

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

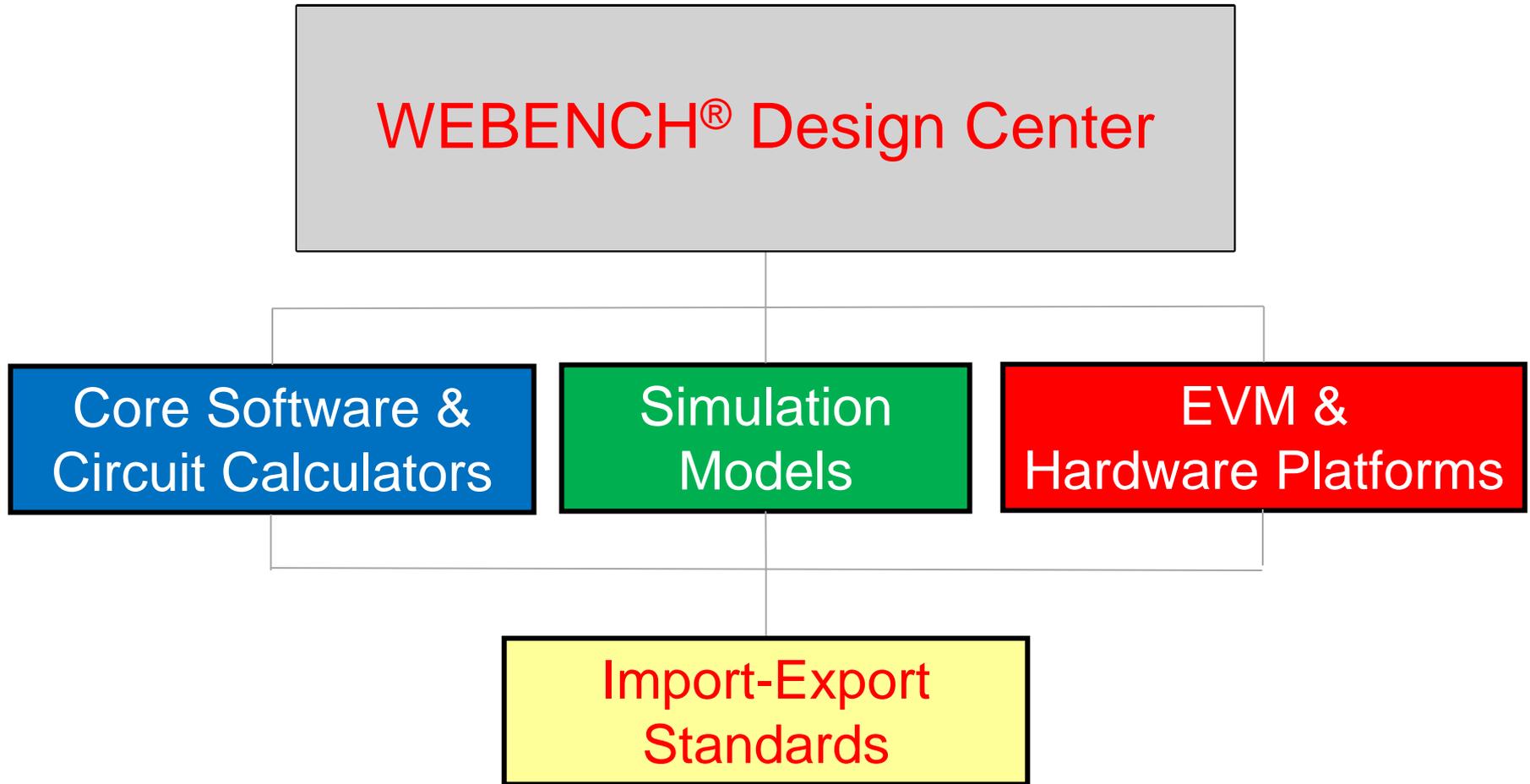
Partner with industry leading component, subsystem, and supply partners to expand resources and gain share. Deliver superior performance solutions at the lowest cost in the shortest time possible

Customers
Come First

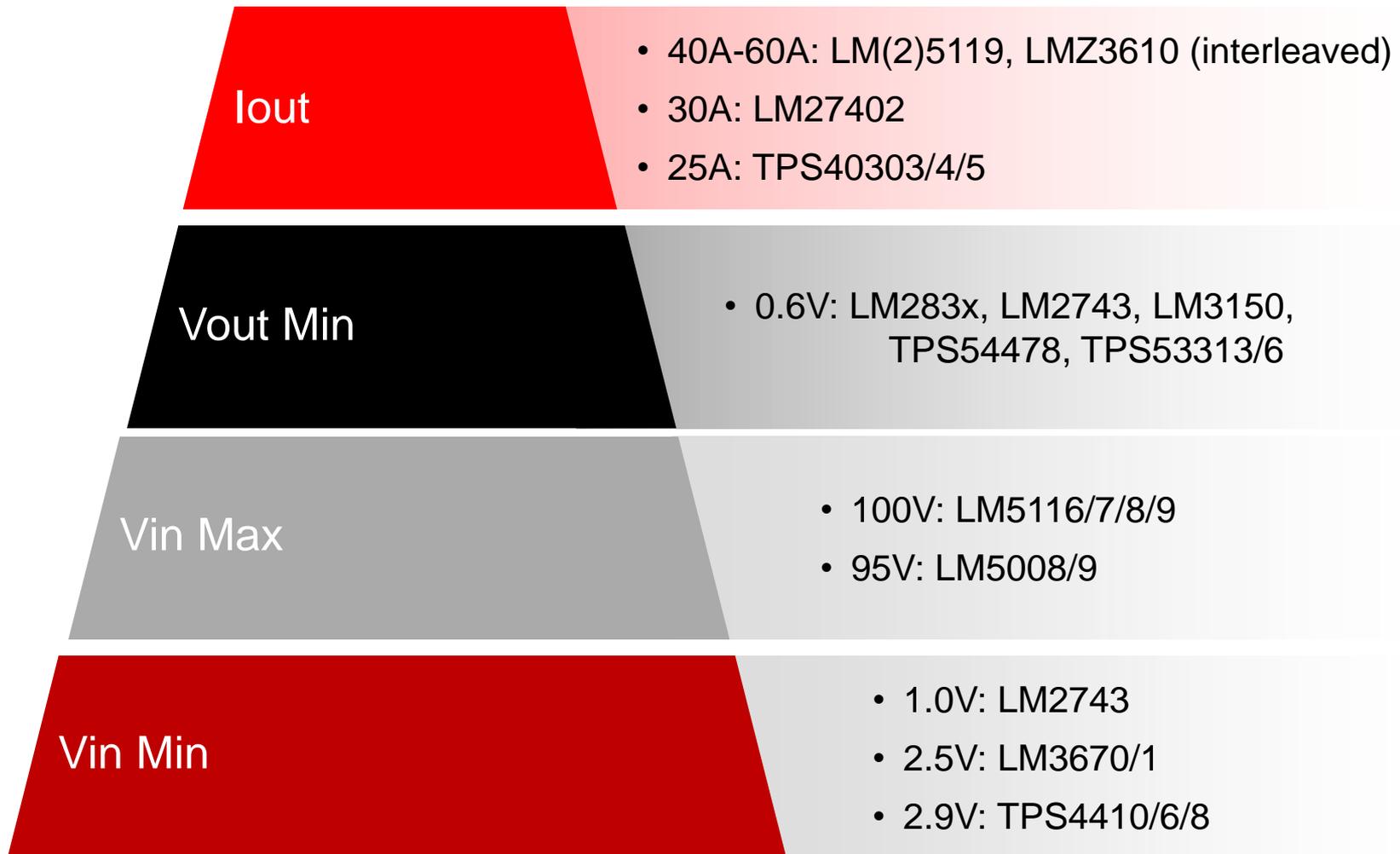
Build loyal customer relationships by enabling new value in their products. Accelerate customers to market with useful design knowledge and timely advice.

Grow TI Analog revenue at 2X the industry rate

WEBENCH[®] Development Vision



Coverage of WEBENCH Enabled Parts (Buck Switchers)



Immediate WEBENCH[®] Queue

Device	V _{in}	V _{out}	I _{out}	
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

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WEBENCH® FET Selection & Design Optimization – 20

