

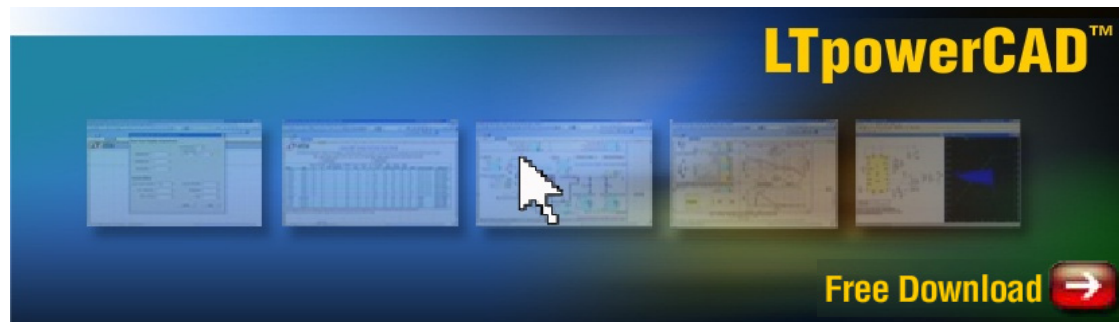


Power Products, Linear Technology Corp.
www.linear.com/LTpowerCAD

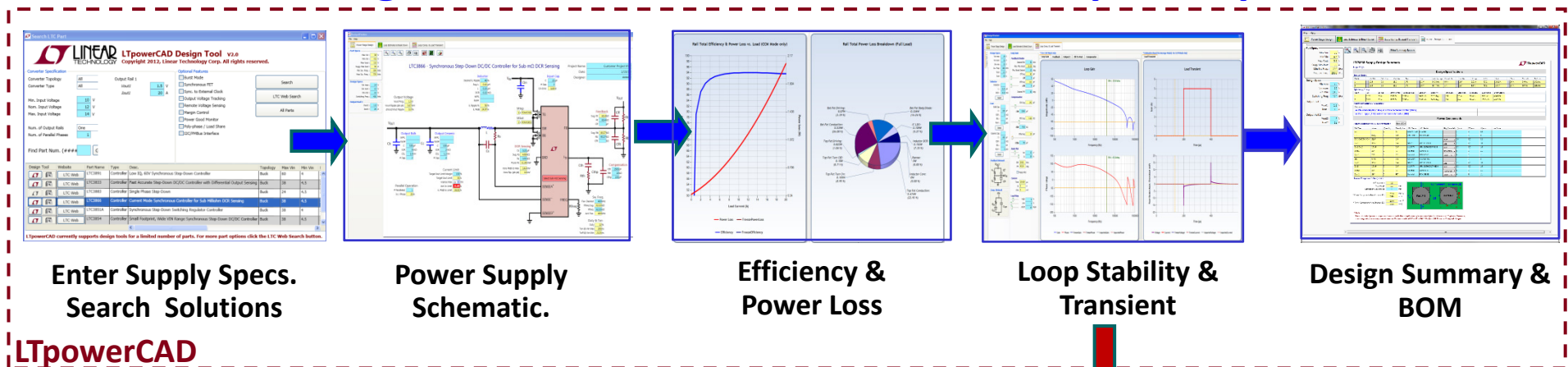
What is the LTpowerCAD™ Program?

2

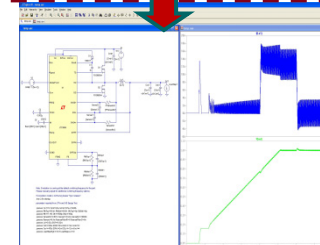
A Complete, Step-by-Step Power Converter Design Tool:



Design a Power Converter In Five Simple Steps:



LTspice™
Simulation



LTspice™:

A powerful circuit **simulation tool** with integrated models for most LTC products.

LTpowerCAD™ Design Tool :

- A power supply **design tool** instead of simulation tool.

- **Searches** for a solution / LTC part for given power supply spec.
- Guides users to select **power stage components**.
- Provides detailed power **efficiency / loss** analysis.
- Provide quick **loop bode plot stability** and load transient analysis.
- Supports selected power products.
- Design file can be exported into LTspice simulation circuit.

- An off-line version is available (Windows PCs only)

- 1) Go to <http://www.linear.com/LTpowerCAD>
- 2) Download & install LTpowerCAD II program on your Windows PC.

See the following pages for installation instructions.

For questions, contact us at LTpowerCAD@linear.com

Boost Converters :

Boost

Updated: 9/30/2016

	Green Cell Background - Excel tool available
	Red Cell Background - LTpowerCAD Non-Excel Tool available

Controller

Monolithic

	2-output	1-output		2-output	1-output
	LTC3784 LTC3788	LTC3787 LTC3862/-1 LTC3786 LTC3769			LT3579 LT3580 LT3581 LT3957 LT3958
		LT3757 LT3758 LT1700			LTC3121 LTC3122 LTC3124 LT8330 LT8580 LT8570

4-SW Buck-Boost Converters :

Buck-Boost

Updated: 9/30/2016

	Green Cell Background - Excel tool available
	Red Cell Background - LTpowerCAD Non-Excel Tool available

Controller

Monolithic

μModule Regulator®

2-output	1-output	3-output	2-output	1-output	2-output	1-output
LTC7812* LTC7813*	LT3791-1 LT8705			LTC3114-1 LTC3118		LTM4605 LTM4607 LTM4609 LTM8054 LTM8055 LTM8056
	LTC3780 LTC3785 LTC3789					

Note: This list was generated on 09/30/2016. New parts could be added to the library after that. Click "Sync-Release" to update LTpowerCAD library & functions.

LTpowerCAD II

Software Installation

The following system and software is required for LTpowerCAD II v2.4.7™

- ✓ **PC with Microsoft Windows 7 or later OS**
- ✓ **Microsoft Office Excel 2000, 2003, 2007, 2010 or 2013**
- ✓ **Microsoft .NET Framework 3.5 SP1, 4.0 or Higher**
<http://www.microsoft.com/net/download>
- ✓ **Microsoft SQL Server Compact 3.5 Service Pack 2**
<http://www.microsoft.com/en-us/download/details.aspx?id=5783>

Note :

The LTpowerCAD installer is made to **automatically download and install** these **the Microsoft .NET and SQL Server** requirements to your system if your system does not already have these installed. However, if for some reason they are not installed automatically, you may need to install them manually from Microsoft download sites.

Note : In most cases your system may already have these requirements installed so LTpowerCAD will skip this process. However in some cases these requirements may not have been complete which may cause errors in LTpowerCAD. This may require you to uninstall these .NET requirements from your system, uninstall LTpowerCAD and then re-install LTpowerCAD to initiate its automatic download and installation process to install these .NET requirements properly. Please refer to the appendix "Installation Troubleshooting" section for more details.

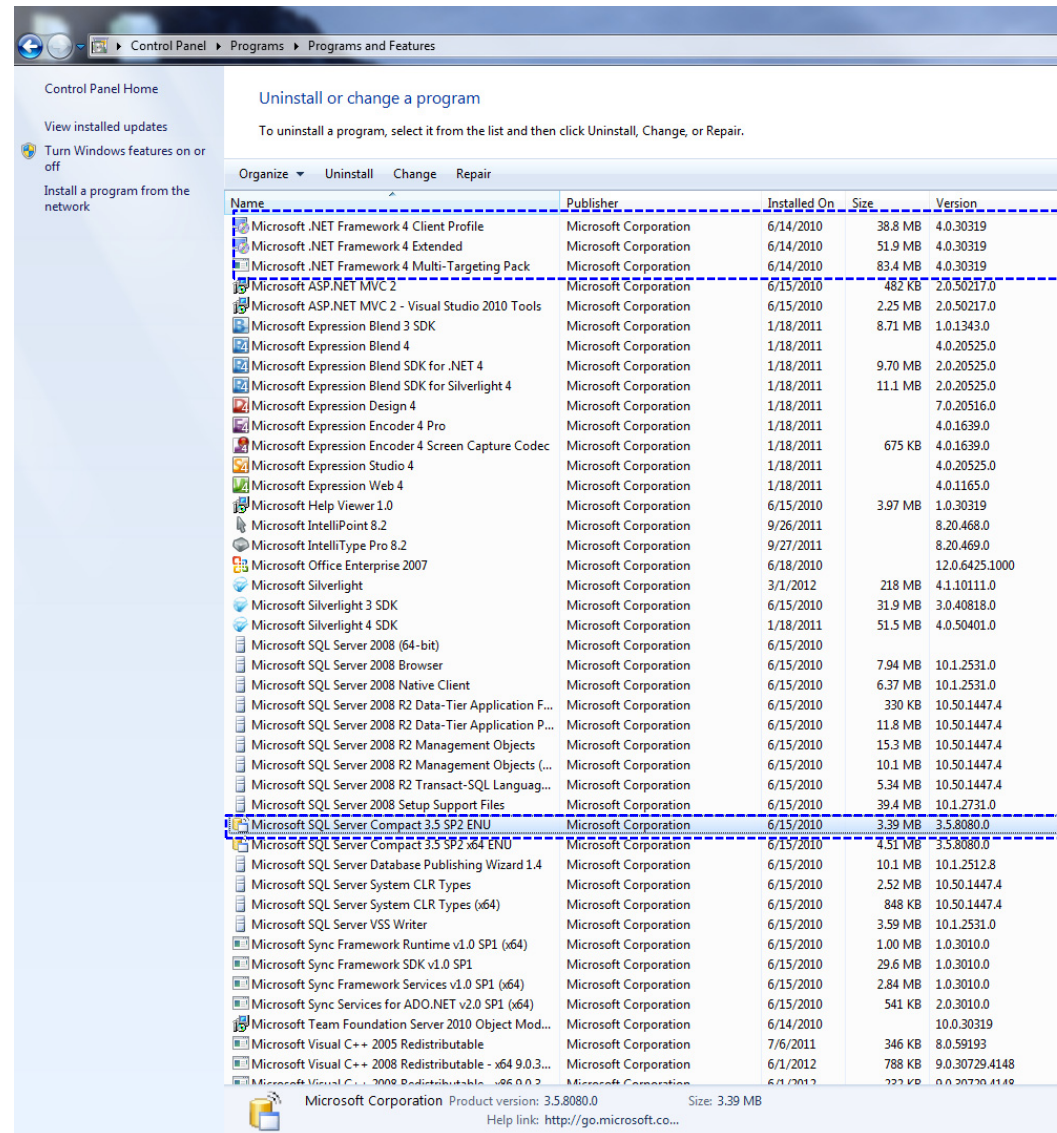
Note:

- **Windows 7, Windows 8, Windows10 based PC has .NET Framework integrated.**
- Some Windows XP based PC may need additional installation of the .NET Framework, which can be freely downloaded at www.microsoft.com.
- Many new computers may already have SQL Server Compact 3.5SP2 installed (check to make sure)

Minimum Requirements (cont'd)

9

Optional: check if .NET and SQL Server are installed:



Microsoft .NET 3.5, 4 or higher is required

Required for accessing part information

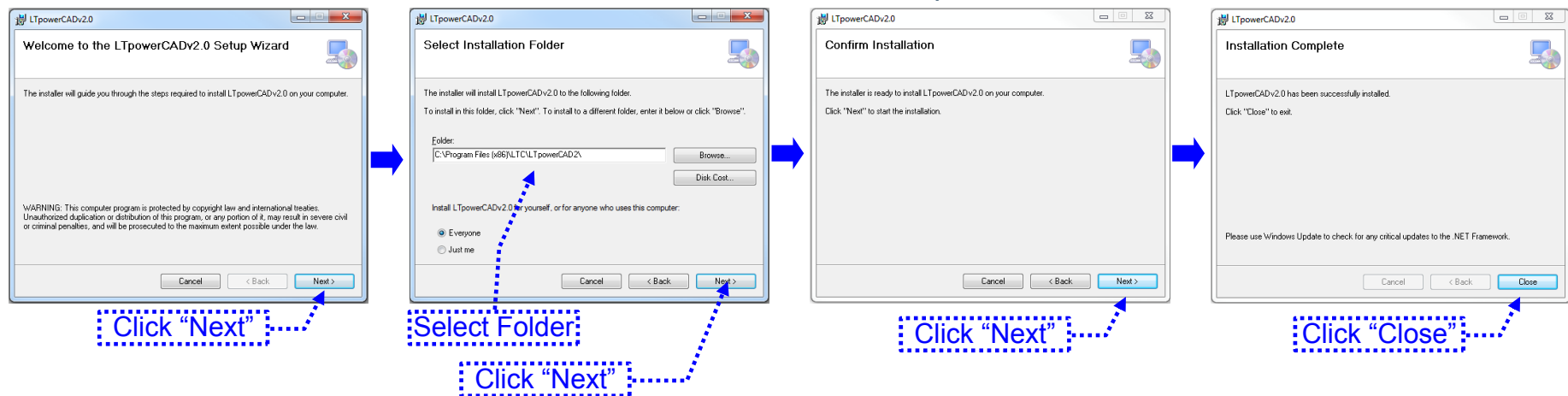
1. Double Click “**Setup.exe**” to Start LTpowerCAD II v2.4.7™ Design Tool Setup Wizard

Note : Do not install by double clicking the “NotForSetup.msi” file as this will prevent the installer from checking to install and installing any missing Microsoft requirements.

2. Click “**Next**”

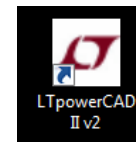
3. Select Installation Folder and Click “**Next**”

4. Click “**Next**” to Confirm Installation and then “**Close**” to complete the Installation



5. Check the contents of the installation folder (see next slide)

Note : The installation will place shortcuts to the LTpowerCAD II v2.4.7.



Getting Start with LTpowerCAD II

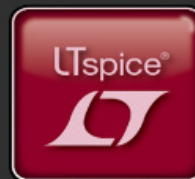
LTpowerCAD®



Supply Design



System Design



Simulation



Open File



Toolbox



Contact



Help

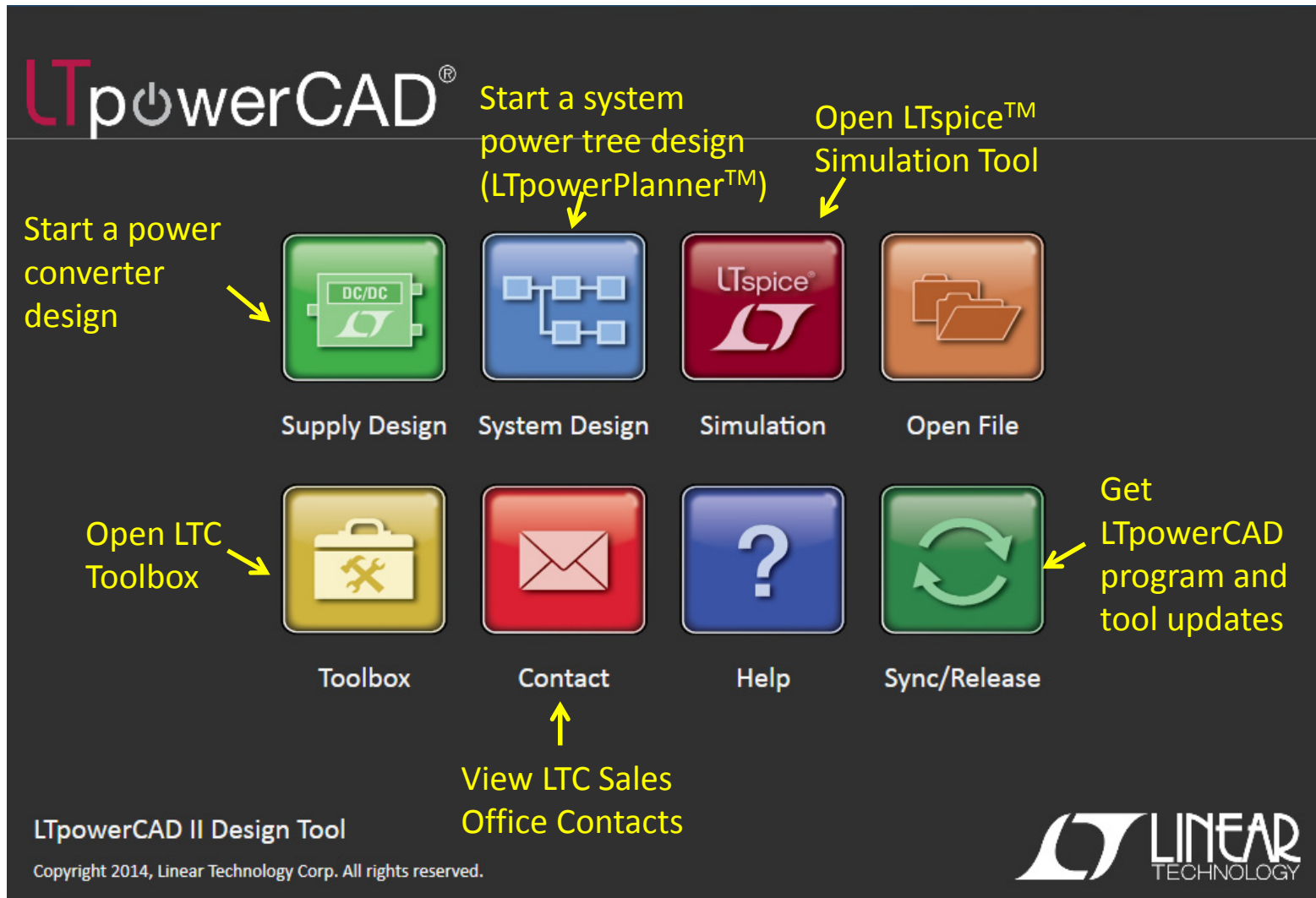


Sync/Release

LTpowerCAD II Design Tool

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- For LTpowerCAD questions/suggestions, please e-mail us at: LTpowerCAD@linear.com




- Click on the “supply design” icon to open this page.

