LTpowerCAD™ II Design Tool

Introduction & Quick Start Guide

Rev. 2.3 10/2014

Design Tool Development Team

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LTpowerCAD@Linear.com

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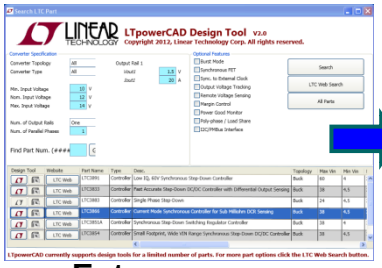
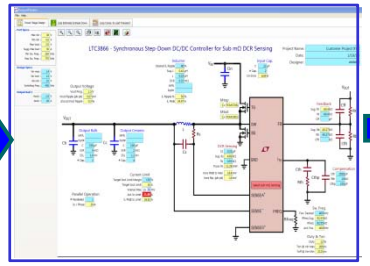
What is the LTpowerCAD Design Tool Program ?

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

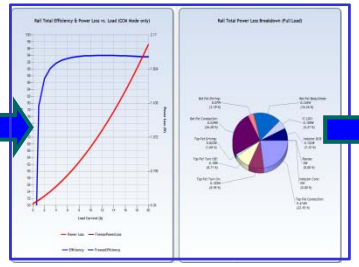
Step-by-Step Power Supply Design:



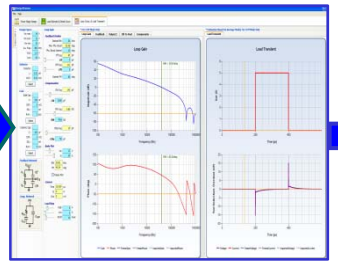
Enter specs, search solution.



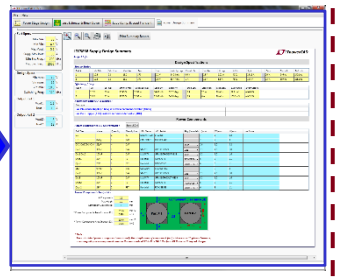
Power Supply Schematic.



Efficiency & Power Loss

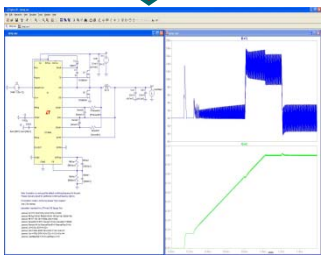


Loop Stability & Transient



Design Summary & BOM

LTpowerCAD



LTspice™ Simulation

LINEAR TECHNOLOGY

How is LTpowerCAD Different from Ltspice ?

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.*

How do I get the free LTpowerCAD II Program ?

1) Go to http://www.linear.com/LTpowerCAD

2) Download & install LTpowerCAD II on your Windows PC.

See the following pages for installation instructions.

LTpowerCAD II v2.3 Supported Parts

Over 200 DC/DC Power Products Supported !

Buck Converters :

Buck

Updated: 1/29/2014

	Green Cell Background - Excel tool available
	Red Cell Background - LTpowerCAD Non-Excel Tool available
Bold	Bold - Polyphase single output compatible

Controller

3-output	2-output	1 output
	LT3742	LT3724
	LTC3838	LT3740
	LTC3850	LT3800
	LTC3855	LT3844
	LTC3857	LT3845
	LTC3857-1	LTC3810
	LTC3858	LTC3810-5
	LTC3858-1	LTC3812-5
	LTC3858-2	LTC3829
	LTC3869	LTC3833
	LTC3869-2	LTC3839
	LTC3880	LTC3851A
	LTC3890	LTC3854
	LTC3890-1	LTC3856
		LTC3864
		LTC3866
		LTC3883
		LTC3891

Monolithic

3-output	2-output		1-output		
LT3507	LT1940	LTC3633	LT1912	LTC3403	LTC3416
LT3507A	LT1940L	LTC3633A	LT1913	LTC3404	LTC3418
	LT3500	LTC3633A-1	LT1938	LTC3405	LTC3549
	LT3501	LTC3633A-2	LT1939	LTC3405A	LTC3561
	LT3506	LTC3633A-3	LT3430	LTC3405A-1.375	LTC3568
	LT3506A		LT3430-1	LTC3405A-1.5	LTC3600
	LT3508		LT3431	LTC3405A-1.8	LTC3601
	LT3509		LT3434	LTC3406/3406B	LTC3602
	LT3510		LT3435	LTC3406-1.2	LTC3603
	LTC3407(CH1)		LT3480	LTC3406-1.5	LTC3604
	LTC3407(CH2)		LT3481	LTC3406-1.8	LTC3605
	LTC3407-2(CH1)		LT3502	LTC3406A	LTC3605A
	LTC3407-2(CH2)		LT3502A	LTC3406AB	LTC3608
	LTC3407-		LT3680	LTC3406AB-2	LTC3609
	LTC3407-		LT3682	LTC3406B-1.2	LTC3610
	LTC3407-4(CH1)		LT3684	LTC3406B-2	LTC3611
	LTC3407-4(CH2)		LT3685	LTC3409	LTC3612
	LTC3417(CH1)		LT3686	LTC3409A	LTC3613
	LTC3417(CH2)		LT3686A	LTC3410	LTC3614
	LTC3417A(CH1)		LT3693	LTC3410-1.2	LTC3616
	LTC3417A(CH2)		LT3694	LTC3410-1.65	LTC3621
	LTC3417A-		LT3970	LTC3410-1.875	LTC3621-2
	LTC3417A-		LT3971	LTC3410B	LTC3646
	LTC3419(CH1)		LT3972	LTC3411	LTC3646-1
	LTC3419(CH2)		LT3973	LTC3411A	LTC3626
	LTC3547(CH1)		LT3975	LTC3412	LT3995
	LTC3547(CH2)		LT3976	LTC3412A	
	LTC3615		LT3980	LTC3413	
	LTC3615(CH1)		LT3990	LTC3414	
	LTC3615(CH2)		LT3991	LTC3415	

µModule Regulator®

4-output	3-output	2-output	1-output
LTM4644		LTM4614	LTM4600
		LTM4615	LTM4600HV
		LTM4616	LTM4601
		LTM4619	LTM4601-1
		LTM4620	LTM4601HV
		LTM4620A	LTM4602
		LTM4628	LTM4602HV
		LTM4630	LTM4603
		LTM4676	LTM4603-1
			LTM4603HV
			LTM4604
			LTM4606
			LTM4608
			LTM4611
			LTM4612
			LTM4613
			LTM4618
			LTM4627
			LTM4637
			LTM8021
			LTM8022
			LTM8023
			LTM8025
			LTM8027
			LTM8029
			LTM8031
			LTM8032
			LTM8033
			LTM4641
			LTM4624

Note: This list was generated on 01/29/2014. New parts could be added to the library after that. Click "Sync-Release" to update LTpowerCAD library & functions.

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LTpowerCAD II v2.3 Supported Parts

Boost Converters :

Boost

Updated: 1/29/2014

Polyphase (Bold)

	Green Cell Background - Excel tool available
	Red Cell Background - LTpowerCAD Non-Excel Tool available
Bold	Bold - Polyphase single output compatible

Controller

3-output	2-output	1-output
	LTC3788	LTC3787
		LTC3862
		LTC3786
		LT3757
		LT3758
		LT1700

Monolithic

3-output	2-output	1-output
		LT3579
		LT3580
		LT3581
		LT3957
		LT3958

µModule Regulator®

3-output	2-output	1-output

Buck-Boost Converters :

Buck-Boost

Updated: 1/29/2014

Polyphase (Bold)

	Green Cell Background - Excel tool available
	Red Cell Background - LTpowerCAD Non-Excel Tool available
Bold	Bold - Polyphase single output compatible

Controller

3-output	2-output	1-output
		LT3791-1
		LT8705
		LTC3780
		LTC3785
		LTC3789

Monolithic

3-output	2-output	1-output

µModule Regulator®

3-output	2-output	1-output
		LTM4605
		LTM4607
		LTM4609

Note: This list was generated on 01/29/2014. New parts could be added to the library after that. Click "Sync-Release" to update LTpowerCAD library & functions.

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LTpowerCAD II

Software Installation

System Minimum Requirements

The following system and software is required for LTpowerCAD II v2.3 ™

- ✓ **PC with Microsoft Windows** XP SP2 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 Vista or Windows 7, Windows 8 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)*

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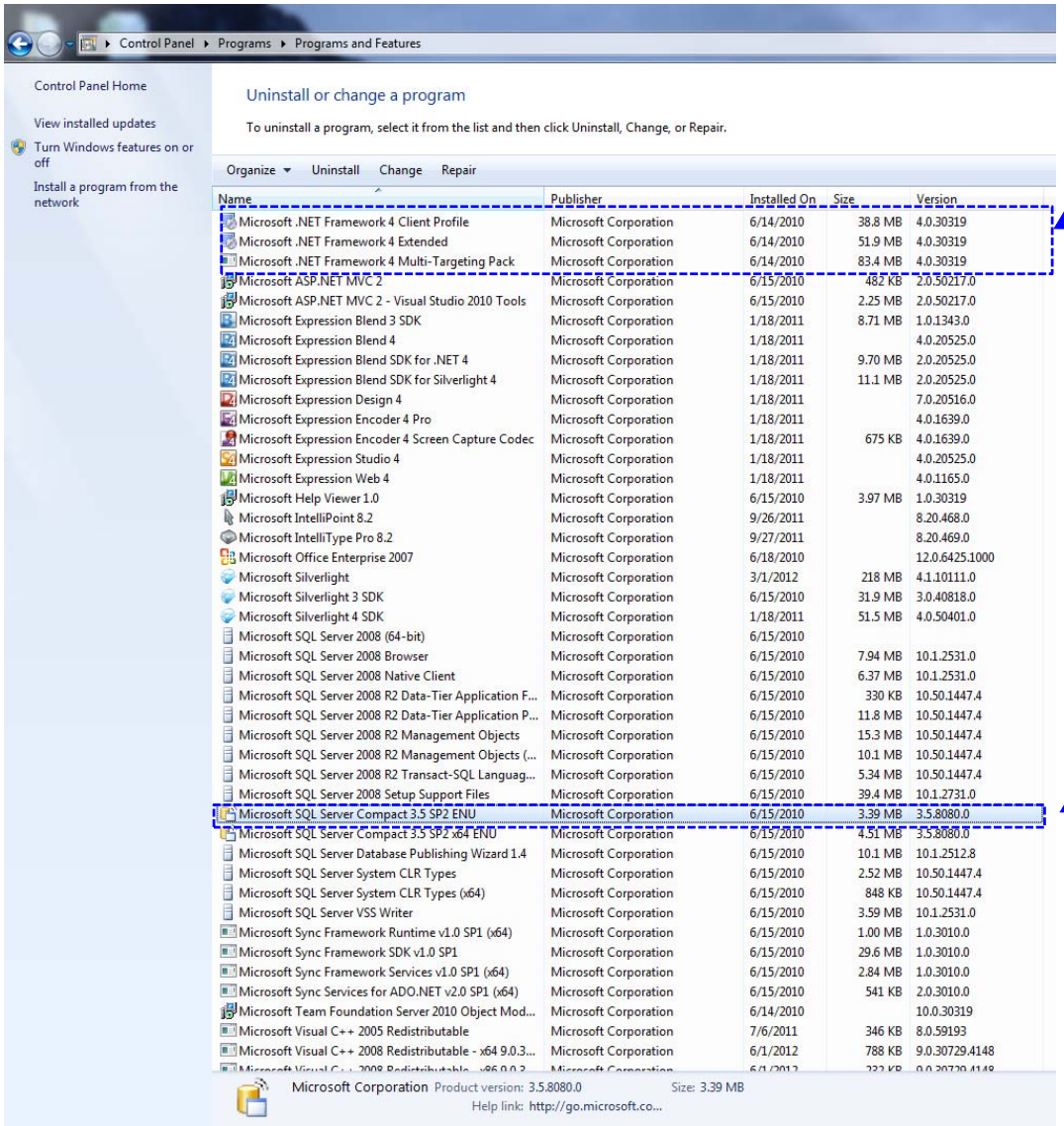
Minimum Requirements (cont'd)

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



Microsoft .NET 3.5, 4 or higher is required

Required for accessing part information

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Installing LTpowerCAD II v2.3™

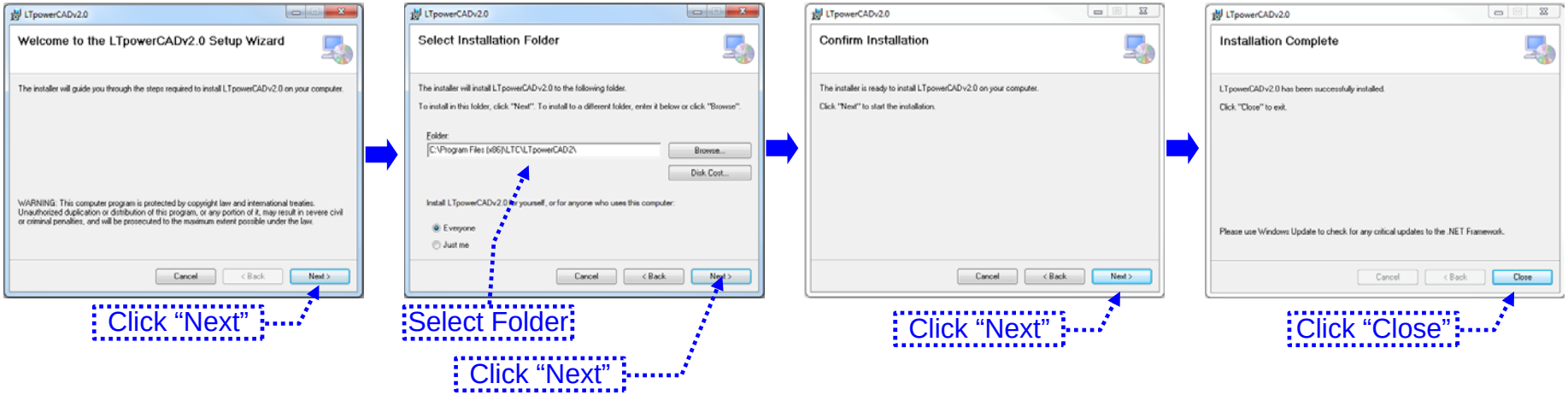
1. Double Click "**Setup.exe**" to Start LTpowerCAD II v2.3™ Design Tool Setup Wizard