WEBENCH® Tools on TI.com

CODE NAME: WOLVERINE

The world's lowest power MCU platform



MAKE THE SWITCH
- TI MCU

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

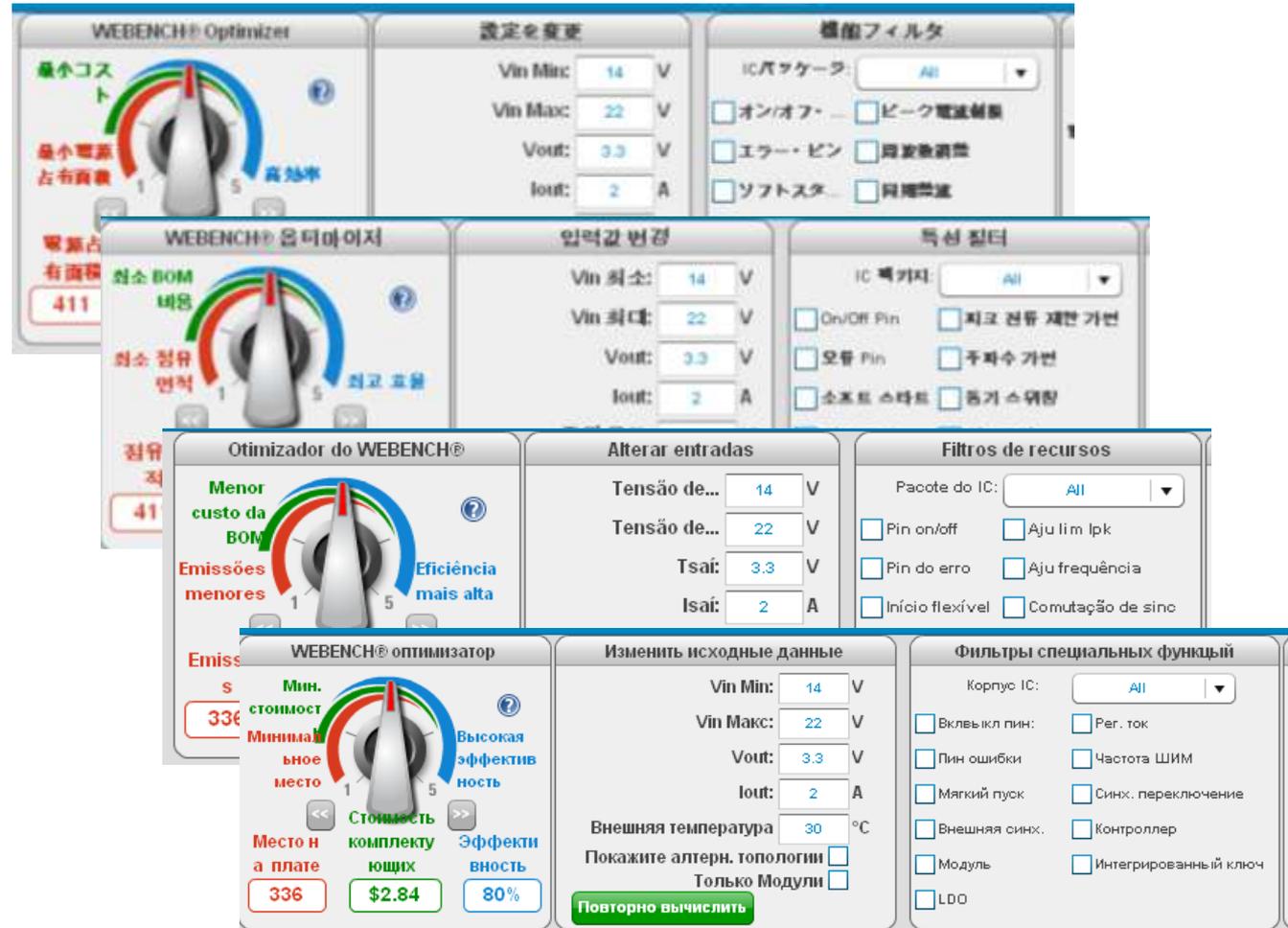
Enter your power supply requirements:

	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 Single Output
Power Architect **Start Design**

WEBENCH® Designer is Multi-Linguual

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



WEBENCH® Start Panel

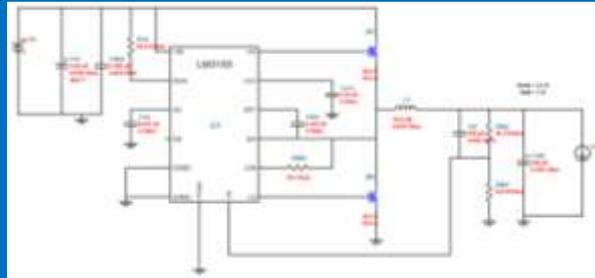
WEBENCH® Designer

Power | FPGA/μP | Sensors | LED

Enter your power supply requirements:

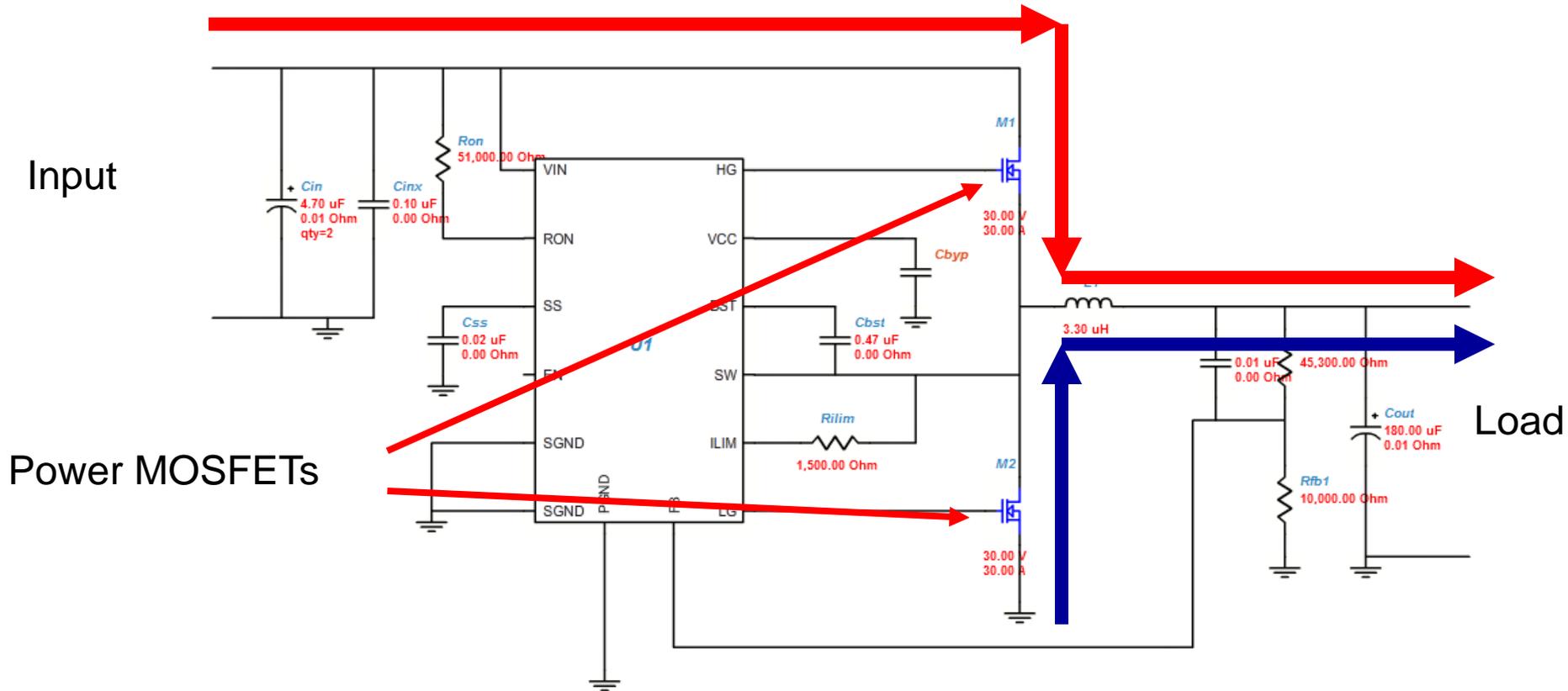
	Min		Max	
Vin	<input type="text" value="14.0"/>	V	<input type="text" value="22.0"/>	V
	Vout		Iout	
Output	<input type="text" value="3.3"/>	V	<input type="text" value="2.0"/>	A
Ambient Temp			<input type="text" value="30"/>	°C

The Foundation Is Mathematics



WEBENCH® Designer Tools

Schematic – Synchronous Buck Controller



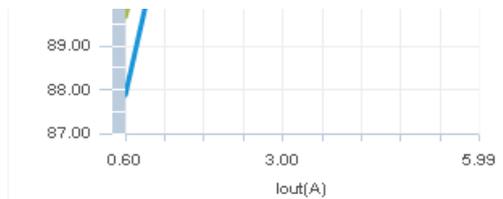
Current Path with High Side Switch On

Current Path with High Side Switch Off

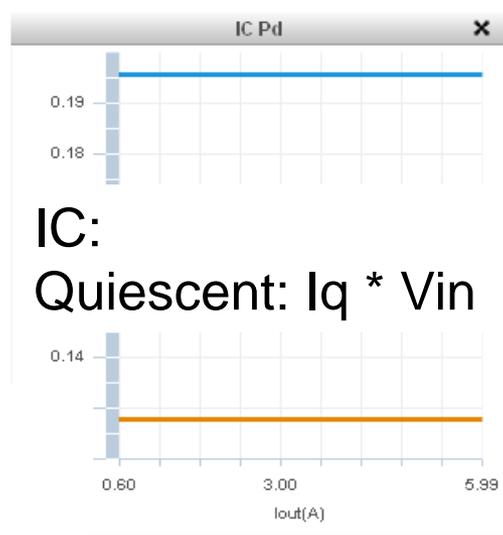
Visualize Behavior – Power Dissipation



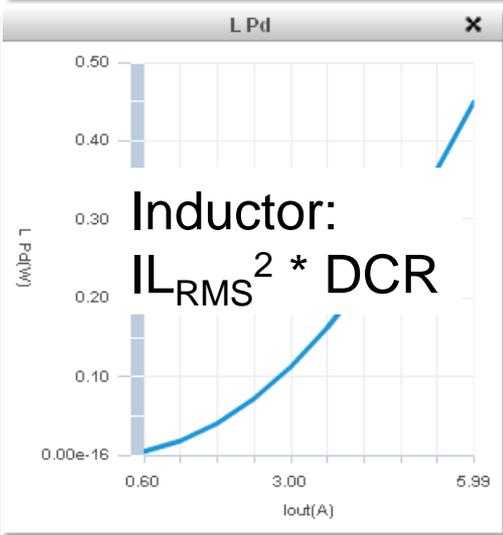
Efficiency = P_{out} / P_{in}
 $P_{in} = V_{out} * I_{out} + P_{diss}$