Note: If you know the LT part number to use you can also enter the 4 digit part # and click “go” to locate the part

Click **LTC Icon**  (for LTpowerCAD II tool)

Or

Click **Excel Icon**  (for Excel-based tool)

Note: If the design tool icon is gray, the design tool is currently unavailable for that part

LTpowerCAD Design Tool v2.4.1
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1. Enter spec.

Converter Specification

Converter Topology: Buck
Converter Type: Controller

Output Rail 1
Vout1: 1 V
Iout1: 20 A

Min. Input Voltage: 10.8 V
Nom. Input Voltage: 12 V
Max. Input Voltage: 13.2 V

Num. of Output Rails: One
Num. of Parallel Phases: 1

Find Part #: (####) Go

2. Search

Search
LTC Web Search
All Parts

3. Select IC and open a Tool

Design Tool	Website	Part Name	Type	Desc.	Topology	Max Vin	Min Vin	Max I	# Ph	# Out	Max Vo	Min V	Max Fr	Min Fr	Synchronous	Burst Mod
	LTC Web	LTC3810-5	Controller	60V Valley Current Mode Synchronous Buck Regulator Controller	Buck	60	0.8	20	1	1	60	0.8	1000	100	<input checked="" type="checkbox"/>	<input type="checkbox"/>
	LTC Web	LTC3812-5	Controller	60V Valley Current Mode Synchronous Buck Regulator Controller	Buck	60	0.8	20	1	1	60	0.8	1000	100	<input checked="" type="checkbox"/>	<input type="checkbox"/>
	LTC Web	LTC3833	Controller	Fast Accurate Buck Controller with Remote Vo Sense, Valley I-mode	Buck	38	4.5	50	1	1	5.5	0.6	2000	200	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	LTC Web	LTC3851A-1	Controller	Synchronous Step-Down Switching Regulator Controller	Buck	38	4	50	1	1	5.5	0.8	750	250	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	LTC Web	LTC3851A-1	Controller	Synchronous Step-Down Switching Regulator Controller	Buck	38	4	50	1	1	5.5	0.8	750	250	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	LTC Web	LTC3851A-1	Controller	Synchronous Step-Down Switching Regulator Controller	Buck	38	4	50	1	1	5.5	0.8	750	250	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	LTC Web	LTC3851A-1	Controller	Synchronous Step-Down Switching Regulator Controller	Buck	38	4	50	1	1	5.5	0.8	750	250	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	LTC Web	LTC3851A-1	Controller	Synchronous Step-Down Switching Regulator Controller	Buck	38	4	50	1	1	5.5	0.8	750	250	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	LTC Web	LTC3851A-1	Controller	Synchronous Step-Down Switching Regulator Controller	Buck	38	4	50	1	1	5.5	0.8	750	250	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	LTC Web	LTC3851A-1	Controller	Synchronous Step-Down Switching Regulator Controller	Buck	38	4	50	1	1	5.5	0.8	750	250	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	LTC Web	LTC3851A-1	Controller	Synchronous Step-Down Switching Regulator Controller	Buck	38	4	50	1	1	5.5	0.8	750	250	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

LTpowerCAD currently supports design tools for a limited number of parts. For more part options click the LTC Web Search button.

Two possible design tool formats:

1. Non-Excel LTpowerCAD II Design Tool:

If available, an active LTC button is shown:



2. (Legacy) Excel-Based Design Tool:

If available, an active Excel button is shown:



Note:

If the icon is in grey color, the design tool is not yet available.

LTpowerCAD II V2.4.7

LINEAR TECHNOLOGY **LTpowerCAD Design Tool** v2.4.7
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Converter Specification

Converter Topology: Output Rail 1: Vout1: V, Iout1: A

Converter Type:

Min. Input Voltage: V
Nom. Input Voltage: V
Max. Input Voltage: V

Num. of Output Rails:
Num. of Parallel Phases:

Find Part #: (####)

Optional Features

☐ Burst Mode
☒ Synchronous FET
☐ Isolated
☒ Run / Enable
☐ Sync. to External Clock
☐ Output Voltage Tracking
☐ Remote Voltage Sensing
☐ Margin Control
☒ Power Good Monitor
☐ Poly-phase / Load Share
☐ I2C/PMBus Interface

Search

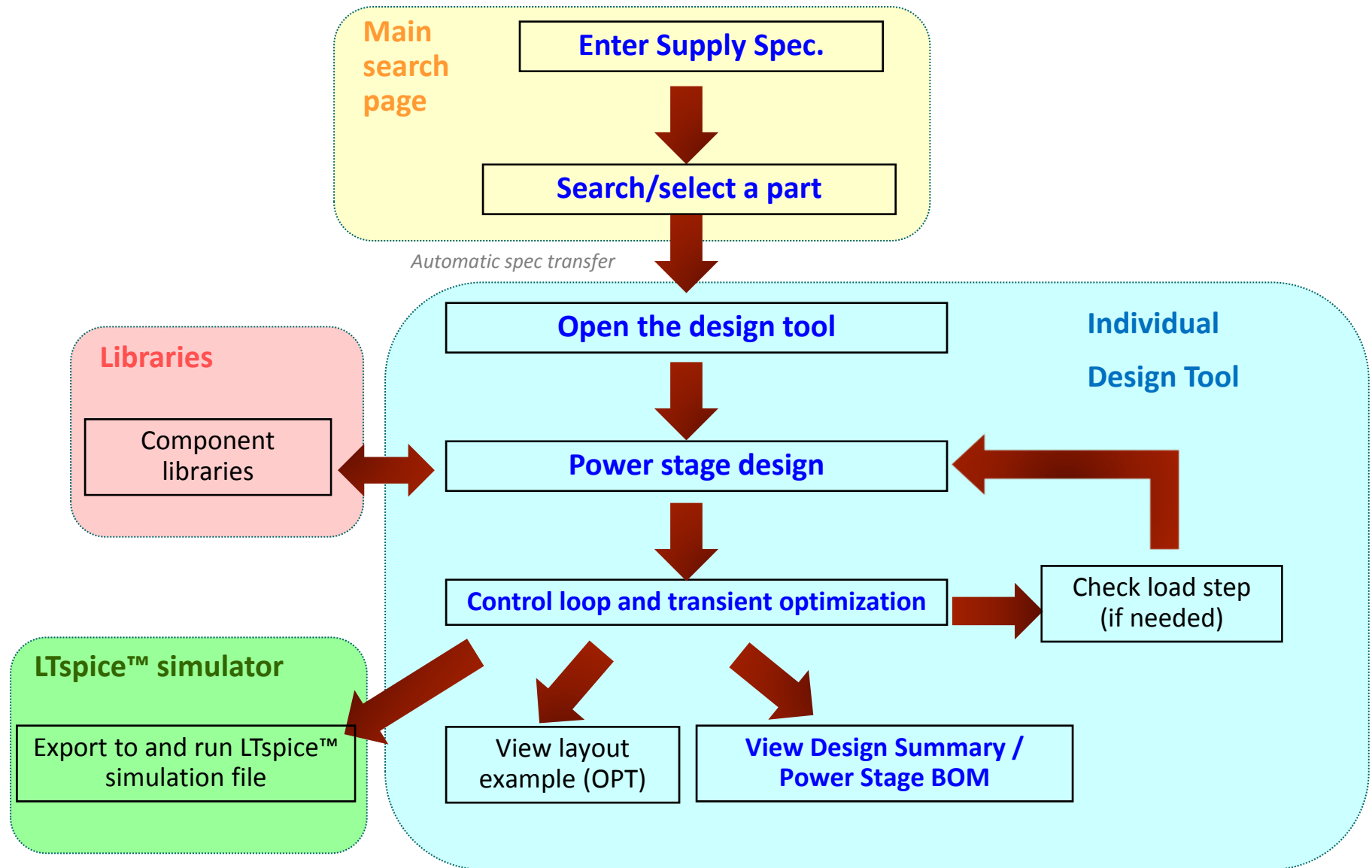
☒ Always Keep Search Page Open

Search For Parts

Design Tool	Website	Part #	Type	Description	Topology	IC Max Vin	IC Min Vin	Max Isw / Phase
	LTC Web	LTM4637	uModule	20Vin, 20A Step Down DC/DC uModule Step-Down Reg	Buck	20	4.5	20
	LTC Web	LTC7130	Monolithic	20Vin, 20A Monolithic Buck Converter with Ultra-Low D	Buck	20	4.5	20
	LTC Web	LTC3876	Controller	Up to 38Vin, Dual Vo Buck Controller for DDR Power	Buck	38	4.5	20
	LTC Web	LTC3866	Controller	Single Phase Current Mode Buck Controller, <1mOhm E	Buck	38	4.5	50
	LTC Web	LTC3883	Controller	Single Phase Step-Down Current Mode Buck Controller	Buck	24	4.5	50
	LTC Web	LTC3812-5	Controller	60V Valley Current Mode Synchronous Buck Regulator	Buck	60	0.8	20
	LTC Web	LTC3810-5	Controller	60V Valley Current Mode Synchronous Buck Regulator	Buck	60	0.8	20
	LTC Web	LTC3810	Controller	100V Valley Current Mode Synchronous Buck Regulator	Buck	100	0.8	20
	LTC Web	LT3740	Controller	Wide Operating Range, Valley Mode, No RSENSE Synch	Buck	22	2.2	20
	LTC Web	LTC3780	Controller	High Efficiency, Synchronous, 4-Switch Buck-Boost Con	Buck-Boost	36	4	20
	LTC Web	LTC3807	Controller	Low IQ, Single Phase 38Vin 24Vo Synchronous Step-Do	Buck	38	4	20
	LTC Web	LTC3789	Controller	High Efficiency, Synchronous, 4-Switch Buck-Boost Con	Buck-Boost	38	4	20

LTpowerCAD currently supports design tools for a limited number of parts. For more part options click the LTC Web Search button.

Step-By-Step Supply Design Procedure using the LTpowerCAD™ Design Tool



Design Steps Example

(Non-Excel based LTpowerCAD design Tool)



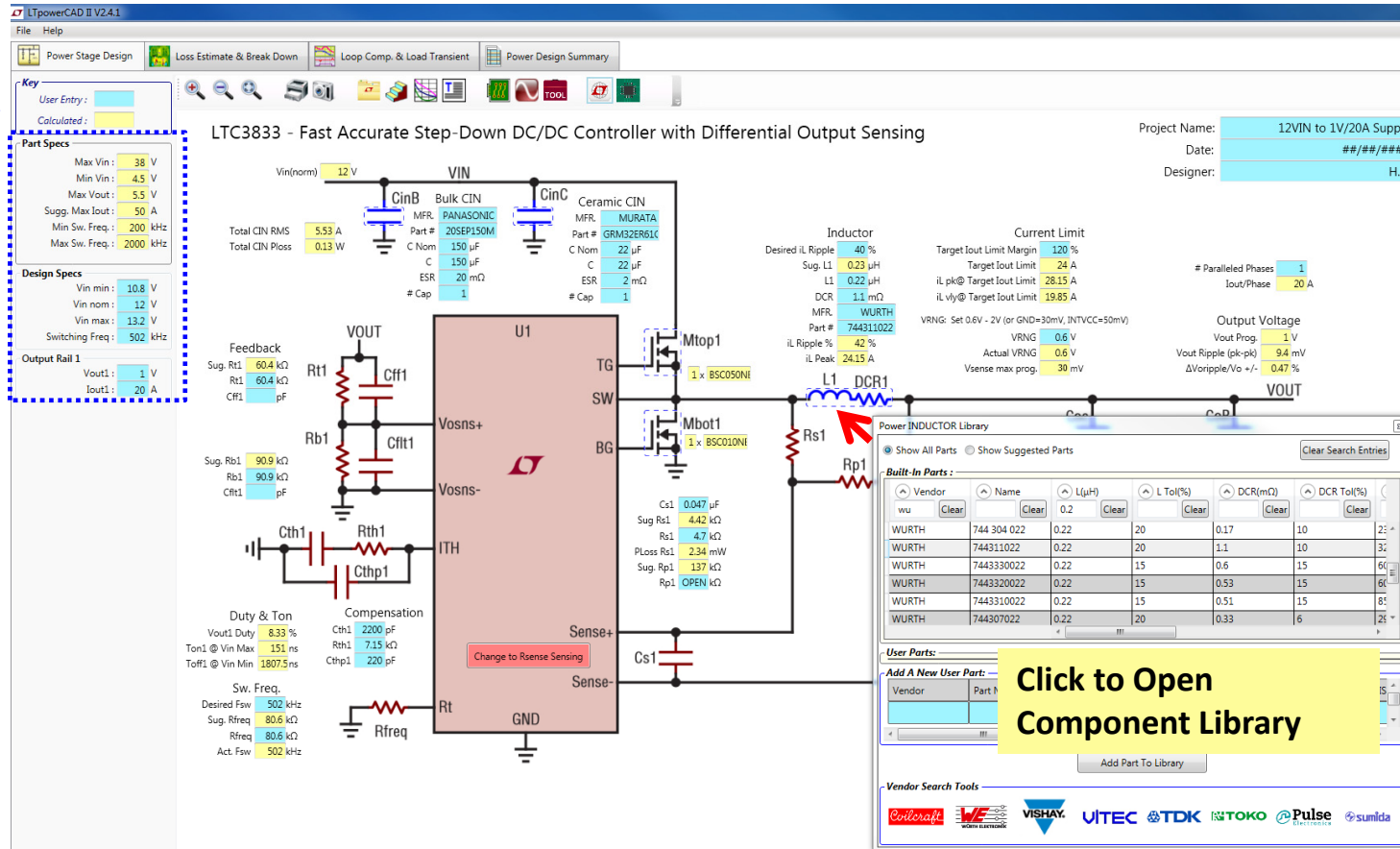
Converter Spec. & Part Limits

Yellow Cell

: Suggested values or calculated parameters (can NOT be edited directly)

