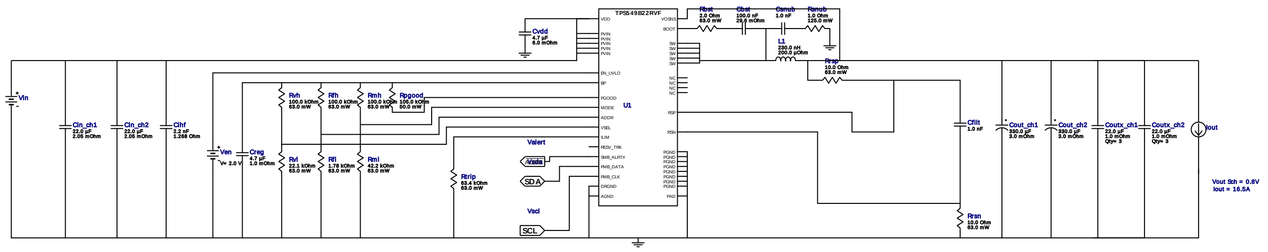
TEXAS INSTRUMENTS	VinMin = 4.5V VinMax = 5.5V Vout = 0.8V Vout Sch = 0.8V Iout = 16.5A	Device = TPS549B22RVFR Topology = Buck Created = 2021-01-06 04:39:00.109 BOM Cost = $6.07 BOM Count = 30 Total Pd = 1.54W

WEBENCH ® Design Report

Design : 9 TPS549B22RVFR

TPS549B22RVFR 4.5V-5.5V to .80V @ 16.5A



Design Alerts

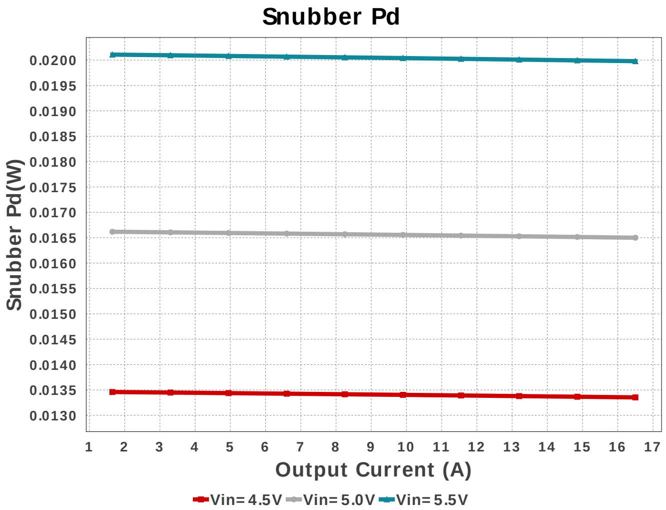
TPS549B22 Design

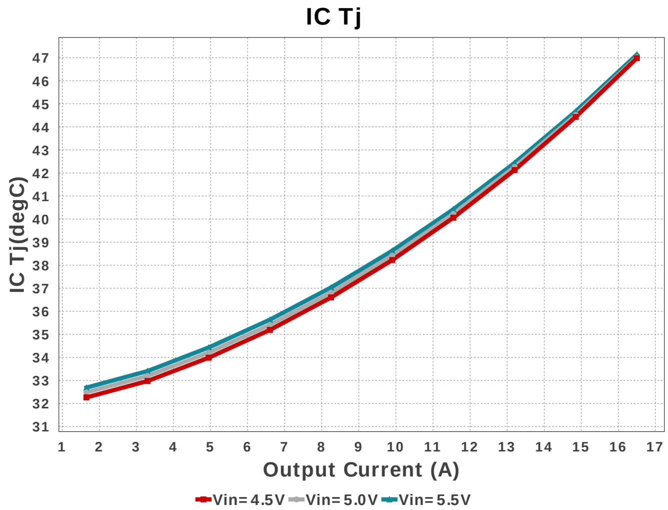
TPS549B22 is a PMBus(TM) device with key features listed below. PMBus(TM) features marked with * are included in WEBENCH(R) Power Designer. - On-the-fly output programming (VOUT_COMMAND) * - Output voltage margining (VOUT_MARGIN) - Programmable switching frequency * - Programmable soft-start rate * - Selectable conduction mode * - Fault reporting (OV, OC, Temperature)Use the Advanced Options on the left side to set the PMBus(TM) commands.Please refer to the TPS549B22 datasheet and visit http://www.ti.com/pmbus for more information.

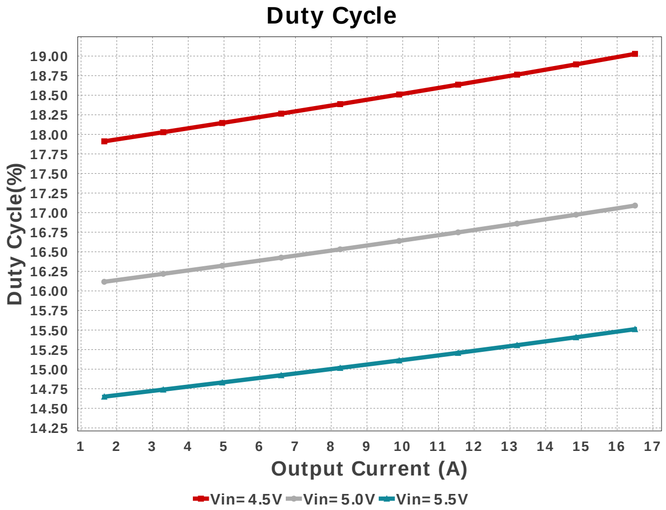
Electrical BOM

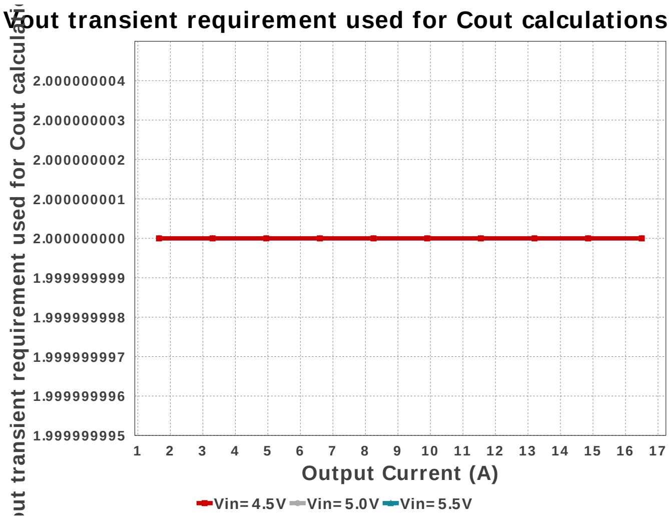
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cbst	TDK	CGA3E2X7R1H104K080AA Series= X7R	Cap= 100.0 nF ESR= 29.6 mOhm VDC= 50.0 V IRMS= 971.99 mA	1	$0.01	0603 5 mm^2
Cfilt	MuRata	GRM1555C1H102JA01J Series= C0G/NP0	Cap= 1.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
Cihf	TDK	CGA1A2X7R1E222K030BA Series= X7R	Cap= 2.2 nF ESR= 1.26834 Ohm VDC= 25.0 V IRMS= 201.468 mA	1	$0.01	0201_033 2 mm^2
Cin_ch1	TDK	C2012X5R1V226M125AC Series= X5R	Cap= 22.0 uF ESR= 2.05 mOhm VDC= 35.0 V IRMS= 4.5559 A	1	$0.33	0805 7 mm^2
Cin_ch2	TDK	C2012X5R1V226M125AC Series= X5R	Cap= 22.0 uF ESR= 2.05 mOhm VDC= 35.0 V IRMS= 4.5559 A	1	$0.33	0805 7 mm^2
Cout_ch1	Panasonic	EEFGX0D331R Series= GX	Cap= 330.0 uF ESR= 3.0 mOhm VDC= 2.0 V IRMS= 10.2 A	1	$0.55	7343-20 59 mm^2
Cout_ch2	Panasonic	EEFGX0D331R Series= GX	Cap= 330.0 uF ESR= 3.0 mOhm VDC= 2.0 V IRMS= 10.2 A	1	$0.55	7343-20 59 mm^2
Coutx_ch1	MuRata	GRM188R60J226MEA0D Series= X5R	Cap= 22.0 uF ESR= 1.0 mOhm VDC= 6.3 V IRMS= 6.0 A	3	$0.05	0603 5 mm^2
Coutx_ch2	MuRata	GRM188R60J226MEA0D Series= X5R	Cap= 22.0 uF ESR= 1.0 mOhm VDC= 6.3 V IRMS= 6.0 A	3	$0.05	0603 5 mm^2