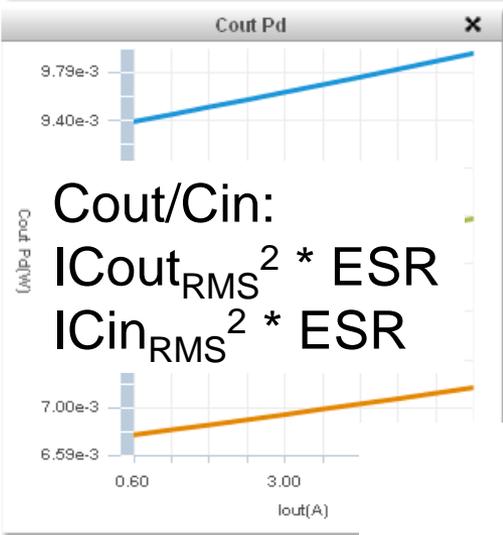
M1, M2:
 M1 DC: $I_{sw_RMS}^2 * R_{sw} * DutyC$
 M2 DC: $I_{sw_RMS}^2 * R_{sw} * 1-DutyC$
 AC: $\frac{1}{2} * V_{in} * I_{sw} * (T_{rise} + T_{fall}) / T_{sw}$



IC:
 Quiescent: $I_q * V_{in}$



Inductor:
 $I_{L_RMS}^2 * DCR$



Cout/Cin:
 $I_{Cout_RMS}^2 * ESR$
 $I_{Cin_RMS}^2 * ESR$

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

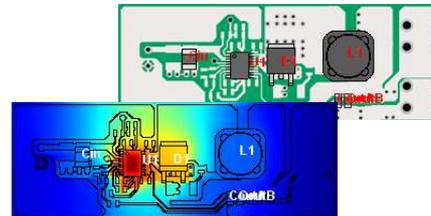
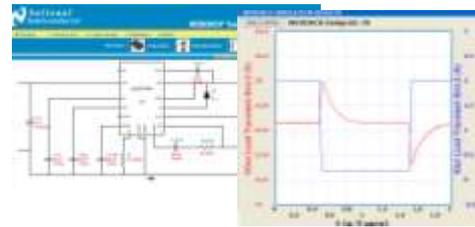
1. Choose a Part



2. Create a Design

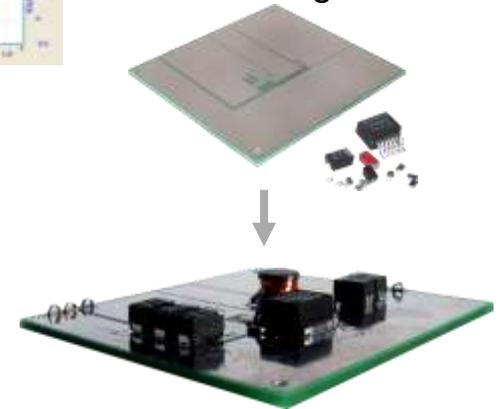


3. Analyze a Design



4. Build It!

Custom Prototype Kit
Overnight



The WEBENCH® Designer Dashboard

The screenshot shows the WEBENCH Designer interface with the following components labeled:

- Simulation:** A red box highlights the 'Sim' and 'Thermal' icons in the top navigation bar.
- Controls:** A label points to the 'Advanced Options' section on the left, which includes sliders for Footprint, BOM Cost, and Efficiency.
- Op Vals Charts:** A label points to the 'Efficiency' graph in the 'Charts' section.
- Schematic:** A label points to the circuit diagram in the 'Schematic' section.
- Optimization:** A label points to the 'Power Dissipation Chart' in the 'Optimization' section.
- Design Inputs:** A label points to the 'IC: LM1122' section on the left, which lists various electrical parameters like Voltage, Vout, and Load.
- Op Vals:** A label points to the 'Operating Values' table at the bottom left.
- BOM/Change Components:** A label points to the 'BOM of Materials' table at the bottom center.
- Build It® & Report:** A label points to the 'Your Complete Design' section on the right, which includes options for downloading files and ordering boards.

Dashboard

- 1) Graphs
- 2) Schematic
- 3) Optimization
- 4) Operating values
- 5) BOM
- 6) Reporting
- 7) Electrical and Thermal Simulation

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

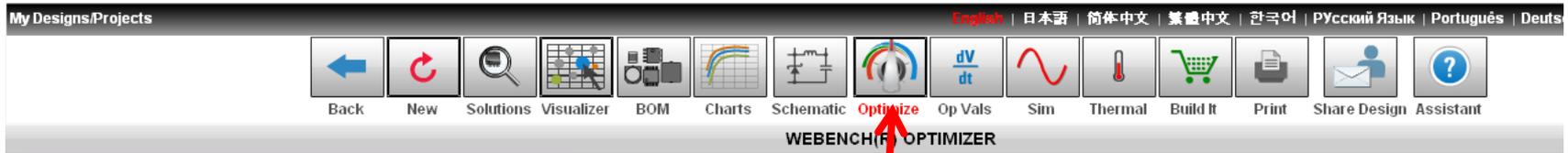
Soft Start Time (ms): 1ms < 1 ms < 25ms

Update

User entry parameters:
Frequency
Soft start time

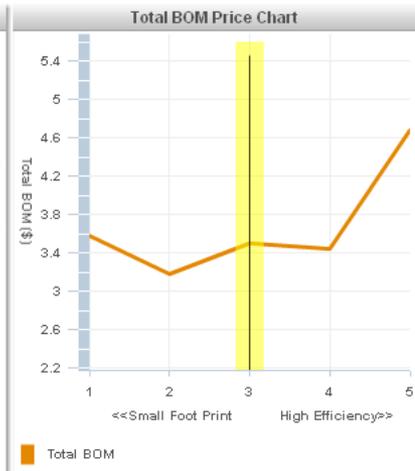
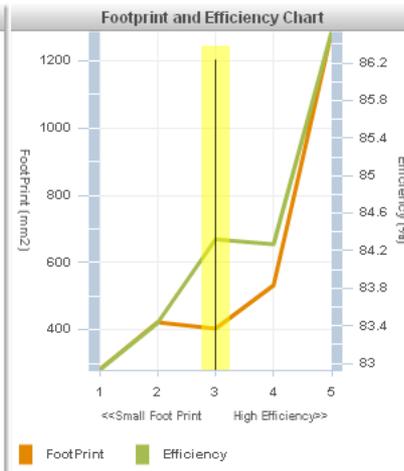
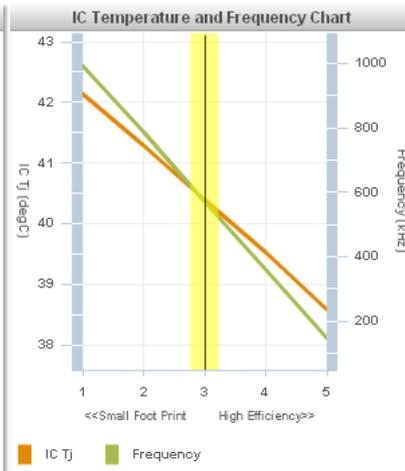
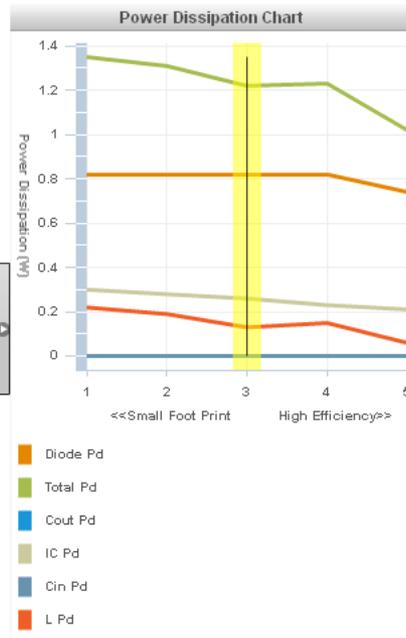


Key Optimization Parameters Graphed



Optimize page

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



Frequency
IC Temperature

Footprint
Efficiency

BOM Cost

Power Dissipation
By Component

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

Click Select Alternate To Change A Component

BILL OF MATERIALS

Export to: BOM Cost: \$3.50 Footprint is component footprint plus 1mm per side.

Part	Manufacturer	Part Number	Quantity	Price	Attributes	Footprint	Top View	Edit
C1	Murata	GRM155R71E33J	1	\$0.81	Cap=33nF, ESR=40fms, VDC=25V	8	-	<input type="button" value="Select Alternate Part"/>
C1yp	TDK	C2012Y5V1E105G	1	\$0.81	Cap=10nF, ESR=3mOhms, VDC=25V	13		<input type="button" value="Select Alternate Part"/>
C1s	TDK	C5750X7R1R106G	1	\$0.68	Cap=10nF, ESR=1mOhms, VDC=50V	48		<input type="button" value="Select Alternate Part"/>
C1se	Kemet	C8905C104K5RA	1	\$0.81	Cap=100nF, ESR=6.640fms, VDC=50V	13		<input type="button" value="Select Alternate Part"/>
C1st	TDK	C3225X506V1E105G	1	\$0.79	Cap=100nF, ESR=2mOhms, VDC=50V	23		<input type="button" value="Select Alternate Part"/>
C1e	Murata	GRM155R71E12J	1	\$0.81	Cap=12nF, ESR=40fms, VDC=25V	-	-	<input type="button" value="Select Alternate Part"/>
L1	Bourns	SR18043-GRBY	1	\$0.34	L=4.5uH, DCR=0.027Ohms, DC=3.3A	98		<input type="button" value="Select Alternate Part"/>
BB1	Vishay-Dale	CRCW0402970R8	1	\$0.81	Resistance=970Ohms, Tolerance=1%, Power=0.062W	8	-	<input type="button" value="Select Alternate Part"/>
BB2	Vishay-Dale	CRCW04023K0R8	1	\$0.81	Resistance=3.0KOhms, Tolerance=1%, Power=0.062W	8	-	<input type="button" value="Select Alternate Part"/>
BB	Vishay-Dale	CRCW040240K8E	1	\$0.81	Resistance=40.0KOhms, Tolerance=1%, Power=0.062W	8	-	<input type="button" value="Select Alternate Part"/>
U1	Texas Instrument	LMP24229TL	1	\$2.88		75		<input type="button" value="Select Alternate Part"/>