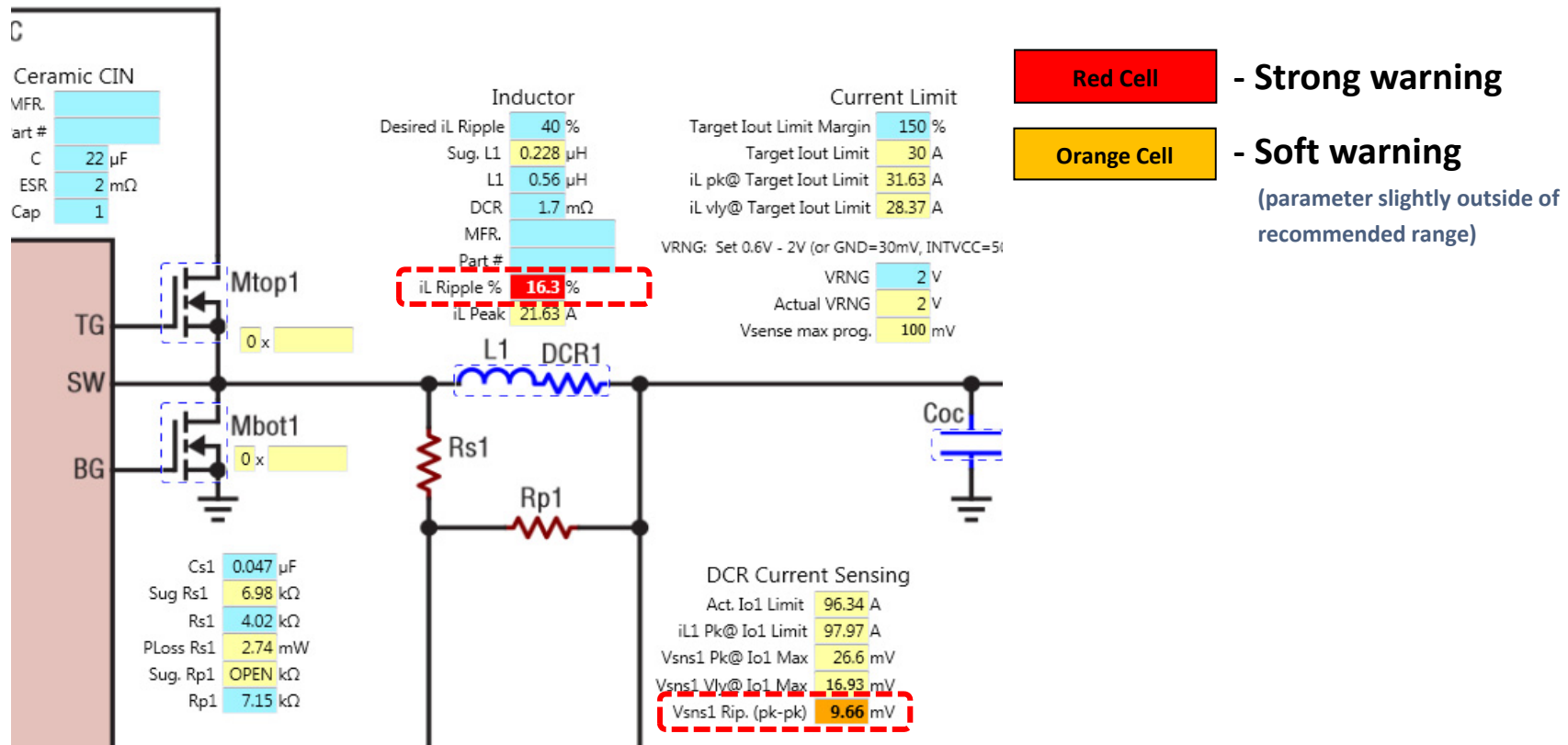
Blue Cell

: User entered values



- Complete Blue Cell entries to specify component values & desired design parameters.
- Yellow cell values show calculated design parameters & component value suggestions
- Red / orange cells show warnings for certain parameters to help guide design choices

- Over 6000 L, C, MOSFET, R_{SENSE} , Diode parts (2016)



- Automatic warnings guide users for proper values

1. Select a switching frequency (f_{sw})

- higher f_{sw} , smaller L/C size, but higher power loss.

2. Select a power inductor (if external) and check/adjust current sensing

- Inductor affects its current ripple.
- Inductor should have sufficient DC and saturation current rating.
- Determine/check current sensing and limit.

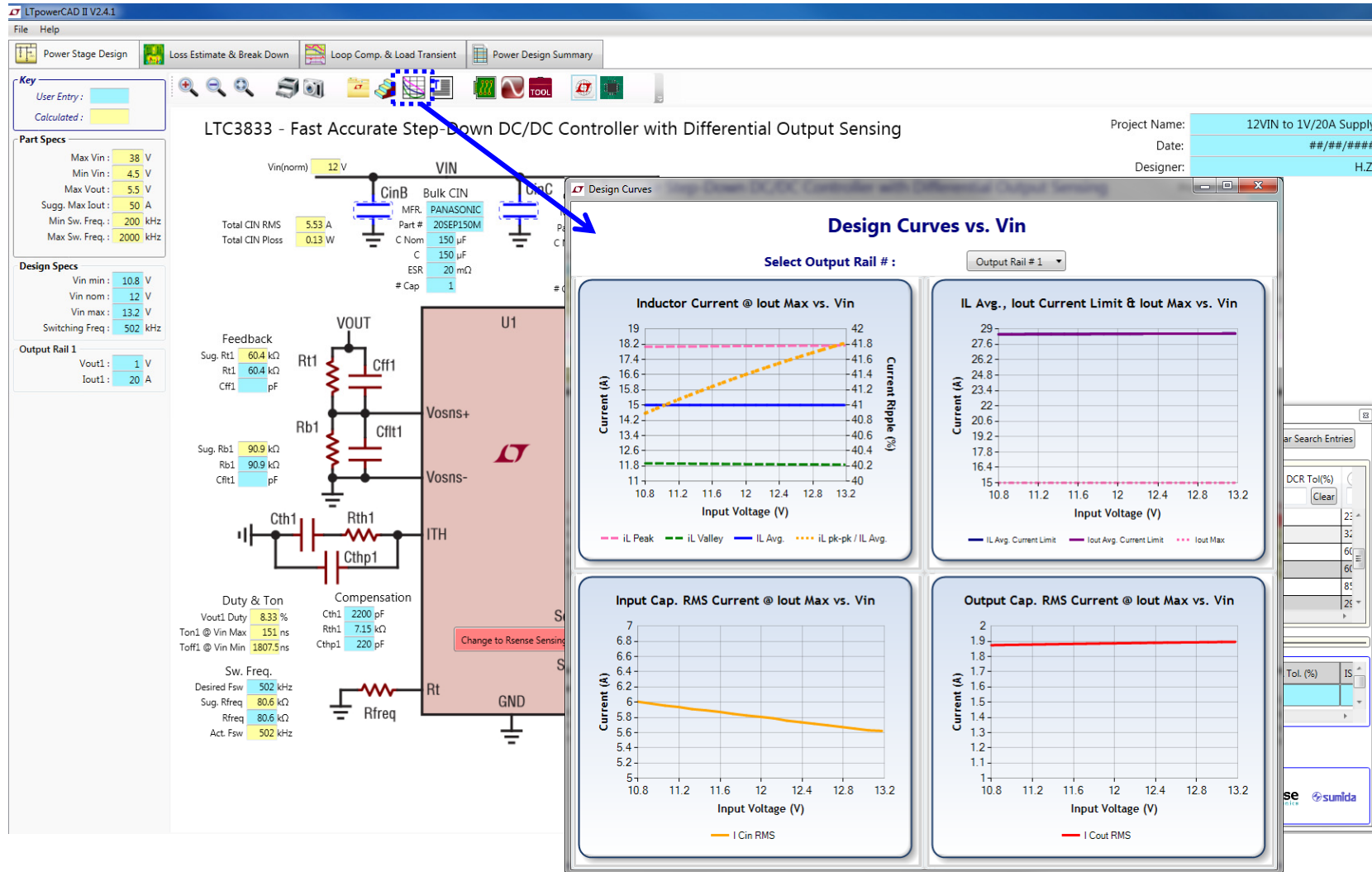
3. Select input and output capacitors

- Considering ripples, RMS current rating, ESR, transient, etc.

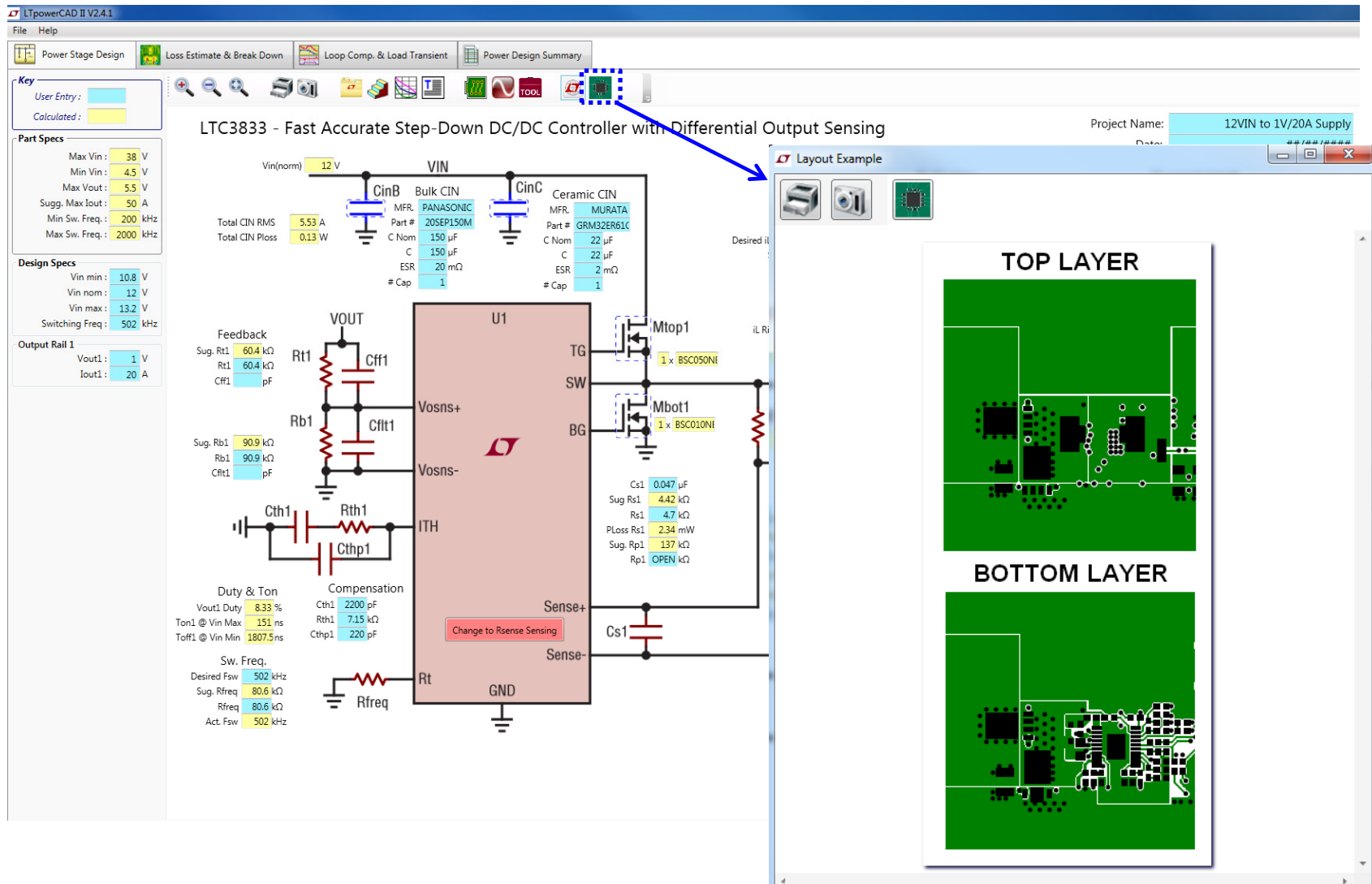
Note: make sure that all the red-warnings are cleared.

View Design Curves If V_{IN} Has a Wide Range

21



Inductor current, Iout current limit, Input and Output Cap. RMS current curves vs. V_{in} help in determining power stage component rating requirements.



PCB Top and Bottom Layer recommended layout example – Picture File

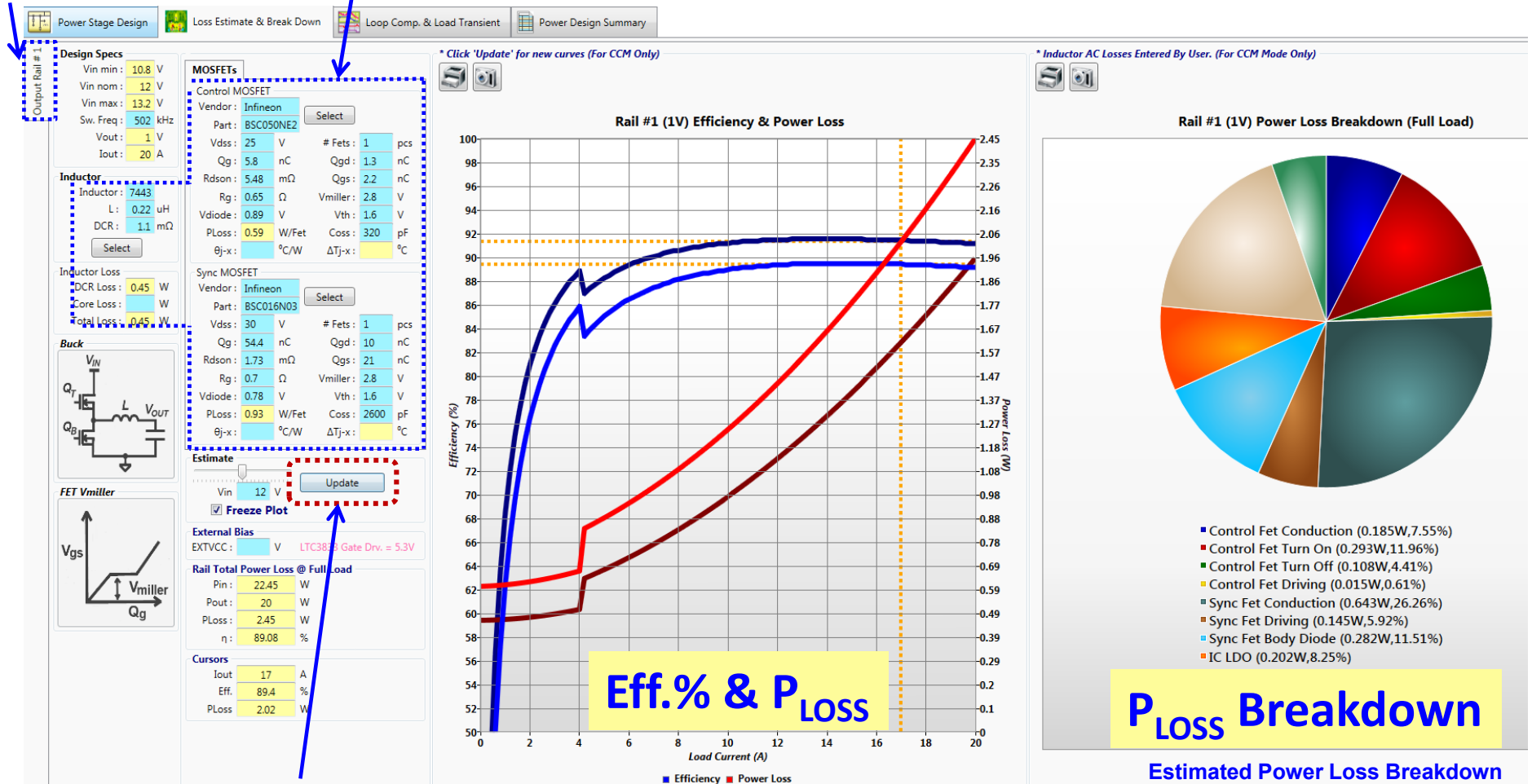
Design Step 2– Select FETs, Optimize Eff % & Power Loss

23

View data for each rail

(each rail has its own tab)

Enter power stage component details & Test Conditions (enter manually or select from built-in library)



Click "Update Plots" to refresh estimates for component value changes.

Estimated Efficiency & Power Loss Curves with Data Point Cursors. Double-click to set axes Preferences

Click "Select" to open MOSFET library.

The screenshot shows the LTpowerCAD II V2.1 software interface. The main window displays the 'Rail #1 (1.2V) Total Efficiency & Power Loss vs. Load (CCM Mode only)' graph. The graph shows efficiency (%) on the y-axis (50 to 100) and load on the x-axis (0 to 1). A blue curve represents the efficiency, which starts at approximately 50% at zero load and rises to about 95% at a load of 1.0. The 'Power MOSFET Library' dialog box is open, showing a table of built-in parts and a section for user-generated parts.