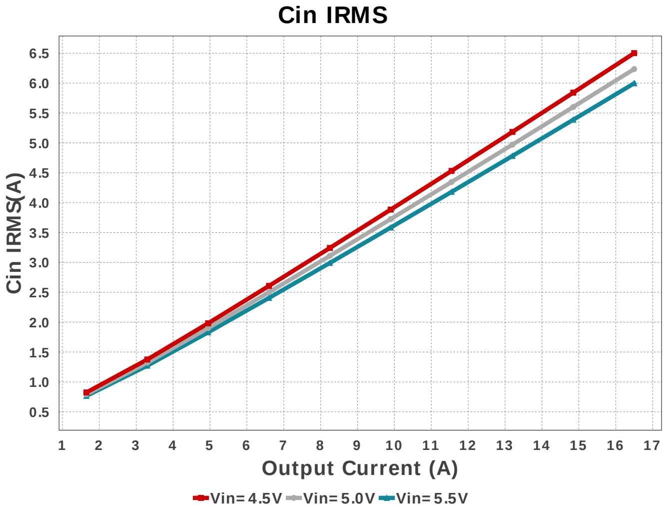
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Creg	Taiyo Yuden	TMK212BJ475KG-T Series= X5R	Cap= 4.7 uF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.06	0805 7 mm^2
Csnub	Yageo	CC0603JRNPO8BN102 Series= C0G/NP0	Cap= 1.0 nF VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm^2
Cvdd	Kemet	C0603C475K8PACTU Series= X5R	Cap= 4.7 uF ESR= 6.0 mOhm VDC= 10.0 V IRMS= 7.24 A	1	$0.07	0603 5 mm^2
L1	Coilcraft	SLC1175-231MEB	L= 230.0 nH 200.0 µOhm	1	$0.48	SLC1175 125 mm^2
Rbst	Vishay-Dale	CRCW04022R00FKED Series= CRCW..e3	Res= 2.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rfh	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rfl	Vishay-Dale	CRCW04021K78FKED Series= CRCW..e3	Res= 1.78 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rmh	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rml	Vishay-Dale	CRCW040242K2FKED Series= CRCW..e3	Res= 42.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rpgood	Yageo	RC0201FR-07105KL Series= ?	Res= 105.0 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm^2
Rrsn	Vishay-Dale	CRCW040210R0FKED Series= CRCW..e3	Res= 10.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rrsp	Vishay-Dale	CRCW040210R0FKED Series= CRCW..e3	Res= 10.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rsnub	Vishay-Dale	CRCW08051R00FKEA Series= CRCW..e3	Res= 1.0 Ohm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm^2
Rtrip	Vishay-Dale	CRCW040263K4FKED Series= CRCW..e3	Res= 63.4 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rvh	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rvl	Vishay-Dale	CRCW040222K1FKED Series= CRCW..e3	Res= 22.1 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
U1	Texas Instruments	TPS549B22RVFR	Switcher	1	$3.24	RVF0040A 63 mm^2