Evaluate and Select Alternate Components

Parameter Specification Limits

Multiple Column Sort

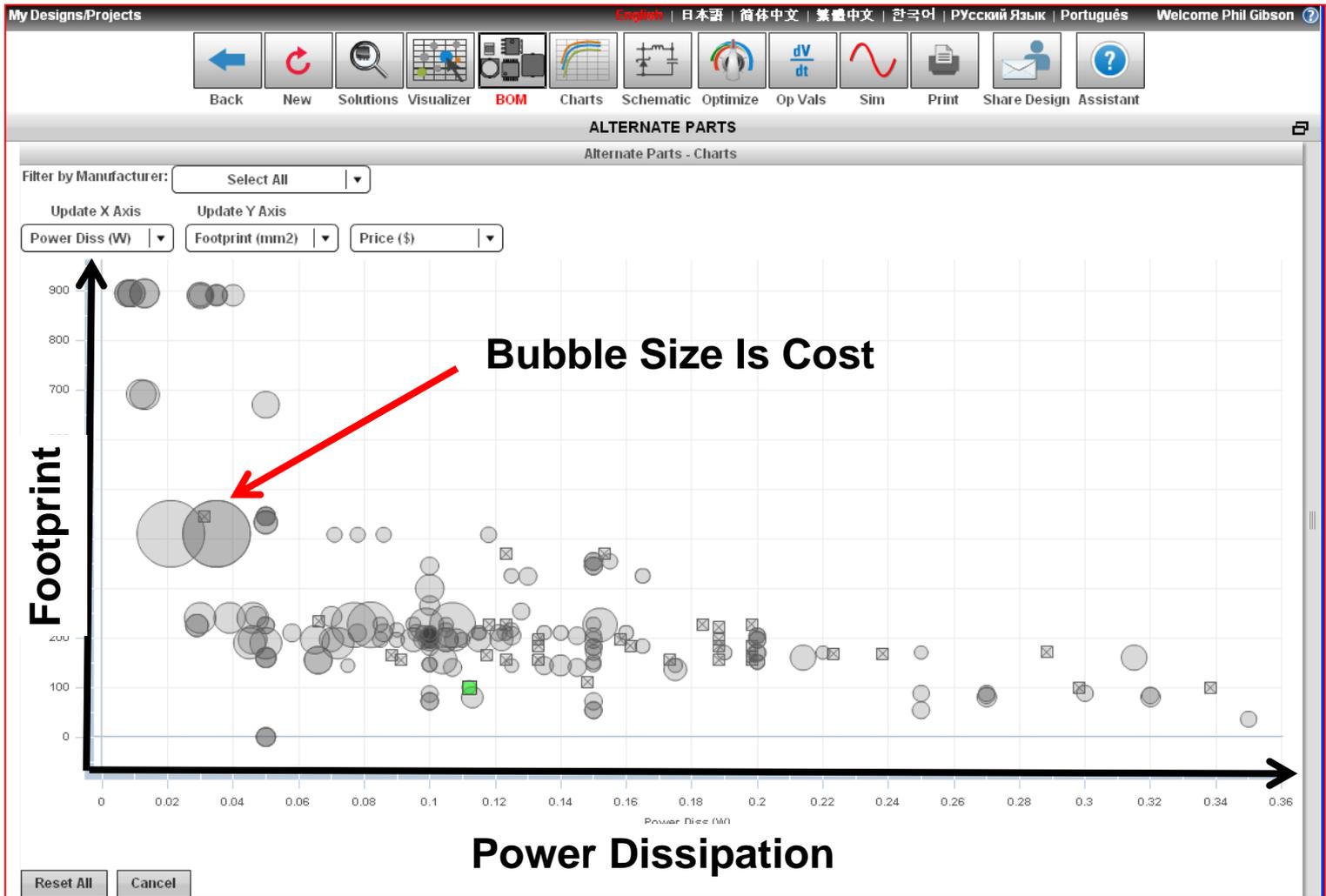
Component Tradeoffs:
Footprint
Pdiss
Price
Performance
Vout Ripple
Transient Resp
Loop Stability

The screenshot shows the 'ALTERNATE PARTS' table in the TI Design Explorer software. The table lists various component alternatives with their specifications. A scatter plot on the left shows the tradeoffs between different parameters. Red arrows point from text labels to specific features in the interface.

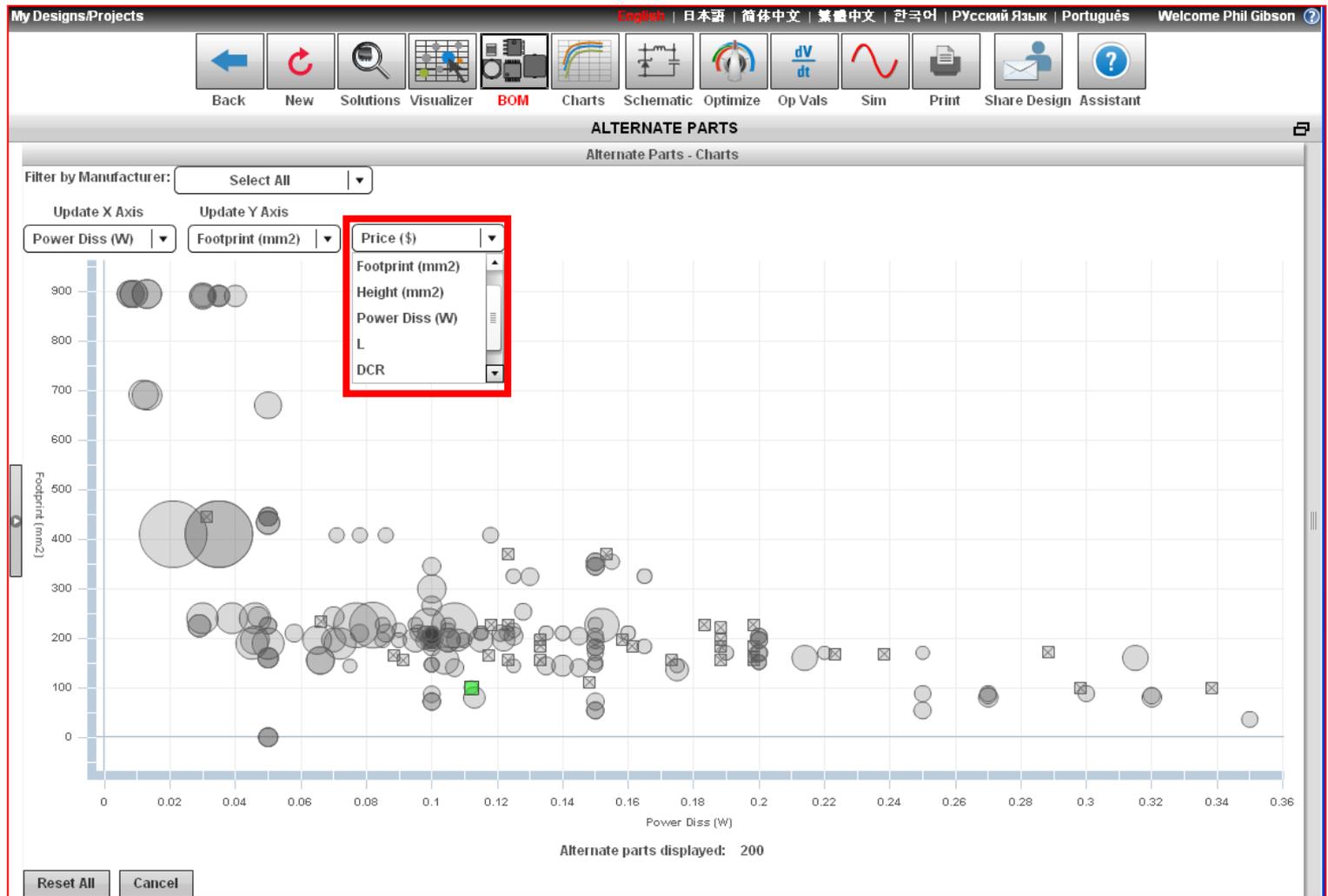
Model	Part Number	L (µH)	DCR (mΩ)	DC (µH)	Price	Qty Avail	Foot Print	Height	Power Diss	Top View
Borens	S201043-402Y	4.5µ	6.472	3.8	\$4.24	9	199	5.3	6.117	
LM75	L (µH)		DCR (mΩ)	DC (µH)						
Upperbound	17.82µ		6.893		44.57					
Lowerbound	1.48µ		5.96µ		3.475					
Target	4.88µ		5.25µ		5.425					

Ctrl	Status	Part Number	L (µH)	DCR (mΩ)	DC (µH)	Price	Qty Avail	Foot Print	Height	Power Diss	Foot Print	
<input type="checkbox"/>	Selected	S201043-402Y	4.5µ	6.472	3.8	\$4.24	9	199	5.3	6.117		
<input type="checkbox"/>	Not Selected	P975110208-1	0µ	9.45	3.8	\$6.37	> 99	179	5.46	6.208		
<input type="checkbox"/>	Not Selected	P975140208-1	4.8µ	6.948	4.3	\$6.37	> 99	179	5.46	6.228		
<input type="checkbox"/>	Not Selected	Borens	S201033-100Y	0µ	6.475	3.8	\$6.36	> 99	148	6.175		
<input type="checkbox"/>	Not Selected	Borens	S201043-302Y	4.2µ	6.475	4.3	\$6.36	9	148	6.175		
<input type="checkbox"/>	Not Selected	CercoA	K3L4070-0025B	4.8µ	6.87	3.8	\$6.48	> 99	26	6.208		
<input type="checkbox"/>	Not Selected	Borens	S201033-700Y	7µ	6.475	4.3	\$6.49	9	148	6.175		
<input type="checkbox"/>	Not Selected	Borens	P913340-0018L	0µ	6.877	3.5	\$6.46	> 99	183	15.5	6.933	

