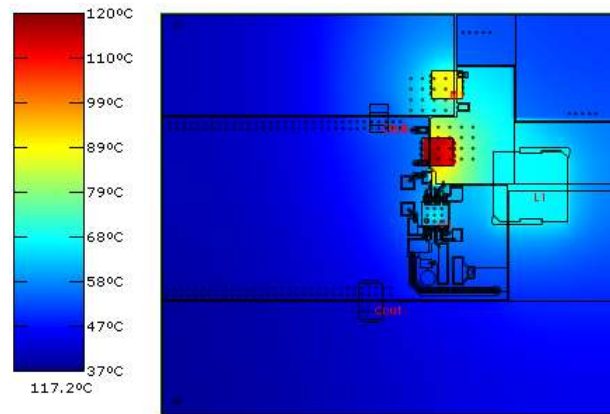
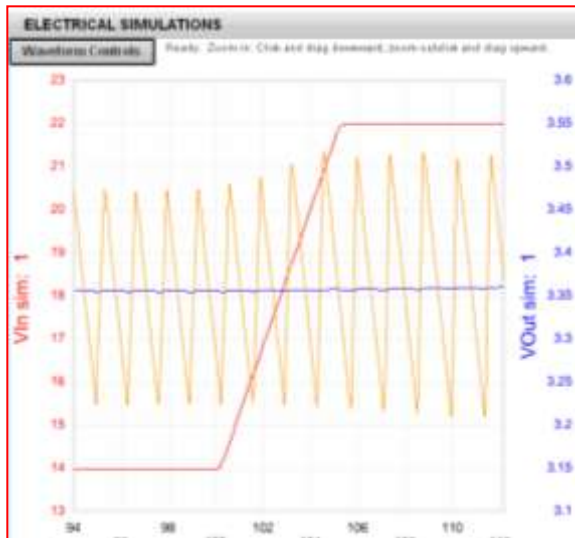
The screenshot displays the WEBENCH® Designer interface, specifically the Simulation tab. The top navigation bar includes icons for Back, New, Solutions, Visualizer, BOM, Charts, Schematic, Optimize, Op Val, Sim (highlighted with a red box), Thermal, Build, Print, Share Design, and Assistant. The main workspace is divided into several panels:

- Optimization Topology:** Shows a graph of Efficiency vs. Operating Values, with curves for different input voltages (V_{in} = 2.00V, 2.50V, 3.00V, 3.50V, 4.00V, 4.50V, 5.00V, 5.50V, 6.00V, 6.50V, 7.00V, 7.50V, 8.00V, 8.50V, 9.00V, 9.50V, 10.00V).
- Summary:** Displays key design parameters: Footprint: \$22, BOM Cost: \$3.97, Efficiency: 88%.
- Schematic:** Shows a circuit diagram of a power converter.
- Power Dissipation Chart:** A graph showing power dissipation vs. efficiency.
- BOM of Materials:** A table listing components and their quantities.

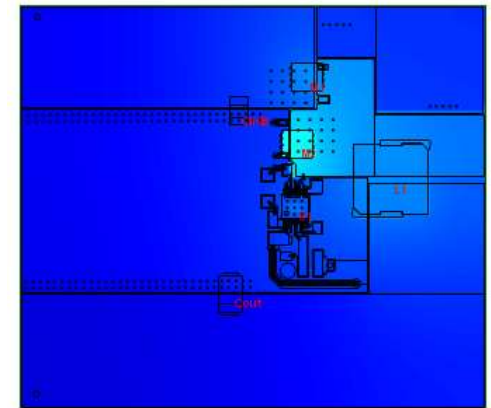
The BOM of Materials table is as follows:

Part	Qty	Part No.	Manufacturer	Unit Price	Total Price	Notes
U1	1	LM1117	TI	\$0.01	\$0.01	
U2	1	LM1117	TI	\$0.01	\$0.01	
U3	1	LM1117	TI	\$0.01	\$0.01	
U4	1	LM1117	TI	\$0.01	\$0.01	
U5	1	LM1117	TI	\$0.01	\$0.01	
U6	1	LM1117	TI	\$0.01	\$0.01	
U7	1	LM1117	TI	\$0.01	\$0.01	
U8	1	LM1117	TI	\$0.01	\$0.01	
U9	1	LM1117	TI	\$0.01	\$0.01	
U10	1	LM1117	TI	\$0.01	\$0.01	
U11	1	LM1117	TI	\$0.01	\$0.01	
U12	1	LM1117	TI	\$0.01	\$0.01	
U13	1	LM1117	TI	\$0.01	\$0.01	
U14	1	LM1117	TI	\$0.01	\$0.01	
U15	1	LM1117	TI	\$0.01	\$0.01	
U16	1	LM1117	TI	\$0.01	\$0.01	
U17	1	LM1117	TI	\$0.01	\$0.01	
U18	1	LM1117	TI	\$0.01	\$0.01	
U19	1	LM1117	TI	\$0.01	\$0.01	
U20	1	LM1117	TI	\$0.01	\$0.01	
U21	1	LM1117	TI	\$0.01	\$0.01	
U22	1	LM1117	TI	\$0.01	\$0.01	
U23	1	LM1117	TI	\$0.01	\$0.01	
U24	1	LM1117	TI	\$0.01	\$0.01	
U25	1	LM1117	TI	\$0.01	\$0.01	
U26	1	LM1117	TI	\$0.01	\$0.01	
U27	1	LM1117	TI	\$0.01	\$0.01	
U28	1	LM1117	TI	\$0.01	\$0.01	
U29	1	LM1117	TI	\$0.01	\$0.01	
U30	1	LM1117	TI	\$0.01	\$0.01	
U31	1	LM1117	TI	\$0.01	\$0.01	
U32	1	LM1117	TI	\$0.01	\$0.01	
U33	1	LM1117	TI	\$0.01	\$0.01	
U34	1	LM1117	TI	\$0.01	\$0.01	
U35	1	LM1117	TI	\$0.01	\$0.01	
U36	1	LM1117	TI	\$0.01	\$0.01	
U37	1	LM1117	TI	\$0.01	\$0.01	
U38	1	LM1117	TI	\$0.01	\$0.01	
U39	1	LM1117	TI	\$0.01	\$0.01	
U40	1	LM1117	TI	\$0.01	\$0.01	
U41	1	LM1117	TI	\$0.01	\$0.01	
U42	1	LM1117	TI	\$0.01	\$0.01	
U43	1	LM1117	TI	\$0.01	\$0.01	
U44	1	LM1117	TI	\$0.01	\$0.01	
U45	1	LM1117	TI	\$0.01	\$0.01	
U46	1	LM1117	TI	\$0.01	\$0.01	
U47	1	LM1117	TI	\$0.01	\$0.01	
U48	1	LM1117	TI	\$0.01	\$0.01	
U49	1	LM1117	TI	\$0.01	\$0.01	
U50	1	LM1117	TI	\$0.01	\$0.01	
U51	1	LM1117	TI	\$0.01	\$0.01	
U52	1	LM1117	TI	\$0.01	\$0.01	
U53	1	LM1117	TI	\$0.01	\$0.01	
U54	1	LM1117	TI			