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 v2.3

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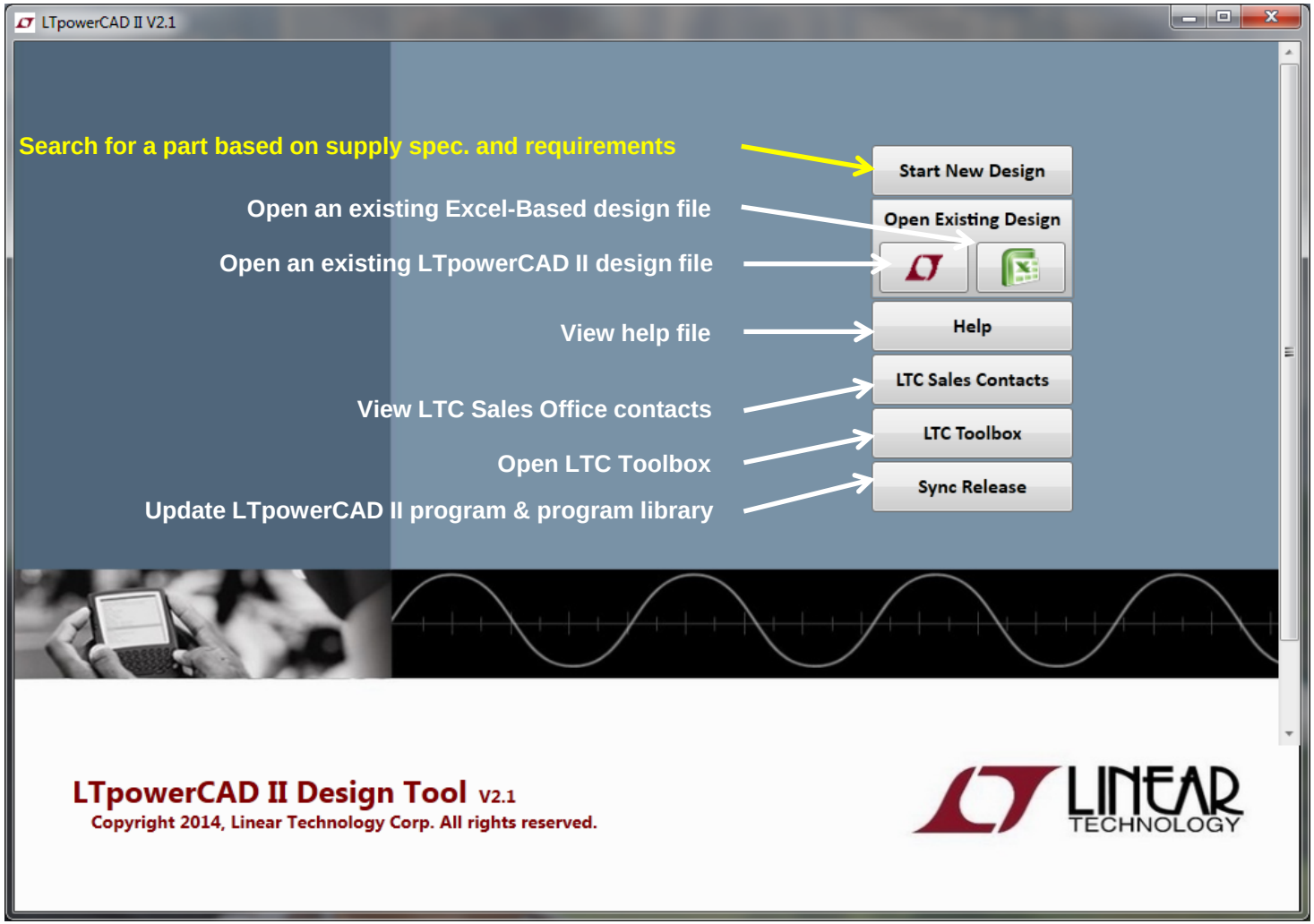
Getting Start with LTpowerCAD II

Main Page



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Search Page

Step 1. Enter power supply spec. & functions required

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

Step 2. Click "Search" (or hit keyboard "Enter" key) after the supply specs are entered to find parts.

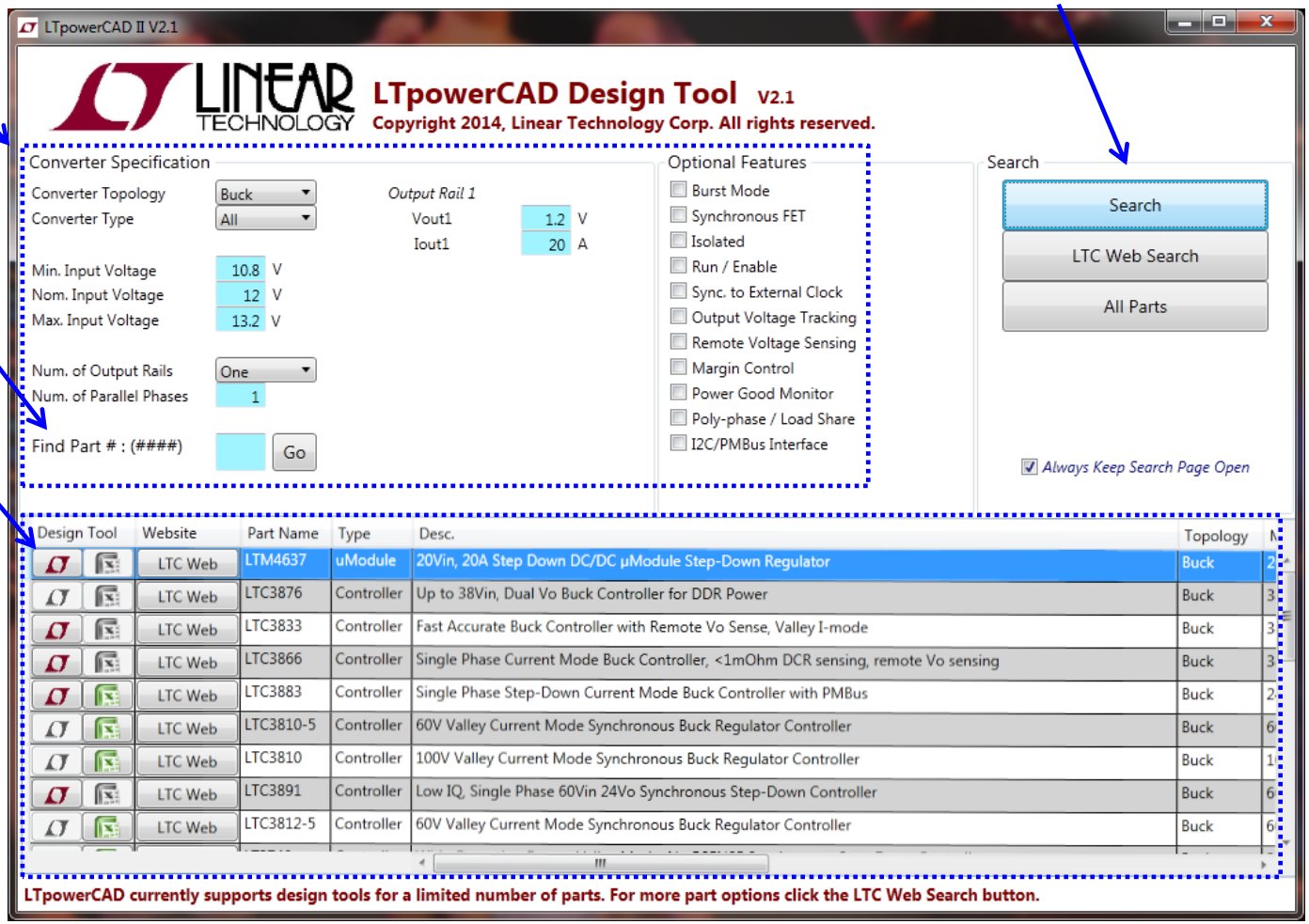
Step 3. Select a Part from Search Results Table:

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



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Design Tool Formats

Two possible design tool formats:

1. Non-Excel LTpowerCAD II Design Tool:

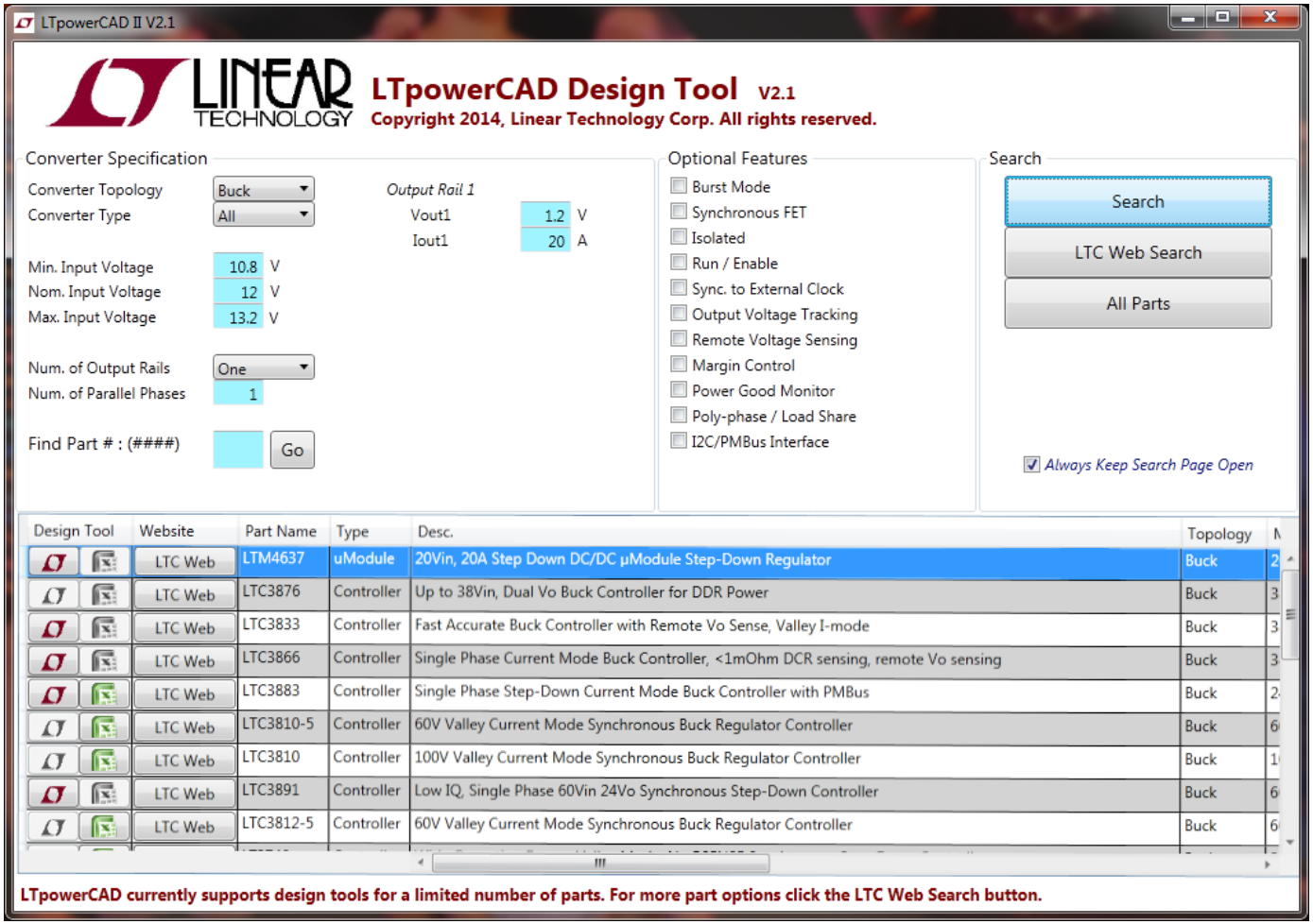
If available, an active LTC button is shown:

2. 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.