Built-In Parts:

Vendor	Part Name	V _{ds} (V)	R _{ds(on)} (mΩ)	Q _g (nC)	Q _{gd} (nC)	Q _{gs} (nC)	R _g (Ω)	V _{diode} (V)	V _{miller} (V)	V _{th} (V)	Package	Channel Type	L (mm)	W (mm)	H (mm)
Fairchild	FDMC86102	100	26.8	8	3.6	3.7	0.50	0.81	4.90	3.0	POWER 3	N	3.4	3.4	1.05
Fairchild	FDMC8624C	150	44.7	11	2.3	2.8	0.50	0.79	4.10	3.0	POWER 3	N	3.4	3.4	1.05
Fairchild	FDMC8651	30	6.3	19.4	4.2	4.8	0.80	0.80	2.10	1.2	POWER 3	N	3.4	3.4	1.05
Fairchild	FDMC8652C	60	9.1	21	4.9	9.6	0.50	0.82	2.90	2.0	POWER 5	N	6	5	1.1
Fairchild	FDMC86500	60	2.9	54	11.5	26.6	1.10	0.79	2.90	2.0	POWER 5	N	6	5	1.1
Fairchild	FDMC8888	30	11	13	5.1	3.5	0.90	0.84	2.90	1.9	POWER 5	N	6	5	1.1
Vishay	SIR438DP	25	1.9	32.6	9.1	9.7	1.00	0.72	2.20	1.7	POWER P	N	6.25	5.26	1.12
Vishay	SIR862DP	25	2.8	28.4	7	9.3	1.10	0.72	2.20	1.8	POWER P	N	6.25	5.26	1.12
Infineon	BSC018NE2	25	1.9	17	4.3	6.3	0.80	0.55	2.20	1.6	PG-TDSON	N	6.35	5.35	1.1
Vishay	SIR892DP	25	3.4	20	5.2	6.3	0.70	0.73	2.25	1.8	POWER P	N	6.25	5.26	1.12

User Parts:

Vendor	Part Name	V _{ds} (V)	R _{ds(on)} (mΩ)	Q _g (nC)	Q _{gd} (nC)	Q _{gs} (nC)	R _g (Ω)	V _{diode} (V)	V _{miller} (V)	V _{th} (V)	Package	Channel Type	L (mm)	W (mm)	H (mm)
Fairchild	FDMC8558S	25	1.3	38	9.7	10	0.90	0.60	2.10	1.7	POWER 5	N	6	5	1.1
Fairchild	FDMC7578	25	6.3	8	1.7	3.7	1.20	0.83	2.90	2.0	POWER 5	N	6	5	1.1

Add A New User Part:

Vendor	Part Name	V _{ds} (V)	R _{ds(on)} (mΩ)	Q _g (nC)	Q _{gd} (nC)	Q _{gs} (nC)	R _g (Ω)	V _{diode} (V)	V _{miller} (V)	V _{th} (V)	Package	Channel Type	L (mm)	W (mm)	H (mm)

Vendor Links:

FAIRCHILD SEMICONDUCTOR® VISHAY. infineon RENESAS

Popular vendor web links

Click "Select" to open Inductor library.

Design Specs

Vin max: 13.2 V
Vin nom: 12 V
Vin min: 10.8 V
Sw. Freq: 370 kHz
Vout: 1.2 V
Iout: 15 A

Inductor

Inductor: XPL7
L: 0.47 μ H
DCR: 4.18 m Ω

Top MOSFET Q1

Vendor: Fairchild
Part: FDM57578
Vdss: 25 V
Qg: 8 nC
Rdson: 6.3 m Ω
Vdiode: 0.83 V
Ploss: 0.347 W (Each Fet)

Bottom MOSFET Q2

Vendor: Fairchild
Part: FDM585585
Vdss: 25 V
Qg: 38 nC
Rdson: 1.3 m Ω
Vdiode: 0.6 V
Ploss: 0.387 W (Each Fet)

Estimate

Vin: 12 V
EXTVCC: V
LTC3838 Gate Drv. = 5.3V

Rail Total Power Loss @ Full Load

Pin: 19.892 W
Pout: 18 W
Ploss: 1.892 W
 η : 90.49 %

Efficiency (%) vs. Load (CCM Mode only)

Power INDUCTOR Library

Built-In Parts:

Vendor	Part Name	Inductance (μ H)	L Tol. (%)	DCR (m Ω)	DCR Tol. (%)	ISat (A)	L Decrease (%)	IHeat (A)	Temp. Rise (C)	Core	L(mm)	W(mm)	H(mm)
COILCRA	SLC76495-3	0.036	20	0.17	20	100	20	39	40	Ferrite	7.49	7.62	4.96
COILCRA	SLC76495-5	0.05	20	0.17	20	84	20	39	40	Ferrite	7.49	7.62	4.96
COILCRA	SLC75305-5	0.05	20	0.12	20	50	20	40	40	Ferrite	6.7	7.5	3
COILCRA	SLC75305-6	0.064	20	0.12	20	32	20	40	40	Ferrite	6.7	7.5	3
COILCRA	SLC76495-7	0.07	20	0.17	20	65	20	39	40	Ferrite	7.49	7.62	4.96
WURTH	744302007	0.072	20	0.235	6	60	20	30	50	Mangan	6.95	6.8	4.5
COILCRA	SLC1049-75	0.075	20	0.27	20	61	20	43	40	Ferrite	10.2	6.88	5.16
COILCRA	SLC75305-8	0.082	20	0.12	20	22	20	40	40	Ferrite	6.7	7.5	3
PULSE	PA0511.900	0.1	20	0.39	10	70	20	31	40	Ferrite	10.2	7	5

User Parts:

Vendor	Part Name	Inductance (μ H)	L Tol. (%)	DCR (m Ω)	DCR Tol. (%)	ISat (A)	L Decrease (%)	IHeat (A)	Temp. Rise (C)	Core	L(mm)	W(mm)	H(mm)
COILCRA	SER1360-33	0.33	20	0.77	20	43	20	16.9	40	Ferrite	12.9	13	5.8

Add A New User Part:

Vendor	Part Name	Inductance (μ H)	L Tol. (%)	DCR (m Ω)	DCR Tol. (%)	ISat (A)	L Decrease (%)	IHeat (A)	Temp. Rise (C)	Core	L(mm)	W(mm)	H(mm)

Vendor Search Tools

Coilcraft, WE, VISHAY, VITEC, TDK, muRata, sumida, Pulse Electronics

Built in library

User generated library

User can add a new part to the user library

Popular vendor web links

Design Step 3 – Optimize Loop Comp & Load Transient

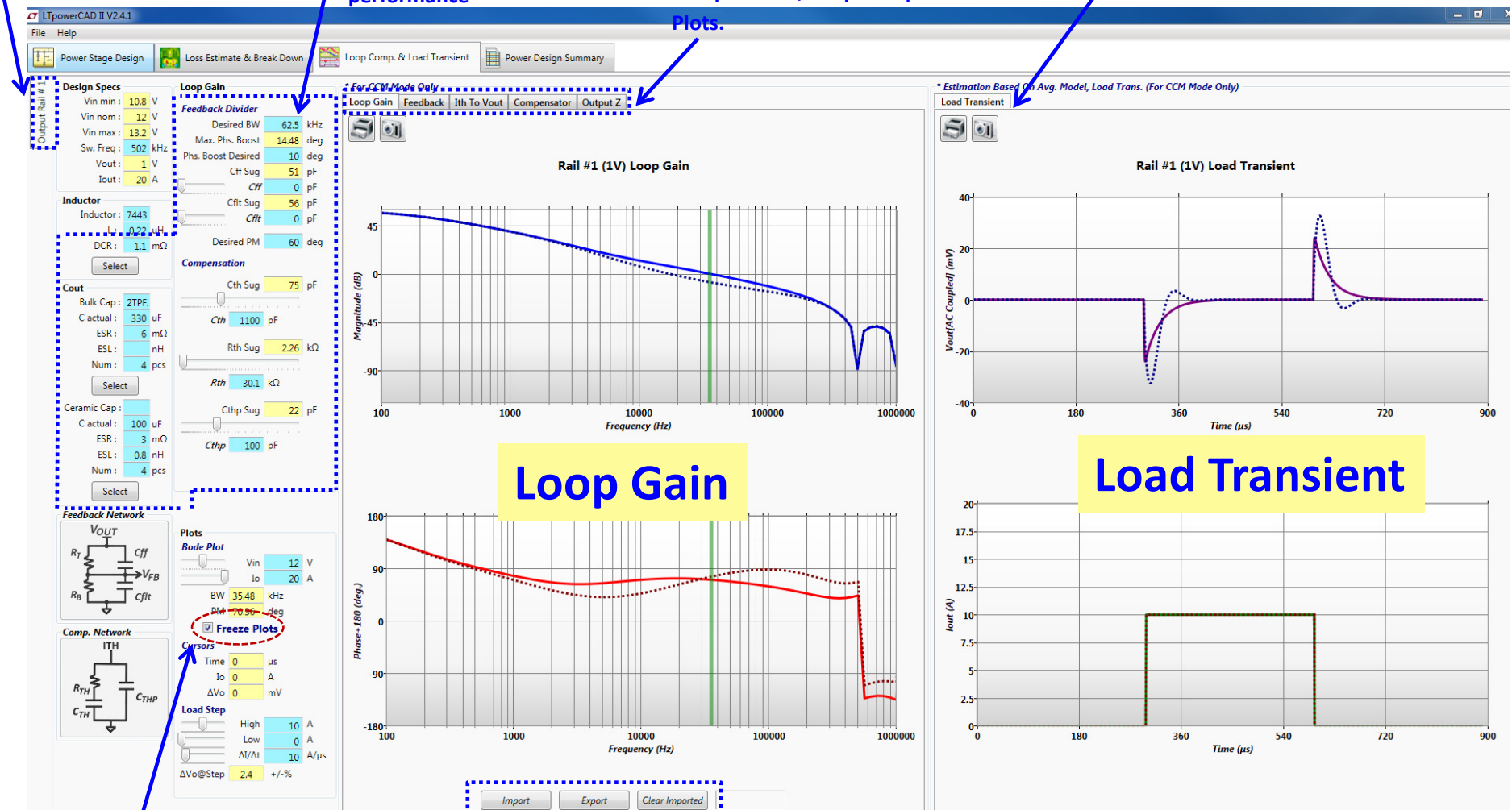
26

View data for each rail
(each rail has its own tab)

Enter component details to
optimize loop & transient
performance

Loop Gain, Feedback Divider, Output
Impedance, Control to Output,
Compensator, Output Impedance
Plots.

Load Transient Estimation plots.
Double-click to set axes Preferences.



Option to plot two curves for comparison.

Import plot data from data file (ie Ridley AP300) or
Export data to data file or Excel.

Click "Select" to open Capacitor library.

Design Specs

Vin max: 13.2 V
Vin nom: 12 V
Vin min: 10.8 V
Sw. Freq: 370 kHz
Vout: 1.2 V
Iout: 15 A

Inductor

Inductor: XPL7
L: 0.47 uH
DCR: 4.18 mΩ

Feedback Divider

Desired BW: 62.5 kHz
Max Phs. Boost: 19.47 deg
Phs. Boost Desired: 10 deg
Cff Sug: 51 pF
Cff: 100 pF
Cfft: 0 pF
Desired PM: 60 deg

Compensation

Cth Sug: 270 pF
Cth: 1000 pF
Rth Sug: 7.32 kΩ
Rth: 12.4 kΩ
Cthp Sug: 68 pF
Cthp: 47 pF

Bode Plot

Vin: 12 V
Io: 15 A
BW: 36.31 kHz
PM: 67.43 deg

Freeze Plots

Cursors
Freq: 0.1 kHz
Gain: 51.91 dB
Phase: 146.08 deg

Load Step

High: 7.5 A
Low: 0 A
ΔI/Δt: 10 A/μs

Power CAPACITOR Library

Built-In Parts:

Vendor	Part Name	Capacitance (μF)	ESR (mΩ)	ESL (nH)	Max Ripple Current (A RMS)	Voltage Rating (V)	Cap. Type	Case Size	Length (mm)	Width (mm)	Height (mm)	Diameter (mm)
SANYO	16SEPC100M	100	10	2.2	4.5	16	OS-CON	C9	6.3	6.3	9	6.3
SANYO	4TPE150ME	150	18	1.6	2.8	4	POSCAP	D2E	7.3	4.3	1.8	
SANYO	6TPE150ME	150	18	1.6	2.8	6.3	POSCAP	D2E	7.3	4.3	1.8	
SANYO	10TPD150M	150	15	1.9	3.6	10	POSCAP	D4D	7.3	4.3	3.6	
SANYO	20SEP150M	150	20	5.8	4.32	20	OS-CON	F13	10	10	13	10
SANYO	20SEQP150M	150	20	5.8	4.32	20	OS-CON	F13	10	10	13	10
SANYO	16SEP180M	180	20	4.1	3.64	16	OS-CON	E12	8	8	12	8
SANYO	16SEPC180M	180	16	4.1	4.36	16	OS-CON	E12	8	8	12	8
SANYO	16SEPC180M	180	16	4.3	4.36	16	OS-CON	E12	8	8	12	8
SANYO	16SEQP180M	180	20	4.1	3.64	16	OS-CON	E12	8	8	12	8

User Parts:

Vendor	Part Name	Capacitance (μF)	ESR (mΩ)	ESL (nH)	Max Ripple Current (A RMS)	Voltage Rating (V)	Cap. Type	Case Size	Length (mm)	Width (mm)	Height (mm)	Diameter (mm)
SANYO	16SEPC100M	100	24	2.6	2.4	16	OS-CON	C6	6	6	6	6

Add A New User Part:

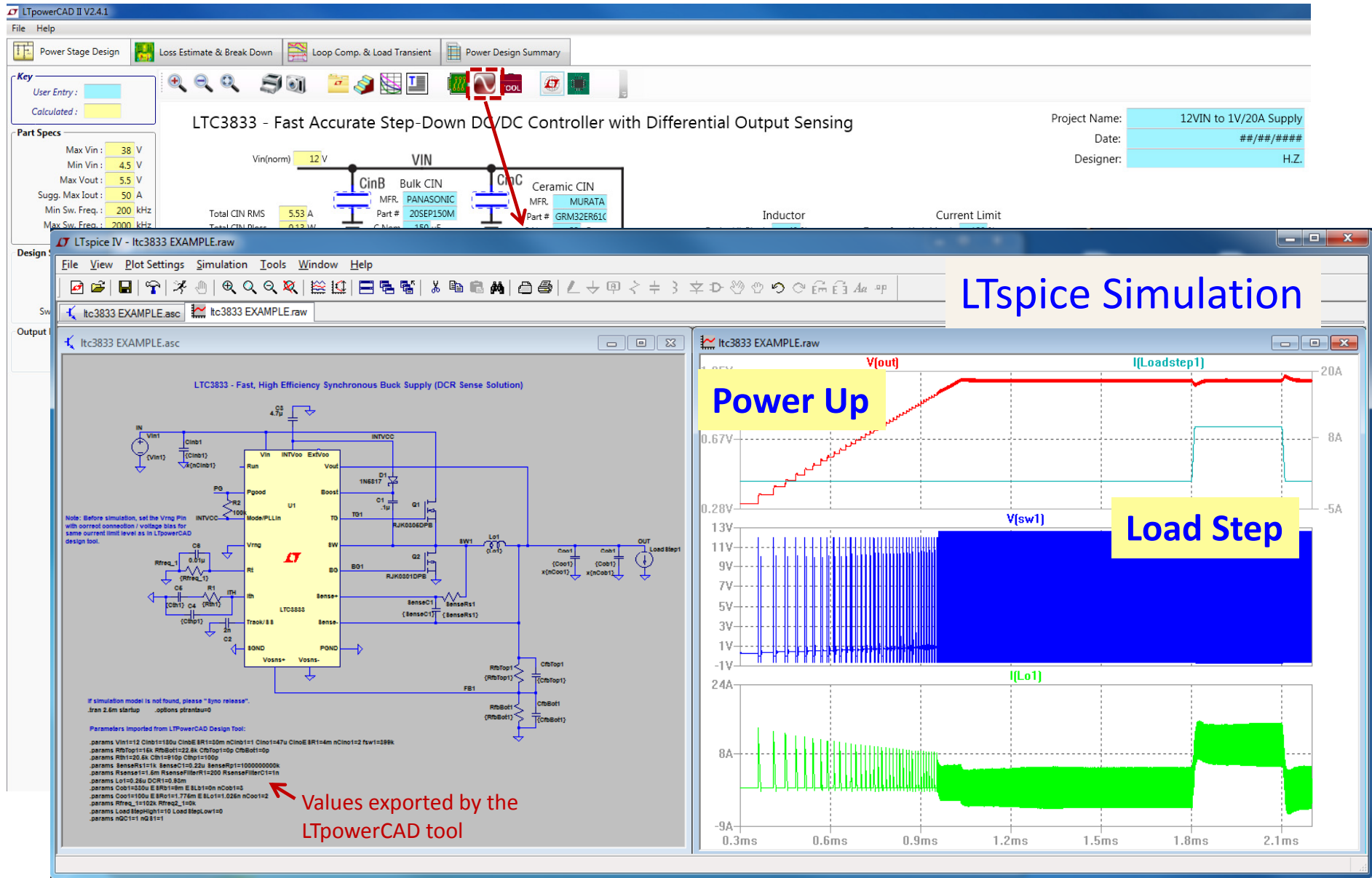
Vendor	Part Name	Capacitance (μF)	ESR (mΩ)	ESL (nH)	Max Ripple Current (A RMS)	Voltage Rating (V)	Cap. Type	Case Size	Length (mm)	Width (mm)	Height (mm)	Diameter (mm)

Vendor Links

AVX Panasonic ideas for life KEMET CHARGED TDK muRata

(Optional) Design Step 4 – Export to LTspice for Simulation

28



LTpowerCAD II V2.4.1

File Help

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

Print Summary Report

Summary Report

LTC3833 Supply Design Summary

Project Info: 12VIN to 1V/20A Supply, ##/##/####, H.Z.