Customize and Simulate Electrically & Thermally



0.5oz copper thickness
Low side FET is 117C



4.0oz thickness
Low side FET is 68C

Offer A Design To A Customer Easily

TEXAS INSTRUMENTS WEBENCH® Designer

My Designs/Projects

Back New Solutions Visualizer BOM Charts Schematic Optimizer Op Vals Sim Thermal Build B Print **Share Design** Assistant

Optimization Tuning

Lowest BOM Cost Smallest Footprint Highest Efficiency

Footprint: 522 BOM Cost: \$3.97 Efficiency: 88

Advanced Options

Used Selected FET: ☐ Update

Current Design: 15522

IC: LM1112

VinMin: 64 V

VinMax: 72 V

Vout: 3.3 V

Ia: 2 A

Ta: 39 degC

FET_Board: B

Charts

Efficiency

Schematic

Design 15522

WEBENCH® Optimizer

23 Designs Complete. Best 5 Designs Selected

The optimization tools on the left to select your desired balance between small footprint, low price and high efficiency

Power Dissipation Chart

Bill of Materials

BOM Cost: \$3.97 Footprint is component footprint plus 1mm per side.

Part	Qty	Part no.	Alt. no.	Manufacturer	Alt. no.	Notes	Alt. no.
U1	1	LM1112	0	TI	LM1112	LM1112	TI
U2	1	LM1112	0	TI	LM1112	LM1112	TI
U3	1	LM1112	0	TI	LM1112	LM1112	TI
U4	1	LM1112	0	TI	LM1112	LM1112	TI
U5	1	LM1112	0	TI	LM1112	LM1112	TI
U6	1	LM1112	0	TI	LM1112	LM1112	TI
U7	1	LM1112	0	TI	LM1112	LM1112	TI
U8	1	LM1112	0	TI	LM1112	LM1112	TI
U9	1	LM1112	0	TI	LM1112	LM1112	TI
U10	1	LM1112	0	TI	LM1112	LM1112	TI
U11	1	LM1112	0	TI	LM1112	LM1112	TI
U12	1	LM1112	0	TI	LM1112	LM1112	TI
U13	1	LM1112	0	TI	LM1112	LM1112	TI
U14	1	LM1112	0	TI	LM1112	LM1112	TI
U15	1	LM1112	0	TI	LM1112	LM1112	TI
U16	1	LM1112	0	TI	LM1112	LM1112	TI
U17	1	LM1112	0	TI	LM1112	LM1112	TI
U18	1	LM1112	0	TI	LM1112	LM1112	TI
U19	1	LM1112	0	TI	LM1112	LM1112	TI
U20	1	LM1112	0	TI	LM1112	LM1112	TI
U21	1	LM1112	0	TI	LM1112	LM1112	TI
U22	1	LM1112	0	TI	LM1112	LM1112	TI
U23	1	LM1112	0	TI	LM1112	LM1112	TI
U24	1	LM1112	0	TI	LM1112	LM1112	TI
U25	1	LM1112	0	TI	LM1112	LM1112	TI
U26	1	LM1112	0	TI	LM1112	LM1112	TI
U27	1	LM1112	0	TI	LM1112	LM1112	TI
U28	1	LM1112	0	TI	LM1112	LM1112	TI
U29	1	LM1112	0	TI	LM1112	LM1112	TI
U30	1	LM1112	0	TI	LM1112	LM1112	TI
U31	1	LM1112	0	TI	LM1112	LM1112	TI
U32	1	LM1112	0	TI	LM1112	LM1112	TI
U33	1	LM1112	0	TI	LM1112	LM1112	TI
U34	1	LM1112	0	TI	LM1112	LM1112	TI
U35	1	LM1112	0	TI	LM1112	LM1112	TI
U36	1	LM1112	0	TI	LM1112	LM1112	TI
U37	1	LM1112	0	TI	LM1112	LM1112	TI
U38	1	LM1112	0	TI	LM1112	LM1112	TI
U39	1	LM1112	0	TI	LM1112	LM1112	TI
U40	1	LM1112	0	TI	LM1112	LM1112	TI
U41	1	LM1112	0	TI	LM1112	LM1112	TI
U42	1	LM1112	0	TI	LM1112	LM1112	TI
U43	1	LM1112	0	TI	LM1112	LM1112	TI
U44	1	LM1112	0	TI	LM1112	LM1112	TI
U45	1	LM1112	0	TI	LM1112	LM1112	TI
U46	1	LM1112	0	TI	LM1112	LM1112	TI
U47	1	LM1112	0	TI	LM1112	LM1112	TI
U48	1	LM1112	0	TI	LM1112	LM1112	TI
U49	1	LM1112	0	TI	LM1112	LM1112	TI
U50	1	LM1112	0	TI	LM1112	LM1112	TI
U51	1	LM1112	0	TI	LM1112	LM1112	TI
U52	1	LM1112	0	TI	LM1112	LM1112	TI
U53	1	LM1112	0	TI	LM1112	LM1112	TI
U54	1	LM1112	0	TI	LM1112	LM1112	TI
U55	1	LM1112	0	TI	LM1112	LM1112	TI
U56	1	LM1112	0	TI	LM1112	LM1112	TI
U57	1	LM1112	0	TI	LM1112	LM1112	TI
U58	1	LM1112	0	TI	LM1112	LM1112	TI
U59	1	LM1112	0	TI	LM1112	LM1112	TI
U60	1	LM1112	0	TI	LM1112	LM1112	TI
U61	1	LM1112	0	TI	LM1112	LM1112	TI
U62	1	LM1112	0	TI	LM1112	LM1112	TI
U63	1	LM1112	0	TI	LM1112	LM1112	TI
U64	1	LM1112	0	TI	LM1112	LM1112	TI
U65	1	LM1112	0	TI	LM1112	LM1112	TI
U66	1	LM1112	0	TI	LM1112	LM1112	TI
U67	1	LM1112	0	TI	LM1112	LM1112	TI
U68	1	LM1112	0	TI	LM1112	LM1112	TI
U69	1	LM1112	0	TI	LM1112	LM1112	TI
U70	1	LM1112	0	TI	LM1112	LM1112	TI
U71	1	LM1112	0	TI	LM1112	LM1112	TI
U72	1	LM1112	0	TI	LM1112	LM1112	TI
U73	1	LM1112	0	TI	LM1112	LM1112	TI
U74	1	LM1112	0	TI	LM1112	LM1112	TI
U75	1	LM1112	0	TI	LM1112	LM1112	TI
U76	1	LM1112	0	TI	LM1112	LM1112	TI
U77	1	LM1112	0	TI	LM1112	LM1112	TI
U78	1	LM1112	0	TI	LM1112	LM1112	TI
U79	1	LM1112	0	TI	LM1112	LM1112	TI
U80	1	LM1112	0	TI	LM1112	LM1112	TI
U81	1	LM1112	0	TI	LM1112	LM1112	TI
U82	1	LM1112	0	TI	LM1112	LM1112	TI
U83	1	LM1112	0	TI	LM1112	LM1112	TI
U84	1	LM1112	0	TI	LM1112	LM1112	TI
U85	1	LM1112	0	TI	LM1112	LM1112	TI
U86	1	LM1112	0	TI	LM1112	LM1112	TI
U87	1	LM1112	0	TI	LM1112	LM1112	TI
U88	1	LM1112	0	TI	LM1112	LM1112	TI
U89	1	LM1112	0	TI	LM1112	LM1112	TI
U90	1	LM1112	0	TI	LM1112	LM1112	TI
U91	1	LM1112	0	TI	LM1112	LM1112	TI
U92	1	LM1112	0	TI	LM1112	LM1112	TI
U93	1	LM1112	0	TI	LM1112	LM1112	TI
U94	1	LM1112	0	TI	LM1112	LM1112	TI
U95	1	LM1112	0	TI	LM1112	LM1112	TI
U96	1	LM1112	0	TI	LM1112	LM1112	TI
U97	1	LM1112	0	TI	LM1112	LM1112	TI
U98	1	LM1112	0	TI	LM1112	LM1112	TI
U99	1	LM1112	0	TI	LM1112	LM1112	TI
U100	1	LM1112	0	TI	LM1112	LM1112	TI