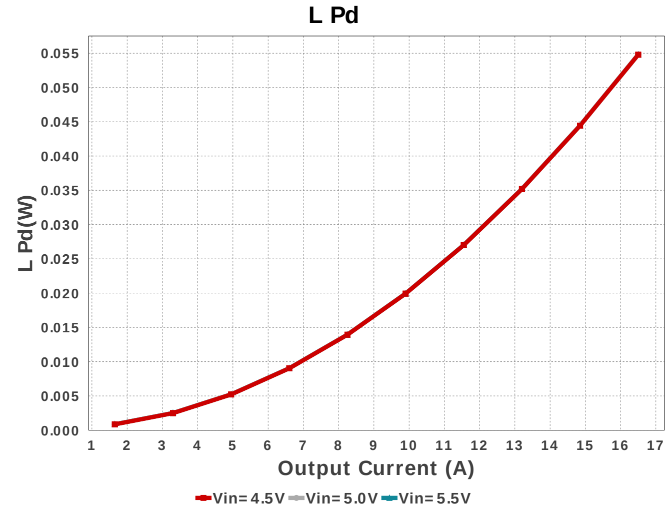

Snubber Pd
Snubber Pd(W)
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V

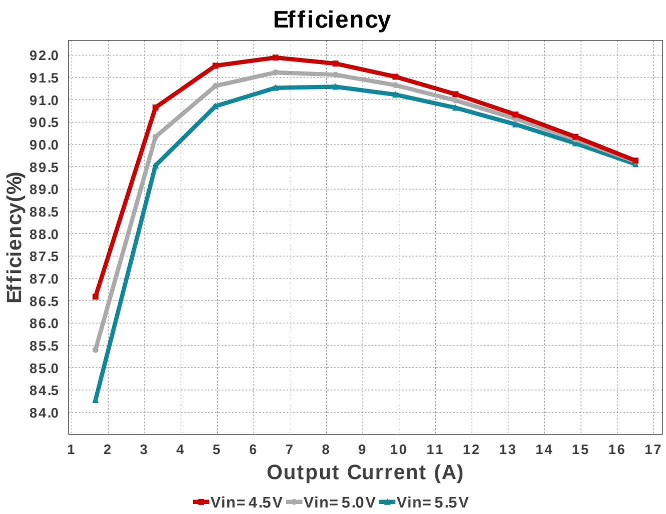

IC Tj
IC Tj(degC)
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V

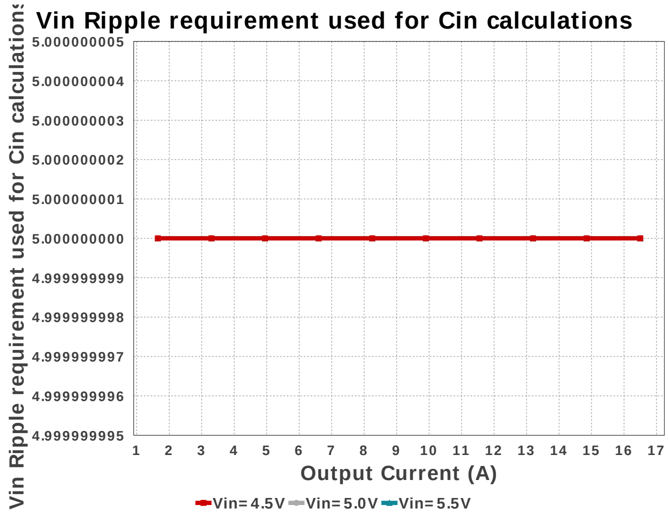

Duty Cycle
Duty Cycle(%)
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V

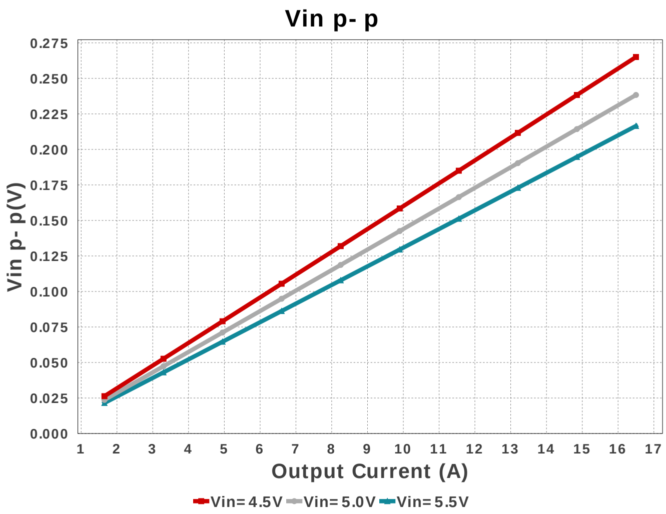

Vout transient requirement used for Cout calculations
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V

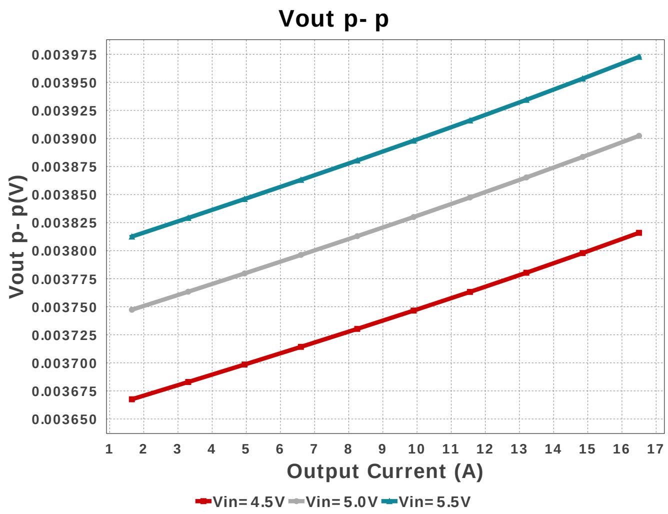

Cin IRMS
Cin IRMS(A)
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V

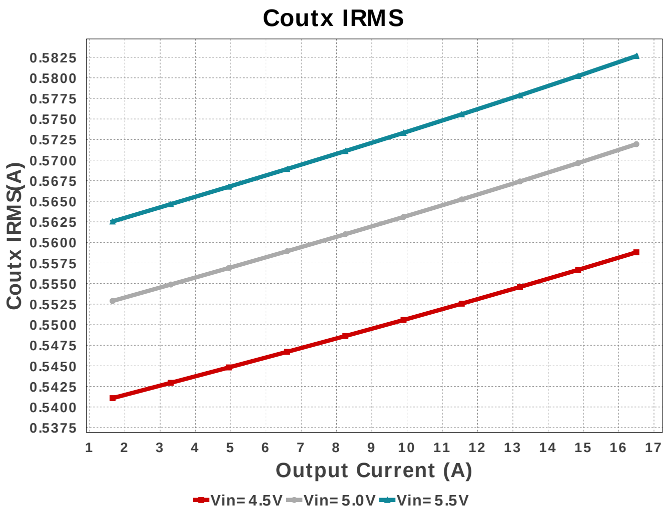

L Pd
L Pd(W)
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V

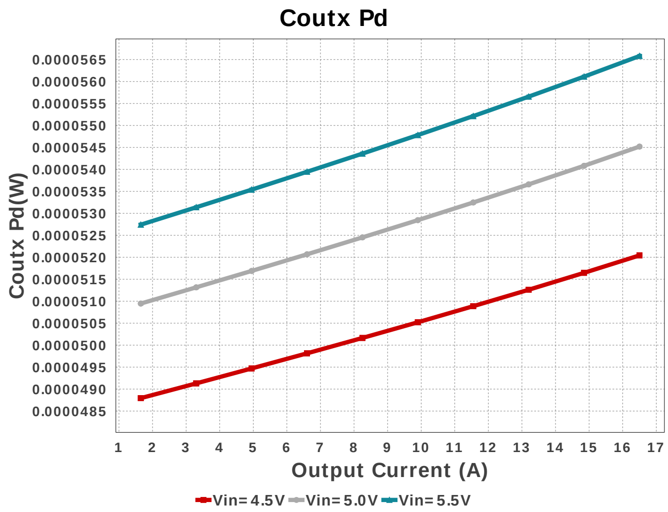

Efficiency
Efficiency(%)
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V

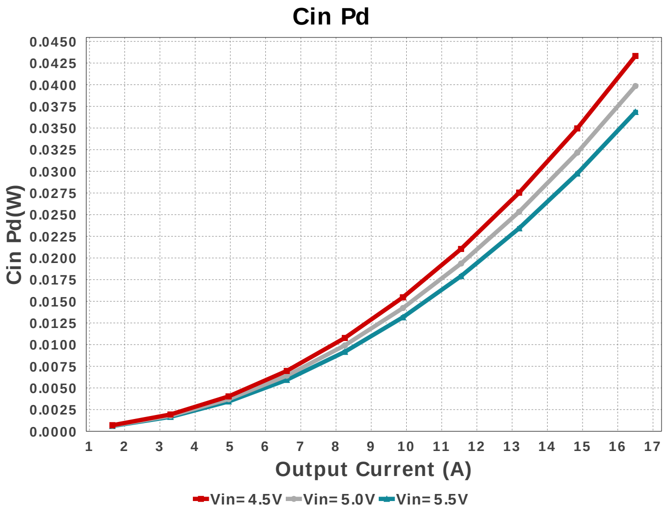

Vin Ripple requirement used for Cin calculations
Vin Ripple requirement used for Cin calculations
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V