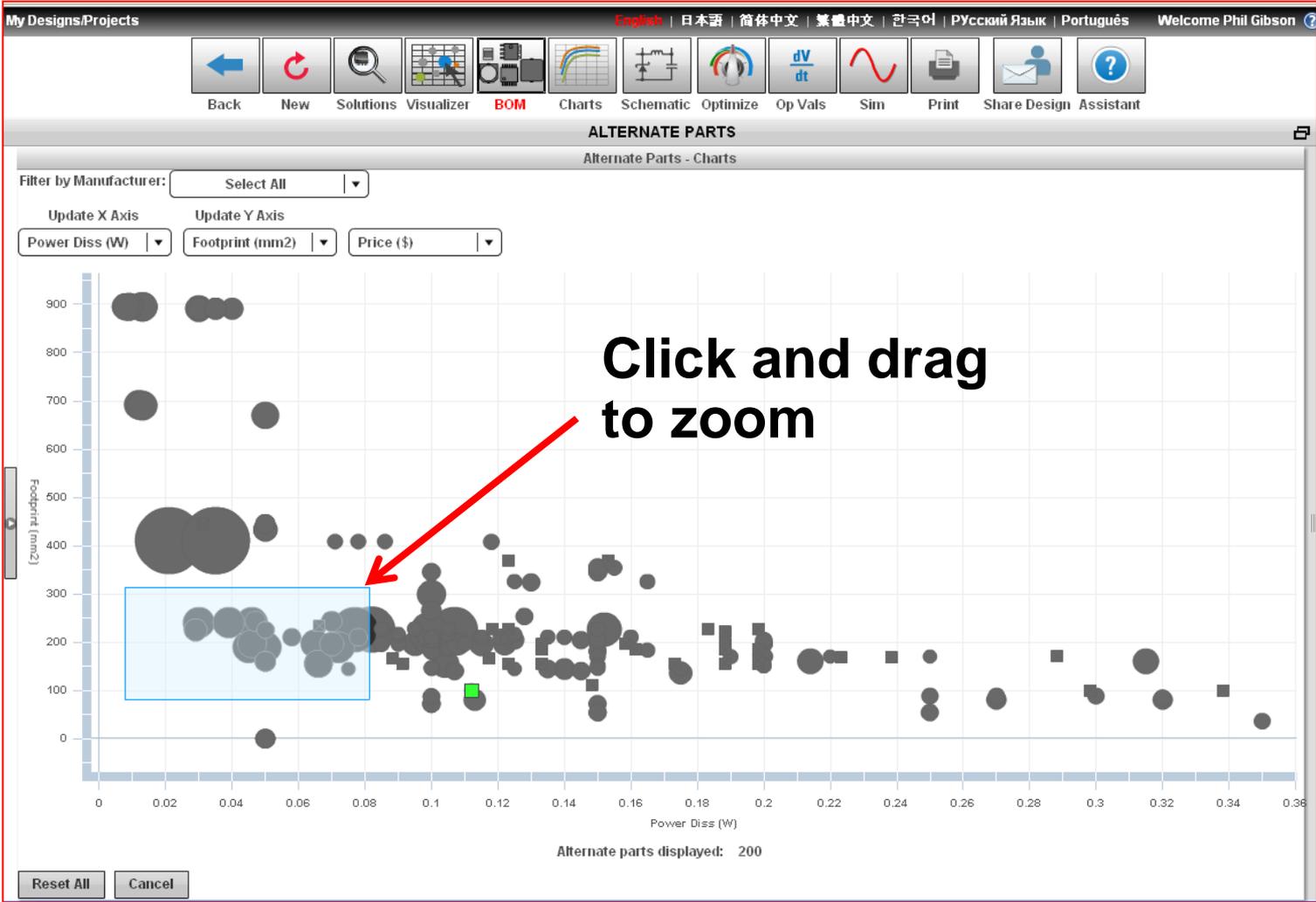
Evaluate Components - Inductor



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

The screenshot shows the 'ALTERNATE PARTS' window in the TI Design Explorer. On the left, a scatter plot shows various components. A zoom box is applied to a specific component. On the right, a table displays the filtered list of components. The first row is highlighted, and a red box highlights the 'Select' button next to it. At the bottom of the table, a red box highlights the 'Create a Custom Part' button.

Model	Part Number	L (in)	DCR (Ohm)	DC (in)	Price	Qty Avail	Foot Print	Height	Power Diss	Top View	
Bores	S201043-020V	4.0in	6.477	3.8	\$8.30	8	199	6.3	6.117		
LIMITS											
		L (in)	DCR (Ohm)	DC (in)							
Upperbound		12.8%		6.993		44.57					
Lowerbound		-6.8%		99%		3.475					
Target		1.0%		8.25in		3.475					
Select an alternate part for Component L1:											
Edit	Model	Part Number	L (in)	DCR (Ohm)	DC (in)	Price	Qty Avail	Foot Print	Height	Power Diss	Foot Print
<input type="button" value="Select"/>	Bores	S201043-020V	4.0in	6.477	3.8	\$8.30	8	199	6.3	6.117	
<input type="button" value="Select"/>	Pulse Engineering	P4751-1038L1	19in	8.85	3.8	\$8.33	> 10	179	5.46	6.208	
<input type="button" value="Select"/>	Pulse Engineering	P4751-0038L1	5.8in	6.944	4.8	\$8.33	> 10	179	5.86	6.229	
<input type="button" value="Select"/>	Bores	S201038-100V	19in	6.475	3.8	\$8.30	> 10	188	3.8	6.125	
<input type="button" value="Select"/>	Bores	S201040-022V	8.2in	6.475	4.8	\$8.30	8	188	3.8	6.175	
<input type="button" value="Select"/>	Celcraft	882-4070-0028E	4.8in	8.87	3.8	\$8.48	> 10	28	3.5	6.208	
<input type="button" value="Select"/>	Bores	S201038-700V	7in	6.475	4	\$8.40	8	188	3.8	6.175	
<input type="button" value="Select"/>		S201040-1000E	19in	6.477	3.5	\$8.40	> 10	183	15.5	6.195	

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

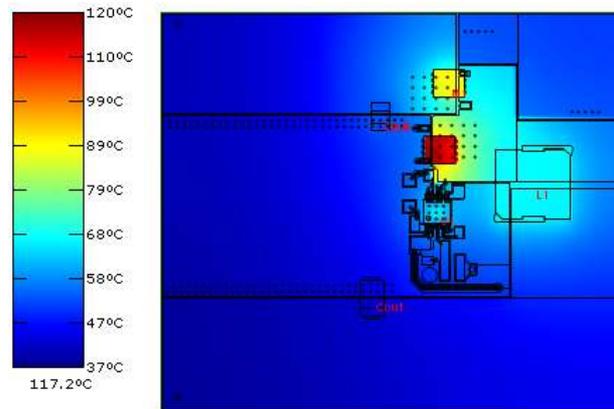
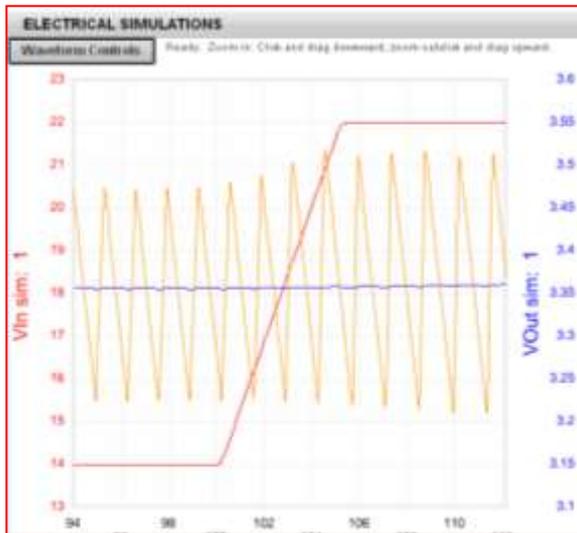
The screenshot displays the WEBENCH Designer interface. At the top, the 'WEBENCH Designer' title is visible. A toolbar contains several icons, with the 'Sim' icon (a red sine wave) highlighted by a red box. Below the toolbar, the interface is divided into several panels:

- Optimization Tracking:** Shows 'Lowest BOM Cost' (\$22), 'Smallest Footprint', and 'Highest Efficiency' (\$3.97, 88%).
- Advanced Options:** Includes 'Use Selected FET' and 'Current Design: 1522'.
- Operating Values:** A graph showing efficiency vs. input power.
- Bill of Materials (BOM):** A table listing components and their costs.
- Simulation:** A schematic diagram of a power converter circuit.
- Power Distribution Chart:** A graph showing power distribution across components.
- Your Complete Design:** A sidebar with links to 'Product Folder', 'View My Orders', and 'Download' options.

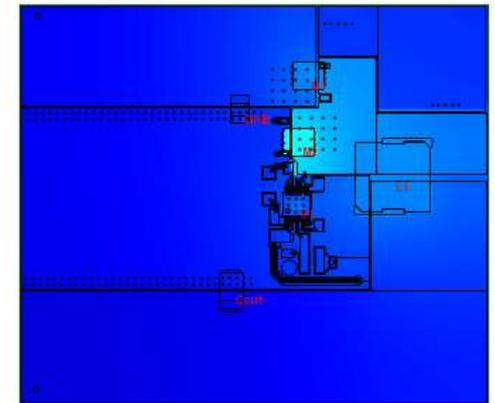
A red box highlights the 'Sim' button in the toolbar, and the word 'Simulation' is written in a white box over the schematic diagram.