Your Complete Design

Product Folder View My Orders

ORDER Evaluation Boards, Samples, ICs

WEBENCH Downloads:

- Schematic File
- Board Layout File
- GERBER File

Assembly Documentation

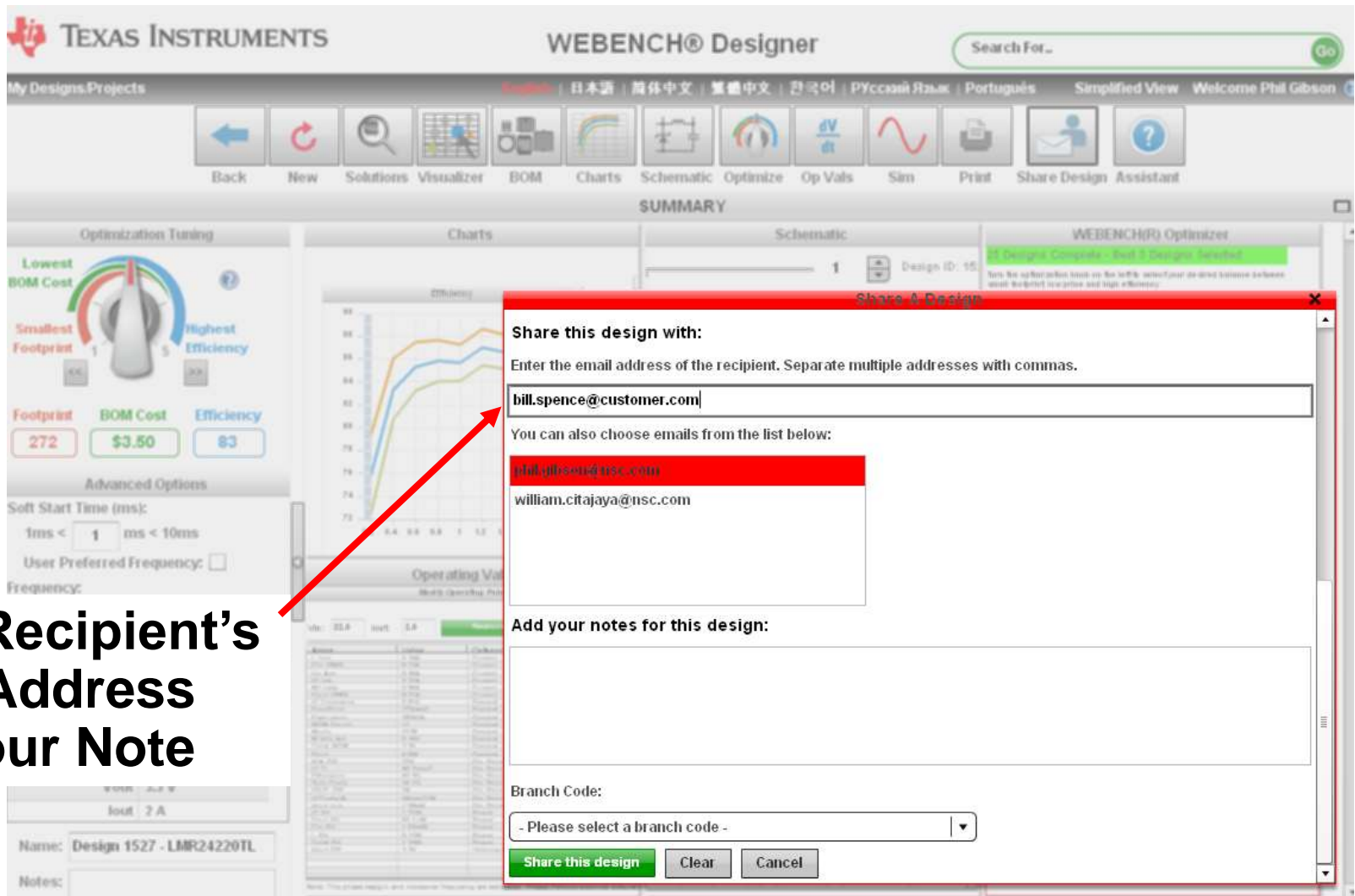
- Design Documentation

Download Altium Designer Trial

- Share this design
- Copy this Design

Click on Share Project button

Share The Design With Team Members Quickly – Start The Lead Flow



Invitation To Open Your Offer:

You forwarded this message on 10/21/2011 9:45 AM.