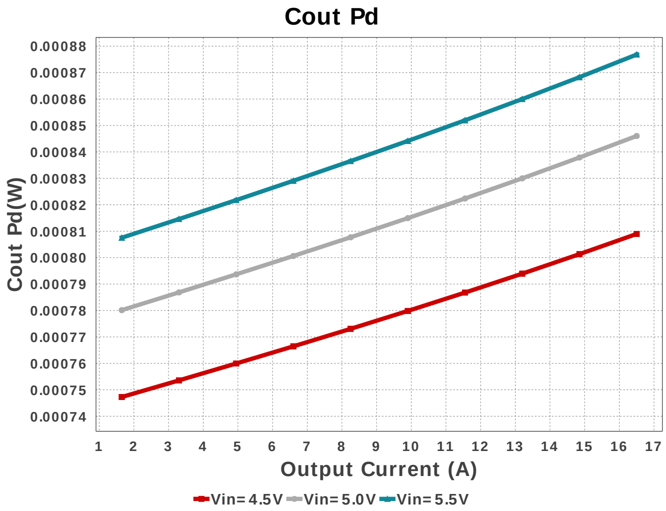

Vin p- p
Vin p- p(V)
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V

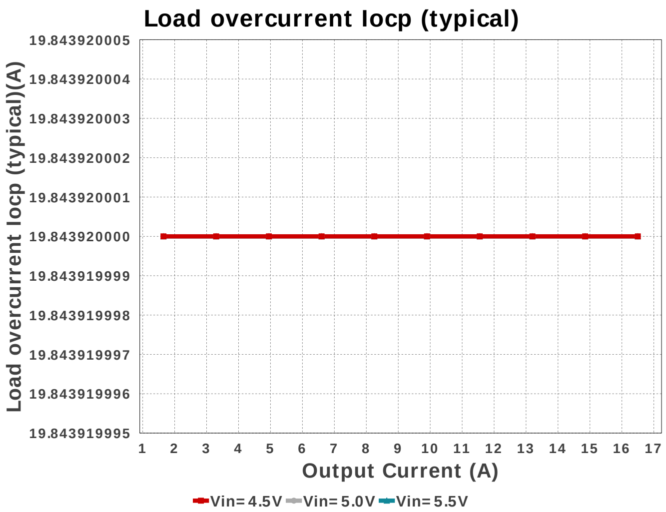

Vout p- p
Vout p- p(V)
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V

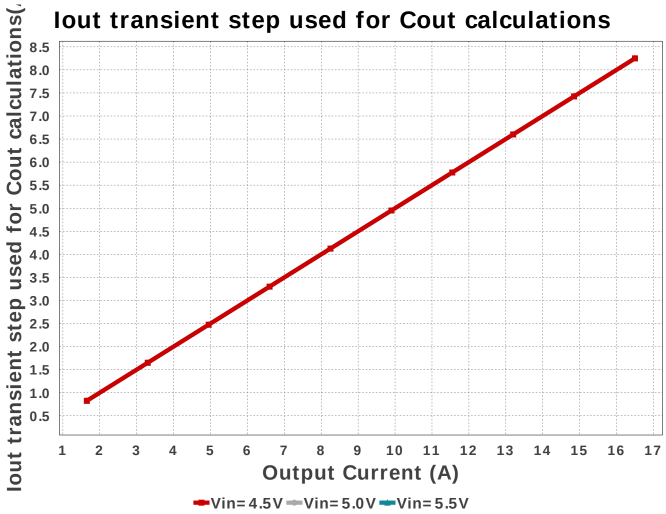

Coutx IRMS
Coutx IRMS(A)
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V

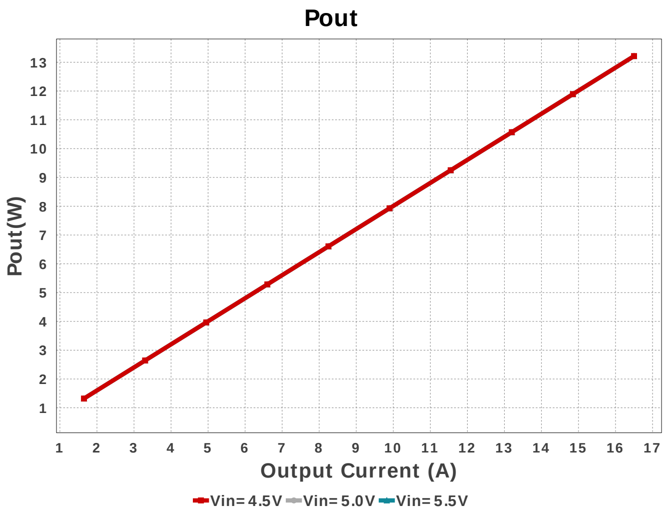

Coutx Pd
Coutx Pd(W)
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V

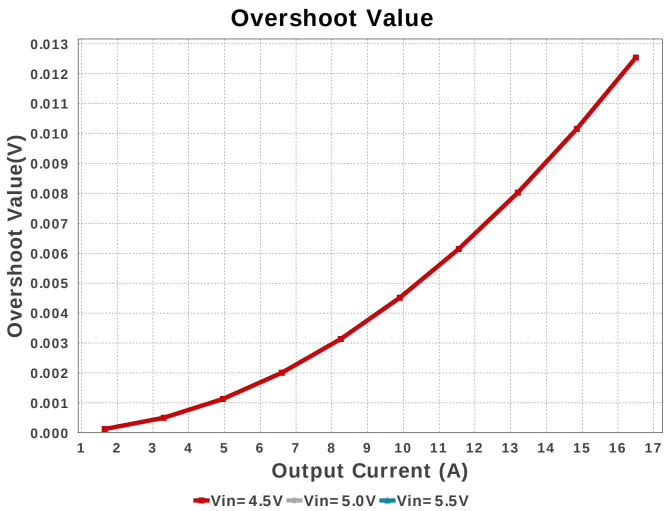

Cin Pd
Cin Pd(W)
0.0450
0.0425
0.0400
0.0375
0.0350
0.0325
0.0300
0.0275
0.0250
0.0225
0.0200
0.0175
0.0150
0.0125
0.0100
0.0075
0.0050
0.0025
0.0000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V

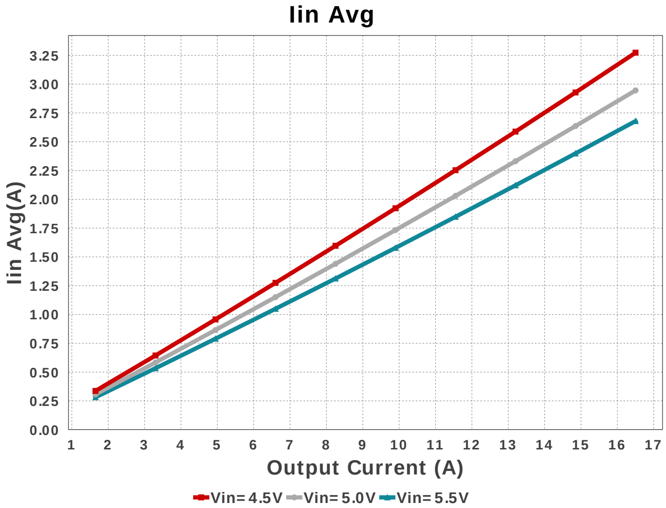

Cout Pd
Cout Pd(W)
0.00088
0.00087
0.00086
0.00085
0.00084
0.00083
0.00082
0.00081
0.00080
0.00079
0.00078
0.00077
0.00076
0.00075
0.00074
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V

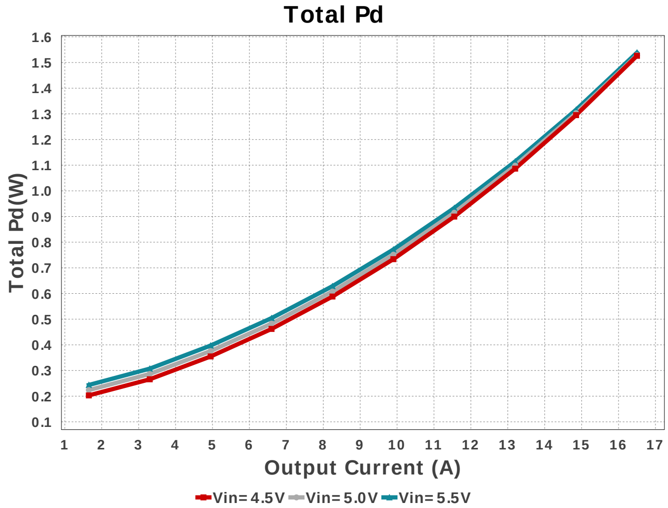

Load overcurrent Iocp (typical)
Load overcurrent Iocp (typical)(A)
19.843920005
19.843920004
19.843920003
19.843920002
19.843920001
19.843920000
19.843919999
19.843919998
19.843919997
19.843919996
19.843919995
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V