Part	Qty	Part No.	Unit Price	Subtotal	Stock	Order
IC1	1	LM1112	\$1.00	\$1.00	1000	Order
IC2	1	LM1112	\$1.00	\$1.00	1000	Order
IC3	1	LM1112	\$1.00	\$1.00	1000	Order
IC4	1	LM1112	\$1.00	\$1.00	1000	Order
IC5	1	LM1112	\$1.00	\$1.00	1000	Order
IC6	1	LM1112	\$1.00	\$1.00	1000	Order
IC7	1	LM1112	\$1.00	\$1.00	1000	Order
IC8	1	LM1112	\$1.00	\$1.00	1000	Order
IC9	1	LM1112	\$1.00	\$1.00	1000	Order
IC10	1	LM1112	\$1.00	\$1.00	1000	Order

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

The screenshot shows the WEBENCH Designer interface. At the top, the Texas Instruments logo and 'WEBENCH® Designer' are visible. A navigation bar contains buttons for Back, New, Solutions, Visualizer, BOM, Charts, Schematic, Optimizer, Op Vals, Sim, Thermal, Dukt II, Print, **Share Design** (highlighted with a red box), and Assistant. The main workspace is divided into several panels: Optimization Tracking, Charts (Efficiency graph), Schematic, WEBENCH Optimizer, Advanced Options, Component Design (IC: LM1112), Operating Modes, Bill of Materials (BOM), and Your Complete Design. A red arrow points from the text 'Click on Share Project button' to the 'Share Design' button.

Click on Share Project button

Click on Share Project button

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

The screenshot displays the Texas Instruments WEBENCH Designer interface. The top navigation bar includes the Texas Instruments logo, the product name 'WEBENCH® Designer', a search bar, and a 'Go' button. Below this is a language selection menu and a 'Welcome Phil Gibson' message. A toolbar contains icons for Back, New, Solutions, Visualizer, BOM, Charts, Schematic, Optimize, Op Vals, Sim, Print, Share Design, and Assistant. The main workspace is divided into several panels: 'Optimization Tuning' with sliders for BOM Cost, Footprint, and Efficiency; 'Charts' showing an efficiency graph; 'Schematic' showing a circuit diagram; and 'WEBENCH® Optimizer' with a 'Designs Complete' notification. A 'Share A Design' dialog box is overlaid on the right side, containing the following fields and buttons:

- Share this design with:** Enter the email address of the recipient. Separate multiple addresses with commas. Input field contains: `bill.spence@customer.com`
- You can also choose emails from the list below:** A list of suggested email addresses: `phil.gibson@nsc.com` (highlighted in red), and `william.citajaya@nsc.com`
- Add your notes for this design:** A large text area for entering notes.
- Branch Code:** A dropdown menu with the text '- Please select a branch code -'
- Buttons:** 'Share this design' (green), 'Clear', and 'Cancel' (grey)

A red arrow points from the text 'Enter Recipient's Email Address And Your Note' to the email input field in the dialog box.

**Enter Recipient's
Email Address
And Your Note**

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.

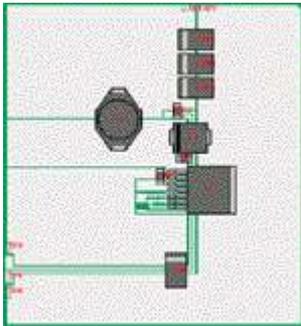
Regards,
The WEBENCH Team at Texas Instruments

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

 **TI E2E™**
Community **e2e.ti.com** engineer.to.engineer,
solving problems

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

SimID	Sim Type	Start Time	Status
1	Bode Plot	2011-12-04 18:54:00.0	Success

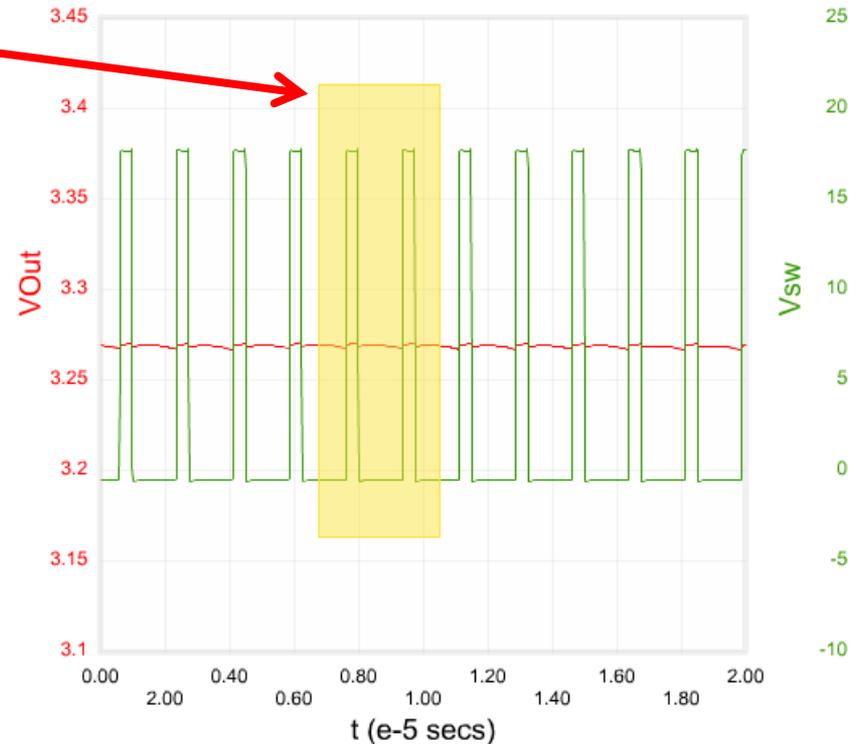
Click to view waveforms

Waveform viewer

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

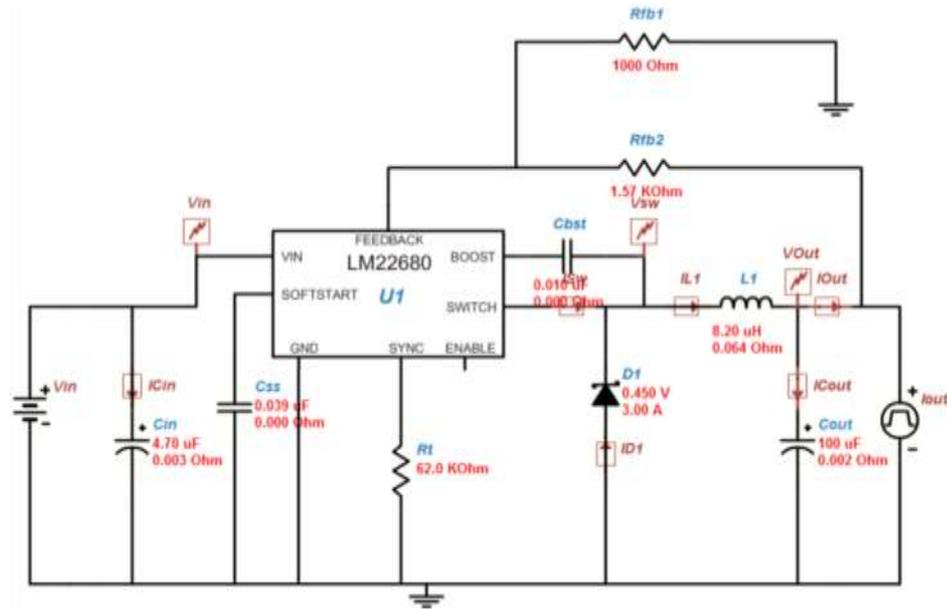


Evaluate Transient Response

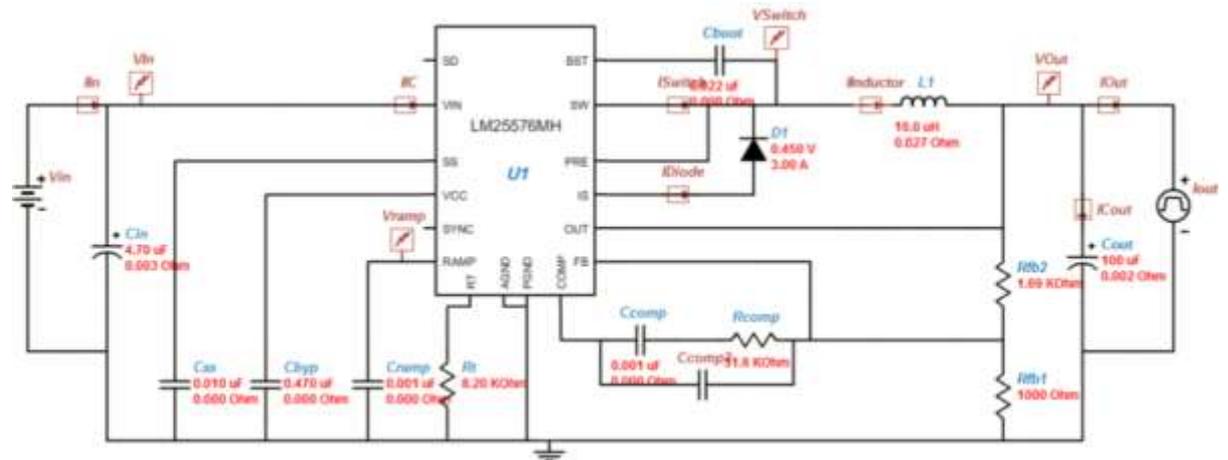
- LM22680
 - Voltage mode pulse width modulation control scheme (PWM)
 - Lower part count – SIMPLE SWITCHER®
- LM25576
 - Emulated current mode (ECM)
 - Fast transient response
- Will evaluate:
 - How does ECM compare with PWM
 - V_{in} : 14-22V, V_{out} : 3.3V, I_{out} : 2A