From: Webench Team [web@national.com]
To: Gibson, Phil
Cc:
Subject: Shared TPS40210 Design#1521 to susan_cunnington@ti.com

Texas Instrument's WEBENCH® Power Designer



Dear Phil Gibson,

Texas Instruments has sent an email on your behalf inviting susan_cunnington@ti.com to use a copy of your WEBENCH® Design #1521, Design 1521 - TPS40210DGQR.

We look forward to helping you create more designs for your customers.

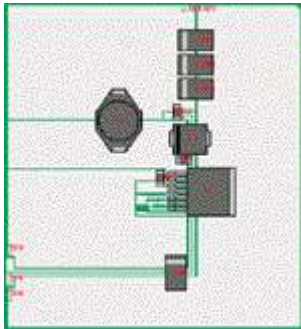
Regards,
The WEBENCH Team at Texas Instruments

If you feel that this email has been sent to you in error, please send us an email at:
new.feedback@nsc.com



WEBENCH® Build It Kit Support

Use WEBENCH Designer To Create Your Design









Order The Build It Kit For Your Design:
PC board & Parts



Assemble The Kit and Test To Your Specifications For An Immediate Prototype



Part	Create	WEBENCH Tools	Schematic	BOM Images
LM22676-ADJ	Open Design	   		 441mm ²

Build It Kit Enabled Design



Why Do Electrical Simulation?

Identify Problems

- Design has been configured for stable operation **BUT**
- May want to verify under dynamic conditions

Try Solutions

- Improve line/load transient response
- Minimize output voltage ripple
- Modify control loop