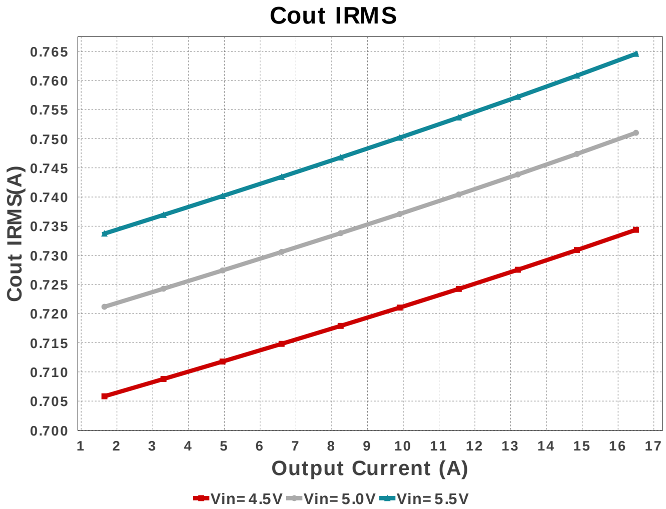

Iout transient step used for Cout calculations
Iout transient step used for Cout calculations(
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V

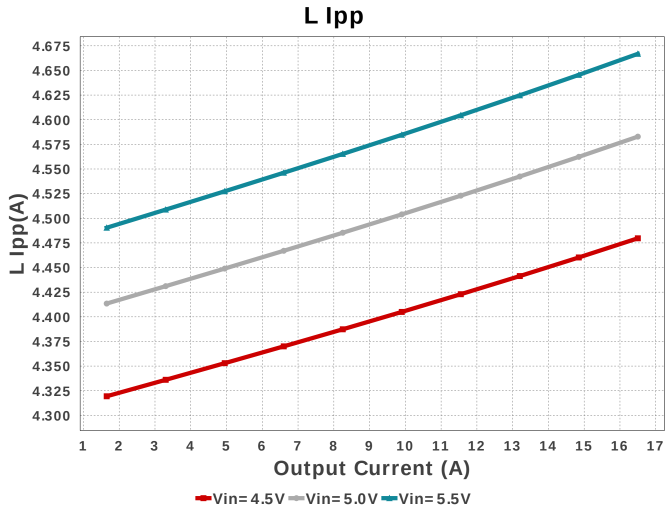

Pout
Pout(W)
13
12
11
10
9
8
7
6
5
4
3
2
1
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V

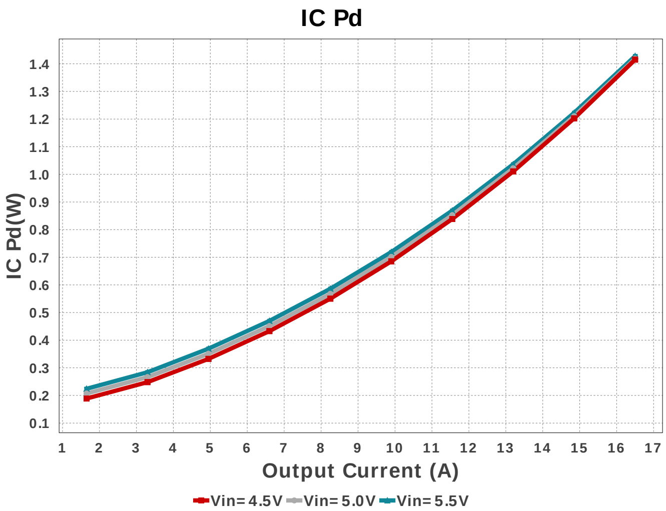

Overshoot Value
Overshoot Value(V)
0.013
0.012
0.011
0.010
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0.000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V

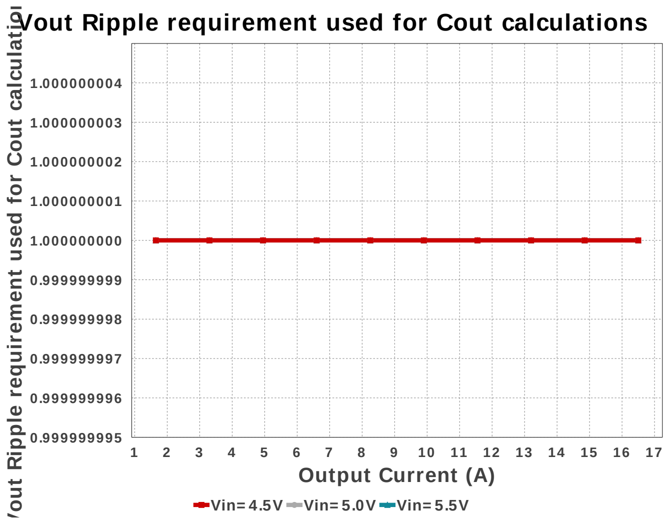

Iin Avg
Iin Avg(A)
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V

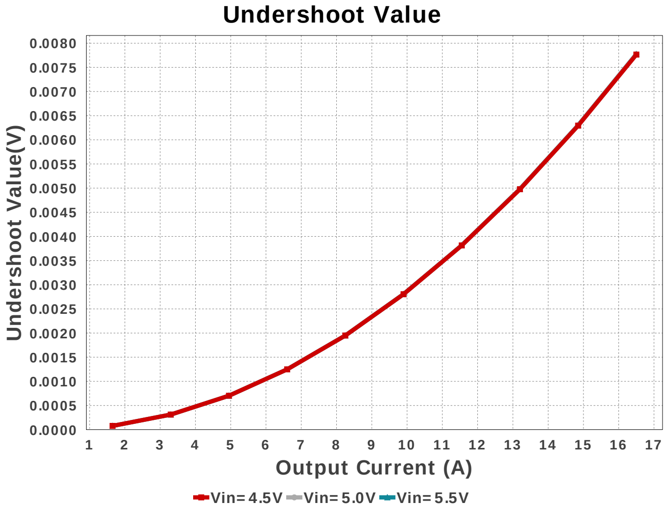

Total Pd
Total Pd(W)
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V


Cout IRMS
Cout IRMS(A)
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V


L Ipp
L Ipp(A)
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V


IC Pd
IC Pd(W)
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V


Vout Ripple requirement used for Cout calculations
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V