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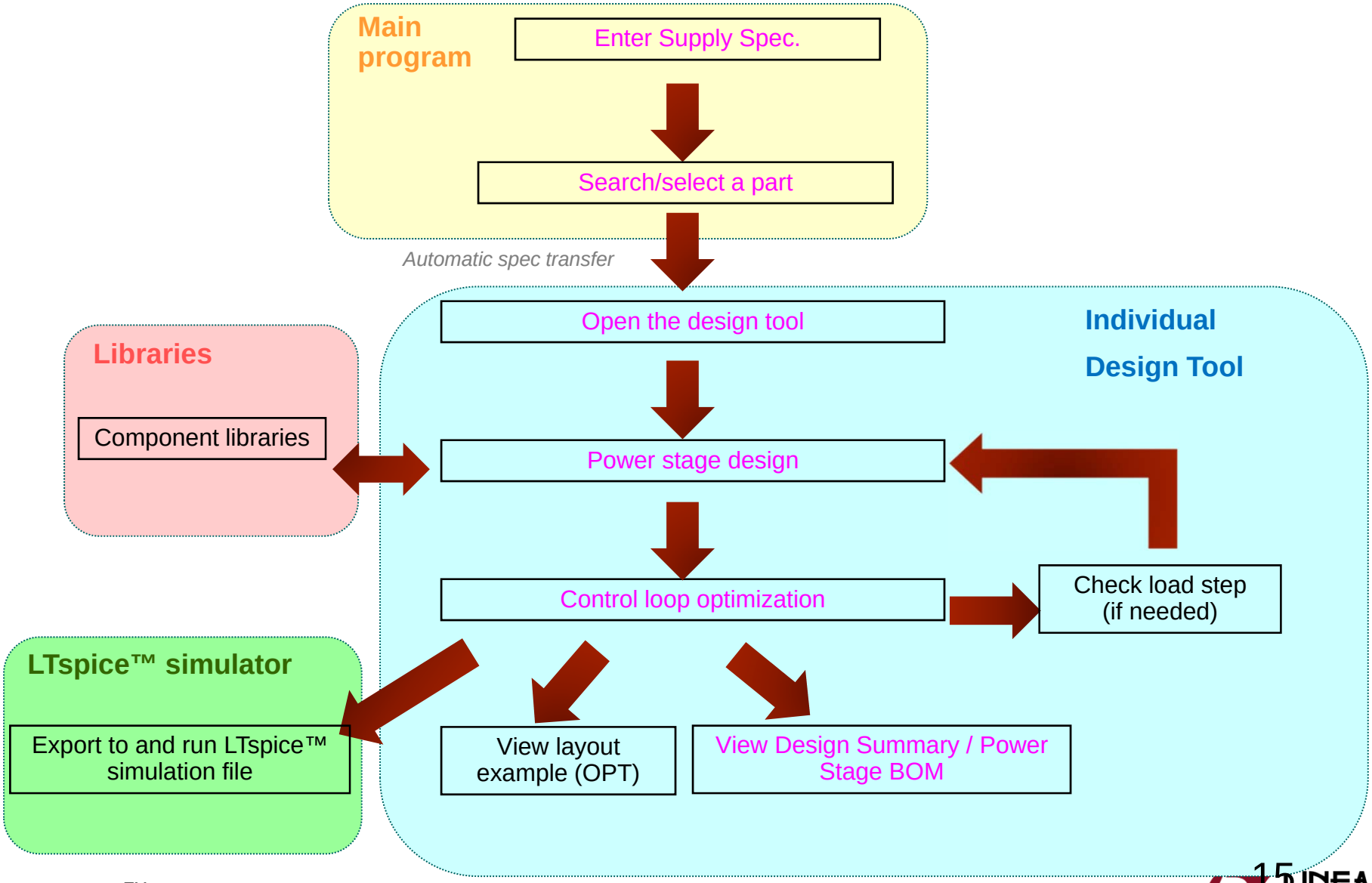
Step-By-Step Supply Design Procedure using the LTpowerCAD™ Design Tool



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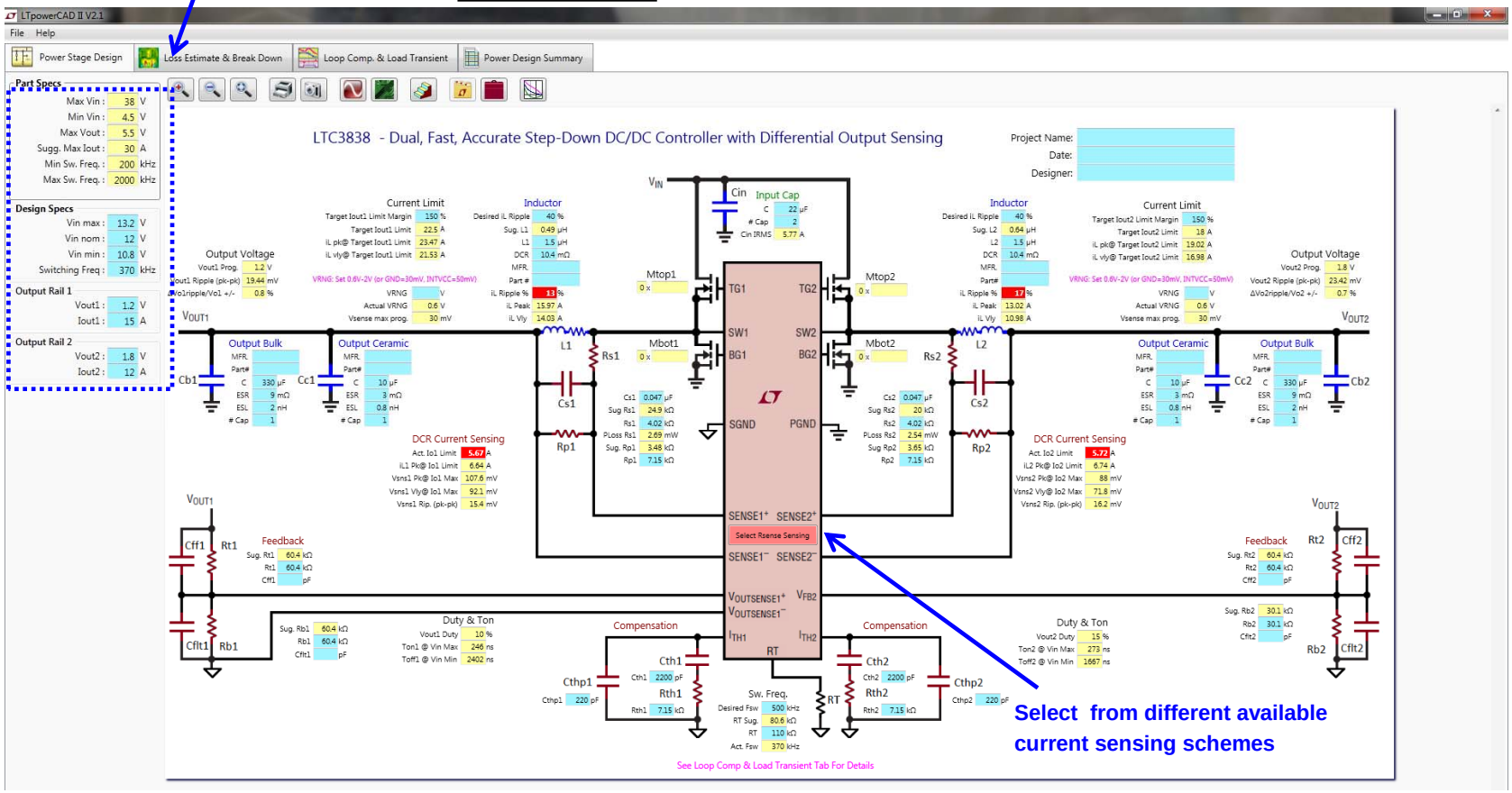
Design Steps Example

(*Non-Excel based* LTpowerCAD design Tool)

Design Step 1 – Power Stage Design

Blue Cell	: Suggested values or calculated parameters
Yellow Cell	: User entered values
Orange Cell	: Soft warnings (parameter outside of recommended range)
Red Cell	: Hard warnings (parameter far outside of recommended range)

Design Requirements & Part Limits



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

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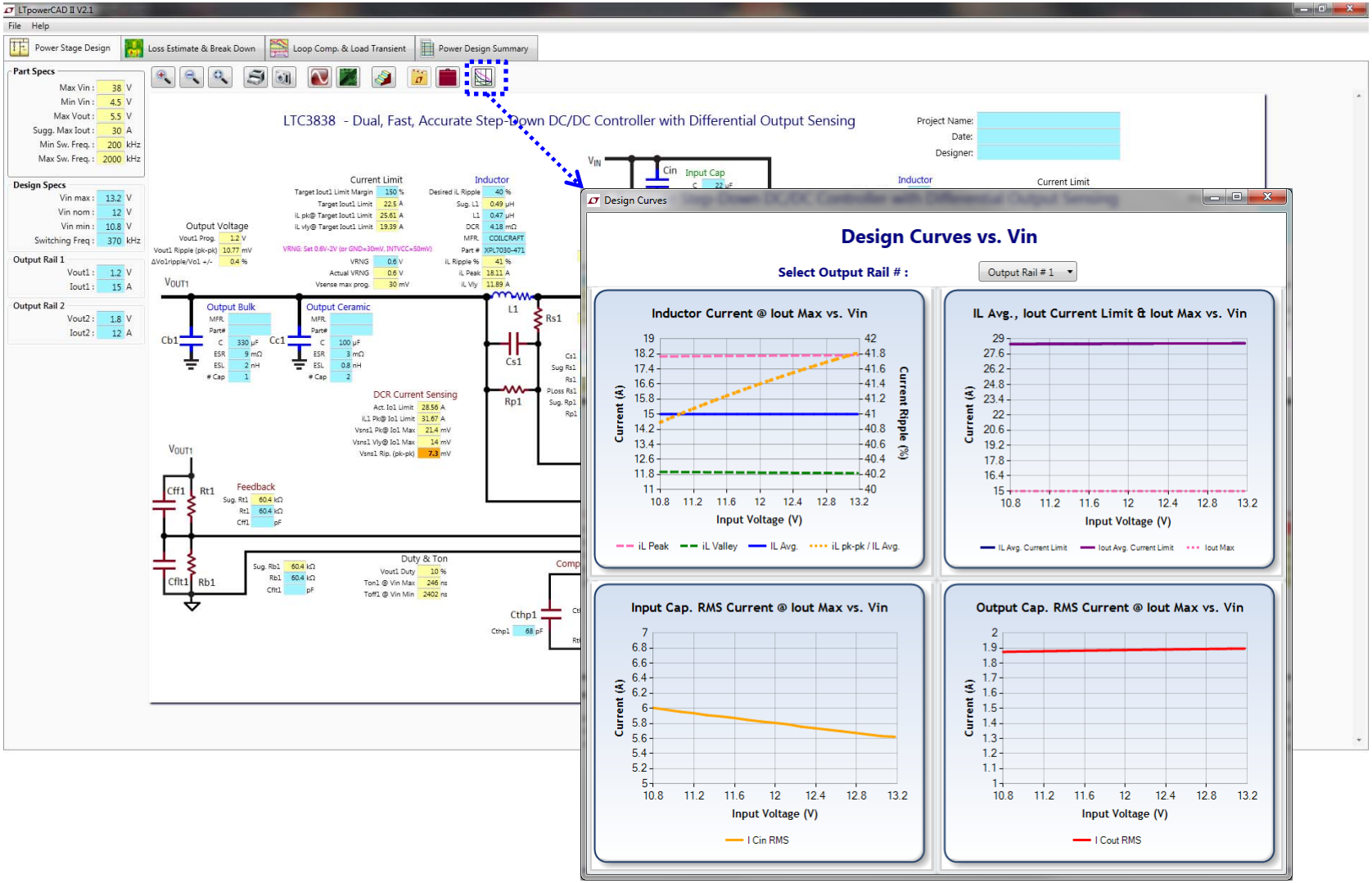
View Design Curves



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

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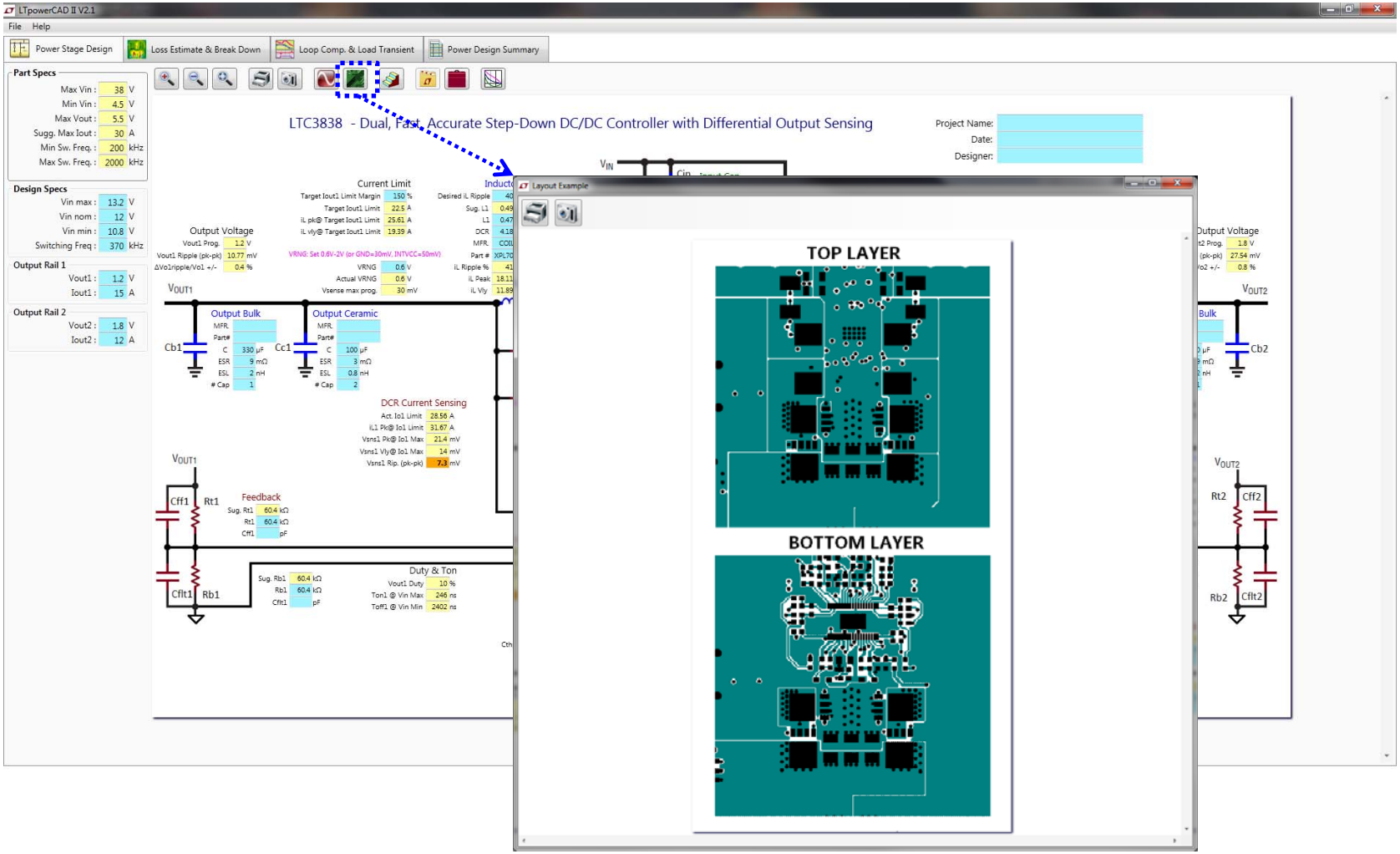
View Layout Example