Design Specifications

Steady State :

Rail #	Vin Min.	Vin Nom.	Vin Max.	Fsw	Vo	ΔV_o rip. p-p	ΔV_o rip.%	Io Max	ΔI_{LP} -p	ΔI_L %	iLpk	Duty	Ton min.	Toff min.
1	10.8 V	12 V	13.2 V	502 kHz	1 V	4.12 mV	0.2 %	20 A	8.3 A	42 %	24.15 A	8.33 %	151 ns	1808 ns

Efficiency and Loop :

Rail #	Vo	Iomax	Eff.@Iomax	PLoss@Iomax	Loop BW	Loop PM	Step Low	Step High	Step Slew	ΔV_o @Step	ΔV_o @Step %
1	1 V	20 A	91.1 %	1.954 W	35.48 kHz	69.92 deg	0 A	10 A	10 A/ μ s	25.6 mV	+/-2.6 %

Recommendations and Warnings :

Message

Power Components

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	0.22 μ H	1	IND	WURTH	744311022		7	6.9	3.8	
Cimb1	150 μ F	1	CAP	PANASONIC	20SEP150M	F13	10	10	13	
Cinc1	22 μ F	1	CAP	MURATA	GRM32ER61C226KE20	1210	3.2	2.5	2.7	
Cob1 Cob2 Cob3 Cob4	330 μ F	4	CAP	PANASONIC	ZTPF330M6	D2E	7.3	4.3	1.8	
Coc1 Coc2 Coc3 Coc4	100 μ F	4	CAP	TAIYO YUDEN	PMK2128B/J107MG-T		2	1.25	1.45	
Qcontrol1	25V	1	FET	Infineon	BSC050NE2LS	PG-TDSON-8	6.35	5.35	1.1	
Qsync1	25V	1	FET	Infineon	BSC010NE2LSI	PG-TDSON-8	6.35	5.35	1.1	

Power Components Footprint :

# Components	Max. Height	Component Clearance (d)	* Power Components Area (Excludes ICs)	* Power Components Area (Includes ICs)
14	13 mm	1 mm	495.2 mm ² 0.768 in ²	515.2 mm ² 0.799 in ²

*** Note :**
The calculated power component area is only the simple sum of component footprint areas with given clearance, assuming all power components are on the same side of PCB. It is NOT the final PCB size with layout design.

Power stage Component Summary

Power stage Components Footprint Area Estimation

Summary of each rail's performance parameters

Warning messages note any undesired parameters

Power stage Component Summary

Power stage Components Footprint Area Estimation

The screenshot shows the LTpowerCAD II V2.1 interface. The 'Power Design Summary' tab is selected. A blue dashed box highlights the 'Print Summary Report' button. A blue arrow points from this button to the 'Print Preview' window, which displays the 'LTC3838 Supply Design Summary' report.

Part Specs

- Max Vin: 38 V
- Min Vin: 4.5 V
- Max Vout: 5.5 V
- Sugg. Max Iout: 30 A
- Min Sw. Freq.: 200 kHz
- Max Sw. Freq.: 2000 kHz

Design Specs

- Vin max: 13.2 V
- Vin nom: 12 V
- Vin min: 10.8 V
- Switching Freq: 370 kHz

Output Rail 1

- Vout1: 1.2 V
- Iout1: 15 A

Output Rail 2

- Vout2: 1.8 V
- Iout2: 12 A

LTC3838 Supply Design Summary

Project Info:

Steady State:

Rail #	Vin Min	Vin Nom	Vin Max	Fsw	Vo
1	10.8	12	13.2	370	1.2 V
2	10.8	12	13.2	370	1.8 V

Efficiency / Loop:

Rail #	Vo	Io_max	Eff.@Io_max	Ploss@Io_max	Loop BW
1	1.2 V	15 A	90.49 %	1.892 W	34.67 kHz
2	1.8 V	12 A	93.93 %	1.395 W	12.02 kHz

Recommendations / Warnings:

- Message
- Rail #1: Vripple (7.3mV) is below recommended value (10mV)
- Rail #2: IL Ripple (73%) is above recommended value (70%)

Power Components Bill Of Materials:

Ref. Des.	Value	Quantity	Description	Mfr. Name	Mfr. Part #
U1		1	IC	LINEAR TECH	LTC3838
Lo1	0.47µH	1	IND	COILCRAFT	XPL7030-471
Cin1 Cin2 Cin3 Cin4	22µF	4	CAP		
Cob1	330µF	1	CAP	SANYO	2RSTPE330M
Coc1 Coc2	100µF	2	CAP	MURATA	GRM31CR60
Qtop1	25V	1	FET	Fairchild	FDM57578
Qbot1	25V	1	FET	Fairchild	FDM585585
Lo2	0.47µH	1	IND	COILCRAFT	XPL7030-471
Cob2	330µF	1	CAP	SANYO	2RSTPE330M
Coc3	100µF	1	CAP	MURATA	GRM31CR60
Qtop2	25V	1	FET	Fairchild	FDM57578
Qbot2	25V	1	FET	Fairchild	FDM585585

Power Components Footprint:

- # Components: 16
- Max. Height: 3.2 mm
- Component Clearance (d): 1 mm
- * Power Components Area (Excludes ICs): 553.6 mm² / 0.858 in²
- * Power Components Area (Includes ICs): 616.6 mm² / 0.956 in²

*** Note:**
The calculated power component area is only the simple sum of component area, assuming all power components are on the same side of PCB. It is NOT the footprint area.

Print Preview

The Print Preview window shows a grid of 12 pages. The first page is the 'LTC3838 Supply Design Summary Report'. The second page shows the circuit schematic. The third and fourth pages show efficiency and loop bandwidth plots. The fifth and sixth pages show power loss and power component area plots. The seventh and eighth pages show transient response plots. The ninth and tenth pages show the power stage solution size. The eleventh and twelfth pages show the power stage solution size.

Summary Report summarizes schematic, performances, components, power stage solution size

LTC3833 - Fast Accurate Step-Down DC/DC Controller with Differential Output Sensing

Project Name: _____ Date: _____

Vin(nom) 12 V

Total CIN RMS 5.53 A
Total CIN Ploss 0.07 W

Feedback
Sug. Rt1 15 kΩ
Rt1 15 kΩ
Cff1 pF

VOUT

Rt1

Cff1

Sug. Rb1 22.6 kΩ
Rb1 22.6 kΩ
Cff1 pF

Rb1

Cff1

Cth1

Rth1

Cthp1

Duty & Ton
Vout1 Duty 8.33 %
t1 @ Vin Max 190 ns
tff1 @ Vin Min 2274.2 ns
Sw Freq

Compens
Cth1 910 pF
Rth1 20.5 kΩ
Cthp1 100 pF

Solutions Library

Built-In Solutions

LTC Part Name	Solution Name	Vin [min] (V)	Vin [nom] (V)	Vin [max] (V)	Rail Voltage(s) (V)	Output Current(s) (A)	Description
LTC3833	Datasheet P30	7	12	38	Vout1 = 5V	Iout1 = 8A	7-38Vin to 5V/8A
LTC3833	Datasheet P36	7	12	14	Vout1 = 5.5V	Iout1 = 4A	Fsw=2MHz Design
LTC3833	DC1516A-A	4.5	12	24	Vout1 = 1.5V	Iout1 = 15A	1.5V/15A DCR Sense
LTC3833	DC1516A-B	4.5	12	24	Vout1 = 1.5V	Iout1 = 15A	1.5V/15A with Rsense
LTC3833	DC1640A-A	4.5	12	24	Vout1 = 1.5V	Iout1 = 20A	1.5V/20A DCR Sense
LTC3833	DC1640A-B	4.5	12	24	Vout1 = 1.5V	Iout1 = 20A	1.5V/20A with Rsense
LTC3833	Reference Design 12Vin to 1Vo 20A	10.8	12	13.2	Vout1 = 1V	Iout1 = 20A	DCR Sense

Existing design solution library

User's Solutions

LTC Part Name	Solution Name	Vin [min] (V)	Vin [nom] (V)	Vin [max] (V)	Rail Voltage(s) (V)	Output Currents(s) (A)	Description	File Name
LTC3833	Ref. Design 5-26Vin to 3.3V 6A	5.52	12	26	Vout1 = 3.3V	Iout1 = 6A	Small size, DCR sense	LTC3833 Ref. Design 5-

Add This Project As A New Solution

New Solution Name : _____

New Solution Description : _____

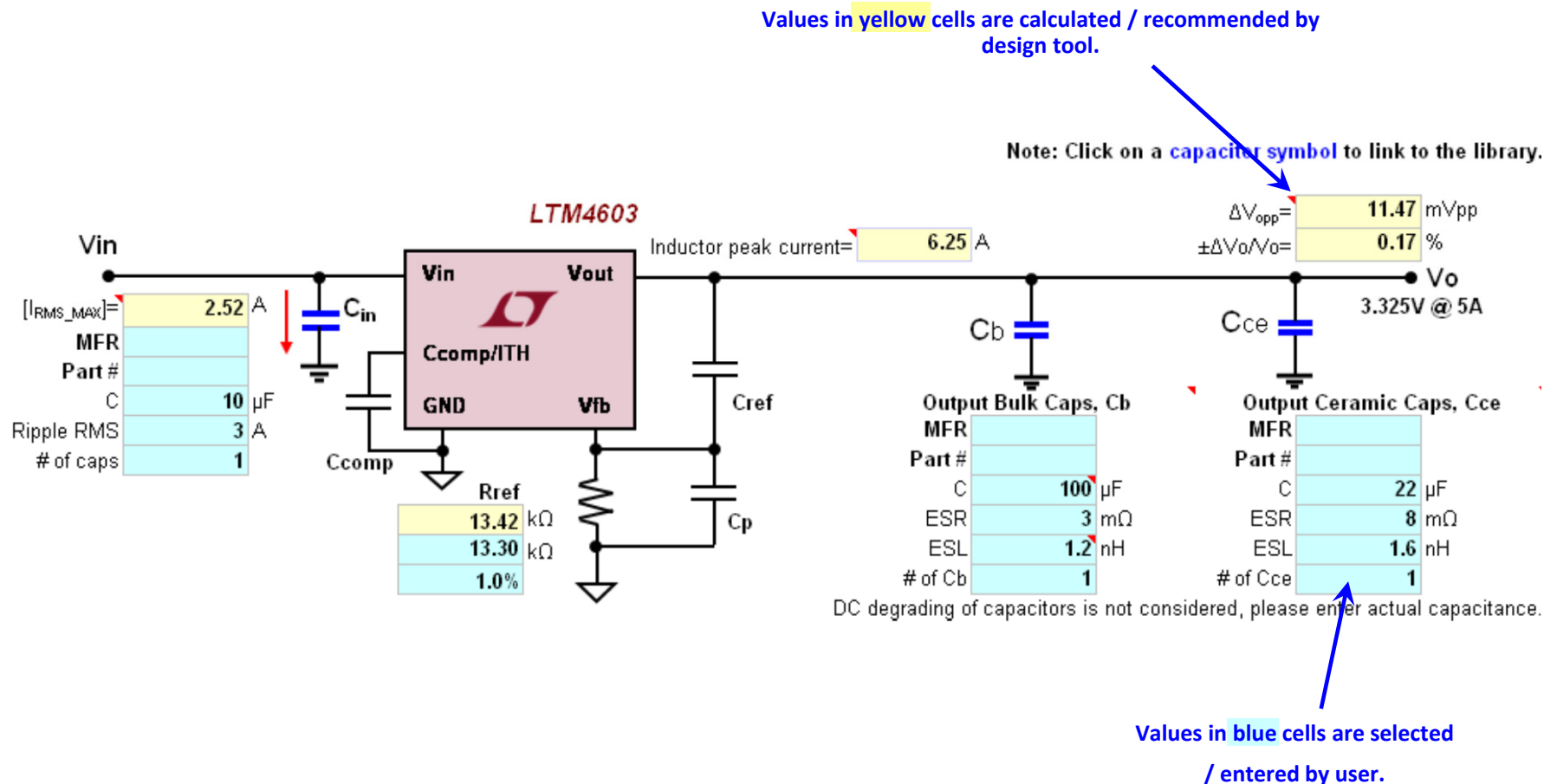
Save New Solution Import Solution Overwrite Selected Solution Cancel / Exit

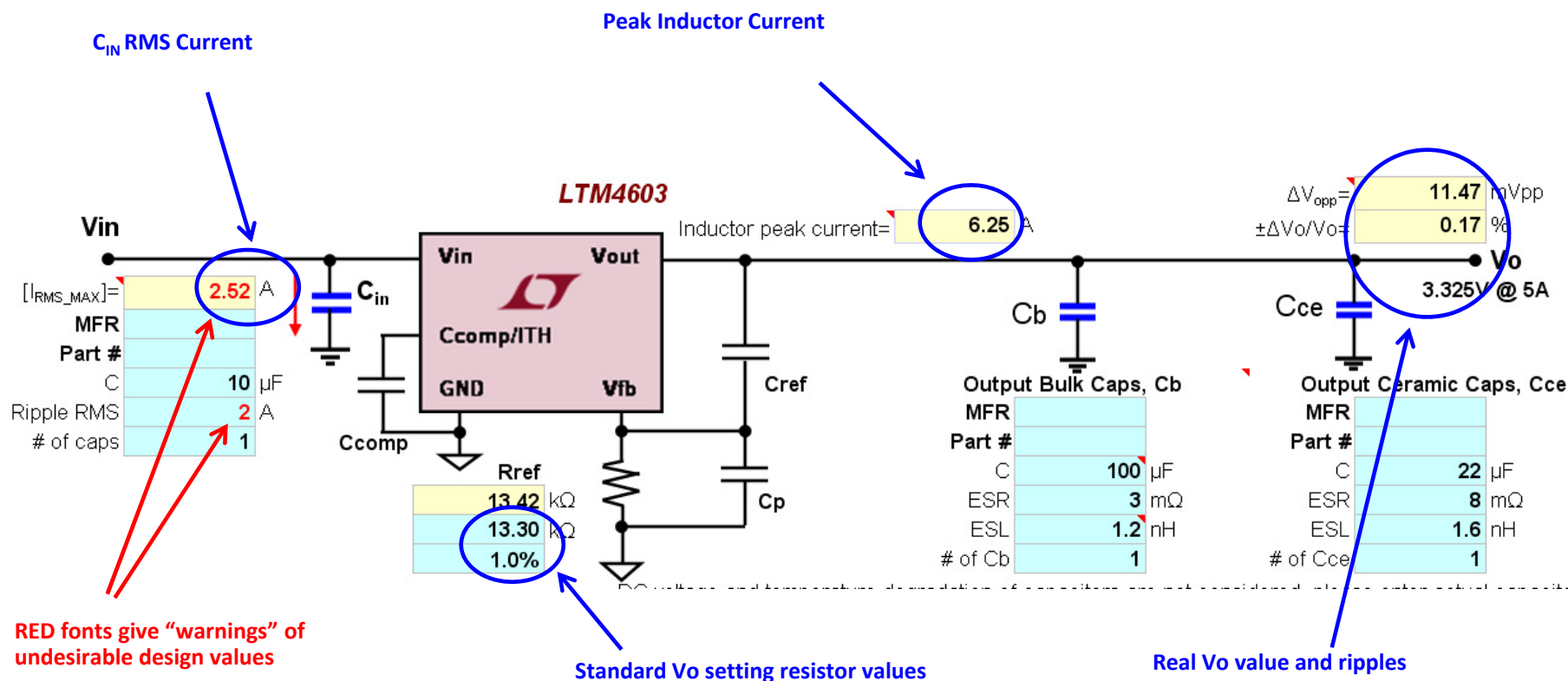
- Many solutions/designs are already in “solution library”.
- Users can add/build their solutions too.
- Leverage existing designs.
- A quick start point of a new design!