Operating Values

#	Name	Value	Category	Description
1.	Ramp Height	Rx2		Ramp height
2.	Cin IRMS	5.997 A	Capacitor	Input capacitor RMS ripple current
3.	Cin Pd	36.859 mW	Capacitor	Input capacitor power dissipation
4.	Cout IRMS	764.56 mA	Capacitor	Output capacitor RMS ripple current
5.	Cout Pd	876.83 µW	Capacitor	Output capacitor power dissipation
6.	Coutx IRMS	582.648 mA	Capacitor	Output capacitor_x RMS ripple current
7.	Coutx Pd	56.58 µW	Capacitor	Output capacitor_x power loss
8.	IC Pd	1.428 W	IC	IC power dissipation
9.	IC Tj	47.135 degC	IC	IC junction temperature
10.	ICThetaJA Effective	12.0 degC/W	IC	Effective IC Junction-to-Ambient Thermal Resistance
11.	Iin Avg	2.679 A	IC	Average input current
12.	L Ipp	4.667 A	Inductor	Peak-to-peak inductor ripple current
13.	L Pd	54.813 mW	Inductor	Inductor power dissipation
14.	PMBus Vout Command	410.0	PMBus	PMBus Vout Command
15.	Cin Pd	36.859 mW	Power	Input capacitor power dissipation
16.	Cout Pd	876.83 µW	Power	Output capacitor power dissipation
17.	Coutx Pd	56.58 µW	Power	Output capacitor_x power loss
18.	IC Pd	1.428 W	Power	IC power dissipation
19.	L Pd	54.813 mW	Power	Inductor power dissipation
20.	Snubber Pd	19.979 mW	Power	Snubber Power Dissipation
21.	Total Pd	1.539 W	Power	Total Power Dissipation
22.	BOM Count	30	System Information	Total Design BOM count
23.	Duty Cycle	15.511 %	System Information	Duty cycle
24.	Efficiency	89.558 %	System Information	Steady state efficiency
25.	FootPrint	412.0 mm^2	System Information	Total Foot Print Area of BOM components
26.	Frequency	660.469 kHz	System Information	Switching frequency
27.	Iout	16.5 A	System Information	Iout operating point
28.	Iout transient step used for Cout calculations	8.25 A	System Information	Custom Transient current step requirement that was used for Cout selection (A).
29.	Load overcurrent Iocp (typical)	19.844 A	System Information	Over current protection threshold
30.	Mode	CCM	System Information	Conduction Mode
31.	Overshoot Value	12.542 mV	System Information	Theoretical Vout Overshoot Value
32.	Pout	13.213 W	System Information	Total output power
33.	Total BOM	$6.07	System Information	Total BOM Cost
34.	Undershoot Value	7.775 mV	System Information	Theoretical Vout Undershoot Value
35.	Vin	5.5 V	System Information	Vin operating point
36.	Vin Ripple requirement used for Cin calculations	5.0 %	System Information	Custom maximum input ripple requirement that was used for Cin selection(% of Minimum Vin).

#	Name	Value	Category	Description
37.	Vin p-p	216.43 mV	System Information	Peak-to-peak input voltage
38.	Vout	800.781 mV	System Information	Operational Output Voltage
39.	Vout Ripple requirement used for Cout calculations	1.0 %	System Information	Custom maximum output ripple requirement that was used for Cout selection(% of Vout).
40.	Vout Tolerance	561.95 m%	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
41.	Vout p-p	3.973 mV	System Information	Peak-to-peak output ripple voltage
42.	Vout transient requirement used for Cout calculations	2.0 %	System Information	Custom Transient voltage change requirement that was used for Cout selection (% of Vout).

Design Inputs

	Name	Value	Description
	Iout	16.5	Maximum Output Current
	VinMax	5.5	Maximum input voltage
	VinMin	4.5	Minimum input voltage
	Vout	800.0 m	Output Voltage
	base_pn	TPS549B22	Base Product Number
	source	DC	Input Source Type
	Ta	30.0	Ambient temperature
1.	Vout Sch	800.0 m	Output voltage selected

WEBENCH® Assembly

Component Testing

Some published data on components in datasheets such as Capacitor ESR and Inductor DC resistance is based on conservative values that will guarantee that the components always exceed the specification. For design purposes it is usually better to work with typical values. Since this data is not always available it is a good practice to measure the Capacitance and ESR values of Cin and Cout, and the inductance and DC resistance of L1 before assembly of the board. Any large discrepancies in values should be electrically simulated in WEBENCH to check for instabilities and thermally simulated in WebTHERM to make sure critical temperatures are not exceeded.

Soldering Component to Board

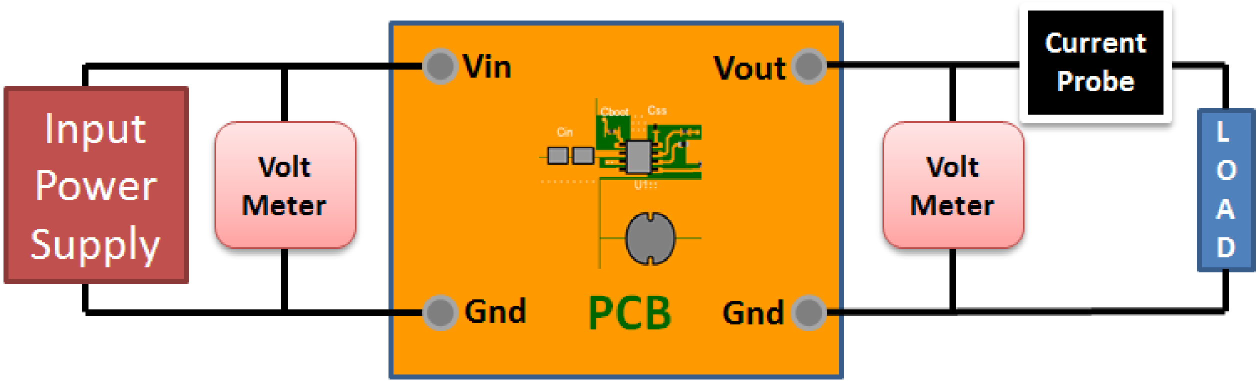
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. To solder the tab town to the board place the iron down on the board while resting against the tab, heating both surfaces simultaneously. Apply light pressure to the top of the plastic case until the solder flows around the part and the part is flush with the PCB. If the solder is not flowing around the board you may need a higher wattage iron (generally 25W to 30W is enough).

Initial Startup of Circuit

It is best to initially power up the board by setting the input supply voltage to the lowest operating input voltage 4.5V and set the input supply's current limit to zero. With the input supply off connect up the input supply to Vin and GND. Connect a digital volt meter and a load if needed to set the minimum Iout of the design from Vout and GND. Turn on the input supply and slowly turn up the current limit on the input supply. If the voltage starts to rise on the input supply continue increasing the input supply current limit while watching the output voltage. If the current increases on the input supply, but the voltage remains near zero, then there may be a short or a component misplaced on the board. Power down the board and visually inspect for solder bridges and recheck the diode and capacitor polarities. Once the power supply circuit is operational then more extensive testing may include full load testing, transient load and line tests to compare with simulation results.

Load Testing

The setup is the same as the initial startup, except that an additional digital voltmeter is connected between Vin and GND, a load is connected between Vout and GND and a current meter is connected in series between Vout and the load. The load must be able to handle at least rated output power + 50% (7.5 watts for this design). Ideally the load is supplied in the form of a variable load test unit. It can also be done in the form of suitably large power resistors. When using an oscilloscope to measure waveforms on the prototype board, the ground leads of the oscilloscope probes should be as short as possible and the area of the loop formed by the ground lead should be kept to a minimum. This will help reduce ground lead inductance and eliminate EMI noise that is not actually present in the circuit.