Visualize Results

- Interactive waveform viewer allows detailed analysis of results

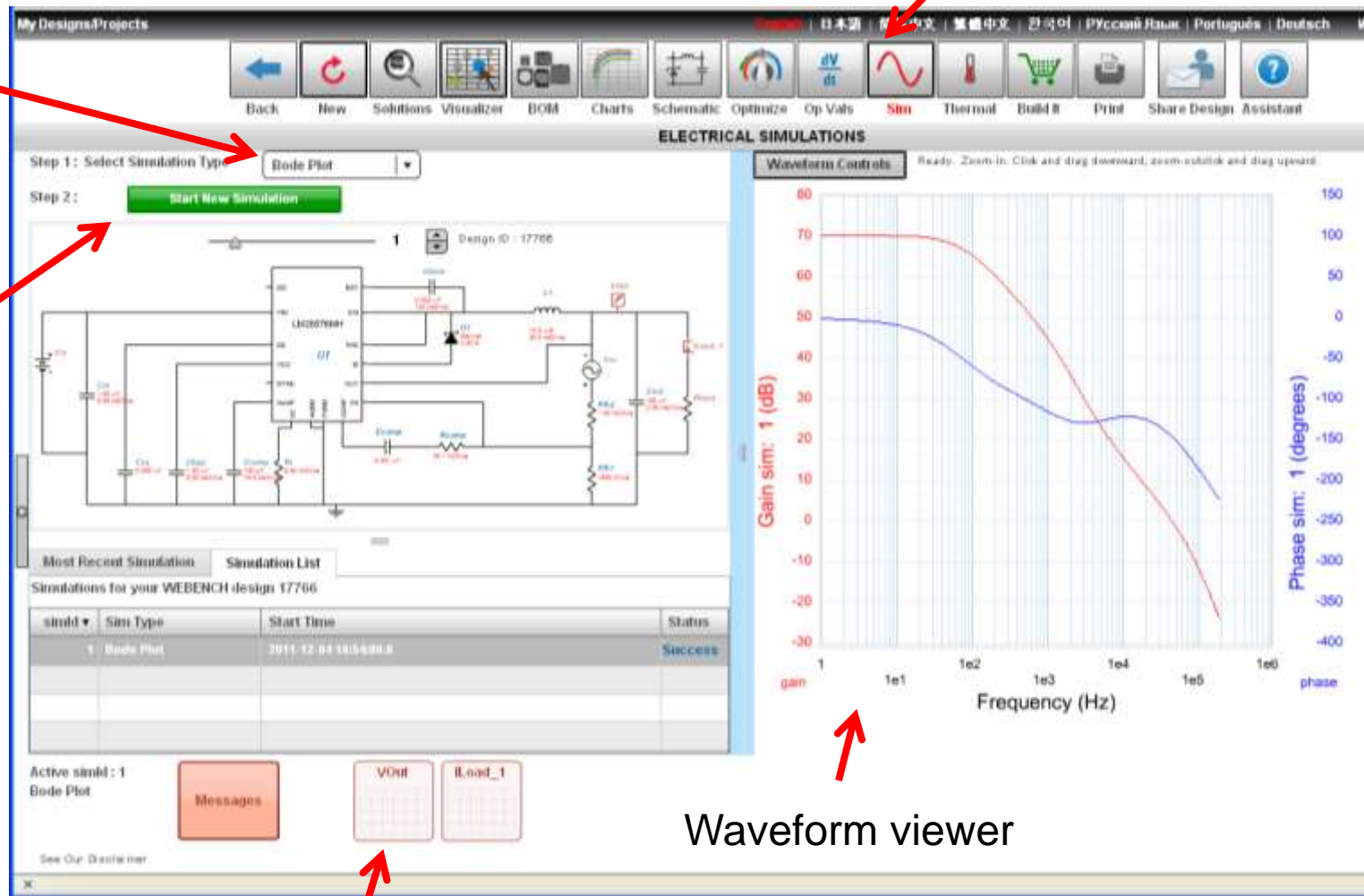
Electrical Simulation

eSim page

Specify sim type

Click start to initiate sim

- Bode Plot
- Line Transient
- Load Transient
- Startup
- Steady State

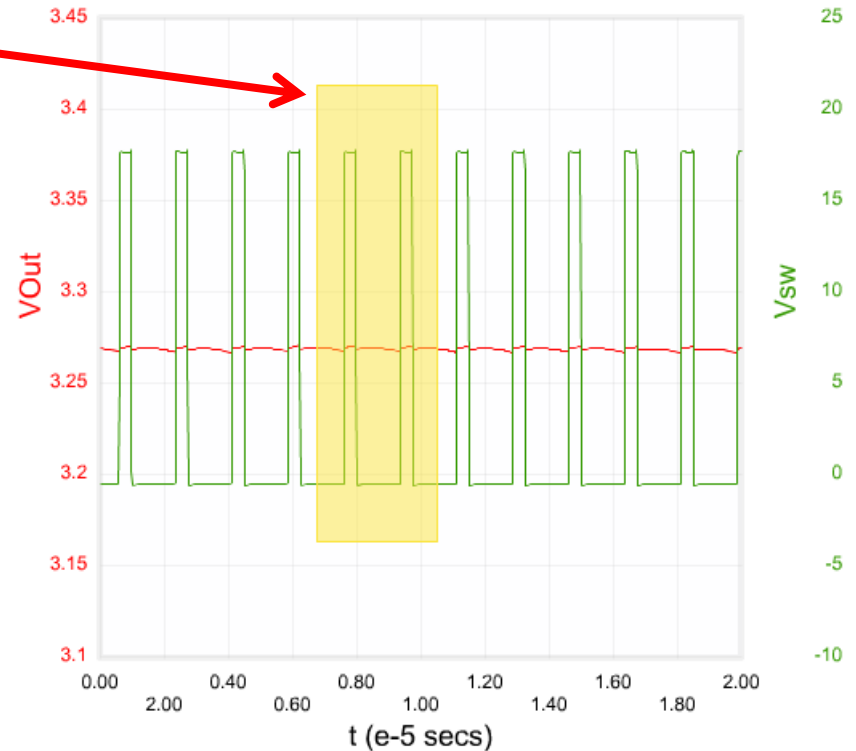


Click to view waveforms

Waveform Viewer

Click and drag down and to the right to zoom in

Click and drag up and to the left to zoom out



Click on a tile to add a waveform

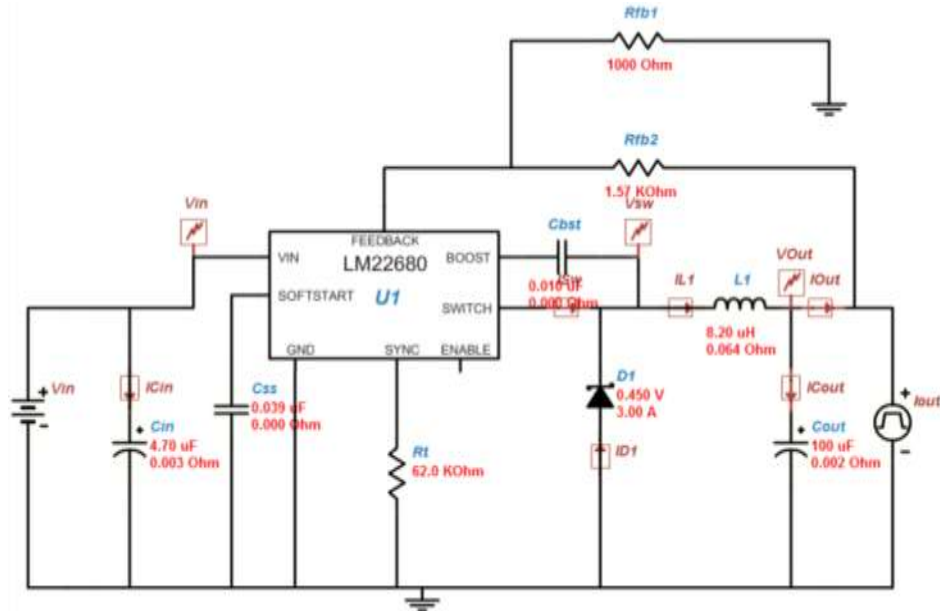


Evaluate Transient Response

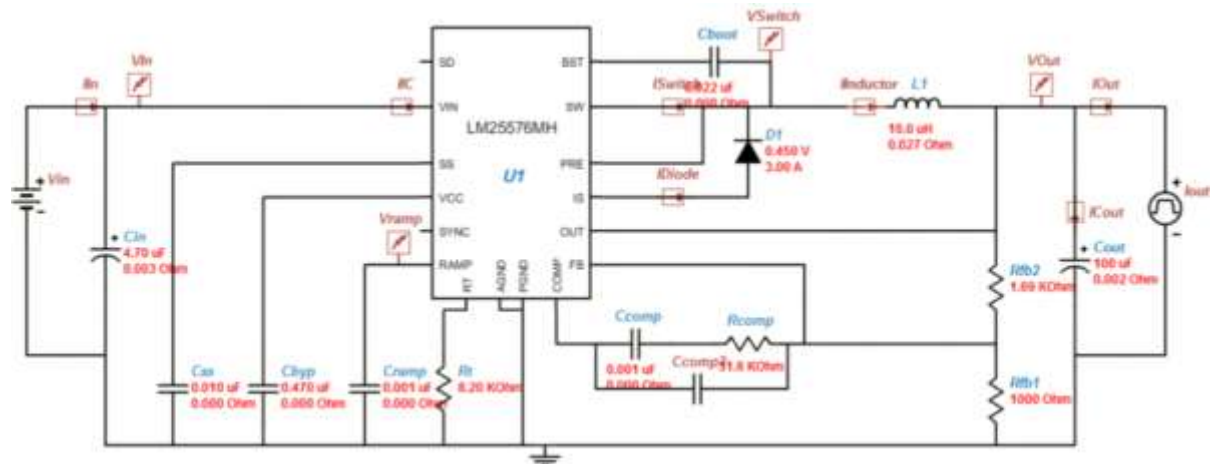
- LM22680
 - Voltage mode pulse width modulation control scheme (PWM)
 - Lower part count – SIMPLE SWITCHER®
- LM25576
 - Emulated current mode (ECM)
 - Fast transient response
- Will evaluate:
 - How does ECM compare with PWM
 - V_{in} : 14-22V, V_{out} : 3.3V, I_{out} : 2A