PCB Top and Bottom Layer recommended layout example

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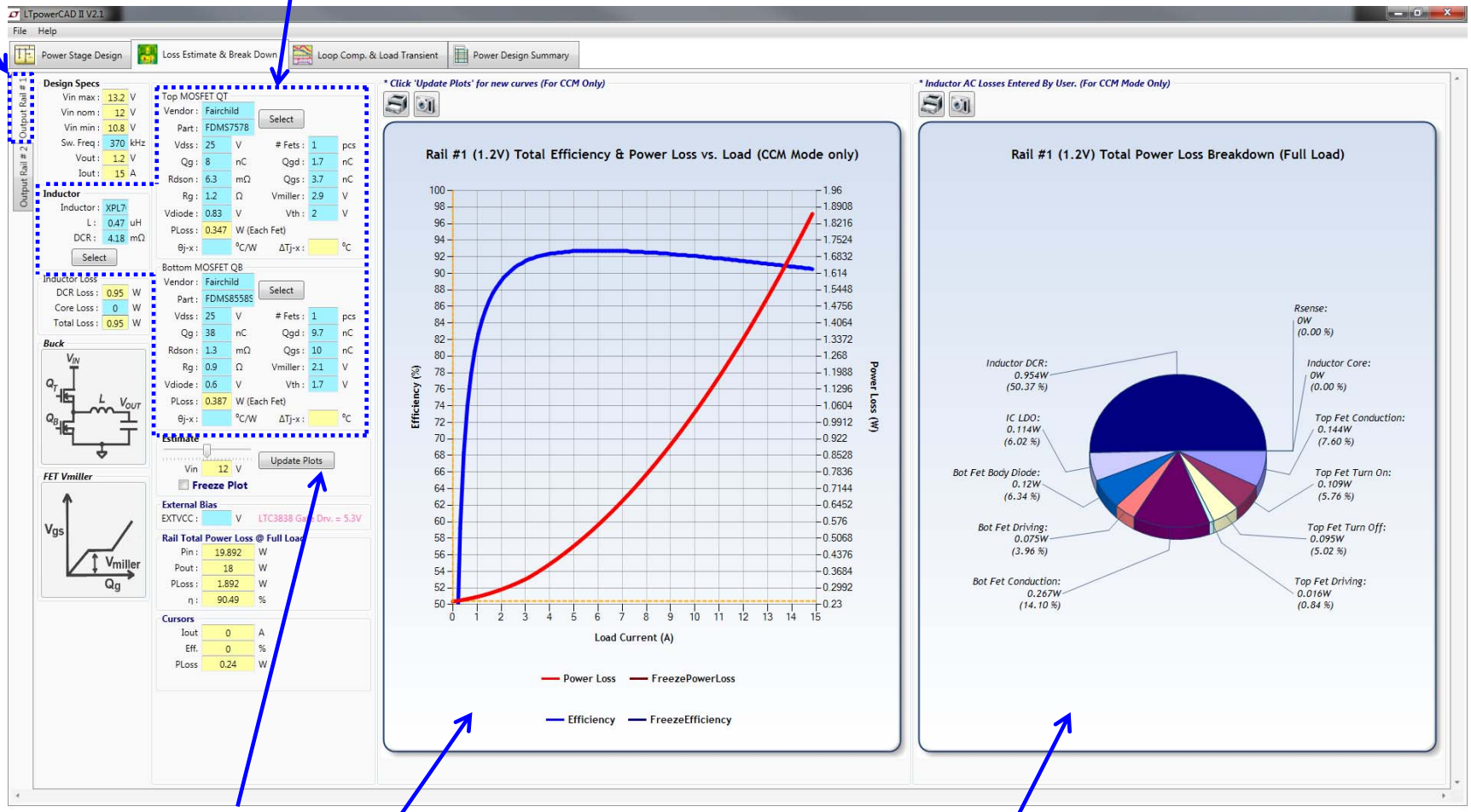
Design Step 2– Select L and FET, Optimize Eff % & Power Loss

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

Estimated Power Loss Breakdown

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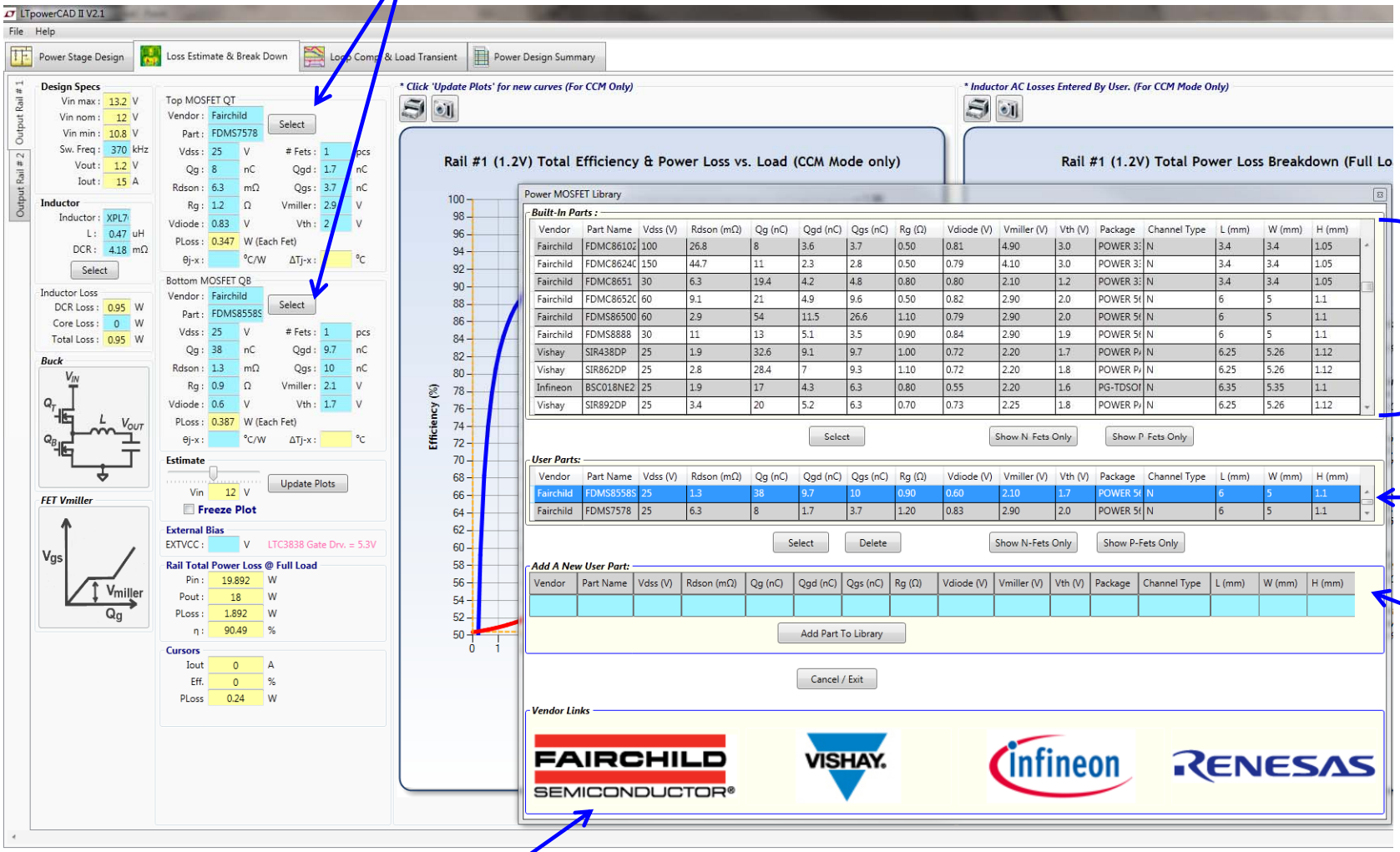
Power Component Library - MOSFETs

Click "Select" to open MOSFET library.



Built in library

User generated library

User can add a new part to the user library

Popular vendor web links

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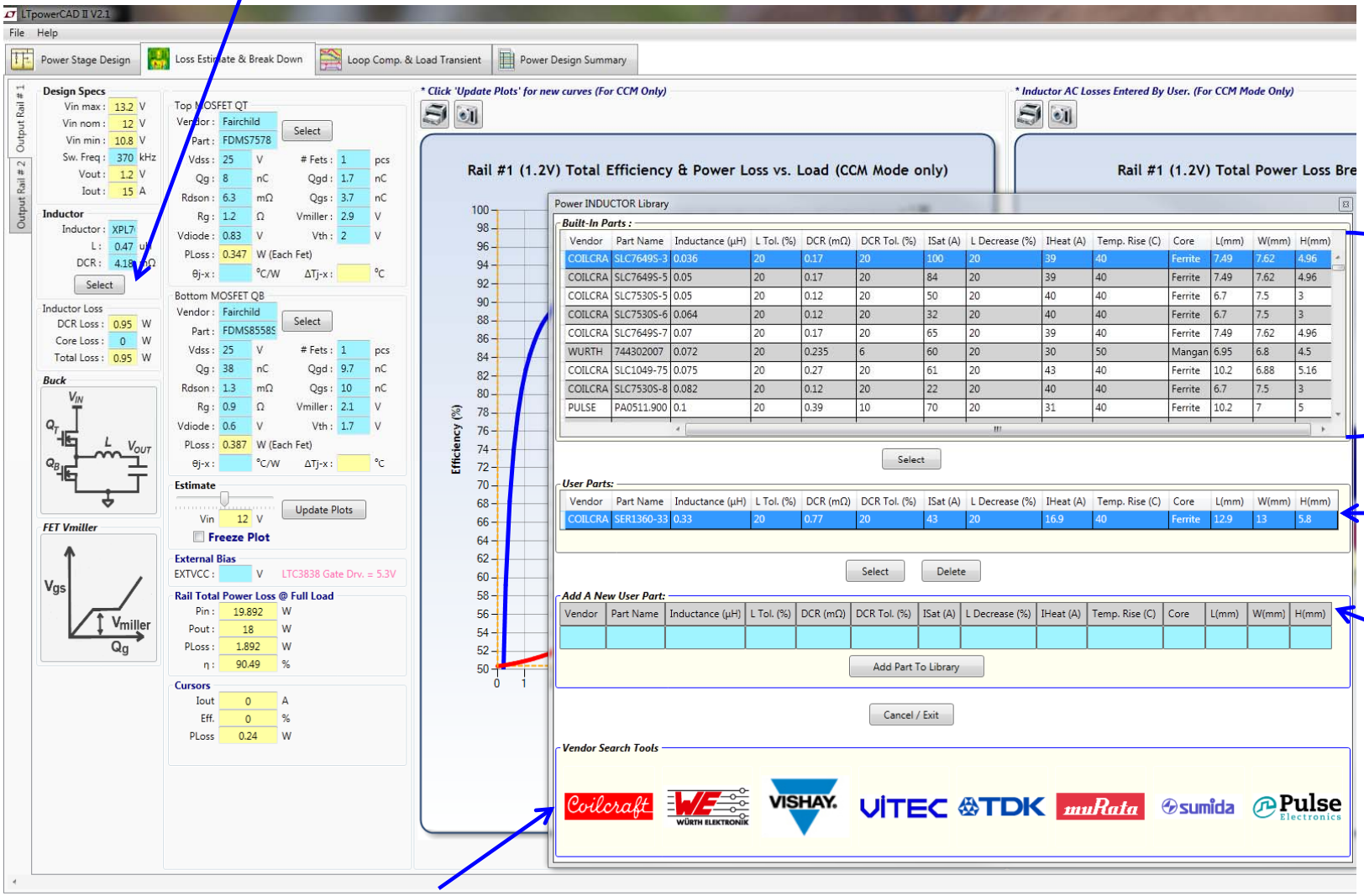
Power Component Library - Inductors

Click "Select" to open Inductor library.