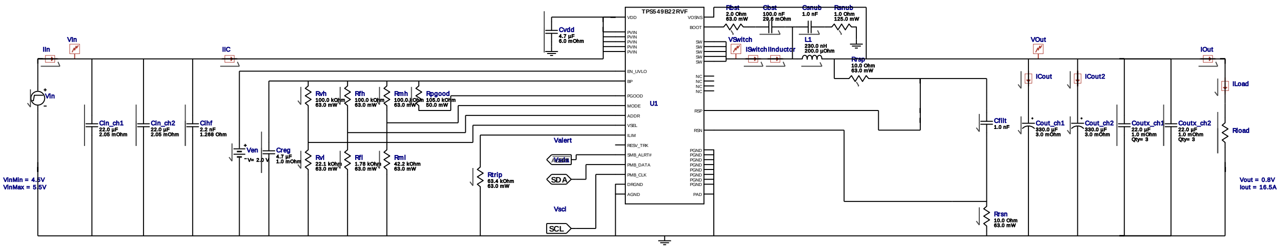


WEBENCH® Electrical Simulation Report

Design Id = 9

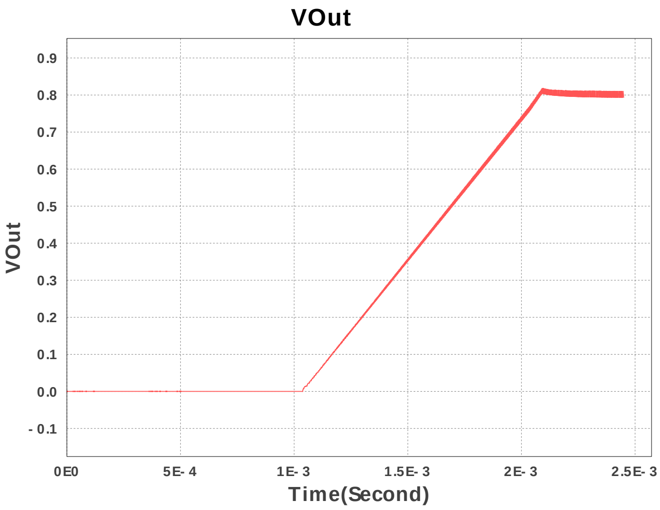
sim_id = 1

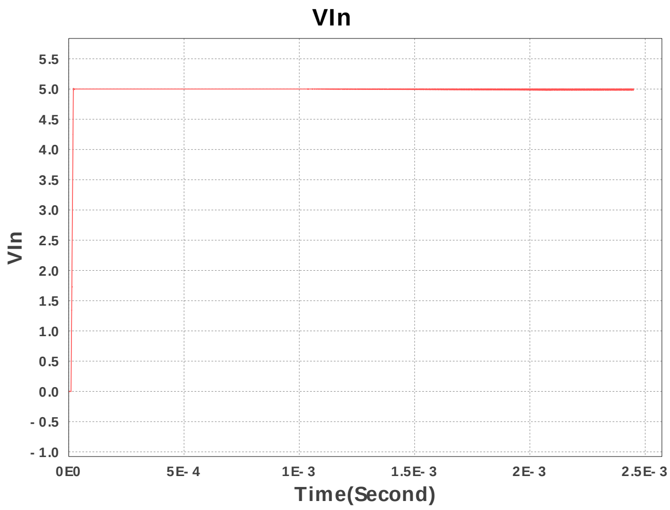
Simulation Type = Startup



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Vsda	V	no description	0 V
2.	Valert	V	no description	0 V
3.	Ven	Signal_type	Signal Type	PULSE
		V1	Initial Input voltage	0 V
		V2	Peak Input voltage	5 V
		Td	Initial time delay	10u s
		Tr	Rise time	10u s
4.	Vscl	V	no description	0 V
5.	Rload	R	Load Resistance	0.04853219696969697 ohm

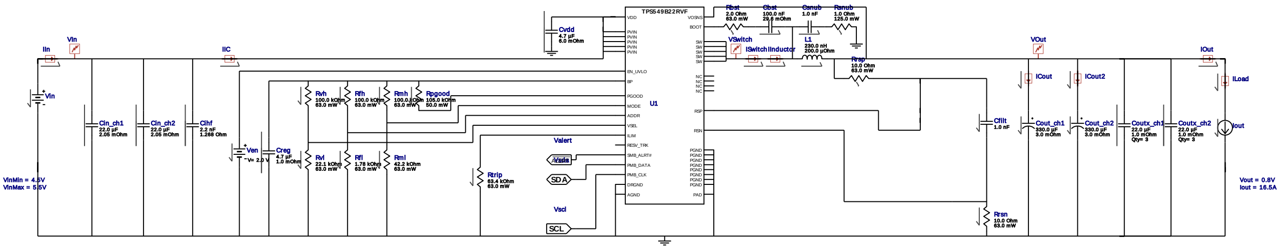




Design Id = 9

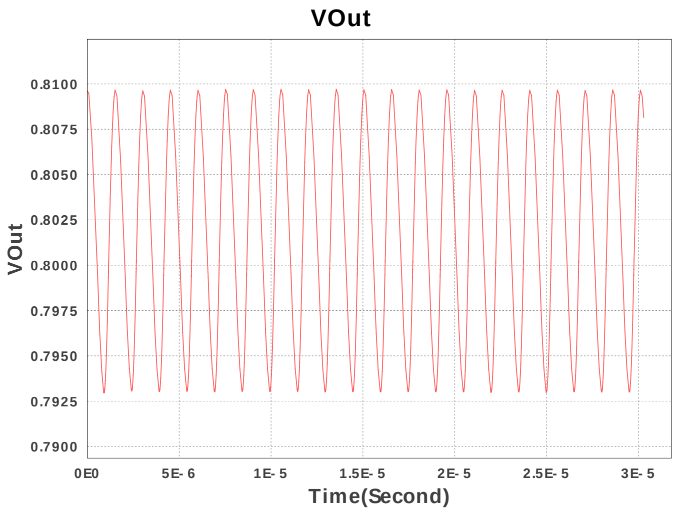
sim_id = 2

Simulation Type = Steady State



Simulation Parameters

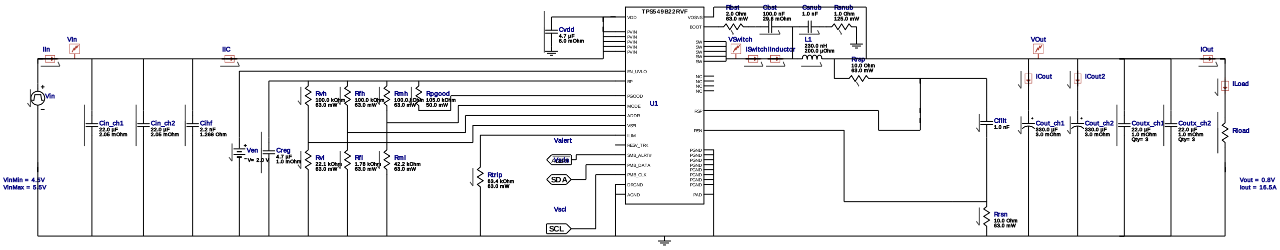
#	Name	Parameter Name	Description	Values
1.	Vsda	V	no description	0
2.	Coutx_ch1	IC	no description	0.8248046875
3.	Coutx_ch2	IC	no description	0.8248046875
4.	Cbst	IC	no description	5
5.	Cout_ch2	IC	no description	0.8248046875 v
6.	Valert	V	no description	0
7.	Ven	V	no description	2
8.	Cout_ch1	IC	no description	0.8248046875 V
9.	Vscl	V	no description	0
10.	L1	IC	Initial Condition	16.5 A
11.	Iout	I	Load current	16.5 A