Buck Schematics

LM22680 PWM



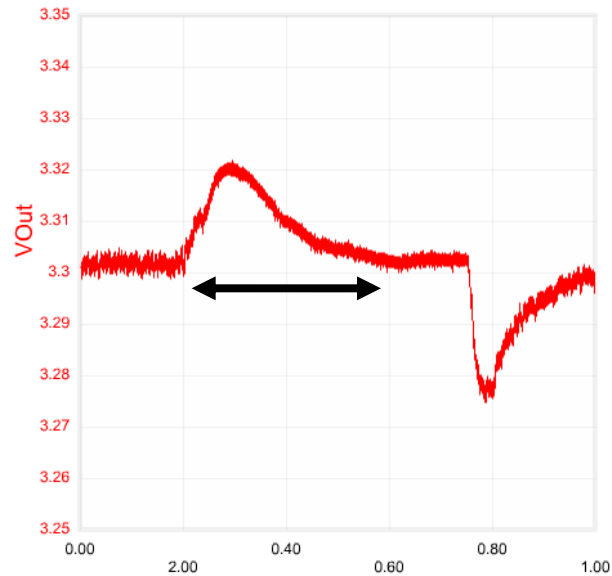
LM25576 ECM



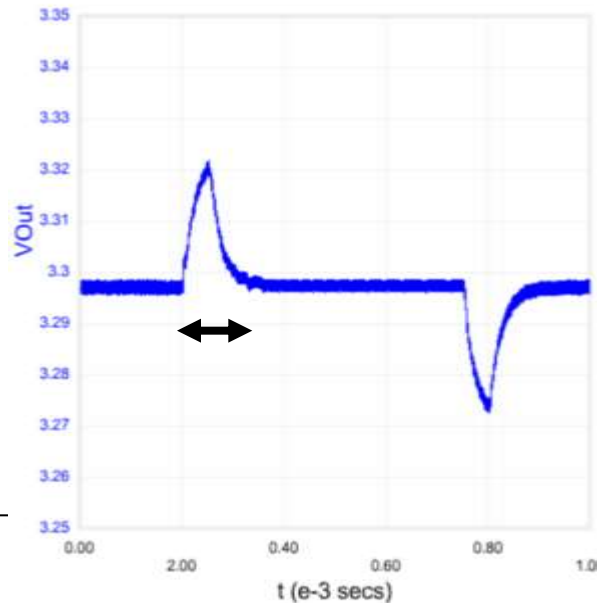
LM22680 vs LM25576

Vout for Load Transient

- LM22680 (Pulse Width Modulated)



- LM25576 (Emulated Current Mode) has faster transient response recovery time



Load Transient:
.2 – 2A
50usec rise/fall time

Why Do Thermal Simulation?

Identify Problems

- Thermal simulation will show focus of hot spots under typical operation
- May want to review environmental influences on operating points

Try Solutions

- Add different copper weighting for dissipation
- Add fan or convection of adjoining components
- Add heat sinks

Visualize Results

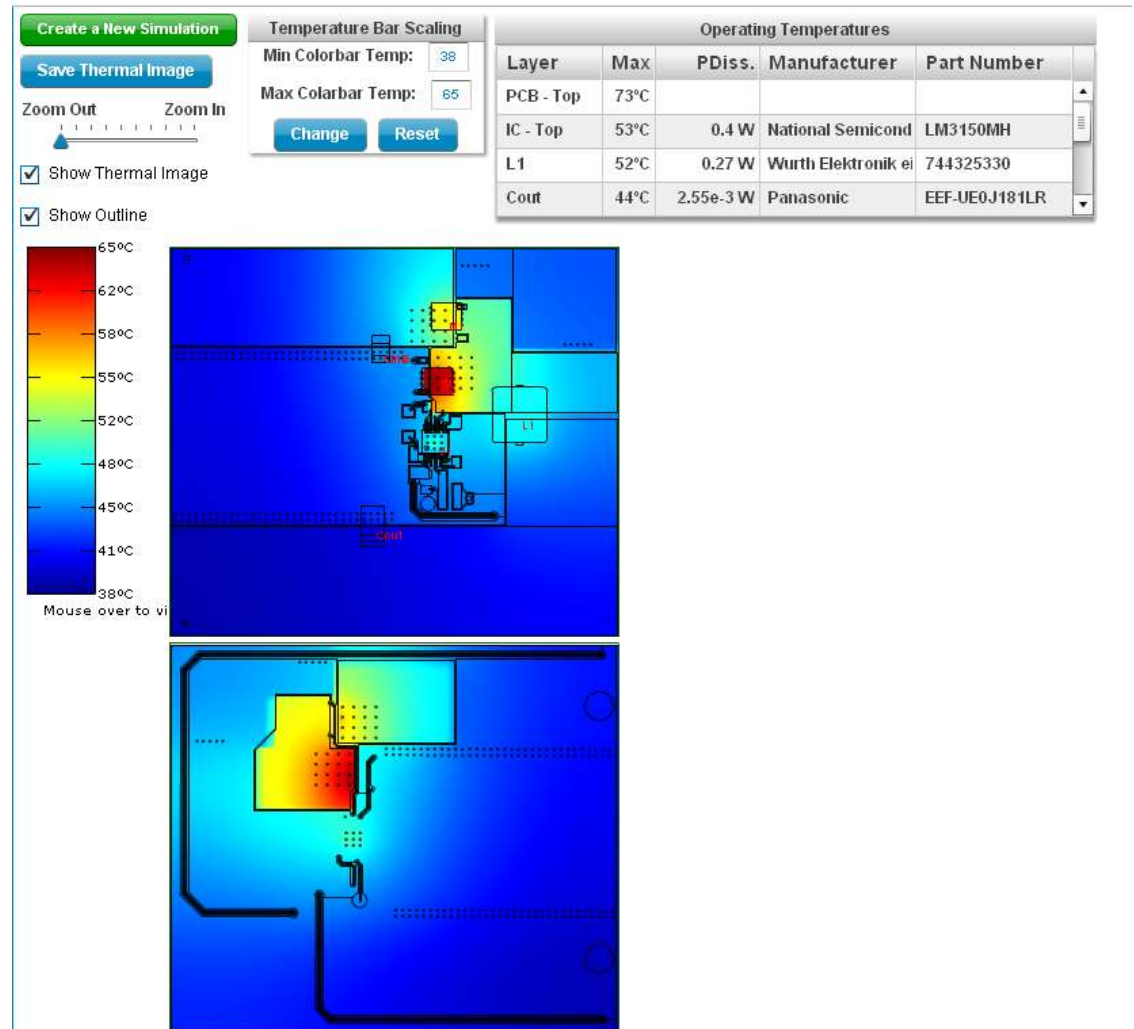
- Change environment and review thermal interactions

WebTHERM® – Board Layout

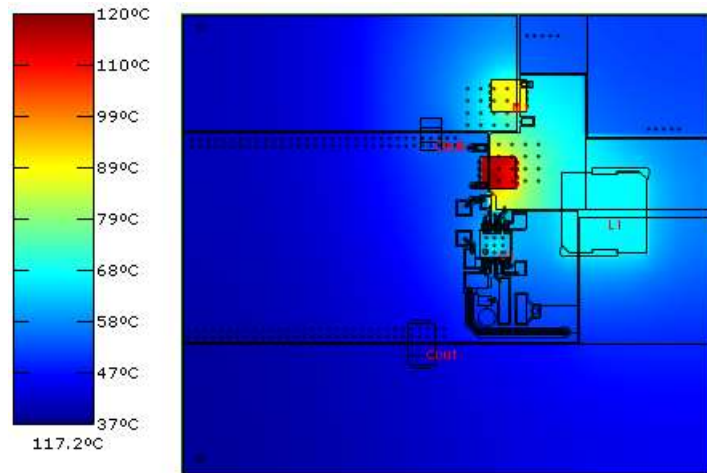
Inputs:
Copper thickness
Airflow
Board orientation