Built in library

User generated library

User can add a new part to the user library

Popular vendor web links

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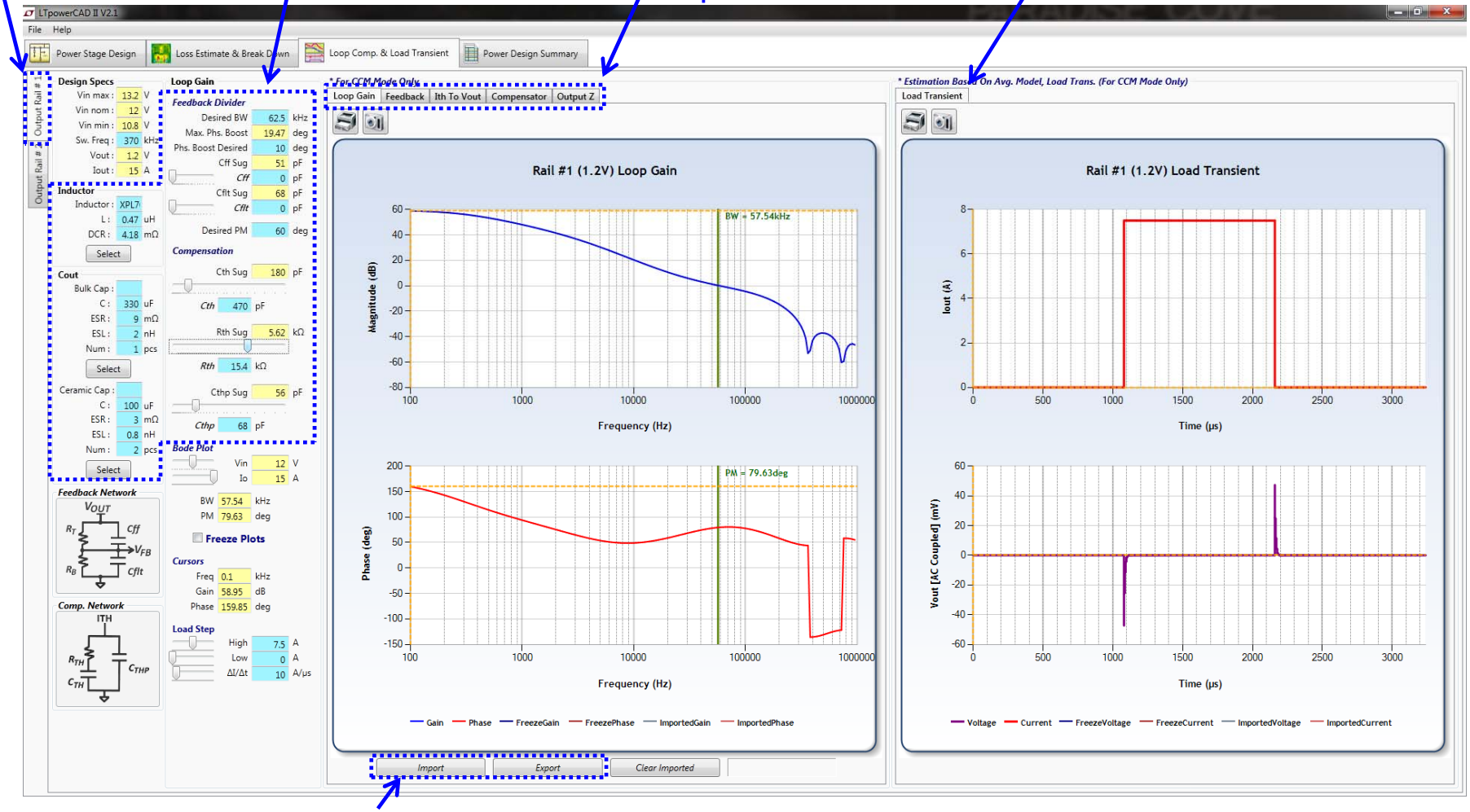
Design Step 3 – Optimize Loop Comp & Load Transient

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.



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

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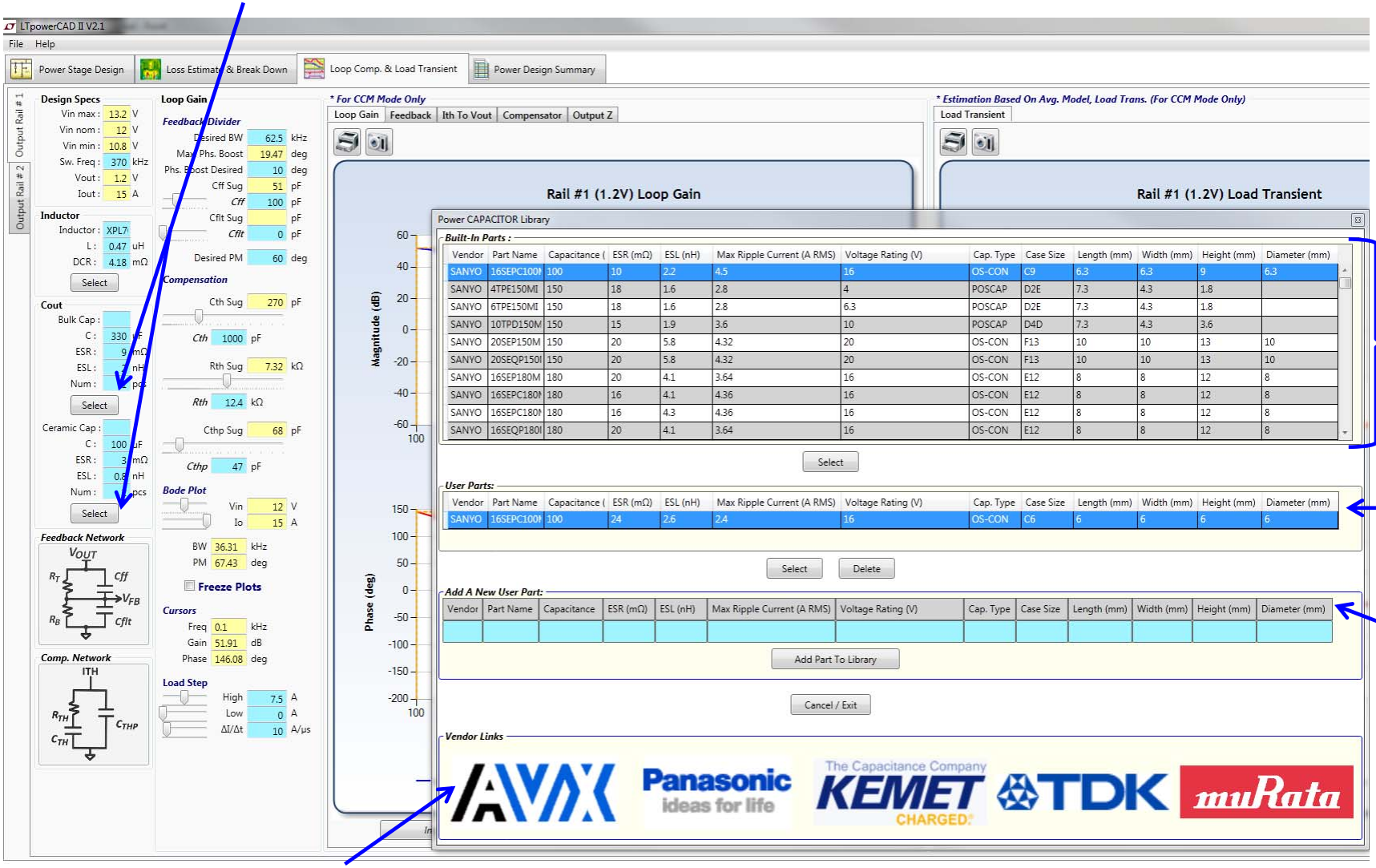
Power Component Library - Capacitors

Click "Select" to open Capacitor library.



Built in library

User generated library

User can add a new part to the user library

Popular vendor web links

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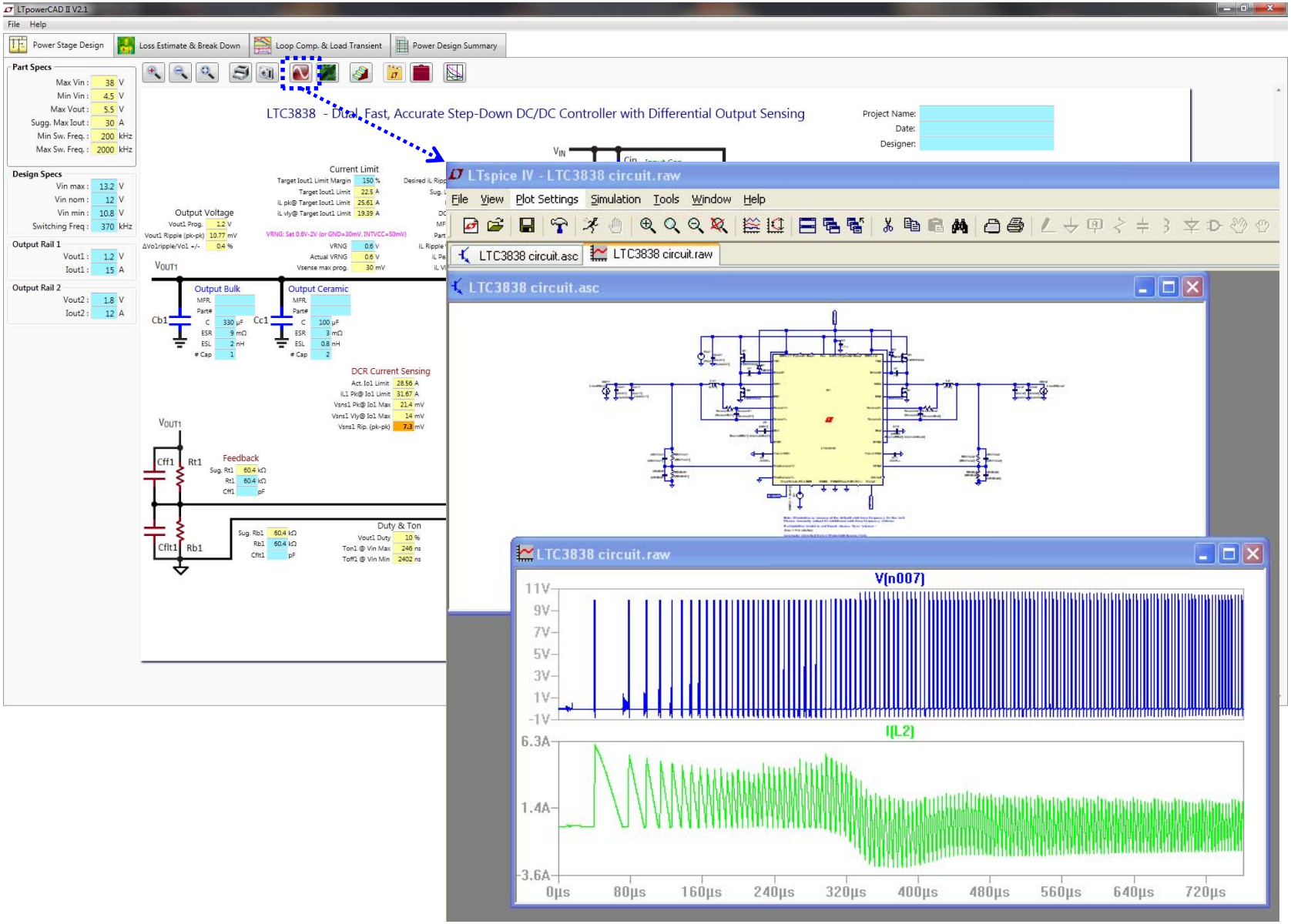
(Optional) Design Step 4 – Export to LTspice for Simulation



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Design Step 5 –Design Summary

LTpowerCAD II V2.1

File Help

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

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

Print Summary Report

LTC3838 Supply Design Summary

LTpowerCAD

Project Info:

Design Specifications

Steady State :

Rail #	Vin Min.	Vin Nom.	Vin Max.	Fsw	Vo	ΔVo rip. p-p	ΔVo rip.%	Io Max	ΔiLp-p	ΔiL%	iLpk	Duty	Ton min.	Toff min.
1	10.8	12	13.2	370	1.2 V	14.18 mV	0.6 %	15 A	6.21 A	41 %	18.11 A	10 %	246 ns	2402 ns
2	10.8	12	13.2	370	1.8 V	35.47 mV	1 %	12 A	8.8 A	73 %	16.4 A	15 %	369 ns	2252 ns

Efficiency / Loop :

Rail #	Vo	Io_max	Eff.@Io_max	PLoss@Io_max	Loop BW	Loop PM	Step Low	Step High	Step Slew	ΔVo@Step	ΔVo@Step %
1	1.2 V	15 A	90.49 %	1.892 W	34.67 kHz	32.52 deg	0 A	7.5 A	10 A/µs	52.7 mV	+/-4.4 %
2	1.8 V	12 A	93.93 %	1.395 W	12.02 kHz	64.28 deg	0 A	6 A	10 A/µs	109.9 mV	+/-6.1 %

Recommendations / Warnings :

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

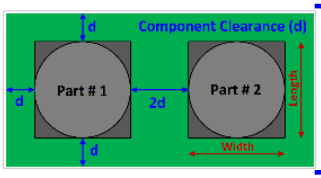
Power Components

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	LTC3838		7	5	0.8	
Lo1	0.47µH	1	IND	COILCRAFT	XPL7030-471		7	7	3	
Cin1 Cin2 Cin3 Cin4	22µF	4	CAP			1206	1.6	1.6	3.2	
Cob1	330µF	1	CAP	SANYO	2R5TPE330M9	D2E	7.3	4.3	1.8	
Coc1 Coc2	100µF	2	CAP	MURATA	GRM31CR60J107ME39	1206	3.2	1.6	1.6	
Qtop1	25V	1	FET	Fairchild	FDMS7578	POWER 56	6	5	1.1	
Qbot1	25V	1	FET	Fairchild	FDMS8558S	POWER 56	6	5	1.1	
Lo2	0.47µH	1	IND	COILCRAFT	XPL7030-471		7	7	3	
Cob2	330µF	1	CAP	SANYO	2R5TPE330M9	D2E	7.3	4.3	1.8	
Coc3	100µF	1	CAP	MURATA	GRM31CR60G107ME39	1206	3.2	1.6	1.6	
Qtop2	25V	1	FET	Fairchild	FDMS7578	POWER 56	6	5	1.1	
Qbot2	25V	1	FET	Fairchild	FDMS8558S	POWER 56	6	5	1.1	

Power Components Footprint :

# Components	16	
Max. Height	3.2	mm
Component Clearance (d)	1	mm
* Power Components Area (Excludes ICs)	553.6	mm^2
	0.858	in^2
* Power Components Area (Includes ICs)	616.6	mm^2
	0.956	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.