Buck Schematics

LM22680 PWM



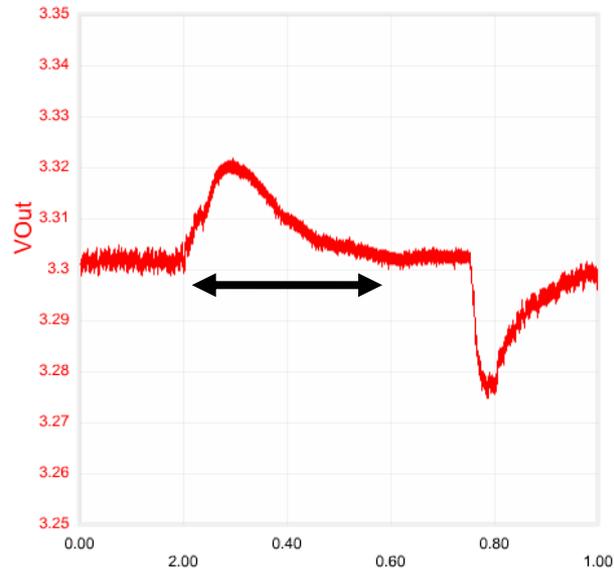
LM25576 ECM



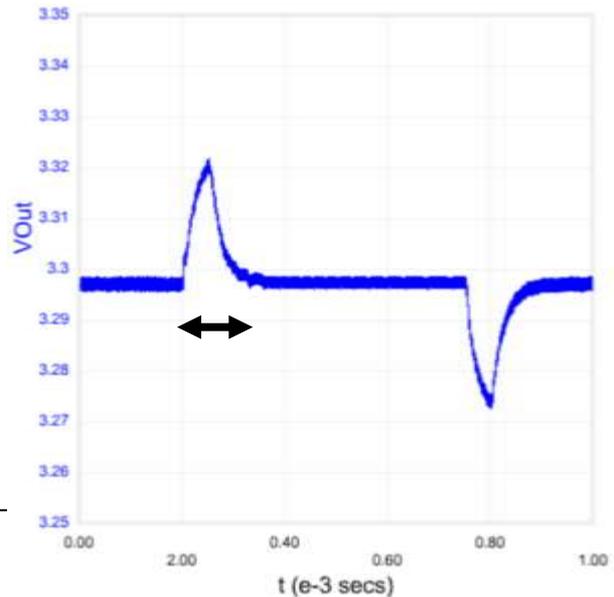
LM22680 vs LM25576

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

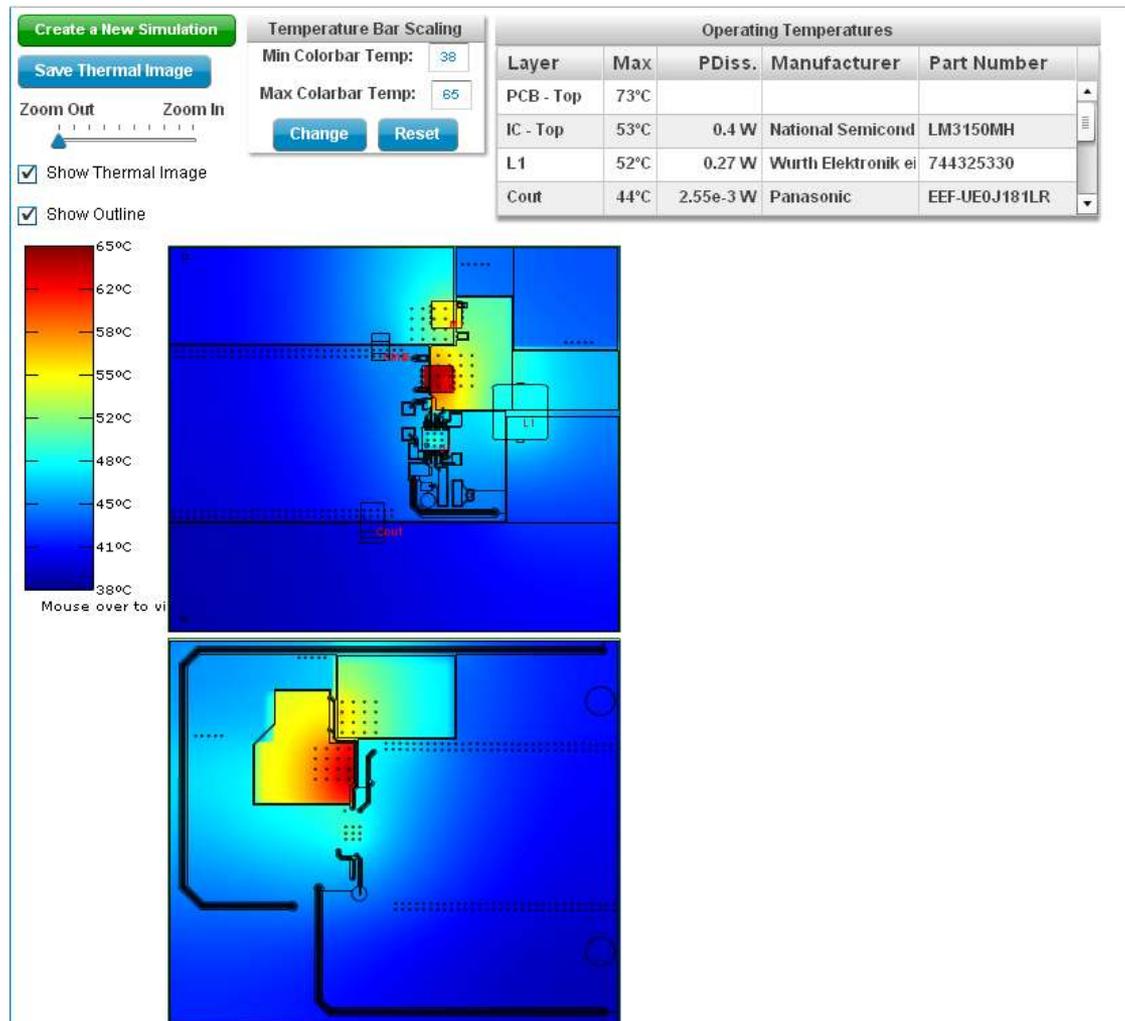
Inputs:
Copper thickness
Airflow
Board orientation

The screenshot displays the WebTHERM software interface. At the top, a navigation bar includes icons for Back, New, Solutions, BOM, Charts, Schematic, Optimize, Op Vals, Sim, and a red-bordered icon. Below this, the 'All WebTHERM™ Simulations' panel is highlighted with a red border. It contains the following sections:

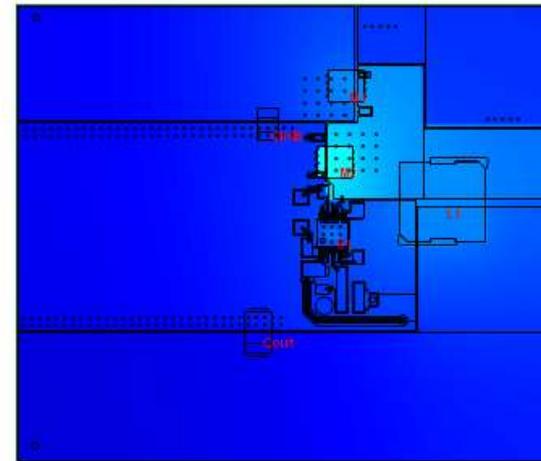
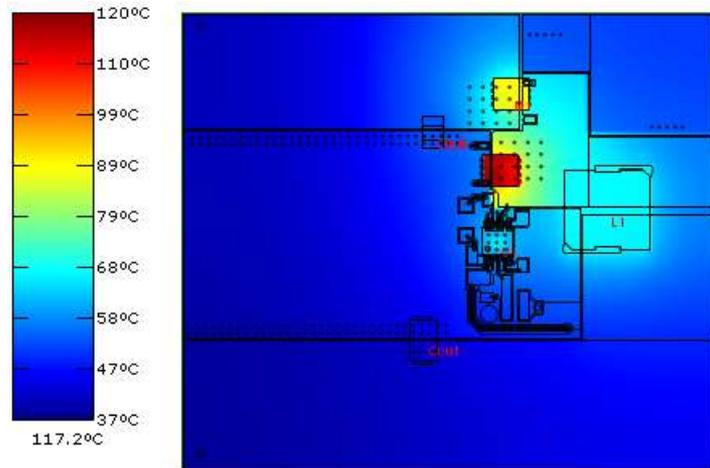
- Simulation ID:** 0
- Name This Simulation:** Simulation for Design 8020
- Comments:**
- Set Up Sim** (green button)
- Operating Condition:** VIn: 2.2, IIn: 8
- Ambient Temperature:** On Bottom: 30 °C, On Top: 30 °C
- Board Condition:** Copper Weight: 2 OZ (0.07142 mm), Board Orientation: Component Side Up
- Air Flow:** Direction (visualized with arrows), Velocity (Fan, None, LFM, LMB)
- Edge Temperatures:** Edge 1, 2, 3, and 4, each with an 'Insulated OR' checkbox and a temperature input field (30 °C).

To the right of the settings panel, a 'Run Simulation' button is visible. Below it are 'Zoom Out' and 'Zoom In' controls. The main visualization area shows a top-down view of a PCB layout with components and a bottom-up view of the board's copper and solder mask layers.