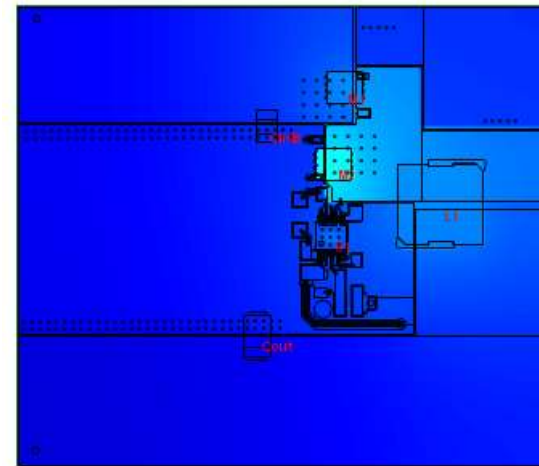
WebTHERM® Thermal Image Results



Example Trade-Offs LM3150 Controller



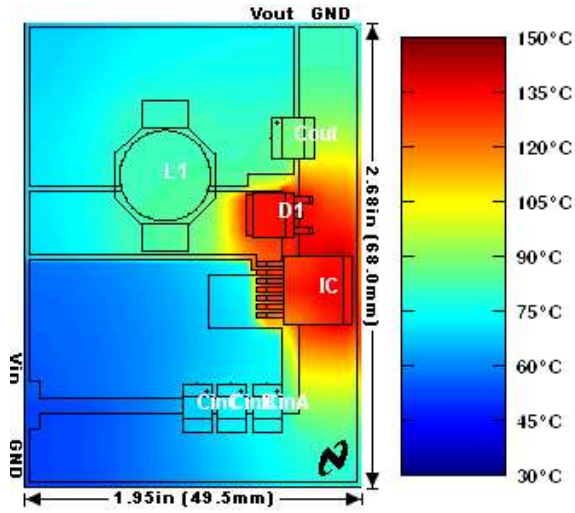
.5oz copper thickness
Low side FET is 117C



4oz copper thickness
Low side FET is 68C

Vin: 14-22V
Vout: 3.3V
Iout: 6A

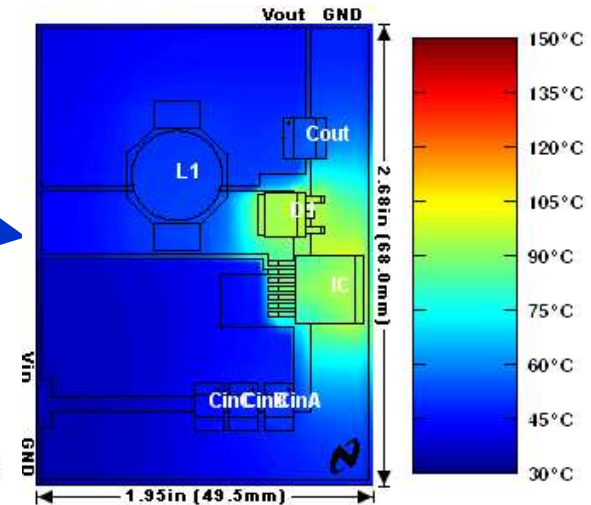
WebTHERM™ Solutions



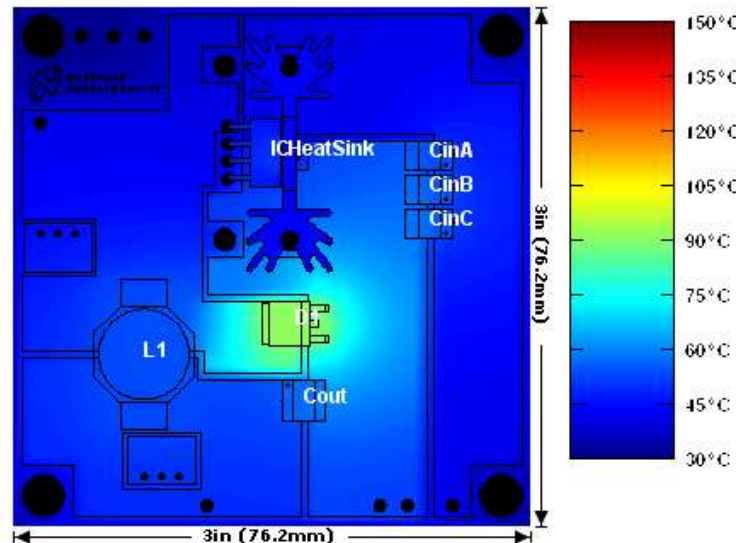
- No airflow
- Diode: 134C
- IC: 146C

Or add a Heat Sink

Use a Fan



- 500 LFM airflow
- Diode: 95C
- IC: 106C



- No airflow
- Diode: 91C
- Heat sink
- IC: 52C

Design Specs:
Vin: 20-22V
Vout: 5V
Iout: 5A

Note: heat sinks not yet enabled in new WEBENCH

Other Helpful Tips, Tricks, & Leads!

MyDesigns or MyProjects

The screenshot displays the TI WEBENCH® Optimizer interface. At the top, a navigation bar includes links for Back, New, Solutions, Visualizer, BOM, Charts, Schematic, Optimize, Op Vals, Sim, Thermal, Build It, Print, Share Design, and Assistant. A red arrow points from the text "MyDesign/Projects Link" to the "Click to view all your designs" link in the top left corner.

The main interface is divided into several sections:

- Optimization Tuning:** A sidebar on the left with a knob for adjusting parameters. It shows "Footprint: 449", "BOM Cost: \$3.16", and "Efficiency: 89%".
- Charts:** A central plot area showing a "Duty Cycle" graph with three lines (yellow, green, blue) plotted against frequency (0.70 to 1.00 MHz). The y-axis ranges from 15.00 to 25.00.
- Operating Values:** A table below the charts showing various operating parameters.
- Bill of Materials:** A table on the right showing the components and their costs.
- Your Complete Design:** A section at the bottom right with links for "Product Folder" and "View My Orders".

A red arrow points from the text "Name, Copy, or Share Your Designs & Projects" to the "Share Design" button in the top navigation bar.