Summary of each rail's performance parameters

Warning messages note any undesired parameters

Power stage Component Summary

Power stage Components Footprint Area Estimation

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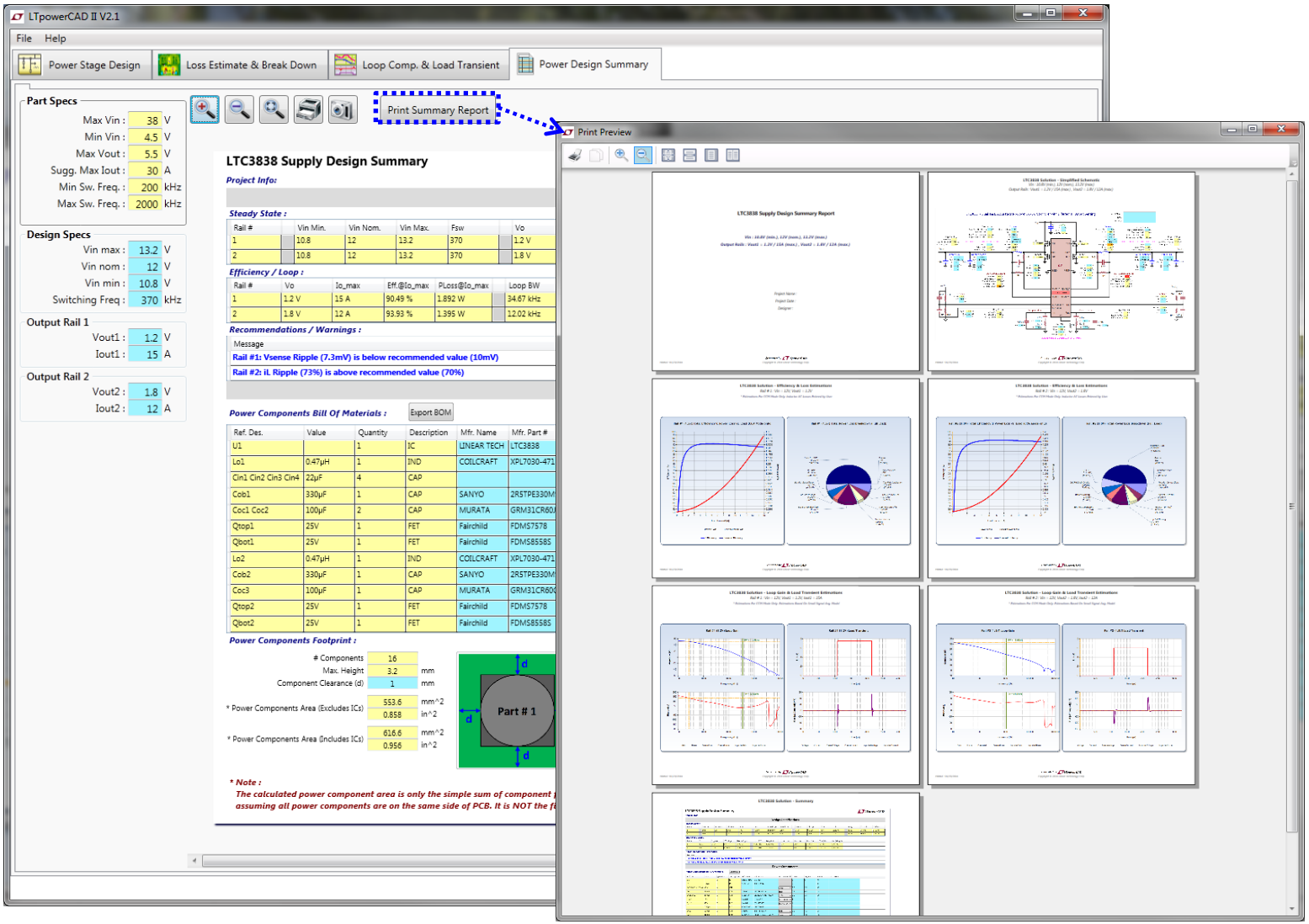
Print Summary Report



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

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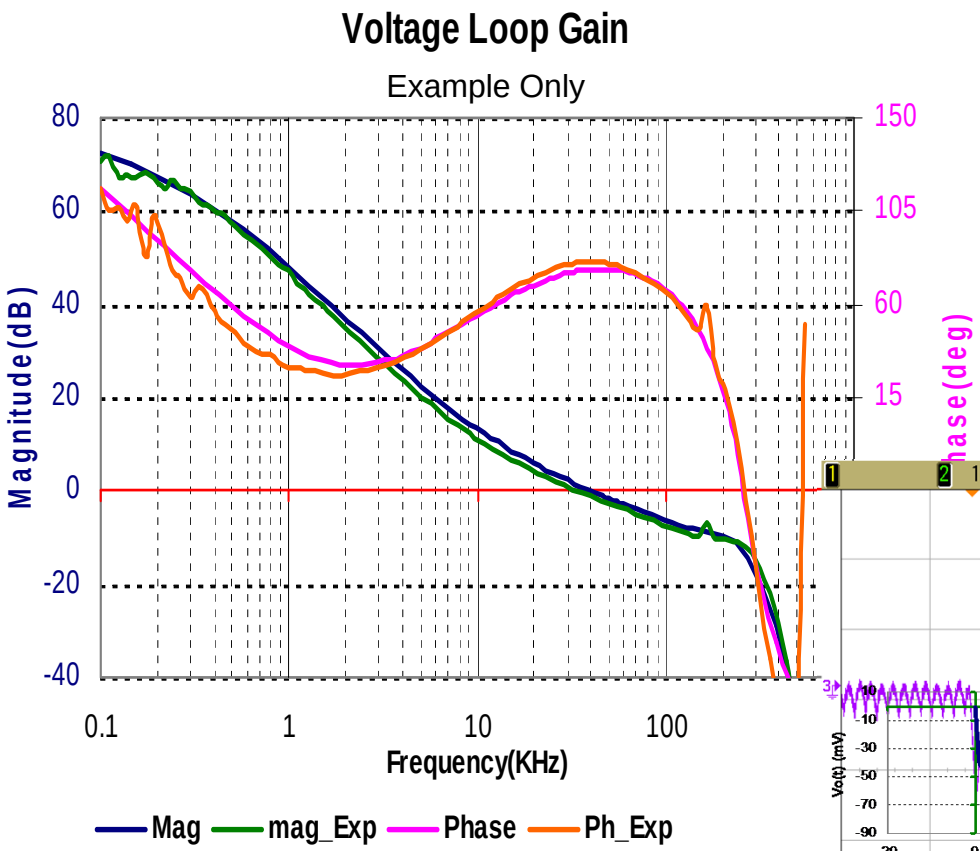
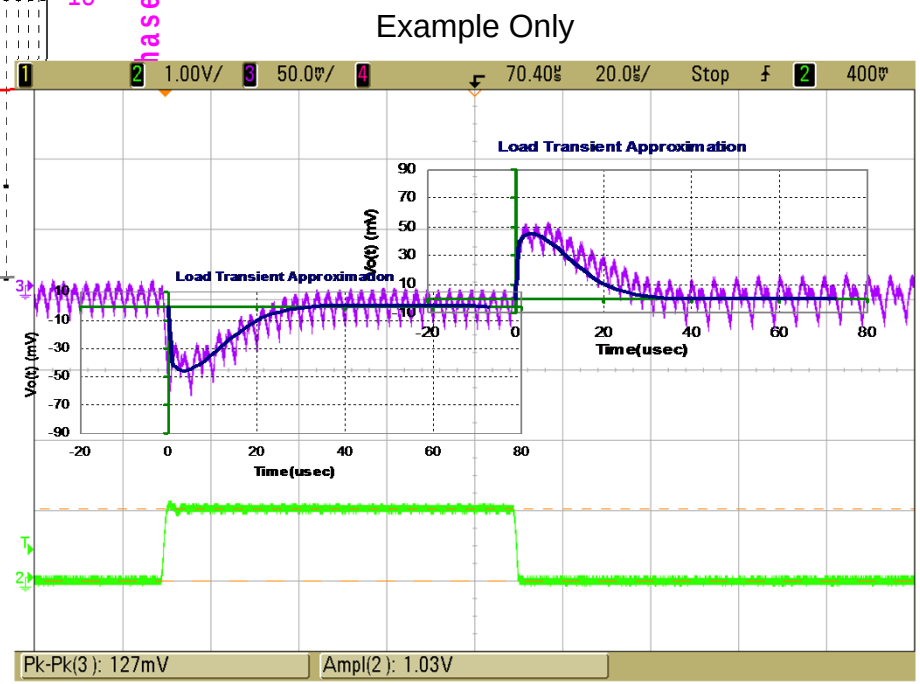
Bench Verified Loop and Load Transient Model

The small signal model of every part in LTpowerCAD has been verified against LTC standard demo board bench results.

**** Still, it remains the user's responsibility to verify their estimated performance against their own bench prototype's performance.***





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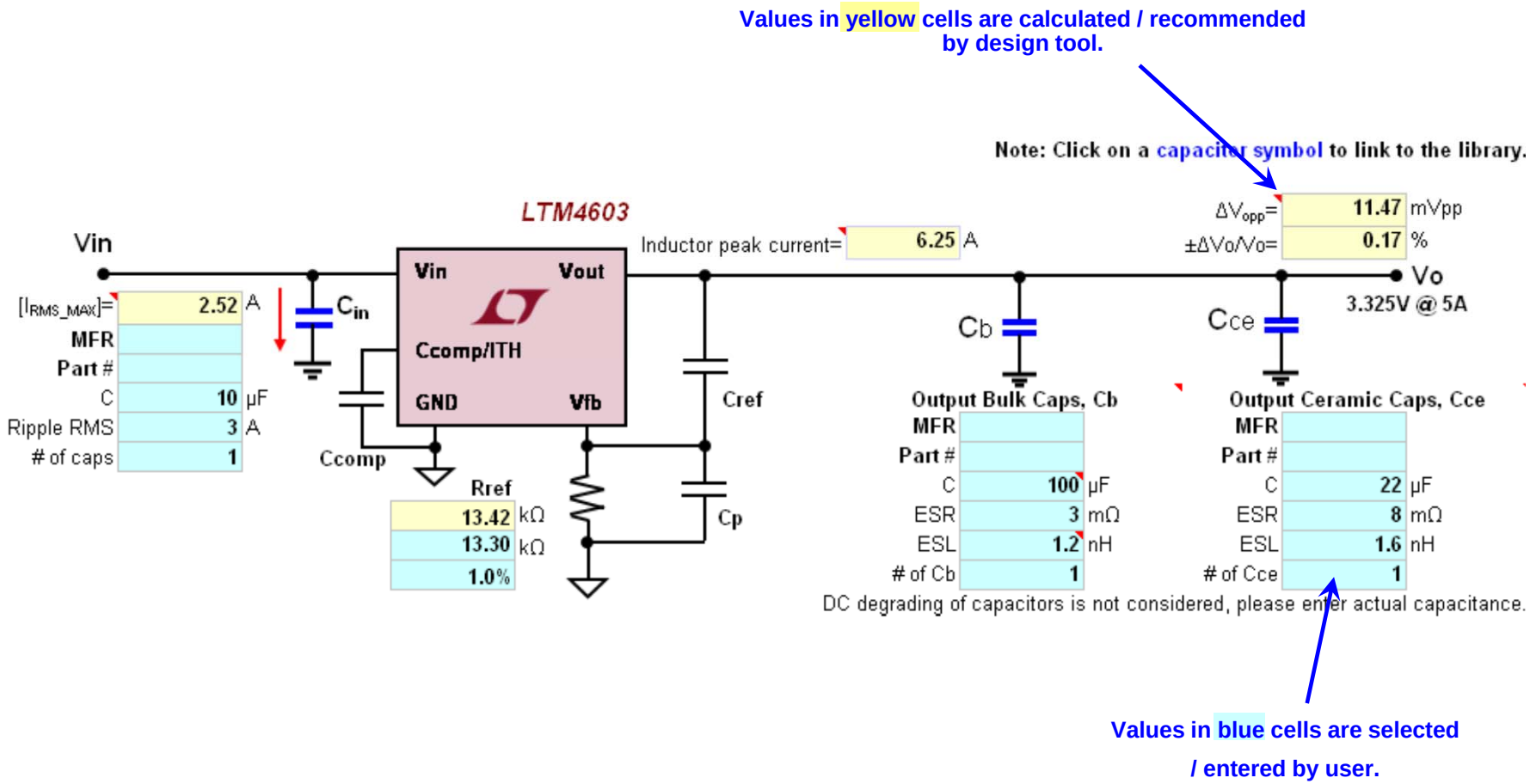
Example of an Excel-Based design Tool