Example of an Excel-Based design Tool



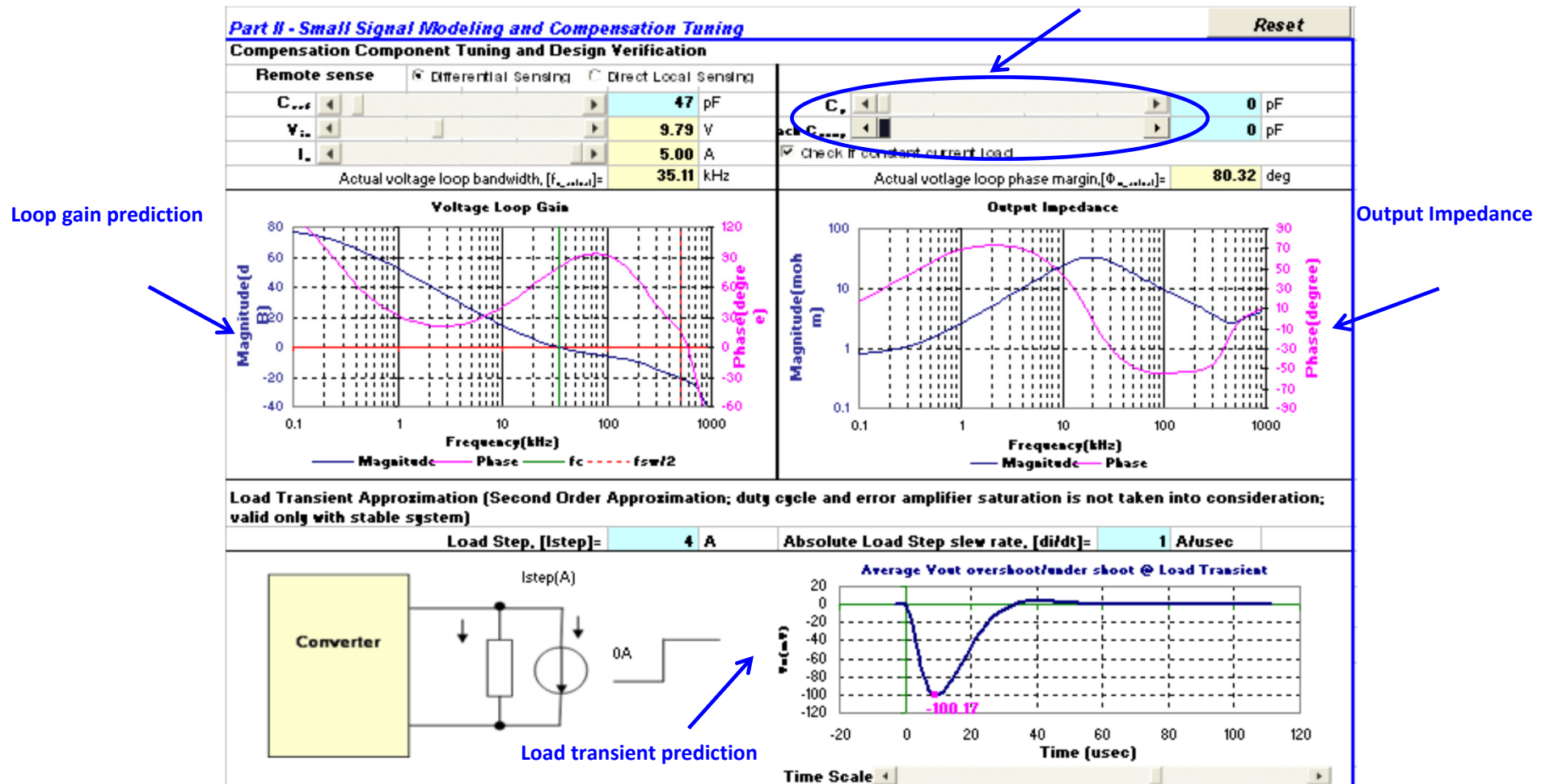
In the design spreadsheet, power components design is guided with schematic interface:



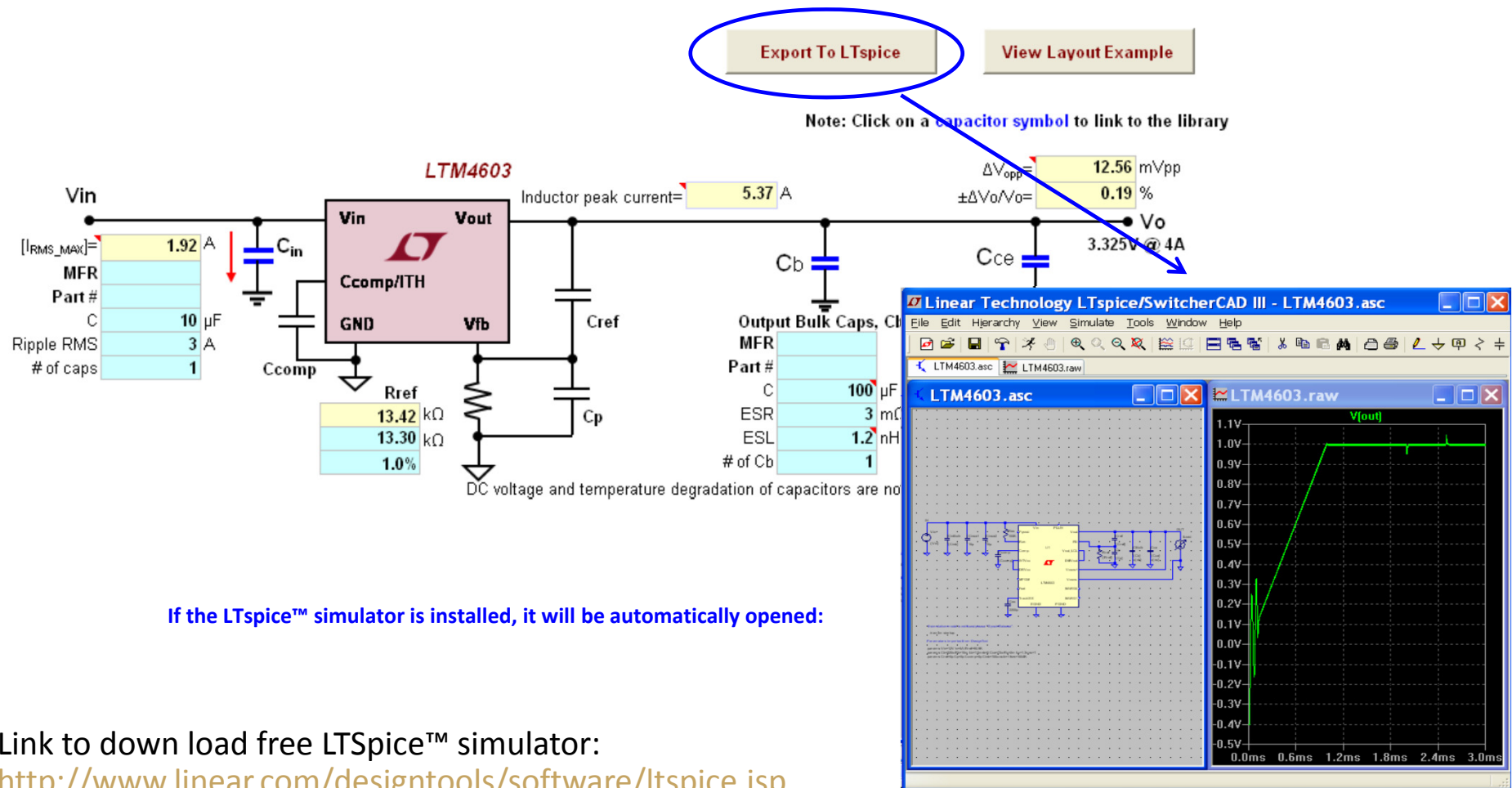


In the design spreadsheet, control loop design can be fine tuned:

Sliding bar for compensation adjustment.



In the design spreadsheet, click the “Export To LTspice” button:



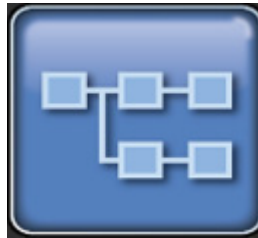
If the LTspice™ simulator is installed, it will be automatically opened:

Link to download free LTspice™ simulator:

<http://www.linear.com/designtools/software/ltspice.jsp>

LTpowerPlanner™ System Level Power Tree Design Tool

A Brief Introduction



- A System-Level Power Planning Tool:

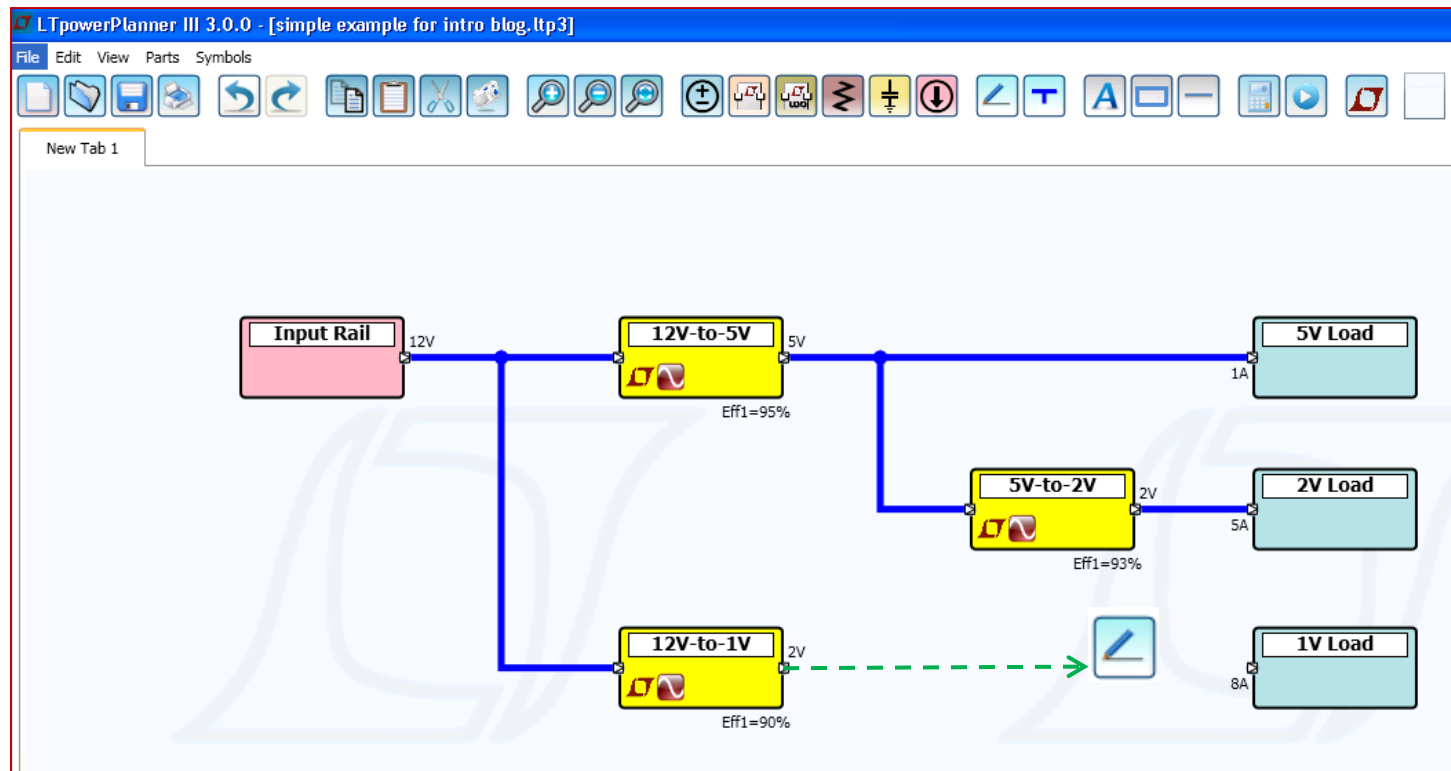
- Create a System “Power Tree” Diagram.
- Estimate Total System Power, Efficiency and Size.
- Optional Links to LTpowerCAD and LTspice Designs.
- Available inside LTpowerCAD tool.
- LTpowerCAD free download:
www.linear.com/LTpowerCAD.
- Windows PC based GUI program.

Why Use 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.

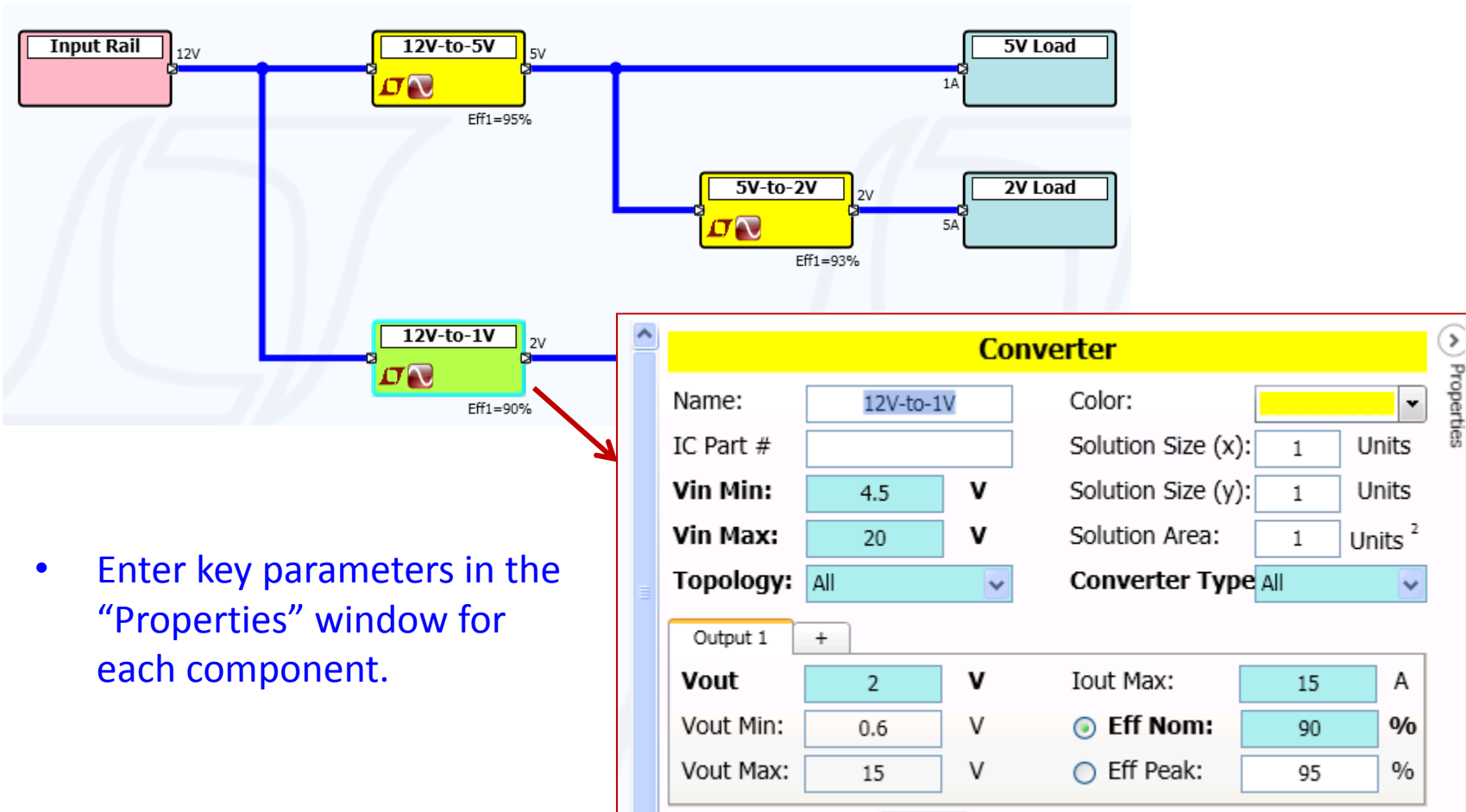


Step 1: Drawing System Power Tree:



- 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)



The diagram shows a power supply system with an input rail at 12V. It branches into three parallel converter paths:

- 12V-to-5V Converter:** Efficiency (Eff1) = 95%. Output is 5V, connected to a 5V Load (1A).
- 5V-to-2V Converter:** Efficiency (Eff1) = 93%. Output is 2V, connected to a 2V Load (5A).
- 12V-to-1V Converter:** Efficiency (Eff1) = 90%. Output is 2V, connected to a 2V Load.