Operating Values Table:

Param	Value	Category	Description
Vin_OP	12V	Op_Point	Vin operat
IC_Tolerances	0.00V	General	IC Feedba
In_Avg	0.33A	Current	Average in
IDUT_DF	2A	Op_Point	load operat
Pout	0.6W	General	Total outp
Efficiency	96.0%	Op_Point	Efficiency
Frequency	2.00MHz	General	Switching
Duty Cycle	50.0%	Op_Point	Duty cycle
Vout_p-p	0.05V	Current	Peak-to-pe
On IRMS	0.73A	Current	Input rms
Out IRMS	0.30A	Current	Output rms
L_Vol	0.00A	Current	Peak-to-pe
Vin_Vol	0.00A	Current	Peak-to-pe
Vout_Vol	0.00A	Current	Peak-to-pe
IC_Pd	0.20W	Power	IC power d
MI_Pd	0.00W	Power	MI power d

Bill of Materials Table:

Part	Manufacturer	Part No.	Q'ty	Price	Attributes	Part	Top View	Bottom
BOM Cost: \$3.16 *Footprint is component footprint plus 1mm per side								

MyProjects MyDesigns Display

My Designs/Projects English | 日本語 | 简体中文 | 繁體中文 | 한국어 | Русский Язык | Português | Deutsch Welcome Phil Gibson

MY DESIGNS / PROJECTS

[Back to Design](#) [Create A New Design](#)

[My Designs](#) [My Projects](#)

ID	Name	Device	Nsid	Design Type	Comments	Topology	Created Date	WEBENCH Tools	Action
1711	Phil's Most Recent Design	LMR24220	LMR24220TL	power	For this presentation	Buck	Feb 28, 2012 06:07 PM		
1710	Design 1710 - LMR24220TL	LMR24220	LMR24220TL	power		Buck	Feb 28, 2012 05:57 PM		
1709	Design 1709 - LM3151MHE-3.3	LM3151	LM3151MHE	power		Buck	Feb 28, 2012 05:53 PM		
1708	Design 1708 - LM3151MHE-3.3	LM3151	LM3151MHE	power		Buck	Feb 28, 2012 05:41 PM		
1707	Design 1707 - LM3151MHE-3.3	LM3151	LM3151MHE						
1706	Design 1706 - LM3151MHE-3.3	LM3151	LM3151MHE						
1705	Design 1705 - LM3151MHE-3.3	LM3151	LM3151MHE						
1704	Design 1704 - LM25576MHX	LM25576	LM25576MH						
1703	Design 1703 - LM25576MHX	LM25576	LM25576MH						
1702	Design 1702 - LM25576MHX	LM25576	LM25576MH						
1701	Design 1701 - LM22676MRE-ADJ	LM22676	LM22676MRE						
1700	Design 1700 - LM5119PSOE	LM5119	LM5119PSOE						
1699	Design 1699 - LM3152MHE-3.3	LM3152	LM3152MHE						
1698	Siemens Project Name here	LMR24220	LMR24220TL						

My Designs/Projects

[Back to Design](#) [Create A New Design](#)

[My Designs](#) [My Projects](#)

ID	Name	Device	Nsid	Design Type
1711	Phil's Most Recent Design	LMR24220	LMR24220TL	power

MyProjects MyDesigns Display

Circuit Calculator

WebTherm

Simulation








































































































Build It Kit

Open Design

Share Design

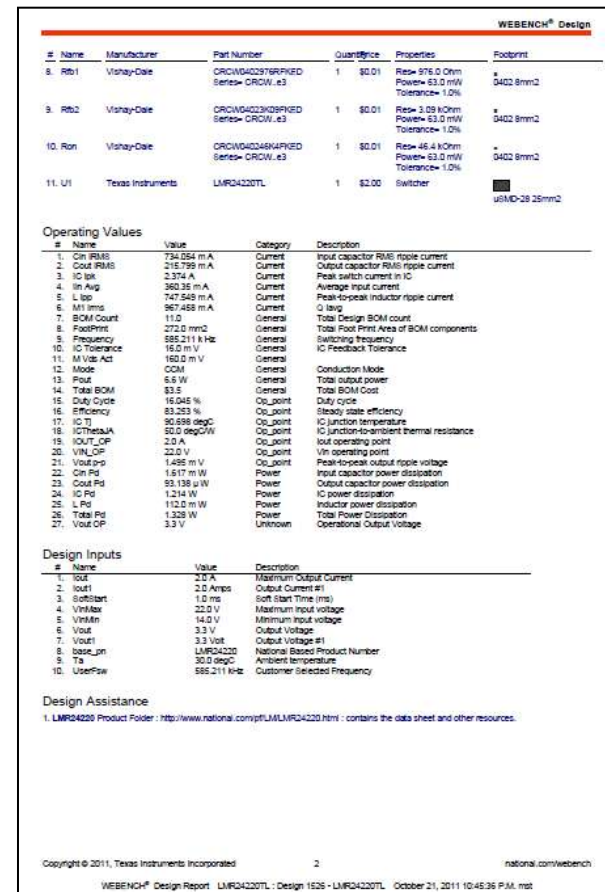
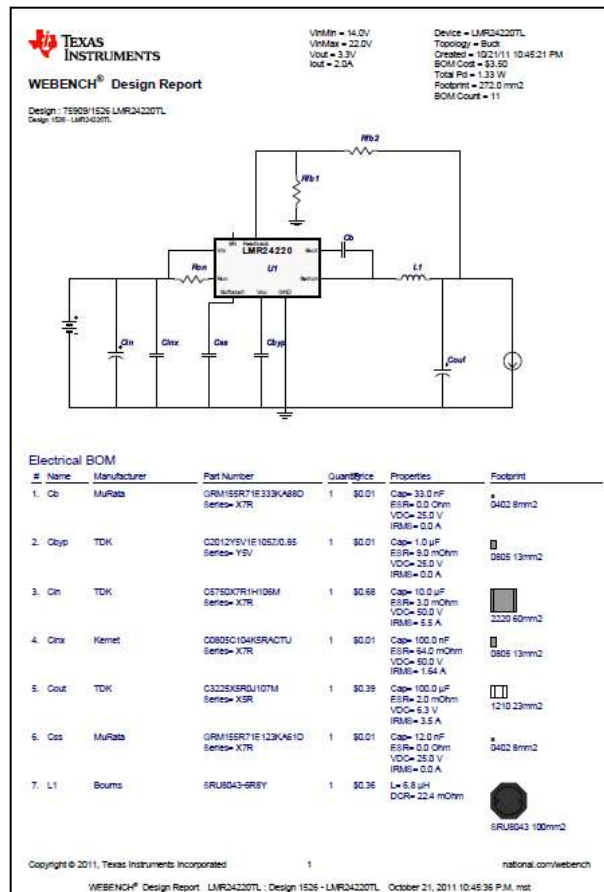
Copy Design

Delete Design

	WEBENCH Tools	Action
012 06:07 PM	 	   
012 05:57 PM	 	   
012 05:53 PM	   	   
012 05:41 PM	   	   
	   	   
	   	   
	   	   
	   	   
	   	   
	   	   
	   	   
		   
	   	   
	 	   

Your Complete Power Supply Design – Automatic Report Generation

Your Design From The Top: Input, Supply, Schematic, BOM



Thank You!