Step 1: Power Components Selection

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



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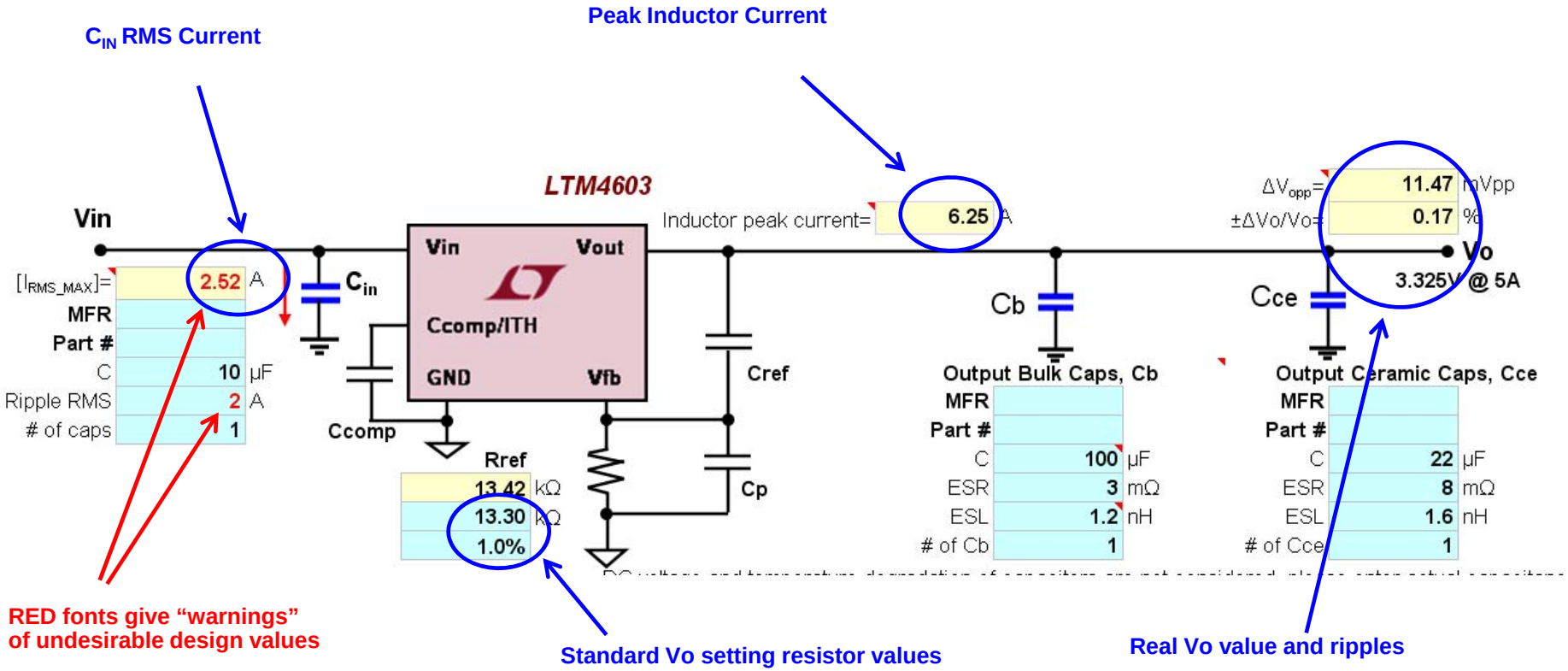
Power Stage Performances



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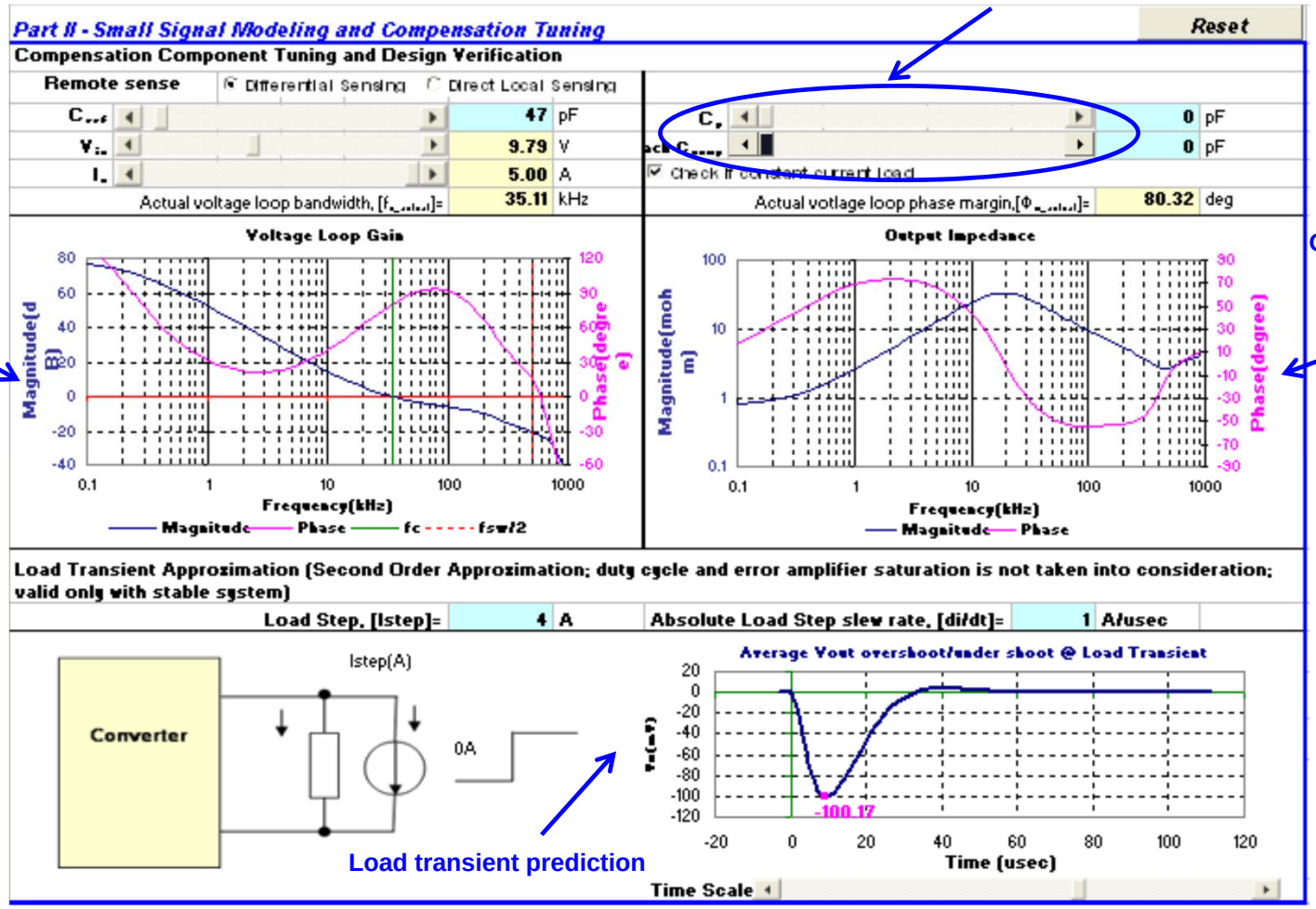
In the design spreadsheet, control loop design can be fine tuned:

Sliding bar for compensation adjustment.

Loop gain prediction

Output Impedance



Load transient prediction

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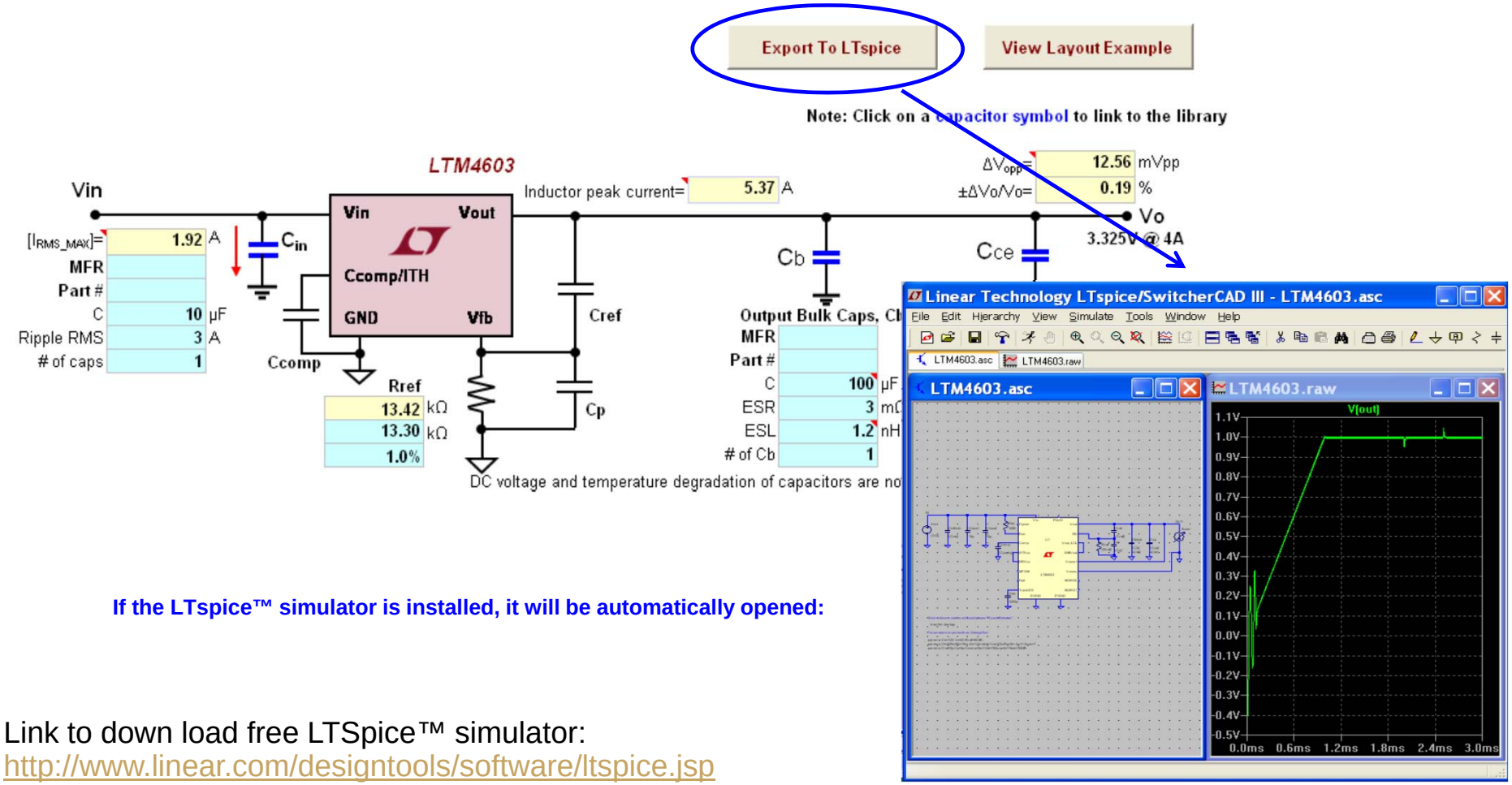
Additional Feature (1): Export to & Run LTspice™ Simulation

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



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

Link to down load free LTSpice™ simulator:
http://www.linear.com/designtools/software/ltspice.jsp

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Additional Feature (2): Summary of design: BOM, size, cost and stress

In the design spreadsheet, click the “Summary” sheet:

Summary of Design

Bill of Material of Power Components

Unit ◉ inch ○ mm

Componnent	Part #	# of parts	Value		Package	L	W	H	Unit Price	Total Price
Cin (bulk)	0	1	100	µF	1210	0.098	0.126	N/A		$0.00
Cin (ceramic)				uF	1206	0.063	0.126	N/A		$0.00
Cout (bulk)	2R5TPE220MC	0	220	µF	0805	0.049	0.079	N/A		$0.00
Cout (ceramic)	0.00	1	72	µF	1210	0.098	0.126	N/A		$0.00
MicroModule	LTM4603	1			LGA (15 X 15 X2.8)	0.591	0.591	0.110		$0.00

Power Component Summary:

Foot print clearance factor= 1.5

Total footprint are W/O output Bulk Capacitors	0.560	inch^2
Total footprint	0.560	inch^2
Total BOM cost W/O input and output Bulk Capacitors	$0.00	
Total BOM cost	$0.00	

Power components summary

Design Analysis

Parameters	Condition	Minimum	Typical	Maximum	Units
Input Votlage		7.000	12.000	14.000	V
Output Votlage		0.984	0.999	1.014	V
Inductor peak-to-peak Ripple			0.909	0.921	A
Frequency			1004.016		KHz
Crossover freq.	Vin=8.09V		119.891		kHz
Phase Margin	Vin=8.09V		39.159		Deg.

Stress analyses

It remains the customer's responsibility to verify proper and reliable operation in the actual application.

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

Please forward your comments to the addresses below.