A red arrow points from the 12V-to-1V converter to its properties window, which is shown below:

Converter

Name: 12V-to-1V Color: [Yellow]

IC Part #: [Empty]

Solution Size (x): 1 Units

Solution Size (y): 1 Units

Solution Area: 1 Units²

Vin Min: 4.5 V

Vin Max: 20 V

Topology: All

Converter Type: All

Output 1 +

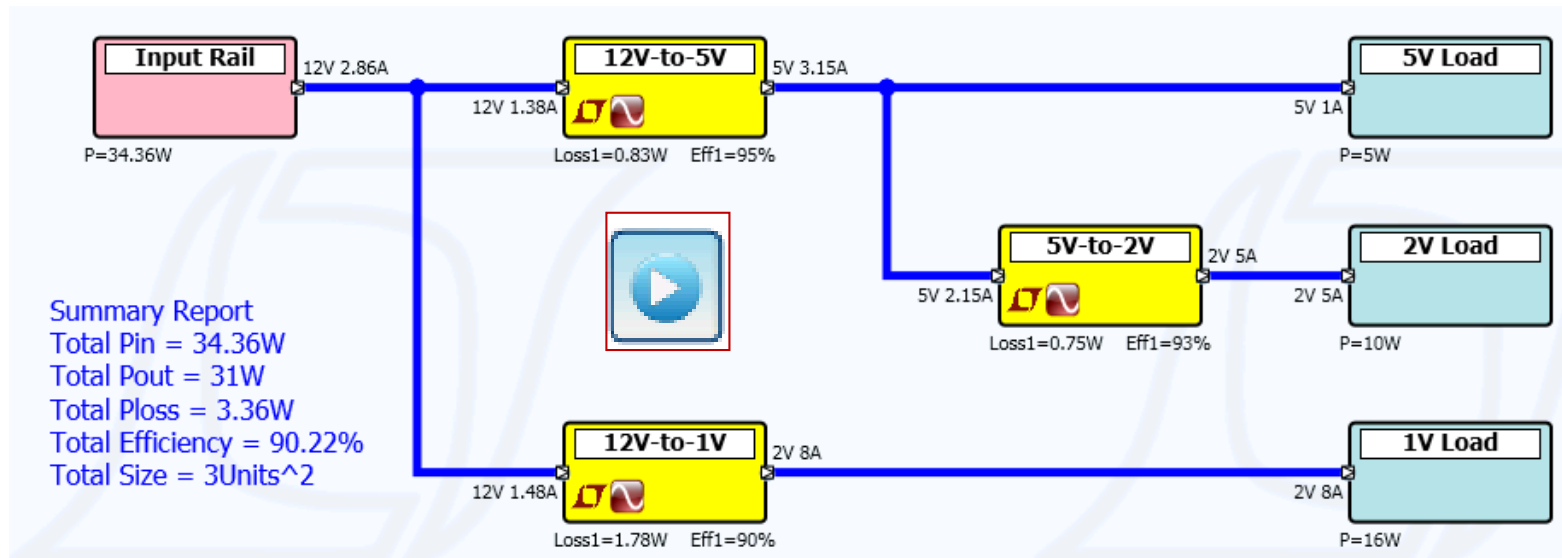
Vout: 2 V Iout Max: 15 A

Vout Min: 0.6 V ☒ Eff Nom: 90 %

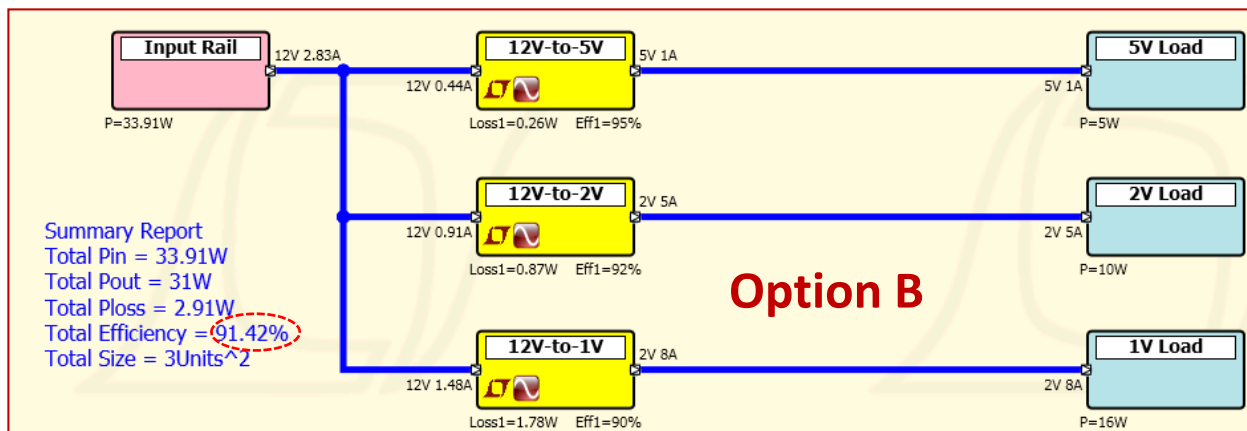
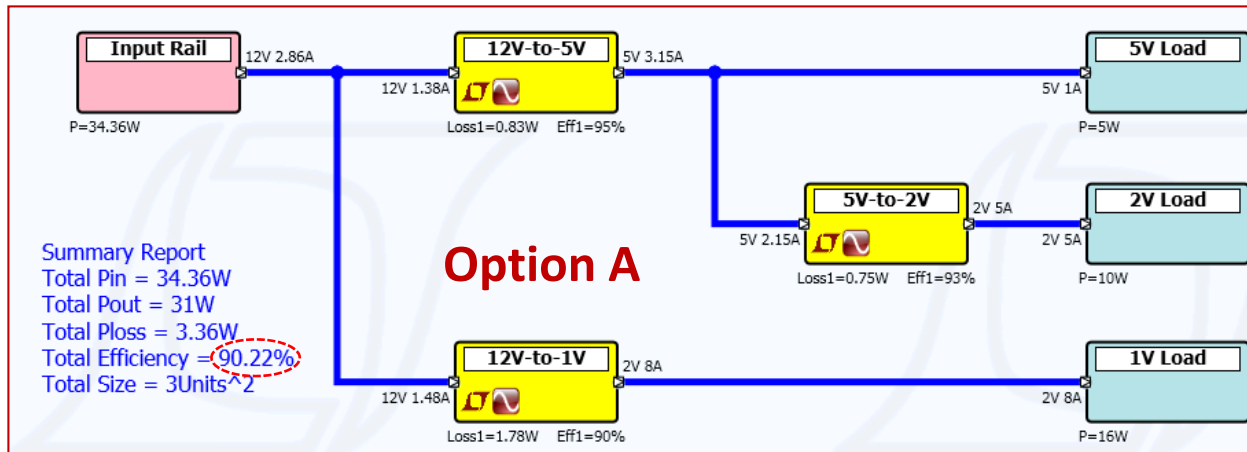
Vout Max: 15 V ☐ Eff Peak: 95 %

- Enter key parameters in the “Properties” window for each component.

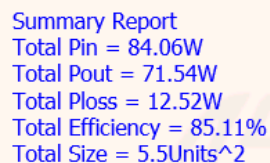
Step 3: Run Calculation:



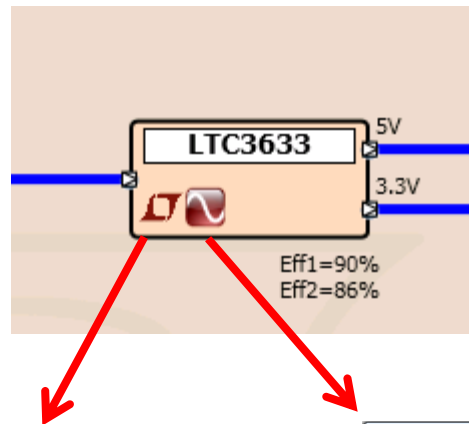
- Calculate total input power, output power, loss, efficiency and size.
 (-based on user's entries of component parameters)



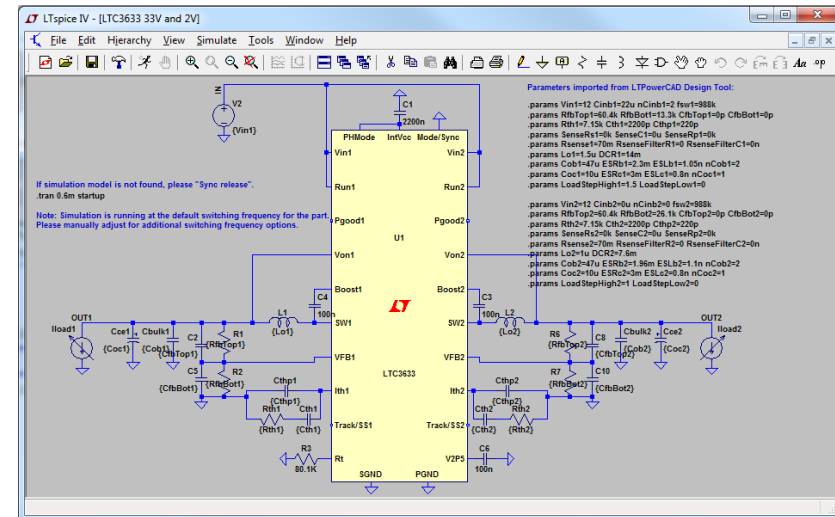
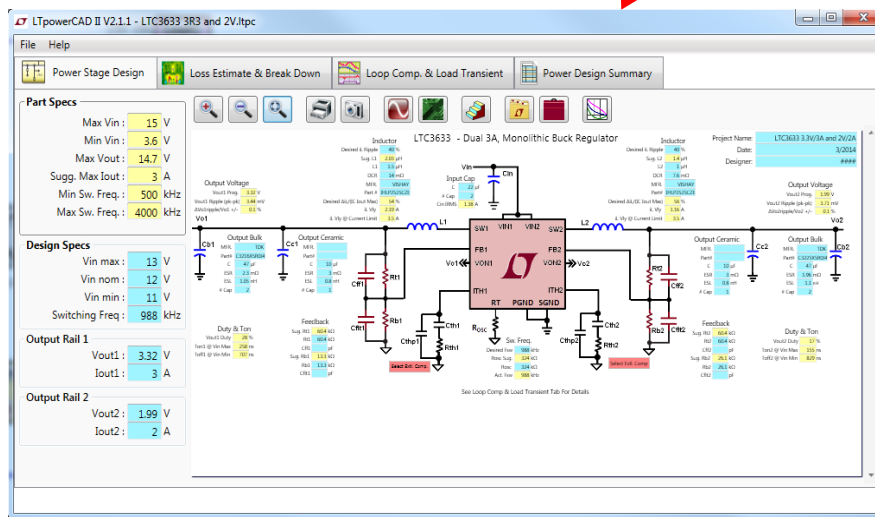
- A Quick Power Tree Comparison for Optimum Design



- 

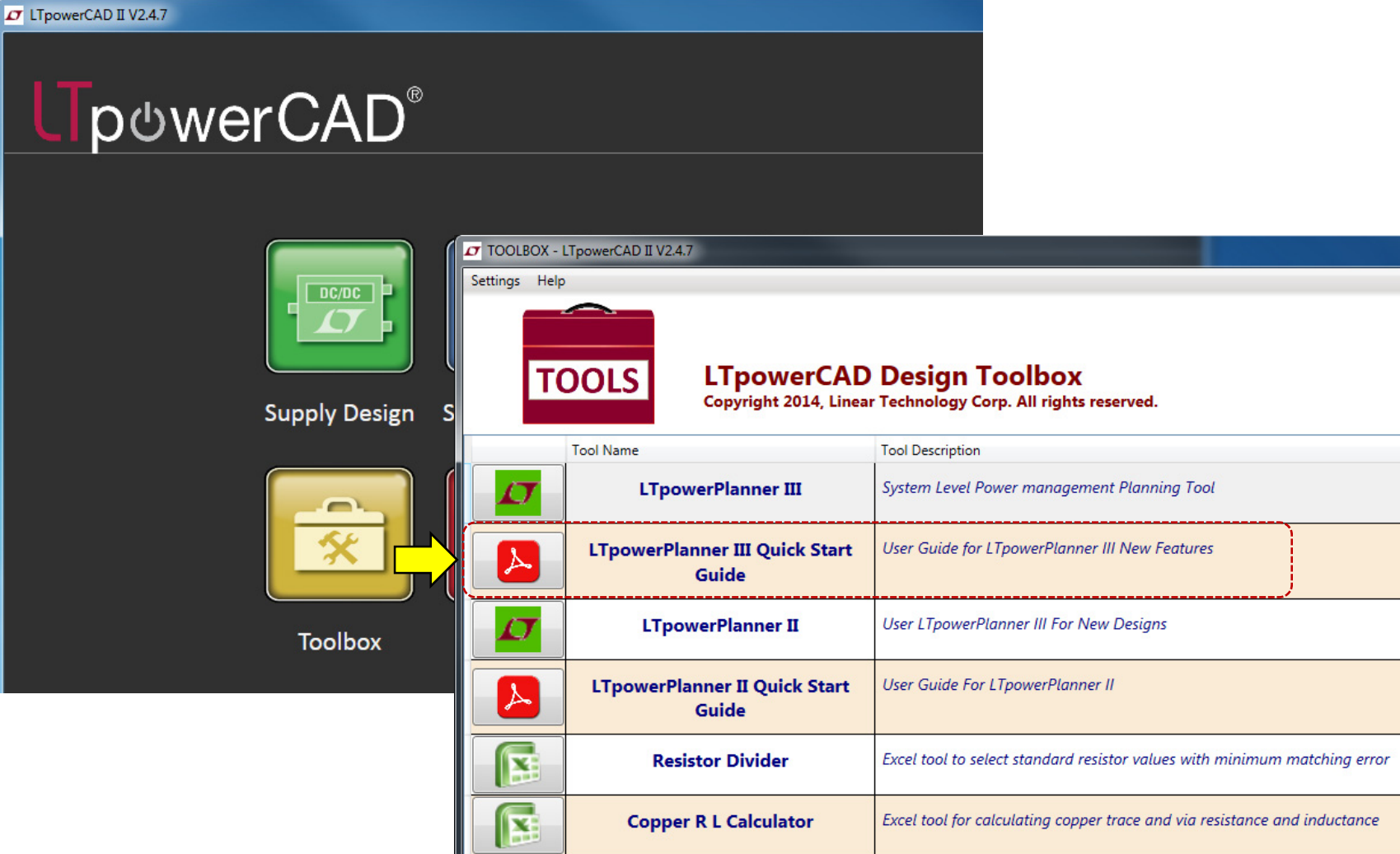


Click “**Properties**” to Link Existing Design Files



- Leverage LTpowerCAD and LTspice tools to design each supply.