WebTHERM® Thermal Image Results



Example Trade-Offs LM3150 Controller

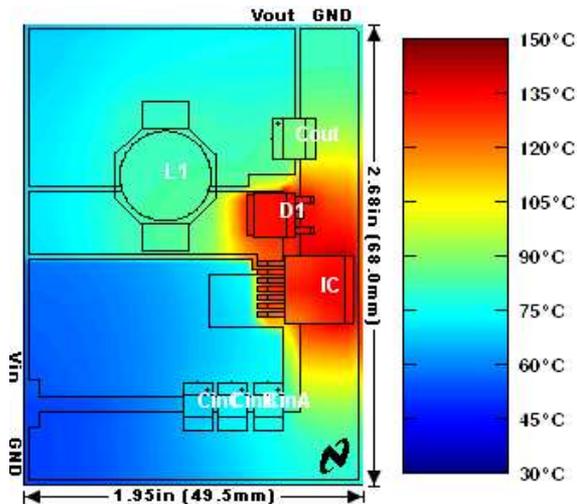


.5oz copper thickness
Low side FET is 117C

4oz copper thickness
Low side FET is 68C

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

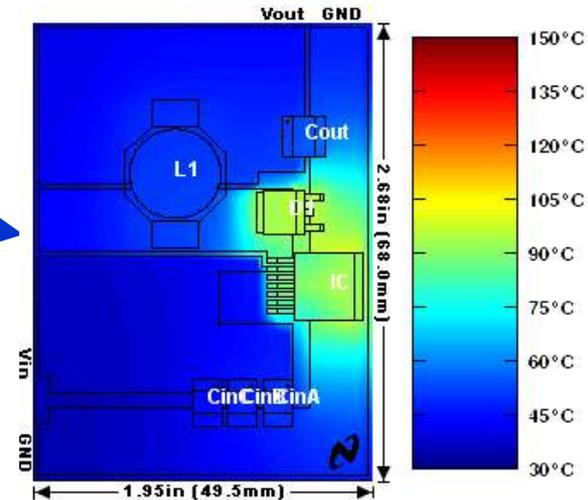
WebTHERM™ Solutions



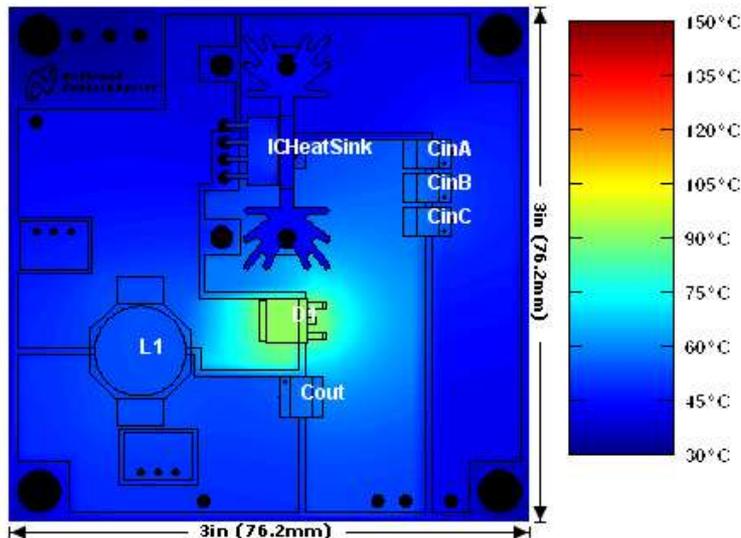
- No airflow
- Diode: 134C
- IC: 146C

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

Other Helpful Tips, Tricks, & Leads!

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	LM25576MHX						
1703	Design 1703 - LM25576MHX	LM25576	LM25576MHX						
1702	Design 1702 - LM25576MHX	LM25576	LM25576MHX						
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

The screenshot shows the 'My Designs' interface. On the left, a table lists designs with IDs 1711, 1710, 1709, and 1708. A red line highlights the row for ID 1708. In the center, a white box contains the following text:

Circuit Calculator
WebTherm
Simulation
Build It Kit

Open Design
Share Design
Copy Design
Delete Design

On the right, a table titled 'WEBENCH Tools' shows a list of designs with columns for 'Action'. A red diagonal line is drawn across the bottom right portion of the interface.

ID	Name
1711	PI D
1710	D LI
1709	D LI
1708	D

Time	Tools	Action
012 06:07 PM	[Icons]	[Icons]
012 05:57 PM	[Icons]	[Icons]
012 05:53 PM	[Icons]	[Icons]
012 05:41 PM	[Icons]	[Icons]

Your Complete Power Supply Design – Automatic Report Generation

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

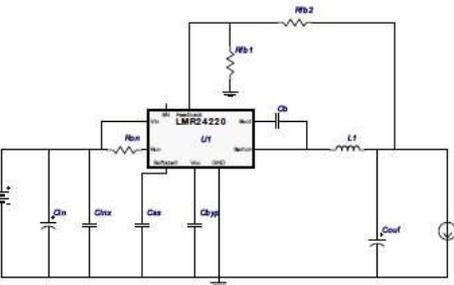


WEBENCH® Design Report

Design: T59281526-LMR24220TL
Design ID#: LMR24220TL

VinMin = 14.0V
VinMax = 22.0V
Vout = 3.3V
Iout = 2.0A

Device = LMR24220TL
Topology = Buck
Created = 10/21/11 10:45:21 PM
BOM Cost = \$3.50
Total Pct = 1.33 W
Footprint = 272.0 mm²
BOM Count = 11



#	Name	Manufacturer	Part Number	Quantity	Price	Properties	Footprint
1.	Co	MuRata	GRM15SR71E333K469D Series= X7R	1	\$0.01	Cap= 33.0 nF ESR= 0.0 Ohm VDC= 25.0 V IRMS= 0.0 A	0402 8mm ²
2.	Clcp	TDK	C2012Y5V1E105J0.85 Series= Y5V	1	\$0.01	Cap= 1.0 µF ESR= 8.0 mOhm VDC= 25.0 V IRMS= 0.0 A	0805 13mm ²
3.	Clm	TDK	C6750K7R1H106M Series= X7R	1	\$0.68	Cap= 10.0 µF ESR= 3.0 mOhm VDC= 50.0 V IRMS= 5.5 A	2320 60mm ²
4.	Cin	Kemet	C0805C104K5RACTU Series= X7R	1	\$0.01	Cap= 100.0 nF ESR= 64.0 mOhm VDC= 50.0 V IRMS= 1.64 A	0805 13mm ²
5.	Coat	TDK	C3225XSRG107M Series= XSR	1	\$0.39	Cap= 100.0 µF ESR= 2.0 mOhm VDC= 6.3 V IRMS= 3.5 A	1210 23mm ²
6.	Cos	MuRata	GRM15SR71E123K461D Series= X7R	1	\$0.01	Cap= 12.0 nF ESR= 0.0 Ohm VDC= 25.0 V IRMS= 0.0 A	0402 8mm ²
7.	L1	Bourns	SRU8043-GR8Y	1	\$0.36	L= 5.8 µH DCR= 22.4 mOhm	SRU8043 100mm ²

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#	Name	Manufacturer	Part Number	Quantity	Price	Properties	Footprint
8.	Rb1	Vishay-Dale	CRCV0402376RPFED Series= CROW.e3	1	\$0.01	Res= 976.0 Ohm Power= 63.0 mW Tolerance= 1.0%	0402 8mm ²
9.	Rb2	Vishay-Dale	CRCV04023026RPFED Series= CROW.e3	1	\$0.01	Res= 2.09 kOhm Power= 63.0 mW Tolerance= 1.0%	0402 8mm ²
10.	Ron	Vishay-Dale	CRCV0402484RPFED Series= CROW.e3	1	\$0.01	Res= 48.4 kOhm Power= 63.0 mW Tolerance= 1.0%	0402 8mm ²
11.	U1	Texas Instruments	LMR24220TL	1	\$2.00	Switcher	uSM-28 25mm ²

Operating Values

#	Name	Value	Category	Description
1.	Clm IRMS	734.054 mA	Current	Input capacitor IRMS ripple current
2.	Coat IRMS	215.798 mA	Current	Output capacitor IRMS ripple current
3.	IC Ipk	2.374 A	Current	Peak switch current in IC
4.	IC Avg	360.35 mA	Current	Average input current
5.	L Ipp	747.548 mA	Current	Peak-to-peak inductor ripple current
6.	M1 rms	967.458 mA	Current	Iavg
7.	BOM Count	11.0	General	Total Design BOM count
8.	FootPrint	272.0 mm ²	General	Total Foot Print Area of BOM components
9.	Frequency	585.211 kHz	General	Switching frequency
10.	IC Tolerance	16.0 mV	General	IC Feedback Tolerance
11.	M Vdc Act	160.0 mV	General	
12.	Mode	CCM	General	Conduction Mode
13.	POut	6.5 W	General	Total output power
14.	Total BOM	\$3.5	General	Total BOM Cost
15.	Duty Cycle	16.045 %	Op_point	Duty cycle
16.	Efficiency	83.25 %	Op_point	Steady state efficiency
17.	IC Tj	90.688 degC	Op_point	IC junction temperature
18.	IC ThetaJA	50.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
19.	IOUT_OP	2.0 A	Op_point	Iout operating point
20.	Vin_OP	22.0 V	Op_point	Vin operating point
21.	Vout_p-p	1.485 mV	Op_point	Peak-to-peak output ripple voltage
22.	Clm Pd	1.617 mW	Power	input capacitor power dissipation
23.	Coat Pd	93.138 µW	Power	Output capacitor power dissipation
24.	IC Pd	1.214 W	Power	IC power dissipation
25.	L Pd	112.0 mW	Power	Inductor power dissipation
26.	Total Pct	1.328 W	Power	Total Power Dissipation
27.	Vout_OP	3.3 V	Unknown	Operational Output Voltage

Design Inputs

#	Name	Value	Description
1.	IOUT	2.0 A	Maximum Output Current
2.	Output	2.0 Amps	Output Current #1
3.	SoftStart	1.0 ms	Soft Start Time (ms)
4.	VinMax	22.0 V	Maximum input voltage
5.	VinMin	14.0 V	Minimum input voltage
6.	Vout	3.3 V	Output Voltage #1
7.	Vout1	3.3 Volt	Output Voltage #1
8.	Isse_pn	National	National Based Product Number
9.	Ta	30.0 degC	Ambient temperature
10.	UserFsw	585.211 kHz	Customer Selected Frequency

Design Assistance

1. LMR24220 Product Folder: <http://www.national.com/pdf/LMR24220.html> : contains the data sheet and other resources.

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Thank You!