LTpowerCAD@Linear.com

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LTpowerCAD II v2.3™

Installation

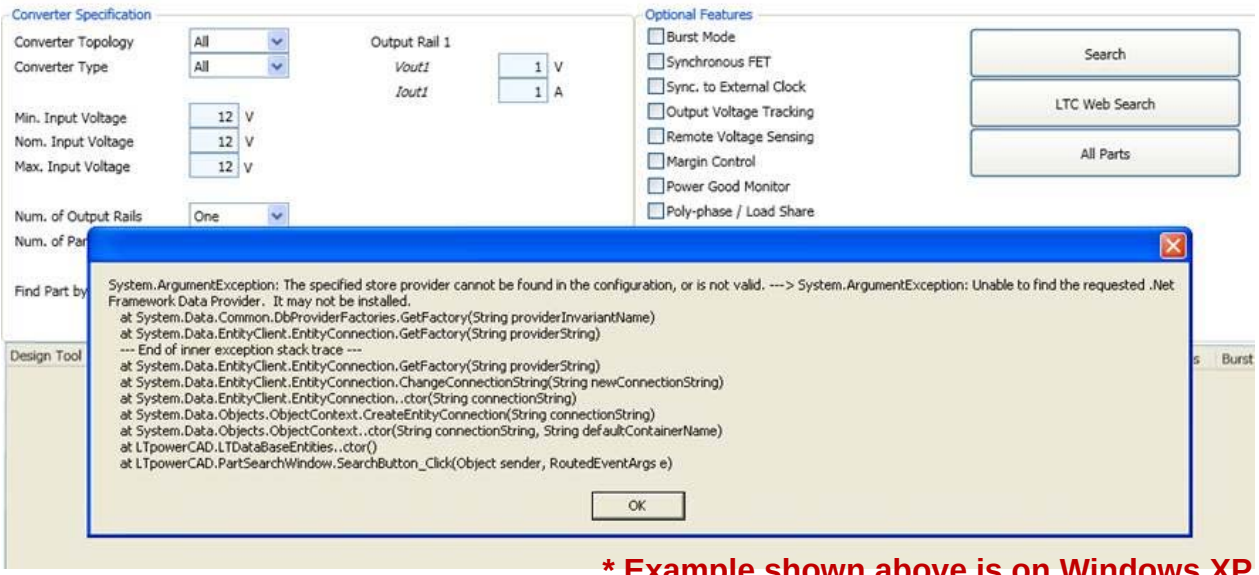
Troubleshooting

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)

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Appendix : Installation Troubleshooting

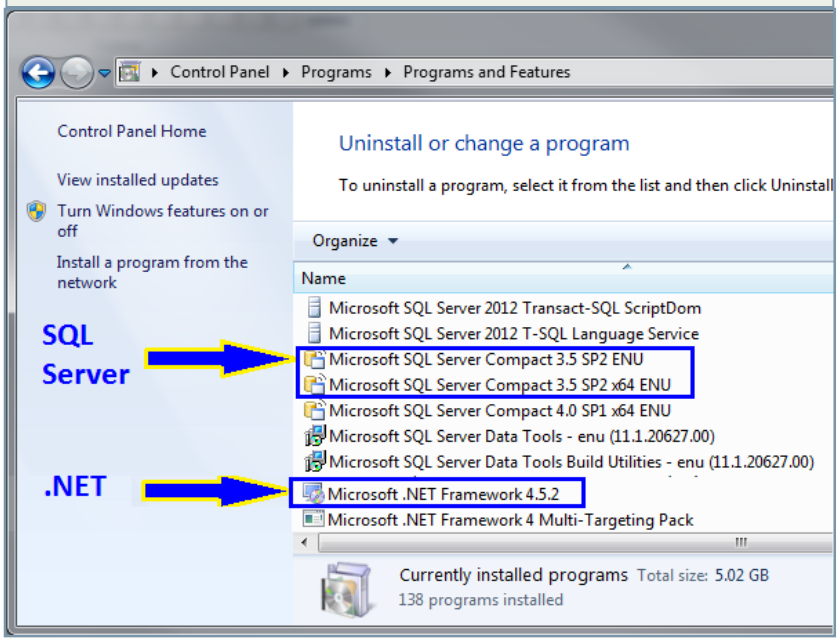
Possible issue solution:

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 :

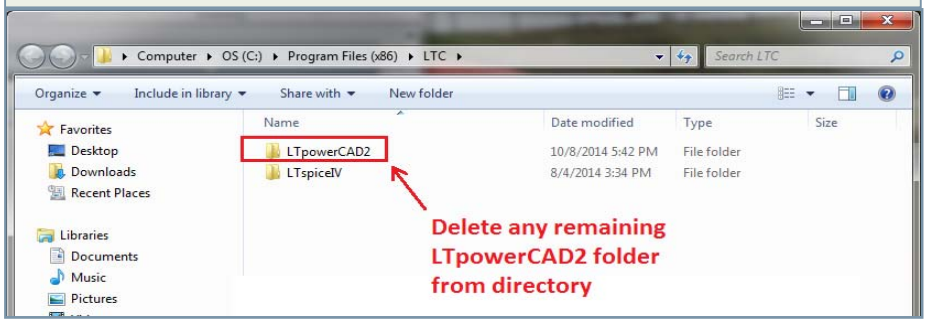
Go to your Currently Installed Programs
(Start Menu → Control Panel → Uninstall a program).

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:

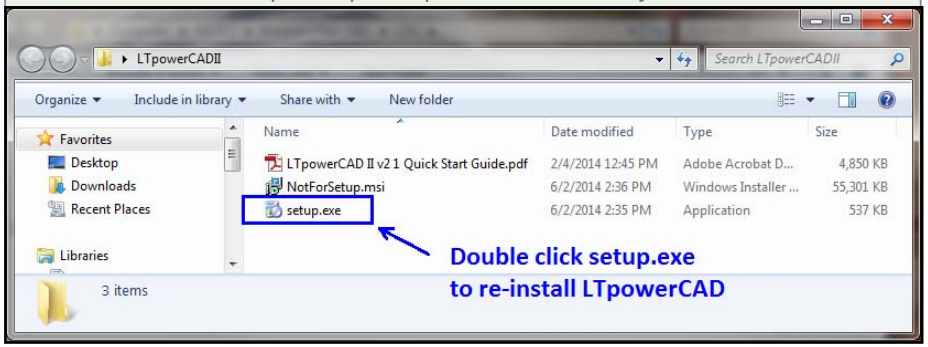
If any of these requirements are ***missing or are present but suspect they may not have been installed properly***, go to your Currently Installed Programs and uninstall LTpowerCAD. Delete any remaining LTpowerCAD2 folder from the LTpowerCAD installation directory.



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)

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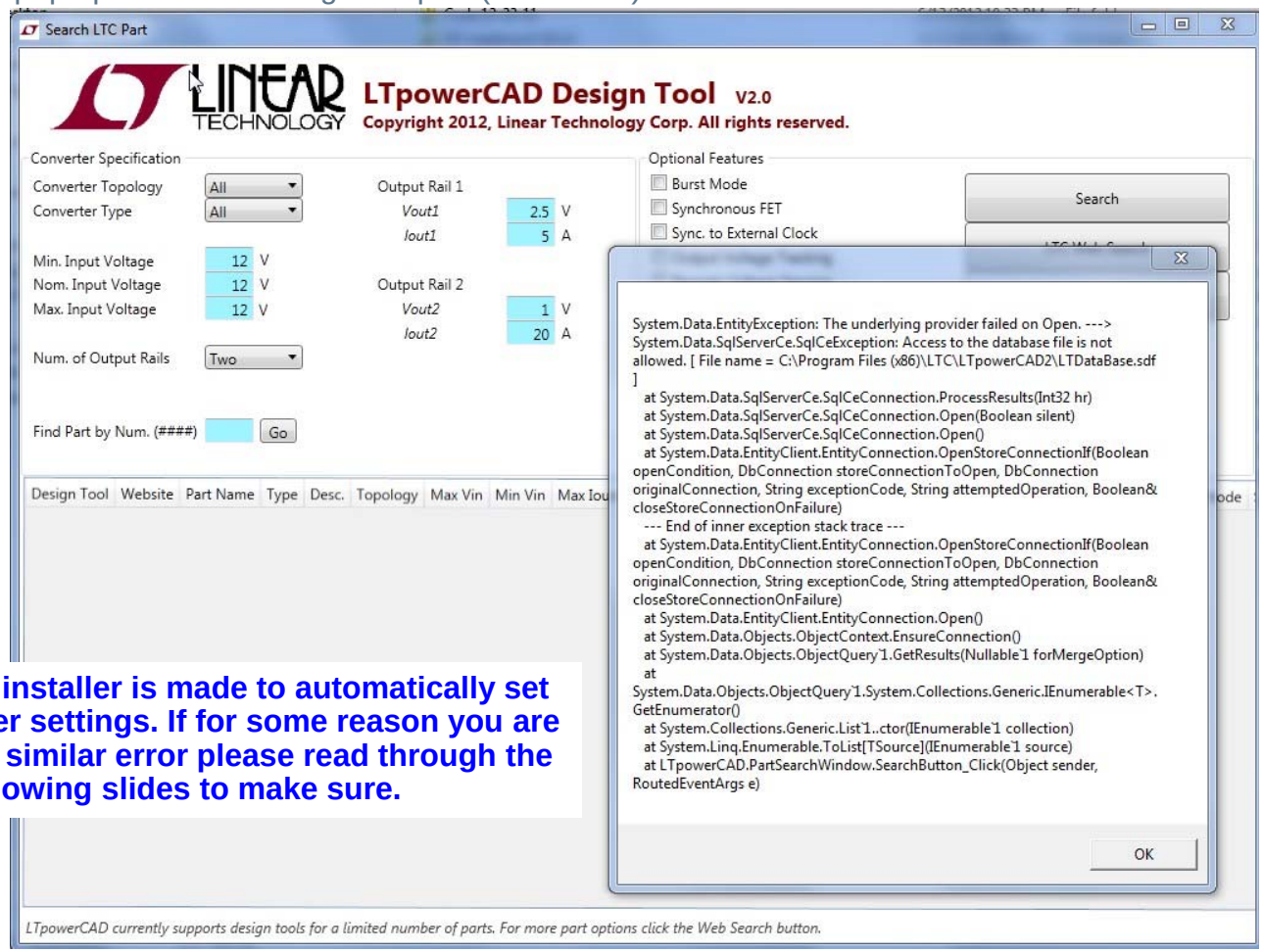
II. Microsoft Security Settings :

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.**

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Appendix : Installation Troubleshooting

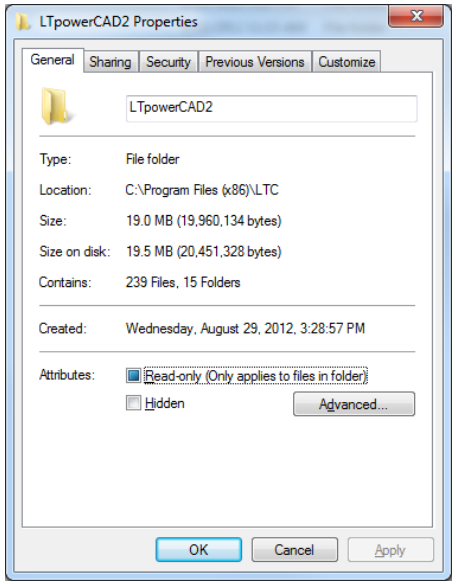
Possible issue solution:

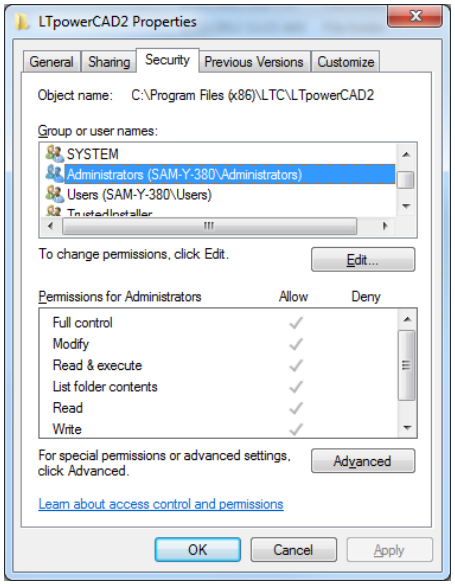
Run the program with an Administrator account , or try to modify your system's Users account security settings for now (see below).

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.





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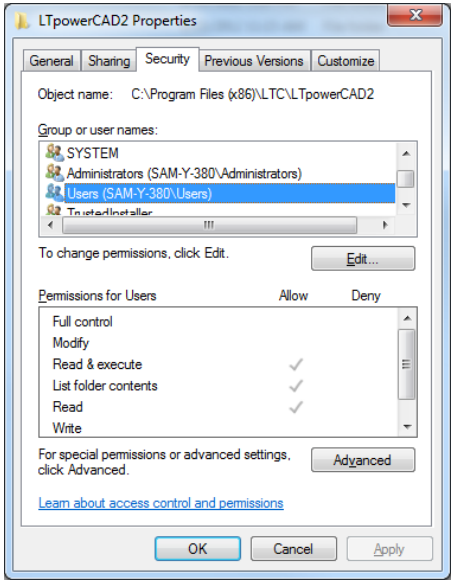
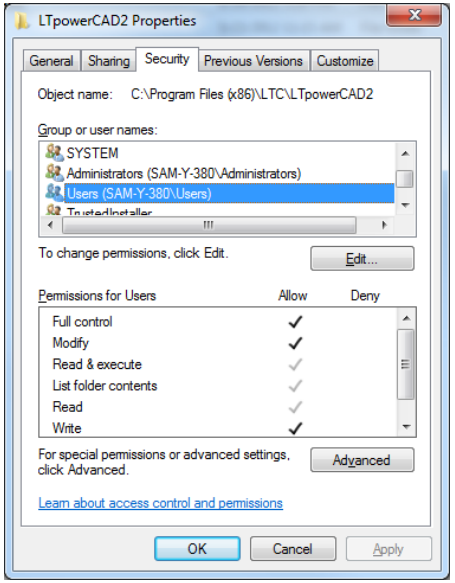
Possible issue solution (cont'd):

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.



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