More Details? – See LTpowerPlanner QSG (inside “Toolbox”)



The screenshot shows the LTpowerCAD II V2.4.7 interface. On the left, the 'Toolbox' icon is highlighted with a yellow arrow. The 'TOOLBOX - LTpowerCAD II V2.4.7' window is open, displaying a list of tools. The 'LTpowerPlanner III Quick Start Guide' is highlighted with a red dashed box.

Tool Name	Tool Description
LTpowerPlanner III	System Level Power management Planning Tool
LTpowerPlanner III Quick Start Guide	User Guide for LTpowerPlanner III New Features
LTpowerPlanner II	User LTpowerPlanner III For New Designs
LTpowerPlanner II Quick Start Guide	User Guide For LTpowerPlanner II
Resistor Divider	Excel tool to select standard resistor values with minimum matching error
Copper R L Calculator	Excel tool for calculating copper trace and via resistance and inductance

Any feedback comments on the program or issues encountered are welcome!

Please forward your comments to the addresses below.

LTpowerCAD@Linear.com

LTpowerCAD II v2.4™

Installation

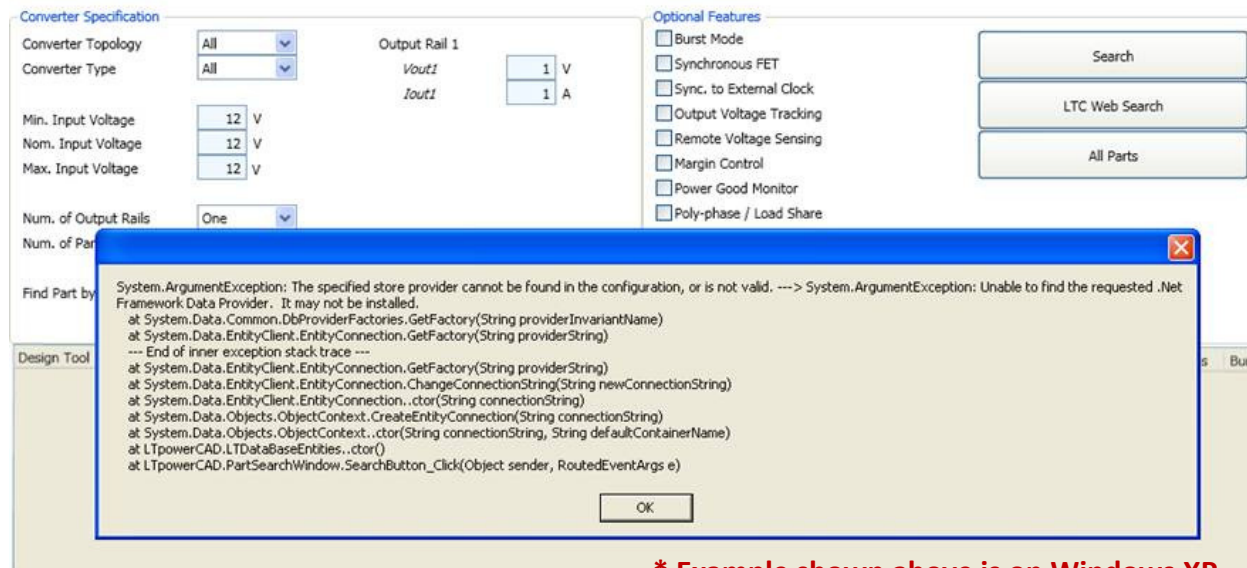
Troubleshooting

I. Microsoft SQL Server Compact 3.5 SP2 ENU requirement :

1) Possible issue: Microsoft SQL Server Compact 3.5 SP2 is requirement missing or was not properly installed

LTPowerCAD II v2.3 requires Microsoft SQL Server Compact 3.5 SP2 to access the internal parts database. If this was not already installed on your system or it was installed but not properly installed, the program may have issues accessing information for parts included in the program.

An example screenshot is shown below where this type of error has occurred. If this is confirmed to be installed on your system, making sure it was installed correctly may require a repair of the installation or an automatic re-installation of this requirement. Please see the following slides for details to resolve this issue.



*** Example shown above is on Windows XP**

Important : Make sure you installed using “setup.exe” file (not the NotForSetup.msi file)

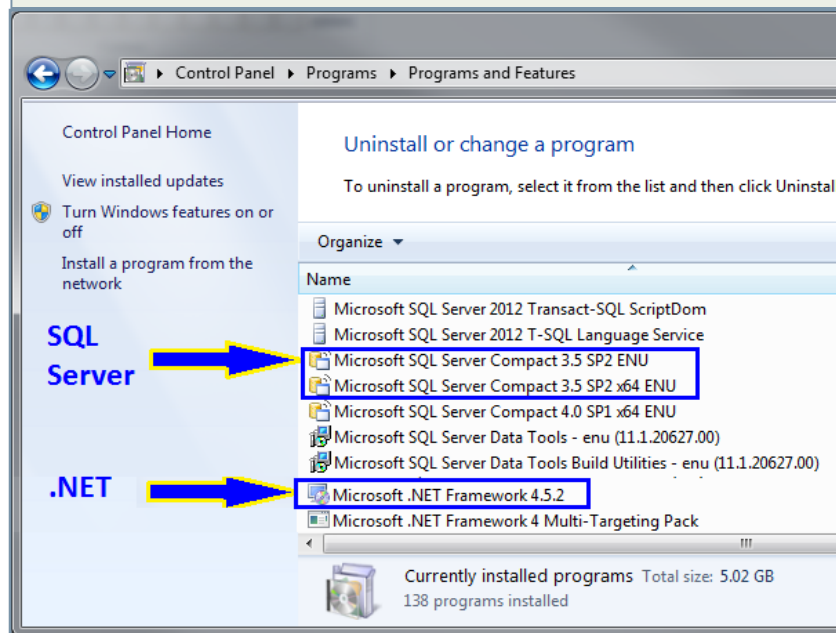
Possible issue solution:

The LTpowerCAD II installer automatically checks if you have the proper Microsoft requirements installed, and if not it will download and install it automatically. Otherwise follow the steps below to ensure these requirements are installed properly.

Step 1 :

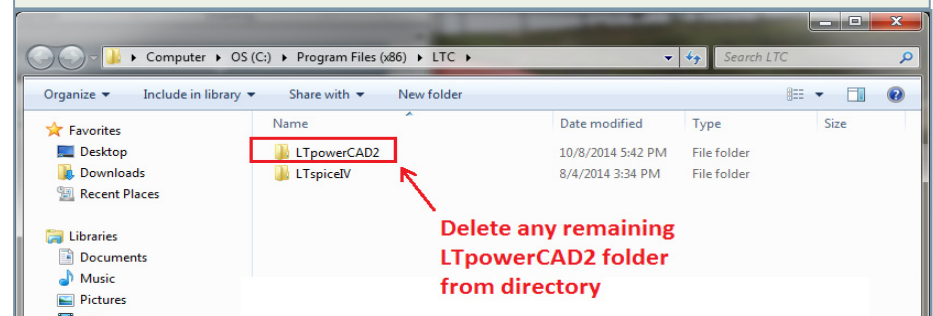
Go to your Currently Installed Programs
(Start Menu → Control Panel → Uninstall a program).

Check the list of installed programs to see if the Microsoft requirements
SQL Server Compact 3.5 SP2, Microsoft .NET Framework 3.5 or higher are present.



Step 2:

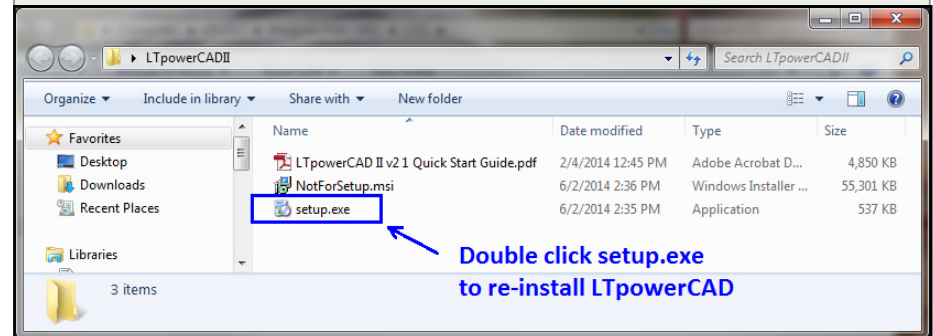
If any of these requirements are missing or are present but suspect they may not have been installed properly, go to your Currently Installed Programs and uninstall LTpowerCAD. Delete any remaining LTpowerCAD2 folder from the LTpowerCAD installation directory.



Step 3 :

Go to your Currently Installed Programs. Uninstall any and all of the requirements that were already installed on your system so that none of the requirements are present on your system.

Install LTpowerCAD again by double clicking installation file setup.exe. LTpowerCAD will automatically download and install the Microsoft requirements. After installation is complete, open LTpowerCAD and verify issue is now resolved.

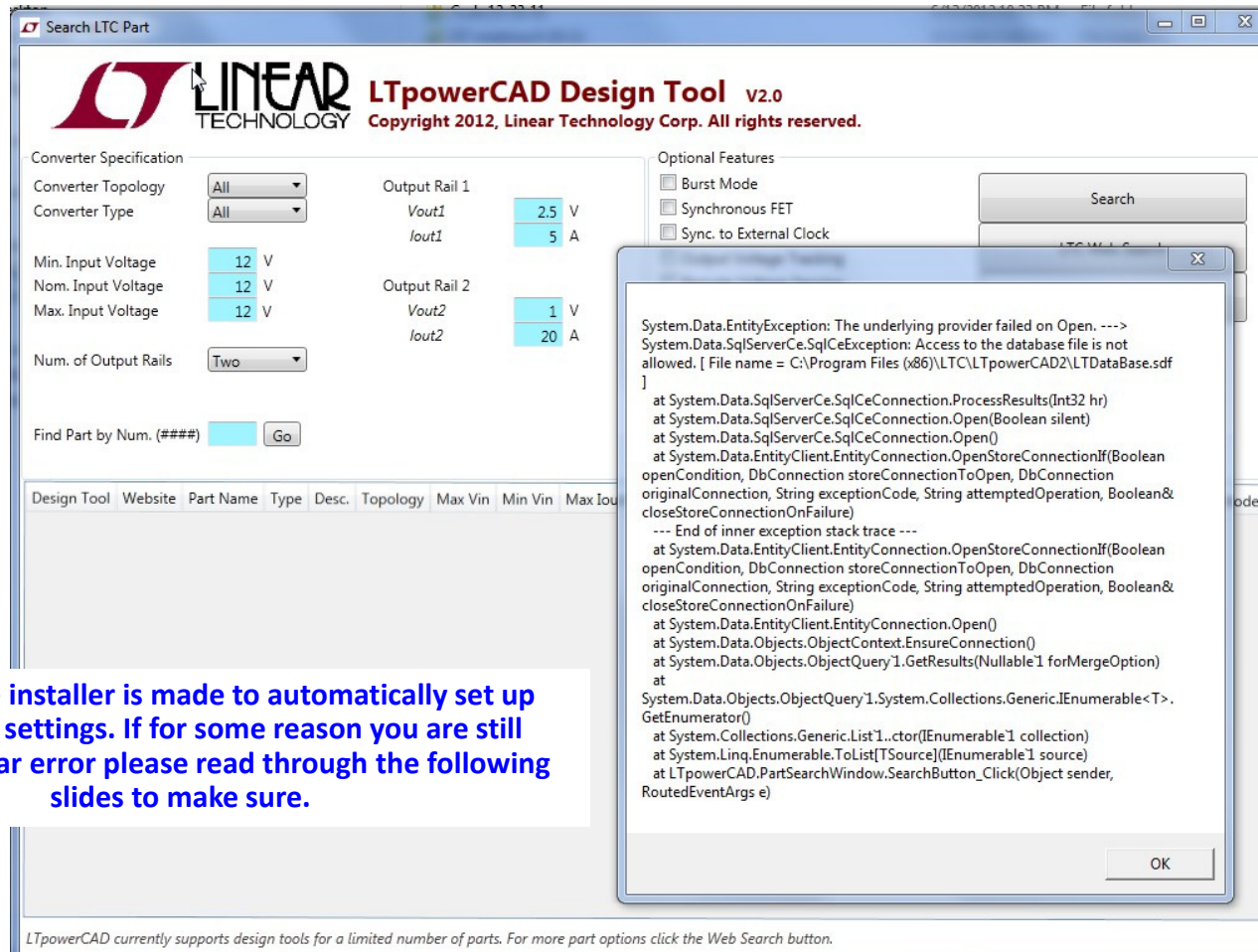


Important : Make sure to install by clicking the “setup.exe” file (not the NotForSetup.msi file)

II. Microsoft Security Settings :

2) Possible issue: Microsoft Security Settings

Security default settings may prevent access of LTpowerCAD II v2.3 from its database causing an error message to pop up when searching for a part (see below).



**** Note :** The installer is made to automatically set up these folder settings. If for some reason you are still getting a similar error please read through the following slides to make sure.

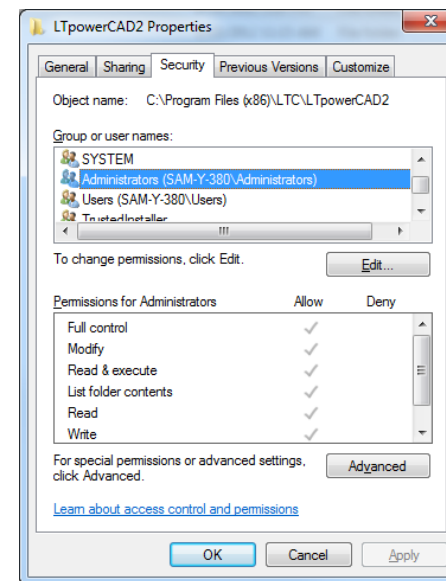
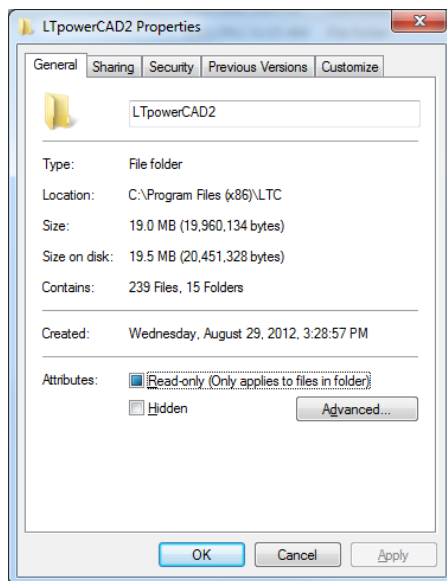
Possible issue solution:

Run the program with an Administrator account , or try to modify your system's Users account security settings for now (see below).

Step 1) Go to the LTC folder location: (ie C:\Program Files (x86)\LTC)

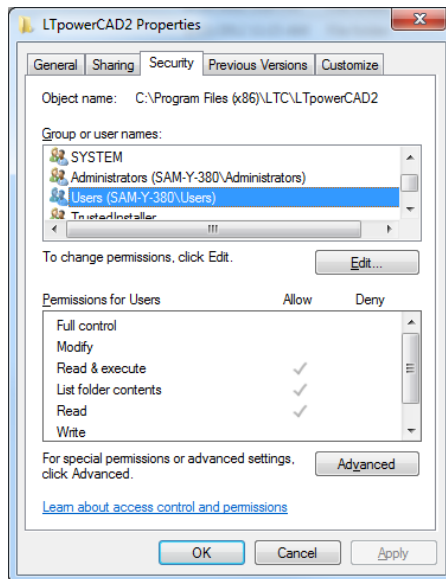
Step 2) Right click on the LTpowerCAD 2 program folder → **Properties**

Step 3) Click on the **Security** tab. Click on your **Administrators** account and see that the permissions should show Allow for all options (except for Special permissions). The **SYSTEM** account should also have the same settings.



Possible issue solution (cont'd):

Step 4) Click on your **Users** account to see the user settings. Your user account may not have the permissions set (like shown below) that are needed. You can change these in the next step.



Step5) Click on the **Edit** button and click on your **Users** account again and click the check boxes on the **Allow** column for **Full control, Modify, Write**. Click **OK**. The settings should now be the same as you saw for the **Administrators** account.