Design Id = 9

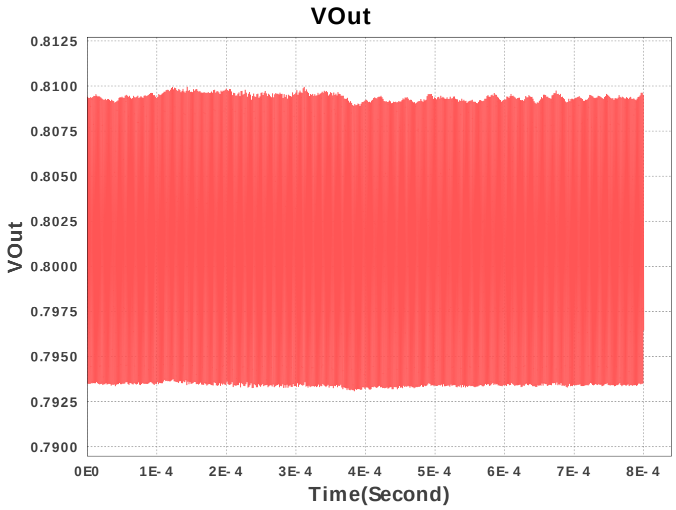
sim_id = 3

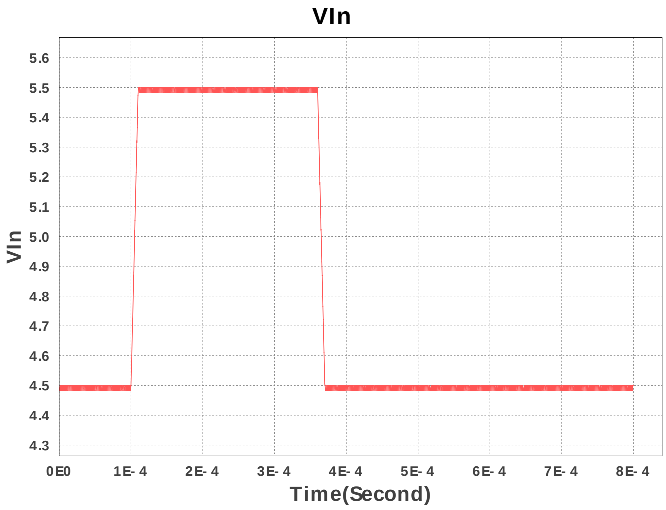
Simulation Type = Input Transient



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Vsda	V	Input voltage	0
2.	Coutx_ch1	IC	Initial Voltage	0.8248046875 V
3.	Coutx_ch2	IC	Initial Voltage	0.8248046875 V
4.	Cbst	IC	no description	5 V
5.	Cout_ch2	IC	no description	0.8248046875 V
6.	Valert	V	no description	0
7.	Ven	V	no description	2
8.	Cout_ch1	IC	no description	0.8248046875 V
9.	Vscl	V	no description	0
10.	L1	IC	no description	16.5 A
11.	Rload	R	Load Resistance	0.04853219696969697 ohm

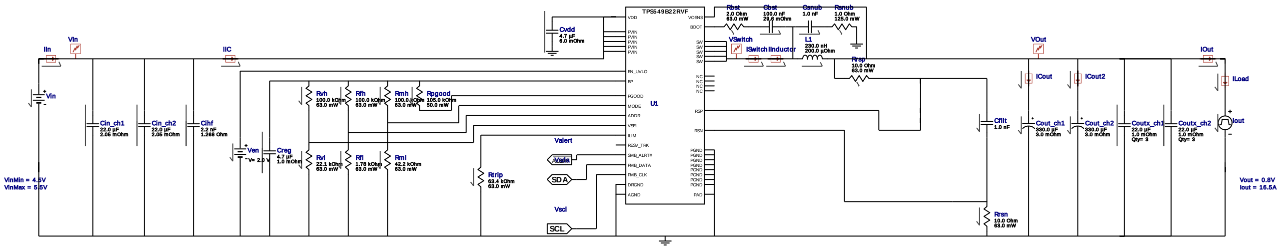




Design Id = 9

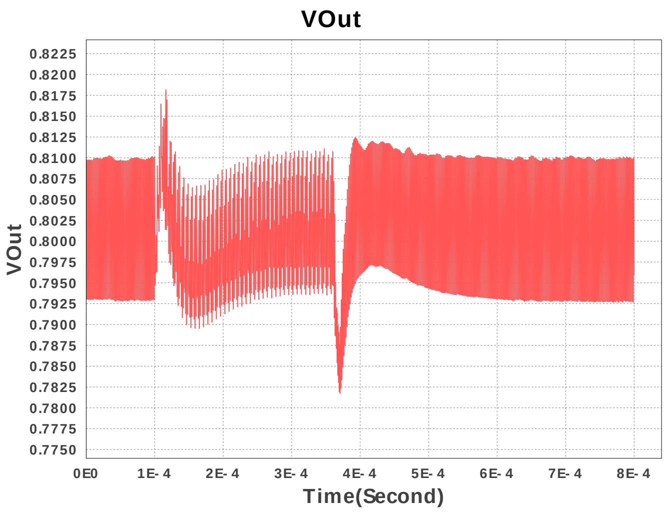
sim_id = 4

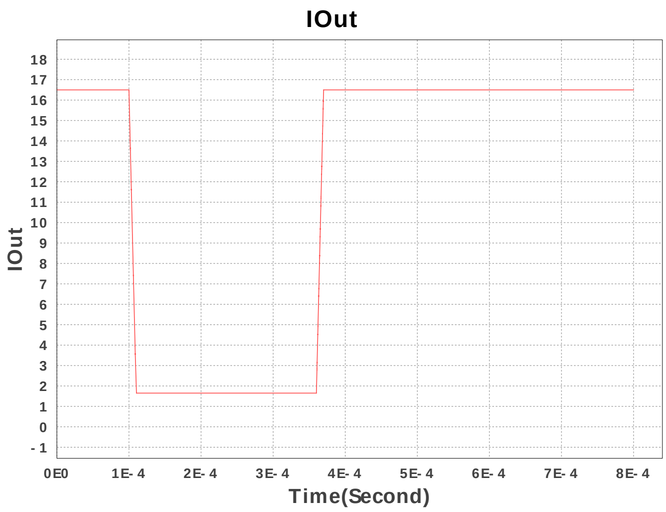
Simulation Type = Load Transient



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Vsda	V	no description	0
2.	Coutx_ch1	IC	Initial Voltage	0.8248046875 V
3.	Coutx_ch2	IC	Initial Voltage	0.8248046875 V
4.	Cbst	IC	no description	5 V
5.	Cout_ch2	IC	no description	0.8248046875 V
6.	Valert	V	no description	0
7.	Ven	V	no description	2 V
8.	Cout_ch1	IC	no description	0.8248046875 V
9.	Vscl	V	no description	0
10.	L1	IC	no description	16.5 V
11.	Iout	signal_type	Signal Type	PULSE
		I1	Initial current	16.5 A
		I2	peak current	1.65 A
		Td	initial time delay	1.0E-4 s
		Tf	fall time	10u s
		Tr	rise time	10u s
		PW	Pulse width	2.5E-4 s





Design Assistance

1. Master key : 3AF91F0BF6545191[v1]

2. **TPS549B22** Product Folder : http://www.ti.com/product/TPS549B22 : contains the data sheet and other resources.

Important Notice and Disclaimer

TI provides technical and reliability data (including datasheets), design resources (including reference designs), application or other design advice, web tools, safety information, and other resources AS IS and with all faults, and disclaims all warranties. These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

Providing these resources does not expand or otherwise alter TI's applicable Terms of Sale or other applicable terms available either on ti.com or provided in conjunction with TI products.